

VETERINARY RESEARCH TOWER SECOND AND THIRD FLOOR STRUCTURAL REPAIRS AND LABORATORY REMEDIATION

Project Manual & Specifications

August 29, 2023

Owner

**Cornell University
Ithaca, New York 14853**

Architect

**LaBella Associates, D.P.C
105 North Tioga Street, Suite 200
Ithaca, New York 14850**

**VETERINARY RESEARCH TOWER SECOND
AND THIRD FLOOR STRUCTURAL REPAIRS
AND LABORATORY REMEDIATION**

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INSTRUCTIONS TO BIDDERS

Project: Veterinary Research Tower Second and Third Floor
Structural Repairs and Laboratory Remediation

Owner: Cornell University
Ithaca, New York 14853

Architect: LaBella Associates, D.P.C
105 North Tioga Street, Suite 200
Ithaca, New York 14850

1. BID DOCUMENTS

The Bid Documents provided electronically by the Owner will consist of the following:

- (1) Instructions to Bidders.
- (2) Bid Proposal Certification Form.
- (3) General Conditions of the Contract and Division 1 - "General Requirements", and Supplemental Conditions.
- (4) Drawings and Specifications.
- (5) Addenda and/or bulletins issued prior to date of opening of Proposals.

Bid Documents are available electronically in the eBuilder Bid Portal under the Bid Package Invitation – Invitation Documents Tab.

Dataflow, Inc. maintains the current set of Documents and all addenda and is the contracted supplier for printed plans and specifications for this project. Contact Dataflow at CUProjects@goDataflow.com.

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2. EXAMINATION OF SITE AND CONTRACT DOCUMENTS

- a. Each Bidder shall acquaint themselves with location conditions as they exist, as well as the character of the necessary work to be carried out under the proposed Contract. A Pre-Bid Zoom meeting will be scheduled and include: a review of project related information, an opportunity to ask and receive responses to Bidder questions, and make such inquiries as are necessary to fully understand the subject facilities, physical conditions and/or restrictions attendant to the work under the Contract.
- b. Boring information, water levels, indications of sub-surface conditions and similar information given on the Drawings or in the Specifications are furnished only for the convenience of the Bidders. The Owner, Architect and Consulting Engineer make no representation regarding the character and extent of the soil data or other sub-surface conditions to be encountered during the work and no guarantee as to the accuracy or validity of interpretation of such data or conditions is made or intended.
- c. Each Bidder shall also thoroughly examine and become familiar with the Drawings, Specifications and associated Bid Documents.
- d. By submitting a Bid, the Bidder covenants and affirms that the Bidder has carefully examined all of the Bid Documents including Drawings, Specifications, and the Addenda and Bulletins, if any, as well as posed any questions associated with the Site, and that Bidder is satisfied as to the nature and location of the work, the general and local conditions, and all matters which may in any way affect the work or its performance.

3. DISCREPANCIES

- a. Should a Bidder find discrepancies in or omissions from the Drawings, Specifications and associated Bid Documents, or be in doubt as to their meaning, Bidder shall at once enter the item in the Q&A Board of the eBuilder Bid Portal and an Addenda with written instructions will be sent to all bidders. Neither the Owner nor the Architect will be responsible for oral instructions. Every request for such interpretation should be in writing and entered into the eBuilder Bid Portal Q&A Board. Inquiries received in advance of the deadline established at the Pre-Bid conference will be given consideration.

4. PRE-BID CONFERENCE

- a. A pre-bid conference has been scheduled for 9:00AM on September 28, 2023, in Room 133 Humphreys Service Building or via Zoom at:

<https://cornell.zoom.us/j/93285975921?pwd=S2ZRanZCTVFWZUErZ2h1bVdlV25lQT09&from=addon>

A Pre-bid walkthrough will follow and will meet at Veterinary Research Tower; 602 Tower Road; Ithaca, New York.

The Pre-Bid Conference is designed to assist Bidders in understanding the Contract Documents, the opportunity to pose clarifying questions or make inquiries regarding Contract Documents. Results will be published in an Addendum.

5. BID SUBMISSION

Bid Submissions must include the following:

- a. Base Bid entered into the eBuilder Portal broken down per the Bid Scope Tab Schedule of Values (Step 1: Bid Form of the Response Form tab).
- b. Additional Required Information:
1. Bid Proposal Certification Form
 2. Bid Bond
 3. Bond Surety Company
 4. Bonding Rate for Change Orders
 5. Proposed Project Team and Resumes
 6. Proposed Project Schedule
 7. Substitutions
- c. Bid Proposal Certification Form: The Bid Proposal Certification Form shall be signed by the Principal(s) or Officer(s) legally authorized to bind the Bidder, and to execute such documents on behalf of their respective firms or organizations, and the Certificates included in the Bid Proposal Certification Form shall be completed accordingly. Bidder's legal name should be fully and accurately stated. Completed form shall be without interlineation, alterations, or erasures unless initialed and dated by the signer; Owner expressly reserves the right to accept or reject any or all bids, and to waive irregularities or informalities in its sole and reasonable discretion.
- d. Bid Bond: Each Bidder will be required to furnish a Bid Bond electronically via the eBuilder Bid Portal in the amount of 10% of the Bid Amount. Such Bid Bond shall guarantee that the Bidder will execute the Contract if it is awarded to him in conformity with his Proposal. Such Proposal Guarantee Bond shall include a statement that the Insurer shall, at the option of the Bidder, be willing to provide to the Bidder the Contract Bonds as described in 13 below.

6. SALES AND USE TAX EXEMPTION

- a. The Owner, Cornell University, a non-profit educational institution, is exempt from payment of certain Sales and Use Taxes.

7. FEDERAL EXCISE TAX

- a. The Owner, Cornell University, a non-profit educational institution, is exempt from payment of certain Federal Excise Taxes.

8. TAX EXEMPT STATUS

- a. Bidders shall inform all prospective subcontractors and suppliers from whom they expect to obtain proposals or quotations of the tax-exempt status of the Owner as set forth above and request that they reflect anticipated tax credits in their proposals or quotations.

9. EXEMPTION CERTIFICATES

- a. At the Contractor's request, following the award of a Contract, Contractor exempt purchase certificates will be furnished by the Owner to the Contractor with respect to such tax-exempt articles or transactions as may be applicable under the Contract.

10. TRADE SUBCONTRACTORS, MATERIAL SUPPLIERS

- a. Each portion of the work shall be performed by an organization equipped and experienced to do work in that particular field, and no portion of the work shall be reserved by the Bidder to himself unless he is so equipped and experienced. Subcontracts shall be awarded only to parties satisfactory to the Owner and the Architect. Each subcontractor and materials supplier shall be approved individually.
- b. In the spaces provided in the eBuilder Bid Portal Bid Scope form, the Bidder shall list all portions of the work he proposes to perform directly with his own forces.
- c. A list of names from which the Bidder proposes to select subcontractors, materials suppliers, and/or manufacturers for the principal trades or subdivisions of the work is required as part of the Proposal.
- d. In the Bid Scope Tab in the eBuilder Bid Portal, a list of the principal trades or subdivisions of the work for which such a listing is required, together with the provisions which govern the listing, selection and approval of principal subcontractors.

11. SUBSTITUTIONS

- a. Proposals shall conform to the requirements of the Bid Documents.
- b. The Bidder may offer substitutions for any item of material or equipment, element of work, or method of construction set forth in the Bid Documents, with the exception of Form of Contract, General Conditions and General Requirements - Division 1, are to be entered into the eBuilder Bid Portal Response Form – Step 3 – Additional Required Information Custom Fields by listing each proposed substitution, together with the amount to be deducted from the Base Bid if the substitution is accepted on the form supplied with these instructions. However, the Bidder is cautioned to make his base proposal on the materials and items specified by name or other particular reference.

12. ALTERNATE PROPOSALS

- a. Certain Alternate Proposals may be requested by the Owner and are included in the General Requirements. They will be listed in the Bid Scope Tab in the eBuilder Bid Portal. All Bidders are required to bid on all Alternates without exception.
- b. Alternate Proposals shall include all overhead, profit and other expenses in connection therewith.

13. METHOD OF SUBMISSION

- a. Base Bid shall be prepared and electronically submitted via the eBuilder Bid Portal. All required fields and attachments in the eBuilder Bid Portal must be completed.
- b. Bid Proposal Certification Form shall be prepared electronically submitted as an attachment via the eBuilder Bid Portal Response Form – Step 3 – Additional Required Information Custom Fields.
- c. Completed and responsive Bid Proposals shall be submitted through the eBuilder Bid Portal no later than **2:00PM on October 17, 2023**.
- d. Bid Proposals shall not contain any recapitulation of the work to be done. No oral, written, electronic or telephonic proposals, or modifications will be considered.

14. BID OPENING

- a. Completed and responsive Bid Proposals will be opened electronically via eBuilder Bid Portal. Responsive Bid results will be posted to the Facilities Contracts website at: <https://finance.fs.cornell.edu/contracts/pob/projects.cfm> The Owner reserves the right to postpone the date and time of opening of proposals at any time prior to the date and time announced in this Instruction to Bidders or amendments thereto.

15. AWARD OF CONTRACT

- a. It is the intent of the Owner to enter into a Contract with one General Contractor for the entire project. All labor and services and materials and supplies, etc. are to be provided in accordance with the Contract.
- b. Award of the Contract shall be made to the bidder submitting the lowest responsive and responsible base bid who, in the opinion of the Owner, is qualified to perform the work. The competence and responsibility of the Bidders' proposed principal subcontractors will be considered in making the Award.
- c. The Owner reserves the right to reject any or all Proposals, and to waive any informalities in Bidding. Contract award shall be subject to approval of Cornell University's Contractors Qualification Statement.
- d. Bidder expressly warrants and commits that its Proposal shall remain unchanged and in full force and effect at the Owner's option for a period of not less than ninety (90) calendar days following the bid opening date.
- e. Bidders may submit, recall, modify, resubmit or withdraw their Bids through the eBuilder Bid Portal up until the Bid Due Date and Time.

- f. The Owner reserves the right to accept any of the Alternate Proposals listed within ninety (90) calendar days following the award of a construction contract or such other time as may be agreed to by the Owner and Contractor.

16. SCHEDULE OF VALUES

- a. The successful Bidder shall submit a complete "Schedule of Values" showing the amounts allocated to the various trades, suppliers, subcontractors, installers and General Contractor's work, aggregating the total sum of the Contract. If requested by the Owner or Architect, the complete "Schedule of Values" shall be submitted prior to award of Contract.

17. PERFORMANCE AND LABOR AND MATERIALS PAYMENT BONDS

Prior to commencement of on-site construction activities, the successful Bidder shall furnish the Owner with "Performance" and "Labor and Material Payment Bonds", each in the amount of 100% of the Contract Price. Each of these Bonds are to be in a form with such sureties as the Owner may approve. The cost of such bonds shall be included in the Bidders Proposal.

18. START OF WORK

- a. Work at the site shall be started within seven (7) calendar days from the date of issuance of written authorization to proceed and shall achieve substantial completion of the project no later than April 1, 2024.
 - 1. NOTE: Prior to commencement of any on-site construction activities, the successful Bidder shall:
 - i. Furnish the Owner with fully executed and satisfactory Payment and Performance bonds. No on-site construction activities may commence until executed and satisfactory bonds are in place for the subject project.
 - ii. Furnish the Owner with safety plan related to COVID-19 pandemic.
- b. The construction schedule and completion are critical. The Contractor shall provide adequate labor and equipment in the Bid to ensure that no slippage of the schedule will occur.

19. ADDENDA AND BULLETINS

- a. Bidders must acknowledge in Step 3 of the Bid Response in the eBuilder Bid Portal each Addendum and/or Bulletin issued during the bidding period.

20. REQUIRED POST-AWARD SUBMISSIONS BY THE APPARENT LOW BIDDER

- a. Within fourteen days after bid opening:
 - (1) Six-Month Workforce Projection

b. Upon Execution of Contract:

- (1) Insurance Certificate
- (2) Performance Bond
- (3) Labor and Material Payment Bond
- (4) Schedule of Work (bar chart)
- (5) Federal Tax Identification Number

END OF SECTION

**VETERINARY RESEARCH TOWER SECOND AND THIRD FLOOR
STRUCTURAL REPAIRS AND LABORATORY REMEDIATION**

Cornell University, Ithaca, New York

BID PROPOSAL CERTIFICATION FORM

Vendor Name:	
Type of Firm, State of Incorporation if Applicable	
Street Address, City, State, Zip	

Having carefully examined the Instructions to Bidders, the "Conditions of the Contract" (General, Division 1 - "General Requirements"), Supplemental Conditions, the Drawings, Specifications and associated Bid Documents dated August 29, 2023, as prepared by LaBella Associates, D.P.C.; 105 North Tioga Street, Suite 200; Ithaca, New York 14850, as well as the premises and conditions affecting the work, proposes to furnish all material, equipment, labor, plant, machinery, tools, supplies, services, applicable taxes and specified insurance necessary to perform the entire work, as set forth in, and in accordance with the said documents.

1. Receipt of the Addenda to the Terms and Conditions, Drawings or Specifications has been acknowledged in the eBuilder Bid Portal.
2. Minority and Women's Business Enterprises (M/WBEs)

Facilities and Campus Services supports Cornell University's ongoing commitment to encourage business opportunities and diversity among its vendor community by promoting minority owned and controlled business' development as a shared responsibility. The University's intention is to create and expand opportunities for minority, women, veteran, LGBTQ, small and locally owned businesses through construction labor opportunities and the procurement of goods and services.

Positive good faith efforts to advance the University's objectives shall be made by all Contractors, engaging, and maximizing these diverse enterprise goals, and to positively drive Cornell's economic impact.

Cornell University Diversity Council Statement:

"Cultivate partnerships with the widest spectrum of Off-Campus entities and include a fully diverse range of Off-Campus participants in Cornell's events, contracts, services, and initiatives."

3. Milestone Dates
 - a. The undersigned agrees, if awarded the Contract, to commence work at the site within seven (7) calendar days after date of issuance of written notice to proceed and to achieve substantial completion of the project no later than April 1, 2024.

- d. Bonding Rate for Change Orders has been entered into the eBuilder Bid Portal Response Form – Step 3 – Additional Required Information Custom Fields

7. Bid Scope - Schedule of Values

- a. The undersigned agrees, prior to the award of a construction contract and upon the request of the Architect or Owner, to submit a complete, itemized and detailed "Schedule of Values" including Alternates elected, if any, showing the amount allocated to the various trades and subdivisions of the work, aggregating to the total Contract Sum submitted in the eBuilder Bid Portal.

8. Substitutions

- a. The Base Bid is predicated on compliance with the Drawings and Specifications without substitutions.
- b. The Bidder may offer substitutions for any item noted in the Specifications, with the exception of Form of Contract, General Conditions and General Requirements - Division 1.
- c. Any Substitutions are to be entered into the eBuilder Bid Portal Response Form – Step 3 – Additional Required Information Custom Fields by listing each proposed substitution, together with the amount to be deducted from the Base Bid if the substitution is accepted.
- d. The Owner reserves the right to accept or reject any proposed substitution.
- e. The sum stated includes any modifications of work or additional work that may be required by reason of acceptance of substitution. Substitute materials must be approved and accepted by the Owner in writing before same may be used in lieu of those named in the Specifications.

9. Unit Price Schedule

- a. The undersigned agrees, if awarded the Contract, to perform work "In addition to" or "deducted from" the scope of the Contract Documents as directed by the Owner and/or Architect, computed in accordance with the unit prices form uploaded in the eBuilder Bid Portal Response Form – Step 3 – Additional Required Information Custom Fields, which prices include all overhead, profit and other expense items in connection therewith, subject to the terms of the Contract Documents.
- b. All unit prices include the installation or omission, complete for each item, together with all work in connection therewith and shall include all shoring, bracing, dewatering and other incidental work.
- c. Adjustments will be computed on net variation of total quantities of like items.
- d. The Owner reserves the right to accept or reject any or all of the unit prices entered into the eBuilder Bid Portal Response Form – Step 3 – Additional Required Information Custom Fields prior to the execution of the Contract.

10. Acceptance

- a. The undersigned agrees that the amount submitted for the Base Bid and any Alternates and Unit Pricing along with the required attachments in the Response Form – Step 3 – Additional Required Information Custom Fields submitted in the eBuilder Bid Portal have been reviewed and are accurate.
- b. It is understood and agreed that the Owner expressly reserves the right to accept or reject any or all bids, and to waive irregularities or informalities in its sole and reasonable discretion.
- c. Upon acceptance of Bidder's Proposal, Bidder expressly agrees and affirms to hold its unchanged Bid Proposal for ninety (90) calendar days. The undersigned will execute an Agreement between Contractor and Owner, amended and/or supplemented, if required, in accordance with the Proposal as accepted. Nothing contained herein shall preclude Bidder and Owner from mutually agreeing upon a Contract based upon the unchanged Bid Proposal if the time elapsed from Award is in excess of ninety (90) calendar days.

- d. The undersigned acknowledges the following Addendum(s) (if applicable):

Addendum No. __ dated ____.

- e. It is understood and agreed that award of the Contract shall be made to the bidder submitting the lowest responsive and responsible bid who, in the opinion of the Owner, is qualified to perform the work.
- f. The undersigned agrees to furnish Owner satisfactory and executed Performance and Payment Bonds prior to the commencement of any Work on-site.
- g. The undersigned acknowledges as Contractor to be and remain exclusively in control of the Project site and Work, as well as the Project's Health & Safety Plan, measures, and/or protocols, for the duration of construction activities.
 - i. The undersigned acknowledges receipt of **Supplemental Conditions** to the Contract surrounding Contractor Response and Health & Safety Protocols for COVID-19, or other viral, bacterial, or microbial presence (as applicable).
 - ii. The undersigned acknowledges that no one will be permitted on the job site until the Health & Safety Plan has been submitted.
- h. Alternates:
 - 1. The undersigned, if awarded the Contract, proposes to perform work in addition to or in place of the scope of the work shown and specified herein associated with the Base Bid in accordance with the Alternate Proposals, which amounts are to be added or deducted to the amount of the Base Bid as indicated for the Alternates specified in Division 1 of the Specifications.

2. It is understood that the Owner reserves the right to accept or reject any of the Alternate Proposals provided in the eBuilder Bid Portal within ninety (90) calendar days following the award of a construction contract or such other time as may be agreed to by the Owner and Contractor.

The following documentation is required to be submitted electronically in the eBuilder Bidding Portal Response Form – Step 3 – Additional Required Information Custom Fields

- ☐ This Form with Proposed Milestone Schedule – signed and executed
- ☐ Bid Bond
- ☐ Proposed Project Team Resumes

(Bidder)

By: _____

Title: _____

Business Address: _____

Dated: _____

CERTIFICATE OF NON-COLLUSION

By submission of this bid, each bidder and each person signing on behalf of any bidder certifies, and in the case of a joint bid each party thereto certifies as to its own organization, under penalty of perjury, that to the best of its knowledge and belief:

a. The prices in this bid have been arrived at independently without collusion, consultation, communication, or agreement, for the purpose of restricting competition, as to any matter relating to such prices with any other bidder or with any competitor.

b. Unless required by law, the prices that have been quoted in this bid have not been knowingly disclosed, directly or indirectly, by the bidder and will not knowingly be disclosed by the bidder to any other bidder or any competitor prior to opening.

c. No attempt has been made or will be made by the bidder to induce any other persons, partnership, or corporation to submit or not submit a bid for the purpose of restricting competition.

(Bidder)

By: _____

Title: _____

Dated: _____

CERTIFICATE AS TO CORPORATE BIDDER

I, _____, certify that I am the
_____ of the Corporation named as Bidder within this Bid Form for General
Contractors; that _____, who signed said Bid Form on behalf of the
bidder was then _____ of said Corporation; that I know his signature; that
his signature thereto is genuine and that said Bid Form and attachments thereto were duly signed and
executed for and on behalf of said Corporation by authority of its governing body.

(Secretary-Clerk)

Dated: _____

GENERAL CONDITIONS

FOR

**VETERINARY RESEARCH TOWER SECOND AND THIRD FLOOR
STRUCTURAL REPAIRS AND LABORATORY REMEDIATION**

**CORNELL UNIVERSITY
ITHACA, NEW YORK**

GENERAL CONDITIONS

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B		Final Release
C		Guarantee
D	Form I	MWBE Utilization Plan
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E		Labor Rate Breakdown
F		Stored Materials Invoicing Documentation
G		Contractor Performance Evaluation

ARTICLE 1 -- INTERPRETATION OF CONTRACT DOCUMENTS

Section 1.01 - Owner

A. The Owner is Cornell University as identified in the Agreement and referred to throughout the Contract Documents as the "Owner" or "Cornell University".

B. Ownership of Documents: All drawings, specifications, computations, sketches, test data, survey results, photographs, renderings and other material relating to the Work, whether furnished to or prepared by the Contractor, are the property of Cornell University. The Contractor shall use such materials or information therefrom only in connection with the Work of this Contract. When requested, the Contractor shall deliver such materials to Cornell University.

C. The Owner shall give all orders and directions contemplated under the Contract relative to the execution of the Work. The Owner shall determine the amount, quality, acceptability, and fitness of the Work and shall decide all questions which may arise in relation to said Work. The Owner's estimates and decisions shall be final except as otherwise expressly provided.

D. Any differences or conflicts concerning performance which may arise between the Contractor and other Contractors performing Work for the Owner shall be adjusted and determined by the Owner.

E. The table of contents, titles, captions, headings, running headlines, and marginal notes contained herein and in said documents is intended to facilitate reference to various provisions of the Contract Documents and in no way affect the interpretation of the provisions to which they refer.

Section 1.02 - Meaning and Intent of Specifications, Plans and Drawings

The meaning and intent of all specifications, plans and drawings shall be determined in a manner approved by the Owner.

Section 1.03 - Order of Precedence

A. Should a conflict occur in or between or among any parts of the Contract Documents that are entitled to equal preference, the more expensive way of doing the Work, the sounder technique or workmanship, or better quality or greater quantity of material shall govern, unless the Owner directs otherwise so directs in writing.

B. Drawings and specifications are reciprocal. Anything shown on the plans and not mentioned in the specifications, or mentioned in the specifications and not shown on the plans, shall have the same effect as if shown or mentioned in both.

C. Requirements of reference standards form a part of these specifications to the extent indicated by the reference thereto. When provisions of reference standards conflict with provisions in these specifications, the specifications shall govern.

ARTICLE 2 -- CONTRACTOR

Section 2.01 - Contractor's Obligations

A. The Contractor shall, in good workmanlike manner, perform all the Work required by the Contract within the time specified in the Contract. The Contractor shall comply with all terms of the Contract, and shall do, carry on, and complete the entire Work to the satisfaction of the Owner.

1. All labor for this project shall be paid in accordance with the New York State Department of Labor Prevailing Rate Case No. 2023011333 dated September 20, 2023. The Contractor must provide a copy of the wage schedule to each subcontractor.
2. The Contractor shall post the appropriate prevailing wage schedules in a conspicuous place at the construction site.
3. The Contractor is required to submit a certified copy of its payrolls with each application for payment but not later than 30 days after issuance of its first payroll. Payrolls shall be attached to the designed secured data field in the e-Builder Payment Application. The certified payroll records must show the employees name, address, and last 4 digits of their SS# as well as hours and days worked by each worker. Certified payroll must also show the occupation at which they worked, the hourly wage paid, and the supplements paid or provided.

B. The Contractor shall furnish, erect, maintain, and remove such construction plant and such temporary Work as may be required.

C. The Contractor shall provide and pay for all labor, material, tools, equipment, machinery, as well as utility connections, transportation, and all other facilities and services necessary for the proper execution and completion of the Work, except as otherwise specified elsewhere in the Contract Documents.

D. Whenever a provision of the Specifications conflicts with agreements or regulations in force among members of trade associations, unions, or councils which regulate or distinguish what work shall or shall not be included in the work of a particular trade, the Contractor shall make all necessary arrangements to reconcile such conflict without delay, damage, or cost to the Owner and without recourse to the Architect or the Owner. In case progress of the Work is affected by undue delay in furnishing or installing items of material or equipment required under the Contract because of a conflict involving such agreement or regulations, the Owner or the Architect may require that other material or equipment of equal kind and quality be provided at no additional cost to the Owner.

Section 2.02 - Contractor's Title to Materials

A. The Contractor warrants that the Contractor has full, good and clear title to all materials and supplies used by the Contractor in the Work, free from all liens, claims or encumbrances.

B. All materials, equipment and articles which become the property of the Owner shall be new unless specifically stated otherwise.

Section 2.03 - "Or Equal" Clause

A. Whenever a material, article or piece of equipment or method is identified on the plans or in the specifications by reference to manufacturers' or vendors' names, trade name, catalogue number, or make, no others or alternatives may be substituted. Any and all other "Or Equal" considerations will be handled under this Section in accordance with General Requirements, Section 01 25 00.

B. Where the Architect approves a product proposed by the Contractor and said proposed product requires a revision or redesign of any part of the Work covered by this Contract, or the Work covered by other contracts, all said revision(s) or redesign(s), and all new drawings and details required thereto shall be provided by the Contractor and shall be approved by the Architect. All time spent by the Architect or its agents to evaluate the proposed substitution and or necessary engineering cost to accommodate the requested change shall be reimbursed to the Owner by the Contractor via the Change Order procedure.

Section 2.04 - Quality, Quantity and Labeling

A. The Contractor shall furnish materials and equipment of the quality and quantity specified in the Contract. Unless otherwise provided, all materials and articles incorporated into the Work shall be new and of the most suitable grade of their respective kinds for the purpose. When required by the Contract Documents or when directed by the Owner, the Contractor shall supply the Owner's Representative, for their acceptance, full information concerning any material which the Contractor contemplates incorporating into the Work. Materials and articles installed or used without such acceptance shall be at the risk of subsequent rejection.

B. When materials are specified to conform to any standard, the Owner may require that the materials delivered to the Site shall bear manufacturer's labels stating that the materials meet said standards.

C. The above requirements shall not restrict or affect the Owner's right to test materials as provided in the Contract.

D. Whenever several alternative materials or items are specified by name or other particular reference for one use, the Owner's Representative may require the Contractor to submit in writing a list of the particular materials or items the Contractor intends to use before the Contract is executed.

Section 2.05 - Superintendence by Contractor

A. The Contractor shall employ a full-time effective, responsive and competent construction superintendent and necessary staff; the construction superintendent shall devote full time to the Work and shall have full authority to act for the Contractor at all times. The Contractor shall provide the Owner with the names and authority of such personnel in writing.

B. If at any time the superintendent is not satisfactory to the Owner, the Contractor shall, if requested by the Owner, replace said superintendent with another superintendent satisfactory to the Owner. There shall be no change in superintendent without the Owner's approval.

C. The Contractor shall remove from the Work any employee of the Contractor or of any Subcontractor when so directed by the Owner.

Section 2.06 - Subsurface or Site Conditions

A. The Contractor acknowledges that it has assumed the risk and that the Contract consideration includes such provision as the Contractor deems appropriate and adequate to account for all subsurface conditions as the Contractor could reasonably anticipate encountering from the provisions of the Contract Documents, borings, rock cores, topographical maps and such other information as the Owner made available to the Contractor or from their own inspection and examination of the site prior to the Owner's receipt of Contractor bids.

B. In the event that the Contractor encounters subsurface physical conditions at the site differing substantially from those shown on or described or indicated in the Contract Documents and which could not have been reasonably anticipated from the aforesaid information made available by the Owner or from the Contractor's inspection and examination of the site, the Contractor shall give immediate notice to the Owner of such conditions before they are disturbed. Such notice shall include probable cost and/or any impact to the Project Schedule. The Owner will thereupon promptly investigate the conditions and if Owner finds that they do substantially differ from that which should have been reasonably anticipated by the Contractor, the Owner shall make such changes in the drawings and specifications as may be necessary and a change order shall be issued.

Section 2.07 - Representations of Contractor

The Contractor represents and warrants:

A. That the Contractor is financially solvent, sufficiently stable to secure the required payment and performance bonds, and is sufficiently experienced in and competent to perform the subject Work or retain qualified subcontractors to perform elements of the Work pursuant to the Project's plans and specifications;

B. That the Contractor is familiar with all Federal, State, or other laws, ordinances, orders, building codes, rules and regulations, which may in any way affect the Work;

C. That any temporary and permanent Work required by the Contract can be safely and satisfactorily constructed.

D. That the Contractor has carefully examined the Contract and the Site of the Work and that, from the Contractor's own investigations is satisfied as to the nature and location of the Work, the character, quality and quantity of surface and subsurface materials likely to be encountered, the character of equipment and other facilities needed for the performance of the Work, accounted for weather days, the general and local conditions, and all other materials or items which may affect the Work. The Contractor has correlated those observations with the requirements of the Contract Documents and has made all other investigations essential to a full understanding of the Work and the difficulties which may be encountered in performing the Work.

Section 2.08 - Verifying Dimensions and Site Conditions

A. The Contractor shall take all measurements at the Site and shall verify all dimensions and site conditions at the Site before proceeding with the Work. If said dimensions or conditions are found to be in conflict with the Contract, the Contractor immediately shall refer said conflict to the Owner.

B. During the progress of Work, the Contractor shall verify all field measurements prior to fabrication of building components and equipment, and proceed with the fabrication to meet field conditions.

C. The Contractor shall consult all Contract Documents to determine exact location of all Work and verify spatial relationships of all Work. Any question concerning said location or spatial relationships shall be submitted in a manner approved by the Owner.

D. Specific locations for equipment, pipelines, ductwork and other such items of Work, where not dimensioned on plans, shall be determined in consultation with the Owner and other affected Contractors and Subcontractors.

E. The Contractor shall be responsible for the proper fitting of the Work in place.

F. Should Contractor's failure to perform services under this section result in additional costs to the Owner, the Contractor shall be responsible for such additional costs.

Section 2.09 - Copies of Contract Documents for Contractors

A. The Contractor will have access to view and download the Bid Documents in eBuilder.

B. All drawings, specifications, and copies thereof furnished by the Owner are the property of the Owner. They are not to be used on other work with the exception of the signed Contract Set, are to be returned to the Owner along with the As-Builts at the completion of the Work.

Section 2.10 - Meetings

The Contractor and all subcontractors as requested shall attend all meetings as directed by the Owner or the Owner's Representative.

Section 2.11 - Related Work

The Contractor shall examine the Contract for related work to ascertain the relationship of said work to the Work under the Contract.

Section 2.12 - Surveys and Layout

Unless otherwise expressly provided in the Contract, the Owner shall furnish the Contractor all surveys of the property necessary for the Work, but the Contractor shall lay out the Work.

Section 2.13 - Errors, Omissions or Discrepancies

The Contractor shall examine the Contract thoroughly before commencing the Work and report in writing any errors or discrepancies to the Owner or the Owner's Representative.

Section 2.14 - Project Labor Rates

The Contractor shall submit to the Owner, for review and approval, within thirty (30) days after Contract is awarded all trade labor rates inclusive of fringe benefits, taxes, insurance for the duration of the individual craft agreement in accordance with Exhibit. Revised rates shall be provided within thirty (30) days of signing any new agreements with the individual crafts during this project.

The current Prevailing Wage Rate schedule is contained in the Contract Documents. All updates, corrections and future copies of the annual determination are available at the Department of Labor website (www.labor.state.ny.us).

Section 2.15 – Daily Reports

The Contractor's Construction Superintendent shall submit a Daily Report to the Cornell University Project Manager or the Resident Field Engineer at the job site. Such reports shall, at a minimum, contain the following information:

- Name of Project
- Project Number
- Date of Report
- Weather Conditions
- Equipment on the site
- Contractors on site including name and number of employees on site for each contractor
- Work/area and activity for each contractor
- Overtime worked and planned work progress
- Environmental problems and corrections
- Other information, such as special events, occurrences, materials delivered, accidents or injuries, recommendations, suggestions, visitors, inspections, equipment start-up and check out, occupancy, etc.

ARTICLE 3 -- INSPECTION AND ACCEPTANCE

Section 3.01 - Access to the Work

The Owner and Architect, or their duly authorized representatives, assistants, or inspectors shall at all times and for any purpose have access to the Work and the premises used by the Contractor, and the Contractor shall provide safe and proper facilities therefor. In addition, the Contractor shall, whenever so requested, give the Owner and Architect or their duly authorized representatives access to the proper invoices, bills of lading, specifications, etc., which may be required in determining the adequacy and/or quantity of materials used in completion of the Work.

Section 3.02 - Notice for Testing

If the Contract Documents, laws, ordinances, rules, regulations, or orders of any public authority having jurisdiction require any Work to be inspected, tested, accepted, or approved, the Contractor shall give the Owner timely notice of its readiness and of the date arranged so the Owner may observe such inspection, testing, or approval. The Contractor shall bear all costs of such inspection, tests, and approvals unless otherwise provided.

Section 3.03 - Inspection of Work

A. The Contractor will cooperate in all ways to facilitate the inspection and examination of the Work. The inspections and examinations will be carried out in such a manner that the Work will not be delayed.

B. All Work, all materials whether or not incorporated in the Work, all processes of manufacturer, and all methods of construction shall be, at all times and places, subject to the inspection of the Owner and the Owner shall be the final judge of the quality and suitability of the Work. Any Work not approved by the Owner shall immediately be reconstructed, made good, replaced or corrected by the Contractor including all Work of other Contractors destroyed or damaged by said removal or replacement.

C. Required certificates of inspection, testing, acceptance, or approval shall be secured by the Contractor and promptly delivered to the Owner.

Section 3.04 - Inspection and Testing

All materials and equipment used in the Work shall be subject to inspection and testing in accordance with accepted standards to establish conformance with specifications and suitability for uses intended, unless otherwise specified in the Contract. If any Work shall be covered or concealed without the approval or consent of the Owner, said Work shall, if required by the Owner, be uncovered for examination. If any test results are below specified minimums, the Owner may order additional testing. The cost of said additional testing, any additional professional services required, and any other expenses incurred by the Owner as a result of said additional testing shall be paid by the Contractor. Reexamination of any part of the Work may be ordered by the Owner, and if so ordered the Work must be uncovered by the Contractor. If said Work is found to be in accordance with the Contract, the Owner shall pay the cost of reexamination and replacement. If said Work is found not to be in accordance with the Contract, the Contractor shall pay the cost of reexamination and replacement.

Section 3.05 - Defective or Damaged Work

If, in the opinion of the Owner, it is undesirable to replace any defective or damaged materials or to reconstruct or correct any portion of the Work injured or not performed in accordance with the Contract Documents, the compensation to be paid to the Contractor shall be reduced by an amount which, in the judgment of the Owner, shall be deemed to be equitable.

Section 3.06 - Acceptance

No previous inspection shall relieve the Contractor of the obligation to perform the Work in accordance with the Contract Documents. No payment, either partial or full, by the Owner to the Contractor shall excuse any failure by the Contractor to comply fully with the Contract Documents. The Contractor shall remedy all defects, paying the cost of any damage to other Work resulting therefrom.

ARTICLE 4 -- CHANGES IN WORK

Section 4.01 - Changes

A. The Owner, without invalidating the Contract, may order and approve changes within the general scope of the Contract and the Contractor shall promptly comply with such change orders.

B. A change order is a written direction to the Contractor signed by the Owner, issued after execution of the Contract, authorizing a change in the Work, extra work, or an adjustment in the Contract price or time of performance.

C. No claims for changes, extra work or additional time to complete the Contract or an adjustment in the Contract price shall be allowed unless such change is ordered in writing by the Owner.

D. The Owner shall determine the amount by which the Contract consideration is to be increased or decreased by a change order by one (1) or more of the following methods:

1. By agreement with the Contractor.
2. By applying the applicable price or prices previously bid and approved.
 - (i) To the extent that Unit Prices are applicable, as determined by the Owner, work shall be priced and paid for or credited in accordance with such Unit Prices; except that a Unit Price shall not apply to any portion of work which is either reduced or increased by more than 25%. Said Unit Prices shall be valid for the duration of the project as applicable, unless stipulated elsewhere in the Contract Documents.
 - (ii) For Unit Price items, additions and deletion of like items shall be algebraically summed and then multiplied by the applicable Unit Prices. For Direct Labor and Material items, all additions and deletions shall be algebraically summed for each subcontractor and then multiplied by the applicable markup.
 - (iii) Unit Prices are for work complete, measured in place and cover profit and all other costs and expenses. Unit Prices include, without limit, all conditions of the contract and all general requirements such as layout, reproduction of Drawings and Specifications, testing and inspection, shop drawing and sample coordination, supervision (field and home office), small tools and expendable items, insurance, taxes, temporary facilities and services, including access and safety, "as-built" drawings, and general and administrative overhead and profit.

3. By estimating the fair and reasonable cost of:
 - (i) Labor, including all wages, required wage supplements and insurance required by law paid to employees below the rank of superintendent directly employed at the Site.
 - (ii) Materials
 - (iii) Equipment, excluding hand tools, which in the judgment of the Owner, would have been or will be employed exclusively and directly on the Work. When submitting change orders, equipment which is common to the project scope at hand is expected to be previously paid for as overhead / general conditions to the project. Special rental equipment or tools not common to the project that are required to perform the change order will be accepted as additional costs.
4. By determining the actual cost of the extra work in the same manner as in Subsection 3 except the actual costs of the Contractor shall be used in lieu of estimated costs.

E. Mark-up Percentages

1. Work performed by the Contractor: Where the Work is performed directly by the Contractor by adding to the total of such estimated costs a sum equal to fifteen percent (15%) thereof.
2. Work performed by a Subcontractor: Where the change order work is performed by a Subcontractor under contract with the Contractor, by adding a sum equal to fifteen (15%) of said costs for the benefit of said Subcontractor, and by adding for the benefit of the Contractor an additional sum equal to ten percent (10%) of said costs.
3. Work performed by a Sub-Subcontractor: Where work is performed by a Sub-Subcontractor, by adding the sum equal to fifteen percent (15%) of said costs for the benefit of said Sub-Subcontractor, by adding for the benefit of the Subcontractor an additional sum equal to five percent (5%) of said cost and by adding for the benefit of the Contractor an additional sum equal to five percent (5%) of said cost. The maximum aggregate of all mark-up percentages may not exceed twenty five percent (25%).
4. No Markup on Bonds and Insurance Costs: Change Order cost adjustments due to increases or decreases in bond or insurance costs (if applicable) shall not be subject to any Markup Percentage.
5. Overtime Pay: No mark-up shall be paid on the premium portion of overtime pay.

6. Direct and Indirect Costs Covered by Markup Percentages: As a further clarification, the agreed upon Markup Percentage is intended to cover the Contractor's profit and all indirect costs and expenses associated with the change order work. Items intended to be covered by the Markup Percentage include, without limit: home office expenses, branch office and field office overhead expense of any kind; project management; superintendents, general foremen; estimating, engineering; coordinating; expediting; purchasing; detailing; legal, accounting, data processing or other administrative expenses; reproduction of drawings and specifications; shop drawings and sample coordination; "as-built" drawings; permits; auto insurance and umbrella insurance; pick-up truck costs; parking permits; cellular phones; testing and inspection; temporary facilities; access and safety provisions; and warranty expense costs. The cost for the use of small tools and/or tools already in use on site are also to be considered covered by the Markup Percentage. Small tools shall be defined as tools and equipment (power or non-power) with an individual purchase cost of less than \$750
7. Deduct Change Orders and Net Deduct Changes: The application of the markup percentage will apply to both additive and deductive change orders. In the case of a deductive change order, the credit will be computed by applying the percentage so that a deductive change order would be computed in the same manner as an additive change order. In those instances where a change involves both additive and deductive work, the additions and deductions will be netted and the markup percentage adjustments will be applied to the net amount

F. Regardless of the method used by the Owner in determining the value of a change order, the Contractor, within thirty (30) calendar days after a request for the estimate of value shall submit to the Owner a detailed breakdown of the Contractor's estimate, including all subcontractors details, of the value of the Change Order Work, in the format detailed in Exhibit A. Each submission shall include an electronic .pdf format of all documentation.

G. Unless otherwise specifically provided for in a change order, the compensation specified therein includes and shall constitute a full payment for both the Work covered or arising from the order and for any damage or expense incurred by the Contractor by any delays, including any and all impacts, known or unknown, or delays to other Work to be done under the Contract resulting from said change order. The Contractor expressly waives all rights to any other compensation for said damage or expense.

H. The Contractor shall furnish satisfactory bills, payrolls and vouchers covering all items of cost and when requested by the Owner shall give the Owner access to accounts and records relating thereto.

Section 4.02 – Claims for Extra Work

If the Contractor claims (i) that any work it has been ordered to do is extra work or (ii) that it has performed or is going to perform extra work or (iii) that any action or omission of the Owner or the Architect is contrary to the terms and provisions of the Contract, the Contractor shall:

A. Promptly comply with such order;

B. Notwithstanding the provisions of this Agreement, Article 4 of these General Condition and any other provisions of the Contract documents to the contrary, file with the Owner, within fourteen (14) calendar days after being ordered to perform the work claimed by it to be extra work or within fourteen (14) calendar days after commencing performance of the extra work, whichever date shall be the earlier, or within fourteen (14) calendar days after the said action or omission on the part of the Owner or the Architect occurred, a written notice of the basis of its claim and request a determination thereof;

C. Notwithstanding the provisions of this Agreement and any other provisions of the Contract documents to the contrary, file with the Owner, within thirty (30) calendar days after said alleged extra work was required to be performed or said alleged extra work was commenced, whichever date shall be the earlier, or said alleged action or omission by the Owner or the Architect occurred, a verified detailed statement, with documentary evidence, of the items and basis of its claim;

D. Produce for the Owner's examination, upon notice from the Owner, all its books of account, bills, invoices, payrolls, subcontracts, time books, progress records, daily reports, bank deposit books, bank statements, checkbooks and cancelled checks, showing all of its actions and transactions in connection with or relating to or arising by reason of its claim, and submit persons in its employment and in its subcontractors' employment for examination under oath by any person designated by the Owner to investigate any claims made against the Owner under the Contract, such examination to be made at the offices of the Contractor; and

E. Proceed diligently, pending and subsequent to the determination of the Owner with respect to any such disputed matter, with the performance of the Contract and in accordance with all instructions of the Owner and the Architect.

F. The Contractor's failure to comply with any or all parts of Section 4.02 shall be deemed to be: (i) a conclusive and binding determination on its part that said order, work, action or omission does not involve extra work and is not contrary to the terms and provisions of the Contract; and (ii) a waiver by the Contractor of all claims for additional compensation or damages as a result of said order, work, action or omission. The provisions of Section 4.02 is to promptly afford the Owner opportunity to cancel or revise any order, change its plans, mitigate or remedy the effects or circumstances giving rise to a claim or take such other action as may seem desirable and to verify any claimed expenses or circumstances as they occur. Compliance with such provisions is essential whether or not the Owner is aware of the circumstances of any order or other circumstances which might constitute a basis for a claim and whether or not the Owner has indicated it will consider a claim in connection therewith.

G. No person has power to waive or modify any of the foregoing provisions and, in any action against the Owner to recover any sum in excess of the sum certified by the Owner to be due under or by reason of the Contract, the Contractor must allege in its complaint and prove compliance with the provisions of this Section.

Section 4.03 - Form of Change Orders

All change orders shall be processed, executed and approved via the Owner's E-Builder Change Order Process. No payment for change order Work shall be due the Contractor unless a change order has been issued and approved as noted above and processed via E-Builder.

ARTICLE 5 -- TIME OF COMPLETION

Section 5.01 - Time of Completion

A. The Work shall be commenced at the time stated in the written order of the Owner and shall be completed no later than the dates of completion specified in the Contract. All required overtime to maintain progress schedule is included in the Base Bid.

B. The date of beginning and the times for completion of the Work, as specified in the Contract, are essential conditions of the Contract.

C. The Work shall be prosecuted diligently at such rate of progress as shall insure substantial and full completion within the time specified. It is expressly understood and agreed, that the times for the completion of the Work described herein is a reasonable time, taking into consideration the average climatic range and usual business and labor conditions prevailing in the locality of the Site.

D. Time is of the essence on each and every portion of the Work. In any instance in which additional time is allowed for the completion of any Work, the new time of completion established by said extension shall be of the essence. If in the Architect's or Owner's judgment, it becomes necessary at any time during construction to accelerate and/or complete certain areas of the project, the Contractor shall concentrate efforts and manpower on designated areas.

E. Where Work occurs within occupied areas, perform same only on the approved schedule, so as not to interfere with normal operation of occupied areas.

F. The Contractor shall not be charged with damages or any excess cost if the Owner determines that the Contractor is without fault and the Contractor's reasons for the time extension are acceptable to the Owner. The Contractor shall not be charged with damages or any excess cost for delay in completion of the work if the Owner determines that the delay is due to:

1. any preference, priority or allocation order duly issued by the Government of the United States or the State of New York;
2. unforeseeable cause beyond the control and without the fault or negligence of the Contractor, and approved by the Owner, including, but not limited to, acts of God or of public enemy, acts of the Owner, fires, epidemics, quarantine, restrictions, strikes, freight embargoes and unusually severe weather.

G. The time for completion can only be extended by change order and may be extended for:

1. all of the Work, or
2. only that portion of the Work altered by the change order.

H. Any claim for extension of time shall be made in writing to the Owner not more than ten (10) days after the commencement of the delay; otherwise it shall be waived.

ARTICLE 6 -- TERMINATION

Section 6.01 - Termination for Cause

In the event that any provision of this Contract is violated by the Contractor or by any Subcontractor of the Contractor, the Owner may serve written notice upon the Contractor, and upon the Contractor's surety, if any, of the Owner's intention to terminate the Contract. The notice shall briefly state the reasons for the termination and shall specify a termination date. If arrangements satisfactory to the Owner are not made to remove and remedy the violation, the Contract shall terminate upon the date specified by the Owner in the notice. In the event of termination, the Owner may take over and complete the Work at the expense of the Contractor. The Contractor and Contractor's surety shall be liable to the Owner for all costs thereby incurred by the Owner. In the event of such termination the Owner may take possession of and may utilize such materials, appliances, and plant as may be located on the Site and which may be necessary or useful in completing the Work.

Section 6.02 - Termination for Convenience of Owner

The Owner, at any time, may terminate the Contract in whole or in part. Any said termination shall be effected by delivering to the Contractor a notice of termination specifying the extent to which performance of Work under the Contract is terminated and the date upon which said termination becomes effective. Upon receipt of the notice of termination, the Contractor shall act promptly to minimize the expenses resulting from said termination. The Owner shall pay the Contractor for costs actually incurred by the Contractor up to the effective date of said termination, but in no event shall the Contractor be entitled to compensation in excess of the total consideration of the Contract. In the event of said termination the Owner may take over the Work and prosecute same to completion.

Section 6.03 - Owner's Right to do Work

The Owner may, after notice to the Contractor, without terminating the Contract and without prejudice to any other right or remedy the Owner may have, perform or have performed by others all of the Work or any part thereof and may deduct the cost thereof from any monies due or to become due the Contractor.

ARTICLE 7 -- DISPUTES

Section 7.01 - Disputes Procedure

A. If the Contractor claims that any Work which the Contractor has been ordered to perform will be Work which should have been authorized or directed by change order, or that any action or omission of the Owner is contrary to the terms of the Contract, the Contractor shall:

1. File a notice with the Owner which sets forth the basis of the Contractor's claim and requests a resolution of the dispute. Such notice shall be filed within fifteen (15) working days after being ordered to perform the disputed work or within fifteen (15) working days after commencing performance of the disputed work, whichever is earlier, or within fifteen (15) working days after the act or omission of the Owner which the Contractor claims is contrary to the terms of the Contract.
2. Proceed diligently with the performance of the work in accordance with the instructions of the Owner pending the resolution of the dispute by the Owner.
3. Promptly comply with the order of the Owner regarding the disputed matter.
4. Any such decision, or any other decision of the Owner in respect to a dispute, shall be final unless the Contractor, within ten (10) working days after such decision, shall deliver to the Owner a verified written statement which sets forth the Contractor's contention that the decision is contrary to a provision of the contract. Pending the decision of the Owner, the Contractor shall proceed in accordance with the original decision. The Owner shall determine the validity of the Contractor's claim and such determination shall be final. The Contractor may file a notice with the Owner reserving its rights in connection with the dispute but shall comply with the Owner's decision and complete the work as directed.

B. No claim for additional costs regarding changed or extra work shall be allowed unless the work was done pursuant to a written order of the Owner.

C. The value of claims for extra work, if allowed, shall be determined by the methods described in the Contract. Refer to Article 4 of these General Conditions.

D. The Contractor's failure to comply with any or all parts of Article 7 shall be deemed to be:

1. a conclusive and binding determination on the part of the Contractor that the order, work, action or omission is not contrary to the terms and provisions of the Contract;
2. a waiver by the Contractor of all claims for additional compensation, known or unknown, including time extensions, or damages as a result of said order, work, action, or omission.

ARTICLE 8 -- SUBCONTRACTS

Section 8.01 - Subcontracting

- A. The Contractor may utilize the services of Subcontractors.
- B. The Contractor shall submit to the Owner, in writing, the name of each proposed Subcontractor and Sub-Subcontractor, as required by the Contract. The Contractor shall not award any Work to any Subcontractor or Sub-Subcontractor without the prior written approval of the Owner.
- C. The Contractor shall be fully responsible for the Work, acts and omissions of Subcontractors, and of persons either directly or indirectly employed by Subcontractors.
- D. The Contractor shall cause appropriate provisions to be inserted in all subcontracts relative to the Work to bind Subcontractors to the Contractor by the terms of the Contract insofar as applicable to the Work of Subcontractors, indemnification and to give the Contractor the same power to terminate any subcontract that the Owner may exercise over the Contractor.
- E. The Contractor's use of Subcontractors shall not diminish the Contractor's obligation to complete the Work in accordance with the Contract. The Contractor shall control and coordinate the Work of Subcontractors.
- F. Nothing contained in the Contract shall create any contractual relationship between Subcontractors and the Owner.

ARTICLE 9 -- COORDINATION AND COOPERATION

Section 9.01 - Cooperation with Other Contractors

- A. Normally, the Work will be performed by a single Contractor. However, the Owner reserves the right to perform work related to the Work with its own forces or award separate contracts. In that event, the Contractor shall coordinate its operations with the Owner's forces or separate Contractors.
- B. The Owner cannot guarantee the responsibility, efficiency, unimpeded operations or performance of any contractor. The Contractor acknowledges these conditions and shall bear the risk of all delays including, but not limited to, delays caused by the presence or operations of other contractors.
- C. The Contractor shall keep informed of the progress and workmanship of other contractors and shall notify the Owner immediately of lack of progress or defective workmanship on the part of other contractors where said delay or defective workmanship may interfere with the Contractor's operations.
- D. Failure of a Contractor to keep so informed and failure to give notice of lack of progress or defective workmanship by others shall be construed as acceptance by the Contractor of said progress and workmanship as being satisfactory for proper coordination with the Work.

E. If the Contractor notifies the Owner, in writing, that another contractor on the Site is failing to coordinate the work of said contractor with the Work, the Owner shall investigate the charge. If the Owner finds it to be true, the Owner shall promptly issue such directions to the other contractor with respect thereto as the situation may require. The Owner shall not be liable for any damages suffered by the Contractor by reason of the other contractor's failure to promptly comply with the directions so issued by the Owner, or by reason of another contractor's default in performance.

F. If the Owner shall determine that the Contractor is failing to coordinate the Work with the work of other contractors as the Owner has directed:

1. the Owner shall have the right to withhold any payments due under the Contract until the Owner's directions are complied with by the Contractor; and
2. the Contractor shall indemnify and hold the Owner harmless from any and all claims or judgments for damages and from any costs or damages to which the Owner may be subjected or which the Owner may suffer or incur by reason of the Contractor's failure promptly to comply with the Owner's directions.

G. Should the Contractor sustain any damage through any act or omission of any other contractor having a contract with the Owner or through any act or omission of any Subcontractor of said other contractor, the Contractor shall have no claim against the Owner for said damage.

H. Should any other contractor having a Contract with the Owner sustain damage through any act or omission of the Contractor or its Subcontractor, the Contractor shall reimburse said other contractor for all said damages and shall indemnify and hold the Owner harmless from all said claims.

ARTICLE 10 -- PROTECTION OF RIGHTS, PERSONS AND PROPERTY

Section 10.01 - Accidents and Accident Prevention

A. The Contractor shall at all times take reasonable precautions for the safety of persons engaged in the performance of the Work. The Contractor shall comply fully with all applicable provisions of federal, state, and local law. The Contractor alone shall be responsible for the safety, efficiency and adequacy of the Contractor's Work, plant, appliances and methods, and for any damage which may result from the failure or the improper construction, maintenance, or operation of said Work, plant, appliances and methods.

B. The Contractor shall maintain an accurate record of all cases of death, occupational disease, public health statistics or information, and injury requiring medical attention, pursuant to government authority, or causing loss of time from work, arising out of or in the course of employment on Work under the Contract, and shall immediately notify the Owner in writing of any injury which results in hospitalization or death, or significant near miss incidents that had the potential to result in serious injury or death. The Contractor shall upload all completed Contractor and Subcontractor incident investigation forms and reports within five (5) working days of the incident. The report shall include the extent of damage or injury, the persons involved and their employers, the number of days persons are hospitalized, and any other pertinent information required by Cornell University. Such reporting shall be submitted on the e-Builder Accident Form.

C. The Contractor shall provide to the Project Manager, Material Safety Data Sheets (OSHA Form 20 or the equivalent) for all chemicals to be used on site. All chemicals requiring any precautionary measures (e.g., special storage or disposal requirements, personal protective equipment, or additional ventilation), shall be brought to the attention of Cornell University for review and approval, prior to their use on site.

1. All chemicals brought on site by the Contractor shall be clearly labeled. The label shall state the identity of the chemical, any associated hazards, and the Contractor's name.
2. All Contractor employees who are using chemicals shall be made aware of the hazards associated with their use. Safe chemical handling procedures in accordance with OSHA or other governmental agencies, and manufacturer's recommendations shall be used at all times.
3. The Contractor shall dispose of all chemicals in accordance with EPA and Cornell University requirements, regardless of the size of the container or the quantity of waste, and must receive prior approval of Cornell University.
4. A Contractor's Waste Material Disposal Plan form is required (with or without waste) to be submitted with submission of the first payment. The form can be found at:
<https://ehs.cornell.edu/sites/default/files/FRM-CWMDP-Contractor-Waste-Material-Disposal-Plan-IPDF.pdf>

D. The Contractor shall be responsible for the initiation, maintenance and supervision of safety precautions and programs in connection with the Work.

E. The Contractor shall, at all times, guard the Owner's property from injury or loss in connection with the Work. The Contractor shall, at all times, guard and protect the Contractor's Work. The Contractor shall replace or make good any said loss or injury unless said loss or injury is caused directly by the Owner.

F. The Contractor shall have full responsibility to install, protect and maintain all materials and supplies in proper condition and forthwith repair, replace and make good any damage thereto until Final Acceptance.

Section 10.02 - Adjoining Property

A. The Contractor shall be required to protect all the adjoining property and to repair or replace any such properties damaged or destroyed by the Contractor, its employees or subcontractors thereof, by reason of, or as a result of activities under, for or related to the Contract.

Section 10.03 - Emergencies

A. In case of an emergency which threatens loss or injury to persons or property, the Contractor will be allowed to act, without previous instructions from the Owner, in a diligent manner, to the extent required to avoid or limit such loss or injury, and the Contractor shall notify the Owner immediately thereafter of the action taken.

Section 10.04 - Bonds

A. Before commencing the performance of any work covered by the Contract, the Contractor shall furnish to the Owner any required Bonds. The failure of the Contractor to supply the required Bonds within ten (10) days after the Contract signing shall constitute a default on the part of the Contractor.

Section 10.05 - Risks Assumed by the Contractor

A. Indemnification. The Contractor shall defend, indemnify and hold harmless the Owner and its trustees, officers, agents and employees from and against all claims, damages, losses, fines, and expenses, including reasonable attorneys' fees, arising out of or resulting from the performance of the Work including, but not limited to, bodily or personal injury, sickness, disease, death, or injury or damage to tangible property, to the extent they arise out of or result from:

1. any negligent act or omission, or intentional or willful misconduct, violation of law, or breach of this Contract by the Contractor, or any of its subcontractors, anyone directly or indirectly employed by any of them, or anyone for whose acts any of them may be liable, or
2. any injury to an employee of the Contractor, its subcontractors, anyone directly or indirectly employed by them. The indemnification obligation under this section shall not be limited by the amount or type of damages, compensation or benefits payable by or for the Contractor under workers' compensation, disability benefit or other employee benefit laws.

B. In the event that Contractor is requested but refuses to fully comply with and honor its indemnification obligations hereunder, then the Contractor shall, in addition to all other obligations, pay the cost, including reasonable attorneys' fees, of bringing an action to enforce such indemnification obligations.

C. Neither the Owner's final acceptance of the work to be performed hereunder nor the making of any payment shall release the Contractor from its obligations under this Section. The enumeration elsewhere in the Contract of particular risks assumed by the Contractor or of particular claims for which the Contractor is responsible shall not be deemed to limit the effect of the provisions of this Section or to imply that the Contractor assumes or is only responsible for risk or claims of the type enumerated.

Section 10.06 - Contractor's Compensation and Liability Insurance

A. The Contractor shall procure and maintain, at its own cost and expense, until final acceptance by the Owner of all the work covered by this Contract, the following kinds of insurance:

1. Worker's Compensation Insurance. A policy complying with the requirements of the laws of the State of New York and any other laws that may be applicable thereto, including Coverage B - Employer's Liability with a limit of not less than \$1,000,000.

2. Contractor's Comprehensive General Liability Insurance. A standard comprehensive general liability insurance policy, with contractual, completed operations, explosion, collapse and underground property damage coverage's issued to and covering the liability of the Contractor for all work and operations under this Contract, all obligations assumed by the Contractor under this Contract and all damage to work performed by subcontractors on your behalf. The Contractor shall provide Broad Form Comprehensive General Liability Insurance, and the Owner shall be an additional insured in the policy. The policy shall include cross liability coverage and shall be endorsed to indicate that it is primary coverage. The completed operations coverage's shall be maintained for not less than two years after acceptance of the work. The coverage under such policy shall be not less than a combined single limit for Bodily Injury and Property Damage as follows, or such limits carried by the Contractor, whichever is greater:

**BODILY INJURY AND PROPERTY
DAMAGE LIABILITY (BROAD FORM)**

\$ 5,000,000	Each Occurrence
\$ 5,000,000	Aggregate

3. Automobile Liability Insurance. A policy covering the use in connection with the Work covered by the Contract Documents of all owned, non-owned and hired vehicles bearing, or, under the circumstances under which they are being used, required by the Motor Vehicle Laws of the State of New York to bear license plates. The coverage under such policy shall be not less than a combined single limit for Bodily Injury and Property Damage of:

**BODILY INJURY AND
PROPERTY DAMAGE LIABILITY**

\$ 1,000,000	Each Person
\$ 1,000,000	Each Accident

B. In addition to maintaining all of the above insurances, the Contractor shall indemnify and hold harmless the Owner and its agents and employees from and against liability, including additional premium due because of the Contractor's failure to maintain coverage limits as required under this section.

C. Insurance similar to that required of the Contractor shall be provided by or on behalf of all subcontractors to cover their own operations performed under this Contract. The Contractor shall be held responsible for any modifications in these insurance requirements as they apply to subcontractors.

D. Before commencing the performance of any work covered by the Contract, the Contractor shall furnish to the Owner a current certificate or certificates, in duplicate, of the insurance required under the foregoing provisions including copies of subcontractor's certificates. Such certificates shall be on a form prescribed by the Owner, shall list the various coverage's and shall contain, in addition to any provisions hereinbefore required, a provision that the policy shall not be changed or cancelled and that it will be automatically renewed upon expiration and continued in force until final acceptance by the Owner of all the work covered by the Contract, unless the Owner is given thirty (30) days written notice to the contrary. Upon renewal of each of the Contractor's insurance coverage's, the Owner shall be provided with a new certificate of insurance showing such renewal. Certificates and written notices shall be directed to the Office of Facilities Contracts. The Contractor shall furnish the Owner with a certified copy of each policy including any and all exclusions to such policy.

E. If at any time any of the above required insurance policies should be cancelled, terminated or modified so that insurance is not in effect as above required, then, if the Owner shall so direct, the Contractor shall suspend performance of the work covered in the Contract. If the said work is so suspended, no extension of time shall be due on account thereof. The Owner may, at its option, obtain insurance affording coverage equal to that above required, at the Contractor's expense.

Section 10.07 - Liability Insurance of the Owner

A. The Owner, at its own cost and expense, shall procure and maintain such liability insurance as will, in its opinion, protect the Owner from its contingent liability to others for damages because of bodily injury, including death, and property damage which may arise from operations under this Contract.

Section 10.08 - Owner's and Contractor's Responsibilities for Fire and Extended Coverage Insurance Hazards

A. The Contractor shall purchase and maintain in force a builders risk insurance policy on the entire work. Such insurance shall be written on a completed value form and in an amount equal to the initial contract sum and modified by any subsequent modifications to the contract sum. The insurance shall name Cornell University and the State of New York, all subcontractors and sub- subcontractors. The insurance policy shall contain a provision that the insurance will not be cancelled or allowed to expire until the Contractor has given at least thirty (30) days prior written notice to Cornell University. The insurance shall cover the entire work at the site, including reasonable compensation for Architect's services and expenses made necessary by an insured loss. Insured property shall include portions of the work located away from the site and in transit to the site. The policy shall cover the cost of removing debris and demolition as may be legally necessary. The policy shall cover any boiler or machinery loss which may be suffered during installation and until final acceptance. The insurance required shall be written to cover "all risk" of physical loss including a loss due to collapse. Any deductible shall be the responsibility of the Contractor but in no case shall the deductible be more than \$10,000 unless Cornell University has agreed to a higher deductible. The Contractor shall provide to Cornell University a certificate of insurance and a summary of coverage's including all endorsements and exclusions prior to commencement of the work. Once the policy is received, the Contractor shall provide a copy of such policy to Cornell University. There shall be a mutual waiver of recovery between Cornell University, the Contractor and all other parties to the extent such losses are covered by the builders risk policy. If Cornell University wishes to occupy the building prior to final acceptance and if the policy contains a provision which limits coverage for such partial occupancy, the parties agree work together to obtain consent of the insurance company for such partial occupancy or use under mutually acceptable terms.

B. Losses, if any, under such insurance shall be payable to the Owner.

C. The Contractor shall be responsible for any and all loss of materials connected with the construction due to unexplainable disappearance, theft or misappropriation of any kind or nature.

D. The foregoing provisions shall not operate to relieve the Contractor and subcontractors of responsibility for any loss or damage to their own or rented property or property of their employees, of whatever kind or nature, or on account of labor performed under the Contract incidental to the repair, replacement, salvage, or restoration of such items, including but not limited to tools, equipment, forms, scaffolding, and temporary structures, including their contents, regardless of ownership of such contents, except for such contents as are to be included in and remain a part of the permanent construction. The Owner shall in no event be liable for any loss or damage to any of the aforementioned items, or any other property of the Contractor, subcontractors and the Architect, or employees, agents, or servants of same, which is not to be included in and remain a part of the permanent construction. The Contractor and subcontractors severally waive any rights of recovery they may have against the Owner and the Architect for damage or destruction of their own or rented property, or property of their employees of whatever kind or nature.

Section 10.09 - Effect of Procurement of Insurance

A. Neither the procurement nor the maintenance of any type of insurance by the Owner or the Contractor shall in any way be construed or be deemed to limit, discharge, waive or release the Contractor from any of the obligations and risks imposed upon the Contractor by the Contract or to be a limitation on the nature or extent of such obligations and risks.

Section 10.10 - No Third Party Rights

A. Nothing in the Contract shall create or give to third parties; any claim or right of action against the Contractor, the Architect, and the Owner beyond such as may legally exist irrespective of the Contract.

ARTICLE 11 -- USE OR OCCUPANCY PRIOR TO ACCEPTANCE BY OWNER

Section 11.01 – Substantial Completion

A. The term "substantial completion" means the completion of the Work to the extent that Cornell University may have uninterrupted occupancy or use of the facility or specified portion thereof for the purpose for which intended. The Contractor shall obtain all certificates of occupancy required prior to occupancy, and any electrical, mechanical and plumbing certificates, or other certificates or required approvals and acceptances by City, County, and State governments or other authority having jurisdiction.

Section 11.02 - Occupancy Prior to Acceptance

A. If, before Final Acceptance, the Owner desires Beneficial Occupancy of the Work, or any part thereof, which is completed or partly completed, or to place or install therein equipment and furnishings, the Owner shall have the right to do so, and the Contractor shall in no way interfere with or object to said Beneficial Occupancy by the Owner.

B. Said Beneficial Occupancy (1) shall not constitute acceptance of space, systems, materials or elements of the Work, nor shall said Beneficial Occupancy affect the start of any guarantee period, and (2) shall not affect the obligations of the Contractor for Work which is not in accordance with the requirements of the Contract or other obligations of the Contractor under the Contract.

C. The Contractor shall continue the performance of the Work in a manner which shall not unreasonably interfere with said use, occupancy and operation by the Owner.

ARTICLE 12 -- PAYMENT

Section 12.01 - Provision for Payment

A. The Owner agrees to pay the Contract Price to the Contractor for the performance of this Contract and the fulfillment of all the Contractor's obligations. The Contract Price means all costs reimbursable under the Contract Documents.

B. The final certificate of the Architect shall certify that the Contract has been completed within the stipulated time, and shall not be issued until all drawings and specifications have been returned to the Owner. The issuance of said certificates, however, or any payments made thereon shall not lessen the total responsibility of the Contractor to complete the work to the satisfaction of the Owner in accordance with the Contract.

C. Payments on the Contract Price shall be made each month as the work progresses in accord with the following procedure:

1. The Contractor's schedule of values, including quantities, aggregating the total Contract Price, divided so as to facilitate payments to subcontractors as specified herein, shall be the basis for monthly progress payments. This schedule, as shown in the E-Builder Schedule of Values Process, when approved by the Owner shall be used as a basis for progress payments. In applying for payments, the Contractor shall submit a statement based upon this approved schedule.

2. (a) On a date agreed upon by the Owner, Architect, and Contractor, a meeting shall be held by the Owner to review the work completed and materials on hand. This meeting shall review each item to be submitted by the Contractor in the requisition for payment.

(b) On the first day of each month, or as soon thereafter as practicable, the Contractor shall submit via the E-Builder Payment Application Process, a statement and all applicable documentation setting forth in detail the cost of the work done and materials delivered to the job site up to and including the last day of the previous month and shall make application for payment of ninety percent (90%) of the amount of said statement, less the aggregate of all previous payments made by the Owner against the Contract Price.

(c) Each statement and application shall be accompanied by an affidavit, executed by the Contractor, certifying that the statement is true and correct, and that all bills for labor, and materials incorporated in or delivered to the job, due and payable at the time of the preceding progress payment, have been paid. The Contractor shall attach a single .pdf file of certified payrolls for all employees on the project as indicated in the E-Builder Payment Application Process. Before final payment is made, the Contractor shall submit evidence that all payrolls, material bills and other indebtedness incurred in connection with the Contract have been paid, including final waivers of any liens.

3. Each such application for payment shall be subject to the review and approval of the Architect. If the Architect finds that the affidavit and application for payment are acceptable and that all the above requirements in connection therewith have been complied with, the Architect shall, within seven (7) calendar days after receiving such application for payment, certify to the Owner that the payment applied for is due and payable to the Contractor.

4. The issuance of a Certificate for Payment constitutes a representation by the Architect to the Owner, based on the date of the Application for Payment, that the work has progressed to the point indicated, that, to the best of their knowledge, information, and belief, the quality of the work is in accordance with the Contract Documents and that the Contractor is entitled to payment in the amount certified.

The Owner shall make payment in the manner provided in the Agreement within thirty (30) calendar days of receipt of the approved Certificate in E-Builder.

Approval of the Payment Application by the Architect shall not be deemed to represent that the Architect has made exhaustive or continuous on-site inspections to check the quality or quantity of the work or that the Architect has reviewed the construction means, methods, techniques, sequences, or proceedings or that the Architect has made any examination to ascertain how or for what purpose the Contractor has used the monies previously paid on account of the Contract Sum.

Section 12.02 – Stored Materials & Equipment

A. The Contractor may submit, no more than thirty (30) calendar days after contract approval and prior to the first application for payment, a written request to Cornell University for permission to invoice for critical materials and equipment ready, but not yet incorporated into the work. For the purpose of this paragraph, "critical materials and equipment" eligible for payment are defined as those items affecting project schedule or budget as determined by Cornell University's evaluation of the project schedule. This includes finished goods normally shipped to the job site in a condition ready for incorporation into the work that require significant time for delivery. Raw materials or work-in-process at a manufacturer's plant location shall not be eligible for such consideration unless the Contractor can demonstrate that Cornell University can save money by purchasing material in bulk quantities at the beginning of the project.

B. Cornell University will be under no obligation to accept such requests.

C. Payment authorized by Cornell University for such "long-lead" critical materials and equipment not yet incorporated in the work will be made provided the Contractor submits Exhibit H and complies with the following:

1. Items shall be listed in the "Total Materials Presently Stored" column on the Application for Payment.
2. Transfer of Title shall be executed and included in the Application for Payment.
3. The method used to store off-site items shall be described in the Contractor's request to invoice for such materials and equipment. Cornell University shall give prior approval of the location of off-site storage. Items requiring special environmental conditions to protect their integrity (temperature, humidity, etc.) shall be continuously stored in such an environment.
4. Items in storage shall be identified as property of Cornell University, and a description of the identification method used shall be submitted in the Application for Payment. Contractor shall maintain all necessary insurance on items in storage.
5. A written and photographic inventory of items and method used to verify such inventory, including Contractor's certification that all quantities have been received in good condition at the job site or other location acceptable to Cornell University shall be submitted with the Application for Payment.
6. A copy of the vendor's invoice is included with the Contractor's invoice. Packing lists will not be accepted.

D. Cornell University retains the right to verify storage by physical inspection prior to payment approval and at any time thereafter. Such payment shall not relieve the Contractor of the responsibility for protecting, safeguarding, and properly installing the equipment or materials. The Warranty and Guarantee period shall not commence until installation and final acceptance of the completed work by Cornell University. The Contractor shall bear the cost of transporting materials stored off-site to the site

E. Each subsequent invoice will restate the prior months' materials and equipment not incorporated in the Work and current month additions and deletions for materials and equipment incorporated into the Work.

F. Upon the making of partial payment by Cornell University, all work, materials, and equipment covered thereby shall become the sole property of Cornell University. Partial payments, however, shall not constitute acceptance of the Contractor's work by Cornell University, nor be construed as a waiver of any right or claim by Cornell University.

Section 12.03 – Retention

A. Retention in the amount of ten percent (10%) of the value of the Work done and materials furnished and installed under this Agreement shall be retained by the Owner as part security for the faithful performance of the Contractor's work within the time specified, and shall be paid as indicated in Section 12.06.

B. Cornell University in its sole discretion may, upon the Contractor's application thereof, release retention applicable to a subcontractor, provided that there are no outstanding claims associated with the subcontractor's work and the subcontractor and Contractor submit an acceptable partial or final release when submitting the payment application process. If the project is bonded, a Consent of Surety to the reduction must be attached as well.

Section 12.04 - Withholding Payments

A. The Owner may, on account of contemporaneous or subsequently discovered evidence, withhold or nullify the whole or a part of any Certificate to such extent as may be necessary to protect the Owner from loss on account of:

1. Defective work not remedied.
2. To assure payment of just claims of any persons supplying labor or materials for the work and to discharge any lien filed against the Owner's property.
3. A reasonable doubt that the Contract can be completed for the balance of the Contract Price then unpaid.
4. Damage to another Contractor.
5. Unsatisfactory prosecution of the work by the Contractor.
6. Failure to provide and maintain an acceptable Critical Path Method Network Schedule.

Section 12.05 – Documents and Conditions Precedent to Final Payment

A. As-Built Documentation

1. Prior to acceptance by the Owner of all work covered by the Contract, the Contractor shall furnish to the Owner through the Architect one (1) set of current reproducible full-size Contract Drawings on which the Contractor has recorded in a neat and workmanlike manner all instances where actual field construction differs from work as indicated on the Contract Drawings.

B. Final Documentation:

1. Prior to final payment, and before the issuance of a final certificate for payment in accordance with the provisions of these General Conditions, file the following documents with the Owner.
 - a. Warranties, Bonds, Service & Maintenance Contracts and any other extended guarantees stated in the technical sections of the Specifications.
 - b. Release or Waiver of Lien for the Contractor and Sub-Contractors in accordance with Exhibit C, attached hereto.
 - c. Project Record Documents as defined in General Requirements Section 01 78 39.
 - d. Notification that Final Punch List work has been completed.
 - e. Manufacturers Instruction and Maintenance Manuals as defined in General Requirements Section 01 78 23.
 - f. Fixed Equipment Inventory as defined in General Requirements Section 01 78 22.
2. The Contractor shall also provide a CD containing scanned .pdf format and/or Word Documents of all documentation.

Section 12.06 - Final Payment and Release

A. When the Contractor determines that the work or a designated portion thereof is substantially complete, the Contractor shall prepare for submission to the Owner a list of items to be completed or corrected. This list, prepared by the Contractor, shall constitute a complete detailed list of defects and deficiencies which, when remedied, will complete all Contract requirements. The submittal shall be accompanied by a statement to that effect.

B. The failure to include any items on such list does not alter the responsibility of the Contractor to complete all work in accordance with the Contract Documents. When the Architect, on the basis of an inspection, determines that the work is substantially complete, the Architect will then prepare a Certificate of Substantial Completion.

C. Upon receipt of written notice that the work is ready for final inspection and acceptance, the Architect will promptly make such inspection and, when the Architect finds the work acceptable under the provisions of the Contract Documents, and the Contract fully performed, and if bonds have been required, the written Consent of the Surety to the payment of the balance due, and a satisfactory Release of Lien, attached hereto as Exhibit "C" and made a part of the Contract Documents, has been submitted by the Contractor, each subcontractor and sub-subcontractor, the Contractor will promptly issue a final Certificate for Payment, stating that to the best of their knowledge, information, and belief, and on the basis of their observations and inspections the work has been completed in accordance with the terms and conditions of the Contract Documents, and that the entire balance is due and payable.

D. All prior certificates upon which progress payments may have been made, being estimates, shall be subject to correction to the final certificate.

E. The acceptance by the Contractor of the final payment aforesaid shall constitute a general release of the Owner and its agents or representatives from all claims and liability to the Contractor.

ARTICLE 13 -- TAX EXEMPTION

Section 13.01 - Tax Exemption

A. The Owner is exempt from payment of Federal, State and local taxes, including sales and compensating use taxes on all materials and supplies incorporated into the completed Work. These taxes are not to be included in bids. This exemption does not apply to tools, machinery, equipment or other property leased by or to the Contractor or a Subcontractor, or to supplies and materials which, even though they are consumed, are not incorporated into the completed Work, and the Contractor and Subcontractors shall be responsible for and pay any and all applicable taxes, including sales and compensating use taxes, on said leased tools, machinery, equipment or other property and upon all said unincorporated supplies and materials.

B. The Contractor and Subcontractor shall obtain any and all necessary certificates or other documentation from the appropriate governmental agency or agencies, and use said certificates or other documentation as required by law, rule or regulation.

ARTICLE 14 -- GUARANTEE

Section 14.01 - Guarantee

A. The Contractor, at the convenience of the Owner, shall remove, replace and/or repair at their own costs and expense any defects in workmanship, materials, ratings, capacities or characteristics occurring in or to the work covered by Contract for the period of one (1) year or within such longer period as may otherwise be provided in the Contract, the period of such guarantee to commence with the Owner's final acceptance of all work covered under the Contract, and the Contractor, upon demand, shall pay for all damage to all other work resulting from such defects and all expenses necessary to remove, replace and/or repair such work which may be damaged in removing, replacing or repairing the said defects. Acceptance means final acceptance of the entire work, early partial occupancy notwithstanding

B. In some instances the nature of the work may require the Owner to accept various components, equipment, spaces or phase of the project. In such cases the Contractor shall submit a separate guarantee for the Owner's acceptance on the form attached hereto as Exhibit "E". Upon completion of the project, the Contractor shall submit to the Owner a guarantee for the project on the form attached hereto as Exhibit "E".

ARTICLE 15 -- STANDARD PROVISIONS

Section 15.01 - Provisions Required by Law Deemed Inserted

Each and every provision of law or clause required by law to be inserted in the Contract and made a part hereof, shall be deemed to be inserted herein and, in the event any such provision is not inserted or is not correctly inserted, then upon the application of either party, this Contract shall forthwith be physically amended to make such insertion or correction.

Section 15.02 - Laws Governing the Contract

The Contract shall be governed by the laws of the State of New York, without reference to conflict of law principles. Any and all proceedings relating to the subject matter hereof shall be maintained in New York State Supreme Court, Tompkins County or the federal district court for the Northern District of New York, which courts shall have exclusive jurisdiction for such purposes.

Section 15.03 - Assignments

The Contractor shall not assign the Contract in whole or in part without prior written consent of the Owner.

Section 15.04 - No Third Party Rights

Nothing in the Contract shall create or shall give to third parties any claim or right of action against the Owner, beyond such rights as may legally exist irrespective of the Contract.

Section 15.05 - Waiver of Rights of Owner

A. None of the provisions of the Contract will be considered waived by the Owner except when such waiver is given in writing.

Section 15.06 - Limitation on Actions

No action or proceeding shall be filed or shall be maintained by the Contractor against the Owner unless said action shall be commenced within six (6) months after receipt by the Owner of the Contractor's final requisition or, if the Contract is terminated by the Owner, unless said action is commenced within six (6) months after the date of said termination.

Section 15.07 - Owner's Representative

The Owner shall designate a representative authorized to act in its behalf with respect to the Project. The Owner or its representative shall examine documents and shall render approvals and decisions pertaining thereto promptly, to avoid unreasonable delay in the progress of the Contractor's work. Only directives from Cornell University's designated representative (Jake Perno) shall be recognized by the Contractor.

ARTICLE 16 – MINORITY AND WOMEN BUSINESS ENTERPRISES

Section 16.01 – Definitions

The terms "Minority-owned business enterprise" ("MBE") or "Women-owned business enterprise" ("WBE") or "minority group member" shall have the same meaning as under Section 310 of the New York State Executive Law, as the same may be from time to time amended.

Section 16.02 – Participation by Minority and Women Business Enterprises

A. The Contractor shall, in addition to any other nondiscrimination provision of the Contract and at no additional cost to Owner, fully comply and cooperate with the Owner in the implementation of MBE and WBE programs. These requirements include equal employment opportunities for minority group members and women ("EEO") and contracting opportunities for certified minority and women-owned business enterprises ("MWBES"). The Contractor's demonstration of "good faith efforts" shall be a part of these requirements. These provisions shall be deemed supplementary to, and not in lieu of, the nondiscrimination provisions required by New York State or other applicable federal, state or local laws.

B. The Contractor shall include the provisions of this Article in each and every Agreement and/or Contract in such a manner that the provisions of this Article will be binding upon each subcontractor and supplier as to work in connection with and related to this Agreement.

C. For purposes of this procurement:

Facilities and Campus Services supports Cornell University's ongoing commitment to encourage business opportunities and diversity among its vendor community by promoting minority owned and controlled business' development as a shared responsibility. The University's intention is to create and expand opportunities for minority, women, veteran, LGBTQ, small and locally owned businesses through construction labor opportunities and the procurement of goods and services.

Positive good faith efforts to advance the University's objectives shall be made by all Contractors, engaging, and maximizing these diverse enterprise goals, and to positively drive Cornell's economic impact.

Cornell University Diversity Council Statement:

"Cultivate partnerships with the widest spectrum of Off-Campus entities and include a fully diverse range of Off-Campus participants in Cornell's events, contracts, services, and initiatives."

Section 16.03 – Reports and Records

A. The following forms, attached hereto as Exhibit "D" and made a part of the Contract Documents, are to be used in submitting MBE/WBE Utilization Reports when requested by the Owner.

1. MWBE Utilization Report
2. Affirmative Action Workforce Report

B. The Contractor shall submit an Affirmative Action Workforce Report on a monthly basis, or as requested by Owner. The Contractor shall provide a single monthly report, or as requested by the Owner, inclusive of all subcontractor information for the project labor and such report must document the use of MWBE businesses in the Contract.

ARTICLE 17 -- ACCOUNTINGS, INSPECTION AND AUDIT

The Contractor agrees to keep books and records showing the actual costs incurred for the Work. Such books and records (including, without limitation, any electronic data processing files used by the Contractor in analyzing and recording the Work) shall be open for inspection and audit by the Owner and its authorized representatives at reasonable hours at the Contractor's local office or at the Owner's office, if necessary, and shall be retained by the Contractor for a period of seven years after the Work has been completed, except that if any litigation, claim or audit is started before the expiration date of the seven year period, the records shall be retained until all litigation, claims or audit findings involving the records have been resolved.. Each Sub-Contractor shall be similarly obligated to maintain, for inspection and audit by the Owner, books and records respecting the Work. If requested by the Owner, the Contractor shall furnish copies of any and all subcontracts, purchase orders and/or requisitions of any nature associated with the project.

ARTICLE 18 – CONTRACTOR PERFORMANCE EVALUATION

At project completion the Owner shall schedule a meeting to review with the Contractor their performance for the project unless performance warrants additional reviews. The Owner may schedule a meeting at fifty percent (50% completion) based on project complexity and/or duration. The Owner shall present its review based on the attached “Contractor Performance Evaluation”, Exhibit I. The Contractor shall be given the opportunity to provide input as to the findings of the evaluation after completion by the Owner.

ARTICLE 19 -- ROYALTIES AND PATENTS

The Contractor shall pay all royalties and license fees and shall defend all suits or claims for infringement of any patents, and shall save Cornell University harmless from loss on account thereof; except that Cornell University shall be responsible for all such loss when a particular process or product is specified by Cornell University unless the Contractor shall have reason to believe that the particular process or product infringes a patent, in which event it shall be responsible for loss on account thereof unless it promptly provides such information to Cornell University.

ARTICLE 20 -- CONFIDENTIALITY AND USE OF OWNER'S NAME

Section 20.01 - Release of Information

The Contractor shall not divulge information concerning the Work (including news releases, social media, internal house organizations, applications for permits, etc.) to anyone without Cornell University's prior written approval, except to subcontractors and suppliers to the extent that they need such information to perform their work. The Contractor shall require a similar agreement from each such subcontractor and supplier, requiring their compliance with the foregoing. Cornell University reserves the right to release all information, as well as to time its release and specify its form and content. The Contractor may obtain Cornell University's approval to release information by submitting such request to the Cornell University Project Manager.

Section 20.02 - Confidential Information

The term "Confidential Information" means all unpublished information obtained or received from Cornell University during the term of this Contract which relates to Cornell University's research, development, manufacturing and business affairs. The Contractor shall not disclose confidential information to any person, except to its employees and subcontractors to the extent that they require it in the performance of their Work, during the term of this Contract and until authorized by Cornell University in writing. The Contractor and its subcontractors shall hold all confidential information in trust and confidence for Cornell University, and shall use confidential information only for the purpose of this Contract. The Contractor and its subcontractors shall require all of their employees to whom confidential information is revealed to comply with these provisions. The Contractor shall have an agreement with each subcontractor, requiring their compliance with the foregoing. If it becomes necessary for the Contractor to defend in case of litigation related to its services rendered, permission shall be sought from Cornell University, who shall not unreasonably withhold such permission, before any disclosures are made. This Section does not apply to information which (1) is or becomes known in public domain or (2) is learned by the Contractor from third parties.

Section 20.03 - Use of Owner's Name on Non-Work Related Content

The Contractor shall not use or permit on the job site, in its external, advertising, marketing program, social media, or other promotional efforts, any date, pictures, or other content unrelated to the Contracted Work, or any representation of the Owner except on the specific written authorization in advance of the Owner's Representative.

ARTICLE 21 -- CORNELL UNIVERSITY STANDARDS OF ETHICAL CONDUCT

Cornell University expects all executive officers, trustees, faculty, staff, student employees, and others, when acting on behalf of the university, to maintain the highest standard of ethical conduct as per Cornell University's Policy 4.6 - Standards of Ethical Conduct, a copy of which is available at <https://fcs.cornell.edu/project-contractors-and-consultants>. This includes treating equally all persons and firms currently doing business with or seeking to do business with or for Cornell University, whether as contractors, subcontractors, or suppliers. Such persons and firms are respectfully reminded that Cornell University employees and their families may not personally benefit from Cornell University's business relationships by the acceptance of gifts or gratuities, defined as a gift in excess of \$75.00 given to a Cornell employee for personal use. Items not considered gifts/gratuities include occasional business meals, items of an advertising nature, and items that are generally distributed to all potential customers. In addition, it is expected that the Contractor's officers and employees shall conduct all business related to this Contract within the highest ethical standards, observing applicable policies, practices, regulations, law, and professional standards. All parties are expected to report violations of this policy to appropriate university personnel. You may file a report to on the web https://secure.ethicspoint.com/domain/en/report_custom.asp?clientid=6357 or contact Cornell University through EthicsPoint by dialing toll-free 1-866-293-3077.

CORNELL UNIVERSITY**Construction Contract Change Order Forms
Instructions to Change Order Documentation**

Cornell University has several standard forms related to Changes in the Work. These forms have been prepared to comply with contract requirements related to Changes in the Work. The standard Construction Contract Change Order Request and Change Order Summary Forms shall be used to facilitate preparation of change order requests in conformity with construction contract requirements.

These forms shall be used by the Contractor and by all Subcontractors in preparing their respective cost estimates for services associated with the Changed Work for the Owner's consideration and shall include all associated back-up documentation supporting the request.

Direct Cost of the Work:

- 1. Direct Labor** – Include the “wages paid” hourly direct labor and/or foreman necessary to perform the required change. “Wages paid” is the burdened labor rate documented in accordance with Section 2.14 – Project Labor Rates of the General Conditions. “Assigned Personnel or Work Crews” should be stated by trade or type of work performed not by name of person or company title. For example carpenter, mason, backhoe operator, etc. Supervisory personnel in district or home office shall not be included. Supervisory personnel on the job-site, but with broad supervisory responsibility and paid as salaried personnel, shall not be included as Direct Labor
- 2. Direct Material** – Include the acquisition cost of all materials directly required to perform the required change. Examples of “Unit of Measure” include square feet, cubic yards, linear feet, days, gallons, etc.
- 3. Equipment** – Include the rental cost of equipment items necessary to perform the change. For company-owned equipment items, include documentation of internal rental rates. Charges for small tools, and craft specific tools are not allowed.

Bond Premiums

The Contractor's actual documented bond premium rate as entered into the eBuilder Bid Portal Response Form – Step 3 – Additional Required Information Custom Fields at time of bid shall be added to all direct and indirect costs of the proposed change.

Overhead & Profit

The Contractor's overhead & profit rate shall be added to all direct and indirect costs of the proposed change in accordance with the Contract.

CONSTRUCTION CONTRACT CHANGE ORDER REQUEST

DATE: _____ COR # _____

PROJECT TITLE: _____

CONTRACT NO. _____

☐ Name of Contractor/Subcontractor performing Work: _____DESCRIPTION OF WORK: _____

_____**A. DIRECT COST OF WORK:****1 LABOR** (Attach Supporting Documentation)

ASSIGNED PERSONNEL OR WORK CREW

	HOURLY WAGE RATE PAID	HOURS WORKED	TOTAL COST
_____	_____	_____	\$0
_____	_____	_____	\$0
_____	_____	_____	\$0
_____	_____	_____	\$0
LABOR TOTAL			\$0

2 MATERIAL (Attach Supporting Documentation)

MATERIAL REQUIRED FOR CHANGE

	UNIT PRICE	UNIT OF MEASURE	REQUIRED UNITS	TOTAL COST
_____	_____	_____	_____	\$0
_____	_____	_____	_____	\$0
_____	_____	_____	_____	\$0
_____	_____	_____	_____	\$0
MATERIAL TOTAL				\$0

3 EQUIPMENT (Attach Supporting Documentation)

EQUIPMENT REQUIRED FOR CHANGE

	UNIT PRICE	UNIT OF MEASURE	REQUIRED UNITS	TOTAL COST
_____	_____	_____	_____	\$0
_____	_____	_____	_____	\$0
_____	_____	_____	_____	\$0
_____	_____	_____	_____	\$0
_____	_____	_____	_____	\$0
EQUIPMENT TOTAL				\$0

4**DIRECT COST (SUM 1, 2, 3)****\$0****5****OH&P Rate** _____**\$0****6 SUBCONTRACTOR** (Attach Supporting Documentation)

SUB-SUBCONTRACTOR REQD FOR CHANGE

	SUB-SUB COST OF WORK	SUB-SUB MARK UP %	TOTAL COST
_____	_____	_____	\$0
_____	_____	_____	\$0
_____	_____	_____	\$0
SUB-SUBCONTRACTOR TOTAL			\$0

7 OVERHEAD AND PROFIT**OH&P Rate** _____**\$0****TOTAL COST PLUS OH&P (SUM 4, 5, 6, 7)****\$0****8 BOND PREMIUM** (If applicable)**Bond Premium Rate** _____**\$0****TOTAL COR COST****\$0****TOTAL CONTRACT DAYS ADDED/DELETED FROM PROJECT SCHEDULE****0**

CONSTRUCTION CONTRACT CHANGE ORDER SUMMARY

DATE: _____

PCO # _____

PROJECT TITLE: _____

CONTRACT NO. _____

CONTRACTOR: _____

DETAILED DESCRIPTION OF WORK: _____

1 DIRECT COST OF WORK:

NAME OF CONTRACTOR/SUBCONTRACTORS
PERFORMING WORK

TOTAL
COST

TOTAL COST OF PROPOSED CHANGE ORDER ITEM \$0

TOTAL CONTRACT DAYS ADDED/DELETED FROM PROJECT SCHEDULE

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FINAL RELEASE

EXHIBIT "B"

FINAL WAIVER OF CLAIMS AND LIENS AND RELEASE OF RIGHTS

Date	_____	Contract Date	_____
Project	_____	Contract Price	_____
Address	_____	Net Extras and Deductions	_____
City	_____	Adjusted Contract Price	_____
County	_____	Amount Previously Paid	_____
State	_____	Balance Due - Final Payment	_____

The undersigned hereby acknowledges that the above Balance Due when paid represents payment in full for all labor, materials, etc., furnished by the below named Contractor or Supplier in connection with its work on the above Project in accordance with the Contract.

In consideration of the amounts and sums previously received, and the payment of \$_____ being the full and Final Payment amount due, the below named Contractor or Supplier does hereby waive and release the Owner from any and all claims and liens and rights of liens upon the premises described above, and upon improvements now or hereafter thereon, and upon the monies or other considerations due or to become due from the Owner or from any other person, firm or corporation, said claims, liens and rights of liens being on account of labor, services, materials, fixtures or apparatus heretofore furnished by the below named Contractor or Supplier to the Project. The premises as to which said claims and liens are hereby released are identified as follows:_____

The undersigned further represents and warrants that he/she is duly authorized and empowered to sign and execute this waiver on his/her own behalf and on behalf of the company or business for which he/she is signing; that it has properly performed all work and furnished all materials of the specified quality per plans and specifications and in a good and workmanlike manner, fully and completely; that it has paid for all the labor, materials, equipment and services that it has used or supplied, that it has no other outstanding and unpaid applications, invoices, retentions, holdbacks, expenses employed in the prosecution of work, chargebacks or unbilled work or materials against the Owner as of the date of the aforementioned last and final payment application; and that any materials which have been supplied or incorporated into the above premises were either taken from its fully-paid or open stock or were fully paid for and supplied on the last and final payment application or invoice.

The undersigned further agrees to defend, indemnify and hold harmless the Owner for any losses or expenses (including without limitation reasonable attorneys' fees) should any such claim, lien or right of lien be asserted by the below named Contractor or Supplier or by any of its or their laborers, material persons or subcontractors.

In addition, for and in consideration of the amounts and sums received, the below named Contractor or Supplier hereby waives, releases and relinquishes any and all claims, rights or causes of action in equity or law whatsoever arising out of through or under the above mentioned Contract and the performance of work pursuant thereto.

The below named Contractor or Supplier further guarantees that all portions of the work furnished and installed are in accordance with the Contract and that the terms of the Contract with respect to this guarantee will remain in effect for the period specified in said Contract.

Sworn to before me this

Corporation or Business Name

_____ Day of _____ 20__

By: _____

Title: _____

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GUARANTEE

Date: _____

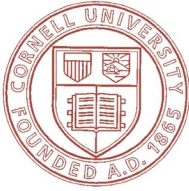
In accordance with plans and specifications and the terms and conditions of our contract with Cornell University dated _____, we hereby guarantee the _____ as found in the specifications for _____, Ithaca, New York to be free
(Project Title)
from defects in materials and workmanship for the period of ____ year(s) from _____, the date of acceptance by the Owner.
(Date)

(COMPANY)

By: _____

Title: _____

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MWBE Utilization Report

PART I – PROJECT INFORMATION

e-Builder Project No.	Project Name:	Contract Value:
Contractor Name and Address:	Primary Contact Name, Phone Number, Email:	Bid Date:
Contractor's MWBE Contact Name, Phone Number, Email:		

PART II – MWBE LIST *(Update as MWBE firms come under contract, sign and date, resubmit)*

Subcontractor Name, Address, Contact, Email, MBE or WBE <i>(List your firm if also MBE or WBE)</i>	Federal ID Number	Dollar Value of Contract or Purchase Order	Description of Work or Supplies	Subcontractor or Supplier Start and End Dates

(Update totals as MWBE firms are added/subtracted to above list)

Print Name of Principal or Officer:	Title:
Signature:	Date:

PART III – Quarterly Utilization Report *(Subcontractors & Sub-subcontractors fill this out and submit to General Contractor to compile into a single form.)* Double click on table to edit.

[illegible]

**SUMMARY OF BID ACTIVITY WITH MBE AND WBE
SUBCONTRACTORS AND VENDORS**

Please print or type all information, except where a signature is required.

PROJECT: _____

Name of Prime Contract Bidder:

Address (Street, City, State and Zip Code):

Contact Person (Name, Title and Telephone Number):

MBE and WBE							
Subcontractor/Vendor (Indicate which)	Item/ Trade	Bid Submitted:		Award Status		Date of	
		Date	Amount	Date	Amount	Elimination	

EXPLANATION OF ELIMINATION: Include meetings held for negotiation, etc.
(Use additional sheet if necessary)

OFFICER OF FIRM:

Name and Title:	Date:
_____	_____
Signature:	

NOTE: The Prime Contractor shall provide a single monthly report inclusive of all subcontractor information for the project.

LABOR RATE BREAKDOWN

PROJECT TITLE:

CONTRACT NO.

CONTRACTOR:

TRADE:

EFFECTIVE DATE:

EXPIRATION DATE:

Base Hourly Rate:

\$

Payroll Taxes and Insurance**% per Hour**

F.I.C.A.

Federal Unemployment (*Base on 1500 hours of work*)State Unemployment (*Base on 1500 hours of work*)

* Worker's Compensation

* Bodily Injury & Property Damage

Disability

TOTAL

%

Payroll Taxes and Insurance Rates: Base Rate (x) Total % =

\$

* Rates are net Contractor cost after premium discounts and experience modifications have been applied against manual rate.

Supplemental Benefits**\$ per Hour**

Vacation

Health & Welfare

Pension

Annuity

Education / Training

Industry

Total Hourly Fringe Benefits

\$

Hourly Labor Rate: Base Rate, Taxes/Insurance and Fringe Benefits

\$

Adjustment for a composite rate which includes apprentices:

\$

CONTRACTOR'S CERTIFICATION

I certify that the labor rates, insurance enumerations, labor fringe enumerations and expenses are correct and in accordance with actual and true cost incurred.

Signature of Authorized Representative:

Print Name:

Print Title:

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**STORED MATERIALS INVOICING
DOCUMENTATION**

PROJECT TITLE:

CONTRACTOR:

SUBCONTRACTOR:

CONTRACT NO.

REASON FOR REQUEST:

APPLICATION FOR PAYMENT NO. _____

DATE:

1 Material Identification

Description:

Quantity:

Provide Specific Location of Materials Stored:

2 Material Value

☐ Attach an Invoice or Quantified Statement of Value.

\$ _____

3 Certificate of Insurance

☐ Attach a Certificate of Insurance for the above specified materials. Certificate shall name "Cornell University" as a loss payee with respect to the specified materials.

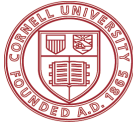
4 Transfer of Title

The Contractor hereby agrees to transfer complete ownership of all listed materials to Cornell University at the time payment is made to Contractor for the above referenced Application for Payment. The Contractor remains responsible for all contractual requirements for the above listed materials including complete installation and providing of all warranties.

Signed:

Date:

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Cornell University

**Contractor Performance
Evaluation**

Project Information

Project Name: _____

Date Of Evaluation _____

Project Number _____

Evaluators;

Project Team _____

Campus _____

Project Start Date _____

Substantial Completion _____

Contractor _____

Prequalification Status _____

Original Contract Amount _____

Total Change Order Amount _____

Contractor Project Manager _____

Initial Evaluation _____

Contractor Superintendent _____

Final Evaluation _____

Type Of Contract

Prime Contractor _____

Subcontractor _____

Construction Manager _____

Project Comments/Description

Performance Evaluation

Please give one rating for each category. Add comments as required to justify your rating.

Fails to Achieve Expectation	Needs Improvement	Fully Achieve Expectation	Freq Exceeds Expectation	Cons Exceed Expectation
1	2	3	4	5

1 Quality of Workmanship

Rate this contractor's performance in regards to quality of work

- a. Compliance with project drawings and specifications
- b. Workmanship quality and accuracy
- c. Tools- quality and sufficient quantity
- d. Equipment - sufficient quantity and operating condition
- e. Quality of jobsite craft personnel

Comments:

2 Scheduling/Productivity

Rate this contractor's performance with regard to producing and meeting contract schedules and milestones

- a. Project schedule quality and completeness
- b. Controlling of project schedule
- c. Manpower allocation for maintaining schedule
- d. Material deliveries to support project schedule
- e. Ability to meet substantial completion date and project milestones
- f. Productivity of work force
- g. Ability to deal with added work and unforeseen issues.

Comments:

3 Subcontractor Management

Rate this contractor's ability, effort and success in managing and coordinating subcontractors (if no subcontractors rate overall management performance)

Comments:

3A Major subcontractor performance(score not added in final Contractor Evaluation)

For contractor information only

- a. Plumbing Contractor overall Performance

Comments:

- b. HVAC Contractor overall Performance

Comments:

- c. Electrical Contractor overall Performance

Comments:

Fails to Achieve Expectation	Needs Improvement	Fully Achieve Expectation	Freq Exceeds Expectation	Cons Exceed Expectation
1	2	3	4	5

4 MBE/WBE Participation

Rate this contractor's MBE/WBE solicitation effort and participation for this project for, Project Team, Subcontractors, Material Vendors

Comments:

5 Safety

Rate this contractor's performance in regards to project safety

- a. Timely submission of site specific safety program
- b. Knowledge of OSHA standards
- c. Implementation of safety rules and regulations
- d. Promotion and creation of safety awareness
- e. Daily overall housekeeping
- f. Safety record
- g. Response to safety concerns
- h. Awareness of public safety

Comments:

6 Contract Administration

Rate this contractor's performance in regards to contract administration as per criteria below

- a. Timely submission of complete and correct documentation required for insurance and bond
- b. Change order processing
- c. Timely submission of RFI's, Shop Drawings, and change orders
- d. Subcontractor payments made promptly
- e. Timely submission of complete and correct payment applications
- f. Quality of paperwork

Comments:

7 Working Relationships

Rate this contractor's working relationships with other parties (Cornell, Design Team, subcontractors, ect.)

Comments:

Fails to Achieve Expectation	Needs Improvement	Fully Achieve Expectation	Freq Exceeds Expectation	Cons Exceed Expectation
1	2	3	4	5

8 Supervisory Personnel Rating

Rate the overall performance of this contractor's on site supervisory personnel and project management staff

Comments:

9 Contract Close-Out

Rate this contractor's overall ability to efficiently close out the project

- a. Timely completion of all punchlist items
- b. Timely resolution of all outstanding change orders
- c. Timely submission of all close out documents(O&M's, As-Built's, warranties, final releases and consent of surety)
- d. Quality of close out documentation and timely completion of any outstanding audit questions

Comments:

Summary Sheet

Project: _____

Contractor: _____

Performance Categories	Rating Per Category	Weight %	Scoring
1 Quality of Workmanship	0	15.00%	0
2 Scheduling	0	10.00%	0
3 Subcontractor Management	0	10.00%	0
4 MBE/WBE Participation	0	10.00%	0
5 Safety	0	10.00%	0
6 Contract Administration	0	10.00%	0
7 Working Relationships	0	10.00%	0
8 On Site Supervisory Personnel Rating	0	18.00%	0
9 Contract Close Out	0	7.00%	0

Over All Rating

0

Rating Reference	
Fails to achieve expectation	1
Needs improvement	2
Fully achieves expectation	3
Frequently exceeds expectation	4
Consistently exceeds expectatio	5

OWNER COMMENTS:

OWNER COMMENTS on 3A Ratings:

CONTRACTOR COMMENTS:

(To be completed by Contractor prior to Owner/Contractor discussion meeting)

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**HEALTH AND SAFETY PLAN REQUISITES FOR CONSTRUCTION
ACTIVITY APPLICABLE TO HIGH IMPACT RESPIRATORY PATHOGEN
PANDEMICS AND CONTAGIONS**

Contractors are required to protect the health and safety of employees, including the prevention and mitigation of high impact respiratory pathogen pandemics and contagions. One element of Contractor compliance with these obligations is the development and implementation of a **High Impact Respiratory Pathogen Pandemic Exposure Prevention, Preparedness and Response Plan** (Plan) for all project jobsites.

The Plan must be based upon information, requirements, recommendations and guidelines from civil authorities including, but not limited to, federal or New York State Executive Orders, CDC, OSHA and New York State Department of Health surrounding health and safety measures designed to eliminate or reduce the transmission of the high impact respiratory pathogen pandemics (HIRPP). Contractor may also amend the Plan based upon and consistent with articulated operational needs and requirements.

The Plan must include the following elements:

- Responsibilities of Managers and Supervisors
 - Responsibilities of Subcontractors and Suppliers to the Jobsites
 - Responsibilities of Employees
 - Jobsite Protective Measures
 - Jobsite Visitors
 - Personal Protective Equipment and Work-Related Controls
 - Jobsite Cleaning and Disinfecting
 - Jobsite Exposure Situation and Response Protocols
 - OSHA or Other Recordkeeping Related Compliance
 - Confidentiality/Privacy Protocols
 - Other Safety Responsibilities & Protocols Related to HIRPP
-

Contractors and businesses are further required to comply with any applicable and then current COVID mandatory, emergency or temporary directives, rules or health and safety practices issued by federal, state or local authorities.

- 1.0 Nothing contained herein shall alter or modify the Contractor's exclusive control over the job site, subcontractors, project labor, Health & Safety Plans, Protocols, Measures, or the Contractor's exclusive control over the methods and means associated with any and all of the foregoing elements.
 - 1.1 Cornell University possesses neither control nor any right of control over the job site, project labor, health & safety practices or programs, or methods and means of advancing the Contracted Work.
 - 1.2 These requirements are provided to the Contractor for the attainment of Contractor's fully compliant health and safety measures and practices communicated by applicable civil authorities as requirements, rules and/or guidance necessary to engage in qualifying construction activities.

- 2.0 Contractors, their subcontractors and suppliers, and workers are required to adhere to applicable and imposed federal, state, and/or local measures to prevent or limit the possible exposure or spread of COVID-19, pathogens, or contagions.
- 2.1 To that end, Contractor shall develop a written Health & Safety Plan related to the protective measures and protocols Contractor shall employ on the Project necessary to manage and mitigate the exposure or transmission of COVID-19, pathogens, or contagions (as applicable).
- 2.2 This Plan shall be submitted to the Owner prior to start of Construction Activity on the Campus. Owner's receipt of the subject Plan is to affirm measures and practices are in place, not for substantive review or approval.
- 2.3 Health and safety practices constitute a continuing compliance obligation, Contractors and their subcontractors and suppliers must remain current with, and immediately implement updated health and safety rules, protocols and practices as they are published. The Campus may request updated elements of the Contractor's written safety plan to address evolving best practices for measures and/or practices designed to prevent or limit the spread of COVID or other pathogen.
- 2.4 The Contractor must notify Cornell immediately upon discovery of any employees of their firm, subcontractors, or suppliers that are, or have been working on the Cornell Campus that have been confirmed to have COVID contagion.
- 2.5 In addition to the foregoing, these requirements may include Contractor compliance and implementation of then applicable federal, state, or local authorities' emergency and/or temporary safety precautions and protocols surrounding COVID *i.e., Federal EO 14042 and/or applicable OSHA COVID-19 Vaccination and Testing; Emergency Temporary Standard, as applicable.*
- 2.6 Further, Owner reserves the right to impose additional COVID or pathogen safety protocols and requirements warranted by worksite factors, including but not limited to, proximity to Cornell students, staff and faculty; activity duration; and jobsite location (*i.e., internal spaces*). These Owner health and safety requirements may be imposed without regard to the number of Contractor employees *i.e., less than 100 employees.*
- 3.0 Project Closure:
- 3.1 Where work is suspended on a project, contractors are directed to follow any additional project shut-down protocols as provided by the Owner. These protocols include but not limited to photographs, securing the work site, and a project status narrative.
- 4.0 Contractor expressly agrees to fully comply and remain exclusively responsible for the implementation of applicable Contractor Health and Safety Protocols and Measures. Contractor expressly agrees Contractor submission of the Plan is a condition precedent to engage in on-site construction activity.

**NEW YORK STATE DEPARTMENT OF LABOR
PREVAILING WAGE RATES**

FOR

**VETERINARY RESEARCH TOWER SECOND AND THIRD FLOOR
STRUCTURAL REPAIRS AND LABORATORY REMEDIATION**

**CORNELL UNIVERSITY
ITHACA, NEW YORK**



Kathy Hochul, Governor

Roberta Reardon, Commissioner

Cornell University

Breanna Brann, Contracts Associates
121 Humphreys Service Building
Ithaca NY 14853

Schedule Year 2023 through 2024
Date Requested 09/20/2023
PRC# 2023011333

Location Veterinary Research Tower
Project ID# eB #12538
Project Type Veterinary Research Tower Second and Third Floor Structural Repairs and Laboratory Remediation

PREVAILING WAGE SCHEDULE FOR ARTICLE 8 PUBLIC WORK PROJECT

Attached is the current schedule(s) of the prevailing wage rates and prevailing hourly supplements for the project referenced above. A unique Prevailing Wage Case Number (PRC#) has been assigned to the schedule(s) for your project.

The schedule is effective from July 2023 through June 2024. All updates, corrections, posted on the 1st business day of each month, and future copies of the annual determination are available on the Department's website www.labor.ny.gov. Updated PDF copies of your schedule can be accessed by entering your assigned PRC# at the proper location on the website.

It is the responsibility of the contracting agency or its agent to annex and make part, the attached schedule, to the specifications for this project, when it is advertised for bids and /or to forward said schedules to the successful bidder(s), immediately upon receipt, in order to insure the proper payment of wages.

Please refer to the "General Provisions of Laws Covering Workers on Public Work Contracts" provided with this schedule, for the specific details relating to other responsibilities of the Department of Jurisdiction.

Upon completion or cancellation of this project, enter the required information and mail **OR** fax this form to the office shown at the bottom of this notice, **OR** fill out the electronic version via the NYSDOL website.

NOTICE OF COMPLETION / CANCELLATION OF PROJECT

Date Completed: _____ Date Cancelled: _____

Name & Title of Representative: _____

Phone: (518) 457-5589 Fax: (518) 485-1870
W. Averell Harriman State Office Campus, Bldg. 12, Room 130, Albany, NY 12226

General Provisions of Laws Covering Workers on Article 8 Public Work Contracts

Introduction

The Labor Law requires public work contractors and subcontractors to pay laborers, workers, or mechanics employed in the performance of a public work contract not less than the prevailing rate of wage and supplements (fringe benefits) in the locality where the work is performed.

Responsibilities of the Department of Jurisdiction

A Department of Jurisdiction (Contracting Agency) includes a state department, agency, board or commission; a county, city, town or village; a school district, board of education or board of cooperative educational services; a sewer, water, fire, improvement and other district corporation; a public benefit corporation; and a public authority awarding a public work contract.

The Department of Jurisdiction (Contracting Agency) awarding a public work contract **MUST** obtain a Prevailing Rate Schedule listing the hourly rates of wages and supplements due the workers to be employed on a public work project. This schedule may be obtained by completing and forwarding a "Request for wage and Supplement Information" form (PW 39) to the Bureau of Public Work. The Prevailing Rate Schedule **MUST** be included in the specifications for the contract to be awarded and is deemed part of the public work contract.

Upon the awarding of the contract, the law requires that the Department of Jurisdiction (Contracting Agency) furnish the following information to the Bureau: the name and address of the contractor, the date the contract was let and the approximate dollar value of the contract. To facilitate compliance with this provision of the Labor Law, a copy of the Department's "Notice of Contract Award" form (PW 16) is provided with the original Prevailing Rate Schedule.

The Department of Jurisdiction (Contracting Agency) is required to notify the Bureau of the completion or cancellation of any public work project. The Department's PW 200 form is provided for that purpose.

Both the PW 16 and PW 200 forms are available for completion [online](#).

Hours

No laborer, worker, or mechanic in the employ of a contractor or subcontractor engaged in the performance of any public work project shall be permitted to work more than eight hours in any day or more than five days in any week, except in cases of extraordinary emergency. The contractor and the Department of Jurisdiction (Contracting Agency) may apply to the Bureau of Public Work for a dispensation permitting workers to work additional hours or days per week on a particular public work project.

Wages and Supplements

The wages and supplements to be paid and/or provided to laborers, workers, and mechanics employed on a public work project shall be not less than those listed in the current Prevailing Rate Schedule for the locality where the work is performed. If a prime contractor on a public work project has not been provided with a Prevailing Rate Schedule, the contractor must notify the Department of Jurisdiction (Contracting Agency) who in turn must request an original Prevailing Rate Schedule from the Bureau of Public Work. Requests may be submitted by: mail to NYSDOL, Bureau of Public Work, State Office Bldg. Campus, Bldg. 12, Rm. 130, Albany, NY 12226; Fax to Bureau of Public Work (518) 485-1870; or electronically at the NYSDOL website www.labor.ny.gov.

Upon receiving the original schedule, the Department of Jurisdiction (Contracting Agency) is **REQUIRED** to provide complete copies to all prime contractors who in turn **MUST**, by law, provide copies of all applicable county schedules to each subcontractor and obtain from each subcontractor, an affidavit certifying such schedules were received. If the original schedule expired, the contractor may obtain a copy of the new annual determination from the NYSDOL website www.labor.ny.gov.

The Commissioner of Labor makes an annual determination of the prevailing rates. This determination is in effect from July 1st through June 30th of the following year. The annual determination is available on the NYSDOL website www.labor.ny.gov.

Payrolls and Payroll Records

Every contractor and subcontractor **MUST** keep original payrolls or transcripts subscribed and affirmed as true under penalty of perjury. As per Article 6 of the Labor law, contractors and subcontractors are required to establish, maintain, and preserve for not less than six (6) years, contemporaneous, true, and accurate payroll records. At a minimum, payrolls must show the following information for each person employed on a public work project: Name, Address, Last 4 Digits of Social Security Number, Classification(s) in which the worker was employed, Hourly wage rate(s) paid, Supplements paid or provided, and Daily and weekly number of hours worked in each classification.

The filing of payrolls to the Department of Jurisdiction is a condition of payment. Every contractor and subcontractor shall submit to the Department of Jurisdiction (Contracting Agency), within thirty (30) days after issuance of its first payroll and every thirty (30) days thereafter, a transcript of the original payrolls, subscribed and affirmed as true under penalty of perjury. The Department of Jurisdiction (Contracting Agency) shall collect, review for facial validity, and maintain such payrolls.

In addition, the Commissioner of Labor may require contractors to furnish, with ten (10) days of a request, payroll records sworn to as their validity and accuracy for public work and private work. Payroll records include, but are not limited to time cards, work description sheets, proof that supplements were provided, cancelled payroll checks and payrolls. Failure to provide the requested information within the allotted ten (10) days will result in the withholding of up to 25% of the contract, not to exceed \$100,000.00. If the contractor or subcontractor does not maintain a place of business in New York State and the amount of the contract exceeds \$25,000.00, payroll records and certifications must be kept on the project worksite.

The prime contractor is responsible for any underpayments of prevailing wages or supplements by any subcontractor.

All contractors or their subcontractors shall provide to their subcontractors a copy of the Prevailing Rate Schedule specified in the public work contract as well as any subsequently issued schedules. A failure to provide these schedules by a contractor or subcontractor is a violation of Article 8, Section 220-a of the Labor Law.

All subcontractors engaged by a public work project contractor or its subcontractor, upon receipt of the original schedule and any subsequently issued schedules, shall provide to such contractor a verified statement attesting that the subcontractor has received the Prevailing Rate Schedule and will pay or provide the applicable rates of wages and supplements specified therein. (See NYS Labor Laws, Article 8 . Section 220-a).

Determination of Prevailing Wage and Supplement Rate Updates Applicable to All Counties

The wages and supplements contained in the annual determination become effective July 1st whether or not the new determination has been received by a given contractor. Care should be taken to review the rates for obvious errors. Any corrections should be brought to the Department's attention immediately. It is the responsibility of the public work contractor to use the proper rates. If there is a question on the proper classification to be used, please call the district office located nearest the project. Any errors in the annual determination will be corrected and posted to the NYSDOL website on the first business day of each month. Contractors are responsible for paying these updated rates as well, retroactive to July 1st.

When you review the schedule for a particular occupation, your attention should be directed to the dates above the column of rates. These are the dates for which a given set of rates is effective. To the extent possible, the Department posts rates in its possession that cover periods of time beyond the July 1st to June 30th time frame covered by a particular annual determination. Rates that extend beyond that instant time period are informational ONLY and may be updated in future annual determinations that actually cover the then appropriate July 1st to June 30th time period.

Withholding of Payments

When a complaint is filed with the Commissioner of Labor alleging the failure of a contractor or subcontractor to pay or provide the prevailing wages or supplements, or when the Commissioner of Labor believes that unpaid wages or supplements may be due, payments on the public work contract shall be withheld from the prime contractor in a sufficient amount to satisfy the alleged unpaid wages and supplements, including interest and civil penalty, pending a final determination.

When the Bureau of Public Work finds that a contractor or subcontractor on a public work project failed to pay or provide the requisite prevailing wages or supplements, the Bureau is authorized by Sections 220-b and 235.2 of the Labor Law to so notify the financial officer of the Department of Jurisdiction (Contracting Agency) that awarded the public work contract. Such officer MUST then withhold or cause to be withheld from any payment due the prime contractor on account of such contract the amount indicated by the Bureau as sufficient to satisfy the unpaid wages and supplements, including interest and any civil penalty that may be assessed by the Commissioner of Labor. The withholding continues until there is a final determination of the underpayment by the Commissioner of Labor or by the court in the event a legal proceeding is instituted for review of the determination of the Commissioner of Labor.

The Department of Jurisdiction (Contracting Agency) shall comply with this order of the Commissioner of Labor or of the court with respect to the release of the funds so withheld.

Summary of Notice Posting Requirements

The current Prevailing Rate Schedule must be posted in a prominent and accessible place on the site of the public work project. The prevailing wage schedule must be encased in, or constructed of, materials capable of withstanding adverse weather conditions and be titled "PREVAILING RATE OF WAGES" in letters no smaller than two (2) inches by two (2) inches.

The "[Public Work Project](#)" notice must be posted at the beginning of the performance of every public work contract, on each job site.

Every employer providing workers. compensation insurance and disability benefits must post notices of such coverage in the format prescribed by the Workers. Compensation Board in a conspicuous place on the jobsite.

Every employer subject to the NYS Human Rights Law must conspicuously post at its offices, places of employment, or employment training centers, notices furnished by the State Division of Human Rights.

Employers liable for contributions under the Unemployment Insurance Law must conspicuously post on the jobsite notices furnished by the NYS Department of Labor.

Apprentices

Employees cannot be paid apprentice rates unless they are individually registered in a program registered with the NYS Commissioner of Labor. The allowable ratio of apprentices to journeyworkers in any craft classification can be no greater than the statewide building trade ratios promulgated by the Department of Labor and included with the Prevailing Rate Schedule. An employee listed on a payroll as an apprentice who is not registered as above or is performing work outside the classification of work for which the apprentice is indentured, must be paid the prevailing journeyworker's wage rate for the classification of work the employee is actually performing.

NYSDOL Labor Law, Article 8, Section 220-3, require that only apprentices individually registered with the NYS Department of Labor may be paid apprenticeship rates on a public work project. No other Federal or State Agency of office registers apprentices in New York State.

Persons wishing to verify the apprentice registration of any person must do so in writing by mail, to the NYSDOL Office of Employability Development / Apprenticeship Training, State Office Bldg. Campus, Bldg. 12, Albany, NY 12226 or by Fax to NYSDOL Apprenticeship Training (518) 457-7154. All requests for verification must include the name and social security number of the person for whom the information is requested.

The only conclusive proof of individual apprentice registration is written verification from the NYSDOL Apprenticeship Training Albany Central office. Neither Federal nor State Apprenticeship Training offices outside of Albany can provide conclusive registration information.

It should be noted that the existence of a registered apprenticeship program is not conclusive proof that any person is registered in that program. Furthermore, the existence or possession of wallet cards, identification cards, or copies of state forms is not conclusive proof of the registration of any person as an apprentice.

Interest and Penalties

In the event that an underpayment of wages and/or supplements is found:

- Interest shall be assessed at the rate then in effect as prescribed by the Superintendent of Banks pursuant to section 14-a of the Banking Law, per annum from the date of underpayment to the date restitution is made.
- A Civil Penalty may also be assessed, not to exceed 25% of the total of wages, supplements, and interest due.

Debarment

Any contractor or subcontractor and/or its successor shall be ineligible to submit a bid on or be awarded any public work contract or subcontract with any state, municipal corporation or public body for a period of five (5) years when:

- Two (2) willful determinations have been rendered against that contractor or subcontractor and/or its successor within any consecutive six (6) year period.
- There is any willful determination that involves the falsification of payroll records or the kickback of wages or supplements.

Criminal Sanctions

Willful violations of the Prevailing Wage Law (Article 8 of the Labor Law) may be a felony punishable by fine or imprisonment of up to 15 years, or both.

Discrimination

No employee or applicant for employment may be discriminated against on account of age, race, creed, color, national origin, sex, disability or marital status.

No contractor, subcontractor nor any person acting on its behalf, shall by reason of race, creed, color, disability, sex or national origin discriminate against any citizen of the State of New York who is qualified and available to perform the work to which the employment relates (NYS Labor Law, Article 8, Section 220-e(a)).

No contractor, subcontractor, nor any person acting on its behalf, shall in any manner, discriminate against or intimidate any employee on account of race, creed, color, disability, sex, or national origin (NYS Labor Law, Article 8, Section 220-e(b)).

The Human Rights Law also prohibits discrimination in employment because of age, marital status, or religion.

There may be deducted from the amount payable to the contractor under the contract a penalty of \$50.00 for each calendar day during which such person was discriminated against or intimidated in violation of the provision of the contract (NYS Labor Law, Article 8, Section 220-e(c)).

The contract may be cancelled or terminated by the State or municipality. All monies due or to become due thereunder may be forfeited for a second or any subsequent violation of the terms or conditions of the anti-discrimination sections of the contract (NYS Labor Law, Article 8, Section 220-e(d)).

Every employer subject to the New York State Human Rights Law must conspicuously post at its offices, places of employment, or employment training centers notices furnished by the State Division of Human Rights.

Workers' Compensation

In accordance with Section 142 of the State Finance Law, the contractor shall maintain coverage during the life of the contract for the benefit of such employees as required by the provisions of the New York State Workers' Compensation Law.

A contractor who is awarded a public work contract must provide proof of workers' compensation coverage prior to being allowed to begin work.

The insurance policy must be issued by a company authorized to provide workers' compensation coverage in New York State. Proof of coverage must be on form C-105.2 (Certificate of Workers' Compensation Insurance) and must name this agency as a certificate holder.

If New York State coverage is added to an existing out-of-state policy, it can only be added to a policy from a company authorized to write workers' compensation coverage in this state. The coverage must be listed under item 3A of the information page.

The contractor must maintain proof that subcontractors doing work covered under this contract secured and maintained a workers' compensation policy for all employees working in New York State.

Every employer providing worker's compensation insurance and disability benefits must post notices of such coverage in the format prescribed by the Workers' Compensation Board in a conspicuous place on the jobsite.

Unemployment Insurance

Employers liable for contributions under the Unemployment Insurance Law must conspicuously post on the jobsite notices furnished by the New York State Department of Labor.



Kathy Hochul, Governor

Roberta Reardon, Commissioner

Cornell University

Breanna Brann, Contracts Associates
121 Humphreys Service Building
Ithaca NY 14853

Schedule Year 2023 through 2024
Date Requested 09/20/2023
PRC# 2023011333

Location Veterinary Research Tower
Project ID# eB #12538
Project Type Veterinary Research Tower Second and Third Floor Structural Repairs and Laboratory Remediation

Notice of Contract Award

New York State Labor Law, Article 8, Section 220.3a requires that certain information regarding the awarding of public work contracts, be furnished to the Commissioner of Labor. One "Notice of Contract Award" (PW 16, which may be photocopied), **MUST** be completed for **EACH** prime contractor on the above referenced project.

Upon notifying the successful bidder(s) of this contract, enter the required information and mail **OR** fax this form to the office shown at the bottom of this notice, **OR** fill out the electronic version via the NYSDOL website.

Contractor Information

All information must be supplied

Federal Employer Identification Number: _____		
Name: _____		
Address: _____ _____		
City: _____	State: _____	Zip: _____
Amount of Contract: \$ _____	Contract Type:	
Approximate Starting Date: ____/____/____	<input type="checkbox"/> (01) General Construction	
Approximate Completion Date: ____/____/____	<input type="checkbox"/> (02) Heating/Ventilation	
	<input type="checkbox"/> (03) Electrical	
	<input type="checkbox"/> (04) Plumbing	
	<input type="checkbox"/> (05) Other : _____	

Phone: (518) 457-5589 Fax: (518) 485-1870
W. Averell Harriman State Office Campus, Bldg. 12, Room 130, Albany, NY 12226

Social Security Numbers on Certified Payrolls:

The Department of Labor is cognizant of the concerns of the potential for misuse or inadvertent disclosure of social security numbers. Identity theft is a growing problem and we are sympathetic to contractors' concern regarding inclusion of this information on payrolls if another identifier will suffice.

For these reasons, the substitution of the use of the last four digits of the social security number on certified payrolls submitted to contracting agencies on public work projects is now acceptable to the Department of Labor. This change does not affect the Department's ability to request and receive the entire social security number from employers during its public work/ prevailing wage investigations.

Construction Industry Fair Play Act: Required Posting for Labor Law Article 25-B § 861-d

Construction industry employers must post the "Construction Industry Fair Play Act" notice in a prominent and accessible place on the job site. Failure to post the notice can result in penalties of up to \$1,500 for a first offense and up to \$5,000 for a second offense. The posting is included as part of this wage schedule. Additional copies may be obtained from the NYS DOL website, <https://dol.ny.gov/public-work-and-prevailing-wage>

If you have any questions concerning the Fair Play Act, please call the State Labor Department toll-free at 1-866-435-1499 or email us at: dol.misclassified@labor.ny.gov .

Worker Notification: (Labor Law §220, paragraph a of subdivision 3-a)

Effective June 23, 2020

This provision is an addition to the existing wage rate law, Labor Law §220, paragraph a of subdivision 3-a. It requires contractors and subcontractors to provide written notice to all laborers, workers or mechanics of the *prevailing wage and supplement rate* for their particular job classification *on each pay stub**. It also requires contractors and subcontractors to *post a notice* at the beginning of the performance of every public work contract *on each job site* that includes the telephone number and address for the Department of Labor and a statement informing laborers, workers or mechanics of their right to contact the Department of Labor if he/she is not receiving the proper prevailing rate of wages and/or supplements for his/her job classification. The required notification will be provided with each wage schedule, may be downloaded from our website www.labor.ny.gov or be made available upon request by contacting the Bureau of Public Work at 518-457-5589. *In the event the required information will not fit on the pay stub, an accompanying sheet or attachment of the information will suffice.

**To all State Departments, Agency Heads and Public Benefit Corporations
IMPORTANT NOTICE REGARDING PUBLIC WORK ENFORCEMENT FUND**

Budget Policy & Reporting Manual

B-610

Public Work Enforcement Fund

effective date December 7, 2005

1. Purpose and Scope:

This Item describes the Public Work Enforcement Fund (the Fund, PWEF) and its relevance to State agencies and public benefit corporations engaged in construction or reconstruction contracts, maintenance and repair, and announces the recently-enacted increase to the percentage of the dollar value of such contracts that must be deposited into the Fund. This item also describes the roles of the following entities with respect to the Fund:

- New York State Department of Labor (DOL),
- The Office of the State of Comptroller (OSC), and
- State agencies and public benefit corporations.

2. Background and Statutory References:

DOL uses the Fund to enforce the State's Labor Law as it relates to contracts for construction or reconstruction, maintenance and repair, as defined in subdivision two of Section 220 of the Labor Law. State agencies and public benefit corporations participating in such contracts are required to make payments to the Fund.

Chapter 511 of the Laws of 1995 (as amended by Chapter 513 of the Laws of 1997, Chapter 655 of the Laws of 1999, Chapter 376 of the Laws of 2003 and Chapter 407 of the Laws of 2005) established the Fund.

3. Procedures and Agency Responsibilities:

The Fund is supported by transfers and deposits based on the value of contracts for construction and reconstruction, maintenance and repair, as defined in subdivision two of Section 220 of the Labor Law, into which all State agencies and public benefit corporations enter.

Chapter 407 of the Laws of 2005 increased the amount required to be provided to this fund to .10 of one-percent of the total cost of each such contract, to be calculated at the time agencies or public benefit corporations enter into a new contract or if a contract is amended. The provisions of this bill became effective August 2, 2005.

To all State Departments, Agency Heads and Public Benefit Corporations
IMPORTANT NOTICE REGARDING PUBLIC WORK ENFORCEMENT FUND

OSC will report to DOL on all construction-related ("D") contracts approved during the month, including contract amendments, and then DOL will bill agencies the appropriate assessment monthly. An agency may then make a determination if any of the billed contracts are exempt and so note on the bill submitted back to DOL. For any instance where an agency is unsure if a contract is or is not exempt, they can call the Bureau of Public Work at the number noted below for a determination. Payment by check or journal voucher is due to DOL within thirty days from the date of the billing. DOL will verify the amounts and forward them to OSC for processing.

For those contracts which are not approved or administered by the Comptroller, monthly reports and payments for deposit into the Public Work Enforcement Fund must be provided to the Administrative Finance Bureau at the DOL within 30 days of the end of each month or on a payment schedule mutually agreed upon with DOL.

Reports should contain the following information:

- Name and billing address of State agency or public benefit corporation;
- State agency or public benefit corporation contact and phone number;
- Name and address of contractor receiving the award;
- Contract number and effective dates;
- Contract amount and PWEF assessment charge (if contract amount has been amended, reflect increase or decrease to original contract and the adjustment in the PWEF charge); and
- Brief description of the work to be performed under each contract.

Checks and Journal Vouchers, payable to the "New York State Department of Labor" should be sent to:

Department of Labor
Administrative Finance Bureau-PWEF Unit
Building 12, Room 464
State Office Campus
Albany, NY 12226

Any questions regarding billing should be directed to NYSDOL's Administrative Finance Bureau-PWEF Unit at (518) 457-3624 and any questions regarding Public Work Contracts should be directed to the Bureau of Public Work at (518) 457-5589.



Required Notice under Article 25-B of the Labor Law

**Attention All Employees, Contractors and Subcontractors:
You are Covered by the Construction Industry Fair Play Act**

The law says that you are an employee unless:

- You are free from direction and control in performing your job, **and**
- You perform work that is not part of the usual work done by the business that hired you, **and**
- You have an independently established business.

Your employer cannot consider you to be an independent contractor unless all three of these facts apply to your work.

It is against the law for an employer to misclassify employees as independent contractors or pay employees off the books.

Employee Rights: If you are an employee, you are entitled to state and federal worker protections. These include:

- Unemployment Insurance benefits, if you are unemployed through no fault of your own, able to work, and otherwise qualified,
- Workers' compensation benefits for on-the-job injuries,
- Payment for wages earned, minimum wage, and overtime (under certain conditions),
- Prevailing wages on public work projects,
- The provisions of the National Labor Relations Act, and
- A safe work environment.

It is a violation of this law for employers to retaliate against anyone who asserts their rights under the law. Retaliation subjects an employer to civil penalties, a private lawsuit or both.

Independent Contractors: If you are an independent contractor, **you must pay all taxes and Unemployment Insurance contributions required by New York State and Federal Law.**

Penalties for paying workers off the books or improperly treating employees as independent contractors:

- **Civil Penalty**
 - First offense: Up to \$2,500 per employee
 - Subsequent offense(s): Up to \$5,000 per employee
- **Criminal Penalty**
 - First offense: Misdemeanor - up to 30 days in jail, up to a \$25,000 fine and debarment from performing public work for up to one year.
 - Subsequent offense(s): Misdemeanor - up to 60 days in jail or up to a \$50,000 fine and debarment from performing public work for up to 5 years.

If you have questions about your employment status or believe that your employer may have violated your rights and you want to file a complaint, call the Department of Labor at (866) 435-1499 or send an email to dol.misclassified@labor.ny.gov. All complaints of fraud and violations are taken seriously. You can remain anonymous.

Employer Name:

IA 999 (09/16)



Attention Employees

THIS IS A: **PUBLIC WORK PROJECT**

If you are employed on this project as a **worker, laborer, or mechanic** you are entitled to receive the **prevailing wage and supplements rate** for the classification at which you are working.

Your pay stub and wage notice received upon hire must clearly state your wage rate and supplement rate.

Chapter 629 of
the Labor Laws
of 2007:

These wages are set by law and must be posted at the work site. They can also be found at:
<https://dol.ny.gov/bureau-public-work>



If you feel that you have not received proper wages or benefits, please call our nearest office.*

Albany	(518) 457-2744	Patchogue	(631) 687-4882
Binghamton	(607) 721-8005	Rochester	(585) 258-4505
Buffalo	(716) 847-7159	Syracuse	(315) 428-4056
Garden City	(516) 228-3915	Utica	(315) 793-2314
New York City	(212) 932-2419	White Plains	(914) 997-9507
Newburgh	(845) 568-5287		

* For New York City government agency construction projects, please contact the Office of the NYC Comptroller at (212) 669-4443, or www.comptroller.nyc.gov – click on Bureau of Labor Law.

Contractor Name: _____

Project Location: _____

Requirements for OSHA 10 Compliance

Article 8 §220-h requires that when the advertised specifications, for every contract for public work, is \$250,000.00 or more the contract must contain a provision requiring that every worker employed in the performance of a public work contract shall be certified as having completed an OSHA 10 safety training course. The clear intent of this provision is to require that all employees of public work contractors, required to be paid prevailing rates, receive such training "prior to the performing any work on the project."

The Bureau will enforce the statute as follows:

All contractors and sub contractors must attach a copy of proof of completion of the OSHA 10 course to the first certified payroll submitted to the contracting agency and on each succeeding payroll where any new or additional employee is first listed.

Proof of completion may include but is not limited to:

- Copies of bona fide course completion card (*Note: Completion cards do not have an expiration date.*)
- Training roster, attendance record or other documentation from the certified trainer pending the issuance of the card.
- Other valid proof

**A certification by the employer attesting that all employees have completed such a course is not sufficient proof that the course has been completed.

Any questions regarding this statute may be directed to the New York State Department of Labor, Bureau of Public Work at 518-457-5589.

WICKS

Public work projects are subject to the Wicks Law requiring separate specifications and bidding for the plumbing, heating and electrical work, when the total project's threshold is \$3 million in Bronx, Kings, New York, Queens and, Richmond counties; \$1.5 million in Nassau, Suffolk and Westchester counties; and \$500,000 in all other counties.

For projects below the monetary threshold, bidders must submit a sealed list naming each subcontractor for the plumbing, HVAC and electrical and the amount to be paid to each. The list may not be changed unless the public owner finds a legitimate construction need, including a change in specifications or costs or the use of a Project Labor Agreement (PLA), and must be open to public inspection.

Allows the state and local agencies and authorities to waive the Wicks Law and use a PLA if it will provide the best work at the lowest possible price. If a PLA is used, all contractors shall participate in apprentice training programs in the trades of work it employs that have been approved by the Department of Labor (DOL) for not less than three years. They shall also have at least one graduate in the last three years and use affirmative efforts to retain minority apprentices. PLA's would be exempt from Wicks, but deemed to be public work subject to prevailing wage enforcement.

The Commissioner of Labor shall have the power to enforce separate specification requirements on projects, and may issue stop-bid orders against public owners for non-compliance.

Other new monetary thresholds, and similar sealed bidding for non-Wicks projects, would apply to certain public authorities including municipal housing authorities, NYC Construction Fund, Yonkers Educational Construction Fund, NYC Municipal Water Finance Authority, Buffalo Municipal Water Finance Authority, Westchester County Health Care Association, Nassau County Health Care Corp., Clifton-Fine Health Care Corp., Erie County Medical Center Corp., NYC Solid Waste Management Facilities, and the Dormitory Authority.

Contractors must pay subcontractors within a 7 days period.

(07.19)

Introduction to the Prevailing Rate Schedule

Information About Prevailing Rate Schedule

This information is provided to assist you in the interpretation of particular requirements for each classification of worker contained in the attached Schedule of Prevailing Rates.

Classification

It is the duty of the Commissioner of Labor to make the proper classification of workers taking into account whether the work is heavy and highway, building, sewer and water, tunnel work, or residential, and to make a determination of wages and supplements to be paid or provided. It is the responsibility of the public work contractor to use the proper rate. If there is a question on the proper classification to be used, please call the district office located nearest the project. District office locations and phone numbers are listed below.

Prevailing Wage Schedules are issued separately for "General Construction Projects" and "Residential Construction Projects" on a county-by-county basis.

General Construction Rates apply to projects such as: Buildings, Heavy & Highway, and Tunnel and Water & Sewer rates.

Residential Construction Rates generally apply to construction, reconstruction, repair, alteration, or demolition of one family, two family, row housing, or rental type units intended for residential use.

Some rates listed in the Residential Construction Rate Schedule have a very limited applicability listed along with the rate. Rates for occupations or locations not shown on the residential schedule must be obtained from the General Construction Rate Schedule. Please contact the local Bureau of Public Work office before using Residential Rate Schedules, to ensure that the project meets the required criteria.

Payrolls and Payroll Records

Contractors and subcontractors are required to establish, maintain, and preserve for not less than six (6) years, contemporaneous, true, and accurate payroll records.

Every contractor and subcontractor shall submit to the Department of Jurisdiction (Contracting Agency), within thirty (30) days after issuance of its first payroll and every thirty (30) days thereafter, a transcript of the original payrolls, subscribed and affirmed as true under penalty of perjury.

Paid Holidays

Paid Holidays are days for which an eligible employee receives a regular day's pay, but is not required to perform work. If an employee works on a day listed as a paid holiday, this remuneration is in addition to payment of the required prevailing rate for the work actually performed.

Overtime

At a minimum, all work performed on a public work project in excess of eight hours in any one day or more than five days in any workweek is overtime. However, the specific overtime requirements for each trade or occupation on a public work project may differ. Specific overtime requirements for each trade or occupation are contained in the prevailing rate schedules.

Overtime holiday pay is the premium pay that is required for work performed on specified holidays. It is only required where the employee actually performs work on such holidays.

The applicable holidays are listed under HOLIDAYS: OVERTIME. The required rate of pay for these covered holidays can be found in the OVERTIME PAY section listings for each classification.

Supplemental Benefits

Particular attention should be given to the supplemental benefit requirements. Although in most cases the payment or provision of supplements is straight time for all hours worked, some classifications require the payment or provision of supplements, or a portion of the supplements, to be paid or provided at a premium rate for premium hours worked. Supplements may also be required to be paid or provided on paid holidays, regardless of whether the day is worked. The Overtime Codes and Notes listed on the particular wage classification will indicate these conditions as required.

Effective Dates

When you review the schedule for a particular occupation, your attention should be directed to the dates above the column of rates. These are the dates for which a given set of rates is effective. The rate listed is valid until the next effective rate change or until the new annual determination which takes effect on July 1 of each year. All contractors and subcontractors are required to pay the current prevailing rates of wages and supplements. If you have any questions please contact the Bureau of Public Work or visit the New York State Department of Labor website (www.labor.ny.gov) for current wage rate information.

Apprentice Training Ratios

The following are the allowable ratios of registered Apprentices to Journey-workers.

For example, the ratio 1:1,1:3 indicates the allowable initial ratio is one Apprentice to one Journeyworker. The Journeyworker must be in place on the project before an Apprentice is allowed. Then three additional Journeyworkers are needed before a second Apprentice is allowed. The last ratio repeats indefinitely. Therefore, three more Journeyworkers must be present before a third Apprentice can be hired, and so on.

Please call Apprentice Training Central Office at (518) 457-6820 if you have any questions.

Title (Trade)	Ratio
Boilermaker (Construction)	1:1,1:4
Boilermaker (Shop)	1:1,1:3
Carpenter (Bldg.,H&H, Pile Driver/Dockbuilder)	1:1,1:4
Carpenter (Residential)	1:1,1:3
Electrical (Outside) Lineman	1:1,1:2
Electrician (Inside)	1:1,1:3
Elevator/Escalator Construction & Modernizer	1:1,1:2
Glazier	1:1,1:3
Insulation & Asbestos Worker	1:1,1:3
Iron Worker	1:1,1:4
Laborer	1:1,1:3
Mason	1:1,1:4
Millwright	1:1,1:4
Op Engineer	1:1,1:5
Painter	1:1,1:3
Plumber & Steamfitter	1:1,1:3
Roofer	1:1,1:2
Sheet Metal Worker	1:1,1:3
Sprinkler Fitter	1:1,1:2

If you have any questions concerning the attached schedule or would like additional information, please contact the nearest BUREAU of PUBLIC WORK District Office or write to:

New York State Department of Labor
Bureau of Public Work
State Office Campus, Bldg. 12
Albany, NY 12226

District Office Locations:	Telephone #	FAX #
Bureau of Public Work - Albany	518-457-2744	518-485-0240
Bureau of Public Work - Binghamton	607-721-8005	607-721-8004
Bureau of Public Work - Buffalo	716-847-7159	716-847-7650
Bureau of Public Work - Garden City	516-228-3915	516-794-3518
Bureau of Public Work - Newburgh	845-568-5287	845-568-5332
Bureau of Public Work - New York City	212-932-2419	212-775-3579
Bureau of Public Work - Patchogue	631-687-4882	631-687-4902
Bureau of Public Work - Rochester	585-258-4505	585-258-4708
Bureau of Public Work - Syracuse	315-428-4056	315-428-4671
Bureau of Public Work - Utica	315-793-2314	315-793-2514
Bureau of Public Work - White Plains	914-997-9507	914-997-9523
Bureau of Public Work - Central Office	518-457-5589	518-485-1870

Tompkins County General Construction

Boilermaker	09/01/2023
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JOB DESCRIPTION Boilermaker

DISTRICT 6

ENTIRE COUNTIES

Cayuga, Clinton, Cortland, Franklin, Jefferson, Lewis, Madison, Oneida, Onondaga, Oswego, Seneca, St. Lawrence, Tompkins

WAGES

Per hour:	07/01/2023	01/01/2024
Boilermaker	\$ 36.98	\$ 37.98

SUPPLEMENTAL BENEFITS

Per hour:		
Journeyman	\$ 26.31* + 1.48	\$ 26.62* + 1.48

*This portion of the benefits subject to the same premium rate as shown for overtime wages.

OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 15, 25) on HOLIDAY PAGE

NOTE: When a holiday falls on Sunday, the day observed by the State or Nation shall be observed. When Christmas Day and New Year's fall on Saturday, Friday will be observed as the holiday.

REGISTERED APPRENTICES

WAGES per hour: Six month terms at the following percentage of Journeyman's wage.

1st	2nd	3rd	4th	5th	6th	7th	8th
65%	65%	70%	75%	80%	85%	90%	95%

SUPPLEMENTAL BENEFITS per hour:

\$ 19.58* + 1.48	\$ 19.58* + 1.48	\$ 20.54* + 1.48	\$ 21.49* + 1.48	\$ 22.44* + 1.48	\$ 23.42* + 1.48	\$ 24.40* + 1.48	\$ 25.35* + 1.48
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*This portion of the benefits subject to the same premium rate as shown for overtime wages.

6-175

Carpenter - Building	09/01/2023
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JOB DESCRIPTION Carpenter - Building

DISTRICT 2

ENTIRE COUNTIES

Chemung, Cortland, Schuyler, Steuben, Tompkins

PARTIAL COUNTIES

Allegany: Only the Township of Alfred.

WAGES

Per hour:	07/01/2023	07/01/2024 Additional	07/01/2025 Additional
Carpenter	\$ 30.50	\$ 1.00*	\$ 1.00*
Floor Coverer	30.50	1.00*	1.00*
Carpet Layer	30.50	1.00*	1.00*
Dry-Wall	30.50	1.00*	1.00*
Diver-Wet Day	61.25	0.00	0.00
Diver -Dry Day	31.50	1.00*	1.00*
Diver Tender	31.50	1.00*	1.00*

*To be allocated at a later date

NOTE ADDITIONAL AMOUNTS PAID FOR THE FOLLOWING WORK LISTED BELOW (per hour worked):

- Pile Drivers/Dock Builders shall receive \$0.25 per hour over the journeyman's rate of pay when performing piledriving/dock building work.
- Certified welders shall receive \$1.00 per hour over the journeyman's rate of pay when the employee is required to be certified and performs DOT or ABS specified welding work
- When an employee performs work within a contaminated area on a State and/or Federally designated hazardous waste site, and where relevant State and/or Federal regulations require employees to be furnished and use or wear required forms of personal protection, then the employee shall receive his regular hourly rate plus \$1.50 per hour.

- Depth pay for Divers based upon deepest depth on the day of the dive (per diem payment):
 - 0' to 80' no additional fee
 - 81'to 100' additional \$.50 per foot
 - 101'to 150' additional \$.75 per foot
 - 151'and deeper additional \$1.25 per foot
- Penetration pay for Divers based upon deepest penetration on the day of the dive (per diem payment):
 - 0' to 50' no additional fee
 - 51' to 100' additional \$.75 per foot
 - 101' and deeper additional \$1.00 per foot
- Diver rates applies to all hours worked on dive day.

SHIFT WORK

On Agency/Owner mandated shift work, the following rates will be applicable:

- 1st Shift - Regular Rate
- 2nd Shift - Premium of 7% of base wage per hour
- 3rd Shift - Premium of 14% of base wage per hour

Shift work shall be defined as implementing at least two (2) shifts in a twenty-four (24) consecutive hour period. Shift work must be for a minimum of three (3) consecutive days.

NOTE - The 'Employer Registration' (30.1) use of a '4 Day/10 Hour Work schedules' will no longer be accepted or processed. All registered projects prior to June 30,2023 will expire within the granted time frame.

For Pre-Registered Projects Four (4), Ten (10) hour days may be worked at straight time during a week, Monday thru Thursday. Friday may be used as a make-up day. Tuesday thru Friday may be worked with no make-up day. For further clarification contact your local Bureau Office.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman \$ 22.48

OVERTIME PAY

See (B, E, E2, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6) on HOLIDAY PAGE

Note: Any holiday which occurs on Sunday shall be observed the following Monday. If Christmas falls on a Saturday, it shall be observed on the prior Friday.

REGISTERED APPRENTICES

CARPENTER APPRENTICES

Wages per hour (1300 hour terms at the following percentage of journeyman's base wage):

1st	2nd	3rd	4th
65%	70%	75%	80%

Supplemental Benefits per hour:

\$ 12.50	\$ 12.50	\$ 15.10	\$ 15.10
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PILEDRIIVER/DOCK BUILDER APPRENTICES

Wages per hour (1300 hour terms at the following percentage of journeyman's base wage):

1st	2nd	3rd	4th
65%*	70%*	75%*	80%*

*Pile Driver/Dock Builder apprentices shall receive an additional \$0.25 per hour worked when performing piledriving/dock building work.

Supplemental Benefits per hour:

\$ 12.50	\$ 12.50	\$ 15.10	\$ 15.10
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LINOLEUM, RESILIENT TILE, AND CARPET LAYER APPRENTICES

Wages per hour (1300 hour terms at the following percentage of journeyman's base wage):

1st	2nd	3rd	4th
65%	70%	75%	80%

Supplemental Benefits per hour:

\$ 12.50	\$ 12.50	\$ 15.10	\$ 15.10
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ADDITIONAL AMOUNTS PAID PER HOUR WORKED TO APPRENTICES FOR SPECIFIC TYPES OF WORK PERFORMED:

- Certified welders shall receive \$1.00 per hour over the apprentices rate of pay when the apprentice is required to be certified and performs DOT or ABS specified welding work
- When an apprentice performs work within a contaminated area on a State and/or Federally designated hazardous waste site, and where relevant State and/or Federal regulations require the apprentice to be furnished and use or wear required forms of personal protection, then the apprentice shall receive his regular hourly rate plus \$1.50 per hour.

2-277B-CS

Carpenter - Building / Heavy&Highway

09/01/2023

JOB DESCRIPTION Carpenter - Building / Heavy&Highway

DISTRICT 2

ENTIRE COUNTIES

Albany, Allegany, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Lewis, Livingston, Madison, Monroe, Montgomery, Niagara, Oneida, Onondaga, Ontario, Orleans, Oswego, Otsego, Rensselaer, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Sullivan, Tioga, Tompkins, Ulster, Warren, Washington, Wayne, Wyoming, Yates

PARTIAL COUNTIES

Orange: The area lying on Northern side of Orange County demarcated by a line drawn from the Bear Mountain Bridge continuing west to the Bear Mountain Circle, continue North on 9W to the town of Cornwall where County Road 107 (also known as Quaker Rd) crosses under 9W, then east on County Road 107 to Route 32, then north on Route 32 to Orrs Mills Rd, then west on Orrs Mills Rd to Route 94, continue west and south on Route 94 to the Town of Chester, to the intersection of Kings Highway, continue south on Kings Highway to Bellvale Rd, west on Bellvale Rd to Bellvale Lakes Rd, then south on Bellvale Lakes Rd to Kain Rd, southeast on Kain Rd to Route 17A, then north and southeast along Route 17A to Route 210, then follow Route 210 to NJ Border.

WAGES

Wages per hour:	07/01/2023	07/01/2024 Additional
Carpenter - ONLY for Artificial Turf/Synthetic Sport Surface	\$ 34.48	\$ 2.25*

*To be allocated at a later date

Note - Does not include the operation of equipment. Please see Operating Engineers rates.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman \$ 26.30

OVERTIME PAY

See (B, E, Q, X) on OVERTIME PAGE

HOLIDAY

Paid: See (5) on HOLIDAY PAGE

Overtime: See (5, 6, 16) on HOLIDAY PAGE

Notes:

When a holiday falls upon a Saturday, it shall be observed on the preceding Friday. When a holiday falls upon a Sunday, it shall be observed on the following Monday.

An employee taking an unexcused day off the regularly scheduled day before or after a paid Holiday shall not receive Holiday pay.

REGISTERED APPRENTICES

Wages per hour (1300 hour terms at the following percentage of Journeyman's wage):

1st	2nd	3rd	4th
65%	70%	75%	80%

Supplemental Benefits per hour:

1st term	\$ 17.56
2nd term	18.04
3rd term	20.06
4th term	20.54

2-42AtSS

Carpenter - Heavy&Highway

09/01/2023

JOB DESCRIPTION Carpenter - Heavy&Highway

DISTRICT 2

ENTIRE COUNTIES

Broome, Cayuga, Chemung, Cortland, Delaware, Jefferson, Lewis, Onondaga, Oswego, Schuyler, Seneca, St. Lawrence, Steuben, Tioga, Tompkins, Yates

WAGES

Per hour	07/01/2023	05/01/2024 Additional
Carpenter	\$ 35.78	\$ 2.75*
Piledriver	35.78	2.75*
Diver-Wet Day	60.78	2.75*
Diver-Dry Day	36.78	2.75*
Diver-Tender	36.78	2.75*

*To be allocated at a later date.

NOTE ADDITIONAL AMOUNTS PAID FOR THE FOLLOWING WORK LISTED BELOW (per hour worked):

- When project owner mandates a single irregular work shift, the employee will receive an additional \$3.00 per hour. A single irregular work shift can start any time from 5:00 p.m. to 1:00 a.m.
- State or Federal designated hazardous site, requiring protective gear shall be an additional \$2.50 per hour.
- Certified welders when required to perform welding work will receive an additional \$2.50 per hour.

ADDITIONAL NOTES PERTAINING TO DIVERS/TENDERS:

- Divers and Tenders shall receive one and one half (1 1/2) times their regular diver and tender rate of pay for Effluent and Slurry diving.
- Divers and tenders being paid at the specified rate for Effluent and Slurry diving shall have all overtime rates based on the specified rate plus the appropriate overtime rates (one and one half or two times the specified rate for Slurry and Effluent divers and tenders).
- The pilot of an ADS or submersible will receive one and one-half (1 1/2) times the Diver-Wet Day Rate for time submerged.
- All crew members aboard a submersible shall receive the Diver-Wet Day rate.
- Depth pay for Divers based upon deepest depth on the day of the dive (per diem payment):
 - 0' to 50' no additional fee
 - 51'to 100' additional \$.50 per foot
 - 101'to 150' additional \$0.75 per foot
 - 151'and deeper additional \$1.25 per foot
- Penetration pay for Divers based upon deepest penetration on the day of the dive (per diem payment):
 - 0' to 50' no additional fee
 - 51' to 100' additional \$.75 per foot
 - 101' and deeper additional \$1.00 per foot
- Diver rates applies to all hours worked on dive day.

NOTE - The 'Employer Registration' (30.1) use of a '4 Day/10 Hour Work schedules' will no longer be accepted or processed. All registered projects prior to June 30,2023 will expire within the granted time frame.

For Pre-Registered Projects Four (4), Ten (10) hour days may be worked at straight time during a week, Monday thru Thursday. Friday may be used as a make-up day. Tuesday thru Friday may be worked with no make-up day. For further clarification contact your local Bureau Office.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman \$ 26.30

OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 6) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

- In the event a Holiday falls on a Saturday, the Friday before will be observed as a Holiday. If a Holiday falls on a Sunday, then Monday will be observed as a Holiday. Employee must work scheduled work day before and after the Holiday.

- The employee must work their scheduled workday before and their scheduled workday after the holiday to receive holiday pay.

REGISTERED APPRENTICES

CAPRENTER APPRENTICES

Wages per hour (1040 hour terms at the following percentage of journeyman's base wage):

1st	2nd	3rd	4th	5th
65%	70%	75%	80%	85%

Supplemental Benefits per hour:

\$ 17.56	\$ 18.04	\$ 20.01	\$ 20.49	\$ 20.97
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PILEDRIIVER/DOCKBUILDER APPRENTICES

Wages per hour (1300 hour terms at the following percentage of journeyman's base wage):

1st	2nd	3rd	4th
65%	70%	80%	85%

Supplemental Benefits per hour:

\$ 17.56	\$ 18.04	\$ 20.49	\$ 20.97
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NOTE ADDITIONAL AMOUNTS PAID PER HOUR WORKED TO APPRENTICES FOR SPECIFIC TYPES OF WORK PERFORMED:

- When project owner mandates a single irregular work shift, the employee will receive an additional \$3.00 per hour. A single irregular work shift can start any time from 5:00 p.m. to 1:00 a.m.
- State or Federal designated hazardous site, requiring protective gear shall be an additional \$2.50 per hour.
- Certified welders when required to perform welding work will receive an additional \$2.50 per hour.

2-277HH-Bro

JOB DESCRIPTION Electrician

DISTRICT 6

ENTIRE COUNTIES

Cortland, Herkimer, Madison, Oneida, Oswego

PARTIAL COUNTIES

Cayuga: Townships of Ira, Locke, Sempronius, Sterling, Summerhill and Victory.

Chenango: Only the Townships of Columbus, New Berlin and Sherburne.

Onondaga: Entire County except Townships of Elbridge and Skaneateles.

Otsego: Only the Townships of Plainfield, Richfield, Springfield, Cherry Valley, Roseboom, Middlefield, Otsego, Exeter, Edmeston, Burlington, Pittsfield and New Lisbon.

Tompkins: Only the Township of Groton.

Wayne: Only the Townships of Huron, Wolcott, Rose and Butler.

WAGES

Per hour: 07/01/2023

Electrician	\$ 44.00
Teledata	44.00
Cable Splicer	48.40

NOTE: Additional premiums for the following work listed:

- Additional \$2.00 per hour for work performed over 35 feet above the ground, floor, or roof levels or where work is required in tunnels, shafts, or under compressed air 35 feet below the ground level.

- Additional \$2.50 per hour for working over 50 feet above or below ground, floor, or roof level. This includes work on ladders, "toothpicks", scaffolds, boatswain chairs, towers, smokestacks or other open structures, or mechanical lifts used over 60 feet.

SHIFT WORK: THE FOLLOWING RATES WILL APPLY ON ALL CONTRACTING AGENCY MANDATED MULTIPLE SHIFTS OF EIGHT (8) HOURS FOR AT LEAST FIVE (5) DAYS DURATION WHICH MAY HAVE BEEN WORKED. WHEN TWO (2) SHIFTS OR THREE (3) SHIFTS ARE WORKED:

1ST SHIFT	8:00AM - 4:30PM:	Regular wage rate
2ND SHIFT	4:30 PM - 1:00 AM:	Regular wage rate plus 15%
3RD SHIFT	12:30 AM - 9:00 AM:	Regular wage rate plus 25%

Occupied Conditions: When necessary to perform alteration and/or renovation work and owner mandates (due to occupied conditions) prevent the work from being performed during "normal" working hours (defined as between 6:00 a.m. and 4:30 p.m. Monday through Friday), alternate hours may be worked, provided: 1) The hours are established for a minimum of five (5) days duration or the length of the job, whichever is shorter; and 2) An entire work scope within a job-site area is performed utilizing the varied hours. If these conditions are satisfied, all hours worked Monday through Friday of a shift that starts before or ends after the "normal" hours, shall be paid at the appropriate rate plus fifteen percent (15%). However, the following restrictions shall apply:

- 1) "Alternate" hours shall consist of a minimum of eight consecutive hours per day
- 2) Hours worked in excess of eight (8) hours per day, Monday through Friday, shall be paid at a rate of one and one-half times the applicable rate (day-shift + 15%)
- 3) Hours worked on Saturday shall be paid at time and one-half the applicable rate.
- 4) Hours worked on Sundays and Holidays shall be paid at double the straight time rate.
- 5) Work of a new construction nature may not be worked under these conditions.

NOTE - The "Employer Registration" (30.1) use of a '4 Day/10 Hour Work schedules' will no longer be accepted or processed. All registered projects prior to June 30, 2023 will expire within the granted time frame.

For Pre-Registered Projects Four (4), Ten (10) hour days may be worked at straight time during a week, Monday thru Thursday. Friday may be used as a make-up day. Tuesday thru Friday may be worked with no make-up day. For further clarification contact your local Bureau Office.

SUPPLEMENTAL BENEFITS

Per hour:	\$ 30.17 plus
Journeyman	3% of hourly wage paid*

*NOTE: The 3% is based on the hourly wage paid, straight time or premium rate.

OVERTIME PAY

See (B, *E, Q) on OVERTIME PAGE

* NOTE: On Saturday the first 10 hours worked shall be paid at a rate of one and one-half times the applicable rate. All additional hours are payable at double the straight time rate.

NOTE: WAGE CAP - Double the straight time hourly base wage shall be the maximum hourly wage compensation for any hour worked. Contractor is still responsible to pay the hourly benefit amount for each hour worked.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

NOTE: If any of the above holidays fall on Saturday, Friday shall be observed as the holiday. If any of the above holidays fall on Sunday, Monday shall be observed as the holiday.

REGISTERED APPRENTICES

WAGES per hour: Hourly terms at the following percentage of Journeyman's wage.

1st period 40% (0-1000 hrs.)	\$ 17.60
2nd period 45% (1001-2000)	19.80
3rd period 50% (2001-3500)	22.00
4th period 60% (3501-5000)	26.40
5th period 70% (5001-6500)	30.80
6th Period 80% (6501-8000)	35.20

SUPPLEMENTAL BENEFITS per hour:

1st period	\$ 13.59*
2nd period	\$ 13.59*
3rd period	\$ 27.42*
4th period	\$ 27.97*
5th period	\$ 28.52*
6th period	\$ 29.07*

* PLUS 3% OF HOURLY WAGE PAID, STRAIGHT TIME RATE OR PREMIUM RATE.

6-43

Electrician

09/01/2023

JOB DESCRIPTION Electrician

DISTRICT 6

ENTIRE COUNTIES

PARTIAL COUNTIES

Cayuga: Only the Township of Genoa.
Schuyler: Only the Townships of Cayuta, Catharine, and Hector.
Seneca: Only the Townships of Lodi and Covert.
Tioga: Only the Townships of Spencer and Candor.
Tompkins: Entire county except the Township of Groton.

WAGES

Per hour:	07/01/2023	06/01/2024
		Additional
Electrician	\$ 40.00	\$ 2.75*

* To be allocated at a later date

Additional \$1.00 per hour for work from trusses, scaffolds, frames, spider baskets, ladders, etc. 40 feet or more from ground floor or in underground mines or tunnels. Work done from personal lift equipment that complies with OSHA requirements are excluded.

Additional \$2.00 per hour when required to work under compressed air, on radio towers, on asbestos abatement projects which require the use of a respirator, work of a hazardous nature, work where gas masks are required or work requiring use of protective arc flash suits.

SHIFT WORK: THE FOLLOWING RATES WILL APPLY WHEN SHIFT WORK IS MANDATED EITHER IN THE JOB SPECIFICATION OR BY THE CONTRACTING AGENCY:

1ST SHIFT	8:00 AM to 4:30 PM	Regular wage rate
2ND SHIFT	4:30 PM to 1:00 AM	Regular wage rate plus 17.3%
3RD SHIFT	12:30 AM to 9:00 AM	Regular wage rate plus 31.4%

SUPPLEMENTAL BENEFITS

Per hour:	\$ 28.80 plus
Journeyman	3% of hourly wage paid*

* NOTE: The 3% is based on the hourly wage paid, straight time rate or premium rate.

OVERTIME PAY

See (B, *E, Q) on OVERTIME PAGE

* NOTE: On Saturday the first 8 hours worked shall be paid at a rate of one and one-half times the applicable rate. All additional hours are payable at double the straight time rate.

NOTE: WAGE CAP - Double the straight time hourly base wage shall be the maximum hourly wage compensation for any hour worked.

Contractor is still responsible to pay the hourly benefit amount for each hour worked.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

NOTE: When a holiday falls on a Saturday, the day preceding shall be celebrated as such, and when falling on a Sunday, Monday will be celebrated as the holiday.

REGISTERED APPRENTICES

WAGES per hour: One year terms at the following percentage of Journeyman's wage.

1st year (47.5%)	\$ 19.00
2nd year (55%)	22.00
3rd year (65%)	26.00
4th year (75%)	30.00
5th year (85%)	34.00

SUPPLEMENTAL BENEFITS per hour:

1st year	\$ 13.25*
2nd year	12.25*
3rd year	21.81*
4th year	23.28*
5th year	24.75*

* PLUS 3% OF HOURLY WAGE PAID, STRAIGHT TIME RATE OR PREMIUM RATE.

6-241

Elevator Constructor

09/01/2023

JOB DESCRIPTION Elevator Constructor

DISTRICT 6

ENTIRE COUNTIES

Broome, Cayuga, Chenango, Cortland, Franklin, Jefferson, Lewis, Onondaga, Oswego, St. Lawrence, Tioga, Tompkins

PARTIAL COUNTIES

Delaware: Only the towns of: Tompkins, Walton, Masonville, Sidney, Franklin and Deposit.

Madison: Only the towns of: Cazenovia, DeRuyter, Eaton, Fenner, Georgetown, Lebanon, Lenox, Nelson and Sullivan.

Oneida: Only the towns of: Camden, Florence and Vienna.

WAGES

Per hour:	07/01/2023	01/01/2024	01/01/2025	01/01/2026
Elevator Constructor	\$ 53.69	\$ 56.02	\$ 58.455	\$ 61.003
Helper	37.58	39.21	40.92	42.70

NOTE - The "Employer Registration" (30.1) use of a '4 Day/10 Hour Work schedules' will no longer be accepted or processed. All registered projects prior to June 30, 2023 will expire within the granted time frame.

For Pre-Registered Projects Four (4), Ten (10) hour days may be worked at straight time during a week, Monday thru Thursday. Friday may be used as a make-up day. Tuesday thru Friday may be worked with no make-up day. For further clarification contact your local Bureau Office.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman	\$ 37.335*	\$ 37.885*	\$ 38.435*	\$ 38.985*
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*NOTE - add 6% of regular hourly rate for all hours worked. Add 8% of regular hourly rate if more than 5 years of service.

OVERTIME PAY

See (D, O) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 6, 15, 16) on HOLIDAY PAGE

Overtime: See (5, 6, 15, 16) on HOLIDAY PAGE

NOTE: When a paid holiday falls on a Saturday, it shall be observed on Friday. When a paid holiday falls on Sunday, it shall be observed on Monday.

REGISTERED APPRENTICES

WAGES per hour: 1 year terms at the following percentage of the Elevator Constructor wage.

0-6 months	6-12 months	2nd year	3rd year	4th year
50%	55%	65%	70%	80%

SUPPLEMENTAL BENEFITS per hour:

0-6 months: 6% of the hourly apprentice rate paid, no additional supplemental benefits.

All other terms: Same as Journeyman.

