FOR INFORMATIONAL USE ONLY - DO NOT USE TO SUBMIT YOUR BID

FORM OF PROPOSAL

Nassau County Department of Public Works
Nassau County Supreme Court Elevator Modernization
100 Supreme Court Drive, Mineola, NY

GENERAL CONSTRUCTION
CONTRACT NO.: B90611-25G

Item No.	Type	Description		
1	LUMP SUM	LUMP SUM for furnishing all labor, materials and equipment required for all **General Construction** work associated with the modernization and rehabilitation of three (3) existing passenger elevators (Elevators #3, # 4, 5) and other Work indicated in the Contract Documents.		
2	ALLOWANCE	Include in bid an allowance of 5% of the lump sum bid for items unforeseen or not specifically characterized in the contract documents, encountered during the course of construction as directed by the County.		
3	ALLOWANCE	Include in bid an allowance of Two Hundred Fifty Thousand Dollars ($250,000.00) for Repair/Maintenance of Elevator Car #5 through the duration of Construction Phase One until such time that Elevator Car #5 is taken out of service for Construction Phase Two.	$250,000	00
4	ALTERNATE 1	Include an add-alternate for the installation of new ADA compliant call buttons at second, third and fourth floors located between Elevator Car #5 and Elevator Car #4 and associated work to make completely functional as indicated in the Contract Documents.		

BASIS OF AWARD: Bids on Lump Sum Contracts will be compared on the basis of the total bid price, arrived at by taking the Sum of each Bid Item, including Allowance Item(s), if any, and plus or minus the cost difference of the Alternate(s), if any, as may be selected by the Architect and/or Owner. The sum of all "Amounts Bid" will determine the low bid and the subsequent award of this Contract.

BID SECURITY: Prospective bidders are cautioned to carefully review the requirements of Paragraph H, Bid Security, of The Instructions to Bidders.

NOTE TO BIDDERS: Prospective bidders must possess a license to handle hazardous materials in the State of New York and shall present evidence of sufficient experience to be qualified as a "Responsible Bidder" (in addition to other requirements as stated in the bid documents).

SPECIFICATIONS

TABLE OF CONTENTS

DIVISION 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS - Issued by Owner

DIVISION 01 - GENERAL REQUIREMENTS

Section 011000 Summary
Section 012100 Allowances
Section 012300 Alternates
Section 013300 Submittal Procedures
Section 014000 Quality Requirements
Section 017300 Execution

DIVISION 02 - EXISTING CONDITIONS

Section 024119 Selective Demolition and Removal

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

Section 078413 Penetration Firestopping
Section 079200 Joint Sealants

DIVISION 09 - FINISHES

Section 096519 Resilient Tile Flooring

DIVISION 14 – CONVEYING EQUIPMENT

Section 142100 Traction Elevators

DIVISION 23 – HEATING, VENTILATION AND AIR CONDITIONING

Section 230500 Common Work Results for HVAC
Section 230513 Common Motor Requirements for HVAC Equipment
Section 230529 Hangers and Supports for HVAC Piping and Equipment
Section 230548 Vibration and Seismic Controls for HVAC
Section 230553 Identification for HVAC Piping and Equipment
Section 230593 Testing, Adjusting, and Balancing for HVAC
Section 230700 HVAC Insulation
Section 230800 Mechanical Commissioning Requirements
Section 233113 Metal Duct
Section 233300 Air Duct Accessories
Section 233400 HVAC Fans

DIVISION 26 – ELECTRICAL AND LIGHTING

Section 260010 Supplemental Requirements for Electrical
Section 260519 Low-Voltage Electrical Power Conductors and Cables
Section 260526 Grounding and Bonding for Electrical Systems
Section 260529 Hangers and Supports for Electrical Systems
Section 260533.13 Conduits for Electrical Systems
Section 260533.16 Boxes and Covers for Electrical Systems
Section 260553 Identification for Electrical Systems
Section 260573.13 Short-Circuit Studies
Section 260573.16 Coordination Studies
Section 260573.19 Arc-Flash Hazard Analysis
Section 262416 Panelboards
Section 262726 Wiring Devices

EXHIBITS

A - BOCA Elevator Report
B - For Information Only/Not for Construction – BOCA elevator drawings VT101 – VT 105
C - Structural Design Letter
D - Asbestos Report
E - Lead Report
F - For Information Only/Not for Construction Section 020000 Asbestos Removal Specifications
G - For Information Only/Not for Construction Section 020001 LCP/LBP Disturbances Using OSHA Lead Safe Work Practices
H - For Information Only/Not for Construction - Hazmat Drawings H100-H105

END OF TABLE OF CONTENTS

SECTION 01 10 00

SUMMARY

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.

1.2 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.

1.3 PROJECT INFORMATION

A. Project Identification: MISSION 21 ELEVATOR MODERNIZATION

1. Project Location: 100 SUPREME CT. DRIVE MINEOLA, NY 11501

B. Owner: NASSAU COUNTY DEPARTMENT OF PUBLIC WORKS (NCDPW)
1. Owner's Representative:
Jacobs Program Management Co.
1305 Franklin Avenue
Suite 245
Garden City, NY 11530

C. Architect: LIRO ARCHITECTS AND PLANNERS, PC

D. Architect's Consultants: Architect has retained the following design professionals who have prepared designated portions of the Contract Documents:

1. MEP ENGINEERS: LIRO ENGINEERS, INC.
3 Aerial Way
Syosset, NY 11791
516.938.5476 [P] 516.937.5421 [F]

2. STRUCTURAL ENGINEERS: LIRO ENGINEERS, INC.
235 E Jericho Turnpike
Mineola, NY 11501
516.746.2350 *[P]*

3. VERTICAL TRANSPORTATION: BOCA GROUP East, LLC
MetLife Building
200 Park Ave, 11th floor
East Mezzanine
New York, NY 10166

4. COST ESTIMATE: NASCO CONSTRUCTION SERVICES
200 Business Park Drive
Armonk, NY 10504

E. Construction Hours & schedule:

1. Typical Construction hours are 8:00 AM–4:00 PM. Any work outside this timeframe will require prior approval from NCDPW.

2. Building security must be notified in advance of scheduled construction activities for coordination and planning purposes.

3. The contractor shall submit a work schedule at least 5 days in advance. Any activities that may cause noise disruption to courts in session must be reviewed and approved by NCDPW prior to beginning work.

4. The owner will occupy the building during construction, and shall remain fully operational while work is in progress.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

1. The modernization and rehabilitation of three (3) existing passenger elevators (Elevators #3, # 4, 5) and other Work indicated in the Contract Documents.

2. All abatement work will be performed by NCDPW's abatement contractor under a separate contract.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 00

SECTION 01 21 00

ALLOWANCES

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.

1.2 SUMMARY

A. Section includes administrative and procedural requirements governing allowances.

B. Types of allowances include the following:

1. Lump-sum allowances.
2. Unit-cost allowances.
3. Quantity allowances.
4. Contingency allowances.
5. Testing and inspecting allowances.

1.3 DEFINITIONS

A. Allowance is a quantity of work or dollar amount established in lieu of additional requirements, used to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.

1.4 SELECTION AND PURCHASE

A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection, or purchase and delivery, of each product or system described by an allowance must be completed by the Owner to avoid delaying the Work.

B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

C. Purchase products and systems selected by Architect from the designated supplier.

1.5 ACTION SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances in the form specified for Change Orders.

1.6 INFORMATIONAL SUBMITTALS

A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.

C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.7 CONTINGENCY ALLOWANCES

A. Use the contingency allowance only as directed by Architect for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.

B. Contractor's **overhead, profit, and** related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation**, taxes**, insurance, equipment rental, and similar costs.

C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit.

D. Payment under this allowance shall be paid on the basis of labor, materials and equipment, plus overhead and profit computed in accordance with the requirements of the agreement, Article 21 "Extra Work".

E. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

1.8 ADJUSTMENT OF ALLOWANCES

A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.

1. Include installation costs in purchase amount only where indicated as part of the allowance.
2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other markups.
3. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit-cost allowances.
4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.

B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.

1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of Work has changed from what could have been foreseen from information in the Contract Documents.

2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

A. Allowance No. 1: Include a contingency allowance of 5% of the construction budget for unforeseen conditions.

B. Allowance No.2: Repair/Maintenance of Elevator Car 5 through the duration of Construction Phase One until such time that Elevator Car 5 is taken out of service for Construction Phase Two.

END OF SECTION 01 21 00

SECTION 012300 - ALTERNATES

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.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.

2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Execute accepted alternates under the same conditions as other work of the Contract.

C. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

BID ALTERNATE 1: TO INSTALL NEW ADA COMPLIANT CALL BUTTONS AT SECOND, THIRD AND FOURTH FLOOR

END OF SECTION 012300

SECTION 01 33 00

SUBMITTAL PROCEDURES

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.

1.2 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

B. Related Requirements:
1. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
2. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
3. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's and Construction Manager's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's and Construction Manager's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.4 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and Construction Manager and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.

2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.

    a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.

4. Format: Arrange the following information in a tabular format:

    a. Scheduled date for first submittal.
    b. Specification Section number and title.
    c. Submittal Category: Action; informational.
    d. Name of subcontractor.
    e. Description of the Work covered.
    f. Scheduled date for Architect's and Construction Manager's final release or approval.
    g. Scheduled dates for purchasing.
    h. Scheduled date of fabrication.
    i. Scheduled dates for installation.
    j. Activity or event number.

1.5 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Architect.
4. Name of Construction Manager.
5. Name of Contractor.
6. Name of firm or entity that prepared submittal.
7. Names of subcontractor, manufacturer, and supplier.
8. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.
9. Category and type of submittal.
10. Submittal purpose and description.
11. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
12. Drawing number and detail references, as appropriate.
13. Indication of full or partial submittal.
14. Location(s) where product is to be installed, as appropriate.
15. Other necessary identification.
16. Remarks.
17. Signature of transmitter.

B. Options: Identify options requiring selection by Architect.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect and

Construction Manager on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

D. Paper Submittals:

1. Place a permanent label or title block on each submittal item for identification; include name of firm or entity that prepared submittal.
2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect and Construction Manager.
3. Action Submittals: Submit three paper copies of each submittal unless otherwise indicated. Architect, through Construction Manager, will return two copies.
4. Informational Submittals: Submit two paper copies of each submittal unless otherwise indicated. Architect and Construction Manager will not return copies.
5. Additional Copies: Unless additional copies are required for final submittal, and unless Architect or Construction Manager observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
6. Transmittal for Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using facsimile of sample form included in Project Manual transmittal form.

E. PDF Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

F. Submittals for Web-Based Project Software: Prepare submittals as PDF files, or other format indicated by Project software website.

1.6 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Email: Prepare submittals as PDF package and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.

a. Architect, through Construction Manager, will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.

2. Web-Based Project Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
3. Paper: Prepare submittals in paper form and deliver to Architect.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.

4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections so processing will not be delayed because of need to review submittals concurrently for coordination.

   Architect and Construction Manager reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 15 days for review of each resubmittal.
4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.

5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to Construction Manager, through Architect, before being returned to Contractor.

   a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect and Construction Manager.

D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's and Construction Manager's action stamp.

E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's and Construction Manager's action stamp.

1.7 SUBMITTAL REQUIREMENTS

A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.

2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

    a. Manufacturer's catalog cuts.
    b. Manufacturer's product specifications.
    c. Standard color charts.
    d. Statement of compliance with specified referenced standards.
    e. Testing by recognized testing agency.
    f. Application of testing agency labels and seals.
    g. Notation of coordination requirements.
    h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

    a. Wiring diagrams that show factory-installed wiring.
    b. Printed performance curves.
    c. Operational range diagrams.
    d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before Shop Drawings, and before or concurrent with Samples.

B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Architect's digital data drawing files is otherwise permitted.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

    a. Identification of products.
    b. Schedules.
    c. Compliance with specified standards.
    d. Notation of coordination requirements.
    e. Notation of dimensions established by field measurement.
    f. Relationship and attachment to adjoining construction clearly indicated.
    g. Seal and signature of professional engineer if specified.

2. Paper Sheet Size: Except for templates, patterns, and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.

    a. Two opaque (bond) copies of each submittal. Architect, through Construction Manager, will return one copy(ies).

C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Permanently attach label on unexposed side of Samples that includes the following:

    a. Project name and submittal number.
    b. Generic description of Sample.
    c. Product name and name of manufacturer.
    d. Sample source.

e. Number and title of applicable Specification Section.
f. Specification paragraph number and generic name of each item.

3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics, and identification information for record.
4. Web-Based Project Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
5. Paper Transmittal: Include paper transmittal including complete submittal information indicated.
6. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

    a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

7. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

    a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect, through Construction Manager, will return submittal with options selected.

8. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

    a. Number of Samples: Submit three sets of Samples. Architect and Construction Manager will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.

        1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
        2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.

3. Number and name of room or space.
4. Location within room or space.

E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

G. Certificates:

1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
2. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

    a. Name of evaluation organization.
    b. Date of evaluation.
    c. Time period when report is in effect.
    d. Product and manufacturers' names.
    e. Description of product.
    f. Test procedures and results.
    g. Limitations of use.

1.8 CONTRACTOR'S REVIEW

A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect and Construction Manager.

B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1. Architect and Construction Manager will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 ARCHITECT'S AND CONSTRUCTION MANAGER'S REVIEW

A. Action Submittals: Architect and Construction Manager will review each submittal, indicate corrections or revisions required, and return it.

1. PDF Submittals: Architect and Construction Manager will indicate, via markup on each submittal, the appropriate action.

2. Paper Submittals: Architect and Construction Manager will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.

3. Submittals by Web-Based Project Software: Architect and Construction Manager will indicate, on Project software website, the appropriate action.

    a. Actions taken by indication on Project software website have the following meanings:

        1) Insert description of each action indicated on Architect's and Construction Manager's stamp.

B. Informational Submittals: Architect and Construction Manager will review each submittal and will not return it or will return it if it does not comply with requirements. Architect and Construction Manager will forward each submittal to appropriate party.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect and Construction Manager.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Architect and Construction Manager will return without review submittals received from sources other than Contractor.

F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 33 00

SECTION 01 40 00

QUALITY REQUIREMENTS

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.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, Construction Manager, or authorities having jurisdiction are not limited by provisions of this Section.
4. Specific test and inspection requirements are not specified in this Section.

1.3 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced" unless otherwise further described means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

B. Field Quality-Control Tests: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.

E. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

F. Source Quality-Control Tests: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.

G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

H. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

I. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect or Construction Manager.

1.4 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements are specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for direction before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 ACTION SUBMITTALS

A. Shop Drawings: For mockups.

1. Include plans, sections, and elevations, indicating materials and size of mockup construction.

2. Indicate manufacturer and model number of individual components.
3. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.6 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data: For Contractor's quality-control personnel.

C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
2. Main wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.

D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

F. Reports: Prepare and submit certified written reports and documents as specified.

G. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within[10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's Construction Schedule.

B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.

1. Project quality-control manager may also serve as Project superintendent.

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:

1. Contractor-performed tests and inspections including Subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by Commissioning Authority.

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.8 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, telephone number, and email address of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspection.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.

12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

1.9 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services

of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor responsibilities include the following:

a. Provide test specimens representative of proposed products and construction.
b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
f. When testing is complete, remove test specimens and test assemblies, and mockups; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, through Construction Manager, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

1.10 QUALITY CONTROL

A. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Engage a qualified testing agency to perform quality-control services.

    a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

B. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

C. Testing Agency Responsibilities: Cooperate with Architect, Commissioning Authority, Construction Manager, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect, Construction Manager, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform duties of Contractor.

D. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

E. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

F. Associated Contractor Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspection equipment at Project site.

G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

H. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's Construction Schedule. Update as the Work progresses.

1. Distribution: Distribute schedule to Owner, Architect, Construction Manager, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.11 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Engage a qualified special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, as indicated in the Statement of Special Inspections attached to this Section, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect, Construction Manager, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect, through Construction Manager, with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's and Construction Manager's reference during normal working hours.

1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspection, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 40 00

SECTION 01 73 00

EXECUTION

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.

1.2 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Coordination of Owner-installed products.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.

B. Related Requirements:

1. Section 011000 "Summary" for limits on use of Project site.
2. Section 013300 "Submittal Procedures" for submitting surveys.
3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
4. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.
5. Section 078413 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.4 PREINSTALLATION MEETINGS

A. Cutting and Patching Conference: Conduct conference at Project site.

1. Prior to commencing work requiring cutting and patching, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:

a. Contractor's superintendent.
b. Trade supervisor responsible for cutting operations.
c. Trade supervisor(s) responsible for patching of each type of substrate.
d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affecting by cutting and patching operations.

2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.

B. Certificates: Submit certificate signed by professional engineer certifying that location and elevation of improvements comply with requirements.

1.6 QUALITY ASSURANCE

A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:

a. Primary operational systems and equipment.
b. Fire separation assemblies.
c. Air or smoke barriers.
d. Fire-suppression systems.
e. Plumbing piping systems.
f. Mechanical systems piping and ducts.
g. Control systems.
h. Communication systems.
i. Fire-detection and -alarm systems.
j. Conveying systems.

k. Electrical wiring systems.
l. Operating systems of special construction.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
   a. Sprayed fire-resistive material.
   b. Equipment supports.
   c. Piping, ductwork, vessels, and equipment.
   d. Noise- and vibration-control elements and systems.

4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services; and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect.

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect and Construction Manager promptly.

B. General: Engage a professional engineer to lay out the Work using accepted surveying practices.
   1. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
   2. Inform installers of lines and levels to which they must comply.
   3. Check the location, level and plumb, of every major element as the Work progresses.
   4. Notify Architect and Construction Manager when deviations from required lines and levels exceed allowable tolerances.
   5. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect and Construction Manager.

   1. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.4 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

   1. Make vertical work plumb and make horizontal work level.
   2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
   3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
   4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

F. Tools and Equipment: Where possible, select tools or equipment that minimize production of excessive noise levels.

G. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

H. Repair or remove and replace damaged, defective, or nonconforming Work.

3.5 CUTTING AND PATCHING

A. Cutting and Patching, 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 in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 011000 "Summary."

F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
5. Proceed with patching after construction operations requiring cutting are complete.

H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as

practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed 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 in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

    a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.

I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.6 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's construction personnel.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.

1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.7 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

    a. Use containers intended for holding waste materials of type to be stored.

4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.9 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.

C. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 01 73 00

SECTION 02 41 19

SELECTIVE DEMOLITION AND REMOVAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Articles 1 through 47 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of a building or structure.
2. Salvage of existing items to be reused or recycled.

B. Related Requirements:

1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.

1.3 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.

1.4 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.

1.5 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 require protection.

1.6 INFORMATIONAL SUBMITTALS

A. Engineering Survey: Submit engineering survey of condition of building.

B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property**,** for environmental protection, dust control and noise control. Indicate proposed locations and construction of barriers.

C. 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 building manager's and other tenants' 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 buildings and of Owner's partial occupancy of completed Work.

D. Pre-demolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Comply with Section 013233 "Photographic Documentation." Submit before Work begins.

E. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 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:

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.

1.9 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding.

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

1.10 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 ASSE 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. Engage a professional engineer to perform an engineering survey of condition of buildings to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

D. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

E. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.

1. Comply with requirements specified in Section 013233 "Photographic Documentation."
2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
3. 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 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.

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. Comply with requirements in Section 017419 "Construction and Demolition Waste Management."

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 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 small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

B. 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.

C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and recycle or dispose of them according to Section 017419 "Construction and Demolition Waste Management."

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 Section 017419 "Construction and Demolition Waste Management."

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 02 41 19

SECTION 07 84 13

PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Articles 1 through 47 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Penetrations in fire-resistance-rated walls.
2. Penetrations in horizontal assemblies.
3. Penetrations in smoke barriers.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 – PRODUCTS

Subject to compliance with requirements, provide product listed or approved equal as indicated.

2.1 MANUFACTURERS

A. Hilti Construction Chemicals, Inc. Tulsa, OK

B. The Carborundum Company, Niagara Falls, NY

C. 3M Fire Protection Products, St. Paul, MN

D. Tremco Commercial Sealants & Waterproofing, Beachwood, OH

E. Specified Technologies, Inc., Somerville, NJ

F. W.R. Grace & Co., Macungie, PA

G. RectorSeal Corp., Houston, TX

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.

2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:

a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.

1) UL in its "Fire Resistance Directory."

2) Intertek Group in its "Directory of Listed Building Products."

3) FM Global in its "Building Materials Approval Guide."

2.3 PENETRATION FIRESTOPPING SYSTEMS

A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.

2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.

3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.

D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at and no more than 50-cfm (0.024-cu. m/s) cumulative total for any 100 sq. ft. (9.3 sq. m) at both ambient and elevated temperatures.

E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.

F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by

penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

1. Permanent forming/damming/backing materials.
2. Substrate primers.
3. Collars.
4. Steel sleeves.

2.4 FILL MATERIALS

A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.

E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.

F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

2.5 MIXING

A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality

with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, 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: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

C. Install fill materials by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches (76 mm) high and with minimum 0.375-inch (9.5-mm) strokes.

1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet (4.57 m) from end of wall and at intervals not exceeding 30 feet (9.14 m).

B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.

B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.

C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

END OF SECTION 07 84 13

SECTION 07 92 00

JOINT SEALANTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Contractor shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and install caulking and sealants.
2. Extent of each type of caulking and sealant is shown or indicated and includes the following:
   a. Interior and exterior joints in equipment and construction systems not filled by another material, and that are not required to be open for operation.
   b. Exposed-to-view joints of all fire-rated sealants.
   c. Joints specified to be re-caulked.

B. Coordination:
1. Review installation procedures under other Sections and coordinate installation of items to be installed with or before caulking and sealants.
2. Notify other trades in advance of installation of caulking and sealants to provide other trades with sufficient time for installing their work that must be installed before caulking and sealants.
3. Coordinate final selection of caulking and sealants so that materials are compatible with all caulking and sealant substrates specified.

1.2 REFERENCES

A. American Society of Testing Material (ASTM) Publications:
1. ASTM C510, Test Method for Staining and Color Change of Single- or Multicomponent Joint Sealants.
2. ASTM C661, Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer.
3. ASTM C793, Test Method for Effects of Accelerated Weathering on Elastomeric Joint Sealants.
4. ASTM C794, Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.
5. ASTM C920, Specification for Elastomeric Joint Sealants.
6. ASTM C1021, Practice for Laboratories Engaged in Testing Building Sealants.
7. ASTM C1087, Test method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems.
8. ASTM C1193, Guide for Use of Joint Sealants.
9. ASTM C1247, Practice for Durability of Sealants Exposed to Continuous Immersion in Liquids.

B. Federal Specifications (FS).
1. FS TT-S-00227, Sealing Compound: Elastomeric Type, Multi-component (for Caulking, Sealing, and Glazing in Buildings and Other Structures).
2. FS TT-S-00230 Sealing Compound: Elastomeric Type, Single Component (for Caulking, Sealing, and Glazing in Buildings and Other Structures).

C. South Coast Air Quality Management District's (SCAQMD).

1. SCAQMD Rule 1168.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Schedule of caulking and sealants installation, indication each specific surface where caulking or sealants are to be provided and the material proposed for each application.
   2. Product Data:
      a. Copies of manufacturer's data sheets including color charts, specifications, recommendations, and installation instructions for each type of sealant, caulking compound, and associated miscellaneous material required. Include manufacturer's published data, indicating that each product complies with the Contract Documents and is intended for the applications shown or indicated.
      b. Product test reports and UL Listed design data sheets

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. Certify that materials are suitable for intended use and materials meet or exceed requirements of the Contract Documents.
      b. Certification from manufacturer that products furnished are appropriate for surfaces and conditions to which they will be applied.
      c. Certify that applicator is approved by manufacturer.
   2. Field Quality Control Submittals:
      a. Results of tests on job mock-ups.
      b. Pre-construction and post-construction field test reports.
      c. Compatibility and adhesion test reports.
      d. Contractor's Field Test Report Logs:
         1) Indicate time present at the Site.
         2) Include observations and results of field tests, and document compliance with manufacturer's installation instructions and supplemental instructions provided to installers.
   3. Pre-installation conference record.
   4. Qualifications: Submit qualifications for:
      a. Installer.
      b. Testing laboratory

C. Closeout Submittals: Submit the following:
   1. Operation and Maintenance Data:
      a. Recommended inspection intervals.
      b. Instructions for repairing and replacing failed sealant joints.
   2. Warranty: Submit written warranties as specified in this Section.

1.4 QUALITY ASSURANCE

A. Qualifications:
   1. Installer:
      a. Engage a single installer, approved by product manufacturer, regularly engaged in caulking and sealant installation and with successful experience in applying types of products required, and who employs only tradesmen with specific skill and successful experience in the type of Work required.

2. Testing Laboratory:
   a. Furnish services of independent testing laboratory qualified according to ASTM C1021, for conducting testing required.

B. Component Supply and Compatibility:
   1. Obtain materials only from manufacturers who will, if required:
      a. Furnish at the Site services of a qualified technical representative to advise installer of proper procedures and precautions for using materials.
      b. Test caulking and sealants for compatibility with substrates for conformance with FS-TT-S-00227, and recommend remedial procedures as required.
   2. Before purchasing each sealant, investigate its compatibility with joint surfaces, joint fillers, and other materials in joint system. Provide products that are fully compatible with actual installation condition, verified by manufacturer's published data or certification, and as shown on approved Shop Drawings and other approved submittals.

C. Product Testing: Provide test results of laboratory pre-construction compatibility and adhesion testing, as specified in Article 3.1 of this Section, by qualified testing laboratory, based on testing of current sealant formulations within a 36-month period preceding the Notice to Proceed for the Work.
   1. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C920 and, where applicable, to other standard test methods.
   2. Test other joint sealants for compliance using specified post-construction field adhesion test.

1.5 DELIVERY, STORAGE AND HANDLING

A. Comply with the following:
   1. Delivery of Products:
      a. Deliver products in caulking and sealant manufacturer's original unopened, undamaged containers, indicating compliance with approved Shop Drawings and approved Sample color selections.
      b. Include the following information on label:
         1) Name of material and Supplier.
         2) Formula or Specification Section number, lot number, color and date of manufacture.
         3) Mixing instructions, shelf life, and curing time, when applicable.
   2. Storage of Products:
      a. Do not store or expose materials to temperature above 90 degrees F or store in direct sunlight.
      b. Do not use materials that are outdated as indicated by shelf life.
      c. Store sealant tape in manner that will not deform tape.
      d. In cool or cold weather, store containers for sixteen hours before using in temperature of approximately 75 degrees F.
      e. When high temperatures prevail, store mixed sealants in a cool place.
   3. Handling:
      a. Do not open containers or mix components until necessary preparatory Work and priming are complete.

1.6 JOB CONDITIONS

A. Conform to applicable OSHA and the New York State Building Codes.

B. Environmental Conditions:
   1. Do not install caulking and sealants under adverse weather conditions, or when temperatures are below or above manufacturer's recommended limitations for installation.
   2. Proceed with the Work when forecasted weather conditions are favorable for proper cure and development of high-early bond strength.
   3. Where joint width is affected by ambient temperature variations, install elastomeric sealants when temperatures are in the lower third of manufacturer's recommended installation temperature range, so that sealant will not be subjected to excessive elongation and bond stress at subsequent low temperatures.
   4. When high temperatures prevail, avoid mixing sealants in direct sunlight.
   5. Supplemental heat sources required to maintain both ambient and surface temperatures within the range recommended by manufacturer for material applications are not available at the Site.
   6. Provide supplemental heat and energy sources, power, equipment, and operating, maintenance, and temperature monitoring personnel.
   7. Do not use heat sources that emit carbon dioxide or carbon monoxide into areas of caulking, sealants, and painting Work, and areas where Owner's personnel or construction personnel may work. Properly locate and vent such heat sources to outdoors so that caulking and sealants and other Work are unaffected by exhaust.

1.7 WARRANTY

A. Provide written warranty, signed by manufacturer and Contractor, agreeing to repair or replace sealants that fail to perform as air-tight and watertight joints; or fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, or general durability; or appear to deteriorate in any other manner not clearly specified in approved Shop Drawings and other submittals, as an inherent quality of material for exposure indicated.
   1. Provide manufacturer warranty for period of one year from date of Substantial Completion of caulking and sealants Work.
   2. Provide installer warranty for period of two years from date of Substantial Completion of caulking and sealants Work.

PART 2 PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Provide elastomeric joint sealants for interior and exterior joint applications that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. VOC Performance Criteria:
   1. VOC content of sealants used shall comply with current VOC content limits of SCAQMD Rule 1168. Sealants used as fillers shall comply with or exceed requirements of BAAQMD Regulation 8, Rule 51.
      a. Sealants: 250 g/L.
      b. Sealant Primers for Nonporous Substrates: 250 g/L.
      c. Sealant Primers for Porous Substrates: 775 g/L.

C. Provide colors selected by Engineer from caulking and sealant manufacturer's standard and custom color charts. "Or equal" manufacturers shall provide same generic products and colors as available from manufacturers specified.

2.2 MATERIALS

A. Exterior and Interior Vertical Joints; Non-submerged:
1. Two-component Polyurethane Sealant:
a. Products and Manufacturers: Provide one of the following:
1) Sikaflex- 2c NS by Sika Corporation.
2) Dymeric 240 FC by Tremco Sealant/Waterproofing Division of RPM International, Inc.
3) Or equal.
b. Polyurethane based, two-component elastomeric sealant complying with:
1) FS TT-S-00227E: Type II (non-sag) Class A and ASTM C920, Type M, Grade NS, Class 25.
2) Adhesion-in-Peel, FS TT-S-00227E and ASTM C794: (Minimum five pounds per linear inch with no adhesion failure): 10 pounds.
3) Hardness (Standard Conditions), ASTM C661: 25 to 35 (Shore A).
4) Stain and color change, FS TT-S-00227E and ASTM C510: No discoloration or stain.
5) Accelerated Aging, ASTM C793: No change in sealant characteristics after 250 hours in weatherometer.
6) Rheological Vertical Displacement at 120 degrees F, FS TT-S-00227E: No sag.
7) VOC Content: 100 g/L, maximum.

B. Exterior and Interior Horizontal Joints; Non-submerged:

1. Two-component Polyurethane Sealant:
a. Products and Manufacturers: Provide one of the following:
1) Sikaflex- 2c SL by Sika Corporation.
2) THC/900 by Tremco Sealant/Waterproofing Division of RPM International, Inc.
3) Or equal.

b. Polyurethane based, two-component elastomeric, self-leveling sealant complying with the following:
1) FS TT-S-00227E, Type I (self-leveling) Class A. and ASTM C920, Type M, Grade P, Class 25
2) Water Immersion Bond, FS TT-S-00227E: Elongation of 50 percent with no adhesive failure.
3) Hardness (Standard Conditions), ASTM C661: 35 to 45.
4) Stain and Color Change, FS TT-S-00227E and ASTM C510: No discoloration or stain.
5) Accelerated Aging, ASTM C793: No change in sealant characteristics after 250 hours in weatherometer.
6) VOC Content: 165 g/L, maximum.

C. Miscellaneous Materials:

1. Joint Cleaner: As recommended by caulking and sealant manufacturer.

2. Joint Primer and Sealer: As recommended for compatibility with caulking and sealant by caulking and sealant manufacturer.

3. Bond Breaker Type: Polyethylene tape or other plastic tape as recommended for compatibility with caulking and sealant by caulking and sealant manufacturer, to be applied to sealant-contact surfaces where bond to substrate or joint filler must be avoided for proper performance of caulking and sealant. Provide self-adhesive tape where applicable.

4. Sealant Backer Rod: Compressible rod stock polyethylene foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam or other flexible, permanent, durable nonabsorptive material as recommended for compatibility with caulking and sealant by caulking and sealant manufacturer. Provide size and shape of rod that will control joint depth for sealant placement, break bond of sealant at bottom of joint, form optimum shape of sealant bead on back side, and provide highly-compressible backer to minimize possibility of sealant extrusion when joint is compressed.
5. Low-temperature Catalyst: As recommended by caulking and sealant manufacturer.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine joint surfaces, substrates, backing, and anchorage of units forming sealant rabbet, and conditions under which caulking, and sealant Work will be performed, and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work and performance of sealants. Do not proceed with caulking and sealant Work until unsatisfactory conditions are corrected.

B. Laboratory Pre-construction Compatibility and Adhesion Testing: Submit to joint sealant manufacturers for testing indicated below samples of materials that will contact or affect joint sealants.
1. Use ASTM C1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Submit at least eight pieces of each type of material, including joint substrates, shims, joint sealant backings, secondary seals, and miscellaneous materials.
3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
4. For products that fail tests, obtain joint-sealant manufacturer’s written instructions for corrective measures including using specially formulated primers.
5. Immersion Testing: ASTM C1247 for potable water and wastewater.
6. Testing will not be required if joint sealant manufacturers submit joint preparation data based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted and mock-up field testing is acceptable.

3.2 PREPARATION

A. Protection: Do not allow caulking and sealants to overflow or spill onto adjoining surfaces, or to migrate into voids of adjoining surfaces including rough textured materials. Use masking tape or other precautionary devices to prevent staining of adjoining surfaces, by either the primer/sealer or caulking and sealant materials.

B. Joint Surface Preparation:
1. Clean joint surfaces immediately before installing sealant compound. Remove dirt, weakly adhering coatings, moisture and other substances that would interfere with bonds of sealant compound as recommended in sealant manufacturer’s written instructions as shown on approved Shop Drawings.
2. If necessary, clean porous materials by grinding, sandblasting, or mechanical abrading. Blow out joints with oil-free compressed air or by vacuuming joints prior to applying primer or sealant.
3. Roughen joint surfaces on vitreous coated and similar non-porous materials,

when sealant manufacturer's data indicates lower bond strength than for porous surfaces. Rub with fine abrasive cloth or steel wool to produce a dull sheen.

C. Mixing:
1. Comply with sealant manufacturer's written instructions for mixing multi-component sealants.
2. Thoroughly mix components before use.
3. Add entire contents of activator can to base container. Do not mix partial units.
4. Mix contents for minimum of five minutes or as recommended by sealant manufacturer, until color and consistency are uniform.

3.3 INSTALLATION

A. Install caulking and sealants after adjacent areas have been cleaned and before joint has been cleaned and primed, to ensure caulking and sealant joints will not be soiled. Replace caulking and sealant joints soiled after installation.

B. Comply with sealant manufacturer's written instructions except where more stringent requirements are shown or indicated in the Contract Documents, and except where manufacturer's technical representative directs otherwise, only as acceptable to Engineer.

C. Prime or seal joint surfaces as shown on approved Shop Drawings and approved other submittals. Do not allow primer or sealer to spill or migrate onto adjoining surfaces. Allow primer to dry prior to applying sealants.

D. Apply masking tape before installing primer, in continuous strips in alignment with joint edge to produce sharp, clean interface with adjoining materials. Remove tape immediately after joints have been sealed and tooled as directed.

E. Do not install sealants without backer rods and bond breaker tape.

F. Roll back-up rod stock into joint to avoid lengthwise stretching. Do not twist, braid, puncture, or prime backer rods.

G. Employ only proven installation techniques that will ensure that sealants are deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of joint bond surfaces equally on opposite sides. Except as otherwise indicated, fill sealant rabbet to a slightly concave surface slightly below adjoining surfaces. Where horizontal joints are between a horizontal surface and a vertical surface, fill joint to form a slight cove, so that joint will not trap moisture and dirt.

H. Install sealants to depths recommended by sealant manufacturer but within the following general limitations, measured at the center (thin) section of bead.
1. For horizontal joints in sidewalks, pavements, and similar locations sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposures, fill joints to depth equal to 75 percent of joint width, but not more than 5/8-inch deep or less than 3/8-inch deep.
2. For vertical joints subjected to normal movement and sealed with elastomeric sealants and not subject to traffic, fill joints to a depth equal to 50 percent of joint width, but not more than 1/2-inch deep or less than 1/4-inch deep.

I. Remove excess and spillage of compounds promptly as the Work progresses.

J. Cure caulking and sealant compounds in compliance with manufacturer's instructions and recommendations, to obtain high-early bond strength, internal cohesive strength, and surface durability.

3.4 EXISTING JOINTS

A. Mechanically remove existing sealant and backer rod.

B. Clean joint surfaces of residual sealant and other contaminates capable of affecting sealant bond to joint surface.

C. Conduct laboratory pre-construction compatibility and adhesion testing on joint surfaces in accordance with Paragraph 3.1.B of this Section.

D. Allow joint surfaces to dry before installing new sealants.

3.5 FIELD QUALITY CONTROL

A. Post-construction Field Adhesion Testing: Before installing elastomeric sealants, field-test joint sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed elastomeric sealant joints as follows:

a. Perform ten tests for the first 1,000 feet of joint length for each type of elastomeric sealant and joint substrate.

b. Perform one test for each 1,000 feet of joint length thereafter, and minimum of one test per each floor per elevation.

c. Test Method: Test joint sealants according to Method A, Field-applied Sealant Joint Hand Pull Tab, and Method D, Water Immersion in Appendix X1 of ASTM C1193. For joints with dissimilar substrates, verify adhesion to each substrate separately by extending cut along one side and verifying adhesion to opposite side. Repeat procedure for opposite side.

d. Inspect joints for complete fill, absence of voids, and joint configuration complying with specified requirements. Record results in a log of field adhesion tests.

e. Inspect tested joints and report on whether:

1) Sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer’s field-adhesion hand-pull test criteria.

2) Sealants filled the joint cavities and are free of voids.

3) Sealant dimensions and configurations comply with specified requirements.

f. Record test results in a log of field adhesion tests. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.

g. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

h. Evaluation of Field Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other requirements will be satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed

applications until test results prove sealants comply with indicated requirements.

i. Do not proceed with installation of elastomeric sealants over joint surfaces that have been painted, lacquered, waterproofed, or treated with water repellent or other treatment or coating unless a laboratory test for durability (adhesion), in compliance with FS TT-S-00227, has successfully demonstrated that sealant bond is not impaired by the coating or treatment. If laboratory test has not been performed or shows bond interference, remove coating or treatment from joint surfaces before installing sealant.

B. Water Leak Testing: Field test for water leaks as follows:

1. Flood the joint exposure with water directed from a 3/4-inch diameter garden hose, without nozzle, held perpendicular to wall face, two feet from joint and connected to water system with 30 psi minimum normal water pressure. Move stream of water along joint at an approximate rate of 20 feet per minute.

2. Test approximately five percent of total joint system, in locations that are typical of every joint condition, and that can be inspected easily for leakage on opposite face. Conduct test in presence of Engineer, who will determine actual percentage of joints to be tested and actual period of exposure to water from hose, based on extent of observed leakage or lack of observed leakage.

3. Where nature of observed leaks indicates potential of inadequate joint bond strength, Engineer may direct that additional testing be performed at a time when joints are fully cured, and before Substantial Completion.

3.6 ADJUSTING AND CLEANING

A. Where leaks and lack of adhesion are evident, replace sealant.

B. Clean adjacent surfaces of sealant and soiling resulting from the Work. Use solvent or cleaning agent recommended by sealant manufacturer. Leave all finish Work in neat, clean condition.

C. Protect sealants during construction so that they will be without deterioration, soiling, or damage at time of readiness for final payment of the Contract.

3.7 PROTECTION

A. During and after curing period, protect joint sealants 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 and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original Work.

END OF SECTION

SECTION 09 65 19

RESILIENT TILE FLOORING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Articles 1 through 47 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the resilient tile flooring, as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Vinyl composition tile.
2. Luxury vinyl tile.
3. Transition strips.
4. Accessories.

1.3 RELATED SECTIONS

A. Resilient Base and Accessories - Section 096513.

1.4 QUALITY ASSURANCE

A. Qualifications of Installers: Use only personnel who are thoroughly trained and experienced in the skills required and completely familiar with the requirements established for this work.

1.5 SUBMITTALS

A. Manufacturer's Data: For information only, submit manufacturer's technical information and installation instructions for type of resilient tile.

B. Samples

1. Submit full-size (3) sample tiles for each type and color required, representative of the expected range of color and pattern variation. Sample submittals will be reviewed for color, texture and pattern only. Compliance with all other requirements is the exclusive responsibility of the Contractor.
2. Submit six (6) inch long samples of transition strips.

C. Submit manufacturer’s warranty as noted herein.

1.6 DELIVERY AND STORAGE

A. Deliver materials to the project site in the manufacturer's original unopened containers, clearly marked to indicate pattern, gauge, lot number and sequence of materials.

B. Carefully handle all materials and store in original containers at not less than seventy (70) degrees F. for at least forty-eight (48) hours before start of installation.

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 floor tile during the following time 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.

1.8 WARRANTY

A. Provide manufacturer’s 5-year limited warranty.

PART 2 PRODUCTS

Subject to compliance with requirements, provide product listed or approved equal as indicated.

2.1 VINYL COMPOSITION TILE (VCT)

A. See Finish Schedule.

2.2 LUXURY VINYL TILE (LVT)

A. See Finish Schedule.

2.3 ACCESSORIES

A. Adhesives: Waterproof, stabilized type, as recommended by the tile manufacturer for the type of service indicated based on a RH of 90%.

B. Concrete Slab Primer: Non-staining type recommended by the tile manufacturer.

C. Leveling Compound: Novoplan 2 made by Mapei, Ardex K-15 or approved equal.

D. Edging Strips: 1/8" thick, homogeneous vinyl or rubber composition, tapered or bullnose edge, color as selected by the Architect from manufacturer's standards.

E. Finish for VCT

1. Cleaner shall be equal to "Super Shine All" made by Hillyard Chemical Co., or approved equal.
2. Wax shall be equal to "Super Hil-Brite" made by Hillyard Chemical Co., or approved equal.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where resilient tile flooring is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 CONDITION OF SURFACES

A. Allowable Variations in Substrate Levels (Floors): ± 1/8" in 10'-0" distance and 1/4" total maximum variation from levels shown.

B. Grind or fill concrete substrates as required to comply with allowable variation.

3.3 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 F 710.

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.
4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the

following:

a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture- vapor-emission rate of 3 lb. of water/1000 sq. ft. in 24 hours.

b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until they are the same temperature as the 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.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.4 INSTALLATION

A. Install tile only after all finishing operations, including painting, have been completed and permanent heating system is operating. Moisture content of concrete slabs, building air temperature and relative humidity must be within limits recommended by tile manufacturer.

B. Place tile units with adhesive cement in strict compliance with the manufacturer's recommendations. Butt tile units tightly to vertical surfaces, thresholds, nosings and edgings. Scribe around obstructions and to produce neat joints, laid tight, even and in straight, parallel lines. Extend tile units into toe spaces, door reveals, and into closet and similar openings.

C. Maintain reference markers, holes, or openings that are in place or plainly marked for future cutting by repeating on the finish tile as marked in the subfloor. Use chalk or other non-permanent marking devices.

D. Lay tile from center marks established with principal walls, discounting minor off-sets, so that tile at opposite edges of the room are of equal width. Adjust as necessary to avoid use of cut widths less than 1/2 tile at room perimeters. Lay tile square to room axis, unless otherwise shown.

E. Match tiles for color and pattern by using tile from cartons in the same sequence as manufactured and packaged. Cut tile neatly to and around all fixtures. Broken, cracked, chipped or deformed tile is not acceptable.

F. Tightly cement tile to sub-base without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks through tile, or other surface imperfections.

G. Lay tile with grain in all tile running in the same direction.

H. Place resilient edge strips tightly butted to tile and secure with adhesive. Provide edging strips

at all unprotected edges of tile, unless otherwise shown.

3.5 CLEANING AND PROTECTION

A. Remove any excess adhesive or other surface blemishes from tile, using neutral type cleaners as recommended by the tile manufacturer. Protect installed flooring from damage by use of heavy Kraft paper or other covering.

B. Finishing for VCT: After completion of the project and just prior to the final inspection of the work, thoroughly clean tile floors and accessories. Apply two (2) coats of wax and buff using materials as specified herein.

END OF SECTION 09 65 19

SECTION 142100

TRACTION ELEVATORS

PART 1 GENERAL

1.1 GENERAL DESCRIPTION

A. Work perform of this section shall include all labor, materials, tools, and services required to modernize the units as specified herein and in accordance with the drawings, general conditions, AIA documents/current edition, supplementary conditions, and all other requirements of the contract documents. The contract is for a complete job in every respect, bidders are cautioned to familiarize themselves with all project related documents.

B. All work will be in accordance applicable ASME-A 17.1 – Safety Code for Elevators and Escalators and building code with all applicable local adoptions.

C. Existing Equipment Information:

1. Number of Elevators:	Three (3)
2. Operation:	Group
3. Floors Served:	Nos. 3-4: 1-4 No. 5: B, 1-4
4. Number of Openings:	Nos. 3-4: four No. 5: five
5. Capacity:	3,500 lbs.
6. Speed:	400 fpm
7. Door Opening Size:	3’-6” W x 7’-0” H
8. Door Style:	Single-speed Center-parting
9. Installation Type:	Overhead Traction
10. Machine Type:	Gearless
11. Controller Type:	Relay Logic
12. Motion Control Type:	Motor Generator
13. Roping Arrangement:	2:1 Double Wrap

D. Direct questions relating to the intent of the specifications, drawings or quality of work required to the Architect. In the event of disagreement, the Architect's interpretations become final, conclusive, and binding on all parties

E. In case of disagreement between drawings and specifications, or within either document itself, the better quality, greater quantity, the stringent standards, or more costly work shall be included in contract price and the matter referred to the Architect's attention.

1.2 RELATED WORK BY OWNER

A. Maintain unobstructed and proper access to the machine room for the elevator in accordance with the appropriate national and local AHJ Codes.

B. Maintain access doors to the machine room. The door shall be self-closing, and self-locking in accordance with the appropriate national and local AHJ Codes. Door shall be properly labeled with letters of a minimum height of 2 inches in accordance with the appropriate national and local AHJ

Codes.

C. Provide suitable storage space for tools and materials brought to the site by the Contractor. Contractor must specify at the beginning of the project the details of storage space required. Storage space requested shall be reasonable and in accordance with the projected schedule.

D. Provide means for heating and cooling in the machine room to evenly maintain ambient temperature between 45 and 90 degrees Fahrenheit with relative humidity not to exceed 85% based upon scheduled heat generation. Contractor shall provide environmental requirements for the proposed equipment along with their bid package to ensure this requirement can be met with the existing equipment.

E. Maintain telephone line and provide Ethernet cable for the in-cab communication systems to the machine room. Communication lines are the responsibility of the Owner and are to be brought to a terminal point in the machine room. Contractor shall install all wiring/cables from the terminal point in the machine room the required elevator equipment.

F. Required electrical power to the elevator system(s) shall be provided by Owner. The existing feeding service, grounding and distribution in the elevator machine/equipment space(s) shall be evaluated based on contractor's power requirements submission. The electrical power to the elevator(s) systems shall be upgraded as required by the equipment and/or Code. Owner shall include but not be limited to the following:

1. Provide new the main line disconnect switches in the machine room. The disconnect switches shall be properly fused, include proper grounding wiring, lockable in the open position and unopenable in the live position.
2. Provide new individual 120V single phase disconnect switches in the machine rooms for elevator's cab lights and fans. The disconnect switches shall be properly fused, include proper grounding wiring, lockable in the open position and unopenable in the live position.
3. Machine Room:
    a. Provide new illuminated light switch for the elevator machine rooms.
    b. Provide new lighting in the machine rooms. Ensure lighting provides a minimum of 19 fc at the floor. Lighting shall be guarded in accordance with the appropriate national and AHJ Codes.
    c. Provide new duplex GFI protected outlets.
4. Pit:
    a. Provide new illuminated switch for each elevator pit.
    b. Provide new pit lighting for the elevator pits. Lighting shall provide a minimum of 10 fc at the floor. Lighting shall be guarded in accordance with the appropriate national and AHJ Codes.
    c. Provide new duplex GFI protected outlets in pit.

G. Verify the following signal from the transfer switches for emergency backup power to the elevator machine room:

1. One dry contact (open or closed depending upon elevator contractor selected) to signal emergency power/normal power.
2. One normally open dry contact to close 30 to 60 seconds prior to transfer onto emergency power or back to normal power.

H. Ensure and maintain smoke sensing devices in machine rooms, secondary spaces, overhead sheave spaces, hoistways, pits and at elevator lobbies, have three (3) dry contacts terminating at a properly marked terminal in the machine room. One dry contact will be for fire recall, the second

for alternate floor fire return, and the third to indicate that the smoke sensor in the machine room has been initiated. Sensing devices shall be properly zoned to provide alternate floor return for fire service recall phase I.

I. Ensure and maintain a code-approved fire extinguisher in the machine room.

J. Building should identify and abate any asbestos located in the existing elevator pit or shaftway. The contractor will be required to identify other hazardous conditions with their bid that may require attention from the owner.

K. Owner is responsible to provide signage as required by code. If code-mandated fire egress signage is not existing or will not be incorporated into new hall station fixtures, owner is responsible to provide signage as required by code. Owner shall also provide fire service operation instructions per code requirements near all fire service key switches.

1.3 SPECIAL REQUIREMENTS BY ELEVATOR CONTRACTOR

A. All work and the required permits shall identify the applicable ASME A17.1 Safety Code for Elevators and Escalators and all local codes and ordinances as codes to be followed for this project.

B. All new lobby, car, hall fixture type, design, finish as well as braille, cab type, design, finish, and any other finishes shall be chosen by a building representative. Failure to gain approval of the owner prior to ordering fixtures may result in contractor having to reorder fixtures acceptable to the owner.

C. Cutting and patching of walls for the purpose of installing new hall fixtures and any other cutouts in hoistway or machine room walls required for elevator equipment installation shall be provided. Any cutting or patching of walls shall be fire stopped per building's requirements. Decorative finish shall be completed by the Owner.

D. Contractor must submit full plans, details, engineering and equipment sheets for hydraulic jacks, power unit and piping along with engineering calculations for jack reactions, guide rails, guide rail brackets and their spacing, engineering calculations for rails reactions, buffer reactions, pit, bottom and top of elevator hoistway equipment dimensions with respective required vertical and horizontal clearances. Identify any structural modifications of walls and floors that need to take place in order for the equipment to be properly installed.

E. Contractor must specify environmental requirements for the proposed equipment along with their bid package.

F. Contractor must file for and perform a Category 5 test when the acceptance test is performed.

G. Old equipment shall be taken away from premises as it is removed and will not be allowed to be stockpiled in building except for needed critical replacement parts and all controller spare parts during the modernization.

1.4 DETERMINATION OF MAXIMUM DEADWEIGHT

A. The Contractor is required to perform investigative and engineering work necessary to determine the maximum amount of weight that can be added to the elevator cabs, in order to preclude the following from occurring:

1. The modified counterweight or additional deadweight would not comply with applicable

elevator or building codes including, but not limited to, ASME A17.1 and all local codes and ordinances.

2. The additional weight would cause the building reactions or the sum of the cab weight and capacity to change by more than 5% compared to the original design.
3. The counterweight frame would no longer be sufficient for the modified counterweight.
4. The modified counterweight would cause any hoistway clearances to be insufficient according to applicable elevator or building codes including, but not limited to, ASME A17.1 and all local codes and ordinances.
5. The manufacturer's reported maximum sheave-shaft load of the hoist machine, manufacturer's reported buffer strike load, manufacturer's reported load per rope, or the manufacturer's reported maximum rated load on safety would be exceeded.

B. These investigations must include, but are not limited to, obtaining original design information on the elevators (if available), including the information from the crosshead data plate, safety data plate, buffer data plate, and hoist machine data plate, obtaining information from the cab company on weight being added and being removed from the cab.

C. The tests specified shall be performed at a minimum on one elevator from each bank. Owner and/or Consultant reserve the right to require that these tests be witnessed, in which case the Contractor shall cooperate with the witness in scheduling these tests.

D. No work should be done on the elevators, and no equipment should be ordered, until all issues and concerns identified as part of the Contractor's investigation have been resolved.

E. Contractor shall perform the following tests as part of its investigation, scheduled in advance with the building:

1. Weigh the empty elevator car at the lowest landing in the hoistway. This procedure should be done with the compensation lifted so that it does not contribute to the measured weight. The approximate weight of all people on the elevator cab must be separately identified and subtracted from the results.
2. Weigh the empty elevator and weigh the counterweight at the mid-point of the hoistway. This procedure should be done with the compensating sheave lifted so that it does not contribute to the measured weight. The approximate weight of all people on the elevator cab must be separately identified and subtracted from the results for the elevator.
3. Remove, weigh, and reinstall all components of the existing elevator cab that are being removed as part of the cab renovation.
4. Calculate the weight of the traveling cables and compensation.
5. Contractor must use a scale with an up-to-date calibration certificate, with sufficient capacity that the weight of the item being measured can be read within the maximum measurement of the scale.

F. These tests are to be performed prior to any work being done on the elevators as part of this project and should be no more than two (2) weeks after the award of contract with finalized conclusions submitted prior to the conclusion of the engineering phase.

G. In making its determination of maximum weight to be added, the Contractor must factor in (and separately identify) any additional weight that will be added to the car during the modernization and how much weight needs to be added or subtracted from the counterweight to meet appropriate counterbalance requirements.

H. If original design information cannot be obtained (precluding a determination of whether any weight increase is within 5% of the original sum of deadweight and capacity), then the Contractor must

report that no net weight increase can be allowed.

I. The Contractor must submit a report to the Owner and Consultant identifying the maximum weight that can be added to the cabs and the backup calculations used to reach its conclusion.

J. Along with its report, Contractor must issue a letter stamped by a Professional Engineer, hired by the Contractor, reporting that the above specified investigations have been completed, and stating that Items A through E above have been reviewed, and stating that all concerns or issues have been noted in the letter and in the report. In addition to identifying all findings and measured results as required above, the report must also include, for the scale used, a photocopy of an up-to-date calibration certificate, a photograph of the zeroed scale face, and a photograph of the scale's serial number.

1.5 ELECTRICAL REQUIREMENTS

A. The Contractor must submit, along with their bid, the electrical requirements for the system(s) being installed.

B. Contractor shall assist Owner as needed in determining requirements for electrical upgrades if needed. Contractor shall be involved in discussions with Owner's electrical contractor and/or Owner's engineering group to ensure proper electrical work is completed with respect to the new equipment being installed.