6-62.1

Glazier

09/01/2023

JOB DESCRIPTION Glazier

DISTRICT 5

ENTIRE COUNTIES

Broome, Chemung, Chenango, Delaware, Otsego, Schuyler, Steuben, Tioga, Tompkins

WAGES

Per hour: 07/01/2023

Glazier \$ 27.90

**** NOTE-**The "Employer Registration" (30.1) use of a '4 Day/10 Hour Work schedules' will no longer be accepted or processed. All registered projects prior to JUNE 30, 2023 will expire within the granted time frame.

For Pre-Registered Projects Four(4),Ten(10)hour days may be worked at straight time during a week Monday thru Thursday. Friday may be used as a make-up day. Tuesday thru Friday may be worked with no make-up day. For further clarification contact your local Bureau Office

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman \$ 28.70

OVERTIME PAY

See (B, E*, E2, Q**) on OVERTIME PAGE.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6) on HOLIDAY PAGE

REGISTERED APPRENTICES

1000 hour terms

Appr. 1st term	\$17.50
Appr. 2nd term	18.50
Appr. 3rd term	19.50
Appr. 4th term	20.50
Appr. 5th term	21.50
Appr. 6th term	22.50
Appr. 7th term	23.50
Appr. 8th term	24.50

Supplemental Benefits per hour:

Appr. 1st term	\$ 12.91
Appr. 2nd term	12.91
Appr. 3rd term	18.91
Appr. 4th term	18.91
Appr. 5th term	19.91
Appr. 6th term	19.91
Appr. 7th term	20.91
Appr. 8th term	20.91

5-677z3

Insulator - Heat & Frost

09/01/2023

JOB DESCRIPTION Insulator - Heat & Frost

DISTRICT 6

ENTIRE COUNTIES

Broome, Cayuga, Chemung, Chenango, Cortland, Herkimer, Jefferson, Lewis, Madison, Oneida, Onondaga, Oswego, Otsego, Schuyler, Seneca, St. Lawrence, Tioga, Tompkins

WAGES

Per hour: 07/01/2023

Asbestos Installer \$ 38.50

Insulation Installer 38.50

(On mechanical systems only)

NOTE: THE FOLLOWING RATES WILL APPLY ON ALL CONTRACTING AGENCY MANDATED SHIFTS WORKED.

1ST SHIFT \$ 38.50

2ND SHIFT 44.27

3RD SHIFT 46.20

NOTE - The "Employer Registration" (30.1) use of a '4 Day/10 Hour Work schedules' will no longer be accepted or processed. All registered projects prior to June 30, 2023 will expire within the granted time frame.

For Pre-Registered Projects Four (4), Ten (10) hour days may be worked at straight time during a week, Monday thru Thursday. Friday may be used as a make-up day. Tuesday thru Friday may be worked with no make-up day. For further clarification contact your local Bureau Office.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman \$ 25.09

OVERTIME PAY

See (*B1, **K, P) on OVERTIME PAGE

*NOTE: First 10 hours on Saturday.

**NOTE: Holidays that fall on Sunday are subject to double time.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (2*,4,6,28) on HOLIDAY PAGE

*Triple time for Labor Day if worked.

REGISTERED APPRENTICES

WAGES per hour: One year terms at the following percentage of Journeyman's wage.

1st	2nd	3rd	4th
60%	70%	80%	90%
\$ 23.10	\$ 26.95	\$ 30.80	\$ 34.65

SUPPLEMENTAL BENEFITS per hour:

\$ 22.59	\$ 22.59	\$ 25.09	\$ 25.09
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6-30-Syracuse

Ironworker

09/01/2023

JOB DESCRIPTION Ironworker

DISTRICT 6

ENTIRE COUNTIES

Broome, Cayuga, Cortland, Onondaga, Oswego, Seneca, Tioga, Tompkins

PARTIAL COUNTIES

Chenango: Only the Townships of Lincklaen, Otsego, Pitcher, Pharsalia, German, McDonough, Preston, Norwich, Smithville, Oxford, Guilford, Greene, Coventry, Bainbridge and Afton.

Jefferson: Only the Townships of Alexandria, Theresa, Clayton, Orleans, Cape Vincent, Lyme, Brownville, Pamela, LeRay, Hounsfield, Watertown, Rutland, Adams, Henderson, Rodman, Ellisburg, Lorraine and Worth.

Madison: Only the Townships of Sullivan, Lenox, Lincoln, Fenner, Smithfield, Cazenovia, Nelson, DeRuyter and Georgetown.

Schuyler: Only the Townships of Cayuta, Catharine, Hector and Montour.

Wayne: Only the Townships of Galen, Savannah, Rose, Butler, Huron and Wolcott

WAGES

Structural, Reinforcing, Re-bar, Machinery Mover & Rigger, Ornamental & Curtain Wall, Window Wall, Pre-Glazed Metal Framed Windows Attached to Steel or Masonry Including Caulking, Fence Erector (Chain Link/Security), Sheeter/Bridge Rail, Pre-Cast Erector, Stone Derrickman, Pre-Engineered Building Erector, Welder

Per hour: 07/01/2023

Ironworker \$ 33.00

NOTE: Shift work mandated by the project owner. All shifts will be (8) hours.

1st Shift \$ 33.00
2nd Shift 36.30
3rd Shift 37.95

WHEN A SINGLE IRREGULAR SHIFT IS WORKED, WITH START TIMES BASED ON SECOND AND THIRD SHIFTS, ADD 10 % TO THE WAGE RATE POSTED ABOVE.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman \$ 30.83

OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

NOTE: Any holiday which occurs on Sunday shall be observed the following Monday.

REGISTERED APPRENTICES

WAGES per hour: One year terms at the following rates.

1st	2nd	3rd	4th
\$ 19.50	\$ 21.50	\$ 23.50	\$ 25.50

SUPPLEMENTAL BENEFITS per hour:

1st year	\$ 12.03
2nd year	20.26
3rd year	21.43
4th year	22.61

6-60

Laborer - Building

09/01/2023

JOB DESCRIPTION Laborer - Building

DISTRICT 2

ENTIRE COUNTIES

Cortland, Tompkins

PARTIAL COUNTIES

Schuyler: Only the Township of Catherine including the Village of Odessa.

Tioga: Townships of Candor & Spencer

WAGES

Per hour:

GROUP #1: Basic Laborer - excavation, concrete vibrator, power-driven buggy, demolition (including acetylene torch work) that is customarily done by a laborer

GROUP #2: Air Tool Operators, Mason Tenders

GROUP #3: Blaster, Rock Drill (compressor driven)

GROUP #4: Asbestos, Hazardous, Toxic Waste, Lead and Mold Remediation

	07/01/2023	07/01/2024 Additional	07/01/2025 Additional	07/01/2026 Additional
GROUP #1	\$ 26.25	\$ 1.00*	\$ 1.00*	\$ 1.25*
GROUP #2	27.25	1.00*	1.00*	1.25*
GROUP #3	28.25	1.00*	1.00*	1.25*
GROUP #4	28.25	1.00*	1.00*	1.25*

*To be allocated at a later date.

IMPORTANT NOTES:

- Laborer tasks on Renewable Energy and Green Energy construction work shall be paid at the appropriate Heavy & Highway rates.
- Wage and supplement rates for the operation of forklift and skid steer may be found under the classification "Operating Engineer".

NOTE - The 'Employer Registration' (30.1) use of a '4 Day/10 Hour Work schedules' will no longer be accepted or processed. All registered projects prior to June 30,2023 will expire within the granted time frame.

For Pre-Registered Projects Four (4), Ten (10) hour days may be worked at straight time during a week, Monday thru Thursday. Friday may be used as a make-up day. Tuesday thru Friday may be worked with no make-up day. For further clarification contact your local Bureau Office.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman \$ 21.95

OVERTIME PAY

See (B, E, E2, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

When a holiday falls on Sunday, it shall be observed on the following Monday.

REGISTERED APPRENTICES

WAGES: 1000 hour terms at the following percentage of Journeyman's wage.

1st	2nd	3rd	4th
70%	80%	85%	90%

SUPPLEMENTAL BENEFITS per hour:

1st term	\$ 14.60
2nd term	15.85
3rd term	16.73
4th term	17.60

2-785b

Laborer - Heavy&Highway

09/01/2023

JOB DESCRIPTION Laborer - Heavy&Highway

DISTRICT 2

ENTIRE COUNTIES

Broome, Chemung, Cortland, Schuyler, Steuben, Tioga, Tompkins

PARTIAL COUNTIES

Chenango: Entire County except the Townships of Sherburne, Columbus and New Berlin.

Delaware: Only the Townships of Sidney, Masonville, Walton, Tompkins, Deposit, Hancock and Colchester.

WAGES

Per hour:

GROUP A: Drill Helper, Flagman, Outboard and Hand Boats.

GROUP B: Basic Rate, Bull Float (where used for strike off only), Chain Saw, Concrete Aggregate Bin, Concrete Bootmen, Gin Buggy, Hand or Machine Vibrator, Jack Hammer, Mason Tender, Mortar Mixer, Pavement Breaker, Handlers of Steel Mesh, Small Generators for Laborers Tools, Installation of Bridge Drainage Pipe, Pipe Layers, Vibrator Type Rollers, Tamper, Drill Doctor, Water Pump Operators (1-1/2" & Single Diaphragm), Nozzle (Asphalt, Guniting, Seeding, and Sand Blasting), Laborers on Chain Link Fence Erection, Rock Splitter and Power Unit, Pusher Type Concrete Saw and all other Gas, Electric, and Air Tool Operators, Wrecking Laborer.

GROUP C: Drilling equipment - only where a separate air compressor unit supplies power, Acetylene Torch Operators, Asphalt Raker, Powder Man, Tail or Screw Operator on Asphalt Paver.

GROUP D: Blasters, Form Setters (slab steel forms on highways, roads, streets & airport runways), Stone or Granite Curb Setters.

GROUP E: Hazardous Waste defined as when an employee performs hazardous waste removal, lead abatement and removal, asbestos abatement and removal work on State and/or Federally designated waste site and were relevant State and/or Federal regulations require employees to use or wear required forms of personal protection.

	07/01/2023	07/01/2024 Additional
GROUP A	\$ 35.06	\$ 2.50*
GROUP B	35.26	2.50*
GROUP C	35.46	2.50*
GROUP D	35.66	2.50*
GROUP E	38.26	2.50*

*To be allocated at a later date.

NOTE ADDITIONAL AMOUNTS FOR THE FOLLOWING CONDITIONS:

- A single irregular work shift starting any time between 5:00 PM and 1:00 AM on governmental mandated night work shall be paid an additional \$3.00 per hour.
- When an employee is required by the employer and/or by the material data safety sheets of a product, during its application, to wear a half or full-face replaceable cartridge respirator for more than (2) hours, then in such case said employee(s) will be paid the Group E rate for the shift.

IMPORTANT NOTES:

- Laborer tasks on Renewable Energy and Green Energy construction work shall be paid at the appropriate Heavy & Highway rates.
- Wage and supplement rates for the operation of forklift and skid steer may be found under the classification "Operating Engineer".

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman \$ 23.85

OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 6) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

- If Holiday falls on Sunday, it will be celebrated on Monday. If the Holiday falls on Saturday, it will be celebrated on Saturday.
- An Employee must work the scheduled working day before and the scheduled working day after a holiday to receive holiday pay. However, an employee not able to report because of proven sickness, death in immediate family, or accident shall be entitled to holiday pay.

REGISTERED APPRENTICES

WAGES: 1000 hour terms at the following percentage of Journeyman's GROUP B wage:

1st	2nd	3rd	4th
70%	80%	85%	90%

SUPPLEMENTAL BENEFITS per hour:

1st term	\$ 21.60
2nd term	22.35
3rd term	22.73
4th term	23.10

2-785h

Laborer - Tunnel

09/01/2023

JOB DESCRIPTION Laborer - Tunnel

DISTRICT 2

ENTIRE COUNTIES

Broome, Chemung, Cortland, Schuyler, Steuben, Tioga, Tompkins

PARTIAL COUNTIES

Chenango: Entire County except the Townships of Sherburne, Columbus, and New Berlin.

Delaware: Only the Townships of Sidney, Masonville, Walton, Tompkins, Deposit, Hancock and Colchester.

WAGES

Per hour:

GROUP A: Change House Man

GROUP B: Miners and all Machine Men, Safety Miner, All Shaft work, Caisson work, Drilling, Blow Pipe, all Air Tools, Tugger, Scaling, Nipper, Guniting pot to nozzle, Bit Grinder, Signal Man (top and bottom), Concrete Man, Shield Driven Tunnels, mixed face and soft ground, liner plate tunnels in free air.

GROUP C: Blaster

GROUP D: Hazardous waste removal work on a State and/or Federally designated waste site where relevant State and/or Federal regulations require employees to use or wear required forms of personal protection.

	07/01/2023	07/01/2024 Additional
Group A	\$ 38.24	\$ 2.50*
Group B	38.44	2.50*
Group C	41.24	2.50*
Group D	41.44	2.50*

*To be allocated at a later date.

NOTE ADDITIONAL AMOUNTS FOR THE FOLLOWING CONDITIONS:

- A single irregular work shift starting any time between 5:00 PM and 1:00 AM on governmental mandated night work shall be paid an additional \$3.00 per hour.
- When an employee is required by the employer and/or by the material data safety sheets of a product, during its application, to wear a half or full face replaceable cartridge respirator for more then (2) hours, then in such case said employee(s) will be paid the Group D rate for the shift.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman \$ 23.85

OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE

- If Holiday falls on Sunday, it will be celebrated on Monday. If the Holiday falls on Saturday, it will be celebrated on Friday.
- An Employee must work the scheduled working day before and the scheduled working day after a holiday to receive holiday pay. However, an employee not able to report because of proven sickness, death in immediate family, or accident shall be entitled to holiday pay.

HOLIDAY

Paid: See (5, 6) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

If the holiday falls on Saturday, it will be celebrated on Friday. If the holiday falls on Sunday, it will be celebrated on Monday

REGISTERED APPRENTICES

WAGES: 1000 hour terms at the following percentage of Group B wage

1st	2nd	3rd	4th
70%	80%	85%	90%

SUPPLEMENTAL BENEFITS per hour:

1st Term	\$ 8.25
2nd Term	8.25
3rd Term	16.25
4th Term	23.85

2-785T

Lineman Electrician

09/01/2023

JOB DESCRIPTION Lineman Electrician

DISTRICT 6

ENTIRE COUNTIES

Albany, Allegany, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Dutchess, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Lewis, Livingston, Madison, Monroe, Montgomery, Niagara, Oneida, Onondaga, Ontario, Orange, Orleans, Oswego, Otsego, Putnam, Rensselaer, Rockland, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Sullivan, Tioga, Tompkins, Ulster, Warren, Washington, Wayne, Wyoming, Yates

WAGES

A Lineman/Technician shall perform all overhead aerial work. A Lineman/Technician on the ground will install all electrical panels, connect all grounds, install and connect all electrical conductors, assembly of all electrical materials, conduit, pipe, or raceway; placing of fish wire; pulling of cables, wires or fiber optic cable through such raceways; splicing of conductors; dismantling of such structures, lines or equipment.

A Groundman/Truck Driver shall: Build and set concrete forms, handle steel mesh, set footer cages, transport concrete in a wheelbarrow, hand or machine concrete vibrator, finish concrete footers, mix mortar, grout pole bases, cover and maintain footers while curing in cold weather, operate jack hammer, operate hand pavement breaker, tamper, concrete and other motorized saws, as a drill helper, operate and maintain generators, water pumps, chainsaws, sand blasting, operate mulching and seeding machine, air tools, electric tools, gas tools, load and unload materials, hand shovel and/or broom, prepare and pour mastic and other fillers, assist digger operator/equipment operator in ground excavation and restoration, landscape work and painting. Only when assisting a lineman technician, a groundman/truck driver may assist in installing conduit, pipe, cables and equipment.

NOTE: Includes Teledata Work within ten (10) feet of High Voltage Transmission Lines. Also includes digging of holes for poles, anchors, footer, and foundations for electrical equipment.

Below rates applicable on all overhead and underground distribution and maintenance work, and all overhead and underground transmission line work and the installation of fiber optic cable where no other construction trades are or have been involved. (Ref #14.01.01)

Per hour:	07/01/2023	05/06/2024
Lineman, Technician	\$ 57.40	\$ 58.90
Crane, Crawler Backhoe	57.40	58.90
Welder, Cable Splicer	57.40	58.90
Digging Mach. Operator	51.66	53.01
Tractor Trailer Driver	48.79	50.07
Groundman, Truck Driver	45.92	47.12
Equipment Mechanic	45.92	47.12
Flagman	34.44	35.34

Additional \$1.00 per hour for entire crew when a helicopter is used.

Below rates applicable on all electrical sub-stations, switching structures, fiber optic cable and all other work not defined as "Utility outside electrical work". (Ref #14.02.01-A)

Lineman, Technician	\$ 57.40	\$ 58.90
Crane, Crawler Backhoe	57.40	58.90
Cable Splicer	63.14	64.79
Certified Welder, Pipe Type Cable	60.27	61.85
Digging Mach. Operator	51.66	53.01
Tractor Trailer Driver	48.79	50.07
Groundman, Truck Driver	45.92	47.12
Equipment Mechanic	45.92	47.12
Flagman	34.44	35.34

Additional \$1.00 per hour for entire crew when a helicopter is used.

Below rates apply on switching structures, maintenance projects, railroad catenary install/maintenance third rail installation, bonding of rails and pipe type cable and installation of fiber optic cable. (Ref #14.02.01-B)

Lineman, Tech, Welder	\$ 58.72	\$ 60.22
Crane, Crawler Backhoe	58.72	60.22
Cable Splicer	64.59	66.24
Certified Welder, Pipe Type Cable	61.66	63.23
Digging Mach. Operator	52.85	54.20
Tractor Trailer Driver	49.91	51.19
Groundman, Truck Driver	46.98	48.18
Equipment Mechanic	46.98	48.18
Flagman	35.23	36.13

Additional \$1.00 per hour for entire crew when a helicopter is used.

Below rates applicable on all overhead and underground transmission line work & fiber optic cable where other construction trades are or have been involved. This applies to transmission line work only, not other construction. (Ref #14.03.01)

Lineman, Tech, Welder	\$ 59.91	\$ 61.41
Crane, Crawler Backhoe	59.91	61.41
Cable Splicer	59.91	61.41
Digging Mach. Operator	53.92	55.27
Tractor Trailer Driver	50.92	52.20
Groundman, Truck Driver	47.93	49.13
Equipment Mechanic	47.93	49.13
Flagman	35.95	36.85

Additional \$1.00 per hour for entire crew when a helicopter is used.

NOTE: THE FOLLOWING RATES WILL APPLY ON ALL CONTRACTING AGENCY MANDATED MULTIPLE SHIFTS OF AT LEAST FIVE (5) DAYS DURATION WORKED BETWEEN THE HOURS LISTED BELOW:

1ST SHIFT 8:00 AM to 4:30 PM REGULAR RATE

2ND SHIFT	4:30 PM to 1:00 AM REGULAR RATE PLUS 17.3 %
3RD SHIFT	12:30 AM to 9:00 AM REGULAR RATE PLUS 31.4 %

NOTE - The "Employer Registration" (30.1) use of a '4 Day/10 Hour Work schedules' will no longer be accepted or processed. All registered projects prior to June 30, 2023 will expire within the granted time frame.

For Pre-Registered Projects Four (4), Ten (10) hour days may be worked at straight time during a week, Monday thru Thursday. Friday may be used as a make-up day. Tuesday thru Friday may be worked with no make-up day. For further clarification contact your local Bureau Office.

SUPPLEMENTAL BENEFITS

Per hour:

	07/01/2023	05/06/2024
Lineman, Technician, or Equipment Operators with Crane License	\$ 29.40 *plus 7% of the hourly wage paid	\$ 30.90 *plus 7% of the hourly wage paid
All other Journeyman	\$ 26.40 *plus 7% of the hourly wage paid	\$ 26.90 *plus 7% of the hourly wage paid

*The 7% is based on the hourly wage paid, straight time or premium time.

OVERTIME PAY

See (B, E, Q, X) on OVERTIME PAGE. *Note* Double time for all emergency work designated by the Dept. of Jurisdiction.

NOTE: WAGE CAP - Double the straight time hourly base wage shall be the maximum hourly wage compensation for any hour worked. Contractor is still responsible to pay the hourly benefit amount for each hour worked.

HOLIDAY

Paid	See (5, 6, 8, 13, 25) on HOLIDAY PAGE plus Governor of NYS Election Day.
Overtime	See (5, 6, 8, 13, 25) on HOLIDAY PAGE plus Governor of NYS Election Day.

NOTE: All paid holidays falling on Saturday shall be observed on the preceding Friday. All paid holidays falling on Sunday shall be observed on the following Monday. Supplements for holidays paid at straight time.

REGISTERED APPRENTICES

WAGES per hour: 1000 hour terms at the following percentage of the applicable Journeyman Lineman wage.

1st	2nd	3rd	4th	5th	6th	7th
60%	65%	70%	75%	80%	85%	90%

SUPPLEMENTAL BENEFITS per hour:

07/01/2023	05/06/2024
\$ 26.40 *plus 7% of the hourly wage paid	\$ 26.90 *plus 7% of the hourly wage paid

*The 7% is based on the hourly wage paid, straight time or premium time.

6-1249a

Lineman Electrician - Teledata

09/01/2023

JOB DESCRIPTION Lineman Electrician - Teledata

DISTRICT 6

ENTIRE COUNTIES

Albany, Allegany, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Dutchess, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Lewis, Livingston, Madison, Monroe, Montgomery, Niagara, Oneida, Onondaga, Ontario, Orange, Orleans, Oswego, Otsego, Putnam, Rensselaer, Rockland, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Sullivan, Tioga, Tompkins, Ulster, Warren, Washington, Wayne, Westchester, Wyoming, Yates

WAGES

Per hour:

For outside work, stopping at first point of attachment (demarcation).

07/01/2023	01/01/2024	01/01/2025
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Cable Splicer	\$ 37.73	\$ 39.24	\$ 40.81
Installer, Repairman	\$ 35.81	\$ 37.24	\$ 38.73
Teledata Lineman	\$ 35.81	\$ 37.24	\$ 38.73
Tech., Equip. Operator	\$ 35.81	\$ 37.24	\$ 38.73
Groundman	\$ 18.98	\$ 19.74	\$ 20.53

NOTE: EXCLUDES Teledata work within ten (10) feet of High Voltage (600 volts and over) transmission lines. For this work please see LINEMAN.

NOTE: THE FOLLOWING RATES WILL APPLY ON ALL CONTRACTING AGENCY MANDATED MULTIPLE SHIFTS OF AT LEAST FIVE (5) DAYS DURATION WORKED:

1ST SHIFT	REGULAR RATE
2ND SHIFT	REGULAR RATE PLUS 10%
3RD SHIFT	REGULAR RATE PLUS 15%

SUPPLEMENTAL BENEFITS

Per hour:	07/01/2023	01/01/2024	01/01/2025
Journeyman	\$ 5.70	\$ 5.70	\$ 5.70
	*plus 3% of the hourly wage paid	*plus 3% of the hourly wage paid	*plus 3% of the hourly wage paid

*The 3% is based on the hourly wage paid, straight time rate or premium rate.

OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE

NOTE: WAGE CAP - Double the straight time hourly base wage shall be the maximum hourly wage compensation for any hour worked. Contractor is still responsible to pay the hourly benefit amount for each hour worked.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 16) on HOLIDAY PAGE

6-1249LT - Teledata

Lineman Electrician - Traffic Signal, Lighting	09/01/2023
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JOB DESCRIPTION Lineman Electrician - Traffic Signal, Lighting

DISTRICT 6

ENTIRE COUNTIES

Albany, Allegany, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Cortland, Delaware, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Lewis, Livingston, Madison, Monroe, Montgomery, Niagara, Oneida, Onondaga, Ontario, Orleans, Oswego, Otsego, Rensselaer, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Sullivan, Tioga, Tompkins, Warren, Washington, Wayne, Wyoming, Yates

WAGES

Lineman/Technician shall perform all overhead aerial work. A Lineman/Technician on the ground will install all electrical panels, connect all grounds, install and connect all electrical conductors which includes, but is not limited to road loop wires; conduit and plastic or other type pipes that carry conductors, flex cables and connectors, and to oversee the encasement or burial of such conduits or pipes.

A Groundman/Truck Driver shall: Build and set concrete forms, handle steel mesh, set footer cages, transport concrete in a wheelbarrow, hand or machine concrete vibrator, finish concrete footers, mix mortar, grout pole bases, cover and maintain footers while curing in cold weather, operate jack hammer, operate hand pavement breaker, tamper, concrete and other motorized saws, as a drill helper, operate and maintain generators, water pumps, chainsaws, sand blasting, operate mulching and seeding machine, air tools, electric tools, gas tools, load and unload materials, hand shovel and/or broom, prepare and pour mastic and other fillers, assist digger operator/equipment operator in ground excavation and restoration, landscape work and painting. Only when assisting a lineman technician, a groundman/truck driver may assist in installing conduit, pipe, cables and equipment.

A flagger's duties shall consist of traffic control only.
(Ref #14.01.01)

Per hour:	07/01/2023	05/06/2024
Lineman, Technician	\$ 49.32	\$ 50.54
Crane, Crawler Backhoe	49.32	50.54
Certified Welder	51.79	53.07
Digging Machine	44.39	45.49
Tractor Trailer Driver	41.92	42.96
Groundman, Truck Driver	39.46	40.43

Equipment Mechanic	39.46	40.43
Flagman	29.59	30.32

Above rates are applicable for installation, testing, operation, maintenance and repair on all Traffic Control (Signal) and Illumination (Lighting) projects, Traffic Monitoring Systems, and Road Weather Information Systems. Includes digging of holes for poles, anchors, footer foundations for electrical equipment; assembly of all electrical materials or raceway; placing of fish wire; pulling of cables, wires or fiber optic cable through such raceways; splicing of conductors; dismantling of such structures, lines or equipment.

NOTE: THE FOLLOWING RATES WILL APPLY ON ALL CONTRACTING AGENCY MANDATED MULTIPLE SHIFTS OF AT LEAST FIVE (5) DAYS DURATION WORKED BETWEEN THE HOURS LISTED BELOW:

1ST SHIFT	8:00 AM TO 4:30 PM	REGULAR RATE
2ND SHIFT	4:30 PM TO 1:00 AM	REGULAR RATE PLUS 17.3%
3RD SHIFT	12:30 AM TO 9:00 AM	REGULAR RATE PLUS 31.4%

NOTE - The "Employer Registration" (30.1) use of a '4 Day/10 Hour Work schedules' will no longer be accepted or processed. All registered projects prior to June 30, 2023 will expire within the granted time frame.

For Pre-Registered Projects Four (4), Ten (10) hour days may be worked at straight time during a week, Monday thru Thursday. Friday may be used as a make-up day. Tuesday thru Friday may be worked with no make-up day. For further clarification contact your local Bureau Office.

SUPPLEMENTAL BENEFITS

Per hour worked (but also required on non-worked holidays):

	07/01/2023	05/06/2024
Lineman, Technician, or Equipment Operators with Crane License	\$ 29.40 *plus 7% of the hourly wage paid	\$ 30.90 *plus 7% of the hourly wage paid
All other Journeyman	\$ 26.40 *plus 7% of the hourly wage paid	\$ 26.90 *plus 7% of the hourly wage paid

*The 7% is based on the hourly wage paid, straight time or premium time.

OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE. *Note* Double time for all emergency work designated by the Dept. of Jurisdiction.

NOTE: WAGE CAP - Double the straight time hourly base wage shall be the maximum hourly wage compensation for any hour worked. Contractor is still responsible to pay the hourly benefit amount for each hour worked.

HOLIDAY

Paid: See (5, 6, 8, 13, 25) on HOLIDAY PAGE plus Governor of NYS Election Day.

Overtime: See (5, 6, 8, 13, 25) on HOLIDAY PAGE plus Governor of NYS Election Day.

NOTE: All paid holidays falling on Saturday shall be observed on the preceding Friday. All paid holidays falling on Sunday shall be observed on the following Monday. Supplements for holidays paid at straight time.

REGISTERED APPRENTICES

WAGES per hour: 1000 hour terms at the following percentage of the applicable Journeyman Lineman wage.

1st	2nd	3rd	4th	5th	6th	7th
60%	65%	70%	75%	80%	85%	90%

SUPPLEMENTAL BENEFITS per hour:

07/01/2023	05/06/2024
\$ 26.40 *plus 7% of the hourly wage paid	\$ 26.90 *plus 7% of the hourly wage paid

*The 7% is based on the hourly wage paid, straight time or premium time.

6-1249a-LT

JOB DESCRIPTION Lineman Electrician - Tree Trimmer

DISTRICT 6

ENTIRE COUNTIES

Albany, Allegany, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Dutchess, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Lewis, Livingston, Madison, Monroe, Montgomery, Niagara, Oneida, Onondaga, Ontario, Orange, Orleans, Oswego, Otsego, Putnam, Rensselaer, Rockland, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Sullivan, Tioga, Tompkins, Ulster, Warren, Washington, Wayne, Wyoming, Yates

WAGES

Applies to line clearance, tree work and right-of-way preparation on all new or existing energized overhead or underground electrical, telephone and CATV lines. This also would include stump removal near underground energized electrical lines, including telephone and CATV lines.

Per hour:	07/01/2023	12/31/2023
Tree Trimmer	\$ 29.80	\$ 31.44
Equipment Operator	26.35	27.80
Equipment Mechanic	26.35	27.80
Truck Driver	21.95	23.15
Groundman	18.07	19.07
Flag person	14.20	14.20*

*NOTE- Rate effective on 01/01/2024 - \$15.00 due to minimum wage increase

SUPPLEMENTAL BENEFITS

Per hour:

	07/01/2023	12/31/2023
Journeyman	\$ 10.48	\$ 10.48
	*plus 4.5% of the hourly wage paid	*plus 4.5% of the hourly wage paid

* The 3% is based on the hourly wage paid, straight time rate or premium rate.

OVERTIME PAY

See (B, E, Q, X) on OVERTIME PAGE

NOTE: WAGE CAP - Double the straight time hourly base wage shall be the maximum hourly wage compensation for any hour worked. Contractor is still responsible to pay the hourly benefit amount for each hour worked.

HOLIDAY

Paid: See (5, 6, 8, 15) on HOLIDAY PAGE

Overtime: See (5, 6, 8, 15, 16, 25) on HOLIDAY PAGE

NOTE: All paid holidays falling on a Saturday shall be observed on the preceding Friday.

All paid holidays falling on a Sunday shall be observed on the following Monday.

6-1249TT

Mason - Building

09/01/2023

JOB DESCRIPTION Mason - Building

DISTRICT 5

ENTIRE COUNTIES

Cortland, Tompkins

WAGES

Per hour:	07/01/2023
Building:	
Brick/Blocklayer, Cement Mason	\$ 33.18
Plasterer/EFIS, Stone Mason, Tuck Pointer	

** NOTE-The "Employer Registration" (30.1) use of a '4 Day/10 Hour Work schedules' will no longer be accepted or processed. All registered projects prior to JUNE 30, 2023 will expire within the granted time frame.

For Pre-Registered Projects Four(4),Ten(10)hour days may be worked at straight time during a week Monday thru Thursday. Friday may be used as a make-up day. Tuesday thru Friday may be worked with no make-up day. For further clarification contact your local Bureau Office.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman	\$ 27.19
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OVERTIME PAY

See (B,E,E2*,Q) on OVERTIME PAGE

*Note - Or other conditions beyond the employer's control such as fire or natural disaster.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6) on HOLIDAY PAGE

REGISTERED APPRENTICES

Wages per hour:

One year terms at the following percentage of Journeyman's wage:

1st	2nd	3rd	4th
\$ 21.25	\$ 26.23	\$ 27.29	\$ 29.86

Supplemental Benefits per hour:

1st	2nd	3rd	4th
\$ 22.91	\$ 23.33	\$ 25.87	\$ 26.91

5-3B lth - Z2

Mason - Heavy&Highway

09/01/2023

JOB DESCRIPTION Mason - Heavy&Highway

DISTRICT 5

ENTIRE COUNTIES

Allegany, Broome, Chautauqua, Chemung, Chenango, Cortland, Delaware, Genesee, Livingston, Monroe, Ontario, Orleans, Otsego, Schuyler, Seneca, Steuben, Tioga, Tompkins, Wayne, Wyoming, Yates

PARTIAL COUNTIES

Cattaraugus: Entire county except in the Township of Perrysburg and the Village of Gowanda only the Bricklayer classification applies.

Erie: Only the Bricklayer classification applies.

Niagara: Only the Bricklayer classification applies.

WAGES

Per hour: 07/01/2023

Heavy & Highway:

Cement Mason \$ 36.88

Bricklayer 36.88

**** NOTE-**The "Employer Registration" (30.1) use of a '4 Day/10 Hour Work schedules' will no longer be accepted or processed. All registered projects prior to JUNE 30, 2023 will expire within the granted time frame.

For Pre-Registered Projects Four(4),Ten(10)hour days may be worked at straight time during a week Monday thru Thursday. Friday may be used as a make-up day. Tuesday thru Friday may be worked with no make-up day. For further clarification contact your local Bureau Office.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman \$ 23.53

OVERTIME PAY

See (B, E, E2, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6) on HOLIDAY PAGE

REGISTERED APPRENTICES

Wages per hour:

1500 hour terms at the following percentage of Journeyman's wage:

1st	2nd	3rd	4th
50%	60%	70%	80%

Supplemental benefits per hour:

1st term	\$ 14.03
2nd term	\$ 22.97
3rd term	\$ 23.11
4th term	\$ 23.25

5-3h

Mason - Tile Finisher

09/01/2023

JOB DESCRIPTION Mason - Tile Finisher

DISTRICT 5

ENTIRE COUNTIES

Broome, Chenango, Cortland, Delaware, Otsego, Tioga, Tompkins

WAGES

Wages

Per hour: 07/01/2023

Building:

Marble, Slate, Terrazzo \$ 31.00

and Tile Finisher

**** NOTE-**The "Employer Registration" (30.1) use of a '4 Day/10 Hour Work schedules' will no longer be accepted or processed. All registered projects prior to JUNE 30, 2023 will expire within the granted time frame.

For Pre-Registered Projects Four(4),Ten(10)hour days may be worked at straight time during a week Monday thru Thursday. Friday may be used as a make-up day. Tuesday thru Friday may be worked with no make-up day. For further clarification contact your local Bureau Office.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman \$ 20.47

OVERTIME PAY

See (B,E,E2*,Q) on OVERTIME PAGE

*Note - Or other conditions beyond the employer's control such as fire or natural disaster.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

REGISTERED APPRENTICES

Wages per hour:

One year terms at the following percentage of Journeyman's wage:

1st	2nd	3rd
\$ 18.60	\$ 21.70	\$ 24.80

Supplemental benefits per hour:

1st	2nd	3rd
\$ 13.29	\$ 13.58	\$ 17.93

5-3TF - Z4

Mason - Tile Setter

09/01/2023

JOB DESCRIPTION Mason - Tile Setter

DISTRICT 5

ENTIRE COUNTIES

Broome, Chemung, Chenango, Cortland, Delaware, Otsego, Schuyler, Steuben, Tioga, Tompkins

PARTIAL COUNTIES

Allegany: Towns of Alfred, Almond, Andover and Burns.

WAGES

Wages

Per Hour: 07/01/2023

Building:

Marble, Slate, Terrazzo \$ 33.24

and Tile Setter

**** NOTE-**The "Employer Registration" (30.1) use of a '4 Day/10 Hour Work schedules' will no longer be accepted or processed. All registered projects prior to JUNE 30, 2023 will expire within the granted time frame.

For Pre-Registered Projects Four(4),Ten(10)hour days may be worked at straight time during a week Monday thru Thursday. Friday may be used as a make-up day. Tuesday thru Friday may be worked with no make-up day. For further clarification contact your local Bureau Office.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman \$ 24.01

OVERTIME PAY

See (B,E,E2*,Q) on OVERTIME PAGE

*Note - Or other conditions beyond the employer's control such as fire or natural disaster.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6) on HOLIDAY PAGE

REGISTERED APPRENTICES

Wages per hour:

One year terms at the following percentage of Journeyman's wage:

1st	2nd	3rd	4th
\$ 19.94	\$ 23.27	\$ 26.59	\$ 29.92

Supplemental benefits per hour:

1st	2nd	3rd	4th
\$ 13.76	\$ 14.12	\$ 23.26	\$ 23.63

5-3TS - Z4

Millwright

09/01/2023

JOB DESCRIPTION Millwright

DISTRICT 6

ENTIRE COUNTIES

Albany, Allegany, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Lewis, Livingston, Madison, Monroe, Montgomery, Niagara, Oneida, Onondaga, Ontario, Orleans, Oswego, Otsego, Rensselaer, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Sullivan, Tioga, Tompkins, Ulster, Warren, Washington, Wayne, Wyoming, Yates

WAGES

THE FOLLOWING RATE APPLIES TO ANY GAS/STEAM TURBINE AND OR RELATED COMPONENT WORK, INCLUDING NEW INSTALLATIONS OR MAINTENANCE AND ANY/ALL WORK PERFORMED WITHIN THE PROPERTY LIMITS OF A NUCLEAR FACILITY.

Per hour:	07/01/2023	07/01/2024	07/01/2025
		Additional	Additional
Millwright - Power Generation	\$ 43.05	\$ 2.50	\$2.50

NOTE: ADDITIONAL PREMIUMS PAID FOR THE FOLLOWING WORK LISTED BELOW (amount subject to any overtime premiums):

- Certified Welders shall receive an additional \$1.75 per hour provided he/she is directed to perform certified welding.
- If a work site has been declared a hazardous site by the Owner and the use of protective gear (including, as a minimum, air purifying canister-type chemical respirators) are required, then that employee shall receive an additional \$1.50 per hour.
- An employee performing the work of a machinist shall receive an additional \$2.00 per hour. For the purposes of this premium to apply, a "machinist" is a person who uses a lathe, Bridgeport, milling machine or similar type of tool to make or modify parts.
- When performing work underground at 500 feet and below, the employee shall receive an additional \$1.00 per hour.

SUPPLEMENTAL BENEFITS

Per hour paid:

Journeyman \$ 27.40*

*NOTE: Subject to OT premium

OVERTIME PAY

See (B, E, E2, Q, V) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6) on HOLIDAY PAGE

NOTE: Any holiday that falls on Sunday shall be observed the following Monday. Any holiday that falls on Saturday shall be observed the preceding Friday.

REGISTERED APPRENTICES

WAGES per hour: One year terms at the following percentage of Journeyman's wage:

Appr. 1st year	65 %*
Appr. 2nd year	75 %*
Appr. 3rd year	80 %*
Appr. 4th year	90 %*

*NOTE: Additional premium for the following work listed below:

Certified Welder	\$ 1.75
Hazardous Waste Work	1.50

Machinist	2.00
Underground (500' and below)	1.00

SUPPLEMENTAL BENEFITS per hour:

Appr. 1st year	\$ 11.89
Appr. 2nd year	22.75
Appr. 3rd year	24.30
Appr. 4th year	25.85

6-1163Power

Millwright

09/01/2023

JOB DESCRIPTION Millwright

DISTRICT 6

ENTIRE COUNTIES

Chemung, Cortland, Livingston, Monroe, Ontario, Orleans, Schuyler, Steuben, Tompkins, Wayne, Wyoming

WAGES

Per hour:	07/01/2023	07/01/2024 Additional	07/01/2025 Additional
Building	\$ 34.55	\$ 2.25	\$ 2.25
Heavy & Highway	37.55	2.75	2.25

NOTE: ADDITIONAL PREMIUMS PAID FOR THE FOLLOWING WORK LISTED BELOW (amount subject to any overtime premiums):

- Certified Welders shall receive an additional \$1.75 per hour provided he/she is directed to perform certified welding.
- On Building projects, If a work site has been declared a hazardous site by the Owner and the use of protective gear (including, as a minimum, air purifying canister-type chemical respirators) are required, then that employee shall receive an additional \$1.50 per hour.
- H/H work performed on hazardous waste sites where employees are required to wear protective gear shall receive an additional \$2.00 per hour over the Millwright H/H rate for all hours worked on the day protective gear was worn.
- An employee performing the work of a machinist shall receive an additional \$2.00 per hour. For the purposes of this premium to apply, a "machinist" is a person who uses a lathe, Bridgeport, milling machine or similar type of tool to make or modify parts.
- When performing work underground at 500 feet and below, the employee shall receive an additional \$1.00 per hour.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman	\$ 26.13
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OVERTIME PAY

See (B, E, E2, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

NOTE: Any holiday that falls on Sunday shall be observed the following Monday. Any holiday that falls on Saturday shall be observed the preceding Friday.

REGISTERED APPRENTICES

WAGES per hour: One year terms at the following percentage of Journeyman's wage:

Appr. 1st year	65 %*
Appr. 2nd year	75 %*
Appr. 3rd year	80 %*
Appr. 4th year	90 %*

*NOTE: Additional premium for the following work listed below:

Certified Welder	\$ 1.75
Hazardous Waste (Bldg)	1.50
Hazardous Waste (H/H)	2.00
Machinist	2.00
Underground (500' and below)	1.00

SUPPLEMENTAL BENEFITS per hour:

Appr. 1st year	\$ 11.89
Appr. 2nd year	21.86
Appr. 3rd year	23.28
Appr. 4th year	24.71

Operating Engineer - Building

09/01/2023

JOB DESCRIPTION Operating Engineer - Building

DISTRICT 6

ENTIRE COUNTIES

Cayuga, Cortland, Jefferson, Lewis, Madison, Oneida, Onondaga, Oswego, Seneca, St. Lawrence, Tompkins

WAGES

NOTE:

---If a prime contract is let for site work only, meaning no buildings are involved in their site contract, the Heavy/Highway rates would be applicable. When a prime contract is let for site work and building excavation is part of that contract, the Building rates would be applicable for the Operators classification.

---In the event that equipment listed below is operated by robotic control, the classification covering the operation will be the same as if manually operated.

---If a second employee is required by the employer for operation of any covered machine, they shall be an Engineer Class C.

CLASS A1*: Cranes, All types (A1 Includes Boom Truck, Cableway, Cherry Picker, Derrick, Dragline, Dredge, Overhead Crane, Pile Driver, Tower Crane, Truck Crane, Whirlies)

CLASS A: Air Plako, Asphalt & Blacktop Roller, Automated Concrete Spreader (CMI or equivalent), Automated Fine Grade Machine (CMI), Backhoe, Barrel Shredder, Belt Placer, Blacktop Spreader (such as Barber-Greene & Blaw Knox), Blacktop Plant (automated), Blast or Rotary Drill (Truck or Cat mounted), Burning Plant Operator, Caisson Auger, Central Mix Plant (automated), Concrete Pump, Crusher (Rock), De-watering Press, Diesel Power Unit, Dirt Filter Press with Operation Equipment, Dual Drum Paver, Elevating Grader (self-propelled or towed), Elevator Hoist - Two Cage, Excavator - all purpose hydraulically operated, Fork Lift (Loed/Lull and other rough terrain type), Front End Loader (4 c.y. and over), Gradall, Grader (Power), Head Tower (Saurman or equal), Hoist (2 or 3 Drum), Hydroblaster (Laser Pump), Light Plants - Compressors and Generators, Locomotive, Maintenance Engineer, Maintenance Welder, Mine Hoist, Mucking Machine or Mole, Quarry Master or Equivalent, Refrigeration Equipment (for soil stabilization), Scraper, Sea Mule, Shovel, Side Boom, Slip Form Paver, Straddle Buggy (Ross Carrier, Lumber Carrier), Tractor Drawn Belt Type Loader (Euclid Loader), Trenching Machine (digging capacity of over 4ft. depth), Truck or Trailer Mounted Log Chipper (self-feeder), Tug Operator (Manned, rented equipment excluded), Tunnel Shovel, Vibro or Sonic Hammer Controls (when not mounted in proximity to Rig Operator), Work Boat Operator including LCM's.

CLASS B: "A" Frame Truck, Back Dumps, Blacktop Plant (non-automatic), Boring Machine, Bulldozer, Cage-Hoist, Central Mix Plant (non-automated), Compressor, Pump, Generator or Welding machine (when used in battery of not more than five (5)), Concrete Paver (single drum over 16'), Core boring machine, Drill Rigs - tractor mounted, Elevator - as material hoist, Farm Tractor (with or without accessories), Fork Lift (over 10 ton with or without attachments), Front End Loader (under 4 c.y.), Grout Pump, Gunit Machine, High Pressure Boiler (15 lbs. & over), Hoist (one drum), Hydraulic Breaking Hammer (Drop Hammer), Kolman Plant Loader (screening gravel), Maintenance Grease Man, Mixer for stabilized base - self-propelled (Seaman Mixer), Monorail Machine, Parapet Concrete or Pavement Grinder, Parts Man, Post Driver (truck or tractor mounted), Post Hole Digger (truck or tractor mounted), Power Sweeper (Wayne or similar), Pump-Crete or Squeeze-Crete, Road Widener (front end of Grader or self-propelled), Roller, Self-contained hydraulic bench drill, Shell Winder (motorized), Skid steer (Bobcat type loader), Snorkel (overhead arms), Snowblower control man, Tractor (with or without accessories), Trenching Machine (digging capacity of 4 ft. or less), Tugger Hoist, Vacuum Machine (self-propelled or mounted), Vibro Tamp, Well Drill / Well Point System (Submersible pumps when used in lieu of Well Point System), Winch (Motor driven), Winch Cat, Winch Truck

CLASS C: Compressor (up to 500 cfm), Concrete Paver or Mixer (under 16'), Concrete Pavement Spreaders & Finishers (not automated), Conveyor (over 12 ft), Electric Submersible Pump (4" and over), Fine Grade Machine (not automated), Fireman, Fork Lift ("with or without" attachments, 10 ton and under), Form Tamper, Generator (2,500 watts and over), Hydraulic Pump, Mechanical Heaters (More than two (2) Mechanical Heaters or any Mechanical Heater or Heaters whose combined output exceeds 640,000 BTU per hour (manufacturer's rating) plus one self-contained heating unit - i.e. Sundog or Air Heat type - New Holland Hay Dryer type excluded), Mulching Machine, Oiler, Power Driven Welding Machine (300 amp and over, other than all electric. One Welding Machine under 300 amp will not require an engineer unless in a battery), Power Heaterman (hay dryer), Pumps (water and trash), Revinus Widener (road widener), Single Light Plant, Steam Cleaner or Jenny.

Per hour: Building	07/01/2023	07/01/2024	07/01/2025
Class A1*	\$ 45.75	\$ 47.62	\$ 49.61
Class A	44.25	46.12	48.11
Class B	42.13	44.00	45.99
Class C	37.91	39.78	41.77

Additional \$2.50 per hour if work requires Personal Protective Equipment for hazardous waste site activities with a level C or over rating.

(*) TONNAGE PREMIUMS:

All cranes 65 ton to 110 ton capacity - A1 rate plus \$ 1.50
All cranes 111 ton to 199 ton capacity - A1 rate plus \$ 2.00
All cranes 200 ton to 399 ton capacity - A1 rate plus \$ 3.00
All cranes 400 ton to 599 ton capacity - A1 rate plus \$ 4.00
All cranes 600 ton to 799 ton capacity - A1 rate plus \$ 5.00

All cranes 800 ton to 999 ton capacity - A1 rate plus \$ 6.00
All cranes 1000 ton capacity and over - A1 rate plus \$ 7.00

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman	\$ 29.91	\$ 31.02	\$ 32.12
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OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 6) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

NOTE: If the holiday falls on Sunday, it will be celebrated on Monday.

REGISTERED APPRENTICES

WAGES per hour: One thousand hour terms at the following percentage of Journeyman's CLASS A wage:

1st year	60%
2nd year	65%
3rd year	70%
4th year	80%

Additional \$2.50 per hour if work requires Personal Protective Equipment for hazardous waste site activities with a level C or over rating.

SUPPLEMENTAL BENEFITS per hour:

	07/01/2023	07/01/2024	07/01/2025
All Terms:	\$ 29.85	\$ 30.95	\$ 32.05

6-158-545b.s

Operating Engineer - Heavy&Highway

09/01/2023

JOB DESCRIPTION Operating Engineer - Heavy&Highway

DISTRICT 6

ENTIRE COUNTIES

Cayuga, Cortland, Jefferson, Lewis, Madison, Oneida, Onondaga, Oswego, Seneca, St. Lawrence, Tompkins

WAGES

NOTE:

---In the event that equipment listed below is operated by robotic control, the classification covering the operation will be the same as if manually operated.

---If a second employee is required by the employer for operation of any covered machine, they shall be an Engineer Class C

CLASS A1*: Cranes, All types (Boom Truck, Cherry Picker, Derrick, Dragline, Overhead Crane (Gantry or Straddle Type), Pile Driver, Tower Crane (including self erecting), Truck Crane)

CLASS A: Asphalt Curb Machine (self-propelled, slipform); Asphalt Paver; Automated Concrete Spreader (CMI type); Automatic Fine Grader; Backhoe (except tractor mounted, rubber tired); Backhoe Excavator, Full Swing (CAT 212 or similar type); Back Filling Machine; Belt Placer (CMI type); Blacktop Plant (automated); Blacktop Roller; Cableway; Bull Dozer being operated with active GPS; Caisson Auger; Central Mix Concrete Plant (automated); Concrete Curb Machine (self-propelled, slipform); Concrete Pump; Directional Boring/Drilling Machine; Dredge; Dual Drum Paver; Excavator (all purpose-hydraulic, Gradall or similar); Front End Loader (4 cu. yd. & over); Head Tower (Sauerman or equal); Hoist (two or three drum); Holland Loader; Maintenance Engineer; Mine Hoist; Mucking Machine or Mole; Pavement Breaker (SP Wertgen; PB-4 and similar type); Profiler (over 105 h.p.); Power Grader; Quad 9; Quarry Master (or equivalent); Rotating Telehandler; Scraper (including challenger type); Shovel; Slip Form Paver; Tractor Drawn Belt-Type Loader; Truck or Trailer Mounted Chipper (self-feeder); Tug Operator (manned rented equipment excluded); Tunnel Shovel

CLASS B: Backhoe (tractor mounted, rubber tired); Bituminous Recycler Machine; Bituminous Spreader and Mixer; Blacktop Plant (non-automated); Blast or Rotary Drill (truck or tractor mounted); Boring Machine; Bridge Deck Finishing Machine; Brokk; Cage Hoist; Central Mix Plant (non-automated) and All Concrete Batching Plants; Concrete Paver (over 16'); Crawler Drill (self-contained); Crusher; Diesel Power Unit; Drill Rigs (truck or tractor mounted); Front End Loader (under 4 cu. yd.); Greaseman - Lubrication Engineer; HiPressure Boiler (15 lbs & over); Hoist (one drum); Hydro-Axe; Kolman Plant Loader & similar type loaders; Locomotive; Material Handling Knuckle Boom; Mini Excavators (under 18,000 lbs.); Mixer (for stabilized base, self-propelled); Monorail Machine; Profiler (105 h.p. and under); Plant Engineer; Prentice Loader; Pug Mill; Pump Crete; Ready Mix Concrete Plant; Refrigeration Equipment (for soil stabilization); Road Widener; Roller (all above subgrade, See Class A for Blacktop Roller); Sea Mule; Self-contained ride-on Rock Drill (excluding Air-Track type drill); Skidder; Tractor with Dozer and/or Pusher; Trencher; Tugger Hoist; Vacuum Machine (mounted or towed); Vermeer Saws (ride-on, any size or type); Welder; Winch and Winch Cat; Work Boat Operator including L.C.M.'s

CLASS C: "A" Frame Winch Hoist (On Truck); Aggregate Plant; Articulated Heavy Hauler; Asphalt or Concrete Grooving Machine (ride-on); Ballast Regulator (ride-on); Bituminous Heater (self-propelled); Boat (powered); Boiler (used in conjunction with production); Cement & Bin Operator; Compressors**; Concrete Pavement Spreader and Finisher; Concrete Paver or Mixer (16' & under); Concrete Saw (self-propelled); Conveyor; Deck Hand; Directional Boring/Drilling Machine Locator; Drill (Core); Drill (Well); Dust Collectors**; Electric Pump When Used in Conjunction with Well Point System; Farm Tractor with accessories; Fine Grade Machine; Fireman; Fork Lift; Form Tamper; Generators**; Grout Pump; Gunite Machine; Hammers (hydraulic self-propelled); Heaters**; Hydra-Spiker (ride-on); Hydraulic Pump (jacking system); Hydro-Blaster (water); Light Plants**; Mulching Machine; Oiler; Parapet Concrete or Pavement Grinder; Post Hole Digger (excluding hand-held); Post Driver; Power Broom (towed); Power Heaterman; Power Sweeper; Pumps**; Revinus Widener; Roller (subgrade & fill); Scarifier (ride-on); Shell Winder; Skid Steer Loader (Bobcat or similar, including all attachments); Span Saw (ride-on); Steam Cleaner; Tamper (ride-on); Tie Extractor (ride-on); Tie Handlers (ride-on); Tie Inserters (ride-on); Tie Spacers (ride-on); Tire Repair; Track Liner (ride-on); Tractor; Tractor (with towed accessories); Vacuum Machine (self-propelled); Vibratory Compactor; Vibro Tamp; Welding Machines**; Well Point

**CLASS C NOTE: Considered Hands-Off (unmanned). Includes only operation and maintenance of the equipment.

Per hour: H/H	07/01/2023	07/01/2024	07/01/2025
CLASS A1*	\$ 54.30	\$ 56.51	\$ 58.85
CLASS A	51.30	53.51	55.85
CLASS B	50.42	52.63	54.97
CLASS C	47.14	49.35	51.69

(*) TONNAGE PREMIUMS:

All cranes 65 ton to 110 ton capacity - A1 rate plus \$ 1.50
All cranes 111 ton to 199 ton capacity- A1 rate plus \$ 2.00
All cranes 200 ton to 399 ton capacity - A1 rate plus \$ 3.00
All cranes 400 ton to 599 ton capacity - A1 rate plus \$ 4.00
All cranes 600 ton to 799 ton capacity - A1 rate plus \$ 5.00
All cranes 800 ton to 999 ton capacity - A1 rate plus \$ 6.00
All cranes 1000 ton capacity and over - A1 rate plus \$ 7.00

- Cranes in Luffer Configuration - A1 rate plus \$ 5.00
- Cranes with external ballast (Tray or Wagon) - A1 rate plus \$ 5.00

Additional \$2.50 per hour for hazardous waste removal work on a State and/or Federally designated waste site which requires employees to wear Level C or above forms of personal protection.

SINGLE IRREGULAR WORK SHIFT: Additional \$2.50 per hour for all employees who work a single irregular work shift starting from 5:00 PM to 1:00 AM that is mandated by the Contracting Agency.

NOTE - The "Employer Registration" (30.1) use of a '4 Day/10 Hour Work schedules' will no longer be accepted or processed. All registered projects prior to June 30, 2023 will expire within the granted time frame.

For Pre-Registered Projects Four (4), Ten (10) hour days may be worked at straight time during a week, Monday thru Thursday. Friday may be used as a make-up day. Tuesday thru Friday may be worked with no make-up day. For further clarification contact your local Bureau Office.

SUPPLEMENTAL BENEFITS

Per hour:	07/01/2023	07/01/2024	07/01/2025
Journeyman	\$ 31.35	\$ 32.45	\$ 33.55

OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 6) on HOLIDAY PAGE
Overtime: See (5, 6) on HOLIDAY PAGE

NOTE: If a holiday falls on Sunday, it will be celebrated on Monday. If an employee works on this Monday, they shall be compensated at double time plus the holiday pay (triple time). If a holiday falls on a Saturday, employees who work a Saturday Holiday shall be paid double time plus the holiday pay.

REGISTERED APPRENTICES

WAGES per hour: One thousand hour terms at the following percentage of Journeyman's CLASS B wage.

1st term	60%
2nd term	70%
3rd term	80%
4th Term	90%

Additional \$2.50 per hour for hazardous waste removal work on a State and/or Federally designated waste site which requires employees to wear Level C or above forms of personal protection.

SUPPLEMENTAL BENEFITS per hour: Same as Journeyman

6-158-545h

Operating Engineer - Survey Crew**09/01/2023**

JOB DESCRIPTION Operating Engineer - Survey Crew**DISTRICT** 12**ENTIRE COUNTIES**

Albany, Allegany, Broome, Cayuga, Chemung, Chenango, Clinton, Columbia, Cortland, Essex, Franklin, Fulton, Greene, Hamilton, Herkimer, Jefferson, Lewis, Livingston, Madison, Monroe, Montgomery, Oneida, Onondaga, Ontario, Oswego, Otsego, Rensselaer, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Tioga, Tompkins, Warren, Washington, Wayne, Yates

PARTIAL COUNTIES

Dutchess: The northern portion of the county from the northern boundary line of the City of Poughkeepsie, north.

Genesee: Only the portion of the county that lies east of a line down the center of Route 98 to include all area that lies within the City of Batavia.

WAGES

These rates apply to Building, Tunnel and Heavy Highway.

Per hour:

SURVEY CLASSIFICATIONS:

Party Chief - One who directs a survey party.

Instrument Person - One who operates the surveying instruments.

Rod Person - One who holds the rods and assists the Instrument Person.

07/01/2023

Party Chief	\$ 48.97
Instrument Person	44.99
Rod Person	33.37

Additional \$3.00/hr. for Tunnel Work

Additional \$2.50/hr. for Hazardous Work Site

SUPPLEMENTAL BENEFITS

Per hour worked:

Journeyman \$ 28.90

OVERTIME PAY

See (B, E, P, *X) on OVERTIME PAGE

*Note: \$24.60/Hr. Only for "ALL" premium hours paid when worked.

HOLIDAY

Paid: See (5, 6) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

REGISTERED APPRENTICES

WAGES: 1000 hour terms based on the Percentage of Rod Persons Wage:

07/01/2023

0-1000	60%
1001-2000	70%
2001-3000	80%

SUPPLEMENTAL BENEFIT per hour worked:

0-1000	\$ 20.68 / PHP \$17.53
1001-2000	23.70 / " 19.95
2001-3000	26.73 / " 22.43

NOTE: PHP is premium hours paid when worked.

12-158-545 D.H.H.

Operating Engineer - Survey Crew - Consulting Engineer**09/01/2023**

JOB DESCRIPTION Operating Engineer - Survey Crew - Consulting Engineer**DISTRICT** 12**ENTIRE COUNTIES**

Albany, Allegany, Broome, Cayuga, Chemung, Chenango, Clinton, Columbia, Cortland, Essex, Franklin, Fulton, Greene, Hamilton, Herkimer, Jefferson, Lewis, Livingston, Madison, Monroe, Montgomery, Oneida, Onondaga, Ontario, Oswego, Otsego, Rensselaer, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Tioga, Tompkins, Warren, Washington, Wayne, Yates

PARTIAL COUNTIES

Dutchess: The northern portion of the county from the northern boundary line of the City of Poughkeepsie, north.

Genesee: Only the portion of the county that lies east of a line down the center of Route 98 to include all area that lies within the City of Batavia.

WAGES

These rates apply to feasibility and preliminary design surveying, line and grade surveying for inspection or supervision of construction when performed under a Consulting Engineer Agreement.

Per hour:

SURVEY CLASSIFICATIONS:

Party Chief - One who directs a survey party.

Instrument Person - One who operates the surveying instruments.

Rod Person - One who holds the rods and assists the Instrument Person.

07/01/2023

Party Chief	\$ 48.97
Instrument Person	44.99
Rod Person	33.37

Additional \$3.00/hr. for Tunnel Work.

Additional \$2.50/hr. for EPA or DEC certified toxic or hazardous waste work.

SUPPLEMENTAL BENEFITS

Per hour worked:

Journeyman	\$ 28.90
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OVERTIME PAY

See (B, E, Q, *X) on OVERTIME PAGE

*Note: \$24.10/Hr. Only for "ALL" premium hours paid when worked.

HOLIDAY

Paid: See (5, 6) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

REGISTERED APPRENTICES

WAGES: 1000 hour terms based on percentage of Rod Persons Wage:

07/01/2023

0-1000	60%
1001-2000	70%
2001-3000	80%

SUPPLEMENTAL BENEFIT per hour worked:

0-1000	\$ 20.68 / PHP \$17.53
1001-2000	\$ 23.70 / " 19.95
2001-3000	\$ 26.73 / " 22.43

NOTE: PHP is premium hours paid when worked.

12-158-545 DCE

Operating Engineer - Tunnel

09/01/2023

JOB DESCRIPTION Operating Engineer - Tunnel

DISTRICT 7

ENTIRE COUNTIES

Albany, Allegany, Broome, Cayuga, Chemung, Chenango, Clinton, Columbia, Cortland, Essex, Franklin, Fulton, Greene, Hamilton, Herkimer, Jefferson, Lewis, Livingston, Madison, Monroe, Montgomery, Oneida, Onondaga, Ontario, Oswego, Otsego, Rensselaer, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Tioga, Tompkins, Warren, Washington, Wayne, Yates

PARTIAL COUNTIES

Dutchess: Northern part of Dutchess, to the northern boundary line of the City of Poughkeepsie, then due east to Route 115 to Bedell Road, then east along Bedell Road to VanWagner Road, then north along VanWagner Road to Bower Road, then east along Bower Road to Rte. 44 east to Rte. 343, then along Rte. 343 east to the northern boundary of the Town of Dover Plains and east along the northern boundary of the Town of Dover Plains, to the borderline of the State of Connecticut.

Genesee: Only that portion of the county that lies east of a line drawn down the center of Route 98 and the entirety of the City of Batavia.

WAGES

CLASS A: Automatic Concrete Spreader (CMI Type); Automatic Fine Grader; Backhoe (except tractor mounted, rubber tired); Belt Placer (CMI Type); Blacktop Plant (automated); Cableway; Caisson Auger; Central Mix Concrete Plant (automated); Concrete Curb Machine (self-propelled slipform); Concrete Pump (8" or over); Dredge; Dual Drum Paver; Excavator; Front End Loader (4 cu. yd & over); Gradall; Head Tower (Sauerman or Equal); Hoist (shaft); Hoist (two or three Drum); Log Chipper/Loader (self-feeder); Maintenance Engineer (shaft and tunnel); any Mechanical Shaft Drill; Mine Hoist; Mining Machine(Mole and similar types); Mucking Machine or Mole; Overhead Crane (Gantry or Straddle Type); Pile Driver; Power Grader; Remote Controlled Mole or Tunnel Machine; Scraper; Shovel; Side Boom; Slip Form Paver (If a second man is needed, they shall be an Oiler); Tripper/Maintenance Engineer (shaft & tunnel); Tractor Drawn Belt-Type Loader; Tug Operator (manned rented equipment excluded); Tunnel Shovel.

CLASS B: Automated Central Mix Concrete Plant; Backhoe (topside); Backhoe (track mounted, rubber tired); Backhoe (topside); Bituminous Spreader and Mixer, Blacktop Plant (non-automated); Blast or Rotary Drill (truck or tractor mounted); Boring Machine; Cage Hoist; Central Mix Plant(non-automated); all Concrete Batching Plants; Compressors (4 or less exceeding 2,000 c.f.m. combined capacity); Concrete Pump; Crusher; Diesel Power Unit; Drill Rigs (tractor mounted); Front End Loader (under 4 cu. yd.); Grayco Epoxy Machine; Hoist (One Drum); Hoist (2 or 3 drum topside); Knuckle Boom material handler; Kolman Plant Loader & similar type Loaders (if employer requires another person to clean the screen or to maintain the equipment, they shall be an Oiler); L.C.M. Work Boat Operator; Locomotive; Maintenance Engineer (topside); Maintenance Grease Man; Mixer (for stabilized base-self-propelled); Monorail Machine; Plant Engineer; Personnel Hoist; Pump Crete; Ready Mix Concrete Plant; Refrigeration Equipment (for soil stabilization); Road Widener; Roller (all above sub-grade); Sea Mule; Shotcrete Machine; Shovel (topside); Tractor with Dozer and/or Pusher; Trencher; Tugger Hoist; Tunnel Locomotive; Vacuum Machine (mounted or towed); Welder; Winch; Winch Cat.

CLASS C: A Frame Truck; All Terrain Telescoping Material Handler; Ballast Regulator (ride-on); Compressors (4 not to exceed 2,000 c.f.m. combined capacity; or 3 or less with more than 1200 c.f.m. but not to exceed 2,000 c.f.m.); Compressors ((any size, but subject to other provisions for compressors), Dust Collectors, Generators, Pumps, Welding Machines, Light Plants (4 or any type combination)); Concrete Pavement Spreaders and Finishers; Conveyor; Drill (core); Drill (well); Electric Pump used in conjunction with Well Point System; Farm Tractor with Accessories; Fine Grade Machine; Fork Lift; Grout Pump (over 5 cu. ft.); Gunite Machine; Hammers (hydraulic-self-propelled); Hydra-Spiker (ride-on); Hydra-Blaster (water); Hydro-Blaster; Motorized Form Carrier; Post Hole Digger and Post Driver; Power Sweeper; Roller grade & fill); Scarifer (ride-on); Span-Saw (ride-on); Submersible Electric Pump (when used in lieu of well points); Tamper (ride-on); Tie-Extractor (ride-on), Tie Handler (ride-on), Tie Inserter (ride-on), Tie Spacer (ride-on); Track Liner (ride-on); Tractor with towed accessories; Vibratory Compactor; Vibro Tamp, Well Point.

CLASS D: Aggregate Plant; Cement & Bin Operator; Compressors (3 or less not to exceed 1,200 c.f.m. combined capacity); Compressors ((any size, but subject to other provisions for compressors), Dust Collectors, Generators, Pumps, Welding Machines, Light Plants (3 or less or any type or combination)); Concrete Saw (self-propelled); Form Tamper; Greaseman; Hydraulic Pump (jacking system); Junior Engineer; Light Plants; Mulching Machine; Oiler; Parapet Concrete or Pavement Grinder; Power Broom (towed); Power Heaterman (when used for production); Revinius Widener; Shell Winder; Steam Cleaner; Tractor.

Per hour:	07/01/2023	07/01/2024	07/01/2025
CLASS A	\$ 53.52	\$ 55.91	\$ 58.44
CLASS B	52.30	54.69	57.22
CLASS C	49.51	51.90	54.43
CLASS D	46.50	48.89	51.42

Additional \$5.00 per hour for Hazardous Waste Work on a state or federally designated hazardous waste site where the Operating Engineer is in direct contact with hazardous material and when personal protective equipment is required for respiratory, skin and eye protection. Fringe benefits will be paid at the hourly wage premium.

CRANES:

Crane 1: All cranes, including self-erecting.

Crane 2: All Lattice Boom Cranes and all cranes with a manufacturer's rating of fifty (50) ton and over.

Crane 3: All hydraulic cranes and derricks with a manufacturer's rating of forty nine (49) ton and below, including boom trucks.

Crane 1	\$ 57.52	\$ 59.91	\$ 62.44
Crane 2	56.52	58.91	61.44
Crane 3	55.52	57.91	60.44

SUPPLEMENTAL BENEFITS

Per hour:	\$ 24.20	\$ 25.05	\$ 25.90
	+ 9.60*	+ 9.85*	+ 10.10*

* This portion of benefits subject to same premium rate as shown for overtime wages.

OVERTIME PAY

See (B, B2, E, Q, X) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 6) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

If a holiday falls on Sunday, it shall be observed on Monday.

REGISTERED APPRENTICES

WAGES:(1000) hours terms at the following percentage of Journeyman's Class B wage.

1st term	60%
2nd term	65%
3rd term	70%
4th term	75%

SUPPLEMENTAL BENEFITS per hour: Same as Journeyman.

7-158-832TL.

Painter	09/01/2023
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JOB DESCRIPTION Painter

DISTRICT 2

ENTIRE COUNTIES

Cortland, Tompkins

WAGES

Per hour:

	07/01/2023	05/01/2024 Additional	05/01/2025 Additional
Painter	\$ 27.00	\$ 1.35*	\$ 1.60*
Taper, Paperhangers, and Vinyl hangers	28.35	1.38*	1.64*

*To be allocated at a later date.

ADDITIONAL AMOUNTS FOR SPECIFIC TYPES OF JOBSITE CONDITIONS (amount subject to any overtime premiums):

- Additional \$ 1.10 per hour for Brush and Roll Epoxy (Solvent Base Only)
- Additional \$ 0.60 per hour for Swing Scaffold, Boatswain chair, Spray helper, Steam cleaning acid and high pressure water, Power grinders with respirator
- Additional \$ 0.60 per hour for Structural steel (buildings) defined as new or old construction where ceilings, walls or the steel itself is to be painted from open trusses which require climbing or crawling without the support of solid scaffolding or scaffolding starting at the floor or ground level.
- Additional \$ 1.00 per hour for Spray Painting
- Additional \$ 1.00 per hour for Steeple Jack (Over 100 feet)
- Additional \$ 1.50 per hour for Spray Epoxy (Solvent Based)
- Additional \$ 0.90 per hour for Sandblasting

NOTE - SEE BRIDGE PAINTER RATES FOR BRIDGES & TANKS

NOTE - The 'Employer Registration' (30.1) use of a '4 Day/10 Hour Work schedules' will no longer be accepted or processed. All registered projects prior to June 30,2023 will expire within the granted time frame.

For Pre-Registered Projects Four (4), Ten (10) hour days may be worked at straight time during a week, Monday thru Thursday. Friday may be used as a make-up day. Tuesday thru Friday may be worked with no make-up day. For further clarification contact your local Bureau Office.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman \$ 23.23

OVERTIME PAY

See (B, E2, F, R) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

A Holiday that falls on a Sunday will be celebrated on Monday, a holiday that falls on a Saturday will be celebrated on Friday.

REGISTERED APPRENTICES

WAGES:

Painter: 750 hour terms at the Painter Apprentice wage rate:

1st	2nd	3rd	4th	5th	6th	7th	8th
\$ 18.00	\$ 19.00	\$ 20.00	\$ 21.00	\$ 22.00	\$ 23.00	\$ 24.00	\$ 25.00

Taper: 750 hour terms at the following Journeyman Taper Apprentice wage rate:

1st	2nd	3rd	4th	5th	6th
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\$ 20.00	\$ 21.00	\$ 22.00	\$ 23.00	\$ 24.00	\$ 25.00
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ADDITIONAL AMOUNTS FOR SPECIFIC TYPES OF JOBSITE CONDITIONS (amount subject to any overtime premiums):

- Additional \$ 1.10 per hour for Brush and Roll Epoxy (Solvent Base Only)
- Additional \$ 0.60 per hour for Swing Scaffold, Boatswain chair, Spray helper, Steam cleaning acid and high pressure water, Power grinders with respirator
- Additional \$ 0.60 per hour for Structural steel (buildings) defined as new or old construction where ceilings, walls or the steel itself is to be painted from open trusses which require climbing or crawling without the support of solid scaffolding or scaffolding starting at the floor or ground level.
- Additional \$ 1.00 per hour for Spray Painting
- Additional \$ 1.00 per hour for Steeple Jack (Over 100 feet)
- Additional \$ 1.50 per hour for Spray Epoxy (Solvent Based)
- Additional \$ 0.90 per hour for Sandblasting

SUPPLEMENTAL BENEFITS per hour:

Painter/Decorator:

1st	2nd	3rd	4th	5th	6th	7th	8th
\$ 6.00	\$ 7.00	\$ 8.00	\$ 9.10	\$ 11.00	\$ 11.00	\$ 13.00	\$ 14.00

Taper/Drywall Finisher:

1st	2nd	3rd	4th	5th	6th
\$ 6.00	\$ 7.00	\$ 8.00	\$ 10.00	\$ 13.00	\$ 14.00

2-178 I

Painter

09/01/2023

JOB DESCRIPTION Painter

DISTRICT 3

ENTIRE COUNTIES

Allegany, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Cortland, Delaware, Erie, Genesee, Herkimer, Jefferson, Lewis, Livingston, Madison, Monroe, Niagara, Oneida, Onondaga, Ontario, Orleans, Oswego, Otsego, Schuyler, Seneca, St. Lawrence, Steuben, Tioga, Tompkins, Wayne, Wyoming, Yates

WAGES

Per hour: 07/01/2023

Bridge	\$ 42.06
Tunnel	42.06
Tank*	40.06

For Bridge Painting Contracts, ALL WORKERS on and off the bridge (including Flagmen) are to be paid Painter's Rate; the contract must be ONLY for Bridge Painting.

Tank rate applies to indoor and outdoor tanks, tank towers, standpipes, digesters, waste water treatment tanks, chlorinator tanks, etc. Covers all types of tanks including but not limited to steel tanks, concrete tanks, fiberglass tanks, etc.

Note an additional \$1.50 per hour is required when the contracting agency or project specification requires any shift to start prior to 6:00am or after 12:00 noon.

SUPPLEMENTAL BENEFITS

Per hour: \$ 30.89

OVERTIME PAY

Exterior work only See (B, E4, F*, R) on OVERTIME PAGE.

All other work See (B, F*, R) on OVERTIME PAGE.

*Note - Saturday is payable at straight time if the employee misses work, except where a doctor's or hospital verification of illness is produced Monday through Friday when work was available to the employee.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6) on HOLIDAY PAGE

REGISTERED APPRENTICES

Wages per hour:

750 hour terms at the following percentage of Journeyman's wage rate:

1st	2nd	3rd	4th	5th	6th
\$ 24.00	\$ 26.00	\$ 28.00	\$ 30.00	\$ 34.00	\$ 38.00

Supplemental benefits per hour:

1st	2nd	3rd	4th	5th	6th
-----	-----	-----	-----	-----	-----

\$ 6.60 \$ 6.95 \$ 7.30 \$ 7.65 \$ 8.00 \$ 8.35

3-4-Bridge, Tunnel, Tank

Painter - Metal Polisher

09/01/2023

JOB DESCRIPTION Painter - Metal Polisher

DISTRICT 8

ENTIRE COUNTIES

Albany, Allegany, Bronx, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Dutchess, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Kings, Lewis, Livingston, Madison, Monroe, Montgomery, Nassau, New York, Niagara, Oneida, Onondaga, Ontario, Orange, Orleans, Oswego, Otsego, Putnam, Queens, Rensselaer, Richmond, Rockland, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Suffolk, Sullivan, Tioga, Tompkins, Ulster, Warren, Washington, Wayne, Westchester, Wyoming, Yates

WAGES

07/01/2023

Metal Polisher \$ 38.18
Metal Polisher* 39.28
Metal Polisher** 42.18

*Note: Applies on New Construction & complete renovation

** Note: Applies when working on scaffolds over 34 feet.

SUPPLEMENTAL BENEFITS

Per Hour: 07/01/2023

Journeyworker:

All classification \$ 12.34

OVERTIME PAY

See (B, E, P, T) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 6, 11, 15, 16, 25, 26) on HOLIDAY PAGE

Overtime: See (5, 6, 9, 11, 15, 16, 25, 26) on HOLIDAY PAGE

REGISTERED APPRENTICES

Wages per hour:

One (1) year term at the following wage rates:

07/01/2023

1st year \$ 16.00
2nd year 17.00
3rd year 18.00

1st year* \$ 16.39
2nd year* 17.44
3rd year* 18.54

1st year** \$ 18.50
2nd year** 19.50
3rd year** 20.50

*Note: Applies on New Construction & complete renovation

** Note: Applies when working on scaffolds over 34 feet.

Supplemental benefits:

Per hour:

1st year \$ 8.69
2nd year 8.69
3rd year 8.69

8-8A/28A-MP

Plumber

09/01/2023

JOB DESCRIPTION Plumber

DISTRICT 6

ENTIRE COUNTIES

Chemung, Cortland, Onondaga, Schuyler, Tompkins

PARTIAL COUNTIES

Madison: Only the Townships of Sullivan, Cazenovia and DeRuyter.

Seneca: Only the Townships of Covert and Lodi.

Steuben: Only the Townships of Addison, Bath, Bradford, Campbell, Caton, Corning, Erwin, Hornby, Lindley, Pulteney, Rathbone, Thurston, Tuscarora, Urbana and Wayne.

Tioga: Only the Townships of Barton, Berkshire, Candor, Nichols, Richford, Spencer and Tioga.

WAGES

Per hour: 07/01/2023

Plumber/Steamfitter	\$ 42.01
Pipefitter/Welder/HVAC	42.01
Refrigeration	42.01

SINGLE IRREGULAR WORK SHIFT: Additional 15% premium added to the wages above for a single irregular work shift outside of normal working hours.

NOTE - The "Employer Registration" (30.1) use of a '4 Day/10 Hour Work schedules' will no longer be accepted or processed. All registered projects prior to June 30, 2023 will expire within the granted time frame.

For Pre-Registered Projects Four (4), Ten (10) hour days may be worked at straight time during a week, Monday thru Thursday. Friday may be used as a make-up day. Tuesday thru Friday may be worked with no make-up day. For further clarification contact your local Bureau Office.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman \$ 26.90*

*NOTE: \$10.27 of the supplemental benefits are paid at the same premium as shown for overtime work performed at semi-conductor manufacturer and/or fabrication plants.

OVERTIME PAY

Time and one half for the 9th & 10th hours Monday thru Friday and first 10 hours on Saturday. All other overtime hours are double-time.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

NOTE: If a holiday falls on Saturday, the holiday will be observed on the prior Friday. If a holiday falls on Sunday, it will be observed on the following Monday.

REGISTERED APPRENTICES

WAGES per hour: One year terms at the following percentage of the Journeyman's wage:

1st	2nd	3rd	4th	5th
50%	55%	60%	70%	85%

SUPPLEMENTAL BENEFITS per hour*:

1st	\$ 13.00
2nd	23.56
3rd	23.93
4th	24.66
5th	25.77

*NOTE: Below is the portion of supplemental benefits paid at overtime premiums for work performed at semi-conductor manufacturer and/or fabrication plants:

1st	n/a
2nd	\$ 8.58
3rd	\$ 8.77
4th	\$ 9.14
5th	\$ 9.71

6-81-SF

Roofer

09/01/2023

JOB DESCRIPTION Roofer

DISTRICT 2

ENTIRE COUNTIES

Broome, Chemung, Chenango, Delaware, Otsego, Schoharie, Schuyler, Steuben, Tioga, Tompkins

WAGES

Per hour:	07/01/2023	06/01/2024 Additional	06/01/2025 Additional
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Roofer, Waterproofer	\$ 29.51 + 0.99*	\$ 2.50**	\$ 2.50**
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*This amount is paid for all hours worked, whether regular or premium hours.

**To be allocated at a later date

NOTE ADDITIONAL PREMIUMS PAID FOR THE FOLLOWING WORK LISTED BELOW (amount not subject to overtime premiums):

- On days where more than one shift is worked on the job, the hours worked after 4:30 PM and before 6:30 AM will be paid an additional \$1.90 per hour premium. This premium is not for use in emergency repair situations.

- Premium of \$1.25 per hour will be paid for the application, rip-off or handling of pitch products. The premium will be paid for pitch that is showing, covered or buried on the roof.

- Premium of \$1.25 per hour will be paid for asbestos abatement requiring a half face respirator.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman \$ 19.84

OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

REGISTERED APPRENTICES

Wages:

Hours per term

0-667 Hrs.	\$ 20.66 + 0.69*
668-1335 Hrs.	22.14 + 0.74*
1336-2002 Hrs.	23.61 + 0.79*
2003-2669 Hrs.	25.08 + 0.84*
2670-3336 Hrs.	26.56 + 0.89*
3337-4000 Hrs.	28.04 + 0.94*

*This amount is paid for all hours worked, whether regular or premium hours.

NOTE ADDITIONAL PREMIUMS PAID FOR THE FOLLOWING WORK LISTED BELOW (amount not subject to overtime premiums):

- On days where more than one shift is worked on the job, the hours worked after 4:30 PM and before 6:30 AM will be paid an additional \$1.90 per hour premium. This premium is not for use in emergency repair situations.

- Premium of \$1.25 per hour will be paid for the application, rip-off or handling of pitch products. The premium will be paid for pitch that is showing, covered or buried on the roof.

- Premium of \$1.25 per hour will be paid for asbestos abatement requiring a half face respirator.

Supplemental Benefits:

0-667 Hrs.	\$ 16.87
668-1335 Hrs.	17.36
1336-2002 Hrs.	17.87
2003-2669 Hrs.	18.35
2670-3336 Hrs.	18.85
3337-4000 Hrs.	19.34

2-203elmi

Sheetmetal Worker

09/01/2023

JOB DESCRIPTION Sheetmetal Worker

DISTRICT 2

ENTIRE COUNTIES

Allegany, Broome, Chemung, Delaware, Otsego, Schuyler, Steuben, Tioga, Tompkins

WAGES

Per hour:

	07/01/2023	05/01/2024 Additional
Sheetmetal Worker	\$ 36.84	\$ 1.75*
Polyresin Fiberglass	36.94	1.75*
CAD Operator	37.84	1.75*

*To be allocated at a later date.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman: \$ 21.46

OVERTIME PAY

See (*B1, Q) on OVERTIME PAGE

*On Saturday, time and one half of the hourly rate for the first ten (10) hours, then two (2) times the hourly wage rate for all hours after ten (10) hours worked.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

Note: Holidays are observed on the Holiday, not on the day that it is locally observed.

REGISTERED APPRENTICES

WAGES per hour:

Half Year Terms

	1st	2nd	3rd	4th	5th	6th	7th	8th
07/01/2023	22.10	22.10	23.94	25.79	27.63	29.47	31.31	33.16

SUPPLEMENTAL BENEFITS per hour:

	1st	2nd	3rd	4th	5th	6th	7th	8th
07/01/2023	1.68	1.68	17.85	17.93	18.01	18.09	18.17	18.25
								2-112

Sprinkler Fitter

09/01/2023

JOB DESCRIPTION Sprinkler Fitter

DISTRICT 1

ENTIRE COUNTIES

Allegany, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Lewis, Livingston, Madison, Monroe, Montgomery, Niagara, Oneida, Onondaga, Ontario, Orleans, Oswego, Otsego, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Tioga, Tompkins, Washington, Wayne, Wyoming, Yates

WAGES

Per hour 07/01/2023

Sprinkler \$ 40.04
Fitter

SUPPLEMENTAL BENEFITS

Per hour

Journey person \$ 28.24

OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

Note: When a holiday falls on Sunday, the following Monday shall be considered a holiday and all work performed on either day shall be at the double time rate. When a holiday falls on Saturday, the preceding Friday shall be considered a holiday and all work performed on either day shall be at the double time rate.

REGISTERED APPRENTICES

Wages per hour

One Half Year terms at the following wage.

1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
\$ 19.15	\$ 21.28	\$ 23.16	\$ 25.29	\$ 27.41	\$ 29.54	\$ 31.67	\$ 33.80	\$ 35.93	\$ 38.05

Supplemental Benefits per hour

1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
\$ 8.74	\$ 8.74	\$ 20.32	\$ 20.32	\$ 20.57	\$ 20.57	\$ 20.57	\$ 20.57	\$ 20.57	\$ 20.57
									1-669

Teamster - Building

09/01/2023

JOB DESCRIPTION Teamster - Building

DISTRICT 6

ENTIRE COUNTIES

Broome, Cayuga, Cortland, Delaware, Onondaga, Seneca, Tompkins, Yates

PARTIAL COUNTIES

Allegany: Only the Townships of Almond, Burns, and Alfred.

Chenango: Only the Townships of Afton, Bainbridge, Coventry, Greene, Guilford, Oxford and Smithville.
Madison: Only the Townships of Cazenovia, DeRuyter, Fenner, Georgetown, Lenox, Nelson and Sullivan.
Oswego: All Townships except Redfield, Boylston and Sandy Creek.
Otsego: Only the Townships of Butternuts, Laurens, Maryland, Millford, Morris, Oneonta, Otego, Unadilla, and Worchester.
Steuben: Only the Townships of Prattsburg, Canisteo, Fremont, Cohoctan, Dansville, Hornell, Hartsville, Greenwood, West Union, Troupsburg, and Jasper.
Tioga: Only the Townships of Berkshire, Candor, Newark Valley, Nichols, Owego, Richford, and Tioga. All territory east of Nichols/Smithboro to Broome County, within State of New York.

WAGES

GROUP A: Straight Trucks
GROUP B: Tractor Trailer, Farm Tractor, Fuel Truck.
GROUP C: Euclid.
GROUP D: On site Mechanic.

Per hour:	07/01/2023	06/01/2024	06/01/2025
Building: (under \$ 5 million*)			
GROUP A,B,C,D	\$ 28.43	\$ 31.43	\$ 34.43
Building: (over \$ 5 million*)			
GROUP A,B	\$ 29.48	\$ 32.48	\$ 35.48
GROUP C	29.83	32.83	35.83
GROUP D	29.63	32.63	35.63

* Total project cost including General Construction, Plumbing, HVAC and Electrical

SUPPLEMENTAL BENEFITS

Per hour:			
(under \$5 million*)	\$ 29.37	\$ 30.02	\$ 30.87
(over \$5 million*)	30.14	30.80	31.67

* Total project cost including General Construction, Plumbing, HVAC and Electrical

OVERTIME PAY

(D, O) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6) on HOLIDAY PAGE

6-317

Teamster - Heavy&Highway	09/01/2023
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JOB DESCRIPTION Teamster - Heavy&Highway

DISTRICT 6

ENTIRE COUNTIES

Cayuga, Cortland, Seneca, Tompkins, Yates

PARTIAL COUNTIES

Allegany: Only the Townships of Almond, Alfred, Burns and West Almond.

Steuben: Only the Townships of Canisteo, Cohocton, Dansville, Freemont, Greenwood, Hartsville, Hornell, Jasper, Prattsburg, Troupsburg, and West Union.

WAGES

GROUP 1: Warehousemen*, Yardmen*, Truck Helpers, Pickups, Panel Trucks, Flatboy Material Trucks (straight jobs), Single Axle Dump Trucks, Dumpsters, Material Checkers & Receivers*, Greasers, Truck Tiremen, Mechanics Helpers and Parts Chasers, Tandems & Batch Trucks, Mechanics, Semi-Trailers, Low-boy Trucks, Asphalt Distributor Trucks and Agitator, Mixer Trucks and Dumpcrete type vehicles, Truck Mechanic, Fuel Trucks.

*NOTE: Applies when a temporary warehouse structure is built/utilized specifically for a public work project.

GROUP 2: Specialized Earth Moving Equipment-Euclid type, or similar off-highway equipment, where not self-loading, Straddle (Ross) Carrier, and self-contained concrete mobile truck, Off-highway Tandem Back-Dump, Twin Engine Equipment and Double-Hitched Equipment where not self-loading.

Per hour:	07/01/2023	07/01/2024
GROUP 1	\$ 32.24	\$ 34.21
GROUP 2	32.44	34.41

NOTE: For all work bid, there shall be a twelve month carryover of the rates in effect at the time of the bid.

NOTE - The "Employer Registration" (30.1) use of a '4 Day/10 Hour Work schedules' will no longer be accepted or processed. All registered projects prior to June 30, 2023 will expire within the granted time frame.

For Pre-Registered Projects Four (4), Ten (10) hour days may be worked at straight time during a week, Monday thru Thursday. Friday may be used as a make-up day. Tuesday thru Friday may be worked with no make-up day. For further clarification contact your local Bureau Office.

SUPPLEMENTAL BENEFITS

Per hour: 07/01/2023 07/01/2024

Journeyman \$ 28.32 \$ 28.85

OVERTIME PAY

See (B, B2, E2, J) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 6) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

6-317(Syr)

Welder

09/01/2023

JOB DESCRIPTION Welder

DISTRICT 1

ENTIRE COUNTIES

Albany, Allegany, Bronx, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Dutchess, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Kings, Lewis, Livingston, Madison, Monroe, Montgomery, Nassau, New York, Niagara, Oneida, Onondaga, Ontario, Orange, Orleans, Oswego, Otsego, Putnam, Queens, Rensselaer, Richmond, Rockland, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Suffolk, Sullivan, Tioga, Tompkins, Ulster, Warren, Washington, Wayne, Westchester, Wyoming, Yates

WAGES

Per hour 07/01/2023

Welder: To be paid the same rate of the mechanic performing the work.*

*EXCEPTION: If a specific welder certification is required, then the 'Certified Welder' rate in that trade tag will be paid.

OVERTIME PAY

HOLIDAY

1-As Per Trade

Overtime Codes

Following is an explanation of the code(s) listed in the OVERTIME section of each classification contained in the attached schedule. Additional requirements may also be listed in the HOLIDAY section.

NOTE: Supplemental Benefits are 'Per hour worked' (for each hour worked) unless otherwise noted

- (AA) Time and one half of the hourly rate after 7 and one half hours per day
- (A) Time and one half of the hourly rate after 7 hours per day
- (B) Time and one half of the hourly rate after 8 hours per day
- (B1) Time and one half of the hourly rate for the 9th & 10th hours week days and the 1st 8 hours on Saturday.
Double the hourly rate for all additional hours
- (B2) Time and one half of the hourly rate after 40 hours per week
- (C) Double the hourly rate after 7 hours per day
- (C1) Double the hourly rate after 7 and one half hours per day
- (D) Double the hourly rate after 8 hours per day
- (D1) Double the hourly rate after 9 hours per day
- (E) Time and one half of the hourly rate on Saturday
- (E1) Time and one half 1st 4 hours on Saturday; Double the hourly rate all additional Saturday hours
- (E2) Saturday may be used as a make-up day at straight time when a day is lost during that week due to inclement weather
- (E3) Between November 1st and March 3rd Saturday may be used as a make-up day at straight time when a day is lost during that week due to inclement weather, provided a given employee has worked between 16 and 32 hours that week
- (E4) Saturday and Sunday may be used as a make-up day at straight time when a day is lost during that week due to inclement weather
- (E5) Double time after 8 hours on Saturdays
- (F) Time and one half of the hourly rate on Saturday and Sunday
- (G) Time and one half of the hourly rate on Saturday and Holidays
- (H) Time and one half of the hourly rate on Saturday, Sunday, and Holidays
- (I) Time and one half of the hourly rate on Sunday
- (J) Time and one half of the hourly rate on Sunday and Holidays
- (K) Time and one half of the hourly rate on Holidays
- (L) Double the hourly rate on Saturday
- (M) Double the hourly rate on Saturday and Sunday
- (N) Double the hourly rate on Saturday and Holidays
- (O) Double the hourly rate on Saturday, Sunday, and Holidays
- (P) Double the hourly rate on Sunday
- (Q) Double the hourly rate on Sunday and Holidays
- (R) Double the hourly rate on Holidays
- (S) Two and one half times the hourly rate for Holidays

- (S1) Two and one half times the hourly rate the first 8 hours on Sunday or Holidays One and one half times the hourly rate all additional hours.
- (T) Triple the hourly rate for Holidays
- (U) Four times the hourly rate for Holidays
- (V) Including benefits at SAME PREMIUM as shown for overtime
- (W) Time and one half for benefits on all overtime hours.
- (X) Benefits payable on Paid Holiday at straight time. If worked, additional benefit amount will be required for worked hours. (Refer to other codes listed.)

Holiday Codes

PAID Holidays:

Paid Holidays are days for which an eligible employee receives a regular day's pay, but is not required to perform work. If an employee works on a day listed as a paid holiday, this remuneration is in addition to payment of the required prevailing rate for the work actually performed.

OVERTIME Holiday Pay:

Overtime holiday pay is the premium pay that is required for work performed on specified holidays. It is only required where the employee actually performs work on such holidays. The applicable holidays are listed under HOLIDAYS: OVERTIME. The required rate of pay for these covered holidays can be found in the OVERTIME PAY section listings for each classification.

Following is an explanation of the code(s) listed in the HOLIDAY section of each classification contained in the attached schedule. The Holidays as listed below are to be paid at the wage rates at which the employee is normally classified.

- (1) None
- (2) Labor Day
- (3) Memorial Day and Labor Day
- (4) Memorial Day and July 4th
- (5) Memorial Day, July 4th, and Labor Day
- (6) New Year's, Thanksgiving, and Christmas
- (7) Lincoln's Birthday, Washington's Birthday, and Veterans Day
- (8) Good Friday
- (9) Lincoln's Birthday
- (10) Washington's Birthday
- (11) Columbus Day
- (12) Election Day
- (13) Presidential Election Day
- (14) 1/2 Day on Presidential Election Day
- (15) Veterans Day
- (16) Day after Thanksgiving
- (17) July 4th
- (18) 1/2 Day before Christmas
- (19) 1/2 Day before New Years
- (20) Thanksgiving
- (21) New Year's Day
- (22) Christmas
- (23) Day before Christmas
- (24) Day before New Year's
- (25) Presidents' Day
- (26) Martin Luther King, Jr. Day
- (27) Memorial Day
- (28) Easter Sunday

(29) Juneteenth

New York State Department of Labor - Bureau of Public Work
State Office Building Campus
Building 12 - Room 130
Albany, New York 12226

REQUEST FOR WAGE AND SUPPLEMENT INFORMATION

As Required by Articles 8 and 9 of the NYS Labor Law

Fax (518) 485-1870 or mail this form for new schedules or for determination for additional occupations.

This Form Must Be Typed

Submitted By:

(Check Only One) ☐ Contracting Agency ☐ Architect or Engineering Firm ☐ Public Work District Office Date:

A. Public Work Contract to be let by: (Enter Data Pertaining to Contracting/Public Agency)

1. Name and complete address ☐ (Check if new or change)

Telephone

Fax

E-Mail:

2. NY State Units (see Item 5).

☐ 01 DOT

☐ 02 OGS

☐ 03 Dormitory Authority

☐ 04 State University
Construction Fund

☐ 05 Mental Hygiene
Facilities Corp.

☐ 06 OTHER N.Y. STATE UNIT

☐ 07 City

☐ 08 Local School District

☐ 09 Special Local District, i.e.,
Fire, Sewer, Water District

☐ 10 Village

☐ 11 Town

☐ 12 County

☐ 13 Other Non-N.Y. State
(Describe)

3. SEND REPLY TO ☐ (check if new or change)
Name and complete address:

Telephone

Fax

E-Mail:

4. SERVICE REQUIRED. Check appropriate box and provide project information.

☐ New Schedule of Wages and Supplements.

APPROXIMATE BID DATE :

☐ Additional Occupation and/or Redetermination

PRC NUMBER ISSUED PREVIOUSLY FOR
THIS PROJECT :

OFFICE USE ONLY

B. PROJECT PARTICULARS

5. Project Title

Description of Work

Contract Identification Number

Note: For NYS units, the OSC Contract No.

6. Location of Project:

Location on Site

Route No/Street Address

Village or City

Town

County

7. Nature of Project - Check One:

☐

1. New Building

☐

2. Addition to Existing Structure

☐

3. Heavy and Highway Construction (New and Repair)

☐

4. New Sewer or Waterline

☐

5. Other New Construction (Explain)

☐

6. Other Reconstruction, Maintenance, Repair or Alteration

☐

7. Demolition

☐

8. Building Service Contract

8. OCCUPATION FOR PROJECT :

☐

Construction (Building, Heavy
Highway/Sewer/Water)

☐

Tunnel

☐

Residential

☐

Landscape Maintenance

☐

Elevator maintenance

☐

Exterminators, Fumigators

☐

Fire Safety Director, NYC Only

☐

Fuel Delivery

☐

Guards, Watchmen

☐

Janitors, Porters, Cleaners,
Elevator Operators

☐

Moving furniture and
equipment

☐

Trash and refuse removal

☐

Window cleaners

☐

Other (Describe)

9. Does this project comply with the Wicks Law involving separate bidding? YES ☐ NO ☐

10. Name and Title of Requester

Signature



NEW YORK STATE DEPARTMENT OF LABOR
Bureau of Public Work - Debarment List

**LIST OF EMPLOYERS INELIGIBLE TO BID ON OR BE
AWARDED ANY PUBLIC WORK CONTRACT**

Under Article 8 and Article 9 of the NYS Labor Law, a contractor, sub-contractor and/or its successor shall be debarred and ineligible to submit a bid on or be awarded any public work or public building service contract/sub-contract with the state, any municipal corporation or public body for a period of five (5) years from the date of debarment when:

- Two (2) final determinations have been rendered within any consecutive six-year (6) period determining that such contractor, sub-contractor and/or its successor has WILLFULLY failed to pay the prevailing wage and/or supplements;
- One (1) final determination involves falsification of payroll records or the kickback of wages and/or supplements.

The agency issuing the determination and providing the information, is denoted under the heading 'Fiscal Officer'. DOL = New York State Department of Labor; NYC = New York City Comptroller's Office; AG = New York State Attorney General's Office; DA = County District Attorney's Office.

Debarment Database: To search for contractors, sub-contractors and/or their successors debarred from bidding or being awarded any public work contract or subcontract under NYS Labor Law Articles 8 and 9, or under NYS Workers' Compensation Law Section 141-b, access the database at this link: <https://apps.labor.ny.gov/EDList/searchPage.do>

For inquiries where WCB is listed as the "Agency", please call 1-866-546-9322

NYSDOL Bureau of Public Work Debarment List 09/15/2023

Article 8

AGENCY	Fiscal Officer	FEIN	EMPLOYER NAME	EMPLOYER DBA NAME	ADDRESS	DEBARMENT START DATE	DEBARMENT END DATE
DOL	DOL	*****5754	0369 CONTRACTORS, LLC		515 WEST AVE UNIT PH 13NORWALK CT 06850	05/12/2021	05/12/2026
DOL	DOL	*****4018	ADIRONDACK BUILDING RESTORATION INC.		4156 WILSON ROAD EAST TABERG NY 13471	03/26/2019	03/26/2024
DOL	AG	*****1812	ADVANCED BUILDERS & LAND DEVELOPMENT, INC.		400 OSER AVE #2300HAUPPAUGE NY 11788	09/11/2019	09/11/2024
DOL	DOL	*****1687	ADVANCED SAFETY SPRINKLER INC		261 MILL ROAD P.O BOX 296EAST AURORA NY 14052	05/29/2019	05/29/2024
DOL	NYC		ALL COUNTY SEWER & DRAIN, INC.		7 GREENFIELD DR WARWICK NY 10990	03/25/2022	03/25/2027
DOL	NYC		AMJED PARVEZ		401 HANOVER AVENUE STATEN ISLAND NY 10304	01/11/2021	01/11/2026
DOL	DOL		ANGELO F COKER		2610 SOUTH SALINA STREET SUITE 14SYRACUSE NY 13205	09/17/2020	09/17/2025
DOL	DOL		ANGELO F COKER		2610 SOUTH SALINA STREET SUITE 14SYRACUSE NY 13205	12/04/2018	12/04/2023
DOL	DOL		ANGELO GARCIA		515 WEST AVE UNIT PH 13NORWALK CT 06850	05/12/2021	05/12/2026
DOL	DOL		ANGELO TONDO		449 WEST MOMBSHA ROAD MONROE NY 10950	06/06/2022	06/06/2027
DOL	DOL		ANITA SALERNO		158 SOLAR ST SYRACUSE NY 13204	01/07/2019	01/07/2024
DOL	DOL	*****4231	ANKER'S ELECTRIC SERVICE, INC.		10 SOUTH 5TH ST LOCUST VALLEY NY 11560	09/26/2022	09/26/2027
DOL	NYC		ARADCO CONSTRUCTION CORP		115-46 132RD ST SOUTH OZONE PARK NY 11420	09/17/2020	09/17/2025
DOL	DOL		ARNOLD A. PAOLINI		1250 BROADWAY ST BUFFALO NY 14212	02/03/2020	02/03/2025
DOL	NYC		ARSHAD MEHMOOD		168-42 88TH AVENUE JAMAICA NY 11432	11/20/2019	11/20/2024
DOL	NYC	*****2591	AVI 212 INC.		260 CROPSEY AVENUE APT 11GBROOKLYN NY 11214	10/30/2018	10/30/2023
DOL	NYC		AVM CONSTRUCTION CORP		117-72 123RD ST SOUTH OZONE PARK NY 11420	09/17/2020	09/17/2025
DOL	NYC		AZIDABEGUM		524 MCDONALD AVENUE BROOKLYN NY 11218	09/17/2020	09/17/2025
DOL	DOL	*****8421	B & B DRYWALL, INC		206 WARREN AVE APT 1WHITE PLAINS NY 10603	12/14/2021	12/14/2026
DOL	NYC		BALWINDER SINGH		421 HUDSON ST SUITE C5NEW YORK NY 10014	02/20/2019	02/20/2024
DOL	NYC	*****8416	BEAM CONSTRUCTION, INC.		50 MAIN ST WHITE PLAINS NY 10606	01/04/2019	01/04/2024
DOL	DOL		BERNARD BEGLEY		38 LONG RIDGE ROAD BEDFORD NY 10506	12/18/2019	12/18/2024
DOL	NYC	*****2113	BHW CONTRACTING, INC.		401 HANOVER AVENUE STATEN ISLAND NY 10304	01/11/2021	01/11/2026
DOL	DOL	*****3627	BJB CONSTRUCTION CORP.		38 LONG RIDGE ROAD BEDFORD NY 10506	12/18/2019	12/18/2024
DOL	DOL	*****4512	BOB BRUNO EXCAVATING, INC		5 MORNINGSIDE DR AUBURN NY 13021	05/28/2019	05/28/2024
DOL	DOL		BOGDAN MARKOVSKI		370 W. PLEASANTVIEW AVE SUITE 2.329HACKENSACK NJ 07601	02/11/2019	02/11/2024
DOL	DOL		BRADLEY J SCHUKA		4 BROTHERS ROAD WAPPINGERS FALLS NY 12590	10/20/2020	10/20/2025
DOL	DOL	*****9383	C.C. PAVING AND EXCAVATING, INC.		2610 SOUTH SALINA ST SUITE 12SYRACUSE NY 13205	09/17/2020	09/17/2025
DOL	DOL	*****9383	C.C. PAVING AND EXCAVATING, INC.		2610 SOUTH SALINA ST SUITE 12SYRACUSE NY 13205	12/04/2018	12/04/2023
DOL	DOL	*****4083	C.P.D. ENTERPRISES, INC		P.O BOX 281 WALDEN NY 12586	03/03/2020	03/03/2025
DOL	DOL	*****5161	CALADRI DEVELOPMENT CORP.		1223 PARK ST. PEEKSKILL NY 10566	05/17/2021	05/17/2026
DOL	DOL	*****3391	CALI ENTERPRISES, INC.		1223 PARK STREET PEEKSKILL NY 10566	05/17/2021	05/17/2026
DOL	NYC		CALVIN WALTERS		465 EAST THIRD ST MT. VERNON NY 10550	09/09/2019	09/09/2024
DOL	AG	*****7247	CENTURY CONCRETE CORP		2375 RAYNOR ST RONKONKOMA NY 11779	08/04/2021	08/04/2026

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DOL	DOL	*****0026	CHANTICLEER CONSTRUCTION LLC		4 BROTHERS ROAD WAPPINGERS FALLS NY 12590	10/20/2020	10/20/2025
DOL	NYC		CHARLES ZAHRADKA		863 WASHINGTON STREET FRANKLIN SQUARE NY 11010	03/10/2020	03/10/2025
DOL	DOL		CHRISTOPHER GRECO		26 NORTH MYRTLE AVENUE SPRING VALLEY NY 10956	02/18/2021	02/18/2026
DOL	DOL		CHRISTOPHER J MAINI		19 CAITLIN AVE JAMESTOWN NY 14701	09/17/2018	09/17/2023
DOL	DOL		CHRISTOPHER PAPASTEFANOU A/K/A CHRIS PAPASTEFANOU		1445 COMMERCE AVE BRONX NY 10461	05/30/2019	05/30/2024
DOL	DOL		CRAIG JOHANSEN		10 SOUTH 5TH ST LOCUST VALLEY NY 11560	09/26/2022	09/26/2027
DOL	DOL	*****3228	CROSS-COUNTY LANDSCAPING AND TREE SERVICE, INC.	ROCKLAND TREE SERVICE	26 NORTH MYRTLE AVENUE SPRING VALLEY NY 10956	02/18/2021	02/18/2026
DOL	DOL	*****2524	CSI ELECTRICAL & MECHANICAL INC		42-32 235TH ST DOUGLSTON NY 11363	01/14/2019	01/14/2024
DOL	DOL	*****7619	DANCO CONSTRUCTION UNLIMITED INC.		485 RAFT AVENUE HOLBROOK NY 11741	10/19/2021	10/19/2026
DOL	DOL		DANIEL ROBERT MCNALLY		7 GREENFIELD DRIVE WARWICK NY 10990	03/25/2022	03/25/2027
DOL	DOL		DARIAN L COKER		2610 SOUTH SALINA ST SUITE 2CSYRACUSE NY 13205	09/17/2020	09/17/2025
DOL	DOL		DARIAN L COKER		2610 SOUTH SALINA ST SUITE 2CSYRACUSE NY 13205	12/04/2018	12/04/2023
DOL	NYC		DAVID WEINER		14 NEW DROP LANE 2ND FLOORSTATEN ISLAND NY 10306	11/14/2019	11/14/2024
DOL	DOL		DELPHI PAINTING & DECORATING CO INC		1445 COMMERCE AVE BRONX NY 10461	05/30/2019	05/30/2024
DOL	DOL	*****5175	EAGLE MECHANICAL AND GENERAL CONSTRUCTION LLC		11371 RIDGE RD WOLCOTT NY 14590	02/03/2020	02/03/2025
DOL	AG		EDWIN HUTZLER		23 NORTH HOWELLS RD BELLPORT NY 11713	08/04/2021	08/04/2026
DOL	DA		EDWIN HUTZLER		2375 RAYNOR STREET RONKONKOMA NY 11779	08/04/2021	08/04/2026
DOL	DOL	*****0780	EMES HEATING & PLUMBING CONTR		5 EMES LANE MONSEY NY 10952	01/20/2002	01/20/3002
DOL	NYC	*****5917	EPOCH ELECTRICAL, INC		97-18 50TH AVE CORONA NY 11368	04/19/2018	04/19/2024
DOL	DOL		FAIGY LOWINGER		11 MOUNTAIN RD 28 VAN BUREN DRMONROE NY 10950	03/20/2019	03/20/2024
DOL	DOL		FRANK BENEDETTO		19 CATLIN AVE JAMESTOWN NY 14701	09/17/2018	09/17/2023
DOL	DOL	*****4722	FRANK BENEDETTO AND CHRISTOPHER J MAINI	B & M CONCRETE	19 CAITLIN AVE JAMESTOWN NY 14701	09/17/2018	09/17/2023
DOL	DA		FREDERICK HUTZLER		2375 RAYNOR STREET RONKONKOMA NY 11779	08/04/2021	08/04/2026
DOL	NYC	*****6616	G & G MECHANICAL ENTERPRISES, LLC.		1936 HEMPSTEAD TURNPIKE EAST MEDOW NY 11554	11/29/2019	11/29/2024
DOL	DOL		GABRIEL FRASSETTI			04/10/2019	04/10/2024
DOL	NYC		GAYATRI MANGRU		21 DAREWOOD LANE VALLEY STREAM NY 11581	09/17/2020	09/17/2025
DOL	DOL		GEOFF CORLETT		415 FLAGGER AVE #302STUART FL 34994	10/31/2018	10/31/2023
DOL	DA		GEORGE LUCEY		150 KINGS STREET BROOKLYN NY 11231	01/19/1998	01/19/2998
DOL	DOL		GIGI SCHNECKENBURGER		261 MILL RD EAST AURORA NY 14052	05/29/2019	05/29/2024
DOL	DA		GIOVANNA TRAVAJA		3735 9TH ST LONG ISLAND CITY NY 11101	01/05/2023	01/05/2028
DOL	DOL		HANS RATH		24 ELDOR AVENUE NEW CITY NY 10956	02/03/2020	02/03/2025
DOL	DOL		HERBERT CLEMEN		42 FOWLER AVENUE CORTLAND MANOR NY 10567	01/24/2023	01/24/2028
DOL	DOL		HERBERT CLEMEN		42 FOWLER AVENUE CORTLAND MANOR NY 10567	10/25/2022	10/25/2027
DOL	DOL		IRENE KASELIS		32 PENNINGTON AVE WALDWICK NJ 07463	05/30/2019	05/30/2024
DOL	DOL	*****9211	J. WASE CONSTRUCTION CORP.		8545 RT 9W ATHENS NY 12015	03/09/2021	03/09/2026

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DOL	DOL		J.M.J CONSTRUCTION		151 OSTRANDER AVENUE SYRACUSE NY 13205	11/21/2022	11/21/2027
DOL	DOL		J.R. NELSON CONSTRUCTION		531 THIRD STREET ALBANY NY 12206	12/22/2022	12/22/2027
DOL	DOL		J.R. NELSON CONSTRUCTION		531 THIRD STREET ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL		J.R. NELSON, LLC		531 THIRD STREET ALBANY NY 12206	12/22/2022	12/22/2027
DOL	DOL		J.R. NELSON, LLC		531 THIRD STREET ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL		J.R.N COMPANIES, LLC		531 THIRD STREET ALBANY NY 12206	12/12/2022	12/12/2027
DOL	DOL		J.R.N COMPANIES, LLC		531 THIRD STREET ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL	*****1147	J.R.N. CONSTRUCTION, LLC		531 THIRD ST ALBANY NY 12206	12/22/2022	12/22/2027
DOL	DOL	*****1147	J.R.N. CONSTRUCTION, LLC		531 THIRD ST ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL		JAMES J. BAKER		7901 GEE ROAD CANASTOTA NY 13032	08/17/2021	08/17/2026
DOL	DOL		JASON P. RACE		3469 STATE RT. 69 PERISH NY 13131	09/29/2021	09/29/2026
DOL	DOL		JASON P. RACE		3469 STATE RT. 69 PERISH NY 13131	02/09/2022	02/09/2027
DOL	DOL		JASON P. RACE		3469 STATE RT. 69 PERISH NY 13131	11/15/2022	11/15/2027
DOL	DOL		JASON P. RACE		3469 STATE RT. 69 PERISH NY 13131	03/01/2022	03/01/2027
DOL	DOL	*****7993	JBS DIRT, INC.		7901 GEE ROAD CANASTOTA NY 13032	08/17/2021	08/17/2026
DOL	DOL	*****2435	JEFFEL D. JOHNSON	JMJ7 AND SON	5553 CAIRNSTRAIL CLAY NY 13041	11/21/2022	11/21/2027
DOL	DOL		JEFFEL JOHNSON ELITE CARPENTER REMODEL AND CONSTRUCTION		C2 EVERGREEN CIRCLE LIVERPOOL NY 13090	11/21/2022	11/21/2027
DOL	DOL	*****2435	JEFFREY M. JOHNSON	JMJ7 AND SON	5553 CAIRNS TRAIL CLAY NY 13041	11/21/2022	11/21/2027
DOL	NYC		JENNIFER GUERRERO		1936 HEMPSTEAD TURNPIKE EAST MEADOW NY 11554	11/29/2019	11/29/2024
DOL	DOL		JIM PLAUGHER		17613 SANTE FE LINE ROAD WAYNEFIELD OH 45896	07/16/2021	07/16/2026
DOL	DOL		JMJ7 & SON CONSTRUCTION, LLC		5553 CAIRNS TRAIL LIVERPOOL NY 13041	11/21/2022	11/21/2027
DOL	DOL		JMJ7 AND SONS CONTRACTORS		5553 CAIRNS TRAIL CLAY NY 13041	11/21/2022	11/21/2027
DOL	DOL		JMJ7 CONTRACTORS		7014 13TH AVENUE BROOKLYN NY 11228	11/21/2022	11/21/2027
DOL	DOL		JMJ7 CONTRACTORS AND SONS		5553 CAIRNS TRAIL CLAY NY 13041	11/21/2022	11/21/2027
DOL	DOL		JMJ7 CONTRACTORS, LLC		5553 CAIRNS TRAIL CLAY NY 13041	11/21/2022	11/21/2027
DOL	DOL		JOHN GOCEK		14B COMMERCIAL AVE ALBANY NY 12065	11/14/2019	11/14/2024
DOL	DOL		JOHN MARKOVIC		47 MANDON TERRACE HAWTHORN NJ 07506	03/29/2021	03/29/2026
DOL	DOL		JOHN WASE		8545 RT 9W ATHENS NY 12015	03/09/2021	03/09/2026
DOL	DOL		JON E DEYOUNG		261 MILL RD P.O BOX 296EAST AURORA NY 14052	05/29/2019	05/29/2024
DOL	DOL		JORGE RAMOS		8970 MIKE GARCIA DR MANASSAS VA 20109	07/16/2021	07/16/2026
DOL	DOL		JORI PEDERSEN		415 FLAGER AVE #302STUART FL 34994	10/31/2018	10/31/2023
DOL	DOL		JOSEPH K. SALERNO		1010 TILDEN AVE UTICA NY 13501	07/24/2023	07/24/2028
DOL	DOL		JOSEPH K. SALERNO II		1010 TILDEN AVE UTICA NY 13501	07/24/2023	07/24/2028
DOL	DOL	*****5116	JP RACE PAINTING, INC. T/A RACE PAINTING		3469 STATE RT. 69 PERISH NY 13131	02/09/2022	02/09/2027
DOL	DOL	*****5116	JP RACE PAINTING, INC. T/A RACE PAINTING		3469 STATE RT. 69 PERISH NY 13131	11/15/2022	11/15/2027
DOL	DOL	*****5116	JP RACE PAINTING, INC. T/A RACE PAINTING		3469 STATE RT. 69 PERISH NY 13131	09/29/2021	09/29/2026

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DOL	DOL	*****5116	JP RACE PAINTING, INC. T/A RACE PAINTING		3469 STATE RT. 69 PERISH NY 13131	03/01/2022	03/01/2027
DOL	DOL	*****5116	JP RACE PAINTING, INC. T/A RACE PAINTING		3469 STATE RT. 69 PERISH NY 13131	03/01/2022	03/01/2027
DOL	DOL	*****1147	JRN CONSTRUCTION, LLC		531 THIRD STREET ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL	*****1147	JRN CONSTRUCTION, LLC		531 THIRD STREET ALBANY NY 12206	12/22/2022	12/22/2027
DOL	DOL		JRN PAVING, LLC		531 THIRD STREET ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL		JRN PAVING, LLC		531 THIRD STREET ALBANY NY 12206	12/22/2022	12/22/2027
DOL	DOL		JULIUS AND GITA BEHREND		5 EMES LANE MONSEY NY 10952	11/20/2002	11/20/3002
DOL	DOL		KARIN MANGIN		796 PHELPS ROAD FRANKLIN LAKES NJ 07417	12/01/2020	12/01/2025
DOL	DOL		KATE E. CONNOR		7088 INTERSTATE ISLAND RD SYRACUSE NY 13209	03/31/2021	03/31/2026
DOL	DOL	*****2959	KELC DEVELOPMENT, INC		7088 INTERSTATE ISLAND RD SYRACUSE NY 13209	03/31/2021	03/31/2026
DOL	DOL		KIMBERLY F. BAKER		7901 GEE ROAD CANASTOTA NY 13032	08/17/2021	08/17/2026
DOL	DA	*****8816	LAKE CONSTRUCTION AND DEVELOPMENT CORPORATION		150 KINGS STREET BROOKLYN NY 11231	08/19/1998	08/19/2998
DOL	DOL		LEROY E. NELSON JR		531 THIRD ST ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL		LEROY E. NELSON JR		531 THIRD ST ALBANY NY 12206	12/22/2022	12/22/2027
DOL	AG	*****3291	LINTECH ELECTRIC, INC.		3006 TILDEN AVE BROOKLYN NY 11226	02/16/2022	02/16/2027
DOL	DOL		LOUIS A. CALICCHIA		1223 PARK ST. PEEKSKILL NY 10566	05/17/2021	05/17/2026
DOL	NYC		LUBOMIR PETER SVOBODA		27 HOUSMAN AVE STATEN ISLAND NY 10303	12/26/2019	12/26/2024
DOL	NYC		M & L STEEL & ORNAMENTAL IRON CORP.		27 HOUSMAN AVE STATEN ISLAND NY 10303	12/26/2019	12/26/2024
DOL	DOL	*****2196	MAINSTREAM SPECIALTIES, INC.		11 OLD TOWN RD SELKIRK NY 12158	02/02/2021	02/02/2026
DOL	DA		MANUEL P TOBIO		150 KINGS STREET BROOKLYN NY 14444	08/19/1998	08/19/2998
DOL	DA		MANUEL TOBIO		150 KINGS STREET BROOKLYN NY 11231	08/19/1998	08/19/2998
DOL	NYC		MAREK FABIJANOWSKI		50 MAIN ST WHITE PLAINS NY 10606	01/04/2019	01/04/2024
DOL	NYC		MARIA NUBILE		84-22 GRAND AVENUE ELMHURST NY 11373	03/10/2020	03/10/2025
DOL	DOL		MATTHEW P. KILGORE		4156 WILSON ROAD EAST TABERG NY 13471	03/26/2019	03/26/2024
DOL	DOL	*****4829	MILESTONE ENVIRONMENTAL CORPORATION		704 GINESI DRIVE SUITE 29MORGANVILLE NJ 07751	04/10/2019	04/10/2024
DOL	NYC	*****9926	MILLENNIUM FIRE PROTECTION, LLC		325 W. 38TH STREET SUITE 204NEW YORK NY 10018	11/14/2019	11/14/2024
DOL	NYC	*****0627	MILLENNIUM FIRE SERVICES, LLC		14 NEW DROP LNE 2ND FLOORSTATEN ISLAND NY 10306	11/14/2019	11/14/2024
DOL	DOL	*****1320	MJC MASON CONTRACTING, INC.		42 FOWLER AVENUE CORTLAND MANOR NY 10567	10/25/2022	10/25/2027
DOL	DOL	*****1320	MJC MASON CONTRACTING, INC.		42 FOWLER AVENUE CORTLAND MANOR NY 10567	01/24/2023	01/24/2028
DOL	NYC		MUHAMMED A. HASHEM		524 MCDONALD AVENUE BROOKLYN NY 11218	09/17/2020	09/17/2025
DOL	NYC		NAMOW, INC.		84-22 GRAND AVENUE ELMHURST NY 11373	03/10/2020	03/10/2025
DOL	DOL	*****7790	NATIONAL BUILDING & RESTORATION CORP		1010 TILDEN AVE UTICA NY 13501	07/24/2023	07/24/2028
DOL	DOL	*****1797	NATIONAL CONSTRUCTION SERVICES, INC		1010 TILDEN AVE UTICA NY 13501	07/24/2023	07/24/2028
DOL	DA	*****9786	NATIONAL INSULATION & GC CORP		180 MILLER PLACE HICKSVILLE NY 11801	12/12/2018	12/12/2023
DOL	NYC		NAVIT SINGH		402 JERICHO TURNPIKE NEW HYDE PARK NY 11040	08/10/2022	08/10/2027

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DOL	DOL		NICHOLE E. FRASER A/K/A NICHOLE RACE		3469 STATE RT. 69 PERISH NY 13131	03/01/2022	03/01/2027
DOL	DOL		NICHOLE E. FRASER A/K/A NICHOLE RACE		3469 STATE RT. 69 PERISH NY 13131	11/15/2022	11/15/2027
DOL	DOL		NICHOLE E. FRASER A/K/A NICHOLE RACE		3469 STATE RT. 69 PERISH NY 13131	09/29/2021	09/29/2026
DOL	DOL		NICHOLE E. FRASER A/K/A NICHOLE RACE		3469 STATE RT. 69 PERISH NY 13131	02/09/2022	02/09/2027
DOL	DOL	*****7429	NICOLAE I. BARBIR	BESTUCCO CONSTRUCTION, INC.	444 SCHANTZ ROAD ALLENTOWN PA 18104	09/17/2020	09/17/2025
DOL	NYC	*****5643	NYC LINE CONTRACTORS, INC.		402 JERICHO TURNPIKE NEW HYDE PARK NY 11040	08/10/2022	08/10/2027
DOL	DOL		PAULINE CHAHALES		935 S LAKE BLVD MAHOPAC NY 10541	03/02/2021	03/02/2026
DOL	DOL		PETER STEVENS		11 OLD TOWN ROAD SELKIRK NY 12158	02/02/2021	02/02/2026
DOL	DOL		PETER STEVENS		8269 21ST ST BELLEROSE NY 11426	12/22/2022	12/22/2027
DOL	DOL	*****0466	PRECISION BUILT FENCES, INC.		1617 MAIN ST PEEKSKILL NY 10566	03/03/2020	03/03/2025
DOL	NYC		RASHEL CONSTRUCTION CORP		524 MCDONALD AVENUE BROOKLYN NY 11218	09/17/2020	09/17/2025
DOL	DOL	*****1068	RATH MECHANICAL CONTRACTORS, INC.		24 ELDOR AVENUE NEW CITY NY 10956	02/03/2020	02/03/2025
DOL	DOL	*****2633	RAW POWER ELECTRIC CORP.		3 PARK CIRCLE MIDDLETOWN NY 10940	07/11/2022	07/11/2027
DOL	DA	*****7559	REGAL CONTRACTING INC.		24 WOODBINE AVE NORTHPORT NY 11768	10/01/2020	10/01/2025
DOL	DOL	*****9148	RICH T CONSTRUCTION		107 WILLOW WOOD LANE CAMILLUS NY 13031	11/13/2018	11/13/2023
DOL	DOL		RICHARD MACONE		8617 THIRD AVE BROOKLYN NY 11209	09/17/2018	09/17/2023
DOL	DOL		RICHARD REGGIO		1617 MAIN ST PEEKSKILL NY 10566	03/03/2020	03/03/2025
DOL	DOL	*****9148	RICHARD TIMIAN	RICH T CONSTRUCTION	108 LAMONT AVE SYRACUSE NY 13209	10/16/2018	10/16/2023
DOL	DOL		RICHARD TIMIAN JR.		108 LAMONT AVE SYRACUSE NY 13209	10/16/2018	10/16/2023
DOL	DOL		RICHARD TIMIAN JR.		108 LAMONT AVE SYRACUSE NY 13209	11/13/2018	11/13/2023
DOL	DOL		ROBBYE BISSEAR		89-51 SPRINGFIELD BLVD QUEENS VILLAGE NY 11427	01/11/2003	01/11/3003
DOL	DOL		ROBERT A. VALERINO		3841 LANYARD COURT NEW PORT RICHEY FL 34652	07/09/2019	07/09/2024
DOL	DOL		ROBERT BRUNO		5 MORNINGSIDE DRIVE AUBURN NY 13021	05/28/2019	05/28/2024
DOL	DOL		ROMEO WARREN		161 ROBYN RD MONROE NY 10950	07/11/2022	07/11/2027
DOL	DOL		RONALD MESSEN		14B COMMERCIAL AVE ALBANY NY 12065	11/14/2019	11/14/2024
DOL	DOL	*****7172	RZ & AL INC.		198 RIDGE AVENUE VALLEY STREAM NY 11581	06/06/2022	06/06/2027
DOL	DOL	*****1365	S & L PAINTING, INC.		11 MOUNTAIN ROAD P.O BOX 408MONROE NY 10950	03/20/2019	03/20/2024
DOL	DOL		SAL FRESINA MASONRY CONTRACTORS, INC.		1935 TEALL AVENUE SYRACUSE NY 13206	07/16/2021	07/16/2026
DOL	DOL		SAL MASONRY CONTRACTORS, INC.		(SEE COMMENTS) SYRACUSE NY 13202	07/16/2021	07/16/2026
DOL	DOL	*****9874	SALFREE ENTERPRISES INC		P.O BOX 14 2821 GARDNER RDPOMPEI NY 13138	07/16/2021	07/16/2026
DOL	DOL		SALVATORE A FRESINA A/K/A SAM FRESINA		107 FACTORY AVE P.O BOX 11070SYRACUSE NY 13218	07/16/2021	07/16/2026
DOL	DOL		SAM FRESINA		107 FACTORY AVE P.O BOX 11070SYRACUSE NY 13218	07/16/2021	07/16/2026
DOL	NYC	*****0349	SAM WATERPROOFING INC		168-42 88TH AVENUE APT.1 AJAMAICA NY 11432	11/20/2019	11/20/2024
DOL	DA	*****0476	SAMCO ELECTRIC CORP.		3735 9TH ST LONG ISLAND CITY NY 11101	01/05/2023	01/05/2028
DOL	NYC	*****1130	SCANA CONSTRUCTION CORP.		863 WASHINGTON STREET FRANKLIN SQUARE NY 11010	03/10/2020	03/10/2025

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DOL	DOL	*****2045	SCOTT DUFFIE	DUFFIE'S ELECTRIC, INC.	P.O BOX 111 CORNWALL NY 12518	03/03/2020	03/03/2025
DOL	DOL		SCOTT DUFFIE		P.O BOX 111 CORNWALL NY 12518	03/03/2020	03/03/2025
DOL	NYC	*****6597	SHAIRA CONSTRUCTION CORP.		421 HUDSON STREET SUITE C5NEW YORK NY 10014	02/20/2019	02/20/2024
DOL	DOL		SHULEM LOWINGER		11 MOUNTAIN ROAD 28 VAN BUREN DRMONROE NY 10950	03/20/2019	03/20/2024
DOL	DA		SILVANO TRAVAJA		3735 9TH ST LONG ISLAND CITY NY 11101	01/05/2023	01/05/2028
DOL	DOL	*****0440	SOLAR GUYS INC.		8970 MIKE GARCIA DR MANASSAS VA 20109	07/16/2021	07/16/2026
DOL	NYC		SOMATIE RAMSUNAHAI		115-46 132ND ST SOUTH OZONE PARK NY 11420	09/17/2020	09/17/2025
DOL	DOL	*****2221	SOUTH BUFFALO ELECTRIC, INC.		1250 BROADWAY ST BUFFALO NY 14212	02/03/2020	02/03/2025
DOL	NYC	*****3661	SPANIER BUILDING MAINTENANCE CORP		200 OAK DRIVE SYOSSET NY 11791	03/14/2022	03/14/2027
DOL	DOL		STANADOS KALOGELAS		485 RAFT AVENUE HOLBROOK NY 11741	10/19/2021	10/19/2026
DOL	DOL	*****3496	STAR INTERNATIONAL INC		89-51 SPRINGFIELD BLVD QUEENS VILLAGE NY 11427	08/11/2003	08/11/3003
DOL	DOL	*****6844	STEAM PLANT AND CHX SYSTEMS INC.		14B COMMERCIAL AVENUE ALBANY NY 12065	11/14/2019	11/14/2024
DOL	DOL	*****9933	STEED GENERAL CONTRACTORS, INC.		1445 COMMERCE AVE BRONX NY 10461	05/30/2019	05/30/2024
DOL	DOL	*****9528	STEEL-IT, LLC.		17613 SANTE FE LINE ROAD WAYNESFIELD OH 45896	07/16/2021	07/16/2026
DOL	DOL		STEFANOS PAPASTEFANOU, JR. A/K/A STEVE PAPASTEFANOU, JR.		256 WEST SADDLE RIVER RD UPPER SADDLE RIVER NJ 07458	05/30/2019	05/30/2024
DOL	DOL		STEVE TATE		415 FLAGER AVE #302STUART FL 34994	10/31/2018	10/31/2023
DOL	DOL	*****3800	SUBURBAN RESTORATION CO. INC.		5-10 BANTA PLACE FAIR LAWN PLACE NJ 07410	03/29/2021	03/29/2026
DOL	DOL	*****1060	SUNN ENTERPRISES GROUP, LLC		370 W. PLEASANTVIEW AVE SUITE 2.329HACKENSACK NJ 07601	02/11/2019	02/11/2024
DOL	DOL	*****9150	SURGE INC.		8269 21ST STREET BELLEROSE NY 11426	12/22/2022	12/22/2027
DOL	DOL		SYED RAZA		198 RIDGE AVENUE NY 11581	06/06/2022	06/06/2027
DOL	DOL	*****8209	SYRACUSE SCALES, INC.		158 SOLAR ST SYRACUSE NY 13204	01/07/2019	01/07/2024
DOL	DOL		TERRY THOMPSON		11371 RIDGE RD WOLCOTT NY 14590	02/03/2020	02/03/2025
DOL	DOL	*****9733	TERSAL CONSTRUCTION SERVICES INC		107 FACTORY AVE P.O BOX 11070SYRACUSE NY 13208	07/16/2021	07/16/2026
DOL	DOL		TERSAL CONTRACTORS, INC.		221 GARDNER RD P.O BOX 14POMPEI NY 13138	07/16/2021	07/16/2026
DOL	DOL		TERSAL DEVELOPMENT CORP.		1935 TEALL AVENUE SYRACUSE NY 13206	07/16/2021	07/16/2026
DOL	DOL		TEST		P.O BOX 123 ALBANY NY 12204	05/20/2020	05/20/2025
DOL	DOL	*****6789	TEST1000		P.O BOX 123 ALBANY NY 12044	03/01/2021	03/01/2026
DOL	DOL	*****5766	THE COKER CORPORATION	COKER CORPORATION	2610 SOUTH SALINA ST SUITE 14SYRACUSE NY 13205	12/04/2018	12/04/2023
DOL	DOL	*****5766	THE COKER CORPORATION	COKER CORPORATION	2610 SOUTH SALINA ST SUITE 14SYRACUSE NY 13205	09/17/2020	09/17/2025
DOL	DA	*****1050	TRI STATE CONSTRUCTION OF NY CORP.		50-39 175TH PLACE FRESH MEADOWS NY 11365	03/28/2022	03/28/2027
DOL	DA	*****4106	TRIPLE H CONCRETE CORP		2375 RAYNOR STREET RONKONKOMA NY 11779	08/04/2021	08/04/2026
DOL	DOL	*****8210	UPSTATE CONCRETE & MASONRY CONTRACTING CO INC		449 WEST MOMBSHA ROAD MONROE NY 10950	06/06/2022	06/06/2027
DOL	DOL	*****6392	V.M.K CORP.		8617 THIRD AVE BROOKLYN NY 11209	09/17/2018	09/17/2023

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DOL	DOL	*****6418	VALHALLA CONSTRUCTION, LLC.		796 PHLEPS ROAD FRANKLIN LAKES NJ 07417	12/01/2020	12/01/2025
DOL	NYC	*****2426	VICKRAM MANGRU	VICK CONSTRUCTI ON	21 DAREWOOD LANE VALLEY STREAM NY 11581	09/17/2020	09/17/2025
DOL	NYC		VICKRAM MANGRU		21 DAREWOOD LANE VALLEY STREAM NY 11581	09/17/2020	09/17/2025
DOL	DOL		VICTOR ALICANTI		42-32 235TH ST DOUGLASTON NY 11363	01/14/2019	01/14/2024
DOL	NYC		VIKTAR PATONICH		2630 CROPSY AVE BROOKLYN NY 11214	10/30/2018	10/30/2023
DOL	DOL		VIKTORIA RATH		24 ELDOR AVENUE NEW CITY NY 10956	02/03/2020	02/03/2025
DOL	NYC	*****3673	WALTERS AND WALTERS, INC.		465 EAST AND THIRD ST MT. VERNON NY 10550	09/09/2019	09/09/2024
DOL	DOL	*****3296	WESTERN NEW YORK CONTRACTORS, INC.		3841 LAYNARD COURT NEW PORT RICHEY FL 34652	07/09/2019	07/09/2024
DOL	DOL	*****8266	WILLIAM CHRIS MCCLENDON	MCCLENDON ASPHALT PAVING	1646 FALLS STREET NIAGARA FALLS NY 14303	05/01/2023	05/01/2028
DOL	DOL		WILLIAM CHRIS MCCLENDON		1646 FALLS STREET NIAGARA FALLS NY 14303	05/01/2023	05/01/2028
DOL	DOL		WILLIAM G. PROERFRIEDT		85 SPRUCEWOOD ROAD WEST BABYLON NY 11704	01/19/2021	01/19/2026
DOL	DOL	*****5924	WILLIAM G. PROPHY, LLC	WGP CONTRACTIN G, INC.	54 PENTAQUIT AVE BAYSHORE NY 11706	01/19/2021	01/19/2026
DOL	DOL	*****4730	XGD SYSTEMS, LLC	TDI GOLF	415 GLAGE AVE #302STUART FL 34994	10/31/2018	10/31/2023



GENERAL REQUIREMENTS

FOR

**VETERINARY RESEARCH TOWER SECOND AND THIRD FLOOR
STRUCTURAL REPAIRS AND LABORATORY REMEDIATION**

**CORNELL UNIVERSITY
ITHACA, NEW YORK**

AUGUST 29, 2023

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SECTION 01 11 00 SUMMARY OF WORK

1.0 GENERAL

1.1 DESCRIPTION

A. Work to be Done

1. Repair all structural damage caused by the fire on the 2nd Floor of the VRT. Restore the 2nd and 3rd floor laboratories in the VRT to their pre-fire state.

B. The Scope of the Work

1. The scope of the WORK in all SECTIONS of this Specification shall consist of the furnishing of all labor, materials, equipment and appliances and the performance of the Work required by the Contract Documents and/or by the conditions at the site, joining all parts of this Work with itself and the Work of others to form a complete, functioning entity.
2. Items not specifically mentioned in the Specifications or shown on the drawings, but which are inherently necessary to make a complete working installation, shall be included.
3. It is the intent and purpose of the Contract Documents to cover and include under each item all materials, machinery, apparatus, and labor necessary to properly install materials and equipment, adjust and put into perfect operation the respective portions of the installation specified and to so interconnect the various items or sections of the work as to form a complete and operating whole. Any equipment, apparatus, machinery, material and small items not mentioned in detail, and labor not hereinafter specifically mentioned, which may be found necessary to complete or perfect any portion of the installation in a substantial manner, and in compliance with the requirements stated, implied, or intended in the Contract Documents, shall be furnished without extra cost to the Owner. The Contractor shall provide the greatest quantity, highest quality, highest degree of safety, and most stringent material, equipment or Work. Should the Drawings or the Specifications disagree in themselves or with each other, the Contractor shall provide the better quality or greater quantity of work and/or materials unless otherwise directed by written addendum to the Contract.

1.2 WORK UNDER OTHER CONTRACTS

- A. The Contractor shall cooperate with other contracts performing related work, including providing labor, materials and other costs necessary to satisfactorily coordinate the Contract work with work performed under others contracts.
- B. Concurrent / Future Work:
 - 1. VRT Building Renovation Project will renovate the eleven-story building. This project will renovate floor layouts, finishes, areas of building envelope, mechanical, electrical, plumbing, life safety systems, and modernize the facility to meet current programmatic requirements.
- C. New York State Electric & Gas (NYSEG):
 - 1. Contractor shall be responsible for the project management of NYSEG work including coordinating any scheduling associated with the Project.
 - 2. The Owner shall be responsible for the cost associated with the work to be performed by NYSEG. No NYSEG costs shall be carried in the Contractor's bid.

2.0 PRODUCTS – NOT USED

3.0 EXECUTION – NOT USED

*****END OF SECTION 01 11 00*****

SECTION 01 14 00 WORK RESTRICTIONS

1.0 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

1.2 CONTRACTOR USE OF PREMISES

- A. All traffic and pedestrian control measures shall be compliant with the **National Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD)** and **17 NYCRR Chapter V** (New York Supplement), (<https://www.dot.ny.gov/mutcd>) and all other local laws and regulations.
- B. The Contractor shall carry on the Work in the manner which will cause the least interruption to pedestrian and vehicular traffic and permit access of emergency vehicles at all times.
- C. The Work shall be scheduled and performed in such a manner that at least one lane of traffic will be maintained on all public streets. Two flag persons, equipped with radio communication devices, must be provided for any activity blocking a traffic lane. One lane of traffic must be maintained at all times. Where traffic must cross open trenches, the Contractor shall provide suitable bridges and railings; including pedestrian bridges.
- D. The Contractor shall maintain 20' minimum fire lane access to all facilities in the area.
- E. The Contractor shall post and maintain flag persons and suitable signs indicating that construction operations are under way and other warning signs as may be required.
- F. The Contractor shall safeguard the use by the public and Owner of all adjacent highways, roadways and footpaths, outside the Contract Limit Lines (work area), and shall conform to all laws and regulations concerning the use thereof, especially limitations on traffic and the movement of heavy equipment. Access to the site for delivery of construction materials and/or equipment shall be made only at the locations shown in the Contract Documents or approved by the Owner's Representative.
- G. The Contractor shall make every effort to keep dirt and debris from making its way to roadways. The Contractor shall immediately remove dirt and debris which may collect on permanent roadways due to the Work.
- H. The Contractor shall limit the extent of its activities to that area of the site defined on the Contract Drawings as being within the Contract Limit Lines.

- I. For that portion of the Work required under this Contract which must be performed in other than the defined areas both on-site and off, including operations involving delivery and removal of materials, the Contractor shall schedule and coordinate its activities through the Owner's Representative, to meet the approval of the Owner and minimize disruption of the normal scheduled activities of the occupants of adjacent spaces.
- J. It is the Owner's expectation that the Contractor will take protective measures to minimize damage caused by construction activities including, but not limited to, the use of personnel lifts, material handling equipment, on-site material storage, etc. All portions of the site, including the staging area and those areas affected by the work, shall be returned to their original condition after completion of Work. Such repair work shall include lawn restoration and reseeding, if required, and shall be included in the Contractor's Guarantee of Work.
- K. Routes to and from the location of the Work shall be as indicated in the Contract or as directed by the Owner's Representative. Temporary roadways shall be closed only with prior approval of the Owner's Representative.
- L. Parking may be made available for staging at Palm Road or other pre-determined area for the duration of the project. The Contractor will be responsible for fencing, securing and maintaining the designated area. All vehicles at Palm Road must be registered with Transportation Services. Due to ongoing work at the Palm Road lot, parking may be limited.

1.3 UNIVERSITY CLOSURES

- A. In the event of University closure, the Contractor should use their judgement, follow their internal guidance on continuity of operations, and the direction of law enforcement, as to whether or not they will maintain operations on construction sites on campus. They should make this decision with the awareness that Cornell response to any project needs (shutdowns, emergencies) will not be possible and the maintenance of roads and walks will not be to normal operating standards.
- B. With your safety as a top priority, the Cornell University Police allows you the ability to take advantage of our Emergency Mass Notification System that enables your cellphone to become a personal safety device for you. Contractor's wishing to participate may text the following: **CornellAlert** to **67283** and you will be set up to receive alert messages. Be advised that you may stop receiving messages at any time by sending "stop" to **CornellAlert**. There will also be a system generated "stop" every year on August 1st at which point you will need to send the text **CornellAlert** to re-enlist.

1.4 WATER USE RESTRICTION

- A. The Contractor shall adhere to any University issued Water Use Restrictions in place at the time of construction.

1.5 PARKING

- A. ParkMobile available at B Lot - across from Cornell University Hospital for Animals.
- B. The Contractor shall make all arrangements, and bear the cost, for transportation of all trade persons from the designated parking area to the construction site as necessary.

- C. It should be noted that there is a fee for all parking on the Cornell University campus. The Contractor is responsible for the payment for all parking costs imposed by the Owner. The Contractor should contact the Project Manager (Jake Perno) for additional information. The Contractor will be required to complete a "New Construction Employee Form" for each permit requested. This form may be found at <http://finance.fs.cornell.edu/contracts/forms/contractors.cfm>.
- D. Contractor shall cooperate with Transportation Services and/or other authorities having jurisdiction, as follows:
 - 1. Ensure parking by all employees of the Contractor, subcontractors, material suppliers, and others connected with this project only within construction fence or the designated parking area.
 - 2. Prohibit employees from parking in any other areas, roads, streets, grounds, etc.
 - 3. Discharge any employee refusing to comply with these requirements.
 - 4. Ensure proper transportation of personnel between the designated parking area and the construction site.
- E. The Contractor shall remove from the parking area and staging area all temporary trailers, rubbish, unused materials, and other materials belonging to the Contractor or used under the Contractor's direction during construction or impairing the use or appearance of the property and shall restore such areas affected by the work to their original condition, and, in the event of its failure to do so, the same shall be removed by the Owner at the expense of the Contractor, and the Contractor shall be liable therefore.

1.6 CHANGEOVERS AND CONTINUITY OF SERVICES

- A. Make all changeovers, tie-ins and removals, etc., of any part of the Work that would affect the continuity of operation of the adjacent services at approved times that will not interfere with the Owner's operations. Secure approval of Owner before proceeding.
- B. Make all necessary temporary connections required to permit operation of the building services and/or equipment. Remove the connections after need has ceased.
- C. The Contractor may be permitted to make changeovers during normal working hours at the Owner's discretion. Should the Contractor perform this Work outside of normal working hours, no extra payment will be made for resulting overtime expenses.
- D. When connecting new facilities do not shut off any existing Mechanical/Electrical facilities or services without prior written approval of Owner's Representative.
- E. The Contractor shall not, except in an emergency condition, shutdown any utility without the express permission of the Owner's Representative. Major, affecting life safety or outside contract limit lines, shutdowns of utilities will be performed by Cornell University to enable Contractor to perform required work. Major shutdowns shall be defined as those affecting life safety or which are outside the project site limits.

- F. Maintain domestic water and firewater in service at all times. No service may be out for more than twenty-four (24) hours. Maintain firewater flow capability (hose, if necessary) to all buildings and coordinate with Cornell Utilities, Cornell Environmental Health and Safety (EH&S), and City of Ithaca Fire Department.
- G. All shutdowns to be scheduled a minimum of seven (7) calendar days in advance and requests shall be submitted via ePM system to the Owner's Representative.
- H. IN THE EVENT OF AN EMERGENCY WHERE THE OWNER'S REPRESENTATIVE IS NOT AVAILABLE, THE CONTRACTOR SHALL DIAL 911 IMMEDIATELY.

1.7 OBSTACLES, INTERFERENCE AND COORDINATION

A. General

- 1. Plans show general design arrangement. Install work substantially as indicated and verify exact location and elevations; DO NOT SCALE PLANS.
- 2. Due to small scale of Drawings, it is not possible to indicate all offsets, fittings, changes in elevations, interferences, etc. Make necessary changes in the Work, equipment locations, etc., after notification to the Owner's Representative and Architect. Obtain approval from same, as part of Contract, to accommodate work to obstacles and interferences encountered.
- 3. Obtain written approval for all major changes before installing. If requested, submit drawings, detailing all such deviations or changes.
- 4. Exposed to view mechanical units, ductwork, conduit, pipes or other building equipment are essential parts of the artistic effect of the building design and shall be installed in locations as shown on the drawings. Conformance to given dimensions and alignments with the structural system, walls, openings, indicated centerlines are a requirement of the Contract and the Contractor shall familiarize himself with the critical nature of proper placement of these items. The Contractor shall notify the Architect of conflicts which would cause such equipment to be installed in locations other than as indicated on the Drawings. The Contractor shall not proceed with the installation of exposed to view mechanical units, ductwork, conduit, pipes, etc. until all conflicts have been identified by the Contractor and resolutions to conflicts approved by the Architect.

B. Interference

- 1. Install work so that all items are operable and serviceable and avoid interfering with removal of rails, filters, belt guards and/or operation of doors, etc. Provide easy and safe access to valves, controllers, motor starters and other equipment requiring frequent attention.

1.8 EQUIPMENT ARRANGEMENTS

- A. Since all equipment of equal capacity is not necessarily of same arrangement, size of construction, these Plans are prepared on basis of one manufacturer as "basis-of-design equipment", even though other manufacturers' names are mentioned.

- B. If Contractor elects to use specified equipment other than "design equipment" which differs in arrangement, size, etc., the Contractor does so subject to following conditions:
 - 1. Submit detailed drawings indicating proposed installations of equipment and showing maintenance and service space required.
 - 2. If revised arrangement meets approval, make all required changes in the work of all trades, including but not limited to louvers, panels, structural supports, pads, etc. at no increase in Contract. Provide larger motors and any additional control devices, valves, fittings and other miscellaneous equipment required for proper operation of revised layout, and assumes responsibility for proper location of roughing in and connections by other trades.
 - 3. If revised arrangement does not meet approval because of increase in pressure loss, possibility of increase in noise, lack of space or headroom, insufficient clearance for removal of parts, or for any other reason, provide equipment which conforms to Contract Drawings and Specifications.

1.9 EXISTING EQUIPMENT, MATERIALS, FIXTURES, ETC.

- A. Where existing equipment, piping, fittings, etc. are to be removed, Contractor shall submit complete list to Owner. All items that Owner wishes to retain shall be carefully removed and salvaged and delivered to building storage where directed by Owner. Items that Owner does not wish to retain shall be removed from the site and legally disposed.

1.10 EXAMINATION OF PREMISES, DRAWINGS, ETC.

- A. Before Submitting Proposal
 - 1. Examine all Drawings and Specifications relating to Work of all trades to determine scope and relation to other work.
 - 2. Examine all existing conditions affecting compliance with Plans and Specifications, by visiting site and/or building.
 - 3. Ascertain access to site, available storage and delivery facilities.
- B. Before Commencing Work on Any Phase or in any Area
 - 1. Verify all governing dimensions at site and/or building.
 - 2. Inspect all adjacent work.

3. All work is to be conducted in such a manner as to cause a minimum degree of interference with the Campus' operation and academic schedule. Prior to the commencement of each phase, submit Shutdown / Demo action plans that clearly describe the steps required to safely shut down utilities, systems and infrastructure that are within the work area (or effecting the work area); and those outside the work area and within approximately 25 feet of the work area limits, as approved by the Owner. The Shutdown / Demo action plan shall identify the shut off point(s) for each utility, system and infrastructure as well as the secondary shut off point(s) to account if the primary points fail or are otherwise inaccessible. To identify shutoff points, trace each utility, system and infrastructure in the presence of the campus representative from the work area to the shutoff points and place clear label on same indicating what the shutoff point is and what it effects and whether it is the primary or secondary shut off. The Shutdown / Demo action plan shall describe the shutdown procedure, identify tools and material required for shutdown, sequence of activities required for proper shutdown, the name of the person(s) or trade(s) deemed competent to perform each activity in the shutdown sequence and names and telephone numbers of the campus staff required to provide access to shut off points, assist in the shut off or perform portions of the shutdown activities. Additionally, the plan will address the Contractor's plan for maintaining MEP to adjacent occupied areas, inclusive of planned tie-in points for any and all necessary, temporary infrastructure, alarming, monitoring etc. Submit the Shutdown / Demo action plan for review and approval at least two weeks prior to field work in the work area. Field work shall not begin until the Shutdown / Demo action plan is reviewed. Contractor is to assign and include a competent crew, knowledgeable of each unique system involved (i.e. Mechanic, Electrician, Sheet metal, Plumber, Controls, IT, etc.). Field investigation is to include any and all necessary ladders, scaffold, temp lighting, cutting tools, photos, labels, PPE, etc. needed to properly locate, access and label shut off points. The University is explicitly requesting heightened awareness and an earnest mitigation of impact. This requirement supplements all other contractual obligations, and requires the dedication of *no less than* an aggregate **40 hours**.

C. Tender of Proposal Confirms Agreement

1. All items and conditions referred to herein and/or indicated on accompanying Drawings.
2. No consideration, additional monies or time extensions will be granted for alleged misunderstanding.

D. Existing or Archived Drawings

1. Existing or Archived drawings of impacted buildings are appended in electronic format only for reference and informational purposes. These historic drawings are not to be considered contract drawings and are provided "FOR INFORMATION ONLY". The Owner makes no representation as to the accuracy of the drawings as representing current conditions.

1.11 STAND DOWN DATES

A. Strict and effective enforcement by Contractor's management and supervision of the following dates and hours is required.

1. **Stand-Down Dates** (No construction work and no deliveries on site):

- a. Commencement Weekend
 - Saturday, May 25, 2024
 - Sunday, May 26, 2024
- b. Reunion Weekend
 - Thursday, June 6, 2024
 - Friday, June 7, 2024
 - Saturday, June 8, 2024
 - Sunday, June 9, 2024

2. **Restricted Work Dates** (delivery & demolition restrictions but otherwise work as usual):

Friday, May 24, 2024	Commencement weekend- deliveries and work outside fence stop at noon
Thursday, Friday June 6 - 7, 2024	Reunion guest arrivals- no work outside fence; no demo or utility work inside fence
Friday, June 7, 2024	Reunion weekend- deliveries and work outside fence stop at noon

1.12 WORKING HOURS

- A. Normal work hours are 7AM-dusk Monday-Saturday except during above noted restrictions. This means that Contractor shall not permit any noise generating activities that could disturb campus occupants or residents to take place outside of these hours. Should any conditions necessitate work to extend beyond these hours – Contractor may submit a detailed request with reasonable advance notice to Cornell. Cornell (at its sole discretion) may issue a written relaxation of the above but Contractor is advised never to assume that it will be granted.
- B. During Construction periods, no work shall take place prior to 9AM in a Residence Hall, Fraternity, Co-Op, Sorority, or any type of Housing Unit. Residence Halls require 72 hours notification to the Student & Academic Services representative prior to entering a Residence Hall or Student Room. This does not apply to Fraternity, Co-Op or Sorority House which require 24 hours notification to the Facilities Manager.
- C. Contractor shall be responsible to complete and submit a Dispensation of Hours to the Department of Labor for overtime or extended hours desired to be worked on the project as needed.

2.0 PRODUCTS – NOT USED

3.0 EXECUTION – NOT USED

*****END OF SECTION 01 14 00*****

SECTION 01 23 00 ALTERNATES

1.0 GENERAL

1.1 RELATED DOCUMENTS

- A. This Section describes the changes to be made under each Alternative.
- B. The Specification Section containing the pertinent requirements of materials and methods to achieve the Work described herein.

1.2 DESCRIPTION OF REQUIREMENTS

- A. Definition: An alternate is an amount proposed by Bidders and stated on the Bid Proposal Submission Form and in the eBuilder Bid Module for certain items that may be added to or deducted from the Base Bid amount if the Owner decides to accept a corresponding change in either the amount of construction to be completed, or in the product, materials, equipment, systems or installation methods described in the Contract Documents. Alternates shall include all overhead, profit and other expenses, including bond costs, in connection therewith.
- B. Coordination: Coordinate related Work and modify or adjust adjacent Work as necessary to ensure that Work affected by each accepted alternate is complete and fully integrated into the Project.
- C. Notification: Immediately following Contract award, prepare and distribute to each party involved, notification of the status of each alternate. Indicate whether alternates have been accepted, rejected or deferred for consideration at a later date. Include a complete description of negotiated modifications to alternates.
- D. Schedule: A "Schedule of Alternates" is included at the end of this Section. Include as part of each alternate, miscellaneous devices, accessory objects or similar items incidental to or required for a complete installation whether or not mentioned as part of the alternate.

2.0 PRODUCTS – NOT USED

3.0 EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. ALTERNATE NO. 1

Alternate scope involves a complete renovation of the 2nd floor lab space to create an open floor plan similar to other modernization efforts that have been done on other floors in the building (A11D, A112, A122, A221, A222, A223, A224, M010, M102, M103, M104, M601, M603, F231, P231, P232, E103, E104, E106, E203, E204, E303, E304, E601, E603, ED202E, ED202W).

*****END OF SECTION 01 23 00****

SECTION 01 25 00 SUBSTITUTIONS AND PRODUCT OPTIONS

1.0 GENERAL

1.1 DESCRIPTION

- A. The Contractor shall furnish and install the products specified, under the options and conditions for substitutions stated in this Section.

1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions that are beyond the Contractor's control, such as unavailability of product, or regulatory changes.
 - a. Products that are not available from Contractor's preferred suppliers does not constitute unavailability of product.
 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.
- B. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 2. New Products: Items that have not previously been incorporated into another project or facility. Items salvaged from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
 3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

- C. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.3 ACTION SUBMITTALS

- A. Substitution Requests: Submit indicated number of copies of each Substitution Request Form, attached hereto, for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. In addition to submission of Substitution Request Form, substitutions shall be listed on the Bid Proposal Submission Form with description, specification references, and corresponding change in base bid

1.4 PRODUCTS LIST

- A. Within thirty (30) days after the award of Contract, submit to the Architect five copies of a complete list of products which are proposed for installation.
- B. Tabulate the products by listing under each specification section title and number.
- C. For products specified only by reference standards, list for each such product:
 - 1. Name and address of the manufacturer.
 - 2. Trade name.
 - 3. Model or catalog designation.
 - 4. Manufacturer's data:
 - a. Reference standards.
 - b. Performance test data.

1.5 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

- B. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
1. Contractor is responsible for providing products and construction methods compatible with other products and construction methods.
 2. If a dispute or compatibility issue arises over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.6 PROCEDURES

- A. Coordination: Modify or adjust affected work as necessary to integrate work of accepted substitutions and approved comparable products.

1.7 EQUIVALENTS – APPROVED EQUAL

- A. Equivalents or Approvals - General
1. The words “similar and equal to”, or “or equal”, “equivalent” and such other words of similar content and meaning shall for the purposes of this Contract be deemed to mean similar or equivalent to one of the named products. For the purposes of Paragraph A and B of this Section 1.4 and for the purposes of Bidding Documents, the word “products” shall be deemed to include the words “articles”, “materials”, “items”, “equipment” and “methods”. Whenever in the Contract documents one or more products are specified, the words “similar and equal to” shall be deemed inserted.
 2. Whenever any product is specified in the Contract documents by a reference to the name, trade name, make or catalog number of any manufacturer or supplier, the intent is not to limit competition, but to establish a standard of quality which the Architect has determined is necessary for the Project. The Contractor may at its option use any product other than that specified in the Contract Documents provided the same is approved by the Architect in accordance with the procedures set forth in Paragraph B of this Section 1.4. In all cases the Architect shall be the sole judge as to whether a proposed product is to be approved and the Contractor shall have the burden of proving, at its own cost and expense, to the satisfaction of the Architect, that the proposed product is similar and equal to the named product. In making such determination the Architect may establish such objective and appearance criteria as it may deem proper that the proposed product must meet in order for it to be approved.
 3. Nothing in the Contract Documents shall be construed as representing, expressly or implied, that the named product is available or that there is or there is not a product similar and equal to any of the named products and the Contractor shall have and make no claim by reason of the availability or lack of availability of the named product or of a product similar and equal to any named product.
 4. The Contractor shall have and make no claim for an extension of time or for damages by reason of the time taken by the Architect or by reason of the failure of the Architect to approve a product proposed by the Contractor.

5. Request for approval of proposed equivalents will be received by the Architect only from the Contractor.
- B. Equivalents or Approvals After Bidding
1. Request for approval of proposed equivalents will be considered by the Architect after bidding only in the following cases: (a) the named product cannot be obtained by the Contractor because of strikes, lockouts, bankruptcies or discontinuance of manufacturer and the Contractor makes a written request to the Architect for consideration of the proposed equivalent within ten (10) calendar days of the date it ascertains it cannot obtain the named product; or (b) the proposed equivalent is superior, in the opinion of the Architect, to the named product; or (c) the proposed equivalent, in the opinion of the Architect, is equal to the named product and its use is to the advantage of the Owner, e.g., the Owner receives an equitable credit, acceptable to it, as a result of the estimated cost savings to the Contractor from the use of the proposed equivalent or the Owner determines that the Contractor has not failed to act diligently in placing the necessary purchase orders and a savings in the time required for the completion of the construction of the Project should result from the use of the proposed equivalent; or (d) the proposed equivalent, in the opinion of the Architect, is equal to the named product and less than ninety (90) calendar days have elapsed since the Notice of Award of the Contract.
 2. Where the Architect pursuant to the provisions of this Section 1.4 approves a product proposed by the Contractor and such proposed product requires a revision or redesign of any part of the work covered by this Contract, all such revision and redesign and all new Drawings and details required therefore shall be subject to approval of the Architect and shall be provided by the Contractor at its own cost and expense.
 3. Where the Architect pursuant to the provisions of this Section approves a product proposed by the Contractor and such proposed product requires a different quantity and/or arrangement of duct work, piping, wiring, conduit or any other part of the work from that specified, detailed or indicated in the Contract Documents, the contractor shall provide the same at its own cost and expense.

1.8 CONTRACTOR'S OPTIONS

- A. For products specified only by reference standard, select any product meeting that standard, by any manufacturer.
- B. For products specified by naming several products or manufacturers, select any one of products and manufacturers named.
 1. Products:
 - a. Restricted List (Products): Where Specifications include paragraphs or subparagraphs titled "Products" or that include the phrase "provide one of the following", and include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products for Contractor's convenience will not be considered.
 - Substitutions may be considered, unless otherwise indicated.

- b. Non-restricted List (Available Products): Where Specifications include paragraphs or subparagraphs titled “Available Products” or that include the phrase “include, but are not limited to, the following”, and include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
- 2. Manufacturers:
 - a. Restricted List (Manufacturers): Where Specifications include paragraphs or subparagraphs titled “Manufacturers” or that include the phrase “provide products by one of the following”, and include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products for Contractor's convenience will not be considered.
 - Substitutions may be considered, unless otherwise indicated.
 - b. Non-restricted List (Available Manufacturers): Where Specifications include paragraphs or subparagraphs titled “Available Manufacturers” or that include the phrase “include, but are not limited to, the following”, and include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
- 3. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named.
 - a. Restricted List (List of Manufacturers): Where Specifications include paragraphs or subparagraphs titled “Basis-of-Design Product”, and include a list of other manufacturers' names, provide the specified or indicated product or a comparable product by one of the other named manufacturers that complies with requirements.
 - Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
 - Substitutions may be considered, unless otherwise indicated.
 - b. Non-restricted List (No List of Manufacturers): Where Specifications include paragraphs or subparagraphs titled “Basis-of-Design Product”, and do not include a list of other manufacturers' names, provide the specified or indicated product or a comparable product by another manufacturer that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.

- C. For products specified by naming one or more products or manufacturers and stating "or equal", the Contractor shall submit a request as for substitutions, for any product or manufacturer not specifically named. Such substitution shall have been listed on Bid Proposal Submission Form as required in Instructions to Bidders. If not so listed, no substitution will be allowed.
- D. For products specified by naming only one product and manufacturer, no option and no substitution will be considered unless listed on the Bid Proposal Submission Form as provided in the Instructions to Bidders. Base Bid must include the specified product or manufacturer. Substitutions will be at the sole discretion of the Owner.

1.9 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 21 days prior to time required for preparation and review of related submittals.
- B. Substitutions for Convenience: Submit requests for substitution within thirty (30) days of contract award.
- C. Submit a separate request for each substitution. Support each request with:
 - 1. Completed "Request for Substitution" form in eBuilder. A request for substitution of a product, material, or process for that specified in the Contract Documents must be formally submitted as such accompanied by evidence that the proposed substitution {1} is equal in quality and serviceability to the specified item; {2} will not entail changes in detail and construction of Other Work; {3} will be acceptable to the Architect and Owner's Design Consultant's in achieving design and artistic intent; and {4} will not result in a cost and/or schedule disadvantage.
 - 2. Complete data substantiating compliance of the proposed substitution with requirements stated in Contract Documents:
 - a. Product identification, including manufacturer's name and address.
 - b. Manufacturer's literature; identify:
 - Product description.
 - Reference standards.
 - Performance and test data.
 - c. Samples, as applicable.
 - d. Name and address of similar projects on which product has been used, and the date of each installation.
 - 3. An itemized comparison of the proposed substitution with the product specified listing any variations.

4. Data relating to any changes in the construction schedule.
 5. The effect of the substitution on each separate contract of the Project.
 6. List any changes required in other work or projects.
 7. Designate any required license fees or royalties.
 8. Designate availability of maintenance services, and source of replacement materials.
- D. Substitutions shall not result in additions to the Contract Sum.
- E. Substitutions will not be considered as having been accepted when:
1. They are indicated or implied on shop drawings or product data submittals without a formal request from the Contractor.
 2. They are requested by a subcontractor or supplier.
 3. The acceptance will require substantial revision of Contract Documents.
- F. Substitute products shall not be ordered or installed without written acceptance of the Owner.
- G. The Owner and the Architect shall be the sole judges of the acceptability of a proposed substitution.

1.10 COMPARABLE PRODUCTS

- A. Conditions for Consideration: Contractor's request for approval of comparable product will be considered when the following conditions are satisfied. If the following conditions are not satisfied, Architect may reject or return requests without action, except to record noncompliance with these requirements. Where products or manufacturers are specified by name, submit the following, in addition to other required submittals, to obtain approval of an unnamed product or manufacturer:
1. Evidence that the proposed product does not require revisions to the Contract Documents that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the product specified.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 5. Samples, if requested.

1.11 CONTRACTOR'S REPRESENTATION

- A. In making a formal request for a substitution the Contractor represents that:
1. By submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor thereby represents that he has determined and verified all dimensions, quantities, field dimensions, relations to existing work, coordination with work to be installed later, coordination with information on previous Shop Drawings, Product Data, or Samples and compliance with all the requirements of the Contract Documents. The accuracy of all such information is the responsibility of the Contractor.
 2. The Contractor has personally investigated the proposed product and has determined that it is equal to or superior in all respects to that specified.
 3. The Contractor will provide the same warranties or bonds for the substitution as for the product specified.
 4. The Contractor will coordinate the installation of an accepted substitution into the Work, and will make such changes as may be required for the Work to be complete in all respects.
 5. The Contractor waives all claims for additional costs related to the substitution which may subsequently become apparent.

1.12 ARCHITECT'S DUTIES

- A. Review Contractor's requests for substitutions with reasonable promptness.
- B. Transmit evaluations and recommendations to the Owner, so that the Owner can notify the Contractor of the decision for acceptance or rejection of the request for substitution.

2.0 PRODUCTS – NOT USED

3.0 EXECUTION – NOT USED

*****END OF SECTION 01 25 00*****

SECTION 01 31 19 PROJECT MEETINGS

1.0 GENERAL

1.1 DESCRIPTION

- A. The Owner will schedule and administer pre-construction meeting, periodic progress meetings, and specially called meetings throughout the progress of the work.
 - 1. Prepare agenda for meetings.
 - 2. Distribute written notice of each meeting four days in advance of meeting date.
 - 3. Make physical arrangements for meetings.
 - 4. Preside at meetings.
 - 5. Record the minutes; include all significant proceedings and decisions.
 - 6. Duplicate and distribute copies of minutes after each meeting.
 - a. To all participants in the meeting.
 - b. To all parties affected by decisions made at the meeting.
 - c. To the Architect.
- B. Representatives of Contractor, subcontractors and suppliers attending the meetings shall be qualified and authorized to act on behalf of the entity each represents.

1.2 PRE-CONSTRUCTION MEETING

- A. Schedule at least fifteen (15) days after date of Notice to Proceed.
- B. Location: A central site, convenient for all parties.
- C. Attendance:
 - 1. Owner's Representative(s)
 - 2. Contractor(s)
 - 3. Architect and its professional consultants
 - 4. Major Subcontractors
 - 5. Major suppliers
 - 6. Safety Representatives for the Owner and Contractor

D. Minimum Agendum:

1. Distribution and discussion of:
 - a. List of major subcontractors and suppliers
 - b. Projected Construction Schedules
2. Critical work sequencing
 - a. Identification of major shut downs and approximate schedule
3. Major equipment deliveries and priorities
4. Project Coordination
 - a. Designation of responsible personnel
5. Procedures and processing of:
 - a. Field decisions
 - b. Proposal requests
 - c. Submittals
 - d. Change Orders
 - e. Applications for Payment
 - f. Requests for Information
 - g. Daily Reports
6. Adequacy of distribution of Contract Documents
7. Procedures for maintaining Record Documents
8. Use of premises:
 - a. Office, work and storage areas
 - b. Owner's requirements
 - c. Job site personnel conduct
 - d. Building access and security
9. Temporary facilities, controls and construction aids
10. Temporary utilities

11. Safety and first-aid procedures
 - a. Contractor's Project Site Specific Plan
12. Security procedures
13. Housekeeping procedures
14. Affirmative Action Plan and Reporting requirements

1.3 PROGRESS MEETINGS

- A. Schedule regular periodic meetings on the site, not less than once every two weeks throughout the Construction period.
- B. Attendance:
 1. Architect
 2. Architect's professional consultants when, in the opinion of the Owner, needed
 3. General Contractor, including Site Superintendent
 4. Owner's Representatives
 5. Subcontractors as appropriate to the agenda
 6. Suppliers as appropriate to the agenda
 7. Safety Representative
- C. Minimum Agenda:
 1. Review, approval of minutes of previous meeting
 2. Review percentage of work to be in place by next meeting by individual trades
 3. Review of work progress since previous meeting
 4. Field observations, problems, and conflicts
 5. Problems which impede Construction Schedule
 6. Review of off-site fabrication, delivery schedules
 7. Corrective measures and procedures to regain projected schedule
 8. Revisions to Construction Schedule
 9. Planned progress and schedule, during succeeding work period
 10. Coordination of schedules

11. Review submittal schedules; expedite as required
 12. Maintenance of quality standards
 13. Review status of all issued proposal requests and change orders
 14. Review proposed changes for:
 - a. Effect on Construction Schedule and on completion date
 - b. Effect on other contracts of the Project
 15. Other business
- D. All decisions, instructions, and interpretations given by the Architect/Engineer or its representative at these meetings shall be binding and conclusive on the Contractor.

1.4 PRE-INSTALLATION CONFERENCE(S)

- A. The Contractor to hold pre-installation conferences where required by individual specification sections or others at the discretion of the Owner. Minimum attendees would be Architect and/or their specific sub-consultant, Owner, Contractor, Subcontractor, key Suppliers, testing & inspection firm, Facilities Engineering subject matter expert, etc. Minimum agenda would include review of key submittals, RFI's, safety, logistics, material procurement, quality control, etc. Contractor to assemble and distribute the Agenda minimum 48 hours prior to meeting as well as distribute meeting minutes a minimum of seven (7) calendar days after the meeting.
- B. Submit a list of pre-installation meetings with preliminary dates within fifteen (15) days of issuance of the Notice to Proceed.

2.0 PRODUCTS – NOT USED

3.0 EXECUTION – NOT USED

******END OF SECTION 01 31 19******

SECTION 01 31 50 ELECTRONIC PROJECT MANAGEMENT

1.0 GENERAL

1.1 SUMMARY

- A. Owner Provided System: The Contractor will utilize the Owner's electronic Project Management (e-PM) system eBuilder on this project.
 - 1. The Owner shall manage the day to day use of the Owner provided ePM system and organize the training, support and maintenance of the ePM Website System for the entire project team for the period of its use on the Project.
- B. There are no fees to utilize this system.

1.2 RELATED SECTIONS

- A. General Conditions Article 9 – Coordination and Cooperation.
- B. Section 01 33 00 – Submittal Procedures

1.3 DEFINITIONS

- A. ePM: defined as an internet-based information and project communication system that allows the entire project team to collaborate in a centralized and secured repository. All project-specific correspondence, workflow processes, and documentation will be stored and routed within the ePM system.

1.4 PROCEDURES

- A. Users will be provided a username and password. The Contractor shall log into the ePM system to enter project documentation. All documentation should be communicated through the ePM system.
- B. Training
 - 1. The Owner will provide training to familiarize team members with the system, and all Contractor staff are expected to attend one of these sessions or otherwise receive proper training on the system's use. All cost for personnel time and travel to attend the training as needed shall be included in the Contractor's proposal.
- C. The Contractor shall provide on-site personnel with personal computer(s) and personal computer equipment that will allow the Contractor's personnel to access and use the ePM system in a timely and efficient manner. At a minimum the Contractor is to provide the following equipment and software:
 - 1. Web Browser: with high-speed connection, up/downloading capability

2. Color printer and plotter capable of full-size document production
 3. Scanner: capable of scanning a high volume of project documents clearly and quickly
 4. Digital Camera: (1) single lens reflex (SLR) type camera
 5. Portable Document Format (PDF) Reader/writer software
- D. Contractor shall log on to the ePM system on a daily basis, and as necessary to be kept fully apprised of the project developments, correspondence, assigned tasks and other matters that occur on the site. These may include but are not limited to RFI's, action items, meeting minutes, discussion threads, schedule updates, submittals, submittal log, punch list items, daily reports, site photos and/or videos and pre-construction surveys.

1.5 PROCESS OVERVIEW

- A. The Contractor is required to timely and accurately post, review, respond, and collaborate with other team members using the following features and/or workflow processes within the ePM system.
- B. Project Team Directory – Contractor shall provide an updated directory of contact information for all companies, subcontractors and project team members who are engaged on this project.
- C. Request for Information (RFI): All project RFI's will be submitted using the ePM system. The submission of a Request for Information (RFI) is the Contractor's exclusive means of requesting information from the Owner and/or Architect. Attachments to RFI's (which may include sketches, photographs, documentation, and the like, will be uploaded to the ePM system and attached to the RFI electronically.
- D. Meeting Minutes: Contractor shall enter meeting agendas, records and minutes in the system for all applicable meetings as designated by the Owner.
- E. General Communications, memorandums and Letters (Project Correspondence): Shall be created in or posted to the ePM system in PDF format electronically linked to action items. These action items shall include names of party (ies) required to respond, time frame within which action is to be taken and any solutions the Contractor recommends.
- F. Drawings and Specifications: The Contract Documents will be posted to the ePM system as directed by the Owner. The Owner shall retain the right to assign download rights to active CAD or model files. CAD or model files, in any format, posted to the ePM system are for viewing and printing only and cannot be edited.
- G. Submittals: All submittals shall be fully electronic. Reference Section 01 33 00.
- H. Submittal Register and Contractor shall review and update on a daily basis and shall close all approved items.

- I. Field Reporting: The Contractor shall post and/or update on a daily basis all reports required by other specification sections. These reports include, but are not limited to, daily construction reports, material location reports, unusual event reports, safety and accident reports.
- J. Project Photographs: Contractor shall upload project photographs to the ePM system, field by date and type including but not limited to:
 - 1. General Progress Photographs
 - 2. RFI Issues
 - 3. Non-Conforming Work
 - 4. Special Events
 - 5. As required by individual Specification Sections
- K. Project Schedule: The contractor shall post, distribute, review, and/or respond to the project schedule, monthly updates, and any other schedule submittals onto the ePM in both native and PDF formats.
- L. Permits & Approvals: Contractor shall upload and maintain current copies of all permits and agency approvals that relate to the project.
- M. Issue Tracking: Contractor to log and respond to issues that are related and affect other stakeholders within the project team.
- N. Quality Assurance: The Owner and/or Architect will issue reports on conforming items in the ePM system. The Contractor is required to review and respond with corrective actions in the system.
- O. Change Management – Cost Events and Change Orders will be managed by the ePM system and the Contractor shall be responsible for reporting potential changes and logging Requests for Change Orders in the system. The Contractor shall also upload and manage all documentation supporting Requested Change Orders.
- P. Pay Applications Requests (Invoices) – The Contractor shall create and submit both pencil and official payment applications (PA) electronically via the ePM system for review by the Owner.
- Q. Budget and Cost Management – Contractor to provide estimates and work breakdown structure (WBS) to provide Owner with accurate budget/cost analysis.

1.6 ADDITIONAL INFORMATION

- A. The Owner may change the standards for distribution and process prescribed above as required to suit the project.
- B. The Owner shall retain ownership of all data entered into either system and shall administrate and distribute all information contained therein.
- C. The Contractor shall make certain that all subcontractors performing significant work on the project shall actively participate in the ePM system. Requirements for participation in the ePM system shall be made part of each bid document and final contract.

2.0 PRODUCTS – NOT USED**3.0 EXECUTION – NOT USED**

******END OF SECTION 01 31 50******

SECTION 01 32 16 CONSTRUCTION SCHEDULE

1.0 GENERAL

1.1 SUMMARY

- A. This Section establishes the Contractor's obligation to prepare, use and update a Critical Path Method ("CPM") network plan for the entire Work and related activities which are essential to the progress of the Work to be designated as the Project Schedule. This Section describes the requirements for development, approval, utilization, and updating of the Project Schedule.
- B. Submit monthly Project Schedule updates.
- C. Submit to Owner and Architect a cash flow projection in accordance with Schedule of Values.
- D. Submit electronic versions of all schedules, including updates, as well as all back-up to the submitted schedules.

1.2 RELATED SECTIONS

- A. General Conditions Article 5 – Time of Completion.
- B. General Conditions Article 9 – Coordination and Cooperation.
- C. Section 01 33 00 – Submittal Procedures.

1.3 DEFINITIONS

- A. Critical Path Method (CPM): A method of planning and scheduling a construction project where activities are arranged based on activity relationships and network calculations determine when activities can be performed and the critical path of the Project.
- B. Critical Path: The longest continuous chain of activities through the network at a given data date for the Schedule to a Contract Milestone or Contract Completion. Where the path to a specific Milestone has become negative, the Critical Path shall be the longest continuous chain of activities with the greatest amount of negative float.
- C. Near Critical Path: Any continuous series of activities through the network to the Contract Milestone or the Contract Completion Date where the Total Float of the activity at the data date along that path is within 10 days of the Total Float possessed by the activity at the data date along the Critical Path.

- D. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
 - 1. Critical activities are activities on the critical path.
 - 2. Predecessor activity is an activity that must be completed before a given activity can be started.
- E. Milestone: A key or critical point in time for reference or measurement.
- F. Float is the measure of flexibility in an activity. Float time belongs to the Project.
 - 1. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the following activity.
 - 2. Total float is the amount of time in starting or completing an activity without adversely affecting the planned project completion date, or an interim milestone that has a constraint.
- G. Fragnet: The sequence of new activity(ies) and/or activity revisions, logic or resource changes that are proposed to be added to the existing schedule to demonstrate the influence of impacts to the schedule. The Fragnet shall identify the predecessors to the new activities and demonstrate the impacts to successor activities.

2.0 PRODUCTS

2.1 SCHEDULING SOFTWARE

- A. The Contractor shall use the current version of Primavera Project Planner Version 3.1 or later to develop and update the Project Schedule, and all submissions of Project Schedule data in electronic form required in this Section shall be in Primavera Project Planner format. An alternate program may be proposed as a substitute “or equal” program to the Owner for review.
- B. In order to be acceptable as a substitute for the use of Primavera Project Planner, the Contractor's software must be capable of exporting all Project Schedule data in a format that may be opened, read, and modified using the current version of Primavera Project Planner without loss of functionality or information.
- C. Terms used herein with reference to the Project Schedule shall have the same definitions as those used within the Primavera Project Planner software.

3.0 EXECUTION

3.1 PROJECT SCHEDULE REQUIREMENTS MEETING

- A. The Contractor shall meet with the Owner within five (5) workdays after notice to proceed to conduct a joint review of the Project Schedule requirements in this section.

3.2 SCHEDULE SUBMISSIONS

A. General Requirements:

1. Prepare a Critical Path Method (CPM) Project Schedule
2. Activity durations shall be in units of whole workdays. Unless a longer duration is approved by the Owner, durations for activities other than submittal and procurement activities shall not exceed fifteen (15) workdays.
3. Except for the first and last activities in the Project Schedule, each activity shall have at least one predecessor and one successor relationship to form a logically connected network plan from Notice to Proceed (NTP) to the Contract completion date.
4. Each activity shall be cost and resource loaded. Labor, material and equipment shall be clearly identified and valued.
5. The Contractor shall provide the native electronic files of the CPM schedule, graphics, cost and resource reports required under this Section and/or as requested by the Owner at no additional cost throughout the entire project performance period until Project completion is achieved. Contractor shall also provide all documents in PDF electronically created from the native files to PDFs (not scans).

B. Preliminary Schedule:

1. Within twenty one (21) calendar days of Notice to Proceed ("NTP"), the Contractor shall submit a Preliminary Schedule in the form and requirements specified in 3.04 with respect to the planned work activities to be performed during the first one hundred twenty (120) calendar days following NTP. Activities beyond the first one hundred twenty (120) calendar days may be depicted in summary form.
2. The Owner will review schedules and return review copy within ten (10) days after receipt.
3. If required, resubmit within seven (7) days after return of review copy.

C. Baseline Project Schedule:

1. Within sixty (60) calendar days following NTP, the Contractor shall submit a proposed Project Schedule in the form specified in 3.04.
2. The Owner will review schedules and return review copy within ten (10) days after receipt.
3. If required, resubmit within seven (7) days after return of review copy.

D. Technical Requirements:

1. Show the complete sequence of construction by activity.

2. At a minimum show the dates for the beginning, and completion of, each major element of construction. Specifically list:
 - a. All submittal and review activities, including preparation of shop drawings, calculations, samples, and mockups, testing of mockups, and Owner review of submittals;
 - b. All procurement activities, including awarding of subcontracts and fabrication, testing, and delivery of materials and equipment;
 - c. All field activities, including mobilization, demobilization, construction, site clearing, site utilities, foundation work, structural framing, subcontractor work, equipment installations, finishes, pre-installation meetings, start-up, testing, balancing, commissioning, and punchlist.
 3. Show projected percentages of completion for each item, as of the first day of each month.
 4. Show estimated dates for the beginning and completion of work which must be completed by or coordinated with the Owner such as hazardous materials abatement, moving, training and other such items as they are identified.
- E. Submittals Schedule for Shop Drawings, Product Data and Samples: Submit Submittals Schedule within thirty (30) calendar days after date of commencement of work. Confer with the Architect and agree on all elements of the Submittals Schedule. The schedule will be based on the understanding that minimum turn-around time in the Architect's office is ten (10) working days. Some submittals or groups of submittals may take longer to review. Submittals which do not conform to the agreed schedule may be subject to delays in processing. Show:
1. The dates for Contractor's submittals.
 2. The dates reviewed submittals will be required from the Architect.
 3. Confirmed lead time for manufacturing, production, fabrication and shipment to the project site of all materials which have an impact on the critical path of the Project's construction schedule.

3.3 SCHEDULE UPDATES

- A. Submit progress update schedules to accompany each application for payment.
- B. Indicate progress of each activity to date of submission.
- C. Show changes occurring since previous submission of schedule:
 1. Major changes in scope
 2. Activities modified since previous submission
 3. Revised projections of progress and completion
 4. Other identifiable changes

- D. When change orders are proposed, potential delays are anticipated, or delays are experienced, the Contractor shall submit a written Time Impact Analysis (TIA) describing the effect of each potential change order, potential delay, delay, or Contractor request on the Substantial Completion Date:
 - 1. The Time Impact Analysis shall meet the requirements for submittal of a Schedule Revision including a fragnet with sufficient supporting documentation to enable the Owner to make a determination on the Contractor's request for time extension.
 - 2. The TIA shall be performed by inserting a fragnet into a copy of the current schedule at the time the impact was identified or occurred.
 - 3. All TIAs shall be incorporated into the current schedule and not prior schedules. Thus, the current schedule shall be updated, accepted, and TIAs incorporated each month.
- E. All approved change orders must be incorporated in the following month's schedule update.

3.4 FORM OF SUBMISSION OF PROJECT SCHEDULE AND UPDATES

- A. All proposed versions of the Project Schedule shall be submitted as follows.
 - 1. The Contractor shall submit an electronic copy of native file and PDF versions of all generated reports.
 - 2. The Preliminary Schedule and proposed Project Schedules shall have the NTP date as the data date, and shall reflect no progress of work activities;
 - 3. Format of column listings: The chronological order of the start of each item of work, activity ID, activity description, early start, late start, early finish, late finish, original duration, remaining duration, percent completion, area code, responsibility code, total float, budgeted cost, budgeted quantity, and calendar ID.
 - 4. Narrative: The Contractor shall submit a narrative including explanation of the following:
 - a. The contract substantial completion date;
 - b. The approach used to plan and sequence the work, including considerations of site logistics, Contract milestones, and where applicable, phasing and coordination with other contractors;
 - c. Steps taken to address exceptions to prior submissions; and
 - d. Identification of all intentional deviations from the specific requirements of this Section, together with a justification for approval of the deviation.
 - e. Description of the activities on the primary and secondary critical paths.

B. Project Schedule Updates shall be submitted as follows:

1. The Contractor shall submit an electronic copy of the Project Schedule Update
2. The Contractor shall submit all proposed revisions after the initial Project Baseline Schedule submission in fragnet form.
3. The Contractor shall submit with all Preliminary Schedule and Project Schedule Updates a narrative addressing the following:
 - a. Current projected substantial completion date and the number of days ahead/behind the contract substantial completion date;
 - b. Variance from prior schedule forecasted (substantial) completion date
 - c. Progress achieved against the planned critical path during the period;
 - d. Description of major work activities performed during the month prior to the Update;
 - e. Description of major work activities anticipated to be performed during the month following the Update;
 - f. The approach used to plan and sequence the work, including considerations of site logistics, Contract milestones, and where applicable, phasing and coordination with other contractors;
 - g. Description of the activities on the primary and secondary critical paths during the month prior to the Update. Any changes to the primary Critical Path since the prior month's update with reason as to why it is now the critical path;
 - h. Sources of potential Project delay, including activities or groups of activities whose float has diminished over the course of prior Updates and their potential impact on the schedule;
 - i. Pending items (submittal reviews, answers to requests for information, change orders, requests for time-extensions, etc.) affecting critical path activities and activities with limited or diminishing available float;
 - j. All revisions introduced into the Project Schedule since the prior Update, the reason for the revision, the Activity ID of all activities affected by the revision, and the impact, if any, to the float for each such activity, as well as the Project completion date; and
 - k. All exceptions taken by the Owner to the Contractor's prior Update and whether they were resolved or not.
 - l. Identification of all intentional deviations from the specific requirements of this Section, together with a justification for approval of the deviation
 - m. Steps taken to address exceptions to prior submissions;
 - n. The effect of new changes on schedule.

3.5 DISTRIBUTION

- A. Distribute copies of the reviewed schedules to:
 - 1. Owner Job Site personnel
 - 2. Subcontractors
 - 3. Other concerned parties
- B. Instruct recipients to report to the Contractor, in writing, any problems anticipated by the projections of the schedule.

*****END OF SECTION 01 32 16*****

SECTION 01 32 33 PHOTOGRAPHIC DOCUMENTATION

1.0 GENERAL

1.1 DESCRIPTION

- A. The Contractor shall provide existing condition photographs taken before commencement of Work, progress photographs taken periodically during progress of the Work, and final photographs upon completion and full occupancy of the building.

1.2 SUBMITTALS

- A. Progress Submittals
1. Key Plan: Submit key plan of Project area and building with notation of vantage points marked for location and direction of each photograph.
 2. Submit digital photograph electronic files, organizationally filed by week, to E-Builder within five (5) days of taking photographs.
 3. Each photograph shall be identified with project title, date, and a description of the view.

2.0 PRODUCTS – NOT USED

3.0 EXECUTION

3.1 EXISTING CONDITION PHOTOGRAPHS

- A. Before commencement of selective demolition, take photographs of Project area and surrounding areas, including existing items to remain during construction.

3.2 PROGRESS PHOTOGRAPHS

- A. Photographs shall be taken weekly in a manner which completely documents the work.
- B. The photographs shall be submitted to the Owner at the end of the first week for review.
- C. Provide photographs of any wall, ceiling or floor assembly containing MEP, A/V or any infrastructure that will thereafter become concealed-prior to closure. Note location on Key Plan.

3.3 FINAL COMPLETION PHOTOGRAPHS

- A. Photographs shall be taken in a manner which completely documents the completed work, for submission as project record documents.

*****END OF SECTION 01 32 33*****

SECTION 01 33 00 SUBMITTAL PROCEDURES

1.0 GENERAL

1.1 DESCRIPTION

- A. Section includes administrative and procedural requirements for submittals, including the following:
 - 1. Shop Drawings
 - 2. Product Data
 - 3. Samples
 - 4. Quality Assurance and Quality Control Submittals
 - 5. Coordination Drawings
 - 6. Certification of Asbestos free products
 - 7. Owner audio/visual
 - 8. Owner furnishings and fixed equipment
- B. Designate in the construction schedule, and/or in a separate Submittals Schedule, the dates for submission and the dates reviewed Shop Drawings, Product Data and Samples will be needed.
- C. With the exception of physical samples and color charts, or as otherwise approved by the Owner, all submittals shall be electronic images in PDF format created electronically (saved with commenting allowed) which shall be submitted for review and approval via the electronic project management web site. PDFs shall be created directly from the native file format electronically. Scanning of paper to PDF shall be used minimally. Any non-electronic submittals shall be approved on a case by case basis and logged into the electronic management system as directed by a Cornell representative.

1.2 SUBMITTAL REGISTRY AND SCHEDULE

- A. The Architect shall provide a draft submittal registry in the template needed for eBuilder importation. It will be part of the contract documents and turned over to the Contractor in native format for their use. The Contractor shall be responsible for review and completion of the registry including addition of dates identified below and other information as deemed necessary by the Owner.

- B. The submittal registry and schedule shall list all submittals required by the specifications, listed in order by the specification section in which they are required. Coordinate the Submittal Schedule with the Contractor's Critical Path Method Construction Schedule and other related documents.
- C. The Submittal Registry shall include the following information:
 - 1. Title (*by Architect for Contractor review*)
 - 2. Related specification section and paragraph numbers (*by Architect for Contractor review*)
 - 3. Subsection (*by Architect for Contractor review*)
 - 4. Category of Submittal (Certification, Mock-Up, Operations/Maintenance Manual, Product Data, Sample, Shop Drawing, Test Report, As Built, etc.) (*by Architect for Contractor review*)
 - 5. Submittal Description including description of the part of the Work covered by the submittal (*by Architect for Contractor review*)
 - 6. Name of Subcontractor, if applicable (*Contractor provided, optional*)
 - 7. Date due from Subcontractor (*Contractor provided, optional*)
 - 8. Date due to be submitted for review (*Contractor provided, required*)
 - 9. Date due for submittal review to be completed (*Contractor provided, required*)
 - 10. Date for transmittal to Subcontractor (*Contractor provided, optional*)
 - 11. Date for material or product delivery to project (*Contractor provided, required*)
 - 12. Priority. Low, normal or high (*Contractor provided, required*)
- D. Schedule a resubmittal for each major submittal. Except where specified otherwise in the contract documents, provide review times for submittals in accordance with Submittal Procedures and Architect's Duties below.
- E. Distribution: Initially submit the Submittal Schedule to the Owner for review via the electronic Project Management system. A submittal schedule compliant with the requirements of this section showing all submittals for the preliminary schedule submission duration shall be submitted with the Contractor's preliminary schedule submittal described in Section 01 32 16. The schedule shall also enumerate all submittals to be processed after the initial preliminary schedule submission duration period, although the date for these submittals does not have to be indicated. A final baseline submittal schedule showing all submittals for the entire project shall be included in the baseline schedule submittal described in Section 01 32 16.

- F. Updating: The Submittal Schedule shall be kept up-to-date by the Contractor until all submittals are approved. Failure to provide the requested information, or delay in submitting required submittals may result in the payment request being returned to the Contractor until the required schedule or submittals are received.

1.3 SHOP DRAWINGS

- A. Drawings shall be newly prepared information drawn accurately to scale by skilled draftsman and presented in a clear and thorough manner.
 - 1. Highlight, encircle, or otherwise indicate deviations from Contract Documents.
 - 2. Do not reproduce Contract Documents or copy standard information as basis of Shop Drawings.
 - 3. Standard information prepared without specific reference to Project is not Shop Drawing.
- B. Shop Drawings include fabrication and installation Drawings, setting diagrams, schedules, patterns, templates and similar Drawings. Include the following information:
 - 1. Dimensions.
 - 2. Identification of products and materials included by sheet and detail number.
 - 3. Compliance with specified standards.
 - 4. Notation of coordination requirements.
 - 5. Notation of dimensions established by field measurements.
 - 6. Submittal:
 - a. For electronic transmittal, submittals shall be distributed electronically via the electronic project management system and will be reviewed and returned electronically marked with action taken.
 - b. Maintain returned document as a "Record Document".

1.4 PRODUCT DATA

- A. Product Data includes brochures, diagrams, standard schedules, performance charts, and instructions that illustrate physical size, appearance and other characteristics of materials and equipment. All submittals shall identify all products as being asbestos free, see Section 01 35 29.

- B. Collect Product Data into a single submittal for each element of construction or system.
1. Clearly mark each copy to show applicable choices and options. Failure to do so will result in rejection of the submission.
 2. Show performance characteristics and capacities.
 3. Show dimensions and clearances required.
 4. Show wiring or piping diagrams and controls.
 5. Where Product Data includes information on products that are not required, eliminate or mark through information that does not apply.
 6. Supplement standard information to provide information specifically applicable to the Work.
 7. Preliminary Submittal: Submit single copy of Product Data where selection of options by Architect is required.
 8. Submittals:
 - a. For electronic transmittal, submittals shall be distributed electronically via the electronic project management system and will be reviewed and returned electronically marked with action taken.
 - b. Maintain one (1) copy as a "Record Document".

1.5 SAMPLES

- A. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture, and pattern.
- B. Office samples shall be of sufficient size and quantity to clearly illustrate:
1. Functional characteristics of the product, with integrally related parts and attachment devices.
 2. Full range of color, texture and pattern.
- C. Field samples and mock-ups:
1. Contractor shall erect, at the Project site, at a location acceptable to the Architect.
 2. Size or area: that specified in the respective specification section.
 3. Fabricate each sample and mock-up complete and finished.
 4. Remove mock-ups when directed by the Architect.
 5. Perform necessary work to bring any area disturbed by mock-ups to the areas original condition.

- D. Submit fully fabricated Samples cured and finished as specified and physically identical with material or product proposed.
 - 1. Mount or display Samples in manner to facilitate review of qualities indicated.
 - 2. Identify Samples with generic description, product name, and name of manufacturer.
 - 3. Submit Samples for review and verification of size, kind, color, pattern, and texture.
 - 4. Where variation in color, pattern, texture, or similar characteristics is inherent in material or product represented, submit at least three (3) multiple units that show approximate limits of variations.
 - 5. Preliminary Submittals: Submit one (1) full set of choices where Samples are submitted for Architect's selection of color, pattern, texture, or similar characteristics from a range of standard choices.
 - 6. Submittals:
 - a. Submit four (4) sets for Architect's review. Architect will return at least one (1) set marked with action taken. Maintain sets of Samples, as returned, at Project Site, for quality comparisons throughout course of construction. Additionally, for electronic transmittal, photograph sample and its label and attached to the submittal item electronically via the electronic project management.

1.6 QUALITY ASSURANCE AND QUALITY CONTROL SUBMITTALS

- A. Quality assurance and quality control submittals include design data, test reports, certifications, manufacturer's instructions, and manufacturer's field reports.
- B. Professional design services or certifications: Where Contract Documents require professional design services or certifications by a design professional, Contractor shall cause such services or certifications to be provided by a qualified design professional, whose registration seal shall appear on drawings, calculations, specifications, certifications, Shop Drawings, and other submittals prepared by such professional. Architect shall be entitled to rely upon adequacy, accuracy, and completeness of services, certifications, or approvals performed by such design professionals.
- C. Inspection and Test Reports: Requirements for submittal of inspection and test reports from independent testing agencies as specified in the Contract Documents.
- D. Manufacturer's instruction: Preprinted instructions concerning proper application or installation of system or product.
- E. Manufacturer's field reports: Reports documenting testing and verification by manufacturer's field representative to verify compliance with manufacturer's standards or instructions.

F. Submittals:

1. For electronic transmittal, submittals shall be distributed electronically via the electronic project management system and will be reviewed and returned electronically marked with action taken.
2. Maintain one (1) additional copy as "Record Document".

1.7 COORDINATION DRAWINGS

- A. The Contractor shall coordinate and manage the preparation and submittal of coordinated layouts of the mechanical, electrical and fire protection systems and equipment for all areas; drawn at a scale not less than 1/4" per foot showing on both plan and elevation including but not limited to all equipment, ducts, pipe sleeves, piping including plumbing and, sprinkler system, lighting, special supports and other items contained within the space. Show mechanical and electrical services as well as architectural and structural features drawn to scale. Provide electronic record of each coordination drawing submitted in TIFF and PDF formats to the Owner. Provide coordination drawings for all corridors, laboratories, offices, mechanical rooms, boiler room, shafts, tunnels, and all congested areas. Copies of coordination drawings shall be distributed to all trades to assure a complete, coordinated installation of work within the space available.
- B. Submittal and review of coordination drawings will be required thirty (30) days prior to commencement of fabrication and/or installation of any work item.
- C. Prepare and submit coordinated layouts of the mechanical and electrical systems and equipment for all areas; drawn at a scale not less than 3/8 inch = 1 foot (1:32) showing on both plan and elevation including but not limited to all equipment, ducts, pipe sleeves, piping including plumbing and, sprinkler system, lighting, special supports and other items contained within the space. Show mechanical and electrical services as well as architectural and structural features drawn to scale. Provide copies of each coordination drawing submitted. Provide coordination drawings for all spaces, including but not limited to, corridors, laboratories, offices, mechanical rooms, boiler room, shafts, tunnels, and other areas. Copies of coordination drawings shall be distributed to all trades to assure a complete, coordinated installation of work within the space available.
 1. Show architectural, structural and other adjacent work requiring coordination with services. Show items, including but not limited to, access doors, ceiling grids, ceiling construction, structural decks and framing, fixtures, devices, and other adjacent work coordinated with services and architectural layouts shown on Drawings.
 2. Prepare plans, sections, elevations, and details as needed to describe relationship of various systems and components. Supplement plan drawings with section drawings where required to adequately represent the Work.
 3. Include room names and numbers of each space.
 4. Coordinate the addition of trade-specific information to the coordination drawings by multiple entities in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.

5. Contract drawings are diagrammatic. Exact location of receptacles, light fixtures, exit signs, fire alarm devices, and other devices shall be coordinated with the Architectural Drawings and shall not be scaled from locations indicated on the Mechanical and Electrical Drawings. Coordinate modifications in layout as necessary to complete the Work in accordance with the design intent.
6. Coordinate modifications in layout and components necessary to ensure maintenance accessibility and prevent conflict between each portion of the Work.
7. Maintain maximum headroom at all locations. Unless indicated otherwise, all mechanical and electrical systems and associated components are to be installed as tight to underside of structure as possible.
8. Indicate functional and spatial relationships of components of architectural, structural, mechanical, plumbing, fire protection, electrical systems, communications systems, security systems, and other portions of the Work. Drawings shall indicate dimensions, to avoid interference with existing conditions, structural frame, ceilings, partitions, services, and other portions of the Work. Where conflicts occur with placement of materials of various portions of the Work, Contractor shall be responsible to resolve conflicts and coordinate the available space to accommodate each portion of the Work. Adjustments resulting from coordination shall be initialed and dated by the entity(s) affected by the adjustments.
9. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
10. Show location and size of access doors and access panels required for access to concealed dampers, valves, and other controls.
11. Indicate required installation sequences.
12. Indicate dimensions, elevations, and alignments shown on the Drawings. Specifically note dimensions, elevations, and alignments that appear to be in conflict with submitted equipment and minimum clearance requirements and notify Architect. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
13. Indicate suspended ceiling heights and show locations of visible ceiling-mounted devices relative to acoustical ceiling grid.
14. Indicate locations of fire-rated partitions, smoke partitions, and other required barriers.
15. Plenum Space: Indicate sub-framing for support of ceiling and wall systems, mechanical and electrical equipment, toilet partitions, overhead-mounted equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components and notify Architect.

16. Exposed Ceiling Construction: In addition to other indicated information, show fully-dimensioned locations of all items exposed at ceiling space. Indicate alignment requirements and centerline locations of light fixtures, ducts, piping, conduit, and other services. Show dashed outline locations of laboratory casework, shelving, and other items that extend 7 feet or more above the floor.
17. Mechanical and Electrical Rooms: Provide coordination drawings for mechanical and electrical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment. Indicate paths of egress from rooms. Indicate paths for equipment removal from rooms. Indicate clear areas required for access and maintenance.
18. Structural Penetrations: Indicate scheduled and requested penetrations and openings required for all disciplines. Request un-scheduled penetrations and openings where Contractor has reviewed, analyzed, and coordinated all possible routing options and structural penetrations are only feasible option to accommodate indicated ceiling heights. Refer to the drawings for general guidelines and request confirmation by Architect for structural penetrations.
19. Mechanical and Plumbing Work: Show dimensioned locations, sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, accessories, and support systems. Show locations of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
20. Electrical Work: Show electrical distribution, systems, equipment, and runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger. Show light fixture, exit light, emergency battery pack, smoke detector, fire alarm, and other device locations. Show panel board, switch board, switchgear, transformer, bus way, generator, and motor control center locations. Show location of pull boxes and junction boxes, dimensioned from column center lines. Show lighting control systems. Show cable tray layouts including vertical and horizontal offsets and transitions, clearances for access above and to side of cable trays, and vertical elevation of cable trays above the floor or bottom of ceiling structure.
21. Fire Suppression System: Show locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
22. Refer to individual Sections for additional Coordination Drawing requirements for Work in those Sections.
23. Contractor Sign-Off: Contractor and each entity performing portions of the Work shall sign and date coordination drawings.

24. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit. Review of coordination drawings shall not reduce Contractor's responsibility for final coordination of installation and maintenance clearances of systems and equipment with existing conditions and each portion of the Work.
- D. Submittal and review of coordination drawings will be required before work can start in any given area of the building.

1.8 CONTRACTOR RESPONSIBILITIES

- A. Review submittals for compliance with Contract Documents and approve submittals prior to transmitting to the Architect.
- B. Specifically record deviations from Contract Document requirements, including minor variations and limitation. Comply with requirements of Section 01 25 00 Substitutions and Product Options.
- C. Contractor's approval of submittals shall indicate that the Contractor has determined and verified materials, field measurements and field construction criteria, and has checked and coordinated information within each submittal with requirement of the Work and Contract Documents. Field conflicts which arise from the contractor's failure to fully review and approve submittals before ordering equipment, will result in the contractor being burdened with all costs to remediate the situation.
- D. Contractor shall be responsible for:
 1. Compliance with the Contract Documents
 2. Confirming and correlating quantities and dimensions
 3. Selecting fabrication processes and techniques of construction.
 4. Coordination of the work represented by each submittal with other trades.
 5. Performing the work in a safe and satisfactory manner.
 6. Compliance with the approved Construction Schedule.
 7. All other provisions of the agreements.
- E. It is understood that the Architect's notation on the submittals is not to be construed as an authorization for additional work or additional cost.

- F. If any notations represent a change to the Contract Sum, submit a cost proposal for the change in accordance with procedures specified before proceeding with the work.
- G. It is understood that the Architect's notation on the submittal is not to be construed as approval of colors. Make all color-related submittals at one time.
- H. Notify the Architect by letter of any notations made by the Architect which the Contractor finds unacceptable. Resolve such issues prior to proceeding with the Work.
- I. Begin no fabrication of work until all specified submittal procedures have been fulfilled.
- J. Do not submit shop drawings, product data or samples representing work for which such submittals are not specified. The Architect shall not be responsible for consequences of inadvertent review of unspecified submittals.
- K. The review of shop drawings shall not relieve the Contractor of the responsibility for proper construction and the furnishing of materials and labor required even though the same may not be indicated on the review shop drawings.
- L. Certify that only asbestos free material is used in the execution of all work. Reference Section 01 35 39.

1.9 SUBMITTAL PROCEDURES

- A. Coordination
 - 1. Coordinate submittals with performance of construction activities in accordance with the Submittal Schedule approved by the Architect and Owner.
 - 2. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals and related activities that require sequential activity.
 - 3. Prepare and transmit each submittal in accordance with the Submittals Schedule, agreed to by all entities involved.
 - 4. Prepare, review, approve and transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.
 - 5. Architect's Review: Allow ten (10) working days for Architect's initial processing of each submittal requiring the Architect's review and response, except for longer periods required as noted below, and where processing must be delayed for coordination with subsequent submittals. The Architect will advise the Contractor promptly when it is determined that a submittal being processed must be delayed for coordination. Allow ten (10) working days for Architect's reprocessing of each submittal. Notify the Architect when processing time for a submittal is critical to the progress of the work, and the work would be expedited if its processing time could be shortened.

An additional five (5) working days will be required for items specified in Divisions 2, 3, 5, 23 and 26, and for Architectural Woodwork, Hollow Metal Work and Hardware Schedules.

6. Allow time for delivery in addition to review.
7. Allow time for reprocessing each submittal.
8. No extension of Contract Time will be authorized because of failure to prepare submittals sufficiently in advance of Work to permit processing.
9. Submittals made which do not conform to the schedule are subject to delays in processing by the Architect.
10. Refer to Section 01 32 16 Construction Schedules for requirements of the Submittals Schedule.
11. Failure of the Contractor to obtain approval of Shop Drawings shall render all work thereafter performed to be at Contractor's sole risk, cost and expense.

B. Submittal Preparation

1. Place permanent label or title block on each submittal for identification.
2. Indicate name of entity that prepared each submittal on label or title block.
3. Provide space on label or beside title block on Shop Drawings to record Contractor's stamp, initialed or signed, certifying to review of submittal, action taken, verification of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the Work and of Contract Documents.
4. Complete all fields on submittal item details in ePM system including meaningful description.
5. Include the following information on submittal documentation:
 - a. Drawing, detail or specification references, including section number, as appropriate to clearly identify intended use of product.
 - b. Field dimensions, clearly identified as such.
 - c. Relation to adjacent or critical features of the work or materials.
 - d. Applicable standards, such as ASTM or Federal Specification numbers.
 - e. Provide a blank space for the Architect's stamps
 - f. On transmittal, record relevant information including deviations from Contract Document requirements, including minor variations and limitations.
6. Identification of revisions on re-submittals, other than those noted by the Architect on previous submittals.
7. Shop drawings with the comment "by others" are not acceptable. All such work must specifically identify the related responsible subcontractor.

C. Submittal Transmittal:

1. Transmit submittals via the electronic project management system to Architect unless otherwise noted or directed.
2. Prepare and generate transmittal in ePM system for submission of samples. Package sample and other each submittal appropriately for transmittal and handling.

1.10 RECORD SUBMITTALS

- A. Provide a record copy of the submittal (electronic format) for the O&M Manual.

1.11 RESUBMISSION REQUIREMENTS

- A. Make any corrections or changes noted on previous submittals.
- B. Shop Drawings and Product Data:
1. Revise initial drawings or data, and resubmit as specified for the initial submittal.
 2. Indicate any changes which have been made other than those noted by the Architect.
- C. Samples: Submit new samples as required for initial submittal.

1.12 ARCHITECT'S DUTIES

- A. Review submittals with reasonable promptness as identified in 1.8, paragraph 5 of this Section.
- B. Notations on the Submittal Review Stamp or eBuilder file mean the following:
1. "Approved (APP)" indicates that no deviations from the design concept have been found and Work may proceed.
 2. "Approved as Noted (AAN)" indicates that deviations from the design concept which have been found are noted, and the Contractor may proceed accordingly.
 3. "Revise and Resubmit (RAR)" indicates that Work covered by submittal, including purchasing, fabrication, delivery, or other activity may not proceed. Revise or prepare new submittal according to Architect's notations; resubmit without delay. Repeat if necessary to obtain different action mark.
 4. "Rejected (REJ)" indicates that Work covered by submittal, including purchasing, fabrication, delivery, or other activity may not proceed. Revise or prepare new submittal according to Architect's notations; resubmit without delay. Repeat if necessary to obtain different action mark.
 5. "On Hold (ONH)" is used in a very limited capacity and means that the Contractor should not take action until the reason for hold has been cleared and may be required to revise and resubmit.

6. “Not Reviewed (NRV)” is used for submittals that were submitted in error, duplicate, or other reason that does not require review by the Architect but need to be closed by the Contractor upon return to them.
7. “For Record Only (FRO)”: Submittals for information or record purposes, including Quality Assurance and Quality Control Submittals, and Material Safety Data Sheets (MSDS), will not require responsive action by the Architect.
 - a. Architect will forward informational submittals without action.
 - b. Architect will reject and return informational submittals not in compliance with Contract Documents.
- C. Incomplete Submittals: Architect will return incomplete submittals without action.
- D. Unsolicited Submittals: Architect will return unsolicited submittals to sender without action.
- E. Return submittals to Contractor for distribution, or for resubmission.

1.13 DISTRIBUTION

- A. Distribute reviewed Shop Drawings and copies of Product Data when possible via the electronic project management system to:
 1. Job site file
 2. Record Documents file
 3. Subcontractors
 4. Installers
 5. Suppliers
 6. Manufacturers
 7. Fabricators
 8. Architect
 9. Owner
- B. Do not permit use of unmarked copies or rejected copies of submittals in connection with construction at Project Site or elsewhere where Work is in progress.

2.0 PRODUCTS – NOT USED

3.0 EXECUTION – NOT USED

*****END OF SECTION 01 33 00*****

SECTION 01 35 29 GENERAL HEALTH & SAFETY

1.0 GENERAL

1.1 DESCRIPTION

- A. This Section provides requirements for general health and safety during the project. The requirements of this Section shall apply to both Contractor and all tiers of sub-contractors involved in the project.
1. General Emergency Information – It is recommended that both Contractor and all sub-tiers:
- a. Sign up for Cornell Emergency Alerts. The instructions can be found at (use the visitors section): <https://emergency.cornell.edu/alert/>
 - b. Signup for Tompkins County Emergency alerts at:
<https://www2.tompkinscountyny.gov/doer/swift911alerts>
 - c. Cornell EHS has brief guidance on some emergency scenarios at:
<https://emergency.cornell.edu/eag/>
- B. In addition to the requirements of this Section, all laws and regulations by applicable local, state, and federal agencies shall apply to the work of this contract. In some cases, the requirements of these Specifications may by intention exceed such legal requirements, but in no case shall this Specification be interpreted or understood to reduce or eliminate such requirements.

1.2 CONTRACTOR'S PROJECT SITE SPECIFIC PLAN

- A. Contractors are required to submit a Project Site Specific Plan (PSSP) for review by Cornell University representatives before commencement of work on the site. The PSSP should address site specific information, controls and or requirements as it relates to the entire scope of work for the project. All contractors shall use the Project Site Specific Plan Template below to develop their Project's PSSP. The template may be downloaded at:
- <https://ehs.cornell.edu/campus-health-safety/occupational-safety/contractor-safety>
1. Within the PSSP Template are example(s) to use as reference. The provided examples demonstrate Cornell University's expectations for providing detailed site specific information, controls and requirements.
 2. Project Site Specific Plan's that inadequately address site specific operations will be returned with comments for resubmission. Failure to submit a PSSP may result in delay of project and/or denial of the payment.
 3. All projects must have the PSSP submitted via e-Builder for review and comment.

- B. PSSP submittal should be submitted a minimum of ten (10) days prior to the commencement of work on site. The Contractor may opt to submit their PSSP in phases. The Contractor must submit a phase submission plan using the PSSP Submission table included in the PSSP template for approval by Owner's Representative with initial submission. Submit remaining phases no later than ten (10) days prior to the start of a new, predetermined project phase or milestone.
1. Projects having less than a ten (10) day turn-around shall coordinate their submittal with the Owner's Representative, who should coordinate with Occupational Health, Safety and Injury Prevention (OHSIP), the University Fire Marshall's Office and Contract College's Codes Enforcement Official, if applicable.
- C. The Contractor is responsible for its employees and its subcontractors. Subcontractors are required to submit their PSSP to the General Contractor. The General Contractor is responsible to ensure all subcontractor(s) PSSP's are adequate per their scope of work.
- D. The General Contractor is required to ensure their project's PSSP is accurately maintained throughout the duration of the contract. Resubmission is required for any new scope elements not previously addressed by the Contractor's original PSSP.
- E. Definitions:
1. Project Site Specific Plan (PSSP): A structured document that details the scope of the contract work and related site specific controls, requirements and information for University and Contractor personnel. This document is not intended to be all inclusive of all applicable local, state and federal laws and regulations for which the General Contractor and its Subcontractor(s) are expected to comply.
2. Authority Having Jurisdiction (AHJ):
- The organization, office or individual responsible for approving equipment, an installation or a procedure (NYS Fire Code).
 - The local government, county government or state agency responsible for the administration and enforcement of an applicable regulation or law (NYS Building Code-§202.2).
3. Occupational Health, Safety and Injury Prevention (OHSIP): A division of Cornell University's Environmental Safety and Health Department. The OHSIP division can be contacted at (607)-255-8200 or by email at askEHS@cornell.edu
4. SME: The University's subject matter expert.

1.3 AERIAL WORK PLATFORMS

- A. The preferred method for Aerial Work Platforms (AWPs) boom storage is fully retracted and fully lowered to the ground.

- B. In some circumstances booms may need to be stored in the air because of vandalism concerns, minimal size of storage location, etc.
 - 1. If this is case, the area under the elevated boom must be blocked or arranged such that prevents people from walking, standing, working or parking vehicles underneath.
 - 2. When booms are stored in the air consult the extended weather forecast. Booms should not be stored in the air during predicted high winds, or severe storms. AWP's become unstable at winds or gusts greater than 25 mph and must be fully lowered to prevent a tip-over.

1.4 ASBESTOS

- A. All products provided for use in construction at Cornell University are to be free of asbestos. At Substantial Completion, prior to beneficial service, the Contractor shall provide a signed certification form "Exhibit AC" stating that all Contractor supplied & installed products are 100% asbestos free. The Contractor has to attach applicable Safety Data Sheets/ Material Safety Data Sheets for each product documenting a 100% asbestos free status. The University may provide random testing of products for asbestos content. Any Contractor installed product found to contain asbestos shall be classified as defective work. Defective work shall be corrected by the Contractor as specified in the General Conditions.
- B. Attached for the Contractor's information are asbestos reports which represent samples taken within the building.
- C. Removal and disposal of asbestos containing material shall be performed by the Contractor in accordance with Division 2 specifications.

1.5 MERCURY COLLECTION

- A. Building may contain mercury. Mercury is a metal that is liquid at room temperature and is toxic to humans and the environment. Mercury can accumulate under laboratory benches and especially in the pipes in old laboratories. Dismantling old fixtures with care can prevent unnecessary spills. The Contractor shall protect workers in accordance with OSHA regulations. Mercury is regulated by OSHA and the EPA. If encountered, mercury shall be collected safely utilizing proper measures to prevent exposure and must be turned over to Cornell Environmental Health & Safety for disposal. **In the event of a spill, leave and secure the area, call Cornell Dispatch 255-1111 and request the campus Spill Response Team.**

1.6 ANIMAL USE FACILITIES-HAZARD COMMUNICATION

- A. Certain facilities at Cornell may be used for research, testing or teaching with animals. Some individuals may be at greater risk for health symptoms and effects from direct or indirect exposure to animals. Individuals with medical conditions such as immunocompromised health status, allergies, pregnancy or anticipated pregnancy may be at greater risk. It is the responsibility of the Contractor to inform their employees of associated potential risks and take appropriate action with respect to their health and safety. Questions regarding the presence of animals in a specific facility may be directed to the Owner's Representative or Facility Manager.

1.7 SITE VISITS

- A. The undertaking of periodic Site Visits by Architects, Engineers or the Owner shall not be construed as supervision of actual construction, or make them responsible for the safety of any persons; or make them responsible for means, methods, techniques, sequences or procedures of construction selected by the Contractor or its Subcontractors; or make them responsible for safety programs and precautions incident to the Work, or for the safe access, visit, use, Work, travel or occupancy of any person.

1.8 CONFINED SPACE

- A. The Contractor shall be responsible for the identification of confined space in accordance with OSHA requirements.

2.0 PRODUCTS – NOT USED

3.0 EXECUTION – NOT USED

*****END OF SECTION 01 35 29*****



Cornell University

CONTRACTOR'S CERTIFICATION OF
ASBESTOS FREE MATERIALS
(Exhibit AC)

Distribution to:

OWNER	<input type="checkbox"/>
ARCHITECT	<input type="checkbox"/>
CONTRACTOR	<input type="checkbox"/>
FIELD	<input type="checkbox"/>
OTHER	<input type="checkbox"/>

PROJECT:

CONTRACT NUMBER:

CONTRACT FOR:

CONTRACT DATE:

DATE OF ISSUANCE:

TO OWNER:
(Name & Address)

CORNELL UNIVERSITY
Facilities Contracts
121 Humphreys Service Building
Ithaca, New York 14853

The undersigned hereby certifies that all materials and equipment furnished for or installed in connection with all work, labor, and services provided with respect to the performance of the Contract referenced above shall be free of asbestos and any asbestos containing material. The undersigned shall provide any and all documents supporting such certification which may reasonably be required the Owner, including where applicable Safety Data Sheets and/or Material Safety Data Sheets.

SUPPORTING DOCUMENTS ATTACHED HERETO:

- Material Safety Data Sheets

CONTRACTOR:
(Name & Address)

BY: _____
(Signature of authorized representative)

NAME: _____
(Printed name)

TITLE: _____

State of: _____)
County of: _____) ss.

Subscribed and sworn to before me this

_____ Day of _____ 20_____

October 4, 2022

Mr. Jake Perno, Project Manager
Cornell University
FCS Engineering and Project Management
119 Humphreys Service Building

Re: Veterinary Research Tower (1140) 2nd Floor Lab Suites T2001, T2003, T2007 and Service Corridor T200UA Asbestos Abatement Project - Asbestos Survey Summary
Delta Project No.: 2021.163.329

Dear Mr. Perno:

The following is associated with the Veterinary Research Tower 2nd Floor Lab Suites T2001, T2003, T2007 and Service Corridor T200UA Asbestos Abatement Project. On July 26, 2022 and August 24, 2022 Delta performed Asbestos Bulk Sampling addressing various suspect materials present on the 1st, 2nd & 3rd floors at the Veterinary Research Tower (VRT) that were damaged and/or impacted by the VRT Lab Suite T2001 Fire Episode. The areas addressed as a part of the sampling included Lecture Hall T1003 Suite, Office Suite T1010, Lab Suites T2001 / T2003 / T2007, Corridors T200CA / TA200CB / T300CA / T300CB, and Service Corridors T200UA & T300UA. Based on a walkthrough and visual inspection of the affected areas / associated suspect materials, a total of one hundred (100) bulk samples were collected representing forty-four (44) separate homogenous building materials. Fifty-two (52) of the samples collected were “Non-friable, Organically Bound” (NOB) materials, representing twenty-six (26) homogenous materials. The remaining forty-eight (48) samples were friable, “non-NOB” materials, representing eighteen (18) homogenous materials.

For the suspect materials present in the 2nd Floor Lab Suites T2001, T2003, T2007 and Service Corridor T200UA Asbestos Abatement Project Area, the following is a breakdown of the Identified Asbestos and Non-Asbestos Materials:

1) Asbestos Containing Materials:

- a. Spray-on Fireproofing - Results for samples of the Spray-on Fireproofing (SOF) collected in the 2nd floor project area were reported as being “Asbestos-Containing”, as “No Asbestos Detected” and as “Non-Asbestos” (> 0% / < 1.0%). As all of the SOF present in the area appeared to be visually homogenous, it is all being considered “Asbestos-Containing”.

2) Non-Asbestos Materials:

- a. 2' x 4' Ceiling Tile – Results for the ceiling tiles present in the area were reported as “No Asbestos Detected”. *But based on the presence of asbestos SOF Debris on the top surface of the majority of the tile, for the purposes of the abatement project, they are to be considered “Asbestos-Contaminated”.*
- b. 2' x 4' Gypsum Ceiling Tile Panels – Results for the gypsum ceiling tile panels present in the area were reported as “No Asbestos Detected”. *But based on the presence of asbestos SOF Debris on the top surface of the majority of the tile, for the purposes of the abatement project, they are to be considered “Asbestos-Contaminated”.*

- c. Sheetrock / Joint Compound Wall Systems – Results for the sheetrock and joint compound associated with the wall systems in the area were reported as “No Asbestos Detected”.
- d. White Textured Wall Coating – Results for the textured wall coating associated with the wall systems in the area were reported as “No Asbestos Detected”.
- e. 12” x 12” Light Gray Mottle-Pattern Floor Tile / associated Yellow Mastic: Results for the floor tile and its associated yellow mastic present in the area were reported as “No Asbestos Detected”.
- f. White Mastic from non-suspect vinyl Cove base: Results for the cove base mastic in the area were reported as “No Asbestos Detected”.
- g. Lab-tops and associated Adhesive / Caulk / Epoxy: Results for the Lab-tops and associated suspect system materials present in the area were reported as “No Asbestos Detected”.

The Complete Bulk Sampling Report is available through the Cornell University Asbestos Program and Delta EAS. If you have any questions, or require any additional information, please feel free to contact me at your convenience.

Respectfully,

DELTA ENGINEERS, ARCHITECTS, LAND SURVEYORS, & LANDSCAPE ARCHITECTS, DPC



Stephen Prislupsky
Director of Environmental Services

SECTION 01 35 43 GENERAL ENVIRONMENTAL REQUIREMENTS

1.0 GENERAL

1.1 DESCRIPTION

- A. This Section and the listed Related Sections provides minimum requirements for the protection of the environment during the project. The requirements of this Section shall apply to both Contractor and all tiers of sub-contractors involved in the project.
- B. In addition to the requirements of this Section and the listed Related Sections, all laws and regulations by applicable local, state, and federal agencies shall apply to the work of this contract. In some cases the requirements of these Specifications may by intention exceed such legal requirements, but in no case shall this Specification be interpreted or understood to reduce or eliminate such requirements.
- C. Prior to bidding, review the entire Bidding Documents and report in writing to the Owner's Representative any error, inconsistency, or omission that may have environmental impacts.

1.2 RELATED SECTIONS

- A. Section 01 35 44 – Spill Control
- B. Section 01 35 45 – Refrigerant Compliance
- C. Section 01 57 13 – Soil Erosion and Sediment Control

1.3 SUBMITTALS

- A. Submit the following in accordance with Section 01 33 00 – Submittals:
 - 1. Analytical laboratory sample results and material Certifications for all imported soil and granular materials ("borrow").
 - 2. Contractor's Waste Material Disposal Plan.
 - 3. Weight tickets from the Borrow Material Supplier.
 - 4. Proposed methods for dewatering and construction water management.
 - 5. Analytical laboratory sample results for all waste materials.
 - 6. Copies of manifests for all waste materials disposed of off-site.

1.4 JOB SITE ADMINISTRATION

- A. In accordance with Article 2 of the General Conditions, provide a competent supervisory representative with full authority to act for the Contractor at the site.
- B. If at any time operations under the representative's supervision do not comply with this Section, or the representative is otherwise unsatisfactory to the Owner, replace, if requested by the Owner, said representative with another representative satisfactory to the Owner. There shall be no change in superintendent without the Owner's approval.
- C. Remove from the Work any employee of the Contractor or any Subcontractor when so directed by the Owner. The Owner may request the removal of any employee who does not comply with these specifications.

1.5 CLEARING, SITE PREPARATION AND SITE USE

- A. In accordance with Section 01 14 00, only that portion of the working area that is absolutely necessary and essential for the work shall be cleared for construction. All clearing should be approved and performed to provide minimum practical exposure of soils.
- B. The Contractor shall make every effort to avoid the destruction of plants, trees, shrubs and lawns outside the area of construction so as not to unduly disturb the ecological or environmental quality of the area.
- C. Topsoil excavated as part of the Project, which can be reused as part of the Project, shall be stockpiled for future use and temporarily stabilized to prevent erosion.

1.6 NOISE AND VIBRATION

- A. Limit and control the nature and extent of activities at all times to minimize the effects of noise and vibrations. Take adequate measures for keeping noise levels, as produced by construction related equipment, to safe and tolerable limits as set forth by the Occupational Safety and Health Administration (OSHA), the New York State Industrial Code Guidelines and Ordinances and all City, Town and Local ordinances. Equip all construction equipment presenting a potential noise nuisance with noise-muffling devices adequate to meet these requirements

1.7 DUST CONTROL

- A. Take adequate measures for controlling dust produced by drilling, excavation, backfilling, loading, saw cutting or other means. The use of calcium chloride or petroleum-based materials for dust control is prohibited. Dust control measures are required throughout the duration of construction.
- B. If, in the opinion of the Owner's Representative, the Contractor is not adequately controlling dust, the Owner will first notify the Contractor. If the Contractor does not take adequate actions necessary, the Owner may, at the Contractor's expense, employ alternative means to control dust.

- C. Erect, maintain, and remove when appropriate barriers or other devices, including mechanical ventilation systems, as required by the conditions of the work for the protection of users of the project area, the protection of the work being done, or the containment of dust and debris. All such barriers or devices shall be provided in conformance with all applicable codes, laws, and regulations including OSHA.

1.8 PROTECTION OF THE ENVIRONMENT

- A. Construction procedures observed by the Contractor, its subcontractors and other employees shall include protection of the environment, in accordance with all pertinent Cornell standards, policies, local laws, executive orders, ordinances, and federal and state regulations. Construction procedures that are prohibited in the undertaking of work associated with this Contract include, but are not limited to:
 - 1. Dumping of spoil material or any liquid or solid pollutant into any storm or sanitary sewer, drainage way, stream sewer, any wetlands (as defined by federal and state regulations), any surface waters, or at unspecified locations.
 - 2. Indiscriminate, arbitrary, or capricious operation of equipment in any stream corridors, any wetlands, or any surface waters.
 - 3. Pumping of any silt-laden water from trenches or other excavations into any storm sewers, sanitary sewers, drainage ways, wetlands, or surface waters.
 - 4. Damaging vegetation beyond the extent necessary for construction of the facilities.
 - 5. Disposal of trees, brush, and other debris in any location on University property, unless such areas are specifically identified on the drawing or in the specifications or specifically approved by the Owner's site representative.
 - 6. Permanent or unspecified alteration of the flow line of a stream.
 - 7. Burning trash, project debris, or waste materials.
- B. Take all necessary precautions to prevent silt or waste of any kind from entering any drainage or waterways or downstream properties as a result of the Work.
- C. Runoff of potable water used for concrete curing or concrete truck or chute cleaning operations shall not be allowed to reach the storm water system or open water due to the levels of residual chlorine (New York State water quality standards, 6 NYCRR Part 703.5) and other potential contaminants. If necessary, obtain permission from the local sewer authority and collect and pump the runoff to the sanitary sewer.
- D. Limit the nature and extent of any activities that could result in the release or discharge of pollutants. Report any such release or discharge immediately to the Owner's Representative and clean up spills immediately, as detailed in Section 01 35 44 – Spill Control Procedures.

1.9 TEMPORARY RE-ROUTING OF PIPING AND DUCTWORK

- A. Obtain approval from the Owner's Representative prior to any temporary re-routing of piping and exhaust ductwork necessary for the completion of the Work. Submit re-routing plans to the Owner's Representative in writing.

The following shall require approval of the Owner:

1. Temporary storm, sanitary or water line connections.
 2. Temporary exhaust ductwork connections where such connections may impact air emissions.
- B. Instruct all personnel to observe extreme caution when working in the vicinity of mechanical equipment and piping. Personnel shall not operate or tamper with any existing valves, switches, or other devices or equipment without prior approval by the Owner's Representative.

1.10 HAZARDOUS OR TOXIC MATERIALS

- A. Inform officers, employees, agents, contractors, subcontractors at every tier, and any other party which may come into contact with any hazardous or toxic materials as a result of its performance hereunder of the nature of such materials, and any health and safety or environmental risks associated therewith.
- B. Do not use hazardous or toxic materials in a manner that will violate Cornell University Policies or any state, federal, or municipal environmental health and safety regulations. In situations where the risks are unclear consult with Environmental Health and Safety (EH&S) for guidance.
- C. Provide complete care and treatment for any injury sustained by any parties coming into contact with any hazardous or toxic materials as a result of Contractor's performance or failure to perform hereunder.
- D. At the completion of project Contractor shall remove all unused chemical products and hazardous materials from campus. Transportation of these materials shall be in accordance with all federal, state, and local regulations. Request and receive written approval from EH&S prior to disposal of any on-site disposal.

1.11 DISPOSAL OF WASTE MATERIAL AND TITLE

- A. Prior to start of work and first payment, Contractor shall prepare and submit "Contractor Waste Material Disposal Plan" to the Owner's Representative. The plan shall identify the waste transportation and treatment, storage or disposal (TSD) companies which will manage all waste material and any site(s) for disposal of the waste material. Contractor must use this form to document waste disposal methods and locations.

- B. The “Contractor Waste Material Disposal Plan” form, together with definitions associated with the form waste descriptions. Forms may be downloaded at:
<https://ehs.cornell.edu/sites/default/files/FRM-CWMDP-Contractor-Waste-Material-Disposal-Plan-IPDF.pdf>
- C. Contractor shall be responsible for the proper cleanup, containment, storage and disposal of any hazardous material/chemical spill occurring during its work. For Cornell University owned hazardous waste EH&S will oversee, approve or effect the proper disposal. Title, risk of loss, and all other incidents of ownership to the Waste Material, shall vest in Contractor at the time Contractor or any transporter acting on its behalf takes physical possession of Waste Material. Complete and maintain full records of the chain of custody and control, including certificates of disposal or destruction, of all Waste Materials loaded, transported and/or disposed of. Deliver all such records to the Owner in accordance with applicable laws and regulations and any instructions from the Owner in a timely manner and in any event prior to final payment(s) under this Contract.

2.0 PRODUCTS – NOT USED

3.0 EXECUTION – NOT USED

*****END OF SECTION 01 35 43*****

SECTION 01 35 44 SPILL CONTROL

1.0 GENERAL

1.1 SPILL PREVENTION

- A. In order to minimize the potential for discharge to the environment of oil, petroleum, or hazardous substances on site, the following requirements shall apply to all projects:
 - 1. All oil, petroleum, or hazardous materials stored or relocated temporarily on site during the construction process shall be stored in such a manner as to provide protection from vehicular damage and to provide containment of leaks or spills. Horizontal diked oil storage tanks, temporary berms or barriers, or similar methods shall be employed as appropriate at each site.
 - 2. Any on-site filling or dispensing activities shall occur within an area in which a temporary berm, boom, or similar containment barrier has been placed to prevent the inadvertent discharge to the environment of harmful quantities of any products.
 - 3. All oil, petroleum, or hazardous materials stored on site shall be located in such a manner as to minimize the potential of damage from construction operations or vehicles, away from drainage ways and environmentally sensitive areas, and in accordance with all fire and safety codes.
- B. Remove immediately from the site any storage, dispensing, or operating equipment that is leaking oil or hazardous substances or is in anyway unsuitable for the safe storage of such materials.

1.2 SPILL CONTROL PROCEDURES

All Contractor personnel working at the project site shall be knowledgeable of the potential health and safety concerns associated with petroleum and other hazardous substances that could potentially be released at the project site. Following are a list of activities that should be conducted by the Contractor in the event of an oil/petroleum spill or the release of any other hazardous substance. In the event of a large quantity spill that would require cleanup procedures that are beyond the means of the Contractor, an emergency spill cleanup contractor shall be hired by the Contractor. In the event the Contractor has the personnel necessary to clean up the spill, the following procedures shall be followed:

- A. Personnel discovering/responding to a spill shall:
 - 1. Identify and locate the source of the spill. If unsafe conditions exist, leave the area, inform nearby personnel, notify the site supervisor, and initiate spill reporting (Section 1. 3).

2. Limit the discharge of product, if safely possible, by: (1) diverting discharge to a containment area; (2) creating temporary dikes with soils or other available materials; and (3) utilizing sorbent materials. If secondary containment is present, verify that valves and drains are closed prior to diverting the product to this area.
3. The individual discovering a spill shall initiate containment procedures to prevent material from reaching a potential migratory route, through implementation of the following actions, or any other methods necessary. Methods employed shall not compromise worker safety.
 - a. Stop the spill at once (if possible).
 - b. Extinguish sources of ignition (e.g., flames, sparks, hot surfaces, cigarettes, etc.).
 - c. Clear personnel from the spill location and rope off the area.
 - d. Utilize available spill control equipment in an effort to ensure that fires, explosions, and releases do not occur, recur, or spread.
 - e. Use sorbent materials to control the spill at the source.
 - f. Construct a temporary containment dike of sorbent materials, cinder blocks, bricks, or other suitable materials to help contain the spill.
 - g. Attempt to identify the character, exact source, amount, and area of the released materials. Identification of the spilled material should be made as soon as possible so that the appropriate cleanup procedure can be identified.
 - h. Assess possible hazards to human health or the environment as a result of the release, fire, or explosion.
 - i. If spill response measures involve the temporary cessation of any operations, the Contractor shall monitor the affected equipment for: (1) leaks; (2) pressure buildup; (3) gas generation; or (4) ruptures in valves, pipes, or other equipment.

B. Spill Cleanup:

1. Following containment of the spill, the following spill cleanup procedures shall be initiated.
 - a. Use proper waste containers.
 - b. Remove bulk liquid by using vacuum, pump, sorbents, or shovel and place material in properly labeled waste container. Be sure not to collect incompatible or reactive substances in the same container.
 - c. Cleanup materials not reclaimed on-site shall be disposed of in accordance with all applicable state and federal regulations.

- d. Apply sorbent materials to pick up remaining liquid after bulk liquid has been removed. The Contractor shall not walk over spilled material. Absorbed material shall be picked up with a shovel and placed in a separate waste container, and shall not be mixed with bulk liquid.
- e. Clean spill control equipment and containers. Replace equipment in its proper location. Restock or reorder any sorbents used to clean up the spill.
- f. Carefully wash spilled product from skin and clothing using soap. Change clothes, if necessary, to avoid further contact with product.
- g. Disposal of all spilled product shall be made off-site, and shall be arranged through the Contractor.
- h. A Spill Report shall be completed, including a description of the event. A sample Spill Documentation Form is provided in Appendix B.

C. Fire or Explosion:

- 1. In the event of a fire or explosion at the site, the Contractor shall:
 - a. Verify that the local fire department and the appropriate response personnel (e.g., ambulance, police) have been notified.
 - b. Report to the scene, if safe to do so, and evaluate the situation (e.g., spill character, source, etc.). Coordinate, as necessary, with other appropriate site and emergency personnel.
 - c. Ensure that people are cleared from the area.
 - d. Ensure that fires are safely extinguished (if possible), valves closed, and other immediate actions necessary to mitigate the emergency, if safe to do so.
 - e. Initiate responsible measures necessary to prevent subsequent fires, explosions, or releases from occurring or spreading to other areas of the site. These measures include stopping processes or operations, collecting and containing released oil, or removing and isolating containers.
 - f. Take appropriate action to monitor for: (1) leaks; (2) pressure build-ups; (3) gas generation; or (4) ruptures in pipes, valves, or other equipment.

1.3 SPILL REPORTING AND DOCUMENTATION

In the event of a spill CALL CORNELL POLICE AT 255-1111 who will notify the appropriate departments within the university and coordinate with the contractor for external reporting, if required.

The contractor shall be responsible for the initiation of spill reporting and documentation procedures. All petroleum spills must be reported to **NYSDEC Spill Hotline at 1-800- 457-7362**, less than two hours following discovery. Notification must be made to Cornell Environmental Health and Safety (EH&S), 607.255.8200, within 24 hours of reporting the release. The Contractor will be expected to provide EH&S with the DEC issued spill number. Any petroleum spill must be reported to NYSDEC unless **ALL** of the following criteria apply:

TABLE 1
CRITERIA TO EXEMPT SPILL REPORTING

CRITERIA	DESCRIPTION
Quantity	The spill must be known to be less than 5 gallons.
Containment	The spill must be contained on an impervious surface or within an impervious structure, such that it cannot enter the environment.
Control	The spill must be under control and not reach a drain or leave the impervious surface.
Cleanup	The spill must be cleaned-up within two hours of occurrence.
Environment	The spill must not have already entered into the soil or groundwater or onto surface water.

A release of a “reportable quantity”¹ or unknown amount of a hazardous substance must also be immediately reported to NYSDEC Spill Hotline. Spills of reportable quantities of chemicals or “harmful quantities”² of oil to navigable waters must be reported to the federal **National Response Center, 1-800-424-8802**.

Spill Reporting Information: When making a telephone report, the caller should be prepared to provide the following information, if possible:

1. The date and time of the spill or release.
2. The identity or chemical name of the material released or spilled, including an indication of whether the material is defined as an extremely hazardous substance.
3. An estimate of the quantity of material released or spilled into the environment and the approximate duration of the event.
4. The exact location of the spill, including the name(s) of the waters involved or threatened, and/or other medium or media affected by the release or spill.
5. The source of the release or spill.
6. The name, address, and telephone number of the party in charge of, or responsible for, the facility or activity associated with the release or spill.

7. The extent of the actual and potential water pollution.
8. The name and telephone number of the person in charge of operations at the spill site.
9. The steps being taken or proposed to contain and cleanup the released or spilled material and any precautions taken to minimize impacts, including evacuation.
10. The extent of injuries, if any.
11. Any known or anticipated acute or chronic health risks associated with the emergency, and information regarding necessary medical attention for exposed individuals.
12. Assistance required, if any.

If the release of a hazardous substance or oil occurs in an amount which exceeds a reportable quantity (RQ) as defined in 40 CFR Part 110, 40 CFR Part 117, 40 CFR Part 302, or 6 NYCRR Part 597, then the Contractor shall do the following:

1. Call to the National Response Center shall be made by the person in charge of the site. The applicable phone numbers are 1-800-424-8802 or 1-202-426-2675.
2. Within 14 days of the release, submit a written description of the release. The description should include: (1) a description of the release, (2) the type of material released, (3) estimated amount of the spill; (4) the date of the release, (5) an explanation of why the release occurred; and (6) a description of the measures to be implemented to prevent and control future releases.

⁽¹⁾*Reportable Quantity:* A Reportable Quantity is the quantity of a hazardous substance or oil that triggers reporting requirements under the Comprehensive Emergency Response, Compensation, and Liability Act (CERCLA) (USEPA, September 1992). While the Contractor is legally responsible for knowing the risks of materials that are part of construction, members of the owner's spill response team have access to information that may help identify these quantities with you.

⁽²⁾*Harmful Quantity:* A Harmful Quantity of oil includes discharges that violate applicable water quality standards; cause a film, sheen, or discoloration on a water surface or adjoining shoreline; or cause a sludge or emulsion to be deposited beneath the water surface or shoreline (40 CFR 110.3).

2.0 PRODUCTS – NOT USED

3.0 EXECUTION – NOT USED

*****END OF SECTION 01 35 44*****

SECTION 01 35 45 REFRIGERANT COMPLIANCE

1.0 GENERAL

1.1 DESCRIPTION

- A. The Contractor shall be responsible and accountable for compliance with the EPA Clean Air Act (CAA) Section 608, 40 CFR Part 82 and any state or local codes for all refrigerant-related work. In general, an EPA-certified technician shall perform any activity involving refrigerant-containing equipment that includes: (1) attaching and detaching hoses and gauges to and from refrigerant containing equipment to measure pressure; (2) adding refrigerant to, or removing refrigerant from equipment; or (3) any other activity that violates the integrity of a refrigerant containing circuit (for example any activity where a refrigerant containing circuit is 'opened' in any manner).
- B. Refrigerant and oil shall be recovered from any equipment that does not meet the definition of a small appliance in 40CFR Part 82 Subpart F before removal and subsequent disposal. Small appliances (as defined in 40CFR Part 82 Subpart F) may be removed from the site with the charge (refrigerant) intact, provided it is properly labeled and handled in such a manner so as to prevent damage to coils. Small Appliances are defined in 40CFR Part 82 Subpart F as: Any appliance that is fully manufactured, charged, and hermetically sealed in a factory with five (5) pounds or less of a Class I or Class II substance used as a refrigerant, including, but not limited to, refrigerators and freezers (designed for home, commercial, or consumer use), medical or industrial research refrigeration equipment, room air conditioners (including window air conditioners and packaged terminal air heat pumps), dehumidifiers, under-the-counter ice makers, vending machines, and drinking water coolers.
- C. All new equipment installed shall utilize non-CFC refrigerants.

1.2 SUBMITTALS

- A. Prior to starting construction, demolition, or service work Contractor shall provide to Owner a list of all service technicians with EPA certification numbers and level of certification. (Copies of EPA certification cards are acceptable for those who will be working on the site.)

1.3 RECORD DOCUMENTS

- A. Contractor shall provide to the Owners Representative all Service Invoices (or equivalent service documentation acceptable to owner) for all work performed by EPA- certified Technicians. Service Invoices (or equivalent documentation) shall include the following information at a minimum for each piece of refrigerant containing equipment serviced:
- Date of Service
 - Name of EPA-Certified Technician
 - Technicians Certification Level
 - Type of Equipment Serviced

- Equipment Manufacture
 - Equipment Model and Serial Number
 - Description of Service Performed
 - Date Leak Discovered (if applicable)
 - Date Leak Repaired (if applicable)
 - Date Follow-Up Leak Test Performed (if applicable)
 - Type of Refrigerant
 - Normal System Full Charge (in pounds)
 - Amount of Initial Refrigerant Charge Recovered During Service
 - Amount of Recovered Refrigerant Returned to System
 - Type of Additional Refrigerant Added to System
 - Amount of Additional Refrigerant Charged to System
 - System Charge at End of Service
- B. Contractor shall provide to Cornell's Environmental Health and Safety Office and IPP Facilities Management Administration Preventative Maintenance Group, via the Owner's Representative, complete equipment documentation including: make, model number, serial number, refrigerant type and full refrigerant charge (quantity), equipment ID tag number and location (room number) for all equipment installed that does not meet the definition of a small appliance (40CFR Part 82).
- C. Contractor shall provide Owners Representative a copy of complete manifests, invoices, or other documentation showing any refrigerant removed from the project by the contractor was disposed of appropriately or reclaimed by an EPA-certified reclaimer.

2.0 PRODUCTS – NOT USED

3.0 EXECUTION

3.1 LEAK TESTING

- A. All new equipment not meeting the definition of a small appliance, including packaged equipment, factory charged, field charged, split systems or field-constructed systems with field-installed refrigerant piping shall be leak tested prior to or during startup. Leak testing shall utilize appropriate electronic leak-testing equipment.
- B. Leak testing shall be conducted by an EPA-certified technician. The contractor shall provide written verification of the leak testing and results.
- C. If a leak is detected, the following procedure shall be followed:
1. Notify the Owner's Site Representative (who will notify the Refrigerant Compliance Coordinator).
 2. Document the leak.
 3. Repair the leak.

4. Document the procedures followed.
5. Leak test to verify the leak was repaired.
6. Schedule and provide a 30-day follow-up verification leak test witnessed by a designated HVAC technician.
7. Document follow-up leak testing.
8. Repeat the above process if follow-up leak is detected.

3.2 DEMOLITION PROCEDURE FOR EQUIPMENT REMOVED BY CONTRACTOR

- A. The Contractor, in contractor-provided refrigerant recovery cylinders, shall take ownership of the recovered refrigerant and transport off site to a proper disposal company or certified reclaimer.
- B. Service Invoices, as described in RECORD DOCUMENTS, shall be provided.
- C. The Contractor technician shall tag the unit that the refrigerant was removed.
- D. Once an EPA-certified technician has removed the refrigerant and tagged the unit, a non-certified person may perform the remainder of the demolition.

*****END OF SECTION 01 35 45*****

SECTION 01 41 00 REGULATORY REQUIREMENTS

1.0 GENERAL

1.1 PERMITS AND LICENSES

- A. The Contractor shall obtain, maintain and pay for all permits and licenses necessary for the execution of the Work and for the use of such Work when completed. Such permits shall include but are not limited to building, electrical, plumbing, backflow prevention, dig safe, fill, street use and building demolition.
- B. For any projects which include demolition of a structure or load-bearing elements of a structure, the Contractor is required to complete a “Notification of Demolition and Renovation” and provide this notification to the United State Environmental Protection Agency (EPA) in advance of the work as specified in 40 CFR 61.145. The Contractor shall also provide a copy of this notification to the Owner’s Representative prior to any demolition.
- C. All Construction / Building / Hot Work and Occupancy permits shall be issued and maintained through Jim Yarbrough, (jey38@cornell.edu) the SUNY Codes Official for Contract Colleges Facilities at Cornell, at no cost to the Contractor.
- D. Ithaca Fire Department Permitting:
 - 1. A permit is required from the Ithaca Fire Department to install or substantially repair a fire suppression, fire detection, or fire alarm system as such as defined under the Uniform Code of New York State.
 - 2. If the scope of work is classified under the Existing Building Code of NYS as Alteration –Level 1; Alteration – Level 2; Alteration – Level 3; or Addition; a permit from the Ithaca Fire Department is required for all work affecting the fire suppression, fire detection, or fire alarm system for that building. A building permit is also required for this type of work.
 - 3. Work classified as a ‘Repair’ under the Existing Building Code of NYS does not require a permit from the Ithaca Fire Department.

1.2 INSPECTIONS

- A. Apply for and obtain all required inspections, pay all fees and charges for same, include all service charges, pavement cuts and repairs.

1.3 COMPLIANCE

- A. The Contractor shall give all notices, pay all fees and comply with all laws, rules and regulations applicable to the Work.

1.4 OWNER'S REQUIREMENTS

- A. The Contractor, Subcontractors, and employees of the Contractor and Subcontractors shall comply with all regulations governing conduct, access to the premises, operation of equipment and systems, and conduct while in or near the premises and shall perform the Work in such a manner as not to unreasonably interrupt or interfere with the conduct of business of the Owner.
- B. Upon completion of the project, the Contractor agrees to provide the Owner with a summary of municipal permit fees paid. This shall include the name of the permits secured, the permit fees paid by the Contractor and a copy of the permit. If no permit fees were required, the Contractor shall so state, in writing, upon completion of the project.

2.0 PRODUCTS – NOT USED

3.0 EXECUTION – NOT USED

*****END OF SECTION 01 41 00*****

SECTION 01 42 00 REFERENCES

1.0 GENERAL

1.1 INTENT OF CONTRACT DOCUMENTS

- A. Notes or instructions shown on any one Drawing, apply where applicable, to all other Drawings.
- B. All references to codes, specifications and standards referred to in the Specification Sections and on the Drawings shall mean, and are intended to be, the latest edition, amendment and/or revision of such reference standard in effect as of the date of these Contract Documents.
- C. Install All Work in Compliance with:
 - 1. NYS Uniform Code
 - a. International Building Code
 - b. International Residential Code
 - c. International Existing Building Code
 - d. International Fire Code
 - e. International Plumbing Code
 - f. International Mechanical Code
 - g. International Fuel Gas Code
 - h. International Property Maintenance Code
 - i. Uniform Code Supplement
 - 2. NYS Energy Code
 - a. International Energy Conservation Code
 - b. ASHRAE 90.1
 - c. Energy Code Supplement
 - 3. National Electric Code
 - 4. Occupational Safety and Health Administration (OSHA).
 - 5. Life Safety Code NFPA 101.
 - 6. All local ordinances
 - 7. Plans and Specifications in excess of code requirements and not contrary to same.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and other Division 1 Specification Sections, apply to this Section.

1.3 DEFINITIONS

- A. “General”: Basic Contract definitions are included in the Conditions of the Contract.
- B. “Contract Documents”: The Contract Documents consist of the Agreement between Owner and Contractor, General Conditions, General Requirements, Drawings, Specifications, addenda issued before execution of the Agreement, other documents listed in the Agreement, and modifications issued after execution of the Agreement.
- C. “The Contract”: The Contract Documents form the Contract for construction and represent the entire integrated Agreement between the Owner and Contractor.
- D. “The Work”: The work comprises the completed construction required by the Contract Documents and includes all labor necessary to produce such construction and all materials and equipment incorporated in such construction.
- E. “Owner”: Cornell University a New York corporation.
- F. “Architect/Engineer”: The Architect or Engineer is the person lawfully licensed to practice architecture and/or engineering in the state of New York, identified as such in the Owner Contractor Agreement, and is referred to throughout the Contract Documents as if singular in number. The terms Architect and/or Engineer mean the Architect and/or his authorized representative.
- G. “Contractor”: The Contractor, person, firm, or corporation with whom the Construction Agreement contract is made by Owner.
- H. “Subcontractor”: A person, firm, or corporation, supplying labor and/or materials for work at site of the project for and under separate contract or agreement with Contractor.
- I. “Delegated Design” describes a collaboration between a design professional and contractor (or subcontractor) where the contractor assumes allocated responsibility for an element or portion of the Project’s design. Delegated design allocation and assignment may occur in any project delivery method and will involve a licensed professional to perform the design. The Contractor or Subcontractor allocated an element or portion of the Project’s design, will submit its engineered, stamped plans to the primary design team, who will check for any conflicts with any other aspect of the Work and make new documents to be included in the Project’s design record. Contractor or Subcontractor allocated a delegated design element of the Project shall provide professional liability insurance for the design work in such amounts and as is required by Owner.
- J. “As Approved” or “Approved”: Architect’s or Owner’s approval.
- K. “As Directed”: Owner’s direction or instruction. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

- L. “Indicated”: Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as “indicated.”
- M. “Regulations”: Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- N. “Furnish”: Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- O. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- P. “Reinstall”. To place back into a former position.
- Q. “Replace”. Provide a substitute for.
- R. “Provide”: Furnish and install, complete and ready for the intended use.
- S. “Concealed”: Work installed in pipe shafts, chases or recesses, behind furred walls, above ceilings, either permanent or removable.
- T. “Exposed”: All capital Work not identified as concealed.
- U. “Project Site”: Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.
- V. “As-Built Documents”: Drawings and other records that are maintained by the Contractor to record all conditions which exist when the building construction is completed. This includes both the elements of the project itself and existing elements that are encountered during the course of project construction.
- W. “Record Drawings”: Shows construction changes in the project and the final location of all services, lines, outlets, and connections including underground and concealed items. The “record” drawings shall be compiled by the Architect based on the working as-built drawings and revised in accordance with the marked-up drawings submitted by the Contractor.
- X. “Shop Drawings”: Drawings, diagrams, illustrations, charts, brochures, and other data that are prepared by Contractor or any Subcontractor, manufacturer, supplier or distributor, for some portion of the work.
- Y. “Samples”: Physical examples furnished to illustrate materials, equipment or workmanship, and to establish standards by which the work will be judged.
- Z. “General Conditions”: The standardized contractual provisions describing the responsibilities, rights and relationships of the Owner and Contractor under the construction contract.

- AA. "Contract Limit Lines": A limit line or perimeter line established on the drawings or elsewhere in the contract documents defining the boundaries of the site available to the contractor for construction purposes.
- BB. "to do", "provide", "furnish", "install", etc., in these Specifications or on Drawings are directions given to the Contractor.

1.5 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.
- D. Abbreviations and Acronyms for Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the organizations responsible for the standards and regulations in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

ADAAG	Americans with Disabilities Act (ADA)	(800) 872-2253
	Architectural Barriers Act (ABA)	(202) 272-0080
	Accessibility Guidelines for Buildings and Facilities	
	Available from Access Board www.access-board.gov	
CFR	Code of Federal Regulations	(866) 512-1800
	Available from Government Printing Office www.gpoaccess.gov/cfr/index.html	(202) 512-1800
FS	Federal Specification	(215) 697-6257
	Available from Department of Defense Single Stock Point http://dodssp.daps.dla.mil	
	Available from Defense Standardization Program www.dps.dla.mil	
	Available from General Services Administration www.gsa.gov	(202) 619-8925

	Available from National Institute of Building Sciences www.nibs.org	(202) 289-7800
UFAS	Uniform Federal Accessibility Standards Available from Access Board www.access-board.gov	(800) 872-2253 (202) 272-0080

1.6 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

AA	Aluminum Association, Inc. (The) www.aluminum.org	(703) 358-2960
AAADM	American Association of Automatic Door Manufacturers www.aaadm.com	(216) 241-7333
AABC	Associated Air Balance Council www.aabchq.com	(202) 737-0202
AAMA	American Architectural Manufacturers Association www.aamanet.org	(847) 303-5664
AASHTO	American Association of State Highway and Transportation Officials www.transportation.org	(202) 624-5800
AATCC	American Association of Textile Chemists and Colorists (The) www.aatcc.org	(919) 549-8141
ABAA	Air Barrier Association of America www.airbarrier.org	(866) 956-5888
ABMA	American Bearing Manufacturers Association www.abma-dc.org	(202) 367-1155
ACI	ACI International (American Concrete Institute) www.aci-int.org	(248) 848-3700
ACPA	American Concrete Pipe Association www.concrete-pipe.org	(972) 506-7216
AEIC	Association of Edison Illuminating Companies, Inc. (The) www.aeic.org	(205) 257-2530

AF&PA	American Forest & Paper Association www.afandpa.org	(800) 878-8878 (202) 463-2700
AGA	American Gas Association www.aga.org	(202) 824-7000
AGC	Associated General Contractors of America (The) www.agc.org	(703) 548-3118
AHAM	Association of Home Appliance Manufacturers www.aham.org	(202) 872-5955
AI	Asphalt Institute www.asphaltinstitute.org	(859) 288-4960
AIA	American Institute of Architects (The) www.aia.org	(800) 242-3837 (202) 626-7300
AISC	American Institute of Steel Construction www.aisc.org	(800) 644-2400 (312) 670-2400
AISI	American Iron and Steel Institute www.steel.org	(202) 452-7100
AITC	American Institute of Timber Construction www.aitc-glulam.org	(303) 792-9559
ALCA	Associated Landscape Contractors of America (Now PLANET - Professional Landcare Network)	
ALSC	American Lumber Standard Committee, Incorporated www.alsc.org	(301) 972-1700
AMCA	Air Movement and Control Association International, Inc. www.amca.org	(847) 394-0150
ANSI	American National Standards Institute www.ansi.org	(202) 293-8020
AOSA	Association of Official Seed Analysts, Inc. www.aosaseed.com	(505) 522-1437
APA	APA - The Engineered Wood Association www.apawood.org	(253) 565-6600
APA	Architectural Precast Association www.archprecast.org	(239) 454-6989

API	American Petroleum Institute www.api.org	(202) 682-8000
ARI	Air-Conditioning & Refrigeration Institute www.ari.org	(703) 524-8800
ARMA	Asphalt Roofing Manufacturers Association www.asphaltroofing.org	(202) 207-0917
ASCE	American Society of Civil Engineers www.asce.org	(800) 548-2723 (703) 295-6300
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers www.ashrae.org	(800) 527-4723 (404) 636-8400
ASME	ASME International (The American Society of Mechanical Engineers International) www.asme.org	(800) 843-2763 (973) 882-1170
ASSE	American Society of Sanitary Engineering www.asse-plumbing.org	(440) 835-3040
ASTM	ASTM International (American Society for Testing and Materials International) www.astm.org	(610) 832-9585
AWI	Architectural Woodwork Institute www.awinet.org	(800) 449-8811 (703) 733-0600
AWPA	American Wood-Preservers' Association www.awpa.com	(334) 874-9800
AWS	American Welding Society www.aws.org	(800) 443-9353 (305) 443-9353
AWWA	American Water Works Association www.awwa.org	(800) 926-7337 (303) 794-7711
BHMA	Builders Hardware Manufacturers Association www.buildershardware.com	(212) 297-2122
BIA	Brick Industry Association (The) www.bia.org	(703) 620-0010
BICSI	BICSI www.bicsi.org	(800) 242-7405 (813) 979-1991

BISSC	Baking Industry Sanitation Standards Committee www.bissc.org	(866) 342-4772
CCC	Carpet Cushion Council www.carpetcushion.org	(203) 637-1312
CDA	Copper Development Association www.copper.org	(800) 232-3282 (212) 251-7200
CGA	Compressed Gas Association www.cganet.com	(703) 788-2700
CIMA	Cellulose Insulation Manufacturers Association www.cellulose.org	(888) 881-2462 (937) 222-2462
CISCA	Ceilings & Interior Systems Construction Association www.cisca.org	(630) 584-1919
CISPI	Cast Iron Soil Pipe Institute www.cispi.org	(423) 892-0137
CLFMI	Chain Link Fence Manufacturers Institute www.chainlinkinfo.org	(301) 596-2583
CPA	Composite Panel Association www.pbmdf.com	(301) 670-0604
CPPA	Corrugated Polyethylene Pipe Association www.cppa-info.org	(800) 510-2772 (202) 462-9607
CRI	Carpet & Rug Institute (The) www.carpet-rug.com	(800) 882-8846 (706) 278-3176
CRSI	Concrete Reinforcing Steel Institute www.crsi.org	(847) 517-1200
CSI	Cast Stone Institute www.caststone.org	(770) 972-3011
CSI	Construction Specifications Institute (The) www.csinet.org	(800) 689-2900 (703) 684-0300
CSSB	Cedar Shake & Shingle Bureau www.cedarbureau.org	(604) 820-7700
CTI	Cooling Technology Institute www.cti.org	(281) 583-4087
DHI	Door and Hardware Institute www.dhi.org	(703) 222-2010

EIA	Electronic Industries Alliance www.eia.org	(703) 907-7500
EIMA	EIFS Industry Members Association www.eima.com	(800) 294-3462 (770) 968-7945
EJCDC	Engineers Joint Contract Documents Committee www.ejdc.org	(703) 295-5000
EJMA	Expansion Joint Manufacturers Association, Inc. www.ejma.org	(914) 332-0040
ESD	ESD Association www.esda.org	(315) 339-6937
FMG	FM Global www.fmglobal.com	(401) 275-3000
FSA	Fluid Sealing Association www.fluidsealing.com	(610) 971-4850
FSC	Forest Stewardship Council www.fsc.org	49 228 367 66 0
GA	Gypsum Association www.gypsum.org	(202) 289-5440
GANA	Glass Association of North America www.glasswebsite.com	(785) 271-0208
GS	Green Seal www.greenseal.org	(202) 872-6400
GSI	Geosynthetic Institute www.geosynthetic-institute.org	(610) 522-8440
HI	Hydraulic Institute www.pumps.org	(888) 786-7744 (973) 267-9700
HI	Hydronics Institute www.gamanet.org	(908) 464-8200
HPVA	Hardwood Plywood & Veneer Association www.hpva.org	(703) 435-2900
HPW	H. P. White Laboratory, Inc. www.hpwhite.com	(410) 838-6550

IBR	Institute of Boiler & Radiation Manufacturers	
ICEA	Insulated Cable Engineers Association, Inc. www.icea.net	(770) 830-0369
ICRI	International Concrete Repair Institute, Inc. www.icri.org	(847) 827-0830
IEC	International Electrotechnical Commission www.iec.ch	41 22 919 02 11
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The) www.ieee.org	(212) 419-7900
IESNA	Illuminating Engineering Society of North America www.iesna.org	(212) 248-5000
IENT	Institute of Environmental Sciences and Technology www.ient.org	(847) 255-1561
IGCC	Insulating Glass Certification Council www.igcc.org	(315) 646-2234
IGMA	Insulating Glass Manufacturers Alliance www.igmaonline.org	(613) 233-1510
ILI	Indiana Limestone Institute of America, Inc. www.iliai.com	(812) 275-4426
ISO	International Organization for Standardization www.iso.ch	41 22 749 01 11
	Available from ANSI www.ansi.org	(202) 293-8020
ISSFA	International Solid Surface Fabricators Association www.issfa.net	(877) 464-7732 (702) 567-8150
ITS	Intertek www.intertek.com	(800) 345-3851 (713) 407-3500
ITU	International Telecommunication Union www.itu.int/home	41 22 730 51 11
KCMA	Kitchen Cabinet Manufacturers Association www.kcma.org	(703) 264-1690
LMA	Laminating Materials Association (Now part of CPA)	

LPI	Lightning Protection Institute www.lightning.org	(800) 488-6864 (804) 314-8955
MBMA	Metal Building Manufacturers Association www.mbma.com	(216) 241-7333
MFMA	Maple Flooring Manufacturers Association, Inc. www.maplefloor.org	(847) 480-9138
MFMA	Metal Framing Manufacturers Association www.metalframingmfg.org	(312) 644-6610
MHIA	Material Handling Industry of America www.mhia.org	(800) 345-1815 (704) 676-1190
MIA	Marble Institute of America www.marble-institute.com	(440) 250-9222
MPI	Master Painters Institute www.paintinfo.com	(888) 674-8937
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc. www.mss-hq.com	(703) 281-6613
NAAMM	National Association of Architectural Metal Manufacturers www.naamm.org	(312) 332-0405
NACE	NACE International (National Association of Corrosion Engineers International) www.nace.org	(800) 797-6623 (281) 228-6200
NADCA	National Air Duct Cleaners Association www.nadca.com	(202) 737-2926
NAIMA	North American Insulation Manufacturers Association www.naima.org	(703) 684-0084
NBGQA	National Building Granite Quarries Association, Inc. www.nbgqa.com	(800) 557-2848
NCAA	National Collegiate Athletic Association (The) www.ncaa.org	(317) 917-6222
NCMA	National Concrete Masonry Association www.ncma.org	(703) 713-1900
NCPI	National Clay Pipe Institute www.ncpi.org	(262) 248-9094

NCTA	National Cable & Telecommunications Association www.ncta.com	(202) 775-3550
NEBB	National Environmental Balancing Bureau www.nebb.org	(301) 977-3698
NECA	National Electrical Contractors Association www.necanet.org	(301) 657-3110
NeLMA	Northeastern Lumber Manufacturers' Association www.nelma.org	(207) 829-6901
NEMA	National Electrical Manufacturers Association www.nema.org	(703) 841-3200
NETA	International Electrical Testing Association www.netaworld.org	(888) 300-6382 (303) 697-8441
NFHS	National Federation of State High School Associations www.nfhs.org	(317) 972-6900
NFPA	NFPA (National Fire Protection Association) www.nfpa.org	(800) 344-3555 (617) 770-3000
NFRC	National Fenestration Rating Council www.nfrc.org	(301) 589-1776
NGA	National Glass Association www.glass.org	(866) 342-5642 (703) 442-4890
NHLA	National Hardwood Lumber Association www.natlhardwood.org	(800) 933-0318 (901) 377-1818
NLGA	National Lumber Grades Authority www.nlga.org	(604) 524-2393
NOFMA	NOFMA: The Wood Flooring Manufacturers Association www.nofma.org	(901) 526-5016
NRCA	National Roofing Contractors Association www.nrca.net	(800) 323-9545 (847) 299-9070
NRMCA	National Ready Mixed Concrete Association www.nrmca.org	(888) 846-7622 (301) 587-1400

NSF	NSF International (National Sanitation Foundation International) www.nsf.org	(800) 673-6275 (734) 769-8010
NSSGA	National Stone, Sand & Gravel Association www.nssga.org	(800) 342-1415 (703) 525-8788
NTMA	National Terrazzo & Mosaic Association, Inc. (The) www.ntma.com	(800) 323-9736 (540) 751-0930
NYBFU	New York Board of Fire Underwriters www.nybfu.org	(212) 227-3700
PCI	Precast/Prestressed Concrete Institute www.pci.org	(312) 786-0300
PDCA	Painting & Decorating Contractors of America www.pdca.com	(800) 332-7322 (314) 514-7322
PDI	Plumbing & Drainage Institute www.pdionline.org	(800) 589-8956 (978) 557-0720
PGI	PVC Geomembrane Institute http://pgi-tp.ce.uiuc.edu	(217) 333-3929
PLANET	Professional Landcare Network www.landcarenetwork.org	(800) 395-2522
PTI	Post-Tensioning Institute www.post-tensioning.org	(602) 870-7540
RCSC	Research Council on Structural Connections www.boltcouncil.org	(800) 644-2400 (312) 670-2400
RFCI	Resilient Floor Covering Institute www.rfci.com	(301) 340-8580
RIS	Redwood Inspection Service www.calredwood.org	(888) 225-7339 (415) 382-0662
SAE	SAE International www.sae.org	(877) 606-7323 (724) 776-4841
SBI	Steel Boiler Institute	
SDI	Steel Deck Institute www.sdi.org	(847) 458-4647
SDI	Steel Door Institute www.steeldoor.org	(440) 899-0010

SEFA	Scientific Equipment and Furniture Association www.sefalabs.com	(516) 294-5424
SGCC	Safety Glazing Certification Council www.sgcc.org	(315) 646-2234
SIA	Security Industry Association www.siaonline.org	(703) 683-2075
SJI	Steel Joist Institute www.steeljoist.org	(843) 626-1995
SMA	Screen Manufacturers Association www.smacentral.org	(561) 533-0991
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association www.smacna.org	(703) 803-2980
SMPTE	Society of Motion Picture and Television Engineers www.smpte.org	(914) 761-1100
SPFA	Spray Polyurethane Foam Alliance www.sprayfoam.org	(800) 523-6154
SPIB	Southern Pine Inspection Bureau (The) www.spib.org	(850) 434-2611
SPRI	Single Ply Roofing Industry www.spri.org	(781) 647-7026
SSINA	Specialty Steel Industry of North America www.ssina.com	(800) 982-0355 (202) 342-8630
SSPC	SSPC: The Society for Protective Coatings www.sspc.org	(877) 281-7772 (412) 281-2331
STI	Steel Tank Institute www.steeltank.com	(847) 438-8265
SWI	Steel Window Institute www.steelwindows.com	(216) 241-7333
SWRI	Sealant, Waterproofing, & Restoration Institute www.swrionline.org	(816) 472-7974
TCA	Tile Council of America, Inc. www.tileusa.com	(864) 646-8453

TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance www.tiaonline.org	(703) 907-7700
TMS	The Masonry Society www.masonrysociety.org	(303) 939-9700
TPI	Truss Plate Institute, Inc. www.tpinst.org	(703) 683-1010
TPI	Turfgrass Producers International www.turfgrassod.org	(847) 649-5555
TRI	Tile Roofing Institute www.tilerroofing.org	(312) 670-4177
UFPO	Underground Facilities Protective Organization www.ufpo.org	(800) 962-7962 (800) 962-7811
UL	Underwriters Laboratories Inc. www.ul.com	(877) 854-3577 (847) 272-8800
UNI	Uni-Bell PVC Pipe Association www.uni-bell.org	(972) 243-3902
USGBC	U.S. Green Building Council www.usgbc.org	(202) 828-7422
WASTEC	Waste Equipment Technology Association www.wastec.org	(800) 424-2869 (202) 244-4700
WCSC	Window Covering Safety Council www.windowcoverings.org	(800) 506-4636
WDMA	Window & Door Manufacturers Association www.wdma.com	(800) 223-2301
WI	Woodwork Institute www.wicnet.org	(916) 372-9943
WMMPA	Wood Moulding & Millwork Producers Association www.wmmpa.com	(800) 550-7889 (530) 661-9591
WSRCA	Western States Roofing Contractors Association www.wsrca.com	(800) 725-0333 (650) 570-5441
WWPA	Western Wood Products Association www.wwpa.org	(503) 224-3930

- B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

IAPMO	International Association of Plumbing and Mechanical Officials www.iapmo.org	(909) 472-4100
ICC	International Code Council www.iccsafe.org	(888) 422-7233 (703) 931-4533
ICC-ES	ICC Evaluation Service, Inc. www.icc-es.org	(800) 423-6587 (562) 699-0543
NEC	National Electric Code	

- C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

CE	Army Corps of Engineers www.usace.army.mil	
CPSC	Consumer Product Safety Commission www.cpsc.gov	(800) 638-2772 (301) 504-7923
DOC	Department of Commerce www.commerce.gov	(202) 482-2000
DOD	Department of Defense http://dodssp.daps.dla.mil	(215) 697-6257
DOE	Department of Energy www.energy.gov	(202) 586-9220
EPA	Environmental Protection Agency www.epa.gov	(202) 272-0167
FAA	Federal Aviation Administration www.faa.gov	(866) 835-5322
FCC	Federal Communications Commission www.fcc.gov	(888) 225-5322
FDA	Food and Drug Administration www.fda.gov	(888) 463-6332

GSA	General Services Administration www.gsa.gov	(800) 488-3111
HUD	Department of Housing and Urban Development www.hud.gov	(202) 708-1112
LBL	Lawrence Berkeley National Laboratory www.lbl.gov	(510) 486-4000
NCHRP	National Cooperative Highway Research Program (See TRB)	
NIST	National Institute of Standards and Technology www.nist.gov	(301) 975-6478
OSHA	Occupational Safety & Health Administration www.osha.gov	(800) 321-6742 (202) 693-1999
PBS	Public Building Service (See GSA)	
PHS	Office of Public Health and Science www.osophs.dhhs.gov/ophs	(202) 690-7694
RUS	Rural Utilities Service (See USDA)	(202) 720-9540
SD	State Department www.state.gov	(202) 647-4000
TRB	Transportation Research Board www.nas.edu/trb	(202) 334-2934
USDA	Department of Agriculture www.usda.gov	(202) 720-2791
USPS	Postal Service www.usps.com	(202) 268-2000

2.0 PRODUCTS - NOT USED

3.0 EXECUTION - NOT USED

*****END OF SECTION 01 42 00*****

SECTION 01 45 00 QUALITY CONTROL

1.0 GENERAL

1.1 DESCRIPTION

- A. The Contractor shall provide and maintain an effective Contractor Quality Control (CQC) program and perform sufficient inspections and tests of all items of work, including those of Subcontractors, to ensure compliance with Contract Documents. Include surveillance and tests specified in the technical sections of the Specifications. Furnish appropriate facilities, instruments, and testing devices required for performance of the quality control function. Controls must be adequate to cover construction operations and be keyed to the construction sequence. Construction shall not begin until the Owner has approved the CQC program.

1.2 CONTROL OF ON-SITE CONSTRUCTION

- A. Include a control system for the following phases of inspection:
1. Pre-Installation Meeting. For all sections where pre-installations are defined, the Contractor shall arrange for a pre-installation meeting. When practical, pre-installation meetings shall be scheduled to take place on the same day as regularly schedule progress meetings. The Contractor shall make available, during this meeting, all approved submittals and products.
 - a. Agenda to include the following:
 - i. Appointment
 - ii. Appointment of official representatives of participants in the Project.
 - iii. Review of existing conditions and affected work, and testing thereof as required.
 - iv. Review of installation procedures and requirements.
 - v. Review of environmental and site condition requirements.
 - vi. Schedule of the applicable portions of the Work.
 - vii. Schedule of submission of samples, color chips, and items for Owners consideration.
 - viii. Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences, Section 01500.
 - ix. Requirements for notification for reviews. Allow a minimum of 48 hour notice to Architect for review of the Work.

- x. Requirements for inspections and tests, as applicable. Schedule and undertake inspections and tests in accordance with Section 01410.
 - xi. Delivery schedule of specified equipment.
 - xii. Special safety requirements and procedures.
- b. The following minimum personnel shall be at the meeting:
- i. Project Manager.
 - ii. Project Field Supervisor
 - iii. Subcontractor
 - iv. Architect's Representative
 - v. Owner's Representative
 - vi. Commissioning Agent, when applicable
 - vii. Testing Agency, when applicable
2. Preparatory Inspection. Perform this inspection prior to beginning work on any definable feature of work. Include a review of contract requirements with the supervisors directly responsible for the performance of the work; check to assure that materials, products, and equipment have been tested, submitted, and approved; check to assure that provisions have been made for required control testing; examine the work area to ascertain that preliminary work has been completed; physically examine materials and equipment to assure that they conform to shop drawings and data and that the materials and equipment are on hand.
3. Initial Inspection. Perform this inspection as soon as work commences on a representative portion of a particular feature of workmanship review control testing for compliance with contract requirements.
4. Follow-up Inspections. Perform these inspections on a regular basis to assure continuing compliance with contract requirements until completion of that particular work.

1.3 CONTROL OF OFF-SITE OPERATIONS

- A. Perform factory quality control inspections for items fabricated or assembled off-site as opposed to "off-the-shelf" items. The CQC Representative at the fabricating plant shall be responsible for release of the fabricated items for shipment to the job site. The CQC Representative at the job site shall receive the item and note any damage incurred during shipment. The Contractor shall be responsible for protecting and maintaining the item in good condition throughout the period of on-site and during erection or installation. Although any item found to be faulty may be rejected before its use, final acceptance of an item by the Owner is based on its satisfactory incorporation into the work and acceptance of the completed project.

1.4 TESTING

- A. The Owner may engage the services of an independent testing laboratory to confirm that an installed item or element of work conforms to the Specification and workmanship requirements.

1.5 OWNER'S REPRESENTATIVE

- A. The Owner shall designate a Representative to monitor the progress and execution of the work. The Representative shall have the authority to call for test samples, to approve or to reject work performed and to stop work in progress, if, in its opinion, the work is not in conformance with the Contract Documents. The Representative shall not be authorized to make changes or interpretations of the Contract Documents.
 - 1. The Contractor shall maintain a project Deficiency/Issues Log in e-Builder to track non-conforming materials or sub-standard workmanship identified by Owner's Representative.

2.0 PRODUCTS – NOT USED

3.0 EXECUTION – NOT USED

*****END OF SECTION 01 45 00*****

SECTION 01 45 29 TESTING LABORATORY SERVICES

1.0 GENERAL

1.1 DESCRIPTION

- A. The Owner will employ and pay for the services of an Independent Testing Laboratory to perform specified services.
 - 1. Contractor shall cooperate with the laboratory to facilitate the execution of its required services.
 - 2. Employment of the laboratory shall in no way relieve Contractor's obligations to perform the Work of the Contract.
- B. Testing Laboratory services are specified in connection with work including but not limited to the following:
 - 1. New York State Building Code, Chapter 17, Special Inspections
 - 2. Concrete Reinforcement: Section 03 20 22.
 - 3. Cast-in-place Concrete: Section 03 30 00.

1.2 QUALIFICATIONS OF LABORATORY

- A. Meet "Recommended Requirements for Independent Laboratory Qualification", latest edition, published by American Council of Independent Laboratories.
- B. Meet basic requirements of ASTM E329-05b, "Standard Specification for Agencies Engaged in Construction Inspection and/or Testing".
- C. Authorized to operate in the State of New York.
- D. Testing and inspections shall be performed under the direction of Licensed Professional Engineer registered in the State of New York who shall be responsible for administering all testing and inspections and shall certify any local agency requirements.
- E. Submit copy of report of inspection of facilities made by Materials Reference Laboratory of National Bureau of Standards during the most recent tour of inspection, with memorandum of remedies of any deficiencies reported by the inspection.
- F. Testing Equipment:
 - 1. Calibrated at maximum 12 month intervals by devices of accuracy traceable to either:
 - a. National Bureau of Standards
 - b. Accepted values of natural physical constants.

2. Submit copy of certificate of calibration made by accredited calibration agency.

1.3 LABORATORY DUTIES

- A. Cooperate with Owner, Architect and Contractor; provide qualified personnel promptly on notice.
- B. Perform specified inspections, sampling and testing of materials and methods of construction.
 1. Comply with specified standards, ASTM, other recognized authorities, and as specified.
 2. Ascertain compliance of materials with requirements of Contract Documents.
- C. Promptly notify Owner, Architect and Contractor of observed irregularities or deficiencies of work or products.
- D. Should Laboratory tests of material performed at specified intervals of time indicate that strengths do not meet Specification requirements, the Inspection Agency and Geotechnical Engineer shall IMMEDIATELY notify the Owner, Contractor, and Architect. The Architect shall determine whether remedial action is necessary.
- E. Promptly submit written report of each test and inspection; one copy each to Architect, Owner, Contractor, and one copy to Record Documents File. Each report shall include:
 1. Date issued.
 2. Project title and number.
 3. Testing laboratory name, address and telephone number.
 4. Name and signature of laboratory inspector.
 5. Date and time of sampling or inspection.
 6. Record of temperature and weather conditions.
 7. Date of test.
 8. Identification of product and specification section.
 9. Location of sample or test in the Project.
 10. Type of inspection or test.
 11. Observations on compliance with Contract Documents.
- F. Prepare a summary report for each category of inspection certifying that the work has been inspected and meets the Contract Documents. Specifically list all discrepancies found which have not yet been repaired or resolved.
- G. Perform additional tests as required by Architect or the Owner.

1.4 LIMITATIONS OF AUTHORITY OF TESTING LABORATORY

- A. Laboratory is not authorized to:
 - 1. Release, revoke, alter or enlarge on requirements of Contract Documents.
 - 2. Approve or accept any portion of the Work.
 - 3. Perform any duties of the Contractor.

1.5 CONTRACTOR'S RESPONSIBILITIES

- A. Cooperate with laboratory personnel. Provide access to Work, and Manufacturer's operations.
- B. Secure and deliver to the laboratory adequate quantities of representative samples of materials proposed to be used and for which testing is specified.
- C. Provide to the laboratory the approved design mixes proposed to be used for concrete, and other material mixes which require control by the testing laboratory.
- D. Furnish copies of Products test reports as required.
- E. Furnish incidental labor and facilities:
 - 1. To provide access to Work to be tested.
 - 2. To obtain and handle samples at the Project site or at the source of the product to be tested.
 - 3. To facilitate inspections and tests.
 - 4. For Laboratory's exclusive use for storage and curing of test samples.
- F. Notify laboratory a minimum of 24 hours in advance of operations to allow for laboratory assignment of personnel and scheduling of tests.
 - 1. When tests or inspections cannot be performed after such notice, reimburse laboratory for personnel and travel expenses incurred due to Contractor's responsibility.
- G. Make arrangements with laboratory and pay for additional samples and tests required for Contractor's convenience.
- H. Employ and pay for the services of a separate, equally qualified independent testing laboratory to perform additional inspections, sampling and testing required when initial tests indicate Work does not comply with Contract Documents.

2.0 PRODUCTS – NOT USED

3.0 EXECUTION – NOT USED

*****END OF SECTION 01 45 29*****

SECTION 01 50 00 TEMPORARY FACILITIES AND CONTROLS

1.0 GENERAL

1.1 DESCRIPTION

- A. The Contractor shall furnish, install and maintain all temporary facilities and services of every kind, as required by the Contractor and by its subcontractors for their performance of the Work and compliance with the Contract Documents, and shall remove such facilities and complete such services upon the completion of all other work, or as Cornell University may direct.
- B. The Contractor shall obtain all required permits and approvals for and shall provide, construct, or install, as well as operate, maintain, service and remove temporary facilities and services.

1.2 REQUIREMENTS OF REGULATORY AGENCIES

- A. Comply with Federal, State and local codes and safety regulations.

2.0 PRODUCTS

2.1 MATERIALS, GENERAL

- A. Choice of materials, as suitable for the accomplishment of the intended purpose, is the Contractor's option.
- B. Materials may be new or used, but must not violate requirements of applicable codes, standards and specifications.

2.2 TEMPORARY FIRST AID FACILITIES

- A. Provide first aid equipment and supplies, with qualified personnel continuously available to render first aid at the site.
- B. Provide a sign, posted at the telephone, listing the telephone numbers for emergency medical services: Physicians, ambulance services and hospitals.

2.3 TEMPORARY FIRE PROTECTION

- A. Provide a fire protection and prevention program for employees and personnel at the site. Any fire watches as a result of construction operations are the responsibility of the Contractor. Comply with NFPA 241. Develop, manage, and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
1. Impairments “Fire Code of NYS Section 901.7”. Impairment; “the removal of fire alarm devices or sprinkler system coverage in a building.” There are two different levels of impairments
- a. Partial Impairment. The removal of fire alarm devices or sprinkler system coverage via control valve in the immediate area of where work is to be performed.
- Basic Impairment Notification will be sent to Local Authority Having Jurisdiction and FM Global.
 - No fire watch will be required in most cases.
- b. Full System Impairment. The complete removal of a fire alarm “system” or sprinkler “system”. Impairment of both the fire alarm system and sprinkler system at the same time is not allowed.
- Full System Impairment Notification will be sent to local Authority Having Jurisdiction, FM Global, Ithaca Fire Department Officers, Building Manager, Maintenance Manager, and Customer Service.
 - Fire Watch will be required and will need the Fire Watch Person’s name and contact information. Cornell EH&S does not perform the fire watch, it is the responsibility of the Contractor.
- B. Equipment:
1. Provide and maintain fire extinguishing equipment ready for instant use at all areas of the Project and at specific areas of critical fire hazard.
2. Hand extinguishers of the types and sizes recommended by the National Board of Fire Underwriters to control fires from particular hazards.
3. Construction period use of permanent fire protection system.
4. Water hoses connected to an adequate water pressure and supply system to reach each area or level of construction upon building enclosure or heating of the building.

5. Maintain existing standpipes and hoses for fire protection. Provide additional temporary hoses where required to comply with requirements. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles. Provide hoses of sufficient length to protect construction areas.
 6. Maintain unobstructed access to fire extinguishers, fire hydrants, siamese connections, standpipes, temporary fire-protection facilities, stairways, and other access routes for firefighting.
 7. Where existing or temporary fire protection services are being replaced with new fire protection services, do not remove or impair existing or temporary services until new services are placed into operation and use.
 8. At earliest feasible date in each area of Project, complete installation of permanent fire-protection facility and systems, including connected services, and place into operation and use. Instruct key personnel on use of facilities. Protect and maintain permanent fire protection system. Repair or replace any components damaged during construction.
- C. Enforce fire-safety discipline:
1. Store combustible and volatile materials in an isolated, protected location.
 2. Avoid accumulations of flammable debris and waste in or about the Project.
 3. Prohibit smoking in the vicinity of hazardous conditions.
 4. There is NO SMOKING allowed on construction sites located in any occupied building. Smoking is prohibited in all Cornell University buildings.
 5. Closely supervise welding and torch-cutting operations in the vicinity of combustible materials and volatile conditions.
 6. Supervise locations and operations of portable heating units and fuel.
- D. Maintain fire extinguishing equipment in working condition, with current inspection certificate attached to each extinguisher.
- E. Welding or burning operations shall be conducted under a Hot Work Permit issued in accordance with Section 01 41 00. Where such work is permitted, the Contractor shall provide an approved fire extinguisher in good operating condition within easy reach of the operating personnel. In each instance, obtain prior approval of Cornell University Environmental Health & Safety.
- F. Advise Cornell University Environmental Health & Safety of any items affecting Life Safety, e.g., road blockages, exit closing, etc.

2.4 CONSTRUCTION AIDS

- A. Provide construction aids and equipment required to assure safety for personnel and to facilitate the execution of the Work; Scaffolds, staging, ladders, stairs, ramps, runways, platforms, railings, hoists, cranes, chutes, fall protection, harness, tie-off points, and other such equipment.
- B. When permanent stair framing is in place, provide temporary treads, platforms and railings, for use by construction personnel.
- C. Maintain all equipment in a safe condition.

2.5 SUPPORTS

- A. The Contractor shall include cost of all materials and labor necessary to provide all supports, beams, angles, hangers, rods, bases, braces, etc. to properly support the Contract Work. All supports, etc. shall meet the approval of the Architect.
- B. Any and all supports that are of “custom” fabrication or installation shall be designed by the Contractor’s NYS licensed PE with stamped & signed shop drawings and calculations provided for same.

2.6 TEMPORARY ENCLOSURES

- A. Provide temporary weather-tight enclosure for building exterior, maintain in-place until installation of permanent enclosures. Provide temporary weather-tight enclosure of exterior walls as work progresses for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities, and as necessary to provide acceptable working conditions, provide weather protection for interior materials, provide weather protection for occupied areas, allow for effective temporary heating, and to prevent entry of unauthorized persons.
 - 1. Provide temporary exterior doors with self-closing hardware and padlocks or locksets.
 - 2. Other enclosures shall be removable as necessary for work and for handling of materials.
 - 3. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
 - 4. Coordinate enclosure with ventilation requirements, material drying or curing requirements, and specified environmental limitations to avoid dangerous or detrimental conditions and effects.

- B. Provide temporary enclosures to separate work areas from areas of the existing building occupied by Owner; to prevent penetration of dust or moisture into occupied areas, to prevent damage to existing equipment, and to protect Owner's employees and operations from construction work.
 - 1. Temporary partition and ceiling enclosures: Framing and sheet materials which comply with structural and fire rating requirements of applicable codes and standards.
 - a. Close joints between sheet materials, and seal edges and intersections with existing surfaces, to prevent penetration of dust or moisture.
 - b. In locations where fire protection is required, paint both sides of partitions and ceilings with fire-retardant paint as required by local fire regulations.
 - 2. Do not remove existing exterior enclosure systems until new exterior enclosure systems are ready for installation. Complete removal of existing exterior enclosure systems as soon as possible. Immediately after completing removal, install new exterior enclosure systems and complete installation as soon as possible.
 - 3. Do not remove existing HVAC systems connected to louvers at existing exterior enclosure systems until new HVAC systems and louvers at exterior enclosure systems are ready for installation. Complete removal of existing HVAC systems and louvers as soon as possible. Immediately after completing removal, install new HVAC systems and new louvers and complete installation as soon as possible.

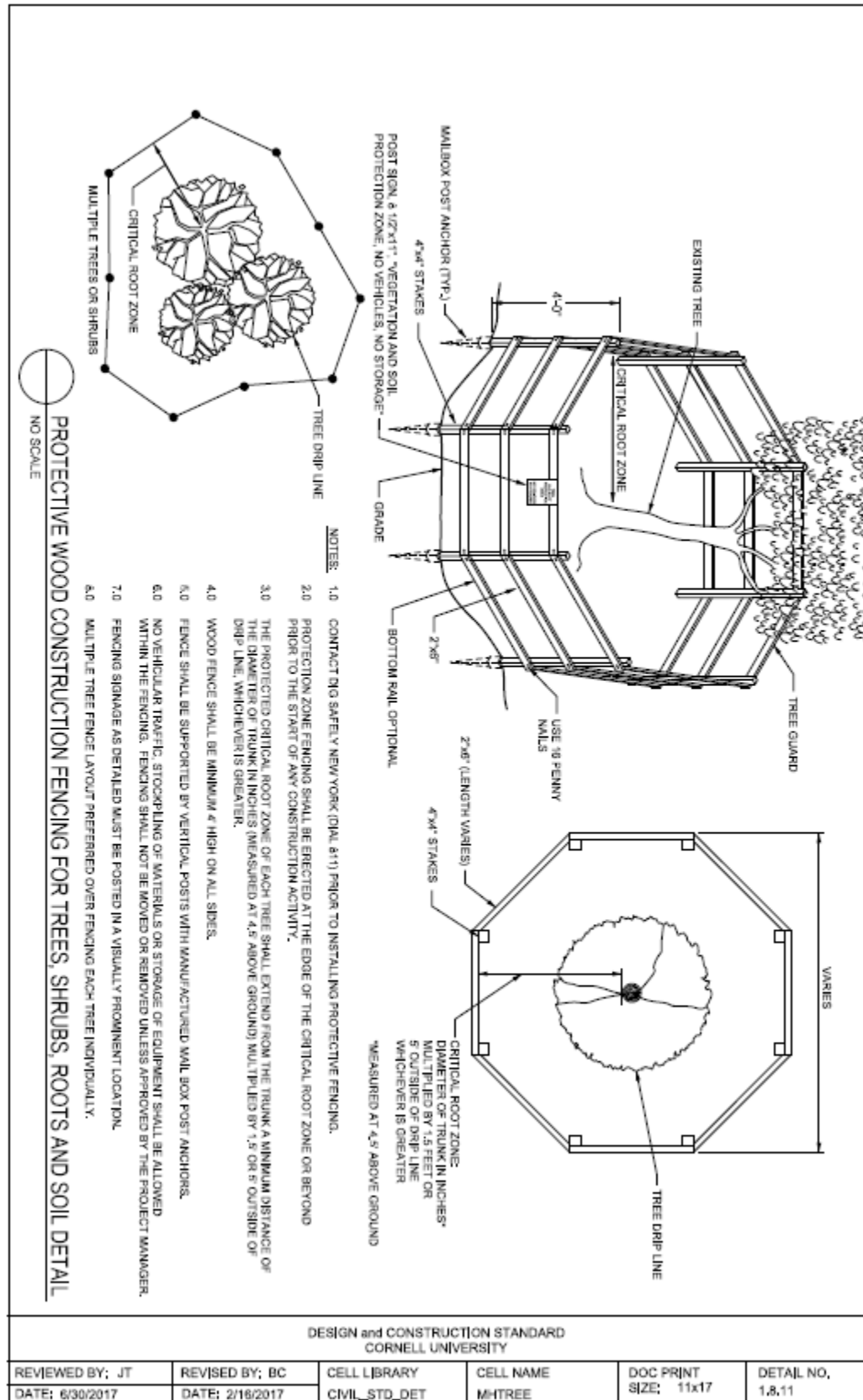
2.7 TEMPORARY WATER CONTROL

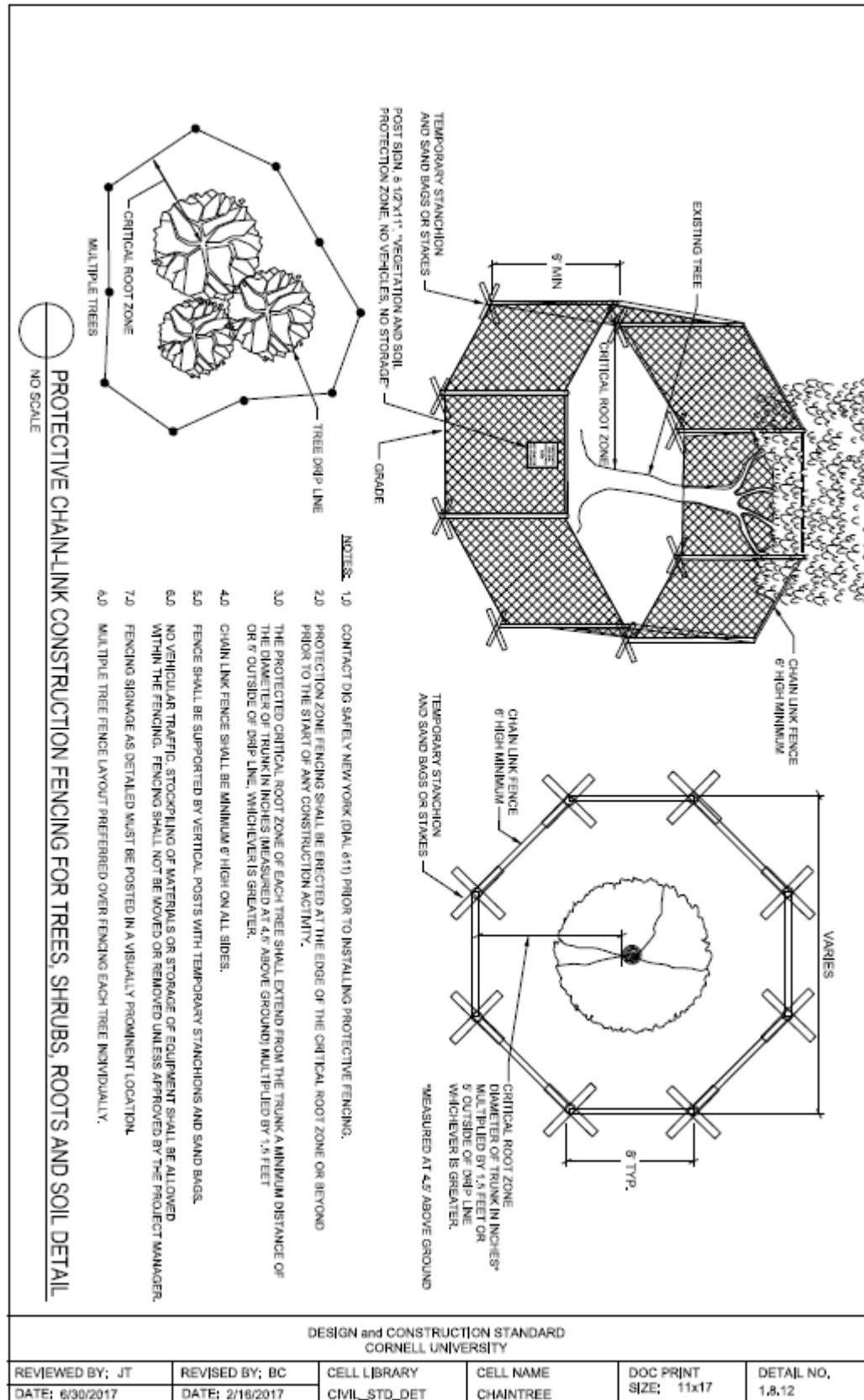
- A. The Contractor shall provide, maintain and operate pumps required to keep the Work free of water at all times.
- B. Dispose of all water with due care and shall not infringe on the rights of others on the Site, of adjacent property owners and of the public. All cost in connection with the removal of such water shall be paid by the Contractor.

2.8 TREE, PLANT AND LAWN PROTECTION

- A. Preserve and protect existing trees, plants and lawns at the site which are designated to remain, and those adjacent to the site.
- B. Consult with Owner, and remove agreed-on roots and branches which interfere with construction.
 - 1. Employ certified arborist to remove, and to treat cuts.
- C. Provide temporary fences to a height of six feet, around each, or around each group of trees and plants. Provide temporary lawn protection to prevent soil compaction. Reference Cornell University Design Standards and Details for wood and chain fencing below.

- D. Protect root zones of trees, plants and lawn areas:
 - 1. Do not allow vehicular traffic or parking.
 - 2. Do not store materials or products.
 - 3. Prevent dumping of refuse or chemically injurious materials or liquids.
 - 4. Prevent puddling or continuous running water.
- E. Carefully supervise excavating, grading and filling, and subsequent construction operations to prevent damage.
- F. Replace, or suitably repair, trees, plants and lawn areas designated to remain which are damaged or destroyed due to construction operations.
- G. Roots 2 inches or larger that are damaged or cut during construction are to be sawed off close to the tree side of the excavation by certified arborist.
- H. During the leafing-out period in the spring, extra care should be exercised to reduce root damage such as keeping exposed roots wet, saturating soil when backfilling around roots, and backfilling as soon as possible.
- I. Consult Cornell University Grounds Department for mitigation of root or tree damage.





2.9 PERSONNEL, PUBLIC AND EMPLOYEE PROTECTION

- A. Provide guardrails, barricades, fences, footways, tunnels and other devices necessary to protect all personnel, employees, and the public, against hazards on, adjacent to or accessing the construction site.
 - 1. Provide signs, warning lights, signals, flags and illumination as necessary to alert persons to hazards and to provide safe, adequate visibility in areas of hazards.
 - 2. Closed sidewalks need to be indicated with OSHA-approved signs, as well as, proper barricades.
 - 3. Provide flag personnel as necessary to guide vehicles, protect personnel, public and employees.

2.10 ACCESS ROADS AND PARKING AREAS

- A. Provide adequate temporary roads and walks to achieve all-weather access into the site from public thoroughfares, and within and adjacent to the site as necessary to provide uninterrupted access to field offices, work and storage areas.
- B. Grade and provide drainage facilities to assure runoff of rainwater and to avoid blockage of flow from adjacent areas.
- C. During dry weather wet down temporary unpaved areas when necessary to prevent blowing dust.

2.11 PROJECT IDENTIFICATION AND SIGNS

- A. No Contractor signs to be displayed at the project site, unless authorized by the Owner.
- B. Owner Construction Project Sign. The Contractor shall install Owner provided project identification signage.

2.12 SECURITY

- A. The Contractor shall provide security services as required to protect the interests of the Owner.

2.13 FIELD OFFICES

- A. The Owner shall designate a space within the facility to serve as a field office for the use of the Contractor and Owner.

3.0 EXECUTION

3.1 PREPARATION

- A. Consult with Owner, review site conditions and factors which affect construction procedures and temporary facilities, including adjacent properties and public facilities which may be affected by execution of the work.
 - 1. Designate the locations and extent of temporary construction, storage, and other temporary facilities and controls required for the expeditious accomplishment of the Work.
 - 2. Allow space for use of the site by Owner and by other contractors, as required by Contract Documents.

3.2 GENERAL

- A. Comply with applicable requirements specified in sections of Division 02 through 40.
- B. Make work structurally, mechanically and electrically sound throughout.
- C. Install work in a neat and orderly manner.
- D. Maintain, clean, service and repair facilities to provide continuous usage, and to the quality specified for the original installation.
- E. Relocate facilities as required by progress of construction, by storage or work requirements, and to accommodate requirements of Owner and other contractors employed at the site.
- F. Keep the site, at all times during the progress of the Work, free from accumulation of waste matter or rubbish and shall confine its apparatus, materials and operations of its workers to the limits prescribed except as the latter may be extended with the approval of the Owner's Representative. Cleaning of the structure or structures must be performed daily and removal of waste matter or rubbish must be performed at least once a week.
- G. Contractor shall at all times keep access road and public roads clean of mud and construction debris and maintain dust control to the satisfaction of the Owner.

3.3 REMOVAL

- A. Completely remove temporary structures, materials, equipment and services:
 - 1. When construction needs can be met by use of permanent construction.
 - 2. At completion of the Project.
- B. Repair damage caused by installation or use of temporary facilities. Clean after removal.

- C. Restore existing or permanent facilities used for temporary purposes to specified, or to original condition.
 - 1. Remove foundations and underground installations for temporary construction and utilities.
 - 2. Grade the areas of the site affected by temporary installations to required elevations and slopes, and clean the area.

*****END OF SECTION 01 50 00*****

SECTION 01 51 00 TEMPORARY UTILITIES

1.0 GENERAL

1.1 DESCRIPTION

- A. The Contractor shall furnish, install and maintain temporary utilities required by all trades for construction. Remove on completion of Work.
- B. The Contractor shall provide all labor and materials for temporary connections and distribution.

1.2 REQUIREMENTS OF REGULATORY AGENCIES

- A. Comply with National Electric Code, current edition.
- B. Comply with Federal, State and local codes and safety regulations and with utility company requirements.

2.0 PRODUCTS

2.1 MATERIALS, GENERAL

- A. Materials may be new or used, but must be adequate in capacity for the required usage, must not create unsafe conditions, and must not violate requirements of applicable codes and standards.

2.2 TEMPORARY ELECTRICITY, LIGHTING AND WATER

- A. The Contractor shall have access to the Owner's water and electric power for constructing the Work. Temporary utility connections shall be made by the Contractor as close to its operations as possible as long as such connections do not over-load the capacity of the Owner's utilities or interfere with its customary utilization thereof. Utility access points shall be determined in cooperation with and acceptable to the Owner.
- B. The Contractor shall be responsible for the economic use of the Owner's Water and Power. The Owner will pay for the water and power consumed in the construction of the Work as long as economical usage of these utilities is maintained. The Owner reserves the right to meter and charge for the power and water consumed if in the opinion of the Owner the usage of these utilities is not economically conducted by the Contractor. In such an event, the Owner shall give three (3) days written notice to the Contractor of its intentions to meter and charge for temporary utilities used by the Contractor.
- C. All temporary power systems including wiring shall be removed by the Contractor when no longer required.

- D. The minimum temporary lighting to be provided is at the rate of fifty foot candles, is to be maintained in each room and changed as required when interior walls are being erected. The required temporary lighting must be maintained for twenty-four (24) hours a day and seven (7) days a week at all stair levels and in all corridors below ground; in any and all egress; in all other spaces temporary lighting is to be maintained only during working hours. All temporary wiring and equipment shall be in conformity with the National Electric Code.
- E. The minimum temporary outdoor security lighting to be provided is as follows:
 - 1. Along the perimeter of the site fence, consisting of vandal-resistant light fixtures with HID lamps, located 150 foot center, mounted on the inside of the construction fence.
 - 2. Lighting for temporary pedestrian paths and roadways, to provide a minimum of 0.1 foot-candle on the path of travel.
- F. Three-phase temporary power circuits shall be installed as required to operate construction equipment of the various trades and to install and test equipment such as pumps and elevators. The Contractor shall install and maintain temporary or permanent service for the permanently installed building equipment such as sump pumps, boilers, boiler controls, fans, pumps, so that such equipment may be operated when required and so ordered by the Owner's Representative for drainage or for temporary heat.
- G. Except as otherwise provided in the Contract, the Contractor shall submit to the Owner or the Owner's Representative for approval a proposed schedule of all utility shutdowns and cutovers of all types which may be required in connection with the Work. Such schedule shall provide a minimum of four (4) weeks advance notice to the Owner prior to the time of the proposed shutdown and cutover. The Contractor shall be responsible for all charges relating to shutdowns.
- H. Discontinuance, Changes and Removal

The Contractor shall:
 - 1. Discontinue all temporary services required by the Contract when so directed by the Owner or the Owner's Representative. The discontinuance of any such temporary service prior to the completion of the Work shall not render the Owner liable for any additional cost entailed thereby.
 - 2. Remove and relocate such temporary facilities as directed by the Owner or the Owner's Representative, and shall restore the Site and the Work to a condition satisfactory to the Owner.

2.3 TEMPORARY USE OF ELEVATOR

- A. Use of Existing Elevator
 - 1. If the Contractor elects to use the existing elevator equipment, the Contractor shall:
 - a. Provide adequate protection for such equipment and shall operate such equipment within a capacity not to exceed that allowed by law, rule or regulation.

- b. Provide for the maintenance and cleaning of the elevator equipment as approved by the Owner's Representative.
- c. Prior to start of construction, accurately record the condition of the existing elevator. Promptly repair or replace items that are damaged as a result of Contractor's use. Service calls that arise as a result of Contractor misuse will be charged to the Contractor. At Substantial Completion, restore elevators to condition existing before initial use.
- d. Use only elevators designated by Owner's Representative at dates and times designated by Owner's Representative. Dates and times available for Contractor's use shall be scheduled with, and at the convenience of, the Owner, and may vary during the course of the Project.
- e. Owner will not provide elevator operators or other monitoring of elevator use.
- f. Do not load elevators beyond their rated weight capacity.
- g. Provide code compliant protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators become damaged, engage elevator maintenance contractor to restore damaged work so no evidence remains of correction work. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.
- h. Procure and coordinate the elevator maintenance contractor to gain access to the elevator shaft as required to complete the work

2.4 TEMPORARY HEAT AND VENTILATION

- A. The Contractor shall furnish temporary heat as may be necessary for constructing the Work.
- B. The Contractor will be permitted to use the building's permanent heating system for temporary heat. Permission to use the building's permanent heating system shall in no way constitute the Owner's acceptance of that portion of the Work.
- C. When using the permanent building systems for space conditioning, provide a written maintenance plan for acceptance by the Owner's Representative, prior to utilizing the equipment. Plan to address temporary filtering of air and water, sealing of open ducts, lubrication, operation outside of normal ranges, and controls/safeties. Return all equipment to its newly installed condition prior to acceptance testing.
 - 1. If the Contractor elects to use the building's permanent heating system for temporary heat, the Contractor shall provide filters with a minimum MERV of 8 at each return-air grille in system, maintain to keep them free of dust and debris, replace if necessary and remove at end of construction and clean HVAC system as required in Section 01 77 00 – Project Closeout.
- D. Any temporary system shall be removed when no longer required.

- E. During heating cycles the enclosures separating the interior building areas from outside shall be maintained closed to conserve heat energy.
- F. The Contractor shall provide for ventilation of all structures until Physical Completion of the Work and shall control such ventilation to avoid excessive moisture levels and rates of drying of construction materials, including but not limited to concrete and to plaster, and to prevent condensation on sensitive surfaces. The Contractor shall be responsible for any moisture intrusion that is detrimental to the Project.

2.5 TEMPORARY CONTRACTOR TELEPHONE SERVICE

- A. Site Superintendent or their Representative shall carry a cellular telephone at all times.
- B. Provide phone number to Cornell project representatives for communication during Work.

2.6 TEMPORARY SANITARY FACILITIES

- A. The Owner shall designate sanitary facilities to be utilized by the Contractor during construction. The Contractor shall maintain neat, clean and sanitary conditions. The Contractor shall be responsible for costs associated with excessive custodial services associated with such usage.

3.0 EXECUTION

3.1 REMOVAL

- A. Completely remove temporary materials and equipment when their use is no longer required.
- B. Clean and repair damage caused by temporary installations or use of temporary facilities.
- C. Restore existing and permanent facilities used for temporary services to specified, or to original, condition.

*****END OF SECTION 01 51 00*****

SECTION 01 51 23 HEAT DURING CONSTRUCTION

1.0 GENERAL

1.1 DESCRIPTION

- A. The Contractor shall maintain existing or temporary building heating systems to accomplish the following:
 - 1. Protect the existing facility and facility plumbing systems against damage due to cold temperatures.
 - 2. Provide sufficient heat so that the Work can be accomplished in accordance with the Contract Documents.
 - 3. Maintain construction schedules as required by the Contract.
- B. Include in the bid price an amount necessary to provide Construction Heat as required.
- C. Existing central steam systems may be used to the extent that they do not interfere with the safe and effective completion of Work. However, any modifications to existing systems shall be corrected prior to the conclusion of work.
- D. No natural gas is available to the facility for temporary heat.
- E. At the conclusion of the project the facility heating systems shall be returned to functional order as necessary to protect the building and facility plumbing systems.

1.2 RESPONSIBILITY

- A. The Contractor shall include in the bid the cost of the temporary heat.
- B. The Contractor shall be responsible for repairs to the facility necessitated by the failure to provide heat during any portion of the Work.

2.0 PRODUCTS – NOT USED

3.0 EXECUTION – NOT USED

*****END OF SECTION 01 51 23*****

SECTION 01 57 13 SOIL EROSION AND SEDIMENT CONTROL

1.0 GENERAL

1.1 DESCRIPTION

- A. The Contractor shall be responsible for preparing and implementing an Erosion and Sediment Control Plan.
- B. This Section describes minimum standards for the prevention and control of erosion during the construction process and may not be sufficient for all sites. The Contractor shall remain responsible for the means and methods of preventing erosion and may be required to employ additional means and methods as required to prevent violations of local, state, or federal standards.

1.2 SUBMITTALS

- A. Submit an Erosion and Sediment Control Plan, as specified herein.
- B. Refer to Section 01 33 00 – Submittal Procedures.

1.3 PLAN AND IMPLEMENTATION GENERAL REQUIREMENTS

- A. Plan shall comply with design specifications in the New York Guidelines for Urban Erosion and Sediment Control, NYS Stormwater Management Design Manual, NYSDEC Technical and Operational Guidance Series, good engineering practices, and this Section.
- B. Erosion and Sediment Control Plan shall be reviewed and approved by the Environmental Health and Safety Office, and implemented prior to any site work.
- C. Maintain Erosion and Sediment Control measures throughout the course of site construction activities until vegetative growth is established to the Owner's satisfaction.
- D. At conclusion of the Project, remove all remaining temporary erosion control structures and properly dispose of accumulated sediment on-site in areas approved by the Owner.

1.4 PERFORMANCE STANDARDS

- A. At no time shall construction operations or any related disturbance of the site result in the impairment of local waterways. "Impairment" is defined by regulations as including, but not limited to, the following:
 - 1. The release of water into receiving waters that causes a substantial visible contrast to natural conditions; or
 - 2. The deposition of significant sediment into such waters.

- B. Such deficiencies shall be corrected immediately by the Contractor to prevent further impairment.
- C. In addition, and without notice to the Contractor, the Owner shall also have the right, based on the Owner's independent assessment, to stop work or engage other contractor(s) to construct or correct such work as may be necessary to prevent the impairment of waterways, and to charge all costs related to such corrective or additional actions against the Contract.
- D. Acceptance of an Erosion and Sediment Control plan shall not in any way imply that the plan will be adequate in preventing impairment of waters, or that maintenance and modification will not be necessary. Rather, acceptance of the plan authorizes the Contractor to begin installation of the control measures under the assumption the appropriate maintenance and modification will be required throughout the life of the project to meet the project requirements.
- E. The Contractor's responsibilities under this Section shall end upon final completion and payment of the Work of the entire Contract.

1.5 EROSION AND SEDIMENT CONTROL PLAN COMPONENTS

- A. The Erosion and Sediment Control Plan submitted shall specifically address project measures, features, and areas critical to proper site erosion and sediment control. The Plan shall specifically include, but are not limited to, the following:
 - 1. Site Map, to scale;
 - 2. Measures to prevent stormwater from running onto the disturbed areas of the site;
 - 3. Inlet protection for storm sewers and catch basins;
 - 4. Measures to be used for dewatering; and
 - 5. Measures to be used for soil stabilization, runoff control, and sediment control, including specific measures for the following:
 - a. Site entrance stabilization
 - b. Staging areas
 - c. Material and soil stock piles
 - d. Concrete curing operations
 - e. Disturbed areas of the site

In addition to the requirements included in these specifications, specific erosion control measures shown on the Contract Drawings, if any, shall also be required.

- B. All features shall be designed and installed in accordance with the references included in Paragraph 1.3 – Plan and Implementation General Requirements of this Section.

- C. Keep access roads and public roads clear of mud and construction debris at all times. Maintain dust control measures throughout construction.

1.6 INSPECTIONS

- A. At the sole discretion of the Owner, inspections may be performed by a third party or on-staff representative of the Owner.
 - 1. The Owner may inspect the site at any time, without prior notification, for compliance with the Erosion and Sediment Control Plan and applicable local, state and federal regulations. Any instances of non-compliances or failure to meet the performance standards found must be resolved within 24 hours, with more immediate responses as required to mitigate active erosion during storm events or similar instances.
 - 2. Modify the Erosion and Sediment Control Plan as necessary, to provide full compliance with the performance standards.

2.0 PRODUCTS – NOT USED

3.0 EXECUTION – NOT USED

*****END OF SECTION 01 57 13*****

SECTION 01 66 00 STORAGE AND PROTECTION

1.0 GENERAL

1.1 DESCRIPTION

- A. Receive, pile, store and handle all materials, equipment and other items incorporated or to be incorporated in the Work, including items furnished by the Owner in a careful and prudent manner and shall protect them against loss or damage from every source.
- B. Obscure from public view, in a manner acceptable to the Owner, staging and storage areas.

1.2 TRANSPORTATION AND HANDLING

- A. Transport and handle products in accordance with manufacturer's instructions; using means and methods that will prevent damage, deterioration, and loss, including theft.
- B. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction space.
- C. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
- D. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installation.
- E. Promptly inspect shipments to assure that products comply with requirements, quantities are correct and products are undamaged.
- F. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement or damage.

1.3 ON-SITE STORAGE

- A. Materials stored on the Site shall be neatly piled and protected, and shall be stored in a neat and orderly manner in locations that shall not interfere with the progress of the Work or with the daily functioning of the Institution.
- B. Materials subject to weather damage shall be protected against the weather by floored weatherproof temporary storage sheds.
- C. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
- D. Storage piles and sheds shall be located within the area designated as the Staging Area. The

- E. Contractor shall work to ensure that the condition of the staging area has no negative impact on the Campus, visually or otherwise; and that outside of that area. The Contractor has no impact at all on the Campus.
- F. Materials stored within the building shall be distributed in such a manner as to avoid overloading of the structural frame, and never shall be concentrated in such a manner as to exceed the equivalent of 50 pounds per square foot uniformly distributed loading. Stored materials shall be moved if they interfere with the progress of the work.
- G. Should it become necessary during the course of the Work to move stored materials or equipment, the Contractor, at the direction of the Owner or the Owner's Representative, shall move such materials or equipment.

1.4 CAMPUS SITE / PALM ROAD STORAGE

- A. All property including construction materials and equipment stored at the Palm Road or other Campus site, shall be stored at the Contractor's sole risk. The Contractor is solely responsible for repair or replacement of property due to any cause of loss. Due to work at the Palm Road lot, staging space is limited and not guaranteed to be provided. If staging space is needed, a request should be submitted to the Project Manager.
- B. The Contractor agrees to hold Cornell harmless from any accident or injury occurring at Palm Road storage or other assigned Campus site associated with the Contractor's storage.
- C. The Contractor understands that Cornell makes "no" warranty regarding any security at the Palm Road or other assigned Campus site.
- D. The Contractor agrees that it is solely responsible for any cleanup of any site contamination caused by the Contractor's storage or storage operations and the Contractor agrees to pay for cleanup of any contamination and restore the site back to the same condition it was found.
- E. It shall be assumed that the Contractor is responsible for site contamination unless the Contractor has reported condition prior to moving storage materials and equipment onto the site. Each Contractor shall be responsible for their own general area whether defined formally or not but in cases where pollutants have traveled or are found in the public areas used by all contractors, the Contractor agrees as follows:
 - 1. If it cannot be determined who is responsible for site contamination after an investigation, all contractors who could be responsible based upon location of the incident agree to share the expense of cleanup equally.
- F. No storage of hazardous materials or environmental contaminants is permitted at the Palm Road or any Campus site. All barrels must have labels affixed identifying contents.
- G. The Contractor will be responsible for securing and maintaining any Campus site area designated to them. All contractor trailers or storage containers located on Cornell Campus Property will need to file for a building permit with the Town of Ithaca. If the trailer/container is there longer than 180 days, the trailer/container will need to meet the Building Code requirements of a permanent structure. The trailer/container will need a means of egress that can be operated from the inside and a fire extinguisher. The contractor will also need to file for a demolition permit when the trailer/container is removed.

- H. Unoccupied storage containers not within the project fence shall be labeled in the Cornell standard. Signs customized for the project shall be ordered from Ithaca Plastics, Inc., 305 West Green Street, Ithaca, New York 14850, Phone - 607.272.8232, Fax - 607.277.2579, Email – db@ithacaplastics.com.

1.5 PROTECTION

- A. The Contractor shall provide security personnel and adopt other security measures as may be necessary to adequately protect materials and equipment stored at the site. The Contractor shall be obligated to replace or pay for all materials and equipment including items furnished by the Owner which have been damaged or stolen prior to completion of the Work.
- B. Protection of Utilities
1. If during the course of the Project, it is necessary to work adjacent to existing utilities, pipelines, structures and equipment, the Contractor shall take all necessary precautions to protect existing facilities from damage.
 2. Locations of utilities as shown on the Contract Documents are approximate only. The Contractor shall excavate or otherwise locate to verify existing utilities in advance of its operation.
- C. Protective Covering
1. All finished surfaces shall be protected by the Contractor as follows:
 - a. Door and window sills and the jambs and soffits of openings used as passageways or through which material is handled, shall be cased and protected adequately against possible damage resulting from the conduct of the work of all trades.
 - b. All surfaces shall be clean and not marred upon delivery of the building to the Owner. The Contractor shall, without extra compensation, replace all blocks, gypsum board, plaster, paint, tile, and all other surfaces, whether or not protected, which are damaged, and shall refinish (including painting as specified) to satisfaction of Owner.
 - c. Tight wood sheathing shall be laid under any materials that are stored on finished concrete surfaces and planking must be laid before moving any materials over these finished areas. Wheelbarrows used over such areas shall have rubber tires on wheels.
 - d. Contractor has the responsibility for protection of carpeting and all finish flooring during all phases of the work including after installation.
 - e. All floors exposed to view as a floor finish shall be protected by overlaying with plywood in all areas subject to construction traffic within and without the building, special care shall be taken to protect all stair finish surfaces including but not limited to flooring, wood in-fill stairs, cabinetry, counters, equipment, etc.

2. HVAC ductwork shall be protected by the Contractor as follows to prevent introduction of contaminants:
 - a. Ductwork with interior lining shall be wrapped at the factory using plastic wrap to exclude moisture and contaminants. The wrapping shall not be removed until immediately prior to installation.
 - b. Ductwork shall not be exposed to moisture or contaminants at any point in the manufacturing, shipping, storage or installation process.
 - c. Ductwork shall not be staged or stored outside or otherwise exposed to the weather.
 - d. Ductwork shall be transported only inside of covered vehicles.
 - e. Once installed, ductwork shall be protected from contamination during the construction process.

1.6 PROTECTION AFTER INSTALLATION

- A. Protect installed products, including Owner-provided products, and control traffic in immediate area to prevent damage from subsequent operations.
- B. Provide protective coverings at walls, projections, corners, and jambs, sills, and soffits of openings in and adjacent to traffic areas.
- C. Cover walls and floors of elevator cabins, and jambs of cab doors, when elevators are used by construction personnel.
- D. Protect finish floors and stairs from dirt, wear, and damage:
 1. Secure heavy sheet goods or similar protective materials in place, in areas subject to foot traffic.
 2. Lay planking or similar rigid materials in place, in areas subject to movement of heavy objects.
 3. Lay planking or similar rigid materials in place, in areas where storage of products will occur.
- E. Protect waterproofed and roofed surfaces:
 1. Restrict use of surfaces for traffic of any kind, and for storage of products.
 2. When an activity is mandatory, obtain recommendations for protection of surfaces from manufacturer. Install protection and remove on completion of activity. Restrict use of adjacent unprotected areas.
- F. Restrict traffic of any kind across planted lawn and landscape areas.

2.0 PRODUCTS – NOT USED

3.0 EXECUTION – NOT USED

*****END OF SECTION 01 66 00*****

SECTION 01 73 29 CUTTING, PATCHING AND REPAIRING

1.0 GENERAL

1.1 DESCRIPTION

- A. The Contractor shall be responsible for all cutting, fitting and patching, including excavation and backfill, required to complete the Work or to:
 - 1. Make its several parts fit together properly.
 - 2. Uncover portions of the Work to provide for installation of ill-timed work.
 - 3. Remove and replace defective work.
 - 4. Remove and replace work not conforming to requirements of Contract Documents.
 - 5. Remove samples of installed work as specified for testing.
 - 6. Repair or restore existing or new surfaces and finishes to match adjacent existing or new surfaces and finishes.
- B. Upon written instructions of the Owner's Representative:
 - 1. Uncover designated portions of Work for Architect's observation of covered work.
 - 2. Remove samples of installed materials for testing beyond that specified.
 - 3. Remove work to provide for the alteration of previously incorrectly installed work.
 - 4. Patch work uncovered or removed.
- C. Do not damage or endanger any work by cutting or altering the Work or any part thereof.
- D. Do not cut or otherwise alter the work of the Owner except with the written consent of the Owner's Representative.
- E. Where cutting and patching involves adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with the original structure.
- F. Openings and Chases
 - 1. Build openings, including but not limited to channels, chases and flues as required to complete the Work as set forth in the Contract.
 - 2. After installation and completion of any work for which openings have been provided, build in, over, and around and finish all such openings as required to complete the Work.

3. Furnish and install all sleeves, inserts, hangers and supports required for the execution of the Work.

1.2 SUBMITTALS

- A. Submit a written request to the Architect prior to executing any cutting, alteration or excavation which affects the work of the Owner, or which may affect the structural safety of any portion of the Project. Include:
 1. Identification of the Project.
 2. Description of the affected work.
 3. The necessity for doing the cutting, alteration or excavation.
 4. The effect on the work of the Owner's property, or on the structural integrity of the Project.
 5. Description of the proposed work:
 - a. The scope of cutting, patching, alteration, or excavation.
 - b. Contractor and trades who will execute the work.
 - c. Products proposed to be used.
 - d. The extent of refinishing to be done.
 6. Alternatives to cutting, patching or excavation.
 7. Designation of the responsibility for the cost of cutting and patching.
 8. Written permission of any separate contractor whose work will be affected.
- B. Should conditions of the work or the schedule indicate a change of products from the original installation, submit a request for substitution as specified in Section 01 25 00 - Substitutions and Product Options.
- C. Submit a written notice to the Architect and the Owner designating the date and the time the work will be uncovered.

1.3 QUALITY ASSURANCE

- A. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would change their load-carrying capacity for load-deflection ratio.
 1. Obtain written approval of the cutting and patching proposal before cutting and patching structural elements, including but not limited to the following:
 - a. Foundation construction

- b. Bearing and retaining walls
 - c. Structural concrete
 - d. Structural steel and lintels
 - e. Structural decking
 - f. Miscellaneous structural metals
 - g. Exterior wall back-up supports and anchoring systems
 - h. Piping, ductwork, vessels, and equipment supports
 - i. Equipment supports
- B. Operational Limitations: Do not cut and patch operating elements or related components in a manner that would result in reducing their capacity to perform as intended. Do not cut and patch operating elements or related components in a manner that would result in increased maintenance or decreased operation life or safety.
- 1. Obtain written approval of the cutting and patching proposal before cutting and patching the following operating elements or safety related systems:
 - a. Primary operational systems and equipment
 - b. Air or smoke barriers
 - c. Water, moisture, or vapor barriers
 - d. Membranes and flashings
 - e. Fire protection systems
 - f. Control systems
 - g. Communication systems
 - h. Electrical wiring systems
 - i. Operating systems of special construction in MEP work
- C. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in the Owner's opinion, reduce the building's aesthetic qualities. Do not cut and patch construction in a manner that would result in visual evidence of cutting and patching. Remove and replace construction which was cut and patched in a visually unsatisfactory manner at no expense to the Owner.

- D. Waterproofing and Water Tightness: Do not cut or alter waterproofed walls or floors or any structural members without written permission of the Owner.
1. Waterproofing and Roofing Membranes
 - a. Employ qualified contractors to accomplish all required cutting, patching, or repairing of existing waterproofing and roofing membranes.
 - b. Before beginning cutting, patching or repairing of existing waterproofing and roofing membranes, obtain approval of all materials, methods and contractor to be used from the Owner and agency, or agencies, holding bond or guarantee/warranty in force for membrane.
 2. Water Tightness
 - a. The Contractor shall be responsible for water tightness of product, materials, and workmanship, including work specified to be watertight and inferred by general practice to be watertight.
 - b. All floors (slabs), walls, roof, glazing, windows, doors, sleeves through foundation walls, flashings, and similar items shall be watertight.
 - c. If details or materials shown or specified are felt not satisfactory to produce water tightness, the Contractor shall inform the Owner's Representative before installation and submit proposed substitution or alternative method for review and approval. The Contractor shall execute approved change and make watertight at no additional cost to the Owner.

1.4 WARRANTIES

- A. Replace, patch, and repair material and surfaces cut or damaged by methods and with materials in such a manner as not to void any warranties required or existing.

2.0 PRODUCTS

2.1 MATERIALS

- A. Comply with the Contract Documents for each product involved.
- B. Use materials identical to in-place or existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible. If identical materials are unavailable or cannot be used, use materials whose installed performance will equal or surpass that of in-place or existing materials, and will match visual appearance of in-place or existing materials.

3.0 EXECUTION

3.1 INSPECTION

- A. Inspect existing conditions of the Project, including elements subject to damage or to movement during:
 - 1. Cutting and patching.
 - 2. Excavation and backfilling.
- B. After uncovering work, inspect the conditions affecting the installation of products, or performance of the work.
- C. Report unsatisfactory or dubious conditions to the Architect in writing; do not proceed with the work until the Architect has provided further instructions.

3.2 PREPARATION

- A. Provide shoring, bracing and other support as necessary to assure the structural safety of that portion of the Work.
- B. Provide devices and methods to protect other portions of the Project from damage.
- C. Provide for vertical and lateral support required to protect adjacent buildings and properties.
- D. Provide protection from the elements for that portion of the Project which may be exposed by cutting and patching work, including but not limited to pumping to maintain excavations free from water.
- E. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- F. Avoid cutting existing pipe, conduit, or ductwork serving the building but scheduled to be removed or relocated until provisions have been made to bypass them.

3.3 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.
 - 1. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.

- B. Cutting: Cut existing construction using methods which will assure safety, will be least likely to damage elements retained or adjoining construction, and will provide proper surfaces to receive new work.
1. In general, where cutting, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
 3. Cut through concrete and masonry using a cutting machine, such as a carbon saw or a diamond-core drill.
 4. Comply with the requirements of applicable MEP work where cutting and patching of services is required.
- C. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.
1. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.
 2. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over patch and apply final paint coat over entire unbroken surface containing patch. Provide additional coats until patch blends with adjacent surfaces.
 3. Refinish entire surfaces as necessary to provide an even finish to match adjacent finishes:
 - a. For continuous surfaces, refinish to nearest intersection.
 - b. For an assembly, refinish the entire unit.
 4. When patching existing plaster finished walls and partitions, the Contractor shall utilize plaster trim, lath and other metal components to match the integrity of the existing system. All plaster finishes shall match existing finishes so as to provide a uniform visual appearance.
 5. Floors and Walls: Where walls or partitions that are demolished extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.

6. Ceilings: Patch, repair, or re-hang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
7. Concrete Masonry Units: Patch walls by toothing-in units using salvaged or new CMU units matching in-place units for type and size. Match coursing patterns, mortar joint profiles, and other features of in-place CMU walls. Use accessory materials compatible with in-place materials.
8. Brick and Masonry: Patch walls by toothing-in units using salvaged or new brick and masonry matching in-place brick and masonry units. Match coursing patterns, mortar joint profiles, and other features of in-place brick and masonry walls. Use accessory materials compatible with in-place materials.
9. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weather-tight condition.
 - a. Existing Roofing: Comply with requirements of existing roofing manufacturer for cutting and patching existing roofing system. Provide flashing and trim, base sheets, base flashing, adhesives, insulation, blocking, substrate boards, accessories, and other required items to patch roofing at penetrations and roof-top mounted items.
- D. Repairs: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
 1. Completely fill holes and depressions in existing masonry walls that are to remain with an approved masonry patching material applied according to manufacturer's written recommendations.
- E. Execute excavating and backfilling by methods which will assure safety, will prevent settlement or damage to other work.
- F. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes.
- G. Restore work which has been cut or removed; install new products to provide completed work in accordance with requirements of Contract Documents.
- H. The Contractor shall replace, repair and patch all surfaces of the ground and of any structure disturbed by its operations and its Work which surfaces and structures are intended to remain even if such operations and work are outside the property lines. Such replacement, repair and patching shall be with like material and shall restore surfaces as they existed.

3.4 CLEANING

- A. Clean area and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar items. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

- B. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

*****END OF SECTION 01 73 29*****

SECTION 01 77 00 PROJECT CLOSEOUT

1.0 GENERAL

1.1 INSPECTIONS

A. Substantial Completion:

1. Within a minimum of five (5) days prior to substantial completion, when the Work has reached such a point of completion that the building or buildings, equipment and apparatus can be occupied and used for the purpose intended, the Contractor shall conduct a detailed inspection of the Work to ensure that all requirements of the Contract have been met and that the Work is complete and is acceptable. Contractor shall prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
2. After receipt of the Contractor's initial punch list, the Architect will make an inspection of the Work to determine that the Work is substantially complete and that requirements of the Contract have been met and that the Work is sufficiently complete and is acceptable for use. The Architect will submit a marked-up list of items to be completed and/or corrected, inclusive of the Contractor's punch list. The Architect shall prepare a Certificate of Substantial Completion, on the basis of an inspection, when the Architect has determined that the work is substantially complete.
3. A copy of the report of the inspection will be furnished to the Contractor as the inspection progresses so that the Contractor may proceed without delay with any part of the Work found to be incomplete or defective.
4. All work performed under a Fire Protection System Installation/Alteration Operating Permit shall be inspected by the Ithaca Fire Department, or if so delegated by the Ithaca Building Department.
 - a. A member of the Ithaca Fire Department shall witness all acceptance or reacceptance testing of work performed under a Fire Protection System Installation Operating Permit. All testing and inspections shall be in compliance with the applicable NFPA codes as referenced by Section 906.1 of the Fire Code of NYS.
 - b. Work classified as a 'Repair' under the Existing Building Code does not require the Ithaca Fire Department to witness the testing of the affected systems. Systems that have been repaired must still be tested as required by the Fire Code of NYS and NFPA.
 - c. The Ithaca Fire Department Shall Witness the Acceptance or Reacceptance Testing for the Following Conditions:
 - Testing of any new installation of a fire alarm, fire suppression, or fire detection system as required by the Fire Code of New York State.

- Hydrostatic testing of sprinkler system where the modification affects more than twenty (20) sprinkler heads and the modified area can be isolated from the rest of the system
- Installation or replacement of a fire pump or drive elements of the fire pump.
- A Fire Alarm System with added or deleted components.
- A Fire Alarm System where the wiring or control circuits have been modified.
- A Fire Alarm System where the control unit (Fire Alarm Panel) has been replaced or the control unit software has been replaced.
- A smoke control system where the master control unit, individual fan control unit, or fan drive unit has been replaced or modified
- An alternative fire suppression system that has been replaced or the actuation elements have been modified. Except: fusible link replacement.
- A modification or extension of the piping for a fire standpipe system where a hydrostatic test is required by NFPA 14.

B. Final Acceptance:

1. When the items appearing on the report of inspection have been completed or corrected, the Contractor shall so advise the Architect. After receipt of this notification and Contractor's certified list of completed items, the Owner's Representative will inform the Contractor of the date and time of final inspection. A copy of the report of the final inspection containing all remaining contract exceptions, omissions and incomplete work will be furnished to the Contractor.
2. After receipt of notification of completion and all remaining contract exceptions, omissions and incomplete work from the Contractor, the Architect will make an inspection to verify completion of the exception items appearing on the report of final inspection.

1.2 SUBMITTALS

- A. Contractor's List of Incomplete Items: Initial punch list submittal at Substantial Completion.**
1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor, listing by room or space number. Organize items applying to each space by major element, including categories for individual exterior face elevations, ceilings, individual walls, floors, doors, roof levels, casework, equipment, and building systems.
- B. Contractor's Certified List of Completed Items: Final signed punch list submittal at Final Completion.**
- C. Certificates of Release: Occupancy permits from authorities having jurisdiction.**

1.3 FINAL CLEAN UP

- A. Upon completion of the work covered by the Contract the Contractor shall leave the completed Project ready for use and occupancy without the need of further cleaning of any kind and with all Work in new condition and in perfect order. In addition, upon completion of all Work the Contractor shall remove from the vicinity of the Work all plant, buildings, rubbish, unused materials, concrete forms and other materials belonging to him or used under its direction during construction or impairing the use or appearance of the property and shall restore such areas affected by the work to their original condition, and, in the event of its failure to do so, the same shall be removed by the Owner at the expense of the Contractor, and the Contractor and/or its surety shall be liable therefore. Final clean-up shall include but not be limited to the following:
1. All finished surfaces shall be swept, dusted, washed and polished. This includes cleaning of the Work of all finishing trades where needed, whether or not cleaning by such trades is included in their respective sections of the specifications.
 2. Roofs, utility tunnels, manholes and pipe trenches and spaces between the new and existing Work shall be left thoroughly cleaned.
 3. Finished flooring shall be thoroughly cleaned in accordance with the manufacturer's recommendations.
 4. Where the finish of floors has been marred or damaged in any space or area, the entire floor of that space or area shall be refinished as recommended by the manufacturers of the flooring.
 5. All equipment shall be in an undamaged, bright, clean, polished and new appearing condition.
 6. All new glass shall be washed and polished, both sides. The Contractor shall be responsible for all breakage of glass in the area of the Work from the commencement of its activities until the building is turned over to Owner. The Contractor shall replace all broken glass and deliver the entire building with all glazing intact and clean.
 7. Provide new filters for all fan convectors after final cleaning.
 8. Refer to exterior clean up. Remove paint and glazing compound from surfaces.
- B. Clean adjacent structures and improvements of dust, dirt, and debris caused by construction operations. Return adjacent areas to condition existing before construction operations began.
- C. Cleaning of Renovated Duct Systems and Existing Duct Systems in Renovated Areas:
1. Cleaning work shall be performed by firm which has minimum three (3) years' experience in mechanical cleaning of air systems. Work shall be done by skilled mechanics, technicians and experienced supervisors.