C. All wiring including, high voltage, low voltage, intercom, fiber optic, plenum, shielded, etc., installed under this contract must be installed in pipe conduit. This pertains to wires installed both inside and outside of the elevator hoistway.

D. Contractor shall be responsible to run all the electrical wiring/conduit from the electrical disconnect to each elevator controller.

1.6 MACHINE ROOM

A. All elevator machinery and control equipment shall be located in the existing machine spaces. Machine, motors, controller, selector, motor control, and mainline switches shall be identified by elevator number. Any work required to facilitate removal of existing equipment and installation of new units in the machine rooms and repair thereof shall be the responsibility of the Contractor. The placement of any new equipment shall meet all current and applicable codes including, but not limited to, ASME A17.1 and all local codes and ordinances.

B. Machine Beams: Contractor shall provide all loads / reactions imposed on the existing machine beams. The Contractor shall indicate whether or not they have increased beyond 5% of the original design.

1.7 OEM EQUIPMENT AND DIAGNOSTIC TOOLS

A. Where OEM equipment is approved for use by Owner and Consultant, the Contractor shall provide to the Owner all special tools required for another competent maintenance contractor to perform a complete maintenance program. This shall include their field service tool, laptop computer, interface to connect to their control equipment and any other hardware and/sort required for diagnostics, adjustments, and testing.

B. If a separate tool is provided, Contractor must provide a flat price for replacement of the tool if accidentally damaged or rendered inoperable in the future. Price will escalate by no more than 5% per year. A published price list must be provided establishing reasonable prices for sale of parts

to other maintenance contractors.

C. Tools may be designed by the Contractor to work only in the building for which they are intended.

D. If a SIM card or any other card that are used for either adjusting, troubleshooting, or testing will be used, Contractor should also be required to provide the Owner with a copy of such a card after demonstrating it is operational in front of the Owner's consultant.

E. Contractor shall provide to the owner one (1) complete set of adjusting, trouble shooting and testing manuals for each type of controller installed.

F. Contractor must provide to the Owner three copies of all manuals required for proper operation of the diagnostic and adjustment tools.

G. Owner shall be provided with a complete set of control boards and components that will be turned over at completion of the installation. These boards should be tested on the actual controllers being installed in the building prior to submission to the client. This set should include at least one of every type of board and controller component to be installed in the building including drive boards for each drive size.

H. Contractor must provide and install all software updates available for the equipment within thirty days of release, throughout the entire life of this equipment. If the Contractor is the Original Equipment Manufacturer, any updates the Contractor installs on the same model of equipment where the Contractor is still performing maintenance must be made available for installation, even if maintenance is being performed on these devices by another company.

I. The Original Equipment Manufacturer must commit to providing engineering support to any future maintenance contractor designated by the Owner.

1.8 SUBMITTALS

A. Once the contract has been awarded and signed, the Contractor shall provide submittals based upon the manufactures and model as accepted with their bid. Any changes in manufacturer or model from those accepted with their bid shall be immediately submitted in written to Owner and Consultant for review.

B. The Contractor shall submit all required submittals within the timeframe agreed upon within the contract schedule. The Contractor shall not proceed with ordering equipment or performing any on-site work prior to obtaining all necessary approvals from the Owner and/or the Owner's architect, and receiving written confirmation from the Consultant that all exceptions noted on the submittals have either been addressed or that the Contractor can proceed as noted.

C. The Contractor shall be responsible for providing all requested submittals as stated including but not limited to the following:

1. Cut sheets of all equipment/components being replaced.
2. Wiring diagrams and manuals.
3. Power Reports
4. Scaled Shop Drawings including but not limited to the following:
    a. Listing of all components of the elevator system including any devices and sub-systems including with indication of:
        1). Manufacture
        2). Model
        3). Quantity

4). Sizing

b. Machine room plans that fully dimensioned and indicate:
   1). Location of all equipment
   2). Equipment size and weight
   3). Mounting details of all components
   4). Machine beams
   5). All reaction/loads concurring in the machine room
   6). Service connections
   7). Ancillary components
   8). Equipment and maintenance clearances
   9). Ventilation and/or smoke holes
   10). Points of access
c. Hoistway plans that are fully dimensions and indicate:
   1). Location of all equipment
   2). Equipment size and weight
   3). Required clearances
   4). Location of all fixtures
   5). Location of inserts
   6). All reactions/load concurring in the hoistway
d. Pit plans that are fully dimensions and indicate:
   1). Location of all equipment
   2). Equipment size and weight
   3). Required clearances
   4). Location of all fixtures
   5). Location of inserts
   6). All reactions/load concurring in the pit.
e. Hoistway section elevations that are fully dimensions and indicate:
   1). Location of all equipment
   2). Equipment size and weight
   3). Required clearances
   4). Location of all fixtures
   5). Location of inserts
   6). All reactions/load concurring in the hoistway.
f. All fixture drawings
g. Fully dimensioned cab drawing indication:
   1). Additional and total weight added to the system
   2). Ventilation calculations
   3). Location of all equipment
   4). Listing of all components, material and finishes.
   5). Mounting details of all components
h. Fully dimension entrance drawing where replacement is being performed.

5. Reaction/load calculations stamped by Professional Engineer for:
   a. Machine beams
   b. Overhead sheave beams
   c. Car and counterweight rails
   d. Car and counterweight buffers
   e. Rail Stacks
   f. Seismic Forces
6. Engineering calculations stamped by Professional Engineer for:
   a. Machines
   b. Hoist ropes
   c. Heat emissions

d. Electrical Loads

7. Ancillary equipment that are not the responsibility of the elevator contractor shall be indicated with “To be provided/installed by others.”
8. Final drawings stamped by a Professional Engineer shall be submitted for record.
9. Final As-Built drawings stamped by a Professional Engineer shall be submitted with closeout package.

D. All submittals should be submitted electronically. Hard copy prints, and AutoCAD layout drawings should be available upon request.

E. All submittals generated by subcontractors or vendors shall be reviewed and approved by the primary Contractor prior to submission to the Consultant for approval.

1.9 PRE-APPROVED MANUFACTURERS

A. The following manufacturer’s equipment are pre- approved for use on this project:

1. Controllers: GAL, MCE, CLaddagh
2. Motor Control: Magnetek, KEB, Yaskawa
3. Machines: HW, Imperial
4. Motors: Imperial, Reuland, Baldor
5. Wire Ropes: Bethlehem, Draka, Brugg
6. Hoistway / Car door equipment: GAL, ECI, Wittur
7. Door Protective Device: Janus, Tri- tronics, Cedes
8. Traveling Cables: Draka, James Monroe
9. Guide Shoes/Rollers: Elsco, HW
10. Fixtures: GAL, EPCO, Monitor, MAD, C.E. Electronics, Innovation
11. Intercommunication: Ringcomm, Janus, Wurtec, Rath

B. All other equipment manufacturers will be considered on an individual basis and be required to be approved by Owner’s representative and Consultant.

PART 2 PRODUCTS

2.1 EQUIPMENT ISOLATION

A. Provide sound-reducing vibration isolation elements at all support points of elevator controllers, solid-state motor drives, isolation transformers and hoisting motors. The elements for controllers, shall be similar to double deflection neoprene-in-shear mounts, as manufactured by Mason Industries, elements between the hoisting machine (utilized base) and machine support beams shall be similar to triple (3) layer ribbed neoprene pads, separated by appropriate steel shims as manufactured by Mason Industries. All bolts through isolation elements are to incorporate resilient washers and bushings.

B. Provide electrical isolation to keep the harmonic distortion and electrical noise within acceptable levels permitted by the appropriate governing authorities, and to minimize disruption to tenants.

C. Provide chokes and filters in order to minimize audible noise and radio frequency interference to acceptable levels.

2.2 CONTROLLER – NEW

A. Provide new solid-state microprocessor controllers designed to meet current elevator code as modified by local jurisdictional authority.

B. All machine room enclosures provided by the control manufacturer (control cabinet, isolation transformers, ripple filters, resistor boxes, etc.) shall be painted the same color.

C. Contractor shall be responsible to run all the electrical wiring/conduit from the electrical disconnect switch to each elevator controller.

D. All memory chips shall be of the non-volatile type to provide for an automatic restart on power-up conditions.

E. Electromechanical relays shall be used on safety circuits where required by Code. Relays shall be of the direct-current type designed to ensure long life and quiet reliable operation without overheating or excessive wear. Contacts supplying highly inductive loads shall be provided with arc deflectors or suppressers.

F. Large resistors shall be mounted such that any heat generated is dissipated from the enclosure without heating other components or wiring.

G. Equipment shall be provided to protect the drive motor and generator or SCR as applicable against overload, phase reversal, low voltage, and single phase in all three phases.

H. Wiring: All controller wiring shall be copper and done in a neat workmanlike manner. All connections shall be made to studs or terminals by means of solder-less connections lugs or similar connections. All studs and terminals shall be labeled for connections of board and external wiring.

I. Marking: All devices on the controller shall be identified with symbols or letters permanently marked on or adjacent to each device. All fuse holders shall be permanently marked with ampere rating.

J. Controllers shall provide efficient, smooth operation with step-less acceleration and deceleration of the elevator-hoisting machine independent of the load in the car.

K. Car speed shall be regulated to +/-5% of contract velocity in either direction with any load up to full load.

L. Controller shall contain door monitoring capabilities per ASME A17.1: 2.26.5 and as modified by the AHJ.

M. Contractor shall be responsible for identifying all special service operations and tagging them on each controller including but not limited to reduced stroke buffers.

N. Controller shall contain capabilities to provide indication for overload per code.

O. Operation –Group Operation

1. Elevators shall operate without attendants as a group and be able to operate with one car removed from the system. Cars shall respond to calls in the order in which the landings are reached by the car, irrespective of the sequence in which the buttons are pressed. When a car is traveling in a particular direction, it shall stop at floors for which car calls have been registered or at floors where hall calls have been registered for the same direction. Similarly, the registering of a hall call shall not interrupt the travel when the car is traveling in the opposite direction, unless there are no calls located further in the direction of travel.
2. Calls shall only be allowed to register if placed in the direction of travel already established.
3. Parking shall be adjustable to allow each car to park on any floor.

P. Provide a monitor in the machine room or an LCD display that allows troubleshooting and can display the status of the elevators. The monitor display will include each car's position, hall and car calls registered, status of the cars, etc. The troubleshooting functions should include the ability to register car calls and hall calls. Controllers shall include security features in order to allow any maintenance contractor to lock out car calls or hall calls on an individual basis without software changes. All lockouts would be overridden by fire service as required by Code. Any passwords or passcodes set on either the monitor or the control system itself must be provided in writing to the building owner and consultant. Updates should be given any time changes are made to passwords or passcodes.

Q. Remote Monitoring Capabilities: If selected by the Owner, the system needs to be connected to the internet and programmed with an IP address. All data collection, data storage and real - time monitoring is then provided by accessing the system with a web browser, no "special" software or licenses are required.

R. Fire Emergency Operation: Elevators shall completely comply with the applicable ASME code as adopted and/or modified by local and state law. All fixtures, operations, and provisions necessary for proper operation must be provided and installed.

S. Emergency Power Operation: The elevator system shall be made to operate properly with the building Emergency Power system, based on the capabilities of that system and according to Code requirements for sequencing and operation. The Contractor will coordinate the emergency power system with building management. Elevator will be able to run on alternate acceleration and deceleration, speed profile when on emergency operation and have all chokes and filters installed to minimize line harmonic line distortion. Sequencing of multiple car banks shall also be provided to match the capabilities of the building's emergency generator system.

T. All date-sensitive functions of the elevator control system shall use a 4-digit year-tracking system.

U. Rubber floor mats shall be provided at the front of the controllers, and at the rear of controllers if serviceable parts are located in the rear.

V. The controller shall be approved to the latest edition of CAN/CSA-B44.1 / ASME-A17.5. The controller manufacturer shall provide a complete procedure for testing and demonstrating compliance to the latest edition of CAN/CSA-B44 / ASME A17.1.

2.3 HOIST MOTOR DRIVE SYSTEM – NEW

A. Provide AC VVVF Drive with solid state adjustment speed control. The drive shall have a velocity profile in a dual-loop feedback system based on car position and speed. The VVVF drive must be capable of varying the torque on the motor providing step-less acceleration and deceleration. It shall be capable of programming the volts per hertz and changing the acceleration and deceleration profiles. The drive shall be able to produce full torque at zero speed using encoder feedback.

B. The AC VVVF Drive system shall include a high performance line regeneration power converter; dynamic braking resistors shall not be required for dissipation of regenerated power. The power convertor shall take excess regenerative energy created from the drive motor and supply it to the incoming AC power source.

C. Neither the AC drive system nor the line regeneration power convertor shall create excessive audible noise in elevator machine room, hoistway or building structure.

D. The equipment must operate at plus or minus 10% of normal feeder voltage and plus or minus 3%

of normal feeder frequency without damage or interruption of elevator service.

2.4 HOIST MACHINE – NEW

A. Provide new AC Permanent Magnet (ACPM) type, specifically made for heavy duty elevator applications.

1. Roping ratio shall match existing.
2. The main bearing shall be permanently sealed. Replacing the main bearing shall be done without having to remove the machine.
3. The machine shall have pole quantities corresponding to the elevator duty. The core laminations slots shall be slanted so to minimize cogging of the motor.
4. New secondary/deflector/2:1 sheaves shall be provided for all new machines. The number and size of grooves shall match the OEM standards for the new installation. Sheave alignment with the hoist machine and the counterweight shall be set.
5. The traction and secondary/deflector/2:1 sheaves shall be of hard alloy cast iron, semi-steel or cast steel of approved composition with proper grooves for deflection. Surface of drive sheave shall have hardness between 220 and 240 Brinnell and shall be plainly stamped.
6. The machine shall be provided with a steel sub-base bedplate/stand in the machine room. The secondary/deflector sheave shall be mounted on this common sub-base bedplate/stand.
7. Sound isolation pads shall be installed beneath the machine bedplate to reduce vibration and noise transmission to the building structure.
8. Hollow machine shafts are not acceptable.
9. Machine and secondary sheaves shall be provided with rope guards and retainers to prevent the hoist ropes from jumping out of their grooves in case of a slack cable condition.

B. The machine shall be securely mounted to existing machine beams in the overhead machine rooms.

C. The motor shall be designed for elevator service with high starting torque and low starting current and be provided with devices to protect against overloading.

1. The motor insulation shall be at least class F rated.
2. The machine shall be designed and CSA Certified to operate continuously for one hour under full load in an ambient environment of 40 C (104 F).
3. Motor shall be designed with inverter duty wire to mitigate corona effect.

D. The machine shall be provided with two independent brakes. Brakes shall be of Direct Current with:

1. a completely enclosed coil
2. independent adjustments for stroke and spring tension
3. means to prevent each shoe from rocking.
4. pivot arms whose travel is stopped on adjustable centering screws which will reduce the noise associated with the solenoid "clapping" when it drops.
5. Brakes shall be provided with a brake monitor switch that will prevent the car from running if:
   a. either or both shoes fail to pick,
   b. either or both shoes fail to drop,
   c. either or both shoes have wear that might affect brake operation,
   d. excessive thrust play might affect brake operation.
6. Brake spring adjustment lock nuts shall be pinned and/or sealed after final adjustment and testing of brake.
7. Provide and install a new micro-switch on the brake to indicate to the controller when the brake

is picked.

8. When dual electro-mechanic brakes are provided to meet emergency brake code requirements, each brake shall be controlled independently. One brake shall be considered the driving-machine brake and the other shall be considered the emergency brake.
   a. The emergency brake shall not provide or assist in the normal stopping of the elevator car. The emergency brake shall be permanently labeled as required by code.
   b. Both the driving-machine brake and the emergency brake shall be capable of independently stopping and holding the elevator car with 125% of the rated load as required by code.

E. Contractor shall provide all angles, plates, bearing plates, blocking steel members to support machine, rope grippers, deflector/secondary sheaves necessary for mounted.

F. Contractor must submit full layouts, details, and equipment sheets for the installation of new traction machines, machine beams, and deflector sheaves, rope grippers, governors, along with engineering calculations for traction, machine beam reactions, rails reactions. Elevator contractor is responsible for any and all engineering required to confirm that the existing building structure can support the new machine. Elevator contractor must provide Professional Engineer stamped drawings showing that the existing structure has been examined and has been deemed able to support the new machine. If the structure is found to be inadequate for the new machine, structural changes/improvements shall be provided by owner. If contractor's plan for bringing in the machine requires structural work, contractor must clearly indicate as such in their bid. Contractor shall include any overtime necessary for hoisting the machines so not to interfere with building operations.

G. Contractor must provide a data tag securely attached to the machine stating but not limited to the maximum allowable sheave shaft load, capacity, speed, roping, and counterbalance..

2.5 SUSPENSION MEANS – NEW

A. Provide a new set of hoist ropes/belts. The ropes/belts will be of sufficient size and number to ensure long life of cables and drive sheave.

B. Provide new wedge shackles and anti-spin devices.

C. The ropes/belts will be identified with a metal tag showing the type, strength, number of strands and date of installation.

2.6 ASCENDING CAR OVERSPEED – NEW

A. Provide overspeed protection means to prevent the car from striking the overhead hoistway structure should failure occur at the (1) electric hoist motor, brake coupling, shaft, or gears: (2) control system: and/or (3) any other elevator component which the speed of the car depends.

B. Any structural engineering required to validate the ability of the building structure to accommodate the rope gripper, or other such device used to meet this requirement as well as the unintended car movement requirement should be included in contractor's bid.

2.7 UNINTENDED CAR MOVEMENT PROTECTION – NEW

A. Provide a protection device to prevent unintended car movement away from the landing when the hoistway and car doors are not locked in the closed position should failure occur at the (1) electric hoist motor, brake coupling, shaft or gears: (2) control system: and/or (3) any other elevator component which the speed of the car depends.

2.8 GOVERNOR AND TENSION SHEAVE

A. Provide a new speed governor, located overhead, to operate the car safety.

B. Maintain the proper tension in the governor rope with a new weighted tension sheave located in the pit. Governor tension sheave must be equipped with a guard. Springs used to develop the tension are not acceptable.

C. Provide rope grip jaws, designed to clamp the governor rope to actuate the car or counterweight safety upon a predetermined overspeed downward. Rope grip jaws directly coupled to the governor mechanism so as to float with governor movement shall not be permitted.

D. Centrifugal type governors shall trip and set rope jaws within 60 degrees of governor sheave rotation after reaching rated tripping speed.

E. Design the governor rope-tripping device so that no appreciable damage to or deformation of the governor rope shall result from the stopping action of the device in operating the car safely.

F. Provide an electrical governor overspeed protective device which, when operated, shall remove power from the driving machine motor and brake before or at the application of the safety. This switch shall operate in the up direction as well. The setting for the overspeed switches shall be as prescribed in the ANSI Code.

G. The governor shall meet all applicable code requirements including, but not limited to, ASME A17.1 and all applicable local codes and ordinances.

H. Provide new governor ropes.

2.9 LOAD WEIGHING - NEW

A. Provide means to measure the load in the car within an accuracy of plus or minus 4% of the elevator capacity.

B. Load weighing system shall be designed and implemented to perform the following:

1. Bypass hall calls when the elevator is fully loaded.
2. Dispatch from the Lobby without additional delay when the elevator becomes fully loaded.
3. Capable of providing signal for audile and visual indication when used as an overload device.
4. Eliminate rollback.

2.10 TOP OF CAR RUN BOX - NEW

A. Provide new top of car run box. Top of car run box shall have an inspection switch which overrides all other inspection switches, with up and down push buttons and a stop switch.

B. The top of the car should be properly lit, and the light should be properly guarded. Steel light guards shall be grounded.

C. The inspection station shall comply with all current code requirements, including operational and labeling requirements.

2.11 CAR AND COUNTERWEIGHT GUIDES - NEW

A. Provide new car and counterweight roller guides of diameter per manufacturer’s standard according to the elevator duty.

B. Guides shall be assembled on a metal base, designed, and mounted so as to provide continuous contact of all rollers with the guide rail surfaces under all conditions of load and operation.

C. The rollers shall be neoprene or polyurethane. Equip roller guides with 16-gauge cover guards.

2.12 DOOR OPERATOR - NEW

A. Door operator shall be GAL Model MOVFR II or approved equal heavy-duty closed-loop door operator. The unit shall have the ability to adjust torque, opening speeds, closing speeds, nudging speed and soft start. It shall be properly filtered to eliminate audible noises.

B. The door shall be designed to operate at an average opening speed of 2' per second. This type of operator shall be designated as a high-speed operator. Automatic closing of the car and hoistway door shall be required, and the closing speed shall be approximately 1' per second. This closing speed shall be reduced as required to limit the kinetic energy of the closing doors to the values permitted by the ASME Code.

C. The doors shall operate smoothly without a slam in both the opening and closing direction. They shall be cushioned in their final movement in both directions of travel either by individual dashpots or by other equally effective approved methods. Electrical power shall be used to open and close doors.

D. Car Door Gibs: Provide each door panel with two removable plastic composition guides, arranged to run in sill grooves with a minimum clearance. The guide mounting shall permit their replacement without removing the door from the hangers. A steel fire stop shall be encased in each guide.

E. In case of interruption or failure of electric power from any cause, the door operating mechanism shall be so designated that it shall instantly permit emergency manual operation of both the car door and the hoistway door within the floor landing zones, and the hoistway door shall continue during emergency operation to be self-locking and self-closing. The door operator shall operate in conjunction with or be equipped with all interlocks and safety contacts specified.

F. All doors operating linkage shall be constructed of heavy steel members. All pivot points shall have either ball or roller bearings, or bronze bushed bearings of ample size. All brackets and other supports required to support door operating mechanism shall be furnished and installed.

G. The door operation shall be adjustable to allow for adjustment of the premature door opening time within the landing zone. The amount of time the door remains open shall be controlled through the door operator or through an electric beam device (as further specified).

H. Car Door Electrical Contact: A new electrical contact shall be provided and arranged to operate with the car doors so that the elevator cannot be operated unless the doors are closed or within the tolerance allowed by ASME Code.

I. Car Door Hangers and Tracks: Provide new to be compatible with new door operators.

J. Provide a new car door clutch compatible with new release roller assembly. Doors shall be provided with one clutch per door panel.

K. Provide new door restrictor compatible with applicable code.

L. Provide new door astragals.

2.13 HOISTWAY ENTRANCE DOOR - REFURBISH

A. Retain and refurbish existing hoistway entrance assemblies including frame and door panels at landings presently served.

B. Retain sight guards for hoistway doors.

C. Secure all existing fascia.

D. Retain all existing dust covers.

E. Provide escutcheon holes with ferrules at all floors.

F. Replace door relating cables.

G. Provide new floor numbering on the hoistway side of the hoistway doors and/or walls at intervals as require by Code.

H. Provide new hangers for hoistway doors of the heavy-duty sheave type, consisting of two (2) ball bearing sheaves not less than 3 ¼ inches in diameter enclosed in steel housings. All sheave wheels shall rotate in a grease packed precision ball bearing. Each hanger shall be equipped with two (2) ball bearing upthrust rollers not less than 1 inch diameter with eccentric adjustment

I. Provide new tracks, which shall be of high carbon cold rolled or drawn steel, shaped, and finished to permit free movement of sheaves. Tracks shall not be less than 3

J. Provide each hoistway entrance with an approved positive electro-mechanical interlock. On center-parting doors, each door panel shall be individually protected with an interlock both electrically and mechanically. Interlock release roller assembly will include one fixed roller attached to the door mounting plate and one moveable roller which activates the interlock release assembly. Interlock shall prevent operation of elevator by normal operating devices, unless all hoistway doors are locked in closed position. Interlock shall also prevent opening of hoistway doors from landing side unless car is within that landing zone and is either stopping or stopped. Interlocks shall be unlockable from elevator car in case of power failure, only within the landing zone. Each hoistway door panel shall be provided with a mechanical closer, and will be self-closing in compliance with Code. The interlocks shall be G.A.L. manufacture or approved equal. Entrances with center-parting doors shall be provided with GAL MOCP interlocks.

K. Door Closers: Install new mechanical closers to assure self-closing of all shaft doors, independently and irrespective of the position of the car. Closers shall be of the sill mounted type manufactured by G.A.L. or an approved equal. Each hall door panel shall be equipped with a mechanical closer.

L. Door Gibs: Provide each door panel with two removable plastic composition guides, arranged to run in sill grooves with a minimum clearance. The guide mounting shall permit their replacement without removing the door from the hangers. A steel fire stop shall be encased in each guide.

M. Hoistway Door “Z” Bracket: Provide one new steel safety “Z” bar guide on the underside of all doors and securely fasten to the underside of the door with steel countersunk machine screws. Mount the safety “Z” guide adjacent to and in between the removable guides.

N. Provide new safety retainer as described in ASME A17.1 Rule 2.11.11.8 on all openings.

O. Replace door astragals.

P. All door equipment must conform to the latest edition of the ASME/A17.1 code.

2.14 DOOR REOPENING DEVICE - NEW

A. Provide a new infrared matrix door reopening device system with independent power supplies.

B. Nudging Action: In the event a detector edge is continually obstructed for a predetermined time interval (no less than 20 seconds) after automatic door closing has been initiated, a buzzer shall sound, and the doors shall be closed at a gentle reduced speed. Timers shall be individually adjustable. This feature must be adjustable for reduced car door closing force. This feature must also have the capability of being turned off on demand.

C. The unit shall be wired such that if power to the unit fails, the doors shall remain open.

2.15 COUNTERWEIGHT – REFURBISH

A. Existing counterweight frame shall be retained, modified, and adjusted for proper counterbalance. The elevator shall be suitably counterbalanced for smooth and economical operation. Counterweights shall be equal to the dead weight of elevator cab plus the engineered percent of the rated capacity. Contractor shall include up to 500 pounds of additional counterweight per elevator in their base bid. The frame shall be checked to ensure all members are fully secure.

B. Contractor shall provide a separate alternate price with their bid for a new counterweight frame and filler weights, in case a new frame becomes necessary. Contractor must include the complete cost of replacing the frame in their alternate price, including, but not limited to, a new buffer if there is a traveling buffer on the counterweight.

1. If additional counterbalancing will be required, the Contractor must inform the Owner and Elevator Consultant if this will cause any one of the following situations to occur:
2. The total loads imposed upon the sheave shaft will exceed the rated design criteria.
3. The additional weight will cause the building reactions to change by more than 5%.
4. The modified counterweight will cause change to the original design criteria.
5. The modified counterweight or additional cab weight will not comply with applicable elevator or building codes including, but not limited to, ASME A17.1 and all local codes and ordinances.

2.16 GUIDE RAILS – REUSE

A. Retain existing car and counterweight guide rails, brackets, and fixings.

B. Thoroughly clean all guide rails of grease, oil and other foreign substances, file and remove all rough edges and surfaces.

C. Tighten bracket bolts and guide clips for smooth and quiet operation of car and counterweight.

D. Correct rail alignment to produce a smooth, quiet ride and to achieve the ride quality criteria stated herein.

2.17 HOISTWAY LIMITS - NEW

A. New normal and final terminal stopping devices shall be provided for the elevator and conforming with Code requirements. Terminal stopping devices located in hoistway of the car and operated by cams shall be fitted with rollers having a rubber or other approved composition tread to provide practically silent operation when actuated by the cam.