2. Clean dirt, dust and debris from air units, associated equipment air ducts; sanitize same. Cleaning shall include:
 - a. Cleaning of air unit's supply, return and exhaust sections including coils, fans, filter racks, outdoor air intake shaft, and interior surfaces.
 - b. Cleaning of dampers, heating coils, humidifiers, and similar devices in ductwork.
 - c. Marking of duct-mounted damper settings, prior to cleaning, and returning dampers to marked positions after cleaning. This includes fire dampers, zone dampers, balancing dampers and volume dampers.
 - d. Cleaning of terminal supply, return and exhaust grilles, registers and diffusers.
 - e. Cutting of access holes in ductwork for cleaning process, as well as sealing and patching of same.
 - f. Removal of portions of duct system which cannot otherwise be thoroughly cleaned, and replacement thereof.
 - g. Sealing of lined duct systems, upon completion.
 - h. Removal and reinstallation of ceiling panels, tiles, ceiling support tracks, and other ceiling construction, as required to facilitate cleaning.
 - i. Providing access doors required to facilitate cleaning.
3. Cleaning shall meet National Air Duct Cleaners Association (NADCA) Standards, capable of verification by NADCA Vacuum Test. Cleanliness shall be subject to Architect's visual review; provide re-cleaning as necessary to satisfy Architect
 - a. Cleaning methods may include vacuuming, brushing, mechanical brushing, scraping, or air washing. Use method best suited for locations involved.
 - b. Do NOT use methods which could damage the system or the building.
 - c. Remove dirt, dust, lint and other accumulations by HEPA filtered air machine capable of minimum 6000 cfm. Air machine shall operate to obtain 1250 fpm across the work space. Use brushes, mechanical agitators or air whips to dislodge contaminants to be collected by the air machine.
 - d. Cleaning shall begin at the furthest point of the return system and at the outdoor air intake. Cleaning shall proceed toward the air handling equipment. Cleaning shall finish at the furthest point of the supply ductwork.

1.4 MAINTENANCE STOCK

- A. Turn over to Owner's Representative the maintenance stock specified. Contractor shall obtain signed receipt from Owner's Representative for all maintenance stock.

2.0 PRODUCTS – NOT USED

3.0 EXECUTION – NOT USED

*****END OF SECTION 01 77 00*****

SECTION 01 78 22 FIXED EQUIPMENT INVENTORY

1.0 GENERAL

1.1 FIXED EQUIPMENT INVENTORY

- A. The Owner shall provide the Contractor with a list of Equipment Types to be inventoried and an Excel template.
- B. The Contractor shall populate the template (see Example Equipment List to be inventoried in Section 1.2). Once populated, the Contractor shall electronically return the list to the Owner's Representative. The initial data to be captured on each piece of equipment shall include:
 - 1. Name of Product
 - 2. Equipment Classification
 - 3. Manufacturer
 - 4. Model Number
 - 5. Serial Number
 - 6. Cost
 - 7. Location (including Building and Room Number)
 - 8. Acquisition Date (Date of Installation)
- C. The Owner shall from the Contractor provided data create a follow-up equipment Excel template that contains the MAXIMO ID for the equipment with all the name plate and specification fields for each type of equipment. This template shall then be returned to the Contractor.
- D. The Contractor shall be responsible for the initial labeling of the equipment and its' disconnects with the MAXIMO ID using an electronic label maker. ID labels shall be in close proximity to Equipment Identification information, visually locatable from the access point to the equipment and on the face of disconnects.
- E. The Contractor shall then populate the MAXIMO Equipment Specification Template with the equipment nameplate, specification information, and warranty information. The Contractor shall electronically submit the equipment data and any related documentation (i.e. - O&M manuals) to the Owner's Representative.

F. EXAMPLE EQUIPMENT LIST

- Building Equipment
- AC Drive/VSD
- Air Dryer
- Backflow Preventor
- Air Compressor
 - Building
 - Sprinkler
 - Control
 - Vacuum
- Pump
 - Condensate
 - Glycol
 - CWC
 - HWC
 - Potable
 - Sanitary Sewer
 - Storm Sewer
 - Sump
 - Quality Water
 - Fuel
- Fan
 - Exhaust
 - Supply
 - Return
- Fume Hood
- Furnace
- Generator
- Hot Water Heater
- Heat Exchangers
- Boiler
- Tank
- Unit Heater
- Fan Coil
- VAV Box
- Transfer Switch
- Motor
 - Pump
 - Fan
- Lift/Levelers
- Water Softener
- Reverse Osmosis

2.0 PRODUCTS – NOT USED

3.0 EXECUTION – NOT USED

*****END OF SECTION 01 78 22*****

SECTION 01 78 23 OPERATING AND MAINTENANCE DATA

1.0 GENERAL

1.1 DESCRIPTION

- A. The Contractor shall compile product data and related information appropriate for Owner's maintenance and operation of products furnished under the Contract.
 - 1. Prepare operating and maintenance data as specified in this Section, as referenced in other pertinent sections of Specifications and as necessary to operate the completed work.
 - 2. Operations and maintenance data, in final format, shall be available to the Owner prior to substantial completion.
- B. Instruct Owner's personnel in the maintenance of products and in the operation of equipment and systems.

1.2 FORM OF SUBMITTALS

- A. Prepare data in the form of an instructional manual for use by Owner's personnel.
- B. Submit a CD with electronic .pdf files, upload electronic files to ePM system of complete manual in final form.
 - 1. Format:
 - a. Size: 8-1/2" x 11".
 - b. Text: Manufacturer's, scanned .pdf and/or neatly typewritten Word file.
 - c. Drawings in electronic format
 - Drawings are required in PDF format. Drawings shall be in AutoCAD v14 or higher format.
 - d. Provide fly-leaf for each separate product, and major component parts of equipment.
 - Provide type description of product, and major component parts of equipment.
 - Provide indexed PDF bookmarks.
 - Provide a series of files organized in subdirectories with a summary index with hyperlinks to the various documents.

- e. Cover: Identify each volume with title "OPERATIONS AND MAINTENANCE INSTRUCTIONS".

List:

- Title of Project
- Identity of separate structure as applicable.
- Identity of general subject matter covered in the manual.

1.3 CONTENT OF MANUAL

- A. Table of contents, typewritten, for each volume, arranged in a systematic order.
 - 1. Contractor, name of responsible principal, address and telephone number.
 - 2. A list of each product required to be included, indexed to the content of the volume.
 - 3. List, with each product, the name, address and telephone number of:
 - a. Subcontract or installer.
 - b. Maintenance contractor, as appropriate.
 - c. Identify the area of responsibility of each.
 - d. Local source of supply for parts and replacement.
 - 4. Identify each product by product name and other identifying symbols as set forth in Contract Documents.
- B. Product Data:
 - 1. Include only those sheets which are pertinent to the specific product.
 - 2. Annotate each sheet to:
 - a. Clearly identify the specific product or part installed.
 - b. Clearly identify the data applicable to the installation.
 - c. Delete reference to inapplicable information.
- C. Submittal Data:
 - 1. Include a record copy of the final, approved product submittal. Record copy shall be a clean copy (free of notes from the design professional) which has been updated to reflect the "as-installed" system.

- D. Drawings:
 - 1. Supplement product data with drawings as necessary to clearly illustrate:
 - a. Relations of component parts of equipment and systems.
 - b. Control and flow diagrams.
 - 2. Coordinate drawings with information on Record Documents to assure correct illustration of completed installation.
 - 3. Do not use Record Documents as maintenance drawings.
- E. Written text, as required to supplement product data for the particular installation:
 - 1. Organize in a consistent format under separate headings for different procedures.
 - 2. Provide a logical sequence of instructions for each procedure.
- F. Original copy of each warranty, bond and service contract issued.
 - 1. Provide information sheet for Owner's personnel, give:
 - a. Proper procedures in the event of failure.
 - b. Instances which might affect the validity of warranties or bonds.

1.4 MANUAL FOR MATERIALS AND FINISHES

- A. Submit electronic .pdf files, upload electronic files to ePM system.
- B. Content, for architectural products, applied materials and finishes:
 - 1. Manufacturer's data, giving full information on products:
 - a. Catalog number, size, and composition.
 - b. Color and texture designations.
 - c. Information required for reordering special-manufactured products.
 - d. Certification as to asbestos free
 - 2. Instructions for care and maintenance:
 - a. Manufacturer's recommendation for types of cleaning agents and methods.
 - b. Cautions against cleaning agents and methods which are detrimental to the product.
 - c. Recommended schedule for cleaning and maintenance.

- C. Content, for moisture-protection and weather-exposed products:
 - 1. Manufacturer's data, giving full information on products.
 - a. Applicable standards
 - b. Chemical composition
 - c. Details of installation
 - 2. Instructions for inspection, maintenance, and repair.
- D. Additional requirements for maintenance data: The respective sections of Specifications.

1.5 MANUAL FOR EQUIPMENT AND SYSTEMS

- A. Submit electronic .pdf files, upload electronic files to ePM system.
- B. Content, for each unit of equipment and system, as appropriate:
 - 1. Description of unit and component parts.
 - a. Function, normal operating characteristics, and limiting conditions.
 - b. Performance curves, engineering data and tests.
 - c. Complete nomenclature and commercial number of all replaceable parts.
 - 2. Operating procedures:
 - a. Start-up, break-in, routine and normal operating instructions.
 - b. Regulation, control, stopping, shut-down and emergency instructions.
 - c. Summer and winter operating instructions.
 - d. Special operating instructions.
 - 3. Maintenance Procedures:
 - a. Routine operations.
 - b. Guide to "trouble-shooting".
 - c. Disassembly, repair and reassembly.
 - d. Alignment, adjusting and checking.
 - 4. Servicing and lubrication required:
 - a. List of lubricants required.
 - 5. Manufacturer's printed operating and maintenance instructions.

6. Description of sequence of operation by control manufacturer.
 7. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
 - a. Predicted life of parts subject to wear.
 - b. Items recommended to be stocked as spare parts.
 8. As-installed control diagrams by controls manufacturer.
 9. Each contractor's coordination drawings.
 - a. As-installed color coded piping diagrams.
 10. Charts of valve tag numbers, with the location and function of each valve.
 11. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.
 12. Other data as required under pertinent sections of Specifications.
- C. Content, for each electric and electronic system, as appropriate:
1. Description of system and component parts:
 - a. Function, normal operating characteristics, and limiting conditions.
 - b. Performance curves, engineering data and tests.
 - c. Complete nomenclature and commercial number of replaceable parts.
 2. Circuit directories of panel boards:
 - a. Electrical service.
 - b. Controls.
 - c. Communications.
 3. As-installed color coded wiring diagrams.
 4. Operating procedures:
 - a. Routine and normal operating instructions.
 - b. Sequences required.
 - c. Special operating instructions.

5. Maintenance procedures:
 - a. Routine operations.
 - b. Guide to "trouble-shooting".
 - c. Disassembly, repair and reassembly.
 - d. Adjustment and checking.
 6. Manufacturer's printed operating and maintenance instructions.
 7. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.
 8. Other data as required under pertinent sections of Specifications.
- D. Additional requirements for operations and maintenance data: See the respective sections of Specifications and General Conditions.

1.6 SUBMITTAL REQUIREMENTS

- A. Submit through ePM system preliminary draft of proposed formats and outlines of contents thirty (30) calendar days after approved submittals.
- B. Submit completed data in final form twenty (20) calendar days prior the Acceptance Phase of the Project.
- C. Submit specified number of copies of approved data in final form prior to final acceptance.

1.7 INSTRUCTIONS OF OWNER'S PERSONNEL

- A. Prior to final inspections or acceptance, fully instruct Owner's designated operating and maintenance personnel in the operation, adjustment and maintenance of all products, equipment and systems:
 1. Instruction time shall be sufficient to fully instruct all shifts of the Owner's operating and maintenance personnel.
- B. Operations and maintenance shall constitute the basis of instruction:
 1. Review contents of manual with personnel in full detail to explain all aspects of operations and maintenance.

- C. Submit typewritten statement, signed by each of Owner's Representatives who have been instructed, describing:
 - 1. Method of Instruction.
 - 2. Equipment and Systems Operated.
 - 3. Length of Instruction Period.
- D. Contractor is fully responsible until final acceptance, even though operated by Owner's personnel, unless otherwise agreed in writing.

1.8 OPERATING INSTRUCTIONS

- A. List under clear plastic (1/8" thick) all operating, maintenance and starting precautions and procedures to be followed by Owner for operating all systems and equipment.

2.0 PRODUCTS – NOT USED

3.0 EXECUTION – NOT USED

*****END OF SECTION 01 78 23*****

SECTION 01 78 36 WARRANTIES AND BONDS

1.0 GENERAL

1.1 DESCRIPTION

The Contractor shall:

- A. Compile specified warranties and bonds.
- B. Compile specified service and maintenance contracts.
- C. Co-execute submittals when so specified.
- D. Review submittals to verify compliance with Contract Documents.
- E. Submit to Architect for transmittal to Owner.

1.2 SUMMARY

- A. This Section specifies general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturers standard warranties on products and special warranties.
 - 1. Refer to the General Conditions for terms of the Contractor's special warranty of workmanship and materials.
 - 2. General closeout requirements are included in Section 01 77 00 - "Project Closeout."
 - 3. Specific requirements for warranties for the Work and products and installations that are specified to be warranted, are included in the individual Sections of Divisions 2 through 40.
 - 4. Certifications and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.
- B. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

1.3 DEFINITIONS

- A. Standard Product Warranties are pre-printed written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.

- B. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

1.4 QUALITY ASSURANCE

- A. Use adequate care and diligence to review Contract Documents to identify detailed requirements relating to warranties and bonds.
- B. Verify that each item required for this submittal conforms with specified requirements.

1.5 WARRANTY REQUIREMENTS

- A. In addition to standard and special warranties described in Divisions 2 through 40, Contractor shall warrant Work included in this project, for a minimum period of one (1) year following acceptance of a Certificate of Substantial Completion by Owner, to cover performance, materials, workmanship and compliance with Contract Documents.
- B. Corrective Work: Provide service within thirty (30) calendar days when requested by Owner. Perform services during normal working hours, unless specifically directed otherwise by Owner. Coordinate with Owner's representative to schedule performance of corrective work. Where designated service providers cannot perform corrective work within the Owner's required time frame, engage another qualified service provider. Submit a written statement to Owner upon completion of corrective work; document work performed and list outstanding items, if any.
 - 1. When a completed breakdown of a piece of equipment occurs or the malfunction of a system affects the environment or program involving 50 or more persons at a time (employees and students combined), or creates a safety or security risk to the Owner, an EMERGENCY may be declared by the Owner. The Owner may declare an emergency as defined above at which time the service response must be within 4 hours and may require action during non-normal working hours.
 - 2. When an emergency condition occurs, the Owner may take immediate corrective action to relieve the problem by making, a minimum as possible, temporary adjustments and/or repairs when necessary to decrease the problem until the designated Contractor's representative can respond. These temporary adjustments and repairs will in no way jeopardize the existing warranty.
 - 3. The Owner's service staff will advise the Contractor's Representative of all temporary adjustments and repairs done in relation to the malfunctioning equipment or facility.
 - 4. If the Contractor fails to respond with actual service within four (4) hours, and/or the necessary repairs or adjustments are not satisfactorily complete twenty-four (24) hours, the Owner will have the authority to make the necessary repairs or adjustments and charge the Contractor for parts and labor.
 - 5. If all adjustments and repairs done by the Owner in relation to the above conditions are done by authorized district personnel, there will be no negative effect of future warranty claims.

- C. Related Damages and Losses: When correcting failed or damaged warranted Work, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.
- D. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
- E. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.
- F. Owner's Recourse: Expressed warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law. Expressed warranty periods shall not be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.
- G. Contractor's Procurement Obligations: Do not purchase, subcontract for, or allow others to purchase or subcontract for materials or units of Work for Project where a special project guaranty, specified product warranty, certification, or similar commitment is required until it has been determined that entities required to sign or countersign such commitments are willing to do so.
- H. Specific Warranty. Where a special warranty, certification, or similar commitment is required on such Work or part of the Work, the Owner reserves the right to refuse to accept the Work until the Contractor presents evidence that entities required to countersign such commitments are willing to do so.

1.6 SUBMITTAL REQUIREMENTS

- A. Submit written warranties to the Architect prior to the date certified for Substantial Completion. If the Architect's Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Architect or Owner.
 - 1. When a designated portion of the Work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Architect and Owner within fifteen (15) days of completion of that designated portion of the Work.
- B. When a special warranty is required to be executed by the Contractor, or the Contractor and a subcontractor, supplier or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner through the Architect for acceptance prior to final execution.

1.7 SUBMITTALS REQUIRED

- A. Submit warranties, bonds, and service and maintenance contracts as specified in the respective sections of Specifications. Submit a schedule listing all required warranties.

2.0 PRODUCTS – NOT USED

3.0 EXECUTION

3.1 FORM OF SUBMITTALS

- A. The Warranties and Bonds shall be in electronic pdf format. Each submission shall include the title of the Project and the name of the Contractor.
- B. Provide a series of files organized in subdirectories with a summary index with hyperlinks to the various documents and or references.
- C. Assemble warranties, bonds and service and maintenance contracts, executed by each of the respective manufacturers, suppliers and subcontractors.
- D. Table of Contents: Neatly typed, in orderly sequence. Provide complete information for each item.
 - 1. Product or work item.
 - 2. Item description.
 - 3. Notation of what the equipment serves (e.g. – Provides perimeter heat)
 - 4. Warranty Provider. Is the warranty provided by a manufacturer or installer?
 - 5. Firm, with name of principal and responsible party, address and telephone number.
 - 6. Scope.
 - 7. Duration.
 - a. Date of beginning of warranty, bond or service and maintenance contract
 - b. End date of warranty, bond or service and maintenance contract.
 - 8. Provide information for Owner's personnel:
 - a. Proper procedure in case of failure.
 - b. Instances which might affect the validity of warranty or bond.
 - 9. Contractor, name of responsible principal, address and telephone number.

3.2 TIME OF SUBMITTALS

- A. Make final submittals within ten (10) days after Date of Substantial Completion, prior to final request for payment.
- B. For items of work when acceptance is delayed materially beyond the Date of Substantial Completion, provide updated submittal within ten (10) days after acceptance, listing the date of acceptance as the start of the warranty period.

*****END OF SECTION 01 78 36*****

SECTION 01 78 39 RECORD DOCUMENTS

1.0 GENERAL

1.1 DESCRIPTION

A. The Contractor shall maintain at the site, during construction, one record copy of:

1. Drawings
2. Specifications
3. Addenda
4. Change Orders and other Modifications to the Contract
5. Architect's Field Orders or written instructions.
6. Final Shop Drawings, Product Data and Samples
7. Field Test records
8. Construction photographs

1.2 MAINTENANCE OF DOCUMENTS AND SAMPLES

- A. Store documents and samples in Contractor's field office apart from documents used for construction.
1. Provide files and racks for storage of documents.
 2. Provide cabinet or storage space for storage of samples.
- B. File documents and samples in accordance with Data Filing Format of the Uniform Construction Index.
- C. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.
- D. Make documents and samples available at all times for review by the Owner's Representative and the Architect.

1.3 RECORDING

- A. Label each document "AS BUILT" in neat large printed letters.

- B. Record information concurrently with construction progress.
 - 1. Do not conceal any work until required information is recorded.
- C. Drawings

As built drawings shall consist of making any changes neatly and clearly on the Contract Drawings using colored ink or pencil, shall be kept current by the contractor on a day-to-day basis in concert with the progress of the work. Where applicable, the change marked on a drawing is to carry the notation "per Change Order No. X", or similar reference which cites the reason for the change. As an alternative approach the Contractor can submit a plan for producing the "As-Built" drawings via electronic mark-up in Bluebeam, Adobe Professional, or other similar program as an alternative to colored pencil or ink mark-ups. Such plan shall be subject to approval of the Owner.

The day-to-day construction as built drawings shall be made available to the Architect or Owner's Representative for review upon request. The "As built" drawings shall show all changes to the following areas of construction:

- 1. Architectural:
 - a. Modifications to components dictated by the building code
 - b. Wall, door, window locations
 - c. Built in casework locations
 - d. New rated door and wall schedules/ locations
 - e. Material and products where submittals are requested
- 2. Civil and Structural
 - a. Dimensions for load carrying elements, both horizontal and vertical
 - b. Materials and products where submittals are requested
 - c. Load carrying elements and foundation systems
 - d. Site related elements including:
 - Building outlines, entranceways, areaways, roof overhangs, downspouts, significant architectural projections and other pertinent data.
 - e. All significant changes in foundations, columns, beams, openings, concrete reinforcing, lintels, concealed anchorages and "knock-out" panels made during construction.
 - f. Building envelope systems including roofing systems and building shell systems
 - g. Geotechnical subsurface information

- h. Items that will require future maintenance
 - i. Life safety critical items
- 3. Mechanical (HVAC, Plumbing and Fire Protection)
 - a. Products where submittals are requested
 - b. Final locations of all equipment.
 - c. Final sizes and materials of piping and ductwork.
 - d. Final locations of inaccessible piping and ductwork.
 - e. Final locations of all controls equipment, including all sensors and actuators.
 - f. Final locations of all valves and dampers, including all shutoff valves, balance dampers and fire dampers.
 - g. Location of access doors for all equipment in concealed locations.
 - h. Final location and arrangement of all mechanical equipment and concealed gas, sprinkler, domestic, sanitary and drainage systems piping and other plumbing, including, but not limited to, supply and circulating mains, principal valves, meters, clean-outs, drains, pumps and controls, vent stacks, sanitary and storm water drainage.
- 4. Electrical
 - a. Products where submittals were requested.
 - b. Circuit (wire and raceway) size, number, and type.
 - c. Main circuit pathways for Fire Alarm, Emergency Power, and Access Control/Security systems.
 - d. Final locations of equipment and devices, interior and exterior luminaires, and power supplies.
 - e. Final location of electric signal system panels, final arrangement of all circuits and any significant changes made in electrical signal system design as a result of Change Order or job conditions.
- 5. Environmental
 - a. Utility related elements and supporting infrastructure

D. Specifications and Addenda

Legibly mark each section to record:

1. Manufacturer, trade name, catalog number, and Supplier of each product and item of equipment actually installed.
2. Changes made by Field Order or by Change Order.

1.4 SUBMITTAL

- A. At Contract close-out, deliver copies of all record documents to the Owner's Representative.
- B. Accompany submittal with transmittal letter in duplicate, containing:
 1. Date
 2. Project title and number
 3. Contractor's name and address
 4. Title and number of each record document
 5. Certification that each document is complete and accurate
 6. Signature of Contractor or its authorized representative.

2.0 PRODUCTS – NOT USED

3.0 EXECUTION – NOT USED

*****END OF SECTION 01 78 39*****

TECHNICAL SPECIFICATIONS

FOR

**VETERINARY RESEARCH TOWER SECOND AND THIRD FLOOR
STRUCTURAL REPAIRS AND LABORATORY REMEDIATION**

**CORNELL UNIVERSITY
ITHACA, NEW YORK**

SECTION 022000 – EXISTING HAZARDOUS MATERIALS INFORMATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

Existing Hazardous Materials reports are included as attachments at the end of this section and are hereby incorporated into the Procurement and Contracting Requirements by reference.

A copy of Delta Engineers, Architects, & Surveyors, "Asbestos Bulk Sampling" report dated August 29, 2022, is bound in this Project Manual (Attachment A).

A copy of Delta Engineers, Architects, & Surveyors, "Asbestos Survey Summary" report dated October 4, 2022, is bound in this Project Manual (Attachment B).

A copy of LaBella Associates, D.P.C., "Limited Pre-Renovation Asbestos-Containing Materials Inspection" report dated August 29, 2023, is bound in this Project Manual (Attachment C).

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 022000



ATTACHMENT A:
ASBESTOS BULK SAMPLING
REPORT

October 4, 2022

Mr. Jake Perno, Project Manager
Cornell University
FCS Engineering and Project Management
119 Humphreys Service Building

Re: Veterinary Research Tower (1140) 2nd Floor Lab Suites T2001, T2003, T2007 and Service Corridor T200UA Asbestos Abatement Project - Asbestos Survey Summary
Delta Project No.: 2021.163.329

Dear Mr. Perno:

The following is associated with the Veterinary Research Tower 2nd Floor Lab Suites T2001, T2003, T2007 and Service Corridor T200UA Asbestos Abatement Project. On July 26, 2022 and August 24, 2022 Delta performed Asbestos Bulk Sampling addressing various suspect materials present on the 1st, 2nd & 3rd floors at the Veterinary Research Tower (VRT) that were damaged and/or impacted by the VRT Lab Suite T2001 Fire Episode. The areas addressed as a part of the sampling included Lecture Hall T1003 Suite, Office Suite T1010, Lab Suites T2001 / T2003 / T2007, Corridors T200CA / TA200CB / T300CA / T300CB, and Service Corridors T200UA & T300UA. Based on a walkthrough and visual inspection of the affected areas / associated suspect materials, a total of one hundred (100) bulk samples were collected representing forty-four (44) separate homogenous building materials. Fifty-two (52) of the samples collected were “Non-friable, Organically Bound” (NOB) materials, representing twenty-six (26) homogenous materials. The remaining forty-eight (48) samples were friable, “non-NOB” materials, representing eighteen (18) homogenous materials.

For the suspect materials present in the 2nd Floor Lab Suites T2001, T2003, T2007 and Service Corridor T200UA Asbestos Abatement Project Area, the following is a breakdown of the Identified Asbestos and Non-Asbestos Materials:

1) Asbestos Containing Materials:

- a. Spray-on Fireproofing - Results for samples of the Spray-on Fireproofing (SOF) collected in the 2nd floor project area were reported as being “Asbestos-Containing”, as “No Asbestos Detected” and as “Non-Asbestos” (> 0% / < 1.0%). As all of the SOF present in the area appeared to be visually homogenous, it is all being considered “Asbestos-Containing”.

2) Non-Asbestos Materials:

- a. 2' x 4' Ceiling Tile – Results for the ceiling tiles present in the area were reported as “No Asbestos Detected”. *But based on the presence of asbestos SOF Debris on the top surface of the majority of the tile, for the purposes of the abatement project, they are to be considered “Asbestos-Contaminated”.*
- b. 2' x 4' Gypsum Ceiling Tile Panels – Results for the gypsum ceiling tile panels present in the area were reported as “No Asbestos Detected”. *But based on the presence of asbestos SOF Debris on the top surface of the majority of the tile, for the purposes of the abatement project, they are to be considered “Asbestos-Contaminated”.*

- c. Sheetrock / Joint Compound Wall Systems – Results for the sheetrock and joint compound associated with the wall systems in the area were reported as “No Asbestos Detected”.
- d. White Textured Wall Coating – Results for the textured wall coating associated with the wall systems in the area were reported as “No Asbestos Detected”.
- e. 12” x 12” Light Gray Mottle-Pattern Floor Tile / associated Yellow Mastic: Results for the floor tile and its associated yellow mastic present in the area were reported as “No Asbestos Detected”.
- f. White Mastic from non-suspect vinyl Cove base: Results for the cove base mastic in the area were reported as “No Asbestos Detected”.
- g. Lab-tops and associated Adhesive / Caulk / Epoxy: Results for the Lab-tops and associated suspect system materials present in the area were reported as “No Asbestos Detected”.

The Complete Bulk Sampling Report is available through the Cornell University Asbestos Program and Delta EAS. If you have any questions, or require any additional information, please feel free to contact me at your convenience.

Respectfully,

DELTA ENGINEERS, ARCHITECTS, LAND SURVEYORS, & LANDSCAPE ARCHITECTS, DPC



Stephen Prislupsky
Director of Environmental Services



ATTACHMENT B:
ASBESTOS SURVEY REPORT

August 29, 2022

Dale W. Houseknecht, Facilities Coordinator Projects II
Cornell University IPP-Facilities Management
FM Administration
116 Humphreys Service Building
Ithaca, New York 14853-3701

**Re: Veterinary Research Tower (1140) 2nd Floor Lab Suite T2001 Fire Incident
1st, 2nd, & 3rd Floors Fire Damaged Materials / Spray-on Fireproofing
Asbestos Bulk Sampling Report
Cornell Task Authorization No. TA-355, Work Order No. 14577601
Delta Project No.: 2021.163.320**

Dear Mr. Houseknecht:

Enclosed, please find the Asbestos Bulk Sample Report Form, the associated Laboratory Analytical Result Sheets, and the Sample Location Drawings for the bulk sampling performed by Delta Certified Asbestos Inspectors Thomas Ferro and Michael Drobak. The sampling was performed on July 26, 2022 and August 24, 2022 and addressed various suspect materials present on the 1st, 2nd & 3rd floors at the Veterinary Research Tower (VRT) that were damaged and/or impacted by the VRT Lab Suite T2001 Fire Episode. The areas addressed as a part of the inspection included Lecture Hall T1003 Suite, Office Suite T1010, Lab Suites T2001 / T2003 / T2007, Corridors T200CA / TA200CB / T300CA / T300CB, and Utility Chase way T300UA. Based on a walkthrough and visual inspection of the affected areas / associated suspect materials, a total of one hundred (100) bulk samples were collected representing forty-four (44) separate homogenous building materials. Fifty-two (52) of the samples collected were “Non-friable, Organically Bound” (NOB) materials, representing twenty-six (26) homogenous materials. The remaining forty-eight (48) samples were friable, “non-NOB” materials, representing eighteen (18) homogenous materials.

For the “Non Spray-on Fireproofing” materials sampled, all were reported as being “Non-Asbestos” with the exception of the **12”x12” Brown w/ White Mottle Floor Tile present in Room T1003A, which was reported as being asbestos-containing**

In regards to the Spray-on Fireproofing (SOF), Delta collected a total of twenty-five (25) samples from the 1st, 2nd and 3rd floors. Out of these twenty-five (25):

- Ten (10) were reported as being “Asbestos Containing” (> 1.0%)
- Four (4) were reported as being “Non-Asbestos” (> 0% / <1.0%)
- Eleven (11) were reported as being “No Asbestos Detected”

All Spray-on Fireproofing Samples collected by Delta were uniform in color and texture. And results varied for samples collected within the same room / functional space from “Asbestos Containing” to “No Asbestos Detected”. Based on this, in Delta’s opinion all Spray-on Fireproofing present at the Veterinary Research Tower should be considered **Asbestos Containing** unless a sufficient number of samples for a given room are collected / analyzed (based on AHERA requirements for Room square footage) and results for “ALL” samples collected for the Room are reported as “No Asbestos Detected”.

Bulk sample analysis was performed by AmeriSci New York, Inc., an independent laboratory approved/accredited by the NYS Department of Health Environmental Laboratory Accreditation Program (ELAP), and the National Voluntary Laboratory Accreditation Program (NVLAP). Analysis of all Non-Friable Organically Bound (NOB) materials was initially performed by Polarized Light Microscopy (PLM) following the NYS DOH ELAP 198.6 methodology. If the PLM results were reported as “non-asbestos”, the sample was then analyzed by Transmission Electron Microscopy (TEM) following the NYS DOH ELAP 198.4 methodology. Analysis of all Non-NOB materials was performed by Polarized Light Microscopy following the NYS DOH ELAP 198.1 Methodology. A “Positive Stop” sample analysis protocol was utilized for a given homogenous material set with multiple samples, with the exception of the Spray-on Fireproofing Samples, which were All Analyzed. Please reference the Asbestos Bulk Sample Report Form for sample particulars and details.

I have also attached Delta Company / Personnel and Laboratory Licenses & Certifications and various photos of the Spray-on Fireproofing sampled, including SOF reported as “Asbestos Containing”, as “Non-Asbestos”, and as “No Asbestos Detected”. If you have any questions, or require any additional information, please feel free to contact me at your convenience.

Respectfully,

DELTA ENGINEERS, ARCHITECTS, LAND SURVEYORS, & LANDSCAPE ARCHITECTS, DPC



Stephen Prislupsky
Director of Environmental Services
Att: Project Paperwork

Attachment A

Asbestos Bulk Sample Report Form

Client: <u>Cornell University</u>	Task Authorization No.: <u>TA-355 / Work Order No.: 14577601</u>	Delta Proj. No.: <u>2021.163.206</u>
Project: <u>Vet Research Tower Lab Suite</u> <u>T2001 Fire Episode - Asbestos Bulk</u> <u>Sampling</u>	Dates Sampling Performed: <u>07/26/2022 & 08/24/2022</u>	Asbestos Inspector: <u>Michael Drobak / Thomas Ferro</u>
	Date of Report: <u>08/29/2022</u>	Number of Samples Collected: <u>100</u>
Building Code: <u>1140</u>	Laboratory: <u>AmeriSci Labs</u>	Number of Samples Analyzed: <u>PLM - 98 / TEM - 49</u>

Asbestos Bulk Sample Report Form

Sample Number	HA*	Floor	Bulk Sample Description / Details	Material Type	Asbestos Type	PLM Result % Asbestos	TEM Result % Asbestos
2021.163.320-01A	01	1	Yellow/Gray Carpet Mastic - Room T1003, Northwest.	Miscellaneous	ND	ND	ND
2021.163.320-01B	01	1	Yellow/Gray Carpet Mastic - Room T1003, Northeast.	Miscellaneous	ND	ND	ND
2021.163.320-02A	02	1	Red Rolled Vinyl Sheet Flooring - Room T1003, North.	Miscellaneous	ND	ND	ND
2021.163.320-02B	02	1	Red Rolled Vinyl Sheet Flooring - Room T1003, North.	Miscellaneous	ND	ND	ND
2021.163.320-03A	03	1	Gray Mastic from HA 02 - Room T1003, North.	Miscellaneous	ND	ND	ND
2021.163.320-03B	03	1	Gray Mastic from HA 02 - Room T1003, North.	Miscellaneous	ND	ND	ND
2021.163.320-04A	04	1	Gray Rolled Vinyl Sheet Flooring - Room T1003, Northeast.	Miscellaneous	ND	ND	ND
2021.163.320-04B	04	1	Gray Rolled Vinyl Sheet Flooring - Room T1003, Northwest.	Miscellaneous	ND	ND	ND
2021.163.320-05A	05	1	Gray Mastic from HA 04 - Room T1003, Northeast.	Miscellaneous	ND	ND	ND
2021.163.320-05B	05	1	Gray Mastic from HA 04 - Room T1003, Northwest.	Miscellaneous	ND	ND	ND
2021.163.320-06A	06	1	Tile - Room T1003, Northwest Under HA 03 & HA 04.	Miscellaneous	ND	ND	ND
2021.163.320-06B	06	1	Tile - Room T1003, Northwest Under HA 03 & HA 04.	Miscellaneous	ND	ND	ND
2021.163.320-07A	07	1	Yellow Mastic from HA 06 - Room T1003, Northwest.	Miscellaneous	NA	NA	NA

Client: <u>Cornell University</u>	Task Authorization No.: <u>TA-355 / Work Order No.: 14577601</u>	Delta Proj. No.: <u>2021.163.206</u>
Project: <u>Vet Research Tower Lab Suite</u> <u>T2001 Fire Episode - Asbestos Bulk</u> <u>Sampling</u>	Dates Sampling Performed: <u>07/26/2022 & 08/24/2022</u>	Asbestos Inspector: <u>Michael Drobak / Thomas Ferro</u>
	Date of Report: <u>08/29/2022</u>	Number of Samples Collected: <u>100</u>
Building Code: <u>1140</u>	Laboratory: <u>AmeriSci Labs</u>	Number of Samples Analyzed: <u>PLM - 98 / TEM - 49</u>

Asbestos Bulk Sample Report Form

Sample Number	HA*	Floor	Bulk Sample Description / Details	Material Type	Asbestos Type	PLM Result % Asbestos	TEM Result % Asbestos
2021.163.320-07B	07	1	Yellow Mastic from HA 06 - Room T1003, Northwest.	Miscellaneous	ND	ND	ND
2021.163.320-08A	08	1	12"x12" Brown w/ White Mottle Floor Tile - Room T1003A, Southeast.	Miscellaneous	Chrysotile	2.1%	NA/PS
2021.163.320-08B	08	1	12"x12" Brown w/ White Mottle Floor Tile - Room T1003A, Southeast.	Miscellaneous		NA/PS	NA/PS
2021.163.320-09A	09	1	Black Mastic from HA 08 - Room T1003A, Southeast.	Miscellaneous	ND	ND	ND
2021.163.320-09B	09	1	Black Mastic from HA 08 - Room T1003A, Southeast.	Miscellaneous	ND	ND	ND
2021.163.320-10A	10	1	Tan Mastic from 4" Vinyl Covebase - Room T1003A, East Wall.	Miscellaneous	ND	ND	ND
2021.163.320-10B	10	1	Tan Mastic from 4" Vinyl Covebase - Room T1003A, East Wall.	Miscellaneous	ND	ND	ND
2021.163.320-11A	11	1	Light Gray Gypsum Wallboard - Room T1003, Southeast.	Miscellaneous	ND	ND	NA
2021.163.320-11B	11	1	Light Gray Gypsum Wallboard - Room T1003, Southeast.	Miscellaneous	ND	ND	NA
2021.163.320-12A	12	1	White Joint Compound - Room T1003, South.	Miscellaneous	ND	ND	NA
2021.163.320-12B	12	1	White Joint Compound - Room T1003, South.	Miscellaneous	ND	ND	NA
2021.163.320-13A	13	1	2'x2' Fissured Drop-in Ceiling Tile - Room T1003A, Center.	Miscellaneous	ND	ND	ND
2021.163.320-13B	13	1	2'x2' Fissured Drop-in Ceiling Tile - Room T1003A, Center.	Miscellaneous	ND	ND	ND

Client: <u>Cornell University</u>	Task Authorization No.: <u>TA-355 / Work Order No.: 14577601</u>	Delta Proj. No.: <u>2021.163.206</u>
Project: <u>Vet Research Tower Lab Suite</u> <u>T2001 Fire Episode - Asbestos Bulk</u> <u>Sampling</u>	Dates Sampling Performed: <u>07/26/2022 & 08/24/2022</u>	Asbestos Inspector: <u>Michael Drobak / Thomas Ferro</u>
	Date of Report: <u>08/29/2022</u>	Number of Samples Collected: <u>100</u>
Building Code: <u>1140</u>	Laboratory: <u>AmeriSci Labs</u>	Number of Samples Analyzed: <u>PLM - 98 / TEM - 49</u>

Asbestos Bulk Sample Report Form

Sample Number	HA*	Floor	Bulk Sample Description / Details	Material Type	Asbestos Type	PLM Result % Asbestos	TEM Result % Asbestos
2021.163.320-	14A	14	1	2'x2'x2" Textured Covering from Fiberglass Drop-in Ceiling Tile - Room T1003, South.	Miscellaneous	ND	ND
2021.163.320-	14B	14	1	2'x2'x2" Textured Covering from Fiberglass Drop-in Ceiling Tile - Room T1003, South.	Miscellaneous	ND	ND
2021.163.320-	15A	15	1	Light Gray Mudded Pipe Fitting - Room T1003, South.	TSI	ND	NA
2021.163.320-	15B	15	1	Light Gray Mudded Pipe Fitting - Room T1003, South.	TSI	ND	NA
2021.163.320-	15C	15	1	Light Gray Mudded Pipe Fitting - Room T1003, South.	TSI	ND	NA
2021.163.320-	16A	16	1	Light Gray Spray-on Fireproofing - Room T1003, Southeast.	Surfacing	ND	NA
2021.163.320-	16B	16	1	Light Gray Spray-on Fireproofing - Room T1003, Southeast.	Surfacing	ND	NA
2021.163.320-	16C	16	1	Light Gray Spray-on Fireproofing - Room T1003, Southeast.	Surfacing	ND	NA
2021.163.320-	17A	17	1	Yellow Carpet Mastic - Room T1010 at Room 1010B.	Miscellaneous	ND	ND
2021.163.320-	17B	17	1	Yellow Carpet Mastic - Room T1010 at Room 1010B.	Miscellaneous	ND	ND
2021.163.320-	18A	18	1	12"x12" Light Gray w/ Gray & Blue Floor Tile - Room 1010Q, South.	Miscellaneous	ND	ND
2021.163.320-	18B	18	1	12"x12" Light Gray w/ Gray & Blue Floor Tile - Room 1010Q, South.	Miscellaneous	ND	ND
2021.163.320-	19A	19	1	Yellow Mastic from HA 18 - Room 1010Q, South.	Miscellaneous	ND	ND

Client: <u>Cornell University</u>	Task Authorization No.: <u>TA-355 / Work Order No.: 14577601</u>	Delta Proj. No.: <u>2021.163.206</u>
Project: <u>Vet Research Tower Lab Suite</u> <u>T2001 Fire Episode - Asbestos Bulk</u> <u>Sampling</u>	Dates Sampling Performed: <u>07/26/2022 & 08/24/2022</u>	Asbestos Inspector: <u>Michael Drobak / Thomas Ferro</u>
	Date of Report: <u>08/29/2022</u>	Number of Samples Collected: <u>100</u>
Building Code: <u>1140</u>	Laboratory: <u>AmeriSci Labs</u>	Number of Samples Analyzed: <u>PLM - 98 / TEM - 49</u>

Asbestos Bulk Sample Report Form

Sample Number	HA*	Floor	Bulk Sample Description / Details	Material Type	Asbestos Type	PLM Result % Asbestos	TEM Result % Asbestos
2021.163.320-	19B	19	1	Yellow Mastic from HA 18 - Room 1010Q, South.	Miscellaneous	ND	ND
2021.163.320-	20A	20	1	Light Tan Mastic from 4" Vinyl Covebase - Room T1010, at Room T1010S.	Miscellaneous	ND	ND
2021.163.320-	20B	20	1	Light Tan Mastic from 4" Vinyl Covebase - Room T1010, at Room T1010S.	Miscellaneous	ND	ND
2021.163.320-	21A	21	1	White Gypsum Wallboard - Room T1010 at Room T1010B.	Miscellaneous	ND	NA
2021.163.320-	21B	21	1	White Gypsum Wallboard - Room T1010 at Room T1010B.	Miscellaneous	ND	NA
2021.163.320-	22A	22	1	White Joint Compound - Room T1010 at Room T1010B.	Miscellaneous	ND	NA
2021.163.320-	22B	22	1	White Joint Compound - Room T1010 at Room T1010B.	Miscellaneous	ND	NA
2021.163.320-	23A	23	1	2'x4' Fissured Drop-in Ceiling Tile - Room T1010 at Room T1010B.	Miscellaneous	ND	ND
2021.163.320-	23B	23	1	2'x4' Fissured Drop-in Ceiling Tile - Room T1010 at Room T1010A.	Miscellaneous	ND	ND
2021.163.320-	24A	24	1	Light Gray Spray-on Fireproofing - Room T1010 at Room T1010A.	Surfacing	ND	NA
2021.163.320-	24B	24	1	Light Gray Spray-on Fireproofing - Room T1010P, East.	Surfacing	ND	NA
2021.163.320-	24C	24	1	Light Gray Spray-on Fireproofing - Room T1010P, West.	Surfacing	ND	NA
2021.163.320-	25A	25	2	12"x12" Light Gray Mottled Floor Tile - Room T2001.	Miscellaneous	ND	ND

Client: <u>Cornell University</u>	Task Authorization No.: <u>TA-355 / Work Order No.: 14577601</u>	Delta Proj. No.: <u>2021.163.206</u>
Project: <u>Vet Research Tower Lab Suite</u> <u>T2001 Fire Episode - Asbestos Bulk</u> <u>Sampling</u>	Dates Sampling Performed: <u>07/26/2022 & 08/24/2022</u>	Asbestos Inspector: <u>Michael Drobak / Thomas Ferro</u>
	Date of Report: <u>08/29/2022</u>	Number of Samples Collected: <u>100</u>
Building Code: <u>1140</u>	Laboratory: <u>AmeriSci Labs</u>	Number of Samples Analyzed: <u>PLM - 98 / TEM - 49</u>

Asbestos Bulk Sample Report Form

Sample Number	HA*	Floor	Bulk Sample Description / Details	Material Type	Asbestos Type	PLM Result % Asbestos	TEM Result % Asbestos
2021.163.320-	25B	25	2	12"x12" Light Gray Mottled Floor Tile - Room T2001.	Miscellaneous	ND	ND
2021.163.320-	26A	26	2	Yellow Mastic from HA 25 - Room T2001.	Miscellaneous	ND	ND
2021.163.320-	26B	26	2	Yellow Mastic from HA 25 - Room T2001.	Miscellaneous	ND	ND
2021.163.320-	27A	27	2	White Mastic from 4" Vinyl Covebase - Room T2001C.	Miscellaneous	ND	ND
2021.163.320-	27B	27	2	White Mastic from 4" Vinyl Covebase - Room T2001C.	Miscellaneous	ND	ND
2021.163.320-	28A	28	2	Light Gray Gypsum Wallboard - Room T2001C.	Miscellaneous	ND	NA
2021.163.320-	28B	28	2	Light Gray Gypsum Wallboard - Room T2001.	Miscellaneous	ND	NA
2021.163.320-	29A	29	2	White Joint Compound - Room T2001C.	Miscellaneous	ND	NA
2021.163.320-	29B	29	2	White Joint Compound - Room T2001C.	Miscellaneous	ND	NA
2021.163.320-	30A	30	2	2'x4' Fissured Drop-in Ceiling Tile - Room T2001.	Miscellaneous	ND	ND
2021.163.320-	30B	30	2	2'x4' Fissured Drop-in Ceiling Tile - Room T2001.	Miscellaneous	ND	ND
2021.163.320-	31A	31	2	Light Gray Spray-on Fireproofing - Room T2001, at Room T2001C.	Surfacing	Non-Asbestos	Trace (< 0.25%)
2021.163.320-	31B	31	2	Light Gray Spray-on Fireproofing - Room T2001, at Entrance	Surfacing	ND	ND

Client: <u>Cornell University</u>	Task Authorization No.: <u>TA-355 / Work Order No.: 14577601</u>	Delta Proj. No.: <u>2021.163.206</u>
Project: <u>Vet Research Tower Lab Suite</u> <u>T2001 Fire Episode - Asbestos Bulk</u> <u>Sampling</u>	Dates Sampling Performed: <u>07/26/2022 & 08/24/2022</u>	Asbestos Inspector: <u>Michael Drobak / Thomas Ferro</u>
	Date of Report: <u>08/29/2022</u>	Number of Samples Collected: <u>100</u>
Building Code: <u>1140</u>	Laboratory: <u>AmeriSci Labs</u>	Number of Samples Analyzed: <u>PLM - 98 / TEM - 49</u>

Asbestos Bulk Sample Report Form

Sample Number	HA*	Floor	Bulk Sample Description / Details	Material Type	Asbestos Type	PLM Result % Asbestos	TEM Result % Asbestos
2021.163.320-31C	31	2	Light Gray Spray-on Fireproofing - Room T2001, at Room T2001E.	Surfacing	Non-Asbestos	0.3%	NA
2021.163.320-32A	32	2	Labtop Backsplash Caulk - Room T2001.	Miscellaneous	ND	ND	ND
2021.163.320-32B	32	2	Labtop Backsplash Caulk - Room T2001.	Miscellaneous	ND	ND	ND
2021.163.320-33A	33	2	Black Labtop - Room T2001.	Miscellaneous	ND	ND	NA
2021.163.320-33B	33	2	Black Labtop - Room T2001.	Miscellaneous	ND	ND	NA
2021.163.320-34A	34	2	Black Labtop Adhesive - Room T2001.	Miscellaneous	ND	ND	ND
2021.163.320-34B	34	2	Black Labtop Adhesive - Room T2001.	Miscellaneous	ND	ND	ND
2021.163.320-35A	35	2	Black Seam Epoxy - Room T2001.	Miscellaneous	ND	ND	ND
2021.163.320-35B	35	2	Black Seam Epoxy - Room T2001.	Miscellaneous	ND	ND	ND
2021.163.320-36A	36	2	Black Soot Sample - Room T2001, Center.	Miscellaneous	ND	ND	NA
2021.163.320-36B	36	2	Black Soot Sample - Room T2001, Adjacent to Room T2001C.	Miscellaneous	ND	ND	NA
2021.163.320-37A	37	2	Black Burn Debris - Room T2001, East.	Miscellaneous	ND	ND	NA
2021.163.320-37B	37	2	Black Burn Debris - Room T2001, West.	Miscellaneous	ND	ND	NA

Client: <u>Cornell University</u>	Task Authorization No.: <u>TA-355 / Work Order No.: 14577601</u>	Delta Proj. No.: <u>2021.163.206</u>
Project: <u>Vet Research Tower Lab Suite T2001 Fire Episode - Asbestos Bulk Sampling</u>	Dates Sampling Performed: <u>07/26/2022 & 08/24/2022</u>	Asbestos Inspector: <u>Michael Drobak / Thomas Ferro</u>
	Date of Report: <u>08/29/2022</u>	Number of Samples Collected: <u>100</u>
Building Code: <u>1140</u>	Laboratory: <u>AmeriSci Labs</u>	Number of Samples Analyzed: <u>PLM - 98 / TEM - 49</u>

Asbestos Bulk Sample Report Form

Sample Number	HA*	Floor	Bulk Sample Description / Details	Material Type	Asbestos Type	PLM Result % Asbestos	TEM Result % Asbestos
2021.163.320-101A	101	3	Spray-on Fireproofing, Corridor T300CA, East End	Surfacing	Chrysotile	5.0%	NA
2021.163.320-101B	101	3	Spray-on Fireproofing, Corridor T300CA, Outside Room T3006	Surfacing	ND	ND	NA
2021.163.320-101C	101	3	Spray-on Fireproofing, Corridor T300CA, West End	Surfacing	Chrysotile	4.0%	NA
2021.163.320-102A	102	3	Soot, Utility Space T300UA, East End	Miscellaneous	ND	ND	NA
2021.163.320-102B	102	3	Soot, Utility Space T300UA, Center	Miscellaneous	ND	ND	NA
2021.163.320-201A	201	2	Spray-on Fireproofing: 2nd Floor, Lab Suite T2003 - Room T2003 (On Beam).	Surfacing	Chrysotile	1.5%	NA
2021.163.320-201B	201	2	Spray-on Fireproofing: 2nd Floor, Lab Suite T2003 - Room T2003A, Center (On Deck).	Surfacing	Non-Asbestos	Trace (< 0.25%)	NA
2021.163.320-201C	201	2	Spray-on Fireproofing: 2nd Floor, Lab Suite T2003 - Room T2003 (On Beam).	Surfacing	Chrysotile	2.8%	NA
2021.163.320-202A	202	2	2'x4' Light Gray Gypsum Ceiling Tile: 2nd Floor, Lab Suite T2003 - Room T2003A, Center.	Miscellaneous	ND	ND	ND
2021.163.320-202B	202	2	2'x4' Light Gray Gypsum Ceiling Tile: 2nd Floor, Lab Suite T2003 - Room T2003A, East.	Miscellaneous	ND	ND	ND
2021.163.320-203A	203	2	White Textured Covering on HA 202: 2nd Floor, Lab Suite T2003 - Room T2003A, Center.	Miscellaneous	ND	ND	ND

Client: <u>Cornell University</u>	Task Authorization No.: <u>TA-355 / Work Order No.: 14577601</u>	Delta Proj. No.: <u>2021.163.206</u>
Project: <u>Vet Research Tower Lab Suite T2001 Fire Episode - Asbestos Bulk Sampling</u>	Dates Sampling Performed: <u>07/26/2022 & 08/24/2022</u>	Asbestos Inspector: <u>Michael Drobak / Thomas Ferro</u>
	Date of Report: <u>08/29/2022</u>	Number of Samples Collected: <u>100</u>
Building Code: <u>1140</u>	Laboratory: <u>AmeriSci Labs</u>	Number of Samples Analyzed: <u>PLM - 98 / TEM - 49</u>

Asbestos Bulk Sample Report Form

Sample Number	HA*	Floor	Bulk Sample Description / Details	Material Type	Asbestos Type	PLM Result % Asbestos	TEM Result % Asbestos
2021.163.320-203B	203	2	White Textured Covering on HA 202: 2nd Floor, Lab Suite T2003 - Room T2003A, East.	Miscellaneous	ND	ND	ND
2021.163.320-204A	204	2	Spray-on Fireproofing: 2nd Floor, Lab Suite T2007 - Room T2007, East (Overspray on Ductwork).	Surfacing	Chrysotile	8.7%	NA
2021.163.320-204B	204	2	Spray-on Fireproofing: 2nd Floor Lab Suite T2007 - Room T2007, West (On	Surfacing	Chrysotile	18.2%	NA
2021.163.320-204C	204	2	Spray-on Fireproofing: 2nd Floor, Lab Suite T2007 - Room T2007A, Center (On	Surfacing	Chrysotile	21.1%	NA
2021.163.320-204D	204	2	Spray-on Fireproofing: 2nd Floor, Lab Suite T2007 - Room T2007C, West (On	Surfacing	Chrysotile	4.3%	NA
2021.163.320-204E	204	2	Spray-on Fireproofing: 2nd Floor, Lab Suite T2007 - Room T2007D, West (On	Surfacing	Chrysotile	16.7%	NA
2021.163.320-205A	205	2	Spray-on Fireproofing: 2nd Floor Corridor T200CB - West.	Surfacing	Chrysotile	14.8%	NA
2021.163.320-205B	205	2	Spray-on Fireproofing: 2nd Floor Corridor T200CB - West-Center.	Surfacing	Non-Asbestos	Trace (< 0.25%)	NA
2021.163.320-205C	205	2	Spray-on Fireproofing: 2nd Floor Corridor T200CB - Center.	Surfacing	ND	ND	NA
2021.163.320-205D	205	2	Spray-on Fireproofing: 2nd Floor Corridor T200CB - East-Center.	Surfacing	ND	ND	NA
2021.163.320-205E	205	2	Spray-on Fireproofing: 2nd Floor Corridor T200CB - East.	Surfacing	ND	ND	NA

HA - Homogenous Area **ND** - No Asbestos Detected **NA** - Not Analyzed by Methodology **NA/PS** - Not Analyzed, Positive Stop

TSI - Thermal System Insulation **Misc** - Miscellaneous Material **Trace / < 1%** - Non-asbestos by definition

Attachment B

Laboratory Analytical Result Sheets

**AmeriSci New York**

117 EAST 30TH ST.
NEW YORK, NY 10016
TEL: (212) 679-8600 • FAX: (212) 679-3114

PLM Bulk Asbestos Report

Delta Engineers
Attn: Stephen Prislupsky
860 Hooper Road

Endwell, NY 13760

Date Received 07/27/22 **AmeriSci Job #** 222074019
Date Examined 07/27/22 **P.O. #**
ELAP # 11480 **Page** 1 of 14
RE: 2021.163.320; Cornell University; Vet Research Tower 2nd Floor
Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk Sampling

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-01A 01	222074019-01 Location: Floor 1, Room T1003, Northwest - Yellow/Gray Carpet Mastic	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Yellow/Gray, Heterogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 26.4%			
2021.163.320-01B 01	222074019-02 Location: Floor 1, Room T1003, Northeast - Yellow/Gray Carpet Mastic	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Yellow/Gray, Heterogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 27%			
2021.163.320-02A 02	222074019-03 Location: Floor 1, Room T1003, North - Red Rolled Vinyl Sheet Flooring	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Red, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 9%			
2021.163.320-02B 02	222074019-04 Location: Floor 1, Room T1003, North - Red Rolled Vinyl Sheet Flooring	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Red, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 6.4%			
2021.163.320-03A 03	222074019-05 Location: Floor 1, Room T1003, North - Gray Mastic From HA 02	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Yellow/Gray, Heterogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 40.9%			

PLM Bulk Asbestos Report

2021.163.320; Cornell University; Vet Research Tower 2nd
Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk
Sampling

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-03B 03 Location: Floor 1, Room T1003, North - Gray Mastic From HA 02	222074019-06	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Yellow/Gray, Heterogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 25%			
2021.163.320-04A 04 Location: Floor 1, Room T1003, Northeast - Gray Rolled Vinyl Sheet Flooring	222074019-07	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Beige, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 12.2%			
2021.163.320-04B 04 Location: Floor 1, Room T1003, Northwest - Gray Rolled Vinyl Sheet Flooring	222074019-08	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Beige, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 12.5%			
2021.163.320-05A 05 Location: Floor 1, Room T1003, Northeast - Gray Mastic From HA 04	222074019-09	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Yellow/Gray, Heterogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 23.8%			
2021.163.320-05B 05 Location: Floor 1, Room T1003, Northwest - Gray Mastic From HA 04	222074019-10	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Yellow/Gray, Heterogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 23.7%			
2021.163.320-06A 06 Location: Floor 1, Room T1003, Northwest Under HA 03 & HA 04 - 12" x 12" White W/ Gray & Blue Mottle Floor Tile	222074019-11	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: White/Blue, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 40.3%			

PLM Bulk Asbestos Report

2021.163.320; Cornell University; Vet Research Tower 2nd
Floor Fire Episode - 1st, 2nd and 3rd Floors Asbestos Bulk
Sampling

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-06B 06	222074019-12	No	NAD
Location: Floor 1, Room T1003, Northwest Under HA 03 & HA 04 - 12" x 12" White W/ Gray & Blue Mottle Floor Tile			(by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: White/Blue, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 35.2%			
2021.163.320-07A 07	222074019-13		NA
Location: Floor 1, Room T1003, Northwest - Yellow Mastic From HA 06 "Insufficient Material Submitted For Preparation"			
Analyst Description: Bulk Material Asbestos Types: Other Material:			
2021.163.320-07B 07	222074019-14	No	NAD
Location: Floor 1, Room T1003, Northwest - Yellow Mastic From HA 06			(by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Yellow, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 13.9%			
2021.163.320-08A 08	222074019-15	Yes	2.1%
Location: Floor 1, Room T1003A, Southeast - 12" x 12" Brown W/ White Mottle Floor Tile			(by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Brown/Gray, Homogeneous, Fibrous, Bulk Material Asbestos Types: Chrysotile 2.1 % Other Material: Non-fibrous 9.6%			
2021.163.320-08B 08	222074019-16		NA/PS
Location: Floor 1, Room T1003A, Southeast - 12" x 12" Brown W/ White Mottle Floor Tile			
Analyst Description: Bulk Material Asbestos Types: Other Material:			
2021.163.320-09A 09	222074019-17	No	NAD
Location: Floor 1, Room T1003A, Southeast - Black Mastic From HA 08			(by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Black, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 24.2%			

PLM Bulk Asbestos Report

2021.163.320; Cornell University; Vet Research Tower 2nd
Floor Fire Epside - 1st, 2nd and 3rd Floors Asbestos Bulk
Sampling

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-09B 09	222074019-18 Location: Floor 1, Room T1003A, Southeast - Black Mastic From HA 08	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Black, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 14.9%			
2021.163.320-10A 10	222074019-19 Location: Floor 1, Room T1003A, East Wall - Tan Mastic From 4" Vinyl Covebase	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Tan/White, Heterogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 32.3%			
2021.163.320-10B 10	222074019-20 Location: Floor 1, Room T1003A, East Wall - Tan Mastic From 4" Vinyl Covebase	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Tan/White, Heterogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 39%			
2021.163.320-11A 11	222074019-21 Location: Floor 1, Room T1003, Southeast - Light Gray Gypsum Wallboard	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Lt. Gray/Brown, Heterogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose 10%, Fibrous glass 1%, Non-fibrous 89%			
2021.163.320-11B 11	222074019-22 Location: Floor 1, Room T1003, Southeast - Light Gray Gypsum Wallboard	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Lt. Gray, Homogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose 1%, Fibrous glass 1%, Non-fibrous 98%			
2021.163.320-12A 12	222074019-23 Location: Floor 1, Room T1003, South - White Joint Compound	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Non-fibrous 100%			

PLM Bulk Asbestos Report

2021.163.320; Cornell University; Vet Research Tower 2nd
Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk
Sampling

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-12B 12	222074019-24 Location: Floor 1, Room T1003, South - White Joint Compound	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Non-fibrous 100%			
2021.163.320-13A 13	222074019-25 Location: Floor 1, Room T1003A, Center - 2' x 2' Fissured Drop-In Ceiling Tile	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: White/Gray, Heterogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 14%			
2021.163.320-13B 13	222074019-26 Location: Floor 1, Room T1003A, Center - 2' x 2' Fissured Drop-In Ceiling Tile	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: White/Gray, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 10.2%			
2021.163.320-14A 14	222074019-27 Location: Floor 1, Room T1003 South - 2' x 2' x 2" Textured Covering From Fiberglass Drop-In Ceiling Tile	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: White/Yellow, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 58.6%			
2021.163.320-14B 14	222074019-28 Location: Floor 1, Room T1003 South - 2' x 2' x 2" Textured Covering From Fiberglass Drop-In Ceiling Tile	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: White/Yellow, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 54.6%			
2021.163.320-15A 15	222074019-29 Location: Floor 1, Room T1003 South - Light Gray Mudded Pipe Fitting	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Gray, Homogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Fibrous glass 25%, Non-fibrous 75%			

PLM Bulk Asbestos Report

2021.163.320; Cornell University; Vet Research Tower 2nd
Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk
Sampling

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-15B 15	222074019-30 Location: Floor 1, Room T1003 South - Light Gray Mudded Pipe Fitting	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Gray, Homogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Fibrous glass 20%, Non-fibrous 80%			
2021.163.320-15C 15	222074019-31 Location: Floor 1, Room T1003 South - Light Gray Mudded Pipe Fitting	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Gray, Homogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Fibrous glass 20%, Non-fibrous 80%			
2021.163.320-16A 16	222074019-32 Location: Floor 1, Room T1003 Southeast - Light Gray Spray-On Fireproofing	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Beige, Homogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Fibrous glass 65%, Non-fibrous 35%			
2021.163.320-16B 16	222074019-33 Location: Floor 1, Room T1003 Southeast - Light Gray Spray-On Fireproofing	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Beige, Homogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Fibrous glass 70%, Non-fibrous 30%			
2021.163.320-16C 16	222074019-34 Location: Floor 1, Room T1003 Southeast - Light Gray Spray-On Fireproofing	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Beige, Homogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Fibrous glass 65%, Non-fibrous 35%			
2021.163.320-17A 17	222074019-35 Location: Floor 1, Room T1010 At Room 1010B - Yellow Carpet Mastic	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Yellow, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 39.4%			

PLM Bulk Asbestos Report

2021.163.320; Cornell University; Vet Research Tower 2nd
Floor Fire Epside - 1st, 2nd and 3rd Floors Asbestos Bulk
Sampling

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-17B 17	222074019-36 Location: Floor 1, Room T1010 At Room 1010B - Yellow Carpet Mastic	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Yellow, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 36.2%			
2021.163.320-18A 18	222074019-37 Location: Floor 1, Room 1010Q, South - 12" x 12" Light Gray W/ Gray & Blue Floor Tile	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Off-White, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 3.5%			
2021.163.320-18B 18	222074019-38 Location: Floor 1, Room 1010Q, South - 12" x 12" Light Gray W/ Gray & Blue Floor Tile	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Off-White, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 7.7%			
2021.163.320-19A 19	222074019-39 Location: Floor 1, Room 1010Q, South - Yellow Mastic From HA 18	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Yellow, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 4.6%			
2021.163.320-19B 19	222074019-40 Location: Floor 1, Room 1010Q, South - Yellow Mastic From HA 18	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Yellow, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 6.5%			
2021.163.320-20A 20	222074019-41 Location: Floor 1, Room 1010, At Room 1010S - Light Tan Mastic From 4" Vinyl Covebase	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Beige, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 55.8%			

PLM Bulk Asbestos Report

2021.163.320; Cornell University; Vet Research Tower 2nd
Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk
Sampling

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-20B 20	222074019-42	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Location: Floor 1, Room 1010, At Room 1010S - Light Tan Mastic From 4" Vinyl Covebase Analyst Description: Beige, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 43.6%			
2021.163.320-21A 21	222074019-43	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Location: Floor 1, Room 1010 At Room 1010B - White Gypsum Wallboard Analyst Description: White/Brown, Heterogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose 8%, Fibrous glass 1%, Non-fibrous 91%			
2021.163.320-21B 21	222074019-44	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Location: Floor 1, Room 1010 At Room 1010B - White Gypsum Wallboard Analyst Description: White/Brown, Heterogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose 10%, Fibrous glass 1%, Non-fibrous 89%			
2021.163.320-22A 22	222074019-45	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Location: Floor 1, Room 1010 At Room 1010B - White Joint Compound Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Non-fibrous 100%			
2021.163.320-22B 22	222074019-46	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Location: Floor 1, Room 1010 At Room 1010B - White Joint Compound Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Non-fibrous 100%			
2021.163.320-23A 23	222074019-47	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Location: Floor 1, Room 1010 At Room 1010B - 2' x 4' Fissured Drop-In Ceiling Tile Analyst Description: White/Gray, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 53.8%			

PLM Bulk Asbestos Report

2021.163.320; Cornell University; Vet Research Tower 2nd
Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk
Sampling

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-23B 23	222074019-48 Location: Floor 1, Room 1010 At Room 1010A - 2' x 4' Fissured Drop-In Ceiling Tile	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: White/Gray, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 54%			
2021.163.320-24A 24	222074019-49 Location: Floor 1, Room 1010 At Room 1010A - Light Gray Spray-On Fireproofing	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Beige, Homogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Fibrous glass 55%, Non-fibrous 45%			
2021.163.320-24B 24	222074019-50 Location: Floor 1, Room 1010P, East - Light Gray Spray-On Fireproofing	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Beige, Homogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Fibrous glass 50%, Non-fibrous 50%			
2021.163.320-24C 24	222074019-51 Location: Floor 1, Room 1010P, West - Light Gray Spray-On Fireproofing	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Beige, Homogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Fibrous glass 55%, Non-fibrous 45%			
2021.163.320-25A 25	222074019-52 Location: Floor 2, Room T2001 - 12" x 12" Light Gray Mottled Floor Tile	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Lt. Gray, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 2.9%			
2021.163.320-25B 25	222074019-53 Location: Floor 2, Room T2001 - 12" x 12" Light Gray Mottled Floor Tile	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Lt. Gray, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 3.1%			

PLM Bulk Asbestos Report

2021.163.320; Cornell University; Vet Research Tower 2nd
Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk
Sampling

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-26A 26	222074019-54 Location: Floor 2, Room T2001 - Yellow Mastic From HA 25	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Yellow/Gray, Heterogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 25%			
2021.163.320-26B 26	222074019-55 Location: Floor 2, Room T2001 - Yellow Mastic From HA 25	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Yellow/Gray, Heterogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 25.4%			
2021.163.320-27A 27	222074019-56 Location: Floor 2, Room T2001C - White Mastic From 4" Vinyl Covebase	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Beige, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 44.3%			
2021.163.320-27B 27	222074019-57 Location: Floor 2, Room T2001C - White Mastic From 4" Vinyl Covebase	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Beige, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 44.1%			
2021.163.320-28A 28	222074019-58 Location: Floor 2, Room T2001C - Light Gray Gypsum Wallboard	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Off-White/Brown, Heterogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose 13%, Fibrous glass Trace, Non-fibrous 87%			
2021.163.320-28B 28	222074019-59 Location: Floor 2, Room T2001 - Light Gray Gypsum Wallboard	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Gray, Homogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Fibrous glass 2%, Non-fibrous 98%			

PLM Bulk Asbestos Report

2021.163.320; Cornell University; Vet Research Tower 2nd
Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk
Sampling

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-29A 29	222074019-60 Location: Floor 2, Room T2001C - White Joint Compound	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Non-fibrous 100%			
2021.163.320-29B 29	222074019-61 Location: Floor 2, Room T2001C - White Joint Compound	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Non-fibrous 100%			
2021.163.320-30A 30	222074019-62 Location: Floor 2, Room T2001 - 2' x 4' Fissured Drop-In Ceiling Tile	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Gray/Beige, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 39.7%			
2021.163.320-30B 30	222074019-63 Location: Floor 2, Room T2001 - 2' x 4' Fissured Drop-In Ceiling Tile	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Gray/Beige, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 34.4%			
2021.163.320-31A 31	222074019-64 Location: Floor 2, Room T2001, At Room T2001C - Light Gray Spray-On Fireproofing	Yes	Trace (<0.25 % pc) (ELAP 400 PC) by Valeriu Voicu on 07/27/22
Analyst Description: Gray, Homogeneous, Fibrous, Bulk Material Asbestos Types: Chrysotile <0.25 % pc Other Material: Cellulose Trace, Fibrous glass 45%, Non-fibrous 55%			
2021.163.320-31B 31	222074019-65 Location: Floor 2, Room T2001, At Entrance - Light Gray Spray-On Fireproofing	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Beige/Gray, Homogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Fibrous glass 60%, Non-fibrous 40%			

PLM Bulk Asbestos Report

2021.163.320; Cornell University; Vet Research Tower 2nd
Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk
Sampling

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-31C 31	222074019-66 Location: Floor 2, Room T2001, At Room T2001E - Light Gray Spray-On Fireproofing	Yes	0.3% (ELAP 400 PC) by Valeriu Voicu on 07/27/22
Analyst Description: Gray, Homogeneous, Fibrous, Bulk Material Asbestos Types: Chrysotile 0.3 % Other Material: Cellulose Trace, Fibrous glass 55%, Non-fibrous 44.7%			
2021.163.320-32A 32	222074019-67 Location: Floor 2, Room T2001 - Labtop Backsplash Caulk	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Clear, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 26.3%			
2021.163.320-32B 32	222074019-68 Location: Floor 2, Room T2001 - Labtop Backsplash Caulk	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Clear, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 16.8%			
2021.163.320-33A 33	222074019-69 Location: Floor 2, Room T2001 - Black Labtop	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Black, Homogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose 35%, Non-fibrous 65%			
2021.163.320-33B 33	222074019-70 Location: Floor 2, Room T2001 - Black Labtop	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Black, Homogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose 30%, Non-fibrous 70%			
2021.163.320-34A 34	222074019-71 Location: Floor 2, Room T2001 - Black Labtop Adhesive	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Black, Homogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Wollastonite 3%, Non-fibrous 31.6%			

PLM Bulk Asbestos Report

2021.163.320; Cornell University; Vet Research Tower 2nd
Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk
Sampling

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-34B 34	222074019-72 Location: Floor 2, Room T2001 - Black Labtop Adhesive	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Black, Homogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 33.6%			
2021.163.320-35A 35	222074019-73 Location: Floor 2, Room T2001 - Black Seam Epoxy	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Black, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Wollastonite 5%, Non-fibrous 23.2%			
2021.163.320-35B 35	222074019-74 Location: Floor 2, Room T2001 - Black Seam Epoxy	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Black, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Wollastonite 2%, Non-fibrous 30.4%			
2021.163.320-36A 36	222074019-75 Location: Floor 2, Room T2001, Center - Black Soot Sample	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Black, Heterogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Fibrous glass 15%, Non-fibrous 85%			
2021.163.320-36B 36	222074019-76 Location: Floor 2, Room T2001, Adjacent To Room T2001C - Black Soot Sample	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Dark Gray/Black, Heterogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose 5%, Fibrous glass Trace, Non-fibrous 95%			
2021.163.320-37A 37	222074019-77 Location: Floor 2, Room T2001, East - Black Burn Debris	No	NAD ¹ (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Black, Heterogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose 20%, Fibrous glass Trace, Non-fibrous 80%			

PLM Bulk Asbestos Report

2021.163.320; Cornell University; Vet Research Tower 2nd
Floor Fire Episode - 1st, 2nd and 3rd Floors Asbestos Bulk
Sampling

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-37B 37	222074019-78 Location: Floor 2, Room T2001, West - Black Burn Debris	No	NAD ¹ (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Black/Gray, Heterogeneous, Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Cellulose 15%, Fibrous glass 3%, Non-fibrous 82%			

Reporting Notes:

(1) Analysis Results For Soil, Dust, Or Debris May Be Highly Variable Because Of The Heterogeneous Nature Of These Samples

Analyzed by: Valeriu Voicu
Date: 7/27/2022



Reviewed by: Khaalid W. Perine



*NAD/NSD =no asbestos detected; NA =not analyzed; NA/PS=not analyzed/positive stop, (SOF-V) = Sprayed On Fireproofing containing Vermiculite; (SM-V) = Surfacing Material containing Vermiculite; PLM Bulk Asbestos Analysis using Olympus, Model BH-2 Pol Scope, Microscope, Serial #: 229915, by Appd E to Subpt E, 40 CFR 763 quantified by either CVES or 400 pt ct as noted for each analysis (NVLAP 200546-0), ELAP PLM Method 198.1 for NY friable samples, which includes the identification and quantitation of vermiculite, or ELAP 198.6 for NOB samples, or EPA 400 pt ct by EPA 600-M4-82-020 (NY ELAP Lab 11480); Note:PLM is not consistently reliable in detecting asbestos in floor coverings and similar non-friable organically bound materials. NAD or Trace results by PLM are inconclusive, TEM is currently the only method that can be used to determine if this material can be considered or treated as non asbestos-containing in NY State (also see EPA Advisory for floor tile, FR 59,146,38970,8/1/94) National Institute of Standards and Technology Accreditation requirements mandate that this report must not be reproduced except in full without the approval of the lab.This PLM report relates ONLY to the items tested. RI Cert AAL-094, CT Cert PH-0186, Mass Cert AA000054, NJ Lab ID #NY031.

_____END OF REPORT_____

Client Name: Delta Engineers

Table I
Summary of Bulk Asbestos Analysis Results

2021.163.320; Cornell University; Vet Research Tower 2nd Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk Sampling

AmeriSci Sample #	Client Sample#	HG Area	Sample Weight (gram)	Heat Sensitive Organic %	Acid Soluble Inorganic %	Insoluble Non-Asbestos Inorganic %	** Asbestos % by PLM/DS	** Asbestos % by TEM
01	2021.163.320-01A	01	0.192	41.4	32.2	26.4	NAD	NAD
	Location: Floor 1, Room T1003, Northwest - Yellow/Gray Carpet Mastic							
02	2021.163.320-01B	01	0.098	35.5	37.5	27.0	NAD	NAD
	Location: Floor 1, Room T1003, Northeast - Yellow/Gray Carpet Mastic							
03	2021.163.320-02A	02	0.191	78.8	12.2	9.0	NAD	NAD
	Location: Floor 1, Room T1003, North - Red Rolled Vinyl Sheet Flooring							
04	2021.163.320-02B	02	0.200	80.2	13.4	6.4	NAD	NAD
	Location: Floor 1, Room T1003, North - Red Rolled Vinyl Sheet Flooring							
05	2021.163.320-03A	03	0.062	17.0	42.1	40.9	NAD	NAD
	Location: Floor 1, Room T1003, North - Gray Mastic From HA 02							
06	2021.163.320-03B	03	0.128	45.1	29.9	25.0	NAD	NAD
	Location: Floor 1, Room T1003, North - Gray Mastic From HA 02							
07	2021.163.320-04A	04	0.171	76.0	11.9	12.2	NAD	NAD
	Location: Floor 1, Room T1003, Northeast - Gray Rolled Vinyl Sheet Flooring							
08	2021.163.320-04B	04	0.230	77.1	10.4	12.5	NAD	NAD
	Location: Floor 1, Room T1003, Northwest - Gray Rolled Vinyl Sheet Flooring							
09	2021.163.320-05A	05	0.081	44.1	32.1	23.8	NAD	NAD
	Location: Floor 1, Room T1003, Northeast - Gray Mastic From HA 04							
10	2021.163.320-05B	05	0.120	43.8	32.6	23.7	NAD	NAD
	Location: Floor 1, Room T1003, Northwest - Gray Mastic From HA 04							
11	2021.163.320-06A	06	0.284	16.7	43.0	40.3	NAD	NAD
	Location: Floor 1, Room T1003, Northwest Under HA 03 & HA 04 - 12" x 12" White W/ Gray & Blue Mottle Floor Tile							
12	2021.163.320-06B	06	0.300	16.7	48.1	35.2	NAD	NAD
	Location: Floor 1, Room T1003, Northwest Under HA 03 & HA 04 - 12" x 12" White W/ Gray & Blue Mottle Floor Tile							
13	2021.163.320-07A	07	----	----	----	----	NA	NA
	Location: Floor 1, Room T1003, Northwest - Yellow Mastic From HA 06 "Insufficient Material Submitted For Preparation"							
14	2021.163.320-07B	07	0.057	65.9	20.2	13.9	NAD	NAD
	Location: Floor 1, Room T1003, Northwest - Yellow Mastic From HA 06							
15	2021.163.320-08A	08	0.257	24.3	63.9	9.6	Chrysotile 2.1	NA
	Location: Floor 1, Room T1003A, Southeast - 12" x 12" Brown W/ White Mottle Floor Tile							
16	2021.163.320-08B	08	0.274	24.0	68.1	7.9	NA/PS	NA
	Location: Floor 1, Room T1003A, Southeast - 12" x 12" Brown W/ White Mottle Floor Tile							

See Reporting notes on last page

Client Name: Delta Engineers

Table I
Summary of Bulk Asbestos Analysis Results

2021.163.320; Cornell University; Vet Research Tower 2nd Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk Sampling

AmeriSci Sample #	Client Sample#	HG Area	Sample Weight (gram)	Heat Sensitive Organic %	Acid Soluble Inorganic %	Insoluble Non-Asbestos Inorganic %	** Asbestos % by PLM/DS	** Asbestos % by TEM
17	2021.163.320-09A	09	0.120	67.3	8.6	24.2	NAD	NAD
	Location: Floor 1, Room T1003A, Southeast - Black Mastic From HA 08							
18	2021.163.320-09B	09	0.083	74.3	10.8	14.9	NAD	NAD
	Location: Floor 1, Room T1003A, Southeast - Black Mastic From HA 08							
19	2021.163.320-10A	10	0.371	47.2	20.5	32.3	NAD	NAD
	Location: Floor 1, Room T1003A, East Wall - Tan Mastic From 4" Vinyl Covebase							
20	2021.163.320-10B	10	0.334	50.6	10.5	39.0	NAD	NAD
	Location: Floor 1, Room T1003A, East Wall - Tan Mastic From 4" Vinyl Covebase							
21	2021.163.320-11A	11	----	----	----	----	NAD	NA
	Location: Floor 1, Room T1003, Southeast - Light Gray Gypsum Wallboard							
22	2021.163.320-11B	11	----	----	----	----	NAD	NA
	Location: Floor 1, Room T1003, Southeast - Light Gray Gypsum Wallboard							
23	2021.163.320-12A	12	----	----	----	----	NAD	NA
	Location: Floor 1, Room T1003, South - White Joint Compound							
24	2021.163.320-12B	12	----	----	----	----	NAD	NA
	Location: Floor 1, Room T1003, South - White Joint Compound							
25	2021.163.320-13A	13	0.513	81.3	4.7	14.0	NAD	NAD
	Location: Floor 1, Room T1003A, Center - 2' x 2' Fissured Drop-In Ceiling Tile							
26	2021.163.320-13B	13	0.231	79.5	10.3	10.2	NAD	NAD
	Location: Floor 1, Room T1003A, Center - 2' x 2' Fissured Drop-In Ceiling Tile							
27	2021.163.320-14A	14	0.256	18.4	23.0	58.6	NAD	NAD
	Location: Floor 1, Room T1003 South - 2' x 2' x 2" Textured Covering From Fiberglass Drop-In Ceiling Tile							
28	2021.163.320-14B	14	0.290	18.3	27.1	54.6	NAD	NAD
	Location: Floor 1, Room T1003 South - 2' x 2' x 2" Textured Covering From Fiberglass Drop-In Ceiling Tile							
29	2021.163.320-15A	15	----	----	----	----	NAD	NA
	Location: Floor 1, Room T1003 South - Light Gray Mudded Pipe Fitting							
30	2021.163.320-15B	15	----	----	----	----	NAD	NA
	Location: Floor 1, Room T1003 South - Light Gray Mudded Pipe Fitting							
31	2021.163.320-15C	15	----	----	----	----	NAD	NA
	Location: Floor 1, Room T1003 South - Light Gray Mudded Pipe Fitting							
32	2021.163.320-16A	16	----	----	----	----	NAD	NA
	Location: Floor 1, Room T1003 Southeast - Light Gray Spray-On Fireproofing							

Client Name: Delta Engineers

Table I
Summary of Bulk Asbestos Analysis Results

2021.163.320; Cornell University; Vet Research Tower 2nd Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk Sampling

AmeriSci Sample #	Client Sample#	HG Area	Sample Weight (gram)	Heat Sensitive Organic %	Acid Soluble Inorganic %	Insoluble Non-Asbestos Inorganic %	** Asbestos % by PLM/DS	** Asbestos % by TEM
33	2021.163.320-16B	16	----	----	----	----	NAD	NA
	Location: Floor 1, Room T1003 Southeast - Light Gray Spray-On Fireproofing							
34	2021.163.320-16C	16	----	----	----	----	NAD	NA
	Location: Floor 1, Room T1003 Southeast - Light Gray Spray-On Fireproofing							
35	2021.163.320-17A	17	0.186	49.5	11.1	39.4	NAD	NAD
	Location: Floor 1, Room T1010 At Room 1010B - Yellow Carpet Mastic							
36	2021.163.320-17B	17	0.229	49.2	14.6	36.2	NAD	NAD
	Location: Floor 1, Room T1010 At Room 1010B - Yellow Carpet Mastic							
37	2021.163.320-18A	18	0.269	14.5	82.0	3.5	NAD	NAD
	Location: Floor 1, Room 1010Q, South - 12" x 12" Light Gray W/ Gray & Blue Floor Tile							
38	2021.163.320-18B	18	0.050	90.3	2.0	7.7	NAD	NAD
	Location: Floor 1, Room 1010Q, South - 12" x 12" Light Gray W/ Gray & Blue Floor Tile							
39	2021.163.320-19A	19	0.050	90.3	5.0	4.6	NAD	NAD
	Location: Floor 1, Room 1010Q, South - Yellow Mastic From HA 18							
40	2021.163.320-19B	19	0.023	89.2	4.3	6.5	NAD	NAD
	Location: Floor 1, Room 1010Q, South - Yellow Mastic From HA 18							
41	2021.163.320-20A	20	0.160	35.2	9.0	55.8	NAD	NAD
	Location: Floor 1, Room 1010, At Room 1010S - Light Tan Mastic From 4" Vinyl Covebase							
42	2021.163.320-20B	20	0.075	39.5	16.9	43.6	NAD	NAD
	Location: Floor 1, Room 1010, At Room 1010S - Light Tan Mastic From 4" Vinyl Covebase							
43	2021.163.320-21A	21	----	----	----	----	NAD	NA
	Location: Floor 1, Room 1010 At Room 1010B - White Gypsum Wallboard							
44	2021.163.320-21B	21	----	----	----	----	NAD	NA
	Location: Floor 1, Room 1010 At Room 1010B - White Gypsum Wallboard							
45	2021.163.320-22A	22	----	----	----	----	NAD	NA
	Location: Floor 1, Room 1010 At Room 1010B - White Joint Compound							
46	2021.163.320-22B	22	----	----	----	----	NAD	NA
	Location: Floor 1, Room 1010 At Room 1010B - White Joint Compound							
47	2021.163.320-23A	23	0.229	27.0	19.2	53.8	NAD	NAD
	Location: Floor 1, Room 1010 At Room 1010B - 2' x 4' Fissured Drop-In Ceiling Tile							
48	2021.163.320-23B	23	0.170	27.0	18.9	54.0	NAD	NAD
	Location: Floor 1, Room 1010 At Room 1010A - 2' x 4' Fissured Drop-In Ceiling Tile							

Client Name: Delta Engineers

Table I
Summary of Bulk Asbestos Analysis Results

2021.163.320; Cornell University; Vet Research Tower 2nd Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk Sampling

AmeriSci Sample #	Client Sample#	HG Area	Sample Weight (gram)	Heat Sensitive Organic %	Acid Soluble Inorganic %	Insoluble Non-Asbestos Inorganic %	** Asbestos % by PLM/DS	** Asbestos % by TEM
49	2021.163.320-24A	24	----	----	----	----	NAD	NA
	Location: Floor 1, Room 1010 At Room 1010A - Light Gray Spray-On Fireproofing							
50	2021.163.320-24B	24	----	----	----	----	NAD	NA
	Location: Floor 1, Room 1010P, East - Light Gray Spray-On Fireproofing							
51	2021.163.320-24C	24	----	----	----	----	NAD	NA
	Location: Floor 1, Room 1010P, West - Light Gray Spray-On Fireproofing							
52	2021.163.320-25A	25	0.286	4.0	93.1	2.9	NAD	NAD
	Location: Floor 2, Room T2001 - 12" x 12" Light Gray Mottled Floor Tile							
53	2021.163.320-25B	25	0.261	14.4	82.5	3.1	NAD	NAD
	Location: Floor 2, Room T2001 - 12" x 12" Light Gray Mottled Floor Tile							
54	2021.163.320-26A	26	0.128	45.2	29.8	25.0	NAD	NAD
	Location: Floor 2, Room T2001 - Yellow Mastic From HA 25							
55	2021.163.320-26B	26	0.138	35.5	39.1	25.4	NAD	NAD
	Location: Floor 2, Room T2001 - Yellow Mastic From HA 25							
56	2021.163.320-27A	27	0.153	35.1	20.6	44.3	NAD	NAD
	Location: Floor 2, Room T2001C - White Mastic From 4" Vinyl Covebase							
57	2021.163.320-27B	27	0.130	33.2	22.7	44.1	NAD	NAD
	Location: Floor 2, Room T2001C - White Mastic From 4" Vinyl Covebase							
58	2021.163.320-28A	28	----	----	----	----	NAD	NA
	Location: Floor 2, Room T2001C - Light Gray Gypsum Wallboard							
59	2021.163.320-28B	28	----	----	----	----	NAD	NA
	Location: Floor 2, Room T2001 - Light Gray Gypsum Wallboard							
60	2021.163.320-29A	29	----	----	----	----	NAD	NA
	Location: Floor 2, Room T2001C - White Joint Compound							
61	2021.163.320-29B	29	----	----	----	----	NAD	NA
	Location: Floor 2, Room T2001C - White Joint Compound							
62	2021.163.320-30A	30	0.167	18.7	41.6	39.7	NAD	NAD
	Location: Floor 2, Room T2001 - 2' x 4' Fissured Drop-In Ceiling Tile							
63	2021.163.320-30B	30	0.232	17.7	47.8	34.4	NAD	NAD
	Location: Floor 2, Room T2001 - 2' x 4' Fissured Drop-In Ceiling Tile							
64	2021.163.320-31A	31	----	----	----	----	Chrysotile <0.25	NA
	Location: Floor 2, Room T2001, At Room T2001C - Light Gray Spray-On Fireproofing							

Client Name: Delta Engineers

Table I
Summary of Bulk Asbestos Analysis Results

2021.163.320; Cornell University; Vet Research Tower 2nd Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk Sampling

AmeriSci Sample #	Client Sample#	HG Area	Sample Weight (gram)	Heat Sensitive Organic %	Acid Soluble Inorganic %	Insoluble Non-Asbestos Inorganic %	** Asbestos % by PLM/DS	** Asbestos % by TEM
65	2021.163.320-31B	31	----	----	----	----	NAD	NA
	Location: Floor 2, Room T2001, At Entrance - Light Gray Spray-On Fireproofing							
66	2021.163.320-31C	31	----	----	----	----	Chrysotile 0.3	NA
	Location: Floor 2, Room T2001, At Room T2001E - Light Gray Spray-On Fireproofing							
67	2021.163.320-32A	32	0.245	61.5	12.2	26.3	NAD	NAD
	Location: Floor 2, Room T2001 - Labtop Backsplash Caulk							
68	2021.163.320-32B	32	0.284	70.0	13.2	16.8	NAD	NAD
	Location: Floor 2, Room T2001 - Labtop Backsplash Caulk							
69	2021.163.320-33A	33	----	----	----	----	NAD	NA
	Location: Floor 2, Room T2001 - Black Labtop							
70	2021.163.320-33B	33	----	----	----	----	NAD	NA
	Location: Floor 2, Room T2001 - Black Labtop							
71	2021.163.320-34A	34	0.176	60.1	5.3	34.6	NAD	NAD
	Location: Floor 2, Room T2001 - Black Labtop Adhesive							
72	2021.163.320-34B	34	0.060	60.7	5.7	33.6	NAD	NAD
	Location: Floor 2, Room T2001 - Black Labtop Adhesive							
73	2021.163.320-35A	35	0.123	61.6	10.2	28.2	NAD	NAD
	Location: Floor 2, Room T2001 - Black Seam Epoxy							
74	2021.163.320-35B	35	0.108	56.6	10.9	32.4	NAD	NAD
	Location: Floor 2, Room T2001 - Black Seam Epoxy							
75	2021.163.320-36A	36	----	----	----	----	NAD	NA
	Location: Floor 2, Room T2001, Center - Black Soot Sample							
76	2021.163.320-36B	36	----	----	----	----	NAD	NA
	Location: Floor 2, Room T2001, Adjacent To Room T2001C - Black Soot Sample							
77	2021.163.320-37A	37	----	----	----	----	NAD	NA
	Location: Floor 2, Room T2001, East - Black Burn Debris							
78	2021.163.320-37B	37	----	----	----	----	NAD	NA
	Location: Floor 2, Room T2001, West - Black Burn Debris							

Client Name: Delta Engineers

Table I
Summary of Bulk Asbestos Analysis Results

2021.163.320; Cornell University; Vet Research Tower 2nd Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk Sampling

AmeriSci Sample #	Client Sample#	HG Area	Sample Weight (gram)	Heat Sensitive Organic %	Acid Soluble Inorganic %	Insoluble Non-Asbestos Inorganic %	** Asbestos % by PLM/DS	** Asbestos % by TEM
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Analyzed by: Khaalid W. Perine
Date: 7/28/2022



Reviewed by: Khaalid W. Perine



**Quantitative Analysis (Semi/Full); Bulk Asbestos Analysis - PLM by Appd E to Subpt E, 40 CFR 763 or NYSDOH ELAP 198.1 for New York friable samples or NYSDOH ELAP 198.6 for New York NOB samples; TEM (Semi/Full) by EPA 600/R-93/116 (or NYSDOH ELAP 198.4; for New York samples). Analysis using Hitachi, Model H600-Noran 7 System, Microscope, Serial #: 542-26-10. NAD = no asbestos detected during a quantitative analysis; NA = not analyzed; Trace = <1%; (SOF-V) = Sprayed On Fireproofing containing Vermiculite; (SM-V) = Surfacing Material containing Vermiculite; Quantitation for beginning weights of <0.1 grams should be considered as qualitative only; Qualitative Analysis: Asbestos analysis results of "Present" or "NVA = No Visible Asbestos" represents results for Qualitative PLM or TEM Analysis only (no accreditation coverage available from any regulatory agency for qualitative analyses): NVLAP (PLM) 200546-0, NYSDOH ELAP Lab 11480, NJ Lab ID #NY031.

Warning Note: PLM limitation, only TEM will resolve fibers <0.25 micrometers in diameter. TEM bulk analysis is representative of the fine grained matrix material and may not be representative of non-uniformly dispersed debris for which PLM evaluation is recommended (i.e. soils and other heterogenous materials).

Client: Cornell University	Delta Project No.: 2021.163.320	Date: 7/26/2022
Project: Vet Research Tower 2nd Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk Sampling	Cornell Work Order No.: TBD	Turnaround Time: RUSH
Collected By: Michael Drobak / Thomas Ferro		

Sample Number	Material Type	Material Condition	Floor	Description / Sample Location
2021.163.320- 01A	Miscellaneous	Good	1	Yellow/Gray Carpet Mastic - Room T1003, Northwest.
2021.163.320- 01B	Miscellaneous	Good	1	Yellow/Gray Carpet Mastic - Room T1003, Northeast.
2021.163.320- 02A	Miscellaneous	Good	1	Red Rolled Vinyl Sheet Flooring - Room T1003, North.
2021.163.320- 02B	Miscellaneous	Good	1	Red Rolled Vinyl Sheet Flooring - Room T1003, North.
2021.163.320- 03A	Miscellaneous	Good	1	Gray Mastic from HA 02 - Room T1003, North.
2021.163.320- 03B	Miscellaneous	Good	1	Gray Mastic from HA 02 - Room T1003, North.
2021.163.320- 04A	Miscellaneous	Good	1	Gray Rolled Vinyl Sheet Flooring - Room T1003, Northeast.
2021.163.320- 04B	Miscellaneous	Good	1	Gray Rolled Vinyl Sheet Flooring - Room T1003, Northwest.

Instructions: Analyze all non-NOB samples by NYS ELAP 198.1 PLM methodology. Analyze all NOB samples initially by NYS ELAP 198.6 PLM methodology. If all samples from a given sample set are reported as non-asbestos by 198.6, analyze by NYS ELAP 198.4 TEM methodology. **Analyze All Samples in a given sample set - DO NOT STOP AFTER 1st POSITIVE.**
Email Results to wjohnson@delta-eas.com, sprislupsky@delta-eas.com, rcherevko@delta-eas.com

222074019

Notes:

Submitted By: Michael Drobak /
 (Signature)
Received By: Justin Moravich /
 (Signature)

Date: 7/26/2022

Date: 7/27/22 10:12

Client: Cornell University	Delta Project No.: 2021.163.320	Date: 7/26/2022
Project: Vet Research Tower 2nd Floor Fire Episode - 1st, 2nd and 3rd Floors Asbestos Bulk Sampling	Cornell Work Order No.: TBD	Turnaround Time: RUSH
Collected By: Michael Drobak / Thomas Ferro		

Sample Number	Material Type	Material Condition	Floor	Description / Sample Location
2021.163.320-05A	Miscellaneous	Good	1	Gray Mastic from HA 04 - Room T1003, Northeast.
2021.163.320-05B	Miscellaneous	Good	1	Gray Mastic from HA 04 - Room T1003, Northwest.
2021.163.320-06A	Miscellaneous	Good	1	12"x12" White w/ Gray & Blue Mottle Floor Tile - Room T1003, Northwest Under HA 03 & HA 04.
2021.163.320-06B	Miscellaneous	Good	1	12"x12" White w/ Gray & Blue Mottle Floor Tile - Room T1003, Northwest Under HA 03 & HA 04.
2021.163.320-07A	Miscellaneous	Good	1	Yellow Mastic from HA 06 - Room T1003, Northwest.
2021.163.320-07B	Miscellaneous	Good	1	Yellow Mastic from HA 06 - Room T1003, Northwest.
2021.163.320-08A	Miscellaneous	Good	1	12"x12" Brown w/ White Mottle Floor Tile - Room T1003A, Southeast.
2021.163.320-08B	Miscellaneous	Good	1	12"x12" Brown w/ White Mottle Floor Tile - Room T1003A, Southeast.
2021.163.320-09A	Miscellaneous	Good	1	Black Mastic from HA 08 - Room T1003A, Southeast.
2021.163.320-09B	Miscellaneous	Good	1	Black Mastic from HA 08 - Room T1003A, Southeast.
2021.163.320-10A	Miscellaneous	Good	1	Tan Mastic from 4" Vinyl Covebase - Room T1003A, East Wall.
2021.163.320-10B	Miscellaneous	Good	1	Tan Mastic from 4" Vinyl Covebase - Room T1003A, East Wall.
2021.163.320-11A	Miscellaneous	Good	1	Light Gray Gypsum Wallboard - Room T1003, Soueast.
2021.163.320-11B	Miscellaneous	Good	1	Light Gray Gypsum Wallboard - Room T1003, Soueast.
2021.163.320-12A	Miscellaneous	Good	1	White Joint Compound - Room T1003, South.
2021.163.320-12B	Miscellaneous	Good	1	White Joint Compound - Room T1003, South.

Client: Cornell University	Delta Project No.: 2021.163.320	Date: 7/26/2022
Project: Vet Research Tower 2nd Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk Sampling	Cornell Work Order No.: TBD	Turnaround Time: RUSH
Collected By: Michael Drobak / Thomas Ferro		

Sample Number	Material Type	Material Condition	Floor	Description / Sample Location
2021.163.320-13A	Miscellaneous	Damaged	1	2'x2' Fissured Drop-in Ceiling Tile - Room T1003A, Center.
2021.163.320-13B	Miscellaneous	Damaged	1	2'x2' Fissured Drop-in Ceiling Tile - Room T1003A, Center.
2021.163.320-14A	Miscellaneous	Good	1	2'x2'x2" Textured Covering from Fiberglass Drop-in Ceiling Tile - Room T1003, South.
2021.163.320-14B	Miscellaneous	Good	1	2'x2'x2" Textured Covering from Fiberglass Drop-in Ceiling Tile - Room T1003, South.
2021.163.320-15A	TSI	Good	1	Light Gray Mudded Pipe Fitting - Room T1003, South.
2021.163.320-15B	TSI	Good	1	Light Gray Mudded Pipe Fitting - Room T1003, South.
2021.163.320-15C	TSI	Good	1	Light Gray Mudded Pipe Fitting - Room T1003, South.
2021.163.320-16A	Surfacing	Good	1	Light Gray Spray-on Fireproofing - Room T1003, Southeast.
2021.163.320-16B	Surfacing	Good	1	Light Gray Spray-on Fireproofing - Room T1003, Southeast.
2021.163.320-16C	Surfacing	Good	1	Light Gray Spray-on Fireproofing - Room T1003, Southeast.
2021.163.320-17A	Miscellaneous	Good	1	Yellow Carpet Mastic - Room T1010 at Room 1010B.
2021.163.320-17B	Miscellaneous	Good	1	Yellow Carpet Mastic - Room T1010 at Room 1010B.
2021.163.320-18A	Miscellaneous	Good	1	12"x12" Light Gray w/ Gray & Blue Floor Tile - Room 1010Q, South.
2021.163.320-18B	Miscellaneous	Good	1	12"x12" Light Gray w/ Gray & Blue Floor Tile - Room 1010Q, South.
2021.163.320-19A	Miscellaneous	Good	1	Yellow Mastic from HA 18 - Room 1010Q, South.
2021.163.320-19B	Miscellaneous	Good	1	Yellow Mastic from HA 18 - Room 1010Q, South.

Client: Cornell University	Delta Project No.: 2021.163.320	Date: 7/26/2022
Project: Vet Research Tower 2nd Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk Sampling	Cornell Work Order No.: TBD	Turnaround Time: RUSH
Collected By: Michael Drobak / Thomas Ferro		

Sample Number	Material Type	Material Condition	Floor	Description / Sample Location
2021.163.320-20A	Miscellaneous	Good	1	Light Tan Mastic from 4" Vinyl Covebase - Room T1010, at Room T1010S.
2021.163.320-20B	Miscellaneous	Good	1	Light Tan Mastic from 4" Vinyl Covebase - Room T1010, at Room T1010S.
2021.163.320-21A	Miscellaneous	Good	1	White Gypsum Wallboard - Room T1010 at Room T1010B.
2021.163.320-21B	Miscellaneous	Good	1	White Gypsum Wallboard - Room T1010 at Room T1010B.
2021.163.320-22A	Miscellaneous	Good	1	White Joint Compound - Room T1010 at Room T1010B.
2021.163.320-22B	Miscellaneous	Good	1	White Joint Compound - Room T1010 at Room T1010B.
2021.163.320-23A	Miscellaneous	Good	1	2'x4' Fissured Drop-in Ceiling Tile - Room T1010 at Room T1010B.
2021.163.320-23B	Miscellaneous	Good	1	2'x4' Fissured Drop-in Ceiling Tile - Room T1010 at Room T1010A.
2021.163.320-24A	Surfacing	Good	1	Light Gray Spray-on Fireproofing - Room T1010 at Room T1010A.
2021.163.320-24B	Surfacing	Good	1	Light Gray Spray-on Fireproofing - Room T1010P, East.
2021.163.320-24C	Surfacing	Good	1	Light Gray Spray-on Fireproofing - Room T1010P, West.
2021.163.320-25A	Miscellaneous	Damaged	2	12"x12" Light Gray Mottled Floor Tile - Room T2001.
2021.163.320-25B	Miscellaneous	Damaged	2	12"x12" Light Gray Mottled Floor Tile - Room T2001.
2021.163.320-26A	Miscellaneous	Damaged	2	Yellow Mastic from HA 25 - Room T2001.
2021.163.320-26B	Miscellaneous	Damaged	2	Yellow Mastic from HA 25 - Room T2001.
2021.163.320-27A	Miscellaneous	Damaged	2	White Mastic from 4" Vinyl Covebase - Room T2001C.

Client: Cornell University	Delta Project No.: 2021.163.320	Date: 7/26/2022
Project: Vet Research Tower 2nd Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk Sampling	Cornell Work Order No.: TBD	Turnaround Time: RUSH
Collected By: Michael Drobak / Thomas Ferro		

Sample Number	Material Type	Material Condition	Floor	Description / Sample Location
2021.163.320- 27B	Miscellaneous	Damaged	2	White Mastic from 4" Vinyl Covebase - Room T2001C.
2021.163.320- 28A	Miscellaneous	Damaged	2	Light Gray Gypsum Wallboard - Room T2001C.
2021.163.320- 28B	Miscellaneous	Damaged	2	Light Gray Gypsum Wallboard - Room T2001.
2021.163.320- 29A	Miscellaneous	Damaged	2	White Joint Compound - Room T2001C.
2021.163.320- 29B	Miscellaneous	Damaged	2	White Joint Compound - Room T2001C.
2021.163.320- 30A	Miscellaneous	Damaged	2	2'x4' Fissured Drop-in Ceiling Tile - Room T2001.
2021.163.320- 30B	Miscellaneous	Damaged	2	2'x4' Fissured Drop-in Ceiling Tile - Room T2001.
2021.163.320- 31A	Surfacing	Damaged	2	Light Gray Spray-on Fireproofing - Room T2001, at Room T2001C.
2021.163.320- 31B	Surfacing	Damaged	2	Light Gray Spray-on Fireproofing - Room T2001, at Entrance
2021.163.320- 31C	Surfacing	Damaged	2	Light Gray Spray-on Fireproofing - Room T2001, at Room T2001E.
2021.163.320- 32A	Miscellaneous	Damaged	2	Labtop Backsplash Caulk - Room T2001.
2021.163.320- 32B	Miscellaneous	Damaged	2	Labtop Backsplash Caulk - Room T2001.
2021.163.320- 33A	Miscellaneous	Damaged	2	Black Labtop - Room T2001.
2021.163.320- 33B	Miscellaneous	Damaged	2	Black Labtop - Room T2001.
2021.163.320- 34A	Miscellaneous	Damaged	2	Black Labtop Adhesive - Room T2001.
2021.163.320- 34B	Miscellaneous	Damaged	2	Black Labtop Adhesive - Room T2001.

Client: Cornell University	Delta Project No.: 2021.163.320	Date: 7/26/2022
Project: Vet Research Tower 2nd Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk Sampling	Cornell Work Order No.: TBD	Turnaround Time: RUSH
Collected By: Michael Drobak / Thomas Ferro		

Sample Number	Material Type	Material Condition	Floor	Description / Sample Location
2021.163.320- 35A	Miscellaneous	Damaged	2	Black Seam Epoxy - Room T2001.
2021.163.320- 35B	Miscellaneous	Damaged	2	Black Seam Epoxy - Room T2001.
2021.163.320- 36A	Miscellaneous	Damaged	2	Black Soot Sample - Room T2001, Center.
2021.163.320- 36B	Miscellaneous	Damaged	2	Black Soot Sample - Room T2001, Adjacent to Room T2001C.
2021.163.320- 37A	Miscellaneous	Damaged	2	Black Burn Debris - Room T2001, East.
2021.163.320- 37B	Miscellaneous	Damaged	2	Black Burn Debris - Room T2001, West.

222074019

**AmeriSci New York**

117 EAST 30TH ST.
NEW YORK, NY 10016
TEL: (212) 679-8600 • FAX: (212) 679-3114

PLM Bulk Asbestos Report

Delta Engineers
Attn: Stephen Prislupsky
860 Hooper Road

Endwell, NY 13760

Date Received 07/27/22 **AmeriSci Job #** 222074017
Date Examined 07/27/22 **P.O. #**
ELAP # 11480 **Page** 1 of 2
RE: 2021.163.320; Cornell University; Vet Research Tower 2nd Floor
Fire Episode - 3rd Floor Spray-On Fireproofing And Spot
Asbestos Bulk Sampling

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-101A Location: Floor 3 - Spray-On Fireproofing, Corridor T300CA, East End Analyst Description: Gray, Homogeneous, Fibrous, Bulk Material Asbestos Types: Chrysotile 5.0 % Other Material: Fibrous glass 60%, Non-fibrous 35%	222074017-01	Yes	5% (ELAP 400 PC) by Bo Sun on 07/27/22
2021.163.320-101B Location: Floor 3 - Spray-On Fireproofing, Corridor T300CA, Outside Room T3006 Analyst Description: Gray, Homogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Fibrous glass 70%, Non-fibrous 30%	222074017-02	No	NAD (by NYS ELAP 198.1) by Bo Sun on 07/27/22
2021.163.320-101C Location: Floor 3 - Spray-On Fireproofing, Corridor T300CA, West End Analyst Description: Gray, Homogeneous, Fibrous, Bulk Material Asbestos Types: Chrysotile 4.0 % Other Material: Fibrous glass 65%, Non-fibrous 31%	222074017-03	Yes	4% (ELAP 400 PC) by Bo Sun on 07/27/22
2021.163.320-102A Location: Soot, Utility Space T300UA, East End Analyst Description: Black, Heterogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose 10%, Fibrous glass 20%, Synthetic fibers 3%, Non-fibrous 67%	222074017-04	No	NAD (by NYS ELAP 198.1) by Bo Sun on 07/27/22
2021.163.320-102B Location: Soot, Utility Space T300UA, Center Analyst Description: Black, Heterogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose 15%, Fibrous glass 25%, Synthetic fibers Trace, Non-fibrous 60%	222074017-05	No	NAD (by NYS ELAP 198.1) by Bo Sun on 07/27/22

PLM Bulk Asbestos Report

2021.163.320; Cornell University; Vet Research Tower 2nd
Floor Fire Episode - 3rd Floor Spray-On Fireproofing And Spot
Asbestos Bulk Sampling

Reporting Notes:

Analyzed by: Bo Sun
Date: 7/27/2022



Reviewed by: Bo Sun



*NAD/NSD =no asbestos detected; NA =not analyzed; NA/PS=not analyzed/positive stop, (SOF-V) = Sprayed On Fireproofing containing Vermiculite; (SM-V) = Surfacing Material containing Vermiculite; PLM Bulk Asbestos Analysis using Olympus, Model BH-2 Pol Scope, Microscope, Serial #: 229003, by Appd E to Subpt E, 40 CFR 763 quantified by either CVES or 400 pt ct as noted for each analysis (NVLAP 200546-0), ELAP PLM Method 198.1 for NY friable samples, which includes the identification and quantitation of vermiculite, or ELAP 198.6 for NOB samples, or EPA 400 pt ct by EPA 600-M4-82-020 (NY ELAP Lab 11480); Note:PLM is not consistently reliable in detecting asbestos in floor coverings and similar non-friable organically bound materials. NAD or Trace results by PLM are inconclusive, TEM is currently the only method that can be used to determine if this material can be considered or treated as non asbestos-containing in NY State (also see EPA Advisory for floor tile, FR 59,146,38970,8/1/94) National Institute of Standards and Technology Accreditation requirements mandate that this report must not be reproduced except in full without the approval of the lab.This PLM report relates ONLY to the items tested. RI Cert AAL-094, CT Cert PH-0186, Mass Cert AA000054, NJ Lab ID #NY031.

_____END OF REPORT_____

Client: Cornell University	Delta Project No.: 2021.163.320	Date: 7/26/2022
Project: Vet Research Tower 2nd Floor Fire Episode - 3rd Floor Spray-on Fireproofing and Soot Asbestos Bulk Sampling	Cornell Work Order No.: TBD	Turnaround Time: RUSH
Collected By: Michael Drobak / Thomas Ferro		

Sample Number	Material Type	Material Condition	Floor	Description / Sample Location
2021.163.320-101A	Surfacing	Intact	3	Spray-on Fireproofing, Corridor T300CA, East End
2021.163.320-101B	Surfacing	Intact	3	Spray-on Fireproofing, Corridor T300CA, Outside Room T3006
2021.163.320-101C	Surfacing	Intact	3	Spray-on Fireproofing, Corridor T300CA, West End
2021.163.320-102A	Miscellaneous	NA	3	Soot, Utility Space T300UA, East End
2021.163.320-102B	Miscellaneous	NA	3	Soot, Utility Space T300UA, Center

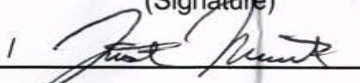
Instructions: Analyze all non-NOB samples by NYS ELAP 198.1 PLM methodology. Analyze all NOB samples initially by NYS ELAP 198.6 PLM methodology. If all samples from a given sample set are reported as non-asbestos by 198.6, analyze by NYS ELAP 198.4 TEM methodology. **Analyze All Samples in a given sample set - DO NOT STOP AFTER 1st POSITIVE.**
Email Results to wjohnson@delta-eas.com, sprislupsky@delta-eas.com, rcherevko@delta-eas.com

Notes:

222074017

Submitted By: Michael Drobak 
 (Signature)

Date: 7/26/2022

Received By: Justin Neretich 
 (Signature)

Date: 7/27/22 10:12

**AmeriSci New York**

117 EAST 30TH ST.
NEW YORK, NY 10016
TEL: (212) 679-8600 • FAX: (212) 679-3114

PLM Bulk Asbestos Report

Delta Engineers
Attn: Stephen Prislupsky
860 Hooper Road

Endwell, NY 13760

Date Received 08/25/22 **AmeriSci Job #** 222083460
Date Examined 08/26/22 **P.O. #**
ELAP # 11480 **Page** 1 of 4
RE: 2021.163.320; Cornell University; Vet Research Tower 2nd Floor
Fire Episode - 2nd Floor Lab Suites T2003, T2007, And Corridor
T200CB Bulk Sampling (Report Amended 8/26/2022)

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-201A 201	222083460-01	Yes	1.5% (ELAP 400 PC) by Valeriu Voicu on 08/26/22
Analyst Description: Off-White/Gray, Heterogeneous, Fibrous, Bulk Material Asbestos Types: Chrysotile 1.5 % Other Material: Cellulose Trace, Fibrous glass 45%, Non-fibrous 53.5%			
2021.163.320-201B 201	222083460-02	Yes	Trace (<0.25 % pc) (ELAP 400 PC) by Valeriu Voicu on 08/26/22
Analyst Description: Gray, Homogeneous, Fibrous, Bulk Material Asbestos Types: Chrysotile <0.25 % pc Other Material: Cellulose Trace, Fibrous glass 65%, Non-fibrous 35%			
2021.163.320-201C 201	222083460-03	Yes	2.8% (ELAP 400 PC) by Valeriu Voicu on 08/26/22
Analyst Description: Off-White/Gray, Heterogeneous, Fibrous, Bulk Material Asbestos Types: Chrysotile 2.8 % Other Material: Cellulose Trace, Fibrous glass 45%, Non-fibrous 52.2%			
2021.163.320-202A 202	222083460-04	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 08/26/22
Analyst Description: Silver/Gray, Heterogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 37.4%			
2021.163.320-202B 202	222083460-05	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 08/26/22
Analyst Description: Silver/Gray, Heterogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 36.9%			

PLM Bulk Asbestos Report

2021.163.320; Cornell University; Vet Research Tower 2nd Floor Fire Episode - 2nd Floor Lab Suites T2003, T2007, And Corridor T200CB Bulk Sampling (Report Amended 8/26/2022)

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-203A 203	222083460-06	No	NAD
Location: 2nd Floor, Lab Suite T2003 - Room T2003A - White Textured Covering On HA 202			(by NYS ELAP 198.6) by Valeriu Voicu on 08/26/22
Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 4.8%			
2021.163.320-203B 203	222083460-07	No	NAD
Location: 2nd Floor, Lab Suite T2003 - Room T2003A - White Textured Covering On HA 202			(by NYS ELAP 198.6) by Valeriu Voicu on 08/26/22
Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 4.3%			
2021.163.320-204A 204	222083460-08	Yes	8.7%
Location: 2nd Floor, Lab Suite T2007 - Room T2007, East (Overspray On Ductwork) - Spray-On Fireproofing			(by NYS ELAP 198.1) by Valeriu Voicu on 08/26/22
Analyst Description: Off-White/Beige, Heterogeneous, Fibrous, Bulk Material			
Asbestos Types: Chrysotile 8.7 %			
Other Material: Cellulose Trace, Fibrous glass 50%, Non-fibrous 41.3%			
2021.163.320-204B 204	222083460-09	Yes	18.2%
Location: 2nd Floor, Lab Suite T2007 - Room T2007, West (On Beam) - Spray-On Fireproofing			(by NYS ELAP 198.1) by Valeriu Voicu on 08/26/22
Analyst Description: Off-White/Gray, Homogeneous, Fibrous, Bulk Material			
Asbestos Types: Chrysotile 18.2 %			
Other Material: Fibrous glass 40%, Non-fibrous 41.8%			
2021.163.320-204C 204	222083460-10	Yes	21.1%
Location: 2nd Floor, Lab Suite T2007 - Room T2007A, Center (On Deck) - Spray-On Fireproofing			(by NYS ELAP 198.1) by Valeriu Voicu on 08/26/22
Analyst Description: Off-White, Homogeneous, Fibrous, Bulk Material			
Asbestos Types: Chrysotile 21.0 %			
Other Material: Cellulose Trace, Fibrous glass 30%, Non-fibrous 48.9%			
2021.163.320-204D 204	222083460-11	Yes	4.3%
Location: 2nd Floor, Lab Suite T2007 - Room T2007C, West (On Beam) - Spray-On Fireproofing			(ELAP 400 PC) by Valeriu Voicu on 08/26/22
Analyst Description: Off-White/Gray, Heterogeneous, Fibrous, Bulk Material			
Asbestos Types: Chrysotile 4.3 %			
Other Material: Cellulose Trace, Fibrous glass 40%, Non-fibrous 55.7%			

PLM Bulk Asbestos Report

2021.163.320; Cornell University; Vet Research Tower 2nd Floor Fire Episode - 2nd Floor Lab Suites T2003, T2007, And Corridor T200CB Bulk Sampling (Report Amended 8/26/2022)

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-204E 204	222083460-12	Yes	16.7%
Location: 2nd Floor, Lab Suite T2007 - Room T2007D, West (On Beam) - Spray-On Fireproofing			(by NYS ELAP 198.1) by Valeriu Voicu on 08/26/22
Analyst Description: Off-White, Homogeneous, Fibrous, Bulk Material			
Asbestos Types: Chrysotile 16.7 %			
Other Material: Cellulose Trace, Fibrous glass 50%, Non-fibrous 33.3%			
2021.163.320-205A 205	222083460-13	Yes	14.8%
Location: 2nd Floor, Corridor T200CB - West. - Spray-On Fireproofing			(by NYS ELAP 198.1) by Valeriu Voicu on 08/26/22
Analyst Description: Off-White, Homogeneous, Fibrous, Bulk Material			
Asbestos Types: Chrysotile 14.8 %			
Other Material: Cellulose Trace, Fibrous glass 60%, Non-fibrous 25.2%			
2021.163.320-205B 205	222083460-14	Yes	Trace (<0.25 % pc)
Location: 2nd Floor, Corridor T200CB - West-Center - Spray-On Fireproofing			(ELAP 400 PC) by Valeriu Voicu on 08/26/22
Analyst Description: Off-White/Beige, Homogeneous, Fibrous, Bulk Material			
Asbestos Types: Chrysotile <0.25 % pc			
Other Material: Cellulose Trace, Fibrous glass 40%, Non-fibrous 60%			
2021.163.320-205C 205	222083460-15	No	NAD
Location: 2nd Floor, Corridor T200CB - Center. - Spray-On Fireproofing			(by NYS ELAP 198.1) by Valeriu Voicu on 08/26/22
Analyst Description: Beige, Homogeneous, Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Cellulose Trace, Fibrous glass 50%, Non-fibrous 50%			
2021.163.320-205D 205	222083460-16	No	NAD
Location: 2nd Floor, Corridor T200CB - East-Center - Spray-On Fireproofing			(by NYS ELAP 198.1) by Valeriu Voicu on 08/26/22
Analyst Description: Beige, Homogeneous, Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Cellulose Trace, Fibrous glass 45%, Non-fibrous 55%			
2021.163.320-205E 205	222083460-17	No	NAD
Location: 2nd Floor, Corridor T200CB - East - Spray-On Fireproofing			(by NYS ELAP 198.1) by Valeriu Voicu on 08/26/22
Analyst Description: Off-White/Beige, Homogeneous, Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Cellulose Trace, Fibrous glass 45%, Non-fibrous 55%			

Client Name: Delta Engineers

PLM Bulk Asbestos Report

2021.163.320; Cornell University; Vet Research Tower 2nd
Floor Fire Episode - 2nd Floor Lab Suites T2003, T2007, And
Corridor T200CB Bulk Sampling (Report Amended 8/26/2022)

Reporting Notes:

Analyzed by: Valeriu Voicu
Date: 8/26/2022



Reviewed by: Valeriu Voicu



*NAD/NSD =no asbestos detected; NA =not analyzed; NA/PS=not analyzed/positive stop, (SOF-V) = Sprayed On Fireproofing containing Vermiculite; (SM-V) = Surfacing Material containing Vermiculite; PLM Bulk Asbestos Analysis using Olympus, Model BH-2 Pol Scope, Microscope, Serial #: 229915, by Appd E to Subpt E, 40 CFR 763 quantified by either CVES or 400 pt ct as noted for each analysis (NVLAP 200546-0), ELAP PLM Method 198.1 for NY friable samples, which includes the identification and quantitation of vermiculite, or ELAP 198.6 for NOB samples, or EPA 400 pt ct by EPA 600-M4-82-020 (NY ELAP Lab 11480); Note:PLM is not consistently reliable in detecting asbestos in floor coverings and similar non-friable organically bound materials. NAD or Trace results by PLM are inconclusive, TEM is currently the only method that can be used to determine if this material can be considered or treated as non asbestos-containing in NY State (also see EPA Advisory for floor tile, FR 59,146,38970,8/1/94) National Institute of Standards and Technology Accreditation requirements mandate that this report must not be reproduced except in full without the approval of the lab.This PLM report relates ONLY to the items tested. RI Cert AAL-094, CT Cert PH-0186, Mass Cert AA000054, NJ Lab ID #NY031.

_____END OF REPORT_____

Client Name: Delta Engineers

Table I
Summary of Bulk Asbestos Analysis Results

2021.163.320; Cornell University; Vet Research Tower 2nd Floor Fire Episode - 2nd Floor Lab Suites T2003, T2007, And Corridor T200CB Bulk Sampling (Report Amended 8/26/2022)

AmeriSci Sample #	Client Sample#	HG Area	Sample Weight (gram)	Heat Sensitive Organic %	Acid Soluble Inorganic %	Insoluble Non-Asbestos Inorganic %	** Asbestos % by PLM/DS	** Asbestos % by TEM
01	2021.163.320-201A	201	----	----	----	----	Chrysotile 1.5	NA
	Location: 2nd Floor, Lab Suite T2003 - Room T2003 (On Beam) - Spray-On Fireproofing							
02	2021.163.320-201B	201	----	----	----	----	Chrysotile <0.25	NA
	Location: 2nd Floor, Lab Suite T2003 - Room T2003A - Spray-On Fireproofing							
03	2021.163.320-201C	201	----	----	----	----	Chrysotile 2.8	NA
	Location: 2nd Floor, Lab Suite T2003 - Room T2003 (On Beam) - Spray-On Fireproofing							
04	2021.163.320-202A	202	0.168	16.8	45.8	37.4	NAD	NAD
	Location: 2nd Floor, Lab Suite T2003 - Room T2003A - 2' x 4' Light Gray Gypsum Ceiling Tile							
05	2021.163.320-202B	202	0.288	16.4	46.7	36.9	NAD	NAD
	Location: 2nd Floor, Lab Suite T2003 - Room T2003A - 2' x 4' Light Gray Gypsum Ceiling Tile							
06	2021.163.320-203A	203	0.141	88.8	6.3	4.8	NAD	NAD
	Location: 2nd Floor, Lab Suite T2003 - Room T2003A - White Textured Covering On HA 202							
07	2021.163.320-203B	203	0.112	89.2	6.5	4.3	NAD	NAD
	Location: 2nd Floor, Lab Suite T2003 - Room T2003A - White Textured Covering On HA 202							
08	2021.163.320-204A	204	----	----	----	----	Chrysotile 8.7	NA
	Location: 2nd Floor, Lab Suite T2007 - Room T2007, East (Overspray On Ductwork) - Spray-On Fireproofing							
09	2021.163.320-204B	204	----	----	----	----	Chrysotile 18.2	NA
	Location: 2nd Floor, Lab Suite T2007 - Room T2007, West (On Beam) - Spray-On Fireproofing							
10	2021.163.320-204C	204	----	----	----	----	Chrysotile 21.0	NA
	Location: 2nd Floor, Lab Suite T2007 - Room T2007A, Center (On Deck) - Spray-On Fireproofing							
11	2021.163.320-204D	204	----	----	----	----	Chrysotile 4.3	NA
	Location: 2nd Floor, Lab Suite T2007 - Room T2007C, West (On Beam) - Spray-On Fireproofing							
12	2021.163.320-204E	204	----	----	----	----	Chrysotile 16.7	NA
	Location: 2nd Floor, Lab Suite T2007 - Room T2007D, West (On Beam) - Spray-On Fireproofing							
13	2021.163.320-205A	205	----	----	----	----	Chrysotile 14.8	NA
	Location: 2nd Floor, Corridor T200CB - West. - Spray-On Fireproofing							
14	2021.163.320-205B	205	----	----	----	----	Chrysotile <0.25	NA
	Location: 2nd Floor, Corridor T200CB - West-Center - Spray-On Fireproofing							
15	2021.163.320-205C	205	----	----	----	----	NAD	NA
	Location: 2nd Floor, Corridor T200CB - Center. - Spray-On Fireproofing							
16	2021.163.320-205D	205	----	----	----	----	NAD	NA
	Location: 2nd Floor, Corridor T200CB - East-Center - Spray-On Fireproofing							

See Reporting notes on last page

Client Name: Delta Engineers

Table I
Summary of Bulk Asbestos Analysis Results

2021.163.320; Cornell University; Vet Research Tower 2nd Floor Fire Episode - 2nd Floor Lab Suites T2003, T2007, And Corridor T200CB Bulk Sampling (Report Amended 8/26/2022)

AmeriSci Sample #	Client Sample#	HG Area	Sample Weight (gram)	Heat Sensitive Organic %	Acid Soluble Inorganic %	Insoluble Non-Asbestos Inorganic %	** Asbestos % by PLM/DS	** Asbestos % by TEM
17	2021.163.320-205E	205	----	----	----	----	NAD	NA
Location: 2nd Floor, Corridor T200CB - East - Spray-On Fireproofing								

Analyzed by: Feyza Gungor
Date: 8/26/2022



Reviewed by: Valeriu Voicu



**Quantitative Analysis (Semi/Full); Bulk Asbestos Analysis - PLM by Appd E to Subpt E, 40 CFR 763 or NYSDOH ELAP 198.1 for New York friable samples or NYSDOH ELAP 198.6 for New York NOB samples; TEM (Semi/Full) by EPA 600/R-93/116 (or NYSDOH ELAP 198.4; for New York samples). Analysis using Hitachi, Model H600-Noran 7 System, Microscope, Serial #: 542-26-10. NAD = no asbestos detected during a quantitative analysis; NA = not analyzed; Trace = <1%; (SOF-V) = Sprayed On Fireproofing containing Vermiculite; (SM-V) = Surfacing Material containing Vermiculite; Quantitation for beginning weights of <0.1 grams should be considered as qualitative only; Qualitative Analysis: Asbestos analysis results of "Present" or "NVA = No Visible Asbestos" represents results for Qualitative PLM or TEM Analysis only (no accreditation coverage available from any regulatory agency for qualitative analyses): NVLAP (PLM) 200546-0, NYSDOH ELAP Lab 11480, NJ Lab ID #NY031.

Warning Note: PLM limitation, only TEM will resolve fibers <0.25 micrometers in diameter. TEM bulk analysis is representative of the fine grained matrix material and may not be representative of non-uniformly dispersed debris for which PLM evaluation is recommended (i.e. soils and other heterogenous materials).

AmeriSci New York	Report Amendment Explanation Form (append to amended report)	Date Amended 8/26/2022
--------------------------	-----------------------------------------------------------------	---------------------------

Client: Delta Engineers

AmeriSci Job #: 222083460

Client Job: 2021.163.320

Analysis Type: ELAP-PLM/TEM

AmeriSci Sample
#s affected: 222083460-2, 3, 9, 10, 11, 12, 14, 15, 16, 17

Amended by
(print/sign): John P. Koubiadis

Original Item(s)
Being Amended: Samples were not analyzed.

Changes Made: Samples were analyzed.

Reason for
Changes: Client sent an email requesting the analysis of the above samples.

Attach original sheet with incorrect item or items to be amended clearly indicated or circled.

222083460

Bulk Sample Data Sheet / COC


Client: <u>Cornell University</u>	Delta Project No.: <u>2021.163.320</u>	Date: <u>8/24/2022</u>
Project: <u>Vet Research Tower 2nd Floor Fire Episode - 2nd Floor Lab Suites T2003, T2007, and Corridor T200CB Bulk Sampling</u>	Cornell Work Order No.: <u>TBD</u>	Turnaround Time: <u>24 Hours</u>
Collected By: <u>Michael C. Drobak</u>		

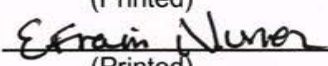
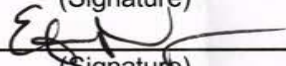
Sample Number	Material Type	Material Condition	Floor	Description / Sample Location
2021.163.320 - 201A	Surfacing	Good	2	Spray-on Fireproofing: 2nd Floor, Lab Suite T2003 - Room T2003 (On Beam).
2021.163.320 - 201B	Surfacing	Good	2	Spray-on Fireproofing: 2nd Floor, Lab Suite T2003 - Room T2003A, Center (On Deck).
2021.163.320 - 201C	Surfacing	Good	2	Spray-on Fireproofing: 2nd Floor, Lab Suite T2003 - Room T2003 (On Beam).
2021.163.320 - 202A	Miscellaneous	Good	2	2'x4' Light Gray Gypsum Ceiling Tile: 2nd Floor, Lab Suite T2003 - Room T2003A, Center.
2021.163.320 - 202B	Miscellaneous	Good	2	2'x4' Light Gray Gypsum Ceiling Tile: 2nd Floor, Lab Suite T2003 - Room T2003A, East.
2021.163.320 - 203A	Miscellaneous	Good	2	White Textured Covering on HA 202: 2nd Floor, Lab Suite T2003 - Room T2003A, Center.
2021.163.320 - 203B	Miscellaneous	Good	2	White Textured Covering on HA 202: 2nd Floor, Lab Suite T2003 - Room T2003A, East.
2021.163.320 - 204A	Surfacing	Good	2	Spray-on Fireproofing: 2nd Floor, Lab Suite T2007 - Room T2007, East (Overspray on Ductwork).
2021.163.320 - 204B	Surfacing	Good	2	Spray-on Fireproofing: 2nd Floor Lab Suite T2007 - Room T2007, West (On Beam).

Instructions: Analyze all non-NOB samples by NYS ELAP 198.1 PLM methodology. Analyze all NOB samples initially by NYS ELAP 198.6 PLM methodology. If all samples from a given sample set are reported as non-asbestos by 198.6, analyze by NYS ELAP 198.4 TEM methodology. Stop analysis after 1st positive for a given sample set.

Email results to wjohnson@delta-eas.com, sprislupsky@delta-eas.com, rcherevko@delta-eas.com

Notes:

Submitted By: Michael C. Drobak / 
(Printed) (Signature)

Received By:  / 
(Printed) (Signature)

Date: 8/24/2022

Date: 8/25/22 1030

222083460

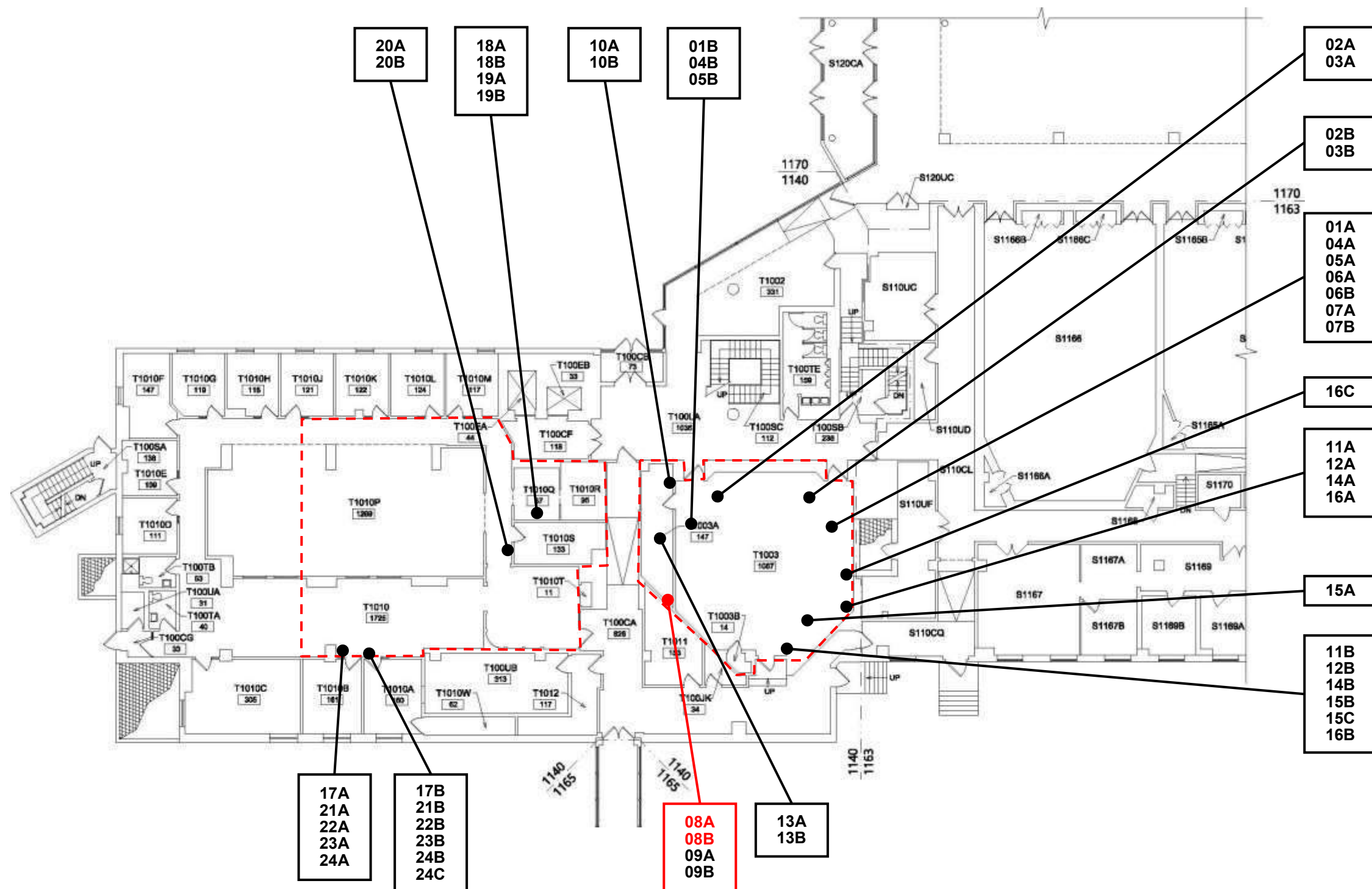
Bulk Sample Data Sheet / COC

Client: <u>Cornell University</u>	Delta Project No.: <u>2021.163.320</u>	Date: <u>8/24/2022</u>
Project: <u>Vet Research Tower 2nd Floor Fire Episode - 2nd Floor Lab Suites T2003, T2007, and Corridor T200CB Bulk Sampling</u>	Cornell Work Order No.: <u>TBD</u>	Turnaround Time: <u>24 Hours</u>
	Collected By: <u>Michael C. Drobak</u>	

Sample Number	Material Type	Material Condition	Floor	Description / Sample Location
2021.163.320 - 204C	Surfacing	Good	2	Spray-on Fireproofing: 2nd Floor, Lab Suite T2007 - Room T2007A, Center (On Deck).
2021.163.320 - 204D	Surfacing	Good	2	Spray-on Fireproofing: 2nd Floor, Lab Suite T2007 - Room T2007C, West (On Beam).
2021.163.320 - 204E	Surfacing	Good	2	Spray-on Fireproofing: 2nd Floor, Lab Suite T2007 - Room T2007D, West (On Beam).
2021.163.320 - 205A	Surfacing	Good	2	Spray-on Fireproofing: 2nd Floor Corridor T200CB - West.
2021.163.320 - 205B	Surfacing	Good	2	Spray-on Fireproofing: 2nd Floor Corridor T200CB - West-Center.
2021.163.320 - 205C	Surfacing	Good	2	Spray-on Fireproofing: 2nd Floor Corridor T200CB - Center.
2021.163.320 - 205D	Surfacing	Good	2	Spray-on Fireproofing: 2nd Floor Corridor T200CB - East-Center.
2021.163.320 - 205E	Surfacing	Good	2	Spray-on Fireproofing: 2nd Floor Corridor T200CB - East.

Attachment C

Sample Location Drawings



860 Hooper Road, Endwell, NY 13760
Tel: 607.231.6600 : Fax: 607.231.6651
www.delta-eas.com

Delta Project No.: 0221.163.320

Project Name: Vet Research Tower Lab T2001 Fire Episode -
Asbestos Bulk Sampling

Work Area: 1st Floor

Sample Type: Bulk

Client: Cornell University

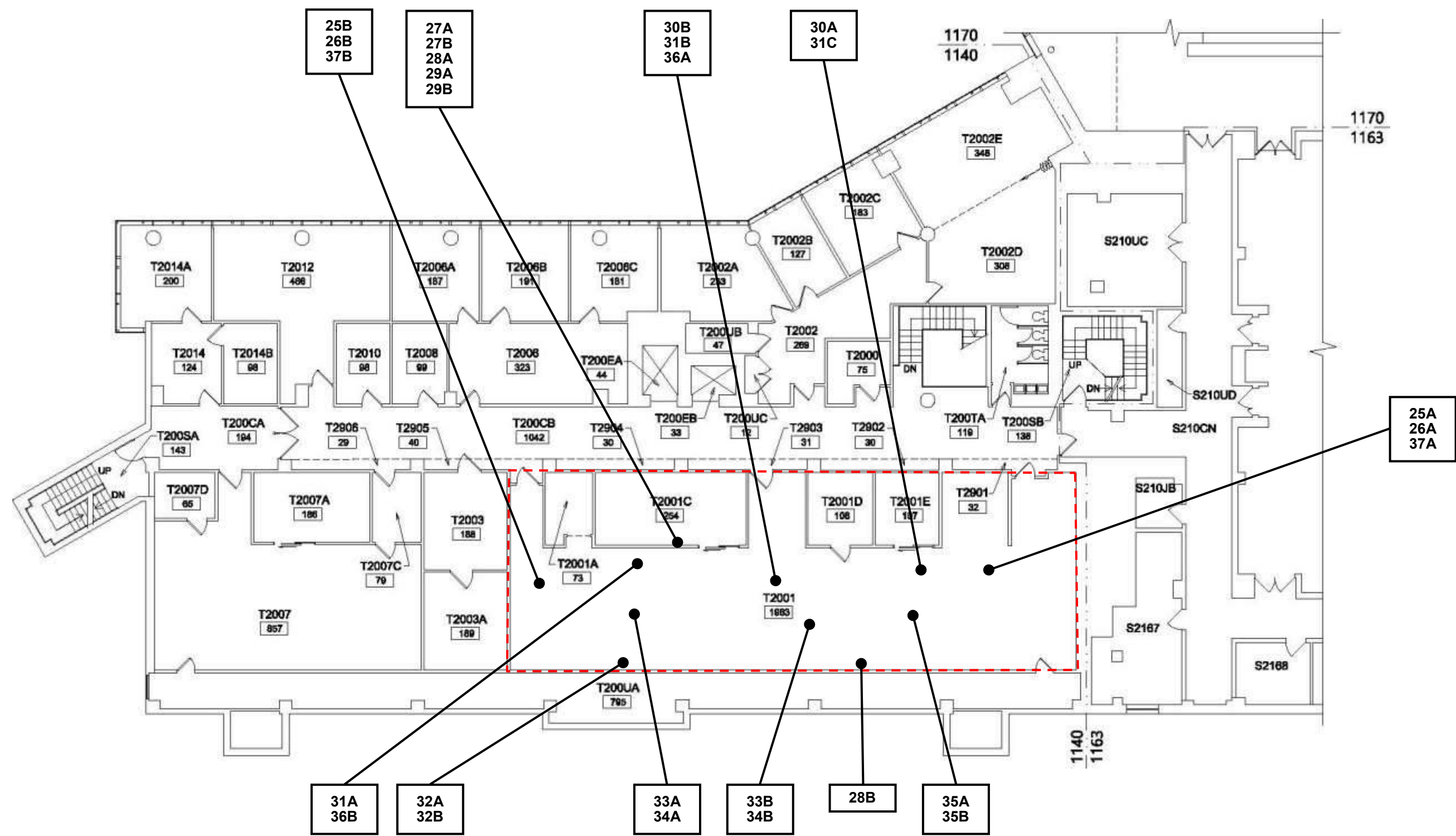
Bldg. No.: 1140

Page 1 of 3

Date(s) Sampled: 07/26/2022

Drawn By: M. Drobak

Scale: NTS



860 Hooper Road, Endwell, NY 13760
Tel: 607.231.6600 : Fax: 607.231.6651
www.delta-eas.com

Delta Project No.: 0221.163.320

Project Name: Vet Research Tower Lab T2001 Fire Episode -
Asbestos Bulk Sampling

Work Area: 2nd Floor

Sample Type: Bulk

Client: Cornell University

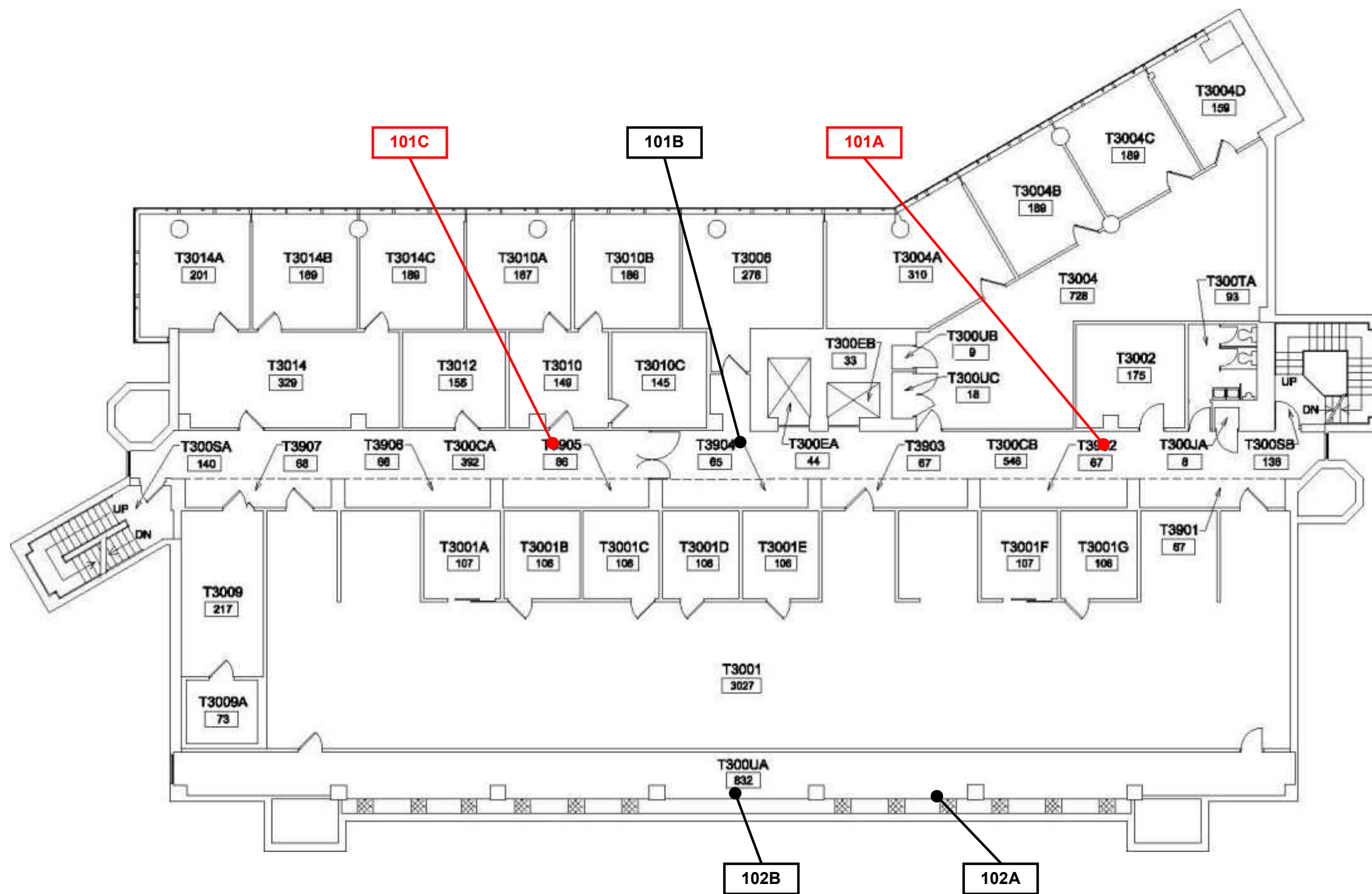
Bldg. No.: 1140

Page 2 **of** 3

Date(s) Sampled: 07/26/2022

Drawn By: M. Drobak

Scale: NTS



860 Hooper Road, Endwell, NY 13760
Tel: 607.231.6600 : Fax: 607.231.6651
www.delta-eas.com

Delta Project No.: 0221.163.320

Project Name: Vet Research Tower Lab T2001 Fire Episode -
Asbestos Bulk Sampling

Work Area: 3rd Floor

Sample Type: Bulk

Client: Cornell University

Bldg. No.: 1140

Page 3 of 3

Date(s) Sampled: 07/26/2022

Drawn By: M. Drobak

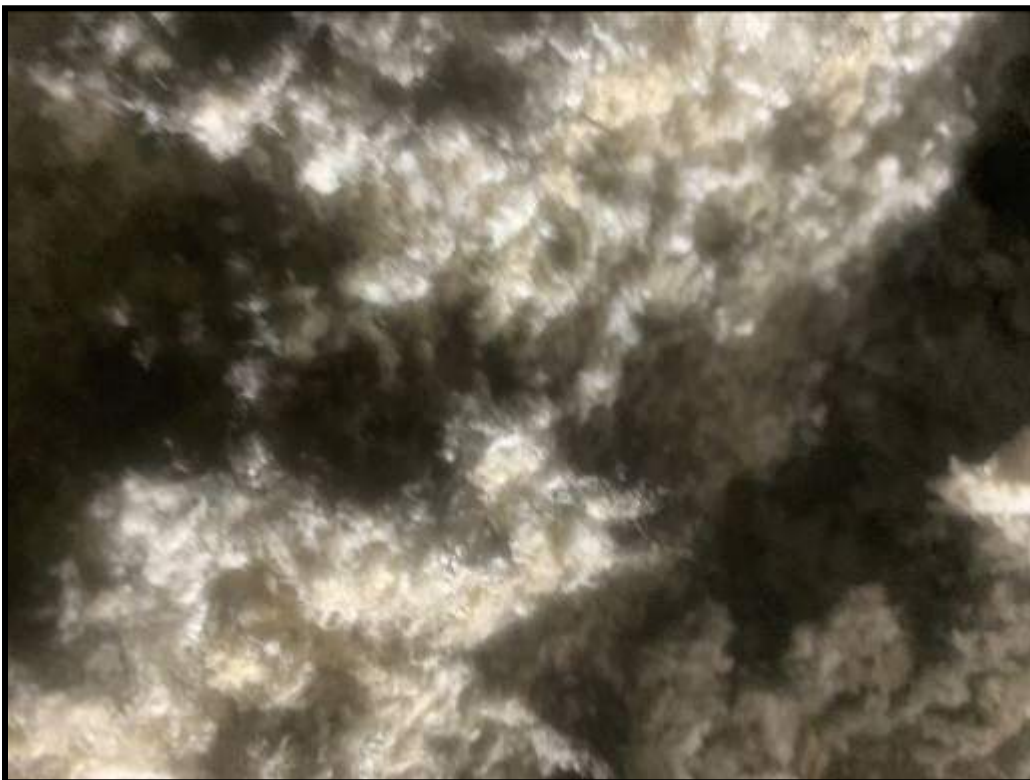
Scale: NTS

Attachment D

Photos



Sample 2021.163.320-31A, Lab Suite T2001, Trace ($< 0.25\%$) Chrysotile, Non-Asbestos



Sample 2021.163.320-31B, Lab Suite T2001, No Asbestos Detected



Sample 2021.163.320-31C, Lab Suite T2001, 0.3% Chrysotile, Non-Asbestos



Sample 2021.163.320-101A, Corridor T300CA, 5.0% Chrysotile, Asbestos Containing



Sample 2021.163.320-101B, Corridor T300CA, No Asbestos Detected



Sample 2021.163.320-101C, Corridor T300CA, 4.0% Chrysotile, Asbestos Containing



Sample 2021.163.320-201A, Lab Suite T2003, 1.5% Chrysotile, Asbestos Containing



Sample 2021.163.320-201B, Lab Suite T2003, Trace ($< 0.25\%$) Chrysotile, Non-Asbestos



Sample 2021.163.320-201C, Lab Suite T2003, 2.8% Chrysotile, Asbestos Containing



Sample 2021.163.320-204A, Lab Suite T2007, 8.7% Chrysotile, Asbestos Containing



Sample 2021.163.320-204B, Lab Suite T2007, 18.2% Chrysotile, Asbestos Containing



Sample 2021.163.320-204C, Lab Suite T2007, 21.1% Chrysotile, Asbestos Containing



Sample 2021.163.320-204D, Lab Suite T2007, 4.3% Chrysotile, Asbestos Containing



Sample 2021.163.320-204E, Lab Suite T2007, 16.7% Chrysotile, Asbestos Containing



Sample 2021.163.320-205A, Corridor T200CB, 14.8% Chrysotile, Asbestos Containing



Sample 2021.163.320-205B, Corridor T200CB, Trace (< 0.25%) Chrysotile, Non-Asbestos



Sample 2021.163.320-205C: Corridor T200CB, No Asbestos Detected



Sample 2021.163.320-205D: Corridor T200CB, No Asbestos Detected



Sample 2021.163.320-205E: Corridor T200CB, No Asbestos Detected

Attachment E

Licenses and Certifications

New York State – Department of Labor

Division of Safety and Health
License and Certificate Unit
State Campus, Building 12
Albany, NY 12240

ASBESTOS HANDLING LICENSE

Delta Engineers, Architects, Land Surveyors, &
Landscape, Architects, D.P.C.

860 Hooper Road

Endwell, NY 13760

FILE NUMBER: 05-0851

LICENSE NUMBER: 29322

LICENSE CLASS: RESTRICTED

DATE OF ISSUE: 10/13/2021

EXPIRATION DATE: 10/31/2022

Duly Authorized Representative – Stephen Prislupsky:

This license has been issued in accordance with applicable provisions of Article 30 of the Labor Law of New York State and of the New York State Codes, Rules and Regulations (12 NYCRR Part 56). It is subject to suspension or revocation for a (1) serious violation of state, federal or local laws with regard to the conduct of an asbestos project, or (2) demonstrated lack of responsibility in the conduct of any job involving asbestos or asbestos material.

This license is valid only for the contractor named above and this license or a photocopy must be prominently displayed at the asbestos project worksite. This license verifies that all persons employed by the licensee on an asbestos project in New York State have been issued an Asbestos Certificate, appropriate for the type of work they perform, by the New York State Department of Labor.



Amy Phillips, Director
For the Commissioner of Labor

STATE OF NEW YORK - DEPARTMENT OF LABOR
ASBESTOS CERTIFICATE



THOMAS P FERRO
CLASS(EXPIRES)
C.ATEC(12/22) D INSP(12/22)
H PM (12/22)

CERT# 99-11328
DMV# 404844888

MUST BE CARRIED ON ASBESTOS PROJECTS

REPRODUCTION OF THIS CERTIFICATE IS PROHIBITED



01213 006208393 63

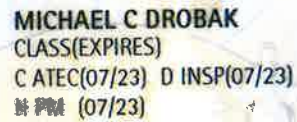
EYES HAZ
HAIR BRO
HGT 5' 08"

IF FOUND RETURN TO:
NYS DOL - L&C UNIT
ROOM 161A BUILDING 12
STATE OFFICE CAMPUS
ALBANY NY 12240



IF FOUND RETURN TO:
NYSOL - L&C UNIT
ROOM 161A BUILDING 12
STATE OFFICE CAMPUS
ALBANY NY 12240

N.Y.S.



CERT# 02-18996
DMV# 846623248

MUST BE CARRIED ON ASBESTOS PROJECTS



**NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER**



Expires 12:01 AM April 01, 2023
Issued April 01, 2022

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

**MR. PAUL J. MUCHA
AMERICA SCIENCE TEAM NEW YORK, INC
117 EAST 30TH ST
NEW YORK, NY 10016**

NY Lab Id No: 11480

*is hereby APPROVED as an Environmental Laboratory for the category
ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE
All approved subcategories and/or analytes are listed below:*

Miscellaneous

Asbestos in Friable Material	Item 198.1 of Manual EPA 600/M4/82/020
Asbestos in Non-Friable Material-PLM	Item 198.6 of Manual (NOB by PLM)
Asbestos in Non-Friable Material-TEM	Item 198.4 of Manual

Serial No.: 64683

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.



ATTACHMENT C:
LIMITED PRE-RENOVATION
ASBESTOS-CONTAINING
MATERIALS INSPECTION

Limited Pre-Renovation Asbestos-Containing Materials Inspection

Location:

Cornell Veterinary Research Tower
618 Tower Road
Ithaca, New York 14850

Prepared for:

Cornell University
121 Humphreys Service Building
Ithaca, New York 14853

LaBella Project No.

2230958

August 29, 2023



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Appendix B – Scope of Work Drawings	
Appendix C – Sample Location Drawings	
Appendix D – Inspection Photos	
Appendix E – Laboratory Analytical Reports	
Appendix F – Licenses and Certifications	
Appendix G – Asbestos Bulk Sampling Report	



1.0 PROJECT DESCRIPTION

In accordance with current regulations, LaBella Associates, D.P.C. (LaBella) conducted a Limited Pre-Renovation Asbestos-Containing Materials (ACM) Inspection of the areas scheduled to be impacted by upcoming renovation at the Cornell Veterinary Research Tower building located at 618 Tower Road in Ithaca, New York. The objective was to identify suspect ACMs that may require abatement or removal prior to or during renovation activities due to applicable regulations.

The inspection was limited to the areas anticipated to be impacted by the upcoming renovation project as shown on the “Scope of Work Drawings” in Appendix B. Materials and locations understood to be impacted by this project were determined from information provided by Cornell University and LaBella’s Building Engineering Division.

2.0 INSPECTION PROCEDURES

The following procedures were used to obtain the data for this Report:

- A. A report titled “Asbestos Bulk Sampling Report”, prepared by Delta Engineers, Architects & Surveys, dated August 29, 2022, was reviewed to develop an understanding of the previously sampled materials and confirmed ACMs at the Site.
- B. A visual inspection of the limited areas referenced in the “Scope of Work Drawings” was conducted to identify visible and accessible sources of suspect ACMs. Photographs captured during this inspection are attached in Appendix D.
- C. Bulk samples of accessible suspect materials were collected and submitted for laboratory analysis.
- D. Asbestos samples were submitted for laboratory analysis. Preliminary Polarized Light Microscopy analyses were performed by LaBella Laboratories, a NYSDOH accredited laboratory, to determine the presence and percentage of asbestos in each sample. Transmission electron microscopy analyses of NOB materials, if necessary, were performed by AMA Laboratories.
- E. Results of the laboratory analyses, field testing and the visual on-site inspection were compiled and summarized.

3.0 INSPECTION LIMITATIONS

This inspection was conducted in accordance with generally accepted environmental engineering practices for this region. Collection of bulk samples of suspect ACMs was limited to those materials readily accessible using hand tools or hand-held power tools. Homogeneous materials were identified and located based on visual observation from readily accessible points. The data derived from representative samples of any given homogeneous material represent conditions that apply only at that particular location. Inspection protocol and methodology requires that sample data be used to draw conclusions about the entire homogeneous area, but such conclusions may not necessarily apply to the general Site as a whole.

No sub-surface investigations were performed to determine the possible presence of regulated materials on or in the immediate vicinity of the Site. No record drawings of the building were available for review as part of this investigation.

LaBella makes no other warranty or representation, either expressed or implied, nor is one intended to be included as part of its services, proposals, contracts, or reports. No inspection can wholly eliminate the uncertainty regarding the potential for undiscovered ACMs. The Work performed by LaBella is intended to reduce, but not eliminate, uncertainty regarding the potential for ACMs at the Site. This inspection report is



not intended to be a bid document for an abatement scope of work. This report is intended to satisfy the requirements of NYS Code Rule 56-5 for inspections.

4.0 INSPECTION RESULTS

4.1 Asbestos-Containing Materials (ACMs)

Based on laboratory analyses of bulk samples collected, the following materials were determined to contain greater than 1% asbestos. However, the following table does not include all of the materials sampled during this inspection; for a full list of materials sampled see the *Asbestos Bulk Sample Summary Table* immediately following this report.

Type of Material	Typical Location ¹	Estimated Amount ²	Friability	Condition
White Joint Compound	See Description Below	3,475 SF	Non-Friable*	Fair
Gray Fireproofing	See Description Below	2,150 SF	Friable	Fair
Brown 12" Floor Tiles	Corridor T200CB - Floor	1,100 SF	Non-Friable	Good

*This material is considered to be non-friable in its current, intact condition. However, this material has the potential to become friable during any renovation/demolition activities that will disturb the material.

ACM Project Specific Details

Joint Compound

White asbestos-containing joint compound is located on the walls in the following locations:

- Corridor T200CB (all walls)
- Room T3001 (north and south walls)

The joint compound within the inspected spaces was observed to be in fair condition. However, the lower portion of the wall system (drywall/joint compound) in Corridor T200CB has been cut and removed; It is undetermined when this took place. Therefore, any renovation activities performed on the wall systems must be performed by a licensed asbestos abatement contractor.

Since these surfaces are painted, it is not possible to determine the exact extent and locations of the joint compound. Joint compound is typically used for both taping joints and filling nail indentations in drywall construction.

Therefore, for removal estimating purposes, it is assumed that the joint compound would be removed along with the underlying drywall, which covers an area of approximately 3,475 square feet. This estimate is based on field measurements taken at the time of the site visit.

Fireproofing

Gray asbestos-containing fireproofing is located in the following locations:

- Corridor T200CB (deck, I-beams, overspray and on ceiling tiles)
- Room T3001 (deck, I-beams, overspray and on ceiling tiles)

The spray-on fireproofing within the inspected spaces was observed to be in fair condition. However, fireproofing debris was observed on the ceiling tiles in various locations throughout Room T3001 and Corridor T200CB. Therefore, any renovation activities performed on or above the suspended ceiling tiles

¹ Typical Location may not be inclusive of all material locations present throughout the building.

² For general reference only: Quantities reflect only those materials understood to be impacted by the project. Estimated amounts of confirmed ACM listed above were obtained through field observations made during site visits. Quantities are approximations and LaBella assumes no responsibility if used for bidding.



must be completed by a licensed asbestos abatement contractor. Ceiling tiles, and any other porous materials located above the suspended ceiling system, shall be considered contaminated and handled in accordance with applicable regulations.

Special Note: Laboratory analytical results for the spray-on fireproofing samples varied from space to space and ranged from “asbestos-containing” to “no asbestos detected.” Based on visual assessment at the time of the inspection, all spray-on fireproofing appeared homogeneous, and was uniform in both color and texture. Given the varied results, inclusive of samples collected by both LaBella and Delta, all spray-on fireproofing within the Veterinary Research Tower should be treated as asbestos-containing.

5.0 OBSERVATIONS AND CAUTIONARY STATEMENTS

Fireproofing

As stated earlier, the presence of asbestos-containing fireproofing is present above the drop ceilings in Corridor T200CB and Room T3001. According to regulations, personnel access to these areas affected shall be restricted. Any work completed on or above the suspended drop ceilings must be performed by a licensed asbestos abatement contractor.

Vermiculite

Vermiculite has been used as loose insulation in attics, walls, CMU block, and as a component of plaster, fireproofing and other building materials. The NYS Department of Health considers loose-fill Vermiculite to be an asbestos-containing material, and that building materials containing Vermiculite should be treated as asbestos-containing until sent for additional analysis and proven negative in accordance with NYS DOH guidelines.

Vermiculite was **not** observed in spaces and materials inspected for this project. However, destructive investigation of wall cavities was not conducted, and therefore the presence or extent of this material’s application throughout the building was not determined. **Therefore**, cautionary measures should be taken during construction, renovation, and demolition to ensure that proper steps are taken if Vermiculite is discovered in previously inaccessible locations. If Vermiculite is discovered, work should be stopped immediately to address the issue and prevent the uncontrolled release and distribution of an asbestos-containing material.

Potentially Hidden/Inaccessible ACMs

As stated earlier, collection of bulk samples of suspect ACMs was limited to those materials readily accessible. Since the building is occupied and open to the public, destructive sampling techniques were limited in order to minimize disruption to business operations and damage to building components.

Although this inspection was conducted in a manner consistent with recognized professional practices, the potential does exist for additional RBMs to be located in the following inaccessible areas because of the operational constraints mentioned above:

- Behind sheetrock surfaces
- Inside wall and/or ceiling cavities
- Electrical components

If future building renovations are to take place, it is recommended that the above areas/materials be re-investigated using destructive sampling techniques as necessary, in order to identify and sample currently hidden/inaccessible suspect RBMs that could potentially be discovered during building renovation.

Asbestos Bulk Sample Summary Table

Asbestos Bulk Sample Summary Table

Limited Pre-Renovation Asbestos-Containing Materials Inspection
Cornell University – Veterinary Research Tower
618 Tower Road
Ithaca, New York 14850

Items in Bold are Confirmed ACM

<i>Sample #</i>	<i>Type of Material</i>	<i>Sample Location</i>	<i>Results % Asbestos</i>
VRT-1A	White Joint Compound	Corridor T200CB, Wall	Chrysotile 3%
VRT-1B	White Joint Compound	Corridor T200CB, Wall	Chrysotile 3%
VRT-2A	Gray Fireproofing Debris	Corridor T200CB, On Ceiling Tile	None Detected
VRT-2B	Gray Fireproofing Debris	Corridor T200CB, On Ceiling Tile	Chrysotile <1%
VRT-2C	Gray Fireproofing Debris	Corridor T200CB, On Ceiling Tile	None Detected
VRT-3A	Gray Mottled 12" Floor Tile	T3001, Floor	None Detected
VRT-3B	Gray Mottled 12" Floor Tile	T3001G, Floor	None Detected
VRT-4A	Black Floor Tile Mastic	T3001, Floor	None Detected
VRT-4B	Black Floor Tile Mastic	T3001G, Floor	None Detected
VRT-5A	Gray Drywall	T3001, Wall	None Detected
VRT-5B	Gray Drywall	T3001, Interior Wall	None Detected
VRT-6A	White Joint Compound	T3001, Wall	Chrysotile 1.7%
VRT-6B	White Joint Compound	T3001, Interior Wall	None Detected
VRT-7A	Gray Fireproofing	T3001, On Beam Above Drop Ceiling	None Detected
VRT-7B	Gray Fireproofing	T3001, On Deck Above Drop Ceiling	None Detected
VRT-7C	Gray Fireproofing	T3001, On Beam Above Drop Ceiling	Chrysotile 4.4%
VRT-7D	Gray Fireproofing	T3001, On Beam Above Drop Ceiling	Chrysotile 1.9%
VRT-7E	Gray Fireproofing	T300UA, On Beam	Chrysotile <1%
VRT-8A	Black Lab Tabletop	T3001, Lab Tabletop	None Detected
VRT-8B	Black Lab Tabletop	T3001, Lab Tabletop	None Detected
VRT-9A	Black Tabletop Mastic	T3001, Lab Tabletop Seams	None Detected
VRT-9B	Black Tabletop Mastic	T3001, Lab Tabletop Seams	None Detected



APPENDIX A:

INSPECTION FACT SHEET

Inspection Fact Sheet

Name and Address of Building/Structure

Cornell University – Veterinary Research Tower

618 Tower Road

Ithaca, New York 14850

Name and Address of Building/Structure Owner

Cornell University

121 Humphreys Service Building

Ithaca, New York 14853

Name and Address of Owner's Agent

LaBella Associates, D.P.C.

300 State Street, Suite 201

Rochester, New York 14614

Name of the Firm & Person Conducting the Inspection

LaBella Associates, D.P.C.