B. New upper and lower terminal slowdown limit devices shall be provided and arranged to stop the car automatically from any speed obtained under normal operation within the top and bottom overtravels independent of the operating device.

2.18 TRAVELERS AND WIRING - NEW

A. Provide all elevators with complete new wiring in the hoistway, pit and machine rooms adequate for the proper operation of the equipment. Conductor shall be copper. The minimum size of conductors, exclusive of those which form an integral part of control devices and/or cabinets, shall be a minimum no. 14 for lighting or power circuits and no. 18 for operating, control, and signal circuits. All material used and method of installation shall conform to the NFPA National Electrical Code and/or local Building Department Code. All insulated wiring, control wiring and wiring in traveling cables shall be tag coded at their terminal in the machine room, shaft box, elevator cab junction box and push-button stations within the cab and shall agree with the submitted wiring diagrams.

B. Existing wire raceway may be reused. When additional wire raceway is required, it shall be zinc-coated rigid steel conduit, intermediate electrical conduit, electrical metallic tubing (EMT), or metal wireways and outlet boxes except for traveling cables. Flexible metal conduit may be used for short connections not subject to moisture, oil, or embedment in concrete. Connections to the controller shall be made in a manner that minimizes transmission of vibration or noise to the building. Hoistway raceway may be in rigid steel wiring duct. Threadless fittings shall not be used with rigid galvanized steel conduit. Electrical connections to machinery shall allow for one foot of lateral motion.

C. Travelers - New traveling cables shall be provided for all elevators and designed for elevator service in accordance with the NFPA National Electrical Code and/or local Building Department Code and shall be sufficiently flexible to readily adapt to all changes in the position of the elevator cab and hang straight without twist. The cables shall be capable of bending 360 degrees with an inside radius of one (1) foot without any permanent set and without cracking of the outer covering. The open loop shall show no tendency to twist upon itself. Cables shall have a flame-retarding and moisture-resistant outer cover. Each traveling cable shall contain 10 percent (10%) spare wires and, in any event, not less than two (2) spare wires. Traveling cables shall contain shielded wires for the intercommunication system.

D. Include all necessary wiring for in cab camera system including but not limited to Coaxial Cable sufficient for a CCTV system. The coaxial cable shall be terminated in the elevator pit, in a separately identified box. The other end of the coax cable shall be dead ended on one of the top corners of the elevator cab. In addition, a duplex GFCI outlet shall be located on the top corner of the elevator cab dedicated for camera power only.

E. Traveling cables exceeding 100 feet in length shall have steel supporting core cables and shall be suspended directly from them to relieve the conductors of strain.

F. Provide ten percent (10%) spare wires between the controller, selector, hatchway junction box and starter’s panel and also provide ten percent (10%) spare wires in each traveling cable. All spares shall be properly tagged or otherwise identified with clear and indelible markings. Install beam pads to prevent chafing of traveling cables.

G. Strain boxes shall be installed not over 80 feet apart.

2.19 PIT BUFFERS – NEW

A. Provide new oil buffers for car and counterweights.

B. Buffers shall comply with code for car speed and capacity.

C. Provide signage with visible engraved characters in the pit stating the maximum counterweight runby.

2.20 PIT DEVICES – NEW

A. Provide new pit stop switches as per code requirements.

B. Provide pit access ladder and platform for elevator nos. 3-4 as per code requirements.

C. Provide new counterweight guard.

2.21 ALARM BELLS - NEW

A. Provide new alarm bells, two (2) per elevator. Lobby bell to be located inside shaft at the entry level and the other bell shall be mounted underneath the platform or on top of the car. The bell located inside the shaft at the entry level shall be located at the rear of the hoistway wall and approximately eight (8) feet from the finished pit floor and shall not be obstructed by the counterweight frame.

B. Bells shall not be less than six inches (6”) in diameter.

C. All required bells shall ring when either the Alarm Button inside the elevator is operated or when the Emergency Stop Switch is activated.

D. The activation of the alarm shall enunciate in the emergency communication system as further specified.

E. Provide four (4) hour battery backup.

2.22 CAR FRAME AND PLATFORM – REUSE

A. Car Frame

1. Retain existing steel frame. Frame shall be completely cleaned and painted.

B. Car Platform

1. Retain the existing car platform and properly align and square it to the existing hall sills to provide equal running clearance at all floors. Platform shall be fire proofed as per code requirements.

C. Provide updated crosshead data plates. Crosshead data plate must indicate the speed, capacity, counterbalance percentage, number and size of ropes, breaking strength of ropes and individual weights of car frame, platform, safety, and cab enclosure.

2.23 TOE GUARD - NEW

A. Provide a new platform toe guard at each car entrance opening to extend below the car entrance opening as per Code requirements for safety reasons.

B. Toe guard shall be not less than the width of the widest hoistway entrance.

C. Toe guard shall extend down 48 inches.

2.24 SAFETY – NEW

A. Provide a governor-actuated mechanical safety device mounted under the car platform and securely bolted to the car sling. The car safety shall be sized for the capacity and speed noted herein.

B. When tripped, the safety mechanism shall engage the rails with sufficient force to stop a fully loaded car with an average rate of retardation within the limits stated in the Code.

C. Install a car safety marking plate of corrosion resistant metal and, in addition to the data required by the Code, indicate the manufacturer's name and manufacturer's catalog designation number for safety.

D. Make provisions to release the car safety. In no event shall the safety be released by downward motion of the car. Raising the car to reset the safety shall be allowed.

E. Provide an electrical safety plank switch that will interrupt the power to the hoist machine when the safety is set. Resetting the plank switch shall be separate from resetting the safety jaws.

2.25 CAB ENCLOSURES - REFURBISH

A. Contractor shall include in their price the Contractor's portion of the work as described in Part C of this subsection. Contractor shall also include an allowance of $40,000.00 per elevator for the Cab Company's portion of the work as described in Part B of this subsection. The owner reserves the right to deduct the allowance for Section B from the Contractor's price and obtain the cab interiors separately. In either event, the Contractor would still be responsible for their entire scope of work as indicated in Part C, including all required coordination to complete the installation of the cabs.

B. Pricing shall include but not be limited to all ventilation, lighting, emergency lighting with battery back-up, doors, flooring, base wainscoting, handrails, entrance columns, returns, strikes, transoms, all necessary cutouts and other cab associated appurtenances as requested by the Owner.

C. Contractor Scope:

1. As stated in the "Determination of Maximum Cab Weight" section of this specification, the Contractor shall make a determination of the maximum cab weight that can be allowed. This weight must be reported to the Owner, Elevator Consultant, and the Cab Company. It is the responsibility of the Contractor to ensure that all alterations shall not increase the original sum of the cab weight and capacity to change by more than 5% compared to the original design.
2. The Contractor must provide all information necessary to the Cab Company and Cab Designer to ensure that the equipment to be installed by the Contractor is accommodated in the design and manufacture of the cab.
3. Perform all necessary work to uninstall and remove the existing electrical and mechanical equipment.
4. Cab steadying plates and bumpers shall be adjusted or replaced as necessary prior to installation or reinstallation of car door equipment.
5. Provide all necessary coordination to ensure efficient and timely installation of the cab.
6. The Contractor is responsible to perform all work required to install and wire all new elevator

equipment being installed in the cab.

7. Contractor is to include the following in their price:
   a. Cab Flooring- Labor to remove existing flooring in its entirety.
   b. Cab Sub-Flooring
   c. Car Door Sill – Assume material to be brushed Nickel Silver
   d. Car Door Hangers
   e. Gate Switches
   f. One set of hanging cab wall pads for each elevator bank and capacity. The pads shall be appropriate for protection of the cab interior when the elevator is used as a service car. Each set must contain all accessories required for building personnel to easily hang the pads.
   g. Cab fans shall be replaced by Contractor.
   h. All work and materials for in-car camera's system.
8. Contractor is responsible to include in their price all permits, tests, fees, and all other costs required by the authorities having jurisdiction to complete the installation according to Code.
9. Contractor shall statically balance the cab after refurbishment is completed.
10. A balanced load test will be conducted when all work, including door equipment, wiring, cab, etc. has been completed.

2.26 ESCAPE HATCH SWITCH - NEW

A. Provide top of car escape hatch with switch with manual reset that stops the elevator when hatch is open or dislodged as per code requirements.

2.27 CAR TOP GUARD RAILING - NEW

A. Provide car top guard rails per local and state code requirements.

2.28 CAR BUTTON STATIONS - NEW

A. The main and auxiliary car station shall contain a series of push buttons to correspond to the landings served. The push buttons shall become individually illuminated as a button for the desired floor is pressed. These lights shall be extinguished as the call is answered. It shall also contain a door open and door close button.

B. The car station shall contain an emergency stop switch with red operating handles or buttons, which when activated shall be arranged to remove electric power from the driving-machine motor and brake. While the emergency stop switch is activated, the emergency alarm bell(s) shall sound. Activation of this switch shall not cancel registered car or corridor calls, and after the switch is released, the car shall continue to answer its registered calls. Also included shall be an alarm button connected to a bell under the car and at the lobby level.

C. The car station shall contain a service cabinet that shall include a fan or blower key switch, an inspection key switch to make normal operation inoperative for the purpose of using the top-of-car operation station, an independent, attendant key switch with direction buttons (as required for service elevators), emergency light test button, a car light key switch and a GFI outlet. These key switches shall be located behind a locked panel door.

D. Independent Service Operation

1. Each new car operating station shall be equipped with a key-operated switch labeled "IND." When placed in the "on" position, this switch shall cause the elevator to bypass all corridor calls and to travel directly to any floor chosen by registration of a car call. During independent

Service Operation, the elevator doors shall remain open at any landing until the door close push button, is pressed.

2. In case elevator is operating on the Independent Service mode and the Fire Emergency Recall system becomes activated, following a period not less than 10 seconds nor more than 30 seconds, the elevator shall automatically override Independent Service Operation and engage Phase I - Fire Emergency Recall Operation.

E. Firefighter's operation controls, auxiliary signals and mandated engraving shall be incorporated in each elevator to comply with all applicable elevator and fire codes as well as ADAAG.

F. Emergency lighting and audible and visual means of indication for overload shall be incorporated in each elevator to comply with all applicable elevator and fire codes as well as ADAAG. Emergency lighting shall be incorporated into cab lighting as opposed to a lens unit in the car station.

G. Car Position Indicator (New): Provide an LCD display type readout in each car station to show floor locations. The LCD display shall have characters shall be 2" high with a screen flush with panel surface of the fixture cover. One transmitter per elevator will be installed to supply the digital position indicators. IF LIGHTED PI: Provide a lighted position indicator with floor directories, which light when a car call is acknowledged. The director and position indicator will be located in the cab above the door. The owner's representative/architect will approve selection.

H. Provide an in-car voice annunciator system for each elevator in accordance with the following:

1. Multitude of standard messages such as but not limited to:
   a. Next direction of travel (i.e., "Going Up" of "going Down")
   b. Nudging Operation (i.e., "please stand clear of the doors)
   c. Floor designation (i.e., "Fourth Floor")
   d. Emergency Messages (initiated by fire service, emergency power, etc.)
   e. Floor Passing Signal
2. Custom Message Recordings Possible
3. Human Female or Male Voices-To Be Available in English or Spanish
4. Discrete Inputs
5. Include Hidden In-Car Speaker
6. Conforms to ADAAG 407.4.8.2

I. Auxiliary Car Station The auxiliary car station shall contain the same components except for the service cabinet features and fire service operation. Engravings shall be located on both main and auxiliary panels.

2.29 SWING FRONT – NEW

A. The main and auxiliary car button station shall be a full swing front return for the passenger elevators. The elevator contractor will be responsible and should include the pricing for all of the following in their base bid price.

B. Perform all necessary work to uninstall, remove and dispose of all existing car station equipment.

C. Provide all necessary coordination to ensure efficient and timely removal and installation of the car station and the swing front return.

D. Mount the sub-plate to the swing front return and wire in all components.

E. Perform all modifications to the cab or coordinate with the cab company to ensure that all

modifications are performed to allow for the installation of a new full swing front return car station, including removal of the existing return.

F. Produce approval drawings showing the design of the swing front return including the equipment to be installed within its surface. Finish to be chosen by the Owner.

G. Return must be installed to easily swing open no less than 90□ to allow easy access to the enclosed equipment.

H. Manufacture the full swing front returns according to approved drawings and compliant with all applicable codes.

2.30 COMMUNICATION – NEW

A. Provide an audio and visual intercommunication system for all elevators for two-way multi-path communication between the elevator car stations and master stations.

B. Intercommunication system shall be a complete two-way conversation multipath intercom system. The system shall include a talkback speaker in the elevator with the capability to initiate a call to the main lobby and the machine room and display provisions shall be provided on the same panel as the “PHONE” push button to with passenger who cannot verbally communicate.

C. Main machine room master shall be capable of calling any elevator, lobby, master, or sub-station.

D. Master station shall be mounted at the front desk located at the lobby entrance and shall be capable of calling all stations in the system.

E. Provide all necessary wire, conduit, fittings, mounting materials, etc., for a complete operating system.

F. Lobby station shall have a latch-in distress feature that will actuate a buzzer and illuminate the appropriate signal lamp whenever the alarm and/or stop button in an elevator is activated. This distress feature shall continue to function until manually reset.

G. Provide means to display video to observe passengers at any location on the car floor to emergency personnel for entrapment assessment shall be provided. The system shall be located at the fire command center where one is provided.

H. Four-hour battery backup to ensure operation of entire system without power.

I. The above system shall comply with ADA Accessibility Guidelines.

2.31 HALL BUTTON STATIONS – NEW

A. Provide new hall button stations for all landings served by the elevator. Stations shall include new up and down push-buttons at all intermediate landings and single button at terminal landings. All buttons will have acknowledging lights that shall become individually illuminated and shall be extinguished as the call is answered.

B. In the lobby fixture, provide fire service operation, communication failure, and provisions for emergency power indication all in compliance with applicable code requirements.

C. Contractor is responsible for all cutting and rough patching required for new hall stations. Required finishing shall be performed by Owner.

D. Hall button stations shall be ADA compliant.

E. Provide standard plates: The cover plates shall be flush mounted and standard size, and the location shall be set to ADA compliant height. Extended plates shall not be allowed. Contractor must remove old covers and boxes completely.

2.32 CAR TRAVELING LANTERNS – NEW

A. Provide new car arrival lantern mounted on the car return or strike post visible from a location in the hall near the push button when the car door is open. A gong mounted in the lantern unit will sound once to indicate that the car will be traveling in the “UP” direction and will sound twice to indicate that the elevator will be traveling in the “DOWN” direction.

2.33 LOBBY POSITION INDICATOR – NEW

A. Provide digital readout for lobby hall LED position indicator at all floors. The characters should be 2” high with a screen flush with panel surface fixture cover. Provide new existing box and provide new wiring. The finish of the fixture that houses the new LED for each car will be selected by Owner.

2.34 HOISTWAY ACCESS SWITCH – NEW

A. Install an approved key switch at top and bottom terminal landings to permit the elevator to be moved at inspection speed with the hoist way doors open at that landing only. The car will only travel a distance necessary for authorized persons to obtain access to the top of car or pit area.

2.35 LOBBY COMMAND PANEL – NEW

A. Provide a new lobby panel. The Contractor shall be responsible for removal of existing panel and wires.

B. The new lobby panel shall be capable of interfacing with the existing elevators in the building that are not being modernized. The Contractor shall include any cost and labor necessary to interface those elevators as part of this scope.

C. Fixture faceplate and details shall be chosen in accordance with building representative.

D. The Contractor shall be responsible for running the wiring and conduit from closest elevator hoistway of each group.

E. Panel shall include the following features:

1. Hands free phone to communicate between the lobby desk, all elevators and machine rooms.
2. A digital position indicator with direction indicator for each elevator. An engraving of the elevator number and floors served shall be located directly above or below each indicator.
3. A rotary key switch to select between automatic or manual selection of which elevator of each grouping will run on emergency power after the lowering phase. Next to the key switch shall be a button for reset and each elevator in the group to select the device to run on emergency power when the key switch is set to manual. Emergency power operation shall be in compliance with the building’s capabilities.
4. An emergency power indicator for each grouping of elevators.
5. An emergency power indicator for each individual elevator.
6. Individual Iindicators to show when each elevator is at the main lobby with its doors open.
7. An in-service light for each individual elevator.

8. A fire service indicator for each grouping of elevators.
9. A fire service key switch for each grouping of elevators.

2.36 SIGNAGE

A. Provide a sign in the machine room stating the range of temperature and humidity as specified by the equipment manufacturer and as required by A17.1.

B. Floor Numbers - Provide floor numbering on the hoistway side of the hoistway doors and/or walls at a minimum of 4” in height and at intervals as required by Code.

C. Properly identify the following equipment with the car number assigned to it. Number shall be a minimum 2” in height and painted, engraved, or securely attached to:

1. Driving Machine
2. Controller
3. Transformers
4. Governors
5. Selector
6. Buffers
7. Main Line Disconnect Switches
8. Crosshead
9. Car Station
10. Adjacent to or on the entrance at the designated level – 3” in height

2.37 ALTERNATE NO. 1 - COUNTERWEIGHT FRAME

A. Install new counterweight frame with filler weights (including all material and labor for related work necessary to replace the frame). Price given should be price to provide new frames, filler weights and counterweight safeties for all traction elevators.

2.38 ALTERNATE NO. 2 - ELEVATOR MANAGEMENT SYSTEM

A. The Elevator Management System must be hard wired from each machine room to the EMS computer. The use of Modems shall not be acceptable. Contractor is responsible for all necessary wiring.

B. Any passwords or passcodes set on either the monitor or the control system itself must be provided in writing to the building owner and consultant. Updates should be given any time changes are made to passwords or passcodes.

C. Provide a desk type interactive computer-based elevator management system (EMS) with multi-display terminals for all elevators. The system shall include:

1. One desk mounted multicolor high resolution flat-panel LCD with a minimum of 17” LCD screen, a computer, and a keyboard at the following Locations:
   a. Lobby desk. Location to be coordinated with Owner.
   b. Building management office.
   c. Each machine room.
2. Serial communication ports, parallel printer ports, power supply and field wire termination shall also be provided.
3. Coordinate space and design requirements with Manager.

D. Monitors for the passenger elevators shall display the information in graphic or tabular form as

follows:

1. Graphic Status Display: An elevation representation of every car in a group shall show for one group at a time per monitor unit.
   a. Floor status
   b. Group operational mode
   c. Car status
   d. Hall calls
   e. Date and time, building and group identification.
2. Tabular Status Display: The information as indicated above except for registered hall and car calls and floor security status shall be displayed on screen simultaneously for all groups connected to the EMS for tabular format.
3. Elevator Alarm and Event Data Display: EMS shall monitor various discrete signals from the elevator system and retain a log of up to the last 200 alarms/events.
4. Security Display and Operation: The system shall display one group at a time on each screen and from the keyboard shall allow modification of the security status of the car in the group, including floors the car is allowed to serve, floors that the car is secured from serving and floors that are cut out from having hall calls registered from them.
5. Interactive Elevator Operations Display and Control: The ability to use the keyboard to initiate and display interactive elevator operations, including, but not limited to, the following shall be provided:
   a. Display faults and events
   b. Alarm messages
   c. Car and hall calls
   d. Modifications of some elevator parameters such as door times, etc.
   e. Security car and hall push button locks shall be controlled on a per unit, per landing, per car or per group basis with fire control over-rides per code.
6. Performance Monitoring Display: The ability to view and print performance data for each group connected to the EMS shall be provided. The following screens shall be provided:
   a. The car operations screen showing the number of door operators, door reversals and car runs.
   b. The car timing averages screen, showing averages for flight time, door opening and closing.
   c. The hall calls screen shall show per group basis the number of hall calls in each direction broken down into the number answered in specified intervals.
   d. The landing summary screen.
7. Traffic Analysis Display: The capability shall be provided to view various reports generated from the data. Using the program provided for viewing, the dedicated EMS PC may be used for viewing if the EMS program is exited. The following information for each group shall be shown in reports:
   a. Total number of hall calls (up/down)
   b. Average waiting times (up/down)
   c. Maximum wait and time at which it occurred.
   d. Number of car calls per car
   e. Number of hall and car calls per landing (up/down)
   f. Average waiting time per landing
   g. Histogram of registration times
   h. Performance records: For preset, adjustable time intervals, for each car, a summary will be given of the number of door operations and car runs and averages will be given of flight times and door times.
   i. Record of every car and hall call registered.
   j. Record of all events and alarms

E. All car and group variables can be displayed and altered. Parameters are displayed, when selected, with a full explanation, including minimum, maximum and current values.

F. The system provides interactive control of features provided in the elevator control system. These features may be revised as the requirements of the building change. Some of these interactive controls may include but are not limited to: security floor lockouts, entering car and hall calls, Fireman's return service, lobby recall, Up/Down peak or hospital Code Blue service. Local codes may affect the availability or operation of these features. All field adjustable variables shall be adjustable through a user interface provided with the controller and also with a laptop computer.

PART 3 EXECUTION

3.1 ACCESSIBILITY REQUIREMENTS

A. All elevators to conform to the Code and ADA Accessibility Guidelines requirements including the following:

1. Provide markings on the car panel adjacent to the floor and control buttons on a contrasting color background to the left of the buttons. Letters and numbers shall be a minimum of 5/8" and raised .03" with Braille indications.
2. Provide floor designations at each entrance on both sides of jamb at a height of 60" above the floor. Designations shall be 2" high, raised .03" and shall be as selected by the Owner's architect with Braille indications on polished stainless-steel plates secured with tamperproof hardware.
3. All push buttons shall be designed and configured in accordance with ADA requirements.
4. The centerline of the new hall push button station shall be 42" above the floor line.
5. Provide an audible signal to tell passengers that the car is stopping or passing a floor served by the elevator.
6. Provide control non-interference door dwell timing features in accordance with ADA requirements.
7. Provide hearing-impaired signaling in accordance with ADA requirements.

3.2 PERFORMANCE REQUIREMENTS

A. Elevators shall be adjusted to meet these performance requirements.

B. Floor to Floor Performance Time: The floor-to-floor performance time is defined as the time elapsed from the time the elevator doors begin to close until the elevator doors are open 3/4 of the way on a one floor run. This time must be equal to or better than 9.0 seconds.

C. Door operating times:

1. Door Opening Time: The time should equal or better than 1.7 seconds.
2. Door Closing Time: This time should equal or better than 2.4 seconds.
3. Non-interference Door Open Duration Time - (stop for car call): adjustable to ten (10) seconds; set to A117.1 standards minimum of three (3) seconds per ADA standards.
4. Non-interference Door Open Duration Time (stop for corridor call): adjustable to twenty (20) seconds; set to A117.1 and ADA standards minimum based on distance from corridor push button and five (5) second advance audible signal provisions.
5. Reduced non-interference time (short door dwell after interruption of photo eye beam and re-establishment of safety provision): adjustable to ten (10) seconds set to one (1) second.
6. Lobby dispatch time: adjustable to sixty (60) seconds; set to five (5) seconds subject to loading, system programming and demand factors.

D. Operating speed: 5% plus or minus rated speed in both directions of travel under load and no-load conditions.

E. Door closing force shall be adjusted for a maximum of 30 lb., measured on the leading edge of the door with the door stopped at any point between one third and two thirds of its travel.

F. Install and adjust elevator equipment to comply with the following:

1. Noise levels inside the car shall not exceed the following:
   a. Car at rest with doors closed and fan off – 40 dba.
   b. Car at rest with doors closed and fan running – 55 dba.
   c. Car running at high speed and fan off – 50 dba.
   d. Door in operation – 60 dba.
2. The maximum horizontal peak-to-peak vibration (using the ISO-weighted filter) shall not exceed 15.0 milli-g in either the front-to-back or side-to-side direction, under any circumstances or conditions, from the time the elevator begins to move until it comes to rest.
3. The maximum vertical peak-to-peak vibration (using the ISO-weighted filter) shall not exceed 20.0 milli-g under any circumstances or conditions, from the time the elevator begins to move until it comes to rest.
4. The Contractor is required to provide a ride-quality analysis printout identifying measured vibration in the X, Y, and Z directions in milli-g units throughout a complete run of the elevator in the up direction and in the down direction. Data shall be filtered using the appropriate filter mentioned herein. Results must confirm that the maximum peak-to-peak vibration does not exceed the values required herein. Analysis must also include noise levels, velocity, acceleration, and jerk rates. Analysis will be performed by contractor after turnover of each car and submitted to owner and consultant.

G. Contractor shall be responsible for performing a ride quality analysis prior to start of any work and upon competition.

H. Statically balance the cab.

3.3 PAINTING

A. The following equipment shall be clearly identified by number using two-inch stenciled numerals: crosshead, pit equipment, stop switches, and all machine room and secondary equipment (including but not limited to machines, controllers, drives, transformers, mainline and auxiliary disconnects, etc.)

B. The pit area shall be completely cleaned and painted from the pit floor up to the floor level of the first opening. This shall include the floor, walls, and all pit elevator equipment including the rails.

C. The top of the elevator shall be completely cleaned and painted. Painting shall include the top of the cab, stiles, crosshead, and all other top of car related equipment.

D. The machine room shall be completely cleaned and painted. Painting shall include the floors, walls, bedplate, machine, pipes, and troughing.

E. The counterweight shall be cleaned and painted.

END OF SECTION

SECTION 230500

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

A. The requirements of this Section apply to all sections of Division 23.

B. Definitions:

1. “Concealed”: Piping, ductwork, and equipment concealed from view and protected from physical contact by building occupants.
2. “Exposed”: Piping, ductwork, and equipment exposed to view in finished rooms.
3. “Finished”: 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.
4. “Furnish”: purchase and supply all materials, labor, equipment, testing apparatus, controls, tests, accessories and all other items customarily required for the proper and complete application for the particular work referred to.
5. “Install”: join, unite, fasten, link, attach, set up or otherwise connect together before testing and turning over to the Owner, complete and ready for regular operation, the particular work referred to.
6. “Option” or “optional”: Contractor's choice of an alternate material or method.
7. “Provide”: Furnish and Install.

1.2 RELATED WORK

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. All sections within Division 23 – Heating, Ventilating, and Air Conditioning.
2. All sections within Division 01 – General Requirements.
3. Relevant sections within Division 02 – Existing Conditions
4. Relevant sections within Division 05 – Metals
5. Relevant sections within Division 07 – Thermal and Moisture Protection
6. Relevant sections within Division 08 – Openings
7. Relevant sections within Division 09 – Finishes
8. Relevant sections within Division 21 – Fire Suppression
9. Relevant sections within Division 22 – Plumbing
10. Relevant sections within Division 26 – Electrical

1.3 QUALITY ASSURANCE

A. Mechanical, electrical and associated systems shall be safe, reliable, efficient, durable, easily and safely operable and maintainable, easily and safely accessible, and in compliance with

applicable codes as specified. The systems shall be comprised of high quality institutional-class and industrial-class products of manufacturers that are experienced specialists in the required product lines. All construction firms and personnel shall be experienced and qualified specialists in industrial and institutional HVAC.