Chris Enright (NYSDOL Cert. #06-08603)

Date the Inspection Was Conducted

July 24, 2023



APPENDIX B:

SCOPE OF WORK DRAWINGS

Cornell Veterinary Research Tower
618 Tower Road, Ithaca New York

Scope of Work Drawings
Second Floor

Key Legend



Walls and Ceiling Investigation



Full Impacted Space Investigation



Cornell Veterinary Research Tower
618 Tower Road, Ithaca New York

Scope of Work Drawings
Third Floor

Walls and Ceiling Investigation

Full Impacted Space Investigation





APPENDIX C:

SAMPLE LOCATION DRAWINGS

Project Number: 2230958

Cornell Veterinary Research Tower
618 Tower Road, Ithaca New York

Second Floor Bulk Samples



Confirmed ACM **Bold and Underlined**

Project Number: 2230958

Cornell Veterinary Research Tower
618 Tower Road, Ithaca New York

Third Floor Bulk Samples

Project Number: 2230958

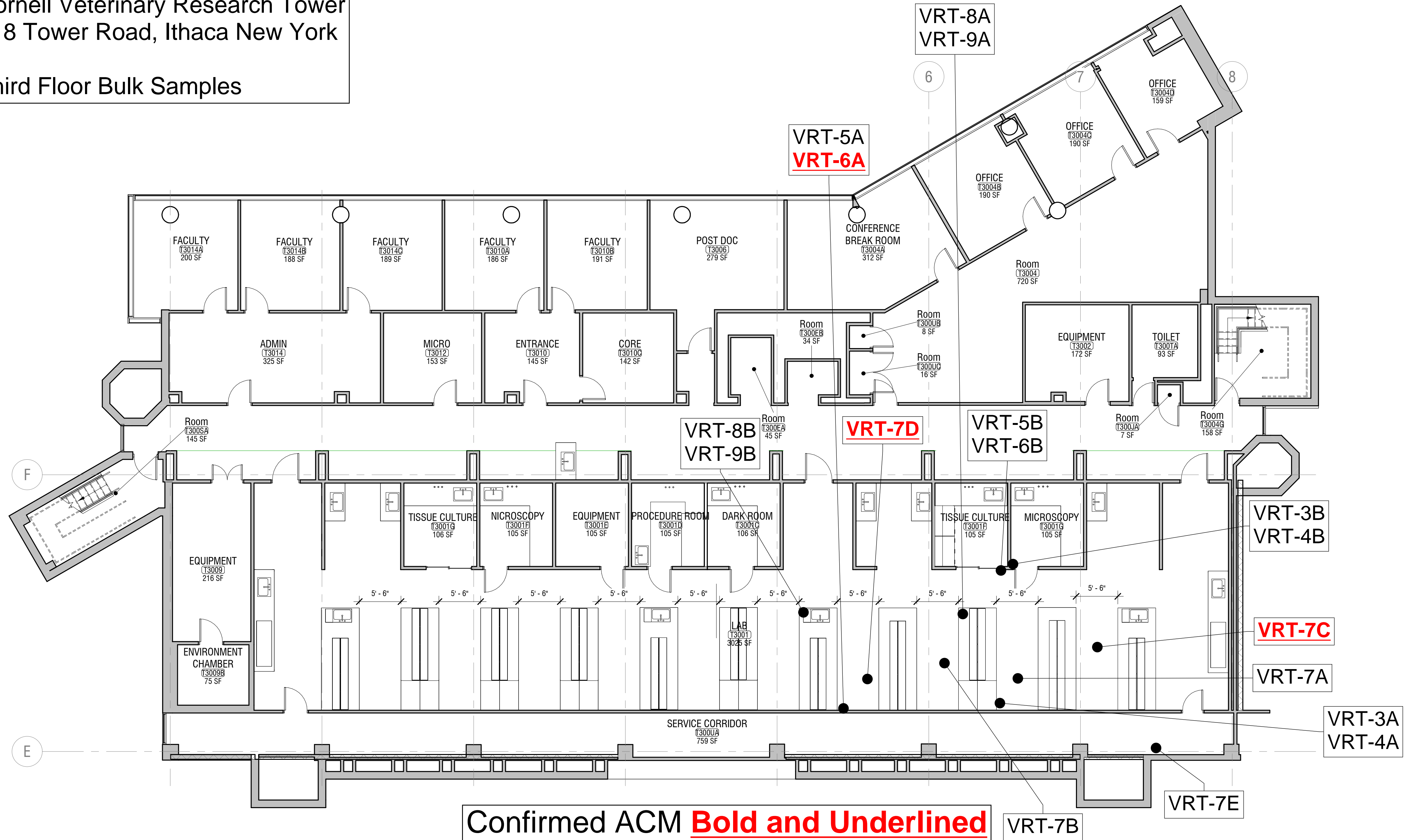
Cornell Veterinary Research Tower
618 Tower Road, Ithaca New York

Third Floor Bulk Samples

Project Number: 2230958

Cornell Veterinary Research Tower
618 Tower Road, Ithaca New York

Third Floor Bulk Samples





APPENDIX D:

INSPECTION PHOTOS

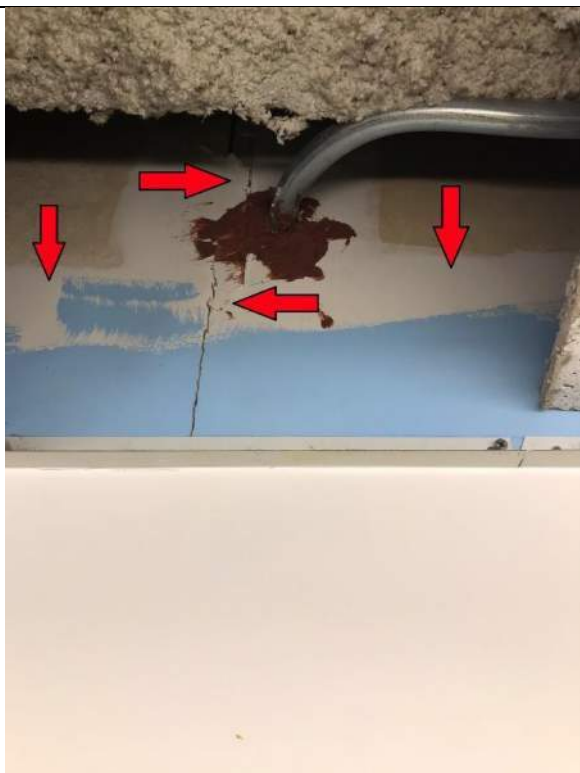


Photo 1

View of White Asbestos-Containing Joint Compound on the Wall in Corridor T200CB

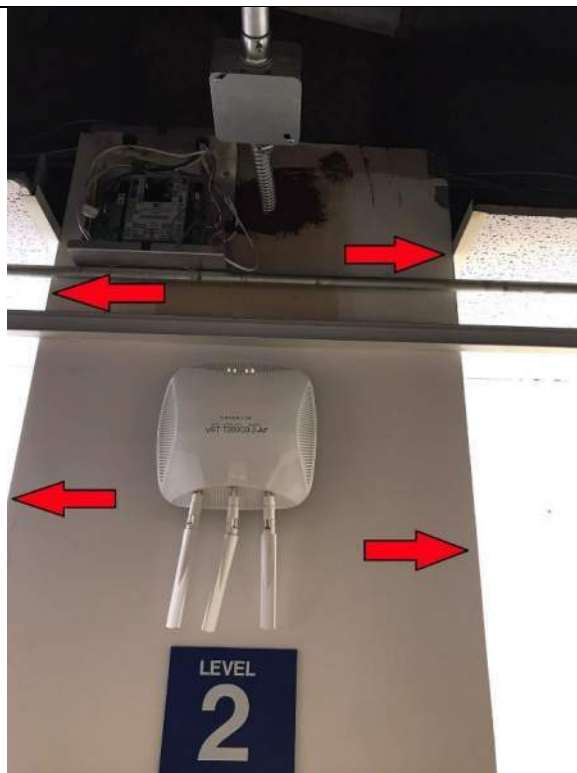


Photo 2

View of White Asbestos-Containing Joint Compound on the Wall in Corridor T200CB



Photo 3

View of Brown with White Mottle Asbestos-Containing 12" Floor Tile in Corridor T200CB



Photo 4

View of Gray Asbestos-Containing Fireproofing on the I-Beams in Room T3001



Photo 5

View of Gray Asbestos-Containing Fireproofing Debris on Ceiling Tiles in Room T3001



Photo 6

View of Gray Asbestos-Containing Fireproofing & Debris on Beams & Ceiling Tile in Corridor T200CB



Photo 7

View of Gray Asbestos-Containing Fireproofing Debris on Ceiling Tiles in Corridor T200CB



Photo 8

View of Gray Asbestos-Containing Fireproofing Debris on Ceiling Tiles in Corridor T200CB



APPENDIX E:
LABORATORY ANALYTICAL
REPORTS

Bulk Sample Asbestos Analytical Report

LABELLA ASSOCIATES, DPC
ANALYTICAL LABORATORY
300 STATE STREET
ROCHESTER, NY 14614
585.454.6110 FAX 585.454.3066

LBL ELAP # 11184
All TEM analysis by AMA Lab, ELAP # 10920
PLM Methods: 198.1, 198.4 & 198.6
RSD: 18.3

LBL JOB # 83123

Page 1 of 2

Client Code:

CLIENT: Labella Associates

Project Number: 2230958

ADDRESS: 300 State Street

Rochester, NY 14614

Sample Type: PLM Bulk

Sample Date: 7/25/2023

PROJECT LOCATION: Cornell University - Vet Research Tower

Field ID	LBL ID	Method	Asbestos Type	%	Other Fibers	%	Matrix	%	Color/Description
VRT-1A	83123-1	P	CHYRSOTILE	3	ND		MIN	97	WHITE JOINT COMPOUND
VRT-1B	83123-2	P	CHYRSOTILE	3	ND		MIN	97	WHITE JOINT COMPOUND
VRT-2A	83123-3	P	ND		CELL/GLASS	80	MIN	20	GRAY FIREPROOFING DEBRIS
VRT-2B	83123-4	P	CHYRSOTILE	<1	CELL/GLASS	80	MIN	20	GRAY FIREPROOFING DEBRIS
VRT-2C	83123-5	P	ND		CELL/GLASS	80	MIN	20	GRAY FIREPROOFING DEBRIS
VRT-3A	83123-6	T	ND		ND		MIN/VINYL	100	GRAY FLOOR TILE
VRT-3B	83123-7	T	ND		ND		MIN/VINYL	100	GRAY FLOOR TILE
VRT-4A	83123-8	G	ND		ND		MASTIC	100	BLACK MASTIC
VRT-4B	83123-9	G	ND		ND		MASTIC	100	BLACK MASTIC
VRT-5A	83123-10	P	ND		CELL	3	MIN	97	GRAY DRYWALL
VRT-5B	83123-11	P	ND		CELL	3	MIN	97	GRAY DRYWALL
VRT-6A	83123-12	P	CHYRSOTILE	1.7	ND		MIN	92.3	WHITE JOINT COMPOUND
VRT-6B	83123-13	P	ND		ND		MIN	100	WHITE JOINT COMPOUND
VRT-7A	83123-14	P	ND		CELL/GLASS	80	MIN	20	GRAY FIREPROOFING
VRT-7B	83123-15	P	ND		CELL/GLASS	80	MIN	20	GRAY FIREPROOFING
VRT-7C	83123-16	P	CHYRSOTILE	4.4	CELL/GLASS	70	MIN	25.6	GRAY FIREPROOFING
VRT-7D	83123-17	P	CHYRSOTILE	1.9	CELL/GLASS	78	MIN	20.1	GRAY FIREPROOFING
VRT-7E	83123-18	P	CHYRSOTILE	<1	CELL/GLASS	80	MIN	20	GRAY FIREPROOFING
VRT-8A	83123-19	P	ND		CELL/GLASS	10	MIN	90	BLACK LAB TABLETOP
VRT-8B	83123-20	P	ND		CELL/GLASS	10	MIN	90	BLACK LAB TABLETOP
VRT-9A	83123-21	T	ND		ND		MIN/BINDER	100	BLACK LAB TABLETOP MASTIC

LAB DIRECTOR:

Matthew Smith

Date:

7/26/23

Method Code: P - Friable PLM result N - NOB PLM result T - TEM result IN* - Inconclusive G - Gravimetric Matrix Reduction where sample residue weight is less than 1% of original sample weight, TEM not required.

Terms: ND** - None Detected CELL - Cellulose JC - Joint Compound MIN - Mineral GLASS - Fiberglass <1** - Trace PLAS - Plaster Vermiculite - Vermiculite is reported as an asbestos-containing mineral in accordance with NYSDOH determinations and requirements. See NYSDOH guidance, available upon request.

* "Polarized-light microscopy (PLM) is not consistently reliable in detecting asbestos in floor coverings and similar non-friable organically bound (NOB) materials. Quantitative transmission electron microscopy (TEM) is currently the only method that can be used to determine if this material can be considered to be non-asbestos containing."

** Please note: Due to interference from sample matrix components results reported via PLM method ELAP 198.1 as negative (ND) or less than 1% (Trace) may be inaccurate and reported as a False Negative. It is recommended that additional analytical techniques such as gravimetric reduction, TEM and others be used to reduce obscuring effects of some matrix components yielding more accurate results.

LaBella Lab Bulk Sample Asbestos Analytical Report

LBL JOB # 83123

Page 2 of 2

Client Code:

CLIENT: Labella Associates

Project Number: 2230958

PROJECT LOCATION: Cornell University - Vet Research Tower

[illegible]

LAB DIRECTOR: Matthew Smith Date: 7/26/23

Method Code: P - Friable PLM result N - NOB PLM result T - TEM result IN* - Inconclusive G - Gravimetric Matrix Reduction where sample residue weight is less than 1% of original sample weight, TEM not required.

Terms: ND** - None Detected CELL - Cellulose JC - Joint Compound MIN - Mineral GLASS - Fiberglass <1** - Trace PLAS - Plaster Vermiculite - Vermiculite is reported as an asbestos-containing mineral in accordance with NYSDOH determinations and requirements. See NYSDOH guidance, available upon request.

* "Polarized-light microscopy (PLM) is not consistently reliable in detecting asbestos in floor coverings and similar non-friable organically bound (NOB) materials. Quantitative transmission electron microscopy (TEM) is currently the only method that can be used to determine if this material can be considered to be non-asbestos containing."

** Please note: Due to interference from sample matrix components results reported via PLM method ELAP 198.1 as negative (ND) or less than 1% (Trace) may be inaccurate and reported as a False Negative. It is recommended that additional analytical techniques such as gravimetric reduction, TEM and others be used to reduce obscuring effects of some matrix components yielding more accurate results.

**ASBESTOS SAMPLING SURVEY
BULK SAMPLE LOG
AND CHAIN OF CUSTODY**

Location: Cornell Vet Research Tower (VRT)

Client: Cornell University

Job No.: 2230958

Rates: 12/20/35 May \$900

Date: 7/25/2023

Relinquished by: Chris Enright

Sampled By: Chris Enright

Received by: Matt Smith 7/25/23

LaBella Lab No.: 83123

Number of Samples: _____

STOP Positive: YES NO

Field ID #	Sample Location	Type of Suspect ACM to be Analyzed	Approx. Amount
+ P 1 VRT-1A	Corridor T200CB, Wall	White Joint Compound	
+ P 2 VRT-1B	Corridor T200CB, Wall	White Joint Compound	
- P 3 VRT-2A	Corridor T200CB, On Ceiling Tile	Gray Fireproofing debris	
- P 4 VRT-2B	Corridor T200CB, On Ceiling Tile	Gray Fireproofing debris	
- P 5 VRT-2C	Corridor T200CB, On Ceiling Tile	Gray Fireproofing debris	
T 6 VRT-3A	T3001, Floor	Gray Mottled 12" Floor Tile	
T 7 VRT-3B	T3001G, Floor	Gray Mottled 12" Floor Tile	
G 8 VRT-4A	T3001, Floor	Black Floor Tile Mastic	
G 9 VRT-4B	T3001G, Floor	Black Floor Tile Mastic	
P 10 VRT-5A	T3001, Wall	Gray Drywall	
P 11 VRT-5B	T3001, Interior Wall	Gray Drywall	
+ P 12 VRT-6A	T3001, Wall	White Joint Compound	
- P 13 VRT-6B	T3001, Interior Wall	White Joint Compound	
- P 14 VRT-7A	T3001, On Beam Above Drop Ceiling	Gray Fireproofing	
- P 15 VRT-7B	T3001, On Deck Above Drop Ceiling	Gray Fireproofing	
+ P 16 VRT-7C	T3001, On Beam Above Drop Ceiling	Gray Fireproofing	
+ P 17 VRT-7D	T3001, On Beam Above Drop Ceiling	Gray Fireproofing	
1 < P 18 VRT-7E	T300UA, On Beam	Gray Fireproofing	
P 19 VRT-8A	T3001, Lab Tabletop	Black Lab Tabletop	
P 20 VRT-8B	T3001, Lab Tabletop	Black Lab Tabletop	
T 21 VRT-9A	T3001, Lab Tabletop	Black Tabletop Mastic	
T 22 VRT-9B	T3001, Lab Tabletop	Black Tabletop Mastic	



APPENDIX F:

LICENSES AND CERTIFICATIONS

WE ARE YOUR DOL



**Department
of Labor**

DIVISION OF SAFETY & HEALTH LICENSE AND CERTIFICATE UNIT, STATE OFFICE CAMPUS, BLDG. 12, ALBANY, NY 12226

ASBESTOS HANDLING LICENSE

LaBella Associates, D.P.C.
300 State Street, Suite 201, Rochester, NY, 14614

License Number: 29278

License Class: RESTRICTED

Date of Issue: 03/24/2023

Expiration Date: 03/31/2024

Duly Authorized Representative: Greg Senecal

This license has been issued in accordance with applicable provisions of Article 30 of the Labor Law of New York State and of the New York State Codes, Rules and Regulations (12 NYCRR Part 56). It is subject to suspension or revocation for a (1) serious violation of state, federal or local laws with regard to the conduct of an asbestos project, or (2) demonstrated lack of responsibility in the conduct of any job involving asbestos or asbestos material.

This license is valid only for the contractor named above and this license or a photocopy must be prominently displayed at the asbestos project worksite. This license verifies that all persons employed by the licensee on an asbestos project in New York State have been issued an Asbestos Certificate, appropriate for the type of work they perform, by the New York State Department of Labor.

Amy Phillips, Director
For the Commissioner of Labor

EXCELSIOR

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER



Expires 12:01 AM April 01, 2024
Issued April 01, 2022
Revised March 30, 2023

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. MATTHEW SMITH
LABELLA ASSOCIATES
300 STATE STREET SUITE 200
ROCHESTER, NY 14614

NY Lab Id No: 11184

*is hereby APPROVED as an Environmental Laboratory for the category
ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE
All approved subcategories and/or analytes are listed below:*

Miscellaneous

Asbestos in Friable Material Item 198.1 of Manual
Asbestos in Non-Friable Material-PLM Item 198.6 of Manual (NOB by PLM)

Serial No.: 66308

Property of the New York State Department of Health. Certificates are valid only at the address shown and must be conspicuously posted by the laboratory. Continued accreditation depends on the laboratory's successful ongoing participation in the Program. Consumers may verify a laboratory's accreditation status online at <https://apps.health.ny.gov/pubdoh/applinks/wc/elappublicweb/>, by phone (518) 485-5570 or by email to elap@health.ny.gov.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER



Expires 12:01 AM April 01, 2024
Issued April 01, 2022
Revised March 30, 2023

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MICHAEL GREENBERG
AMA ANALYTICAL SERVICES INC
4475 FORBES BLVD
LANHAM, MD 20706

NY Lab Id No: 10920

is hereby APPROVED as an Environmental Laboratory for the category
ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE
All approved subcategories and/or analytes are listed below:

Metals I

Lead, Total EPA 7000B

Miscellaneous

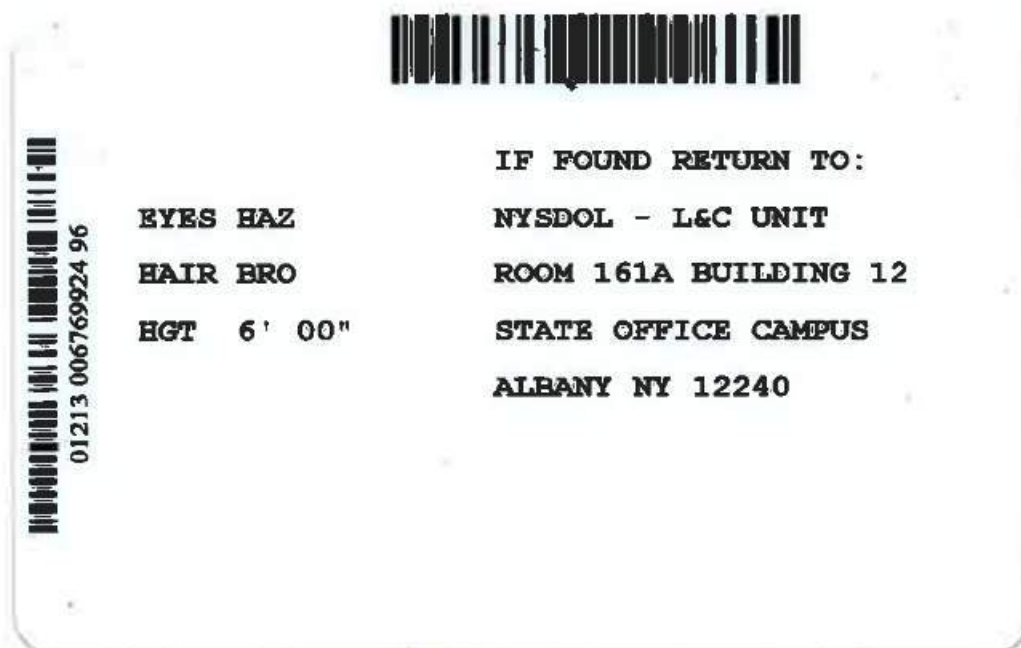
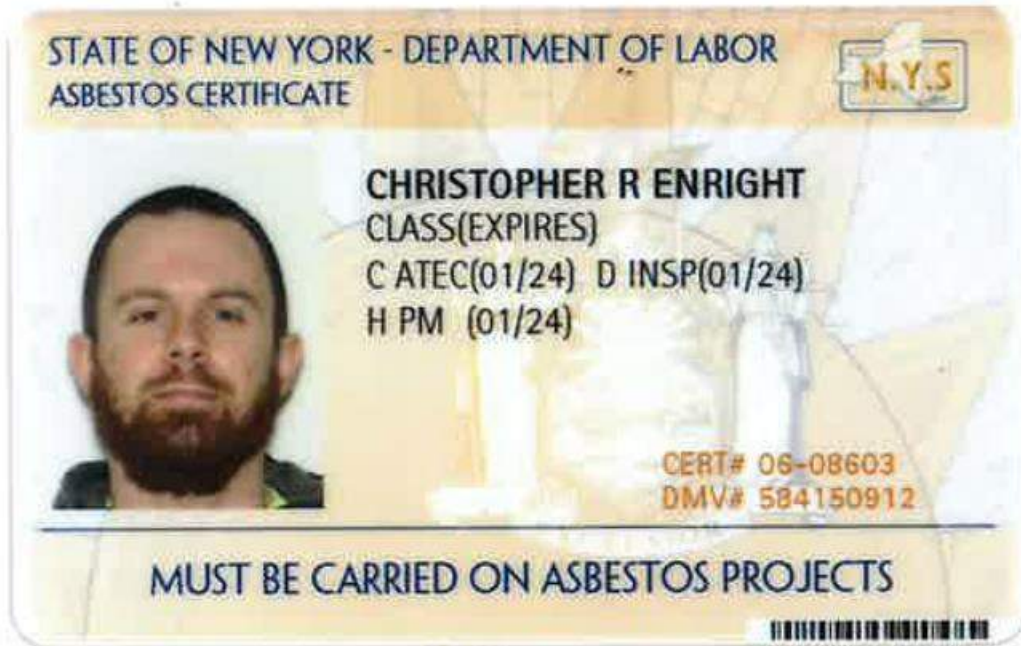
Asbestos in Friable Material Item 198.1 of Manual
EPA 600/M4/82/020
Asbestos in Non-Friable Material-PLM Item 198.6 of Manual (NOB by PLM)
Asbestos in Non-Friable Material-TEM Item 198.4 of Manual
Lead in Dust Wipes EPA 7000B
Lead in Paint EPA 7000B

Sample Preparation Methods

ASTM E-1979-17

Serial No.: 66247

Property of the New York State Department of Health. Certificates are valid only at the address shown and must be conspicuously posted by the laboratory. Continued accreditation depends on the laboratory's successful ongoing participation in the Program. Consumers may verify a laboratory's accreditation status online at <https://apps.health.ny.gov/pubdoh/applinks/wc/elappublicweb/>, by phone (518) 485-5570 or by email to elap@health.ny.gov.





APPENDIX G:
ASBESTOS BULK SAMPLING REPORT

DELTA ENGINEERS, ARCHITECTS & SURVEYS

AUGUST 29, 2022

August 29, 2022

Dale W. Houseknecht, Facilities Coordinator Projects II
Cornell University IPP-Facilities Management
FM Administration
116 Humphreys Service Building
Ithaca, New York 14853-3701

**Re: Veterinary Research Tower (1140) 2nd Floor Lab Suite T2001 Fire Incident
1st, 2nd, & 3rd Floors Fire Damaged Materials / Spray-on Fireproofing
Asbestos Bulk Sampling Report
Cornell Task Authorization No. TA-355, Work Order No. 14577601
Delta Project No.: 2021.163.320**

Dear Mr. Houseknecht:

Enclosed, please find the Asbestos Bulk Sample Report Form, the associated Laboratory Analytical Result Sheets, and the Sample Location Drawings for the bulk sampling performed by Delta Certified Asbestos Inspectors Thomas Ferro and Michael Drobak. The sampling was performed on July 26, 2022 and August 24, 2022 and addressed various suspect materials present on the 1st, 2nd & 3rd floors at the Veterinary Research Tower (VRT) that were damaged and/or impacted by the VRT Lab Suite T2001 Fire Episode. The areas addressed as a part of the inspection included Lecture Hall T1003 Suite, Office Suite T1010, Lab Suites T2001 / T2003 / T2007, Corridors T200CA / TA200CB / T300CA / T300CB, and Utility Chase way T300UA. Based on a walkthrough and visual inspection of the affected areas / associated suspect materials, a total of one hundred (100) bulk samples were collected representing forty-four (44) separate homogenous building materials. Fifty-two (52) of the samples collected were “Non-friable, Organically Bound” (NOB) materials, representing twenty-six (26) homogenous materials. The remaining forty-eight (48) samples were friable, “non-NOB” materials, representing eighteen (18) homogenous materials.

For the “Non Spray-on Fireproofing” materials sampled, all were reported as being “Non-Asbestos” with the exception of the **12”x12” Brown w/ White Mottle Floor Tile present in Room T1003A, which was reported as being asbestos-containing**

In regards to the Spray-on Fireproofing (SOF), Delta collected a total of twenty-five (25) samples from the 1st, 2nd and 3rd floors. Out of these twenty-five (25):

- Ten (10) were reported as being “Asbestos Containing” (> 1.0%)
- Four (4) were reported as being “Non-Asbestos” (> 0% / <1.0%)
- Eleven (11) were reported as being “No Asbestos Detected”

All Spray-on Fireproofing Samples collected by Delta were uniform in color and texture. And results varied for samples collected within the same room / functional space from “Asbestos Containing” to “No Asbestos Detected”. Based on this, in Delta’s opinion all Spray-on Fireproofing present at the Veterinary Research Tower should be considered **Asbestos Containing** unless a sufficient number of samples for a given room are collected / analyzed (based on AHERA requirements for Room square footage) and results for “ALL” samples collected for the Room are reported as “No Asbestos Detected”.

Bulk sample analysis was performed by AmeriSci New York, Inc., an independent laboratory approved/accredited by the NYS Department of Health Environmental Laboratory Accreditation Program (ELAP), and the National Voluntary Laboratory Accreditation Program (NVLAP). Analysis of all Non-Friable Organically Bound (NOB) materials was initially performed by Polarized Light Microscopy (PLM) following the NYS DOH ELAP 198.6 methodology. If the PLM results were reported as “non-asbestos”, the sample was then analyzed by Transmission Electron Microscopy (TEM) following the NYS DOH ELAP 198.4 methodology. Analysis of all Non-NOB materials was performed by Polarized Light Microscopy following the NYS DOH ELAP 198.1 Methodology. A “Positive Stop” sample analysis protocol was utilized for a given homogenous material set with multiple samples, with the exception of the Spray-on Fireproofing Samples, which were All Analyzed. Please reference the Asbestos Bulk Sample Report Form for sample particulars and details.

I have also attached Delta Company / Personnel and Laboratory Licenses & Certifications and various photos of the Spray-on Fireproofing sampled, including SOF reported as “Asbestos Containing”, as “Non-Asbestos”, and as “No Asbestos Detected”. If you have any questions, or require any additional information, please feel free to contact me at your convenience.

Respectfully,

DELTA ENGINEERS, ARCHITECTS, LAND SURVEYORS, & LANDSCAPE ARCHITECTS, DPC



Stephen Prislupsky
Director of Environmental Services
Att: Project Paperwork

Attachment A

Asbestos Bulk Sample Report Form

Client: <u>Cornell University</u>	Task Authorization No.: <u>TA-355 / Work Order No.: 14577601</u>	Delta Proj. No.: <u>2021.163.206</u>
Project: <u>Vet Research Tower Lab Suite</u> <u>T2001 Fire Episode - Asbestos Bulk</u> <u>Sampling</u>	Dates Sampling Performed: <u>07/26/2022 & 08/24/2022</u>	Asbestos Inspector: <u>Michael Drobak / Thomas Ferro</u>
	Date of Report: <u>08/29/2022</u>	Number of Samples Collected: <u>100</u>
Building Code: <u>1140</u>	Laboratory: <u>AmeriSci Labs</u>	Number of Samples Analyzed: <u>PLM - 98 / TEM - 49</u>

Asbestos Bulk Sample Report Form

Sample Number	HA*	Floor	Bulk Sample Description / Details	Material Type	Asbestos Type	PLM Result % Asbestos	TEM Result % Asbestos
2021.163.320-01A	01	1	Yellow/Gray Carpet Mastic - Room T1003, Northwest.	Miscellaneous	ND	ND	ND
2021.163.320-01B	01	1	Yellow/Gray Carpet Mastic - Room T1003, Northeast.	Miscellaneous	ND	ND	ND
2021.163.320-02A	02	1	Red Rolled Vinyl Sheet Flooring - Room T1003, North.	Miscellaneous	ND	ND	ND
2021.163.320-02B	02	1	Red Rolled Vinyl Sheet Flooring - Room T1003, North.	Miscellaneous	ND	ND	ND
2021.163.320-03A	03	1	Gray Mastic from HA 02 - Room T1003, North.	Miscellaneous	ND	ND	ND
2021.163.320-03B	03	1	Gray Mastic from HA 02 - Room T1003, North.	Miscellaneous	ND	ND	ND
2021.163.320-04A	04	1	Gray Rolled Vinyl Sheet Flooring - Room T1003, Northeast.	Miscellaneous	ND	ND	ND
2021.163.320-04B	04	1	Gray Rolled Vinyl Sheet Flooring - Room T1003, Northwest.	Miscellaneous	ND	ND	ND
2021.163.320-05A	05	1	Gray Mastic from HA 04 - Room T1003, Northeast.	Miscellaneous	ND	ND	ND
2021.163.320-05B	05	1	Gray Mastic from HA 04 - Room T1003, Northwest.	Miscellaneous	ND	ND	ND
2021.163.320-06A	06	1	Tile - Room T1003, Northwest Under HA 03 & HA 04.	Miscellaneous	ND	ND	ND
2021.163.320-06B	06	1	Tile - Room T1003, Northwest Under HA 03 & HA 04.	Miscellaneous	ND	ND	ND
2021.163.320-07A	07	1	Yellow Mastic from HA 06 - Room T1003, Northwest.	Miscellaneous	NA	NA	NA

Client: <u>Cornell University</u>	Task Authorization No.: <u>TA-355 / Work Order No.: 14577601</u>	Delta Proj. No.: <u>2021.163.206</u>
Project: <u>Vet Research Tower Lab Suite</u> <u>T2001 Fire Episode - Asbestos Bulk</u> <u>Sampling</u>	Dates Sampling Performed: <u>07/26/2022 & 08/24/2022</u>	Asbestos Inspector: <u>Michael Drobak / Thomas Ferro</u>
	Date of Report: <u>08/29/2022</u>	Number of Samples Collected: <u>100</u>
Building Code: <u>1140</u>	Laboratory: <u>AmeriSci Labs</u>	Number of Samples Analyzed: <u>PLM - 98 / TEM - 49</u>

Asbestos Bulk Sample Report Form

Sample Number	HA*	Floor	Bulk Sample Description / Details	Material Type	Asbestos Type	PLM Result % Asbestos	TEM Result % Asbestos
2021.163.320-07B	07	1	Yellow Mastic from HA 06 - Room T1003, Northwest.	Miscellaneous	ND	ND	ND
2021.163.320-08A	08	1	12"x12" Brown w/ White Mottle Floor Tile - Room T1003A, Southeast.	Miscellaneous	Chrysotile	2.1%	NA/PS
2021.163.320-08B	08	1	12"x12" Brown w/ White Mottle Floor Tile - Room T1003A, Southeast.	Miscellaneous		NA/PS	NA/PS
2021.163.320-09A	09	1	Black Mastic from HA 08 - Room T1003A, Southeast.	Miscellaneous	ND	ND	ND
2021.163.320-09B	09	1	Black Mastic from HA 08 - Room T1003A, Southeast.	Miscellaneous	ND	ND	ND
2021.163.320-10A	10	1	Tan Mastic from 4" Vinyl Covebase - Room T1003A, East Wall.	Miscellaneous	ND	ND	ND
2021.163.320-10B	10	1	Tan Mastic from 4" Vinyl Covebase - Room T1003A, East Wall.	Miscellaneous	ND	ND	ND
2021.163.320-11A	11	1	Light Gray Gypsum Wallboard - Room T1003, Southeast.	Miscellaneous	ND	ND	NA
2021.163.320-11B	11	1	Light Gray Gypsum Wallboard - Room T1003, Southeast.	Miscellaneous	ND	ND	NA
2021.163.320-12A	12	1	White Joint Compound - Room T1003, South.	Miscellaneous	ND	ND	NA
2021.163.320-12B	12	1	White Joint Compound - Room T1003, South.	Miscellaneous	ND	ND	NA
2021.163.320-13A	13	1	2'x2' Fissured Drop-in Ceiling Tile - Room T1003A, Center.	Miscellaneous	ND	ND	ND
2021.163.320-13B	13	1	2'x2' Fissured Drop-in Ceiling Tile - Room T1003A, Center.	Miscellaneous	ND	ND	ND

Client: <u>Cornell University</u>	Task Authorization No.: <u>TA-355 / Work Order No.: 14577601</u>	Delta Proj. No.: <u>2021.163.206</u>
Project: <u>Vet Research Tower Lab Suite</u> <u>T2001 Fire Episode - Asbestos Bulk</u> <u>Sampling</u>	Dates Sampling Performed: <u>07/26/2022 & 08/24/2022</u>	Asbestos Inspector: <u>Michael Drobak / Thomas Ferro</u>
	Date of Report: <u>08/29/2022</u>	Number of Samples Collected: <u>100</u>
Building Code: <u>1140</u>	Laboratory: <u>AmeriSci Labs</u>	Number of Samples Analyzed: <u>PLM - 98 / TEM - 49</u>

Asbestos Bulk Sample Report Form

Sample Number	HA*	Floor	Bulk Sample Description / Details	Material Type	Asbestos Type	PLM Result % Asbestos	TEM Result % Asbestos
2021.163.320-	14A	14	1	2'x2'x2" Textured Covering from Fiberglass Drop-in Ceiling Tile - Room T1003, South.	Miscellaneous	ND	ND
2021.163.320-	14B	14	1	2'x2'x2" Textured Covering from Fiberglass Drop-in Ceiling Tile - Room T1003, South.	Miscellaneous	ND	ND
2021.163.320-	15A	15	1	Light Gray Mudded Pipe Fitting - Room T1003, South.	TSI	ND	NA
2021.163.320-	15B	15	1	Light Gray Mudded Pipe Fitting - Room T1003, South.	TSI	ND	NA
2021.163.320-	15C	15	1	Light Gray Mudded Pipe Fitting - Room T1003, South.	TSI	ND	NA
2021.163.320-	16A	16	1	Light Gray Spray-on Fireproofing - Room T1003, Southeast.	Surfacing	ND	NA
2021.163.320-	16B	16	1	Light Gray Spray-on Fireproofing - Room T1003, Southeast.	Surfacing	ND	NA
2021.163.320-	16C	16	1	Light Gray Spray-on Fireproofing - Room T1003, Southeast.	Surfacing	ND	NA
2021.163.320-	17A	17	1	Yellow Carpet Mastic - Room T1010 at Room 1010B.	Miscellaneous	ND	ND
2021.163.320-	17B	17	1	Yellow Carpet Mastic - Room T1010 at Room 1010B.	Miscellaneous	ND	ND
2021.163.320-	18A	18	1	12"x12" Light Gray w/ Gray & Blue Floor Tile - Room 1010Q, South.	Miscellaneous	ND	ND
2021.163.320-	18B	18	1	12"x12" Light Gray w/ Gray & Blue Floor Tile - Room 1010Q, South.	Miscellaneous	ND	ND
2021.163.320-	19A	19	1	Yellow Mastic from HA 18 - Room 1010Q, South.	Miscellaneous	ND	ND

Client: <u>Cornell University</u>	Task Authorization No.: <u>TA-355 / Work Order No.: 14577601</u>	Delta Proj. No.: <u>2021.163.206</u>
Project: <u>Vet Research Tower Lab Suite</u> <u>T2001 Fire Episode - Asbestos Bulk</u> <u>Sampling</u>	Dates Sampling Performed: <u>07/26/2022 & 08/24/2022</u>	Asbestos Inspector: <u>Michael Drobak / Thomas Ferro</u>
	Date of Report: <u>08/29/2022</u>	Number of Samples Collected: <u>100</u>
Building Code: <u>1140</u>	Laboratory: <u>AmeriSci Labs</u>	Number of Samples Analyzed: <u>PLM - 98 / TEM - 49</u>

Asbestos Bulk Sample Report Form

Sample Number	HA*	Floor	Bulk Sample Description / Details	Material Type	Asbestos Type	PLM Result % Asbestos	TEM Result % Asbestos
2021.163.320-	19B	19	1	Yellow Mastic from HA 18 - Room 1010Q, South.	Miscellaneous	ND	ND
2021.163.320-	20A	20	1	Light Tan Mastic from 4" Vinyl Covebase - Room T1010, at Room T1010S.	Miscellaneous	ND	ND
2021.163.320-	20B	20	1	Light Tan Mastic from 4" Vinyl Covebase - Room T1010, at Room T1010S.	Miscellaneous	ND	ND
2021.163.320-	21A	21	1	White Gypsum Wallboard - Room T1010 at Room T1010B.	Miscellaneous	ND	NA
2021.163.320-	21B	21	1	White Gypsum Wallboard - Room T1010 at Room T1010B.	Miscellaneous	ND	NA
2021.163.320-	22A	22	1	White Joint Compound - Room T1010 at Room T1010B.	Miscellaneous	ND	NA
2021.163.320-	22B	22	1	White Joint Compound - Room T1010 at Room T1010B.	Miscellaneous	ND	NA
2021.163.320-	23A	23	1	2'x4' Fissured Drop-in Ceiling Tile - Room T1010 at Room T1010B.	Miscellaneous	ND	ND
2021.163.320-	23B	23	1	2'x4' Fissured Drop-in Ceiling Tile - Room T1010 at Room T1010A.	Miscellaneous	ND	ND
2021.163.320-	24A	24	1	Light Gray Spray-on Fireproofing - Room T1010 at Room T1010A.	Surfacing	ND	NA
2021.163.320-	24B	24	1	Light Gray Spray-on Fireproofing - Room T1010P, East.	Surfacing	ND	NA
2021.163.320-	24C	24	1	Light Gray Spray-on Fireproofing - Room T1010P, West.	Surfacing	ND	NA
2021.163.320-	25A	25	2	12"x12" Light Gray Mottled Floor Tile - Room T2001.	Miscellaneous	ND	ND

Client: <u>Cornell University</u>	Task Authorization No.: <u>TA-355 / Work Order No.: 14577601</u>	Delta Proj. No.: <u>2021.163.206</u>
Project: <u>Vet Research Tower Lab Suite</u> <u>T2001 Fire Episode - Asbestos Bulk</u> <u>Sampling</u>	Dates Sampling Performed: <u>07/26/2022 & 08/24/2022</u>	Asbestos Inspector: <u>Michael Drobak / Thomas Ferro</u>
	Date of Report: <u>08/29/2022</u>	Number of Samples Collected: <u>100</u>
Building Code: <u>1140</u>	Laboratory: <u>AmeriSci Labs</u>	Number of Samples Analyzed: <u>PLM - 98 / TEM - 49</u>

Asbestos Bulk Sample Report Form

Sample Number	HA*	Floor	Bulk Sample Description / Details	Material Type	Asbestos Type	PLM Result % Asbestos	TEM Result % Asbestos
2021.163.320-	25B	25	2	12"x12" Light Gray Mottled Floor Tile - Room T2001.	Miscellaneous	ND	ND
2021.163.320-	26A	26	2	Yellow Mastic from HA 25 - Room T2001.	Miscellaneous	ND	ND
2021.163.320-	26B	26	2	Yellow Mastic from HA 25 - Room T2001.	Miscellaneous	ND	ND
2021.163.320-	27A	27	2	White Mastic from 4" Vinyl Covebase - Room T2001C.	Miscellaneous	ND	ND
2021.163.320-	27B	27	2	White Mastic from 4" Vinyl Covebase - Room T2001C.	Miscellaneous	ND	ND
2021.163.320-	28A	28	2	Light Gray Gypsum Wallboard - Room T2001C.	Miscellaneous	ND	NA
2021.163.320-	28B	28	2	Light Gray Gypsum Wallboard - Room T2001.	Miscellaneous	ND	NA
2021.163.320-	29A	29	2	White Joint Compound - Room T2001C.	Miscellaneous	ND	NA
2021.163.320-	29B	29	2	White Joint Compound - Room T2001C.	Miscellaneous	ND	NA
2021.163.320-	30A	30	2	2'x4' Fissured Drop-in Ceiling Tile - Room T2001.	Miscellaneous	ND	ND
2021.163.320-	30B	30	2	2'x4' Fissured Drop-in Ceiling Tile - Room T2001.	Miscellaneous	ND	ND
2021.163.320-	31A	31	2	Light Gray Spray-on Fireproofing - Room T2001, at Room T2001C.	Surfacing	Non-Asbestos	Trace (< 0.25%)
2021.163.320-	31B	31	2	Light Gray Spray-on Fireproofing - Room T2001, at Entrance	Surfacing	ND	ND

Client: <u>Cornell University</u>	Task Authorization No.: <u>TA-355 / Work Order No.: 14577601</u>	Delta Proj. No.: <u>2021.163.206</u>
Project: <u>Vet Research Tower Lab Suite</u> <u>T2001 Fire Episode - Asbestos Bulk</u> <u>Sampling</u>	Dates Sampling Performed: <u>07/26/2022 & 08/24/2022</u>	Asbestos Inspector: <u>Michael Drobak / Thomas Ferro</u>
	Date of Report: <u>08/29/2022</u>	Number of Samples Collected: <u>100</u>
Building Code: <u>1140</u>	Laboratory: <u>AmeriSci Labs</u>	Number of Samples Analyzed: <u>PLM - 98 / TEM - 49</u>

Asbestos Bulk Sample Report Form

Sample Number	HA*	Floor	Bulk Sample Description / Details	Material Type	Asbestos Type	PLM Result % Asbestos	TEM Result % Asbestos
2021.163.320-31C	31	2	Light Gray Spray-on Fireproofing - Room T2001, at Room T2001E.	Surfacing	Non-Asbestos	0.3%	NA
2021.163.320-32A	32	2	Labtop Backsplash Caulk - Room T2001.	Miscellaneous	ND	ND	ND
2021.163.320-32B	32	2	Labtop Backsplash Caulk - Room T2001.	Miscellaneous	ND	ND	ND
2021.163.320-33A	33	2	Black Labtop - Room T2001.	Miscellaneous	ND	ND	NA
2021.163.320-33B	33	2	Black Labtop - Room T2001.	Miscellaneous	ND	ND	NA
2021.163.320-34A	34	2	Black Labtop Adhesive - Room T2001.	Miscellaneous	ND	ND	ND
2021.163.320-34B	34	2	Black Labtop Adhesive - Room T2001.	Miscellaneous	ND	ND	ND
2021.163.320-35A	35	2	Black Seam Epoxy - Room T2001.	Miscellaneous	ND	ND	ND
2021.163.320-35B	35	2	Black Seam Epoxy - Room T2001.	Miscellaneous	ND	ND	ND
2021.163.320-36A	36	2	Black Soot Sample - Room T2001, Center.	Miscellaneous	ND	ND	NA
2021.163.320-36B	36	2	Black Soot Sample - Room T2001, Adjacent to Room T2001C.	Miscellaneous	ND	ND	NA
2021.163.320-37A	37	2	Black Burn Debris - Room T2001, East.	Miscellaneous	ND	ND	NA
2021.163.320-37B	37	2	Black Burn Debris - Room T2001, West.	Miscellaneous	ND	ND	NA

Client: <u>Cornell University</u>	Task Authorization No.: <u>TA-355 / Work Order No.: 14577601</u>	Delta Proj. No.: <u>2021.163.206</u>
Project: <u>Vet Research Tower Lab Suite T2001 Fire Episode - Asbestos Bulk Sampling</u>	Dates Sampling Performed: <u>07/26/2022 & 08/24/2022</u>	Asbestos Inspector: <u>Michael Drobak / Thomas Ferro</u>
	Date of Report: <u>08/29/2022</u>	Number of Samples Collected: <u>100</u>
Building Code: <u>1140</u>	Laboratory: <u>AmeriSci Labs</u>	Number of Samples Analyzed: <u>PLM - 98 / TEM - 49</u>

Asbestos Bulk Sample Report Form

Sample Number	HA*	Floor	Bulk Sample Description / Details	Material Type	Asbestos Type	PLM Result % Asbestos	TEM Result % Asbestos
2021.163.320-101A	101	3	Spray-on Fireproofing, Corridor T300CA, East End	Surfacing	Chrysotile	5.0%	NA
2021.163.320-101B	101	3	Spray-on Fireproofing, Corridor T300CA, Outside Room T3006	Surfacing	ND	ND	NA
2021.163.320-101C	101	3	Spray-on Fireproofing, Corridor T300CA, West End	Surfacing	Chrysotile	4.0%	NA
2021.163.320-102A	102	3	Soot, Utility Space T300UA, East End	Miscellaneous	ND	ND	NA
2021.163.320-102B	102	3	Soot, Utility Space T300UA, Center	Miscellaneous	ND	ND	NA
2021.163.320-201A	201	2	Spray-on Fireproofing: 2nd Floor, Lab Suite T2003 - Room T2003 (On Beam).	Surfacing	Chrysotile	1.5%	NA
2021.163.320-201B	201	2	Spray-on Fireproofing: 2nd Floor, Lab Suite T2003 - Room T2003A, Center (On Deck).	Surfacing	Non-Asbestos	Trace (< 0.25%)	NA
2021.163.320-201C	201	2	Spray-on Fireproofing: 2nd Floor, Lab Suite T2003 - Room T2003 (On Beam).	Surfacing	Chrysotile	2.8%	NA
2021.163.320-202A	202	2	2'x4' Light Gray Gypsum Ceiling Tile: 2nd Floor, Lab Suite T2003 - Room T2003A, Center.	Miscellaneous	ND	ND	ND
2021.163.320-202B	202	2	2'x4' Light Gray Gypsum Ceiling Tile: 2nd Floor, Lab Suite T2003 - Room T2003A, East.	Miscellaneous	ND	ND	ND
2021.163.320-203A	203	2	White Textured Covering on HA 202: 2nd Floor, Lab Suite T2003 - Room T2003A, Center.	Miscellaneous	ND	ND	ND

Client: <u>Cornell University</u>	Task Authorization No.: <u>TA-355 / Work Order No.: 14577601</u>	Delta Proj. No.: <u>2021.163.206</u>
Project: <u>Vet Research Tower Lab Suite T2001 Fire Episode - Asbestos Bulk Sampling</u>	Dates Sampling Performed: <u>07/26/2022 & 08/24/2022</u>	Asbestos Inspector: <u>Michael Drobak / Thomas Ferro</u>
	Date of Report: <u>08/29/2022</u>	Number of Samples Collected: <u>100</u>
Building Code: <u>1140</u>	Laboratory: <u>AmeriSci Labs</u>	Number of Samples Analyzed: <u>PLM - 98 / TEM - 49</u>

Asbestos Bulk Sample Report Form

Sample Number	HA*	Floor	Bulk Sample Description / Details	Material Type	Asbestos Type	PLM Result % Asbestos	TEM Result % Asbestos
2021.163.320-203B	203	2	White Textured Covering on HA 202: 2nd Floor, Lab Suite T2003 - Room T2003A, East.	Miscellaneous	ND	ND	ND
2021.163.320-204A	204	2	Spray-on Fireproofing: 2nd Floor, Lab Suite T2007 - Room T2007, East (Overspray on Ductwork).	Surfacing	Chrysotile	8.7%	NA
2021.163.320-204B	204	2	Spray-on Fireproofing: 2nd Floor Lab Suite T2007 - Room T2007, West (On	Surfacing	Chrysotile	18.2%	NA
2021.163.320-204C	204	2	Spray-on Fireproofing: 2nd Floor, Lab Suite T2007 - Room T2007A, Center (On	Surfacing	Chrysotile	21.1%	NA
2021.163.320-204D	204	2	Spray-on Fireproofing: 2nd Floor, Lab Suite T2007 - Room T2007C, West (On	Surfacing	Chrysotile	4.3%	NA
2021.163.320-204E	204	2	Spray-on Fireproofing: 2nd Floor, Lab Suite T2007 - Room T2007D, West (On	Surfacing	Chrysotile	16.7%	NA
2021.163.320-205A	205	2	Spray-on Fireproofing: 2nd Floor Corridor T200CB - West.	Surfacing	Chrysotile	14.8%	NA
2021.163.320-205B	205	2	Spray-on Fireproofing: 2nd Floor Corridor T200CB - West-Center.	Surfacing	Non-Asbestos	Trace (< 0.25%)	NA
2021.163.320-205C	205	2	Spray-on Fireproofing: 2nd Floor Corridor T200CB - Center.	Surfacing	ND	ND	NA
2021.163.320-205D	205	2	Spray-on Fireproofing: 2nd Floor Corridor T200CB - East-Center.	Surfacing	ND	ND	NA
2021.163.320-205E	205	2	Spray-on Fireproofing: 2nd Floor Corridor T200CB - East.	Surfacing	ND	ND	NA

HA - Homogenous Area **ND** - No Asbestos Detected **NA** - Not Analyzed by Methodology **NA/PS** - Not Analyzed, Positive Stop

TSI - Thermal System Insulation **Misc** - Miscellaneous Material **Trace / < 1%** - Non-asbestos by definition

Attachment B

Laboratory Analytical Result Sheets

**AmeriSci New York**

117 EAST 30TH ST.
NEW YORK, NY 10016
TEL: (212) 679-8600 • FAX: (212) 679-3114

PLM Bulk Asbestos Report

Delta Engineers
Attn: Stephen Prislupsky
860 Hooper Road

Endwell, NY 13760

Date Received 07/27/22 **AmeriSci Job #** 222074019
Date Examined 07/27/22 **P.O. #**
ELAP # 11480 **Page** 1 of 14
RE: 2021.163.320; Cornell University; Vet Research Tower 2nd Floor
Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk Sampling

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-01A 01	222074019-01 Location: Floor 1, Room T1003, Northwest - Yellow/Gray Carpet Mastic	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Yellow/Gray, Heterogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 26.4%			
2021.163.320-01B 01	222074019-02 Location: Floor 1, Room T1003, Northeast - Yellow/Gray Carpet Mastic	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Yellow/Gray, Heterogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 27%			
2021.163.320-02A 02	222074019-03 Location: Floor 1, Room T1003, North - Red Rolled Vinyl Sheet Flooring	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Red, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 9%			
2021.163.320-02B 02	222074019-04 Location: Floor 1, Room T1003, North - Red Rolled Vinyl Sheet Flooring	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Red, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 6.4%			
2021.163.320-03A 03	222074019-05 Location: Floor 1, Room T1003, North - Gray Mastic From HA 02	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Yellow/Gray, Heterogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 40.9%			

PLM Bulk Asbestos Report

2021.163.320; Cornell University; Vet Research Tower 2nd
Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk
Sampling

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-03B 03 Location: Floor 1, Room T1003, North - Gray Mastic From HA 02	222074019-06	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Yellow/Gray, Heterogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 25%			
2021.163.320-04A 04 Location: Floor 1, Room T1003, Northeast - Gray Rolled Vinyl Sheet Flooring	222074019-07	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Beige, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 12.2%			
2021.163.320-04B 04 Location: Floor 1, Room T1003, Northwest - Gray Rolled Vinyl Sheet Flooring	222074019-08	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Beige, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 12.5%			
2021.163.320-05A 05 Location: Floor 1, Room T1003, Northeast - Gray Mastic From HA 04	222074019-09	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Yellow/Gray, Heterogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 23.8%			
2021.163.320-05B 05 Location: Floor 1, Room T1003, Northwest - Gray Mastic From HA 04	222074019-10	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Yellow/Gray, Heterogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 23.7%			
2021.163.320-06A 06 Location: Floor 1, Room T1003, Northwest Under HA 03 & HA 04 - 12" x 12" White W/ Gray & Blue Mottle Floor Tile	222074019-11	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: White/Blue, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 40.3%			

PLM Bulk Asbestos Report

2021.163.320; Cornell University; Vet Research Tower 2nd
Floor Fire Episode - 1st, 2nd and 3rd Floors Asbestos Bulk
Sampling

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-06B 06	222074019-12	No	NAD
Location: Floor 1, Room T1003, Northwest Under HA 03 & HA 04 - 12" x 12" White W/ Gray & Blue Mottle Floor Tile			(by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: White/Blue, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 35.2%			
2021.163.320-07A 07	222074019-13		NA
Location: Floor 1, Room T1003, Northwest - Yellow Mastic From HA 06 "Insufficient Material Submitted For Preparation"			
Analyst Description: Bulk Material			
Asbestos Types:			
Other Material:			
2021.163.320-07B 07	222074019-14	No	NAD
Location: Floor 1, Room T1003, Northwest - Yellow Mastic From HA 06			(by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Yellow, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 13.9%			
2021.163.320-08A 08	222074019-15	Yes	2.1%
Location: Floor 1, Room T1003A, Southeast - 12" x 12" Brown W/ White Mottle Floor Tile			(by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Brown/Gray, Homogeneous, Fibrous, Bulk Material			
Asbestos Types: Chrysotile 2.1 %			
Other Material: Non-fibrous 9.6%			
2021.163.320-08B 08	222074019-16		NA/PS
Location: Floor 1, Room T1003A, Southeast - 12" x 12" Brown W/ White Mottle Floor Tile			
Analyst Description: Bulk Material			
Asbestos Types:			
Other Material:			
2021.163.320-09A 09	222074019-17	No	NAD
Location: Floor 1, Room T1003A, Southeast - Black Mastic From HA 08			(by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Black, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 24.2%			

PLM Bulk Asbestos Report

2021.163.320; Cornell University; Vet Research Tower 2nd
Floor Fire Epside - 1st, 2nd and 3rd Floors Asbestos Bulk
Sampling

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-09B 09	222074019-18 Location: Floor 1, Room T1003A, Southeast - Black Mastic From HA 08	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Black, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 14.9%			
2021.163.320-10A 10	222074019-19 Location: Floor 1, Room T1003A, East Wall - Tan Mastic From 4" Vinyl Covebase	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Tan/White, Heterogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 32.3%			
2021.163.320-10B 10	222074019-20 Location: Floor 1, Room T1003A, East Wall - Tan Mastic From 4" Vinyl Covebase	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Tan/White, Heterogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 39%			
2021.163.320-11A 11	222074019-21 Location: Floor 1, Room T1003, Southeast - Light Gray Gypsum Wallboard	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Lt. Gray/Brown, Heterogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose 10%, Fibrous glass 1%, Non-fibrous 89%			
2021.163.320-11B 11	222074019-22 Location: Floor 1, Room T1003, Southeast - Light Gray Gypsum Wallboard	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Lt. Gray, Homogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose 1%, Fibrous glass 1%, Non-fibrous 98%			
2021.163.320-12A 12	222074019-23 Location: Floor 1, Room T1003, South - White Joint Compound	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Non-fibrous 100%			

PLM Bulk Asbestos Report

2021.163.320; Cornell University; Vet Research Tower 2nd
Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk
Sampling

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-12B 12	222074019-24 Location: Floor 1, Room T1003, South - White Joint Compound	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Non-fibrous 100%			
2021.163.320-13A 13	222074019-25 Location: Floor 1, Room T1003A, Center - 2' x 2' Fissured Drop-In Ceiling Tile	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: White/Gray, Heterogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 14%			
2021.163.320-13B 13	222074019-26 Location: Floor 1, Room T1003A, Center - 2' x 2' Fissured Drop-In Ceiling Tile	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: White/Gray, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 10.2%			
2021.163.320-14A 14	222074019-27 Location: Floor 1, Room T1003 South - 2' x 2' x 2" Textured Covering From Fiberglass Drop-In Ceiling Tile	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: White/Yellow, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 58.6%			
2021.163.320-14B 14	222074019-28 Location: Floor 1, Room T1003 South - 2' x 2' x 2" Textured Covering From Fiberglass Drop-In Ceiling Tile	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: White/Yellow, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 54.6%			
2021.163.320-15A 15	222074019-29 Location: Floor 1, Room T1003 South - Light Gray Mudded Pipe Fitting	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Gray, Homogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Fibrous glass 25%, Non-fibrous 75%			

PLM Bulk Asbestos Report

2021.163.320; Cornell University; Vet Research Tower 2nd
Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk
Sampling

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-15B 15	222074019-30 Location: Floor 1, Room T1003 South - Light Gray Mudded Pipe Fitting	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Gray, Homogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Fibrous glass 20%, Non-fibrous 80%			
2021.163.320-15C 15	222074019-31 Location: Floor 1, Room T1003 South - Light Gray Mudded Pipe Fitting	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Gray, Homogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Fibrous glass 20%, Non-fibrous 80%			
2021.163.320-16A 16	222074019-32 Location: Floor 1, Room T1003 Southeast - Light Gray Spray-On Fireproofing	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Beige, Homogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Fibrous glass 65%, Non-fibrous 35%			
2021.163.320-16B 16	222074019-33 Location: Floor 1, Room T1003 Southeast - Light Gray Spray-On Fireproofing	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Beige, Homogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Fibrous glass 70%, Non-fibrous 30%			
2021.163.320-16C 16	222074019-34 Location: Floor 1, Room T1003 Southeast - Light Gray Spray-On Fireproofing	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Beige, Homogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Fibrous glass 65%, Non-fibrous 35%			
2021.163.320-17A 17	222074019-35 Location: Floor 1, Room T1010 At Room 1010B - Yellow Carpet Mastic	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Yellow, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 39.4%			

PLM Bulk Asbestos Report

2021.163.320; Cornell University; Vet Research Tower 2nd
Floor Fire Epside - 1st, 2nd and 3rd Floors Asbestos Bulk
Sampling

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-17B 17	222074019-36 Location: Floor 1, Room T1010 At Room 1010B - Yellow Carpet Mastic	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Yellow, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 36.2%			
2021.163.320-18A 18	222074019-37 Location: Floor 1, Room 1010Q, South - 12" x 12" Light Gray W/ Gray & Blue Floor Tile	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Off-White, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 3.5%			
2021.163.320-18B 18	222074019-38 Location: Floor 1, Room 1010Q, South - 12" x 12" Light Gray W/ Gray & Blue Floor Tile	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Off-White, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 7.7%			
2021.163.320-19A 19	222074019-39 Location: Floor 1, Room 1010Q, South - Yellow Mastic From HA 18	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Yellow, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 4.6%			
2021.163.320-19B 19	222074019-40 Location: Floor 1, Room 1010Q, South - Yellow Mastic From HA 18	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Yellow, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 6.5%			
2021.163.320-20A 20	222074019-41 Location: Floor 1, Room 1010, At Room 1010S - Light Tan Mastic From 4" Vinyl Covebase	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Beige, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 55.8%			

PLM Bulk Asbestos Report

2021.163.320; Cornell University; Vet Research Tower 2nd
Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk
Sampling

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-20B 20	222074019-42	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Location: Floor 1, Room 1010, At Room 1010S - Light Tan Mastic From 4" Vinyl Covebase Analyst Description: Beige, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 43.6%			
2021.163.320-21A 21	222074019-43	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Location: Floor 1, Room 1010 At Room 1010B - White Gypsum Wallboard Analyst Description: White/Brown, Heterogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose 8%, Fibrous glass 1%, Non-fibrous 91%			
2021.163.320-21B 21	222074019-44	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Location: Floor 1, Room 1010 At Room 1010B - White Gypsum Wallboard Analyst Description: White/Brown, Heterogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose 10%, Fibrous glass 1%, Non-fibrous 89%			
2021.163.320-22A 22	222074019-45	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Location: Floor 1, Room 1010 At Room 1010B - White Joint Compound Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Non-fibrous 100%			
2021.163.320-22B 22	222074019-46	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Location: Floor 1, Room 1010 At Room 1010B - White Joint Compound Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Non-fibrous 100%			
2021.163.320-23A 23	222074019-47	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Location: Floor 1, Room 1010 At Room 1010B - 2' x 4' Fissured Drop-In Ceiling Tile Analyst Description: White/Gray, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 53.8%			

PLM Bulk Asbestos Report

2021.163.320; Cornell University; Vet Research Tower 2nd
Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk
Sampling

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-23B 23	222074019-48 Location: Floor 1, Room 1010 At Room 1010A - 2' x 4' Fissured Drop-In Ceiling Tile	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: White/Gray, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 54%			
2021.163.320-24A 24	222074019-49 Location: Floor 1, Room 1010 At Room 1010A - Light Gray Spray-On Fireproofing	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Beige, Homogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Fibrous glass 55%, Non-fibrous 45%			
2021.163.320-24B 24	222074019-50 Location: Floor 1, Room 1010P, East - Light Gray Spray-On Fireproofing	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Beige, Homogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Fibrous glass 50%, Non-fibrous 50%			
2021.163.320-24C 24	222074019-51 Location: Floor 1, Room 1010P, West - Light Gray Spray-On Fireproofing	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Beige, Homogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Fibrous glass 55%, Non-fibrous 45%			
2021.163.320-25A 25	222074019-52 Location: Floor 2, Room T2001 - 12" x 12" Light Gray Mottled Floor Tile	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Lt. Gray, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 2.9%			
2021.163.320-25B 25	222074019-53 Location: Floor 2, Room T2001 - 12" x 12" Light Gray Mottled Floor Tile	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Lt. Gray, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 3.1%			

PLM Bulk Asbestos Report

2021.163.320; Cornell University; Vet Research Tower 2nd
Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk
Sampling

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-26A 26	222074019-54 Location: Floor 2, Room T2001 - Yellow Mastic From HA 25	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Yellow/Gray, Heterogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 25%			
2021.163.320-26B 26	222074019-55 Location: Floor 2, Room T2001 - Yellow Mastic From HA 25	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Yellow/Gray, Heterogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 25.4%			
2021.163.320-27A 27	222074019-56 Location: Floor 2, Room T2001C - White Mastic From 4" Vinyl Covebase	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Beige, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 44.3%			
2021.163.320-27B 27	222074019-57 Location: Floor 2, Room T2001C - White Mastic From 4" Vinyl Covebase	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Beige, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 44.1%			
2021.163.320-28A 28	222074019-58 Location: Floor 2, Room T2001C - Light Gray Gypsum Wallboard	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Off-White/Brown, Heterogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose 13%, Fibrous glass Trace, Non-fibrous 87%			
2021.163.320-28B 28	222074019-59 Location: Floor 2, Room T2001 - Light Gray Gypsum Wallboard	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Gray, Homogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Fibrous glass 2%, Non-fibrous 98%			

PLM Bulk Asbestos Report

2021.163.320; Cornell University; Vet Research Tower 2nd
Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk
Sampling

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-29A 29 Location: Floor 2, Room T2001C - White Joint Compound	222074019-60	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Non-fibrous 100%			
2021.163.320-29B 29 Location: Floor 2, Room T2001C - White Joint Compound	222074019-61	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Non-fibrous 100%			
2021.163.320-30A 30 Location: Floor 2, Room T2001 - 2' x 4' Fissured Drop-In Ceiling Tile	222074019-62	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Gray/Beige, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 39.7%			
2021.163.320-30B 30 Location: Floor 2, Room T2001 - 2' x 4' Fissured Drop-In Ceiling Tile	222074019-63	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Gray/Beige, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 34.4%			
2021.163.320-31A 31 Location: Floor 2, Room T2001, At Room T2001C - Light Gray Spray-On Fireproofing	222074019-64	Yes	Trace (<0.25 % pc) (ELAP 400 PC) by Valeriu Voicu on 07/27/22
Analyst Description: Gray, Homogeneous, Fibrous, Bulk Material Asbestos Types: Chrysotile <0.25 % pc Other Material: Cellulose Trace, Fibrous glass 45%, Non-fibrous 55%			
2021.163.320-31B 31 Location: Floor 2, Room T2001, At Entrance - Light Gray Spray-On Fireproofing	222074019-65	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Beige/Gray, Homogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Fibrous glass 60%, Non-fibrous 40%			

PLM Bulk Asbestos Report

2021.163.320; Cornell University; Vet Research Tower 2nd
Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk
Sampling

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-31C 31	222074019-66 Location: Floor 2, Room T2001, At Room T2001E - Light Gray Spray-On Fireproofing	Yes	0.3% (ELAP 400 PC) by Valeriu Voicu on 07/27/22
Analyst Description: Gray, Homogeneous, Fibrous, Bulk Material Asbestos Types: Chrysotile 0.3 % Other Material: Cellulose Trace, Fibrous glass 55%, Non-fibrous 44.7%			
2021.163.320-32A 32	222074019-67 Location: Floor 2, Room T2001 - Labtop Backsplash Caulk	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Clear, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 26.3%			
2021.163.320-32B 32	222074019-68 Location: Floor 2, Room T2001 - Labtop Backsplash Caulk	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Clear, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 16.8%			
2021.163.320-33A 33	222074019-69 Location: Floor 2, Room T2001 - Black Labtop	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Black, Homogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose 35%, Non-fibrous 65%			
2021.163.320-33B 33	222074019-70 Location: Floor 2, Room T2001 - Black Labtop	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Black, Homogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose 30%, Non-fibrous 70%			
2021.163.320-34A 34	222074019-71 Location: Floor 2, Room T2001 - Black Labtop Adhesive	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Black, Homogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Wollastonite 3%, Non-fibrous 31.6%			

PLM Bulk Asbestos Report

2021.163.320; Cornell University; Vet Research Tower 2nd
Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk
Sampling

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-34B 34	222074019-72 Location: Floor 2, Room T2001 - Black Labtop Adhesive	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Black, Homogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 33.6%			
2021.163.320-35A 35	222074019-73 Location: Floor 2, Room T2001 - Black Seam Epoxy	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Black, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Wollastonite 5%, Non-fibrous 23.2%			
2021.163.320-35B 35	222074019-74 Location: Floor 2, Room T2001 - Black Seam Epoxy	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 07/27/22
Analyst Description: Black, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Wollastonite 2%, Non-fibrous 30.4%			
2021.163.320-36A 36	222074019-75 Location: Floor 2, Room T2001, Center - Black Soot Sample	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Black, Heterogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose Trace, Fibrous glass 15%, Non-fibrous 85%			
2021.163.320-36B 36	222074019-76 Location: Floor 2, Room T2001, Adjacent To Room T2001C - Black Soot Sample	No	NAD (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Dark Gray/Black, Heterogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose 5%, Fibrous glass Trace, Non-fibrous 95%			
2021.163.320-37A 37	222074019-77 Location: Floor 2, Room T2001, East - Black Burn Debris	No	NAD ¹ (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Black, Heterogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose 20%, Fibrous glass Trace, Non-fibrous 80%			

PLM Bulk Asbestos Report

2021.163.320; Cornell University; Vet Research Tower 2nd
Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk
Sampling

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-37B 37	222074019-78 Location: Floor 2, Room T2001, West - Black Burn Debris	No	NAD ¹ (by NYS ELAP 198.1) by Valeriu Voicu on 07/27/22
Analyst Description: Black/Gray, Heterogeneous, Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Cellulose 15%, Fibrous glass 3%, Non-fibrous 82%			

Reporting Notes:

(1) Analysis Results For Soil, Dust, Or Debris May Be Highly Variable Because Of The Heterogeneous Nature Of These Samples

Analyzed by: Valeriu Voicu
Date: 7/27/2022



Reviewed by: Khaalid W. Perine



*NAD/NSD =no asbestos detected; NA =not analyzed; NA/PS=not analyzed/positive stop, (SOF-V) = Sprayed On Fireproofing containing Vermiculite; (SM-V) = Surfacing Material containing Vermiculite; PLM Bulk Asbestos Analysis using Olympus, Model BH-2 Pol Scope, Microscope, Serial #: 229915, by Appd E to Subpt E, 40 CFR 763 quantified by either CVES or 400 pt ct as noted for each analysis (NVLAP 200546-0), ELAP PLM Method 198.1 for NY friable samples, which includes the identification and quantitation of vermiculite, or ELAP 198.6 for NOB samples, or EPA 400 pt ct by EPA 600-M4-82-020 (NY ELAP Lab 11480); Note:PLM is not consistently reliable in detecting asbestos in floor coverings and similar non-friable organically bound materials. NAD or Trace results by PLM are inconclusive, TEM is currently the only method that can be used to determine if this material can be considered or treated as non asbestos-containing in NY State (also see EPA Advisory for floor tile, FR 59,146,38970,8/1/94) National Institute of Standards and Technology Accreditation requirements mandate that this report must not be reproduced except in full without the approval of the lab.This PLM report relates ONLY to the items tested. RI Cert AAL-094, CT Cert PH-0186, Mass Cert AA000054, NJ Lab ID #NY031.

_____END OF REPORT_____

Client Name: Delta Engineers

Table I
Summary of Bulk Asbestos Analysis Results

2021.163.320; Cornell University; Vet Research Tower 2nd Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk Sampling

AmeriSci Sample #	Client Sample#	HG Area	Sample Weight (gram)	Heat Sensitive Organic %	Acid Soluble Inorganic %	Insoluble Non-Asbestos Inorganic %	** Asbestos % by PLM/DS	** Asbestos % by TEM
01	2021.163.320-01A	01	0.192	41.4	32.2	26.4	NAD	NAD
	Location: Floor 1, Room T1003, Northwest - Yellow/Gray Carpet Mastic							
02	2021.163.320-01B	01	0.098	35.5	37.5	27.0	NAD	NAD
	Location: Floor 1, Room T1003, Northeast - Yellow/Gray Carpet Mastic							
03	2021.163.320-02A	02	0.191	78.8	12.2	9.0	NAD	NAD
	Location: Floor 1, Room T1003, North - Red Rolled Vinyl Sheet Flooring							
04	2021.163.320-02B	02	0.200	80.2	13.4	6.4	NAD	NAD
	Location: Floor 1, Room T1003, North - Red Rolled Vinyl Sheet Flooring							
05	2021.163.320-03A	03	0.062	17.0	42.1	40.9	NAD	NAD
	Location: Floor 1, Room T1003, North - Gray Mastic From HA 02							
06	2021.163.320-03B	03	0.128	45.1	29.9	25.0	NAD	NAD
	Location: Floor 1, Room T1003, North - Gray Mastic From HA 02							
07	2021.163.320-04A	04	0.171	76.0	11.9	12.2	NAD	NAD
	Location: Floor 1, Room T1003, Northeast - Gray Rolled Vinyl Sheet Flooring							
08	2021.163.320-04B	04	0.230	77.1	10.4	12.5	NAD	NAD
	Location: Floor 1, Room T1003, Northwest - Gray Rolled Vinyl Sheet Flooring							
09	2021.163.320-05A	05	0.081	44.1	32.1	23.8	NAD	NAD
	Location: Floor 1, Room T1003, Northeast - Gray Mastic From HA 04							
10	2021.163.320-05B	05	0.120	43.8	32.6	23.7	NAD	NAD
	Location: Floor 1, Room T1003, Northwest - Gray Mastic From HA 04							
11	2021.163.320-06A	06	0.284	16.7	43.0	40.3	NAD	NAD
	Location: Floor 1, Room T1003, Northwest Under HA 03 & HA 04 - 12" x 12" White W/ Gray & Blue Mottle Floor Tile							
12	2021.163.320-06B	06	0.300	16.7	48.1	35.2	NAD	NAD
	Location: Floor 1, Room T1003, Northwest Under HA 03 & HA 04 - 12" x 12" White W/ Gray & Blue Mottle Floor Tile							
13	2021.163.320-07A	07	----	----	----	----	NA	NA
	Location: Floor 1, Room T1003, Northwest - Yellow Mastic From HA 06 "Insufficient Material Submitted For Preparation"							
14	2021.163.320-07B	07	0.057	65.9	20.2	13.9	NAD	NAD
	Location: Floor 1, Room T1003, Northwest - Yellow Mastic From HA 06							
15	2021.163.320-08A	08	0.257	24.3	63.9	9.6	Chrysotile 2.1	NA
	Location: Floor 1, Room T1003A, Southeast - 12" x 12" Brown W/ White Mottle Floor Tile							
16	2021.163.320-08B	08	0.274	24.0	68.1	7.9	NA/PS	NA
	Location: Floor 1, Room T1003A, Southeast - 12" x 12" Brown W/ White Mottle Floor Tile							

See Reporting notes on last page

Client Name: Delta Engineers

Table I
Summary of Bulk Asbestos Analysis Results

2021.163.320; Cornell University; Vet Research Tower 2nd Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk Sampling

AmeriSci Sample #	Client Sample#	HG Area	Sample Weight (gram)	Heat Sensitive Organic %	Acid Soluble Inorganic %	Insoluble Non-Asbestos Inorganic %	** Asbestos % by PLM/DS	** Asbestos % by TEM
17	2021.163.320-09A	09	0.120	67.3	8.6	24.2	NAD	NAD
	Location: Floor 1, Room T1003A, Southeast - Black Mastic From HA 08							
18	2021.163.320-09B	09	0.083	74.3	10.8	14.9	NAD	NAD
	Location: Floor 1, Room T1003A, Southeast - Black Mastic From HA 08							
19	2021.163.320-10A	10	0.371	47.2	20.5	32.3	NAD	NAD
	Location: Floor 1, Room T1003A, East Wall - Tan Mastic From 4" Vinyl Covebase							
20	2021.163.320-10B	10	0.334	50.6	10.5	39.0	NAD	NAD
	Location: Floor 1, Room T1003A, East Wall - Tan Mastic From 4" Vinyl Covebase							
21	2021.163.320-11A	11	----	----	----	----	NAD	NA
	Location: Floor 1, Room T1003, Southeast - Light Gray Gypsum Wallboard							
22	2021.163.320-11B	11	----	----	----	----	NAD	NA
	Location: Floor 1, Room T1003, Southeast - Light Gray Gypsum Wallboard							
23	2021.163.320-12A	12	----	----	----	----	NAD	NA
	Location: Floor 1, Room T1003, South - White Joint Compound							
24	2021.163.320-12B	12	----	----	----	----	NAD	NA
	Location: Floor 1, Room T1003, South - White Joint Compound							
25	2021.163.320-13A	13	0.513	81.3	4.7	14.0	NAD	NAD
	Location: Floor 1, Room T1003A, Center - 2' x 2' Fissured Drop-In Ceiling Tile							
26	2021.163.320-13B	13	0.231	79.5	10.3	10.2	NAD	NAD
	Location: Floor 1, Room T1003A, Center - 2' x 2' Fissured Drop-In Ceiling Tile							
27	2021.163.320-14A	14	0.256	18.4	23.0	58.6	NAD	NAD
	Location: Floor 1, Room T1003 South - 2' x 2' x 2" Textured Covering From Fiberglass Drop-In Ceiling Tile							
28	2021.163.320-14B	14	0.290	18.3	27.1	54.6	NAD	NAD
	Location: Floor 1, Room T1003 South - 2' x 2' x 2" Textured Covering From Fiberglass Drop-In Ceiling Tile							
29	2021.163.320-15A	15	----	----	----	----	NAD	NA
	Location: Floor 1, Room T1003 South - Light Gray Mudded Pipe Fitting							
30	2021.163.320-15B	15	----	----	----	----	NAD	NA
	Location: Floor 1, Room T1003 South - Light Gray Mudded Pipe Fitting							
31	2021.163.320-15C	15	----	----	----	----	NAD	NA
	Location: Floor 1, Room T1003 South - Light Gray Mudded Pipe Fitting							
32	2021.163.320-16A	16	----	----	----	----	NAD	NA
	Location: Floor 1, Room T1003 Southeast - Light Gray Spray-On Fireproofing							

Client Name: Delta Engineers

Table I
Summary of Bulk Asbestos Analysis Results

2021.163.320; Cornell University; Vet Research Tower 2nd Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk Sampling

AmeriSci Sample #	Client Sample#	HG Area	Sample Weight (gram)	Heat Sensitive Organic %	Acid Soluble Inorganic %	Insoluble Non-Asbestos Inorganic %	** Asbestos % by PLM/DS	** Asbestos % by TEM
33	2021.163.320-16B	16	----	----	----	----	NAD	NA
	Location: Floor 1, Room T1003 Southeast - Light Gray Spray-On Fireproofing							
34	2021.163.320-16C	16	----	----	----	----	NAD	NA
	Location: Floor 1, Room T1003 Southeast - Light Gray Spray-On Fireproofing							
35	2021.163.320-17A	17	0.186	49.5	11.1	39.4	NAD	NAD
	Location: Floor 1, Room T1010 At Room 1010B - Yellow Carpet Mastic							
36	2021.163.320-17B	17	0.229	49.2	14.6	36.2	NAD	NAD
	Location: Floor 1, Room T1010 At Room 1010B - Yellow Carpet Mastic							
37	2021.163.320-18A	18	0.269	14.5	82.0	3.5	NAD	NAD
	Location: Floor 1, Room 1010Q, South - 12" x 12" Light Gray W/ Gray & Blue Floor Tile							
38	2021.163.320-18B	18	0.050	90.3	2.0	7.7	NAD	NAD
	Location: Floor 1, Room 1010Q, South - 12" x 12" Light Gray W/ Gray & Blue Floor Tile							
39	2021.163.320-19A	19	0.050	90.3	5.0	4.6	NAD	NAD
	Location: Floor 1, Room 1010Q, South - Yellow Mastic From HA 18							
40	2021.163.320-19B	19	0.023	89.2	4.3	6.5	NAD	NAD
	Location: Floor 1, Room 1010Q, South - Yellow Mastic From HA 18							
41	2021.163.320-20A	20	0.160	35.2	9.0	55.8	NAD	NAD
	Location: Floor 1, Room 1010, At Room 1010S - Light Tan Mastic From 4" Vinyl Covebase							
42	2021.163.320-20B	20	0.075	39.5	16.9	43.6	NAD	NAD
	Location: Floor 1, Room 1010, At Room 1010S - Light Tan Mastic From 4" Vinyl Covebase							
43	2021.163.320-21A	21	----	----	----	----	NAD	NA
	Location: Floor 1, Room 1010 At Room 1010B - White Gypsum Wallboard							
44	2021.163.320-21B	21	----	----	----	----	NAD	NA
	Location: Floor 1, Room 1010 At Room 1010B - White Gypsum Wallboard							
45	2021.163.320-22A	22	----	----	----	----	NAD	NA
	Location: Floor 1, Room 1010 At Room 1010B - White Joint Compound							
46	2021.163.320-22B	22	----	----	----	----	NAD	NA
	Location: Floor 1, Room 1010 At Room 1010B - White Joint Compound							
47	2021.163.320-23A	23	0.229	27.0	19.2	53.8	NAD	NAD
	Location: Floor 1, Room 1010 At Room 1010B - 2' x 4' Fissured Drop-In Ceiling Tile							
48	2021.163.320-23B	23	0.170	27.0	18.9	54.0	NAD	NAD
	Location: Floor 1, Room 1010 At Room 1010A - 2' x 4' Fissured Drop-In Ceiling Tile							

Client Name: Delta Engineers

Table I
Summary of Bulk Asbestos Analysis Results

2021.163.320; Cornell University; Vet Research Tower 2nd Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk Sampling

AmeriSci Sample #	Client Sample#	HG Area	Sample Weight (gram)	Heat Sensitive Organic %	Acid Soluble Inorganic %	Insoluble Non-Asbestos Inorganic %	** Asbestos % by PLM/DS	** Asbestos % by TEM
49	2021.163.320-24A	24	----	----	----	----	NAD	NA
	Location: Floor 1, Room 1010 At Room 1010A - Light Gray Spray-On Fireproofing							
50	2021.163.320-24B	24	----	----	----	----	NAD	NA
	Location: Floor 1, Room 1010P, East - Light Gray Spray-On Fireproofing							
51	2021.163.320-24C	24	----	----	----	----	NAD	NA
	Location: Floor 1, Room 1010P, West - Light Gray Spray-On Fireproofing							
52	2021.163.320-25A	25	0.286	4.0	93.1	2.9	NAD	NAD
	Location: Floor 2, Room T2001 - 12" x 12" Light Gray Mottled Floor Tile							
53	2021.163.320-25B	25	0.261	14.4	82.5	3.1	NAD	NAD
	Location: Floor 2, Room T2001 - 12" x 12" Light Gray Mottled Floor Tile							
54	2021.163.320-26A	26	0.128	45.2	29.8	25.0	NAD	NAD
	Location: Floor 2, Room T2001 - Yellow Mastic From HA 25							
55	2021.163.320-26B	26	0.138	35.5	39.1	25.4	NAD	NAD
	Location: Floor 2, Room T2001 - Yellow Mastic From HA 25							
56	2021.163.320-27A	27	0.153	35.1	20.6	44.3	NAD	NAD
	Location: Floor 2, Room T2001C - White Mastic From 4" Vinyl Covebase							
57	2021.163.320-27B	27	0.130	33.2	22.7	44.1	NAD	NAD
	Location: Floor 2, Room T2001C - White Mastic From 4" Vinyl Covebase							
58	2021.163.320-28A	28	----	----	----	----	NAD	NA
	Location: Floor 2, Room T2001C - Light Gray Gypsum Wallboard							
59	2021.163.320-28B	28	----	----	----	----	NAD	NA
	Location: Floor 2, Room T2001 - Light Gray Gypsum Wallboard							
60	2021.163.320-29A	29	----	----	----	----	NAD	NA
	Location: Floor 2, Room T2001C - White Joint Compound							
61	2021.163.320-29B	29	----	----	----	----	NAD	NA
	Location: Floor 2, Room T2001C - White Joint Compound							
62	2021.163.320-30A	30	0.167	18.7	41.6	39.7	NAD	NAD
	Location: Floor 2, Room T2001 - 2' x 4' Fissured Drop-In Ceiling Tile							
63	2021.163.320-30B	30	0.232	17.7	47.8	34.4	NAD	NAD
	Location: Floor 2, Room T2001 - 2' x 4' Fissured Drop-In Ceiling Tile							
64	2021.163.320-31A	31	----	----	----	----	Chrysotile <0.25	NA
	Location: Floor 2, Room T2001, At Room T2001C - Light Gray Spray-On Fireproofing							

Client Name: Delta Engineers

Table I
Summary of Bulk Asbestos Analysis Results

2021.163.320; Cornell University; Vet Research Tower 2nd Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk Sampling

AmeriSci Sample #	Client Sample#	HG Area	Sample Weight (gram)	Heat Sensitive Organic %	Acid Soluble Inorganic %	Insoluble Non-Asbestos Inorganic %	** Asbestos % by PLM/DS	** Asbestos % by TEM
65	2021.163.320-31B	31	----	----	----	----	NAD	NA
	Location: Floor 2, Room T2001, At Entrance - Light Gray Spray-On Fireproofing							
66	2021.163.320-31C	31	----	----	----	----	Chrysotile 0.3	NA
	Location: Floor 2, Room T2001, At Room T2001E - Light Gray Spray-On Fireproofing							
67	2021.163.320-32A	32	0.245	61.5	12.2	26.3	NAD	NAD
	Location: Floor 2, Room T2001 - Labtop Backsplash Caulk							
68	2021.163.320-32B	32	0.284	70.0	13.2	16.8	NAD	NAD
	Location: Floor 2, Room T2001 - Labtop Backsplash Caulk							
69	2021.163.320-33A	33	----	----	----	----	NAD	NA
	Location: Floor 2, Room T2001 - Black Labtop							
70	2021.163.320-33B	33	----	----	----	----	NAD	NA
	Location: Floor 2, Room T2001 - Black Labtop							
71	2021.163.320-34A	34	0.176	60.1	5.3	34.6	NAD	NAD
	Location: Floor 2, Room T2001 - Black Labtop Adhesive							
72	2021.163.320-34B	34	0.060	60.7	5.7	33.6	NAD	NAD
	Location: Floor 2, Room T2001 - Black Labtop Adhesive							
73	2021.163.320-35A	35	0.123	61.6	10.2	28.2	NAD	NAD
	Location: Floor 2, Room T2001 - Black Seam Epoxy							
74	2021.163.320-35B	35	0.108	56.6	10.9	32.4	NAD	NAD
	Location: Floor 2, Room T2001 - Black Seam Epoxy							
75	2021.163.320-36A	36	----	----	----	----	NAD	NA
	Location: Floor 2, Room T2001, Center - Black Soot Sample							
76	2021.163.320-36B	36	----	----	----	----	NAD	NA
	Location: Floor 2, Room T2001, Adjacent To Room T2001C - Black Soot Sample							
77	2021.163.320-37A	37	----	----	----	----	NAD	NA
	Location: Floor 2, Room T2001, East - Black Burn Debris							
78	2021.163.320-37B	37	----	----	----	----	NAD	NA
	Location: Floor 2, Room T2001, West - Black Burn Debris							

Client Name: Delta Engineers

Table I
Summary of Bulk Asbestos Analysis Results

2021.163.320; Cornell University; Vet Research Tower 2nd Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk Sampling

AmeriSci Sample #	Client Sample#	HG Area	Sample Weight (gram)	Heat Sensitive Organic %	Acid Soluble Inorganic %	Insoluble Non-Asbestos Inorganic %	** Asbestos % by PLM/DS	** Asbestos % by TEM
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Analyzed by: Khaalid W. Perine
Date: 7/28/2022



Reviewed by: Khaalid W. Perine



**Quantitative Analysis (Semi/Full); Bulk Asbestos Analysis - PLM by Appd E to Subpt E, 40 CFR 763 or NYSDOH ELAP 198.1 for New York friable samples or NYSDOH ELAP 198.6 for New York NOB samples; TEM (Semi/Full) by EPA 600/R-93/116 (or NYSDOH ELAP 198.4; for New York samples). Analysis using Hitachi, Model H600-Noran 7 System, Microscope, Serial #: 542-26-10. NAD = no asbestos detected during a quantitative analysis; NA = not analyzed; Trace = <1%; (SOF-V) = Sprayed On Fireproofing containing Vermiculite; (SM-V) = Surfacing Material containing Vermiculite; Quantitation for beginning weights of <0.1 grams should be considered as qualitative only; Qualitative Analysis: Asbestos analysis results of "Present" or "NVA = No Visible Asbestos" represents results for Qualitative PLM or TEM Analysis only (no accreditation coverage available from any regulatory agency for qualitative analyses): NVLAP (PLM) 200546-0, NYSDOH ELAP Lab 11480, NJ Lab ID #NY031.

Warning Note: PLM limitation, only TEM will resolve fibers <0.25 micrometers in diameter. TEM bulk analysis is representative of the fine grained matrix material and may not be representative of non-uniformly dispersed debris for which PLM evaluation is recommended (i.e. soils and other heterogenous materials).

Client: Cornell University	Delta Project No.: 2021.163.320	Date: 7/26/2022
Project: Vet Research Tower 2nd Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk Sampling	Cornell Work Order No.: TBD	Turnaround Time: RUSH
Collected By: Michael Drobak / Thomas Ferro		

Sample Number	Material Type	Material Condition	Floor	Description / Sample Location
2021.163.320-01A	Miscellaneous	Good	1	Yellow/Gray Carpet Mastic - Room T1003, Northwest.
2021.163.320-01B	Miscellaneous	Good	1	Yellow/Gray Carpet Mastic - Room T1003, Northeast.
2021.163.320-02A	Miscellaneous	Good	1	Red Rolled Vinyl Sheet Flooring - Room T1003, North.
2021.163.320-02B	Miscellaneous	Good	1	Red Rolled Vinyl Sheet Flooring - Room T1003, North.
2021.163.320-03A	Miscellaneous	Good	1	Gray Mastic from HA 02 - Room T1003, North.
2021.163.320-03B	Miscellaneous	Good	1	Gray Mastic from HA 02 - Room T1003, North.
2021.163.320-04A	Miscellaneous	Good	1	Gray Rolled Vinyl Sheet Flooring - Room T1003, Northeast.
2021.163.320-04B	Miscellaneous	Good	1	Gray Rolled Vinyl Sheet Flooring - Room T1003, Northwest.

Instructions: Analyze all non-NOB samples by NYS ELAP 198.1 PLM methodology. Analyze all NOB samples initially by NYS ELAP 198.6 PLM methodology. If all samples from a given sample set are reported as non-asbestos by 198.6, analyze by NYS ELAP 198.4 TEM methodology. **Analyze All Samples in a given sample set - DO NOT STOP AFTER 1st POSITIVE.**

Email Results to wjohnson@delta-eas.com, sprislupsky@delta-eas.com, rcherevko@delta-eas.com

222074019

Notes:

Submitted By: Michael Drobak /
 (Signature)

Received By: Justin Moravich /
 (Signature)

Date: 7/26/2022

Date: 7/27/22 10:12

Client: Cornell University	Delta Project No.: 2021.163.320	Date: 7/26/2022
Project: Vet Research Tower 2nd Floor Fire Episode - 1st, 2nd and 3rd Floors Asbestos Bulk Sampling	Cornell Work Order No.: TBD	Turnaround Time: RUSH
Collected By: Michael Drobak / Thomas Ferro		

Sample Number	Material Type	Material Condition	Floor	Description / Sample Location
2021.163.320-05A	Miscellaneous	Good	1	Gray Mastic from HA 04 - Room T1003, Northeast.
2021.163.320-05B	Miscellaneous	Good	1	Gray Mastic from HA 04 - Room T1003, Northwest.
2021.163.320-06A	Miscellaneous	Good	1	12"x12" White w/ Gray & Blue Mottle Floor Tile - Room T1003, Northwest Under HA 03 & HA 04.
2021.163.320-06B	Miscellaneous	Good	1	12"x12" White w/ Gray & Blue Mottle Floor Tile - Room T1003, Northwest Under HA 03 & HA 04.
2021.163.320-07A	Miscellaneous	Good	1	Yellow Mastic from HA 06 - Room T1003, Northwest.
2021.163.320-07B	Miscellaneous	Good	1	Yellow Mastic from HA 06 - Room T1003, Northwest.
2021.163.320-08A	Miscellaneous	Good	1	12"x12" Brown w/ White Mottle Floor Tile - Room T1003A, Southeast.
2021.163.320-08B	Miscellaneous	Good	1	12"x12" Brown w/ White Mottle Floor Tile - Room T1003A, Southeast.
2021.163.320-09A	Miscellaneous	Good	1	Black Mastic from HA 08 - Room T1003A, Southeast.
2021.163.320-09B	Miscellaneous	Good	1	Black Mastic from HA 08 - Room T1003A, Southeast.
2021.163.320-10A	Miscellaneous	Good	1	Tan Mastic from 4" Vinyl Covebase - Room T1003A, East Wall.
2021.163.320-10B	Miscellaneous	Good	1	Tan Mastic from 4" Vinyl Covebase - Room T1003A, East Wall.
2021.163.320-11A	Miscellaneous	Good	1	Light Gray Gypsum Wallboard - Room T1003, Soueast.
2021.163.320-11B	Miscellaneous	Good	1	Light Gray Gypsum Wallboard - Room T1003, Soueast.
2021.163.320-12A	Miscellaneous	Good	1	White Joint Compound - Room T1003, South.
2021.163.320-12B	Miscellaneous	Good	1	White Joint Compound - Room T1003, South.

Client: Cornell University	Delta Project No.: 2021.163.320	Date: 7/26/2022
Project: Vet Research Tower 2nd Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk Sampling	Cornell Work Order No.: TBD	Turnaround Time: RUSH
Collected By: Michael Drobak / Thomas Ferro		

Sample Number	Material Type	Material Condition	Floor	Description / Sample Location
2021.163.320-13A	Miscellaneous	Damaged	1	2'x2' Fissured Drop-in Ceiling Tile - Room T1003A, Center.
2021.163.320-13B	Miscellaneous	Damaged	1	2'x2' Fissured Drop-in Ceiling Tile - Room T1003A, Center.
2021.163.320-14A	Miscellaneous	Good	1	2'x2'x2" Textured Covering from Fiberglass Drop-in Ceiling Tile - Room T1003, South.
2021.163.320-14B	Miscellaneous	Good	1	2'x2'x2" Textured Covering from Fiberglass Drop-in Ceiling Tile - Room T1003, South.
2021.163.320-15A	TSI	Good	1	Light Gray Mudded Pipe Fitting - Room T1003, South.
2021.163.320-15B	TSI	Good	1	Light Gray Mudded Pipe Fitting - Room T1003, South.
2021.163.320-15C	TSI	Good	1	Light Gray Mudded Pipe Fitting - Room T1003, South.
2021.163.320-16A	Surfacing	Good	1	Light Gray Spray-on Fireproofing - Room T1003, Southeast.
2021.163.320-16B	Surfacing	Good	1	Light Gray Spray-on Fireproofing - Room T1003, Southeast.
2021.163.320-16C	Surfacing	Good	1	Light Gray Spray-on Fireproofing - Room T1003, Southeast.
2021.163.320-17A	Miscellaneous	Good	1	Yellow Carpet Mastic - Room T1010 at Room 1010B.
2021.163.320-17B	Miscellaneous	Good	1	Yellow Carpet Mastic - Room T1010 at Room 1010B.
2021.163.320-18A	Miscellaneous	Good	1	12"x12" Light Gray w/ Gray & Blue Floor Tile - Room 1010Q, South.
2021.163.320-18B	Miscellaneous	Good	1	12"x12" Light Gray w/ Gray & Blue Floor Tile - Room 1010Q, South.
2021.163.320-19A	Miscellaneous	Good	1	Yellow Mastic from HA 18 - Room 1010Q, South.
2021.163.320-19B	Miscellaneous	Good	1	Yellow Mastic from HA 18 - Room 1010Q, South.

Client: Cornell University	Delta Project No.: 2021.163.320	Date: 7/26/2022
Project: Vet Research Tower 2nd Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk Sampling	Cornell Work Order No.: TBD	Turnaround Time: RUSH
Collected By: Michael Drobak / Thomas Ferro		

Sample Number	Material Type	Material Condition	Floor	Description / Sample Location
2021.163.320-20A	Miscellaneous	Good	1	Light Tan Mastic from 4" Vinyl Covebase - Room T1010, at Room T1010S.
2021.163.320-20B	Miscellaneous	Good	1	Light Tan Mastic from 4" Vinyl Covebase - Room T1010, at Room T1010S.
2021.163.320-21A	Miscellaneous	Good	1	White Gypsum Wallboard - Room T1010 at Room T1010B.
2021.163.320-21B	Miscellaneous	Good	1	White Gypsum Wallboard - Room T1010 at Room T1010B.
2021.163.320-22A	Miscellaneous	Good	1	White Joint Compound - Room T1010 at Room T1010B.
2021.163.320-22B	Miscellaneous	Good	1	White Joint Compound - Room T1010 at Room T1010B.
2021.163.320-23A	Miscellaneous	Good	1	2'x4' Fissured Drop-in Ceiling Tile - Room T1010 at Room T1010B.
2021.163.320-23B	Miscellaneous	Good	1	2'x4' Fissured Drop-in Ceiling Tile - Room T1010 at Room T1010A.
2021.163.320-24A	Surfacing	Good	1	Light Gray Spray-on Fireproofing - Room T1010 at Room T1010A.
2021.163.320-24B	Surfacing	Good	1	Light Gray Spray-on Fireproofing - Room T1010P, East.
2021.163.320-24C	Surfacing	Good	1	Light Gray Spray-on Fireproofing - Room T1010P, West.
2021.163.320-25A	Miscellaneous	Damaged	2	12"x12" Light Gray Mottled Floor Tile - Room T2001.
2021.163.320-25B	Miscellaneous	Damaged	2	12"x12" Light Gray Mottled Floor Tile - Room T2001.
2021.163.320-26A	Miscellaneous	Damaged	2	Yellow Mastic from HA 25 - Room T2001.
2021.163.320-26B	Miscellaneous	Damaged	2	Yellow Mastic from HA 25 - Room T2001.
2021.163.320-27A	Miscellaneous	Damaged	2	White Mastic from 4" Vinyl Covebase - Room T2001C.

Client: Cornell University	Delta Project No.: 2021.163.320	Date: 7/26/2022
Project: Vet Research Tower 2nd Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk Sampling	Cornell Work Order No.: TBD	Turnaround Time: RUSH
Collected By: Michael Drobak / Thomas Ferro		

Sample Number	Material Type	Material Condition	Floor	Description / Sample Location
2021.163.320- 27B	Miscellaneous	Damaged	2	White Mastic from 4" Vinyl Covebase - Room T2001C.
2021.163.320- 28A	Miscellaneous	Damaged	2	Light Gray Gypsum Wallboard - Room T2001C.
2021.163.320- 28B	Miscellaneous	Damaged	2	Light Gray Gypsum Wallboard - Room T2001.
2021.163.320- 29A	Miscellaneous	Damaged	2	White Joint Compound - Room T2001C.
2021.163.320- 29B	Miscellaneous	Damaged	2	White Joint Compound - Room T2001C.
2021.163.320- 30A	Miscellaneous	Damaged	2	2'x4' Fissured Drop-in Ceiling Tile - Room T2001.
2021.163.320- 30B	Miscellaneous	Damaged	2	2'x4' Fissured Drop-in Ceiling Tile - Room T2001.
2021.163.320- 31A	Surfacing	Damaged	2	Light Gray Spray-on Fireproofing - Room T2001, at Room T2001C.
2021.163.320- 31B	Surfacing	Damaged	2	Light Gray Spray-on Fireproofing - Room T2001, at Entrance
2021.163.320- 31C	Surfacing	Damaged	2	Light Gray Spray-on Fireproofing - Room T2001, at Room T2001E.
2021.163.320- 32A	Miscellaneous	Damaged	2	Labtop Backsplash Caulk - Room T2001.
2021.163.320- 32B	Miscellaneous	Damaged	2	Labtop Backsplash Caulk - Room T2001.
2021.163.320- 33A	Miscellaneous	Damaged	2	Black Labtop - Room T2001.
2021.163.320- 33B	Miscellaneous	Damaged	2	Black Labtop - Room T2001.
2021.163.320- 34A	Miscellaneous	Damaged	2	Black Labtop Adhesive - Room T2001.
2021.163.320- 34B	Miscellaneous	Damaged	2	Black Labtop Adhesive - Room T2001.

Client: Cornell University	Delta Project No.: 2021.163.320	Date: 7/26/2022
Project: Vet Research Tower 2nd Floor Fire Epsiode - 1st, 2nd and 3rd Floors Asbestos Bulk Sampling	Cornell Work Order No.: TBD	Turnaround Time: RUSH
Collected By: Michael Drobak / Thomas Ferro		

Sample Number	Material Type	Material Condition	Floor	Description / Sample Location
2021.163.320- 35A	Miscellaneous	Damaged	2	Black Seam Epoxy - Room T2001.
2021.163.320- 35B	Miscellaneous	Damaged	2	Black Seam Epoxy - Room T2001.
2021.163.320- 36A	Miscellaneous	Damaged	2	Black Soot Sample - Room T2001, Center.
2021.163.320- 36B	Miscellaneous	Damaged	2	Black Soot Sample - Room T2001, Adjacent to Room T2001C.
2021.163.320- 37A	Miscellaneous	Damaged	2	Black Burn Debris - Room T2001, East.
2021.163.320- 37B	Miscellaneous	Damaged	2	Black Burn Debris - Room T2001, West.

222074019

**AmeriSci New York**

117 EAST 30TH ST.
NEW YORK, NY 10016
TEL: (212) 679-8600 • FAX: (212) 679-3114

PLM Bulk Asbestos Report

Delta Engineers
Attn: Stephen Prislupsky
860 Hooper Road

Endwell, NY 13760

Date Received 07/27/22 **AmeriSci Job #** 222074017
Date Examined 07/27/22 **P.O. #**
ELAP # 11480 **Page** 1 of 2
RE: 2021.163.320; Cornell University; Vet Research Tower 2nd Floor
Fire Episode - 3rd Floor Spray-On Fireproofing And Spot
Asbestos Bulk Sampling

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-101A Location: Floor 3 - Spray-On Fireproofing, Corridor T300CA, East End Analyst Description: Gray, Homogeneous, Fibrous, Bulk Material Asbestos Types: Chrysotile 5.0 % Other Material: Fibrous glass 60%, Non-fibrous 35%	222074017-01	Yes	5% (ELAP 400 PC) by Bo Sun on 07/27/22
2021.163.320-101B Location: Floor 3 - Spray-On Fireproofing, Corridor T300CA, Outside Room T3006 Analyst Description: Gray, Homogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Fibrous glass 70%, Non-fibrous 30%	222074017-02	No	NAD (by NYS ELAP 198.1) by Bo Sun on 07/27/22
2021.163.320-101C Location: Floor 3 - Spray-On Fireproofing, Corridor T300CA, West End Analyst Description: Gray, Homogeneous, Fibrous, Bulk Material Asbestos Types: Chrysotile 4.0 % Other Material: Fibrous glass 65%, Non-fibrous 31%	222074017-03	Yes	4% (ELAP 400 PC) by Bo Sun on 07/27/22
2021.163.320-102A Location: Soot, Utility Space T300UA, East End Analyst Description: Black, Heterogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose 10%, Fibrous glass 20%, Synthetic fibers 3%, Non-fibrous 67%	222074017-04	No	NAD (by NYS ELAP 198.1) by Bo Sun on 07/27/22
2021.163.320-102B Location: Soot, Utility Space T300UA, Center Analyst Description: Black, Heterogeneous, Fibrous, Bulk Material Asbestos Types: Other Material: Cellulose 15%, Fibrous glass 25%, Synthetic fibers Trace, Non-fibrous 60%	222074017-05	No	NAD (by NYS ELAP 198.1) by Bo Sun on 07/27/22

PLM Bulk Asbestos Report

2021.163.320; Cornell University; Vet Research Tower 2nd
Floor Fire Episode - 3rd Floor Spray-On Fireproofing And Spot
Asbestos Bulk Sampling

Reporting Notes:

Analyzed by: Bo Sun
Date: 7/27/2022



Reviewed by: Bo Sun



*NAD/NSD =no asbestos detected; NA =not analyzed; NA/PS=not analyzed/positive stop, (SOF-V) = Sprayed On Fireproofing containing Vermiculite; (SM-V) = Surfacing Material containing Vermiculite; PLM Bulk Asbestos Analysis using Olympus, Model BH-2 Pol Scope, Microscope, Serial #: 229003, by Appd E to Subpt E, 40 CFR 763 quantified by either CVES or 400 pt ct as noted for each analysis (NVLAP 200546-0), ELAP PLM Method 198.1 for NY friable samples, which includes the identification and quantitation of vermiculite, or ELAP 198.6 for NOB samples, or EPA 400 pt ct by EPA 600-M4-82-020 (NY ELAP Lab 11480); Note:PLM is not consistently reliable in detecting asbestos in floor coverings and similar non-friable organically bound materials. NAD or Trace results by PLM are inconclusive, TEM is currently the only method that can be used to determine if this material can be considered or treated as non asbestos-containing in NY State (also see EPA Advisory for floor tile, FR 59,146,38970,8/1/94) National Institute of Standards and Technology Accreditation requirements mandate that this report must not be reproduced except in full without the approval of the lab.This PLM report relates ONLY to the items tested. RI Cert AAL-094, CT Cert PH-0186, Mass Cert AA000054, NJ Lab ID #NY031.

_____END OF REPORT_____

Client: Cornell University	Delta Project No.: 2021.163.320	Date: 7/26/2022
Project: Vet Research Tower 2nd Floor Fire Episode - 3rd Floor Spray-on Fireproofing and Soot Asbestos Bulk Sampling	Cornell Work Order No.: TBD	Turnaround Time: RUSH
Collected By: Michael Drobak / Thomas Ferro		

Sample Number	Material Type	Material Condition	Floor	Description / Sample Location
2021.163.320-101A	Surfacing	Intact	3	Spray-on Fireproofing, Corridor T300CA, East End
2021.163.320-101B	Surfacing	Intact	3	Spray-on Fireproofing, Corridor T300CA, Outside Room T3006
2021.163.320-101C	Surfacing	Intact	3	Spray-on Fireproofing, Corridor T300CA, West End
2021.163.320-102A	Miscellaneous	NA	3	Soot, Utility Space T300UA, East End
2021.163.320-102B	Miscellaneous	NA	3	Soot, Utility Space T300UA, Center

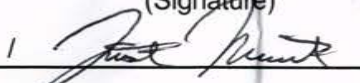
Instructions: Analyze all non-NOB samples by NYS ELAP 198.1 PLM methodology. Analyze all NOB samples initially by NYS ELAP 198.6 PLM methodology. If all samples from a given sample set are reported as non-asbestos by 198.6, analyze by NYS ELAP 198.4 TEM methodology. **Analyze All Samples in a given sample set - DO NOT STOP AFTER 1st POSITIVE.**
Email Results to wjohnson@delta-eas.com, sprislupsky@delta-eas.com, rcherevko@delta-eas.com

Notes:

222074017

Submitted By: Michael Drobak 
 (Signature)

Date: 7/26/2022

Received By: Justin Neretich 
 (Signature)

Date: 7/27/22 10:12

**AmeriSci New York**

117 EAST 30TH ST.
NEW YORK, NY 10016
TEL: (212) 679-8600 • FAX: (212) 679-3114

PLM Bulk Asbestos Report

Delta Engineers
Attn: Stephen Prislupsky
860 Hooper Road

Endwell, NY 13760

Date Received 08/25/22 **AmeriSci Job #** 222083460
Date Examined 08/26/22 **P.O. #**
ELAP # 11480 **Page** 1 of 4
RE: 2021.163.320; Cornell University; Vet Research Tower 2nd Floor
Fire Episode - 2nd Floor Lab Suites T2003, T2007, And Corridor
T200CB Bulk Sampling (Report Amended 8/26/2022)

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-201A 201	222083460-01	Yes	1.5% (ELAP 400 PC) by Valeriu Voicu on 08/26/22
Analyst Description: Off-White/Gray, Heterogeneous, Fibrous, Bulk Material Asbestos Types: Chrysotile 1.5 % Other Material: Cellulose Trace, Fibrous glass 45%, Non-fibrous 53.5%			
2021.163.320-201B 201	222083460-02	Yes	Trace (<0.25 % pc) (ELAP 400 PC) by Valeriu Voicu on 08/26/22
Analyst Description: Gray, Homogeneous, Fibrous, Bulk Material Asbestos Types: Chrysotile <0.25 % pc Other Material: Cellulose Trace, Fibrous glass 65%, Non-fibrous 35%			
2021.163.320-201C 201	222083460-03	Yes	2.8% (ELAP 400 PC) by Valeriu Voicu on 08/26/22
Analyst Description: Off-White/Gray, Heterogeneous, Fibrous, Bulk Material Asbestos Types: Chrysotile 2.8 % Other Material: Cellulose Trace, Fibrous glass 45%, Non-fibrous 52.2%			
2021.163.320-202A 202	222083460-04	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 08/26/22
Analyst Description: Silver/Gray, Heterogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 37.4%			
2021.163.320-202B 202	222083460-05	No	NAD (by NYS ELAP 198.6) by Valeriu Voicu on 08/26/22
Analyst Description: Silver/Gray, Heterogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 36.9%			

PLM Bulk Asbestos Report

2021.163.320; Cornell University; Vet Research Tower 2nd Floor Fire Episode - 2nd Floor Lab Suites T2003, T2007, And Corridor T200CB Bulk Sampling (Report Amended 8/26/2022)

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-203A 203	222083460-06	No	NAD
Location: 2nd Floor, Lab Suite T2003 - Room T2003A - White Textured Covering On HA 202			(by NYS ELAP 198.6) by Valeriu Voicu on 08/26/22
Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 4.8%			
2021.163.320-203B 203	222083460-07	No	NAD
Location: 2nd Floor, Lab Suite T2003 - Room T2003A - White Textured Covering On HA 202			(by NYS ELAP 198.6) by Valeriu Voicu on 08/26/22
Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 4.3%			
2021.163.320-204A 204	222083460-08	Yes	8.7%
Location: 2nd Floor, Lab Suite T2007 - Room T2007, East (Overspray On Ductwork) - Spray-On Fireproofing			(by NYS ELAP 198.1) by Valeriu Voicu on 08/26/22
Analyst Description: Off-White/Beige, Heterogeneous, Fibrous, Bulk Material			
Asbestos Types: Chrysotile 8.7 %			
Other Material: Cellulose Trace, Fibrous glass 50%, Non-fibrous 41.3%			
2021.163.320-204B 204	222083460-09	Yes	18.2%
Location: 2nd Floor, Lab Suite T2007 - Room T2007, West (On Beam) - Spray-On Fireproofing			(by NYS ELAP 198.1) by Valeriu Voicu on 08/26/22
Analyst Description: Off-White/Gray, Homogeneous, Fibrous, Bulk Material			
Asbestos Types: Chrysotile 18.2 %			
Other Material: Fibrous glass 40%, Non-fibrous 41.8%			
2021.163.320-204C 204	222083460-10	Yes	21.1%
Location: 2nd Floor, Lab Suite T2007 - Room T2007A, Center (On Deck) - Spray-On Fireproofing			(by NYS ELAP 198.1) by Valeriu Voicu on 08/26/22
Analyst Description: Off-White, Homogeneous, Fibrous, Bulk Material			
Asbestos Types: Chrysotile 21.0 %			
Other Material: Cellulose Trace, Fibrous glass 30%, Non-fibrous 48.9%			
2021.163.320-204D 204	222083460-11	Yes	4.3%
Location: 2nd Floor, Lab Suite T2007 - Room T2007C, West (On Beam) - Spray-On Fireproofing			(ELAP 400 PC) by Valeriu Voicu on 08/26/22
Analyst Description: Off-White/Gray, Heterogeneous, Fibrous, Bulk Material			
Asbestos Types: Chrysotile 4.3 %			
Other Material: Cellulose Trace, Fibrous glass 40%, Non-fibrous 55.7%			

PLM Bulk Asbestos Report

2021.163.320; Cornell University; Vet Research Tower 2nd Floor Fire Episode - 2nd Floor Lab Suites T2003, T2007, And Corridor T200CB Bulk Sampling (Report Amended 8/26/2022)

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
2021.163.320-204E 204	222083460-12	Yes	16.7%
Location: 2nd Floor, Lab Suite T2007 - Room T2007D, West (On Beam) - Spray-On Fireproofing			(by NYS ELAP 198.1) by Valeriu Voicu on 08/26/22
Analyst Description: Off-White, Homogeneous, Fibrous, Bulk Material			
Asbestos Types: Chrysotile 16.7 %			
Other Material: Cellulose Trace, Fibrous glass 50%, Non-fibrous 33.3%			
2021.163.320-205A 205	222083460-13	Yes	14.8%
Location: 2nd Floor, Corridor T200CB - West. - Spray-On Fireproofing			(by NYS ELAP 198.1) by Valeriu Voicu on 08/26/22
Analyst Description: Off-White, Homogeneous, Fibrous, Bulk Material			
Asbestos Types: Chrysotile 14.8 %			
Other Material: Cellulose Trace, Fibrous glass 60%, Non-fibrous 25.2%			
2021.163.320-205B 205	222083460-14	Yes	Trace (<0.25 % pc)
Location: 2nd Floor, Corridor T200CB - West-Center - Spray-On Fireproofing			(ELAP 400 PC) by Valeriu Voicu on 08/26/22
Analyst Description: Off-White/Beige, Homogeneous, Fibrous, Bulk Material			
Asbestos Types: Chrysotile <0.25 % pc			
Other Material: Cellulose Trace, Fibrous glass 40%, Non-fibrous 60%			
2021.163.320-205C 205	222083460-15	No	NAD
Location: 2nd Floor, Corridor T200CB - Center. - Spray-On Fireproofing			(by NYS ELAP 198.1) by Valeriu Voicu on 08/26/22
Analyst Description: Beige, Homogeneous, Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Cellulose Trace, Fibrous glass 50%, Non-fibrous 50%			
2021.163.320-205D 205	222083460-16	No	NAD
Location: 2nd Floor, Corridor T200CB - East-Center - Spray-On Fireproofing			(by NYS ELAP 198.1) by Valeriu Voicu on 08/26/22
Analyst Description: Beige, Homogeneous, Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Cellulose Trace, Fibrous glass 45%, Non-fibrous 55%			
2021.163.320-205E 205	222083460-17	No	NAD
Location: 2nd Floor, Corridor T200CB - East - Spray-On Fireproofing			(by NYS ELAP 198.1) by Valeriu Voicu on 08/26/22
Analyst Description: Off-White/Beige, Homogeneous, Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Cellulose Trace, Fibrous glass 45%, Non-fibrous 55%			

PLM Bulk Asbestos Report

2021.163.320; Cornell University; Vet Research Tower 2nd
Floor Fire Episode - 2nd Floor Lab Suites T2003, T2007, And
Corridor T200CB Bulk Sampling (Report Amended 8/26/2022)

Reporting Notes:

Analyzed by: Valeriu Voicu
Date: 8/26/2022



Reviewed by: Valeriu Voicu



*NAD/NSD =no asbestos detected; NA =not analyzed; NA/PS=not analyzed/positive stop, (SOF-V) = Sprayed On Fireproofing containing Vermiculite; (SM-V) = Surfacing Material containing Vermiculite; PLM Bulk Asbestos Analysis using Olympus, Model BH-2 Pol Scope, Microscope, Serial #: 229915, by Appd E to Subpt E, 40 CFR 763 quantified by either CVES or 400 pt ct as noted for each analysis (NVLAP 200546-0), ELAP PLM Method 198.1 for NY friable samples, which includes the identification and quantitation of vermiculite, or ELAP 198.6 for NOB samples, or EPA 400 pt ct by EPA 600-M4-82-020 (NY ELAP Lab 11480); Note:PLM is not consistently reliable in detecting asbestos in floor coverings and similar non-friable organically bound materials. NAD or Trace results by PLM are inconclusive, TEM is currently the only method that can be used to determine if this material can be considered or treated as non asbestos-containing in NY State (also see EPA Advisory for floor tile, FR 59,146,38970,8/1/94) National Institute of Standards and Technology Accreditation requirements mandate that this report must not be reproduced except in full without the approval of the lab.This PLM report relates ONLY to the items tested. RI Cert AAL-094, CT Cert PH-0186, Mass Cert AA000054, NJ Lab ID #NY031.

_____END OF REPORT_____

Client Name: Delta Engineers

Table I
Summary of Bulk Asbestos Analysis Results

2021.163.320; Cornell University; Vet Research Tower 2nd Floor Fire Episode - 2nd Floor Lab Suites T2003, T2007, And Corridor T200CB Bulk Sampling (Report Amended 8/26/2022)

AmeriSci Sample #	Client Sample#	HG Area	Sample Weight (gram)	Heat Sensitive Organic %	Acid Soluble Inorganic %	Insoluble Non-Asbestos Inorganic %	** Asbestos % by PLM/DS	** Asbestos % by TEM
01	2021.163.320-201A	201	----	----	----	----	Chrysotile 1.5	NA
	Location: 2nd Floor, Lab Suite T2003 - Room T2003 (On Beam) - Spray-On Fireproofing							
02	2021.163.320-201B	201	----	----	----	----	Chrysotile <0.25	NA
	Location: 2nd Floor, Lab Suite T2003 - Room T2003A - Spray-On Fireproofing							
03	2021.163.320-201C	201	----	----	----	----	Chrysotile 2.8	NA
	Location: 2nd Floor, Lab Suite T2003 - Room T2003 (On Beam) - Spray-On Fireproofing							
04	2021.163.320-202A	202	0.168	16.8	45.8	37.4	NAD	NAD
	Location: 2nd Floor, Lab Suite T2003 - Room T2003A - 2' x 4' Light Gray Gypsum Ceiling Tile							
05	2021.163.320-202B	202	0.288	16.4	46.7	36.9	NAD	NAD
	Location: 2nd Floor, Lab Suite T2003 - Room T2003A - 2' x 4' Light Gray Gypsum Ceiling Tile							
06	2021.163.320-203A	203	0.141	88.8	6.3	4.8	NAD	NAD
	Location: 2nd Floor, Lab Suite T2003 - Room T2003A - White Textured Covering On HA 202							
07	2021.163.320-203B	203	0.112	89.2	6.5	4.3	NAD	NAD
	Location: 2nd Floor, Lab Suite T2003 - Room T2003A - White Textured Covering On HA 202							
08	2021.163.320-204A	204	----	----	----	----	Chrysotile 8.7	NA
	Location: 2nd Floor, Lab Suite T2007 - Room T2007, East (Overspray On Ductwork) - Spray-On Fireproofing							
09	2021.163.320-204B	204	----	----	----	----	Chrysotile 18.2	NA
	Location: 2nd Floor, Lab Suite T2007 - Room T2007, West (On Beam) - Spray-On Fireproofing							
10	2021.163.320-204C	204	----	----	----	----	Chrysotile 21.0	NA
	Location: 2nd Floor, Lab Suite T2007 - Room T2007A, Center (On Deck) - Spray-On Fireproofing							
11	2021.163.320-204D	204	----	----	----	----	Chrysotile 4.3	NA
	Location: 2nd Floor, Lab Suite T2007 - Room T2007C, West (On Beam) - Spray-On Fireproofing							
12	2021.163.320-204E	204	----	----	----	----	Chrysotile 16.7	NA
	Location: 2nd Floor, Lab Suite T2007 - Room T2007D, West (On Beam) - Spray-On Fireproofing							
13	2021.163.320-205A	205	----	----	----	----	Chrysotile 14.8	NA
	Location: 2nd Floor, Corridor T200CB - West. - Spray-On Fireproofing							
14	2021.163.320-205B	205	----	----	----	----	Chrysotile <0.25	NA
	Location: 2nd Floor, Corridor T200CB - West-Center - Spray-On Fireproofing							
15	2021.163.320-205C	205	----	----	----	----	NAD	NA
	Location: 2nd Floor, Corridor T200CB - Center. - Spray-On Fireproofing							
16	2021.163.320-205D	205	----	----	----	----	NAD	NA
	Location: 2nd Floor, Corridor T200CB - East-Center - Spray-On Fireproofing							

Client Name: Delta Engineers

Table I
Summary of Bulk Asbestos Analysis Results

2021.163.320; Cornell University; Vet Research Tower 2nd Floor Fire Episode - 2nd Floor Lab Suites T2003, T2007, And Corridor T200CB Bulk Sampling (Report Amended 8/26/2022)

AmeriSci Sample #	Client Sample#	HG Area	Sample Weight (gram)	Heat Sensitive Organic %	Acid Soluble Inorganic %	Insoluble Non-Asbestos Inorganic %	** Asbestos % by PLM/DS	** Asbestos % by TEM
17	2021.163.320-205E	205	----	----	----	----	NAD	NA
Location: 2nd Floor, Corridor T200CB - East - Spray-On Fireproofing								

Analyzed by: Feyza Gungor
Date: 8/26/2022



Reviewed by: Valeriu Voicu



**Quantitative Analysis (Semi/Full); Bulk Asbestos Analysis - PLM by Appd E to Subpt E, 40 CFR 763 or NYSDOH ELAP 198.1 for New York friable samples or NYSDOH ELAP 198.6 for New York NOB samples; TEM (Semi/Full) by EPA 600/R-93/116 (or NYSDOH ELAP 198.4; for New York samples). Analysis using Hitachi, Model H600-Noran 7 System, Microscope, Serial #: 542-26-10. NAD = no asbestos detected during a quantitative analysis; NA = not analyzed; Trace = <1%; (SOF-V) = Sprayed On Fireproofing containing Vermiculite; (SM-V) = Surfacing Material containing Vermiculite; Quantitation for beginning weights of <0.1 grams should be considered as qualitative only; Qualitative Analysis: Asbestos analysis results of "Present" or "NVA = No Visible Asbestos" represents results for Qualitative PLM or TEM Analysis only (no accreditation coverage available from any regulatory agency for qualitative analyses): NVLAP (PLM) 200546-0, NYSDOH ELAP Lab 11480, NJ Lab ID #NY031.

Warning Note: PLM limitation, only TEM will resolve fibers <0.25 micrometers in diameter. TEM bulk analysis is representative of the fine grained matrix material and may not be representative of non-uniformly dispersed debris for which PLM evaluation is recommended (i.e. soils and other heterogenous materials).

AmeriSci New York	Report Amendment Explanation Form (append to amended report)	Date Amended 8/26/2022
--------------------------	-----------------------------------------------------------------	---------------------------

Client: Delta Engineers

AmeriSci Job #: 222083460

Client Job: 2021.163.320

Analysis Type: ELAP-PLM/TEM

AmeriSci Sample
#s affected: 222083460-2, 3, 9, 10, 11, 12, 14, 15, 16, 17

Amended by
(print/sign): John P. Koubiadis

Original Item(s)
Being Amended: Samples were not analyzed.

Changes Made: Samples were analyzed.

Reason for
Changes: Client sent an email requesting the analysis of the above samples.

Attach original sheet with incorrect item or items to be amended clearly indicated or circled.

222083460

Bulk Sample Data Sheet / COC


Client: <u>Cornell University</u>	Delta Project No.: <u>2021.163.320</u>	Date: <u>8/24/2022</u>
Project: <u>Vet Research Tower 2nd Floor Fire Episode - 2nd Floor Lab Suites T2003, T2007, and Corridor T200CB Bulk Sampling</u>	Cornell Work Order No.: <u>TBD</u>	Turnaround Time: <u>24 Hours</u>
Collected By: <u>Michael C. Drobak</u>		

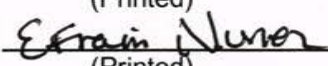
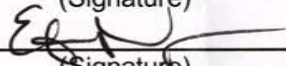
Sample Number	Material Type	Material Condition	Floor	Description / Sample Location
2021.163.320 - 201A	Surfacing	Good	2	Spray-on Fireproofing: 2nd Floor, Lab Suite T2003 - Room T2003 (On Beam).
2021.163.320 - 201B	Surfacing	Good	2	Spray-on Fireproofing: 2nd Floor, Lab Suite T2003 - Room T2003A, Center (On Deck).
2021.163.320 - 201C	Surfacing	Good	2	Spray-on Fireproofing: 2nd Floor, Lab Suite T2003 - Room T2003 (On Beam).
2021.163.320 - 202A	Miscellaneous	Good	2	2'x4' Light Gray Gypsum Ceiling Tile: 2nd Floor, Lab Suite T2003 - Room T2003A, Center.
2021.163.320 - 202B	Miscellaneous	Good	2	2'x4' Light Gray Gypsum Ceiling Tile: 2nd Floor, Lab Suite T2003 - Room T2003A, East.
2021.163.320 - 203A	Miscellaneous	Good	2	White Textured Covering on HA 202: 2nd Floor, Lab Suite T2003 - Room T2003A, Center.
2021.163.320 - 203B	Miscellaneous	Good	2	White Textured Covering on HA 202: 2nd Floor, Lab Suite T2003 - Room T2003A, East.
2021.163.320 - 204A	Surfacing	Good	2	Spray-on Fireproofing: 2nd Floor, Lab Suite T2007 - Room T2007, East (Overspray on Ductwork).
2021.163.320 - 204B	Surfacing	Good	2	Spray-on Fireproofing: 2nd Floor Lab Suite T2007 - Room T2007, West (On Beam).

Instructions: Analyze all non-NOB samples by NYS ELAP 198.1 PLM methodology. Analyze all NOB samples initially by NYS ELAP 198.6 PLM methodology. If all samples from a given sample set are reported as non-asbestos by 198.6, analyze by NYS ELAP 198.4 TEM methodology. Stop analysis after 1st positive for a given sample set.

Email results to wjohnson@delta-eas.com, sprislupsky@delta-eas.com, rcherevko@delta-eas.com

Notes:

Submitted By: Michael C. Drobak / 
(Printed) (Signature)

Received By:  / 
(Printed) (Signature)

Date: 8/24/2022

Date: 8/25/22 1030

222083460

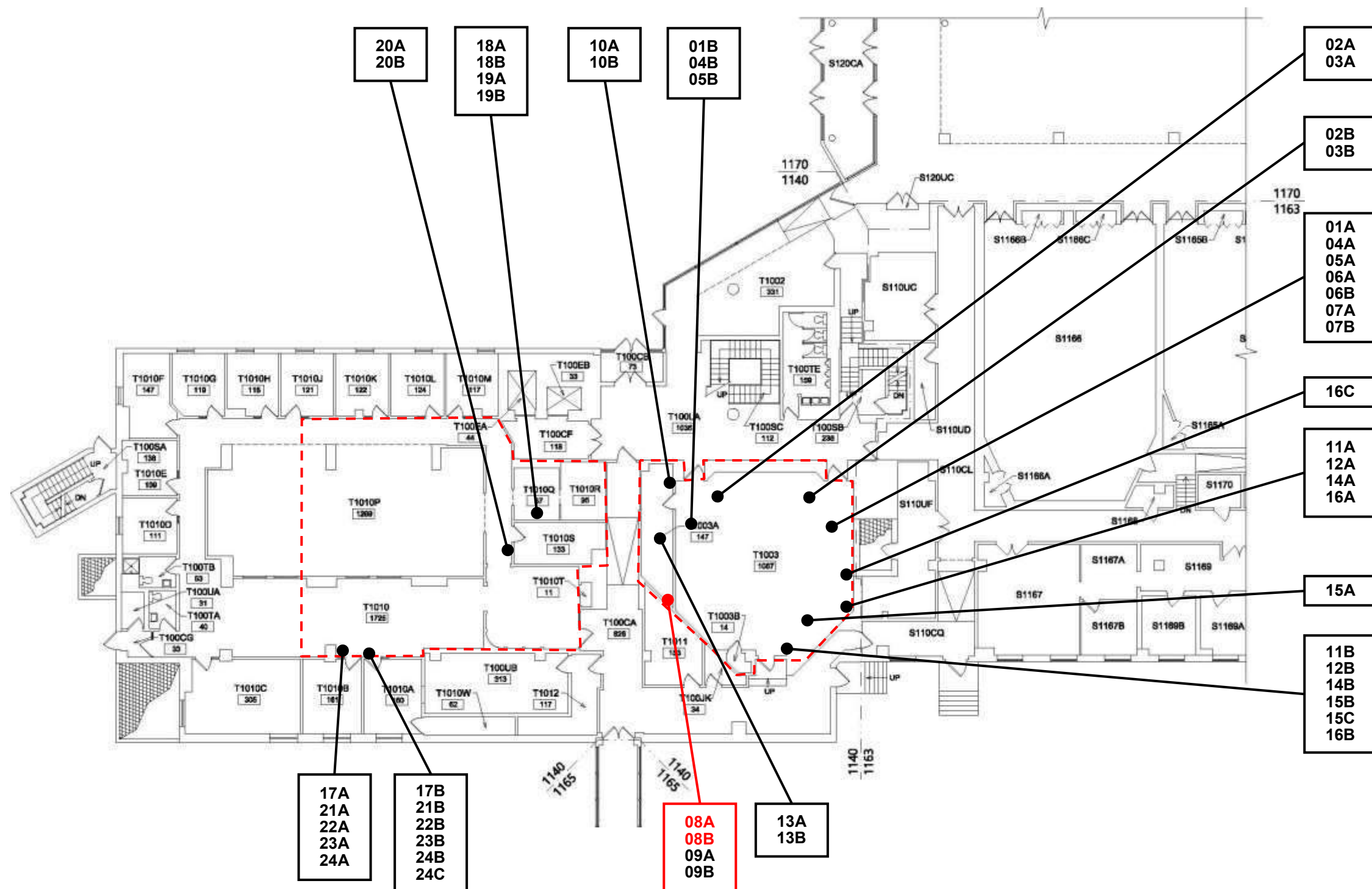
Bulk Sample Data Sheet / COC

Client: <u>Cornell University</u>	Delta Project No.: <u>2021.163.320</u>	Date: <u>8/24/2022</u>
Project: <u>Vet Research Tower 2nd Floor Fire Episode - 2nd Floor Lab Suites T2003, T2007, and Corridor T200CB Bulk Sampling</u>	Cornell Work Order No.: <u>TBD</u>	Turnaround Time: <u>24 Hours</u>
	Collected By: <u>Michael C. Drobak</u>	

Sample Number	Material Type	Material Condition	Floor	Description / Sample Location
2021.163.320 - 204C	Surfacing	Good	2	Spray-on Fireproofing: 2nd Floor, Lab Suite T2007 - Room T2007A, Center (On Deck).
2021.163.320 - 204D	Surfacing	Good	2	Spray-on Fireproofing: 2nd Floor, Lab Suite T2007 - Room T2007C, West (On Beam).
2021.163.320 - 204E	Surfacing	Good	2	Spray-on Fireproofing: 2nd Floor, Lab Suite T2007 - Room T2007D, West (On Beam).
2021.163.320 - 205A	Surfacing	Good	2	Spray-on Fireproofing: 2nd Floor Corridor T200CB - West.
2021.163.320 - 205B	Surfacing	Good	2	Spray-on Fireproofing: 2nd Floor Corridor T200CB - West-Center.
2021.163.320 - 205C	Surfacing	Good	2	Spray-on Fireproofing: 2nd Floor Corridor T200CB - Center.
2021.163.320 - 205D	Surfacing	Good	2	Spray-on Fireproofing: 2nd Floor Corridor T200CB - East-Center.
2021.163.320 - 205E	Surfacing	Good	2	Spray-on Fireproofing: 2nd Floor Corridor T200CB - East.

Attachment C

Sample Location Drawings



860 Hooper Road, Endwell, NY 13760
Tel: 607.231.6600 : Fax: 607.231.6651
www.delta-eas.com

Delta Project No.: 0221.163.320

Project Name: Vet Research Tower Lab T2001 Fire Episode -
Asbestos Bulk Sampling

Work Area: 1st Floor

Sample Type: Bulk

Client: Cornell University

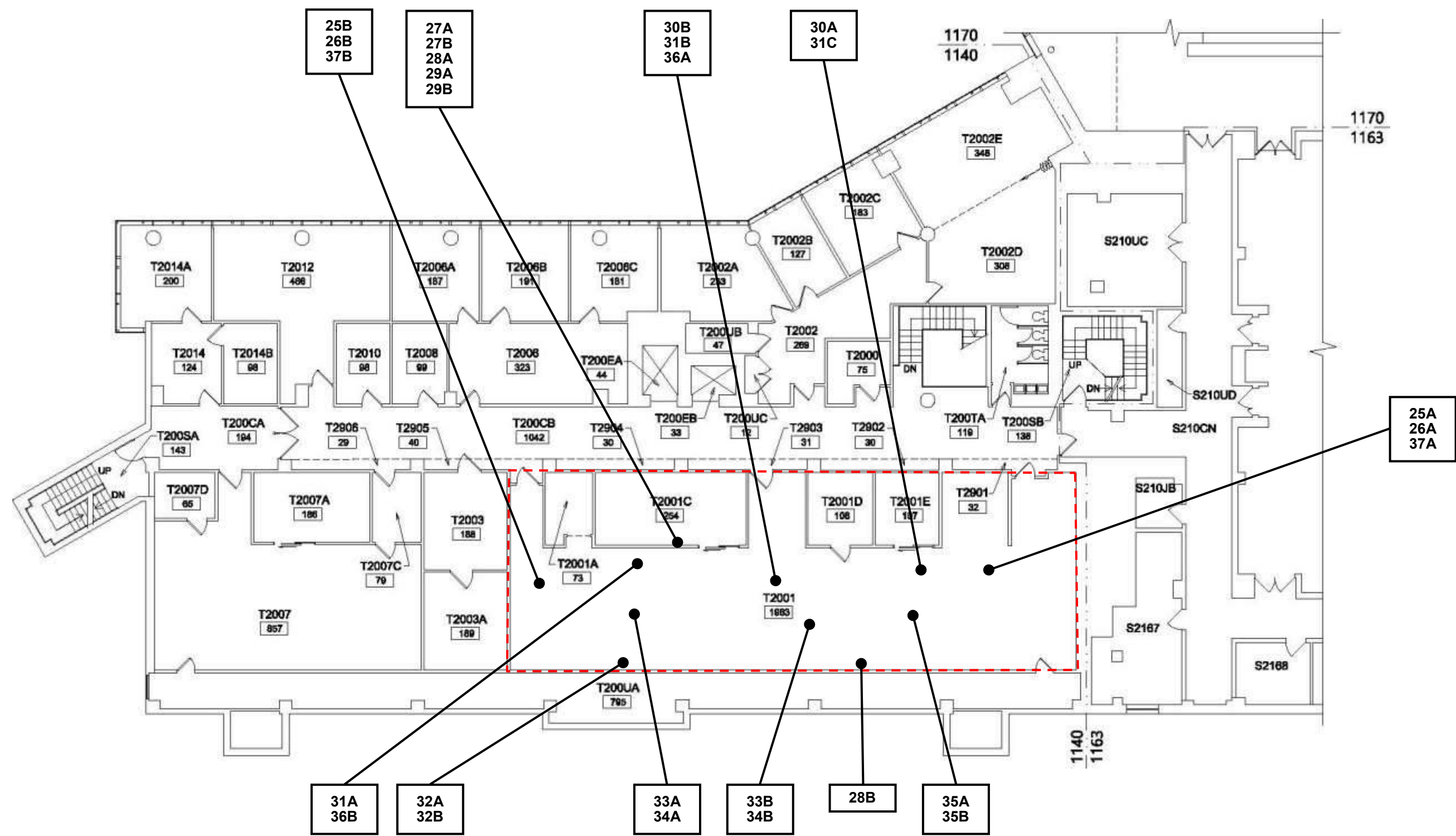
Bldg. No.: 1140

Page 1 of 3

Date(s) Sampled: 07/26/2022

Drawn By: M. Drobak

Scale: NTS



860 Hooper Road, Endwell, NY 13760
Tel: 607.231.6600 : Fax: 607.231.6651
www.delta-eas.com

Delta Project No.: 0221.163.320

Project Name: Vet Research Tower Lab T2001 Fire Episode - Asbestos Bulk Sampling

Work Area: 2nd Floor

Sample Type: Bulk

Client: Cornell University

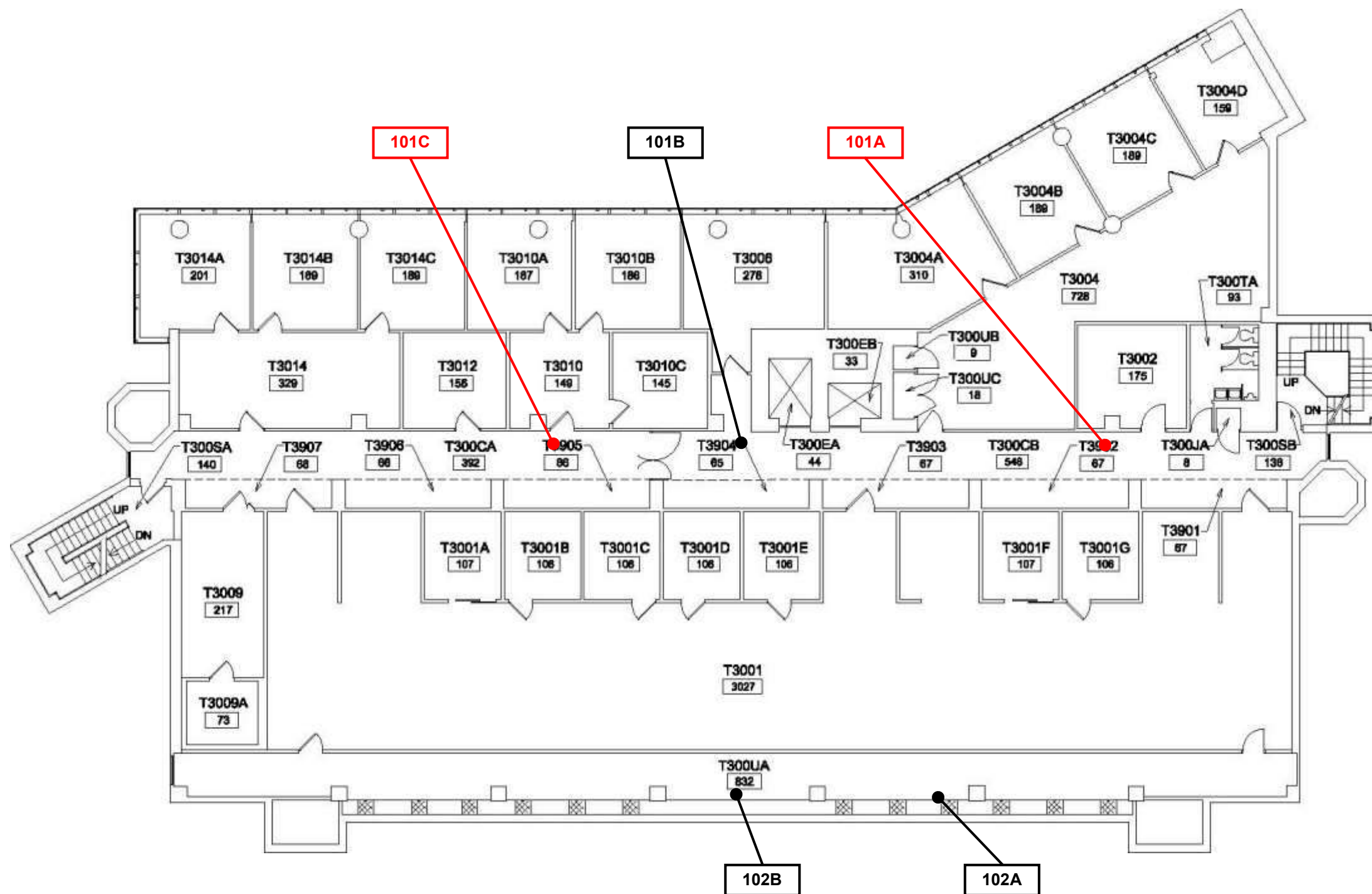
Bldg. No.: 1140

Page 2 **of** 3

Date(s) Sampled: 07/26/2022

Drawn By: M. Drobak

Scale: NTS



860 Hooper Road, Endwell, NY 13760
Tel: 607.231.6600 : Fax: 607.231.6651
www.delta-eas.com

Delta Project No.: 0221.163.320

Project Name: Vet Research Tower Lab T2001 Fire Episode -
Asbestos Bulk Sampling

Work Area: 3rd Floor

Sample Type: Bulk

Client: Cornell University

Bldg. No.: 1140

Page 3 of 3

Date(s) Sampled: 07/26/2022

Drawn By: M. Drobak

Scale: NTS



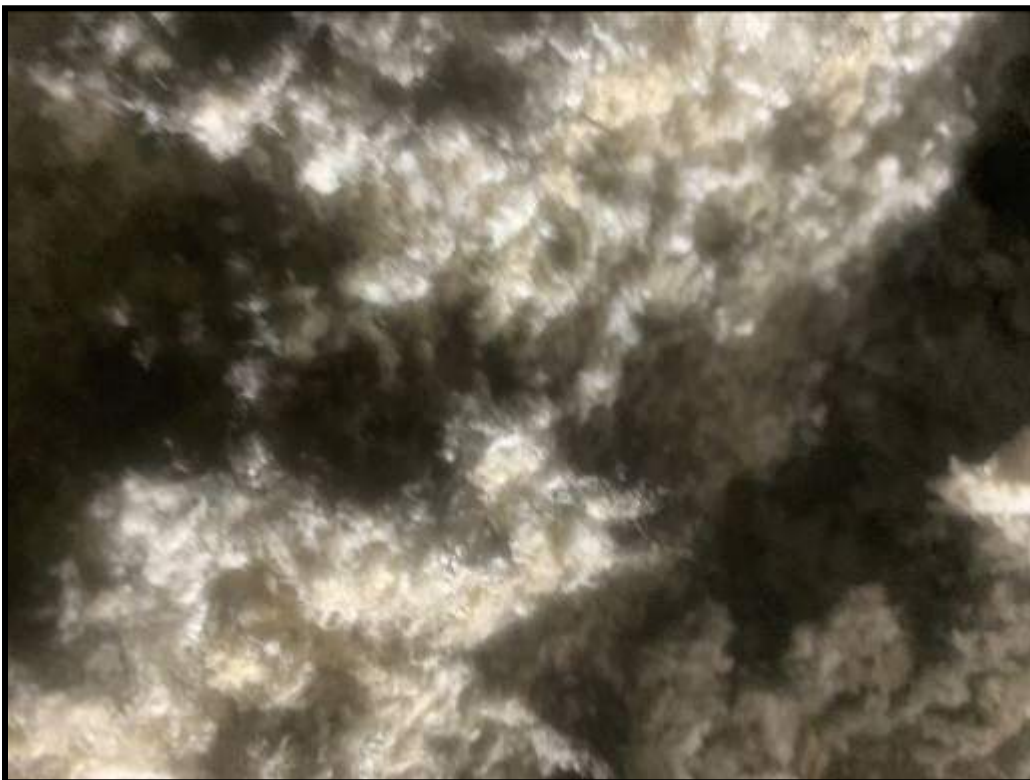
Scale: NTS

Attachment D

Photos



Sample 2021.163.320-31A, Lab Suite T2001, Trace ($< 0.25\%$) Chrysotile, Non-Asbestos



Sample 2021.163.320-31B, Lab Suite T2001, No Asbestos Detected



Sample 2021.163.320-31C, Lab Suite T2001, 0.3% Chrysotile, Non-Asbestos



Sample 2021.163.320-101A, Corridor T300CA, 5.0% Chrysotile, Asbestos Containing



Sample 2021.163.320-101B, Corridor T300CA, No Asbestos Detected



Sample 2021.163.320-101C, Corridor T300CA, 4.0% Chrysotile, Asbestos Containing



Sample 2021.163.320-201A, Lab Suite T2003, 1.5% Chrysotile, Asbestos Containing



Sample 2021.163.320-201B, Lab Suite T2003, Trace ($< 0.25\%$) Chrysotile, Non-Asbestos



Sample 2021.163.320-201C, Lab Suite T2003, 2.8% Chrysotile, Asbestos Containing



Sample 2021.163.320-204A, Lab Suite T2007, 8.7% Chrysotile, Asbestos Containing



Sample 2021.163.320-204B, Lab Suite T2007, 18.2% Chrysotile, Asbestos Containing



Sample 2021.163.320-204C, Lab Suite T2007, 21.1% Chrysotile, Asbestos Containing



Sample 2021.163.320-204D, Lab Suite T2007, 4.3% Chrysotile, Asbestos Containing



Sample 2021.163.320-204E, Lab Suite T2007, 16.7% Chrysotile, Asbestos Containing



Sample 2021.163.320-205A, Corridor T200CB, 14.8% Chrysotile, Asbestos Containing



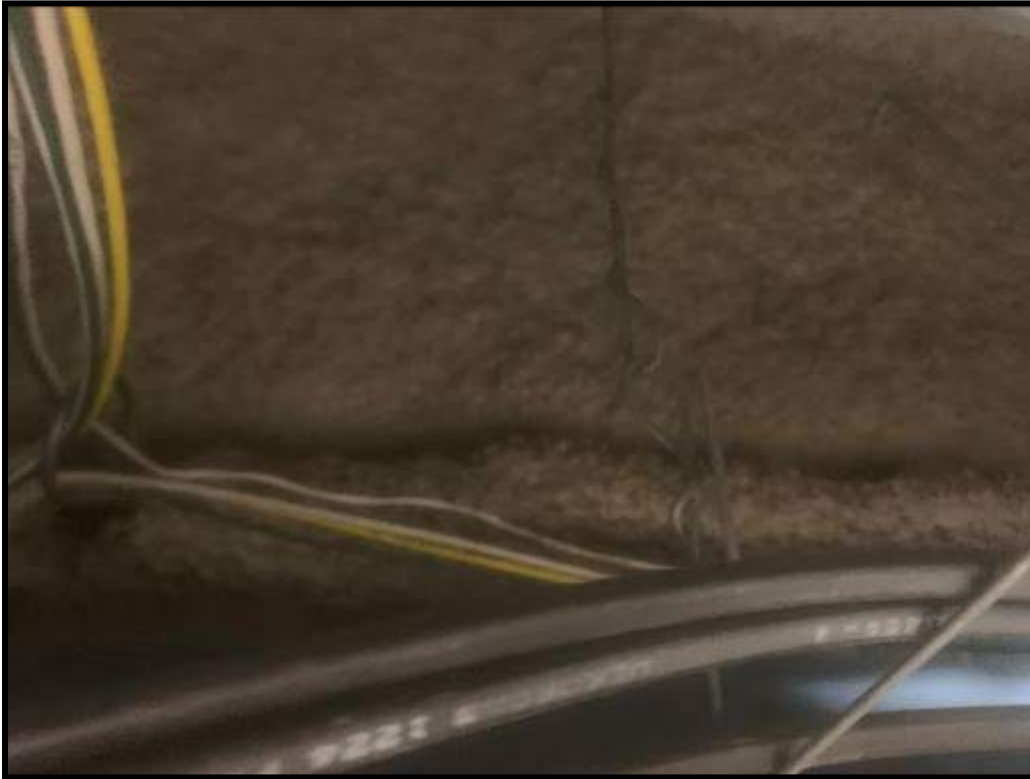
Sample 2021.163.320-205B, Corridor T200CB, Trace (< 0.25%) Chrysotile, Non-Asbestos



Sample 2021.163.320-205C: Corridor T200CB, No Asbestos Detected



Sample 2021.163.320-205D: Corridor T200CB, No Asbestos Detected



Sample 2021.163.320-205E: Corridor T200CB, No Asbestos Detected

Attachment E

Licenses and Certifications

New York State – Department of Labor

Division of Safety and Health
License and Certificate Unit
State Campus, Building 12
Albany, NY 12240

ASBESTOS HANDLING LICENSE

Delta Engineers, Architects, Land Surveyors, &
Landscape, Architects, D.P.C.

860 Hooper Road

Endwell, NY 13760

FILE NUMBER: 05-0851

LICENSE NUMBER: 29322

LICENSE CLASS: RESTRICTED

DATE OF ISSUE: 10/13/2021

EXPIRATION DATE: 10/31/2022

Duly Authorized Representative – Stephen Prislupsky:

This license has been issued in accordance with applicable provisions of Article 30 of the Labor Law of New York State and of the New York State Codes, Rules and Regulations (12 NYCRR Part 56). It is subject to suspension or revocation for a (1) serious violation of state, federal or local laws with regard to the conduct of an asbestos project, or (2) demonstrated lack of responsibility in the conduct of any job involving asbestos or asbestos material.

This license is valid only for the contractor named above and this license or a photocopy must be prominently displayed at the asbestos project worksite. This license verifies that all persons employed by the licensee on an asbestos project in New York State have been issued an Asbestos Certificate, appropriate for the type of work they perform, by the New York State Department of Labor.



Amy Phillips, Director
For the Commissioner of Labor

STATE OF NEW YORK - DEPARTMENT OF LABOR
ASBESTOS CERTIFICATE



THOMAS P FERRO
CLASS(EXPIRES)
C.ATEC(12/22) D INSP(12/22)
H PM (12/22)

CERT# 99-11328
DMV# 404844888

MUST BE CARRIED ON ASBESTOS PROJECTS

01213 006208393 63



01213 006208393 63

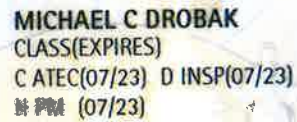
EYES HAZ
HAIR BRO
HGT 5' 08"

IF FOUND RETURN TO:
NYS DOL - L&C UNIT
ROOM 161A BUILDING 12
STATE OFFICE CAMPUS
ALBANY NY 12240



IF FOUND RETURN TO:
NYSOL - L&C UNIT
ROOM 161A BUILDING 12
STATE OFFICE CAMPUS
ALBANY NY 12240

N.Y.S.



CERT# 02-18996
DMV# 846623248

MUST BE CARRIED ON ASBESTOS PROJECTS



**NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER**



Expires 12:01 AM April 01, 2023
Issued April 01, 2022

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

**MR. PAUL J. MUCHA
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NEW YORK, NY 10016**

NY Lab Id No: 11480

*is hereby APPROVED as an Environmental Laboratory for the category
ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE
All approved subcategories and/or analytes are listed below:*

Miscellaneous

Asbestos in Friable Material	Item 198.1 of Manual EPA 600/M4/82/020
Asbestos in Non-Friable Material-PLM	Item 198.6 of Manual (NOB by PLM)
Asbestos in Non-Friable Material-TEM	Item 198.4 of Manual

Serial No.: 64683

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SECTION 020800 – ASBESTOS REMOVAL

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Work of this Section shall be performed in accordance with the requirements of the Contract Documents, including but not limited to Instructions to Bidders, Agreement and General Conditions and General Requirements.
- B. This Section references procedures for the removal of existing asbestos-containing materials (ACM) that will be disturbed or are disturbed during construction of this project.
- C. Furnish all labor, materials, supervision, construction tools and equipment necessary to remove and dispose of **all asbestos-containing materials** disturbed during construction.

An asbestos inspection report titled “Limited Pre-Renovation Asbestos-Containing Materials Inspection”, dated August 29, 2023, prepared by LaBella Associates, D.P.C., can be found in Section 002500 – Hazardous Materials Information. This report incorporates and includes all testing data obtained for the site, based on project scope and materials reported to be disturbed by planned renovations. See the attached report for detailed descriptions of the types of ACM identified and the locations.

The asbestos-containing materials identified within the project limits are shown on Drawings AD102 and AD103, and are listed below:

- 1. White Joint Compound
 - 2. Gray Fireproofing
 - 3. Brown 12” Floor Tiles
- D. The Contractor shall be aware of all conditions of the Project and is responsible for verifying quantities and locations of all Work to be performed referenced in the Contract Documents. Failure to do so shall not relieve the Contractor of its obligation to furnish all labor and materials necessary to perform the Work.
- E. Removal or disturbance of ACM shall be completed in compliance with all governing regulations, including Code Rule 56. Any Contractor, other than the asbestos abatement contractor, who requires the removal or disturbance of asbestos-containing material (ACM) to complete his work shall obtain the services of a certified asbestos abatement contractor to remove the ACM in compliance with this specification and all applicable rules and regulations.
- F. The Owner’s Representative shall approve the asbestos abatement contractor prior to the beginning of the work.
- G. Working hours shall be as required and approved by the Owner. Asbestos abatement activities including, but not limited to, work area preparation, gross removal activities, cleaning activities, waste removal, etc. may need to be performed during ‘off-hours’ (including nights and weekends). In addition, multiple mobilizations may be required to perform the work identified in this project. The Contractor shall coordinate and schedule all Work with the facility and Owner’s representative.

- H. Locations and quantities of all materials to be removed by the abatement contractor must be field verified. Information given on drawings and in the specifications is for general orientation and information only.
- I. The contractor shall have at least one supervisor on the job site at all times who can read and write and is fluent in English, while the project is in progress. The supervisor must be able to communicate fluently with all employees.
- J. Contractor shall provide temporary protection to keep the work areas enclosed, where required, during the performance of the Contract Work. The Contractor shall be responsible for any damage caused as a result of improper temporary protection.
- K. The Contractor is responsible for keeping the work area in a clean and safe condition at all times.
- L. Contractor is to coordinate with other trades on the job concerning scheduling, phasing, etc.

1.2 **SPECIAL CONDITIONS**

- A. Any special job conditions, including variances obtained by the Owner, are described below.
 - No Variance Petitions have been submitted to date
- B. Abatement may occur in portions of the Veterinary Research Tower where immediately adjacent floors or areas are occupied. The Contractor shall carefully observe regulatory requirements for the isolation of abatement work areas and appropriate notifications to occupants and signage at project area boundaries.

1.3 **CODES AND REGULATIONS**

- A. General Applicability of Codes and Regulations and Standards: Except to the extent that more explicit or more stringent requirements are written directly into the Contract Documents, all applicable codes, regulations and standards have the same force and effect (and are made a part of the Contract Documents by reference) as if copied directly into the Contract Documents, or as if published copies are bound herewith.
- B. Contractor Responsibility: The Contractor shall assume full responsibility and liability for the compliance with all applicable Federal, State and local regulations pertaining to work practices, hauling, disposal, and protection of workers, visitors to the site and persons occupying areas adjacent to the site. The Contractor is responsible for providing medical examinations and maintaining medical records of personnel as required by the applicable Federal, State and local regulations. The contractor shall hold the Owner and Owner's Representative harmless for failure to comply with any applicable work, hauling, disposal, safety, health or other regulation on the part of himself, his employees or his subcontractors.
- C. Federal Requirements which govern asbestos abatement work or hauling and disposal of asbestos waste materials include but are not limited to the following:

OSHA: U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), including but not limited to:

Occupational Exposure to Asbestos, Tremolite, Anthophyllite, and Actinolite; Final
Rules Title 29, Part 1926, Section 1101 of the Code of Federal Regulations

Respiratory Protection
Title 29, Part 1910, Section 134 of the Code of Federal Regulations

Access to Employee Exposure and Medical Records
Title 29, Part 1910, Section 2 of the Code of Federal Regulations

Hazard Communication
Title 29, Part 1910, Section 1200 of the Code of Federal Regulations

DOT: U.S. Department of Transportation, including but not limited to:

Hazardous Substances
Title 29, Part 171 and 172 of the Code of Federal Regulations

EPA: U.S. Environmental Protection Agency (EPA), including but not limited to:

National Emission Standard for Hazardous Air Pollutants (NESHAPS)
National Emission Standard for Asbestos
Title 40, Part 61, Subpart A, and revised Subpart M (Revised Subpart B) of the Code of
Federal Regulations dated November 20, 1990

- D. State Requirements which govern asbestos abatement work or hauling and disposal of asbestos waste materials include but are not limited to the following:

New York State Department of Labor (NYSDOL) 12 NYCCR Part 56, as amended March 21, 2007. Also known as Industrial Code Rule 56 (ICR 56).

New York State Department of Environmental Conservation (DEC) Regulations regarding waste collector registration Title 6, Part 364 of the New York State Official compilation of Codes, Rules and Regulations. An annual "Industrial Waste Hauler Permit" specifically for asbestos-containing materials is required for transportation of asbestos-containing waste to the disposal site.

- E. Local Requirements: Abide by all local requirements which govern asbestos abatement work or hauling and disposal of asbestos waste materials.

1.4 SUBMITTALS

- A. Prior to commencement of any work (minimum of seven days prior to starting work) involving the disturbance of ACM, the Contractor shall submit the following to the Owner's Representative for review and approval:
1. Copy of current NYSDOL Asbestos Contractor's License (DOH-432)
 2. Copies of current worker's Asbestos Handler's Certificates
 3. Provide a statement signed by an authorized representative of the company stating that the Building Occupants/Other Trades notification required by ICR 56 will be or has been posted

- at least 10 days prior to the start of abatement. Provide a copy of the notification that will be posted at the job site
4. Copies of all proposed site-specific variances
 5. Copy of current insurance certificate held by the Asbestos Contractor that names Cornell University as an additional insured and provides the following coverages: 1) Pollution liability in a general aggregate of \$2,000,000; and 2) General Liability with \$1,000,000/\$2,000,000 for each occurrence/general aggregate; and 3) Workers Compensation
 6. Copies of Project Notifications and proof of submittal (e.g., certified mail receipt) to NYSDOL and USEPA
 7. Copy of NYSDEC permit for waste hauler
 8. Name and address of landfill where asbestos-containing waste materials are to be buried. Include contact person and telephone number, and NYSDEC Part 360 permit number or other applicable permits
 9. Site-specific work plan in accordance with Section 1.5 D
 10. On a weekly basis, submit copies of all waste shipment records and disposal site receipts to the Owner
- B. During the project, legible copies of the following items must be submitted to the Owner's Representative (LaBella Associates, P.C.). If personnel records are not available at this time, workers will not be able to work on-site until copies are provided:
1. NYSDOL Asbestos Handling Certificates (DOH 442) for all persons employed on the project
 2. Project Logbook entries
 3. Any and all changes to the Contract, should any occur
 4. Personal sampling results within 24 hours of sampling
- C. Upon completion of the project, legible copies of the following items must be submitted to the Owner's Representative (LaBella Associates, P.C.):
1. Waste manifests, shipment records, and landfill receipts signed by the landfill operator submitted within 30 days after the waste leaves the site. A percentage of the final payment will be withheld until the Owner or Owner's Representative receives the waste shipment record.

1.5 QUALITY ASSURANCE

- A. Comply with the most recent edition of compilation of Codes, Rules and Regulations of the State of New York (Statutory Authority: Labor Law Section 906), including Rule 56 of Title 12 NYCRR, New York State, Department of labor, most currently amended (hereinafter referred to in this Specification as Code Rule 56). Note: Article 30 of the Labor Law sets forth procedures and standards that must be met by parties who desire to obtain variations of any of the requirements of this rule.
- B. Comply with all current and appropriate Federal, State and Local rules and regulations regarding work of this section, including those of the following agencies:
- New York State Uniform Fire Prevention and Building Code
 - New York State Department of Labor
 - New York State Department of Environmental Conservation (DEC)

- Occupational Safety and Health Administration (OSHA)
 - United States Environmental Protection Agency (EPA)
- C. Pre-Work Conference: Before the work of this section is scheduled to commence, a conference may be held at the site for the purpose of reviewing the Contract Documents, discussing requirements for the work and reviewing the work procedures. The conference shall be attended by the asbestos abatement contractor.
- D. Work Plan: The Contractor shall prepare a detailed work plan and submit the plan no later than one week prior to the start of the abatement project. The work plan shall include, but not be limited to:
1. A preliminary schedule for completion of the work:
 - a. Show the complete sequence of abatement activities and the sequencing of Work within each building or building section.
 - b. Show the dates for the beginning and completion of each major element of Work including substantial completion dates for each Work Area, building, or phase.
 2. Work procedures that will be utilized (including anticipated decon and dumpster locations).
 3. Estimated crew size.
 4. The anticipated work hours.
 5. Emergency procedures for fire and medical emergencies and for failure of containment barriers.
 6. Project Notifications: As required by Federal and State regulatory agencies together with proof of transmittal (i.e., certified mail return receipt).
 7. Building Occupant Notification: As required by regulatory agencies.
 8. Abatement Work Plan: Provide plans that clearly indicate the following:
 - a. All Work Areas/containments numbered sequentially.
 - b. Locations and types of all decontamination enclosures.
 - c. Entrances and exits to each Work Areas/containments.
 - d. Type of abatement activity/technique for each Work Area/containment.
 - e. Number and location of negative air units and exhaust. Also provide calculations for determining number of negative air pressure units.
 - f. Proposed location and construction of storage facilities and field office.
 - g. Location of water and electrical connections to building services.
 - h. Waste transport routes through the building to the waste storage container.
 9. Disposal Site/Landfill Permit from applicable regulatory agency.
 10. NYS Department of Environmental Conservation Waste Transporter Permit.
- E. Progress Meetings: The Owner's Representative will hold general progress meetings as required. A representative of the Contractor and the Owner is to be properly represented at each meeting.
- F. Daily Log: The Contractor is to maintain within the Decontamination Unit a daily log documenting the dates and time of, but not limited to, the following items:
1. Meetings; purpose, attendees, brief discussion
 2. Visitations; authorized and unauthorized
 3. Special or unusual events, i.e. barrier breeching, equipment failures, accidents
 4. Air monitoring tests and test results.
 5. Other entries as detailed in Code Rule 56-7.3 Asbestos Contractor Daily Project Log.

Submit three (3) copies of this log at final closeout of the Project as a Project closeout submittal.

G. Project Monitor: The Project Monitor shall be a representative of the Owner during the asbestos abatement portion of the project. The Project Monitor has the following responsibilities:

1. The Project Monitor shall oversee work practices and inspect for compliance with all applicable regulations and standards, and the Contract Documents.
2. The Project Monitor shall have at all times access to the work areas whenever it is in preparation or in progress. The Contractor shall provide the Project Monitor with keys to all locks located on the entrance(s) to the decontamination unit(s) and all other secured areas.
3. The Project Monitor, in conjunction with the Owner, will be the interpreter of the requirements of the Contract Documents and the judge of the performance thereunder.
4. The Project Monitor and/or the Owner will have the authority to reject work which is not in compliance with the requirements of the Contract Documents or Federal, State, or Local Regulations. The decision of the Owner will be final.

H. Air Sampling and Analysis

1. Area Air Sampling and Analysis

- a. The Owner will be responsible for hiring an independent third party firm to perform the required area air sampling and analysis in accordance with ICR 56.
- b. The Contractor is required to ensure cooperation of its personnel with the Air Sampling Technician (AST) for general air sampling, and testing of each work area after completion of asbestos work prior to removal of containment barriers.
- c. All air samples shall be analyzed using Phase Contrast Microscopy (PCM) in accordance with NIOSH method 7400.

2. Personal Air Sampling:

- a. As per the requirements of OSHA 1926.1101, the Contractor shall be required to perform personal air monitoring in order to determine that appropriate respiratory protection is being utilized.
- b. The analysis of personal air samples shall be conducted by an ELAP approved laboratory, subject to approval of the Owner or the Owner's Representative.
- c. Results of personnel air sample analyses shall be available, verbally, within twenty-four (24) hours of sampling and shall be posted at the work site within 48 hours. Results shall be submitted in accordance with the requirements of Section 1.5 F.

3. Final Clearance Air Sampling:

- a. For Code Rule 56 PCM Analysis: When required, the clearance air monitoring results shall be considered satisfactory when every sample demonstrates an airborne concentration of asbestos fibers of less than 0.01 fibers per cubic centimeter, or the background level, whichever is greater.
- b. The Contractor shall pay for all additional costs incurred by the Owner, including additional air monitoring, project monitoring, engineering fees, and sample analysis required if clearance air monitoring fails, or if completion of abatement work is not in accordance with approved progress schedule.

1.6 GENERAL PROCEDURES

- A. General Requirements - Comply with Code Rule 56's procedures for entry, exit, logging in, showering, personal protective equipment, tools, clothing, etc., throughout the asbestos abatement. Respiratory equipment shall be as required by OSHA and air monitoring results. (Except for authorized visitors as required by Rule 56). Non-certified workers will not be allowed in the work area.
- B. Equipment and Waste Container Decontamination and Removal – Code Rule 56's procedures for large projects (cleaning, recontainerization, holding areas, etc.) shall be followed.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. General Requirements: Code Rule 56's requirements for materials and equipment shall apply.
- B. Miscellaneous protective materials - Provide plywood sheathing, hardboard, etc., as required to provide protective cover over surfaces of existing construction and finishes to eliminate damage resulting from work of this section, including impact and water damage. Poly shall comply with Code Rule-56 including fire retardant requirements.
- C. Water and electricity shall be furnished by Owner without charge. Contractor shall provide an in-line backflow preventer at water source, and utilize non-leaking hoses.
- D. The Contractor shall supply the Project Monitor and Air Monitor with sufficient electricity to operate all high-volume air monitoring pumps as may be required during the project.

PART 3 - EXECUTION

3.1 REMOVAL REQUIREMENTS

- A. Perform work under this contract in accordance with the standards referenced in Part 1 of this Section. The provisions of any site-specific variances to Code Rule 56, or other asbestos standards, obtained for this project may not be implemented until approval is given by the Owner or Owner's Representative.
- B. Work that results in the disturbance of asbestos-containing materials shall be performed by a licensed asbestos abatement contractor who employs certified workers in accordance with all applicable standards referenced herein. If additional suspect ACM is discovered during the course of abatement, the Contractor shall notify the Owner or Owner's Representative immediately.
- C. The Contractor shall protect all items/existing construction intended to remain.

- D. Should the area beyond the asbestos work area(s) become contaminated with asbestos-containing dust or debris as a consequence of the work, immediately institute emergency procedures established for asbestos removal. All costs incurred in decontaminating such non-work areas shall be borne by the Contractor at no additional cost to the Owner.

3.2 WORK AREA PREPARTION

- A. General Requirements: Code Rule 56's requirements for general work area preparation shall apply, including vacating, signs, power, timing, HVAC isolation, isolation barriers, objects, exits, toilets, etc.

3.3 PERSONAL AND WASTE DECONTAMINATION ENCLOSURE SYSTEMS

- A. Comply with Code Rule 56's requirements for enclosure, showers, room types and configuration, etc.

3.4 DECONTAMINATION ENCLOSURE SYSTEMS/WORK AREA BARRIERS

- A. General Requirements: Comply with Code Rule 56 requirements for maintenance of work area barriers. (Setting, inspection, repairs, cleaning, etc.)

3.5 HANDLING AND REMOVAL PROCEDURES

- A. General Requirements: Comply with Code Rule 56 requirements regarding handling and removal procedures.
- B. Dry removal or disturbance: No dry removal or disturbance of asbestos materials shall be permitted.
- C. Wetting requirements: The asbestos material shall be wetted as necessary with amended water to keep asbestos fibers from becoming airborne. If any friable material is encountered, all of its surfaces shall be saturated.
- D. The use of open flame, torches, welding and other Hot Work is not permitted without review and approval by the Owner or Owner's Representative. A Hot Work Permit system shall be required for authorized use.
- E. Cleaning of surfaces: After completion of all stripping work, surfaces where asbestos material has been removed or handled shall be HEPA vacuumed.

3.6 CLEANING PROCEDURES

- A. General requirements: Code Rule 56's requirements for containerization, dust cleanup, tools and enclosure cleanup, etc., shall apply. Cleanup shall be by HEPA vacuum.
- B. Post abatement requirements: Code Rule 56's requirements shall apply (tool/equipment cleanup, general cleanup, waste removal, clearance air monitoring, etc.).

3.7 ASBESTOS WASTE TRANSPORTATION AND DISPOSAL

- A. Contractor shall minimally transport and dispose of all of the Category I non-friable asbestos waste materials according to correct applicable NYSDEC transportation requirements, Part 364, and solid waste requirements Part 360.
- B. If any removed material is "friable", Contractor shall handle it as such and transport and dispose of as "friable" asbestos waste per regulations referenced in Part 1 of this Section.
- C. All waste generated as a result of this work shall be removed from the site within 10 days of completion and clearance of abatement work.
- D. Log disposal site transportation names, etc., per Code Rule 56.
- E. All loading, transportation, and disposal shall also comply with NESHAPS 40 CFR 61 - 150 paragraphs C, D and E including all requirements for loading signs, shipment records, content certificate, record receipts, notifications, etc.

3.8 TEMPORARY PROTECTION OF FACILITIES

- A. Contractor shall provide temporary enclosure as required to protect the existing facilities from adverse weather conditions and maintain the interior environment in its normal condition. The contractor shall maintain the building secure from intrusion at all times and exits shall be operational during construction whenever the building is occupied. Temporary door and window enclosures shall be secure, weather resistant and lockable, if operable.

3.9 RESTORATION

- A. Remove temporary decontamination facilities and restore area designated for these facilities to its original condition or better.
- B. After final clearance, the Contractor shall replace all filters of the associated portions of the existing building HVAC system that were affected by the abatement operations, remove locks and restore power. All temporary power supplies shall be disconnected, power lockouts removed and building power restored. All temporary plumbing shall be removed.
- C. Finishes damaged by asbestos removal operation shall be restored prior to final payment.
 - 1. Finishes unable to be restored shall be replaced under this Contract.
 - 2. All foam and expandable foam products and materials used to seal Work Area openings shall be completely removed upon completion of abatement activities.
- D. All penetrations (including, but not limited to, pipes, ducts, etc.) through fire rated construction shall be fire stopped using materials and systems tested in accordance with ASTM E814 on projects where re-insulation is part of the required work.

3.10 PROJECT COMPLETION REQUIREMENTS

- A. Submission by the Contractor to the Owner Representative of the job logbook as described in Section 1.5 paragraph F.
- B. Inspection of the work sites by the Contractor's Project Manager's representative and the Owner's Representative for substantial completion of the Scope of Work.
- C. Submission by the Contractor to the Owner of the waste disposal manifest verifying that all waste generated at the project site has been disposed of at an EPA approved waste site. A 10% payment retainage shall be withheld by the Owner until receipt of all waste manifests.

END OF SECTION 020800

SECTION 020810 - PROTECTION OF WORKERS – LEAD-CONTAINING MATERIALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Work of this Section shall be performed in accordance with the requirements of the Contract Documents, including but not limited to Instructions to Bidders, Agreement and General Conditions and General Requirements.

1.2 SCOPE

- A. Contractors are alerted to the fact that the paint coatings on surfaces in this project have the potential to contain lead. Lead is a toxic metal capable of causing damage to the nervous system, kidneys, bones, heart and reproductive system.
- B. Any surface coated with paint is considered to contain some percentage of lead, based on the previous reports. Any alteration and/or repair that results in the disturbance of the paint coatings shall meet the requirements of OSHA CFR 29 1926.62 Construction Lead Standard.

1.3 SUBMITTALS

- A. Contractors of each trade shall submit their written Lead Program prior to the start of work. The plan must identify potential sources of lead exposure and propose specific procedures to protect workers from those exposures.

1.4 DEFINITIONS

- A. **Action Level** means employee exposure, without regard to the use of respirators, to an airborne concentration of lead of 30 micrograms per cubic meter of air (30 ug/m³) calculated as an 8-hour time weighted average (TWA).
- B. **Exposure Assessment** means a Contractor's requirement to determine if any Contractor's employees may be exposed to lead at or above the action level.
- C. **Lead** means metallic lead, all inorganic lead compounds and organic lead soaps. Excluded from this definition are all other organic lead compounds.
- D. **Permissible Exposure Limit (PEL)** means employee exposure, without the use of respirators, to an airborne concentration of lead of 50 ug/m³ averaged over an 8-hour period.

PART 2 - PRODUCTS

None Specified.

PART 3 - EXECUTION

3.1 PROTECTION OF WORKERS

- A. All Contractors shall be responsible to conduct an exposure assessment and shall initially determine if any Contractor's employee may be exposed to lead at or above the action level where their work causes the disturbance of paint or paint coatings, or provide a negative exposure assessment for work tasks to be completed under this scope of work.

3.2 EXPOSURE ASSESSMENT

- A. The Contractor shall collect personal samples representative of a full shift including at least one sample for each job classification in each work area either for each shift or for the shift with the highest exposure.
 - 1. **Below the Action Level** - should the initial personal air monitoring results be less than 30 ug/m³ the Contractor shall make a written record of such determination. Further exposure determination need not be repeated except as follows:
 - a. Whenever there has been a change of equipment, process, control, personnel or a new task has been initiated that may result in additional employees being exposed to lead at or above the action level or may result in employees already exposed at or above the action level being exposed above the PEL, the employer shall conduct additional monitoring.
 - 2. **At or Above the Action Level but At or Below the PEL** - the Contractor shall perform monitoring until at least two consecutive measurements taken at least 7 days apart, are below the action level at which time the Contractor may discontinue monitoring for that employee except as otherwise provided in paragraph 3.02.A.1.a.
 - 3. **Above the PEL** - the Contractor shall perform monitoring until at least two consecutive measurements taken at least 7 days apart, are at or below the PEL but at or above the action level at which time the Contractor shall repeat monitoring for that Contractor's employee as specified in 3.02.A.2.
- B. The Contractor may submit a negative exposure assessment in lieu of performing exposure monitoring.

3.3 METHODS OF COMPLIANCE

- A. To the extent feasible, Contractors must reduce worker lead exposure to the Permissible Exposure Limit (PEL) of 50 ug/m³ by a combination of engineering controls, work practice, and administrative controls.

- B. Respiratory protection and other protective equipment must be provided and used to the extent that the engineering and work practice controls cannot reduce exposure to the PEL as specified within 29 CFR 1926.62.

3.4 HOUSEKEEPING (required whenever lead is disturbed)

- A. All surfaces shall be maintained as free as practical of accumulations of lead.
- B. Clean up of floors and other surfaces where lead accumulates shall wherever possible be cleaned by vacuuming or other methods that minimize the likelihood of lead becoming airborne.
- C. Shoveling, dry or wet sweeping and brushing may be used only where vacuuming or other equally effective methods have been tried and found not to be effective.
- D. Where vacuuming methods are selected, the vacuums shall be equipped with HEPA filters and used and emptied in a manner which minimizes the reentry of lead into the workplace.
- E. Compressed air shall not be used to remove lead from any surface unless the compressed air is used in conjunction with a ventilation system designed to capture the airborne dust created by the compressed air.

3.5 HYGIENE FACILITIES AND PRACTICES (required above the PEL)

- A. The Contractor shall assure that in areas where Contractor's employees are exposed to lead above the PEL without regard to the use of respirators, food or beverage is not present or consumed, tobacco products are not present or used, and cosmetics are not applied.
- B. Change Areas (required above the PEL and during exposure assessment)
 - 1. The Contractor shall provide clean change areas for employees whose airborne exposure to lead is above the PEL, and as interim protection for employees.
 - 2. The Contractor shall assure that change areas are equipped with separate storage facilities for protective work clothing and equipment and for street clothes which prevent cross-contamination.
 - 3. The Contractor shall assure that Contractor's employees do not leave the workplace wearing any protective clothing or equipment that is required to be worn during the work shift.
- C. Showers (required above the PEL)
 - 1. The Contractor shall provide shower facilities, where feasible, for use by Contractor's employees whose airborne exposure to lead is above the PEL.
 - 2. The Contractor shall assure where shower facilities are available, that Contractor's employees shower at the end of the work shift and shall provide an adequate supply of cleansing agents and towels for use by affected Contractor's employees.
- D. Eating Facilities (required above the PEL)
 - 1. The Contractor shall provide lunchroom facilities or eating areas for Contractor's employees whose airborne exposure to lead is above the PEL, without regard to the use of respirators.
 - 2. The Contractor shall assure that lunchroom facilities or eating areas are as free as practicable from lead contamination and are readily accessible to Contractor's employees.

3. The Contractor shall assure that Contractor's employees whose airborne exposure to lead is above the PEL, without regard to the use of a respirator, wash their hands and face prior to eating, drinking, smoking or applying cosmetics.
4. The Contractor shall assure that Contractor's employees do not enter lunchroom facilities or eating areas with protective work clothing or equipment unless surface lead dust has been removed by vacuuming, downdraft booth, or other cleaning method that limits dispersion of lead dust.

E. Handwashing Facilities (required whenever lead is disturbed)

1. The Contractor shall provide adequate handwashing facilities for use by Contractor's employees exposed to lead.
2. Where showers are not provided the Contractor shall assure that Contractor's employees wash their hands and face at the end of the work shift.

3.6 MEDICAL SURVEILLANCE (required whenever lead is disturbed)

- A. The Contractor is responsible for providing medical examinations and maintaining medical records of personnel as required by 29 CFR 1926.62 (j) Medical Surveillance.

3.7 TRAINING (required whenever lead is disturbed)

- A. For all Contractor's employees who are subject to exposure to lead at or above the action level on any day or who are subject to exposure to lead compounds which may cause skin or eye irritation, the Contractor shall provide a training program in accordance with 29 CFR 1926.62 (l)(2).

3.8 SIGNS (required above the PEL)

- A. The Contractor shall post the following warning signs in each work area where Contractor's employees exposure to lead is above the PEL.

**WARNING
LEAD WORK AREA
POISON
NO SMOKING OR EATING**

- B. The Contractor shall assure that signs are illuminated and cleaned as necessary so that the legend is readily visible.

3.9 RECORDKEEPING (required whenever lead is disturbed)

- A. The Contractor is responsible to establish and maintain an accurate record of all monitoring and other data used in conducting Contractor's employee exposure assessments and for each Contractor's employee subject to medical surveillance as required per 29 CFR 1926.62 (n).

3.10 OBSERVATION OF MONITORING (required whenever lead is disturbed)

- A. The Contractor shall provide affected Contractor's employees or their designated representatives an opportunity to observe any monitoring of employee exposure to lead.
- B. Whenever observation of the monitoring of employee exposure to lead requires entry into an area where the use of respirators, protective clothing or equipment is required, the Contractor shall provide the observer with and assure the use of such respirators, clothing and equipment.
- C. Without interfering with the monitoring, observers shall be entitled to:
 - 1. Receive an explanation of the measurement procedures;
 - 2. Observe all steps related to the monitoring of lead performed at the place of exposure; and
 - 3. Record the results obtained or receive copies of the results when returned by the laboratory.

END OF SECTION 020810

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Salvage of existing items to be reused or recycled.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and store.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.4 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
1. Inspect and discuss condition of construction to be selectively demolished.
 2. Review structural load limitations of existing structure.

3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.5 INFORMATIONAL SUBMITTALS

- A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
- B. Schedule of Selective Demolition Activities: Indicate the following:
 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 3. Coordination for shutoff, capping, and continuation of utility services.
 4. Use of elevator and stairs.
 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- C. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by salvage and demolition operations.

1.6 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.

1.7 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
 1. Before selective demolition, Owner will remove the following items:
 - a. **<Insert items to be removed by Owner>.**
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

- D. Hazardous Materials: Present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
 - 1. Hazardous material remediation is specified elsewhere in the Contract Documents.
 - 2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
 - 3. Owner will provide material safety data sheets for suspected hazardous materials that are known to be present in buildings and structures to be selectively demolished because of building operations or processes performed there.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.8 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

- D. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video and templates.
 - 1. Inventory and record the condition of items to be removed and salvaged.
 - 2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 - 2. Arrange to shut off utilities with utility companies.
 - 3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.3 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.

2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of selective demolition.
- C. Remove temporary barricades and protections where hazards no longer exist.

3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 5. Maintain fire watch during and for at least a half hour after flame-cutting operations.
 6. Maintain adequate ventilation when using cutting torches.
 7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 10. Dispose of demolished items and materials promptly.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area on-site, designated by Owner.
5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts. No jackhammering is allowed.
- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- C. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.
 1. Do not allow demolished materials to accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 4. Comply with requirements specified in Division 01 sections.
- B. Burning: Do not burn demolished materials.

3.7 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

SECTION 032000 - CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel reinforcement bars.
2. Welded-wire reinforcement.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Steel-reinforcement installation.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Each type of steel reinforcement.
2. Bar supports.

B. Shop Drawings: Comply with ACI SP-066:

1. Include placing drawings that detail fabrication, bending, and placement.
2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.

C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.

1. Location of construction joints is subject to approval of Architect.

1.4 INFORMATIONAL SUBMITTALS

A. Material Test Reports: For the following, from a qualified testing agency:

1. Steel Reinforcement:

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
 - 1. Store reinforcement to avoid contact with earth.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.
- B. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

2.2 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.
 - 1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
- B. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.
 - 1. Finish: Plain.

2.3 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

- A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
- B. Accurately position, support, and secure reinforcement against displacement.

1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
 2. Do not tack weld crossing reinforcing bars.
- C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- D. Provide concrete coverage in accordance with ACI 318.
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Splices: Lap splices as indicated on Drawings.
1. Bars indicated to be continuous, and all vertical bars to be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
 2. Stagger splices in accordance with ACI 318.
- G. Install welded-wire reinforcement in longest practicable lengths.
1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."
 - a. For reinforcement less than W4.0 or D4.0, continuous support spacing to not exceed 12 inches.
 2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.
 3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
 4. Lace overlaps with wire.

3.3 JOINTS

- A. Construction Joints: Pour concrete monolithically. Construction Joints are not allowed.
- B. Doweled Joints: Install dowel bars and support assemblies at joints where indicated.

3.4 INSTALLATION TOLERANCES

- A. Comply with ACI 117.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections: Steel-reinforcement placement.

END OF SECTION 032000

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:

1. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.

1.2 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

- B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

- a. Contractor's superintendent.
- b. Independent testing agency responsible for concrete design mixtures.
- c. Ready-mix concrete manufacturer.
- d. Concrete Subcontractor.
- e. Special concrete finish Subcontractor.

2. Review the following:

- a. Special inspection and testing and inspecting agency procedures for field quality control.
- b. Doweled joints.
- c. Concrete finishes and finishing.
- d. Curing procedures.
- e. Shoring.
- f. Methods for achieving specified floor and slab flatness and levelness.
- g. Floor and slab flatness and levelness measurements.

- h. Concrete repair procedures.
- i. Concrete protection.

1.4 ACTION SUBMITTALS

A. Product Data: For each of the following.

- 1. Fly ash.
- 2. Slag cement.
- 3. Blended hydraulic cement.
- 4. Silica fume.
- 5. Aggregates.
- 6. Admixtures:
 - a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
- 7. Fiber reinforcement.
- 8. Curing materials.
- 9. Repair materials.

B. Design Mixtures: For each concrete mixture, include the following:

- 1. Mixture identification.
- 2. Minimum 28-day compressive strength.
- 3. Maximum w/cm.
- 4. Calculated equilibrium unit weight, for lightweight concrete.
- 5. Slump limit.
- 6. Air content.
- 7. Nominal maximum aggregate size.
- 8. Synthetic micro-fiber content.
- 9. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
- 10. Intended placement method.
- 11. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:

- 1. Ready-mixed concrete manufacturer.

B. Material Certificates: For each of the following, signed by manufacturers:

- 1. Cementitious materials.
- 2. Admixtures.

3. Fiber reinforcement.
4. Bonding agents.
5. Chemical adhesives.
6. Repair materials.

C. Material Test Reports: For the following, from a qualified testing agency:

1. Fly ash.
2. Slag cement.
3. Blended hydraulic cement.
4. Silica fume.
5. Aggregates.

D. Research Reports:

1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.

E. Preconstruction Test Reports: For each mix design.

1.6 QUALITY ASSURANCE

A. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.

1. Personnel performing laboratory tests to be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor to be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.

1. Include the following information in each test report:
 - a. Admixture dosage rates.
 - b. Slump.
 - c. Air content.
 - d. Seven-day compressive strength.
 - e. 28-day compressive strength.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C94/C94M and ACI 301.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

- A. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
3. Obtain aggregate from single source.
4. Obtain each type of admixture from single source from single manufacturer.

- B. Cementitious Materials:

1. Fly Ash: ASTM C618, Class C or F.
2. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
3. Blended Hydraulic Cement: ASTM C595/C595M, Type IS portland blast-furnace slag, Type IP portland-pozzolan, Type IL portland-limestone, or Type IT ternary blended cement.
4. Silica Fume: ASTM C1240 amorphous silica.

- C. Lightweight Aggregate: ASTM C330/C330M, 3/8-inch nominal maximum aggregate size.

- D. Air-Entraining Admixture: ASTM C260/C260M.

- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
4. Mid-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type A or Type F. Water content reduction to be greater than 7%.
5. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
6. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
7. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

- F. Water and Water Used to Make Ice: ASTM C94/C94M, potable

2.3 FIBER REINFORCEMENT

- A. Synthetic Macro-Fiber: Polyolefin macro-fibers (containing no reprocessed olefin materials) engineered and designed for use as secondary reinforcing in concrete, complying with ASTM C 1116/C 1116M, Type III, 1 1/4 to 2-1/4 inches long, varying fiber thickness, and no water absorption.

2.4 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- B. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
- C. Water: Potable or complying with ASTM C1602/C1602M.

2.5 RELATED MATERIALS

- A. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- B. Chemical Anchor Adhesives: Heavy duty, two component injectable adhesive designed to be dispensed using double chamber gun with mixing nozzle. Adhesives in capsule form will not be accepted.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hilti, Inc.; Hit-HY 200; Hit-Ice
 - b. ITW Redhead; Epcon C6.
 - c. DeWalt Anchors and Fasteners, Inc.; AC100+ Gold.

2.6 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4100 psi at 28 days when tested in accordance with ASTM C109/C109M.

2.7 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.
 - 1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
- B. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
 - 1. Use water-reducing high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use a mid-range water-reducing admixture in pumped concrete.

2.8 CONCRETE MIXTURES

- A. Structural lightweight concrete used for interior suspended slabs.
 - 1. Exposure Class: ACI 318 F0.
 - 2. Minimum Compressive Strength: 3000 psi at 28 days.
 - 3. Calculated Equilibrium Unit Weight: 110 lb/cu. ft., plus or minus 3 lb/cu. ft. as determined by ASTM C567/C567M.
 - 4. Slump Limit: 8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture at Project site.
 - 5. Air Content:
 - a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
 - 6. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
 - 7. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of 4.0 lb/cu. yd..

2.9 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M and ASTM C1116/C1116M, and furnish batch ticket information.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions:

1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:
 1. Daily access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
 4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.
 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.

3.4 JOINTS

- A. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- B. Doweled Joints:
 1. Install dowel bars and support assemblies at joints where indicated on Drawings.

3.5 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of reinforcement and embedded items is complete and that required inspections are completed.
- B. Notify Engineer and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.

1. With each concrete mixture submittal, indicate amounts of mixing water to be withheld for later addition at Project site.
 2. Water added must not increase the water-cement ratio past the approved mix design ratio.
 3. Add additional water reducer or plasticizer to mix instead of adding water to achieve flowable, workable concrete. Do not add water to concrete after adding these admixtures to mixture.
 4. Do not add water after truck is more than half empty.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
1. If a section cannot be placed continuously, provide construction joints as indicated.
 2. Deposit concrete to avoid segregation.
 3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
 - a. Do not use vibrators to transport concrete inside forms.
 - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
 - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
 - d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Do not place concrete floors and slabs in a checkerboard sequence.
 2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 3. Maintain reinforcement in position on chairs during concrete placement.
 4. Screed slab surfaces with a straightedge and strike off to correct elevations.
 5. Level concrete, cut high areas, and fill low areas.
 6. Slope surfaces uniformly to drains where required.
 7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
 8. Do not further disturb slab surfaces before starting finishing operations.

3.6 FINISHING FLOORS AND SLABS

- A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Float Finish:

1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
2. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
3. Apply float finish to surfaces to receive trowel finish.

C. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface.
5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
6. Apply a trowel finish to surfaces to be covered with resilient flooring.
7. Finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor surface:

a. Suspended Slabs:

- 1) Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch.

3.7 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:

1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

3.8 CONCRETE CURING

A. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:

1. Begin curing immediately after finishing concrete.
2. Interior Concrete Floors:
 - a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:

- 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12 inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
- 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.

3.9 TOLERANCES

- A. Conform to ACI 117.

3.10 CONCRETE SURFACE REPAIRS

- A. Defective Concrete:

1. Repair and patch defective areas when approved by Engineer.
2. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.

- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

- C. Repairing Unformed Surfaces:

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
 - a. Correct low and high areas.
 - b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.
 - a. Finish repaired areas to blend into adjacent concrete.

5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
 - a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - b. Feather edges to match adjacent floor elevations.
 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.
 - a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
 - b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
 - c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
 - d. Place, compact, and finish to blend with adjacent finished concrete.
 - e. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.
 - a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
 - b. Dampen cleaned concrete surfaces and apply bonding agent.
 - c. Place patching mortar before bonding agent has dried.
 - d. Compact patching mortar and finish to match adjacent concrete.
 - e. Keep patched area continuously moist for at least 72 hours.
- D. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.
- E. Repair materials and installation not specified above may be used, subject to Engineer's approval.

3.11 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.
- B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
 1. Testing agency to be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
 2. Testing agency to immediately report to Engineer, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
 3. Testing agency to report results of tests and inspections, in writing, to Owner, Engineer, Contractor, and concrete manufacturer within 48 hours of inspections and tests.

- a. Test reports to include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
 - 1) Project name.
 - 2) Name of testing agency.
 - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
 - 4) Name of concrete manufacturer.
 - 5) Date and time of inspection, sampling, and field testing.
 - 6) Date and time of concrete placement.
 - 7) Location in Work of concrete represented by samples.
 - 8) Date and time sample was obtained.
 - 9) Truck and batch ticket numbers.
 - 10) Design compressive strength at 28 days.
 - 11) Concrete mixture designation, proportions, and materials.
 - 12) Field test results.
 - 13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
 - 14) Type of fracture and compressive break strengths at seven days and 28 days.
- C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.
- D. Inspections:
 1. Headed bolts and studs.
 2. Verification of use of required design mixture.
 3. Concrete placement, including conveying and depositing.
 4. Curing procedures and maintenance of curing temperature.
 5. Verification of concrete strength before removal of shores and forms from beams and slabs.
 6. Batch Plant Inspections: On a random basis, as determined by Engineer.
- E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M to be performed in accordance with the following requirements:
 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C143/C143M:

- a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - b. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C173/C173M volumetric method, for structural lightweight concrete.
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C1064/C1064M:
 - a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
5. Unit Weight: ASTM C567/C567M fresh unit weight of structural lightweight concrete.
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
6. Compression Test Specimens: ASTM C31/C31M:
 - a. Cast and laboratory cure six (6) cylinder specimens 6-inch by 12-inch or 4-inch by 8-inch cylinder specimens for each composite sample.
7. Compressive-Strength Tests: ASTM C39/C39M.
 - a. Test two standard cured specimens at 7 days, three specimens at 28 days, and retain one specimen for testing at 56 days as deemed necessary by Engineer.
 - b. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
10. Additional Tests:
 - a. Testing and inspecting agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer.
 - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Engineer.

- 1) Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.6.6.3.
11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION 033000

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural-steel materials.
2. Shear stud connectors.

B. Related Requirements:

1. Section 053100 "Steel Decking" for field installation of shear stud connectors through deck.

1.2 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

1.3 COORDINATION

- A. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data:

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Shear stud connectors.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.

3. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and fabricator.
- B. Welding certificates.
- C. Mill test reports for structural-steel materials, including chemical and physical properties.
- D. Product Test Reports: For the following:
 1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
 2. Shear stud connectors.
- E. Survey of existing conditions.

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD is preferred. At least 10 projects completed of a similar size and scope to Project.
- B. Installer Qualifications: At least 10 projects completed of similar size and scope.
- C. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the following specifications and documents:
 - 1. ANSI/AISC 303.
 - 2. ANSI/AISC 360.
 - 3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- B. Connection Design Information:
 - 1. Fabricator's experienced steel detailer selects or completes connections in accordance with ANSI/AISC 303.
 - a. Select and complete connections using ANSI/AISC 360.

2.2 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A992/A992M.
- B. Angles, Plate and Bar: ASTM A36/A36M.
- C. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

- A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
- B. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

2.4 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
 - 1. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
 - 2. Mark and match-mark materials for field assembly.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 2.
- E. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.
- F. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 - 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.5 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

PART 3 - EXECUTION

3.1 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.
- B. Maintain erection tolerances of structural steel within ANSI/AISC 303.
- C. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- D. Splice members only where indicated.

- E. Do not use thermal cutting during erection.
- F. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.2 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
- C. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:
 - 1. Verify structural-steel materials and inspect steel frame joint details.
 - 2. Verify weld materials and inspect welds.
 - 3. Verify connection materials and inspect high-strength bolted connections.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
 - 1. Bolted Connections: Inspect bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 - 2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.
 - 3. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - b. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

END OF SECTION 051200

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Composite floor deck.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for lightweight structural concrete fill over steel deck.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Composite floor deck.

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Test and Evaluation Reports:

1. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
 - a. Power-actuated mechanical fasteners.
2. Research Reports: For steel deck, from ICC-ES showing compliance with the building code.

D. Qualification Statements: For welding personnel.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with SDI QA/QC and the following welding codes:
 - 1. AWS D1.1/D1.1M.
 - 2. AWS D1.3/D1.3M.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Store products in accordance with SDI MOC3. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck in accordance with AISI S100.

2.2 COMPOSITE FLOOR DECK

- A. Fabrication of Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with SDI C, with the minimum section properties indicated, and with the following:
 - 1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33, G60 zinc coating.
 - 2. Profile Depth: 1-1/2 inches.
 - 3. Design Uncoated-Steel Thickness: 0.0598 inch.
 - 4. Span Condition: Triple span or more.

2.3 ACCESSORIES

- A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- G. Galvanizing Repair Paint: ASTM A780/A780M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories in accordance with SDI C, SDI NC, and SDI RD, as applicable; manufacturer's written instructions; and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install in accordance with deck manufacturer's written instructions.
- J. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

3.3 INSTALLATION OF FLOOR DECK

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
 - 1. Weld Diameter: 3/4 inch, nominal.
 - 2. Weld Spacing:
 - a. Weld edge ribs of panels at each support. Space additional welds an average of 16 inches apart, but not more than 18 inches apart.
 - b. Space and locate welds as indicated.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 36 inches, and as follows:
 - 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
 - 2. Mechanically clinch or button punch.
 - 3. Fasten with a minimum of 1-1/2-inch-long welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Lapped or butted at Contractor's option.
- D. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, in accordance with SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.4 REPAIR

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint in accordance with ASTM A780/A780M and manufacturer's written instructions.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
 - 1. Special inspections and qualification of welding special inspectors for cold-formed steel floor and roof deck in accordance with quality-assurance inspection requirements of SDI QA/QC.
 - a. Field welds will be subject to inspection.
 - 2. Steel decking will be considered defective if it does not pass tests and inspections.

3. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded shear connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors that are already tested.
- C. Prepare test and inspection reports.

END OF SECTION 053100

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Miscellaneous framing and supports.
2. Miscellaneous steel trim.

1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Fasteners.
2. Shop primers.

B. Shop Drawings: Show fabrication and installation details. Provide Shop Drawings for the following:

1. Miscellaneous framing and supports for applications where framing and supports are not specified in other Sections.

1.4 INFORMATIONAL SUBMITTALS

- A. Mill Certificates: Signed by stainless steel manufacturers, certifying that products furnished comply with requirements.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - 3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Stainless Steel Sheet, Strip, and Plate: ASTM A240/A240M or ASTM A666, Type 304.
- D. Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 304.
- E. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.
- F. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.
- G. Aluminum Plate and Sheet: ASTM B209, Alloy 6061-T6.
- H. Aluminum Extrusions: ASTM B221, Alloy 6063-T6.
- I. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.
- J. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.

2.2 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - 1. Provide stainless steel fasteners for fastening aluminum or stainless steel.

- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.
- C. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593; with hex nuts, ASTM F594; and, where indicated, flat washers; Alloy Group 1.
- D. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.
- E. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.
- F. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.
- G. Post-Installed Anchors: Torque-controlled expansion anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

2.3 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that comply with Section 099123 "Interior Painting."

2.4 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

2.5 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
- C. Prime miscellaneous framing and supports with where indicated.

2.6 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- C. Prime miscellaneous steel trim.

2.7 GENERAL FINISH REQUIREMENTS

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.8 STEEL AND IRON FINISHES

- A. Shop prime iron and steel items unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 - 1. Shop prime with primers specified in Section 099123 "Interior Painting" unless indicated.
- B. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
- C. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.9 ALUMINUM FINISHES

- A. As-Fabricated Finish: AA-M12.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
 - 1. Cast Aluminum: Heavy coat of bituminous paint.
 - 2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

3.3 INSTALLATION OF MISCELLANEOUS STEEL TRIM

- A. Anchor to concrete construction to comply with manufacturer's written instructions.

3.4 REPAIRS

- A. Touchup Painting:
 - 1. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099123 "Interior Painting."

END OF SECTION 055000

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood products.
2. Fire-retardant-treated lumber.
3. Dimension lumber framing.

1.2 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal (38 mm actual) size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) size or greater but less than 5 inches nominal (114 mm actual) size in least dimension.
- C. Exposed Framing: Framing not concealed by other construction.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
 3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency in accordance with ASTM D5664.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates:

1. For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS

- A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
 - 3. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content:
 - 1. Boards: **[15]** percent.
 - 2. Dimension Lumber: **[15 percent for 2-inch nominal (38-mm actual) thickness or less]** unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWP A U1, Use categories as follows:
 - 1. UC2: Interior construction not in contact with ground but may be subject to moisture. Include **[all rough carpentry.]**
 - a. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.

2.3 FIRE-RETARDANT-TREATED LUMBER

- A. General: Where fire-retardant-treated materials are indicated, materials are to comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested in accordance with ASTM E84, and with no evidence of

significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Treatment is not to promote corrosion of metal fasteners.
 2. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested in accordance with ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
- C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent.[**Kiln-dry plywood after treatment to maximum moisture content of 15 percent.**]
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency and other information required by authorities having jurisdiction.
- E. Application: Treat [**all rough carpentry unless otherwise indicated.**]
1. Concealed blocking.
 2. Framing for non-load-bearing partitions.
 3. Wood cants, nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing.

2.4 DIMENSION LUMBER FRAMING

- A. Non-Load-Bearing Interior Partitions by Grade: [**Construction or No. 2**] grade.
1. Application: [**All interior partitions**].
 2. Species:
 - a. Hem-fir (north); NLGA.
 - b. Southern pine or mixed southern pine; SPIB.
 - c. Spruce-pine-fir; NLGA.
 - d. Hem-fir; WCLIB, or WWPA.
 - e. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
 - f. Northern species; NLGA.
 - g. Eastern softwoods; NeLMA.
 - h. Western woods; WCLIB or WWPA.

2.5 FASTENERS

- A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches (38 mm) into wood substrate.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

- D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on [ICC-ES AC01] [ICC-ES AC58] [ICC-ES AC193] [or] [ICC-ES AC308] as appropriate for the substrate.

2.6 MISCELLANEOUS MATERIALS

- A. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate [furring,]nailers, blocking, [grounds,]and similar supports to comply with requirements for attaching other construction.
- C. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- D. Do not splice structural members between supports unless otherwise indicated.
- E. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
 - 1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches (2438 mm) o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
 - 2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches (2438 mm) o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal (38-mm actual) thickness.
 - 3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. (9.3 sq. m) and to solidly fill space below partitions.
- F. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- G. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.10.1, "Fastening Schedule," in ICC's International Building Code (IBC).

- H. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 INSTALLATION OF WOOD BLOCKING AND NAILERS

- A. Install where indicated and where required for **[screeding or]** attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach wood blocking to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

3.3 INSTALLATION OF WALL AND PARTITION FRAMING

- A. General: Provide single bottom plate and double top plates using members of 2-inch nominal (38-mm actual) thickness whose widths equal that of studs, except single top plate may be used for non-load-bearing partitions. Fasten plates to supporting construction unless otherwise indicated.
 1. For interior partitions and walls, provide **[2-by-6-inch nominal- (38-by-140-mm actual-)]** o.c. unless otherwise indicated.
 2. Provide continuous horizontal blocking at midheight of partitions more than 96 inches (2438 mm) high, using members of 2-inch nominal (38-mm actual) thickness and of same width as wall or partitions.
- B. Construct corners and intersections with three or more studs[, **except that two studs may be used for interior non-load-bearing partitions**].
- C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.
 1. For non-load-bearing partitions, provide double-jamb studs and headers not less than 4-inch nominal (89-mm actual) depth for openings 48 inches (1200 mm) and less in width, 6-inch nominal (140-mm actual) depth for openings 48 to 72 inches (1200 to 1800 mm) in width, 8-inch nominal (184-mm actual) depth for openings 72 to 120 inches (1800 to 3000 mm) in width, and not less than 10-inch nominal (235-mm actual) depth for openings 10 to 12 feet (3 to 3.6 m) in width.

END OF SECTION 061000

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Mineral-wool blanket insulation.
- B. Related Requirements:
 - 1. **Section 092900 "Gypsum Board"** for sound attenuation blanket used as acoustic insulation.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Mineral-wool blanket insulation.

1.3 INFORMATIONAL SUBMITTALS

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indexes less than **25 and 450** when tested in accordance with ASTM E84.
- B. Fire-Resistance Ratings: Comply with ASTM E119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory."
- C. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.2 MINERAL-WOOL BLANKET INSULATION

- A. Mineral-Wool Blanket Insulation, Unfaced, ASTM C665, Type I (blankets without membrane facing); consisting of fibers; passing ASTM E136 for combustion characteristics.

2.3 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
- B. Insulation Standoff: Spacer fabricated from galvanized mild-steel sheet for fitting over spindle of insulation anchor to maintain air space of **1 inch (25 mm)** between face of insulation and substrate to which anchor is attached.
- C. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Install insulation with manufacturer's R-value label exposed after insulation is installed.
- D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. For wood-framed construction, install blankets in accordance with ASTM C1320 and as follows:
 - a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.

3.4 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.
- B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 078100 - APPLIED FIRE PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sprayed fire-resistive materials.

1.2 DEFINITIONS

A. SFRM: Sprayed fire-resistive materials.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review products, design ratings, restrained and unrestrained conditions, densities, thicknesses, bond strengths, and other performance requirements.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Sprayed fire-resistive materials.
2. Substrate primers.
3. Bonding agent.

B. Shop Drawings: Framing plans or schedules, or both, indicating the following:

1. Extent of fire protection for each construction and fire-resistance rating.
2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
3. Minimum sprayed fire-resistive material thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of sprayed fire-resistive material.

C. Evaluation Reports: For sprayed fire-resistive material, from ICC-ES.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by sprayed fire-resistive material manufacturer as experienced and with sufficient trained staff to install manufacturer's products in accordance with specified requirements.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply fire protection when ambient or substrate temperature is 44 deg F or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.
- B. Ventilation: Ventilate building spaces during and after application of fire protection, providing complete air exchanges in accordance with manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fire protection dries thoroughly.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Assemblies: Provide fire protection, including auxiliary materials, in accordance with requirements of each fire-resistance design and manufacturer's written instructions.
- B. Source Limitations: Obtain fire protection from single source.
- C. Fire-Resistance Design: Indicated on Drawings, tested in accordance with ASTM E119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Steel members are to be considered unrestrained unless specifically noted otherwise.
- D. Asbestos: Provide products containing no detectable asbestos.

2.2 SPRAYED FIRE-RESISTIVE MATERIALS

- A. Sprayed Fire-Resistive Material: Manufacturer's standard, factory-mixed, lightweight, dry formulation, complying with indicated fire-resistance design, and conveyed in a dry state and mixed with atomized water at place of application.
 - 1. Manufacturers: Subject to compliance with requirements, provide the following:
 - a. Cafco Blaze-Shield II/Isolatek Type II.
 - 2. Bond Strength: Minimum 150-lbf/sq. ft. cohesive and adhesive strength based on field testing in accordance with ASTM E736.
 - 3. Density: Not less than density specified in the approved fire-resistance design, in accordance with ASTM E605.

4. Thickness: As required for fire-resistance design indicated, measured in accordance with requirements of fire-resistance design or ASTM E605, whichever is thicker, but not less than 0.375 inch.
5. Combustion Characteristics: ASTM E136.
6. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 10 or less.
 - b. Smoke-Developed Index: 10 or less.
7. Compressive Strength: Minimum 10 lbf/sq. in. in accordance with ASTM E761.
8. Corrosion Resistance: No evidence of corrosion in accordance with ASTM E937.
9. Deflection: No cracking, spalling, or delamination in accordance with ASTM E759.
10. Effect of Impact on Bonding: No cracking, spalling, or delamination in accordance with ASTM E760.
11. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. in 24 hours in accordance with ASTM E859.
12. Fungal Resistance: Treat products with manufacturer's standard antimicrobial formulation to result in no growth on specimens per ASTM G21.
13. Sound Absorption: NRC of 0.65 to 0.75 in accordance with ASTM C423 for Type A mounting in accordance with ASTM E795.
14. Finish: Spray-textured finish.

2.3 AUXILIARY MATERIALS

- A. Provide auxiliary materials that are compatible with sprayed fire-resistive material and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.
- B. Substrate Primers: Primers approved by sprayed fire-resistive material manufacturer and complying with one or both of the following requirements:
 1. Primer and substrate are identical to those tested in required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 2. Primer's bond strength in required fire-resistance design complies with specified bond strength for sprayed fire-resistive material and with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction, based on a series of bond tests in accordance with ASTM E736.
- C. Bonding Agent: Product approved by sprayed fire-resistive material manufacturer and complying with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and in accordance with each fire-resistance design.
 - 1. Verify that substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fire protection with substrates under conditions of normal use or fire exposure.
 - 2. Verify that objects penetrating fire protection, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
 - 3. Verify that substrates receiving fire protection are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fire protection application.
- B. Verify that concrete work on steel deck is complete before beginning Work.
- C. Conduct tests in accordance with sprayed fire-resistive material manufacturer's written instructions to verify that substrates are free of substances capable of interfering with bond.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Cover other work subject to damage from fallout or overspray of fire protection materials during application.
- B. Clean substrates of substances that could impair bond of fire protection.
- C. Prime substrates where included in fire-resistance design and where recommended in writing by sprayed fire-resistive material manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fire protection.
- D. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fire protection. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

3.3 APPLICATION

- A. Construct fire protection assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, sealers, topcoats, finishing, and other materials and procedures affecting fire protection Work.
- B. Comply with sprayed fire-resistive material manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fire protection; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.
- C. Coordinate application of fire protection with other construction to minimize need to cut or remove fire protection.
 - 1. Do not begin applying fire protection until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.
 - 2. Defer installing ducts, piping, and other items that would interfere with applying fire protection until application of fire protection is completed.
- D. Install auxiliary materials as required, as detailed, and in accordance with fire-resistance design and sprayed fire-resistive material manufacturer's written instructions for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by sprayed fire-resistive material manufacturer.
- E. Spray apply fire protection to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by sprayed fire-resistive material manufacturer.
- F. Extend fire protection in full thickness over entire area of each substrate to be protected.
- G. Install body of fire protection in a single course unless otherwise recommended in writing by sprayed fire-resistive material manufacturer.
- H. For applications over encapsulant materials, including lockdown (post-removal) encapsulants, apply fire protection that differs in color from that of encapsulant over which it is applied.
- I. Where sealers are used, apply products that are tinted to differentiate them from fire protection over which they are applied.
- J. Provide a uniform finish complying with description indicated for each type of fire protection material and matching finish approved for required mockups.
- K. Cure fire protection in accordance with sprayed fire-resistive material manufacturer's written instructions.
- L. Do not install enclosing or concealing construction until after fire protection has been applied, inspected, and tested and corrections have been made to deficient applications.
- M. Finishes: Where indicated, apply fire protection to produce the following finishes:

1. Manufacturer's Standard Finishes: Finish in accordance with manufacturer's written instructions for each finish selected.
2. Spray-Textured Finish: Finish left as spray applied with no further treatment.
3. Rolled, Spray-Textured Finish: Even finish produced by rolling spray-applied finish with a damp paint roller to remove drippings and excessive roughness.
4. Skip-Troweled Finish: Even leveled surface produced by troweling spray-applied finish to smooth out the texture and neaten edges.
5. Skip-Troweled Finish with Corner Beads: Even, leveled surface produced by troweling spray-applied finish to smooth out the texture, eliminate surface markings, and square off edges.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 1. Test and inspect as required by the IBC, Subsection 1705.14, "Sprayed Fire-Resistant Materials."
- B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fire protection for the next area until test results for previously completed applications of fire protection show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.
- C. Fire protection will be considered defective if it does not pass tests and inspections.
 1. Remove and replace fire protection that does not pass tests and inspections, and retest.
 2. Apply additional fire protection, in accordance with manufacturer's written instructions, where test results indicate insufficient thickness, and retest.
- D. Prepare test and inspection reports.

3.5 CLEANING

- A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

3.6 PROTECTION

- A. Protect fire protection, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fire protection is without damage or deterioration at time of Substantial Completion.

3.7 REPAIRS

- A. As installation of other construction proceeds, inspect fire protection and repair damaged areas and fire protection removed due to work of other trades.
- B. Repair fire protection damaged by other work before concealing it with other construction.
- C. Repair fire protection by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION 078100

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Urethane joint sealants.
2. Mildew-resistant joint sealants.
3. Butyl joint sealants.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Urethane joint sealants.
2. Mildew-resistant joint sealants.
3. Butyl joint sealants.

B. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Manufacturers' special warranties.
- B. Installer's special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Authorized representative who is trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified in accordance with ASTM C1021 to conduct the testing indicated.

1.7 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.8 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 - 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - 2. Disintegration of joint substrates from causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 URETHANE JOINT SEALANTS

- A. Urethane, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

2.3 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

2.4 BUTYL JOINT SEALANTS

- A. Butyl-Rubber-Based Joint Sealants: ASTM C1311.

2.5 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin), Type O (open-cell material), Type B (bicellular material with a surface skin), or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.6 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Masonry.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.

- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants in accordance with requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

3.4 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior standard steel doors and frames.
2. Interior custom hollow-metal doors and frames.

B. Related Requirements:

1. **Section 087100 "Door Hardware"** for door hardware for hollow-metal doors.

1.2 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings in accordance with NAAMM-HMMA 803 or ANSI/SDI A250.8.

1.3 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Interior standard steel doors and frames.

B. Product Data Submittals: For each product.

1. Include construction details, material descriptions, core descriptions, **fire-resistance ratings**, and finishes.

C. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.

6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
7. Details of anchorages, joints, field splices, and connections.
8. Details of accessories.
9. Details of moldings, removable stops, and glazing.

1.5 CLOSEOUT SUBMITTALS

- A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
 1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings **and temperature-rise limits** indicated on Drawings, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.

2.2 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Standard-Duty Doors and Frames: ANSI/SDI A250.8, Level 1; ANSI/SDI A250.4, Level C. **At locations indicated in the Door and Frame Schedule on Drawing.**
 1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule on Drawings.
 - b. Thickness: **[1-3/4 inches (44.5 mm)]**

2. Frames:
 - a. Materials: **Metallic-coated** steel sheet, minimum thickness of 0.042 inch (1.0 mm).
 - b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
3. Exposed Finish: Factory

2.3 FRAME ANCHORS

- A. Jamb Anchors:
 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches (610 mm) of frame height above 7 feet (2.1 m).
 3. Postinstalled Expansion Anchor: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at top of underlayment.
- D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
 1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.

2.4 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.
- E. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

2.5 FABRICATION

- A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
 - 1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding[, **or by rigid mechanical anchors**].
 - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
 - 4. Terminated Stops (Hospital Stops): Terminate stops [**6 inches (152 mm)**] **<Insert dimension>** above finish floor with a [**45**] [**90**]-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.
- B. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with ANSI/SDI A250.6, the Door Hardware Schedule on Drawings, and templates.
 - 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 - 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

2.6 STEEL FINISHES

- A. Factory Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, complying with ANSI/SDI A250.3.
 - 1. Color and Gloss: **As indicated by manufacturer's designations.**

PART 3 - EXECUTION

3.1 PREPARATION

- A. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

- A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.
- B. Hollow-Metal Frames: Comply with **NAAMM-HMMA 840**.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
 - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
 - b. Install frames with removable stops located on secure side of opening.
 - 2. Fire-Rated Openings: Install frames in accordance with NFPA 80.
 - 3. Floor Anchors: Secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 - 4. Solidly pack mineral-fiber insulation inside frames.
 - 5. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. **Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.**
 - 6. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.
- C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
 - 1. Non-Fire-Rated Steel Doors: Comply with **NAAMM-HMMA 841 and NAAMM-HMMA guide specification indicated**.
 - 2. Fire-Rated Doors: Install doors with clearances in accordance with NFPA 80.
 - 3. Smoke-Control Doors: Install doors in accordance with NFPA 105.

3.3 REPAIR

- A. with same material used for factory finish in accordance with manufacturer's written instructions.

- B. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

SECTION 081816.13 - SLIDING ALUMINUM-FRAMED GLASS DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior sliding aluminum-framed glass doors.

B. Related Requirements:

1. [Section 087100 "Door Hardware"] for hardware not specified in Section 081816.13.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Cornell University.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Interior sliding aluminum-framed glass doors.

B. Product Data Submittals: For each product.

1. Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions.

C. Shop Drawings: For sliding aluminum-framed glass doors.

1. Include plans, elevations, sections, and details.
2. Detail attachments to other work, and between units, if any.
3. Include hardware and required clearances.

D. Product Schedule: For sliding aluminum-framed glass doors. [Use same designations indicated on Drawings.]

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each sliding aluminum-framed glass door, for tests performed by [a **qualified testing agency**], and for each class and performance grade indicated, tested at AAMA gateway size.

- B. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes, weather stripping, operable panels, and operating hardware to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer capable of fabricating sliding aluminum-framed glass doors that meet or exceed performance requirements indicated and of documenting this performance by inclusion in lists and by labels, test reports, and calculations.
- B. Installer Qualifications: An installer acceptable to sliding aluminum-framed glass door manufacturer for installation of units required for this Project.
- C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockup for sliding aluminum-framed glass doors, as indicated on Drawings.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace components of sliding aluminum-framed glass doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure to meet performance requirements.
 - b. Structural failures including excessive deflection.
 - c. Excessive water leakage or air infiltration.
 - d. Faulty operation of movable panels and hardware.
 - e. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Warranty Period:
 - a. Sliding Door: [**Five**] years from date of Substantial Completion.
 - b. Laminated Glass: [**Five**] years from date of Substantial Completion.
 - c. Aluminum Finish: [**Five**] years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
 - 1. Product Certification: AAMA certified with label attached to each door.
- B. Thermal Movements: Provide sliding aluminum-framed glass doors, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
- C. Sound Transmission Class (STC): Rated for not less than [28] STC when tested for laboratory sound transmission loss in accordance with ASTM E90 and determined by ASTM E413.

2.2 INTERIOR SLIDING ALUMINUM-FRAMED GLASS DOORS

- A. Source Limitations: Obtain sliding aluminum-framed glass doors from single source from single manufacturer.
- B. Frames and Door Panels: Fabricated from aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.
 - 1. Thermally Improved Construction: Fabricate frames and door panels with an integral, concealed, low-conductance thermal barrier located between exterior and interior surfaces in a manner that eliminates direct metal-to-metal contact.
- C. Threshold and Sill Cap/Track: Provide extruded-aluminum threshold and track of thickness, dimensions, and profile indicated; designed to comply with performance requirements indicated with manufacturer's standard finish.
 - 1. Low-Profile Floor Track: ADA-ABA compliant.

2.3 GLAZING

- A. Glass and Glazing: Manufacturer's standard glazing system that produces weathertight seal.
 - 1. Glass: ASTM C1036, Type 1, q3, Category II safety glass complying with testing requirements in 16 CFR 1201.
 - 2. Safety Glazing Labeling: Permanently mark safety glazing with certification label of [the SGCC] . Label must indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
 - 3. Tint: [Clear]

2.4 HARDWARE

- A. General: Provide manufacturer's standard hardware, fabricated from a corrosion-resistant material compatible with aluminum complying with AAMA 907 and designed to smoothly operate, tightly close, and securely lock sliding aluminum-framed glass doors.
- B. Door Pulls: Provide manufacturer's standard pull.
 - 1. Color and Finish: [**Match door frame**]
- C. Lock: Install manufacturer's keyed cylinder lock and locking device on each movable panel, lockable from the inside [**and outside**]. Adjust locking device to allow unobstructed movement of the panel across adjacent panel in the direction indicated.

2.5 ACCESSORIES

- A. Fasteners: Noncorrosive and compatible with door members, trim, hardware, anchors, and other components.
 - 1. Exposed Fasteners: Do not use exposed fasteners to the greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.
- B. Anchors, Clips, and Accessories: Provide anchors, clips, and accessories of aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron for sliding aluminum-framed glass doors, complying with ASTM B456 or ASTM B633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

2.6 FABRICATION

- A. Fabricate sliding aluminum-framed glass doors in sizes indicated. Include a complete system for assembling components and anchoring doors.
- B. Fabricate sliding aluminum-framed glass doors that are reglazable without dismantling panel framing.
- C. Weather Stripping: Provide full-perimeter weather stripping for each door panel.
- D. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.
- E. Factory-Glazed Fabrication: Glaze sliding aluminum-framed glass doors in the factory where practical and possible for applications indicated. Comply with requirements in Section 088000 "Glazing" and with AAMA/WDMA/CSA 101/I.S.2/A440.

2.7 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify rough opening dimensions, levelness of threshold substrate, and operational clearances.
- C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weathertight sliding aluminum-framed glass door installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing doors, hardware, accessories, and other components.
- B. Windborne-Debris Resistance: Anchor sliding aluminum-framed glass doors that have been tested for windborne-debris resistance to structure using anchoring method, fastener type, and fastening frequency identical to that used in windborne-debris resistance testing.
- C. Install sliding aluminum-framed glass doors level, plumb, square, true to line, without distortion, without warp or rack of frames and panels, and without impeding thermal movement; anchored securely in place to structural support; and in proper relation to wall flashing, vapor retarders, air barriers, water/weather barriers, and other adjacent construction.
- D. Set sill members in bed of sealant or with gaskets, as indicated, to provide weathertight construction.
- E. Install sliding aluminum-framed glass doors and components to drain condensation, water penetrating joints, and moisture migrating within doors to the exterior.
- F. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. Lubricate hardware and moving parts.
- B. Adjust operating panels and screens to provide a tight fit at contact points and weather stripping for smooth operation, without binding, and a weathertight closure. Adjust hardware for proper alignment, smooth operation, and proper latching without unnecessary force or excessive clearance.
- C. Clean exposed surfaces immediately after installing sliding aluminum-framed glass doors. Avoid damaging protective coatings and finishes. Remove nonpermanent labels, excess sealants, glazing materials, dirt, and other substances.
- D. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- E. Protect sliding aluminum-framed glass door surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances contact sliding aluminum-framed glass door surfaces, remove contaminants immediately in accordance with manufacturer's written instructions.
- F. Refinish or replace sliding aluminum-framed glass doors with damaged finishes.
- G. Replace damaged components.

END OF SECTION 081816.13

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hinges.
2. Continuous, gear-type hinges.
3. Surface bolts and manual flush bolts.
4. Lock cylinders.
5. Door closers
6. Door stops.
7. Architectural seals.
8. Thresholds.
9. Sliding door hardware.

B. Related Requirements:

1. Section 081113 "Hollow Metal Doors and Frames" **for astragals provided as part of labeled fire-rated assemblies.**

1.2 COORDINATION

- A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- B. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- C. to existing construction or where modifications to existing door hardware are required, field-verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Hinges.
2. Continuous, gear-type hinges.
3. Surface bolts and manual flush bolts.
4. Lock cylinders.
5. Door closers
6. Door stops.
7. Architectural seals..

8. Thresholds.
9. Sliding door hardware.

B. Product Data Submittals: For each product.

1. Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

C. Door Hardware Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant. Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item
 - b. Manufacturer of each item.
 - c. Fastenings and other installation information.
 - d. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - e. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials
 - h. Warranty information for each product.

D. Keying Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of door hardware to include in maintenance manuals.
- B. Schedules: Final **[door hardware]** **[and]** **[keying]** schedule.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

- B. Continuing Service: Beginning at Substantial Completion, and running concurrent with the specified warranty period, provide continuous (6) months full maintenance including repair and replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door opening operation. Provide parts and supplies as used in the manufacture and installation of original products.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lockup for door hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including excessive deflection, cracking, or breakage.
 - b. Faulty operation of doors and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 - 2. Warranty Period: **[One]** year from date of Substantial Completion unless otherwise indicated below:
 - a. Electromagnetic and Delayed-Egress Locks: **[Two]** years from date of Substantial Completion.
 - b. Exit Devices: **[Five]** years from date of Substantial Completion.
 - c. Manual Closers: **[10]** years from date of Substantial Completion.
 - d. Mortise locks and latches: **[10]** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
- B. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

- C. Accessibility Requirements: For door hardware on doors in an accessible route, comply with [ICC A117.1]
1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
 2. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
 - b. Sliding or Folding Doors: 5 lbf applied parallel to door at latch.
 - c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
 4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.
 5. Adjust spring hinges so that, from an open position of 70 degrees, the door will take at least 1.5 seconds to move to the closed position.

2.2 HINGES

- A. Hinges: ANSI/BHMA A156.1. certified butt hinges
1. Quantity: Provide the following hinge quantity, unless otherwise indicated:
 - a. Three Hinges: For doors with heights 61 to 90 inches.
 - b. Plus one hinge for every 30 inches of door height greater than 90 inches.
 2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
 - a. Widths up to 3'-0": 4-1/2" standard or heavy weight as specified.
 - b. Widths from 3'-1" to 4'-0": 5" standard or heavy weight as specified.
 3. Hinge Options: Comply with the following where indicated in the Hardware Sets or on Drawings:
 - a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed from all out-swinging lockable doors
 4. Acceptable Manufacturers:
 - a. Bommer Industries (BO)
 - b. Hager Companies (HA)
 - c. McKinney Products (MK)

2.3 CONTINUOUS HINGES

- A. Continuous Geared Hinges: ANSI/BHMA A156.26 certified continuous geared hinge with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Provide concealed flush mount (with or without inset), full surface, or half surface, in standard and heavy-duty models, as specified in the Hardware Sets. Concealed continuous hinges to be U.L. listed for use on up to and including 90 minute rated door installations and

U.L. listed for windstorm components where applicable. Factory cut hinges for door size and provide with removable service power transfer panel where indicated at electrified openings.

1. Acceptable Manufacturers:
 - a. Bommer Industries (BO)
 - b. Hager Companies (HA)
 - c. Pemko Manufacturing (PE)

2.4 SURFACE BOLTS AND MANUAL FLUSH BOLTS

- A. ANSI/BHMA A156.3 and A156.16, Grade 1, certified automatic, self-latching, and manual flush bolts and surface bolts. Manual flush bolts to be furnished with top rod of sufficient length to allow bolt location approximately six feet from the floor. Furnish dust proof strikes for bottom bolts. Surface bolts to be minimum 8" in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.

1. Acceptable Manufacturers:
 - a. Burns Manufacturing (BU).
 - b. Door Controls International (DC).
 - c. Rockwood Manufacturing (RO)
 - d. Trimco (TC)

2.5 LOCK CYLINDERS

- A. General: Cylinder manufacturer to have minim (10) years' experience designing secured master key systems and have on record a published security keying policy.
- B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.
 1. Acceptable Manufacturer:
 - a. Sargent Manufacturing (SA)
- C. Cylinders: Cylinders to comply with the following:
 1. Mortise Type: Threaded cylinders with rings and straight- or clover-type cam.
 2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
 4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
 5. Keyway: Match Facility Restricted Keyway.

2.6 KEYING

- A. Keying System: Factory registered, complying with guidelines in ANSI/BHMA A156.28, appendix. Each type of lock and cylinders to be factory keyed. Conduct specified "Keying Conference" to define and document keying system instructions and requirements. Furnish

factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner. Incorporate decisions made in keying conference, and as follows:

1. Existing System:
 - a. Master key or grand master key locks to Owner's existing system.
- B. Keys Quantity: Provide the following minimum number of keys:
 1. Top Master Key: One (1)
 2. Change Keys per Cylinder: Two (2)
 3. Master Keys (per Master Key Group): Two (2)
 4. Grand Master Keys (per Grand Master Key Group): Two (2)
 5. Construction Keys (where required): Ten (10)
- C. Construction Keying: Provide construction master keyed cylinders or temporary keyed construction cores where specified. (Typically exterior doors, doors in construction barriers, office suite doors to corridor, etc.) Provide construction master keys in quantity as required by project Contractor. Replace construction cores with permanent cores. Furnish permanent cores for installation as directed under specified "Keying Conference".
- D. Key Registration List: Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
- E. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.
 1. Acceptable Manufacturers:
 2.
 - a. Lund Equipment (LU).
 - b. MMF Industries (MM).
 - c. Telkee (TK).

2.7 SURFACE CLOSERS

- A. Surface Closers: ANSI/BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
 1. Acceptable Manufacturers:
 - a. LCN Closers (LC) - 4040XP Series
 - b. Sargent Manufacturing (SA) - 351 Series

2.8 DOOR STOPS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Acceptable Manufacturers

- a. Burns Manufacturing (BU).
- b. Rockwood Manufacturing (RO).
- c. Trimco (TC).

- C. Overhead Door Stops and Holders: ANSI/BHMA A156.6, Grade 1 certified overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Acceptable Manufacturers

- a. Rixson Door Controls (RF).
- b. Sargent Manufacturing (SA).
- c. Glynn Johnson (GJ)..

2.9 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and UBC 7-2, Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated, based on testing according to ASTM E 1408.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Acceptable Manufacturers:
 1. National Guard Products (NG).
 2. Pemko Manufacturing (PE).
 3. Reese Enterprises, Inc. (RS).

2.10 THRESHOLDS

- A. Thresholds: ANSI/BHMA A156.21; fabricated to full width of opening indicated.

2.11 SLIDING DOOR HARDWARE

- A. Sliding Door Hardware: ANSI/BHMA A156.14; consisting of complete sets, including rails, hangers, supports, bumpers, floor guides, and accessories indicated.

2.12 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended.

2.13 FINISHES

- A. Standard: Designations use in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.19, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames in accordance with ANSI/SDI A250.6.

3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights **to comply with the following** unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel doors and Frames."
 - 2. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
 - 3. Provide blocking in drywall partitions where wall stops, or other wall mounted hardware is located.
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

- E. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
 - 1. Do not notch perimeter gasketing to install other surface-applied hardware.

3.4 FIELD QUALITY CONTROL

- 1. Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating, and adjusted.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper function and finish.

3.6 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

3.7 DOOR HARDWARE SCHEDULE

- A. Hardware Sets located on Architectural Drawing A601

END OF SECTION 087100

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Framing systems.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Framing systems.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of code-compliance certification for studs and tracks.

1.4 QUALITY ASSURANCE

- A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association the Steel Framing Industry Association the Steel Stud Manufacturers Association or the Supreme Steel Framing System Association.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Notify manufacturer of damaged materials received prior to installation.
- B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, in accordance with ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.
- C. Design framing systems in accordance with AISI S220, "North American Specification for the Design of Cold-Formed Steel Framing - Nonstructural Members," unless otherwise indicated.
- D. Design Loads: As indicated on architectural Drawings or 5 lbf/sq. ft. minimum as required by the IBC.
- E. Design framing systems to accommodate deflection of primary building structure and construction tolerances and to withstand design loads with a maximum deflection of.

2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with AISI S220 for conditions indicated.
 - 1. Steel Sheet Components: Comply with AISI S220 requirements for metal unless otherwise indicated
 - 2. Protective Coating: Comply with AISI S220; ASTM A653/A653M, G40; or coating with equivalent corrosion resistance. Galvannealed products are unacceptable.
 - a. Coating demonstrates equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction.
- B. Studs and Track: AISI S220.
 - 1. Minimum Base-Steel Thickness: 0.0329 inch.
 - 2. Depth: As indicated on Drawings.
- C. Slip-Type Head Joints: Where indicated, provide the following:
 - 1. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- D. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Steel Thickness: 0.0329 inch.
- F. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-steel thickness, with minimum 1/2-inch-wide flanges.
1. Depth: 1-1/2 inches.
 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.
- G. Hat-Shaped, Rigid Furring Channels:
1. Minimum Base-Steel Thickness: 0.0329 inch.
 2. Depth: As indicated on Drawings.
- H. Resilient Furring Channels: 1/2-inch-deep, steel sheet members designed to reduce sound transmission.
1. Configuration: Asymmetrical or hat shaped.
- I. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.
1. Depth: As indicated on Drawings.
 2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch.
 3. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.
- J. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 3/4 inch, minimum uncoated-steel thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

2.3 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide one of the following:
1. Asphalt-Saturated Organic Felt: ASTM D226/D226M, Type I (No. 15 asphalt felt), nonperforated.
 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
 - 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.
- B. Coordination with Sprayed Fire-Resistive Materials:
 - 1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling tracks to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.
 - 2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C754.
 - 1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C841 that apply to framing installation.
 - 2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C1063 that apply to framing installation.
 - 3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C844 that apply to framing installation.
 - 4. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLATION OF FRAMING SYSTEMS

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
 - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
 - 6. Curved Partitions:
 - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
 - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches o.c.

E. Direct Furring:

1. Screw to wood framing.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

F. Z-Shaped Furring Members:

1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.

B. Related Requirements:

1. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Gypsum wallboard.
2. Gypsum board, Type X.
3. Interior trim.
4. Joint treatment materials.

B. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.

1.3 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.4 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or blotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of gypsum panel and joint finishing material from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated in accordance with ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.

2.3 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.4 INTERIOR GYPSUM BOARD

- A. Gypsum Wallboard: ASTM C1396/C1396M.
 - 1. Thickness: 1/2 inch.
 - 2. Long Edges: Tapered and featured (rounded or beveled) for prefilling
- B. Gypsum Board, Type X: ASTM C1396/C1396M.
 - 1. Thickness: 5/8 inch.
 - 2. Long Edges: Tapered and featured (rounded or beveled) for prefilling

2.5 TRIM ACCESSORIES

- A. Interior Trim: ASTM C1047.
 - 1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet
 - a. Cornerbead.
 - b. Bullnose bead.
 - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - d. L-Bead: L-shaped; exposed long flange receives joint compound.
 - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - f. Expansion (control) joint.
 - g. Curved-Edge Cornerbead: With notched or flexible flanges.

2.6 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
 - 2. Exterior Gypsum Soffit Board: Paper.
 - 3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
 - 4. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use [setting-type taping] [drying-type, all-purpose] compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 3. Fill Coat: For second coat, use [setting-type, sandable topping] [drying-type, all-purpose] compound.
 - 4. Finish Coat: For third coat, use [setting-type, sandable topping] [drying-type, all-purpose] compound.
 - 5. Skim Coat: For final coat of Level 5 finish, use [setting-type, sandable topping compound] [drying-type, all-purpose compound] [high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish].

2.7 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
 - 1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- C. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

- A. Comply with ASTM C840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

- I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:

1. Wallboard Type: **As indicated on Drawings**
2. Type X: **Where required for fire-resistance-rated assembly**

- B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels **vertically (parallel to framing)** unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

- C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers **and face layers separately to supports with screws**

- D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.
- E. Curved Surfaces:
 - 1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch-long straight sections at ends of curves and tangent to them.
 - 2. For double-layer construction, fasten base layer to studs with screws 16 inches o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches o.c.

3.4 INSTALLATION OF TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints **in accordance with ASTM C840**.
- C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners **unless otherwise indicated**.
 - 2. Bullnose Bead: Use **at outside corners**
 - 3. LC-Bead: Use **at exposed panel edges**
 - 4. U-Bead: Use **at exposed panel edges**
 - 5. Curved-Edge Cornerbead: Use at curved openings.

3.5 FINISHING OF GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, **rounded or beveled edges**, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

3.6 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Acoustical panels.
2. Metal suspension system.
3. Metal edge moldings and trim.

B. Related Requirements:

1. Section 095123 "Acoustical Tile Ceilings" for ceilings consisting of mineral-base acoustical tiles used with fully concealed suspension systems, stapling, or adhesive bonding.
2. Section 095133 "Acoustical Metal Pan Ceilings" for ceilings consisting of metal-pan units with exposed and concealed suspension systems.

C. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Cornell University.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Acoustical panels.
2. Metal suspension system.
3. Metal edge moldings and trim.

B. Sustainable Design Submittals:

C. Samples: For each exposed product and for each color and texture specified, 6 inches in size.

D. Samples for Initial Selection: For components with factory-applied finishes.

E. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:

1. Acoustical Panels: Set of 2'x2'x3/4" Square. Samples of each type, color, pattern, and texture.

2. Exposed Suspension-System Members, Moldings, and Trim: Set of **6-inch**-long Samples of each type, finish, and color.
3. Clips: Full-size **hold-down** and impact clips.

F. Delegated Design Submittals: For seismic restraints for ceiling systems.

1. Include design calculations for seismic restraints including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension-system members.
2. Structural members to which suspension systems will be attached.
3. Method of attaching hangers to building structure.
 - a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
5. Size and location of initial access modules for acoustical panels.
6. Items penetrating finished ceiling and ceiling-mounted items including the following:
 - a. Lighting fixtures.
 - b. Diffusers.
 - c. Grilles.
 - d. Speakers.
 - e. Sprinklers.
 - f. Access panels.
 - g. Perimeter moldings.
7. Show operation of hinged and sliding components covered by or adjacent to acoustical panels.
8. Minimum Drawing Scale: **1/8 inch = 1 foot**

B. Qualification Data: For testing agency.

C. Product Test Reports: For each acoustical panel ceiling, for tests performed **a qualified testing agency**.

D. Evaluation Reports: For each acoustical panel ceiling suspension system **and anchor and fastener type**, from ICC-ES.

E. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Units: Full-size panels equal to [2] percent of quantity installed.
 - 2. Suspension-System Components: Quantity of each exposed component equal to [2] percent of quantity installed.
 - 3. Hold-Down Clips: Equal to [2] percent of quantity installed.
 - 4. Impact Clips: Equal to [2] percent of quantity installed.

1.7 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockup of typical ceiling area as indicated on Drawings.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
 - 1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Source Limitations for Ceiling System: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic restraints for ceiling systems.
- B. Seismic Performance: Suspended ceilings to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7
- C. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Class [A] in accordance with ASTM E1264.
 - 2. Smoke-Developed Index: [50] or less.
- D. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL or from the listings of another qualified testing agency.

2.3 ACOUSTICAL PANELS

- A. Acoustical Panel Standard: Provide manufacturer's standard panels in accordance with ASTM E1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
- B. Classification: Provide [**fire-resistance-rated**] panels as follows:
 - 1. Type and Form, Type IV Form 2: Mineral base with membrane-faced overlay; Form 2, water felted
 - 2. Pattern: [**E (lightly textured)**] [**G (smooth)**]
- C. Color: White
- D. Light Reflectance (LR): Not less than 0.90
- E. Ceiling Attenuation Class (CAC): Not less than 35
- F. Noise Reduction Coefficient (NRC): Not less than 0.75
- G. Edge/Joint Detail: **As indicated by manufacturer's designation** SLT.

H. Thickness:

1. 3/4 inch (19 mm)

I. Modular Size: 24 by 24 inches

- J. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested in accordance with ASTM D3273, ASTM D3274, or ASTM G21 and evaluated in accordance with ASTM D3274 or ASTM G21.

2.4 METAL SUSPENSION SYSTEM

- A. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories in accordance with ASTM C635/C635M and designated by type, structural classification, and finish indicated.

1. High-Humidity Finish: Where indicated, provide coating tested and classified for "severe environment performance" in accordance with ASTM C635/C635M.

2.5 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

- B. Wire Hangers, Braces, and Ties: Provide wires as follows:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
2. Stainless Steel Wire: ASTM A580/A580M, Type 304, nonmagnetic.
3. Nickel-Copper-Alloy Wire: ASTM B164, nickel-copper-alloy UNS No. N04400.
4. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than **0.106-inch** diameter wire.

- C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

- D. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

- E. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch-thick, galvanized-steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch-diameter bolts.

- F. Hold-Down Clips: Manufacturer's standard hold-down.

- G. Impact Clips: Manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

- H. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical panels in place during a seismic event.
- I. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- J. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

2.6 METAL EDGE MOLDINGS AND TRIM

- A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
 - 1. Edge moldings to fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
- B. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements.
 - 1. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
 - 2. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils. Comply with ASTM C635/C635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2.7 ACOUSTICAL SEALANT

- A. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated and comply with layout shown on reflected ceiling plans.
- B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION OF ACOUSTICAL PANEL CEILINGS

- A. Install acoustical panel ceilings in accordance with ASTM C636/C636M, **seismic design requirements**, and manufacturer's written instructions.
 - 1. Fire-Rated Assembly: Install fire-rated ceiling systems in accordance with tested fire-rated design.
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required **and, if permitted with fire-resistance-rated ceilings**, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 - 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 - 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 - 8. Do not attach hangers to steel deck tabs.
 - 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - 10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.

11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
 1. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected ceiling plans.
 - b. Install panels with pattern running in one direction parallel to [long] [short] axis of space.
 - c. Install panels in a basket-weave pattern.
 2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
 3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 4. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
 5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 6. Install clips in areas indicated; space in accordance with panel manufacturer's written instructions unless otherwise indicated.
 - a. Hold-Down Clips: Space 24 inches o.c. on all cross runners.
 7. Install clean-room gasket system in areas indicated, sealing each panel and fixture as recommended by panel manufacturer's written instructions.
 8. Protect lighting fixtures and air ducts in accordance with requirements indicated for fire-resistance-rated assembly.

3.4 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
- B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 096513 – RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Thermoplastic-rubber base.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
- C. Samples: For each exposed product and for each color and texture specified, not less than 12 inches (300 mm) long.
- D. Samples for Initial Selection: For each type of product indicated.
- E. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches (300 mm) long.
- F. Product Schedule: For resilient base and accessory products. Refer to A602, Designation: RB-1.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials **from the same product run**, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Coordinate mockups in this Section with mockups specified in other Sections.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.7 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following periods:
 1. 48 hours before installation.
 2. During installation.
 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Acceptable Manufacturers
 1. Tarkett

2.2 THERMOPLASTIC-RUBBER BASE **RB-1**

- A. Product Standard: ASTM F1861, Type TP (rubber, thermoplastic).
 1. Group: [**I (solid, homogeneous)**]
 2. Style and Location:
 - a. Style B, Cove: [**Provide in areas with resilient floor coverings**]
- B. Thickness: **0.125 inch**.
- C. Height: [**4 inches**]

- D. Lengths: **[Cut lengths 48 inches long or coils in manufacturer's standard length]**.
- E. Outside Corners: **[Job formed]**
- F. Inside Corners: **[Job formed]**
- G. Colors: 40 Black

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
- C. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient stair-tread manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until materials are the same temperature as space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than **3 inches** in length.
 - a. Form without producing discoloration (whitening) at bends.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than **3 inches** in length.
 - a. **[Miter or cope]** corners to minimize open joints.

3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Stair Accessories:
 - 1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
 - 2. Tightly adhere to substrates throughout length of each piece.
 - 3. For treads installed as separate, equal-length units, install to produce a flush joint between units.
- C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
 - 1. Remove adhesive and other blemishes from surfaces.
 - 2. Sweep and vacuum horizontal surfaces thoroughly.
 - 3. Damp-mop horizontal surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

SECTION 096519 - RESILIENT TILE FLOORING

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections:
 - 1. Other Division 9 sections for floor finishes related to this section but not the work of this section
 - 2. Division 3 Concrete; not the work of this section
 - 3. Division 6 Wood and Plastics; not the work of this section
 - 4. Division 7 Thermal and Moisture Protection; not the work of this section

1.2 SUMMARY

- A. Section Includes:
 - 1. Vinyl composition floor tile.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of resilient floor tile.
 - 1. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
 - 2. Show details of special patterns.
- C. Samples: Full-size units of each color, texture, and pattern of floor tile required.
- D. Samples for Initial Selection: For each type of floor tile indicated.
- E. Samples for Verification: Full-size units of each color and pattern of floor tile required.
- F. Product Schedule: For floor tile. [**VCT-1**]

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials **from the same product run**, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Floor Tile: Furnish one box for every **[50]** boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.7 QUALITY ASSURANCE

- A. Single-Source Responsibility: provide types of flooring and accessories supplied by one manufacturer, including moisture mitigation systems, primers, leveling and patching compounds, and adhesives.
- B. Select an installer who is experienced and competent in the installation of Armstrong resilient vinyl composition tile flooring and the use of Armstrong Flooring subfloor preparation products.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

1.9 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than **65 deg F** or more than **100 deg F** in spaces to receive floor tile during the following periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than **55 deg F** or more than **95 deg F**.
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Armstrong Flooring

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.3 VINYL COMPOSITION FLOOR TILE

- A. Tile Standard: ASTM F1066, [**Class 2, through pattern**]
- B. Wearing Surface: [**Smooth**]
- C. Thickness: 0.125 inch.
- D. Size: 12 by 12 inches.
- E. Colors and Patterns: [**5C899 Silk White**] or other **Approved Color by Owner**.

2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- B. Wall Base Materials
 - 1. For top set wall base: [Provide 1/8 in. (3.18 mm) thick, 4 in. (10.16 cm) high Armstrong Flooring Wall Base with a matte finish, conforming to ASTM F 1861, Type TP - Rubber, Thermoplastic, Group 1 - Solid, Style B – Cove.] [Provide 1/4 in. (6.35 mm) thick, 4.5 in. (11.43 cm) high Armstrong Flooring Color-Integrated Wall Base with a matte finish, conforming to ASTM F 1861, Type TP - Rubber, Thermoplastic, Group 1 - Solid, Style A – Straight.]
- C. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.
 - 1. For Tile Installation System, Full Spread: Provide Armstrong [S-515 Floor Tile Adhesive] [S-525 BBT® Bio-Flooring Adhesive] under the tile and Armstrong S-725 Wall Base Adhesive at the wall base as recommended by the flooring manufacturer.
 - 2. [For Tile Installation System, Tile On: Provide Armstrong [S-515 Floor Tile Adhesive] [S-525 BBT® Bio-Flooring Adhesive] under the tile over smooth, completely bonded existing resilient flooring and Armstrong S-725 Wall Base Adhesive at the wall base as recommended by the flooring manufacturer].
 - 3. [Provide Armstrong S-1000 Flooring Adhesive under the flooring and Armstrong S-725 Wall Base Adhesive at the wall base as recommended by the flooring manufacturer].
- D. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.

- E. For sealing joints between the top of wall base or integral cove cap and irregular wall surfaces such as masonry, provide plastic filler applied according to the manufacturer's recommendations.
- F. Provide transition/reducing strips tapered to meet abutting materials.
- G. Provide threshold of thickness and width as shown on the drawings.
- H. Provide resilient edge strips of width shown on the drawings, of equal gauge to the flooring, homogeneous vinyl, or rubber composition, tapered or bullnose edge, with color to match or contrast with the flooring, or as selected by the Architect from standard colors available.
- I. Provide metal edge strips of width shown on the drawings and of required thickness to protect exposed edges of the flooring. Provide units of maximum available length to minimize the number of joints. Use butt-type metal edge strips for concealed anchorage or overlap-type metal edge strips for exposed anchorage. Unless otherwise shown, provide strips made of extruded aluminum with a mill finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Report conditions contrary to contract requirements that would prevent a proper installation. Do not proceed with the installation until unsatisfactory conditions have been corrected.
- D. Failure to call attention to defects or imperfections will be construed as acceptance and approval of the subfloor. Installation indicates acceptance of substrates regarding conditions existing at the time of installation.

3.2 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than [9] pH.
- C. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.
- D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- E. Do not install floor tiles until materials are the same temperature as space where they are to be installed.
1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
- F. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Install flooring in strict accordance with the latest edition of Armstrong Flooring Guaranteed Installation Systems. Failure to comply may result in voiding the manufacturer's warranty listed in Section.
- C. Install flooring wall to wall before the installation of floor-set cabinets, casework, furniture, equipment, movable partitions, etc. Extend flooring into toe spaces, door recesses, closets, and similar openings as shown on the drawings.
- D. If required, install flooring on pan-type floor access covers. Maintain continuity of color and pattern within pieces of flooring installed on these covers. Adhere flooring to the subfloor around covers and to covers.
- E. Scribe, cut, and fit to permanent fixtures, columns, walls, partitions, pipes, outlets, and built-in furniture and cabinets.
- F. Install flooring with adhesives, tools, and procedures in strict accordance with the manufacturer's written instructions. Observe the recommended adhesive trowel notching, open times, and working times.

3.4 INSTALLATION OF ACCESSORIES

- A. Apply top set wall base to walls, columns, casework, and other permanent fixtures in areas where top-set base is required. Install base in lengths if practical, with inside corners fabricated

from base materials that are mitered or coped. Tightly bond base to vertical substrate with continuous contact at horizontal and vertical surfaces.

- B. Fill voids with plastic filler along the top edge of the resilient wall base or integral cove cap on masonry surfaces or other similar irregular substrates.
- C. Place resilient edge strips tightly butted to flooring, and secure with adhesive recommended by the edge strip manufacturer. Install edge strips at edges of flooring that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
- B. Perform the following operations immediately after completing floor tile installation:
 - 1. Remove adhesive and other blemishes from surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.
- E. Joint Sealant: Apply sealant to resilient terrazzo floor tile perimeter and around columns, at door frames, and at other joints and penetrations.
- F. Sealers and Finish Coats: Remove soil, visible adhesive, and surface blemishes from resilient terrazzo floor tile surfaces before applying liquid cleaners, sealers, and finish products.
- G. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Primers.
 - 2. Water-based finish coatings.
 - 3. Floor sealers and paints.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include preparation requirements and application instructions.
 - 2. Indicate VOC content.
- B. Samples: For each type of topcoat product.
- C. Samples for Initial Selection: For each type of topcoat product.
- D. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- E. Product Schedule: Use same designations indicated on Drawings and in the Interior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint Products: **5** percent, but not less than **1 gal.** of each material and color applied.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures of less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Provide The Sherwin Williams Company products indicated or comparable products per Owner approval.
- B. Comparable Products: Comparable products of approved manufacturers will be considered in accordance with Section 016000 "Product Requirements," and the following:
 - 1. Products are approved by manufacturer in writing for application specified.
 - 2. Products meet performance and physical characteristics of basis of design product including published ratio of solids by volume, plus or minus two percent.
- C. Source Limitations: Obtain each paint product from single source from single manufacturer.

2.2 PAINT PRODUCTS, GENERAL

- A. Material Compatibility:
 - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- B. VOC Content: For field applications that are inside the weatherproofing system, paints and coatings shall provide materials that comply with VOC limits of authorities having jurisdiction and for interior paints and coatings applied at Project site, the following VOC limits exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Flat Paints and Coatings: 50 g/L.

2. Nonflat Paints and Coatings: 150 g/L.
3. Primers, Sealers, and Undercoaters: 200 g/L.
4. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
5. Floor Coatings: 100 g/L.

- C. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small Scale Environmental Chambers."
- D. Colors: **[SW 7036 Accessible Beige] or approved color by Owner.**

2.3 PRIMERS

- A. Interior Latex Primer Sealer: Water-based latex sealer used on new interior plaster, concrete, and gypsum wallboard surfaces.
- B. Interior, Institutional Low-Odor/VOC Primer Sealer: Water-based primer sealer with low-odor characteristics and a VOC of less than 10 grams per liter for use on new interior plaster, concrete, and gypsum wallboard surfaces that are subsequently to be painted with latex finish coats.

2.4 WATER-BASED FINISH COATS

- A. Interior, Latex, Flat: Pigmented, water-based paint for use on primed/sealed interior plaster and gypsum board, and metals.
1. Gloss and Sheen Level: **[Manufacturer's standard flat finish]**
- B. Interior, Latex, Institutional Low Odor/VOC, Flat: White or colored latex paint with low-odor characteristics and a VOC of less than 10 grams per liter, for use in areas, such as hospitals and other occupied buildings, where the odor and VOC levels of conventional latex products would preclude their use.
1. Gloss and Sheen Level: **[Manufacturer's standard flat finish]**

2.5 FLOOR SEALERS AND PAINTS

- A. Water-Based Concrete Floor Sealer: Clear, water-based, acrylic-copolymer-emulsion sealer formulated for oil, gasoline, alkali, and water resistance and for use on concrete traffic surfaces.
- B. Solvent-Based Concrete Floor Sealer: Clear, acrylic, solvent-based sealer formulated for oil, gasoline, alkali, and water resistance and for use on concrete traffic surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Fiber-Cement Board: 12 percent.
 - 3. Masonry (Clay and CMUs): 12 percent.
 - 4. Wood: 15 percent.
 - 5. Gypsum Board: 12 percent.
 - 6. Plaster: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Plaster Substrates: Verify that plaster is fully cured.
- E. Spray-Textured Ceiling Substrates: Verify that surfaces are dry.
- F. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- G. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer. [**but not less than the following:**]
 - 1. SSPC-SP 2.
 - 2. SSPC-SP 3.
 - 3. SSPC-SP 7/NACE No. 4.
 - 4. SSPC-SP 11.
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Aluminum Substrates: Remove loose surface oxidation.
- J. Wood Substrates:
 - 1. Scrape and clean knots and apply coat of knot sealer before applying primer.
 - 2. Sand surfaces that will be exposed to view and dust off.
 - 3. Prime edges, ends, faces, undersides, and backsides of wood.
 - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- K. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 INSTALLATION

- A. Apply paints according to manufacturer's written instructions.
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 FIELD QUALITY CONTROL

- A. Dry-Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry-film thickness.
 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 2. If test results show that dry-film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry-film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
 1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
 2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
 3. Allow empty paint cans to dry before disposal.
 4. Collect waste paint by type and deliver to recycling or collection facility.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Pedestrian Traffic Surfaces:
 1. Latex Floor Enamel System:

- a. First Coat: Floor paint, latex, slip-resistant, matching topcoat.
 - b. Topcoat: Floor paint, latex, slip-resistant, low gloss: S-W ArmorSeal Tread-Plex, B90 Series, at 1.5 to 2.0 mils (0.038 to 0.051 mm) dry per coat.
2. Epoxy and Urethane Coatings: Refer to Section 099600 "High-Performance Coatings."

B. [Gypsum Board] Substrates:

1. Latex System:
 - a. Prime Coat: Primer, latex, interior:
 - 1) S-W ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils (0.102 mm) wet, 1.0 mils (0.025 mm) dry.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, flat:
 - 1) S-W ProMar 200 Zero VOC Latex Flat, B30-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.

END OF SECTION 099123

SECTION 115313 - LABORATORY FUME HOODS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bench-top laboratory fume hood.
2. Chemical hood with chemical storage cabinet below.
3. Wiring to light fixtures, receptacles, fan switches, and fan included.
4. Fume hood base cabinets.
5. Fume hood base stands.
6. Worktops within fume hoods.
7. Electrical receptacles in fume hoods.
8. Gas fittings and piping.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood blocking for anchoring fume hoods.
2. Section 092216 "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring fume hoods.
3. Section 096513 "Resilient Base and Accessories" for resilient base applied to fume hood base cabinets.
4. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for field quality-control testing of fume hoods.
5. Section 230923 "Direct Digital Control (DDC) System for HVAC" for VAV controls for fume hood exhaust.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Cornell University.

1.3 COORDINATION

- A. Coordinate layout and installation of framing and reinforcements for lateral support of fume hoods.
- B. Coordinate installation of fume hoods with laboratory casework and other laboratory equipment.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For laboratory fume hoods.

1. Include plans, elevations, sections, and attachment details.
2. Indicate details for anchoring fume hoods to permanent building construction including locations of blocking and other supports.
3. Indicate locations and types of service fittings together with associated service supply connection required.
4. Indicate duct connections, electrical connections, and locations of access panels.
5. Include roughing-in information for mechanical, plumbing, and electrical connections.
6. Show adjacent walls, doors, windows, other building components, laboratory casework, and other laboratory equipment. Indicate clearances from the above items.
7. Include layout of fume hoods in relation to lighting fixtures and air-conditioning registers and grilles.
8. Include coordinated dimensions for laboratory equipment specified in other Sections.
9. Include information of hood material construction.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Showing compliance with specified performance requirements for as-manufactured containment and static pressure loss, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish complete touchup kit for each type and color of fume hood finish provided. Include fillers, primers, paints, and other materials necessary to perform permanent repairs to damaged fume hood finish.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or another suitable material.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install fume hoods until building is enclosed, wet work and utility roughing-in are complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Locate concealed framing, blocking, and reinforcements that support fume hoods by field measurements before being enclosed, and indicate measurements on Shop Drawings.
- C. Demonstrate fume hood performance before shipment by testing [**one fume hood for each type required**] [**fume hoods**] according to ASHRAE 110[**as modified in "Performance Requirements" Article**]. Provide testing facility, instruments, equipment, and materials needed for tests.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Mott Manufacturing Ltd.

2.2 SOURCE LIMITATIONS

- A. Obtain laboratory fume hoods from same source **from same manufacturer** as laboratory casework.
- B. Product Designations: Drawings indicate sizes, types, and configurations of fume hoods by referencing designated manufacturer's catalog numbers. Other manufacturers' fume hoods of similar sizes, types, and configurations, and complying with the Specifications, may be considered. See Section 016000 "Product Requirements."

2.3 PERFORMANCE REQUIREMENTS

- A. Containment: Provide fume hoods that comply with the following when tested according to ASHRAE 110:
1. As-Manufactured (AM) Rating: [**AM 0.01 (0.01 ppm)**]
 2. Average Face Velocity: **100 fpm** plus or minus 10 percent with sashes fully open.
 3. Face-Velocity Variation: Not more than 5 percent of average face velocity across the face opening with sashes fully open.
 4. Sash Position: Fully open.
 - a. Test hoods with horizontal sashes with maximum opening on one side, with maximum opening in the center, and with one opening at each side equal to half of maximum opening.
 - b. Test hoods with combination sashes fully raised, with maximum opening on one side, with maximum opening in the center, and with one opening at each side equal to half of maximum opening.
 5. Release Rate: [**4.0 L/min.**]
- B. Static-Pressure Loss: Not more than [**1/4 inch**] at [**100-fpm**] face velocity with sash fully open when measured at four locations 90 degrees apart around the exhaust duct and at least three duct diameters downstream from duct collar.
- C. Noise Criterion: The hood shall have a Noise Criterion (NC) rating of less than 50; measured 36" in front of the hood with full open sash,

2.4 FUME HOODS, GENERAL

- A. Product Standards: Comply with SEFA 1, "Laboratory Fume Hoods - Recommended Practices."
"Provide fume hoods UL listed and labeled for compliance with UL 1805.
- B. For the majority of laboratory projects on campus, air change rates in the lab environment typically inform the final system design. Fume hoods shall be of the Restricted Bypass Type suitable for 2-position or VAV airflow operation. They shall be designed to contain at an average face velocity of 100 FPM at an 18-inch sash opening height.
- C. Generally, vertical rising sashes are preferred. The horizontal sliding or combination sashes may be used in the following situations, but only with final review and approval by EH&S and facilities Engineering:
 - 1. Barrier Free (ADA) Fume Hoods
 - 2. When specifically requested by the Principal Investigator.
- D. Lining and workstation materials are to be suitable for the intended chemical use.
- E. Fixed baffles are preferred over adjustable baffles.
- F. Fume hoods shall have stops installed at an 18-inch sash height.
- G. Auxiliary Air Fume Hoods shall not be used.
- H. Fume hoods shall be specified to meet "As Manufactured" ANSI/ASHRAE 110 defined performance tests conducted on a representative hood that demonstrates adequate hood containment.
- I. Acceptable Models, General Purpose:
 - 1. Bedcolab: Balanced Air, Variable Air Volume (VBV)
 - 2. Jamestown: F-100 Series Isolator Gen-5
 - 3. Kewaunee: Supreme Air H05
 - 4. Labconco: Protector Premier
 - 5. Mott: Pro Restricted Bypass

2.5 ACCESSIBLE (BARRIER FREE) FUME HOODS

- A. In addition to the requirements stated above, accessible fume hoods shall have the following features:
 - 1. Airfoil by-pass with spill trough.
 - 2. Manual hydraulic Lift Base Stand, Labconco or approved equal.
 - 3. Lever handles on all plumbing service fitting.
- B. Acceptable Models, Barrier Free:
 - 1. Bedcolab: Fully Accessible Fume Hood (VBH).
 - 2. Jamestown: F-100 Series Isolator Gen-5.

3. Labconco: Protector XL.
4. Mott: Fully Accessible Restricted By-Pass – Combination Sash.

2.6 HIGH PERFORMANCE (LOW VELOCITY) FUME HOODS

- A. For laboratories expected to have a high hood density or with small footprint where the air change rate due to fume hood exhaust will exceed the minimum laboratory air change rate established by EH&S, the use of high-performance fume hood can be considered. These fume hoods shall be designed to capture at a face velocity of 100 fpm and below, at an 18-inch sash opening height. Use of these hods will be evaluated on a project-by-project basis, and shall be allowed only after approval from Facilities Engineering and EH&S.
- B. The acceptable manufacturers listed below have all been vetted to have the following preferred design features:
 1. Aerodynamic curve of the airfoil, sash and side walls that reduce eddy currents and encourage sweeping of air to the back of the hood.
 2. Baffles and passive opening at eh top and bottom of the sash that aid in sweeping to the back and reduce eddy currents.
- C. “Belly Bars” and multi-slotted airfoils shall not be installed as they increase ergonomic issues with the use of the fume hood.
 1. Kewaunee: Supreme Air LV05.
 2. Jamestown: F-350 Series Isolator3.
 3. Labconco: Protector XStream.
 4. Mott: Model RFV2,

2.7 MATERIALS

- A. Steel Sheet: Cold-rolled, commercial steel (CS) sheet, complying with ASTM A1008/A1008M; matte finish; suitable for exposed applications.
- B. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.
 1. For perchloric acid fume hoods, use Type 316L instead of Type 304.
- C. Epoxy: Factory molded, modified epoxy-resin formulation with smooth, nonspecular finish.
 1. Physical Properties:
 - a. Flexural Strength: Not less than 10,000 psi.
 - b. Modulus of Elasticity: Not less than 2,000,000 psi.
 - c. Hardness (Rockwell M): Not less than 100.
 - d. Water Absorption (24 Hours): Not more than 0.02 percent.
 - e. Heat Distortion Point: Not less than 260 deg F.
 - f. Flame-Spread Index: 25 or less according to ASTM E84.

2. Chemical Resistance: As follows when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.4.5:
 - a. No Effect: Acetic acid (98 percent), acetone, ammonium hydroxide (28 percent), benzene, carbon tetrachloride, dimethyl formamide, ethyl acetate, ethyl alcohol, ethyl ether, methyl alcohol, nitric acid (70 percent), phenol, sulfuric acid (60 percent), and toluene.
 - b. Slight Effect: Chromic acid (60 percent) and sodium hydroxide (50 percent).
3. Color: **[As selected by Architect from manufacturer's full range]**
- D. Polypropylene: Unreinforced polypropylene complying with ASTM D4101, Group 01, Class 1, Grade 2.
- E. Glass: Clear, laminated tempered glass complying with ASTM C1172, Kind LT, Condition A, Type I, Class I, Quality-Q3; **[with two plies not less than 3.0 mm thick and]** with clear, polyvinyl butyral interlayer.
- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Fasteners: Provide stainless steel fasteners where exposed to fumes.

2.8 FABRICATION

- A. General: Assemble fume hoods in factory to greatest extent possible. Disassemble fume hoods only as necessary for shipping and handling limitations. Fume hoods to be capable of being partly disassembled as necessary to permit movement through a 35-by-79-inch door opening.
- B. Steel Exterior: Fabricate from steel sheet, 0.048 inch thick, with component parts screwed together to allow removal of end panels, front fascia, and airfoil and to allow access to plumbing lines and service fittings. Apply chemical-resistant finish to interior and exterior surfaces of component parts before assembly.
- C. Stainless Steel Exterior: Fabricate from stainless steel sheet, 0.050 inch thick, with component parts screwed together to allow removal of end panels, front fascia, and airfoil and to allow access to plumbing lines and service fittings.
- D. Polypropylene Exterior: Fabricate from fully stress-relieved polypropylene sheet, 1/2 inch thick, with welded seams. Access panels to be 1/4 inch thick, flush mounted, and fastened with flat-head polypropylene screws.
- E. Ends: Fabricate with double-wall end panels without projecting corner posts or other obstructions to interfere with smooth, even airflow. Close area between double walls at front of fume hood and as needed to house sash counterbalance weights, utility lines, and remote-control valves.
- F. Splay top and sides of face opening to provide an aerodynamic shape to ensure smooth, even flow of air into fume hood.

- G. Interior Lining: Provide **[one of]** the following unless otherwise indicated:
1. Epoxy, not less than 1/4 inch thick.
 2. Polypropylene, not less than 1/4 inch thick.
- H. Lining Assembly: Unless otherwise indicated, assemble with stainless steel fasteners or epoxy adhesive, concealed where possible. Seal joints by filling with chemical-resistant sealant during assembly.
- I. Exhaust Plenum: Full width of fume hood and with adequate volume to provide uniform airflow from hood, of same material as hood lining, and with duct stub for exhaust connection.
1. Duct-Stub Material: **[Epoxy-coated steel]**
- J. Bypass Grilles: Provide grilles at bypass openings of fume hoods.
- K. Sashes: Provide operable sashes of type indicated.
1. Fabricate from **0.048-inch- (1.21-mm-) thick steel sheet, with chemical-resistant finish or PVC extrusions**. Form into four-sided frame with bottom corners welded and finished smooth. Make top member removable for glazing replacement. Set glazing in chemical-resistant, U-shaped gaskets.
 2. Glaze with laminated safety glass.
 3. Glaze with 0.236-inch-thick polycarbonate glazing **[where indicated]**.
 4. Counterbalance vertical-sliding sash with sash weight and stainless steel cable system to hold sash in place regardless of position. Provide ball-bearing sheaves, plastic glides in stainless steel guides, and stainless steel lift handles. Provide rubber bumpers at top and bottom of each sash unit.
- L. Airfoil: Unless otherwise indicated, provide airfoil at bottom of fume hood face opening with 1-inch space between airfoil and work top. Sash closes on top of airfoil, leaving 1-inch opening for air intake. Airfoil directs airflow across work top to remove heavier-than-air gases and to prevent reverse airflow.
1. Fabricate airfoil from stainless steel **[coated with polytetrafluoroethylene or polyvinylidene fluoride]**.
- M. Light Fixtures: Provide vaporproof, two-tube, rapid-start, fluorescent light fixtures, of longest practicable length; complete with tubes at each fume hood. Shield tubes from hood interior with 1/4-inch- (6.35-mm-) thick laminated glass or 3-mm-thick tempered glass, sealed into hood with chemical-resistant rubber gaskets. Provide units with fluorescent tubes easily replaceable from outside of fume hood.
1. Provide fluorescent tubes with color temperature of 3500 K and minimum color-rendering index of 85.
 2. Provide vaporproof, acid-resistant, incandescent light fixtures complete with 100-W, Type A, long-life bulbs instead of fluorescent fixtures at perchloric acid and radioisotope fume hoods. Provide two fixtures for hoods up to 60 inches long and one fixture for every 24 inches of length for longer hoods.
- N. Perchloric Acid Fume Hood Washdown System: Provide perchloric acid fume hoods with washdown system consisting of stainless steel spray nozzles, washdown valve, and associated

piping. Design system to thoroughly rinse all surfaces of fume hood interior, including areas behind and above baffles, and to direct rinse water toward drain trough at rear of work top. Provide T-fitting for extending system to additional spray nozzles in exhaust ducts.

- O. Filler Strips: Provide as needed to close spaces between fume hoods **or fume hood base cabinets** and adjacent building construction. Fabricate from same material and with same finish as fume hoods **or fume hood base cabinets, as applicable**.
- P. Ceiling Extensions: Provide filler panels matching fume hood exterior to enclose space above fume hoods at front and sides of fume hoods and extending from tops of fume hoods to ceiling.
- Q. Finished Back Panels: Where rear surfaces of fume hoods are exposed to view, provide finished back panels matching rest of fume hood enclosure.
- R. Comply with requirements in other Sections for installing water and laboratory gas service fittings, piping, electrical devices, and wiring. Install according to Shop Drawings. Securely anchor fittings, piping, and conduit to fume hoods unless otherwise indicated.

2.9 FUME HOOD SYSTEMS

- A. Comply with [Section 123553.13 "Metal Laboratory Casework."] **Provide metal base cabinets in finish matching fume hood exterior finish.**
- B. Fume Hood Base Stands: Welded steel tubing legs, not less than 2 inches square with channel stretchers and aprons. Weld or bolt stretchers to legs and cross-stretchers, and bolt legs to aprons. Provide leveling device welded to bottom of each leg.

2.10 CHEMICAL-RESISTANT FINISH

- A. General: Prepare, treat, and finish welded assemblies after welding. Prepare, treat, and finish components that are to be assembled with mechanical fasteners before assembling. Prepare, treat, and finish concealed surfaces same as exposed surfaces.
- B. Preparation: Clean steel surfaces, other than stainless steel, of mill scale, rust, oil, and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it.
- C. Chemical-Resistant Finish: Immediately after cleaning and pretreating, apply fume hood manufacturer's standard two-coat, chemical-resistant, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.
 - 1. Chemical and Physical Resistance of Finish System: Finish complies with acceptance levels of cabinet surface finish tests in SEFA 8M. Acceptance level for chemical spot test to be no more than four Level 3 conditions.
 - 2. Colors for Fume Hood Finish: **[As indicated by manufacturer's designations]**

2.11 ACCESSORIES

- A. Airflow Indicator: Provide each fume hood with [**manufacturer's standard**] airflow indicator:
 - 1. Thermal anemometer that measures fume hood face velocity and displays data as digital readout.
- B. Airflow Alarm: Provide fume hoods with audible and visual alarm that activates when airflow sensor reading is outside of preset range.
 - 1. Provide with **thermal-anemometer** airflow sensor.
 - 2. Provide with reset and test switches.
 - 3. Provide with switch that silences audible alarm and automatically resets when airflow returns to within preset range.
- C. Sash Alarm: Provide fume hoods with audible and visual alarm that activates when sash is opened beyond preset position.
 - 1. Provide with silence and test switches.
- D. Sash Stops: Provide fume hoods with sash stops to limit hood opening to 50 percent of sash height. Sash stops can be manually released to open sash fully for cleaning fume hood and for placing large apparatus within fume hood.
- E. Bypass Grille Blank-off Panel: Provide fume hoods with blank-off panel on bypass grille designed for use with sash stops to reduce exhaust air volume and provide design face velocity with sash at 50 percent open position.

2.12 FUME HOOD UTILITIES

- A. Valves: Provide pre-piped valve with remote post mount handle:
 - 1. Valve to be needle type, forged brass or machined stainless steel.
 - 2. Valve extension and post mounted handle, mounted on right post.
 - 3. Unique color key and label for each utility.
 - 4. Maximum allowable working pressure: full vacuum to 120 psig.
- B. Nozzles:
 - 1. Nozzles to be color keyed to match valve tag.
 - 2. Locate nozzles on right interior side of hood.
 - 3. Nozzle to be barbed and shall point downward toward work surface,
- C. Utility Piping:
 - 1. Nozzles to be color keyed to match valve tag.
 - 2. Nozzles and handles to be chrome plated or chemical resistant powder painted.
 - 3. Utility piping is to be pre-piped in the hood with one point of connection at the top or from the service chase behind the equipment
 - 4. Vacuum Pipe, Fittings and Joints:
 - a. Pipe Material: Piping Material shall be 'ACR' Type 'L' copper hard drawn soft annealed seamless tubing.
 - b. Fitting Material: Fittings shall be wrought copper fittings matching the pipe material and complying with ANSI B16.22.

5. Compressed Air Pipe, Fittings and Joints:
 - a. Pipe Material: Piping shall be 'ACR' Type 'L' copper hard drawn soft annealed seamless tubing.
 - b. Fitting Material: Fittings shall be wrought copper fittings matching the pipe material and complying with ANSI B16.22.
 - c. Instrument Grade Double Ferrule Compression Joints: All joints in copper water tubing shall be made in accordance with Copper Development Association recommendations.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of fume hoods.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install fume hoods according to manufacturer's written instructions. Install level, plumb, and true; shim as required, using concealed shims, and securely anchor to building and adjacent laboratory casework. Securely attach access panels but provide for easy removal and secure reattachment. Where fume hoods abut other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.
- B. Comply with requirements in [Section 123553.13 "Metal Laboratory Casework"] for installing fume hood base cabinets, work tops, and sinks.
- C. Comply with requirements for installing water and laboratory gas service fittings and electrical devices.
- D. Coordinate plumbing connections with house services.
- E. Install pressure regulating devices in a concealed location to avoid pressure adjustment by users.

3.3 FIELD QUALITY CONTROL

- A. Field test installed fume hoods according to ASHRAE 110 to verify compliance with performance requirements.
 1. Adjust fume hoods, hood exhaust fans, and building's HVAC system, or replace hoods and make other corrections until tested hoods perform as specified.
 2. After making corrections, retest fume hoods that failed to perform as specified.

3.4 ADJUSTING AND CLEANING

- A. Adjust moving parts for smooth, near silent, accurate sash operation with one hand. Adjust sashes for uniform contact of rubber bumpers. Verify that counterbalances operate without interference.
- B. Set pressure control devices to specified pressures.
- C. Clean finished surfaces, including both sides of glass; touch up as required; and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

3.5 FUME HOOD SCHEDULE

- A. Bench-Top Fume Hood: 48" W per drawings. Refer to manufacturer shop drawings for additional information.
- B. Floor-Mounted Fume Hood: 72"W per drawings. Refer to manufacturer shop drawings for additional information.

3.6 FUME HOOD UTILITY SCHEDULE

- A. Vacuum: Provide one vacuum nozzle and needle valve on the right side of the fume hood.
- B. Compressed air: Provide one compressed air nozzle and needle valve on the right side of the fume hood.

END OF SECTION 115313

SECTION 123553.13 - METAL LABORATORY CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal laboratory casework.
2. Auxiliary cabinets.
3. Countertops.
4. Laboratory casework systems.
5. Laboratory accessories.
6. Water and laboratory gas service fittings.
7. Electrical and communication service fittings.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood blocking for anchoring laboratory casework.
2. Section 092216 "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring laboratory casework.
3. Section 096513 "Resilient Base and Accessories" for resilient base applied to laboratory casework.
4. Section 115313 "Laboratory Fume Hoods" for fume hoods, **including base cabinets and countertops under fume hoods.**

1.2 COMPLIANCE WITH THE AMERICANS WITH DISABILITIES ACT. (ADA)

- A. Laboratory furniture, accessories, fixtures, fittings and similar equipment are to make accommodations for public access and comply with ADA accessibility standards.
- B. Coordinate installation of laboratory casework, workstations, counter heights, knee spaces, utility connections for power, data, valves, connectors and support devices in accordance with height and reach distances.

1.3 COORDINATION

- A. Coordinate layout and installation of framing and reinforcements for support of laboratory casework.
- B. Coordinate installation of laboratory casework with installation of laboratory equipment.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

B. Shop Drawings: For laboratory casework.

1. Include plans, elevations, sections, and attachments to other work including blocking and reinforcements required for installation.
2. Indicate types and sizes of casework.
3. Indicate manufacturer's catalog numbers for casework.
4. Show fabrication details, including types and locations of hardware.
5. Indicate locations and types of service fittings, hoses, overhead service panels and connectors.
6. Include details of utility spaces showing supports for conduits and piping.
7. Include details of support framing system.
8. Include details of exposed conduits, if required, for service fittings.
9. Indicate locations of and clearances from adjacent walls, doors, windows, other building components, and laboratory equipment.
10. Include coordinated dimensions for laboratory equipment specified in other Sections.

C. Keying Schedule: Include schematic keying diagram, and index each key set to unique designations that are coordinated with the Contract Documents.

D. Samples: For casework finishes and materials requiring color selection.

E. Samples for Initial Selection: For casework finishes and materials requiring color selection.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Product Test Reports:

1. Casework: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating compliance of laboratory casework with requirements of specified product standard **and system structural performance specified in "Performance Requirements" Article.**
2. Countertop Surface Material: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating compliance of laboratory countertop surface material with requirements specified for chemical and physical resistance.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or other suitable material.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install laboratory casework until building is enclosed, utility roughing-in and wet-work are complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

- B. Established Dimensions: Where laboratory casework is indicated to fit to other construction, establish dimensions for areas where casework is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.
- C. Field Measurements: Where laboratory casework is indicated to fit to existing construction, verify dimensions of existing construction by field measurements before fabrication and indicate measurements on Shop Drawings. Provide fillers and scribes to allow for trimming and fitting.
- D. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before enclosing them, and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain laboratory casework from single source from single manufacturer unless otherwise indicated.
 - 1. Acceptable Manufacturer: Mott Manufacturing Ltd.
- B. Product Designations: Drawings indicate sizes and configurations of laboratory casework by referencing designated manufacturer's catalog numbers. Other manufacturers' laboratory casework of similar sizes and similar door and drawer configurations and complying with Specifications may be considered. See Section 016000 "Product Requirements."

2.2 CASEWORK, GENERAL

- A. Casework Product Standard: Comply with SEFA 8 M, "Laboratory Grade Metal Casework."
- B. Flammable Liquid Storage: Where cabinets are indicated for solvent or flammable liquid storage, provide units that are listed and labeled as complying with requirements in NFPA 30 by **a testing and inspecting agency acceptable to authorities having jurisdiction.**
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 METAL LABORATORY CASEWORK

- A. Steel Sheet: Cold-rolled, commercial steel (CS) sheet, complying with ASTM A1008/A1008M; matte finish; suitable for exposed applications.
- B. Nominal Metal Thickness:
 - 1. Sides, Ends, Fixed Backs, Bottoms, Tops, Soffits, and Items Not Otherwise Indicated: 0.048 inch. Except for flammable liquid storage cabinets, bottoms may be 0.036 inch if reinforced.

2. Back Panels, Doors, Drawer Fronts and Bodies, and Shelves: 0.036 inch except 0.048 inch for back panels and doors of flammable liquid storage cabinets and for unreinforced shelves more than 36 inches long.
3. Intermediate Horizontal Rails, Table Aprons and Cross Rails, Center Posts, and Top Gussets: 0.060 inch.
4. Drawer Runners, Sink Supports, and Hinge Reinforcements: 0.075 inch.
5. Leveling and Corner Gussets: 0.105 inch.

2.4 AUXILIARY CABINETS

- A. Acid Storage-Cabinet Lining: 1/4-inch-thick, **glass-fiber cement board complying with ASTM C1186 or polyethylene, polypropylene, epoxy, or phenolic-composite lining material.**
- B. Laminated Glass for Glazed Doors: Clear laminated annealed glass complying with ASTM C1172, Kind LA, Condition A, Type I, Class I, Quality-Q3; with two plies not less than 3.0 mm thick and with clear, polyvinyl butyral interlayer.
- C. Frameless Glass Doors: Clear tempered glass complying with ASTM C1048, Kind FT, Condition A, Type I, Class 1, Quality-Q3; not less than **[5.0 mm] [6.0 mm]** thick; with exposed edges seamed before tempering.

2.5 CABINET HARDWARE

- A. General: Provide laboratory casework manufacturer's standard, commercial-quality, heavy-duty hardware complying with requirements indicated for each type.
- B. Hinges: **[Stainless]** steel, five-knuckle hinges complying with BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Provide two for doors 48 inches high or less and three for doors more than 48 inches high.
- C. Hinged-Door and Drawer Pulls: **Stainless steel**, back-mounted pulls. Provide two pulls for drawers more than 24 inches wide.
 1. Design: **[As selected from manufacturer's full range]**
 2. Overall Size: **[As selected from manufacturer's full range]**
- D. Sliding-Door Pulls: **[Stainless steel or chrome-plated] [Epoxy-coated-steel]** recessed flush pulls.
 1. Design and Size: **[As selected from manufacturer's full range]**
- E. Recessed Pulls: **[Aluminum]**. Provide two pulls for drawers more than 24 inches wide.
- F. Channel Pulls: Full-width, recessed channel pulls; integrally formed from front pan of doors and drawer fronts.
- G. Door Catches: **[Permanent magnet]** catches. Provide two catches on doors more than 48 inches high.

H. Drawer Slides: ANSI/BHMA A156.9.

1. Manufacturer's standard.
2. General-purpose drawers; provide **100 lb** load capacity.
3. File drawers; provide **150 lb** load capacity.

I. Locks: Cam or half-mortise type, brass with chrome-plated finish; complying with BHMA A156.11, Type E07281, [**Type E07261,**] Type E07111, or Type E07021.

J. Sliding-Door Hardware Sets: Laboratory casework manufacturer's standard, to suit type and size of sliding-door units.

2.6 COUNTERTOPS

A. General: Provide laboratory tabletops and countertops as indicated on Drawings.

B. Phenolic Composite: Solid, high-pressure decorative laminate, complying with NEMA LD 3, Grade CGS.

1. Chemical Resistance: Composite countertop material has the following ratings when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.4.5:

- a. No Effect: Acetic acid (98 percent), acetone, ammonium hydroxide (28 percent), ethyl acetate, ethyl alcohol, formaldehyde (37 percent), furfural, phosphoric acid (85 percent), sulfuric acid (33 percent), toluene, [benzene] [carbon tetrachloride] [dimethyl formamide] [hydrochloric acid (37 percent)] [hydrofluoric acid (48 percent)] [nitric acid (30 percent)] [sodium hydroxide (20 percent)] [and] [zinc chloride].

2. Color: **As selected by Architect from phenolic-composite manufacturer's full range.**

C. Stainless Steel Sheet: ASTM A240/A240M, [Type 304] [Type 316L].

2.7 LABORATORY CASEWORK SYSTEMS

A. Provide casework manufacturer's standard integrated system that includes support framing, suspended modular cabinets, filler and closure panels, **wall panels**, countertops, and fittings needed to assemble system. System includes hardware and fasteners for securing support framing to permanent construction.

1. Cabinets can be removed and reinstalled without use of special tools for relocation within system.
2. Base cabinets can be removed without providing temporary support for, or removing, countertops.
3. Sinks are supported independent of base cabinets.
4. Support framing has provision for fastening pipe supports at utility space in not more than 1-inch increments.

5. System includes filler and closure panels to close spaces between support framing, cabinets, shelves, countertops, floors, and walls unless otherwise indicated. Fabricate panels from same material and with same finish as metal cabinets and with hemmed or flanged edges.
- B. Support Framing: Casework manufacturer's standard system consisting of vertical supports and connecting braces and rails as follows:
 1. Cabinets, shelves, and countertops are supported from vertical supports **except where floor-supported base cabinets are indicated**. Vertical positioning of supported cabinets, shelves, and countertops can be varied in 1-inch increments through full height of supports.
 2. Vertical supports rest on adjustable leveling bases and are secured to floor with metal clips fastened to floor.
 3. Vertical supports are installed with braces and rails, connecting them to each other and to permanent building walls to create a stable, rigid structure with framed utility spaces where indicated.
- C. Countertops: Provide in modular lengths indicated, without seams.

2.8 METAL CABINET FINISH

- A. General: Prepare, treat, and finish welded assemblies after assembling. Prepare, treat, and finish components that are to be assembled with mechanical fasteners before assembling. Prepare, treat, and finish concealed surfaces same as exposed surfaces.
- B. Preparation: After assembly, clean surfaces of mill scale, rust, oil, and other contaminants. After cleaning, apply a conversion coating suited to organic coating to be applied over it.
- C. Chemical-Resistant Finish: Immediately after cleaning and pretreating, apply laboratory casework manufacturer's standard two-coat, chemical-resistant, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.
 1. Chemical and Physical Resistance of Finish System: Finish complies with acceptance levels of cabinet surface finish tests in SEFA 8 M. Acceptance level for chemical spot test shall be no more than for Level 3 conditions.

2.9 LABORATORY ACCESSORIES

- A. Reagent Shelves: Provide as indicated, fabricated from same material as adjacent countertop unless otherwise indicated.
- B. Plastic or Resin Pegboards: Polypropylene, epoxy, or phenolic-composite pegboards with removable polypropylene pegs and stainless steel drip troughs with drain outlet.

2.10 WATER AND LABORATORY GAS SERVICE FITTINGS

A. Pure Water Faucets:

1. Chrome plated, forged brass, tin lined fitting with manual closure valve.
2. Deck mount with 6" rigid gooseneck and removable serrated nozzle.
3. Coordinate valve handle orientation with cup sinks and lab sink arrangements as well as with swing down eyewash fitting.
4. Color coded service identifier tag.
5. Watersaver, Model L691 or approved equal.

B. Laboratory Mixing Faucets:

1. Chrome plated, forged brass, mixing valve.
2. Deck mount with 6" rigid/ swing gooseneck and removable serrated nozzle.
3. Vacuum breaker, manual valve closure.
4. Color coded service identifier tag.
5. Watersaver, Model L414VB or approved equal.

C. Laboratory Sink Drain fitting:

1. Chrome plated, forged brass, strainer grid.
2. Solids restrictors with forged brass or fire retardant polypropylene drain fitting and tailpiece.

D. Laboratory Gas Cocks:

1. Chrome plated, forged brass, needle valve.
2. Chrome plated forged brass, ball valve.
3. Deck mount turret with single or 180° dual valves.
4. Clamp type mount for mobile casework systems.
5. Color coded service identifier tag.
6. Watersaver, Model L2880 for deck mount needle valve or approved equal.
7. Watersaver, Model L4200 for deck mount ball valve or approved equal.
8. Provide similar fittings for modular casework systems with clamping accessories.

E. Utility Hoses: Utility hoses for modular laboratory casework systems.

1. 3/8" ID., PVC, nylon reinforced hose with working pressure range from 24" wc. Vacuum to 300 psig. Color coded hose coordinated with quick coupling color, identifying utility.
2. 3/8" ID., corrugated stainless steel appliance connector, working pressure range to of 50 psig.
3. Permanent, quick coupling plug, end connections to match service panel and valve connections.
4. Unique, standardized coupling for each service.
5. End connection to match gas cock connection.
6. Compressed Air and Vacuum: Mott PVHA or approved equal.
7. Natural Gas: Mott, Corrugated stainless steel tubing.

F. Quick Couplings:

1. 3/8" NPT end connection with color coded band.
2. Coupling in panel, plug fitting on hose.
3. Working pressure range, vacuum to 150 psig.
4. Coordinate with ceiling mounted service panel.
5. Mott, MCPV or approved equal.

- G. Overhead Service Panels:
 - 1. Powder coated steel panel with structural return bend, lay in ceiling grid, 24" x 12", color white.
 - 2. Pre-punched for utility connections. (coordinate with plumbing, electrical and data.)
 - 3. Mott, OSP or approved equal.

2.11 ELECTRICAL AND COMMUNICATION SERVICE FITTINGS

A. Mobile Laboratory Benches

- 1. Electric Surface Raceways
 - a. (1) two channel, steel raceway installed on each side of bench. Raceway finish to match bench finish.
 - b. Raceways mounted on upper shelving supports, above benchtop.
 - c. Bench is prewired for (2) 120 volt / 20 amp circuits per bench.
 - d. (6) duplex receptacles (NEMA 5-20R) installed on each side of bench.
 - e. (1) power cord with twistlock plug (NEMA L14-20P) per bench assembly
 - f. Dedicated channel for data.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of reinforcements, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF CABINETS

- A. Comply with installation requirements in SEFA 2. Install level, plumb, and true in line; shim as required using concealed shims. Where laboratory casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical. Do not exceed the following tolerances:
 - 1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet.
 - 2. Variation of Bottoms of Upper Cabinets from Level: 1/8 inch in 10 feet.
 - 3. Variation of Faces of Casework from a True Plane: 1/8 inch in 10 feet.
 - 4. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch.
 - 5. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch.
- B. Utility-Space Framing: Secure to floor with two fasteners at each frame. Fasten to partition framing, wood blocking, or metal reinforcements in partitions and to base cabinets.

- C. Base Cabinets: Fasten cabinets to utility-space framing, partition framing, wood blocking, or reinforcements in partitions, with fasteners spaced not more than 16 inches o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform.
 - 1. Where base cabinets are installed away from walls, fasten to floor at toe space at not more than 24 inches o.c. and at sides of cabinets with not less than two fasteners per side.
- D. Wall Cabinets: Fasten to hanging strips, masonry, partition framing, blocking, or reinforcements in partitions. Fasten each cabinet through back, near top, at not less than 16 inches o.c.
- E. Install hardware uniformly and precisely.
- F. Adjust operating hardware so doors and drawers align and operate smoothly without warp or bind and contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.

3.3 INSTALLATION OF COUNTERTOPS

- A. Comply with installation requirements in SEFA 2. Abut top and edge surfaces true in plane with flush hairline joints and with internal supports placed to prevent deflection. Locate joints where indicated on Shop Drawings.
- B. Field Jointing: Where possible, make in same manner as shop-made joints, using dowels, splines, fasteners, adhesives, and sealants recommended by manufacturer. Shop prepare edges for field-made joints.
 - 1. Plastic-Laminate Countertops: Secure field-made joints using concealed clamping devices located within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten in accordance with manufacturer's written instructions to exert a uniform heavy pressure at joints.
- C. Fastening:
 - 1. Secure countertops, except for epoxy countertops, to cabinets with Z-type fasteners or equivalent, using two or more fasteners at each cabinet front, end, and back.
 - 2. Secure epoxy countertops to cabinets with epoxy cement, applied at each corner and along perimeter edges at not more than 48 inches o.c.
 - 3. Where necessary to penetrate countertops with fasteners, countersink heads approximately 1/8 inch and plug hole flush with material equal to countertop in chemical resistance, hardness, and appearance.
- D. Provide holes and cutouts required for service fittings.
- E. Seal unfinished edges and cutouts in plastic-laminate countertops with heavy coat of polyurethane varnish.
- F. Provide scribe moldings for closures at junctures of countertop, curb, and splash with walls as recommended by manufacturer for materials involved. Match materials and finish to adjacent laboratory casework. Use chemical-resistant, permanently elastic sealing compound where recommended by manufacturer.

- G. Dress joints smooth, remove surface scratches, and clean entire surface.

3.4 INSTALLATION OF SINKS

- A. Comply with installation requirements in SEFA 2.
- B. Drop-in Installation of Epoxy Sinks: Rout groove in countertop to receive sink rim if not shop prepared. Set sink in adhesive and fill remainder of groove with sealant or adhesive. Use procedures and products recommended by sink and countertop manufacturers. Remove excess adhesive and sealant while still wet and finish joint for neat appearance.
- C. Underside Installation of Epoxy Sinks: Use laboratory casework manufacturer's recommended adjustable support system for table- and cabinet-type installations. Set top edge of sink unit in sink and countertop manufacturers' recommended chemical-resistant sealing compound or adhesive, and firmly secure to produce a tight and fully leakproof joint. Adjust sink and securely support to prevent movement. Remove excess sealant or adhesive while still wet and finish joint for neat appearance.
- D. Semiflush Installation of Stainless Steel Sinks: Before setting, apply sink and countertop manufacturers' recommended sealant under rim lip and along top. Remove excess sealant while still wet and finish joint for neat appearance.
- E. Installation of Epoxy and Polypropylene Cup Sinks:
 - 1. Drop-in Installation: Rout groove in countertop to receive sink rim if not shop prepared. Set sink in adhesive and fill remainder of groove with sealant or adhesive. Use procedures and products recommended by sink and countertop manufacturers. Remove excess adhesive and sealant while still wet and finish joint for neat appearance.
 - 2. Surface Installation: Set sink in sealant or adhesive. Use procedures and products recommended by sink and countertop manufacturers. Remove excess sealant or adhesive while still wet and finish joint for neat appearance.
- F. Installation of Plumbing Fittings:
 - 1. Install grid drain and tailpieces on cup sinks and sinks.

3.5 INSTALLATION OF LABORATORY ACCESSORIES

- A. Install accessories in accordance with Shop Drawings, installation requirements in SEFA 2, and manufacturer's written instructions.
- B. Securely fasten adjustable shelving supports, stainless steel shelves, and pegboards to partition framing, wood blocking, or reinforcements in partitions.
- C. Install shelf standards plumb and at heights to align shelf brackets for level shelves. Install shelving level and straight, closely fitted to other work where indicated.
- D. Securely fasten pegboards to partition framing, wood blocking, or reinforcements in partitions.

3.6 INSTALLATION OF SERVICE FITTINGS

- A. Comply with requirements in other Sections for installing water and laboratory gas service fittings and electrical devices and this Section.
- B. Install fittings in accordance with Shop Drawings, installation requirements in SEFA 2, and manufacturer's written instructions. Set bases and flanges of sink- and countertop-mounted fittings in sealant recommended by manufacturer of sink or countertop material. Securely anchor fittings to laboratory casework unless otherwise indicated.
- C. Coordinate fittings with laboratory casework, plumbing and electrical/ data utilities.

3.7 CLEANING AND PROTECTING

- A. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.
- B. Protect countertop surfaces during construction with 6-mil plastic or other suitable water-resistant covering. Tape to underside of countertop at a minimum of 48 inches o.c.

3.8 PLUMBING ACCESSORIES SCHEDULE.

- A. Deck Mount Pure Water Faucets.
 - 1. Chrome plated, 6" rigid gooseneck with manual operation valve.
- B. Deck Mount Mixing Faucet.
 - 1. Chrome plated, 6" rigid/ swing gooseneck mixing faucet with vacuum breaker.
- C. Laboratory Gas Cocks.
 - 1. Chrome plated valve with serrated nozzle.
 - 2. Deck mount with single or dual turret.
 - 3. Fitting clamp for modular casework systems on rail.
 - 4. Compressed Air and Natural Gas: Needle valve
 - 5. Vacuum: Ball valve.
- D. Laboratory Gas Hoses.
 - 1. Compressed air and Vacuum: PVC Hose.
 - 2. Natural Gas: Corrugated Stainless Steel Appliance Hose.
- E. Overhead Service Panels.
 - 1. Ceiling Mount: Powder coated service panel with quick couplings, electrical connections and data ports.

END OF SECTION 123553.13

SECTION 123661.16 - SOLID SURFACING COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid surface material countertops.
2. Solid surface material backsplashes.
3. Solid surface material end splashes.

1.2 ACTION SUBMITTALS

A. Product Data: For countertop materials **and sinks**.

B. Sustainable Design Submittals:

C. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

1. Show locations and details of joints.
2. Show direction of directional pattern, if any.

D. Samples for Initial Selection: For each type of material exposed to view.

E. Samples for Verification: For the following products:

1. Countertop material, 6 inches square.
2. One full-size solid surface material countertop, with front edge **and backsplash**, 8 by 10 inches, of construction and in configuration specified.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops like that required for this Project, and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of countertops.
- C. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.
 - 1. Build mockup of typical countertop as indicated on Drawings.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements **after base cabinets are installed but** before countertop fabrication is complete.

1.7 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 SOLID SURFACE COUNTERTOP MATERIALS

- A. Solid Surface Material: Homogeneous-filled plastic resin complying with ISFA 2-01.
 - 1. Type: Provide Standard type
 - 2. Colors and Patterns: [**As indicated by manufacturer's designations**]].

2.2 FABRICATION

- A. Countertops:
 - 1. [**3/4-inch- (19-mm-)**] thick, solid surface phenolic resin material [**with front edge built up with same material**].
- B. Backsplashes: [**3/4-inch-**] thick, solid surface material.
- C. Cutouts and Holes:
 - 1. Undercounter Plumbing Fixtures: Make cutouts for fixtures[**in shop**] using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

- a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch into fixture opening.
 - b. Provide vertical edges, rounded to 3/8-inch radius at juncture of cutout edges with top surface of countertop, slightly eased at bottom, and projecting 3/16 inch into fixture opening.
 - c. Provide 3/4-inch full bullnose edges projecting 3/8 inch into fixture opening.
2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by solid surface material manufacturer.
- B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.
- B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
- D. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop,

form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

- E. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
 - 1. Install metal splines in kerfs in countertop edges at joints[**where indicated**]. Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.
 - 2. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.
- F. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
- G. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer.
- H. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
 - 1. Seal edges of cutouts in particleboard subtops by saturating with varnish.
- I. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION 123661.16

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel pipe and fittings.
2. Air vent.
3. Valves
4. Sprinkler piping specialties.
5. Sprinklers.
6. Manual control stations.
7. Pressure gauges.

1.2 CODES AND STANDARDS

A. Comply with the following codes and standards:

1. Fire Code of New York State
2. All other related Codes of New York State
3. NFPA 13, NFPA 25 and related NFPA Standards
4. FM Global Standards. (Refer to FM Data Sheets at www.fmglobal.com)
5. The requirements of the Authority Having Jurisdiction (AHJ)

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For wet-pipe sprinkler systems.

1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.
3. Design Submittals: Shop drawings and hydraulic calculations for wet-pipe sprinkler systems are to comply with performance requirements and design criteria in these specifications, prepared and sealed by a Registered Professional Engineer in the State of New York.
4. Include calculations for future sprinkler piping to fully sprinkle the second floor of the VRT Building.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Sprinkler system plans and sections, to be drawn to scale, showing the items described in this Section and coordinated with all building trades.

- B. Qualification Data: For qualified Installer.
- C. Design Data: Approved sprinkler piping working plans, prepared according to FM Global Data Sheets and NFPA 13, which ever is more stringent, including documented approval by authorities having jurisdiction, and including hydraulic calculations. The calculations are to be submitted to the Cornell University Fire Protection Engineer.
- D. Pipe Sizing Criteria: The design pressure shall be a minimum of 10 PSIG greater than the minimum system requirement. Maximum design velocity for sprinkler piping shall not exceed 20 feet per second.
- E. Field Test Reports: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
- F. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
- B. Redlines of any changes to the fire protection system.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer registered in the State of New York.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Sprinkler system equipment, specialties, accessories, installation, and testing to comply with FM Global and NFPA 13.
- C. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
 - 1. Available fire-pump flow test records indicate the following conditions:

- a. Date: 05-20-2022.
 - b. Time: 08:36 a.m.
 - c. Performed by: Dustin Brunner of Cornell University.
 - d. Pump test data:
 - 1) Churn. 69 psi suction, 137 psi discharge, 0 gpm.
 - 2) 50%. 66 psi suction, 134 psi discharge, 250 gpm.
 - 3) 100%. 60 psi suction, 120 psi discharge, 500 gpm.
 - 4) 150%. 52 psi suction, 104 psi discharge, 750 gpm.
 - e. Location of Fire Pump: VRT basement.
2. Sprinkler Occupancy Hazard Classifications:
- a. University Research Laboratory, associated support spaces and offices: FM Global, Fire Protection for Non-storage Occupancies, Hazard Class, HC-2.
 - b. System design to be FMG, HC-2 future. (After overall building and replacement fire pump is in place)
 - c. Density for system using existing fire pump, reduced design parameters: FM Global, HC-1. 0.15 GPM over 1,500 sq. ft.
3. Minimum Density for Automatic-Sprinkler Piping Design:
- a. Hazard Class HC-2: 0.20 gpm/sq. ft. over 2,500 sq. ft.
4. Maximum Protection Area per Sprinkler:
- a. Entire Second Floor: 130 sq. ft./ Hd.
- D. Obtain documented approval of sprinkler system design from authorities having jurisdiction.

2.2 STEEL PIPE AND FITTINGS

- A. 1" - 4", Schedule 40 Steel Pipe: ASTM A53, Type F Furnace butt welded, Grade A. MIC preventative internal coating. Pipe ends may be factory or field formed to match joining method.
- B. 6" - 8", Schedule 40 Steel Pipe: ASTM A53, Type E electrically welded longitudinal seam, Grade B. MIC preventative internal coating. Pipe ends may be factory or field formed to match joining method.
- C. Steel Pipe Nipples: black-steel pipe, ASTM A733, made of ASTM A53/A53M, standard-weight, seamless steel pipe with threaded ends. To match standard pipe materials and coatings.
- D. Steel Couplings: ASTM A865/A865M, threaded.
- E. Gray-Iron Threaded Fittings: Gray-iron threaded fittings, ASME B16.4, Class 125, standard pattern.

- F. Malleable- or Ductile-Iron Unions: UL 860.
- G. Cast-Iron Flanges: ASME 16.1, Class 125.
- H. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
 - 1. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic and asbestos free or EPDM rubber gasket.
 - a. Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
 - b. Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.
- I. Grooved-Joint, Steel-Pipe Appurtenances:
 - 1. Pressure Rating: 175-psig minimum.
 - 2. Grooved-End Fittings for Steel Piping: Painted grooved-end fittings, ASTM A47/A47M, malleable-iron casting or ASTM A536, ductile-iron casting, with dimensions matching steel pipe.

2.3 AIR VENT AND SYSTEM DRAINS.

- A. Manual Air Vent, Drain and Flushing Valves:
 - 1. Description: Manual ball valve.
 - 2. Body: Forged brass.
 - 3. Ends: Threaded.
 - 4. Type: Standard Port for vents, Full Port for drains.
 - 5. Minimize Size: 1/2 inch for vent valves, 1" for low point drains and flushing valves.
 - 6. Minimum Water Working Pressure Rating: 300 psig.
 - 7. Standard: UL listed or FM Global approved for use in wet-pipe fire sprinkler system.

2.4 VALVES

- A. IRON BODY BUTTERFLY VALVES WITH INDICATORS
 - 1. Standard: UL 1091 and FM Global standard for indicating valves, butterfly type.
 - a. Minimum Pressure Rating: 175 psig.
 - b. Body Material: Cast or ductile iron with nylon, EPDM, epoxy, or polyamide coating].
 - c. Seat Material: EPDM.
 - d. Stem: Stainless steel.
 - e. Disc: Ductile iron, nickel plated and EPDM or SBR coated.
 - f. Actuator: Worm gear.
 - g. Supervisory Switch: External.
 - h. Body Design: Lug Style.
 - 2. Acceptable Manufacturers:
 - a. Central Sprinkler Corp.

- b. Kennedy Valve
- c. NIBCO Inc.
- d. Milwaukee Valve
- e. Victaulic Company
- f. Watts.

B. CHECK VALVES

1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.
 - a. Minimum Pressure Rating: 175 psig.
 - b. Type: Single swing check.
 - c. Body Material: Cast iron, ductile iron, or bronze.
 - d. Clapper: Bronze.
 - e. Clapper Seat: Brass.
 - f. Hinge Shaft: Bronze.
 - g. Hinge Spring: Stainless steel.
 - h. End Connections: Flanged, grooved, or threaded.
2. Acceptable Manufacturers:
 - a. Kennedy Valve
 - b. Mueller Valve
 - c. Viking Group

C. BRONZE BALL VALVES

1. Standard: UL 258 and FM Global standard for fire-service valves.
 - a. Minimum Pressure Rating: 175 psig.
 - b. Body and Bonnet Material: Bronze.
 - c. Ball: Full Port, Brass with Chrome plating.
 - d. Seat: EPDM or TFE.
 - e. Stem: Brass or bronze.
 - f. Packing: Non-asbestos PTFE.
 - g. Supervisory Switch: Not required.
 - h. End Connections: Threaded.
2. Acceptable Manufacturers:
 - a. Central Sprinkler Corp.
 - b. Kennedy Valve
 - c. NIBCO Inc.
 - d. Milwaukee Valve
 - e. Victaulic Company
 - f. Watts.

2.5 SPRINKLER PIPING SPECIALTIES

- A. Auto-Test Zone Flow Switch: Zone flow switch with auto test, does not require drain for testing.

1. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
2. Pressure Rating: 175-psig.
3. Body Material: Cast iron Saddle and Steel U-bolt.
4. Size: 2 ½".
5. Flow Switch: (2) SPDT, form C, 10A @125 vac. NEMA 4,
6. Trip Flow: 4-10 gpm.
7. Addressable Relays: Yes.
8. Adjustable Signal Retard: 0-90 Sec.
9. Power Requirements: 24 vdc.
10. Mfg: Potter VSR AT-4.

B. Flexible Sprinkler Hose Fittings:

1. Standard: UL 1474.
2. Type: Flexible hose for connection to sprinkler, and with bracket for connection to suspended ceiling grid.
3. Pressure Rating: 175-psig minimum.
4. Size: Same as connected piping, for sprinkler.
5. Mfg: Reliable Automatic Sprinkler Company

2.6 SPRINKLERS

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Pressure Rating for Automatic Sprinklers: 175-psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Quick Response Applications: UL 1767.
2. Nonresidential Applications: UL 199.
3. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6 for HC-1 Occupancy, Nominal 3/4" orifice with Discharge Coefficient K of 8.0 for HC-2 Occupancy unless otherwise indicated or required by application.
4. Temperature Rating: 165° F head. Provide 135° F rated cover for concealed head.

D. Sprinkler Finishes:

1. Ceiling Mounting: Factory painted, - White, Concealed type head and cover.
2. Sidewall Mounting: Factory painted, white finish.
3. Utility areas: Bronze, natural finish, upright.

E. Sprinkler Guards:

1. Standard: UL 199.
2. Type: Wire cage with fastening device for attaching to sprinkler.

F. Acceptable Manufacturers:

1. Reliable Automatic Sprinkler Company.
2. Victaulic Company

2.7 MANUAL CONTROL STATIONS

- A. Field assembled from specified components.
- B. Factory Assembled zone control station meeting component specifications.

2.8 PRESSURE GAUGES

- A. Standard: UL 393.
- B. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- C. Pressure Gauge Range: 0- to 250-psig.
- D. Label: Include "WATER" label on dial face.
- E. Available Manufacturers:
 - 1. Ashcroft
 - 2. Winters
 - 3. Approved Equal.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
 - 2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- B. Piping Standard: Comply with FM Global Data Sheets and NFPA 13 requirements for installation of sprinkler piping. Where there deviations between standards, use the more stringent standard.
- C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

- G. Install sprinkler piping with drains for complete system drainage.
- H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- I. Install alarm devices in piping systems.
- J. Install hangers and supports for sprinkler system piping according to NFPA 13.
- K. Install pressure gauges on zone branch at each flow test connection,
- L. Fill wet system sprinkler piping with water.
- M. Install sleeves for piping penetrations of walls, ceilings, and floors.
- N. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.2 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- I. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.3 INSTALLATION OF VALVES AND SPECIALTIES

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection.
- D. Specialty Valves:
 - 1. Install valves in Horizontal position for proper direction of flow, in main supply to system.
- E. Air Vent and Drain Valves:
 - 1. Provide at least one air vent in each wet pipe sprinkler system in accordance with NFPA 13 requirements. Connect vent into top of fire sprinkler piping.
 - 2. Provide drain valves at each low point in the fire sprinkler piping.
 - 3. Provide dielectric union for dissimilar metals, ball, or globe valve.
 - 4. Install threaded plug-in air vent and drain valves.

3.4 INSTALLATION OF SPRINKLERS

- A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.
- B. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid where flexible connections are used.

3.5 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 4. Energize circuits to electrical equipment and devices.

5. Coordinate with fire-alarm tests. Operate as required.
6. Coordinate with fire-pump tests. Operate as required.

- B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.7 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.8 PIPING SCHEDULE

- A. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 2 and Smaller, to Be One of the Following:
 1. Standard-Weight, Schedule 40, black-steel pipe with threaded ends with MIC preventative internal coating, gray-iron threaded fittings; and threaded joints.
 2. Standard-weight, Schedule 40, black-steel pipe with cut grooved ends, MIC preventative internal coating, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- B. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 2-1/2 to NPS 4 (DN 65 to DN 100), to Be One of the Following:
 1. Standard-weight, Schedule 40], black-steel pipe with cut grooved ends, MIC preventative internal coating, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.9 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
 1. Rooms without Ceilings: Upright sprinklers.
 2. Rooms with Suspended Ceilings: Concealed sprinklers.
 3. Wall Mounting: Sidewall sprinklers.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
 1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
 2. Upright Sprinklers: Rough brass. Provide wire guard where head is located below 8 feet.
 3. Sidewall Sprinklers: Factory painted, white.

3.10 SPRINKLER VALVE SCHEDULE

- A. Zone Isolation: Iron butterfly valve.

- B. Zone Check Valve: Cast iron, ductile iron, or bronze.
- C. Air Vent, Drain and Flushing Valves: Bronze ball valve.
 - 1. Flushing valves shall be installed so as to maintain a minimum of 10 ft./sec velocity for any given pipe size, per NFPA 25.
 - 2. Flushing valve, general sizing to be as follows:
 - a. 1" to 2 ½" pipe size: Line size full port bronze ball valve.
 - b. 3" pipe: One (1) 2 ½" bronze ball valve.
 - c. 4" pipe: Two (2) 2 ½" bronze ball valve.

END OF SECTION 211313

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Penetrations through fire rated construction.
 - 5. Grout.
 - 6. Plumbing demolition.
 - 7. Equipment installation requirements common to equipment sections.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, and spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. CPVC: Chlorinated polyvinyl chloride plastic.
 - 2. PE: Polyethylene plastic.
 - 3. PP: Polypropylene plastic
 - 4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.
3. PTFE: Polytetrafluoroethylene. (Teflon)

1.4 QUALITY ASSURANCE

- A. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.6 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate work with other trades to remove existing pipe and supports from existing walls to be replaced. Determine the extent of the demolition and remove supports and pipe in effected areas.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- C. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

2.4 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Available Manufacturers:
 - a. Eslon Thermoplastics.
 - b. IPEX Endfield
- B. Plastic-to-Glass Transition Fittings: FRPP, Fire Retardant Polypropylene, 1-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with proprietary clamp connection and one with threaded or electrofusion joint.
 - 1. Available Manufacturers:
 - a. IPEX Endfield

2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting that is design to eliminate electrolytic reactions with dissimilar metals. Plain flanged end connection with electrically isolated sleeve for bolts.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Do not use dielectric unions on Cornell University piping systems.
- D. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- E. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

- F. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene, or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.6 PENETRATIONS THROUGH FIRE RATED CONSTRUCTION

- A. Fire stopping systems shall maintain a barrier against the spread of flame, smoke, and vapors in adverse conditions caused by extreme heat. Systems shall be UL listed for the specific application.
 - 1. Available Manufacturers:
 - a. Hilti USA
 - b. 3M Corporation
 - c. Approved Equal
 - 2. Fire Rated Assemblies:
 - a. Refer to plumbing details for specific assemblies and fire ratings.
 - b. Alternate assemblies are to be submitted, for review prior to ordering and installing materials.

2.7 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Short lengths are allowed to be abandoned in place. Remove long lengths of abandoned pipe unless otherwise noted. Cap or plug piping with same or compatible piping material rated for system temperature and pressure.
 - 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.

- 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials that form a UL listed assembly to match the fire rating.
- M. Verify final equipment locations for roughing-in.
- N. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Wet Piping Systems: Install dielectric fittings/ flanges to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel, and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.6 PENETRATIONS THROUGH FIRE RATED CONSTRUCTION.

- A. Plumbing and process pipe penetrations through fire rated construction shall be sealed using UL rated assemblies that have the same rating as the rating of floors, walls and barriers being breached.
- B. Contractor shall provide and install fire rated assemblies using specified clearances, fill materials, escutcheons, insulation, and manufacturers installation procedures to maintain rating in accordance with the UL listed assemblies.
- C. A manufacturer's representative (not distributor or agent) shall conduct training of construction personnel for installation of systems and procedures to be used on the construction site, prior to the start of pipe installation.
- D. Manufacturers representative shall list each individual that has received training and certify that the installation requirements for the systems being installed have been taught.

3.7 PAINTING

- A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

3.9 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 220500

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves without water stop.
2. Sleeve-seal systems.
3. Grout.
4. Silicone sealants.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES WITHOUT WATER STOP

- A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends.
- B. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot dip galvanized, with plain ends.
- C. Steel Sheet Sleeves: ASTM A653/A653M, 0.0239-inch minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.

2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
1. Designed to form a hydrostatic seal of 5 psig minimum.
 2. Sealing Elements: High-temperature-silicone.
 3. Pressure Plates: Stainless steel.
 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 GROUT

- A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000 psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.4 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.
 - 1. Standard: ASTM C920, Type S, Grade NS, Class 25, Use NT.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES - GENERAL

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas **2 inches** above finished floor level.
 - 3. Using **grout or silicone sealant**, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide **1/4-inch** annular clear space between sleeve and pipe or pipe insulation.

3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.

- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping.", and per details on the drawings.

3.2 INSTALLATION OF SLEEVE-SEAL SYSTEMS

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building and passing through exterior walls.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
 2. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
- B. Prepare test and inspection reports.

3.4 SLEEVE SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 1. Concrete Slabs above Grade:
 - a. Sleeves with water stops.
 2. Interior Partitions:
 - a. Sleeves without water stops.

END OF SECTION 220517

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Escutcheons.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
 1. Escutcheons for New Piping and Relocated Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
 - b. Chrome-Plated Piping: One-piece steel with polished, chrome-plated finish.
 - c. Insulated Piping: One-piece steel with polished, chrome-plated finish.
 - d. Insulated Piping: One-piece stamped steel with polished, chrome-plated finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
 - f. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stamped steel with polished, chrome-plated finish.
 - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.

- h. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stamped steel with polished, chrome-plated finish.

3.2 FIELD QUALITY CONTROL

- A. Using new materials, replace broken and damaged escutcheons.

END OF SECTION 220518

SECTION 220519 - VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Brass ball valves.
2. Bronze ball valves.
3. CPVC Corzan® Ball Valves

1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Standards:

1. Domestic water valves intended to convey or dispense water for human consumption or for tepid water must comply with NSF 61 and NSF 372 that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.5 for flanges on steel valves.
4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
5. ASME B16.18 for cast copper solder-joint connections.
6. ASME B16.22 for wrought copper and copper alloy solder-joint connections.
7. ASME B16.34 for flanged and threaded end connections
8. ASME B31.9 for building services piping valves.

C. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

D. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

E. Valve Sizes: Same as upstream piping unless otherwise indicated.

F. Valve Actuator Type:

1. Hand Lever: For quarter-turn valves smaller than NPS 2.

G. Valves in Insulated Piping:

1. Provide 2-inch (50-mm) extended neck stems.
2. Extended operating handles with nonthermal-conductive covering material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

2.2 BRASS BALL VALVES

A. Brass Ball Valves, Two Piece with Full Port and Stainless-Steel Trim, Threaded, Soldered or ProPress Ends:

1. Standard: MSS SP-110; MSS SP-145; IAPMO/ANSI Z1157.
2. CWP Rating: Minimum 200 psig.
3. Body Design: Two piece.
4. Body Material: Forged brass.
5. Ends: Threaded, Soldered or Viega ProPress.
6. Press-End Connections Rating: Minimum 200 psig.
7. Seats: PTFE or RPTFE.
8. Stem: Stainless steel.
9. Ball: Stainless steel, vented.
10. Port: Full.
11. O-Ring Seal: Buna-N or EPDM.

2.3 BRONZE BALL VALVES

A. Bronze Ball Valves, Two Piece with Full Port, and Bronze or Brass Trim, Threaded, Soldered or ProPress Ends:

1. Standard: MSS SP-110; MSS SP-145.
2. CWP Rating: 600 psig (4140 kPa).
3. Body Design: Two piece.
4. Body Material: Bronze.
5. Ends: Threaded, Soldered or Viega ProPress.
6. Seats: PTFE.
7. Stem: Bronze or brass.
8. Ball: Chrome-plated brass.
9. Port: Full.

2.4 CPVC CORZAN ® BALL VALVES

A. CPVC Union Ball Valves:

1. Standard: MSS SP-122.
2. Pressure Rating and Temperature: 150 psig at 73 deg F.

3. Body Material: CPVC (Corzan ®).
4. Body Design: Union type.
5. End Connections for Valves NPS 2 and Smaller: Detachable, socket.
6. Ball: CPVC; full port.
7. Seals: PTFE or EPDM-rubber O-rings.
8. Handle: Tee shaped.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves. Remove defective valves from site.

3.2 INSTALLATION OF VALVES

- A. Install valves with unions or flanges at each piece of equipment arranged to allow space for service, maintenance, and equipment removal without system shutdown.
- B. Provide support to piping adjacent to valves such that no force is imposed upon valves.
- C. Locate valves for easy access.
- D. For valves in horizontal piping, install valves with stem at or above center of pipe.
- E. Install valves in position to allow full valve actuation movement.
- F. Valve Tags: Provide valve tags and schedules for valves in closeout documentation.
- G. Adhere to manufacturer's written installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's recommended maximum.
- H. Adjust or replace valve packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves exhibiting leakage.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified CWP ratings are unavailable, provide the same types of valves with higher CWP ratings.
- B. Select valves with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
 - 2. Steel Piping for natural gas, See Specification Section 226313.
 - 3. For Stainless Steel Tubbing, NPS 2 and Smaller: See Specification Section 216313.
 - 4. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
 - 5. Brass ball valves, two pieces with full port, and stainless-steel trim.

3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 (DN 50) and Smaller:
 - 1. Brass ball valves, two pieces with full port, and stainless-steel trim. Provide with threaded solder or Viega ProPress end connection.
 - 2. Bronze ball valves, two pieces with full port, and stainless-steel trim. Provide with threaded, solder or Viega ProPress end connection.

3.5 REVERSE OSMOSIS WATER

- A. CPVC Corzan ®, Pipe NPS 2 and Smaller: Union ball valve solvent cement end connection.

END OF SECTION 220519.

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal hanger-shield inserts.
4. Fastener systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses.
1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe and Tube Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of Carbon Steel.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with MSS SP-58 carbon-steel hanger rods, nuts, saddles, U-bolts, or proprietary clamping systems.

2.4 THERMAL HANGER-SHIELD INSERTS

- A. Insulation-Insert Material for Hot and Cold Insulated Piping: High Density Fiberglass insert with minimum density of 18 lbs./cf.
- B. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- C. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- D. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 BEAM ATTACHMENTS.

- A. Mechanical Beam Clamp: ANSI/ MSS SP-69, MSS SP-58, (Type 19 and 23) ductile iron, wide throat beam clamp.
 - 1. Indoor Applications: Zinc-coated Ductile Iron.

2.6 CONCRETE EXPANSION ANCHORS.

- A. Description: ACI 355.2 Plated Steel body with a minimum embedment of 2".
- B. Provide rod couplings and continuous threaded rod to hanger device.
- C. To be used in fully cured concrete only. (28 days minimum cure time).

2.7 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

2.8 CLEVIS HANGERS

- A. Description: ANSI/ MSS SP-69, MSS SP-58, (Type 1) Adjustable clevis hanger.
 - 1. Indoor Applications: Zinc-plated carbon steel.
 - 2. Removable bolt and yoke.

3. Hanger to be of similar material to piping system or provide cladding or coating to resist electrolysis.
4. Size clevis to accommodate pipe insulation.

2.9 MATERIALS

- A. Carbon Steel: ASTM A1011/A1011M.
- B. Structural Steel: ASTM A36/A36M carbon-steel plates, shapes, and bars; black and galvanized.
- C. Stainless Steel: ASTM A240/A240M.
- D. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 1. Properties: Non-staining, noncorrosive, and nongaseous.
 2. Design Mix: 5000-psi 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
 2. Field fabricate from ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation:
 1. Install Beam attachments in accordance with manufacturers instructions. Attach to the top of beams.

2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- F. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- G. Install lateral bracing with pipe hangers and supports to prevent swaying.
- H. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping.
- I. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- K. Insulated Piping:
 1. Attach supports to outside of pipe insulation for pipe less than 2 inch in size.
 2. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 3. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches.
 4. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers or ceiling mount service panels.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

- B. Trim excess length of continuous-thread hanger and support rods to 1/2 inch.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Clean and touchup paint of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal hanger-shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
 - 3. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.

- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to several types of building attachments.
 - 2. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F (49 to 232 deg C) piping installations.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 - 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 - 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 - 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 - 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 - 6. C-Clamps (MSS Type 23): For structural shapes.
 - 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 - 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 - 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 - 10. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 - 3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.
- N. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- O. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.

B. Related Requirements:

1. Section 226113 "Laboratory Piping".
2. Section 226313 "Gas Piping for Laboratory Facilities"

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
2. Letter and Background Color: As indicated for specific application under Part 3.
3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
4. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
5. Fasteners: Stainless steel rivets or self-tapping screws.
6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
2. Letter and Background Color: As indicated for specific application under Part 3.
3. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.

4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 6. Fasteners: Stainless steel rivets or self-tapping screws.
 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
- D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- E. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- F. Fasteners: Stainless steel rivets or self-tapping screws.
- G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- H. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

- E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:
 - 1. Pipe size.
 - 2. Flow-Direction Arrows: Include flow-direction arrows on [main] distribution piping. Arrows may be either integral with label or applied separately.
 - 3. Lettering Size: At least 1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances].

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION, GENERAL REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

- A. Permanently fasten labels on each item of plumbing equipment.
- B. Sign and Label Colors.
 - 1. White letters on an ANSI Z535.1 safety-green background.
- C. Locate equipment labels where accessible and visible.

3.4 INSTALLATION OF PIPE LABELS

- A. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
- B. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Within 3 ft. of each valve and control device.

2. At access doors, manholes, and similar access points that permit view of concealed piping.
 3. Within 3 ft. of equipment items and other points of origination and termination.
 4. Spaced at maximum intervals of 20 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping and equipment.
- C. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.
- D. Flow-Direction Flow Arrows: Use arrows, in compliance with ASME A13.1, to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- E. Pipe-Label Color Schedule:
1. Low-Pressure Compressed-Air Piping: White letters on an ANSI Z535.1 safety-blue background.
 2. High-Pressure Compressed-Air Piping: White letters on an ANSI Z535.1 safety-blue background.
 3. Vacuum Piping: White letters on an ANSI Z535.1 Safety blue background.
 4. Domestic Cold, Tepid, Hot and Hot Return Water Piping: White letters on an ANSI Z535.1 safety-green background.
 5. Acid Waste and Vent Piping: Black letters on an ANSI Z535.1 Orange background.
 6. Reverse Osmosis Water Piping: White letters on an ANSI Z535.1 safety-blue background.
 7. Low Pressure Natural Gas: Black letters on an ANSI Z535.1 Yellow background.
 8. Carbon Dioxide piping: Black letters on an ANSI Z535.1 Yellow background.
 9. Nitrogen piping: White letters on an ANSI Z535.1 Green background.

END OF SECTION 220553

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating the following plumbing piping services:
 - 1. Domestic cold-water piping.
 - 2. Domestic hot-water piping.
 - 3. Domestic recirculating hot-water piping
- B. Related Sections:
 - 1. Section 220529 "Hangers and Supports for Plumbing Piping and Equipment.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

1.4 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.5 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
 - 1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials shall not be used.
- F. Glass-Fiber, Preformed Pipe: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 850 deg F in accordance with ASTM C411. Comply with ASTM C547.
 - 1. Preformed Pipe Insulation: Type I, Grade A with factory applied ASJ.
 - 2. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
 - 3. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Glass-Fiber and Mineral Wool Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- C. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.

2.4 MASTICS AND COATINGS

- A. Materials shall be compatible with insulation materials, jackets, and substrates.

B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.

1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
2. Service Temperature Range: 0 to 180 deg F.
3. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
2. Service Temperature Range: 0 to 180 deg F.
3. Color: White.

2.5 SEALANTS

A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.

B. Joint Sealants:

1. Permanently flexible, elastomeric sealant.
2. Service Temperature Range: 0 to 180 deg F.
3. Color: White.

C. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:

1. Fire- and water-resistant, flexible, elastomeric sealant.
2. Service Temperature Range: -40 to 250 deg F.
3. Color: White.

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C1136, Type I, unless otherwise indicated.

1. Color: White.
2. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

- b. Moisture Barrier for Indoor Applications: 1-mil thick, heat-bonded polyethylene and kraft paper.
- c. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.8 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
 - 1. Width: 3 inches.
 - 2. Thickness: 11.5 mils.
 - 3. Adhesion: 90 ounces force/inch in width.
 - 4. Elongation: 2 percent.
 - 5. Tensile Strength: 40 lbf/inch in width.
 - 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

2.9 SECUREMENTS

- A. Bands:
 - 1. Aluminum: ASTM B209 Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch wide, stainless steel or Monel.

2.10 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Clean and prepare surfaces to be insulated.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

2.11 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.
- D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with the contract documents.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
 - 3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
 - 2. Cover circumferential joints with 3-inch-wide strips of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least [4 inches (100 mm)] <Insert value> beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Cleanouts.

2.12 PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
- C. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies.

2.13 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles below.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered or routed fittings] made from same material and density as that of adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers where required. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe

- insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

2.14 INSTALLATION OF GLASS-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install prefabricated pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with glass-fiber pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.

2. When prefabricated sections are not available, install fabricated sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

2.15 INSTALLATION OF FIELD-APPLIED JACKETS

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

2.16 FINISHES

A. Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with specified paint system identified below.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Color: Color of all insulation to be white.

C. Do not field paint aluminum or stainless-steel jackets.

2.17 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections.

Retain first paragraph below to require Contractor to hire an independent testing agency.

- B. Engage a qualified testing agency to perform tests and inspections.

Retain "Perform tests and inspections" Paragraph below to require Contractor to perform tests and inspection and retain option to require Contractor to arrange for the assistance of a factory-authorized service agent.

- C. All insulation applications will be considered defective if they do not pass visual inspections by Engineer.

2.18 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage pipe and fittings in casework.

2.19 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
 - 1. NPS 4 and Smaller: Insulation shall be the following:
 - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
- B. Domestic Hot and Recirculated Hot Water:
 - 1. NPS 2" and smaller: Insulation shall be the following:
 - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

END OF SECTION 220719

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper tube and fittings - domestic water.
2. Piping joining materials - domestic water.
3. Transition fittings - domestic water.
4. Dielectric fittings - domestic water.

1.2 ACTION SUBMITTALS

A. Product data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Domestic water piping, tubing, fittings, joints, and appurtenances intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PIPING MATERIALS

- A. Potable-water piping, and components are to comply with NSF 14, NSF 61, and NSF 372.

2.3 COPPER TUBE AND FITTINGS - DOMESTIC WATER, TEPID WATER

- A. Drawn-Temper Copper Tube: ASTM B88, Type L.
- B. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings. Do not use solder joints on pipe sizes greater than NPS 4.
- C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings. Do not use solder joints on pipe sizes greater than NPS 4.
- D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Do not use solder joints on pipe sizes greater than NPS 4.

- E. Cast Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends. Do not use solder joints on pipe sizes greater than NPS 4.
- F. Wrought Copper Unions: ASME B16.22. Do not use solder joints on pipe sizes greater than NPS 4.
- G. Pressure-Seal-Joint Fittings, Copper, or Bronze - Domestic Water:
 - 1. Viega Pro-press Fittings. Owner will not accept alternate manufacturers.
 - 2. Housing: Copper.
 - 3. O-Rings and Pipe Stops: EPDM.
 - 4. Tools: Manufacturer's special tools.
 - 5. Minimum 200 psig working-pressure rating at 250 deg F.

2.4 PIPING JOINING MATERIALS - DOMESTIC WATER

- A. Pipe-Flange Gasket Materials:
 - 1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
 - 2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B32, lead-free alloys.
 - 1. 95% Sn, 5% Sb.
 - 2. 95.5 Sn, 4% Cu, 0.5% Ag.
- D. Flux: ASTM B813, water flushable.
- E. General Requirements:
 - 1. Same size as pipes to be joined.
 - 2. Pressure rating at least equal to pipes to be joined.
 - 3. End connections compatible with pipes to be joined.
- F. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- G. Sleeve-Type Transition Couplings - Domestic Water: AWWA C219.

2.5 DIELECTRIC FITTINGS - DOMESTIC WATER

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions - Domestic Water:

1. Dielectric Unions are prohibited by the Owner.
- C. Dielectric Flanges - Domestic Water:
1. Standard: ASSE 1079.
 2. Factory-fabricated, bolted, companion-flange assembly.
 3. Pressure Rating: 150 psig.
 4. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits - Domestic Water:
1. Nonconducting materials for field assembly of companion flanges.
 2. Pressure Rating: 150 psig.
 3. Gasket: Phenolic, Temperature Rating: 225 deg F.
 4. Bolt Sleeves: Phenolic or polyethylene.
 5. Washers: Phenolic with steel backing washers.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Aboveground domestic water piping, NPS 2 (DN 50) and smaller is to be the following:
 1. Drawn-temper copper tube, ASTM B88, Type L.
 - a. Solder-joint, wrought copper fittings.
 - b. Pressure-seal-joint fittings wrought copper fittings, Viega Propress pressure-sealed joints only.

3.2 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install valves in accordance with applicable Specification Sections.
- C. Install domestic water piping level and plumb.
- D. Rough-in domestic water piping for casework and coordinate with other trades.
- E. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

- F. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- H. Install piping to permit valve servicing.
- I. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- J. Install piping free of sags and bends.
- K. Install fittings for changes in direction and branch connections.
- L. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- M. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- N. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1. Provide adapters for copper piping systems.
- D. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings in accordance with ASTM B828 or CDA's "Copper Tube Handbook."
- E. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.

3.4 INSTALLATION OF TRANSITION FITTINGS

- A. Install transition flanges at joints of dissimilar piping.

3.5 INSTALLATION OF DIELECTRIC FITTINGS

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric flanges.