B. Products Criteria:

1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years (or longer as specified elsewhere). The design, model and size of each item shall have been in satisfactory and efficient operation on at least three installations for approximately three years. However, digital electronics devices, software and systems such as controls, instruments, computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least three years. See other specification sections for any exceptions and/or additional requirements.
2. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
3. Conform to codes and standards as required by the specifications. Conform to local codes, if required by local authorities such as the natural gas supplier, if the local codes are more stringent than those specified. Refer any conflicts to the Engineer.
4. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
5. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
6. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
7. Asbestos products or equipment or materials containing asbestos shall not be used.

C. Equipment Service Organizations:

1. HVAC: Products and systems shall be supported by service organizations that maintain a complete inventory of repair parts and are located within 50 miles to the site.

D. HVAC Mechanical Systems Welding: Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:

1. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications".
2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
3. Certify that each welder has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.

E. Execution (Installation, Construction) Quality:

1. Apply and install all items in accordance with manufacturer's written instructions. Refer conflicts between the manufacturer's instructions and the contract drawings and specifications to the Engineer for resolution.
2. Provide complete layout drawings as required by Paragraph “SUBMITTALS” below. Do not commence construction work on any system until the layout drawings have been approved.

F. Upon request, provide lists of previous installations for selected items of equipment. Include contact persons who will serve as references, with telephone numbers and e-mail addresses.

1.4 SUBMITTALS

A. Submit in accordance with Division 01, and with requirements in the individual specification sections.

B. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements.

C. If equipment is submitted which differs in arrangement from that shown, provide drawings that show the rearrangement of all associated systems. Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.

D. Prior to submitting shop drawings for approval, contractor shall certify in writing that manufacturers of all major items of equipment have each reviewed drawings and specifications, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.

E. Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together and complete in a group. Coordinate and properly integrate materials and equipment in each group to provide a completely compatible and efficient.

F. Manufacturer's Literature and Data: Submit under the pertinent section rather than under this section.

1. Submit belt drive with the driven equipment. Submit selection data for specific drives when requested by the Engineer.
2. Submit electric motor data and variable speed drive data with the driven equipment.
3. Equipment and materials identification.
4. Fire-stopping materials.
5. Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers.
6. Wall, floor, and ceiling plates.

G. HVAC Maintenance Data and Operating Instructions:

1. Maintenance and operating manuals in accordance with Division 01, for systems and equipment.
2. Provide a listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment. Include in the listing belts for equipment: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.

H. Provide copies of approved HVAC equipment submittals to the Testing, Adjusting and Balancing Subcontractor.

1.5 COORDINATION DRAWINGS

A. Coordinate all new work with existing structure and with existing work which is to remain. Note all existing conditions which may interfere with new work as shown on the documents of this trade and of all other trades which are part of this project. In form the Architect and Engineers of all such conditions in writing with sufficient time to address the conflicts so as not to affect project schedule.

B. Prepare a complete set of construction Coordination Drawings indicating the equipment actually purchased and the exact routing for all lines such as piping, busway, conduit, ductwork, etc., including conduit embedded in concrete. Use the sheetmetal shop drawings as the base drawings to which all other contractors will add their work.

C. Color Coordinated drawings (with different color per trade) shall be provided for all areas with acceptance sign off from all trades required at time of shop drawing submittals, including, but not limited to:
   1. Plumbing Contractor
   2. Electrical Contractor
   3. IT Contractor
   4. AV Contractor
   5. Ceiling Support Contractor
   6. General Contractor
   7. Testing Adjusting and Balancing Contractor
   8. Controls Contractor
   9. Fire Sprinkler Contractor
   10. Fire Alarm Contractor

D. Drawings shall indicate coordination with work in other Divisions which must be incorporated in mechanical spaces, including, but not limited to:
   1. Irrigation Equipment and Piping.
   2. Elevator Equipment.
   3. Electrical Equipment.
   4. Cable Trays.
   5. Architectural features, including doors and partitions
   6. IT/Electrical outlets
   7. Plumbing equipment

E. Indicate piping loads and support points for all piping 4" and larger, racked piping, racked conduit, and busway, and submit to the Structural Engineer for review and approval. Indicate the elevation, location, support points, static, dynamic and expansion forces and loads imposed on the structure at support, anchor points, and size of all lines. Indicate all beam penetrations and slab penetrations sized and coordinated. Indicate all work routed underground or embedded in concrete by dimension to column and building lines.

F. Work installed which interferes with work of any other trade will be corrected at no cost to the project.

1.6 COORDINATION

A. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces.

B. Cooperate with all other Divisions performing work on this project as necessary to achieve a complete neatly fitted installation for each condition. Consult the Drawings and Specifications to

determine nature and extent of work specified in other Divisions that adjoins, shares space with, or attaches to the work of this Division. Confer with other Divisions at the site to coordinate this work with theirs in view of job conditions to the end that interferences may be eliminated and that maximum headroom and clearance may be obtained. In the event that interferences develop, the Owner's Representative's decision will be final as to which Division shall relocate its work, and no additional compensation will be allowed for the moving of piping, ductwork, conduit or equipment to clear such interferences.

C. The mechanical drawings show the general arrangement of equipment, ductwork, piping and appurtenances. Follow these drawings as closely as the actual construction and the work of other trades will permit. Provide offsets, fittings, and accessories which may be required but not shown on the drawings. Investigate the site, structural and finish ground conditions affecting the work, and arrange the work accordingly. Provide such work and accessories as may be required to meet such conditions, at no additional cost to the project.

D. Examine and compare the contract drawings and specifications with the drawings and specifications of other trades, and report any discrepancies between them to the Engineer and obtain from him written instructions for changes necessary in the work. Install and coordinate the work in cooperation with other related trades. Before installation, make proper provisions to avoid interferences.

E. Wherever the work is of sufficient complexity, prepare additional detail drawings to scale similar to that of the design drawings, prepared on tracing medium of the same size as contract drawings. With these layouts, coordinate the work with the work of other trades. Such detailed work to be clearly identified on the drawings as to the area to which it applies. Submit these drawings to the Engineer for review. At completion include a set of such drawings with each set of as-built drawings.

1.7 DELIVERY, STORAGE AND HANDLING

A. Protection of Equipment:

1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Owner has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.
2. Place damaged equipment in first class, new operating condition; or, replace same as determined and directed by the Engineer. Such repair or replacement shall be at no additional cost.
3. Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before painting or placing equipment in operation.
4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

B. Cleanliness of Piping and Equipment Systems:

1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.
2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
3. Clean interior of all tanks prior to delivery
4. Boilers shall be left clean following final internal inspection

5. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

1.8 JOB CONDITIONS – WORK IN EXISTING BUILDING

A. Building Operation: Employees will be continuously operating and managing all facilities, including temporary facilities that serve the building.

B. Maintenance of Service: Schedule all work to permit continuous service as required by the medical center.

C. Phasing of Work: Comply with all requirements shown on drawings or specified.

D. Building Working Environment: Maintain the architectural and structural integrity of the building and the working environment at all times. Maintain the interior of building at 65 degrees F minimum. Limit the opening of doors, windows or other access openings to brief periods as necessary for rigging purposes. No storm water or ground water leakage permitted. Provide daily clean up of construction and demolition debris on all floor surfaces and on all equipment.

E. Acceptance of Work: As new facilities are made available for operation and these facilities are of beneficial use, inspections will be made and tests will be performed. Based on the inspections, a list of contract deficiencies will be issued to the Contractor. After correction of deficiencies as necessary for beneficial use, the Contracting Officer will process necessary acceptance and the equipment will then be under the control and operation of the Owner.

PART 2 - PRODUCTS

2.1 FACTORY-ASSEMBLED PRODUCTS

A. Provide maximum standardization of components to reduce spare part requirements.

B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.

1. All components of an assembled unit need not be products of same manufacturer.
2. Constituent parts that are alike shall be products of a single manufacturer.
3. Components shall be compatible with each other and with the total assembly for intended service.
4. Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

C. Components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a name plate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

D. Major items of equipment, which serve the same function, must be the same make and model. Exceptions will be permitted if performance requirements cannot be met.

2.2 COMPATIBILITY OF RELATED EQUIPMENT

Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational plant that conforms to contract requirements.

PART 3 - EXECUTION

3.1 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

A. Coordinate location of piping, sleeves, inserts, hangers, ductwork and equipment. Locate piping, sleeves, inserts, hangers, ductwork and equipment clear of windows, doors, openings, light outlets, and other services and utilities. Prepare equipment layout drawings to coordinate proper location and personnel access of all facilities. Submit the drawings for review as required by Part 1. Follow manufacturer's published recommendations for installation methods not otherwise specified.

B. Operating Personnel Access and Observation Provisions: Select and arrange all equipment and systems to provide clear view and easy access, without use of portable ladders, for maintenance and operation of all devices including, but not limited to: all equipment items, valves, filters, strainers, transmitters, sensors, control devices. All gages and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Do not reduce or change maintenance and operating space and access provisions that are shown on the drawings.

C. Equipment and Piping Support: Coordinate structural systems necessary for pipe and equipment support with pipe and equipment locations to permit proper installation.

D. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.

E. Cutting Holes:

1. Cut holes through concrete and masonry by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill will not be allowed, except as permitted by Owner where working area space is limited.
2. Locate holes to avoid interference with structural members such as beams or grade beams. Holes shall be laid out in advance and drilling done only after approval by Owner. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to Owner for approval.
3. Do not penetrate membrane waterproofing.

F. Protection and Cleaning:

1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the Owner. Damaged or defective items in the opinion of the Owner, shall be replaced.
2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water chemical, or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.

G. Install gages, thermometers, valves and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position thermometers and gages to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.

H. Install steam piping expansion joints as per manufacturer's recommendations.

I. Switchgear/Electrical Equipment Drip Protection: Every effort shall be made to eliminate the installation of pipe above electrical and telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints. Installation of piping, ductwork, leak protection apparatus or other installations foreign to the electrical installation shall be located in the space equal to the width and depth of the equipment and extending from to a height of 6 ft. above the equipment or to ceiling structure, whichever is lower (NFPA 70).

J. Inaccessible Equipment:

1. Where the Owner determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost.
2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

3.2 TEMPORARY PIPING AND EQUIPMENT

A. Continuity of operation of existing facilities will generally require temporary installation or relocation of equipment and piping.

B. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be properly supported, sloped to drain, operate without excessive stress, and shall be insulated where injury can occur to personnel by contact with operating facilities. The requirements of Paragraph 3.1 apply.

C. Temporary facilities and piping shall be completely removed and any openings in structures sealed. Provide necessary blind flanges and caps to seal open piping remaining in service.

3.3 RIGGING

A. Design is based on application of available equipment. Openings in building structures are planned to accommodate design scheme.

B. Alternative methods of equipment delivery may be offered by Contractor and will be considered under specified restrictions of phasing and maintenance of service as well as structural integrity of the building.

C. Close all openings in the building when not required for rigging operations to maintain proper environment in the facility for operation and maintenance of service.

D. Contractor shall provide all facilities required to deliver specified equipment and place on foundations. Attachments to structures for rigging purposes and support of equipment on

structures shall be Contractor's full responsibility. Upon request, the Owner will check structure adequacy and advise Contractor of recommended restrictions.

E. Contractor shall check all clearances, weight limitations and shall offer a rigging plan designed by a Registered Professional Engineer. All modifications to structures, including reinforcement thereof, shall be at Contractor's cost, time and responsibility.

F. Rigging plan and methods shall be referred to Owner for evaluation prior to actual work.

G. Restore building to original condition upon completion of rigging work.

3.4 MECHANICAL DEMOLITION

A. Rigging access, other than indicated on the drawings, shall be provided by the Contractor after approval for structural integrity by the Owner. Such access shall be provided without additional cost or time. Where work is in an operating plant, provide approved protection from dust and debris at all times for the safety of plant personnel and maintenance of plant operation and environment of the plant.

B. In an operating facility, maintain the operation, cleanliness and safety. Personnel will be carrying on their normal duties of operating, cleaning and maintaining equipment and plant operation. Confine the work to the immediate area concerned; maintain cleanliness and wet down demolished materials to eliminate dust. Do not permit debris to accumulate in the area to the detriment of plant operation. Perform all flame cutting to maintain the fire safety integrity of this plant. Adequate fire extinguishing facilities shall be available at all times. Perform all work in accordance with recognized fire protection standards.

C. Completely remove all piping, wiring, conduit, and other devices associated with the equipment not to be re-used in the new work. This includes all pipe, valves, fittings, insulation, and all hangers including the top connection and any fastenings to building structural systems. Seal all openings, after removal of equipment, pipes, ducts, and other penetrations in roof, walls, floors, in an approved manner and in accordance with plans and specifications where specifically covered. Structural integrity of the building system shall be maintained. Reference shall also be made to the drawings and specifications of the other disciplines in the project for additional facilities to be demolished or handled.

D. All valves including gate, globe, ball, butterfly and check, all pressure gages and thermometers with wells shall remain property of the Owner and shall be removed and delivered to Owner and stored as directed. The Contractor shall remove all other material and equipment, devices and demolition debris under these plans and specifications. Such material shall be removed from the property expeditiously and shall not be allowed to accumulate.

E. Existing refrigerants shall be recovered and disposed properly in an approved fashion. Refrigerants shall be purged into a refrigeration canister and disposed of at a recycling center.

3.5 CLEANING AND PAINTING

A. Prior to final inspection and acceptance of the plant and facilities for beneficial use, the plant facilities, equipment and systems shall be thoroughly cleaned and painted.

B. In addition, the following special conditions apply:

1. Cleaning shall be thorough. Use solvents, cleaning materials and methods recommended by the manufacturers for the specific tasks. Remove all rust prior to painting and from surfaces to remain unpainted. Repair scratches, scuffs, and abrasions prior to applying prime and finish coats.
2. Material And Equipment Not To Be Painted Includes:
   a. Motors, controllers, control switches, and safety switches.
   b. Control and interlock devices.
   c. Control valves and thermostatic elements.
   d. Lubrication devices and grease fittings.
   e. Copper, brass, aluminum, stainless steel and bronze surfaces.
   f. Valve stems and rotating shafts.
   g. Pressure gauges and thermometers.
   h. Glass.
   i. Name plates.
3. Control and instrument panels shall be cleaned, damaged surfaces repaired, and shall be touched-up with matching paint obtained from panel manufacturer.
4. Pumps, motors, steel and cast iron bases, and coupling guards shall be cleaned, and shall be touched-up with the same color as utilized by the pump manufacturer
5. Temporary Facilities: Apply paint to surfaces that do not have existing finish coats.
6. Paint shall withstand the following temperatures without peeling or discoloration:
7. Final result shall be smooth, even-colored, even-textured factory finish on all items. Completely repaint the entire piece of equipment if necessary to achieve this.

3.6 LUBRICATION

A. Lubricate all devices requiring lubrication prior to initial operation. Field-check all devices for proper lubrication.

B. Equip all devices with required lubrication fittings or devices. Provide a minimum of one quart of oil and one pound of grease of manufacturer's recommended grade and type for each different application; also provide 12 grease sticks for lubricated plug valves. Deliver all materials to Owner in unopened containers that are properly identified as to application.

C. Provide a separate grease gun with attachments for applicable fittings for each type of grease applied.

D. All lubrication points shall be accessible without disassembling equipment, except to remove access plates.

3.7 STARTUP AND FIELD ADJUSTMENT

A. Startup Service:

1. Prior to startup, ensure that systems are ready, including checking the following: Proper equipment rotation, proper wiring, auxiliary connections, lubrications, venting fan balance, controls and installed properly set relief and safety valves.
2. Start and operate all systems. Provide services of factory trained technicians for startup of major equipment and systems including boilers, fire pumps, etc.

B. Contractor shall be responsible to change or adjust belts, drives, pulleys, motors, impellers, as required by balancing company to achieve the desired air and water delivery in an energy efficient manor by all air handling equipment, fans and pumps. Refer to Section 23 05 93.

C. Start up equipment as described in equipment specifications. Verify that vibration is within specified tolerance prior to extended operation.

3.8 OPERATING AND PERFORMANCE TESTS

A. Prior to the final inspection, perform required tests as specified in Division 01 and submit the test reports and records to the Engineer.

B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost.

C. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then make performance tests for heating systems and for cooling systems respectively during first actual seasonal use of respective systems following completion of work.

3.9 OPERATING INSTRUCTIONS

A. Each Contractor shall thoroughly instruct the representative(s) of the Owner, to the complete satisfaction of the Architect, in the proper operation of all systems and equipment provided by him. Each Contractor shall make arrangements, via the Prime Contractor as to whom the instructions are to be given in the operation of the basic and auxiliary systems and the periods of time in which they are to be given.

B. The Architect shall be completely satisfied that the representative of the Owner has been thoroughly and completely instructed in the proper operation of all systems and equipment before final payment is made. If the Architect determines that complete and thorough instructions have not been given by each Contractor to the Owner's representative, then each Contractor shall be directed by the Architect to provide whatever instructions are necessary until the intent of this paragraph of the specification has been complied with. All time required for Owner's instruction to satisfy the above requirements shall be included in this Contract. No extra compensation for such instructions will be allowed.

C. Provide operating instructions and maintenance data books for all equipment and materials furnished under this Division.

D. Maintenance instruction manuals to include complete oiling, cleaning, and servicing data compiled in clearly and easily understandable form. Show all model numbers of each piece of equipment, complete lists of replacement parts, motor ratings, and actual loads. Include for each piece of equipment the name, address, e-mail address, and phone number of service personnel.

END OF SECTION 230500

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 poly-phase, general-purposed, 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 the requirements of this section except when stricter requirements are specified in HVAC equipment schedules or sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

C. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C 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 POLY-PHASE MOTORS

A. Description: NEMA MG, 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: Re-greaseable, 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 fram sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

1. 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.
2. Motors Used with Variable Frequency Controllers: Rating, characteristics, and feature coordinate with an approved by control manufacturer.
    a. 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.
    b. Energy-and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
    c. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
    d. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
3. Sever-Duty Motors: Comply with IEEE 842, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

1. Motors larger than 1/20 HP shall be on of the following, to suit starting torque and requirements of specific motor application:
    a. Permanent-split capacitor
    b. Split phase
    c. Capacitor start, inductor run
    d. Capacitor start, capacitor run
2. Multispeed Motors: Variable-torque, permanent split-capacitor type.
3. Bearings: Pre-lubricated, anti-friction ball bearings or sleeve bearings suitable for radial and thrust loading.
4. Motors 1/20 Hp and Smaller: Shaded-pole type.
5. Thermal Protection: Internal protection to automatically open power supply circuit ot 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 230529

HANGERS AND SUPPORTS 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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Equipment supports.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 230516 "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
3. Section 230548 "Vibration and Seismic Controls for HVAC" for vibration isolation devices.
4. Section 233113 "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

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.
3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Design Calculations: Calculate requirements for designing trapeze hangers.

D. Welding certificates.

1.6 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 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 or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
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.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, 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, and U-bolts.

2.3 METAL FRAMING SYSTEMS

A. Manufacturer Metal Framing Systems:

1. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
2. Standard: Comply with MFMA-4.
3. Channels: Continuous slotted steel channel with inturned lips.
4. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
6. Coating: Zinc.

2.4 THERMAL-HANGER SHIELD INSERTS

A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

B. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 PIPE STANDS

A. General Requirements for Pipe Stands: 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.

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:

1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Stainless steel.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, 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 carbon-steel shapes.

2.8 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-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.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal 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 the building structure.

B. Metal 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 for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.

G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

I. 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.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. 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.

L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. 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.

N. Insulated Piping:

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 allowed by 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.

    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.

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 or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 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 bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 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/D1.1M 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 so contours of welded surfaces match adjacent contours.

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 1-1/2 inches.

3.5 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 a minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

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-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 carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.

F. Use stainless-steel pipe hangers and fiberglass pipe hangers and fiberglass strut systems and stainless-steel or corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. 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 non-insulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of non-insulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of non-insulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of non-insulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.

19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

K. 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.

L. 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.

M. 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. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. 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.

c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. 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.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

a. Horizontal (MSS Type 54): Mounted horizontally.
b. Vertical (MSS Type 55): Mounted vertically.
c. Trapeze (MSS Type 56): Two vertical type supports and one trapeze member.

P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

SECTION 230548

VIBRATION AND SEISMIC CONTROLS FOR HVAC

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. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Open-spring isolators.
5. Housed-spring isolators.
6. Restrained-spring isolators.
7. Housed-restrained-spring isolators.
8. Pipe-riser resilient supports.
9. Resilient pipe guides.
10. Elastomeric hangers.
11. Spring hangers.
12. Snubbers.
13. Restraint channel bracings.
14. Restraint cables.
15. Seismic-restraint accessories.
16. Mechanical anchor bolts.
17. Adhesive anchor bolts.
18. Vibration isolation equipment bases.
19. Restrained isolation roof-curb rails.

B. Related Requirements:

1. Section 210548 "Vibration and Seismic Controls for Fire Suppression" for devices for fire-suppression equipment and systems.
2. Section 220548 "Vibration and Seismic Controls for Plumbing" for devices for plumbing equipment and systems.

1.3 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning & Development (for the State of California).

1.4 SUBMITTALS

A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.

a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.

1. Include design calculations and details for selecting vibration isolators, seismic restraints, and vibration isolation bases complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Design Calculations: Calculate static and dynamic loading due to equipment weight, operation, and seismic and wind forces required to select vibration isolators and seismic and wind restraints and for designing vibration isolation bases.

a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.

3. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.
4. Seismic and Wind-Restraint Details:

a. Design Analysis: To support selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.
b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.

c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
d. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

D. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

E. Qualification Data: For testing agency.

F. Welding certificates.

G. test data performed by an independent agency.

H. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: 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 and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Ace Mountings Co., Inc.
b. CADDY; a brand of nVent.
c. California Dynamics Corporation.
d. Isolation Technology, Inc.
e. Kinetics Noise Control, Inc.

f. Korfund.
g. Mason Industries, Inc.
h. Novia; A Division of C&P.
i. Vibration Eliminator Co., Inc.
j. Vibration Isolation.
k. Vibration Mountings & Controls, Inc.

2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
3. Size: Factory or field cut to match requirements of supported equipment.
4. Pad Material: Oil and water resistant with elastomeric properties.
5. Surface Pattern: Smooth, Ribbed, or Waffle pattern.
6. Infused nonwoven cotton or synthetic fibers.
7. Load-bearing metal plates adhered to pads.
8. Sandwich-Core Material: Resilient or elastomeric

a. Surface Pattern: Smooth, Ribbed, or Waffle pattern.
b. Infused nonwoven cotton or synthetic fibers.

2.2 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Ace Mountings Co., Inc.
b. CADDY; a brand of nVent.
c. California Dynamics Corporation.
d. Isolation Technology, Inc.
e. Kinetics Noise Control, Inc.
f. Korfund
g. Mason Industries, Inc.
h. Novia; A Division of C&P.
i. Vibration Eliminator Co., Inc.
j. Vibration Isolation.
k. Vibration Management Corp.
l. Vibration Mountings & Controls, Inc.

B. Mounting Plates:

a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.

2. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.3 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Ace Mountings Co., Inc.
b. CADDY; a brand of nVent.
c. California Dynamics Corporation.

d. Isolation Technology, Inc.
e. Kinetics Noise Control, Inc.
f. Korfund.
g. Mason Industries, Inc.
h. Novia; A Division of C&P.
i. Vibration Eliminator Co., Inc.
j. Vibration Isolation.
2. Vibration Management Corp.
3. Vibration Mountings & Controls, Inc.

B. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

a. Housing: Cast-ductile iron or welded steel.
b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.4 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators:

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.5 RESTRAINED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint.

1. Mason Industries
2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.

a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
b. Top plate with threaded mounting holes.
c. Internal leveling bolt that acts as blocking during installation.

3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.6 HOUSED-RESTRAINED-SPRING ISOLATORS

A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing.

1. Mason Industries
2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.

    a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
    b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.7 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
8. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.8 SNUBBERS

A. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
3. Maximum 1/4-inch air gap, and minimum 1/4-inch- thick resilient cushion.

2.9 RESTRAINT CHANNEL BRACINGS

A. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.10 RESTRAINT CABLES

A. Restraint Cables: ASTM A 603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.11 SEISMIC-RESTRAINT ACCESSORIES

A. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.12 MECHANICAL ANCHOR BOLTS

A. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.13 VIBRATION ISOLATION EQUIPMENT BASES

A. Steel Rails: Factory-fabricated, welded, structural-steel rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide rails.

    a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Rails shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

B. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

C. Concrete Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic- and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

C. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

D. Equipment Restraints:

1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES that provides required submittals for component.

E. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

F. Install cables so they do not bend across edges of adjacent equipment or building structure.

G. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES that provides required submittals for component.

H. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

I. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

J. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

K. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are

encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 232113 "Hydronic Piping" for piping flexible connections.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.
9. Test and adjust restrained-air-spring isolator controls and safeties.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

3.7 AIR-SPRING ISOLATOR INSTALLATION

A. Independent Isolator Installation:

1. Install tank valve into each air isolator.
2. Inflate each isolator to heigh and pressure specified on Drawings.

B. Pressure-Regulated Isolator Installation:

1. Coordinate the constant pressure-regulated air supply to air springs with the requirements for piping and connections specified in Section 221513 "General-Service Compressed-Air Piping."
2. Connect all pressure regulators to a single dry, filtered constant air supply.
3. Inflate isolators to height and or pressure specified on Drawings.

3.8 VIBRATION ISOLATION EQUIPMENT BASES INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork.

END OF SECTION 230548

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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Valve tags.
6. Warning tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to be included in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.

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 up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters 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.

B. 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-quarters 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.

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.

D. 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) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Red.

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-quarters 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. 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 according to ASME A13.1.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include 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: Size letters according to ASME A13.1 for piping. At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

2.4 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Refer to section 3.5.

C. Background Color: Refer to section 3.5.

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-quarters 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; also include 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.

2.5 VALVE TAGS

A. Description: 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 chain 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.

2.6 WARNING TAGS

A. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 by 7 inches.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Red background with white lettering.

PART 3 - EXECUTION

3.1 PREPARATION

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 GENERAL INSTALLATION 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.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. 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. 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 and on both sides of 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 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

C. Pipe Label Color Schedule:

1. Chilled-Water Piping: White letters on a safety-green background
2. Heating Water Piping: White letters on a safety-green background.
3. Refrigerant Piping: White letters on a safety-purple background.

3.5 DUCT LABEL INSTALLATION

A. Install plastic-laminated duct labels with permanent adhesive on air ducts in the following color codes:

1. Blue: For cold-air supply ducts.
2. Yellow: For hot-air supply ducts.
3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.

B. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.6 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. All services: 2 inches, round.

2. Valve-Tag Colors:

    a. All services: Natural

3. Letter Color:

    a. All services: Black

3.7 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

SECTION 230593

TESTING, ADJUSTING, AND BALANCING FOR HVAC

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. Balancing Air Systems:
    a. Constant-volume air systems.
    b. Variable-air-volume systems.
2. Balancing Hydronic Piping Systems:
    a. Constant-flow hydronic systems.
    b. Variable-flow hydronic systems.
    c. Primary-secondary hydronic systems.
3. Balancing steam systems.
4. Testing, Adjusting, and Balancing Equipment:
    a. Motors.
    b. Chillers.
    c. Heat-transfer coils.
5. Testing, adjusting, and balancing existing systems and equipment.
6. Sound tests.
7. Vibration tests.
8. Duct leakage tests.
9. Control system verification.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. BAS: Building automation systems.