3.6 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Install hangers for copper pipe, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, State Plumbing Codes and authorities having jurisdiction requirements, whichever are most stringent.
- C. Support horizontal piping within 12 inches of each fitting.
- D. Support vertical runs of copper pipe to comply with MSS SP-58, State Plumbing Codes and authorities having jurisdiction requirements, whichever are most stringent.

3.7 PIPING CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to water mains within the building with a shutoff valve; extend and connect to the following:
 - 1. Plumbing and Laboratory Water fixtures: Cold, hot, and tepid water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
 - 2.

3.8 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system in accordance with either of the following:

- 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours. Note chlorine is to unscented and specifically for disinfection of domestic water piping.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
- c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to an approved lab for analysis.
 - f. Upon receipt of the laboratory report, submit to the Engineer and Client for review.
 - g. If the laboratory report identifies organic contamination in excess of the State regulations, the Contractor shall repeat the above procedure.

3.10 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust calibrated balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application were used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Piping Inspections:

- a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
- b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after installation and before setting fixtures.

- 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph and to ensure compliance with requirements.
 - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections, and arrange for reinspection.
 - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
2. Piping Tests:
- a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - d. Cap and subject piping to static water pressure of 100 psig. Do not exceed pressure rating of piping system materials or components. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
 - f. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Water pressure-reducing valves.
3. Balancing valves.
4. Temperature-actuated, water mixing valves.
5. Strainers for domestic water piping.
6. Trap-seal device.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For domestic water piping specialties.
1. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. Test and inspection reports.
- B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

- A. Domestic water piping specialties intended to convey or dispense water for human consumption are to comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or to be certified in compliance with NSF 61 and NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig.

2.3 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Standard: ASSE 1001.
2. Size: NPS 1/4 to NPS 3, as required to match connected piping.
3. Body: Bronze.
4. Inlet and Outlet Connections: Threaded.
5. Finish: Rough bronze, or Chrome plated in finished spaces.

2.4 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Standard: ASSE 1003.
2. Pressure Rating: Initial working pressure of 150 psig.
3. Size: As indicated.
4. Design Flow Rate: 0-3 GPM
5. Design Inlet Pressure: 125 psig.
6. Design Outlet Pressure Setting: 5-30 PSIG adjustable.
7. Body: Bronze for NPS 2 and smaller.
8. End Connections: Threaded or solder for NPS 2 and smaller.

2.5 BALANCING VALVES

A. Memory-Stop Balancing Valves:

1. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 2 or smaller.
4. Body: Copper alloy.
5. Port: Standard or full port.
6. Ball: Chrome-plated brass or stainless steel.
7. Seats and Seals: Replaceable.
8. End Connections: Solder joint or threaded.
9. Handle: Vinyl-covered steel with memory-setting device.

2.6 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Thermostatic, Water Mixing Valves:

1. Standard: ASSE 1017.
2. Pressure Rating: 125 psig minimum unless otherwise indicated.
3. Type: Exposed mount, thermostatically controlled, water mixing valve.
4. Material: Bronze body with corrosion-resistant interior components.
5. Connections: Threaded union inlets and outlet.
6. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.

7. Tempered-Water Setting: 85 deg F.
8. Tempered-Water Design Flow Rate: 0.5 – 5 gpm for low flow valve, 5 – 25 gpm for high flow valve. .
9. Selected Valve Flow Rates at maximum 25-psig Pressure Drop.
10. Valve Finish: Rough bronze.

2.7 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers <Insert drawing designation if any>:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller.
3. End Connections: Threaded.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.020 inch.
6. Drain: Threaded plug.

2.8 TRAP-SEAL DEVICE

A. Trap-Seal Device:

1. Standard: ASSE 1072.
2. Material: ABS Rigid frame, Silicone seal.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES

- A. Water Regulators: Install with inlet and outlet shutoff valves. Install pressure gauges on inlet and outlet.
- B. Balancing Valves: Install in locations where they can easily be adjusted. Set at indicated design flow rates.
- C. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 1. Install surface mount units on wall as specified.
- D. Y-Pattern Strainers: For water, install on supply side of each water pressure-reducing valve.
- E. Trap-Seal Device: Install trap seals in floor drain body, trap. Check seal device to assure proper flow through the floor drain.

3.2 PIPING CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.
- C. Use existing branch connections in service corridor where possible. Where no branch valve exists, provide a shutoff valve in the service corridor.
- D. If no branch or branch valve is available, install a branch tee in the line and provide a shutoff valve in the service corridor..

3.3 IDENTIFICATION

- A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Backflow preventers.
 - 2. Water pressure-reducing valves.
 - 3. Balancing valves.
 - 4. Temperature-actuated, water mixing valves.

3.4 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.
- D. Adjust each pressure vacuum breakers in accordance with manufacturer's written instructions, authorities having jurisdiction and the device's reference standard.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Perform the following tests and inspections.
 - 1. Test each pressure vacuum breaker and temperature actuated mixing valve according to authorities having jurisdiction and the device's reference standard.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: Test for function to confirm unit operation.
 - 4. Test and adjust controls and safeties including, flow, temperature and pressure. Replace damaged and malfunctioning controls and equipment.

- C. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 221119

SECTION 224500 - EMERGENCY PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Emergency showers.
2. Eyewash equipment.
3. Water-tempering equipment.

B. Related Sections:

1. 115300 – Laboratory Equipment.
2. 221119 - Domestic Water Piping Specialties.

1.2 RELATED

1.3 DEFINITIONS

- A. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.
- C. Portable, Self-Contained Emergency Plumbing Fixture: Fixture with flushing-fluid supply.
- D. Tepid: Between 60 and 100 deg F.

1.4 ACTION SUBMITTALS

A. Product data:

1. Mounting and support details.
2. Details of equipment assemblies. Indicate dimensions, flow rates and compliance with ANSI standards.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ANSI/ISEA Z358.1 for emergency plumbing fixtures including third-party certification of fixtures.
- B. Comply with ASSE 1071 for temperature-actuated mixing valves for plumbed emergency fixtures.
- C. Comply with ASME A112.18.1/CSA B125.1 for water-supply fittings.
- D. Comply with ASME A112.18.2/CSA B125.2 for plumbing waste fittings.
- E. Comply with NSF 61 and NSF 372 for fixture materials that will be in contact with potable water.
- F. Comply with requirements in ICC A117.1 for plumbing fixtures for people with disabilities.

2.2 EMERGENCY SHOWERS

- A. Emergency Showers – Supported from building structure, plumbed.
 - 1. Capacity: Not less than **20 gpm** for at least 15 minutes.
 - 2. Supply Piping: **NPS 1-1/4 galvanized steel** with flow regulator and stay-open control valve.
 - 3. Control-Valve Actuator: Pull rod.
 - 4. Shower Head: **8-inch** minimum-diameter, **stainless steel**.
 - 5. Mounting: Field assembled support system with bracing to accommodate standard forces during use.
 - 6. Accessories:
 - a. Ceiling escutcheon for shower head and pull rod.
 - b. Stainless steel pull rod pipe painted nipple below ceiling.
 - c. Stainless steel ball valve.
 - d. Safety shower identifying signage, mounted from ceiling or on adjacent walls.
 - e. Pre-cut, adhesive backed floor sign, noting emergency showers station, “KEEP CLEAR OF OBSTRUCTIONS.” Safety yellow or green, 36” x 36” centered under shower head.

2.3 EYEWASH EQUIPMENT

- A. Eyewash Units - Standard, deck mounted, plumbed:
 - 1. Capacity: Not less than **0.4 gpm** for at least 15 minutes.
 - 2. Supply Piping: **NPS 1/2** chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
 - 3. Control-Valve Actuator: Vertical, swing down, back to front.

4. Spray-Head Assembly: Two, off-center mount spray heads, coordinated with lab sink faucets.
5. Drain Piping:
 - a. Via laboratory sink.
6. Accessories:
 - a. Swing away dust covers upon actuation of fitting.
 - b. Safety eyewash identifying signage, mounted from ceiling or on adjacent casework.

2.4 WATER-TEMPERING EQUIPMENT

A. Water-Tempering Equipment - Hot and Cold Water:

1. Description: Factory-fabricated equipment with thermostatic mixing valve.
 - a. Thermostatic Mixing Valve: Designed to provide **85 deg F** tepid, potable water at emergency plumbing fixtures, to maintain temperature throughout required 15-minute test period, and in case of unit failure to continue cold-water flow with union connections, controls, and metal piping.
 - b. Supply Connections: For hot and cold water.

PART 3 - EXECUTION

3.1 INSTALLATION OF EMERGENCY PLUMBING FIXTURES

- A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.
- B. Install fixtures level and plumb.
- C. Fasten fixtures to substrate.
- D. Install shutoff valves in water-supply piping to fixtures, to facilitate maintenance of equipment. Use ball with removable handle. Install valves in open position with handle tapped to the supply pipe. Install valves in locations where they can easily be reached for operation.
 1. Exceptions:
 - a. Omit shutoff valve on supply to group of plumbing fixtures that includes emergency equipment.
 - b. Omit shutoff valve on supply to emergency equipment if prohibited by authorities having jurisdiction.
- E. Install dielectric fitting in supply piping to emergency equipment if piping and equipment connections are made of different metals. Comply with requirements for dielectric fittings specified in Section 221116 "Domestic Water Piping."

- F. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations.

3.2 PIPING CONNECTIONS

- A. Install emergency plumbing fixtures when fixtures are supplied by casework vendor.
- B. Connect cold-water-supply piping to plumbed emergency plumbing fixtures not having water-tempering equipment. Comply with requirements for cold-water piping specified in Section 221116 "Domestic Water Piping."
- C. Connect hot- and cold-water-supply piping to hot- and cold-water, water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures. Comply with requirements for hot- and cold-water piping specified in Section 221116 "Domestic Water Piping."
- D. Where installing piping adjacent to emergency plumbing fixtures, allow space for service and maintenance of fixtures.

3.3 IDENTIFICATION

- A. Install equipment nameplates or equipment markers on emergency plumbing fixtures and adjacent floors, walls, or ceilings.

3.4 FIELD QUALITY CONTROL

- A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: Test fixture and verify flow, temperature, and spray pattern for proper unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 5. Emergency plumbing fixtures will be considered defective if they do not pass tests and inspections.
 - 6. Test and inspect existing temperature mixing valves and conform proper operation. Where existing equipment is defective, note failure in test report.
- C. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Operate and adjust existing and new emergency plumbing fixtures and controls. Replace new damaged and malfunctioning fixtures and controls. Notify the Owner if existing equipment is malfunctioning.
- B. Adjust or replace fixture flow regulators for proper flow.
- C. Adjust equipment temperature settings.

3.6 CLEANING AND PROTECTION

- A. Clean emergency plumbing fixtures with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed emergency plumbing fixtures and fittings.
- C. Do not allow use of emergency plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224500

SECTION 226313 - GAS PIPING FOR LABORATORY FACILITIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Carbon dioxide piping designated "laboratory carbon dioxide", CO2.
2. Compressed air piping, designated "laboratory compressed air," CA.
3. Nitrogen piping designated "laboratory nitrogen," N2.
4. Natural gas piping designated "natural gas," NG.
5. Vacuum piping, designated "laboratory vacuum", Vac.
6. Ball valves.
7. Check valves.
8. Bellows sealed valves.
9. Diaphragm valves.
10. Pressure Control Valves.
11. Specialty Gas Manifolds.
12. Cylinder Storage Racks.

B. Owner/ Vendor -Furnished Material:

The Owner or the specified Vendor, under separate contract will be responsible for the

1. Casework mounted gas cocks and fittings.
2. Ceiling service panels, quick connect couplings and extension hoses.
3. Cylinder source laboratory gases.

C. Related Requirements:

1. Section 123553 "Laboratory Casework" for gas outlets in laboratory casework.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Brazing certificates.
- C. Field quality-control reports.
- D. Source Quality-Control Reports:

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
- B. Redlines of installed piping systems documenting changes to the piping drawings.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Mechanical Swaged Fittings and Joints: Individual(s) who are trained by an approved manufacturers representative.
- B. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications," or AWS B2.2/B2.2M.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Piping systems for Laboratory Gases and Vacuum service.

2.2 PIPES, TUBES, AND FITTINGS, GENERAL

- A. Cylinder sourced laboratory specialty gas piping, tubing, and fittings shall have been cleaned, purged. The pipe/ tube is to be oil and particle free, sealed with end caps and individually protected in plastic bags.
- B. Each length of tubing shall be delivered plugged or capped by the manufacturer and kept sealed until prepared for installation.
 - 1. Fittings and other components shall be delivered manufacturer sealed and kept sealed until prepared for installation.
 - 2. Cover or cap open pipe ends during pipe fabrication.

2.3 Copper Tube/ pipe, (CU-01):

- 1. Maximum working pressure: 100 psig.
- 2. ASTM B88, Type L, seamless, drawn temper, cleaned and degreased.
- 3. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type.
- 4. Solder: ASTM B32, 95/5% Tin/ Silver. (Sn/Ag)
- 5. Flux: ASTM 61 listed, ASTM B813, water flushable.
- 6. Threaded fittings: PTFE – Joint Tape.

2.4 Copper Tube/ Pipe, (CU-02):

1. Maximum working pressure: 100 to 150 psig.
2. ASTM B88, Type L, seamless, drawn temper, cleaned and degreased.
3. Wrought-Copper Fittings: ASME B16.22, brazed-joint pressure type.
4. Brazing material: ASTM B32, 6.0/ 7.25% Cu, Silver/Phosphorus/Copper. (Ag/ P/ Cu)
5. Melting Point: Sodus, 1190 °F. Liquidous, 1325 °F.
6. Flux: Self Fluxing.
7. Threaded fittings: PTFE – Joint Tape.
8. Sizes noted on drawings for copper services are nominal Internal Diameter. Do not use OD tube for copper unless specifically noted.

2.5 Carbon Steel Pipe, (CS-01):

1. Maximum working pressure: 5 psig.
2. ASME B16.10, ASTM A53/ A53M, Schedule 40 steel, seamless or welded seam.
3. Fittings: ASME B16.3, malleable iron, Class 150.
4. Threaded fittings: PTFE – Joint Tape, compatible with natural gas systems.

2.6 Stainless Steel Tube, (SS-01):

1. Maximum working pressure: 3,000 psig.
2. ASTM A269, ASME B31.3, 316L SS, seamless tubing cleaned and degreased per Swagelok specification SC-10 or approved equal.
3. Fittings: ASME B31.3, 316 SS, Proprietary tube fitting system. Swagelok Fittings only.
4. Threaded fittings: NPT sizes, PTFE – Joint Tape, compatible with specialty gas system.
5. Sizes noted on drawings for stainless steel tube is Outside Diameter.

2.7 VALVES

A. General Requirements for Valves: Manufacturer cleaned and degreased, bagged.

B. Ball Valves: BV-01

1. Standard: MSS SP-110.
2. Description: Two-piece body, brass, or bronze.
3. Pressure Rating: 150 psig minimum.
4. Ball: Full-port, SS.
5. Seats: PTFE or TFE.
6. Handle: Lever type with locking device.
7. Stem: Blowout proof, SS with PTFE or TFE seal.
8. Ends: Solder or threaded.

9. Positive-pressure gas valves cleaned and degreased.
 - a. Valves shall be delivered sealed and labeled and kept sealed until prepared for installation.
 - b. Apollo Valve or approved equal.

C. Ball Valves: BV-02

1. Standard: MSS SP-110.
2. Description: Three-piece body, brass, or bronze.
3. Pressure Rating: 150 psig minimum.
4. Ball: Full-port, SS.
5. Seats: PTFE or TFE.
6. Handle: Lever type with locking device.
7. Stem: Blowout proof, SS with PTFE or TFE seal.
8. Ends: Solder/ Brazing cup, ASTM B819 tube extension or threaded.
9. Positive-pressure gas valves cleaned and degreased.
 - a. Valves shall be delivered sealed and labeled and kept sealed until prepared for installation.
 - b. Apollo Valve or approved equal.

D. Ball Valves: BV-03

1. Standard: MSS SP-110.
2. Description: Two-piece body, brass, or bronze.
3. Pressure Rating: 50 psig minimum.
4. Ball: Standard port, Chrome Plated.
5. Seats: PTFE or TFE.
6. Handle: Lever type with locking device.
7. Stem: Blowout proof with PTFE or TFE seal.
8. Ends: Threaded.
9. "UL-1477, listed shut-off gas valve, cleaned and degreased."
 - a. Valves shall be delivered sealed and labeled and kept sealed until prepared for installation.
 - b. Apollo Valve, Series 80-100 or approved equal.

E. Bellows Sealed Valves: BSV-01

1. Description: Pneumatically actuated, 1/4" bellows sealed valve, stainless steel body. Emergency Shut Down Valve (ESDV)
2. Pressure Rating: 3,500 psig.
3. Bellows: SS.
4. Stem tip: PCTFE.
5. Actuator: Pneumatic, normally closed, air to open.
6. Instrument air pressure: Minimum 50, Maximum 70 psig.
7. Stem: Stainless Steel.
8. Ends: Swagelok or orbital weld with or without tube extensions.

9. Cleaning Specification: Standard SC-11.
 - a. Valves shall be delivered sealed and kept sealed until prepared for installation.
 - b. Swagelok Series HB, SS-HBS4-C.
 10. 3-way pilot solenoid valve, (CO2 shut-down system):
 - a. Interlocked with CO2 detection system. (Mechanical scope)
 - b. 24 VAC, vents control air to DSV-01 valve when de-energized, Isolates control air source.
 - c. Manufacturer, ASCO 8320 Series or approved Equal.
- F. Diaphragm Valves: DV-01
1. Description: Quarter turn, 1/4" diaphragm valve, stainless steel body and diaphragm.
 2. Pressure Rating: 3,500 psig.
 3. Diaphragm: SS.
 4. Seats: PTFE.
 5. Handle: Lever type, quarter turn.
 6. Stem: Stainless Steel.
 7. Ends: Swagelok or orbital weld with or without tube extensions.
 8. Cleaning: Swagelok SC-10 minimum.
 - a. Valves shall be delivered sealed and kept sealed until prepared for installation.
 - b. Swagelok Series DL.
- G. Check Valves: CKV-02
1. Description: In-line poppet, 316 SS.
 2. Pressure Rating: 3,000 psig minimum.
 3. Operation: Spring loaded.
 4. Ends: Swagelok.
 5. Crack Pressure: 1/3 psig.
 6. Cleaned and degreased, bagged.
 - a. Valves shall be delivered sealed and labeled and kept sealed until prepared for installation.
 - b. Swagelok C Series.
- H. Pressure Control Valves: PCV-01
1. Die cast aluminum body.
 2. Construction: NBR diaphragm, relieving type.
 3. Pressure Rating: 100 psig inlet maximum.
 4. Settings: 4- 60 psig.
 5. Pressure Gauge: Integral 0-100 psig
 6. Cleaning: Cleaned and degreased.
 - a. Valves shall be delivered sealed and labeled and kept sealed until prepared for installation.
 - b. Norgren R84G or approved equal.

I. Pressure Control Valves: PCV-02

1. Stainless-steel body and trim.
 2. Spring-loaded, diaphragm-operated, relieving type.
 3. Stages: Single stage doe nitrogen, 2 stage foe CO2.
 4. Manual pressure-setting adjustment.
 5. Pressure rating: 0-3,000 inlet pressure.
 6. Settings: 0 - 5 psig outlet pressure.
 7. Pressure Gauge: 0- 30 psig.
 8. Cleaning: Cleaned and degreased.
- a. Valves shall be delivered sealed and labeled and kept sealed until prepared for installation.
 - b. Swagelok or approved Equal.

2.8 SPECIALTY GAS MANIFOLDS.

A. Cylinder manifold: CO2, N2,

1. CGA fitting:
 - a. 320 CGA for CO2 service
 - b. 580 CGA for N2 service.
 - c. Verify CGA connections with Owner's gas supplier.
2. High pressure nipple: 1/4" 316 SS with threaded connection to regulator. 3,000 psig minimum pressure rating.
3. Regulator: See PVC-02 this document.
4. Outlet isolation valve: See DV-01 this document.
5. Outlet Connection: 1/4" NPT or Swagelok fitting.
6. Flexible pigtail with SS, NPT, or Swagelok end connection. 36" length, stainless steel over-braid.

2.9 GAS-SERVICE CONNECTIONS

A. General Requirements for Laboratory Gas-Service Connections:

1. All positive-pressure gas-service connections, for all gas types, shall be manufacturer cleaned, degreased, and sealed.
2. Suitable for specific gas pressure and suction service listed.

B. Laboratory fittings provided under separate contract: Coordinate connections to Laboratory fittings, provided under separate contract.

C. Connection is to be installed to allow for removal of equipment.

2.10 GAS CYLINDER STORAGE RACKS

- A. Wall Storage Racks: Fabricate racks with 12-gauge strut, cylinder saddle and restraining straps for upright specialty gas cylinders, as indicated.
- B. Anchor cylinder rack to adjacent walls where not in conflict with sliding door hardware. Provide floor mount post brackets and bracing where securement to walls is not possible.
- C. Support Strut: Minimum 1.625" by 12-gauge, steel channel with galvanized finish or powder paint. All joints to have smooth edges.
- D. Tank Restraints: Cast aluminum saddle and nylon strap, minimum 1" wide and stainless-steel buckle.
- E. Comply with NFPA 55.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Cleaning of Laboratory Gas Pipe and tubing: Pipe and tube is to be clean and free of dust, dirt, or stains. Maintain clean storage area and keep pipe and tube in plastic bags. Fittings must be cleaned and stored in protective bags or boxes.
 - 1. Laboratory pipe and tubing is to be clean and degreased prior to installation.
 - 2. Cap open ends during fabrication to maintain clean pipe interior.

3.2 INSTALLATION OF PIPING AND TUBING.

- A. General Location and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of laboratory gas pipe and tub. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Comply with NFPA 55 for installation of laboratory gas piping.
- C. Isolate existing active laboratory gas services from new work using Lock-out Tag-out (LOTO) procedures. The Contractor is to have a minimum of two individuals responsible for applying LOTO devices on the existing utilities and services. Do not remove LOTO devices until testing on new and existing pipe or tube is complete and has passed. Document the locations for LOTO devices and inspect those locations daily.
- D. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited.

- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- G. Install piping adjacent to equipment and specialties to allow service and maintenance.
- H. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than system pressure rating used in applications specified in "Piping Schedule" Article unless otherwise indicated.
- I. Install piping to permit valve servicing.
- J. Install piping free of sags and bends.
- K. Install fittings for changes in direction and for branch connections in piping systems.
- L. Tube bends are acceptable for stainless steel tube. Tube bend to be minimum of 5 tube diameters for bend radius. (Eg., 1/4" tube to have a bend radius of 1 1/4" minimum)
- M. Install laboratory gas service connections recessed in walls or within casework pipe chases. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.
- N. Connect gas piping to gas sources and to gas outlets/ equipment requiring gas service.
- O. Install unions in laboratory pipe/ tube to allow for equipment removal. Unions are to be accessible.
- P. Install sleeves for piping penetrations of walls, ceilings, and floors.
- Q. Install sleeve seals for piping penetrations of concrete walls and slabs.
- R. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.3 INSTALLATION OF VALVES

- A. Install shutoff valve at each connection to gas laboratory equipment and specialties.
- B. Install check valves to maintain correct direction of gas flow from laboratory gas supplies.
- C. Install valve at ceiling service panels above ceiling.
- D. Install pressure regulators on gas piping where reduced pressure is required.

3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.
- C. Threaded Joints: Apply appropriate tape to external pipe threads.

- D. Brazed Joints: Join copper tube and fittings in accordance with CDA's "Copper Tube Handbook," Ch. "Brazed Joints." Do not use flux. Continuously purge joint with oil-free, dry nitrogen during brazing.
- E. Soldered Joints: Apply ASTM B813, water-flushable flux to tube end. Join copper tube and fittings in accordance with ASTM B828.
- F. Mechanical Compression Joints: Install mechanical compression joint, (Swagelok fittings) in accordance with the manufacturer's instructions. Installers are to have received training by a factory authorized instructor.

3.5 INSTALLATION OF GAS-SERVICE COMPONENTS

- A. Assemble ceiling service panels, supplied under separate contract, and make connection to utilities. Install with supplies concealed in walls and ceilings.
- B. Connect laboratory piping to fixed casework in chase. Connect fume hood piping from above or by using wall chase.
- C. Install specialty gas pipe/ tubing and provide connections to laboratory equipment.
- D. Install flexible tubing provided under separate contract, from ceiling service panels quick connects to portable laboratory table gas cocks.
- E. Install specialty gas pressure-control valves on Owner supplied cylinders and at points of connection where gas pressure is to be reduced.
- F. Assemble ceiling service panels and anchor to building substrate. Provide structural steel, hanger rods, anchors, and fasteners in addition to components furnished with specialties necessary to fabricate supports.
- G. Install gas manifolds and connect to specialty gas cylinders.
- H. Install gas cylinders, (provided by owner) and support accessories. Connect regulator/ manifold assembly to distribution piping.

3.6 INSTALLATION OF HANGERS AND SUPPORTS

- A. Install hangers and supports in accordance with Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Vertical Piping: MSS Type 8 or Type 42, clamps.

3.7 IDENTIFICATION

- A. Install identifying labels and devices for laboratory gas piping, specialty gas piping and valves.
- B. Refer to Section 220553 "Identification for Plumbing Piping and Equipment"

3.8 FIELD QUALITY CONTROL FOR LABORATORY FACILITY SPECIALTY GAS

A. Testing and Inspections:

1. Perform tests and inspections on laboratory gas piping and equipment.
2. Remove components or isolate equipment that is not rated for test pressure.
3. Pneumatic testing is to be performed during non-standard hours or at a time where no other trades are in the laboratory area. Only personnel associated with the test are to be in the project area.
4. Piping Leak Tests for Specialty Gas Piping: Test new and modified parts of existing piping. Cap and fill specialty gas piping with oil-free, dry nitrogen to pressure 1.5 times that of the system operating pressure, but not less than 150 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
5. High pressure service is to be tested at 2,800 psig for nitrogen and 1,000 psig for carbon dioxide.
6. Repair leaks and retest until no leaks exist.
7. Inspect specialty gas regulators for proper operation.

B. Piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.9 PROTECTION

A. Protect tubing from damage.

B. Retain sealing plugs in tubing, fittings, and specialties before and during installation.

C. Clean tubing not properly sealed, and where sealing is damaged, in accordance with "Preparation" Article.

3.10 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain gas storage tanks.

3.11 PIPING SCHEDULE

A. Connect new pipe/ tube to existing pipe/ tube with specified joining systems.

B. Laboratory Gas Piping to include Nitrogen, Compressed Air, Laboratory Vacuum. Piping NPS 3 and smaller with an operating pressure of less than 100 psig: CU-01, BV-01, CKV-01.

C. Laboratory Gas Piping to include Nitrogen, Compressed Air Piping, NPS 3 and smaller with an operating pressure between 100 psig and 150 psig: CU-02, BV-02.

- D. Natural Gas Piping, NPS 2 and smaller, with an operating pressure of 10 psig or less: CS-01, BV-03.
- E. Cylinder Source Gas Piping, Specialty Gas NPS 1 and Smaller. Maximum operating pressure 3,000 psig, SS-01, DV-01.
- F. Cylinder Source Gas Shutdown Valves (ESDV). NPS ¼.” Maximum operating pressure 3,000 psig, BSV-01, normally closed pneumatic valve. SS-HBS4-C

END OF SECTION 226313

SECTION 226600 - CHEMICAL-WASTE SYSTEMS FOR LABORATORY FACILITIES

1.1 SUMMARY

A. Section Includes:

1. Single-wall piping.
2. Piping specialties.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- #### A. Chemical waste (AW, AV) for Acid Waste and Acid Vent pipe and fittings, for laboratory drainage systems.

2.2 PERFORMANCE REQUIREMENTS

- #### A. Single-Wall Piping Pressure Rating: Nominal 15 feet of water for 30 minutes.

2.3 SINGLE-WALL PIPE AND FITTINGS

- #### A. FRPP Drainage Pipe and Fittings: ASTM D4112, F1412, extruded pipe and drainage-pattern fittings molded, with Schedule 40 dimensions and with fire-retardant additive complying with ASTM D4101; with electro-fusion and mechanical joint ends.
1. Joints and fittings on piping mains and branches to be electrofusion using proprietary fusion system manufactured by the same manufacturer of the pipe.
 2. Joints connecting to the existing system and at connections to equipment, which are not in concealed locations of above ceilings, may be connected using mechanical couplings.
 3. Endfield or approved Equal.

2.4 JOINING MATERIALS

- A. Couplings: Assemblies with combinations of clamps, gaskets, sleeves, and threaded or flanged parts; compatible with piping and system liquid; and made by piping manufacturer for joining system piping.
- B. Adapters and Transition Fittings: Assemblies with combinations of clamps, couplings, adapters, gaskets, and threaded or flanged parts; compatible with piping and system liquid; and made for joining different piping materials such as glass.
- C. Flanges: Assemblies of companion flanges and gaskets complying with ASME B16.21 and compatible with system liquid, and bolts and nuts.

2.5 PIPING SPECIALTIES

- A. Corrosion-Resistant Traps:
 - 1. Type: P-trap with removable bowl.
 - 2. Size: NPS 1-1/2 or as required to match connected piping.
 - 3. Material: ASTM D4101, Polypropylene with electro-fusion-joint pipe connections.
 - 4. Manufacturer: IPEX – Endfield or approved equal.
- B. FRPP Floor Drains:
 - 1. Body: Polypropylene, 6” dia. top, with flashing flange and clamp.
 - 2. Strainer: Polypropylene, 100 PSI weight rating @ 72 deg. F
 - 3. Outlet: Bottom, to match connecting pipe, with NPS 4 outlet as indicated.
 - 4. P-Trap: Polypropylene with fusion joint connections
 - 5. Provide Trap seal.
- C. Air Admittance Valve:
 - 1. Air admittance valves, 2”, ASTM D-4101, Flame Retardant Polypropylene, ASSE- 1049, NSF-14 compliant.
 - 2. Suitable for chemical waste drain systems.
 - 3. Manufacturer: IPS - Studor, Chem-Vent or approved equal.
- D. Trap Seal:
 - 1. ASSE 1072,
 - 2. Body: Polypropylene, Silicone.
 - 3. Size: as noted on drawings.
 - 4. Manufacturer: IPS Corp, Trap-Tite or approved equal.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Chemical-Waste Piping Inside the Building: (AW, AV)

1. Install piping adjacent to equipment, accessories, and specialties, to allow space for service and maintenance.
2. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used unless otherwise indicated.
3. Flanges may be used on aboveground piping in non-concealed locations unless otherwise indicated.
4. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
5. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
6. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
7. Install piping at indicated slopes.
8. Install piping free of sags and bends.
9. Install fittings for changes in direction and branch connections.
10. Verify final equipment locations for roughing-in.
11. Install sleeves for piping penetrations of walls, ceilings, and floors.
12. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.2 PIPING SPECIALTY INSTALLATION

- A. Embed floor drains in 4-inch minimum depth of concrete around bottom and sides. Coordinate locations and installation with general contractor.
- B. Fasten grates to drains.
- C. Set floor drains with tops 1/16" below surrounding finished floor surface.
- D. Install cleanouts and riser extension from AW pipe to cleanouts.
 1. Set cleanout bodies in cast-in-place concrete Set top 1/16" below surrounding floor surface.
 2. Install trap seals in floor drains.
- E. Install adapter fittings on existing glass pipe system that match that system's end connections.
- F. Install air admittance valves in casework per Plumbing Code
- G. Install Chemical drain traps for sinks and cup sinks.

3.3 JOINT CONSTRUCTION

A. Chemical-Waste Piping (AW, AV) Chemical-Waste Piping Inside the Building:

1. Plastic-Piping Fusion Joints: Fabricate FRPP drainage-piping joints in accordance with ASTM F1290.
2. Install fusion joints in concealed locations and above suspended ceilings. Minimize the use of mechanical joints.
3. Mechanical joints may be used in exposed locations at the connection to existing systems and for connections to equipment.
4. Dissimilar-Material Piping Joints: Make joints using adapters compatible with both system materials.

3.4 HANGER AND SUPPORT INSTALLATION

A. Pipe sizes in this article refer to aboveground single-wall piping.

B. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices. Install the following:

1. Vertical Piping: MSS Type 8 or MSS Type 42 riser clamps.
2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.

C. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, to minimum of 3/8 inch.

F. Install vinyl-coated hangers for FRPP piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 2: 33 inches with 3/8-inch rod.
2. NPS 2-1/2 and NPS 3: 42 inches with 1/2-inch rod.
3. NPS 4: 48 inches with 5/8-inch rod.

G. Install supports for vertical FRPP piping every 72 inches.

H. Support piping and tubing not listed above in accordance with MSS SP-58.

3.5 CONCRETE PLACEMENT

A. Coordinate with concrete placement and install floor drains in locations specified prior to placing concrete.

3.6 PIPING CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Make connections to existing piping, so finished Work complies as nearly as practical with requirements specified for new Work.
- C. Use commercially manufactured wye fittings for AW and AV system branch connections. Remove section of existing pipe; install wye fitting into existing piping.
- D. Protect existing piping to prevent concrete or debris from entering while making connections. Remove debris or other extraneous material that may accumulate.
- E. Where installing piping adjacent to equipment, allow space for service and maintenance.

3.7 LABELING AND IDENTIFICATION

- A. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for labeling of equipment and piping.

3.8 ADJUSTING

- A. Adjust piping so as to not have any low points, sags and will run true to specified slopes.

3.9 CLEANING

- A. Use procedures prescribed by authorities having jurisdiction or, if not prescribed, use procedures described below:
 - 1. Flush new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Flushing media to be cold potable water.

3.10 FIELD QUALITY CONTROL

- A. Inspect interior of AW and AV piping to determine whether line displacement or other damage has occurred.
- B. Defects requiring correction include the following:
 - a. Alignment: Maintain alignment with less than 1/4" horizontal variation. Provide additional supports where pipe has sagged.
 - b. Replace crushed, broken, cracked, or otherwise damaged piping.
 - c. Hydrostatic Tests for Drainage Piping:
 - 1) Fill system with cold potable water. Allow system to acclimate to ambient temperature.
 - 2) Purge air and refill with water where necessary.

- 3) Disconnect water supply.
 - 4) Test and inspect joints for leaks.
 - 5) System pressure to be 15 feet of head. Loss shall be zero over a 15-minute period.
- d. Air Tests for Drainage Piping: Do not use compressed air for drainage system testing.
2. Leaks and loss in test pressure constitute defects that must be repaired.
 3. Submit separate reports for each test.
- C. Replace leaking AW, AV piping using new materials, and repeat testing until leakage is within allowances specified.
- D. Perform tests and inspections: Owner's representative will observe Contractors testing.
- E. Chemical-waste piping will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

3.11 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below unless otherwise indicated.
- B. Single-Wall, Chemical-Waste Sewerage Piping: Use the following piping materials for each size range:
1. NPS 1-1/2 to NPS 4: FRPP drainage pipe and fittings with fusion joints. Mechanical fitting may be used where connecting to equipment or at transitions to dissimilar materials.

END OF SECTION 226600

SECTION 230512 - COMMON WORK RESULTS FOR HVAC

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Sleeves.
 - 5. Escutcheons.
 - 6. Grout.
 - 7. HVAC demolition.
 - 8. Equipment installation requirements common to equipment sections.
 - 9. Painting and finishing.
 - 10. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Dielectric fittings.
2. Mechanical sleeve seals.
3. Escutcheons.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."

PART 2 _PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
 - 1. Manufacturers:
 - a. Epco Sales, Inc.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150-psig minimum working pressure as required to suit system pressures.
 - 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Epco Sales, Inc.
 - c. Watts Industries, Inc.; Water Products Div.
- E. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F.
 - 1. Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Victaulic Co. of America.

2.5 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Metraflex Co.
 - c. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Plastic. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.6 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- E. PVC Pipe: ASTM D 1785, Schedule 40.

2.7 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.

2.8 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
- M. All uninsulated, uncoated steel components installed by the mechanical contractor should be primed and finish painted (i.e., supports, hangers, etc.).
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Insulated Piping: One-piece, stamped-steel type with spring clips.
- N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Joint sealer shall be silicone rubber base non-sag sealant, FS TT-S-01543A, class A low modulus, chemical curing as manufactured by Dow or General Electric.

- O. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.
- P. Verify final equipment locations for roughing-in.
- Q. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- F. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

- A. Painting of HVAC systems, equipment, and components is specified in Division 9 Sections "Interior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- B. Field Welding: Comply with AWS D1.1.

3.7 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 100 deg F and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers:
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

SECTION 230517 – SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Sleeves.
- 2. Grout.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 PRODUCTS

2.1 SLEEVES

- A. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

2.2 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 - 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- C. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."
- D. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

3.2 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Interior Partitions:
 - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.

END OF SECTION

SECTION 230518 - ESCUTCHEON FOR HVAC PIPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- B. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
- C. Split-Plate, Stamped-Steel Type: With chrome-plated finish, and exposed-rivet hinge, and spring-clip fasteners.

2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with exposed-rivet hinge.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. New Piping: One-piece, floor-plate type.

END OF SECTION

SECTION 230519 – METERS AND GAGES FOR HVAC EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Liquid-in-glass thermometers.
 - 2. Thermowells.
 - 3. Gage attachments.
 - 4. Test plugs.

- B. Related Sections:

- 1. Division 23 Section "Hydronic Piping" for hydronic piping.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

- 1. Manufacturers: Subject to compliance with requirements:
 - a. Trerice, H. O. Co.
 - b. Weiss Instruments, Inc.
 - c. Winters Instruments - U.S.
 - 2. Standard: ASME B40.200.
 - 3. Case: Cast aluminum or non-metallic material; 9-inch nominal size unless otherwise indicated.
 - 4. Case Form: Adjustable angle unless otherwise indicated.

5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Window: Glass or plastic.
8. Stem: Aluminum or brass and of length to suit installation. Thermometer shall be secured to well by tapered bushing and not by set screws.
9. Scale: Scale shall be selected to provide a mid-scale reading at normal operating temperatures.
 - a. Design for Thermowell Installation: Bare stem.
10. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
11. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200. Thermowell length shall be in accordance with ISA standards.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: Brass.
4. Material for Use with Steel Piping: Brass, stainless steel for steam and condensate service.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing. Extension neck shall be included when required to match thermowell and insulation thickness.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.3 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements:

1. Peterson Equipment Co., Inc.
2. Trerice, H. O. Co.
3. Weiss Instruments, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

- D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- F. Core Inserts: self-sealing. Seals shall be appropriate for operating water temperature and pressure. Nordel Seat - hot water, glycol; Neoprene Seat - cold, chilled water. Use extended body style to allow for insulation thickness.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending in accordance with ISA standards and shall include the appropriate extension to allow for pipe installation.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions to be easily read from the floor position.
- F. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.
- G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- H. Install valve in piping for each pressure gage for fluids.
- I. Install test plugs in piping tees.
- J. Install a P/T test port in addition to the pressure gauge.
- K. Install flow indicators in piping systems in accessible positions for easy viewing.
- L. Install thermometers in the following locations:
 - 1. As shown on drawings.
 - 2. As required for building controls.

3.2 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gages to proper angle for best visibility.

END OF SECTION

SECTION 230523 – GENERAL DUTY VALVES FOR HVAC PIPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Ball valves – Water Service.

- B. Related Sections:

- 1. Division 23 HVAC piping Sections for specialty valves applicable to those Sections only.
 - 2. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.4 GENERAL REQUIREMENTS

- A. Unless otherwise noted, all valves for shut-off and bypass service shall be ball valves, 2" and below.
- B. Valves for balancing operations shall not be ball or butterfly.
- C. All end connections shall be the same as is used for fittings for 2" and below.

- D. A manufacturer's valve tag shall be on all valves identifying the valve type and major component materials.
- E. Install valves after welding adjacent to valve is complete to protect seat and disk.
- F. Insulated valves shall have extended handle stems. Coordinate extension with insulation thickness.
- G. All valves for all services shall be fully bi-directional and suitable for dead end service.
- H. On all valves the packing compression is to be independent of the stem, ball or handle systems. All valve stems are to be blowout proof. Packing shall be accessible without disturbing the insulation.
- I. All valves used for vent or drain service on water systems shall have a brass hose connection with cap and chain.

1.5 SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.6 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.1 for power piping valves.
 - 3. ASME B31.9 for building services piping valves.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set ball and balance valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 _PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to HVAC valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Handlever: For quarter-turn valves NPS 3 and smaller.
 - 2. All valves shall be provided with Lock-out tag out capability.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
- F. Valve-End Connections:
 - 1. Solder Joint: With sockets according to ASME B16.18.
 - 2. Threaded: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

- A. Two-Piece, Standard-Port, Bronze Ball Valves with 316 Stainless-Steel Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 300 psig at 250 F Minimum.
 - c. Body WP Rating: 300 psig at 250 F Minimum.
 - d. WOG Rating: 300 psig Minimum.
 - e. Saturated Steam rating: 150 psig Minimum.
 - f. Body Design: Two piece.
 - g. Body Material: Bronze.
 - h. Ends: Threaded.
 - i. Seats: RTFE.
 - j. Stem: Stainless steel.

- k. Ball: Stainless steel, vented.
- l. Port: Standard.
- m. Handle: Lever action with lock-out capability.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Steel Piping, NPS 2 and Smaller: Threaded ends.

3.5 VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Ball Valves: Two piece, full port, bronze with stainless-steel trim.

END OF SECTION

SECTION 230529 – HANGER AND SUPPORT FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following hangers and supports for HVAC system piping and equipment:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Fastener systems.
 - 5. Pipe stands.
 - 6. Equipment supports.
- B. Related Sections include the following:
 - 1. Division 5 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Division 23 Section "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
 - 3. Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze pipe hangers. Include Product Data for components.
 - 2. Metal framing systems. Include Product Data for components.
 - 3. Equipment supports.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."
- B. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.3, "Structural Welding Code--Sheet Steel."
 - 3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. Grinnell Corp.
 - 3. National Pipe Hanger Corporation.
 - 4. Piping Technology & Products, Inc.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. Power-Strut Div.; Tyco International, Ltd.
 - 3. Thomas & Betts Corporation.
 - 4. Unistrut Corp.; Tyco International, Ltd.
- C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. MKT Fastening, LLC.
 - e. Powers Fasteners.

2.6 PIPE STAND FABRICATION

- A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

1. Manufacturers:

- a. ERICO/Michigan Hanger Co.
- b. MIRO Industries.

- C. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.7 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

2.9 PAINTING

- A. All uninsulated, uncoated steel components installed by the mechanical contractor should be primed and finish painted (i.e., supports, hangers, etc.).

PART 3 EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.

- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 3. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 4. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 5. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. C-Clamps (MSS Type 23): For structural shapes.
 6. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 7. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 8. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 9. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

10. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
11. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
- K. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- L. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- M. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Fastener System Installation:
 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 7 Section "Roof Accessories" for curbs.
- F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- M. Insulated Piping: Comply with the following:
1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.

- b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
- 5. Pipes NPS 8 and Larger: Include wood inserts.
 - 6. Insert Material: Length at least as long as protective shield.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 230553 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Valve tags.
4. Ductwork.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- C. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

2. Letter Color: White.
 3. Background Color: Black.
 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 2. Lettering Size: At least 1-1/2 inches.

2.3 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or

space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.4 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Black.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
 2. Lettering Size: At least 1-1/2 inches.

2.5 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
 1. Stencil Material: Fiberboard or metal.
 2. Stencil Paint: Exterior, gloss, alkyd enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
 3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated.

PART 3 EXECUTION

3.1 PREPARATION

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 25 feet along each run. Reduce intervals to 10 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Pipe And Duct Label Color Schedule:
 - 1. Heating-Water Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.
 - c. Abbreviation: HWS & HWR

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 - 1. Valve-Tag Size and Shape:
 - a. Heating Hot Water: 1-1/2 inches, round.

2. Valve-Tag Color:
 - a. Same as system label
3. Letter Color:
 - a. Same as system label

3.5 DUCT LABEL INSTALLATION

- A. Install duct labels with permanent adhesive on air ducts in the following color codes:
 1. Blue: For cold-air supply ducts.
 2. Yellow: For dual temperature-air supply ducts.
 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
 4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
- B. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, may be provided instead of plastic-laminated duct labels, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.
- C. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 25 feet in each space where ducts are exposed or concealed by removable ceiling system.

END OF SECTION

SECTION 230593 – TESTING, ADJUSTING AND BALANCING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes TAB to produce design objectives for the following:
 - 1. Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume systems.
 - 2. Hydronic Piping Systems:
 - a. Constant-flow systems.
 - 3. HVAC equipment quantitative-performance settings.
 - 4. Hydronic pumps and bypass balancing.
 - 5. Canopy hood airflow balancing.
 - 6. Fume Hood Testing and Exhaust hood airflow balancing.
 - 7. Space pressurization testing and adjusting.
 - 8. Verifying that automatic control devices are functioning properly.
 - 9. Reporting results of activities and procedures specified in this Section.

1.3 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.
- C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.
- D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- E. NC: Noise criteria.

- F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- G. RC: Room criteria.
- H. Report Forms: Test data sheets for recording test data in logical order.
- I. Stair Pressurization System: A type of smoke-control system that is intended to positively pressurize stair towers with outdoor air by using fans to keep smoke from contaminating the stair towers during an alarm condition.
- J. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- K. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- L. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- M. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- N. TAB: Testing, adjusting, and balancing.
- O. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- P. Test: A procedure to determine quantitative performance of systems or equipment.
- Q. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 SUBMITTALS

- A. Qualification Data: Within 30 days from Contractor's Notice to Proceed, submit 4 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days from Contractor's Notice to Proceed, submit 4 copies of the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 30 days from Contractor's Notice to Proceed, submit 6 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.
- D. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- E. Sample Report Forms: Submit two sets of sample TAB report forms.

- F. Warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.
- B. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.
1. Agenda Items: Include at least the following:
- Submittal distribution requirements.
 - The Contract Documents examination report.
 - TAB plan.
 - Work schedule and Project-site access requirements.
 - Coordination and cooperation of trades and subcontractors.
 - Coordination of documentation and communication flow.
- C. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
- Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.
- D. TAB Report Forms: Use standard forms from NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems." Or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing."
- E. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems, NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
- F. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
- Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.6 PROJECT CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

- B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.8 WARRANTY

- A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
- B. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:
 - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
 - 1. Contract Documents are defined in the General and Supplementary Conditions of Contract.
 - 2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing

devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine Project Record Documents described in Division 1 Section "Project Record Documents."
- D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
- F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- G. Examine system and equipment test reports.
- H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- K. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.
- L. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- M. Examine strainers for clean screens and proper perforations.
- N. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- O. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

- P. Examine system pumps to ensure absence of entrained air in the suction piping.
- Q. Examine equipment for installation and for properly operating safety interlocks and controls.
- R. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.
 - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in units, plenums, mixing boxes, and variable-air-volume terminals.
 - 4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
 - 5. Space sensors are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 6. Sensors are located to sense only the intended conditions.
 - 7. Sequence of operation for control modes is according to the Contract Documents.
 - 8. Controller set points are set at indicated values.
 - 9. Interlocked systems are operating.
 - 10. Changeover from heating to cooling mode occurs according to indicated values.
- S. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - 1. Permanent electrical power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, blast gates, and fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.
 - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and this Section.

- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.
- C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- E. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check for proper sealing of air-handling control equipment components.
- K. Check for proper sealing of air duct system.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.

- c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 3. Measure static pressures entering and leaving other devices such as sound louvers, reheat coils, under final balanced conditions.
 4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
 5. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
 6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
 1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure terminal outlets and inlets without making adjustments.
 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
 1. Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.
 2. Measure total system airflow. Adjust to within indicated airflow.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
 1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure terminal outlets and inlets without making adjustments.
 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.
 3. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
 4. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
 5. Record the final fan performance data.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 - 1. Open all manual valves for maximum flow.
 - 2. Check expansion tank liquid level.
 - 3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
 - 4. Check flow-control valves for specified sequence of operation and set at indicated flow.
 - 5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
 - 6. Set system controls so automatic valves are wide open to heat exchangers.
 - 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
 - 8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.8 PROCEDURES FOR HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:
 - 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 - 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 - 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 - 4. Report flow rates that are not within plus or minus 5 percent of design.
- B. Set calibrated balancing valves, if installed, at calculated presettings.
- C. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 - 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

- E. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
 - 1. Determine the balancing station with the highest percentage over indicated flow.
 - 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 - 3. Record settings and mark balancing devices.
- F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.9 PROCEDURES FOR COILS

- A. Measure water flow through all circuits.
- B. Adjust water flow to within specified tolerances.
- C. Measure inlet and outlet water temperatures.
- D. Measure inlet and outlet water pressure drop.
- E. Record settings.

3.10 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer, model, and serial numbers.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Efficiency rating.
 - 5. Nameplate and measured voltage, each phase.
 - 6. Nameplate and measured amperage, each phase.
 - 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.11 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Water Coils: Measure the following data for each coil:
 - 1. Entering- and leaving-water temperature.
 - 2. Water flow rate.
 - 3. Water pressure drop.

4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

3.12 PROCEDURES FOR TEMPERATURE MEASUREMENTS

- A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

3.13 PROCEDURES FOR SPACE PRESSURIZATION MEASUREMENTS AND ADJUSTMENTS

- A. Before testing for space pressurization, observe the space to verify the integrity of the space boundaries. Verify that windows and doors are closed and applicable safing, gaskets, and sealants are installed. Report deficiencies and postpone testing until after the reported deficiencies are corrected.
- B. Measure, adjust, and record the pressurization of each room, each zone, and each building by adjusting the supply, return, and exhaust airflows to achieve the indicated conditions.
- C. Measure space pressure differential where pressure is used as the design criteria, and measure airflow differential where differential airflow is used as the design criteria for space pressurization.
 1. For pressure measurements, measure and record the pressure difference between the intended spaces at the door with all doors in the space closed. Record the high-pressure side, low-pressure side, and pressure difference between each adjacent space.
- D. To achieve indicated pressurization, set the supply airflow to the indicated conditions and adjust the exhaust and return airflow to achieve the indicated pressure or airflow difference.
- E. For spaces with pressurization being monitored and controlled automatically, observe and adjust the controls to achieve the desired set point.
 1. Compare the values of the measurements taken to the measured values of the control system instruments and report findings.
 2. Check the repeatability of the controls by successive tests designed to temporarily alter the ability to achieve space pressurization. Test over pressurization and under pressurization, and observe and report on the system's ability to revert to the set point.
 3. For spaces served by variable-air-volume supply and exhaust systems, measure space pressurization at indicated airflow and minimum airflow conditions.

- F. In spaces that employ multiple modes of operation, such as normal mode and emergency mode or occupied mode and unoccupied mode, measure, adjust, and record data for each operating mode.
- G. Record indicated conditions and corresponding initial and final measurements. Report deficiencies.

3.14 PROCEDURES FOR SOUND PERFORMANCE MEASUREMENTS

- A. Contractor shall provide the testing equipment and perform measurements. Contractor shall work with Controls contractor sequencing equipment as required to perform testing.

3.15 PROCEDURES FOR LABORATORY SPACE PRESSURIZATION SYSTEM MEASUREMENTS AND ADJUSTMENTS

- A. Before testing, verify that construction is complete. Verify the following:
 - 1. Walls and ceiling are free of unintended openings and are capable of achieving a pressure boundary.
 - 2. Sealants are installed.
 - 3. Doors, door closers, and door gaskets are installed and adjusted.
 - 4. Louvers and damper installations are complete and functional.
- B. Measure and record wind speed and direction, outside-air temperature, and relative humidity on each test day.
- C. Test each system as a single system. If multiple fans serve a system, operate the fans together through out the control process.
- D. Air Balance:
 - 1. For ducted systems, measure the fan airflow by duct Pitot-tube traverse.
- E. Pressurization Test:
 - 1. After air balancing is complete, perform space pressurization tests.
 - 2. Establish a consistent procedure for recording data throughout the entire test.
 - 3. With the HVAC systems operating in their normal mode of operation and the space pressurization systems on, measure and record the following:
 - a. Pressure difference across each space with all doors closed.
 - b. Force necessary to open each door, using a spring-type scale.
 - c. Adjust the space pressure to prevent overpressurization.
 - d. Use a spring scale to measure and record the force needed to open the doors. With the initial door held in the open position, measure and record the pressure difference across the space.
 - e. Open the doors measure and record the direction and velocity through each of the open doors by a traverse of every 1 sq. ft. grid of door opening.

- f. Calculate the average of the door velocity measurements. Compare the average velocity to the Contract Documents and governing code requirements.
4. Repeat the pressurization tests with the high level H2-control systems and the HVAC systems operating.
5. Criteria for Acceptance:
 - a. The opening force on any door shall not exceed 30 lbf.
 - b. Code requirements.
 - c. Space pressure of (-) 0.06" WG, targeted value subject to adjustment measure.
- F. Operational Tests:
 1. Check the proper space pressurization system(s) in response to all means of HVAC systems operation, and automatic free cooling control. Include dock door access and connection.
 2. Verify that each initiating occurrence produces the proper system response under each of the following modes of operation:
 - a. Normal.
 - b. Partial load
 - c. Full load.
 - d. Refer to drawing M603.
 3. Conduct additional tests required by authorities having jurisdiction.
- G. Prepare a complete report of observations, measurements, and deficiencies.

3.16 PROCEDURES FOR FUME HOOD TESTING and MEASUREMENTS

- A. All new and renovation fume hood installations shall be properly commissioned, with a balance performed of the total exhaust flow using a duct traverse followed by face velocity measurements. If the hood is equipped with VAV or two position controls, these shall be exercised in all modes of the intended operation.
- B. All hood installations must pass a smoke-dry ice capture test.
- C. When required by the Dept. of Environmental Health and Safety, single hood installations, major renovations, and new construction projects shall be subject to having a tracer gas capture test performed on one hood of each type in the project.
- D. All hood testing must be in accordance with methods outlined in ASHRAE Standard 110-1995.
- E. Observe and record the following conditions for each Fume Hood:
 1. Occupied and Unoccupied flow Conditions.
 2. Fume hood sash monitoring performance verification.
 3. Alarms and trending.
 4. Response times.
 5. Fume hood smoke dry ice capture test report.
 6. All requirements outlined in ASHRAE Standard 110-1995.

3.17 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Check free travel and proper operation of control devices such as damper and valve operators.
- F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.
- G. Check the interaction of electrically operated switch transducers.
- H. Check the interaction of interlock and lockout systems.
- I. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.
- J. Note operation of electric/pneumatic actuators using spring return for proper fail-safe operations.

3.18 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 5 percent.
 - 2. Air Outlets and Inlets: 0 to minus 10 percent.
 - 3. Heating-Water Flow Rate: 0 to minus 10 percent.

3.19 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems

found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.20 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
 - 1. Include a list of instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to certified field report data, include the following:
 - 1. Manufacturers' test data.
 - 2. Field test reports prepared by system and equipment installers.
 - 3. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
 - 1. Title page.
 - 2. Name and address of TAB firm.
 - 3. Project name.
 - 4. Project location.
 - 5. Architect's name and address.
 - 6. Engineer's name and address.
 - 7. Contractor's name and address.
 - 8. Report date.
 - 9. Signature of TAB firm who certifies the report.
 - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 - 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 - 12. Nomenclature sheets for each item of equipment.
 - 13. Data for terminal units, including manufacturer, type size, and fittings.
 - 14. Notes to explain why certain final data in the body of reports varies from indicated values.
 - 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outside-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.

- e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
 - 1. Quantities of supply and exhaust airflows.
 - 2. Water flow rates.
 - 3. Duct, outlet, and inlet sizes.
 - 4. Pipe and valve sizes and locations.
 - 5. Terminal units.
 - 6. Balancing stations.
 - 7. Position of balancing devices.
- F. Apparatus-Coil Test Reports:
 - 1. Coil Data:
 - a. System identification.
 - b. Location.
 - c. Coil type.
 - d. Number of rows.
 - e. Fin spacing in fins per inch o.c.
 - f. Make and model number.
 - g. Face area in sq. ft..
 - h. Tube size in NPS.
 - i. Tube and fin materials.
 - j. Circuiting arrangement.
 - 2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm.
 - b. Average face velocity in fpm.
 - c. Air pressure drop in inches wg.
 - d. Entering-air, wet- and dry-bulb temperatures in deg F.
 - e. Leaving-air, wet- and dry-bulb temperatures in deg F.
 - f. Water flow rate in gpm.
 - g. Water pressure differential in feet of head or psig.
 - h. Entering-water temperature in deg F.
 - i. Leaving-water temperature in deg F.
- G. Fan Test Reports: For existing supply and exhaust fans, include the following:
 - 1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.

- e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches, and bore.
 - h. Sheave dimensions, center-to-center, and amount of adjustments in inches.
- 2. Motor Data:
 - a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
 - g. Number of belts, make, and size.
 - h. Variable speed drive setting when applicable.
- 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.
- H. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
 - 1. Report Data:
 - a. System and air-handling unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F.
 - d. Duct static pressure in inches wg.
 - e. Duct size in inches.
 - f. Duct area in sq. ft..
 - g. Indicated airflow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual airflow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig.
- I. Air-Terminal-Device Reports:
 - 1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Test apparatus used.
 - d. Area served.
 - e. Air-terminal-device make.
 - f. Air-terminal-device number from system diagram.

- g. Air-terminal-device type and model number.
 - h. Air-terminal-device size.
 - i. Air-terminal-device effective area in sq. ft..
 - 2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm.
 - b. Air velocity in fpm.
 - c. Preliminary airflow rate as needed in cfm.
 - d. Preliminary velocity as needed in fpm.
 - e. Final airflow rate in cfm.
 - f. Final velocity in fpm.
 - g. Space temperature in deg F.
 - h. Low air flow rate in cfm.
 - i. High air flow rate in cfm.
- J. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
 - 1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Room or riser served.
 - d. Coil make and size.
 - e. Flowmeter type.
 - 2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm.
 - b. Entering-water temperature in deg F.
 - c. Leaving-water temperature in deg F.
 - d. Water pressure drop in feet of head or psig.
 - e. Entering-air temperature in deg F.
 - f. Leaving-air temperature in deg F.

3.21 INSPECTIONS

- A. Initial Inspection:
 - 1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
 - 2. Randomly check the following for each system:
 - a. Measure airflow of at least 10 percent of air outlets.
 - b. Measure water flow of at least 5 percent of terminals.
 - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - d. Measure sound levels at two locations.
 - e. Measure space pressure of at least 10 percent of locations.

- f. Verify that balancing devices are marked with final balance position.
- g. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:

- 1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Construction Manager.
- 2. TAB firm test and balance engineer shall conduct the inspection in the presence of Construction Manager.
- 3. Construction Manager shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.
- 4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- 5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- 6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
- 7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.22 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION

SECTION 230712 – HVAC INSULATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Insulation Materials:
 - a. Flexible elastomeric.
 - b. Mineral fiber.
- 2. Insulating cements.
- 3. Adhesives.
- 4. Mastics.
- 5. Lagging adhesives.
- 6. Sealants.
- 7. Field-applied fabric-reinforcing mesh.
- 8. Field-applied jackets.
- 9. Tapes.
- 10. Securements.
- 11. Corner angles.

- B. Related Sections:

- 1. Division 23 Section "Metal Ducts" for duct liners.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84,

by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports."
- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; All-Service Duct Wrap.
- H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glas.
 - d. Knauf Insulation; Insulation Board.
 - e. Manson Insulation Inc.; AK Board.
 - f. Owens Corning; Fiberglas 700 Series.
- I. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000 Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 3. Type II, 1200 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- J. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Manson Insulation Inc.; AK Flex.
 - e. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Insulco, Division of MFS, Inc.; Triple I.
 - b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.
- B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Insulco, Division of MFS, Inc.; SmoothKote.
 - b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
 - c. Rock Wool Manufacturing Company; Delta One Shot.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA Inc.; AeroSeal.

- b. Armacell LCC; 520 Adhesive.
 - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
 - d. RBX Corporation; Rubatex Contact Adhesive.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
- D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); 739, Dow Silicone.
 - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Speedline Vinyl Adhesive.

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. ITW TACC, Division of Illinois Tool Works; CB-50.
 - d. Marathon Industries, Inc.; 590.
 - e. Mon-Eco Industries, Inc.; 55-40.
 - f. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-10.
 - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
 - c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
 - d. Marathon Industries, Inc.; 550.
 - e. Mon-Eco Industries, Inc.; 55-50.
 - f. Vimasco Corporation; WC-1/WC-5.
2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F.
4. Solids Content: 63 percent by volume and 73 percent by weight.
5. Color: White.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-52.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-42.
 - c. Marathon Industries, Inc.; 130.
 - d. Mon-Eco Industries, Inc.; 11-30.
 - e. Vimasco Corporation; 136.
2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
3. Service Temperature Range: Minus 50 to plus 180 deg F.
4. Color: White.

2.6 SEALANTS

A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.
4. Color: White or gray.

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch for covering pipe and pipe fittings.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Vimasco Corporation; Elastafab 894.
- B. Woven Glass-Fiber Fabric for Duct and Equipment Insulation: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. inch for covering equipment.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; Chil-Glas No. 5.

2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto PVC Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
5. Factory-fabricated tank heads and tank side panels.

D. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; Metal Jacketing Systems.
 - b. PABCO Metals Corporation; Surefit.
 - c. RPR Products, Inc.; Insul-Mate.
2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing for large custom equipment.
 - b. Factory cut and rolled to size for piping systems.
 - c. Finish and thickness are indicated in field-applied jacket schedules.
 - d. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
 - e. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
 - f. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.

- 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- E. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The), Saran 540 Vapor Retarder Film.
- F. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.9 TAPES

- A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - b. Compac Corp.; 110 and 111.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
 - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
 2. Width: 3 inches.
 3. Thickness: 6.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
 - b. Compac Corp.; 130.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
 - d. Venture Tape; 1506 CW NS.
 2. Width: 2 inches.
 3. Thickness: 6 mils.

4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - b. Compac Corp.; 120.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
 - d. Venture Tape; 3520 CW.
2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

D. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
2. Width: 3 inches.
3. Film Thickness: 4 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch in width.

E. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); Saran 560 Vapor Retarder Tape.
2. Width: 3 inches.
3. Film Thickness: 6 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch in width.

2.10 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.

- c. RPR Products, Inc.; Bands.
 - 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.015 inch thick, 3/4 inch wide with closed seal.
 - 3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with closed seal.
 - 4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- B. Insulation Pins and Hangers:
 - 1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; CD.
 - 3) Midwest Fasteners, Inc.; CD.
 - 4) Nelson Stud Welding; TPA, TPC, and TPS.
 - 2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.
 - 3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
 - 2) GEMCO; Press and Peel.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Products: Subject to compliance with requirements, provide one of the following:

- 1) GEMCO.
- 2) Midwest Fasteners, Inc.

2.11 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.

5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
 1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
 1. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems" for firestopping and fire-resistive joint sealers.
- D. Insulation Installation at Floor Penetrations:

1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Pipe: Install insulation continuously through floor penetrations.
3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems."

3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
 - d. Do not overcompress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches.
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.

9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
 10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
 2. Seal longitudinal seams and end joints.

3.6 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for

- above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.7 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.

4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.

2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

E. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface.

Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- F. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
 5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and

- inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.9 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
 1. Draw jacket material smooth and tight.
 2. Install lap or joint strips with same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.
- E. Where PVDC jackets are indicated, install as follows:
 1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
 2. Wrap factory-presize jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presize jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
 3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.

4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch- circumference limit allows for 2-inch- overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.10 FINISHES

- A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 9 painting Sections.
 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.11 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 1. Outdoor, exposed supply and outdoor air.
 2. Indoor, concealed supply and outdoor air.
 3. Indoor, exposed supply and outdoor air.
 4. Indoor, concealed return located in nonconditioned space.
 5. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
- B. Items Not Insulated:
 1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
 2. Factory-insulated plenums and casings.
 3. Flexible connectors.
 4. Vibration-control devices.
 5. Factory-insulated access panels and doors.

3.12 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, round and flat-oval, supply-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.
 2. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.
- B. Concealed, round and flat-oval, return-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.
 2. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.
- C. Concealed, rectangular, supply-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.
 2. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.
- D. Concealed, rectangular, exhaust-air duct insulation as identified on contract drawings shall be one of the following:
1. Mineral-Fiber Blanket: 1 and 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.
 2. Mineral-Fiber Board: 1 and 1-1/2 inches thick and 2-lb/cu. ft. nominal density.
- E. Exposed, round and flat-oval, supply-air duct insulation shall be the following:
1. Mineral-Fiber Board: 1-1/2 inches thick and 3-lb/cu. ft. nominal density.
- F. Exposed, rectangular, supply-air duct insulation shall be the following:
1. Mineral-Fiber Board: 1-1/2 inches thick and 3-lb/cu. ft. nominal density.
- G. Exposed, supply-air plenum insulation shall be the following:
1. Mineral-Fiber Board: 1-1/2 inches thick and 3-lb/cu. ft. nominal density.
- H. Exposed, exhaust-air ductwork identified on contract drawings, insulation shall be the following:
1. Mineral-Fiber Board: 1 and 1-1/2 inches thick and 3-lb/cu. ft. nominal density.
- I. Exposed, exhaust-air plenum insulation shall be the following:
1. Mineral-Fiber Board: 1-1/2 inches thick and 3-lb/cu. ft. nominal density.

3.13 EQUIPMENT INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.
- C. Hot-water reheat insulation shall be the following:
1. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
 2. Mineral-Fiber Pipe and Tank: 2 inches thick.

3.14 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.15 INDOOR PIPING INSULATION SCHEDULE

- A. Condensate and Equipment Drain Water below 60 Deg F:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 3/4 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
- B. Heating-Hot-Water Supply and Return (HWS & HWR), 200 Deg F and below:
 - 1. NPS 1" and Smaller: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 1 inch thick.
 - 2. NPS 1.5" and Larger: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 2 inches thick.
- C. Hot Service Drains:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.
- D. Hot Service Vents:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.

3.16 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Ducts and Plenums, Exposed:

1. Aluminum, Stucco Embossed: 0.040 inch thick.
- D. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
1. Aluminum, Stucco Embossed with: 0.040 inch thick.
- E. Piping, Exposed:
1. PVC: 30 mils thick.
 2. Jacketing system shall be applied at equipment, and shall continue to cover pipe insulation to a minimum elevation of 10'-0" above finish floor, plat form or equipment plat form. Jacketing system shall be applied continuous from boilers to economizers and a distance e of 10'-0" above service walkways for piping servicing boilers and economizers.

END OF SECTION

SECTION 230920 – LABORATORY CONTROL

PART 1 GENERAL

1.1 DESCRIPTION

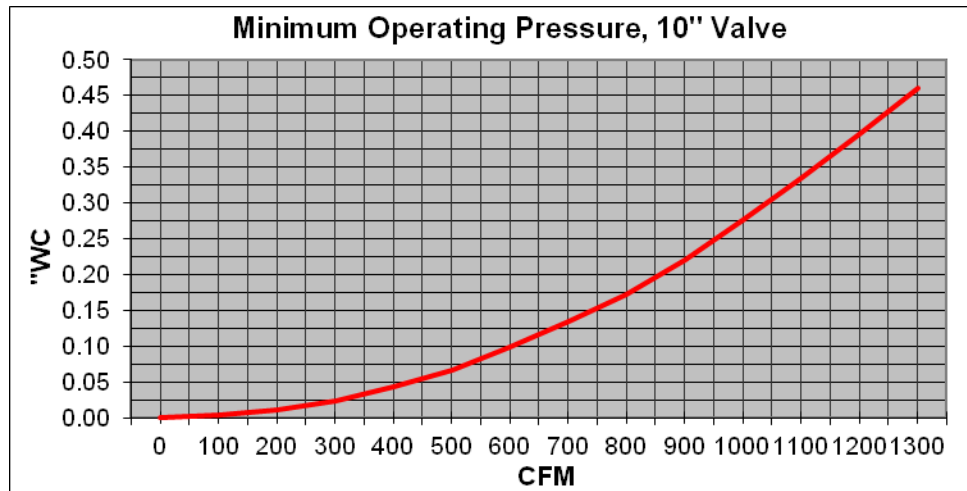
- A. General Room ventilation shall be provided to prevent the buildup of fugitive emissions in the laboratory. A general room ventilation system shall be designed to maximize the clearance of contaminants from the room while minimizing overall energy use. A laboratory airflow control system shall be furnished and installed to control the airflow into and out of laboratory rooms. The exhaust flow rate of a laboratory fume hood shall be precisely controlled to maintain a constant average face velocity into the fume hood at either a standard/in-use or standby level based on an operator being present in front of the fume hood. Velocity control shall be through sash positioning sensors.
- B. The laboratory control system shall vary the amount of make-up/supply air into the room to operate the laboratories at the scheduled airflow rates necessary to maintain temperature control, achieve minimum ventilation rates, and maintain laboratory pressurization in relation to adjacent spaces.
- C. Supply air shall be properly balanced with hood and general exhaust in each room. Supply air should be slightly less than exhaust air to allow for laboratory rooms to be under negative pressure at all times. Laboratory static pressures of $-.02''$ to $-.06''$ w.g. negative relative to the corridors shall be established. Pressurization shall be established by initial balance and maintained by linked supply and exhaust flow. Through-the-wall pressurization controllers are not acceptable.
- D. The basis of design includes variable volume fume hoods with restricted bypass grills; refer to architectural drawings and specifications for fume hoods. All new hood installations shall be designed to provide an average face velocity of 100 FPM @ 18 inch sash opening height and full open average face velocity of 65 to 80 FPM. At the normal working sash height (8 inches to 18 inches), the average face velocity shall not exceed 150 FPM. When the laboratory area is in the unoccupied mode, it is encouraged to provide control systems that will reduce the fume hood face velocity of vertical rising sash styles to 65 FPM if the sash position is a maximum of 18 inches open.
- E. All new hoods must be equipped with the following minimum control and alarm points:
 - 1. Visible and audible alarms for high and low face velocity
 - 2. Local alarm reset
 - 3. Dry contact for alarm status.
 - 4. Un-Occupied sash alarm
- F. The intent of this Specification is to define the hardware and control requirements for the airflow valve and fume hood control system. The system specified shall be based on electronically pressure independent critical environment airflow control valves used on the supply, general exhaust and fume hood exhaust from the laboratory space. The fume hood control system specified shall be based on variable fume hood exhaust volume with sash position reset control of fume hoods.
- G. All control equipment required to fulfill this Specification shall be manufactured and provided by the laboratory airflow control system equipment manufacturer and shall integrate into the building

management system. The building management system subcontractor shall be responsible for this section as a single controls package for the project and interface.

- H. It shall be understood that the Drawings and Specifications describe the approximate locations of the work. Do not scale the drawings to determine exact positions and clearances. Obtain from Architect, Engineer, Commissioning Agent or the Owner any dimensions not shown.
- I. Details of construction and of workmanship where not specifically described herein or indicated on the drawings shall be subject to the Engineer's or Owner's approval. It is the intent of these Specifications to provide complete systems, left in good working order, ready for operation, including necessary labor and materials, whether or not specifically shown on the Drawings or mentioned herein.
- J. Before submitting proposals, examine the Specifications and all Drawings relating to the work and become fully informed as to the extent and character of the work and the relation of the work to that of other Sections. Examine the Drawings of other Sections to become familiar with all the problems and details of the building construction and to note conditions, which affect the work.
- K. A Technical Proposal shall be submitted to the Engineer's office on or before bid day describing the laboratory airflow control valves and fume hood controllers proposed for product other than listed under "basis of design". It shall include a "line-by-line" comparison to the specifications and a statement of compliance or non-compliance to the specification on a "line-by-line" basis. Where there is non-compliance, details on the product and system as proposed shall be provided with an explanation as to why it should be accepted as an alternate.
- L. Any changes required in the ductwork, air handling equipment or any other mechanical systems, which would be required for the application of any proposed laboratory airflow equipment other than the specified "Base Bid" or "Basis of Design" shall be the responsibility of the healthcare airflow control system supplier. Any additional engineering, sheet metal or mechanical equipment (i.e. upsized supply/exhaust systems) costs other than that as required by the "Basis of Design" shall be borne by the laboratory airflow control valve supplier. All changes shall be subject to prior approval by the Architect/Engineer.
- M. Only those devices specifically named under "acceptable manufacturers" or through addendum shall be considered for approval. Other devices submitted after the bid opening will be returned without review.
- N. Being listed herein as an approved manufacturer does not permit the manufacturer to provide standard manufactured equipment which does not comply with the performance and/or physical characteristic requirements of the Contract Documents.
- O. All substitutions must be included in the Base Bid, and must be accompanied by a letter of equivalency certifying the products equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be all inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Project specifications/documents shall not be revised to reflect the substitution should the substitution be approved.
- P. Minimizing energy consumption is of primary importance in the system design; therefore any airflow control valve considered for this project must be submitted with test data showing the Minimum Operating Pressure of the valve as tested in accordance with ANSI/ASHRAE STD

130-2008 Paragraph 5.3. The submitted test data must be in the form of an xy plot, with the y axis representing differential pressure measured across the fully opened valve and the x axis representing airflow volume measured through the fully opened valve. The test data for each size valve must include the entire published operating range of the valve.

The example below is provided for an airflow control valve with a published minimum operating pressure of 0.3" wc and full scale range of 1,000 cfm.



Standard literature for submitted valve must show both a curve and spreadsheet of minimum operating pressure drop versus CFM throughout its operating range. Any airflow control valve that does not publish this information will not be considered for this project.

1.2 ACCEPTABLE MANUFACTURERS

- A. The plans and specifications for the laboratory airflow control system are based on systems and equipment manufactured by Accutrol Accuvalve, Critical Room Control, Phoenix Controls Corporation is an acceptable alternative; contractor shall coordinate controls and installation requirements that will modify sheet metal layouts which shall be represented in coordination and shop drawings. Phoenix controls shall also be required to substitute standard air pressure device with an alternative air flow pressure sensing device suitable for installation with exposure to H₂ and CH₄ gases.
- B. The laboratory airflow system provider shall be an entity that designs, develops, manufactures and sells products and services to control the environment and airflow of critical spaces using a Quality Management System registered to ISO 9001:2000.
- C. In strict accordance with this specification, alternative laboratory airflow control systems and equipment shall only be considered for approval provided that the equipment be equal in every respect to the operational characteristics, capacities, and intent of control sequences specified herein. Approval to bid does not relieve the laboratory airflow control system supplier from complying with the minimum requirements or intent of this specification.
- D. The engineer and owner shall be the sole judges of quality and equivalence of equipment, materials, methods, and life cycle cost.

- E. Only those systems specifically named in this specification or by addendum shall be considered for approval. Other systems submitted after the bid opening will be returned without review.

1.3 DESCRIPTION OF WORK

- A. Furnish laboratory airflow control valves including supply, return and exhaust valves as listed in schedule and on drawings. All installation labor shall be as stated below under "Work By Others".
- B. Furnish low pressure drop laboratory airflow control valves with vortex airflow measurement, high speed electric actuation and integral access panel for all associated devices as shown on drawings and as scheduled. All installation materials shall be as stated below under "Work By Others".
- C. Furnish (where required) in addition to above, integral electronic pressure independent controller with standard "Native BACnet" interface allowing direct communication to Building Automation System.
- D. Furnish fume hood controllers, sash sensors and monitors as required.
- E. All materials and equipment used shall be standard components, regularly manufactured for this and/or other systems and shall not be custom designed especially for this project. All components shall have been thoroughly tested and proven in actual use.
- F. Coordinated as a package work by others.
- G. The Building Automation System (BAS) subcontractor shall be responsible for the following:
 - 1. Installation of Fume Hood controllers, with exception to sash position sensors and fume hood monitor displays. (Sash sensors and fume hood monitor displays shall be supplied by the Fume Hood Control System contactor and factory mounted by fume hood manufacturer.)
 - 2. Provision, installation and final termination of all control wiring, including airflow control valves, and network communications wiring. (Refer to BAS section for control wiring specifications.)
 - 3. Provision and installation of power wiring to all fume hood controllers and airflow control valves as required.
 - 4. Provision of laboratory reheat control valve (where required). Valve shall receive either a 4-20 MA or 2-10 VDC signal.
- H. The HVAC subcontractor shall:
 - 1. Install reheat coils as required. Install all room reheat valves as provided by BAS subcontractor.
- I. The sheet metal subcontractor shall:
 - 1. Install all supply and exhaust airflow control valves.
 - 2. Provide and install all standard fittings, hangers, and ancillary devices required to install duct devices shall be provided by this subcontractor.
- J. The air balancing subcontractor shall:
 - 1. Verify airflow volume readings and control points in each control mode.

- K. System turnover: The fume hood control system shall be commissioned by the fume hood control system subcontractor.

1.4 QUALITY ASSURANCE

- A. Laboratory Airflow Valve and Fume Hood Control System subcontractor shall provide written approvals and certifications after installation has been completed.
- B. Laboratory Airflow Valve and Fume Hood Control System airflow control valve subcontractor must prove that they have been engaged in the provision, installation and service of this type of equipment for at least five (5) years and has a fully equipped, factory trained and authorized service organization.
- C. For any equipment submitted for approval other than “Basis of Design”, the Laboratory Airflow Valve and Fume Hood Control System subcontractor shall state what, if any, specific points of the system operation differ from these Specifications.
- D. The Laboratory Airflow Valve and Fume Hood Control System subcontractor shall continue to bear the liability for replacement of accepted substituted equipment in the event that the equipment fails to perform as specified, or to meet approval of all authorities having jurisdiction, within five (5) years after beneficial use by the Owner.
- E. Should the following airflow control technologies be considered as alternate to the “Basis of Design” they will be required to meet at minimum the additional criteria listed below:
1. Venturi valves, Single blade dampers with venturi airflow sensors and Single blade dampers:
 - a. Airflow valves must be fabricated with access doors upstream and downstream of the airflow control valve to allow visual inspection of the valve internals. The cost of these inspection ports shall be borne by the airflow control valve manufacturer. (This shall not be a requirement of the AccuValve due to the inspection panel provided as a standard).
 - b. Airflow valves must be provided with pilot-positioners in order to detect linkage or actuator failure. Pilot positioners must be wired to controllers to provide alarms in the event that proper valve position is not obtained.
 - c. Venturi valves must be provided with pressure switches to indicate low pressure in the ductwork. The pressure switch must be able to operate below .15” WC on the supply and makeup air valves without nuisance alarms.
 - d. Venturi valves must be provided with airflow sensors to create a true closed loop control to insure the valve is controlling to the required airflow volume throughout its entire control range at the specified operating pressure noted within the airflow valve schedule or specification if no data is shown on airflow valve schedule. Airflow valves that are provided with airflow sensors that rely on the spring/cone calibration for control below 350 fpm at the entrance to the valve are unacceptable.
 - e. Airflow sensors provided with airflow valves shall meet the criteria of this specification. Airflow valves incorporating mechanical pressure independence only are not acceptable.
 - f. Airflow valves submitted as alternate to “Basis of Design” must provide certificate of third party testing data matching published accuracy of +/-5% of reading without straight run of duct on either side of airflow valve.
 - g. Airflow valves that are provided as coated aluminum must be provided with drawband clamps for connection to ductwork. This is because a coated valve cannot be welded or screwed.

- h. Airflow valves using velocity pressure measurement with pitot, orifice or venturi shall utilize two (2) differential pressure transmitters.
- i. If the airflow valve can only be mounted in either a vertical or horizontal mounting plane and must be specifically ordered as such, then at least 5 extra horizontal and 5 extra vertical valves of each size and material shall be provided by the airflow valve supplier at no extra cost to the manufacturer to avoid delays in construction, installation and certification.
- j. If the airflow valve submitted uses velocity pressure measurement, the airflow valve manufacturer shall provide a 5 year maintenance service contract to the owner at no additional charge, including recalibration and re-zero for all airflow valves on a quarterly basis with associated report.
- k. If the airflow valve submitted uses mechanical means for creating pressure independence such as springs and plungers, the airflow valve manufacturer shall provide a 5 year service contract to the owner at no additional charge due to the higher maintenance associated to the venturi type valve. The maintenance contract shall provide for every valve to be inspected via the inspection doors once per quarter. The laboratory airflow control valve contractor shall provide the owner with a quarterly report verifying that the cones are not sticking and no debris from the exhaust or supply airstream has attached itself to the valve mechanism.
- l. If valves requiring greater than those pressures listed under 2.3.J are submitted the providing contractor shall be responsible for providing reimbursement to the customer of \$16,000 per 10,000 CFM of exhaust of the system for the additional breakhorsepower requirements of the additional static pressure system requirement and shall be shown as a separate line item on the technical proposal / quotation. In order to ensure the minimum operating pressure of any valve meets the specification any valve must be provided with a Minimum Operating Pressure curve as tested in accordance with ANSI/ASHRAE STD 130 Paragraph 5.3 as described in 1.1.K of this specification. Any airflow control valve that does not publish this information will not be considered for this project. It will be assumed that a single blade damper require at least 0.8" of pressure to operate to get it into a responsive range of operation.
- m. Additional materials must be provided, mounted, wired and programmed by the venturi valve supplier for Demand Based Static Pressure Reset Control (reference specification section 2.3.L.2-5 for details).

2. Energy Considerations

- a. Due to the higher static pressure required for venturi valves or orifice plates over the specified AccuValve, any laboratory airflow control valve supplier providing venturi valves or orifice plates shall provide the customer with the cost associated with running both the exhaust and supply systems at a higher static pressure for a 5 year period. The cost shall be \$16,000 per 10,000 CFM of exhaust. Any CFM amount shall be rounded UP to the nearest 10,000 CFM. The laboratory airflow control valve supplier shall also provide any additional money required for additional equipment cost associated with operating at the higher system static pressure.
- b. In order to ensure the minimum operating pressure meets the specification every valve must be provided with a Minimum Operating Pressure curve as tested in accordance with ANSI/ASHRAE STD 130 Paragraph 5.3 as described in 1.1.G of this specification. Any airflow control valve that does not publish this information will not be considered for this project.

1.5 PREVENTIVE MAINTENANCE

The laboratory airflow control system supplier shall provide at no additional cost to the owner during and after the warranty period, five years of required preventive maintenance on all airflow sensors (e.g., pitot tube, flow cross, orifice ring, air bar, hot wire, vortex shedder, side wall sensors, etc.), and flow transducers provided under this section. Airflow sensors shall be removed, inspected and cleaned annually during the five-year period to prevent inaccuracies due to long-term buildup from corrosion, lab tissues, wet or sticky particles, or other materials that foul the sensor. If impractical to remove the airflow sensors, the laboratory airflow control system supplier shall include in the proposal the cost of supplying and installing duct access doors, one for each sensor. The transducer shall be checked and recalibrated annually to ensure long-term accuracy. Note that auto-zero recalibration of transducers is not acceptable as a substitute for annual recalibration.

1.6 WARRANTY PERIOD

Warranty shall commence upon the date of shipment and extend for a period of five years whereupon any defects in materials or laboratory airflow control system performance shall be repaired by the supplier at no cost to the owner.

PART 2 SYSTEM PERFORMANCE REQUIREMENTS

2.1 AIRFLOW CONTROL SYSTEM DESCRIPTION

- A. Each laboratory shall have a dedicated laboratory airflow control system.
- B. The laboratory airflow control system shall employ individual controllers that directly measure the area of the fume hood sash opening and proportionally control the hood's exhaust airflow to maintain a constant face velocity over a minimum range of 10 to 100% of sash travel. The corresponding minimum hood exhaust flow turndown ratio shall be 10 to 1.
- C. The hood exhaust airflow control device shall respond to the fume hood sash opening by achieving 90% of its commanded value within one second of the sash reaching 90% of its final position (with no more than 5% overshoot/undershoot) of required airflow. Rate of sash movement shall be between 1.0 to 1.5 feet per second.
- D. The hood exhaust airflow control device shall be automatically switched between in-use and standby levels based on operator presence immediately in front of the hood. A presence and motion sensor shall activate the switching. The airflow control device shall achieve the required in-use commanded value in less than one second from moment of detection with no more than a 5% overshoot or undershoot.
- E. The laboratory airflow control system shall maintain specific airflow ($\pm 5\%$ of signal within one second of a change in duct static pressure) regardless of the magnitude of the pressure change (within 0.3" to 3.0" wc), airflow change or quantity of airflow control devices on the manifold.
- F. The laboratory airflow control system shall use volumetric offset control to maintain room pressurization. The system shall maintain proper room pressurization polarity (negative or positive) regardless of any change in room/system conditions such as the raising and lowering of any or all fume hood sashes or rapid changes in duct static pressure. Systems using differential pressure measurement or velocity measurement to control room pressurization are unacceptable.

G. The laboratory airflow control system shall maintain specific airflow ($\pm 5\%$ of signal) with a minimum 16 to 1 turndown to insure accurate pressurization at low airflow and guarantee the maximum system diversity and energy efficiency.

H. General: Proximity sensors shall not be utilized on fume hoods.

I. Air Flow for Fume Hood Laboratory and Process Exhaust Applications

1. The Airflow Control Valve (Model AV3000) shall consist of a compression section, two airflow control surfaces, factory-mounted digital vortex airflow measuring device factory-mounted high speed electric actuator, integral access panel and integrated high performance closed-loop feedback controller with native BACnet.
2. The compression section shall divide the airstream into at least two separate airstreams. Each airstream shall be approximately equal in size and the total open area shall be approximately 50% of the duct open area. The divided sections shall cause compression therefore creating a more laminar flow for better airflow measurement and turndown. The compression section shall be of an aerodynamic shape with a static regain section to insure minimal pressure drop. The valve shall not require any duct straight runs either upstream or downstream of the airflow valve to achieve required specified performance.
3. Airflow control valves shall be a linear type and shall operate with a minimum turndown ratio of 8 to 1. Accuracy of the airflow valve shall be 5% of reading in the 8 to 1 range of the damper.
4. The airflow control valve shall respond less than one second of a change in duct static pressure when provided with factory controls.
5. The airflow control valve shall be capable of being mounted in any position (360° mounting plane) in ductwork without the need for recalibration. It shall not be required to specify mounting plane when ordering valve. If valve provided can only be mounted in either a horizontal or vertical plane and must be specifically ordered as such, then at least 5 extra horizontal and 5 extra vertical valves of each size and material shall be provided by the valve supplier at no extra cost to the manufacturer to avoid delays in construction, installation and certification.
6. Valve body material for Fume Hood or other corrosive service shall be 316SS; 20gauge for body and 16gauge for blades. Valve shaft material shall be 316SS. Shall be a venturi valve, they must be provided with drawband clamps for connection to ductwork. This will also allow removal of the venturi valve for required recalibration. These clamps shall be provided at no additional cost to the customer. Gasket material for the valve and clamp shall be silicone and PTFE. **Specify Acid Valve finishes**
7. Airflow control valves shall operate without linkages, springs, levers, or bearings, in the airstream due to the effect of fume hood exhaust on those materials, and shall exhibit no deadband or hysteresis. Airflow control valves shall be field selectable fail-safe to either the open or closed position depending on the application. For airflow valves with linkage, springs, levers or bearings in the airstream access doors must be provided upstream and downstream of each and every damper for inspection of those devices for maintenance purposes.
8. All critical components of the airflow control valve shall be easily accessible from one side of the valve. All linkages shall be out of the airstream to avoid possible corrosion and loss of accuracy.
9. Airflow control valves shall be of a low pressure drop design for energy efficiency. Valves shall not require greater pressure drop than listed at "Max CFM" on project valve schedule or 0.3", whichever is less. Airflow control valves that require higher pressures to operate shall not be acceptable. The provision of a larger airflow control valve that is scheduled to accommodate the lower scheduled pressure drop is not acceptable. Airflow control valves that require higher pressures to operate shall not be acceptable.

10. The airflow valve shall be complete with a digital vortex type airflow sensing device providing true airflow feedback for the system. Airflow valves using mechanical means for creating pressure independence will not be acceptable. If an airflow valve such as a venturi valve is submitted that uses mechanical means for creating pressure independence such as springs and plungers, the valve manufacturer shall provide a 5 year service contract to the owner at no additional charge.
11. Demand Based Static Pressure Reset Control (DBSPRC) – Valve must be capable of being utilized with a demand based static pressure reset control scheme as described in ASHRAE Standard 90.1-6.5.3.2.3.
12. Airflow measuring devices shall be of the Vortex Shedding type, capable of continuously monitoring the airflow volume of the duct served and electronically transmitting a signal linear to the airflow volume.
13. Individual airflow sensors shall be of rugged construction, and shall not require special handling during installation. Sensors shall be mounted on support bars. Standard materials shall be manufactured of corrosion resistant plastic.
14. Individual velocity sensors shall not be affected by dust, temperature, pressure, or humidity. The sensors shall be passive in nature, with no active parts within the air stream. The output from individual sensors shall be linear with respect to airflow velocity and shall be capable of sensing airflow in one direction only. The velocity sensors shall not require calibration.
15. The airflow sensors shall be easily accessible in the valve for inspection without removing valve from the duct.
16. Use of valve or damper position for calculation of airflow volume is not acceptable. Direct airflow measurements must be taken.
17. Airflow Control Valve shall have factory installed high speed electric actuator specifically adapted to the stroke of the valve which shall operate on 24VAC. Power requirement for each airflow valve actuator shall not exceed 24VA.
18. Airflow Control Valve (where required) shall have an integral closed-loop feedback controller. Airflow measurement through the vortex airflow sensor shall send the digital signal to the controller which modulates the high speed electric actuator to maintain desired airflow setpoint. The airflow setpoint shall have the capability of being provided through analog input, digital input, and communications over BACnet MS/TP or AVC internal program memory. Analog output signal shall be provided for airflow and alarm outputs must be provided to indicate abnormal airflow conditions.
 - a. Airflow Control Valve integral controller shall provide an EIA-485 port supporting BACnet MS/TP as a Full Master Node state machine. Field programming shall be accomplished through an intuitive PC based UI (User Interface) tool. Connection between the integral controller and the computer shall be provided through a USB port located on the AVC control module.
 - b. Power requirement for each airflow valve with integral controller shall not exceed 27VA for all single valves and 50VA for dual valves.

J. Air Flow for Supply Air Applications

1. Supply valves shall be of the same construction as exhaust valves with the following construction features. Valve body material for Supply Air shall be galvanized steel or aluminum; 20gauge (galvanized) / 16gauge (aluminum) for body and 16gauge for blades. Valve shaft material shall be 316SS.

K. Fume Hood Monitors: All fume hoods shall be fitted with a fume hood monitor. Monitor shall be capable of receiving inputs from the BACS to permit change of the hood face velocity setpoints for

occupied/unoccupied control strategy. The system shall utilize sash position to reset the volume setpoint in the duct exhaust volume sensing equipment.

1. Acceptable manufacturers: Accotrol, Air Monitor, Critical Room, Control Phoenix
- L. Fume Hood Controllers: All VAV fume hoods shall be fitted with a fume hood controller. Controller shall be capable of receiving inputs from the BAS to permit change of the hood face velocity setpoints for occupied/unoccupied control strategy.
1. Exhaust airflow volume shall be controlled based on sash position at each laboratory fume hood by a dedicated fume hood controller. The fume hood controller shall be a fully functioning, independent control unit, capable of operating as a standalone element in a distributed laboratory airflow control system. Control hardware distribution shall be such that the failure of one controller shall not affect any other fume hoods on the network.
 2. The fume hood controller shall consist of a controller, display module and sash position sensors. The sash position sensors shall mount physically on the fume hood sash and frame assemblies.
 3. The fume hood controller shall also have integral airflow measurement circuitry to receive a signal directly proportional to duct air velocity, from a vortex-shedding type airflow measuring device, for the purpose of monitoring and controlling fume hood airflow volume. The signal shall be digitally processed by the controller, with no analog-to-digital circuitry required, eliminating A/D conversion error. The airflow measurement shall be incorporated in the control sequence as performed by the airflow controller, and communicated to other airflow controllers, via the network, as required. Measurement system accuracy shall be plus or minus 2% of volumetric airflow rate. Turndown capability shall be at least 10:1.
 4. The fume hood sash shall be fitted with sash position measuring sensor(s). Vertical position measuring devices shall be of the retracting drawstring potentiometer type. The sensors shall be permanently affixed to the fume hood structure and the drawstring affixed to the moving sash frame as best fits the particular hood design. The monitor shall be able to accept up to four (4) sash position measuring arrays for application on multiple-sash hoods. The monitor shall be cable-connected to and powered by the controller.
 5. The controller module shall be microprocessor based. The transmitter module shall be powered by 24VAC. It shall be provided with two 4-20mA analog outputs, two contact inputs, a SPDT alarm relay output, and a native BACnet MS/TP communications port.
 6. In the controller, the actual fume hood exhaust duct airflow (CFM) shall be compared to the desired fume hood exhaust airflow setpoint. The setpoint shall be continuously reset proportional sash open area, based on sash position.
 7. Control equations shall be of the P+I type. Microprocessor based controllers shall read the airflow, perform control calculations, and update the output to the damper a minimum of ten times per second. Floating "Gap" control will not be acceptable.
 8. The controller shall output a 4-20mA electronic signal to a dedicated electronic actuator and airflow control valve, as specified elsewhere in this document. Control response time shall be sufficient to contain fumes at all times when the sash is opened.
 9. The fume hood controller shall be fully configurable via a PC. Configuration shall be accomplished through an intuitive graphical interface. Fume hood controllers provided with menu driven configuration will not be acceptable.
 10. The Controller shall have unoccupied mode capability based upon hood proximity or room occupancy.
- M. Fume Hood Display:
1. Sash Position Indicators: All fume hoods shall be fitted with a sash position indicator.

2. The fume hood controller shall provide a 4-digit display to indicate the calculated face velocity or actual exhaust airflow in CFM. Energy use meters shall not be acceptable alternatives to the digital display of the above parameters.
3. A green LED shall indicate that face velocity is within operating condition at the fume hood. A red LED indicator shall display either a high or low face velocity alarm condition. When an alarm condition occurs, the alarm LED shall flash and the alarm beeper shall sound. The operator shall be able to silence the beeper through a mute button located on the face of the fume hood display.
4. The display shall provide the option to read in "Alpha" mode instead of numeric.

N. Fail Positions shall be as follows:

1. Fume Hood Exhaust: Normally open
2. Supply Air: Normally closed
3. Process Exhaust: Normally open

2.2 AIRFLOW CONTROL SOUND SPECIFICATIONS

- A. Unless otherwise specified the airflow control device shall not exceed the sound power levels scheduled. The airflow control valve shall not exceed the NC levels shown in the Table 1. NC levels are calculated based on the octave band sound attenuation factors shown in Table 2.
- B. If the airflow control device cannot meet the NC levels specified a properly sized silencer or sound attenuator must be used. Contractor shall be responsible for coordination of any silencers required to be installed with coordination and layout of sheetmetal systems.
- C. All silencers must be of a packless design (constructed of at least 18 gauge 316L stainless steel when used with fume hood exhaust) with a maximum pressure drop at the device's maximum rated flow rate not to exceed 0.20 inches of water.

Table 1: Maximum NC Levels of Supply, Radiated and Exhaust airflow control valves

Valve Size inches	Airflow CFM	Pressure Drop ("wg)		Maximum NC Level		
		AccuValve	Venturi	Supply	Radiated	Exhaust
6	290	1.0	2.0	<20	<20	51
8	700	1.0	2.0	23	27	49
10	1000	1.0	2.0	23	22	41
12	1500	1.0	2.0	25	21	52
14	2200	1.0	2.0	22	23	51
12x18	2000	1.0	2.0	29	27	47
12x24	3000	1.0	2.0	25	26	44
12x36	4500	1.0	2.0	33	31	51
12x48	6000	1.0	2.0	29	30	47

Table 2: Octave Band Sound Attenuation Factors

Radiated Sound	Octave Band					
	2	3	4	5	6	7
Environmental Effect	2	1	0	0	0	0

Ceiling/Space Effect	16	18	20	26	31	36
Total dB Reduction	18	19	20	26	31	36

Discharge Sound	Octave Band					
	2	3	4	5	6	7
Environmental Effect	2	1	0	0	0	0
Duct Lining	2	6	12	25	29	18
End Reflection	9	5	2	0	0	0
5 ft., 8 in Flex Duct	6	10	18	20	21	12
Space Effect	5	6	7	8	9	10
Total dB Reduction	24	28	39	53	59	40

Exhaust Sound	Octave Band					
	2	3	4	5	6	7
Environmental Effect	2	1	0	0	0	0
Space Effect	5	6	7	8	9	10
Total dB Reduction	7	7	7	8	9	10

The following dB adjustments are used, per ARI 885-98 for the calculation of NC above 300 CFM						
	Octave Band					
	2	3	4	5	6	7
300-700 CFM	2	1	1	-2	-5	-1
Over 700 CFM	4	3	2	-2	-7	-1

2.3 USAGE BASED CONTROL EQUIPMENT

- A. For variable air volume (VAV) systems, a sash sensor shall be provided to measure the height of each vertically-moving fume hood sash. Control systems employing sidewall mounted velocity sensors shall be unacceptable.
- B. A presence and motion sensor shall be provided to determine an operator's presence in front of a hood by detecting the presence and/or motion of an operator, and to command the laboratory airflow control system from an in-use operating face velocity (e.g., 100 fpm) to a standby face velocity (e.g., 60 fpm) and vice versa.
 1. The sensor shall define a detection zone that extends approximately 20" (50 cm) from the front of the fume hood. If the sensor does not detect presence and/or motion in its detection zone within five seconds, it shall command the system to the user adjustable standby face velocity. When the sensor detects the presence and/or motion of an operator within the detection zone, it shall command the system to the in-use face velocity within 1.0 second.
 2. The sensor shall have a control circuit that adapts to its specific surroundings and automatically adjusts for inanimate objects placed within its detection zone. It shall map the area into memory and, after a period of five minutes, nullify the image of the inanimate object and return to a standby mode. Operators shall enter and leave the zone with the unit automatically adjusting between in-use and standby modes. If the inanimate object is moved or taken out of the zone, the unit shall automatically re-map the area.
 3. Wide area motion detectors (on the hood or room level) shall be unacceptable.
- C. The airflow at the fume hood shall vary in a linear manner between two adjustable minimum and maximum flow set points to maintain a constant face velocity throughout this range. A minimum volume flow shall be set to assure flow through the fume hood even with the sash totally closed.
- D. A fume hood monitor shall be provided to receive the sash sensor output and presence and/or motion signal. This same monitor shall generate an exhaust airflow control signal for the appropriate airflow control device in order to provide a constant average face velocity. Audible and separate visual alarms shall be provided for both flow alarm and emergency exhaust conditions.

2.4 AIRFLOW CONTROL DEVICE—GENERAL

- A. The airflow control device shall be integrated into the building management system.
- B. The valve assembly manufacturer's Quality Management System shall be registered to ISO 9001:2000.
- C. The airflow control device shall be pressure independent over its specified differential static pressure operating range. An integral pressure independent assembly shall respond and maintain specific

airflow within one second of a change in duct static pressure irrespective of the magnitude of pressure and/or flow change or quantity of airflow controllers on a manifold system.

- D. The airflow control device shall maintain accuracy within $\pm 5\%$ of signal over an airflow turndown range of no less than 16 to 1. No minimum entrance or exit duct diameters shall be required to ensure accuracy and/or pressure independence.

E. Actuation

- 1. For electrically-actuated VAV operation, a UL 916 listed electronic actuator shall be factory mounted to the valve. Loss of main power shall cause the valve to position itself in an appropriate failsafe state. Options for these failsafe states include: normally open-maximum position, normally closed-minimum position, or last position. This position shall be maintained constantly without external influence, regardless of external conditions on the valve (within product specifications).

F. Certification

- 1. Each airflow control device shall be factory calibrated to the job specific airflows as detailed on the plans and specifications using NIST traceable air stations and instrumentation having a combined accuracy of no more than $\pm 1\%$ of signal over the entire range of measurement. Electronic airflow control devices shall be further calibrated and their accuracy verified to $\pm 5\%$ of signal at a minimum of eight different airflows across the full operating range of the device.
- 2. All airflow control devices shall be individually marked with device specific and factory characterization data. As a minimum, it should include: tag number, serial number, model number, characterization information (for electronic devices), and quality control inspection numbers. All information shall be stored by the manufacturer. Job related information, such as tag number, serial number and model number, shall be stored by the manufacturer for use with as-built documentation.

2.5 LABORATORY CONTROL UNIT

- A. A laboratory control unit shall control the supply and/or general exhaust airflow control devices to maintain proper room pressurization polarity (positive or negative). Each individual laboratory shall have a dedicated laboratory control unit.
- B. The control unit shall be electronic. The inputs shall accept linear feedback signals from fume hood, canopy, snorkel, biosafety cabinet, and office supply airflow control devices. The output signals shall control supply, general exhaust/return airflow control devices and/or variable frequency drives with signals that are linearly proportional to the desired supply or exhaust airflows.
- C. The control unit shall maintain a constant design offset between the sum of the room's total exhaust and make-up/supply airflows. This offset shall be field adjustable and represents the volume of air that will enter (or exit) the room from the corridor or adjacent spaces.
- D. The control unit shall provide linear signals that are proportional to all airflow sources, sash sensors, and flow alarms. The signals shall be available for hard-wired connection to the facility's direct digital control (DDC) system, or through an integrated control unit that interfaces directly into the facility's DDC system.

- E. The laboratory control unit may be either panel or valve mounted.
- F. Refer to the DDC Control specification for the required input/output summary for the necessary points to be monitored and or controlled.
- G. Each laboratory shall have a dedicated 120 Vac line connection to power the laboratory's airflow control system power supply. Contractor shall be responsible for providing all power requirements for Laboratory Control Systems.

PART 3 EXECUTION

3.1 INSTALLATION

- A. The automatic temperature controls (ATC) contractor shall install the sash sensors, interface boxes, presence and motion sensor, and fume hood monitor on the fume hood under initial supervision of the laboratory airflow control system supplier. Reel-type sash sensors and their stainless steel cables shall be hidden from view. Bar-type sash sensors shall be affixed to the individual sash panels. Sash interface boxes with interface cards shall be mounted in an accessible location.
- B. The ATC contractor shall install the laboratory control unit (if panel-mounted) and wall-mounted power supply (as required) in an accessible location in the designated laboratory room.
- C. The ATC contractor shall remove all existing pneumatic supply air and control devices, capping pneumatic lines at mains. All associated panels, mounting hardware shall also be removed for system components not required for the laboratory revisions.
- D. The ATC contractor shall terminate and connect all cables as required (refer to the chart below). In addition, integrated laboratory control unit connectors shall be furnished by the ATC.
- E. The mechanical contractor shall install all airflow control devices in the ductwork and shall connect all airflow control valve linkages.
- F. The mechanical contractor shall provide and install all reheat coils and transitions.
- G. The mechanical contractor shall provide and install insulation as required.
- H. The ATC contractor shall wire, power circuit and control wiring to the laboratory control unit or power supply.

3.2 SYSTEM START-UP AND TRAINING

- A. System start-up shall be provided by a factory-authorized representative of the laboratory airflow control system manufacturer. Start-up shall include calibrating the fume hood monitor and any combination sash sensing equipment as required. Start-up shall also provide electronic verification of airflow (fume hood exhaust, supply, make-up, general exhaust, or return).
- B. The balancing contractor shall be responsible for final verification and reporting of all airflows.
- C. The laboratory airflow control system supplier shall furnish a minimum of eight hours of owner training by factory trained and certified personnel. The training will provide an overview of the job specific airflow control components, verification of initial fume hood monitor calibration, general

procedures for verifying airflows of air valves, and general troubleshooting procedures.

- D. Operation and maintenance manuals, including as-built wiring diagrams and component lists, shall be provided for each training attendee.

END OF SECTION

SECTION 230923 – DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC

PART 1 GENERAL

1.1 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Section 23 09 13.23 - Sensors and Transmitters:

1. Flow meters (Refer to specification section 230519)
2. Flow switches
3. Coordinate piping thermo-wells with mechanical contractor.

B. Section 23 09 13.33 - Control Valves:

1. Control valves

1.3 PRODUCTS NOT FURNISHED OR INSTALLED BUT INTEGRATED WITH THE WORK OF THIS SECTION

A. General:

1. Coordination Meeting: The Installer furnishing the DDC network shall meet with the Installer(s) furnishing each of the following products to coordinate details of the interface between these products and the DDC network. The Owner or his designated representative shall be present at this meeting. Each Installer shall provide the Owner and all other Installers with details of the proposed interface including PICS for BACnet equipment, hardware and software identifiers for the interface points, network identifiers, wiring requirements, communication speeds, and required network accessories. The purpose of this meeting shall be to insure there are no unresolved issues regarding the integration of these products into the DDC network. Submittals for these products shall not be approved prior to the completion of this meeting.

B. Section 23 09 20 – Analog Laboratory Control:

1. VAV boxes: VAV Terminal Units shall be furnished configured to accept control inputs from an external building automation system controller as specified in Section 23 09 93. Factory mounted safeties and other controls shall not interfere with this controller.
2. EVAV boxes: EVAV Terminal Units shall be furnished configured to accept control inputs from an external building automation system controller as specified in Section 23 09 93. Factory mounted safeties and other controls shall not interfere with this controller.
3. FHM: FHM monitoring and control Units shall be furnished configured to accept control inputs from an external building automation system controller as specified in Section 23 09 93. Factory mounted safeties and other controls shall not interfere with this controller.

C. Section 22 63 13 - Specialty Gas Piping for Laboratory Facilities :

1. Specialty Gas System Shut Down Controllers: The Specialty Gas System Shut Down Controllers vendor shall furnish systems with an interface to the control and monitoring points specified in Section 22 63 13. These specified points shall be the minimum acceptable interface to the Gas Shut Down and Alarm Controllers. The connection to these points shall be by one of

the following methods: (a) Hardwired connection such as relay.

D. Section 26 33 00 – Gas Detection and Alarm Controllers:

1. Gas Detection and Alarm Controllers: The Gas Detection and Alarm Controllers vendor shall furnish systems with an interface to the control and monitoring points specified in Section 26 33 00. These specified points shall be the minimum acceptable interface to the Gas Detection And Alarm Controllers. The connection to these points shall be by one of the following methods: (a) Hardwired connection such as relay.

E. Communications with Third Party Equipment:

1. Any additional integral control systems included with the products integrated with the work of this section shall be furnished with a BACnet interface for integration into the Direct Digital Control System described in this section.

1.4 RELATED SECTIONS

- A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents.
- B. Cornell University Design and Construction Standards (http://cds.pdc.cornell.edu/cds_mechanical.cfm):
 1. 15955 BACS Guidelines
 2. 15956 Building Automation & Control System Communications & Interoperability.

C. The following sections constitute related work:

1. Drawings – Diagrams, Control Sequences and Point Listings
2. Division 01 - General Requirements
3. Section 01 60 00 - Product Requirements
4. Section 01 80 00 - Performance Requirements
5. Section 23 05 12 - Common Work Results for HVAC
6. Section 23 05 53 – Identification for HVAC piping and Equipment
7. Section 23 05 93 – Testing, Adjusting and Balancing
8. Section 23 09 20 – Analog Laboratory Control
9. Section 23 09 24 – Building Automation & Control System Communications & Interoperability
10. Section 23 21 13 - HVAC Piping
11. Section 23 31 13 - HVAC Ductwork
12. Section 23 36 00 – Air Terminals
13. Section 26 05 00 - Common Work Results for Electrical
14. Section 26 06 00 - Schedules for Electrical
15. Section 26 09 00 - Instrumentation and Control for Electrical Systems
16. Section 26 20 00 - Low Voltage Electrical Transmission
17. Section 26 50 00 – Lighting controls and motion detection
18. Section 28 00 00 - Electronic Safety and Security (includes Fire and Smoke)

1.5 DESCRIPTION

- A. General: The control system shall consist of a high-speed, peer-to-peer network of DDC controllers and a web-based operator interface. Depict each mechanical system and building floor plan by a point-and-click graphic. A web server with a network interface card shall gather data from this system and

generate web pages accessible through a conventional web browser on each PC connected to the network. Operators shall be able to perform all normal operator functions through the web browser interface.

- B. The Building Automation Control System (BACS) is configured as a network with control functions at multiple levels, and with multiple points of operator control and supervision. The BACS includes centralized head-end computers, the Energy Management and Controls System (EMCS) workstations, data transmission systems, field panels and controllers, necessary interfacing controls, sensors and actuators. The controllers contain microprocessors and other supporting electronics that perform local control functions and execute application programs without requiring communications with the centralized head-end computers or workstations.
- C. The system shall directly control HVAC equipment as specified in – Sequence of Operations for HVAC Controls, refer to M800 series contract drawings. Each zone controller shall provide occupied and unoccupied modes of operation by individual zone. Furnish energy conservation features such as optimal start and stop, night setback, request-based logic, and demand level adjustment of setpoints as specified in the sequence.
- D. Provide for future system expansion to include monitoring of occupant card access, fire alarm, and lighting control systems.
- E. System shall use the BACnet protocol for communication to the operator workstation or web server and for communication between control modules. I/O points, schedules, setpoints, trends, and alarms specified on drawings – "Sequence of Operations for HVAC Controls" shall be BACnet objects.

1.6 APPROVED CONTROL SYSTEMS

- A. Use control system hardware and software that meet the requirements of this specification and are scheduled on contract drawings in equipment schedules. The existing building control system is manufactured by Automated Logic Corporation, and shall be an extension of this system. A portion of an existing building is to be renovated, the new control system shall integrate seamlessly with the existing control system.

1.7 QUALITY ASSURANCE

- A. Installer and Manufacturer Qualifications
 - 1. Installer shall have an established working relationship with Control System Manufacturer.
 - 2. Installer shall have successfully completed Control System Manufacturer's control system training. Upon request, Installer shall present record of completed training including course outlines.

1.8 CODES AND STANDARDS

- A. Work, materials, and equipment shall comply with the most restrictive of local, state, and federal authorities' codes and ordinances or these plans and specifications. As a minimum, the installation shall comply with current editions in effect 30 days prior to receipt of bids of the following codes:
 - 1. National Electric Code (NEC)
 - 2. New York State Mechanical, Energy Codes

3. Cornell University Design and Construction Standards 15955 and 15956, access by web for current standards. http://cds.pdc.cornell.edu/cds_mechanical.cfm
4. ANSI/ASHRAE 135-2004: Data Communication Protocol for Building Automation and Control Systems (BACNET).
5. ATA/ANSI 878.1 (1992), ARCNET Local Area Network.

1.9 SYSTEM PERFORMANCE

- A. Performance Standards. System shall conform to the following minimum standards over network connections. Systems shall be tested using manufacturer's recommended hardware and software for operator workstation (server and browser for web-based systems).
1. Graphic Display. A graphic with 20 dynamic points shall display with current data within 10 sec.
 2. Graphic Refresh. A graphic with 20 dynamic points shall update with current data within 8 sec. and shall automatically refresh every 15 sec.
 3. Configuration and Tuning Screens. Screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within 6 sec.
 4. Object Command. Devices shall react to command of a binary object within 2 sec. Devices shall begin reacting to command of an analog object within 2 sec.
 5. Alarm Response Time. An object that goes into alarm shall be annunciated at the workstation within 15 sec.
 6. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 sec. Select execution times consistent with the mechanical process under control.
 7. Performance. Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per sec. Select execution times consistent with the mechanical process under control.
 8. Multiple Alarm Annunciation. Each workstation on the network shall receive alarms within 5 sec of other workstations.
 9. Reporting Accuracy. System shall report values with minimum end-to-end accuracy listed in Table 1.
 10. Control Stability and Accuracy. Control loops shall maintain measured variable at setpoint within tolerances listed in Table 2.

Table 1
Reporting Accuracy

Measured Variable	Reported Accuracy
Space Temperature	±0.5°C (±1°F)
Ducted Air	±0.5°C (±1°F)
Outside Air	±0.25°C (±0.4°F)
Water Temperature	±0.25°C (±0.4°F)
Delta-T	±0.15°C (±0.25°F)
Airflow (terminal)	±10% of full scale (see Note 1)
Airflow (measuring stations)	±5% of full scale
Airflow (pressurized spaces)	±3% of full scale
Air Pressure (ducts)	±25 Pa (±0.1 in. w.g.)
Air Pressure (space)	±3 Pa (±0.01 in. w.g.)
Electrical (A, V, W, Power Factor)	±1% of reading

Note 1: Accuracy applies to 10% - 100% of scale

Table 2
Control Stability and Accuracy

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	±50 Pa (±0.2 in. w.g.) ±3 Pa (±0.01 in. w.g.)	0-1.5 kPa (0-6 in. w.g.) -25 to 25 Pa (-0.1 to 0.1 in. w.g.)
Airflow	±10% of full scale	
Space Temperature	±1.0°C (±2.0°F)	
Duct Temperature	±1.5°C (±3°F)	

1.10 SUBMITTALS

- A. Product Submittal Requirements: Meet requirements of Division 01 on Shop Drawings, Product Data, and Samples. Provide six copies of shop drawings and other submittals on hardware, software, and equipment to be installed or furnished. Begin no work until submittals have been approved for conformity with design intent. Provide drawings as AutoCAD 2006 (or newer) compatible files on magnetic or optical disk (file format: .DWG, .DXF, .VSD, or comparable) and 3 prints of each drawing on 11" x 17" paper. When manufacturer's cutsheets apply to a product series rather than a specific product, clearly indicate applicable data by highlighting or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cutsheets to fulfill submittal requirements. Select and show submittal quantities appropriate to scope of work. Submittal approval does not relieve Contractor of responsibility to supply sufficient quantities to complete work. Provide submittals within 12 weeks of contract award on the following:

1. Direct Digital Control System Hardware

- a. Complete bill of materials indicating quantity, manufacturer, model number, and relevant technical data of equipment to be used.
- b. Manufacturer's description and technical data such as performance curves, product specifications, and installation and maintenance instructions for items listed below and for relevant items not listed below:
 - i. Direct digital controllers (controller panels)
 - ii. Transducers and transmitters
 - iii. Sensors (include accuracy data)
 - iv. Actuators
 - v. Valves
 - vi. Relays and switches
 - vii. Control panels
 - viii. Power supplies
 - ix. Batteries
 - x. Wiring
- c. Wiring diagrams and layouts for each control panel. Show termination numbers.
- d. Floor plan schematic diagrams indicating field sensor and controller locations.
- e. Riser diagrams showing control network layout, communication protocol, and wire types.

2. Central System Hardware and Software

- a. Complete bill of material indicating quantity, manufacturer, model number, and relevant technical data of equipment used.
- b. Manufacturer's description and technical data such as product specifications and installation and maintenance instructions for items listed below and for relevant items furnished under this contract not listed below:
 - i. Central Processing Unit (CPU) or web server
 - ii. Power supplies
 - iii. Battery backups
 - iv. Interface equipment between CPU or server and control panels
 - v. Operating System software
 - vi. Operator interface software

- vii. Graphical screen set up display for owner review and customization.
- viii. Third-party software|

- c. Schematic diagrams of control, communication, and power wiring for central system installation. Show interface wiring to control system.
- d. Network riser diagrams of wiring between central control unit and control panels.

3. Controlled Systems

- a. Riser diagrams showing control network layout, communication protocol, and wire types.
 - b. Schematic diagram of each controlled system. Label control points with point names. Graphically show locations of control elements.
 - c. Schematic wiring diagram of each controlled system. Label control elements and terminals. Where a control element is also shown on control system schematic, use the same name.
 - d. Instrumentation list (Bill of Materials) for each controlled system. List each control system element in a table. Show element name, type of device, manufacturer, model number, and product data sheet number.
 - e. Complete description of control system operation including sequences of operation. Include and reference schematic diagram of controlled system. List I/O points and software points specified in Section 23 09 93. Indicate alarmed and trended points.
4. Description of process, report formats, and checklists to be used in Section 23 09 23 Article (Control System Demonstration and Acceptance).
5. BACnet Protocol Implementation Conformance Statement (PICS) for each submitted type of controller and operator interface.
6. Control Schematics: Control schematics shall be utilized to graphically indicate the systems, show the schematic configuration of the systems and location of control devices, define the point names and addresses (as applicable), and define the setpoints for control elements. Control schematics are required both as part of the contract documents (generated by the design professional), shop drawing submittals, and as-built document submittals. The following shall be included in the controls schematics at a minimum:
- a. Point names. See DCS 15956 for requirements.
 - b. Point addresses (not applicable to the contract documents).
 - c. Point type.
 - d. Normal position of output devices.
 - e. Device ranges.
 - f. Initial design intent setpoints modified as refined during construction/ commissioning for as-built submittals.
 - g. Bill of materials listing all devices and manufacturer numbers (not applicable to the contract documents).
 - h. Legend of device symbols.
7. Product Data: Submit manufacturer's technical product data for each control device, panel, controller, and accessory furnished indicating dimensions, capacities, performance and electrical characteristics, and material finishes. Also include installation, start-up, calibration, and maintenance instructions as well as all cable and tubing requirements. Provide these as a part of the shop drawings and as-built submittal.
8. Valve Schedules: Either with the control schematic or separately in shop drawing submittal and as-built submittal provide a valve schedule listing the following:
- a. Size.
 - b. CV.
 - c. Design maximum flow.

- d. Pressure drop at design maximum flow.
 - e. Position of valve at design condition.
 - f. Manufacturer.
 - g. Model/product number.
 - h. Close off rating.
 - i. Normal positions.
 - j. Valve characteristic.
 - k. Valve turndown.
 - l. Actuator information.
 - m. Design controlled circuit pressure differential range (coordinated with the submittals).
 - n. Valves shall be selected such that they are not, as a practice, "oversized." Valve sizes shall be picked as close as possible to meet the design pressure drop. The minimum CV shall be no less than 1.9 on all valves.
9. Damper Schedules: Either with the control schematic or separately in shop drawing submittal and as-built submittal, provide a damper schedule listing the following:
- a. System served.
 - b. Damper information: Quantity, Model Number, Fail Position (NO, NC), Type and Size.
 - c. Duct Size.
 - d. Actuator Information: Quantity, Model Number, Pilot (Y/N). Actuator Range, Mounting Position.
10. Control System Architecture Diagram: Provide a system architecture one-line diagram indicating schematic location of all controllers, workstations, LAN interface devices, gateways, etc. Indicate address and type for each control unit. Indicate physical media, protocol, communication speed, and type of each LAN.
11. Control Sequence of Operations "Detailed Written Sequences of Operation"
12. Provide a detailed sequence of operations. Sequences may be on the control schematics or in detailed document, but shall be included with the control schematics for the shop drawing and as-built submittal. Control sequences shall be highly detailed in the initial submittal and shall maintain this detail throughout the as-built submittal phase. The following shall be included as a minimum:
- a. Sequences in all modes of operation (i.e., on, off, occupied, unoccupied, warm-up, cool-down, summer, winter, etc.);
 - b. Detailed steps during mode switches;
 - c. Details of operation during and after a power outage. Loss of status associated with power outages must not be indicated as failures with a subsequent alarm or lock out;
 - d. Specific direction on failure scenarios for loss of proof and all safety device trips;
 - e. Setpoints, trip points, and ranges. Initially these shall be the designer's intent, and eventually be the actual setting at time of as-built submittal;
13. All related equipment should be grouped together by areas served. Also, group all sequences into functional sections (i.e., start/stop, static pressure control, etc.).
14. Points List: A detailed point list shall be provided in tabular form either with the control schematics or separately. Indicate all physical and virtual points and organize by system/sub-system. Include names, descriptors, addresses (when known) and point types with applicable range as a minimum. These shall be provided electronically in either a database format or in a spreadsheet format.
15. Alarms and Alarms List: Either as part of the points list or as a separate list, an alarms list shall be provided. The list shall include the alarm point name, point type, and alarm parameters. All analog control loops shall include an adjustable setpoint deviation alarm based upon error and time. The alarm parameters shall be the state the point is in to cause a particular alarm. An example of a point in this list is as follows:
- a. Supply air temp (AI) +/-5°F from setpoint.
16. Floor Plans: Provide a set of floor plans with all controllers/control panels, sensors, operator workstations, interface devices, UPS's, etc., located and identified. All network components

(repeaters, routers, etc.) shall also be identified on the floor plan drawings. All BACS network wiring shall be shown and identified on the floor plan drawings.

17. Detailed Wiring Diagrams: Shop drawings and as-built submittals shall include detailed wiring diagrams. Indicate all required electrical wiring. Wiring diagrams shall include both ladder logic type diagrams for motor starter, control, and safety circuits and detailed digital interface panel point termination diagrams with all wire numbers and terminal block numbers identified. Provide panel termination drawings on separate drawings. Ladder diagrams shall appear on the system schematic. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed. These shall be submitted with shop drawing and as-built submittals. All wiring of related components that make up a system shall be grouped together in one diagram (e.g., all wiring diagrams for the components and devices on a particular AHU shall be shown on one drawing. The supply fan components and devices should not be shown separate from return fan components and devices, etc.).
18. Sample Graphics and Trends: If the project includes web-based graphics and trends for the use of interfacing to the BACS, the vendor shall submit for approval draft samples of the actual graphics to be used for the project. Design professional and project manager, after consultation with the HVACR Shop, shall approve the graphics.

B. Schedules

1. Schedule of work provided within one month of contract award, indicating:
 - a. Intended sequence of work items
 - b. Start date of each work item
 - c. Duration of each work item
 - d. Planned delivery dates for ordered material and equipment and expected lead times
 - e. Milestones indicating possible restraints on work by other trades or situations
2. Monthly written status reports indicating work completed and revisions to expected delivery dates. Include updated schedule of work.

C. Project Record Documents. Submit six copies of record (as-built) documents upon completion of installation for approval prior to final completion. Submittal shall consist of:

1. Hard Copy: Paper copies of the indicated deliverables shall be provided as directed by the project manager. Final quantities shall be enumerated as identified item 2 below. During construction, at a minimum, three sets of hard copies shall be maintained; one at the facility, one in the HVACR shop, and one in the project maintenance manual.
2. Project Record Drawings. (As-Built Drawings): As-built documentation as indicated herein shall be maintained and submitted to reflect the final installed condition of the BACS. The as-built documents shall be kept up to date throughout the warranty period and submitted as final at the end of the warranty period. One set of documents and files shall be provided to be stored locally at the new facility and two sets shall be provided to be stored centrally. As-built versions of submittal shop drawings provided as AutoCAD 2006 (or newer) compatible files on magnetic or optical disk (file format: .DWG, .DXF, .VSD, or comparable) and 6 prints of each drawing on 11" x 17" paper.
 - a. Electronic Copy: All submittal and as-built documents shall be provided electronically, to the HVACR shop. Different documents may be in different formats, however each shall be provided in one of the first two formats as well as in the format in which the document was originally created, if it is different.
 - i. Microsoft Office format (Word, Excel, etc.)
 - ii. Adobe Portable Document Format (PDF).
3. Hard Copy (Control Panels): In addition to the six copies, each control panel on the project shall include an as-built hard copy of all drawings and documentation associated with that panel and

its field devices. This documentation shall be provided in a plastic protective pocket mounted inside the panel door. In addition, see Operation and Maintenance Materials.

4. Testing and Commissioning Reports and Checklists. Completed versions of reports, checklists, and trend logs used to meet requirements of Section 23 09 23 Article 3.17 (Control System Demonstration and Acceptance).
5. Operation and Maintenance (O&M) Manual. Printed, electronic, or online help documentation of the following:
 - a. As-built versions of submittal product data.
 - b. Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.
 - c. Operator's manual with procedures for operating control systems: logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing setpoints and variables.
 - d. Programming manual or set of manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
 - e. Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points, panels, and other hardware; how to perform preventive maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.
 - f. Documentation of programs created using custom programming language including setpoints, tuning parameters, and object database. Electronic copies of programs shall meet this requirement if control logic, setpoints, tuning parameters, and objects can be viewed using furnished programming tools.
 - g. Graphic files, programs, and database on magnetic or optical media.
 - h. List of recommended spare parts with part numbers and suppliers.
 - i. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
 - j. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation or web server software, and graphics software.
 - k. Licenses, guarantees, and warranty documents for equipment and systems.
 - l. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.

- D. Training Materials: Provide course outline and materials for each class at least six weeks before first class. Training shall be furnished via instructor-led sessions, computer-based training, or web-based training. Engineer will modify course outlines and materials if necessary to meet Owner's needs. Engineer will review and approve course outlines and materials at least three weeks before first class.

1.11 WARRANTY

A. Warrant work as follows:

1. Warrant labor and materials for specified control system free from defects for a period of 12 months after final acceptance. Control system failures during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within 24 hours of Owner's warranty service request.

2. Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate warranty start date and period.
3. If Engineer determines that equipment and systems operate satisfactorily at the end of final start-up, testing, and commissioning phase, Engineer will certify in writing that control system operation has been tested and accepted in accordance with the terms of this specification. Date of acceptance shall begin warranty period.
4. Provide updates to operator workstation or web server software, project-specific software, graphic software, database software, and firmware that resolve Contractor-identified software deficiencies at no charge during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without Owner's written authorization.
5. Exception: Contractor shall not be required to warrant reused devices except those that have been rebuilt or repaired. Installation labor and materials shall be warranted. Demonstrate operable condition of reused devices at time of Engineer's acceptance.

1.12 OWNERSHIP OF PROPRIETARY MATERIAL

- A. Project-specific software and documentation shall become Owner's property. This includes, but is not limited to:
 1. Graphics
 2. Record drawings
 3. Database
 4. Application programming code
 5. Documentation

PART 2 PRODUCTS

2.1 MATERIALS

- A. Use new products the manufacturer is currently manufacturing and selling for use in new installations. Do not use this installation as a product test site unless explicitly approved in writing by Owner. Spare parts shall be available for at least five years after completion of this contract.

2.2 COMMUNICATION

- A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet internetwork. Controller and operator interface communication shall conform to ANSI/ASHRAE Standard 135-2004, BACnet.
- B. Install new wiring and network devices as required to provide a complete and workable control network. Use existing Ethernet backbone for network segments marked "existing" on project drawings.
- C. Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.

- D. Internetwork operator interface and value passing shall be transparent to internetwork architecture.
 - 1. An operator interface connected to a controller shall allow the operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, and control algorithms shall be viewable and editable from each internetwork controller.
 - 2. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. Program and test all cross-controller links required to execute control strategies specified on drawings. An authorized operator shall be able to edit cross-controller links by typing a standard object address or by using a point-and-click interface.
- E. Controllers with real-time clocks shall use the BACnet Time Synchronization service. System shall automatically synchronize system clocks daily from an operator-designated controller via the internetwork. If applicable, system shall automatically adjust for daylight saving and standard time.
- F. System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring.

2.3 OPERATOR INTERFACE

- A. Operator Interface. Web server shall reside on high-speed network with building controllers. Each standard browser connected to server shall be able to access all system information.
- B. Communication. Web server to SUNY central campus workstation and controllers shall communicate using BACnet protocol. Web server or workstation and control network backbone shall communicate using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing as specified in ANSI/ASHRAE 135-2004, BACnet Annex J.
- C. Hardware. Existing workstation or web server shall be extended for this project:
 - 1. Hardware Base. Industry-standard hardware shall meet or exceed DDC system manufacturer's recommended specifications and shall meet response times specified in Section 23 09 23 Paragraph 1.9. Hard disk shall have sufficient memory to store system software, one year of data for trended points specified in Section 23 09 93, and a system database at least twice the size of the existing database at system acceptance. Configure computers and network connections if multiple computers are required to meet specified memory and performance. Web server or workstations shall be IBM-compatible PCs with a minimum of:
- D. Operator Functions. Operator interface shall allow each authorized operator to execute the following functions as a minimum:
 - 1. Log In and Log Out. System shall require user name and password to log in to operator interface.
 - 2. Point-and-click Navigation. Operator interface shall be graphically based and shall allow operators to access graphics for equipment and geographic areas using point-and-click navigation.
 - 3. View and Adjust Equipment Properties. Operators shall be able to view controlled equipment status and to adjust operating parameters such as setpoints, PID gains, on and off controls, and sensor calibration.
 - 4. View and Adjust Operating Schedules. Operators shall be able to view scheduled operating hours of each schedulable piece of equipment on a weekly or monthly calendar-based graphical schedule display, to select and adjust each schedule and time period, and to simultaneously

schedule related equipment. System shall clearly show exception schedules and holidays on the schedule display.

5. View and Respond to Alarms. Operators shall be able to view a list of currently active system alarms, to acknowledge each alarm, and to clear (delete) unneeded alarms.
6. View and Configure Trends. Operators shall be able to view a trend graph of each trended point and to edit graph configuration to display a specific time period or data range. Operator shall be able to create custom trend graphs to display on the same page data from multiple trended points.
7. View and Configure Reports. Operators shall be able to run preconfigured reports, to view report results, and to customize report configuration to show data of interest.
8. Manage Control System Hardware. Operators shall be able to view controller status, to restart (reboot) each controller, and to download new control software to each controller.
9. Manage Operator Access. Typically, only a few operators are authorized to manage operator access. Authorized operators shall be able to view a list of operators with system access and of functions they can perform while logged in. Operators shall be able to add operators, to delete operators, and to edit operator function authorization. Operator shall be able to authorize each operator function separately.

E. System Software.

1. Operating System. Web server shall have an industry-standard professional-grade operating system.
2. System Graphics. Operator interface shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, and graphics that summarize conditions on each floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using dynamic colors to represent zone temperature relative to zone setpoint.
 - a. Functionality. Graphics shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment, to use point-and-click navigation between zones or equipment, and to edit setpoints and other specified parameters.
 - b. Animation. Graphics shall be able to animate by displaying different image files for changed object status.
 - c. Alarm Indication. Indicate areas or equipment in an alarm condition using color or other visual indicator.
 - d. Format. Graphics shall be saved in an industry-standard format such as BMP, JPEG, PNG, or GIF. Web-based system graphics shall be viewable on browsers compatible with World Wide Web Consortium browser standards. Web graphic format shall require no plug-in (such as HTML and JavaScript) or shall only require widely available no-cost plug-ins (such as Active-X and Macromedia Flash).

F. System Tools. System shall provide the following functionality to authorized operators as an integral part of the operator interface or as stand-alone software programs. If furnished as part of the interface, the tool shall be available from each workstation or web browser interface.

1. Automatic System Database Configuration. Each workstation or web server shall store on its hard disk a copy of the current system database, including controller firmware and software. Stored database shall be automatically updated with each system configuration or controller firmware or software change.
2. Controller Memory Download. Operators shall be able to download memory from the system database to each controller.
3. System Configuration. Operators shall be able to configure the system.

4. Online Help. Context-sensitive online help for each tool shall assist operators in operating and editing the system.
Security. System shall require a user name and password to view, edit, add, or delete data.
 - a. Operator Access. Each user name and password combination shall define accessible viewing, editing, adding, and deleting functions in each system application, editor, and object.
 - b. Automatic Log Out. Automatically log out each operator if no keyboard or mouse activity is detected. Operators shall be able to adjust automatic log out delay.
 - c. Encrypted Security Data. Store system security data including operator passwords in an encrypted format. System shall not display operator passwords.
5. System Diagnostics. System shall automatically monitor controller and I/O point operation. System shall annunciate controller failure and I/O point locking (manual overriding to a fixed value).
6. Alarm Processing. System input and status objects shall be configurable to alarm on departing from and on returning to normal state. Operator shall be able to enable or disable each alarm and to configure alarm limits, alarm limit differentials, alarm states, and alarm reactions for each system object. Configure and enable alarm points as specified in Section 23 09 93 – Sequence of Operations for HVAC Controls. Alarms shall be BACnet alarm objects and shall use BACnet alarm services.
7. Alarm Messages. Alarm messages shall use an English language descriptor without acronyms or mnemonics to describe alarm source, location, and nature.
8. Alarm Reactions. Operator shall be able to configure (by object) actions workstation or web server shall initiate on receipt of each alarm. As a minimum, workstation or web server shall be able to log, print, start programs, display messages, send e-mail, send page, and audibly annunciate.
9. Alarm Maintenance. Operators shall be able to view system alarms and changes of state chronologically, to acknowledge and delete alarms, and to archive closed alarms to the workstation or web server hard disk from each workstation or web browser interface.
10. Trend Configuration. Operator shall be able to configure trend sample or change of value (COV) interval, start time, and stop time for each system data object and shall be able to retrieve data for use in spreadsheets and standard database programs. Controller shall sample and store trend data and shall be able to archive data to the hard disk. Configure trends as specified in Section 23 09 93 – Sequence of Operations for HVAC Controls. Trends shall be BACnet trend objects.
11. Object and Property Status and Control. Operator shall be able to view, and to edit if applicable, the status of each system object and property by menu, on graphics, or through custom programs.
12. Reports and Logs. Operator shall be able to select, to modify, to create, and to print reports and logs. Operator shall be able to store report data in a format accessible by standard spreadsheet and word processing programs.
13. Standard Reports. Furnish the following standard system reports:
 - a. Objects. System objects and current values filtered by object type, by status (in alarm, locked, normal), by equipment, by geographic location, or by combination of filter criteria.
 - b. Alarm Summary. Current alarms and closed alarms. System shall retain closed alarms for an adjustable period.
 - c. Logs. System shall log the following to a database or text file and shall retain data for an adjustable period:
 - i. Alarm History.
 - ii. Trend Data. Operator shall be able to select trends to be logged.

- iii. Operator Activity. At a minimum, system shall log operator log in and log out, control parameter changes, schedule changes, and alarm acknowledgment and deletion. System shall date and time stamp logged activity.
- 14. Graphics Generation. Graphically based tools and documentation shall allow Operator to edit system graphics, to create graphics, and to integrate graphics into the system. Operator shall be able to add analog and binary values, dynamic text, static text, and animation files to a background graphic using a mouse.
- 15. Graphics Library. Complete library of standard HVAC equipment graphics shall include equipment such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. Library shall include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. Library graphic file format shall be compatible with graphics generation tools.
- 16. Custom Application Programming. Operator shall be able to create, edit, debug, and download custom programs. System shall be fully operable while custom programs are edited, compiled, and downloaded. Programming language shall have the following features:
 - a. Language. Language shall be graphically based or English language oriented. If graphically based, language shall use function blocks arranged in a logic diagram that clearly shows control logic flow. Function blocks shall directly provide functions listed below, and operators shall be able to create custom or compound function blocks. If English language oriented, language shall be based on the syntax of BASIC, FORTRAN, C, or PASCAL, and shall allow for free-form programming that is not column-oriented or "fill-in-the-blanks."
 - b. Programming Environment. Tool shall provide a full-screen, cursor-and-mouse-driven programming environment that incorporates word processing features such as cut and paste. Operators shall be able to insert, add, modify, and delete custom programming code, and to copy blocks of code to a file library for reuse in other control programs.
 - c. Independent Program Modules. Operator shall be able to develop independently executing program modules that can disable, enable and exchange data with other program modules.
 - d. Debugging and Simulation. Operator shall be able to step through the program observing intermediate values and results. Operator shall be able to adjust input variables to simulate actual operating conditions. Operator shall be able to adjust each step's time increment to observe operation of delays, integrators, and other time-sensitive control logic. Debugger shall provide error messages for syntax and for execution errors.
 - e. Conditional Statements. Operator shall be able to program conditional logic using compound Boolean (AND, OR, and NOT) and relational (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
 - f. Mathematical Functions. Language shall support floating-point addition, subtraction, multiplication, division, and square root operations, as well as absolute value calculation and programmatic selection of minimum and maximum values from a list of values.
 - g. Variables: Operator shall be able to use variable values in program conditional statements and mathematical functions.
 - i. Time Variables. Operator shall be able to use predefined variables to represent time of day, day of the week, month of the year, and date. Other predefined variables or simple control logic shall provide elapsed time in seconds, minutes, hours, and days. Operator shall be able to start, stop, and reset elapsed time variables using the program language.

- ii. System Variables. Operator shall be able to use predefined variables to represent status and results of Controller Software and shall be able to enable, disable, and change setpoints of Controller Software as described in Controller Software section.
- G. Portable Operator's Terminal. Provide all necessary software to configure an IBM-compatible laptop computer for use as a Portable Operator's Terminal. Operator shall be able to connect configured Terminal to the system network or directly to each controller for programming, setting up, and troubleshooting.
- H. BACnet. Web server or workstation shall have demonstrated interoperability during at least one BMA Interoperability Workshop and shall substantially conform to BACnet Operator Workstation (B-OWS) device profile as specified in ASHRAE/ANSI 135-2001, BACnet Annex L.

2.4 CONTROLLER SOFTWARE

- A. Building and energy management application software shall reside and operate in system controllers. Applications shall be editable through operator workstation, web browser interface, or engineering workstation.
- B. System Security. See Paragraph 2.3.F.5 (Security) and Paragraph 2.3.F.15.c (Operator Activity).
- C. Scheduling. See Paragraph 2.3.D.4 (View and Adjust Operating Schedules). System shall provide the following schedule options as a minimum:
 - 1. Weekly. Provide separate schedules for each day of the week. Each schedule shall be able to include up to 5 occupied periods (5 start-stop pairs or 10 events).
 - 2. Exception. Operator shall be able to designate an exception schedule for each of the next 365 days. After an exception schedule has executed, system shall discard and replace exception schedule with standard schedule for that day of the week.
 - 3. Holiday. Operator shall be able to define 24 special or holiday schedules of varying length on a scheduling calendar that repeats each year.
- D. System Coordination. Operator shall be able to group related equipment based on function and location and to use these groups for scheduling and other applications.
- E. Binary and Analog Alarms. See Paragraph 2.3.F.7 (Alarm Processing).
- F. Alarm Reporting. See Paragraph 2.3.F.9 (Alarm Reactions).
- G. Remote Communication. System shall automatically contact operator workstation or server on receipt of critical alarms. If no network connection is available, system shall use a modem connection.
- H. Demand Limiting.
 - 1. System shall monitor building power consumption from building power meter pulse generator signals or from building feeder line watt transducer or current transformer.
 - 2. When power consumption exceeds adjustable levels, system shall automatically adjust setpoints, de-energize low-priority equipment, and take other programmatic actions to reduce demand as specified in Section 23 09 93 – Sequence of Operations for HVAC Controls. When demand drops below adjustable levels, system shall restore loads as specified.

- I. Maintenance Management. System shall generate maintenance alarms when equipment exceeds adjustable runtime, equipment starts, or performance limits. Configure and enable maintenance alarms as specified in Section 23 09 93 – Sequence of Operations for HVAC Controls.
- J. Sequencing. Application software shall sequence all equipment as specified on drawings – Sequence of Operations for HVAC Controls.
- K. PID Control. System shall provide direct- and reverse-acting PID (proportional-integral-derivative) algorithms. Each algorithm shall have anti-windup and selectable controlled variable, setpoint, and PID gains. Each algorithm shall calculate a time-varying analog value that can be used to position an output or to stage a series of outputs.
- L. Staggered Start. System shall stagger controlled equipment restart after power outage. Operator shall be able to adjust equipment restart order and time delay between equipment restarts.
- M. Energy Calculations.
 - 1. System shall accumulate and convert instantaneous cooling (tons) or flow rates (gpm) and temperatures to energy usage data.
 - 2. System shall calculate a sliding-window average (rolling average). Operator shall be able to adjust window interval to 15 minutes, 30 minutes, or 60 minutes.
- N. Anti-Short Cycling. Binary output objects shall be protected from short cycling by means of adjustable minimum on-time and off-time settings.
- O. On and Off Control with Differential. System shall provide direct- and reverse-acting on and off algorithms with adjustable differential to cycle a binary output based on a controlled variable and setpoint.
- P. Runtime Totalization. System shall provide an algorithm that can totalize runtime for each binary input and output. Operator shall be able to enable runtime alarm based on exceeded adjustable runtime limit. Configure and enable runtime totalization and alarms as specified in Section 23 09 93 – Sequence of Operations for HVAC Controls.
- Q. Space air change rate: System shall utilize air change rate information as supplied on drawings for occupied and unoccupied settings. Each individual room shall have a graphical room air change rate setting which can be user set. Actual room air change rate shall be a calculated value based upon measured air flows for supply and exhaust, this value shall be displayed.

2.5 CONTROLLERS

- A. General. Provide Building Controllers (BC), Advanced Application Controllers (AAC), Application Specific Controllers (ASC), Smart Actuators (SA), and Smart Sensors (SS) as required to achieve performance specified in Section 23 09 23 Article 1.9 (System Performance). Every device in the system which executes control logic and directly controls HVAC equipment must conform to a standard BACnet Device profile as specified in ANSI/ASHRAE 135-2004, BACnet Annex L. Unless otherwise specified, hardwired actuators and sensors may be used in lieu of BACnet Smart Actuators and Smart Sensors.
- B. BACnet.

1. Building Controllers (BCs). Each BC shall conform to BACnet Building Controller (B-BC) device profile as specified in ANSI/ASHRAE 135-2004, BACnet Annex L and shall be listed as a certified B-BC in the BACnet Testing Laboratories (BTL) Product Listing.
2. Advanced Application Controllers (AACs). Each AAC shall conform to BACnet Advanced Application Controller (B-AAC) device profile as specified in ANSI/ASHRAE 135-2004, BACnet Annex L and shall be listed as a certified B-AAC in the BACnet Testing Laboratories (BTL) Product Listing.
3. Application Specific Controllers (ASCs). Each ASC shall conform to BACnet Application Specific Controller (B-ASC) device profile as specified in ANSI/ASHRAE 135-2004, BACnet Annex L and shall be listed as a certified B-ASC in the BACnet Testing Laboratories (BTL) Product Listing.
4. Smart Actuators (SAs). Each SA shall conform to BACnet Smart Actuator (B-SA) device profile as specified in ANSI/ASHRAE 135-2004, BACnet Annex L and shall be listed as a certified B-SA in the BACnet Testing Laboratories (BTL) Product Listing.
5. Smart Sensors (SSs). Each SS shall conform to BACnet Smart Sensor (B-SS) device profile as specified in ANSI/ASHRAE 135-2004, BACnet Annex L and shall be listed as a certified B-SS in the BACnet Testing Laboratories (BTL) Product Listing.
6. BACnet Communication.
 - a. Each BC shall reside on or be connected to a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing.
 - b. BACnet routing shall be performed by BCs or other BACnet device routers as necessary to connect BCs to networks of AACs and ASCs.
 - c. Each AAC shall reside on a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol with BACnet/IP addressing, or it shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
 - d. Each ASC shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
 - e. Each SA shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
 - f. Each SS shall reside on a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol with BACnet/IP addressing, or it shall reside on a BACnet network using ARCNET or MS/TP Data Link/Physical layer protocol.

C. Communication.

1. Service Port. Each controller shall provide a service communication port for connection to a Portable Operator's Terminal. Connection shall be extended to space temperature sensor ports where shown on drawings.
2. Signal Management. BC and ASC operating systems shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and to allow for central monitoring and alarms.
3. Data Sharing. Each BC and AAC shall share data as required with each networked BC and AAC.
4. Stand-Alone Operation. Each piece of equipment specified in Section 23 09 93 shall be controlled by a single controller to provide stand-alone control in the event of communication failure. All I/O points specified for a piece of equipment shall be integral to its controller. Provide stable and reliable stand-alone control using default values or other method for values normally read over the network.

D. Environment. Controller hardware shall be suitable for anticipated ambient conditions.

1. Controllers used outdoors or in wet ambient conditions shall be mounted in waterproof enclosures and shall be rated for operation at -29°C to 60°C (-20°F to 140°F).
 2. Controllers used in conditioned space shall be mounted in dust-protective enclosures and shall be rated for operation at 0°C to 50°C (32°F to 120°F).
- E. Keypad. Provide a local keypad and display for each BC and AAC. Operator shall be able to use keypad to view and edit data. Keypad and display shall require password to prevent unauthorized use. If the manufacturer does not normally provide a keypad and display for each BC and AAC, provide the software and any interface cabling needed to use a laptop computer as a Portable Operator's Terminal for the system.
- F. Real-Time Clock. Controllers that perform scheduling shall have a real-time clock.
- G. Serviceability.
1. Controllers shall have diagnostic LEDs for power, communication, and processor.
 2. Wires shall be connected to a field-removable modular terminal strip or to a termination card connected by a ribbon cable.
 3. Each BC and AAC shall continually check its processor and memory circuit status and shall generate an alarm on abnormal operation. System shall continuously check controller network and generate alarm for each controller that fails to respond.
- H. Memory
1. Controller memory shall support operating system, database, and programming requirements.
 2. Each BC and AAC shall retain BIOS and application programming for at least 72 hours in the event of power loss.
 3. Each ASC and SA shall use nonvolatile memory and shall retain BIOS and application programming in the event of power loss. System shall automatically download dynamic control parameters following power loss.
- I. Immunity to Power and Noise. Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).
- J. Transformer. ASC power supply shall be fused or current limiting and shall be rated at a minimum of 125% of ASC power consumption.

2.6 INPUT AND OUTPUT INTERFACE

- A. General. Hard-wire input and output points to BCs, AACs, ASCs, or SAs.
- B. Protection. Shorting an input or output point to itself, to another point, or to ground shall cause no controller damage. Input or output point contact with up to 24 V for any duration shall cause no controller damage.
- C. Binary Inputs. Binary inputs shall monitor the on and off signal from a remote device. Binary inputs shall provide a wetting current of at least 12 mA and shall be protected against contact bounce and noise. Binary inputs shall sense dry contact closure without application of power external to the controller.

- D. Pulse Accumulation Inputs. Pulse accumulation inputs shall conform to binary input requirements and shall accumulate up to 10 pulses per second.
- E. Analog Inputs. Analog inputs shall monitor low-voltage (0-10 Vdc), current (4-20 mA), or resistance (thermistor or RTD) signals. Analog inputs shall be compatible with and field configurable to commonly available sensing devices.
- F. Binary Outputs. Binary outputs shall send an on-or-off signal for on and off control. Building Controller binary outputs shall have three-position (on-off-auto) override switches and status lights. Outputs shall be selectable for normally open or normally closed operation.
- G. Analog Outputs. Analog outputs shall send a modulating 0-10 Vdc or 4-20 mA signal as required to properly control output devices. Each Building Controller analog output shall have a two-position (auto-manual) switch, a manually adjustable potentiometer, and status lights. Analog outputs shall not drift more than 0.4% of range annually.
- H. Tri-State Outputs. Control three-point floating electronic actuators without feedback with tri-state outputs (two coordinated binary outputs). Tri-State outputs may be used to provide analog output control in zone control and terminal unit control applications such as VAV terminal units, duct-mounted heating coils, and zone dampers.
- I. Universal Inputs and Outputs. Inputs and outputs that can be designated as either binary or analog in software shall conform to the provisions of this section that are appropriate for their designated use.

2.7 POWER SUPPLIES AND LINE FILTERING

- A. Power Supplies. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.
 - 1. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection and shall be able to withstand 150% current overload for at least three seconds without trip-out or failure.
 - a. Unit shall operate between 0°C and 50°C (32°F and 120°F). EM/RF shall meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.
 - b. Line voltage units shall be UL recognized and CSA listed.
- B. Power Line Filtering.
 - 1. Provide internal or external transient voltage and surge suppression for workstations and controllers. Surge protection shall have:
 - b. Dielectric strength of 1000 V minimum
 - c. Response time of 10 nanoseconds or less
 - d. Transverse mode noise attenuation of 65 dB or greater
 - e. Common mode noise attenuation of 150 dB or greater at 40-100 Hz

2.8 AUXILIARY CONTROL DEVICES

A. Motorized Control Dampers.

1. Type. Control dampers shall have linear flow characteristics and shall be parallel- or opposed-blade type as specified below or as scheduled on drawings.
 - a. Outdoor and return air mixing dampers and face-and-bypass dampers shall be parallel-blade and shall direct airstreams toward each other.
 - b. Other modulating dampers shall be opposed-blade.
 - c. Two-position shutoff dampers shall be parallel- or opposed-blade with blade and side seals.
2. Frame. Damper frames shall be 2.38 mm (13 gauge) galvanized steel channel or 3.175 mm (1/8 in.) extruded aluminum with reinforced corner bracing.
3. Blades. Damper blades shall not exceed 20 cm (8 in.) in width or 125 cm (48 in.) in length. Blades shall be suitable for medium velocity (10 m/s [2000 fpm]) performance. Blades shall be not less than 1.5875 mm (16 gauge).
4. Shaft Bearings. Damper shaft bearings shall be as recommended by manufacturer for application, oil impregnated sintered bronze, or better.
5. Seals. Blade edges and frame top and bottom shall have replaceable seals of butyl rubber or neoprene. Side seals shall be spring-loaded stainless steel. Blade seals shall leak no more than 50 L/s·m² (10 cfm per ft²) at 1000 Pa (4 in. w.g.) differential pressure. Blades shall be airfoil type suitable for wide-open face velocity of 7.5 m/s (1500 fpm).
6. Sections. Damper sections shall not exceed 125 cm - 150 cm (48 in. - 60 in.). Each section shall have at least one damper actuator.
7. Linkages. Dampers shall have exposed linkages.

B. Electric Damper and Valve Actuators.

1. Stall Protection. Mechanical or electronic stall protection shall prevent actuator damage throughout the actuator's rotation.
2. Spring-return Mechanism. Actuators used for power-failure and safety applications shall have an internal mechanical spring-return mechanism or an uninterruptible power supply (UPS).
3. Signal and Range. Proportional actuators shall accept a 0-10 Vdc or a 0-20 mA control signal and shall have a 2-10 Vdc or 4-20 mA operating range. (Floating motor actuators may be substituted for proportional actuators in terminal unit applications as described in paragraph 2.6H.)
4. Standard Electronic Actuators: Shall be designed for a minimum of 60,000 full cycles at full torque and be UL 873 listed. Provide stroke indicator. Actuators shall have a positive positioning circuit and selectable inputs. Full stroke shall be within 90 seconds. Where fail positions are required, provide spring return on the actuator with adequate close off force.
5. Wiring. 24 Vac and 24 Vdc actuators shall operate on Class 2 wiring.
6. Manual Positioning. Operators shall be able to manually position each actuator when the actuator is not powered. Non-spring-return actuators shall have an external manual gear release. Spring-return actuators with more than 7 N·m (60 in.-lb) torque capacity shall have a manual crank.
7. Manufacturer: Belimo or approved equal. Refer to contract drawings for scheduled requirements.
8. For terminal unit dampers: Standard Electronic Actuators: Shall be designed for a minimum of 60,000 full cycles at full torque. Provide stroke indicator. Output to modulating damper

actuators may be analog or floating.

C. Control Valves.

1. General. Select body and trim materials in accordance with manufacturer's recommendations for design conditions and service shown.
2. Type. Provide two-way control valves for modulating service as shown.
3. Manufacturer: Belimo or approved equal. Refer to contract drawings for scheduled requirements.
4. Water Valves.
 - a. Valves providing two-position service shall be quick opening. Two-way valves shall have replaceable disc or ball.
 - b. Close-off (Differential) Pressure Rating. Valve actuator and trim shall provide the following minimum close-off pressure ratings.
 - i. Two-way: 150% of total system (pump) head.
 - c. Ports. Valves providing modulating service shall have equal percentage ports.
 - d. Sizing.
 - i. Two-position service: line size.
 - ii. Two-way modulating service: select pressure drop equal to the greatest of twice the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or 35 kPa (5 psi).
 - e. Fail Position. Water valves shall fail normally open or closed as follows unless otherwise specified.
 - i. Reheat coils and terminal radiation valves: fail last.
 - ii. Other applications: as scheduled or as required by sequences of operation.

D. Binary Temperature Devices.

1. Low-Voltage Space Thermostats. Low-voltage space thermostats shall be 24 V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed setpoint adjustment, 13°C-30°C (55°F-85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.
2. Line-Voltage Space Thermostats. Line-voltage space thermostats shall be bimetal-actuated, open-contact type or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listing for electrical rating, concealed setpoint adjustment, 13°C-30°C (55°F-85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.
3. Low-Limit Thermostats. Low-limit airstream thermostats shall be UL listed, vapor pressure type. Element shall be at least 6 m (20 ft) long. Element shall sense temperature in each 30 cm (1 ft) section and shall respond to lowest sensed temperature. Low-limit thermostat shall be manual reset only.

E. Temperature Sensors.

1. Type. Temperature sensors shall be Resistance Temperature Device (RTD) or thermistor.
2. Duct Sensors. Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of 1.5 m (5 ft) in length per 1 m² (10 ft²) of duct cross-section.

3. Immersion Sensors. Provide immersion sensors with a separable stainless steel well. Well pressure rating shall be consistent with system pressure it will be immersed in. Well shall withstand pipe design flow velocities.
4. Space Sensors. Space sensors shall have setpoint adjustment, override switch, display, and communication port as shown.
5. Differential Sensors. Provide matched sensors for differential temperature measurement.

F. Static pressure Transducers.

1. Manufactured by Setra Model 267MR unidirectional.
2. Refer to fan schedules and location for pressure range and requirements, select for mid range set point.
3. Accuracy: Plus or minus 1% of full scale for static.
4. Acceptable Manufacturers (General and Static Pressure): Mamac, Setra, Veris Industries.

G. Relays

1. Control Relays. Control relays shall be plug-in type, UL listed, and shall have dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage shall be suitable for application.
2. Time Delay Relays. Time delay relays shall be solid-state plug-in type, UL listed, and shall have adjustable time delay. Delay shall be adjustable $\pm 100\%$ from setpoint shown. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure for relays not installed in local control panel.

H. Override Timers

1. Unless implemented in control software, override timers shall be spring-wound line voltage, UL Listed, with contact rating and configuration required by application. Provide 0-6 hour calibrated dial unless otherwise specified. Flush mount timer on local control panel face or where shown.

I. Current Transmitters

1. AC current transmitters shall be self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4-20 mA two-wire output. Full-scale unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A, with internal zero and span adjustment. Unit accuracy shall be $\pm 1\%$ full-scale at 500 ohm maximum burden.
2. Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized.
3. Unit shall be split-core type for clamp-on installation on existing wiring.

J. Current Transformers

1. AC current transformers shall be UL/CSA recognized and shall be completely encased (except for terminals) in approved plastic material.
2. Transformers shall be available in various current ratios and shall be selected for $\pm 1\%$ accuracy at 5 A full-scale output.

3. Use fixed-core transformers for new wiring installation and split-core transformers for existing wiring installation.

K. Voltage Transformers

1. AC voltage transformers shall be UL/CSA recognized, 600 Vac rated, and shall have built-in fuse protection.
2. Transformers shall be suitable for ambient temperatures of 4°C-55°C (40°F-130°F) and shall provide $\pm 0.5\%$ accuracy at 24 Vac and 5 VA load.
3. Windings (except for terminals) shall be completely enclosed with metal or plastic.
 - a.

L. Pressure Transducers

1. Transducers shall have linear output signal and field-adjustable zero and span.
2. Continuous operating conditions of positive or negative pressure 50% greater than calibrated span shall not damage transducer sensing elements.
3. Water pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Transducer shall have 4-20 mA output, suitable mounting provisions, and block and bleed valves.
4. Water differential pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Over-range limit (differential pressure) and maximum static pressure shall be 2000 kPa (300 psi.) Transducer shall have 4-20 mA output, suitable mounting provisions, and 5-valve manifold.

M. Local Control Panels

1. All BACS panels shall be metal enclosures containing the controller, I/O modules, power supplies, termination strips, battery (if not integral to the controller or I/O module) and a spare AC outlet.
2. All penetrations of the BACS or outboard gear panels in mechanical rooms shall be from the bottom of the enclosure with wireway and conduit stubs from the wireway up to the panel.
3. All transformers and power supplies shall be mounted outside of the central panel.
4. Enclosures located in mechanical rooms shall be NEMA 4.
5. Enclosures located in labs and other relatively dust free and dry spaces may be NEMA 1.
6. Enclosures shall be mounted on walls or free-standing supports.
7. Provide enclosures with key lockable doors.
8. Indoor control panels shall be fully enclosed construction with hinged door key-lock latch and removable sub-panels. A common key shall open each control panel and sub-panel.
9. Prewire internal and face-mounted device connections with color-coded stranded conductors tie-wrapped or neatly installed in plastic troughs. Field connection terminals shall be UL listed for 600 V service, individually identified per control and interlock drawings, with adequate clearance for field wiring.
10. Each local panel shall have a control power source power switch (on-off) with overcurrent protection.
11. Power Supplies
 - a. The Contractor shall provide a regulated, protected power supply as required with the ability to produce at least 33% more current than required by the transmitters and controls being installed. Output regulation shall be less than 0.5mV. There shall be no overshoot on turn on or off. Operating temperature shall be -20 to +70°C.
 - b. The BACS Contractor shall certify in writing at the time of shop drawing submittal that the DDC equipment provided will not cause, as a result of its operation, either directly or indirectly, electrical interference to be induced into the building's electrical power systems.

- c. Class II transformers shall be used.

12. Panel Fabrication

- a. The Contractor shall size the panel such that no more than 80% of the surface of the enclosure back plate is used.
- b. Plastic wire way (e.g., Panduit) shall be used to organize all wiring in the panel.
- c. Sufficient wire way shall be provided in the panel such that it is filled no more than 80% capacity.
- d. Panel layout and construction shall be neat and professional.
- e. All controllers, wiring, and components in the panels shall be labeled. All labeling shall match the reference numbers on the cabinet drawings that shall be provided for each panel.
- f. Label the power source and circuit number for each panel.

2.9 WIRING AND RACEWAYS

- A. General. Provide copper wiring, plenum cable, and raceways as specified in applicable sections of Division 26.
- B. Insulated wire shall use copper conductors and shall be UL listed for 90°C (200°F) minimum service.
- C. All control wiring in mechanical equipment rooms or other spaces in which it is readily accessible shall be installed in electrical metal tubing (EMT) with compression fittings.
- D. All control wiring run in interstitial spaces shall either be run in EMT or a cable tray or raceway.
- E. All control wiring installed outdoors or any area subject to moisture shall be installed per code.
- F. All control wiring installed in vertical chases shall be installed in EMT.
- G. All control wiring above non-accessible ceilings shall be installed in EMT.
- H. All control wiring installed above accessible ceiling spaces which are not laboratories or AHU's shall be plenum type, not installed in conduit, but neatly run with generous use of rings or ties.
- I. Wire shall be unspliced from the controller to the sensor or device.
- J. Control wiring shall not be routed in the same raceway as power wiring.
- K. Unless specifically required otherwise by the BACS equipment manufacturer, all I/O wiring shall be twisted shielded pair cable. For sensors, the shield shall be grounded at the panel and taped back at the sensor. For communications, the above control wiring requirements and the BACS equipment manufacturer's installation guidelines and recommendations shall apply.
- L. Control wiring shall be color coded and labeled at all points of termination.
- M. Remove and properly dispose of all abandoned control wiring, conduit, tubing, boxes, enclosures, components, and other controls-related work.
- N. Responsibilities - The BACS contractor wiring responsibilities shall include the following:
 - 1. All wiring from mechanical and electrical alarms and functions (as scheduled on the drawings) as required to report these alarms and functions to the BACS head-end.
 - 2. All line and low voltage wiring for the control of all HVAC motors (whether individual or as part of packaged equipment), automatic control valves, and dampers, including: wiring for EPs, Pes, relays, controllers, thermostats, actuating devices, unit heater controls, and cabinet heater controls, except as noted below.
 - 3. The electrical trade shall provide "lock-out stop" control wiring.

4. ATC contractor shall provide all power supply wiring for all ATC supplied components.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Thoroughly examine project plans for control device and equipment locations. Report discrepancies, conflicts, or omissions to Architect or Engineer for resolution before starting rough-in work.
- B. Inspect site to verify that equipment can be installed as shown. Report discrepancies, conflicts, or omissions to Engineer for resolution before starting rough-in work.
- C. Examine drawings and specifications for work of others. Report inadequate headroom or space conditions or other discrepancies to Engineer and obtain written instructions for changes necessary to accommodate Section 23 09 23 work with work of others. Controls Contractor shall perform at his expense necessary changes in specified work caused by failure or neglect to report discrepancies.

3.2 Protection

- A. Controls Contractor shall protect against and be liable for damage to work and to material caused by Contractor's work or employees.
- B. Controls Contractor shall be responsible for work and equipment until inspected, tested, and accepted. Protect material not immediately installed. Close open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.3 COORDINATION

A. BACS CONFIGURATION MANAGEMENT

1. All controls for Cornell University shall maintain site-wide configuration documentation. This project involves extension of the BACS, the documentation shall be provided/updated per configuration management requirements to reflect the entire installation on the campus. Device naming and addressing shall conform to Cornell's specific conventions as detailed in Cornell Design & Construction Standard 15956. No device will be connected to a Cornell network until these conventions have been demonstrated and met.
- B. Configuration of System.
 1. The control panels/enclosures housing the controllers will be located on each floor, to the extent possible, to share vertical and horizontal wire-ways to facilitate and minimize the cost of home-runs to terminal equipment.
 2. Control panels shall be located in the equipment rooms, where practicable, and in locations such that the ambient conditions are between 50 and 90°F and 10 to 85% relative humidity. Control panels located in areas where conditions are outside of these ranges shall have enclosures outfitted with heating or cooling devices to provide the proper environmental conditions. Hoffman style enclosures with removable back plates and keyed, hinged covers shall be used.

Enclosures shall be rated NEMA 4 when located in mechanical spaces and NEMA 1 when located in occupied spaces.

3. The HVACR Shop must have quick, direct access to all control panels to maintain building integrity similar to that provided for fire emergencies without going through user spaces. Field panels will be located outside of user areas where practical. If field panels must be located in user areas, they shall be in areas with easy access. Protection and separation for user activities will be provided.