C. NEBB: National Environmental Balancing Bureau.

D. TAB: Testing, adjusting, and balancing.

E. TABB: Testing, Adjusting, and Balancing Bureau.

F. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

G. TDH: Total dynamic head.

1.4 PREINSTALLATION MEETINGS

A. TAB Conference: Conduct a TAB conference at Project site with the Architect, Construction Manager, Commissioning Authority, and Engineer after approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.

1. Minimum Agenda Items:

a. The Contract Documents examination report.
b. The TAB plan.
c. Needs for coordination and cooperation of trades and subcontractors.
d. Proposed procedures for documentation and communication flow.

1.5 ACTION SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within **30** days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports.

G. Sample report forms.

H. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.6 QUALITY ASSURANCE

A. TAB Specialists Qualifications: The balancing agency shall be an independent contractor certified by NEBB, or TABB and shall have no affiliation with a mechanical contracting or sheet metal company and shall have at least one Professional Engineer registered in the State in which the services are to be performed.

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC, NEBB, or, TABB.
2. TAB Technician: Employee of the TAB specialist and certified by AABC, NEBB, or, TABB as a TAB technician.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TAB SPECIALISTS

3.2 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.

B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

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 ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.

1. 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.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible, and their controls are connected and functioning.

K. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.

L. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. 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.

3.3 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:

a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
b. Duct systems are complete with terminals installed.

c. Volume, smoke, and fire dampers are open and functional.
d. Clean filters are installed.
e. Fans are operating, free of vibration, and rotating in the correct direction.
f. Variable-frequency controllers' startup is complete, and safeties are verified.
g. Automatic temperature-control systems are operational.
h. Ceilings are installed.
i. Windows and doors are installed.
j. Suitable access to balancing devices and equipment is provided.

2. Hydronics:

a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
b. Piping is complete with terminals installed.
c. The water treatment is complete.
d. Systems are flushed, filled, and air purged.
e. Strainers are pulled and cleaned.
f. Control valves function per the sequence of operation.
g. Shutoff and balance valves have been verified to be 100 percent open.
h. Pumps are started and proper rotation is verified.
i. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
j. Variable-frequency controllers' startup is complete, and safeties are verified.
k. Suitable access to balancing devices and equipment is provided.

3.4 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 Total System Balance" or ASHRAE 111 or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems", SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230700 "HVAC Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check 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 outdoor-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 condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.6 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 total airflow.

    a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
    c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
    d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

2. Measure fan static pressures as follows:

    a. Measure static pressure directly at the fan outlet or through the flexible connection.
    b. Measure static pressure directly at the fan inlet or through the flexible connection.
    c. Measure static pressure across each component that makes up the air-handling system.
    d. Report artificial loading of filters at the time static pressures are measured.

3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
4. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
5. 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 occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

1. Measure airflow of submain and branch ducts.
2. Adjust submain and branch duct volume dampers for specified airflow.
3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

3.7 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Adjust the variable-air-volume systems as follows:

1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge.
2. Verify that the system is under static pressure control.
3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure and adjust system static pressure control set point so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:

a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
d. Adjust controls so that terminal is calling for minimum airflow.

e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
f. When in full cooling or full heating, ensure that there is no mixing of hot-deck and cold-deck airstreams unless so designed.
g. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.

5. After terminals have been calibrated and balanced, test and adjust the system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.

a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.
c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

6. Measure fan static pressures as follows:

a. Measure static pressure directly at the fan outlet or through the flexible connection.
b. Measure static pressure directly at the fan inlet or through the flexible connection.
c. Measure static pressure across each component that makes up the air-handling system.
d. Report any artificial loading of filters at the time static pressures are measured.

7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

a. Balance the return-air ducts and inlets the same as described for constant-volume air systems.
b. Verify that terminal units are meeting design airflow under system maximum flow.

8. Re-measure the inlet static pressure at the most critical terminal unit and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls contractor.
9. Verify final system conditions as follows:

a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
b. Re-measure and confirm that total airflow is within design.
c. Re-measure final fan operating data, rpms, volts, amps, and static profile.
d. Mark final settings.
e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
f. Verify tracking between supply and return fans.

3.8 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:

1. Check liquid level in expansion tank.
2. Check highest vent for adequate pressure.
3. Check flow-control valves for proper position.
4. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
5. Verify that motor starters are equipped with properly sized thermal protection.
6. Check that air has been purged from the system.

3.9 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Adjust pumps to deliver total design gpm.

1. Measure total water flow.

a. Position valves for full flow through coils.
b. Measure flow by main flow meter, if installed.
c. If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

2. Measure pump TDH as follows:

a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
c. Convert pressure to head and correct for differences in gage heights.
d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

B. Adjust flow-measuring devices installed in mains and branches to design water flows.

1. Measure flow in main and branch pipes.
2. Adjust main and branch balance valves for design flow.
3. Re-measure each main and branch after all have been adjusted.

C. Adjust flow-measuring devices installed at terminals for each space to design water flows.

1. Measure flow at terminals.
2. Adjust each terminal to design flow.
3. Re-measure each terminal after it is adjusted.
4. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
5. Perform temperature tests after flows have been balanced.

D. For systems with pressure-independent valves at terminals:

1. Measure differential pressure and verify that it is within manufacturer's specified range.
2. Perform temperature tests after flows have been verified.

E. For systems without pressure-independent valves or flow-measuring devices at terminals:

1. Measure and balance coils by either coil pressure drop or temperature method.
2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

F. Verify final system conditions as follows:

1. Re-measure and confirm that total water flow is within design.
2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
3. Mark final settings.

G. Verify that memory stops have been set.

3.10 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals, and proceed as specified above for hydronic systems.

B. Adjust the variable-flow hydronic system as follows:

1. Verify that the differential-pressure sensor is located as indicated.
2. Determine whether there is diversity in the system.

C. For systems with no diversity:

1. Adjust pumps to deliver total design gpm.

a. Measure total water flow.

1) Position valves for full flow through coils.
2) Measure flow by main flow meter, if installed.
3) If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

b. Measure pump TDH as follows:

1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.

2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
3) Convert pressure to head and correct for differences in gage heights.
4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
5) With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

c. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

2. Adjust flow-measuring devices installed in mains and branches to design water flows.

a. Measure flow in main and branch pipes.
b. Adjust main and branch balance valves for design flow.
c. Re-measure each main and branch after all have been adjusted.

3. Adjust flow-measuring devices installed at terminals for each space to design water flows.

a. Measure flow at terminals.
b. Adjust each terminal to design flow.
c. Re-measure each terminal after it is adjusted.
d. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
e. Perform temperature tests after flows have been balanced.

4. For systems with pressure-independent valves at terminals:

a. Measure differential pressure and verify that it is within manufacturer's specified range.
b. Perform temperature tests after flows have been verified.

5. For systems without pressure-independent valves or flow-measuring devices at terminals:

a. Measure and balance coils by either coil pressure drop or temperature method.
b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

6. Prior to verifying final system conditions, determine the system differential-pressure set point.
7. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
8. Mark final settings and verify that all memory stops have been set.
9. Verify final system conditions as follows:

a. Re-measure and confirm that total water flow is within design.
b. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
c. Mark final settings.

10. Verify that memory stops have been set.

D. For systems with diversity:

1. Determine diversity factor.
2. Simulate system diversity by closing required number of control valves, as approved by the design engineer.
3. Adjust pumps to deliver total design gpm.

    a. Measure total water flow.

        1) Position valves for full flow through coils.
        2) Measure flow by main flow meter, if installed.
        3) If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

    b. Measure pump TDH as follows:

        1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
        2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
        3) Convert pressure to head and correct for differences in gage heights.
        4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
        5) With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

    c. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

4. Adjust flow-measuring devices installed in mains and branches to design water flows.

    a. Measure flow in main and branch pipes.
    b. Adjust main and branch balance valves for design flow.
    c. Re-measure each main and branch after all have been adjusted.

5. Adjust flow-measuring devices installed at terminals for each space to design water flows.

    a. Measure flow at terminals.
    b. Adjust each terminal to design flow.
    c. Re-measure each terminal after it is adjusted.
    d. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
    e. Perform temperature tests after flows have been balanced.

6. For systems with pressure-independent valves at terminals:

    a. Measure differential pressure, and verify that it is within manufacturer's specified range.
    b. Perform temperature tests after flows have been verified.

7. For systems without pressure-independent valves or flow-measuring devices at terminals:

a. Measure and balance coils by either coil pressure drop or temperature method.
b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

8. Open control valves that were shut. Close a sufficient number of control valves that were previously open to maintain diversity, and balance terminals that were just opened.
9. Prior to verifying final system conditions, determine system differential-pressure set point.
10. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
11. Mark final settings and verify that memory stops have been set.
12. Verify final system conditions as follows:

    a. Re-measure and confirm that total water flow is within design.
    b. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
    c. Mark final settings.

13. Verify that memory stops have been set.

3.11 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

A. Balance the primary circuit flow first.

B. Balance the secondary circuits after the primary circuits are complete.

C. Adjust pumps to deliver total design gpm.

1. Measure total water flow.

    a. Position valves for full flow through coils.
    b. Measure flow by main flow meter, if installed.
    c. If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

2. Measure pump TDH as follows:

    a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
    b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
    c. Convert pressure to head and correct for differences in gage heights.
    d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
    e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

D. Adjust flow-measuring devices installed in mains and branches to design water flows.

1. Measure flow in main and branch pipes.
2. Adjust main and branch balance valves for design flow.
3. Re-measure each main and branch after all have been adjusted.

E. Adjust flow-measuring devices installed at terminals for each space to design water flows.

1. Measure flow at terminals.
2. Adjust each terminal to design flow.
3. Re-measure each terminal after it is adjusted.
4. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
5. Perform temperature tests after flows have been balanced.

F. For systems with pressure-independent valves at terminals:

1. Measure differential pressure and verify that it is within manufacturer's specified range.
2. Perform temperature tests after flows have been verified.

G. For systems without pressure-independent valves or flow-measuring devices at terminals:

1. Measure and balance coils by either coil pressure drop or temperature method.
2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

H. Verify final system conditions as follows:

1. Re-measure and confirm that total water flow is within design.
2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
3. Mark final settings.

I. Verify that memory stops have been set.

3.12 PROCEDURES FOR MOTORS

A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.13 PROCEDURES FOR CHILLERS

A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller

installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:

1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
6. Capacity: Calculate in tons of cooling.
7. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.14 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record fan and motor operating data.

3.15 PROCEDURES FOR BOILERS

A. Hydronic Boilers:

1. Measure and record entering- and leaving-water temperatures.
2. Measure and record water flow.
3. Record relief valve pressure setting.

B. Steam Boilers:

1. Measure and record entering-water temperature.
2. Measure and record feed water flow.
3. Measure and record leaving-steam pressure and temperature.
4. Record relief valve pressure setting.

3.16 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop for major (more than 20 gpm) equipment coils, excluding unitary equipment such as reheat coils, unit heaters, and fan-coil units.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.

B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each steam coil:

1. Dry-bulb temperature of entering and leaving air.
2. Airflow.
3. Inlet steam pressure.

D. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.

3.17 SOUND TESTS

A. After the systems are balanced and construction is Substantially Complete, measure and record sound levels at **5** locations as designated by the Architect.

B. Instrumentation:

1. The sound-testing meter shall be a portable, general-purpose testing meter consisting of a microphone, processing unit, and readout.
2. The sound-testing meter shall be capable of showing fluctuations at minimum and maximum levels, and measuring the equivalent continuous sound pressure level (LEQ).
3. The sound-testing meter must be capable of using 1/3 octave band filters to measure mid-frequencies from 31.5 Hz to 8000 Hz.
4. The accuracy of the sound-testing meter shall be plus or minus one decibel.

C. Test Procedures:

1. Perform test at quietest background noise period. Note cause of unpreventable sound that affects test outcome.
2. Equipment should be operating at design values.
3. Calibrate the sound-testing meter prior to taking measurements.
4. Use a microphone suitable for the type of noise levels measured that is compatible with meter. Provide a windshield for outside or in-duct measurements.
5. Record a set of background measurements in dBA and sound pressure levels in the eight un-weighted octave bands 63 Hz to 8000 Hz (NC) with the equipment off.
6. Take sound readings in dBA and sound pressure levels in the eight un-weighted octave bands 63 Hz to 8000 Hz (NC) with the equipment operating.
7. Take readings no closer than 36 inches from a wall or from the operating equipment and approximately 60 inches from the floor, with the meter held or mounted on a tripod.
8. For outdoor measurements, move sound-testing meter slowly and scan area that has the most exposure to noise source being tested. Use A-weighted scale for this type of reading.

D. Reporting:

1. Report shall record the following:

    a. Location.
    b. System tested.
    c. dBA reading.
    d. Sound pressure level in each octave band with equipment on and off.

2. Plot sound pressure levels on NC worksheet with equipment on and off.

3.18 VIBRATION TESTS

A. After systems are balanced and construction is Substantially Complete, measure and record vibration levels on equipment having motor horsepower equal to or greater than.

B. Instrumentation:

1. Use portable, battery-operated, and microprocessor-controlled vibration meter with or without a built-in printer.
2. The meter shall automatically identify engineering units, filter bandwidth, amplitude, and frequency scale values.
3. The meter shall be able to measure machine vibration displacement in mils of deflection, velocity in inches per second, and acceleration in inches per second squared.
4. Verify calibration date is current for vibration meter before taking readings.

C. Test Procedures:

1. To ensure accurate readings, verify that accelerometer has a clean, flat surface and is mounted properly.
2. With the unit running, set up vibration meter in a safe, secure location. Connect transducer to meter with proper cables. Hold magnetic tip of transducer on top of the bearing, and measure unit in mils of deflection. Record measurement, then move transducer to the side of the bearing and record in mils of deflection. Record an axial reading in mils of deflection by holding nonmagnetic, pointed transducer tip on end of shaft.
3. Change vibration meter to velocity (inches per second) measurements. Repeat and record above measurements.
4. Record CPM or rpm.
5. Read each bearing on motor, fan, and pump as required. Track and record vibration levels from rotating component through casing to base.

D. Reporting:

1. Report shall record location and the system tested.
2. Include horizontal-vertical-axial measurements for tests.
3. Verify that vibration limits follow Specifications, or, if not specified, follow the General Machinery Vibration Severity Chart or Vibration Acceleration General Severity Chart from the AABC National Standards. Acceptable levels of vibration are normally "smooth" to "good."
4. Include in report General Machinery Vibration Severity Chart, with conditions plotted.

3.19 CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Verify temperature control system is operating within the design limitations.
2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.
8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.20 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: 0% to +5%.
2. Air Outlets and Inlets: 0% to +5%.
3. Heating-Water Flow Rate: 0% to +5%.
4. Cooling-Water Flow Rate: 0% to +5%.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.21 PROGRESS 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: Prepare biweekly progress 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.

3.22 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
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 supervisor 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's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, 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.

D. 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 outdoor, supply, return, and exhaust airflows.
2. Water and steam 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.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches, and bore.
    i. Center-to-center dimensions of sheave and amount of adjustments in inches.
    j. Number, make, and size of belts.
    k. Number, type, and size of filters.

2. Motor Data:

    a. Motor 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. Center-to-center dimensions of sheave and amount of adjustments in inches.

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. Filter static-pressure differential in inches wg.
    f. Preheat-coil static-pressure differential in inches wg.
    g. Cooling-coil static-pressure differential in inches wg.
    h. Heating-coil static-pressure differential in inches wg.
    i. Outdoor airflow in cfm.
    j. Return airflow in cfm.
    k. Outdoor-air damper position.
    l. Return-air damper position.
    m. Vortex damper position.

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. Outdoor-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Water flow rate in gpm.
i. Water pressure differential in feet of head or psig.
j. Entering-water temperature in deg F.
k. Leaving-water temperature in deg F.
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig.
n. Refrigerant suction temperature in deg F.
o. Inlet steam pressure in psig.

G. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Coil identification.
d. Capacity in Btu/h.
e. Number of stages.
f. Connected volts, phase, and hertz.
g. Rated amperage.
h. Airflow rate in cfm.
i. Face area in sq. ft..
j. Minimum face velocity in fpm.

2. Test Data (Indicated and Actual Values):

a. Heat output in Btu/h.
b. Airflow rate in cfm.
c. Air velocity in fpm.
d. Entering-air temperature in deg F.
e. Leaving-air temperature in deg F.
f. Voltage at each connection.
g. Amperage for each phase.

H. Fan Test Reports: For supply, return, 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. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Motor Data:

a. Motor 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. Center-to-center dimensions of sheave, and amount of adjustments in inches.
g. Number, make, and size of belts.

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.

I. 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.

J. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Apparatus used for test.
d. Area served.
e. Make.
f. Number from system diagram.
g. Type and model number.
h. Size.
i. 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.

K. 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.

L. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Service.
    d. Make and size.
    e. Model number and serial number.
    f. Water flow rate in gpm.
    g. Water pressure differential in feet of head or psig.
    h. Required net positive suction head in feet of head or psig.
    i. Pump rpm.
    j. Impeller diameter in inches.
    k. Motor make and frame size.
    l. Motor horsepower and rpm.
    m. Voltage at each connection.
    n. Amperage for each phase.
    o. Full-load amperage and service factor.
    p. Seal type.

2. Test Data (Indicated and Actual Values):

    a. Static head in feet of head or psig.
    b. Pump shutoff pressure in feet of head or psig.

c. Actual impeller size in inches.
d. Full-open flow rate in gpm.
e. Full-open pressure in feet of head or psig.
f. Final discharge pressure in feet of head or psig.
g. Final suction pressure in feet of head or psig.
h. Final total pressure in feet of head or psig.
i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.

M. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.23 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Construction Manager.

B. The Construction Manager shall randomly select measurements, documented in the final report, to be rechecked. 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.

C. If 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."

D. 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.

E. If TAB work fails, proceed as follows:

1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.

F. Prepare test and inspection reports.

3.24 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB 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 TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230700 - HVAC INSULATION

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. Insulation Materials
    a. Flexible Elastomeric
    b. Mineral-Fiber Blanket Insulation
    c. Mineral-Fiber Board Insulation
    d. Mineral-Fiber Preformed Pipe Insulation
    e. Mineral-Fiber Pipe and Tank Insulation
2. Fire-Rated Insulation Materials
3. Adhesives
4. Mastics
5. Lagging Adhesives
6. Sealants
7. Factory-Applied Jackets
8. Field-Applied Fabric-Reinforcing Mesh
9. Field-Applied Cloths
10. Field-Applied Jackets
11. Tapes
12. Securements
13. 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, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, dampers, flanges, valves, and specialties and flanges for each type of insulation.
5. Detail removable insulation at piping specialties and equipment connections.

6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

C. Qualification Data: For qualified Installer.

D. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing 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 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 sizes and locations of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with Installer for insulation application. Before preparing 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. General

1. Comply with requirements in insulation schedule articles for where insulating materials shall be applied.
2. Products shall not contain asbestos, lead, mercury, or mercury compounds.
3. 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.
4. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
5. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

B. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Aeroflex USA, Inc.; Aerocel.
    b. Armacell LLC; AP Armaflex.
    c. K-Flex USA; Insul-Sheet, K-Flex Gray Duct Liner, and K-FLEX LS.

C. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. CertainTeed Corp.; SoftTouch Duct Wrap.
    b. Johns Manville; Microlite.
    c. Knauf Insulation; Friendly Feel Duct Wrap.
    d. Manson Insulation Inc.; Alley Wrap.
    e. Owens Corning; SOFTR All-Service Duct Wrap.

D. 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. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, provide products by 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.

E. Mineral-Fiber, Preformed Pipe Insulation:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Fibrex Insulations Inc.; Coreplus 1200.
    b. Johns Manville; Micro-Lok.

c. Knauf Insulation; 1000-Degree Pipe Insulation.
d. Manson Insulation Inc.; Alley-K.
e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ or ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

F. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ 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. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, provide products by 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 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Aeroflex USA, Inc.; Aeroseal.
b. Armacell LLC; Armaflex 520 Adhesive.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
d. K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
b. Eagle Bridges - Marathon Industries; 225.

c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Dow Corning Corporation; 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; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
b. Eagle Bridges - Marathon Industries; 570.

c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

2.4 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
b. Eagle Bridges - Marathon Industries; 405.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
d. Mon-Eco Industries, Inc.; 44-05.

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 (Minus 40 to plus 121 deg C).
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 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 (Minus 40 to plus 121 deg C).
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 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 C 1136, Type I.

2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms (0.86 metric perm) when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.6 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. (203 g/sq. m) with a thread count of 5 strands by 5 strands/sq. in. (2 strands by 2 strands/sq. mm) for covering ducts.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas No. 5.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm), in a Leno weave, for ducts.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
b. Vimasco Corporation; Elastafab 894.

2.7 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. (271 g/sq. m).

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.

C. Metal Jacket:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
c. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.

a. Sheet and roll stock ready for shop or field sizing or factory cut and rolled to size.
b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ABI, Ideal Tape Division; 428 AWF ASJ.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
c. Compac Corporation; 104 and 105.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches (75 mm).
3. Thickness: 11.5 mils (0.29 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ABI, Ideal Tape Division; 491 AWF FSK.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
c. Compac Corporation; 110 and 111.
d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches (75 mm).
3. Thickness: 6.5 mils (0.16 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ABI, Ideal Tape Division; 370 White PVC tape.
b. Compac Corporation; 130.
c. Venture Tape; 1506 CW NS.

2. Width: 2 inches (50 mm).
3. Thickness: 6 mils (0.15 mm).
4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ABI, Ideal Tape Division; 488 AWF.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
c. Compac Corporation; 120.
d. Venture Tape; 3520 CW.

2. Width: 2 inches (50 mm).
3. Thickness: 3.7 mils (0.093 mm).
4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.10 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ITW Insulation Systems; Gerrard Strapping and Seals.
b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm) wide with wing seal or closed seal.
3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide with wing seal or 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, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.

    a. Manufacturers: Subject to compliance with requirements, provide products by 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, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) AGM Industries, Inc.; CHP-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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
        2) GEMCO; Perforated Base.
        3) Midwest Fasteners, Inc.; Spindle.

    b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
    c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch- (2.6-mm-) 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) GEMCO; Nylon Hangers.
        2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.

    b. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.
    c. Spindle: Nylon, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).
    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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
        2) GEMCO; Peel & Press.
        3) Midwest Fasteners, Inc.; Self Stick.

    b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
    c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch- (2.6-mm-) 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- (0.41-mm-) thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

    a. Manufacturers: Subject to compliance with requirements, provide products by 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- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) GEMCO.
2) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

D. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. C & F Wire.

2.11 CORNER ANGLES

A. PVC Corner Angles: 30 mils (0.8 mm) thick, minimum 1 by 1 inch (25 by 25 mm), PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch (0.61 mm) thick, minimum 1 by 1 inch (25 by 25 mm), stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. 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. 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 (0.127 mm) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range between 140 and 300 deg F (60 and 149 deg C). 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 (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. 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 ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct 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- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to 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 duct 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 (100 mm) 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 (50 mm) below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall 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 wall flashing and overlap wall flashing at least 2 inches (50 mm).
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: 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 (50 mm).

1. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Duct: 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 (50 mm).
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 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. 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.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

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.

3.7 INSTALLATION OF MINERAL-FIBER INSULATION ON DUCT SYSTEMS

A. 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 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 (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) 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 (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) 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 (10 deg C) at 18-foot (5.5-m) 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 two times the insulation thickness, but not less than 3 inches (75 mm).

5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) 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- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

B. 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 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 (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.

b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) 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 (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) 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 (10 deg C) at 18-foot (5.5-m) 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 two times the insulation thickness, but not less than 3 inches (75 mm).

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- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.8 INSTALLATION OF MINERAL-FIBER INSULATION ON PIPING SYSTEMS

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 (150 mm) o.c.
4. For insulation with factory-applied 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 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 (25 mm), 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.

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 (50-mm) overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where PVC jackets are indicated, install with 1-inch (25-mm) 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.

C. Where metal jackets are indicated, install with 2-inch (50-mm) 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 (300 mm) o.c. and at end joints.

3.10 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 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 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

3. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.12 DUCT INSULATION SCHEDULE

A. General:
1. Plenums and Ducts Requiring Insulation:
a. Indoor, concealed supply and outdoor air.
b. Indoor, exposed supply and outdoor air.
c. Indoor, concealed return located in unconditioned space.
d. Indoor, exposed return located in unconditioned space.
e. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
f. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
g. Indoor, concealed oven and warewash exhaust.
h. Indoor, exposed oven and warewash exhaust.
i. Indoor, concealed exhaust between isolation damper and penetration of building exterior.

j. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
k. Outdoor, concealed supply and return.
l. Outdoor, exposed supply and return.

2. Items Not Insulated:
   a. Fibrous-glass ducts.
   b. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
   c. Factory-insulated flexible ducts.
   d. Factory-insulated plenums and casings.
   e. Flexible connectors.
   f. Vibration-control devices.
   g. Factory-insulated access panels and doors.
3. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Duct Insulation Schedule:

Duct System	**Location**	**Insulation**	**Jacket**
Exhaust	Indoors: Mechanical rooms, shafts, crawlspaces, trenches	Mineral-Fiber Board: 2” thick 3-lb/cu. ft.	None

3.13 PIPING INSULATION SCHEDULE

A. General:
1. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range.
2. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
   a. Drainage piping located in crawl spaces.
   b. Underground piping.
   c. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

B. Pipe, Valve, and Fitting Insulation Material Schedule:

Pipe System	**Insulation Material**	**Vapor Barrier Locations**
Refrigerant	Preformed Flexible Elastomeric Insulation	-
Cold Condensate Drain	Preformed Flexible Elastomeric Insulation	-

C. Pipe, Valve, and Fitting Insulation Thickness Schedule:

Pipe System	**Insulation Thickness**
Refrigerant	1.5”
Cold Condensate Drain	0.5”

1. The above table is based on insulation having a conductivity (k) not exceeding 0.27 Btu per inch/h · ft2 °F.

2. For insulation with a thermal conductivity not equal to 0.27 Btu · inch/h · ft2 · °F at a mean temperature of 75°F, the minimum required pipe thickness is adjusted using the following equation;

   T = r [(1+tlr)K/k-1]

   where:

   T = Adjusted insulation thickness (in).

   r = Actual pipe radius (in).

   t = Insulation thickness from applicable cell in table (in).

   K = New thermal conductivity at 75°F (Btu · in/hr · ft2 · °F).

   k = 0.27 Btu · in/hr · ft2 · °F

D. Pipe, Valve, and Fitting Insulation Field-Applied Jacketing Schedule:

Pipe System Location	**Jacket**
Outdoors	Aluminum
Indoors, inaccessible Portions of Shafts	None
Indoors, exposed	PVC

END OF SECTION 230713

SECTION 230800
MECHANICAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1. DESCRIPTION

A. General provisions and other mechanical systems are specified in other Sections of Division 23.

B. Commissioning is an ongoing process and shall be performed throughout construction. Commissioning requires the participation of Division 23 to ensure that all systems are operating in a manner consistent with the Contract Documents. Division 23 shall be familiar with the commissioning plan issued by the Commissioning Authority (CA) as it applies to the work of Division 23 and shall execute all commissioning responsibilities assigned to them in the Contract Documents. The Contractors should also review Specifications Section 019113 for additional information.