C. Controllers.

1. The controllers provided pursuant to this guideline shall meet the performance requirements for throughput, response time, point capacity, trend log capacity, etc., as stated in this section and Cornell University Design & Construction Standard 15956. The controllers shall also be configured and programmed to carry out the sequences of operation contained in the project documents. While Standard 15956 contains several constraints on the controller system architecture, it is recognized that a variety of configurations may be equally acceptable. For example, it may be possible to meet the project requirements with a single large controller or several smaller ones. Therefore, this guideline does not generally prescribe controllers' system architecture or controllers' detailed characteristics, such as processor speed, amount of memory, amount of I/O, power supply details, etc.
2. Since these guidelines with respect to controllers are performance oriented, rather than prescriptive, they will generally refer simply to "controllers" meaning computers capable of direct digital control. In those cases where distinguishing between controllers with differing capabilities is needed, the following nomenclature will be used (and is also defined in Standard 15956):
 - A. Building-level controller. These are controllers that are connected to the campus backbone network and communicate over Ethernet using BACnet/IP. They will typically be used to control and monitor one or more large systems or be applied to other building-wide functions. They shall, at a minimum, meet the requirements of a BACnet Building Controller (B-BC).
 - B. System-level controller. These controllers may, or may not, be directly connected to the campus backbone network. They will typically be dedicated to the control of a single large piece of equipment such as an air handler or chiller and a lab environment with fume hoods. They shall, at a minimum, meet the requirements of a BACnet Advanced Application Controller (B-AAC).
 - C. Field-level controller. These controllers will be on a lower performance BACnet LAN such as MS/TP or ARCNET. They will typically be used for control of "unitary" devices such as VAV boxes, fan coil units, etc. They shall, at a minimum, meet the requirements of a BACnet Application Specific Controller (B-ASC).

D. Site.

1. Assist in coordinating space conditions to accommodate the work of each trade where work will be installed near or will interfere with work of other trades. If installation without coordination causes interference with work of other trades, Contractor shall correct conditions without extra charge.
2. Coordinate and schedule work with other work in the same area and with work dependent upon other work to facilitate mutual progress.
3. Work is within an existing facility and requires removal of existing HVAC equipment. Remove all existing control equipment within the proposed work area which does not comply with the proposed replacement and upgrades.
4. Remove and properly dispose of all abandoned control wiring, conduit, tubing, boxes, enclosures, components, and other controls-related work.

E. Submittals. See Section 23 09 23 Article 1.10 (Submittals).

F. Test and Balance.

1. Provide Test and Balance Contractor a single set of necessary tools to interface to control system for testing and balancing.
2. Train Test and Balance Contractor to use control system interface tools.
3. Provide a qualified technician to assist with testing and balancing the first 20 terminal units.
4. Test and Balance Contractor shall return tools undamaged and in working condition at completion of testing and balancing.

G. Life Safety.

1. Duct smoke detectors required for air handler shutdown are provided under Division 28. Interlock smoke detectors to air handlers.

H. Coordination with Other Controls. Integrate with and coordinate controls and control devices furnished or installed by others as follows.

1. Communication media and equipment shall be provided as specified in Section 23 09 23 Article 2.2 (Communication).
2. Each supplier of a controls product shall configure, program, start up, and test that product to meet the sequences of operation described in Section 23 09 93 Appendix A regardless of where within the contract documents those products are described.
3. Coordinate and resolve incompatibility issues that arise between control products provided under this section and those provided under other sections or divisions of this specification.
4. Controls Contractor shall be responsible for integration of control products provided by multiple suppliers regardless of where integration is described within the contract documents.

3.4 GENERAL WORKMANSHIP

- A. Install equipment, piping, and wiring or raceway horizontally, vertically, and parallel to walls wherever possible.
- B. Provide sufficient slack and flexible connections to allow for piping and equipment vibration isolation.
- C. Install equipment in readily accessible locations as defined by National Electrical Code (NEC) Chapter 1 Article 100 Part A.
- D. Verify wiring integrity to ensure continuity and freedom from shorts and ground faults.
- E. Equipment, installation, and wiring shall comply with industry specifications and standards and local codes for performance, reliability, and compatibility.
- F. Accessibility - Keep BACS and equipment out of, and above user areas, as much as practical. The HVACR Shop must have quick and direct access with sufficient room for operation and maintenance. Keep equipment out of elevated and/or enclosed spaces. Provide suitable access panels or doors only when this is not practical. The access panels or doors shall be a minimum size of 18 x18 inches.

3.5 FIELD QUALITY CONTROL

- A. Work, materials, and equipment shall comply with rules and regulations of applicable local, state, and federal codes and ordinances as identified in Section 23 09 23 Article 1.8 (Codes and Standards).
- B. Continually monitor field installation for code compliance and workmanship quality.
- C. Contractor shall arrange for work inspection by local or state authorities having jurisdiction over the work.

3.6 EXISTING EQUIPMENT

- A. Wiring. Interconnecting control wiring shall be removed and shall become Contractor's property unless specifically noted or shown to be reused.
- B. Local Control Panels. Remove.
- C. Repair. Unless otherwise directed, Contractor is not responsible for repair or replacement of existing energy equipment and systems, valves, dampers, or actuators. Notify Engineer in writing immediately of existing equipment that requires maintenance.
- D. Indicator Gauges. Ensure operation of and recalibrate for reasonable accuracy or replace existing gauges.
- E. Room Thermostats. Remove and patch and finish holes and marks left by removal to match existing walls.
- F. Electronic Sensors and Transmitters. Remove.
- G. Controllers and Auxiliary Electronic Devices. Remove.
- H. Damper Actuators, Linkages, and Appurtenances: Remove.
- I. Control Valves. Replace existing control valves with new.
- J. Existing System Operating Schedule. Existing mechanical system may not be disabled during this work.
- K. Maintain fan scheduling using existing control systems throughout the control system installation.
- L. Patch holes and finish to match existing walls.
- M. At Owner's request, items to be delivered to Owner shall instead be properly disposed of. Hazardous materials shall be disposed of under Division 02.

3.7 WIRING

- A. Control and interlock wiring and installation shall comply with national and local electrical codes, Division 26, and manufacturer's recommendations. Where the requirements of Section 23 09 23 differ from Division 26, Section 23 09 23 shall take precedence.
- B. NEC Class 1 (line voltage) wiring shall be UL listed in approved raceway as specified by NEC and Division 26.

- C. Low-voltage wiring shall meet NEC Class 2 requirements. Subfuse low-voltage power circuits as required to meet Class 2 current limit.
- D. NEC Class 2 (current-limited) wires not in raceway but in concealed and accessible locations such as return air plenums shall be UL listed for the intended application.
- E. Install wiring in raceway where subject to mechanical damage and at levels below 3 m (10ft) in mechanical, electrical, or service rooms.
- F. Install Class 1 and Class 2 wiring in separate raceways. Boxes and panels containing high-voltage wiring and equipment shall not be used for low-voltage wiring except for the purpose of interfacing the two through relays and transformers.
- G. Do not install wiring in raceway containing tubing.
- H. Run exposed Class 2 wiring parallel to a surface or perpendicular to it and tie neatly at 3 m (10 ft) intervals.
- I. Use structural members to support or anchor plenum cables without raceway. Do not use ductwork, electrical raceways, piping, or ceiling suspension systems to support or anchor cables.
- J. Secure raceways with raceway clamps fastened to structure and spaced according to code requirements. Raceways and pull boxes shall not be hung on or attached to ductwork, electrical raceways, piping, or ceiling suspension systems.
- K. Size raceway and select wire size and type in accordance with manufacturer's recommendations and NEC requirements.
- L. Include one pull string in each raceway 2.5 cm (1 in.) or larger.
- M. Use color-coded conductors throughout.
- N. Locate control and status relays in designated enclosures only. Do not install control and status relays in packaged equipment control panel enclosures containing Class 1 starters.
- O. Conceal raceways except within mechanical, electrical, or service rooms. Maintain minimum clearance of 15 cm (6 in.) between raceway and high-temperature equipment such as steam pipes or flues.
- P. Adhere to requirements in Division 26 where raceway crosses building expansion joints.
- Q. Install insulated bushings on raceway ends and enclosure openings. Seal top ends of vertical raceways.
- R. Terminate control and interlock wiring related to the work of this section. Maintain at the job site updated (as-built) wiring diagrams that identify terminations.
- S. Flexible metal raceways and liquid-tight flexible metal raceways shall not exceed 1 m (3 ft) in length and shall be supported at each end. Do not use flexible metal raceway less than ½ in. electrical trade size. Use liquid-tight flexible metal raceways in areas exposed to moisture including chiller and boiler rooms.
- T. Install raceway rigidly, support adequately, ream at both ends, and leave clean and free of obstructions. Join raceway sections with couplings and according to code. Make terminations in boxes with fittings. Make terminations not in boxes with bushings.

3.8 COMMUNICATION WIRING

- A. Communication wiring shall be low-voltage Class 2 wiring and shall comply with Article 3.7 (Wiring).
- B. Install communication wiring in separate raceways and enclosures from other Class 2 wiring.
- C. During installation do not exceed maximum cable pulling, tension, or bend radius specified by the cable manufacturer.
- D. Verify entire network's integrity following cable installation using appropriate tests for each cable.
- E. Install lightning arrestor according to manufacturer's recommendations between cable and ground where a cable enters or exits a building.
- F. Each run of communication wiring shall be a continuous length without splices when that length is commercially available. Runs longer than commercially available lengths shall have as few splices as possible using commercially available lengths.
- G. Label communication wiring to indicate origination and destination.
- H. Ground coaxial cable according to NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."

3.10 INSTALLATION OF SENSORS

- A. Install sensors according to manufacturer's recommendations.
- B. Mount sensors rigidly and adequately for operating environment.
- C. Install room temperature sensors on concealed junction boxes properly supported by wall framing.
- D. Air seal wires attached to sensors in their raceways or in the wall to prevent sensor readings from being affected by air transmitted from other areas.
- E. Use averaging sensors in mixing plenums and hot and cold decks. Install averaging sensors in a serpentine manner vertically across duct. Support each bend with a capillary clip.
- F. Install mixing plenum low-limit sensors in a serpentine manner horizontally across duct. Support each bend with a capillary clip. Provide 3 m (1 ft) of sensing element for each 1 m² (1 ft²) of coil area.
- G. Install pipe-mounted temperature sensors in wells. Install liquid temperature sensors with heat-conducting fluid in thermal wells.
- H. Install outdoor air temperature sensors on north wall at designated location with sun shield, and watertight gasket to prevent water seepage.. On 100% OA systems and lab buildings, locate sensor in outside air plenum.
- I. Differential Air Static Pressure.
 - 1. Supply Duct Static Pressure. Pipe high-pressure tap to duct using a pitot tube. Make pressure tap connections according to manufacturer's recommendations.

2. Return Duct Static Pressure. Pipe high-pressure tap to duct using a pitot tube. Make pressure tap connections according to manufacturer's recommendations.
 3. Building Static Pressure. Pipe pressure sensor's low-pressure port to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe high-pressure port to a location behind a thermostat cover.
 4. Piping to pressure transducer pressure ports shall contain a capped test port adjacent to transducer.
 5. Pressure transducers, except those controlling VAV boxes, shall be located in control panels, not on monitored equipment or on ductwork. Mount transducers in a vibration-free location accessible for service without use of ladders or special equipment.
 6. Mount gauge tees adjacent to air and water differential pressure taps. Install shut-off valves before tee for water gauges.
- J. Smoke detectors, freezestats, high-pressure cut-offs, and other safety switches shall be hard-wired to de-energize equipment as described in the sequence of operation. Switches shall require manual reset. Provide contacts that allow DDC software to monitor safety switch status.

3.11 ACTUATORS

- A. General. Mount actuators and adapters according to manufacturer's recommendations.
- B. Electric and Electronic Damper Actuators. Mount actuators directly on damper shaft or jackshaft unless shown as a linkage installation. Link actuators according to manufacturer's recommendations.
1. For low-leakage dampers with seals, mount actuator with a minimum 5° travel available for damper seal tightening.
 2. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, then tighten linkage.
 3. Check operation of damper-actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
 4. Provide necessary mounting hardware and linkages for actuator installation.
- C. Valve Actuators. Connect actuators to valves with adapters approved by actuator manufacturer.

3.12 WARNING LABELS

- A. Affix permanent warning labels to equipment that can be automatically started by the control system.
1. Labels shall use white lettering (12-point type or larger) on a red background.
 2. Warning labels shall read as follows.

CAUTION

This equipment is operating under automatic control and may start or stop at any time without warning. Switch disconnect to "Off" position before servicing.

- B. Affix permanent warning labels to motor starters and control panels that are connected to multiple power sources utilizing separate disconnects.
1. Labels shall use white lettering (12-point type or larger) on a red background.
 2. Warning labels shall read as follows.

CAUTION

This equipment is fed from more than one power source with separate disconnects. Disconnect all power sources before servicing.

3.13 IDENTIFICATION OF HARDWARE AND WIRING

- A. Label wiring and cabling, including that within factory-fabricated panels, with control system address or termination number at each end within 5 cm (2 in.) of termination.
- B. Permanently label or code each point of field terminal strips to show instrument or item served.
- C. Label control panels with minimum 1 cm (½ in.) letters on laminated plastic nameplates.
- D. Label each control component with a permanent label. Label plug-in components such that label remains stationary during component replacement.
- E. Label room sensors related to terminal boxes or valves with nameplates.
- F. Manufacturers' nameplates and UL or CSA labels shall be visible and legible after equipment is installed.
- G. Label identifiers shall match record documents.

3.14 PROGRAMMING

- A. Point Naming. Name points as shown on the equipment points list provided with each sequence of operation. See Section 23 09 93 (Sequences of Operation). If character limitations or space restrictions make it advisable to shorten the name, the abbreviations given in Appendix B to Section 23 09 93 may be used. Where multiple points with the same name reside in the same controller, each point name may be customized with its associated Program Object number. For example, "Zone Temp 1" for Zone 1, "Zone Temp 2" for Zone 2.
- B. Software Programming. Programming shall provide actions for each possible situation. Graphic- or parameter-based programs shall be documented. Text-based programs shall be modular, structured, and commented to clearly describe each section of the program.
 - 1. Application Programming. Provide application programming that adheres to sequences of operation specified in Section 23 09 93. Program documentation or comment statements shall reflect language used in sequences of operation.
 - 2. System Programming. Provide system programming necessary for system operation.
- C. Operator Interface.
 - 1. Standard Graphics. Provide graphics as specified in Section 23 09 23 Article 2.3 Paragraph E.2 (System Graphics). Show on each equipment graphic input and output points and relevant calculated points such as indicated on the applicable Points List in Section 23 09 93. Point information on graphics shall dynamically update.
 - 2. Install, initialize, start up, and troubleshoot operator interface software and functions (including operating system software, operator interface database, and third-party software installation and integration required for successful operator interface operation) as described in Section 23 09 23.

D. Updating Databases and Graphics.

1. **Controllers:** Controllers shall be provided with a real-time operating system resident in ROM. It shall support all specified functions. It shall provide a command prioritization scheme to allow functional override of control functions. At a minimum, the following shall be provided:
 - A. Real-time operating system software.
 - B. Real-time clock/calendar and network time synchronization (except field-level controllers).
 - C. Controller diagnostic software.
 - D. DDC software.
 - E. Alarm processing and buffering software.
 - F. Energy management software.
 - G. Data trending, reporting, and buffering software.
 - H. I/O (physical and virtual) database. Inputs and outputs shall have the capability to be overridden for emergency modes and testing. If the design documentation does not specifically indicate for which points this is required, control vendor shall request in writing a list of such points. If this has not been requested, the vendor shall reprogram or reconfigure the systems as required during testing.
2. **Programming:** The programming shall be logically segmented, documented, and titled, and expand on the specified sequence of operations. Each segment shall contain control logic for a specific controlled component of a system. This is to improve the ability of the end user to understand and interpret the logic easily. All software shall be submitted to the engineer and commissioning agent for review.
3. **Trending:** To support commissioning and building data mining, the BACS shall be capable of trending and archiving all points on building- and system-level controllers at a minimum of 15 minute intervals. The BACS shall also have the capability of trending at least five points on each field-level controller at an interval of 15 minutes. The trend data shall be uploaded to a central database as needed to prevent buffer overflow in the controller. Controller memory capability, network architecture, and communications bandwidth shall be designed to account for this trending. The controls vendor shall provide control trends during start up and prior to functional performance testing of the systems. Reports shall be scheduled to output the data to a common format such as comma separated text, Microsoft formats such as Excel and Access, and portable database format. Trended data may also be archived in an Owner-accessible SQL database.
4. **Trend Graphs:** Web-based software shall provide for displaying graphic plots of the trended values. The software shall support multiple scales, points and point types simultaneously. Control vendor shall configure these graphs in a logical manner for each system. Consult with the commissioning team members and project manager for required configuration. Provide a trend for every analog control loop that includes the setpoint, process variable, and control output.
5. **Real-time Plotting:** Software shall be provided for real time plotting/graphing of multiple values in user-defined time intervals. These graphs will typically be used in commissioning to observe loop responses and system reactions. Control vendor shall configure these graphs in a logical manner for each system. Consult with the commissioning team members and project manager for required configuration.
6. **Web-based Graphic:** In the event that a Web server is to be supplied to supply access to graphic displays, these screens shall be provided:
 - A. **Floor Plan Screens.**
 - A. Provide floor plan screens for each floor and/or section of the building. Indicate the location of all equipment that is not located on the equipment room screens. Indicate the location of temperature sensors and VAV boxes associated with each temperature-controlled zone (i.e., VAV terminals, fan-coils, single-zone AHU's etc.) on the floor plan screens. Display the space temperature point

- adjacent to each temperature sensor symbol. Indicate room numbers as provided by Cornell University. Provide a graphic link from each zone and/or equipment symbol shown on the graphic floor plan screens to each corresponding equipment schematic graphic screen;
- B. Provide floor plan screens for each mechanical equipment room and, if mechanical equipment is situated there, the roof. Indicate the location of each item of mechanical equipment. Provide a link from each equipment symbol shown on the plan view screen to each corresponding mechanical system schematic graphic;
 - C. If multiple floor plans are necessary to show all areas, provide a graphic building key plan. Use elevation views and/or plan views as necessary to graphically indicate the location of all of the larger scale floor plans. Link the graphic building key plan to larger scale partial floor plans. Provide links from each larger scale floor plan graphic to the building key plan and to each of the other graphic floor plan screens;
- B. System Schematic Screens.
- A. Provide graphics for each air handling system. Indicate OA temperature and enthalpy, and mode of operation as applicable (i.e., occupied, unoccupied, warm-up, cool-down, etc.). Link screens for air handlers to the heating system and cooling system graphics. Link screens for supply and exhaust systems, if they are not available in a single graphic;
 - B. Provide a system schematic graphic for each HVAC subsystem controlled. Each I/O point in the project shall appear in at least one graphic. System graphics shall include flow diagrams with status, setpoints, current analog input and output values, operator commands, etc., as applicable. General layout of the system shall be schematically correct. I/O devices shall be shown in their schematically correct locations. Include appropriate engineering units for each displayed point value. Verbose names (English language descriptors) shall be included for each point on all graphics; this may be accomplished by the use of a pop-up window accessed by selecting the displayed point with the cursor. Indicate all adjustable setpoints on the applicable system schematic graphic or, if space does not allow, on a supplemental linked setpoint screen. All outputs shall be represented in terms of percent open and include a pop-up link to the control logic;
 - C. Provide a graphic for each hydronic system;
 - D. Provide a graphic for each terminal unit. In addition to points associated with the unit, indicate mode of operation as applicable (i.e., normal occupied, unoccupied, warm-up, maximum heating, maximum cooling, etc.). Provide links between the applicable floor plan screen and this screen. Also provide links to the graphics representing the parent systems.
 - E. Link screens for heating and cooling system graphics to utility history reports showing current and monthly energy usage, demands, peak values, etc.
 - F. Link screens to all schedules and setpoints.

Install, initialize, start up, and troubleshoot operator interface software and functions (including operating system software, operator interface database, and third-party software installation and integration required for successful operator interface operation) as described in Section 23 09 233.16 **CONTROL SYSTEM**

CHECKOUT AND TESTING

- A. Startup Testing. Complete startup testing to verify operational control system before notifying Owner of system demonstration. Provide Owner with schedule for startup testing. Owner may have representative

present during any or all startup testing.

1. Calibrate and prepare for service each instrument, control, and accessory equipment furnished under Section 23 09 23.
2. Verify that control wiring is properly connected and free of shorts and ground faults. Verify that terminations are tight.
3. Enable control systems and verify each input device's calibration. Calibrate each device according to manufacturer's recommendations.
4. Verify that binary output devices such as relays, solenoid valves, two-position actuators and control valves, and magnetic starters, operate properly and that normal positions are correct.
5. Verify that analog output devices such as I/Ps and actuators are functional, that start and span are correct, and that direction and normal positions are correct. Check control valves and automatic dampers to ensure proper action and closure. Make necessary adjustments to valve stem and damper blade travel.
6. Prepare a log documenting startup testing of each input and output device, with technician's initials certifying each device has been tested and calibrated.
7. Verify that system operates according to sequences of operation. Simulate and observe each operational mode by overriding and varying inputs and schedules. Tune PID loops and each control routine that requires tuning.
8. Alarms and Interlocks.
 - a. Check each alarm with an appropriate signal at a value that will trip the alarm.
 - b. Trip interlocks using field contacts to check logic and to ensure that actuators fail in the proper direction.
 - c. Test interlock actions by simulating alarm conditions to check initiating value of variable and interlock action.

3.15 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

- A. Demonstration. Prior to acceptance, perform the following performance tests to demonstrate system operation and compliance with specification after and in addition to tests specified in Article 3.17 (Control System Checkout and Testing). Provide Engineer with log documenting completion of startup tests.
 1. Engineer will be present to observe and review system demonstration. Notify Engineer at least 10 days before system demonstration begins.
 2. Demonstration shall follow process submitted and approved under Section 23 09 23 Article 1.10 (Submittals). Complete approved checklists and forms for each system as part of system demonstration.
 3. Demonstrate actual field operation of each sequence of operation as specified in Section 23 09 93. Provide at least two persons equipped with two-way communication. Demonstrate calibration and response of any input and output points requested by Engineer. Provide and operate test equipment required to prove proper system operation.
 4. Demonstrate compliance with Section 23 09 23 Part 1 (System Performance).
 5. Demonstrate compliance with sequences of operation through each operational mode.
 6. Demonstrate complete operation of operator interface.
 7. Demonstrate each of the following.
 - a. DDC loop response. Supply graphical trend data output showing each DDC loop's response to a setpoint change representing an actuator position change of at least 25% of full range. Trend sampling rate shall be from 10 seconds to 3 minutes, depending on loop speed. Each sample's trend data shall show setpoint, actuator position, and

- controlled variable values. Engineer will require further tuning of each loop that displays unreasonably under- or over-damped control.
- b. Demand limiting. Supply trend data output showing demand-limiting algorithm action. Trend data shall document action sampled each minute over at least a 30-minute period and shall show building kW, demand-limiting setpoint, and status of setpoints and other affected equipment parameters.
 - c. Building fire alarm system interface.
 - d. Trend logs for each system. Trend data shall indicate setpoints, operating points, valve positions, and other data as specified in the points list provided with each sequence of operation in Section 23 09 93. Each log shall cover three 48-hour periods and shall have a sample frequency not less than 10 minutes or as specified on its points list. Logs shall be accessible through system's operator interface and shall be retrievable for use in other software programs as specified in Section 23 09 23 Article 2.3 Paragraph E.11 (Trend Configuration).
8. Tests that fail to demonstrate proper system operation shall be repeated after Contractor makes necessary repairs or revisions to hardware or software to successfully complete each test.

B. Acceptance.

1. After tests described in this specification are performed to the satisfaction of both Engineer and Owner, Engineer will accept control system as meeting completion requirements. Engineer may exempt tests from completion requirements that cannot be performed due to circumstances beyond Contractor's control. Engineer will provide written statement of each exempted test. Exempted tests shall be performed as part of warranty.
2. System shall not be accepted until completed demonstration forms and checklists are submitted and approved as required in Section 23 09 23 Article 1.10 (Submittals).

3.16 CLEANING

- A. Each day clean up debris resulting from work. Remove packaging material as soon as its contents have been removed. Collect waste and place in designated location.
- B. On completion of work in each area, clean work debris and equipment. Keep areas free from dust, dirt, and debris.
- C. On completion of work, check equipment furnished under this section for paint damage. Repair damaged factory-finished paint to match adjacent areas. Replace deformed cabinets and enclosures with new material and repaint to match adjacent areas.

3.17 TRAINING

- A. Provide training for a designated staff of Owner's representatives. Training shall be provided via self-paced training, web-based or computer-based training, classroom training, or a combination of training methods.
- B. Training shall enable students to accomplish the following objectives.
 1. Proficiently operate system
 2. Understand control system architecture and configuration
 3. Understand DDC system components
 4. Understand system operation, including DDC system control and optimizing routines (algorithms)

5. Operate workstation and peripherals
 6. Log on and off system
 7. Access graphics, point reports, and logs
 8. Adjust and change system setpoints, time schedules, and holiday schedules
 9. Recognize common HVAC system malfunctions by observing system graphics, trend graphs, and other system tools
 10. Understand system drawings and Operation and Maintenance manual
 11. Understand job layout and location of control components
 12. Access data from DDC controllers
 13. Operate portable operator's terminals
 14. Create and change system graphics
 15. Create, delete, and modify alarms, including configuring alarm reactions
 16. Create, delete, and modify point trend logs (graphs) and multi-point trend graphs
 17. Configure and run reports
 18. Add, remove, and modify system's physical points
 19. Create, modify, and delete application programming
 20. Add operator interface stations
 21. Add a new controller to system
 22. Download firmware and advanced applications programming to a controller
 23. Configure and calibrate I/O points
 24. Maintain software and prepare backups
 25. Interface with job-specific, third-party operator software
 26. Add new users and understand password security procedures
- C. Divide presentation of objectives into three sessions (1-13, 14-23, and 24-26). Participants will attend one or more of sessions, depending on knowledge level required.
1. Day-to-day Operators (objectives 1-13)
 2. Advanced Operators (objectives 1-13 and 14-23)
 3. System Managers and Administrators (objectives 1-13 and 24-26)
- D. Provide course outline and materials according to Section 23 09 23 Article 1.10 (Submittals). Provide one copy of training material per student.
- E. Instructors shall be factory-trained and experienced in presenting this material.
- F. Perform classroom training using a network of working controllers representative of installed hardware.

APPENDIX A: Glossary of Terms

Terms used within the Specification Text:

- **Advanced Application Controller (AAC):**

A fully programmable control module. This control module may be capable of some of the advanced features found in Building Controllers (storing trends, initiating read and write requests, etc.) but it does not serve as a master controller. Advanced Application Controllers may reside on either the Ethernet/IP backbone or on a subnet.

- **Application Specific Controller (ASC):**

A pre-programmed control module which is intended for use in a specific application. ASCs may be configurable, in that the user can choose between various pre-programmed options, but it does not support full custom programming. ASCs are often used on terminal equipment such as VAV boxes or fan coil units. In many vendors' architectures ASCs do not store trends or schedules but instead rely upon a Building Controller to provide those functions.

- **BACnet/IP:**

An approved BACnet network type which uses an Ethernet carrier and IP addressing.

- **BACnet MS/TP:**

An approved BACnet network type which uses a Master-Slave Token Passing configuration. MS/TP networks are unique to BACnet and utilize EIA485 twisted pair topology running at 9600 to 76,800 bps.

- **BACnet over ARCNET:**

An approved BACnet network type which uses an ARCNET (attached resource computer network) carrier. ARCNET is an industry standard that can utilize several speeds and wiring standards. The most common configuration used by BACnet controllers is an EIA485 twisted pair topology running at 156,000 bps.

- **Building Controller (BC):**

A fully programmable control module which is capable of storing trends and schedules, serving as a router to devices on a subnet, and initiating read and write requests to other controllers. Typically this controller is located on the Ethernet/IP backbone of the BAS. In many vendors' architectures a Building Controller will serve as a master controller, storing schedules and trends for controllers on a subnet underneath the Building Controller.

- **Direct Digital Control (DDC):**

A control system in which a digital computer or microprocessor is directly connected to the valves, dampers, and other actuators which control the system, as opposed to indirectly controlling a system by resetting setpoints on an analog pneumatic or electronic controller.

- **PICS - Protocol Implementation Conformance Statement:**

A written document, created by the manufacturer of a device, which identifies the particular options specified by BACnet that are implemented in the device.

- **Smart Actuator (SA):**

An actuator which is controlled by a network connection rather than a binary or analog signal. (0-10v, 4-20mA, relay, etc.)

- **Smart Sensor (SS):**

A sensor which provides information to the BAS via network connection rather than a binary or analog signal. (0-10000 ohm, 4-20mA, dry contact, etc.)

- **Web services:**

Web services are a standard method of exchanging data between computer systems using the XML (extensible markup language) and SOAP (simple object access protocol) standards. Web services can be used at any level within a Building Automation System (BAS), but most commonly they are used to

transfer data between BAS using different protocols or between a BAS and a non-BAS system such as a tenant billing system or a utility management system.

Terms used within the Sequences of Operation:

- **adj.**
Adjustable by the end user, through the supplied user interface.
 - **AI, AO, etc. (Column Headings on Points List)**
AI = Analog Input. A physical input to the control module.
AO = Analog Output. A physical output from the control module.
AV = Analog Value. An intermediate (software) point that may be editable or read-only. Editable AVs are typically used to allow the user to set a fixed control parameter, such as a setpoint. Read Only AVs are typically used to display the status of a control operation. A network-visible analog point whose value is determined by a controller computation.
BI = Binary Input. A physical input to the control module.
BO = Binary Output. A physical output from the control module.
BV = Binary Value. An intermediate (software) point that may be editable or read-only. Editable BVs are typically used to allow the user to set a fixed control parameter, such as a setpoint. Read Only BVs are typically used to display the status of a control operation.
Sched = Schedule. The control algorithm for this equipment shall include a user editable schedule.
Trend. The control system shall be configured to collect and display a trend log of this object. The trending interval shall be no less than one sample every 5 minutes. (Change of Value trending, where a sample is taken every time the value changes by more than a user-defined minimum, is an acceptable alternative.)
Alarm. The control system shall be configured to generate an alarm when this object exceeds user definable limits, as described in the Sequence of Controls.
- Note:** If the specifications require use of the BACnet protocol, all of the above shall be provided as BACnet objects.
- **KW Demand Limiting: ***
An energy management strategy that reduces energy consumption when a system's electric power meter exceeds an operator-defined threshold.
When power consumption exceeds defined levels, the system automatically adjust setpoints, de-energizes low priority equipment, and takes other pre-programmed actions to avoid peak demand charges. As the demand drops, the system restores loads in a predetermined manner.
 - **Occupant Override Switch, or Timed Local Override:**
A control option that allows building occupants to override the programmed HVAC schedule for a limited period of time.
When the override time expires, the zone returns to its unoccupied state.
 - **Occupant Setpoint Adjustment:**
A control option that allows building occupants to adjust - within limits set by the HVAC control system - the heating and cooling setpoints of selected zones. Typically the user interface for this function is built into the zone sensor.
 - **Optimal Start-Up: ***
A control strategy that automatically starts an HVAC system at the latest possible time yet ensures comfort conditions by the time the building becomes occupied.

In a typical implementation, a controller measures the temperature of the zone and the outside air. Then, using design heating or cooling capacity at the design outside air temperature, the system computes how long a unit must run at maximum capacity to bring the zone temperature to its occupied setpoint. The optimal start algorithm often includes a self-learning feature to adjust for variations from design capacity.

A distributed system must use Run on Request with Optimal Start. (See below.)

- **Requested, or Run on Request: ***

A control strategy that optimizes the runtime of a source piece of equipment that supplies one or more receiving units - such as an air handler unit supplying zone terminal units with heating, cooling, ventilation, or similar service. Source equipment runs only when needed, not on a fixed schedule.

The source equipment runs when one or more receiving units request its services. An operator determines how many requests are required to start the source equipment.

For example, if all the zones in a building are unoccupied and the zone terminal units do not need heating or cooling, the AHU will shut down. However, if a zone becomes occupied or needs cooling, the terminal unit will send a run request to the AHU to initiate the start-up sequence. If this AHU depends on a central chiller, it can send a run request to the chiller.

The run on request algorithm also allows an operator to schedule occupancy for individual zones based on the needs of the occupants without having to adjust the schedules of related AHUs and chillers.

- **Trim and Respond, or Setpoint Optimization: ***

A control strategy that optimizes the setpoint of a source piece of equipment that supplies one or more receiving units - such as an air handler unit supplying zone terminal units with heating, cooling, ventilation, or similar service.

The source unit communicates with receiving units to determine heating, cooling, and other requirements, and then adjusts its setpoint.

For example, if all zones are comfortable and do not request cooling, the AHU will gradually increase (trim) its supply air setpoint. When a zone requests cooling, the AHU responds by dropping its setpoint. The more zones that request cooling, the more it drops the setpoint. The AHU repeats this process throughout the day to keep zones cool, but with a supply air setpoint that is no cooler than necessary.

Contracting Terms:

- **Furnished or Provided:**

The act of supplying a device or piece of equipment as required meeting the scope of work specified and making that device or equipment operational. All costs required to furnish the specified device or equipment and make it operational are borne by the division specified to be responsible for providing the device or equipment.

- **Install or Installed:**

The physical act of mounting, piping or wiring a device or piece of equipment in accordance with the manufacturer's instructions and the scope of work as specified. All costs required to complete the installation are borne by the division specified to include labor and any ancillary materials.

- **Interface:**

The physical device required to provide integration capabilities from an equipment vendor's product to the control system. The equipment vendor most normally furnishes the interface device. An example of an interface is the chilled water temperature reset interface card provided by the chiller manufacturer in order to allow the control system to integrate the chilled water temperature reset function into the

control system.

- **Integrate:**

The physical connections from a control system to all specified equipment through an interface as required to allow the specified control and monitoring functions of the equipment to be performed via the control system.

APPENDIX B: Abbreviations

The following abbreviations may be used in graphics, schematics, point names, and other UI applications where space is at a premium.

AC - Air Conditioning
ACU - Air Conditioning Unit
AHU - Air Handling Unit
AI - Analog Input
AO - Analog Output
AUTO - Automatic
AUX - Auxiliary
BI - Binary Input
BO - Binary Output
C - Common
CHW - Chilled Water
CHWP - Chilled Water Pump
CHR - Chilled Water Return
CHS - Chilled Water Supply
COND - Condenser
CW - Condenser Water
CWP - Condenser Water Pump
CR - Condenser Water Return
CS - Condenser Water Supply
DA - Discharge Air
EA - Exhaust Air
EF - Exhaust Fan
FCU - Fan Coil Unit
HOA - Hand / Off / Auto
HP - Heat Pump
HRU - Heat Recovery Unit
HTEX - Heat Exchanger
HW - Hot Water
HWP - Hot Water Pump
HWR - Hot Water Return
HWS - Hot Water Supply
MAX - Maximum
MIN - Minimum
MISC - Miscellaneous
NC - Normally Closed
NO - Normally Open
OA - Outdoor Air
PIU - Powered Induction Unit
RA - Return Air
RF - Return Fan

RH - Relative Humidity

SA - Supply Air

SF - Supply Fan

SP - Static Pressure

TEMP - Temperature

UH - Unit Heater

VAV - Variable Air Volume

W/ - with

W/O - without

END OF SECTION

SECTION 230924 – AUTOMATION AND CONTROLS SYSTEM COMMUNICATIONS

PART 1 GENERAL

1.1 GENERAL

Historically, the use of building automation and direct digital control systems at Cornell has been hampered by the difficulties associated with interconnecting systems from different manufacturers to one another and to the campus Energy Management and Control System (EMCS) computers at Chilled Water Plant 1. To overcome this, Cornell has been at the center of the effort to develop a data communication standard for such building control equipment. A result has been the development of ANSI/ASHRAE Standard 135-2004, *BACnet - A Data Communication Protocol for Building Automation and Control Networks*. BACnet is now, also, an international standard, ISO 16484-5. In the interest of both competitive procurement and long-term viability, it is Cornell's intention that henceforth all installations of digital building automation and control equipment shall support communications via the BACnet standard.

1.2 OVERVIEW

This section provides the communication and interoperability requirements for building automation and control system components to be supplied to Cornell. Because the University's systems have evolved over many years and involve products from multiple vendors and, in several cases, multiple generations of control systems from single vendors, attention must be given to the integration of the old and the new. The objectives of this integration include: providing a mechanism for competitive procurement of building control products; assisting in meeting the University's energy conservation and environmental protection goals; improving the operational systems available to our facilities management and operations staff; reducing, if possible, overall facilities management costs; and providing an infrastructure for optimizing performance in a deregulated utility environment.

The objectives shall be met by the use, to the extent possible, of existing, widely-accepted data communication standards and practices.

1.3 APPLICABLE STANDARDS

The following standards shall govern the design and selection of equipment supplied to fulfill the requirements of this section:

- A. ANSI/ASHRAE Standard 135-2004: *BACnet[®] - A Data Communication Protocol for Building Automation and Control Networks*, as amended, and hereinafter referred to as "BACnet," American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. 2004.
- B. ATA/ANSI 878.1 (1992), ARCNET Local Area Network.
- C. ISO/IEC 8802-3 (1993), Information processing systems - Local area networks - Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications.

1.4 DEFINITIONS

In addition to the definitions contained in the applicable standards of 1.03, the following should be noted:

- A. ARCNET - Attached Resource Computer Network. See BACnet, Clause 8 and ATA/ANSI 878.1.
- B. BACnet/IP - BACnet Annex J Devices. Annex J of BACnet describes how BACnet devices can make use of IP directly for communicating across IP-based internets.
- C. BACnet PICS - A Protocol Implementation Conformance Statement that describes the BACnet capabilities of a specific device. See BACnet, Annex A.
- D. BACS - Building Automation and Control System.
- E. BBMD - BACnet Broadcast Management Device. See BACnet, Annex J.
- F. BMA - BACnet Manufacturers Association.
- G. BTL - The BACnet Testing Laboratories of the BMA. The organization responsible for testing products to assure that they conform to the BACnet standard. Listings of tested products are available at www.bacnetassociation.org.
- H. Campus Backbone - A fiber optic data communication infrastructure on the Cornell campus managed by CIT. Users connect to the backbone by means of CIT-supplied Ethernet concentrators in each building and appropriate 10/100BASE-T unshielded, twisted pair wiring. The backbone uses the Internet Protocol (IP) for routing messages to and from computers both on and off the Cornell campus.
- I. CIT - Cornell Information Technologies. The organization that manages the Cornell campus networking infrastructure, including the provision of network connections in Cornell buildings.
- J. Computer Section - The computer group within the Cornell Utilities and Energy Management Department. The Computer Section is responsible for the EMCS and the coordination of BACS device addressing and network numbering.
- K. BIBB - BACnet Interoperability Building Block. A collection of one or more BACnet services defined for the purpose of describing communication functionality in an unambiguous way. See BACnet, Annex K.
- L. Device Profile - A collection of BIBBs that describes the minimum BACnet capabilities of a particular device in order to achieve reliable communication in one of five specified "interoperability areas." Devices include BACnet Building Controllers (B-BC), BACnet Advanced Application Controllers (B-AAC) and BACnet Application Specific Controllers (B-ASC). See BACnet, Annex L.
- M. EMCS - A computer complex, housed at Chilled Water Plant 1 that provides Energy Management and Control System functions for the University. The EMCS is connected to

the campus backbone and uses the IP for the routing of messages to and from individual buildings.

- N. Ethernet - A carrier sensing multiple access with collision detection network technology defined by ISO/IEC 8802-3.
- O. Gateway - A device that translates BACnet messages into those of a non-BACnet protocol and vice-versa.
- P. Internetwork - A set of two or more BACnet networks interconnected by routers.
- Q. Interoperability Area - A communications domain in which functional cooperation is desired. These areas are currently: 1) data sharing; 2) alarm and event management; 3) trending; 4) scheduling; and 5) device and network management. See BACnet, Clause 22.
- R. IP - The Internet Protocol. A networking protocol originally developed by the federal Defense Advanced Research Projects Agency. BACnet messages can traverse the campus backbone by being encapsulated in routable IP packets.
- S. Local - Pertaining to the requirements of a specific job or building project.
- T. LAN - Local Area Network. One of the approved BACnet network technologies: Ethernet, ARCNET or MS/TP.
- U. MS/TP - Master-Slave/Token-Passing Network. One of the approved BACnet LANs. See BACnet, Clause 9.
- V. Network - One of the communication technologies for data communications specified in BACnet. Approved network technologies at Cornell are Ethernet, ARCNET and MS/TP.
- W. PICS - Protocol Implementation Conformance Statement. A document that describes in detail a device's BACnet capabilities. See BACnet, Annex A.
- X. UDP - The User Datagram Protocol. One of the IP family of protocols. UDP is used to convey BACnet/IP messages and is characterized by a "port number" for each protocol. BACnet/IP typically uses UDP port X'BAC0' or decimal 47808.
- Y. VLAN - Virtual Local Area Network. A network configuration that allows devices to communicate across multiple physical local area networks (LANs) using their hardware or "medium access control" (MAC) addresses as if they shared a common networking medium. As with a physical LAN, "local" broadcast messages are also propagated to each of the participating LANs. VLAN capability depends on the configuration of the interconnecting data communication equipment. VLAN configuration is performed by CIT.

1.5 SUBMITTALS

In addition to any requirements specified elsewhere, the Contractor shall provide both proposed and as-built versions of the following:

- A. Schematic drawings that represent the system architecture and configuration, in both hardcopy and editable electronic format.
- B. A points list that includes, for each physical or logical point, the name, description, display units, alarm limits and definitions, along with the BACnet object description, object ID, and associated device ID. The list shall also indicate whether Trend Log or Schedule objects have been established for the point.
- C. Documentation for any non-standard BACnet objects, properties, or enumerations utilized detailing their structure, data types, and any associated lists of enumerated values.
- D. PICS files indicating the BACnet functionality and configuration of each device. In addition to the requirements of BACnet, Annex A, the Contractor shall provide information on any limitations on the numbers of supported objects in a given device including, specifically, Trend Log and Schedule objects.
- E. Documentation on submitted products that have been tested and listed by the BACnet Testing Laboratory (BTL) or a letter on manufacturer's company letterhead indicating the anticipated date by which testing is expected to be completed. If, for any reason, BTL testing and listing has not been completed, a written commitment shall be provided to upgrade installed controls to a version that meets BTL testing and listing requirements should deficiencies be found during BTL testing.

1.6 COORDINATION

The Contractor shall be responsible for all coordination of subcontractors' work relative to the BACS. Specific questions relating to communication and interoperability shall be submitted to the Computer Section.

PART 2 PRODUCTS

2.1 GENERAL

Each networked device supplied pursuant to this section shall be installed and configured so as to correctly execute all sequences of operation for its intended application, as defined in other sections of this specification. In addition, each networked device shall provide, at a minimum, the BACnet communication capabilities prescribed in the device profiles for devices of its type. See 2.02.

2.2 REQUIREMENTS FOR SYSTEM COMPONENTS

This clause prescribes the minimum requirements for devices supplied pursuant to this section.

- A. Controller Requirements: Controller devices supplied to meet the functional and operational requirements of this specification shall conform, at a minimum, to one the BACnet device profiles contained in BACnet, Annex L: BACnet Building Controller (B-BC), BACnet Advanced Application Controller (B-AAC) or BACnet Application Specific Controller (B-ASC). The interoperability requirements of such devices are contained in BACnet, Annex L. B-BC controller devices shall communicate using BACnet/IP. Other devices may use BACnet over ARCNET or BACnet over MS/TP.

- B. Router Requirements: In the event that devices are provided that do not use BACnet/IP over Ethernet as their communication technology, BACnet routers shall be provided that route between BACnet/IP over Ethernet and the other BACnet LAN type(s), whether ARCNET or MS/TP. These routers shall conform to the specifications of BACnet, Clause 6.
- C. Gateways: BACS devices that use BACnet as their native protocol are preferred. The use of gateways, in circumstances where no native BACnet devices are available, requires the specific approval of the Owner in each instance.

2.3 REQUIREMENTS FOR NETWORK CONNECTIONS

This clause prescribes the means of interconnecting BACS devices provided pursuant to this specification.

A. Local Area Networks (LANs)

1. All control devices meeting the B-BC device profile shall be connected to an ISO 8802-3 (Ethernet) LAN provided by the Contractor. This LAN, in turn, shall be connected to the campus backbone network. Unless otherwise specified, the connection shall be via a 10/100BASE-T port provided by the Owner. The location of the jack will be determined in consultation with the Computer Section, which will arrange with CIT for the jack's installation. The Contractor shall also provide any additional data communication hardware, such as hubs and repeaters, which may be needed to interconnect the supplied BACS equipment and to connect to the Owner's backbone network.
2. To facilitate maintenance technician access to the LAN, the Contractor shall also provide at least one additional 10/100BASE-T access point in each mechanical room that contains BACS equipment. This requirement may be met by supplying either a hub with a spare port or a dedicated jack.
3. Control devices that meet the B-ASC profile, but do not support Ethernet, must use another approved BACnet LAN technology. These technologies are ARCNET and MS/TP. If Ethernet is not supported on any part of the internet-work, a standalone BACnet router, or a BACnet Building Controller with built-in routing capability, must be provided for routing between the Ethernet and ARCNET or MS/TP LANs.

PART 3 EXECUTION

3.1 GENERAL

This clause provides specific interoperability and networking requirements that pertain to the use of BACnet.

3.2 REQUIREMENTS BY INTEROPERABILITY AREA

This clause provides requirements pertaining to the five interoperability areas of data sharing, alarm and event management, trending, scheduling, and device and network management.

- A. Data Sharing: Data Sharing requirements apply to the exchange of information between

BACnet devices for archival storage, generating graphics and reports, the sharing of common sensor or calculated values, carrying out interlocked control strategies, and the modification of setpoints or other operational parameters.

All such data to be exchanged shall be represented as BACnet objects and conveyed using BACnet messages. Only standard BACnet objects and messages may be used to implement data sharing requirements unless the non-standard extensions are explicitly approved by the Owner. Any extensions to BACnet shall be fully documented in the manner used within the BACnet standard. Submission of such documentation is a prerequisite for obtaining approval of an extension.

1. Points List:

The Contractor shall provide devices installed and configured with all points indicated in the BACS points list. The Contractor shall provide any additional points needed to fully implement the sequence of operations and other functionality described in this specification.

2. Data Presentation:

In the event that workstation/web server capabilities have been specified, the following characteristics shall apply to graphic displays:

- a. The graphic displays shall include schematic diagrams of the systems being displayed.
- b. When a graphic display is being viewed all values displayed shall be updated when a change of value (COV) notification is received or, if COV is not implemented, within five seconds.
- c. Any data value from any networked device shall be available for plotting at a workstation in real time. The operator shall be able to select binary and analog data concurrently and to plot multiple instances of each data type on the same screen. The operator shall be able to select sampling intervals from 1 second to 60 seconds. For devices that implement COV reporting, the operator shall be able to select this as the means to update the plot. It shall be possible to save such real-time plots for subsequent recall.

3. Monitoring of Any Property:

The operator shall be able to display any value of any property of any object from any networked device including all properties required by BACnet, all supported optional properties, and any proprietary extensions.

4. Global Object Definitions:

The control system shall be configured with system-wide unique BACnet objects as needed to convey all globally significant information necessary to implement the control strategy.

5. Setpoint and Parameter Modifications:

Operators with appropriate authority shall be able to modify all control loop setpoints and tuning parameters via BACnet messages initiated through operator interaction with graphics displays.

6. Peer-to-Peer Data Dependencies:

All BACnet devices shall be installed and configured to exchange data values directly, without the need for operator or workstation intervention, to implement the sequence of operations specified in the mechanical system drawings and to share global data values.

B. Alarm and Event Management

1. Alarm and Event Management is the exchange of data between BACnet devices related to the occurrence of predefined conditions that meet specific criteria. Such conditions are called “events” and may be the basis for the initiation of a particular control action in response or the simple logging of the event’s occurrence. The event may also be deemed to represent a condition that constitutes an “alarm” requiring human acknowledgment and intervention.
2. All alarms and events shall be implemented using standard BACnet event detection and notification mechanisms. Either intrinsic reporting or algorithmic change reporting may be used but the intrinsic reporting method is preferred. See BACnet, Clause 13.
3. Alarm Lists:
 - a. The Contractor shall provide devices installed and configured to detect alarms and events for the points indicated in the system drawings. Software logic shall be provided to avoid nuisance alarms, e.g., no temperature or status alarms shall be generated when fan systems are not running or during start-up and shut-down transitions. It shall be possible to configure a delay between the occurrence of an alarm condition and its enunciation.
 - b. Alarms shall appear at the EMCS and any local operator workstation(s) within five seconds of their occurrence. The workstations shall display an alarm message window that appears on top of any other open windows. The alarm message window shall have a distinctive color and appearance to attract the operator's attention. Operators with sufficient privilege shall be able to configure the workstation to emit an audible signal (or not) when an alarm message is received.
 - c. Alarms that require operator acknowledgement shall cause the alarm window to remain active until such an acknowledgement is received. If multiple alarms are received, unacknowledged alarms shall be displayed on a first come first served basis grouped by priority, with the highest priority alarms displayed first.
 - d. Alarms shall be distributed using the BACnet notification class mechanism. Assignment of classes and destinations shall be configured according to details provided by the Owner. One destination shall, in all cases, be the EMCS.
 - e. BACnet provides a mechanism for prioritizing alarm and event notification messages using a numerical range of 0-255 with 0 being the highest priority and 255 being the lowest priority. The priorities presented in the Table 1 are consistent with the safety requirements of UL 864 (applies to fire systems) and UL 1076 (applies to security systems).
 - f. Alarm and event notification priorities shall be configured in the Priority Range as indicated in Table 1 below, and shall be conveyed using the indicated Network Priority. See BACnet, Clause 6.

Table 1. Cornell Alarm and Event Priorities

Message Group	Priority Range	Network Priority	Brief Description
Life Safety	00 - 31	Life Safety Message	Notifications related to an immediate threat to life, safety or health such as fire detection or armed robbery.
Property Safety	32 - 63	Life Safety Message	Notifications related as an immediate threat to property such as forced entry.
Supervisory	64 - 95	Critical Equipment Message	Notifications related to improper operation, monitoring failure (particularly of Life Safety or Property Safety monitoring), or monetary loss.
Trouble	96 - 127	Critical Equipment Message	Notifications related to communication failure (particularly of Life Safety or Property Safety equipment).
Miscellaneous Higher Priority Alarm and Events	128 - 191	Urgent Message	Higher-level notifications related to occupant discomfort, normal operation, normal monitoring, or return to normal.
Miscellaneous Lower Priority Alarm and Events	192 - 255	Normal Message	Lower-level notification related to occupant discomfort, normal operation, normal monitoring, or return to normal.

4. Alarm Acknowledgment:

Alarms shall be acknowledged through the EMCS alarm acknowledgement process.

5. Alarm Summarization:
Alarm summarization shall be handled through the EMCS alarm summarization process.
6. Alarm Parameter Adjustment:
Operators with sufficient privilege shall be able to change alarm parameters for all standard BACnet event types.
7. Alarm Routing Adjustment:
Operators with sufficient privilege shall be able to change alarm routing (BACnet notification classes) for each alarm including the destination for each type of alarm and alarm priority, the day of week and time of day, and the type of transition involved (TO-OFFNORMAL, TO-NORMAL, etc.).

Initially, notification classes shall be configured in a manner that distinguishes between the EMCS and any local workstation, if provided.

C. Scheduling

Scheduling is the exchange of data between BACnet devices related to the establishment and maintenance of dates and time at which specified output actions are to be taken. All schedules shall be implemented using BACnet objects and messages.

1. Schedule Lists:
 - a. The Contractor shall provide devices installed and configured with start/stop, mode change, and night setback schedules as defined in the sequence of operations. As part of the installation process, the Contractor shall configure vacation, holiday, and any special event schedules as provided by the Owner.
 - b. The system shall have the ability to program alterations to programmed operating schedules based on the priority of events and shall include the following scenario:
 - Based on operator privileges, the operator shall have the ability to temporarily override the programmed schedule of equipment. Operational override of a programmed schedule shall be for a specific duration following which the schedule shall revert back to the preprogrammed schedule.
2. Display of Start and Stop Times and Actions:

An operator shall be able to inspect the content of any schedule and determine the specific control actions that will occur at any time, on any date. For any particular device or system parameter that is the subject of a schedule, an operator shall be able to determine the schedule of actions related to that particular device or parameter.
3. Modification of Schedules:

All calendar entries and schedules shall be modifiable from the EMCS or local workstation by an operator with sufficient privilege.

D. Trending

Trending is the accumulation of (time, value) data pairs at specified rates for a specified duration. Trends are distinguished from real-time plotting of data by the fact that the data are destined for long-term storage.

1. **Archival Storage of Data:**
Archival storage of data will be handled by the EMCS. However, the Owner may specify local trend archiving and display through the use of BACnet Trend Log objects.
2. **Modification of Trend Log Parameters:**
An operator with sufficient privilege shall be able to change the data points to be logged, the sampling rate, and the duration of a trend log.

E. Device and Network Management

Device and network management is the exchange of data between BACnet devices concerning the operation and status of specific devices. If local workstation capabilities are provided, the following functions shall be available:

1. **Display of Device Status Information:**
Operators shall be able to display at any time the operational status of any device on the BACnet internetwork.
2. **Display of BACnet Object Information:**
Operators shall be able to display, at any time, any property of any BACnet object. Operators shall be able to display property values of objects grouped by object type, object location, and building system.
3. **Silencing Devices that are Transmitting Erroneous Data:**
Operators shall be able to direct a field device to stop transmitting event, alarm or COV notifications until a subsequent command to resume transmissions is received.
4. **Time Synchronization:**
Operators shall be able to set the time and date in any device on the network that supports time-of-day functionality. The operator shall be able to select to set the time and date for an individual device, or all devices on a single local network.
5. **Remote Device Reinitialization:**
Operators shall have the ability to issue reinitialization commands to any device that supports remote reinitialization.
6. **Backup and Restore:**

Operators shall have the ability to backup and restore all BACnet devices on the network that support this capability.

7. **Configuration Management of Half-Routers, Routers and BBMDs:**
Operators shall have the ability to display and modify the routing table entries in all

supplied BACnet half-routers and routers and the broadcast distribution and foreign device registration tables in all BBMDs.

3.3 USE OF BACNET OBJECTS

This clause provides requirements that are specific to the representation of data and functionality using BACnet objects.

A. Naming Conventions: The following sections list the requirements for the assignment of names and identifiers for BACnet objects:

1. Device Names:

The EMCS uses a system for naming its control devices based on facility name, location within a facility, the system or systems that the device monitors and/or controls, or the area served. Names can be up to 254 characters in length, without embedded spaces. Only the characters A-Z, 0-9, ".", and "-" may be used. The goal is the shortest descriptive, but unambiguous, name. For example, if there is only one chilled water pump "P1", a valid name would be "DUFFIELD.CW.P1.CONTROL".

If there are two pumps designated "P1", one in the basement mechanical room and one in the penthouse mechanical room, the names could be "CHP.BSMT.CW.P1.CONTROL" or "CHP.PENT.CW.P1.CONTROL". In the case of unitary controllers, for example a VAV box controller, a name might be "COURT.122.TV-LOUNGE". These names should be used for the value of the "Object_Name" property of the BACnet Device objects of the controllers involved so that the BACnet name and the EMCS name are the same.

2. Device Instance Numbers:

- a. BACnet allows 4194305 device instances per BACnet internetwork, each of which must be unique. Cornell's unique device instances are formed as follows:
Device Instance = "FFFFNDD" where:

FFFF = Facility Code (see below)

N = 0-9 This allows up to 10 networks per facility or building.

DD = 00-99 This allows up to 100 devices per network.

- b. Facility Code assignments are currently:

0000-0999 Open

1000-1999 Statutory Facilities

2000-2999 Endowed Facilities

3000-3999 Housing and Dining Facilities

4000-4999 Off-Campus Facilities

5000-5999 Utilities

- c. Some facilities have a facility code with an alphabetic suffix to denote wings, related structures, etc. The suffix will be ignored. Network numbers for facility codes above 4193 will be assigned in the range 0000-0999.

- d. The Contractor shall contact the Computer Section for assignment, or confirmation, of the Facility Code to be used prior to beginning device

configuration.

3. Non-Device Object Names:
Objects other than Device objects shall be named in a manner analogous to Device objects. The names shall consist of a facility.[sub-facility.]system.[sub-system.]point designation.
4. Non-Device Object Instance Numbers:
The instance numbers for objects other than Device objects may be assigned at the Contractor's discretion subject only to the constraint that they be unique for a given object type within a given device.

B. Commissioning/Diagnostic Mode

In order to support commissioning and troubleshooting functions, the Out_Of_Service property of all Analog, Binary, Multi-state, Loop, and Program objects shall be writable using BACnet services.

C. Using Object Descriptions

1. Each device object and every object in BACnet Building Controllers (B-BC) shall be configured with a Description property. The descriptions used shall be submitted to the Owner for approval.
2. For all object types in all devices that support Description properties, the available string length and whether or not the Description is writable using BACnet services shall be specified in the device's PICS.

D. Issues Relating to Specific BACnet Object Types

This clause provides requirements that pertain to the use of specific BACnet object types.

1. Analog Input, Output, and Value:
All Analog_Input, Analog_Output, and Analog_Value objects shall have the capability of using the change of value (COV) reporting mechanism and the COV_Increment property shall be writable using BACnet services.
2. Binary Input:
The Inactive_Text and Active_Text properties of Binary Input objects shall be configured with text string values as indicated on the points list. Binary Input objects shall support COV reporting.
3. Binary Output:

The Inactive_Text and Active_Text properties of Binary Output objects shall be configured with text string values as indicated on the points list. All Binary Output objects associated with motor on/off status shall track changes of state and runtime. Binary Output objects shall support COV reporting.

4. Binary Value:
The Inactive_Text and Active_Text properties of Binary Value objects shall be

configured with text string values as indicated on the points list. Binary Value objects shall support COV reporting.

5. Calendar:

1. Devices providing scheduling capability shall also provide at least one Calendar object with a capacity of at least ten entries. Operators shall be able to view the calendar object and make modifications from any BACnet workstation on the network.
2. If the Calendar's Date_List property is writable using BACnet services, all calendar entry data types shall be supported.

6. Loop:

All control loops using any combination of proportional, integral, and/or derivative control shall be represented by BACnet Loop objects. Operators with sufficient authority shall be able to adjust at least the Update_Interval, Setpoint, Proportional_Constant, Integral_Constant, and Derivative_Constant using BACnet services. Loop objects shall support COV reporting.

7. Multi-state Input, Output, and Value:

The text to be used for the Multi-state object types shall be determined from the points list. Feedback_Value shall be determined by sensing the actual condition or mode of the device. All Multi-state objects shall support COV reporting.

8. Schedule:

All building systems with date and time scheduling requirements shall have schedules represented by BACnet Schedule objects. All operators shall be able to view the entries for a schedule. Operators with sufficient privilege shall be able to modify schedule entries from any BACnet workstation. Required schedules are shown on the drawings as part of the occupied and unoccupied modes.

E. Dynamic Object Creation

BACnet Building Controllers shall be configured to allow the dynamic creation of Trend Log, Calendar, and Schedule objects by means of the BACnet Create Object service. This shall be possible from any supplied BACnet workstation by operators with appropriate authority.

3.4 USE OF BACNET SERVICES

This clause provides requirements that are specific to the use of BACnet communication services.

A. Interoperable Commands

All dampers, valves, fans, or other mechanical equipment that may need to be controlled by more than one application shall be represented as commandable BACnet objects. The application programs interacting with this equipment shall be configured to use the command priorities listed in Table 2. If implementing the sequence of operations or other required functionality requires using a command priority not listed in Table 2, the priority

assignment must be approved by the Owner.

Table 2. Cornell Command Priorities

Priority Level	Application	Priority Level	Application
1	Manual-Life Safety	9	Available
2	Automatic-Life Safety	10	Available
3	Available	11	Load Shedding
4	Available	12	Available
5	Critical Equipment Control	13	Available
6	Minimum On/Off	14	Available
7	Available	15	Available
8	Manual Operator	16	Available

B. Alarming

This clause provides requirements that are specific to the use of BACnet for alarm processing.

1. Alarm Priorities:
All alarm and event notification priorities shall be configured as indicated in 3.02.B.1.
2. Notification Classes:
The EMCS shall be designated as a recipient for all alarm notifications.

The Priority, Ack_Required, and Recipient_List properties of Notification Class objects shall be writable over the network using BACnet services.

3. Event Notification Message Texts:
Alarm and event processing shall be configured to convey descriptive text messages along with the notification.

C. Operator Authority Levels

If local workstation capability is provided, there shall be at least three levels of authority:

Administrator - All privileges
Control Shop - All programming and configuration
Building Coordinator - Read only

D. Change of Value Processing

1. All local workstations shall be able to display property values based on the receipt of confirmed and unconfirmed Change of Value notifications. Operators shall have the ability from any workstation to subscribe to COV notifications for all objects that

support COV subscriptions.

2. After initialization, all graphic display screens shall update the displayed values using COV notifications if COV notification capabilities are available from the data source.
3. The COV increment shall be adjustable by an operator using BACnet services.

3.5 LOCAL AREA NETWORKS

This clause provides requirements that are specific to the integration of multiple BACnet networks, possibly on different LAN types, into a single BACnet internetwork.

A. Network Numbering

1. Cornell BACnet network numbers are based on a "facility code, network" concept. The "facility code" is the Cornell-assigned numeric value assigned to a specific facility or building. See 3.03.A.2 above. The "network" typically corresponds to a "floor" or other logical configuration within the building. BACnet allows 65535 network numbers per BACnet internetwork.
2. Cornell's network numbers are thus formed as follows: Network Number = "FFFFN" where:
FFFF = Facility Code
N = 0-9 This allows up to 10 networks per facility or building.

N = 0 will generally be assigned to a facility's BACnet Ethernet LAN. Normally, this network is connected to the campus backbone. The additional N-numbers will be assigned to any ARCNET or MS/TP networks as required.

3. The Contractor shall contact the Computer Section for assignment, or confirmation, of the Network Number(s) to be used prior to beginning device configuration.

B. IP Address Assignments

1. Cornell maintains specially configured VLANs for the purpose of securely transporting BACS communication traffic. Address assignments are coordinated by the Computer Section.
2. The Contractor shall contact the Computer Section for assignment of IP addresses (and possibly non-standard UDP ports) prior to beginning device configuration.

3.6 BACNET ROUTERS

This clause provides requirements that are specific to the use of BACnet routers.

A. Error Message Destination

The Contractor shall configure each BACnet router to transmit network layer (routing) error messages to the EMCS.

END OF SECTION

SECTION 232113 – HYDRONIC PIPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
 - 1. Hot-water heating piping.
 - 2. Air-vent piping.
 - 3. Coil and system drain piping.

1.3 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
 - 1. Hot-water heating piping: 150 psig at 200 deg F.

1.4 SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
- B. Field quality-control test reports.
- C. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
- C. Wrought-Copper Fittings: ASME B16.22.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. S. P. Fittings; a division of Star Pipe Products.
 - c. Victaulic Company of America.
- D. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. T-DRILL Industries Inc.
- E. Wrought-Copper Unions: ASME B16.22.

2.2 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

- a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- E. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- F. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.3 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - e. Zurn Plumbing Products Group; AquaSpec Commercial Products Division.
 - 3. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 deg F.
- D. Dielectric Nipples:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Perfection Corporation; a subsidiary of American Meter Company.
 - b. Precision Plumbing Products, Inc.

- c. Sioux Chief Manufacturing Company, Inc.
 - d. Victaulic Company of America.
3. Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.4 VALVES

- A. Balance, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "Valves."
- B. Bronze, Calibrated-Orifice, Balancing Valves:
- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong Pumps, Inc. CBV
 - b. ITT Corporation; Bell & Gossett.
 - c. Tour Anderson.
 - 2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
 - 3. Ball: Brass or stainless steel.
 - 4. Plug: Resin.
 - 5. Seat: PTFE.
 - 6. End Connections: Flanged, Threaded or socket.
 - 7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 - 8. Handle Style: Lever, with memory stop to retain set position. Provide a minimum of three full 360 degree turns from full open to full closed position.
 - 9. CWP Rating: Minimum 125 psig.
 - 10. Maximum Operating Temperature: 250 deg F.

2.5 CONSTRUCTED IN ACCORDANCE WITH ASME CODE HYDRONIC PIPING SPECIALTIES

- A. Y-Pattern Strainers:
- 1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
 - 2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
 - 3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
 - 4. CWP Rating: 125 psig.

PART 3 _EXECUTION

3.1 PIPING APPLICATIONS

- A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be any of the following:
 - 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

3.2 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.
- B. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

3.3 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, NPS $\frac{3}{4}$ ball valve, and short NPS $\frac{3}{4}$ threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

- M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- P. Install valves according to Division 23 Section "Valves."
- Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- S. Install strainers on inlet side of each control valve, pressure-reducing valve, control valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers.
- T. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Pipe Expansion Fittings and Loops."
- U. Identify piping as specified in Division 23 Section "Mechanical Identification."

3.4 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports." Comply with the following requirements for maximum spacing of supports.
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
 - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 - 2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 - 3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 - 4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
- D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS ¾: Maximum span, 5 feet; minimum rod size, ¼ inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, ¼ inch.
3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
6. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

3.6 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

3.7 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gages."

3.8 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
4. Set temperature controls so all coils are calling for full flow.
5. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
6. Verify lubrication of motors and bearings.

END OF SECTION

SECTION 233113 – METAL DUCTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Single-wall rectangular ducts and fittings.
 - 2. Single-wall round ducts and fittings.
 - 3. Sheet metal materials.
 - 4. Sealants and gaskets.
 - 5. Hangers and supports.

- B. Related Sections:

- 1. Division 23 Section for mechanical equipment.
 - 2. Division 23 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
 - 3. Division 23 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing requirements for metal ducts.

1.3 PERFORMANCE REQUIREMENTS

- A. Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated. Refer to Part 3.00 for duct construction and sealing class.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"

1.4 SUBMITTALS

- A. Product Data: For each type of the following products:
 - 1. Sealants and gaskets.

- B. Shop Drawings:

- 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.

2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts, elevations bottom of duct.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.
13. Existing ductwork field verified within the renovation area for coordination and connections.
14. Exhaust plenums including access door details.
15. Control damper mountings to penetrations.
16. VAV and EVAV control devices.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations for selecting hangers and supports.

D. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. The project involves renovations to an existing facility. The contractor shall field verify all existing conditions and shall be responsible to coordinate and alter proposed ductwork or existing services to allow installation of ductwork. Prior to shop drawing preparation, the contractor shall document existing conditions in the areas requiring ductwork. Existing ductwork to remain shall be field verified for size and elevation, all proposed connections to existing shall be clearly documented on the shop and coordination drawings.
3. Structural members to which duct will be attached.
4. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Motion detectors.
 - d. Lab service suspended framing units.
 - e. Soffits and special ceiling configurations.
 - f. Access panels.

E. Welding certificates.

- F. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 - 2. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

PART 2 PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Lindab Inc.

- b. McGill AirFlow LLC.
 - c. SEMCO Incorporated.
 - d. Sheet Metal Connectors, Inc.
 - e. Spiral Manufacturing Co., Inc.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
 - 2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: : G90.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be as indicated in the "Duct Schedule" Article.
- D. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- E. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 2. Tape Width: 4 inches.
 3. Sealant: Modified styrene acrylic.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 7. Service: Indoor and outdoor.
 8. Service Temperature: Minus 40 to plus 200 deg F.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
- C. Water-Based Joint and Seam Sealant:
 1. Application Method: Brush on.
 2. Solids Content: Minimum 65 percent.
 3. Shore A Hardness: Minimum 20.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. VOC: Maximum 75 g/L (less water).
 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 8. Service: Indoor or outdoor.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Solvent-Based Joint and Seam Sealant:
 1. Application Method: Brush on.
 2. Base: Synthetic rubber resin.
 3. Solvent: Toluene and heptane.
 4. Solids Content: Minimum 60 percent.
 5. Shore A Hardness: Minimum 60.
 6. Water resistant.
 7. Mold and mildew resistant.
 8. VOC: Maximum 395 g/L.

9. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
10. Service: Indoor or outdoor.
11. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

G. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Duct Accessories" for fire and smoke dampers.
- L. Access doors shall be installed at each fire damper, control damper or duct mounted coil.
- M. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."
- N. Flexible ductwork shall only be allowed above concealed ceiling spaces on supply air ductwork only to make the connection from branch ducts to diffusers and shall be a maximum of 3 feet long. Flexible ductwork shall be jacketed, insulated and have a double-ply polyester core and rated for a minimum of 3" WG.

- O. All rectangular ductwork shall be in accordance with the latest SMACNA Standards with regard to duct gage thickness, reinforcement spacing, bracing, and hangers and supports. All longitudinal seams shall be made with a Pittsburgh Lock (Type L-1). Transverse joints shall be made with a Pocket Lock (Type T-17) for ductwork up to 3" wg. For ductwork rated at 3" wg and above, the transverse joints shall be made with the Ductmate, Ward, or Nexus ductwork connection system. No slip and drive joints shall be permitted.
- P. Provide breakaway joints for fire dampers and comply with local and state codes.
- Q. Round and oval ductwork shall be spiral seam. Spiral seam ductwork construction shall be in accordance with the latest SMACNA Standards, with the following exceptions: Duct thickness shall be a minimum of 26 gage. Drawband and crimp type transverse joints (RT-3 and RT-5 respectively) are not permitted. Pleated, adjustable, and mitered elbows are not permitted, and segmented elbows shall be constructed with five segments, minimum.
- R. Branch Ducts and Volume Dampers: All branch duct takeoff shall be made with 45 degree entry fittings; splitter dampers and extractors are not allowed. Volume dampers are required at each supply and return air submain, branch main, and branch takeoff and shall be shown on the shop drawings.
- S. All fume hood exhaust ductwork and laboratory exhaust ductwork shall have all duct seams and joints shall be sealed. Stainless steel ductwork shall be welded.

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 SEAM AND JOINT SEALING

- A. Seal duct seams and joints for duct static-pressure and leakage classes specified in "Performance Requirements" Article, according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements," unless otherwise indicated.
- B. Seal Classes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements."

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 9 painting Sections.

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual."
2. Test the following systems:
 - a. Supply air.
 - b. Exhaust systems.
3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before insulation application.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.8 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.9 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as follows:

B. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.
2. Stainless-Steel Ducts:
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Galvanized.

C. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."

- a. Velocity All:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows." Air foil mitered turning vanes are required.
- 2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity All: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or Welded.
- D. Branch Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.
 - 2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees."
 - a. Velocity 1000 to 1500 fpm: Conical tap.
 - b. Velocity 1500 fpm or Higher: 45-degree lateral.
- E. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
 - 1. Fume hood exhaust system, EF-I-02, EF-I-02, and EF-III-09 entire system stainless steel.
 - 2. Canopy hood located in room B92, aluminum.
- F. Supply Ducts:
 - 1. Supply Ductwork:
 - a. Pressure Class: Positive 4-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 6.
 - 2. Ducts Connected to Equipment Not Listed Above:

- a. Pressure Class: Positive 4-inch wg.
- b. Minimum SMACNA Seal Class: A.
- c. SMACNA Leakage Class for Rectangular: 6.
- d. SMACNA Leakage Class for Round and Flat Oval: 6.

G. Exhaust Ducts:

- 1. Ducts Connected to Fans Exhausting Laboratory and Process (ASHRAE 62.1, Class 3 and 4) Air:
 - a. Type 316, stainless-steel sheet, minimum gauge 26.
 - 1) Exposed to View: No. 4 finish.
 - 2) Concealed: No. 2B finish.
 - b. Pressure Class: Positive or negative 4-inch wg.
 - c. Minimum SMACNA Seal Class: A Welded seams, joints, and penetrations.
 - d. SMACNA Leakage Class: 3.

END OF SECTION

SECTION 233300 – DUCT ACCESSORIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Manual volume dampers.
 - 2. Control dampers.
 - 3. Fire/Smoke dampers.
 - 4. Flange connectors.
 - 5. Turning vanes.
 - 6. Duct-mounted access doors.
 - 7. Flexible connectors.
 - 8. Flexible ducts.
 - 9. Duct accessory hardware.
- B. Related Sections:
 - 1. Division 28 Section "Fire Alarm" for duct-mounted fire and smoke detectors.
 - 2. Division 23 Section "Intake and Relief Ventilators" for roof-mounted ventilator caps, ductwork and requirements.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
 - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control-damper installations.

- d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
- e. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
- B. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

1.7 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. NFPA 80, 90A, 92, 101 and 105.
- C. CSFM Fire Damper Listing.
- D. CSFM Leakage (Smoke) Damper Listing.
- E. Applicable Building Codes.
- F. Comply with AMCA 500-D testing for damper rating.
- G. Dampers shall be tested, rated, and labeled in accordance with:
 - 1. UL 555 (Most Current Edition)
 - 2. UL 555S (Most Current Edition)
- H. Dampers shall bear the AMCA Certified Ratings Seal for Air Performance in accordance with AMCA 511.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Flexmaster U.S.A., Inc.
 - d. McGill AirFlow LLC.
 - e. METALAIRE, Inc.
 - f. Ruskin Company.
 - g. Vent Products Company, Inc.
 - 2. Low leakage rating, with linkage outside airstream.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames:
 - a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized-steel, 0.064 inch thick.

6. Blade Axles: Galvanized steel.
7. Bearings:
 - a. Oil-impregnated bronze.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
8. Tie Bars and Brackets: Galvanized steel.

2.3 CONTROL DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Arrow United Industries; a division of Mestek, Inc.
 2. Ruskin Company. CD 50
- B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
- C. Frames:
 1. As required for installation shaped.
 2. Galvanized-steel channels, 0.064 inch thick.
 3. Mitered and welded corners.
- D. Blades:
 1. Multiple blade with maximum blade width of 8 inches.
 2. Opposed-blade design.
 3. Extruded aluminum air foil blade.
 4. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.
- E. Blade Axles: 1/2-inch- diameter; stainless steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
 1. Operating Temperature Range: From minus 40 to plus 200 deg F.
- F. Bearings:
 1. Stainless-steel sleeve.
 2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 3. Thrust bearings at each end of every blade.

2.4 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Air Balance Inc.; a division of Mestek, Inc.

2. Arrow United Industries; a division of Mestek, Inc.
 3. Cesco Products; a division of Mestek, Inc.
 4. METALAIRE, Inc.
 5. Ruskin Company.
 6. Vent Products Company, Inc.
- B. Type: Static; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.
- D. Fire Rating: 1-1/2 hours.
- E. Frame: Curtain type with blades outside air stream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
1. Minimum Thickness: 0.052 or 0.138 inch thick, as indicated, and of length to suit application.
 2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, 0.034-inch-thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

2.5 FIRE/SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Basis of Design: Greenheck FSD-200 series
 2. Air Balance Inc.; a division of Mestek, Inc.
 3. Arrow United Industries; a division of Mestek, Inc.
 4. Cesco Products; a division of Mestek, Inc.
 5. METALAIRE, Inc.
 6. Ruskin Company.
 7. Vent Products Company, Inc.
- B. Type: Dampers shall be supplied with RRL/OCI; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 6-inch wg static pressure class and minimum 2000-fpm velocity.

- D. Rating: 1-1/2 hours Fire Rating, Class I Smoke Rating.
- E. Frame: Damper frame shall be 16 ga. galvanized steel formed into a 5" x 1" structural hat channel. Dampers less than 17" high shall utilize low profile geometry and 20 ga. galvanized steel for the top and bottom frame members to maximize free area. Frame shall be 4-piece construction with 1 1/2" (minimum) integral overlapping gusset reinforcements in each corner to assure square corners and provide maximum resistance to racking. No welding of damper frames shall be permitted.
- F. Damper Assembly: Damper blades shall be 16 ga. galvanized steel strengthened by three longitudinal 1" deep Vee grooves running the entire length of each blade. Each blade shall be symmetrical relative to its axle pivot point, presenting identical performance characteristics with air flowing in either direction through the damper. Provide symmetrical blades of varying size as required to completely fill the damper opening.
- G. Seals: Blade Edge: Blade seals shall be extruded silicone rubber mechanically secured to the appropriate blade edges.
- H. Jamb: Flexible stainless steel compression type.
- I. Blade linkages shall be non-adjustable and concealed within the jamb of the damper.
- J. Bearings: Axle bearings shall be stainless steel sleeve type rotating in polished extruded holes in the damper frame.
- K. Finish: Galvanized steel
- L. Actuator: Electric, 24V DC, 2-position, mounting type External (outside of duct), coordinate with facility life safety systems.
- M. Testing capability: Dampers shall be supplied with test switch package. Test switches enable testing and maintenance on combination fire smoke dampers to be performed by one person. All test switch packages incorporate separate open and closed lights for positive indication of the damper's full operating range and are intended to be mounted locally on the damper or in a more conveniently accessed location remote from the damper.
- N. Sleeves: Damper shall be supplied as a single assembly with a factory installed sleeve made of material matching that of the damper.
- O. Mounting Orientation: Vertical or horizontal as indicated.
- P. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.
- Q. Heat-Responsive Device: RRL (Reusable Resettable Link), an electric heat-responsive device standard on any combination fire-smoke damper that performs the same function as a fusible link. An RRL shall reset, eliminating the need to replace a fusible link, 165 deg F rated.

2.6 SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Basis of Design: Greenheck SMD-200 series
 - 2. Air Balance Inc.; a division of Mestek, Inc.
 - 3. Arrow United Industries; a division of Mestek, Inc.
 - 4. Cesco Products; a division of Mestek, Inc.
 - 5. METALAIRE, Inc.
 - 6. Ruskin Company.
 - 7. Vent Products Company, Inc.
- B. Type: Dampers shall be supplied 250 F rated and labeled according to UL 555S.
- C. Closing rating in ducts up to 6-inch wg static pressure class and minimum 2000-fpm velocity.
- D. Rating: Class I Smoke Rating.
- E. Frame: Damper frame shall be 16 ga. galvanized steel formed into a 5" x 1" structural hat channel. Dampers less than 17" high shall utilize low profile geometry and 20 ga. galvanized steel for the top and bottom frame members to maximize free area. Frame shall be 4-piece construction with 1 1/2" (minimum) integral overlapping gusset reinforcements in each corner to assure square corners and provide maximum resistance to racking. No welding of damper frames shall be permitted.
- F. Damper Assembly: Damper blades shall be 16 ga. galvanized steel strengthened by three longitudinal 1" deep Vee grooves running the entire length of each blade. Each blade shall be symmetrical relative to its axle pivot point, presenting identical performance characteristics with air flowing in either direction through the damper. Provide symmetrical blades of varying size as required to completely fill the damper opening.
- G. Seals: Blade Edge: Blade seals shall be extruded silicone rubber mechanically secured to the appropriate blade edges.
- H. Jamb: Flexible stainless steel compression type.
- I. Blade linkages shall be non-adjustable and concealed within the jamb of the damper.
- J. Bearings: Axle bearings shall be stainless steel sleeve type rotating in polished extruded holes in the damper frame.
- K. Finish: Galvanized steel
- L. Actuator: Electric, 120V AC, 2-position, mounting type External (outside of duct), coordinate with facility life safety systems.
- M. Testing capability: Momentary Test Switch: Test and cycle the damper on location.
- N. Sleeves: Damper shall be supplied as a single assembly with a factory installed sleeve made of material matching that of the damper.
- O. Mounting Orientation: Vertical or horizontal as indicated.

- P. Damper frame shall be 16 ga. galvanized steel formed into a 5" x 1" structural hat channel. Top and bottom frame members on dampers less than 17" high shall be low profile design to maximize the free area of these smaller dampers. Frame shall be 4-piece construction with 1 1/2" (minimum) integral overlapping gusset reinforcements in each corner to assure square corners and provide maximum resistance to racking.
- Q. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

2.7 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Nexus PDQ; Division of Shilco Holdings Inc.
 - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Description: Add-on, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

2.8 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. METALAIRE, Inc.
 - 4. SEMCO Incorporated.
 - 5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
 - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."
- E. Vane Construction: Double wall.

2.9 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Warming and Ventilating; a division of Mestek, Inc.
 - 2. CESCO Products; a division of Mestek, Inc.
 - 3. Ductmate Industries, Inc.
 - 4. Flexmaster U.S.A., Inc.
 - 5. Greenheck Fan Corporation.
 - 6. Ventfabrics, Inc.
 - 7. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
 - 1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - d. Fabricate doors airtight and suitable for duct pressure class.
 - 2. Frame: Galvanized sheet steel, with bend-over tabs and low leakage gaskets.
 - 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
 - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.10 DUCT ACCESS PANEL ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Flame Gard, Inc.
 - 3. 3M.
- B. Labeled according to UL 1978 by an NRTL.
- C. Panel and Frame: Minimum thickness 0.0428-inch stainless steel.
- D. Fasteners: Stainless steel. Panel fasteners shall not penetrate duct wall.

- E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.
- F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.11 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. Ventfabrics, Inc.
 - 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches wide attached to 2 strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd..
 - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 deg F.
- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 - 1. Minimum Weight: 24 oz./sq. yd..
 - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
 - 3. Service Temperature: Minus 50 to plus 250 deg F.

2.12 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Flexmaster U.S.A., Inc.
 - 2. McGill AirFlow LLC.
 - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Insulated, Flexible Duct: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
 - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 - 2. Maximum Air Velocity: 4000 fpm.

3. Temperature Range: Minus 20 to plus 210 deg F.
 4. Insulation R-value: Comply with ASHRAE/IESNA 90.1-2004.
- C. Flexible exhaust:
1. Provide flexible exhaust rated for 6" WG +/- and suitable for oil and water exposure.
- D. Flexible Duct Connectors:
1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.
 2. Non-Clamp Connectors: Adhesive plus sheet metal screws.

2.13 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install control dampers at outlet of exhaust fans or exhaust ducts as close as possible to roof line unless otherwise indicated.
- D. Install control dampers for fresh air intake louvers at vertical wall surface louver. Provide framed sheet metal panel to enclose full louver, and framing as required to mount control damper.
- E. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts.
1. Install steel volume dampers in steel ducts.
- F. Set dampers to fully open position before testing, adjusting, and balancing.

- G. Install test holes at fan inlets and outlets and elsewhere as indicated.
- H. Install fire dampers according to UL listing.
- I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils.
 - 2. In fresh air intake plenums as shown on drawings.
 - 3. At outdoor-air intakes and mixed-air plenums.
 - 4. At drain pans and seals.
 - 5. Downstream from control dampers, and equipment.
 - 6. Adjacent to and close enough to fire dampers, to reset or reinstall fusible links. Access doors for access to fire dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - 7. At each change in direction and at maximum 50-foot spacing.
 - 8. Upstream from turning vanes.
 - 9. Control devices requiring inspection.
 - 10. Elsewhere as indicated.
- J. Install access doors with swing against duct static pressure.
- K. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches.
 - 2. Two-Hand Access: 12 by 6 inches.
 - 3. Head and Hand Access: 18 by 10 inches.
 - 4. Head and Shoulders Access: 21 by 14 inches.
 - 5. Body Access: 25 by 14 inches.
 - 6. Body plus Ladder Access: 25 by 17 inches.
 - 7. Full size walk through on Fresh air intake plenums 36 by 72 inches.
- L. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- M. Install flexible connectors to connect ducts to equipment.
- N. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- O. Connect diffusers to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- P. Connect flexible ducts to metal ducts with threaded hose clamps, limit lengths to 3'-0" and can only be used for terminal diffuser connections above concealed ceiling systems on AHU-II-02, Area II.
- Q. Install duct test holes where required for testing and balancing purposes.

- R. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Inspect turning vanes for proper and secure installation.
4. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 23 30 00

SECTION 233416 – CENTRIFUGAL HVAC FANS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: For each product.
 - 1. Airfoil centrifugal fans.
 - 2. Backward-inclined centrifugal fans.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Include rated capacities, furnished specialties, and accessories for each fan.
 - 2. Certified fan performance curves with system operating conditions indicated.
 - 3. Certified fan sound-power ratings.
 - 4. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 5. Material thickness and finishes, including color charts.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.
 - 4. Design Calculations: Calculate requirements for selecting vibration isolators and provide vibration isolation bases.
 - 5. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show fan room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.
- B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For centrifugal fans to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Belts: One set(s) for each belt-driven unit.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AMCA Compliance:
 - 1. Comply with AMCA performance requirements and bear the AMCA-Certified Ratings Seal.
 - 2. Operating Limits: Classify according to AMCA 99.
- B. Service Conditions:
 - 1. Ambient Temperature:
 - 2. Altitude: 960 above sea level.
 - 3. Chemical resistance.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Capacities and Characteristics:
 - 1. In addition to the following refer to drawings for scheduled equipment.
 - 2. All fans used for fume exhaust shall be AMCA Type B spark-resistant construction.
 - 3. Fans shall be Class 1 belted utility sets with a steel scroll sized to operate below 2,000 RPM..
 - 4. Class: I.
 - 5. Arrangement: 8 with weather cover.
 - 6. Housing Material: Reinforced steel.
 - 7. Special Housing Coating: All components exposed to the air stream shall be coated with primer, baked enamel and baked Heresite.
 - 8. Special Wheel Coating: All components exposed to the air stream shall be coated with primer, baked enamel and baked Heresite.
 - 9. Fan Rpm: maximum of 2,000.
 - 10. Motor:
 - a. Motor Enclosure: Open, dripproof.
 - b. Enclosure Materials: Cast iron.
 - c. Motor Bearings: **<Insert requirements>**.
 - d. Efficiency: Premium efficient, VSD duty, refer to electrical motor specifications.

e. NEMA Design: Insert designation.

11. Vibration Isolators: Spring isolators having a static deflection of 1 inch.
12. Spark-Resistance Class: B.

2.2 AIRFOIL CENTRIFUGAL IN-Line FANS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Chicago Blower Corporation.
2. Loren Cook Company.
3. New York Blower Company (The).

B. Description:

1. Factory-fabricated, -assembled, -tested, and -finished, belt-driven in-line centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, guards, weather cover and support structure.
2. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.
3. Factory-installed and -wired disconnect switch.

C. Housings:

1. Formed panels to make curved-scroll housings with shaped cutoff.
2. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
3. Horizontally split, bolted-flange housing.
4. Spun inlet cone with flange.
5. Outlet flange.

D. Airfoil Wheels:

1. Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange.
2. Heavy backplate.
3. Hollow die-formed, airfoil-shaped blades continuously welded at tip flange and backplate.
4. Cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws.

E. Shafts:

1. Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with adjustable alignment and belt tensioning.
2. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.
3. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

F. Grease-Lubricated Shaft Bearings:

1. Self-aligning, pillow-block-type, tapered roller bearings with double-locking collars and two-piece, cast-iron housing.
2. Ball-Bearing Rating Life: ABMA 9, L10 at 120,000 hours.
3. Roller-Bearing Rating Life: ABMA 11, L10 at 120,000 hours.

G. Belt Drives:

1. Factory mounted, with adjustable alignment and belt tensioning.
2. Service Factor Based on Fan Motor Size: 1.2.
3. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
4. Motor Pulleys: Adjustable pitch for use with motors through [5] <Insert number> hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
5. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
6. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
7. Motor Mount: Adjustable for belt tensioning.

H. Accessories:

1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.
2. Scroll Drain Connection: NPS 1 steel pipe coupling welded to low point of fan scroll.
3. Companion Flanges: Rolled flanges for duct connections of same material as housing.
4. Variable Inlet Vanes: With blades supported at both ends with two permanently lubricated bearings of same material as housing. Variable mechanism terminating in single control lever with control shaft for double-width fans.
5. Discharge Dampers: Assembly with [parallel] [opposed] blades constructed of two plates formed around and to shaft, channel frame, and sealed ball bearings; with blades linked outside of airstream to single control lever of same material as housing.
6. Inlet Screens: Grid screen of same material as housing.
7. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
8. Spark-Resistant Construction: AMCA 99.
9. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
10. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.

2.3 BACKWARD-INCLINED CENTRIFUGAL FANS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or a comparable product by one of the following:
1. Aerovent; a Twin City Fan company.
 2. Barry Blower a Snyder Co.
 3. Chicago Blower Corporation.
 4. Loren Cook Company.
 5. New York Blower Company (The).

B. Description:

1. Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.
2. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.
3. Factory-installed and -wired disconnect switch.

C. Housings:

1. Formed panels to make curved-scroll housings with shaped cutoff.
2. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
3. Horizontally split, bolted-flange housing.
4. Spun inlet cone with flange.
5. Outlet flange.

D. Backward-Inclined Wheels:

1. Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange, backplate, backward-inclined blades, and fastened to shaft with set screws.
2. Welded or riveted to flange and backplate; cast-iron or cast-steel hub riveted to backplate.

E. Shafts:

1. Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with adjustable alignment and belt tensioning.
2. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.
3. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

F. Prelubricated and Sealed Shaft Bearings:

1. Self-aligning, pillow-block-type ball bearings.
2. Ball-Bearing Rating Life: ABMA 9, L10 at [50,000] [120,000] hours <Insert hours>.
3. Roller-Bearing Rating Life: ABMA 11, L10 at [50,000] [120,000] hours <Insert hours>.

G. Grease-Lubricated Shaft Bearings:

1. Self-aligning, pillow-block-type, tapered roller bearings with double-locking collars and two-piece, cast-iron housing.
2. Ball-Bearing Rating Life: ABMA 9, L10 at [50,000] [120,000] hours <Insert hours>.
3. Roller-Bearing Rating Life: ABMA 11, L10 at [50,000] [120,000] hours <Insert hours>.

H. Grease-Lubricated Shaft Bearings:

1. Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.
2. Ball-Bearing Rating Life: ABMA 9, L10 at [50,000] [120,000] hours <Insert hours>.
3. Roller-Bearing Rating Life: ABMA 11, L10 at [50,000] [120,000] hours <Insert hours>.

I. Belt Drives:

1. Factory mounted, with adjustable alignment and belt tensioning.
2. Service Factor Based on Fan Motor Size: [1.5] [1.4] [1.3] [1.2].
3. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
4. Motor Pulleys: Adjustable pitch for use with motors through [5] <Insert number> hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
5. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
6. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
7. Motor Mount: Adjustable for belt tensioning.

J. Accessories:

1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.
2. Scroll Drain Connection: NPS 1 steel pipe coupling welded to low point of fan scroll.
3. Companion Flanges: Rolled flanges for duct connections of same material as housing.
4. Variable Inlet Vanes: With blades supported at both ends with two permanently lubricated bearings of same material as housing. Variable mechanism terminating in single control lever with control shaft for double-width fans.
5. Discharge Dampers: Assembly with [parallel] [opposed] blades constructed of two plates formed around and to shaft, channel frame, and sealed ball bearings; with blades linked outside of airstream to single control lever of same material as housing.
6. Inlet Screens: Grid screen of same material as housing.
7. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
8. Spark-Resistant Construction: AMCA 99.
9. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
10. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.

2.4 FORWARD-CURVED CENTRIFUGAL FANS

- A. Manufacturers: Subject to compliance with requirements, **[provide products by the following]** **[provide products by one of the following]** **[available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
- B. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings]** <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
1. Acme Engineering & Mfg. Corp.
 2. Central Blower Company.
 3. Howden Buffalo Inc.
 4. Lau Industries.
 5. New York Blower Company (The).

6. <Insert manufacturer's name>.

C. Description:

1. Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.
2. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.
3. Factory-installed and -wired disconnect switch.

D. Housings:

1. Formed panels to make curved-scroll housings with shaped cutoff.
2. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
3. Horizontally split, bolted-flange housing.
4. Spun inlet cone with flange.
5. Outlet flange.

E. Forward-Curved Wheels:

1. Black-enameled or galvanized-steel construction with inlet flange, backplate, shallow blades with inlet and tip curved forward in direction of airflow.
2. Mechanically secured to flange and backplate; cast-steel hub swaged to backplate and fastened to shaft with set screws.

F. Shafts:

1. Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with adjustable alignment and belt tensioning.
2. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.
3. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

G. Prelubricated and Sealed Shaft Bearings:

1. Self-aligning, pillow-block-type ball bearings.
2. Ball-Bearing Rating Life: ABMA 9, L10 at [50,000] [120,000] hours <Insert hours>.
3. Roller-Bearing Rating Life: ABMA 11, L10 at [50,000] [120,000] hours <Insert hours>.

H. Grease-Lubricated Shaft Bearings:

1. Self-aligning, pillow-block-type, tapered roller bearings with double-locking collars and two-piece, cast-iron housing.
2. Ball-Bearing Rating Life: ABMA 9, L10 at [50,000] [120,000] hours <Insert hours>.
3. Roller-Bearing Rating Life: ABMA 11, L10 at [50,000] [120,000] hours <Insert hours>.

I. Grease-Lubricated Shaft Bearings:

1. Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.
2. Ball-Bearing Rating Life: ABMA 9, L10 at [50,000] [120,000] hours <Insert hours>.
3. Roller-Bearing Rating Life: ABMA 11, L10 at [50,000] [120,000] hours <Insert hours>.

J. Belt Drives:

1. Factory mounted, with adjustable alignment and belt tensioning.
2. Service Factor Based on Fan Motor Size: [1.5] [1.4] [1.3] [1.2].
3. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
4. Motor Pulleys: Adjustable pitch for use with motors through [5] <Insert number> hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
5. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
6. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
7. Motor Mount: Adjustable for belt tensioning.

K. Accessories:

1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.
2. Scroll Drain Connection: NPS 1 steel pipe coupling welded to low point of fan scroll.
3. Companion Flanges: Rolled flanges for duct connections of same material as housing.
4. Variable Inlet Vanes: With blades supported at both ends with two permanently lubricated bearings of same material as housing. Variable mechanism terminating in single control lever with control shaft for double-width fans.
5. Discharge Dampers: Assembly with [parallel] [opposed] blades constructed of two plates formed around and to shaft, channel frame, and sealed ball bearings; with blades linked outside of airstream to single control lever of same material as housing.
6. Inlet Screens: Grid screen of same material as housing.
7. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
8. Spark-Resistant Construction: AMCA 99.
9. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
10. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.

2.5 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

2.6 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210/ASHRAE 51, "Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating."

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install centrifugal fans level and plumb.
- B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.
- D. Equipment Mounting: Install centrifugal fans on cast-in-place concrete equipment base(s) using **[elastomeric pads] [elastomeric mounts] [restrained spring isolators] <Insert device>**. Comply with requirements for equipment bases specified in Division 03 Section "[**Cast-in-Place Concrete**] [**Miscellaneous Cast-in-Place Concrete**]." Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
 - 1. Minimum Deflection: **[1/4 inch] [1 inch] <Insert dimension>**.
 - 2. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.
 - 3. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 4. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete floor.
 - 5. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 6. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 7. Install on **[4-inch-] [6-inch-] <Insert thickness>** high concrete base**[designed to withstand, without damage to equipment, seismic force required by code]**.
- E. Equipment Mounting: Install centrifugal fans using **[elastomeric pads] [elastomeric mounts] [restrained spring isolators] <Insert device>**. Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
 - 1. Minimum Deflection: **[1/4 inch] [1 inch] <Insert dimension>**.
- F. Equipment Mounting: Install centrifugal fans on vibration isolation equipment base. Comply with requirements specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

- G. Equipment Mounting: Install centrifugal fans with **<Insert seismic-restraint device>**. Comply with requirements for seismic-restraint devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- H. Equipment Mounting: Install continuous-thread hanger rods and **[elastomeric hangers]** **[spring hangers]** **[spring hangers with vertical-limit stop]** of size required to support weight of dehumidification unit.
 - 1. Comply with requirements for seismic-restraint devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
 - 2. Comply with requirements for hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- I. Curb Support: Install roof curb on roof structure, level and secure, according to "The NRCA Roofing and Waterproofing Manual," Low-Slope Membrane Roofing Construction Details Section, Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install and secure centrifugal fans on curbs, and coordinate roof penetrations and flashing with roof construction.**[\$ds~Secure units to curb support with anchor bolts.]**
- J. Unit Support: Install centrifugal fans level on structural **[curbs]** **[pilings]**. Coordinate wall penetrations and flashing with wall construction.**[\$ds~Secure units to structural support with anchor bolts.]**
- K. Isolation Curb Support: Install centrifugal fans on isolation curbs, and install **[flexible duct connectors]** and vibration isolation and seismic-control devices.
 - 1. Comply with requirements in Division 23 Section "Air Duct Accessories" for flexible duct connectors.
 - 2. Comply with requirements in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation and seismic-control devices.
- L. Install units with clearances for service and maintenance.
- M. Label fans according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."
- B. Install ducts adjacent to fans to allow service and maintenance.
- C. Install piping from scroll drain connection, with trap with seal equal to 1.5 times specified static pressure, to nearest floor drain with pipe sizes matching the drain connection.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections[**with the assistance of a factory-authorized service representative**]:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Adjust belt tension.
 - 6. Adjust damper linkages for proper damper operation.
 - 7. Verify lubrication for bearings and other moving parts.
 - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 - 9. See Division 23 Section "Testing, Adjusting, and Balancing For HVAC" for testing, adjusting, and balancing procedures.
 - 10. Remove and replace malfunctioning units and retest as specified above.
- D. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.4 DEMONSTRATION

- A. [**Engage a factory-authorized service representative to train**] [**Train**] Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

END OF SECTION

SECTION 233713 – DIFFUSERS, REGISTERS, AND GRILLES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Rectangular laboratory supply diffusers, perforated directional face.
 - 2. Rectangular horizontal blade register exhaust heavy duty.
- B. Related Sections:
 - 1. Division 23 Section "Duct Accessories" for fire dampers and volume-control dampers not integral to diffusers, and registers.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings. The manufacturer shall provide published (printed or electronic) performance data for the diffuser. Performance data shall include 2 - 7 octave band sound power levels. The diffuser or register shall be tested in accordance to the data standards at the time of product introduction or ANSI/ASHRAE Standard 70.
 - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Method of attaching hangers to building structure.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, life safety devices, access panels, and special moldings.
 - 5. Duct access panels.

PART 2 PRODUCTS

2.1 CEILING DIFFUSERS

A. Square Ceiling Diffusers SA-1 drawing designation:

1. Basis-of-Design Product: Subject to compliance with requirements, Krueger model TAD (aluminum) non-aspirating, radial displacement diffuser shall be a of the sizes shown on the plans and diffuser schedule. The unit shall be configured to allow one of two means for providing uniform discharge flow over the face of the unit. They shall include a factory backpan with duct collar. Installed in the suspended ceiling system or “approved equal” product by one of the following:
 - a. Krueger.
 - b. Titus.
 - c. Anemostat Products; a Mestek company.
2. Provide for each diffuser, where required, a distribution plenum with internal spreading means and an inlet collar.
3. The diffuser shall have a flow measuring tap for ease of balancing.
4. The face of the diffuser shall have a free area not exceeding 15% to ensure true non-aspirating flow.
5. The diffuser shall meet the following performance criteria: The air diffuser shall be tested for sound generation and pressure drop in accordance with the ANSI/ASHRAE 70. Room air velocities shall be determined in accordance with ASHRAE Standard 113.
6. The paint finish shall be #44 British White, powder coat paint, baked at 425°F. The paint thickness shall be 2.0 – 3.0 mils, gloss at 60° per ASTM D523-89 of 60 – 70%, pencil hardness per ASTM D3363-92A of H – 2H, crosshatch adhesion per ASTM D3359-83 of 5B, salt spray per ASTM B117-9048 of 1000 hours, humidity per ASTM D2247-92 of 1000 hours and conical mandrel per ASTM D522 of 1/8” conical bend, no cracking shows.
7. The paint finish shall be powder coat paint, baked at 425°F. The paint thickness shall be 2.0 – 3.0 mils, gloss at 60° per ASTM D523-89 of 55 – 65%, pencil hardness per ASTM D3363-92A of H – 2H, crosshatch adhesion per ASTM D3359-83 of 5B, salt spray per ASTM B117-9048 of 1000 hours, humidity per ASTM D2247-92 of 1000 hours and conical mandrel per ASTM D522 of 1/8” conical bend, no cracking shows.
8. Material: Aluminum.
9. Finish: White baked-on epoxy.
10. The finish of the back pan assembly shall be White baked-on epoxy.
11. Face Size: 24 by 48.
12. Face Style: Perforated, directional 2-way.
13. Mounting: exposed with support clips and mounting rod attachments.
14. Pattern: Directional. 2-way.
15. Dampers: A volume balancing damper shall be installed with the diffuser and shall be adjustable and accessible from the room side.

2.2 REGISTERS AND GRILLES

- A. Fixed Bar Register EX-1 drawing designation:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Anemostat Products; a Mestek company.
 - b. Carnes.
 - c. Krueger.
 - d. Titus.
 - 2. The single deflection supply grille shall be a Krueger model S80H (steel). This grille must have (H models) 0° and 35° deflection blades on 3/4" centers made of 22 gage steel (S80). The frame of the grille must be constructed of 22 gage steel (80) with countersunk screw holes. This frame must also produce a border of 1 1/4" around all sides of the grille with mitered corners.
 - 3. Material: Steel.
 - 4. Finish: Baked enamel, white.
 - 5. Face Blade Arrangement: Horizontal spaced 3/4 inch apart.
 - 6. Core Construction: Integral.
 - 7. Frame: 1-1/4 inches wide.
 - 8. Mounting: Exposed ductwork.
 - 9. Damper Type: Blast gate installed in ductwork.

PART 3 _ EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 238216 – AIR COILS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following types of air coils that are not an integral part of air-handling units:
 - 1. Hot-water. Minimum 2 row.
- B. Related Sections include the following:
 - 1. Division 23 Sections for air coils that are integral to air-handling units.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each air coil. Include rated capacity and pressure drop for each air coil.
- B. Operation and Maintenance Data: For air coils to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 PRODUCTS

2.1 WATER COILS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Aerofin Corporation.

2. Heatcraft Refrigeration Products LLC; Heat Transfer Division.
 3. Trane.
-
- B. Performance Ratings: Tested and rated according to ARI 410 and ASHRAE 33.
 - C. Minimum Working-Pressure/Temperature Ratings: 200 psig, 325 deg F.
 - D. Source Quality Control: Factory tested to 300 psig.
 - E. Tubes: ASTM B 743 copper, minimum 0.035 inch thick. Minimum 2 row.
 - F. Fins: Aluminum, minimum 0.010 inch thick.
 - G. Headers: Seamless copper tube with brazed joints, prime coated.
 - H. Frames: Galvanized-steel channel frame, minimum 0.079 inch thick for flanged mounting.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine ducts, plenums, and casings to receive air coils for compliance with requirements for installation tolerances and other conditions affecting coil performance.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before coil installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install coils level and plumb.
- B. Install coils in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."
- C. Straighten bent fins on air coils.
- D. Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to coils to allow service and maintenance.

- C. Connect water piping with unions and shutoff valves to allow coils to be disconnected without draining piping. Control valves are specified in Division 23 Section "HVAC Instrumentation and Controls," and other piping specialties are specified in Division 23 Section "Hydronic Piping."

END OF SECTION

SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The contractor shall review and comply with all Cornell University Design and Construction Standards. The standard is available at the following website:
<https://fcs.cornell.edu/content/2018-design-and-construction-standards>

1.2 SUMMARY

- A. Section Includes:
 - 1. Electrical equipment coordination and installation.
 - 2. Sleeves for raceways and cables.
 - 3. Sleeve seals.
 - 4. Grout.
 - 5. Common electrical installation requirements.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

- A. Product Data: For sleeve seals.

1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting raceways and cables will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping".

PART 2 PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 3. Pressure Plates: Carbon steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using [steel] pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 26 05 00

SECTION 260505 - GENERAL COMPLETION FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The contractor shall review and comply with all Cornell University Design and Construction Standards. The standards are available at the following website:
<https://fcs.cornell.edu/content/2018-design-and-construction-standards>.

1.2 SUMMARY

- A. Section Includes:
 - 1. Codes and Standards
 - 2. Inspections
 - 3. Submittals
 - 4. Certification and Testing
 - 5. Warranties

1.3 CODES AND STANDARDS

- A. Electrical equipment and installation shall be in compliance with the most recent versions of the National Electrical Code ("NEC"), National Fire Protection Association ("NFPA"), American National Standards Institute Code ("ANSI"), The American with Disabilities Act ("ADA"), International Conference of Building Officials Codes ("ICBO"), State of New York Codes, Rules, & Regulations ("NYCRR"), Illuminating Engineering Society of North America Standards ("IESNA"), The Institute of Electrical and Electronics Engineers standards ("IEEE"), The International Organization for Standardization ("ISO"), and state, municipal or other codes, rules or regulations applicable to the work shall be followed.
- B. Electrical equipment, components, and accessories shall be UL certified for the purpose for which the equipment, components, and accessories are used.

1.4 INSPECTIONS

- A. The authority having jurisdiction for this project is the SUNY Code Enforcement Officer. Permits and inspections shall be issued by the SUNY CEO (Ralph J. D'Amato) or his approved agent. Electrical Inspections shall be conducted by a licensed 3rd party Electrical Inspection Agency that is approved by the SUNY Code Official. The electrical contractor shall engage the services of this agency and furnish the original Certificate of Inspection to the Cornell University Electrical Shop, and a copy to Cornell University's Project Manager for the following items before submitting their final payment requisition at the end of the project.
 - 1. Temporary inspection of electrical work for temporary construction power for the job site and contractor trailers requiring power.

2. Temporary inspection of building primary and secondary power systems, before energizing building permanent power.
 3. Final inspection of the complete electrical system, submitting the final payment requisition at end of project.
- B. Cornell University's Department of Environmental Health & Safety shall inspect fire detection, alarm, and suppression systems work for this project. The electrical contractor shall furnish a Systems Installation Permit to the Cornell University Electrical Shop before submitting their final payment requisition at the end of the project.
- C. The Contractor shall assist Cornell University's Department of Environmental Health & Safety during the walk-through. The electrical contractor shall furnish a satisfactorily completed Pre-Occupancy Safety Checklist to the Cornell University Electrical Shop before submitting their final payment requisition at the end of the project.

1.5 SUBMITTALS

- A. Submit manufacturers' shop drawings for proposed equipment, components, and accessories.
- B. Submit names, addresses, telephone numbers, sales and technical contacts, and other details for each of the proposed equipment, components, and accessories manufacturers ("Manufacturers") and the proposed manufacturers' local representatives ("Manufacturers' Representatives"). Provide Uniform Resource Locator ("URL") addresses (i.e., web-site addresses) when available.
- C. Submit delivery lead times for proposed equipment, components, and accessories with the manufacturers' shop drawings. The Electrical Contractor shall supply detailed delivery schedules to Cornell University's Project Manager of long lead items within five (5) business days after shop drawing review is found in compliance with the specifications by the Engineer of Record.
- D. Submit instructional manuals where required for approved equipment, components, and accessories.
- E. Submit submittals, shop drawings, schematics, documents, requests for authorization, as-built drawings, and instructional manuals as described in Cornell University's Design & Construction Standards (see Division 01001 - General Requirements).
- F. Four (4) copies each of submittals, shop drawings, schematics, documents, as-built drawings, and instructional manuals shall be provided and submitted in compliance with Cornell University's Design & Construction Standards (see Division 01001 - General Requirements) to: Cornell University's Project Manager at Planning, Design, & Construction, Cornell University, 201 Humphreys Service Building, Ithaca, NY. 14853-3701.

1.6 CERTIFICATION AND TESTING

- A. The Electrical Contractor shall assist Cornell University's Environmental Health & Safety Department during the Pre-Occupancy Safety Checklist walk-through.

- B. The Electrical Contractor shall test all systems for proper operation, code compliance, and standards compliance. (Note: Lighting fixtures, devices, and panels shall be tested in a manner that does not affect the equipments', components', or accessories' performance.)
- C. Perform testing at a time convenient to Cornell University's representatives. The Contractor shall pay costs associated with the scheduling, performance, and completion of the testing.

1.7 WARRANTIES

- A. The Electrical Contractor shall warranty the complete electrical work for a period of one year from the date the complete electrical system is accepted by Cornell University's Project Manager. The warranty shall include parts, labor, travel (expense necessary for repairs at the job site), and expendables (used during the course of repair such as lubricating oil, filters, antifreeze, and other service items made unusable by defect).

END OF SECTION 26 05 05

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The contractor shall review and comply with all Cornell University Design and Construction Standards. The standard is available at the following website:
<https://fcs.cornell.edu/content/2018-design-and-construction-standards>

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
 - 3. Sleeves and sleeve seals for cables.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Alcan Products Corporation; Alcan Cable Division.
 - 2. American Insulated Wire Corp.; a Leviton Company.
 - 3. General Cable Corporation.
 - 4. Senator Wire & Cable Company.
 - 5. Southwire Company.
- C. Copper Conductors: Annealed copper, 98% conductivity, comply with NEMA WC 70.
- D. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN, XHHW-2.

2.2 CONNECTORS AND SPLICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Hubbell Power Systems, Inc.
 - 3. O-Z/Gedney; EGS Electrical Group LLC.
 - 4. 3M; Electrical Products Division.
 - 5. Tyco Electronics Corp.
- C. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.
- D. All cables installed exposed in spaces above suspended ceiling systems shall be plenum rated.

PART 3 EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid or stranded for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid or stranded for No. 10 AWG and smaller; stranded for No. 8 AWG and larger. Unless otherwise noted, minimum size shall be No. 12 AWG.

3.2 CONDUCTOR INSULATION AND WIRING METHODS

- A. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
- B. Exposed Branch Circuits, Including in Crawlspace: Type THHN-THWN, single conductors in raceway.

- C. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- D. XHHW-2 shall be used for outdoor service, feeder and branch circuits, underground street lighting, low voltage distribution, and underground building service entrances. XHHW-2 shall be used in indoor dry or wet locations where needed for additional insulation abrasion resistance and/or long vertical cable runs as determined by the design engineer

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
- F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.5 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- B. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 26 05 19

SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The contractor shall review and comply with all Cornell University Design and Construction Standards. The standard is available at the following website:
<https://fcs.cornell.edu/content/2018-design-and-construction-standards>.

1.2 SUMMARY

- A. Section Includes:
 - 1. Control-circuit conductors.
 - 2. Identification products.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- C. Plenum: A space forming part of the air distribution system to which one or more air ducts are connected. An air duct is a passageway, other than a plenum, for transporting air to or from heating, ventilating, or air-conditioning equipment.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 PERFORMANCE REQUIREMENTS

- A. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262 by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.
 - 1. Flame Travel Distance: 60 inches (1520 mm) or less.
 - 2. Peak Optical Smoke Density: 0.5 or less.
 - 3. Average Optical Smoke Density: 0.15 or less.
- B. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.

2.3 CONTROL-CIRCUIT CONDUCTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Encore Wire Corporation.
 - 2. General Cable Technologies Corporation.
 - 3. Southwire Company.
- B. Class 1 Control Circuits: Stranded copper, Type THHN-2-THWN-2, in raceway, complying with UL 44.
- C. Class 2 Control Circuits: Stranded copper, Type THHN-2-THWN-2, in raceway.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Test cables on receipt at Project site.

3.2 INSTALLATION OF RACEWAYS AND BOXES

- A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or modified in this Section.

1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.
 2. Flexible metal conduit shall not be used.
- B. Comply with TIA-569-B for pull-box sizing and length of conduit and number of bends between pull points.
- C. Install manufactured conduit sweeps and long-radius elbows if possible.
- D. Raceway Installation in Equipment Rooms:
1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.
 2. Install cable trays to route cables if conduits cannot be located in these positions.
 3. Secure conduits to backboard if entering the room from overhead.
 4. Extend conduits 3 inches (75 mm) above finished floor.
 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- E. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1 and NFPA 70.
- B. General Requirements for Cabling:
1. Terminate all conductors and optical fibers; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
 2. Cables may not be spliced.
 3. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 4. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems" and Ch. 6, "Optical Fiber Structured Cabling Systems." Install lacing bars and distribution spools.
 5. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 6. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.
 7. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems" and Ch. 6, "Optical Fiber Structured Cabling Systems." Monitor cable pull tensions.
 8. Support: Do not allow cables to lay on removable ceiling tiles.

9. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.

C. Installation of Control-Circuit Conductors:

1. Install wiring in raceways. Comply with requirements specified in Section 260533 "Raceways and Boxes for Electrical Systems."

D. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-B recommendations for separating unshielded copper voice and data communications cable from potential EMI sources including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 12 inches (305 mm).
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 24 inches (600 mm).
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 12 inches (305 mm).
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 3 inches (75 mm).
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.4 REMOVAL OF CONDUCTORS AND CABLES

CONTROL-VOLTAGE ELECTRICAL POWER CABLES

260523-4

- A. Remove abandoned conductors and cables. Abandoned conductors and cables are those installed that are not terminated at equipment and are not identified for future use with a tag.

3.5 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-B, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping" Chapter.

3.6 GROUNDING

- A. For low-voltage control wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.7 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Identify data and communications system components, wiring, and cabling according to TIA-606-A; label printers shall use label stocks, laminating adhesives, and inks complying with UL 969.

3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
- B. End-to-end cabling will be considered defective if it does not pass tests and inspections.

END OF SECTION 26 05 23

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The contractor shall review and comply with all Cornell University Design and Construction Standards. The standard is available at the following website:
<https://fcs.cornell.edu/content/2018-design-and-construction-standards>.

1.2 SUMMARY

- A. Section includes grounding and bonding systems and equipment.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Burndy; Part of Hubbell Electrical Systems.
 - 2. ERICO International Corporation.

3. ILSCO.
4. O-Z/Gedney; A Brand of the EGS Electrical Group.

2.2 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.
- C. Refer to construction drawings for specific grounding materials, methods and requirements.

2.3 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 1. Stranded Conductors: ASTM B 8.
 2. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.
 1. U-bolt type with malleable-iron clamp and copper ground connector.
- C. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid or stranded conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Conductor Terminations and Connections:
 1. Equipment Grounding Conductor Terminations: Bolted connectors.

- C. Grounding Conductors: Green-colored insulation with continuous yellow stripe.

3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.

3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Bonding to Equipment Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3. Bonding across flexible conduit connections at equipment: Use a bolted clamp connectors on either side of flexible conduit and provide braided bonding jumper between connectors.
- C. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 - 4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

3. Test completed grounding system at each location where a maximum ground-resistance level is specified. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
- B. Grounding system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.
- D. Report measured ground resistances that exceed the following values:
 1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
 2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
- E. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The contractor shall review and comply with all Cornell University Design and Construction Standards. The standard is available at the following website:
<https://fcs.cornell.edu/content/2018-design-and-construction-standards>

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. RMC: Rigid metal conduit.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze hangers. Include Product Data for components.
 - 2. Equipment supports.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 3. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 2. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 3. Hanger Rods: Threaded steel.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

- 1. Secure raceways and cables to these supports with two-bolt conduit clamps.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Existing Concrete: Expansion anchor fasteners.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 05 29

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The contractor shall review and comply with all Cornell University Design and Construction Standards. The standard is available at the following website:
<https://fcs.cornell.edu/content/2018-design-and-construction-standards>

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.
- C. LFMC: Liquidtight flexible metal conduit.

1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Allied Tube & Conduit; a Tyco International Ltd. Co.

2. Manhattan/CDT/Cole-Flex.
 3. O-Z Gedney; a unit of General Signal.
 4. Wheatland Tube Company.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. EMT: ANSI C80.3.
- D. FMC: Zinc-coated steel.
- E. LFMC: Flexible steel conduit with PVC jacket.
- F. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
1. Fittings for EMT: Steel, compression type.
- G. Joint Compound for Rigid Steel Conduit: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 BOXES, ENCLOSURES, AND CABINETS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 2. Hoffman.
 3. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
 4. O-Z/Gedney; a unit of General Signal.
 5. RACO; a Hubbell Company.
 6. Thomas & Betts Corporation.
- B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- E. Outlet Device Type Boxes
1. Switch and receptacle boxes in masonry walls and partitions where wiring is concealed shall be a standard 4" square, 1 ½" or greater in depth with extension cover for the particular device they will receive.
 2. Use plaster extension covers not less than ¾" deep for boxes installed in plastered or sheetrock walls.
 3. Use 1 ½" deep square corner tile wall extension for boxes installed in tiles, exposed brick, or exposed block masonry walls.

4. Boxes shall be securely fastened to structure.
5. Boxes shall be set plumb and square with building lines.
6. Wiring device boxes shall NOT be installed back to back in walls.
7. No boxes shall be mounted in floor or baseboard level where subjected to wet mopping operations unless approved type.
8. Octagon boxes that are installed to support lighting fixtures shall not support lighting fixtures that weigh more than fifty pounds.
9. Outlet boxes shall not be used as the sole support for ceiling suspended (paddle) fans. Exception: Boxes listed for the application shall be permitted as the sole means of support.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
 1. Exposed Conduit: Rigid steel conduit.
 2. Concealed Conduit, Aboveground: Rigid steel conduit, EMT.
 3. Underground Conduit:
 - a. Horizontal locations: RNC, Type EPC-80-PVC, direct buried.
 - b. Vertical risers: Rigid steel conduit
 - c. Penetrations through concrete slabs: Rigid steel conduit.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Comply with the following indoor applications, unless otherwise indicated:
 1. Exposed, Not Subject to Physical Damage: EMT.
 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 5. Damp or Wet Locations: Rigid steel conduit.
 6. Boxes and Enclosures: NEMA 250, Type 1.
- C. Minimum Raceway Size
 1. Conduit: 3/4-inch (16-mm) trade size.
 2. Surface raceway: 1-1/4" x 7/8"
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- H. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- J. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.
- K. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings as required by NFPA 70.
- L. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for [recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - 1. Use LFMC in damp or wet locations subject to severe physical damage.
 - 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- M. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Division 31 Section "Earth Moving."
3. Minimum burial depth for underground raceways is 18" below finished grade. Concrete encasement is not required.
4. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."

3.4 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33

SECTION 260533.23 - SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Surface metal raceways and fittings.
2. Wireways and auxiliary gutters.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The contractor shall review and comply with all Cornell University Design and Construction Standards. The standard is available at the following website:
<https://fcs.cornell.edu/content/2018-design-and-construction-standards>

1.3 ACTION SUBMITTALS

A. Product Data:

1. Surface metal raceways and fittings.
2. Surface nonmetallic raceways.
3. Strut-type channel raceways and fittings.
4. Wireways and auxiliary gutters.

PART 2 - PRODUCTS

2.1 SURFACE METAL RACEWAYS AND FITTINGS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.
2. Listing Criteria: UL CCN RJBT; including UL 5.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

C. UL RJBT - Surface Metal Raceways and Fittings with Metal Covers:

1. Manufacturers: Subject to compliance with requirements, **[provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
 - a. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - b. MonoSystems, Inc.
 - c. Wiremold; Legrand North America, LLC.
2. Options:
 - a. Galvanized steel base with snap-on covers.
 - b. Manufacturer's standard enamel finish in color selected by Architect.
 - c. Wiring Channels: Single, Dual. Multiple channels must be capable of housing a standard 20 to 30 A device flush within the raceway.

2.2 WIREWAYS AND AUXILIARY GUTTERS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria:
 - a. UL CCN ZOYX; including UL 870.
 - b. UL 94, V-0 requirements for self-extinguishing characteristics.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

C. UL ZOYX - Metal Wireways and Auxiliary Gutters:

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
2. Additional Characteristics:
 - a. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
 - b. Finish: Manufacturer's standard enamel finish.
3. Options:
 - a. Degree of Protection: Type 1 unless otherwise indicated.
 - b. Wireway Covers: Screw-cover type unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION OF SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:
 - 1. Auxiliary Gutters: Article 366 of NFPA 70.
 - 2. Surface Metal Raceway: Article 386 of NFPA 70.
 - 3. Consult Architect for resolution of conflicting requirements.
- C. Special Installation Techniques:
 - 1. Install surface raceways only where indicated on Drawings.
 - 2. Install surface raceway with a minimum 2 inch (50 mm) radius control at bend points.
 - 3. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inch (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway in accordance with manufacturer's published instructions. Tape and glue are unacceptable support methods.
 - 4. Identification: Provide labels for surface raceways and associated electrical equipment.
 - a. Identify field-installed conductors, interconnecting wiring, and components.
 - b. Provide warning signs.
- D. Interfaces with Other Work:
 - 1. Coordinate with process piping at lab benches.

3.2 CLEANING

- A. Remove construction dust and debris from surface raceways before installing covers.

3.3 PROTECTION

- A. After installation, protect surface raceways from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 260533.23

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The contractor shall review and comply with all Cornell University Design and Construction Standards. The standard is available at the following website:
<https://fcs.cornell.edu/content/2018-design-and-construction-standards>

1.2 SUMMARY

- A. Section Includes:
 - 1. Color and legend requirements for raceways, conductors, and warning labels and signs.
 - 2. Labels.
 - 3. Signs.
 - 4. Cable ties.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Comply with NFPA 70E requirements for arc-flash warning labels.
- F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

- G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage.
- B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded feeder and branch-circuit conductors.
 - 1. Color shall be factory applied.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Color for Neutral: White.
 - 4. Color for Equipment Grounds: Green with a yellow stripe.
- C. Raceways and Cables Carrying Circuits at More Than 600 V:
 - 1. Black letters on an orange field.
 - 2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."
- D. Warning Label Colors:
 - 1. Identify system voltage with black letters on an orange background.
- E. Warning labels and signs shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER – HIGH VOLTAGE - ELECTRICAL SHOCK HAZARD."
 - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 60 INCHES."
- F. Equipment Identification Labels:
 - 1. Black letters on a yellow field.

2.3 LABELS

- A. Self-Adhesive Wraparound Labels: Write-on, 3-mil- (0.08-mm-) thick, polyester flexible label with acrylic pressure-sensitive adhesive.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.
 - b. Ideal Industries, Inc.
 - c. LEM Products Inc.
 2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
 3. Marker for Labels: Permanent, waterproof, black ink marker recommended by tag manufacturer.
- B. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil- (0.08-mm-) thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, pre-printed, configured for intended use and location.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Brady Corporation.
 - b. Brother International Corporation.
 - c. Ideal Industries, Inc.
 - d. Panduit Corp.
 2. Minimum Nominal Size:
 - a. 1-1/2 by 6 inches (37 by 150 mm) for raceway and conductors.
 - b. 3-1/2 by 5 inches (76 by 127 mm) for equipment.
 - c. As required by authorities having jurisdiction.

2.4 SIGNS

- A. Laminated Acrylic or Melamine Plastic Signs:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.
 - b. Carlton Industries, LP.
 - c. emedco.
 2. Engraved legend.
 3. Thickness:
 - a. For signs up to 20 sq. in. (129 sq. cm), minimum 1/16 inch (1.6 mm) thick.

- b. For signs larger than 20 sq. in. (129 sq. cm), 1/8 inch (3.2 mm) thick.
- c. Engraved legend with black letters on white face.
- d. Self-adhesive.
- e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.5 CABLE TIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. HellermannTyton.
 - 2. Ideal Industries, Inc.
 - 3. Marking Services, Inc.
 - 4. Panduit Corp.
- B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch (5 mm).
 - 2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D638: 12,000 psi (82.7 MPa).
 - 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
 - 4. Color: Black, except where used for color-coding.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Verify identity of each item before installing identification products.
- C. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, operation and maintenance manual, and owner.
- D. Apply identification devices to surfaces that require finish after completing finish work.

- E. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- F. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
 - 1. Secure tight to surface of conductor, cable, or raceway.
- G. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.
 - 1. Secure to surface of raceway.
- H. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.
- I. Self-Adhesive Labels:
 - 1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
- J. Cable Ties: General purpose, for attaching tags, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.

3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Accessible Raceways, More Than 600 V: Self-adhesive labels.
 - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
- D. Accessible Raceways, 600 V or Less, for Feeder Circuits: Identify with self-adhesive raceway labels.
 - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

E. Arc Flash Warning Labeling: Self-adhesive labels.

F. Equipment Identification Labels:

1. Indoor Equipment: Self-adhesive label.
2. Outdoor Equipment: Self-adhesive label, Stenciled legend 4 inches (100 mm) high.
3. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a self-adhesive label.
 - b. Enclosures and electrical cabinets.
 - c. Switchgear.
 - d. Power Supplies
 - e. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and equipment supplied by the secondary.
 - f. Substations.
 - g. Receptacles.

END OF SECTION 260553

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. General-use switches.
2. General-grade duplex straight-blade receptacles.
3. Hospital-grade straight-blade receptacles.
4. Receptacles with ground-fault protective devices.
5. Locking receptacles.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The contractor shall review and comply with all Cornell University Design and Construction Standards. The standard is available at the following website:

<https://fcs.cornell.edu/content/2018-design-and-construction-standards>

1.3 ACTION SUBMITTALS

A. Product Data:

1. General-use switches.
2. General-grade duplex straight-blade receptacles.
3. Receptacles with ground-fault protective devices.
4. Locking receptacles.

B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 GENERAL-USE SWITCHES

A. Toggle Switch

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - b. Leviton Manufacturing Co., Inc.
 - c. Pass & Seymour; Legrand North America, LLC.
2. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.
3. General Characteristics:
 - a. Reference Standards: UL CCN WMUZ and UL 20.
4. Options:
 - a. Device Color: White.
 - b. Configuration:
 - 1) Extra-heavy-duty, 120-277 V, 20 A, single pole, three way, four way.
5. Accessories:
 - a. Cover Plate: brushed stainless steel; from same manufacturer as wiring device.
 - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.2 GENERAL-GRADE DUPLEX STRAIGHT-BLADE RECEPTACLES

A. Duplex Straight-Blade Receptacle:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - b. Leviton Manufacturing Co., Inc.
 - c. Pass & Seymour; Legrand North America, LLC.
2. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
3. General Characteristics:
 - a. Reference Standards: UL CCN RTRT and UL 498.

4. Options:
 - a. Device Color: White.
 - b. Configuration:
 - 1) Heavy-duty, NEMA 5-15R, NEMA 5-20R.
5. Accessories:
 - a. Cover Plate: brushed stainless steel; from same manufacturer as wiring device.
 - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.3 RECEPTACLES WITH GROUND-FAULT PROTECTIVE DEVICES

A. General-Grade, Duplex Straight-Blade Receptacle with GFCI Device:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - b. Leviton Manufacturing Co., Inc.
 - c. Pass & Seymour; Legrand North America, LLC.
2. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
3. General Characteristics:
 - a. Reference Standards: UL CCN KCXS, UL 498, and UL 943.
4. Options:
 - a. Device Color: White.
 - b. Configuration: Heavy-duty, NEMA 5-15R, NEMA 5-20R.
5. Accessories:
 - a. Cover Plate: brushed stainless steel; from same manufacturer as wiring device.
 - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.4 LOCKING RECEPTACLES

A. NEMA, 250 V, Locking Receptacle

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - b. Leviton Manufacturing Co., Inc.
 - c. Pass & Seymour; Legrand North America, LLC.
2. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
3. General Characteristics:
 - a. Reference Standards: UL CCN RTRT and UL 498.
4. Options:
 - a. Device Color: Black with blue voltage indication on face.
 - b. Configuration:
 - 1) 2 pole, 3 wire, grounding, NEMA L6-20R.
 - 2) 3 pole, 4 wire, grounding, NEMA L15-20R, threaded collar for installation in ceiling service panels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receptacles:

1. Verify that receptacles to be procured and installed for Owner-furnished equipment are compatible with mating attachment plugs on equipment.

3.2 INSTALLATION OF SWITCHES

A. Comply with manufacturer's instructions.

B. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
3. Consult Architect for resolution of conflicting requirements.

C. Identification:

1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."

3.3 INSTALLATION OF STRAIGHT-BLADE RECEPTACLES

A. Comply with manufacturer's instructions.

B. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
3. Receptacle Orientation: Unless otherwise indicated in Contract Documents, orient receptacle to match configuration diagram in NEMA WD 6.

C. Identification:

1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF LOCKING RECEPTACLES

A. Comply with manufacturer's instructions.

B. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
3. Receptacle Orientation: Unless otherwise indicated in Contract Documents, orient receptacle to match configuration diagram in NEMA WD 6.
4. Consult Architect for resolution of conflicting requirements.

C. Identification:

1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."

D. Interfaces with Other Work:

1. Coordinate installation of new products for ceiling service panels with process piping work.

3.5 FIELD QUALITY CONTROL OF SWITCHES

A. Tests and Inspections:

1. Perform tests and inspections in accordance with manufacturers' instructions.

B. Nonconforming Work:

1. Unit will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

3.6 FIELD QUALITY CONTROL OF STRAIGHT-BLADE RECEPTACLES

A. Tests and Inspections:

1. Insert and remove test plug to verify that device is securely mounted.
2. Verify polarity of hot and neutral pins.
3. Measure line voltage.
4. Measure percent voltage drop.
5. Measure grounding circuit continuity; impedance must be not greater than 2 ohms.
6. Perform additional installation and maintenance inspections and diagnostic tests in accordance with NECA NEIS 130 and manufacturers' instructions.

B. Nonconforming Work:

1. Device will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

3.7 FIELD QUALITY CONTROL OF LOCKING RECEPTACLES

A. Tests and Inspections:

1. Insert and remove test plug to verify that device is securely mounted.
2. Verify polarity of hot and neutral pins.
3. Measure line voltage.
4. Measure percent voltage drop.
5. Measure grounding circuit continuity; impedance must be not greater than 2 ohms.
6. Perform additional installation and maintenance inspections and diagnostic tests in accordance with NECA NEIS 130 and manufacturers' instructions.

B. Nonconforming Work:

1. Device will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

3.8 PROTECTION

A. Devices:

1. Schedule and sequence installation to minimize risk of contamination of wires and cables, devices, device boxes, outlet boxes, covers, and cover plates by plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other materials.
2. After installation, protect wires and cables, devices, device boxes, outlet boxes, covers, and cover plates from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The contractor shall review and comply with all Cornell University Design and Construction Standards. The standard is available at the following website:
<https://fcs.cornell.edu/content/2018-design-and-construction-standards>

1.2 SUMMARY

- A. Section Includes:
 - 1. Cartridge fuses rated 600 V ac and less for use in the following:
 - a. Control circuits.
 - b. Enclosed controllers.
 - c. Enclosed switches.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
 - 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
 - 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 - 3. Current-limitation curves for fuses with current-limiting characteristics.
 - 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.5 FIELD CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Bussmann; Eaton, Electrical Sector.
 - 2. Littelfuse, Inc.
 - 3. Mersen USA.
- B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
 - 1. Type RK-5: 250-V, zero- to 600-A rating, 200 kAIC, time delay.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
 - 1. Motor Branch Circuits: Class RK5, time delay.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Enclosures.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The contractor shall review and comply with all Cornell University Design and Construction Standards. The standard is available at the following website:
<https://fcs.cornell.edu/content/2018-design-and-construction-standards>

1.3 DEFINITIONS

- A. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

A. Product Data:

1. For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
2. Enclosure types and details for types other than UL 50E, Type 1.
3. Current and voltage ratings.
4. Short-circuit current ratings (interrupting and withstand, as appropriate).
5. Include evidence of qualified electrical testing laboratory listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

B. Shop Drawings: For enclosed switches and circuit breakers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include wiring diagrams for power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

- A. Warranty documentation.

1.6 WARRANTY

- A. Special Installer Extended Warranty: Installer warrants that fabricated and installed enclosed switches and circuit breakers perform in accordance with specified requirements and agrees to repair or replace components or products that fail to perform as specified within extended-warranty period.
 - 1. Extended-Warranty Period: Two years from date of Substantial Completion; full coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain products from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Eaton.
 - 2. Siemens Industry, Inc., Energy Management Division.
 - 3. Square D; Schneider Electric USA.
- B. Type HD, Heavy Duty:
 - 1. Single throw.
 - 2. Three pole.
 - 3. 240 V(ac).
 - 4. 200 A and smaller.
 - 5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses.
 - 6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

2. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
3. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, UL 50E, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: Enclosure must be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (UL 50E Type 1).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 1. Commencement of work will indicate Installer's acceptance of areas and conditions as satisfactory.

3.2 SELECTION OF ENCLOSURES

- A. Indoor, Dry and Clean Locations: UL 50E, Type 1.

3.3 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Special Techniques:
 1. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
 2. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
 3. Install fuses in fusible devices.

3.4 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections for Switches:

1. Visual and Mechanical Inspection:

- a. Inspect physical and mechanical condition.
- b. Inspect anchorage, alignment, grounding, and clearances.
- c. Verify that unit is clean.
- d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
- e. Verify that fuse sizes and types match the Specifications and Drawings.
- f. Verify that each fuse has adequate mechanical support and contact integrity.
- g. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Use low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels must be in accordance with manufacturer's published data. In absence of manufacturer's published data, use NETA ATS Table 100.12.
- h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on Drawings.
- i. Verify correct phase barrier installation.
- j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

2. Electrical Tests:

- a. Perform resistance measurements through bolted connections with low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.
- b. Measure contact resistance across each switchblade fuseholder. Drop values may not exceed high level of manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.
- c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In absence of manufacturer's

published data, use Table 100.1 from NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.

- d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
- e. Perform ground fault test in accordance with NETA ATS Section 7.14 "Ground Fault Protection Systems, Low-Voltage."

B. Nonconforming Work:

1. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
2. Remove and replace defective units and retest.

C. Collect, assemble, and submit test and inspection reports.

1. Test procedures used.
2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
3. List deficiencies detected, remedial action taken, and observations after remedial action.

D. Manufacturer Services:

1. Engage factory-authorized service representative to **[support]** **[supervise]** field tests and inspections.

3.6 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

3.7 PROTECTION

- A. After installation, protect enclosed switches and circuit breakers from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

3.8 MAINTENANCE

- A. Infrared Scanning of Enclosed Switches and Breakers: Two months after Substantial Completion, perform infrared scan of joints and connections. Remove covers so joints and connections are accessible to portable scanner. Take visible light photographs at same locations and orientations as infrared scans for documentation to ensure follow-on scans match same conditions for valid comparison.
 1. Instruments and Equipment: Use infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

2. Follow-up Infrared Scanning: Perform two follow-up infrared scans of enclosed switches and breakers, one at four months and another at 11 months after Substantial Completion.
3. Instrument: Use infrared-scanning device designed to measure temperature or to detect significant deviations from normal values. Provide documentation of device calibration.
4. Report: Prepare certified report that identifies units checked and that describes scanning results. Include notation of deficiencies detected, remedial actions taken, and scanning observations after remedial action.

END OF SECTION 262816

262923 - SECTION VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes separately enclosed, preassembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The contractor shall review and comply with all Cornell University Design and Construction Standards. The standard is available at the following website:
<https://fcs.cornell.edu/content/2018-design-and-construction-standards>

1.3 DEFINITIONS

- A. CE: Conformance Europeene (European Compliance).
- B. CPT: Control power transformer.
- C. DDC: Direct digital control.
- D. EMI: Electromagnetic interference.
- E. LED: Light-emitting diode.
- F. NC: Normally closed.
- G. NO: Normally open.
- H. OCPD: Overcurrent protective device.
- I. PID: Control action, proportional plus integral plus derivative.
- J. RFI: Radio-frequency interference.
- K. VFC: Variable-frequency motor controller.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type and rating of VFC indicated.

1. Include dimensions and finishes for VFCs.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For each VFC indicated.

1. Include mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each VFC from manufacturer.
- B. Harmonic Analysis Report: Provide Project-specific calculations and manufacturer's statement of compliance with IEEE 519.
- C. Source quality-control reports.
- D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals.
 1. Manufacturer's written instructions for setting field-adjustable overload relays.
 2. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
 3. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside controllers and install temporary electric heating, with at least 250 W per controller.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 VARIABLE-FREQUENCY MOTOR CONTROLLERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. ABB .
 2. Eaton.
 3. Yaskawa Electric America, Inc.

2.2 SYSTEM DESCRIPTION

- A. General Requirements for VFCs:
 1. VFCs and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Comply with NEMA ICS 7, NEMA ICS 61800-2,
- B. Application: Constant torque and variable torque.
- C. VFC Description: Variable-frequency motor controller, consisting of power converter that employs pulse-width-modulated inverter, factory built and tested in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.
 1. Units suitable for operation of NEMA MG 1, Design A and Design B motors, as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."

2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
 3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.
- D. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
- E. Output Rating: Three phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.
- F. Unit Operating Requirements:
1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFC input voltage rating.
 2. Input AC Voltage Unbalance: Not exceeding 3 percent.
 3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.
 4. Minimum Efficiency: 96 percent at 60 Hz, full load.
 5. Minimum Displacement Primary-Side Power Factor: 96 percent under any load or speed condition.
 6. Minimum Short-Circuit Current (Withstand) Rating: 22 kA.
 7. Ambient Temperature Rating: Not less than 32 deg F (0 deg C) and not exceeding 104 deg F (40 deg C).
 8. Humidity Rating: Less than 95 percent (noncondensing).
 9. Altitude Rating: Not exceeding 3300 feet (1000 m).
 10. Vibration Withstand: Comply with NEMA ICS 61800-2.
 11. Overload Capability: 1.5 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
 12. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
 13. Speed Regulation: Plus or minus 5 percent.
 14. Output Carrier Frequency: Selectable; 0.75 to 15 kHz.
 15. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.
- G. Inverter Logic: Microprocessor based, 16 bit, isolated from all power circuits.
- H. Internal Adjustability Capabilities:
1. Minimum Speed: 5 to 25 percent of maximum rpm.
 2. Maximum Speed: 80 to 100 percent of maximum rpm.
 3. Acceleration: 0.1 to 999.9 seconds.
 4. Deceleration: 0.1 to 999.9 seconds.
 5. Current Limit: 30 to minimum of 150 percent of maximum rating.
- I. Self-Protection and Reliability Features:
1. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
 2. Under- and overvoltage trips.
 3. Inverter overcurrent trips.
 4. VFC and Motor-Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for

- providing VFC overtemperature and motor-overload alarm and trip; settings selectable via the keypad.
 - 5. Critical frequency rejection, with three selectable, adjustable deadbands.
 - 6. Instantaneous line-to-line and line-to-ground overcurrent trips.
 - 7. Loss-of-phase protection.
 - 8. Reverse-phase protection.
 - 9. Short-circuit protection.
 - 10. Motor-overtemperature fault.
- J. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.
- K. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.
- L. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.
- M. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.
- N. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
- O. Integral Input Disconnecting Means and OCPD: NEMA KS 1, fusible switch with pad-lockable, door-mounted handle mechanism.
- 1. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFC input current rating, whichever is larger.
 - 2. Auxiliary Contacts: NO or NC, arranged to activate before switch blades open.
 - 3. Auxiliary contacts "a" and "b" arranged to activate with circuit-breaker handle.

2.3 CONTROLS AND INDICATION

- A. Status Lights: Door-mounted LED indicators displaying the following conditions:
- 1. Power on.
 - 2. Run.
 - 3. Overvoltage.
 - 4. Line fault.
 - 5. Overcurrent.
 - 6. External fault.
- B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English-language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.

1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
 2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.
 - a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.
- C. Historical Logging Information and Displays:
1. Real-time clock with current time and date.
 2. Running log of total power versus time.
 3. Total run time.
 4. Fault log, maintaining last four faults with time and date stamp for each.
- D. Indicating Devices: Digital display and additional readout devices as required, mounted flush in VFC door and connected to display VFC parameters including, but not limited to:
1. Output frequency (Hz).
 2. Motor speed (rpm).
 3. Motor status (running, stop, fault).
 4. Motor current (amperes).
 5. Motor torque (percent).
 6. Fault or alarming status (code).
 7. PID feedback signal (percent).
 8. DC-link voltage (V dc).
 9. Set point frequency (Hz).
 10. Motor output voltage (V ac).
- E. Control Signal Interfaces:
1. Electric Input Signal Interface:
 - a. A minimum of two programmable analog inputs: 0- to 10-V dc 4- to 20-mA dc.
 - b. A minimum of six multifunction programmable digital inputs.
 2. Output Signal Interface: A minimum of one programmable analog output signal(s) (4- to 20-mA dc), which can be configured for any of the following:
 - a. Output frequency (Hz).
 - b. Output current (load).
 - c. DC-link voltage (V dc).
 - d. Motor torque (percent).
 - e. Motor speed (rpm).
 - f. Set point frequency (Hz).
 3. Remote Interface: A minimum of two programmable dry-circuit relay outputs (120-V ac, 10 A) for the following:

- a. Drive run
 - b. Bypass run.
 - c. Control devices (for dampers, etc.)
- F. Interface with DDC System for HVAC: Factory-installed hardware and software shall interface with DDC system for HVAC to monitor, control, display, and record data for use in processing reports. VFC settings shall be retained within VFC's nonvolatile memory.
 - 1. Hardwired Points:
 - a. Monitoring: On-off status, <Insert monitoring point>.
 - b. Control: On-off operation, <Insert control point>.
 - 2. Communication Interface: Comply with university standard, BACnet over MS/TP.

2.4 LINE CONDITIONING AND FILTERING

- A. Input Line Conditioning: Based on the manufacturer's harmonic analysis study and report, provide input filtering, as required, to limit total demand (harmonic current) distortion and total harmonic voltage demand at the defined point of common coupling to meet IEEE 519 recommendations.
- B. Output Filtering: THD limited to 5% or less

2.5 OPTIONAL FEATURES

- A. Communication Port: RS-232 port, USB 2.0 port, or equivalent connection capable of connecting a printer and a notebook computer.

2.6 ENCLOSURES

- A. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.
 - 1. Dry and Clean Indoor Locations: Type 1.
- B. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying VFC as "Plenum Rated."

2.7 ACCESSORIES

- A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFC enclosure cover unless otherwise indicated.
- B. Breather and drain assemblies, to maintain interior pressure and release condensation in NEMA 250, enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

2.8 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect VFCs according to requirements in NEMA ICS 61800-2.
 - 1. Test each VFC while connected to a motor that is comparable to that for which the VFC is rated.
 - 2. Verification of Performance: Rate VFCs according to operation of functions and features specified.
- B. VFCs will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.
- B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Wall-Mounting Controllers: Install with tops at uniform height and with disconnect operating handles not higher than 79 inches (2000 mm) above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."
- B. Install fuses in each fusible-switch VFC.
- C. Install fuses in control circuits if not factory installed. Comply with requirements in Section 262813 "Fuses."
- D. Comply with NECA 1.

3.3 CONTROL WIRING INSTALLATION

- A. Install wiring between VFCs and remote devices and facility's central-control system. Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."

- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic-control devices where applicable.
 - 1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switches are in manual-control position.
 - 2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor-overload protectors.

3.4 IDENTIFICATION

- A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each VFC with engraved nameplate.
 - 3. Label each enclosure-mounted control and pilot device.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections with the assistance of a factory-authorized service representative.
- C. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- D. Tests and Inspections:
 - 1. Inspect VFC, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
 - 2. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.
 - 3. Test continuity of each circuit.
 - 4. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect before starting the motor(s).
 - 5. Test each motor for proper phase rotation.
 - 6. Perform tests according to the Inspection and Test Procedures for Adjustable Speed Drives stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

8. Perform the following infrared (thermographic) scan tests and inspections, and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each VFC. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each VFC 11 months after date of Substantial Completion.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- E. VFCs will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 ADJUSTING

- A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.
- B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

3.8 PROTECTION

- A. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFCs.

END OF SECTION 262923

SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The contractor shall review and comply with all Cornell University Design and Construction Standards. The standard is available at the following website:

<https://fcs.cornell.edu/content/2018-design-and-construction-standards>

1.2 SUMMARY

- A. Section Includes:
 - 1. Recessed, linear.
 - 2. Materials.
 - 3. Luminaire support.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaires.
 - 4. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.

5. Photometric data and adjustment factors based on laboratory tests, complying with IES "Lighting Measurements Testing and Calculation Guides" for each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project.
 - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
 - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing laboratory providing photometric data for luminaires.
- B. Product Certificates: For each type of luminaire.
- C. Product Test Reports: For each type of luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Sample warranty.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.

1.7 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications:
 1. Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
 2. Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- B. Provide luminaires from a single manufacturer for each luminaire type.
- C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.9 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Ambient Temperature: 41 to 104 deg F (5 to 40 deg C).
 - 1. Relative Humidity: Zero to 95 percent.
- B. Altitude: Sea level to 1000 feet (300 m).

2.2 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - 1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI.
- C. Recessed luminaires shall comply with NEMA LE 4.

2.3 RECESSED, LINEAR

- A. Nominal Operating Voltage: 120 V ac.
- B. Lamp:
 - 1. Minimum 2,000 lm.
 - 2. Minimum allowable efficacy of 85 lm/W.

3. CRI of minimum 80. CCT of 3500 K.
4. Rated lamp life of 42,000 hours to L70.
5. Dimmable from 100 percent to zero percent of maximum light output.
6. Internal driver.
7. Lens Thickness: At least 0.2-inch minimum unless otherwise indicated.

C. Housings:

1. 24 Ga steel housing and heat sink.
2. powder-coat finish.
3. With integral mounting provisions.

D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

E. Diffusers and Globes:

1. Frosted.
2. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
3. Glass: Annealed crystal glass unless otherwise indicated.
4. Lens Thickness: At least 0.2-inch minimum unless otherwise indicated.

F. Standards:

1. ENERGY STAR certified.
2. RoHS compliant.
3. UL Listing: Listed for damp location.
4. NEMA LE 4.

2.4 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

2.5 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.6 LUMINAIRE SUPPORT

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Provide support for luminaire without causing deflection of ceiling or wall.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- E. Ceiling-Grid-Mounted Luminaires:
 - 1. Secure to any required outlet box.
 - 2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
 - 3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.
- F. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.

END OF SECTION 265119

SECTION 265213 - EMERGENCY AND EXIT LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exit signs.
2. Materials.

1.2 DEFINITIONS

- A. Lumen (lm): The SI derived unit of luminous flux equal to the luminous flux emitted within a unit solid angle by a unit point source (1 lm = 1 cd-sr).

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of exit sign.
 - a. Include data on features, accessories, and finishes.
 - b. Include physical description of unit and dimensions.
 - c. Battery and charger for light units.
 - d. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of luminaire.
- B. Product Test Reports: For each luminaire for tests performed by, or under supervision of, qualified luminaire photometric testing laboratory.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.6 WARRANTY

- A. Special Installer Extended Warranty for Emergency and Exit Lighting: Installer warrants that fabricated and installed emergency luminaires and exit signs, perform in accordance with specified requirements and agrees to repair or replace components and assemblies that fail to perform as specified within extended warranty period.
 - 1. Extended Warranty Period: Two year(s) from date of Substantial Completion; full coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 EXIT SIGNS

- A. General Characteristics: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Sign:
 - 1. Operating at nominal voltage of 120 / 277 V(ac).
 - 2. Lamps for AC Operation:
 - a. LEDs; 50,000 hours minimum rated lamp life.

2.2 MATERIALS

- A. Metal Parts:
 - 1. Free of burrs and sharp corners and edges.
 - 2. Sheet metal components must be steel unless otherwise indicated.
 - 3. Form and support to prevent warping and sagging.
- B. Doors, Frames, and Other Internal Access:
 - 1. Smooth operating, free of light leakage under operating conditions.
 - 2. Designed to permit relamping without use of tools.
 - 3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- C. Conduit: EMT, minimum metric designator 21 (trade size 3/4).

2.3 METAL FINISHES

- A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.

2.4 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- B. Install lamps in each luminaire.
- C. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position when testing emergency power unit.
 - 3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
 - 4. Luminaire-mounting devices must be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of luminaire weight.
- D. Wall-Mounted Luminaire Support:
 - 1. Attached to structural members in walls.
 - 2. Do not attach luminaires directly to gypsum board.

3.3 FIELD QUALITY CONTROL

- A. Field tests and inspections must be witnessed by authorities having jurisdiction.
- B. Tests and Inspections:

1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

C. Nonconforming Work:

1. Luminaire will be considered defective if it does not pass operation tests and inspections.
2. Remove and replace defective units and retest.

3.4 ADJUSTING

A. Adjustments: Within 12 months of date of Substantial Completion, provide on-site visit to do the following:

1. Inspect luminaires. Replace exit signs that are defective.
 - a. Parts and supplies must be manufacturer's authorized replacement parts and supplies.

3.5 PROTECTION

A. Remove and replace luminaires and exit signs that are damaged or caused to be unfit for use by construction activities.

END OF SECTION 265213

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The contractor shall review and comply with all Cornell University Design and Construction Standards. The standard is available at the following website:
<http://cds.pdc.cornell.edu/default.cfm>.

1.2 SUMMARY

- A. Section Includes:
 - 1. Communications equipment coordination and installation.
 - 2. Sleeves for pathways and cables.
 - 3. Common communications installation requirements.

1.3 COORDINATION

- A. Coordinate arrangement, mounting, and support of communications equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting pathways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping".

PART 2 PRODUCTS

2.1 SLEEVES FOR PATHWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

PART 3 EXECUTION

3.1 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both communications equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Communications penetrations occur when pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pathway or cable, unless indicated otherwise.
- F. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- G. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetrations. Install sleeves and seal pathway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.3 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 270500

SECTION 270505 - GENERAL COMPLETION FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The contractor shall review and comply with all Cornell University Design and Construction Standard, 27000, Communications, April, 2022. The standard is available at the following website:

<http://cds.pdc.cornell.edu/default.cfm>.

1.2 SUBMITTALS

- A. Submit manufacturers' shop drawings for proposed equipment, components, and accessories.
- B. Submit names, addresses, telephone numbers, sales and technical contacts, and other details for each of the proposed equipment, components, and accessories manufacturers ("Manufacturers") and the proposed manufacturers' local representatives ("Manufacturers' Representatives"). Provide Uniform Resource Locator ("URL") addresses (i.e., web-site addresses) when available.
- C. Submit delivery lead times for proposed equipment, components, and accessories with the manufacturers' shop drawings. The Electrical Contractor shall supply detailed delivery schedules to Cornell University's Project Manager of long lead items within five (5) business days after shop drawing review is found in compliance with the specifications by the Engineer of Record.
- D. Submit instructional manuals where required for approved equipment, components, and accessories.
- E. Submit submittals, shop drawings, schematics, documents, requests for authorization, as-built drawings, and instructional manuals as described in Cornell University's Design & Construction Standards (see Division 01001 - General Requirements).
- F. Four (4) copies each of submittals, shop drawings, schematics, documents, as-built drawings, and instructional manuals shall be provided and submitted in compliance with Cornell University's Design & Construction Standards (see Division 01001 - General Requirements) to: Cornell University's Project Manager at Planning, Design, & Construction, Cornell University, 201 Humphreys Service Building, Ithaca, NY. 14853-3701.

1.3 WARRANTIES

- A. The Electrical Contractor shall warranty the complete electrical work for a period of one year from the date the complete electrical system is accepted by Cornell University's Project Manager. The warranty shall include parts, labor, travel (expense necessary for repairs at the job site), and expendables (used during the course of repair such as lubricating oil, filters, antifreeze, and other service items made unusable by defect).

PART 2 - PRODUCTS

- 2.1 Not Applicable

PART 3 - EXECUTION

- 3.1 Not Applicable

END OF SECTION 27 05 05

SECTION 271513 - COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Category 6 twisted pair cable.
2. Twisted pair cable hardware.
3. Cable management system.
4. Identification products.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The contractor shall review and comply with all Cornell University Design and Construction Standards, 270000 Communications, April 2022. The standard is available at the following website:
<http://cds.pdc.cornell.edu/default.cfm>

1.3 DEFINITIONS

- A. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- B. EMI: Electromagnetic interference.
- C. FTP: Shielded twisted pair.
- D. F/FTP: Overall foil screened cable with foil screened twisted pair.
- E. F/UTP: Overall foil screened cable with unscreened twisted pair.
- F. IDC: Insulation displacement connector.
- G. Jack: Also commonly called an "outlet," it is the fixed, female connector.
- H. LAN: Local area network.
- I. Plug: Also commonly called a "connector," it is the removable, male telecommunications connector.
- J. RCDD: Registered Communications Distribution Designer.

- K. Screen: A metallic layer, either a foil or braid, placed around a pair or group of conductors.
- L. Shield: A metallic layer, either a foil or braid, placed around a pair or group of conductors.
- M. S/FTP: Overall braid screened cable with foil screened twisted pair.
- N. S/UTP: Overall braid screened cable with unscreened twisted pairs.
- O. UTP: Unscreened (unshielded) twisted pair.

1.4 COPPER HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable cabling system shall provide interconnections between the existing data rack in the 4th floor I/T closet (T4 004) and the dual port data outlets in the project areas. Cabling system consists of horizontal cables and terminations.
 - 1. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications equipment outlet.
 - 2. Bridged taps and splices shall not be installed in the horizontal cabling.
- B. The maximum allowable horizontal cable length is 295 feet (90 m).

1.5 ACTION SUBMITTALS

- A. Product Data:
 - 1. Category 6 twisted pair cable.
 - 2. Twisted pair cable hardware.
 - 3. Multiuser telecommunications outlet assembly (MUTOA).
 - 4. Cable management system.
 - 5. Identification products.
- B. Shop Drawings: Reviewed and stamped by RCDD.
 - 1. System Labeling Schedules:
 - a. Electronic copy of labeling schedules, in software and format selected by Owner.
 - b. Electronic copy of labeling schedules that are part of cabling and asset identification system of software.
 - 2. Cabling administration Drawings and printouts.
 - 3. Wiring diagrams and installation details of telecommunications equipment, to show location and layout of telecommunications equipment, including the following:
 - a. Telecommunications pathways.
 - b. Telecommunications system access points.
 - c. Telecommunications conductor drop locations.
- C. Twisted pair cable testing plan.
- D. Field Quality-Control Submittals:

1. Field quality-control reports.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For RCDD, Installer, installation supervisor, and field inspector.
- B. Product Certificates: For each type of product.
- C. Source quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For splices and connectors to include in maintenance manuals.
- B. Software and Firmware Operational Documentation:
 1. Software operating and upgrade manuals.
 2. Program Software Backup: On USB media or compact disk, complete with data files.
 3. Device address list.
 4. Printout of software application and graphic screens.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Cover Plates: One of each type.
 2. Jacks: Ten of each type.
 3. Multiuser Telecommunications Outlet Assemblies: two of each type.

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 1. Layout Responsibility: Preparation of Shop Drawings, cabling administration Drawings, and field testing program development by an RCDD.
 2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
 3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- B. Testing Agency Qualifications: Testing agency must have personnel certified by BICSI on staff.
 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 - 1. Test each pair of twisted pair cable for open and short circuits.

1.11 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.12 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.
- B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.
- C. Grounding: Comply with TIA-607-B.

2.2 GENERAL CABLE CHARACTERISTICS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:
 - 1. Communications, Plenum Rated:
 - a. Type CM, Type CMG, Type CMP, Type CMR, or Type CMX in metallic conduit installed according to NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."
- B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.
- C. RoHS compliant.

2.3 CATEGORY 6 TWISTED PAIR CABLE

- A. Category 6 Twisted Pair Cable: Four-pair, balanced -twisted pair cable, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250 MHz.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Berk-Tek - Lanmark 1000.
 - 2. CommScope - Systimax 1071E.
 - 3. Panduit - GenSPEED
 - 4. Superior Essex - DataGain.
- C. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.
- D. Conductors: 100-ohm, 23 AWG solid copper.
- E. Shielding/Screening: Unshielded twisted pairs (UTP).
- F. Cable Rating: Plenum.
- G. Jacket: Blue thermoplastic.

2.4 TWISTED PAIR CABLE HARDWARE

- A. Twisted Pair Cable Hardware: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.
- B. General Requirements for Twisted Pair Cable Hardware:
 - 1. Comply with the performance requirements of Category 6.
 - 2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
 - 3. Cables shall be terminated with connecting hardware of same category or higher.
- C. Source Limitations: Obtain twisted pair cable hardware from same manufacturer as twisted pair cable, from single source.
- D. Plugs and Plug Assemblies:
 - 1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
 - 2. Standard: Comply with TIA-568-C.2.
 - 3. Marked to indicate transmission performance.
 - 4. Manufacturer: Panduit
- E. Jacks and Jack Assemblies:

1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
2. Designed to snap-in to a patch panel or cover plate.
3. Standard: Comply with TIA-568-C.2.
4. Marked to indicate transmission performance.
5. Manufacturer: Panduit

F. Cover Plate:

1. Two port, vertical double gang cover plates designed to mount to double gang wall boxes.
2. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.
 - a. Flush mounting jacks, positioning the cord at a 45-degree angle.
3. Manufacturer: Panduit

G. Legend:

1. Machine printed, in the field, using adhesive-tape label.
2. Snap-in, clear-label covers and machine-printed paper inserts.

2.5 IDENTIFICATION PRODUCTS

- A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.6 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test cables on reels according to TIA-568-C.1.
- C. Factory test twisted pair cables according to TIA-568-C.2.
- D. Cable will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 WIRING METHODS

- A. Routing:

1. Install cables in raceway, except within consoles, cabinets, desks, and counters. Conceal raceway and cables, except in unfinished spaces.
 - a. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- B. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools. Install conductors parallel with or at right angles to sides and back of enclosure.

3.2 INSTALLATION OF PATHWAYS

- A. Comply with Section 260533 "Raceways and Boxes for Electrical Systems."

3.3 INSTALLATION OF TWISTED PAIR HORIZONTAL CABLES

- A. Comply with NECA 1 and NECA/BICSI 568.
- B. General Requirements for Cabling:
 1. Comply with TIA-568-C.0, TIA-568-C.1, and TIA-568-C.2.
 2. Comply with BICSI's "Information Transport Systems Installation Methods Manual (ITSIMM), Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.
 3. Install 110-style IDC termination hardware unless otherwise indicated.
 4. Do not untwist twisted pair cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.
 5. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 6. Consolidation points may be used only for making a direct connection to equipment outlets:
 - a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
 - b. Locate consolidation points for twisted pair cables at least 49 feet (15 m) from communications equipment room.
 7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 8. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.
 9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section. Use lacing bars and distribution spools.

10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation, and replace it with new cable.
 11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 12. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
 13. Pulling Cable: Comply with BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Pulling and Installing Cable" Section. Monitor cable pull tensions.
- C. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- D. Group connecting hardware for cables into separate logical fields.
- E. Separation from EMI Sources:
1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.
 2. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
 3. Separation between communications cables in grounded metallic raceways, power lines, and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
 4. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).

3.4 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-D, Annex A, "Firestopping."
- C. Comply with "Firestopping Systems" Article in BISC's "Telecommunications Distribution Methods Manual."

3.5 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA-606-B.
- B. Cable and Wire Identification:
 - 1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at the device if wire color is consistent with associated wire connected and numbered within panel or cabinet.
 - 3. Label each terminal strip, and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group, extended from a panel or cabinet to a building-mounted device, with the name and number of a particular device.
 - b. Label each unit and field within distribution racks and frames.
- C. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-606-B requirements for the following:
 - 1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.6 FIELD QUALITY CONTROL

- A. Field tests and inspections must be witnessed by Cornell IT.
- B. Tests and Inspections:
 - 1. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 3. Test twisted pair cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test

Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

- C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similarly to Table 10.1 in BICSI's "Telecommunications Distribution Methods Manual," or shall be transferred from the instrument to the computer, saved as text files, printed, and submitted.
- D. Nonconforming Work:
 - 1. End-to-end cabling will be considered defective if it does not pass tests and inspections.
 - 2. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
- E. Collect, assemble, and submit test and inspection reports.

END OF SECTION 271513

SECTION 284621.11 - ADDRESSABLE FIRE-ALARM SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The contractor shall review and comply with all Cornell University Design and Construction Standards and Cornell EH&S. The standard is available at the following website:
<http://cds.pdc.cornell.edu/default.cfm>

1.2 SUMMARY

- A. Section Includes:
 - 1. Notification appliances.
 - 2. Heat detectors
 - 3. Addressable monitor modules

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level III technician.
- C. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.4 PROJECT CONDITIONS

- A. Perform a full test of the existing system prior to starting work. Document any equipment or components not functioning as designed.
- B. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:
 - 1. Notify Owner no fewer than seven days in advance of proposed interruption of fire-alarm service.
 - 2. Do not proceed with interruption of fire-alarm service without Owner's written permission.

- C. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.5 SEQUENCING AND SCHEDULING

- A. Existing Fire-Alarm Equipment: Existing FACP is Honeywell Gamewell / FCI 7200 Series. Existing system outside of project area shall remain operational during construction period.
 - 1. Removals – disconnect, remove, and store devices. Pull wiring back to accommodate renovations.
 - 2. Temporary fire alarm system devices – provide temporary heat detectors in project areas during construction period. Disconnect and remove temporary devices after relocated devices are in operation.
 - 3. Relocate existing devices in project area as indicated on construction drawings. Extend wiring as required.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Source Limitations for Fire-Alarm System and Components: Existing fire alarm system is Gamewell / FCI 7200 Series. Components shall be compatible with, and operate as an extension of, existing system. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.
- B. Noncoded, UL-certified addressable system, with multiplexed signal transmission and horn/strobe evacuation.
- C. All components provided shall be listed for use with the selected system.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 SYSTEM SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be two-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
 - a. Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).

2.3 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

1. Temperature sensors shall test for and communicate the sensitivity range of the device.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.

1. Mounting: Adapter plate for outlet box mounting.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F (88 deg C).

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.4 ADDRESSABLE CONTROL MODULE

- A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address and control for wired applications via normally open contacts.
- B. Integral Relay: Capable of providing a direct signal.

2.5 ADDRESSABLE MONITOR MODULE

- A. General:
 - 1. Include address-setting means on the module.
 - 2. Store an internal identifying code for control panel use to identify the module type.
- B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.

2.6 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Individually addressed, connected to a signaling-line circuit, equipped for mounting as indicated, and with screw terminals for system connections.
- B. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.
 - 1. Rated Light Output:
 - a. 15 cd.
 - b. 15/30/75/110 cd, selectable in the field.
 - 2. Mounting: Wall mounted unless otherwise indicated.
 - 3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
 - 4. Flashing shall be in a temporal pattern, synchronized with other units.
 - 5. Strobe Leads: Factory connected to screw terminals.
 - 6. Mounting Faceplate: Factory finished, red.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.

1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
 1. Devices placed in service before all other trades have completed cleanup shall be replaced.
 2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.
- B. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.
 1. Connect new equipment to existing control panel in existing part of the building.
 2. Connect new equipment to existing monitoring equipment at the supervising station.
 3. Expand, modify, and supplement existing monitoring equipment as necessary to extend existing monitoring functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.
- C. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.

3.3 PATHWAYS

- A. Pathways above recessed ceilings and in non accessible locations may be routed exposed.
 1. Exposed pathways located less than 96 inches above the floor shall be installed in EMT.
- B. Pathways shall be installed in EMT.
- C. Exposed EMT shall be painted red enamel.

3.4 GROUNDING

- A. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.5 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by authorities having jurisdiction.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
- D. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 - b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
 - 2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - 3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
 - 4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
 - 5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
 - 6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
- E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- F. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.
- H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly,

END OF SECTION 284621.11