C. Commissioning shall conclude with the completion of all required deferred testing, training and system documentation as specified and required to ensure the proper operation of the mechanical equipment and systems provided by this Division.

D. This Section covers mechanical systems commissioning, as required to demonstrate that the equipment and systems of Division 23 are ready for safe and satisfactory operation, as defined by project documents. Commissioning shall include, but shall not be limited to, identification of piping and equipment, cleaning, lubrication, start-up, check-out, and testing, adjusting, and balancing of systems, preparation of equipment and systems documentation and of maintenance and operation manuals, Owner training, and preparation of record drawings.

E. This section does not alter the commissioning requirements indicated in Section 019113 of the General Commissioning Requirements. This section is to help define/supplement the requirements of Section 019113 where applicable.

1.2. QUALITY ASSURANCE

A. The mechanical contractor shall identify a mechanical commissioning supervisor. The mechanical commissioning supervisor should have a minimum of ten years of experience in mechanical contracting. The mechanical commissioning supervisor shall become familiar with the design intent and the requirements of the commissioning process as defined in this Section. The mechanical commissioning supervisor shall attend all commissioning meetings and coordinate the commissioning schedule as outlined by the CA. The mechanical commissioning supervisor shall assist the CA in coordinating and executing the required commissioning activities.

1.3. MECHANICAL, PLUMBING, AND FIRE PROTECTION CONTRACTOR RESPONSIBILITIES

A. Include and itemize the cost of commissioning in the contract price with an estimated breakdown of hours for meeting and functional testing requirements.

B. The mechanical commissioning supervisor shall be responsible for scheduling, supervising, and coordinating the startup, testing and commissioning activities as specified herein with the CA. Specific requirements of the mechanical contractor and associated subcontractors are identified in this Section and in other Sections of this Division.

C. The CA shall conduct independent verification of installation, pre-functional, start-up and functional testing as per section 019113.

D. Mechanical commissioning shall take place in three phases. Commissioning requirements for each phase are as follows:

1. Construction Phase

a. The Contractor shall attend a Commissioning Scoping meeting and additional commissioning meetings as required throughout the commissioning process. These commissioning meetings will be monthly during early construction and may increase in frequency to weekly during the start-up, pre-functional and functional testing phases. The Contractor shall assure that all subcontractors who have commissioning responsibilities attend the Commissioning Scoping meeting and other commissioning meetings, as appropriate, during the construction process.

b. The Contractor shall report, in writing, to the CA at least as often as commissioning meetings are scheduled concerning the status of his activities as they affect the commissioning process, the status of each discrepancy identified, the pre-functional and functional testing process, explanations of any disagreements with the identified deficiencies, and proposed resolution and schedule.

c. The Contractor shall provide the CA with normal cut sheets and shop drawing submittals of equipment that is to be commissioned.

d. The Contractor shall provide documentation to the CA for development of pre-functional and functional performance testing procedures, prior to normal O&M manual submittals. This documentation shall include detailed manufacturer installation, start-up, operating, troubleshooting and maintenance procedures; full details of any owner-contracted tests; fan and pump curves; full factory testing reports, if any; and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation, start-up and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the CA. The CA may request further documentation necessary for the development of functional performance testing and the commissioning process. This data request may be made prior to normal submittals.

e. The Contractor shall develop and submit to CA, for review prior to equipment or system startup, a complete startup and initial checkout plan using manufacturer's start-up procedures.

f. The Contractor shall review and complete the CA's pre-functional check-sheets and sign-off on the appropriate areas when the Contractor and sub-contractors are complete. The pre-functional test sheets will be developed by the CA. The CA may conduct their own pre-functional testing check in parallel with the Contractors or verify the contractors completed pre-functional forms after submission.

g. The Contractor shall provide a copy of the O&M manuals and submittals of commissioned equipment, through normal channels, to the CA for review.

h. The Contractor shall assist in clarifying the proposed operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.

i. The CA shall prepare the specific functional test procedures as specified herein. The Contractors shall review the CA's proposed functional performance test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.

j. Contractor shall prepare a preliminary schedule for Division 23 commissioning activities, to include pipe and duct system testing, flushing and cleaning, equipment start-up, and TAB start and completion, for use by the CA and shall update the schedule as appropriate. CA will assist in providing expected time durations for Cx activities.

k. The Contractor shall update the commissioning activities and notify any delays in the progress meetings. Contractor shall notify the CA during the commissioning meetings when commissioning activities not yet performed or not yet scheduled will delay construction. Mechanical equipment start-up shall not be initiated until the complete sign-off of the pre-functional check-sheets as developed by the CA as specified in other Sections of Division 23.

l. The Contractor shall provide startup testing for all HVAC equipment, including the building automation control system and shall execute the mechanical-related portions of the pre-functional checklists for all commissioned equipment during the startup and initial checkout process. The CA shall conduct an independent start-up once the Contractor is complete with their requirements.

m. The Contractor shall perform and clearly document all completed start-up and system operational checkout procedures, providing a copy to the CA.

n. The Contractor shall correct current A/E punch list and CA deficiency items before functional performance testing can begin. Air and water TAB shall be completed with discrepancies and problems remedied before functional testing of the respective air or water related systems.

o. The CA shall generate the functional testing procedure and record to the mechanical contractor. The mechanical contractor shall review and provide support to the functional testing process. Contractor shall operate boilers, pumps, etc., and systems in accordance with the CA requirements, open and close disconnects and switch normal and emergency power requirements as directed by the CA and the functional testing procedures.

p. The Contractor shall report in writing to the CA at least as often as commissioning meetings are being scheduled concerning the status of each outstanding discrepancy identified during commissioning, pre-functional and functional performance testing. Report shall include description of the identified discrepancy, explanations of any disagreements, and proposals and schedule for correction of the discrepancy.

2. Acceptance Phase. The Contractor shall assist and cooperate with the CA in the commissioning process by:

a. Putting all HVAC equipment and systems into operation and continuing the operation during each working day of the test and balance and commissioning effort, as required.

b. For a given area, have all required pre-functional checklists, calibrations, startup and selected functional tests of the mechanical system and associated controls completed and approved by the CA prior to beginning the test and balance process.

c. Provide a qualified technician to operate the controls as required to assist the TAB contractor in performing TAB, or provide sufficient training for TAB to operate the system without assistance.

d. Provide a TAB representative to assist the CA on conducting a random 10% check of the air and water distribution requirements.

e. Including cost of sheaves and belts that may be required to obtain required equipment performance, as measured by the test and balance effort.

f. Providing test holes in ducts and plenums where directed by TAB to allow air measurements and air balancing. Providing an approved plug.

g. Providing temperature and pressure taps according to the Construction Documents for TAB and commissioning testing.

h. Installing a P/T plug at each water sensor that is an input point to the Control System.

i. Providing skilled technicians to execute starting and operation of equipment.

j. The CA will conduct functional performance testing. The Contractor may be required to have a skilled technician present during functional testing, although it is suggested that one be available to make adjustments or assist in problem-solving.
k. The CA will require full and part load performance verifications as well as seasonal and simulated testing requirements. The Contractor shall be prepared to operate different components of various systems (example, DX and hot water systems to generate loading strategies) during the functional testing.
l. Correct deficiencies (differences between specified and observed performance) as interpreted by the CA and A/E.
m. Prepare O&M manuals according to the Contractor Documents, including clarifying and updating the original sequence of operation to as-built conditions.
n. Maintain on site redline as built drawings and produce final “As-built” drawings for all project drawings and contractor-generated coordination drawings. List and clearly identify on the as-built drawings the locations of all airflow stations and sensor installations that are not equipment mounted.
o. Provide specified training of the Owner’s operating personnel in accordance with the CA’s overview and outline.
p. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.
q. Provide updated diagrammatical logic for all TAB adjustments to the system.

3. Warranty Period. During the warranty period, the Contractor shall:

a. Be available during seasonal or deferred functional performance testing conducted by the CA, according to the specifications.
b. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

1.4. TAB CONTRACTOR RESPONSIBILITIES

A. Six weeks prior to the starting of the T&B, submit to the CA, the qualifications of the site technician(s) for the project, including three (3) names of contractors and facility managers of recent projects on which the personnel were in charge. The Owner and CA will approve the site technician for this job.

B. Three months prior to the start of the TAB, submit a TAB plan and approach for each system. The plan shall be reviewed by the TAB and the CA for review and approval. The submitted plan shall include:

1. Certification that the TAB contractor has reviewed the construction documents and the systems with the design engineers and Contractors to sufficiently understand the design intent for each system.
2. An explanation of the intended use of the building control system.
3. All field check-out sheets and logs to be used that lists each piece of equipment to be tested adjusted and balanced with the data cells to be gathered for each.
4. Final test report forms to be used during this process:

a. Detailed step by step procedures for TAB work for each system and issue: terminal flow calibration; diffuser proportioning; branch and submain proportioning; total flow calculations; and rechecking diversity issues.
b. List all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of each of the test procedures, parameters and formulas to be used.
c. Details of how total flow will be determined (Air: sum of terminal flows via BMS calibrated readings or via hood, pitot tube or flow stations). Details of how total water

flow will be determined (Water: pump curves, circuit setters, flow station, ultrasonic, etc.).

d. The identification and types of measurement instruments to be used and their most recent calibration date.
e. Specific procedures that will ensure that both air and watersides will be operating at their lowest possible pressure at the point where the system will operate.
f. Confirmation that the TAB contractor understands the outside air ventilation criteria under all conditions and how this will be measured during normal, economizer and unoccupied conditions.
g. Details of how building static, room static and exhaust fan capacity will be checked.
h. Proposed selection points for traverse measurement locations on the as-built documents. Review the placement of the HVAC measurement devices for proper straight runs and accuracy.
i. Submit a plan for testing and checking the fume hood system exhaust requirements.
j. Plan for formal progress reports including scope and frequency.
k. Plan for formal deficiency reports including scope and frequency.

5. TAB contractor shall attend commissioning meetings as directed by the CA and the general contractor.
6. TAB contractor shall communicate in writing to the controls contractor and the CA all set-point and parameter changes made or problems and discrepancies identified during the TAB process that would affect the control loop system set-up and operation.
7. Submit written report of discrepancies, deficit or uncompleted work by others, contract interpretation requests and list of completed tests to the CA at least once per week.
8. After the TAB plan is accepted and two-weeks prior to TAB work, the contractor shall conduct a pre-balancing conference. Prior to the pre-balancing conference, the TAB contractor shall inspect the system readiness for testing and balancing. The TAB contractor shall prepare a list of deficiencies and uncompleted work that will affect the TAB process. This list shall be submitted to the CA and the general contractor.
9. The TAB contractor shall review the projected schedule and provide, in writing, to the CA and CM any delays in the schedule and what items will require completion prior to the TAB work.
10. The CA agent shall conduct independent verification of 10% of air and water end-devices for acceptance after the TAB contractor states in writing that they are complete with Testing & Balancing. The TAB contractor shall provide a mechanic to assist the CA in this verification and shall include this in the scope and price of the Work.
11. The TAB agent shall submit the TAB report to the CA for his review and comment. All data contained shall be re-verified in the field by the CA. A minimum of ten percent of the airflow readings shall be verified by the CA using his own equipment. All selection points shall be random. Total airflow shall be verified on all mains in the supply and the exhaust ducts.

1.5. CONTROL CONTRACTOR RESPONSIBILITIES

A. Include and itemize the cost of commissioning in the contract price with an estimated breakdown of hours for meeting and functional testing requirements.

B. The controls commissioning supervisor shall be responsible for scheduling, supervising, and coordinating the startup, testing and commissioning activities as specified herein with the CA. Specific requirements of the controls contractor and associated subcontractors are identified in this Section and in other Sections of this Division.

C. The CA shall conduct independent verification of installation, pre-functional, start-up and functional testing as per section 019113.

D. Controls commissioning shall take place in three phases. Commissioning requirements for each phase are as follows:

1. Construction Phase

a. Contractor shall attend a Commissioning Scope meeting and additional commissioning meetings as required throughout the commissioning process. These commissioning meetings will be monthly during early construction and increase in frequency to weekly during the start-up, pre-functional and functional testing phases. Contractor shall assure that all subcontractors who have commissioning responsibilities attend the Commissioning Scope meeting and other commissioning meetings, as appropriate, during the construction process.

b. Contractor shall report, in writing, to the CA at least as often as commissioning meetings are scheduled concerning the status of his activities as they affect the commissioning process, the status of each discrepancy identified, the pre-functional and functional testing process, explanations of any disagreements with the identified deficiencies, and proposed resolution and schedule.

c. Contractor shall provide the CA with normal cut sheets and shop drawing submittals of equipment that is to be commissioned.

d. Contractor shall provide documentation to the CA for development of pre-functional and functional performance testing procedures, prior to normal O&M manual submittals. This documentation shall include detailed manufacturer installation, start-up, operating, troubleshooting and maintenance procedures; full details of any owner-contracted tests; points listing; full factory testing reports, if any; and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation, start-up and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the CA. The CA may request further documentation necessary for the development of functional performance testing and the commissioning process. This data request may be made prior to normal submittals.

e. The Contractor shall develop and submit to CA, for review prior to equipment or system startup, a complete startup and initial checkout plan using manufacturer's start-up procedures.

f. The Contractor shall review and complete the CA's pre-functional check-sheets and sign-off on the appropriate areas when the Contractor and sub-contractors are complete. The pre-functional test sheets will be developed by the CA. The CA may conduct their own pre-functional testing check in parallel with the Contractors or verify the contractors completed pre-functional forms after submission.

g. Contractor shall provide a copy of the O&M manuals and submittals of commissioned equipment, through normal channels, to the CA for review.

h. Contractor shall assist in clarifying the proposed operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.

i. CA shall prepare for the specific functional test procedures as specified herein. The Contractors shall review the CA's proposed functional performance test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.

j. Controls contractor shall prepare a preliminary schedule for their commissioning activities, to include wiring, instrument installation, calibration, point-to-point verification, sequence of operation testing and emergency operating procedural testing for use by the CA and shall update the schedule as appropriate. The Contractor shall update the commissioning activities and notify any delays in the progress meetings. Contractor shall notify the CA during the commissioning meetings when

commissioning activities not yet performed or not yet scheduled will delay construction.

k. Controls instrument and equipment start-up shall not be initiated until the complete sign-off of the pre-functional check-sheets as developed by the CA as specified in other Sections of Division 23.

l. Contractor shall provide startup testing for all HVAC equipment, including the building automation control system and shall execute the mechanical/controls-related portions of the pre-functional checklists for all commissioned equipment during the startup and initial checkout process. The CA shall conduct an independent start-up once the Contractor is complete with their requirements.

m. Contractor shall perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CA.

n. Contractor shall correct current A/E punch list and CA deficiency items before functional performance testing can begin. Point-to-point verification shall be completed with discrepancies and problems remedied before functional testing of the respective controls related systems.

o. The CA shall generate the functional testing procedure and record to the controls contractor. The controls contractor shall review and provide support to the functional testing process. Contractor shall aid in operating boilers, pumps, etc., and systems in accordance with the CA requirements, turn on and off normal and emergency power requirements as directed by the CA and the functional testing procedures.

p. Contractor shall report, in writing, to the CA at least as often as commissioning meetings are being scheduled concerning the status of each outstanding discrepancy identified during commissioning, pre-functional and functional performance testing. Report shall include description of the identified discrepancy, explanations of any disagreements, and proposals and schedule for correction of the discrepancy.

2. Acceptance Phase. Contractor shall assist and cooperate with the CA in the commissioning process by:

a. Putting all HVAC equipment and systems into operation and continuing the operation during each working day of the test and balance and commissioning effort, as required.

b. For a given area, have all required, pre-functional checklists, calibrations, startup and selected functional tests of the mechanical system and associated controls completed and approved by the CA prior to beginning the test and balance process.

c. Provide a qualified technician to operate the controls as required to assist the TAB contractor in performing TAB, or provide sufficient training for TAB to operate the system without assistance.

d. Provide a controls representative to assist the CA on conducting a random 10% check of the air and water distribution requirements.

e. Providing skilled technicians to execute starting and operation of equipment.

f. The CA will conduct functional performance testing. The Contractor may be required to have a skilled technician present during functional testing, although it is suggested that one be available to make adjustments or assist in problem-solving.

g. The CA will require full and part load performance verifications as well as seasonal and simulated testing requirements. The Contractor shall be prepared to operate different components of various systems (example, chilled water and hot water systems to generate loading strategies) during the functional testing.

h. Correct deficiencies (differences between specified and observed performance) as interpreted by the CA and A/E.

i. Prepare O&M manuals according to the Contractor Documents, including clarifying and updating the original sequence of operation to as-built conditions.
j. Maintain on site redline as built drawings and produce final “As-built” drawings for all project drawings and contractor-generated coordination drawings. List and clearly identify on the as-built drawings the locations of all airflow stations and sensor installations that are not equipment mounted.
k. Provide specified training of the Owner’s operating personnel in accordance with the CA’s overview and outline.
l. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.
m. Provide a detailed marked up drawings of all the instruments and their installed location (P&ID) for instruments and components.

3. Warranty Period. During the warranty period, the Contractor shall:

a. Be available during seasonal or deferred functional performance testing conducted by the CA, according to the specifications.
b. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

PART 2 - PRODUCTS

2.1 SYSTEMS TO BE COMMISSIONED

A. The systems to be commissioned include the following (100% primary systems and 20% sampling of secondary systems):

1. Exhaust Fans
2. Building Automation System
3. Testing, Adjusting and Balancing

2.2. TEST EQUIPMENT

A. All standard testing equipment required for the mechanical portion startup, initial checkout shall be provided by the Contractor responsible for the equipment or system being tested. This includes TAB and controls verification.

B. The CA shall perform their own system verification and performance check-out. The CA shall provide their own calibrated equipment as required for this testing.

C. All testing equipment associated with functional performance verification and point-to-point required by the CA shall be the responsibility of the CA. All testing equipment associated with the control’s contractor point-to-point verification shall be the responsibility of the control’s contractor.

D. Special equipment, tools and instruments (only available from vendor or specific to a piece of equipment) required for the functional testing of that equipment, according to the requirements of the contract documents and the functional test procedures shall be provided to the CA by the installing contractor and shall become the property of the Owner at project completion as indicated in the specification.

E. Proprietary test equipment and software required by any manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide test equipment, demonstrate its use and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the

Owner upon successful completion of the commissioning process as required in the specifications.

PART 3 - EXECUTION

3.1. SUBMITTALS

A. Division 23 shall provide submittal documentation relative to commissioning as required in this Section Part 1 and Section 019113.

3.2 STARTUP PLAN AND PREFUNCTIONAL TESTING

A. The mechanical contractor and associated subcontractors shall be responsible for the installation of complete systems and sub-systems, fully functional, meeting the design objectives of the Contract Documents. Contractor shall follow the approved start-up, initial checkout, and pre-functional testing procedures. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility to the CA or Owner.

B. Pre-functional testing as directed and performed by the contractor shall be required for each piece of equipment to ensure that the equipment and systems are properly installed and ready for operation, so that functional performance testing to may proceed without delays. Sampling strategies shall not be used for pre-functional testing. The pre-functional testing for all equipment and subsystems of a given system shall be successfully completed and documented prior to functional performance testing of the system. The mechanical contractor and subcontractors shall sign off on the CA's pre-functional test sheets that they are complete and the system is ready. The CA will verify and conduct their own independent verification and start-up in parallel to the Contractor's verification. Any deficiencies identified during this process shall be noted and reviewed by the Contractors. Start-up and functional testing shall not proceed until all the deficiencies are corrected and verified by the CA.

C. The following procedures shall apply to all equipment and systems to be commissioned.

1. Start-up and Initial Checkout Plan. The contractor shall develop the detailed start-up and pre-functional testing plans for all equipment to be reviewed by the CA. The primary role of the CA in this process shall be to review the installation for construction completeness and ensure that all components have been installed as per the design documents. Only when pre-functional testing is complete and signed off by all Contractors, shall the Contractor start-up the equipment. Equipment and systems to be commissioned are identified in this Section Part 2.
2. The start-up and initial checkout plan shall consist of the following as a minimum:

    a. The manufacturer's standard written start-up and checkout procedures copied from the installation manuals and manufacturer's normally used field checkout sheets. The plan shall include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan.
    b. First-run checklist for equipment, to include:

        1) Equipment properly set.
        2) Alignment of shafts and couplings.
        3) Adjustment of vibration isolators.
        4) Piping and equipment properly connected.
        5) Completion of initial lubrication procedures.
        6) Clean filters in place, as appropriate.
        7) Wiring properly connected.

8) Electrical overload relays appropriate for load.
9) Electrical accessories properly installed and adjusted.
10) Controls, safeties, and time switches properly calibrated and set-up.
11) Verification of direction of motor rotation after final electrical connections by jogging motor.
12) Measurements of ampere draw of electric motors and comparison with nameplate rating and with overload heater ratings.

3. The Contractor shall submit the start-up reports to the CA for review.

D. The CA shall review and approve the procedures and the format for documenting them, noting any procedures that need to be added.

E. Two weeks prior or startup, the Contractor shall schedule start-up and checkout with the Owner and CA. The execution of the start-up and checkout shall be directed and performed by the Contractor, in accordance with manufacturer's published procedures and with the approved procedures. The CA may be present for the Contractor's required startup and checkout of all systems and equipment to be commissioned.

F. Sensor Calibration. Calibration of all sensors shall be included as part of the pre-functional testing and listed on the appropriate test checklists and reports, according to the specified procedures and accuracies for the devices and systems being tested.

G. All contractor responsible start-up, checkout forms shall be completed and submitted to the CA for review.

3.3 FUNCTIONAL PERFORMANCE TESTS

A. Functional Performance Verification (FPV) is the dynamic testing of systems (rather than just individual components) under full, part and seasonal requirements. Systems are tested under various loads and control sequences, such as low cooling and heating loads, component failures, unoccupied modes, fire alarm, etc. The systems are run through all the control sequences of operation and components are verified to be responding as the design intent and documents. FPV shall include; testing all sequences of operations, verification of system capacity, generating simulated signals to simulate sensor values, conducting simulated conditions to tests all loads and verify system performance during all conditions of operation and verifying design intent. In addition, each system shall be tested through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part and full load). Proper responses such as power failures, freeze conditions, low-oil pressures, equipment failures, etc. shall also be tested. The CA develops the functional test sheets and procedures in sequential written form, coordinates the testing, conducts the testing and documents the testing. Each contractor is required is supply personnel to assist during the functional performance testing where applicable.

B. No system, equipment or component thereof shall be tested until the Contractor and the CM has certified, in writing, that the system, equipment and / or components are complete, have been tested, adjusted and balanced and are ready for validating and performance testing. FPV is scheduled by the CA after the pre-functional testing requirements are complete and signed-off by the CM and the CA. FPV will not be conducted until a written notice of completion by the CM confirming that the system is ready for FPV. The air balancing and water balancing must be complete and the controls must be debugged prior to the performance verification.

C. Functional testing shall be conducted by the CA. Functional testing may not proceed until the systems have been properly installed, started-up and all deficiencies have been corrected.

D. Functional testing is intended to begin upon completion of a system. Functional testing may proceed prior to the completion of systems or sub-systems at the discretion of the CA and CM.

Beginning system testing before full completion shall not relieve the Contractor from fully completing the system, including all pre-functional checklists.

E. The Contractor shall provide personnel to operate the systems while functional performance testing is commencing. This shall include but not be limited to; starting and stopping of systems, opening and closing valves to create false loads on the system (with the capabilities of the existing system) and allowing the CA to manipulate the building automation systems to modulate the system requirements.

F. The Contractor shall review the commissioning functional performance testing procedure supplied by the CA. After functional testing commences, the Contractor and the CA shall sign the functional test record and provide the owner and the CM a copy to review. All deficiencies either corrected in the field or outstanding shall be documented on the functional test forms for review by all parties.

G. All functional testing must be completed and approved by the CA and the owner before the project will be considered substantially complete.

3.4 DEFERRED TESTING

A. Deferred Testing. The Contractor shall be available to assist in seasonal testing (Summer, Winter and Intermediate), tests delayed until weather or other conditions until building construction is completed, required building occupancy or loading, or other conditions are suitable for the demonstration of equipment or system's performance, as specified. These deferred tests shall be conducted in the same manner as the seasonal tests as soon as possible. Deferred testing shall be executed, documented and deficiencies corrected as specified herein for functional performance testing. Any adjustments or corrections to the O&M manuals and "As built" documents required by the results of the testing shall be made before the seasonal testing process is considered complete.

3.5 TESTING DOCUMENTATION, NON-CONFORMANCE AND APPROVALS

A. The CA shall clearly list any outstanding items of the initial start-up and pre-functional procedures that were not completed successfully. The testing form and any outstanding deficiencies shall be provided to the CM/Owner within two days of test completion. The CA shall review the Contractor's startup testing reports and shall submit either a non-compliance report or an approval form to the Contractor. The CA shall work with the Contractor and others as necessary, to correct and retest deficiencies or uncompleted items. The Contractor shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner, and shall notify the CA as soon as outstanding items have been corrected and resubmit an updated start-up report with a Statement of Correction on the original non-compliance report. When all requirements are satisfactorily completed, the CA shall recommend approval of the startup and pre-functional testing of each system and schedule the functional testing of the equipment or system.

B. As functional performance testing progresses and a deficiency is identified, the CA shall discuss the issue with the executing contractor and the commissioning team.

1. When there is no dispute of the deficiency and the Contractor accepts responsibility for correcting it, the CA shall document the deficiency and the Contractor's response and intentions and the testing shall proceed, if possible. Corrections of minor deficiencies identified may be made by the Contractor during the functional performance testing, at the discretion of the CA. Every effort shall be made or expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the commissioning effort.

2. When the identified deficiency is corrected, the Contractor shall sign the statement of correction at the bottom of the non-compliance form, certifying that the equipment is ready to be retested, and return the form to the CA. The CA shall schedule the retest of the equipment or system involved.
3. If there is a dispute about an identified deficiency, the CA shall document the deficiency and the Contractor's response, and provide a copy to the Contractor. Every attempt shall be made to resolve the dispute at the lowest management level possible. When the dispute resolution has been decided, the appropriate party corrects the deficiency, signs the statement of correction on the non-compliance form and returns the form to the CA. The CA shall schedule the retest of the equipment or system involved. Final interpretive authority shall be the A/E. Final acceptance authority shall be the Owner.

C. During the functional performance testing of multiple units of similar equipment, the CA will test all of the installed equipment and components identified. If, under such a testing procedure, three or more identical pieces of equipment (size along does not constitute difference) fail to perform to the requirements of the Contract Documents (mechanically or substantively) due to manufacturing or installation defects not allowing it to meet its submitted performance spec, all identical units may be considered unacceptable by the CA. In such a case, the Contractor shall provide the CA with the following:

1. Within one week of notification from the CA, the Contractor or manufacturer's representative shall examine all other identical units making a record of the findings. The findings shall be provided to the CA within two weeks of the original notice.
2. Within two weeks of the original notification, the Contractor shall provide the CA and the A/E a signed and dated, written explanation of the problem, cause of failures, etc., and proposed solution, including full equipment submittals for corrective or replacement equipment, if appropriate. The proposed solution shall not be for less than the specification requirements of the original installation.
3. When approved, two examples of the proposed solution shall be installed by the Contractor and the CA shall schedule and conduct functional testing of the proposed solution. Upon completion of the functional testing of the proposed solution, the CA shall recommend the acceptance or disapproval of the proposed solution to the Owner.
4. Upon acceptance of the proposed solution by the Owner, the Contractor shall replace or repair all identical items, at their expenses and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week of approval of the proposed solution.

D. Cost of Retesting

1. The cost for CA and/or Owner personnel to conduct the retesting of a functional performance testing requirements necessitated because a specific pre-functional or start-up test item, reported to have been successfully completed, but found to be incomplete or faulty, shall be the responsibility of the Contractor.
2. For a deficiency identified during the functional testing, not related to any pre-functional checklist or start-up fault, the CA and Owner shall direct the retesting of the equipment once at "no charge" for their time. However, all costs for any subsequent retesting shall be the responsibility of the Contractor.
3. Items left incomplete, which later cause deficiencies or delays during functional testing may result in back-charges to the responsible party.

3.6 OPERATION AND MAINTENANCE (O&M) MANUALS

A. The following O&M manual requirements do not replace O&M manual documentation requirements elsewhere in these specifications. A detailed listing of O&M requirements is listed in Section 019113.

B. Division 23 shall compile and prepare documentation for all equipment and systems covered in Division 23 and deliver this documentation to the CM for inclusion in the O&M manuals, according to this section and Section 019113, prior to the training of owner personnel.

C. The CA shall receive a copy of the O&M manuals for review.

D. Operation and maintenance documentation, in hardback 3-ring loose-leaf binders except full size drawings and diskettes, shall cover all mechanical systems. Documentation shall include the following: operations and maintenance documentation directory; emergency information; operating manual; emergency information; maintenance manual; test reports; and construction documents.

E. The operation and maintenance documentation package shall be submitted as one comprehensive package to the Owner and CA before systems start-up and commissioning, and shall be updated, revised and completed during, and at completion of, commissioning.

3.7 TRAINING OF OWNER PERSONNEL

A. The mechanical commissioning supervisor shall be responsible for training coordination and scheduling of required training and for ensuring that all required training is completed. The CA shall oversee the content and adequacy of the training of Owner personnel.

B. Prepare and submit a syllabus describing an overview of the program, describing how the program will be conducted, when and where meetings are to be held, names and company affiliations of lecturers, description of contents and outline for each lecture, and recommended reference material and outside reading. Obtain direction from the Owner on which operating personnel shall be instructed in each system. Proposed training schedules, materials, and lesson plans shall be submitted to the CA for review of the content and adequacy of the training of Owner personnel for commissioned equipment or systems.

C. Mechanical Contractor. The mechanical contractor shall have the following training responsibilities:

1. Provide the CA with training plan one week before the planned training.
2. Provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of equipment.
3. Training shall normally start with classroom sessions followed by hands-on training on each piece of equipment.
4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
5. The appropriate trade or manufacturer’s representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer’s representative. Practical building operating expertise, as well as in-depth knowledge of all modes of operation of the specific piece of equipment, is required. More than one party may be required to execute the training.
6. The controls contractor shall attend sessions other than the controls training, for each type of equipment controlled by the BAS, to discuss the interaction of the BAS as it relates to the equipment being discussed.
7. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.

3.8 WRITTEN WORK PRODUCTS

A. Written work products of Contractors shall consist of the start-up and initial checkout plan and the filled out start-up, initial checkout and pre-functional checklists.

END OF SECTION 230800

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 01 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 “Hangers and Supports for HVAC Piping and Equipment”
2. Division 23 Section “Vibration Controls for HVAC Piping and Equipment”
3. Division 23 Section "Testing, Adjusting, and Balancing for HVAC"
4. Division 23 Section “HVAC Insulation”
5. Division 23 Section "Air Duct Accessories"

1.3 PERFORMANCE REQUIREMENTS

A. Delegated 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 in "Duct Schedule" Article.

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 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. 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.
5. Dimensions of main duct runs in relation to 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.

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, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports.
6. Design and selection of hangers and supports for all ductwork hung from the building exterior. Provide all gravity, expansion (coordinate with 230516), thrust, wind loads, and other related stresses to structural engineer and steel contractor prior to installation.

1.5 INFORMATIONAL SUBMITTALS

A. 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 in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:

    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.
    f. Perimeter moldings.

B. Welding certificates.

C. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated 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 with performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports shall withstand the effects of loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.

D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."

E. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

F. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

2.2 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.

1. Construct ducts of galvanized sheet steel unless otherwise indicated.
2. For ducts exposed to weather, construct of Type 304 or Type 316 stainless steel indicated by manufacturer to be suitable for outdoor installation.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse 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."

1. For ducts with longest side less than 36 inches (914 mm), select joint types in accordance with Figure 2-1.
2. For ducts with longest side 36 inches (914 mm) or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," 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 4, "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."

2.3 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. Construct ducts of galvanized sheet steel unless otherwise indicated.
2. For ducts exposed to weather, construct of Type 304 or Type 316 stainless steel indicated by manufacturer to be suitable for outdoor installation.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse 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."

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 3-2, "Round Duct Longitudinal Seams," 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 (1830 mm) 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 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "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."

2.4 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 (Z275).
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B for exposed installations and No. 2D for concealed installations unless otherwise indicated in the "Duct Schedule" Article.
   1. For ducts exposed to weather, construct of Type 304 or 316 stainless steel indicated by manufacturer to be suitable for outdoor installation.

D. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M) Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

E. 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.

F. 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.

2.5 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
   1. Maximum Thermal Conductivity:

      a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K) at 75 deg F (24 deg C) mean temperature.
      b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F (0.033 W/m x K) at 75 deg F (24 deg C) mean temperature.

   2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
   3. Solvent Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C916.

      a. Adhesive shall have a VOC content of 80 g/L or less.
      b. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C534/C534M, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
   1. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
   2. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

      a. Adhesive shall have a VOC content of 80 g/L or less.

b. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Fiberglass-Free Duct Liner: Made from partially recycled cotton or polyester products and containing no fiberglass. Airstream surface overlaid with fire-resistant facing to prevent surface erosion by airstream, complying with NFPA 90A or NFPA 90B. Treat natural-fiber products with antimicrobial coating.

1. Maximum Thermal Conductivity: 0.24 Btu x in./h x sq. ft. x deg F (0.034 W/m x K) at 75 deg F (24 deg C) mean temperature when tested in accordance with ASTM C518.
2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with ASTM E84; certified by an NRTL.
3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

a. Adhesive shall have a VOC content of 80 g/L or less.
b. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized steel; with beveled edge sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) in diameter.

E. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm (12.7 m/s)or greater.
7. Secure liner with mechanical fasteners 4 inches (100 mm) from corners and at intervals not exceeding 12 inches (300 mm) transversely; at 3 inches (75 mm) from transverse joints and at intervals not exceeding 18 inches (450 mm) longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

a. Fan discharges.
b. Intervals of lined duct preceding unlined duct.
c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm (12.7 m/s) or where indicated.

9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.

    a. Sheet Metal Inner Duct Perforations: 3/32-inch (2.4-mm) diameter, with an overall open area of 23 percent.

10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.6 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. 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 (2500 Pa), 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.

C. 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.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

E. Round Duct Joint O-Ring Seals:

1. Basis-of-Design Product: Subject to requirements, provide Nordfab Ducting, LLC; QF O-ring.

2. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m at 250 Pa) and shall be rated for 10-inch wg (2500-Pa) static-pressure class, positive or negative.
3. Butyl Rubber O-ring to seal in concave bead in coupling or fitting spigot.

2.7 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 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. 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.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. 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 ducts in maximum practical lengths with fewest possible joints.

D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

I. 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 (38 mm).

J. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

K. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

M. Elbows: Use long-radius elbows wherever they fit.

1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
2. Fabricate 90-degree round elbows with a minimum of three segments for 12 inches (300 mm) and smaller and a minimum of five segments for 14 inches (350 mm) and larger.

N. Branch Connections: Use lateral or conical branch connections.

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. All interior ductwork exposed in occupied areas is to be round spiral type.

B. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

C. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

D. 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.

E. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

F. Repair or replace damaged sections and finished work that does not comply with these requirements.

G. Prime and paint, finish to match space aesthetic according to architect.

3.3 DUCTWORK EXPOSED TO WEATHER

A. All external joints are to have secure watertight mechanical connections. Seal all openings to provide weatherproof construction.

B. Construct ductwork to resist external loads of wind, snow, ice, and other effects of weather. Provide necessary supporting structures.

C. Single Wall:
1. Ductwork shall be galvanized steel.

a. If duct outer surface is uninsulated, protect outer surface with suitable paint. Paint materials and application requirements are specified in Section 099113 "Exterior Painting."

2. Where ducts have external insulation, provide weatherproof aluminum jacket. See Section 230713 "Duct Insulation."

3.4 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts at a minimum to the following seal classes in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated:

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "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 (100 mm) thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) 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 (5 m).

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.

3.6 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 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 09 painting Sections.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Test ducts for leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
3. Test the following systems:

    a. Indoor ducts with a pressure class higher than 3-Inch wg, where indicated on duct construction schedule, ducts in risers, and supply ducts upstream of terminal units (e.g. VAV boxes, reheat coils, etc.):
        1) Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.
        2) If any of the representative duct sections fail leak testing, then an additional representative duct section totaling no less that 25 percent of total installed duct area shall be tested.
        3) If any section of the second 25 percent fails, then the entire system shall be leak tested.
    b. Outdoor ducts, product-conveying exhaust ducts, and pressurization-critical exhaust ducts:
        1) Test 100 percent of total installed duct area for each designated pressure class.
    c. Leakage test requirements are intentionally more stringent that standard SMACNA requirements.
4. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
5. Test for leaks before applying external insulation.
6. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
7. 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.

3.9 DUCT CLEANING

A. Clean new and existing duct system(s) before testing, adjusting, and balancing.

B. For cleaning of existing ductwork, see Section 230130.52 "Existing HVAC Air Distribution System Cleaning."

C. Use duct cleaning methodology as indicated in NADCA ACR.

D. 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 "Air 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.

E. 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.

F. 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.

G. 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.

3.10 DUCT SCHEDULE

A. Duct Construction Schedule:

Air System	SMACNA Pressure Class	SMACNA Seal Class	SMACNA Leakage Class	Material	Transverse Joints	Notes
Supply (Low-Pressure)	+2	A	2	Galvanized	TDF/TDC, Slip/Drive, Slip/Screw	
Return/ Exhaust	-4	A	2	Galvanized	TDF/TDC	

B. Applicable Standards

1. SMACNA HVAC Duct Construction Standards Latest Edition (Metal and Flexible):
   a. Sheet Metal Ductwork
   b. Duct Liners
   c. Adhesives
   d. Fasteners
   e. Flexible Ductwork
2. SMACNA HVAC Air Duct Leakage Test Manual Latest Edition
   a. Duct Leakage Testing
   b. Duct Seal Classification

C. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.

D. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.
2. PVC-Coated Ducts:

   a. Exposed to Airstream: Match duct material.
   b. Not Exposed to Airstream: Match duct material.

3. Stainless-Steel Ducts:

   a. Exposed to Airstream: Match duct material.
   b. Not Exposed to Airstream: Match duct material\.

4. Aluminum Ducts: Aluminum or galvanized sheet steel coated with zinc chromate.

E. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

   a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
   b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
   c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "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) Radius-to Diameter Ratio: 1.5.

   b. Round Elbows, 12 Inches (305 mm) and Smaller in Diameter: Stamped or pleated.
   c. Round Elbows, 14 Inches (356 mm) and Larger in Diameter: Welded.

F. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

   a. Rectangular Main to Rectangular Branch: 45-degree entry.
   b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

   a. Velocity 1000 fpm (5 m/s) or Lower: 90-degree tap.
   b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap.
   c. Velocity 1500 fpm (7.6 m/s) or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233300

AIR DUCT 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. Backdraft dampers
2. Manual volume dampers
3. Control dampers
4. Fire dampers
5. Combination fire and smoke dampers
6. Flange connectors
7. Turning vanes
8. Remote damper operators
9. Duct-mounted access doors
10. Flexible connectors
11. Duct accessory hardware

B. Related Requirements
1. Division 28 Section “Digital, Addressable Fire-Alarm System” for duct-mounted fire and smoke detectors.

1.3 SUBMITTALS

A. Product Data: For each type of product.

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 dimension, 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 installation
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. Duct security bars.
f. Wiring Diagrams: For power, signal, and control wiring.

C. 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 form installers of the items involved

D. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

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. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, “Installation of Air Conditioning and Ventilation Systems,” and with NFPA 90B, “Installation of Warm Air Heating and Air Conditioning Systems.”

B. Comply with SMACNAS’S “HVAC Duct Construction Standards – Metal and Flexible” for acceptable materials, materials 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.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
1. Galvanized Coating Designation: G90.
2. Exposed-surface Finish: Mill phosphatized.

B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a 2D finish for concealed ducts and 2B finish for exposed ducts.

C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard 1-side bright finish for exposed ducts.

D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. 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.

2.3 BACKDRAFT 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. American Warming and Ventilating; a division of Mestek, Inc.
3. Greenheck Fan Corporation.
4. Nailor Industries Inc.
5. Pottorff.
6. Ruskin Company.
7. Vent Products Company, Inc.

B. Description: Gravity balanced.

C. Maximum Air Velocity: 3000 fpm.

D. Maximum System Pressure: 4-inch wg.

E. Frame: Hat-shaped, 20 gage roll-formed galvanized steel or 0.125-inch extruded aluminum, with welded corners and mounting flange.

F. Blades: Multiple single-piece blades, maximum 6-inch width, 28 gage roll-formed galvanized steel or 0.070-inch extruded aluminum with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Extruded vinyl, mechanically locked.

I. Blade Axles:

1. Material: Nonmetallic or plated steel.

J. Tie Bars and Brackets: Aluminum or Galvanized steel.

K. Return Spring: Adjustable tension.

L. Bearings: Steel ball or synthetic pivot bushings.

M. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Electric actuators.
4. Chain pulls.
5. Screen Mounting for open installations:
    a. Front mounted in sleeve.
        1) Sleeve Thickness: 20 gage minimum.
        2) Sleeve Length: 6 inches minimum.
    b. Screen Mounting: Rear mounted.
    c. Screen Material: Galvanized steel or Aluminum.
    d. Screen Type: Insect.
6. 90-degree stops.

2.4 MANUAL VOLUME DAMPERS

A. 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 Ventilation; a division of Mestek, Inc.
    c. Greenheck Fan Corporation
    d. Nailor Industries Inc.
    e. Pottorff.
    f. Ruskin Company.
    g. Vent Products Company, Inc.
2. Performance
    a. Comply with AMCA 500-D testing for damper rating.
    b. Pressures to 4.0 in wg.

c. Velocities to 200 fpm.
d. Temperatures to 180 deg F.

3. Linkage outside airstream and concealed in jamb.
4. Suitable for horizontal or vertical applications.
5. Frames:
   a. Frame: Hat-shaped, 0.094-inch-thick galvanized sheet steel, 0.10-inch-thick aluminum sheet channels, or 0.05-inch-thick stainless steel to match material of connecting ductwork.
   b. Mitered and welded corners.
   c. Flanges for attaching to walls and flangeless frames for installing in ducts.
6. Blades:
   a. 6” wide.
   b. Multiple blade.
   c. Opposed-blade design.
   d. Stiffen damper blades for stability.
   e. Galvanized-steel, extruded aluminum, or stainless-steel to match frame material.

2.5 CONTROL DAMPERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Ruskin CD60 Low Leakage Control Damper or comparable product by one of the following:

1. Ruskin Company.
2. Greenheck Fan Corporation.
3. American Warming and Ventilating; a division of Mestek, Inc.

B. Low-leakage rating, with linkage outside airstream and concealed in frame, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
1. Leakage shall be less than 3 cfm/sq ft at 1-inch of static pressure.
2. AMCA licensed as a Class 1A damper.

C. Frames:

1. Hat shaped.
2. 16 gage galvanized steel or 0.125-inch thick aluminum to match material of connecting ductwork
3. Mitered and welded corners.

D. Blades:

1. Multiple blade with maximum blade width of 6 inches.
2. Opposed-blade design.
3. Galvanized-steel with double skin construction or Extruded Aluminum to match frame material.
4. Airfoil shaped.
5. Blade Edging: Closed-cell neoprene.

E. Blade Axles: 1/2-inch- diameter; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 72 to plus 275 deg F.

2. Removable control shaft extends 6 inches beyond frame

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.

2.6 FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ruskin Company.
2. Greenheck Fan Corporation.
3. Pottorff.
4. Air Balance Inc.; a division of Mestek, Inc.
5. Nailor Industries Inc.

B. Type: Dynamic; 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 2000-fpm velocity.

D. Fire Rating: 1-1/2 and 3 hours, as required by the Building Code to match allowable resistance for each penetrated construction's fire rating.

E. Integral Sleeve Frame:
1. Material: 20 gage roll formed galvanized steel.
2. Frame and sleeve are roll formed together as one-piece integral sleeve frame.
3. Length: 16 inches.

F. Mounting Orientation: Vertical or horizontal as indicated.

G. Blades:
1. Style: Curtain type, out of airstream.
2. Action: Spring or gravity closure upon fusible link release.
3. Material: 24 gage roll formed, galvanized steel.

H. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

I. Heat-Responsive Device: UL listed, Replaceable, 165 deg F (74 deg C) rated, fusible links.

2.7 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ruskin Company.
2. Greenheck Fan Corporation.
3. Pottorff.
4. Air Balance Inc.; a division of Mestek, Inc.
5. Nailor Industries Inc.

B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.

D. Fire Rating: 1-1/2 and 3 hours, as required by the Building Code to match allowable resistance for each penetrated construction's fire rating.

E. Leakage: Class I.

F. Frame: 5 inches thick, 16 gage roll formed, galvanized steel hat-shaped channel, reinforced at corners.

G. Heat-Responsive Device:
1. Electric resettable device and switch package, factory installed, rated.
   a. Close (in a controlled manner) and lock damper during test, smoke detection, power failure, or fire conditions through actuator closure spring. At no time shall actuator disengage from damper blades.
   b. Allow damper to be automatically and remotely reset after test or power failure conditions. After exposure to high temperature or fire, inspect damper before reset to ensure proper operation.
   c. Controlled closing and locking of damper in 7 to 15 seconds to allow duct pressure to equalize. Instantaneous closure is not acceptable.
   d. Release Temperature: 165 deg F.]
2. Fire stat: UL classified dual temperature device allows the damper to be re-opened after initial closure from high heat.
   a. Electrically and mechanically locks damper in closed position when duct temperatures exceed 165 degrees F.
   b. Allow damper to remain operable through a high limit temperature sensor for smoke management purposes while temperature is below 250 degrees F or 350 degrees F.
   c. Blade position indicator switches: Two position indicator switches linked directly to damper blade in order to allow remote indication of damper blade position.]

H. Blades:
1. Style: Airfoil-shaped, single piece, double skin.
2. Action: Opposed.
3. Material: Minimum 14 gage equivalent thickness, galvanized steel.
4. Width: Maximum 6 inches.

I. Bearings: Self-lubricating stainless steel sleeve, turning in extruded hole in frame.

J. Seals:
1. Blade: Inflatable silicone fiberglass material to maintain smoke leakage rating to a minimum of 450 degF.
2. Jamb: Stainless steel, flexible metal compression type.

K. Linkage: Concealed in frame.

L. Rated pressure and velocity to exceed design airflow conditions.

M. Mounting Sleeve: Factory-installed, 20 gage galvanized sheet steel; minimum 12 inches long.

N. Actuator:
1. Type: Electric 120 V, 60 Hz, two-position, fail close.
2. Mounting: External or internal as required for access.

O. Master control panel for use in dynamic smoke-management systems.

P. Damper Motors: Modulating action.

Q. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 23 Section "Instrumentation and Control for HVAC" and Division 26 Sections.
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
7. Electrical Connection: 115 V, single phase, 60 Hz.

R. Accessories:

1. Auxiliary switches for position indication.
2. Test and reset switches, remote mounted.

2.8 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 or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.9 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. Elgen Manufacturing.
4. METALAIRE, Inc.
5. SEMCO Incorporated.
6. 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 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

E. Vane Construction: Single wall for ducts up to 48 inches (1200 mm) wide and double wall for larger dimensions.

2.10 REMOTE DAMPER OPERATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Young Regulator Company.
2. Ventfabrics, Inc.
3. Pottorff.

B. Description: Cable system with gear drive and controller designed for remote manual damper adjustment.

C. Control Wire: Stainless steel encapsulated in flexible galvanized spiral wire sheath.

D. Wall-Box Mounting: Recessed.

E. Wall-Box Cover-Plate Material: Zinc.

2.11 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. Elgen Manufacturing.
5. Flexmaster U.S.A., Inc.
6. Greenheck Fan Corporation.

7. McGill AirFlow LLC.
8. Nailor Industries Inc.
9. Pottorff.
10. Ventfabrics, Inc.
11. 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 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Door:

   a. Double wall, rectangular.
   b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
   c. Vision panel.
   d. Hinges and Latches: Continuous piano hinge and cam latches.
   e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam 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: Continuous and two sash locks.
   c. Access Doors up to 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.
   d. Access Doors Larger Than 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.

2.12 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. Elgen Manufacturing.
4. Ventfabrics, Inc.
5. 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 two 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.

G. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

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 back-draft dampers on exhaust discharges and outside air intakes. Coordinate with fan specification to determine if backdraft dampers are already provided at the fan unit.

D. Install control dampers at inlet of exhaust fans or exhaust ducts as closed as possible to exhaust fan unless otherwise indicated.
   1. All outdoor air intake and exhaust systems shall be equipped with motorized dampers that will automatically shut when the systems or spaces served are not in use.

E. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct ;liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
   1. Install steel volume dampers in steel ducts.
   2. Install aluminum volume dampers in aluminum ducts.

F. Provide concealed remote volume damper operators for all volume dampers in inaccessible locations. Operator shall be installed within the ceiling or wall such that the unit is flush with the finished surface. Operators for diffusers shall not be located in active supply portions of the diffuser but may be installed in blank-off location and/or return diffusers. Coordinate location of operator with the Engineer.

G. Set dampers to fully open position before testing, adjusting, and balancing.

H. Install test holes at fan inlets and outlets and elsewhere as indicated.

I. Provide fire and smoke dampers, fire dampers at location where ducts and outlets pass through fire rated components taking into account the matching of fire area to that of the adjacent duct. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
   1. Install fire, smoke and combination fire and smoke dampers according to UL listing.
   2. Install all dampers in accordance with SMACNA fire damper guide and manufacturer’s instructions.
   3. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92A.
   4. Install dampers square and free from racking with blades running horizontally.
   5. Do not compress or stretch damper frame into duct or opening.
   6. Handle damper using sleeve or frame. Do not lift damper using blades, actuator, or jack shaft.
   7. Install bracing for multiple section assemblies to support assembly weight and to hold against system pressure. Install bracing as needed.

J. Connect ducts to duct silencers with flexible duct connectors.

K. 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. Upstream and downstream from duct filters.
   3. At outdoor-air intakes and mixed-air plenums.
   4. At drain pans and seals.
   5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
   6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusile 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. Control devices requiring inspection
   8. Elsewhere as indicated.

L. Install access doors with swing against duct static pressure.

M. 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.

N. Label access doors according to Division 23 Section “Identification for HVAC Piping and Equipment” to indicate the purpose of access door.

O. Install flexible connectors to connect ducts to equipment.

P. For fans developing static pressures of 5-inch wg. and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

Q. Connect terminal units to supply ducts directly. Do not use flexible ducts to change directions.

R. Connect diffuser or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place. Do not use flexible ducts to change directions.

S. Connect flexible ducts to metal ducts with draw bands.

T. Install duct test holes where required for testing and balancing purposes.

U. 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 (6-mm) 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. Operate fire, smoke and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 233400

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:

1. In-line 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
6. Dampers, including housings, linkages, and operators.
7. Roof curbs.
8. Fan speed controllers.

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 seismic restraints and for design vibration isolation bases.
5. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to support equipment. Include auxiliary motor slides and rails, and base weights.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show fan 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. Operations and Maintenance Data: For centrifugal fans to include in emergency, operation and maintenance manuals.

1.6 QUALITY ASSURANCE

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. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

1.7 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate sizes and locations of concrete bases with actual equipment provided.

C. Coordinate sizes and location of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.8 EXTRA MATERIALS

A. Furnish extra materials describe below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Belts: Two (2) set(s) for each belt-driven unit.

PART 2 - PRODUCTS

2.1 IN-LINE CENTRIFUGAL 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. Greenheck (Basis-of-Design)
2. Loren Cook Company
3. PennBarry
4. Twin City Fan & Blowers

B. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

C. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing; with wheel, inlet cone, and motor on swing-out service door.

D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

E. Accessories:
1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
3. Companion Flanges: For inlet and outlet duct connections.
4. Fan Guards: 1/2-inch by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
5. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor and efficiency requirements for motors specified in Section 230513 “Common Motor Requirements for HVAC Equipment”.

2.3 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 test 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 fans level and plumb.

B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer’s writing instructions.

C. Lift and support units with manufacturer’s designated lifting or supporting points.

D. Equipment Mounting:
   1. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 “Vibration and Seismic Controls for HVAC.”

E. Unit Support: Install fans level on structural curbs or piling. Coordinate wall penetration and flashing with wall construction. Secure units to structural support with anchor bolts.

F. Install units with clearances for service and maintenance.

G. Label fans according to requirements specified in Section 230553 “Identification for HVAV Piping and Equipment.”

3.2 CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connection with flexible connectors. Flexible connectors are specified in Section 233300 “Air Duct Accessories.”

B. Install ducts adjacent to fans to allow service and maintenance.

C. Ground equipment according to section 260526 “Grounding and Bonding for Electrical Systems.”

D. Connect wiring according to Section 260519 “low-Voltage Electrical Power Conductors and Cables.”

3.3 FIELD QUALITY CONTROL

A. Testing Agency: 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 installation, including connections.

C. Perform the following test and inspections:
   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 bearing and other moving parts.
   8. Verify that manual and automatic volume control and fire and smoke damper in connected ductwork systems are in fully open position.
   9. Comply with requirements in section 230593 “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 test and inspections.

E. Prepare tests and inspection reports.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner’s maintenance personnel to adjust, operate, and maintain fans.

END OF SECTION 233400

SECTION 260010 – SUPPLEMENTAL REQUIREMENTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Supplemental requirements generally applicable to the Work specified in Division 26. This Section is also referenced by related Work specified in other Divisions.

1.2 REFERENCES

A. Abbreviations and Acronyms for Electrical Terms and Units of Measure:

1. A: Ampere, unit of electrical current.
2. AC or ac: Alternating current.
3. AFCI: Arc-fault circuit interrupter.
4. AIC: Ampere interrupting capacity.
5. AL, Al, or ALUM: Aluminum.
6. ASD: Adjustable-speed drive.
7. ATS: Automatic transfer switch.
8. AWG: American wire gauge; see ASTM B258.
9. BAS: Building automation system.
10. BIL: Basic impulse insulation level.
11. BIM: Building information modeling.
12. CAD: Computer-aided design or drafting.
13. CATV: Community antenna television.
14. CB: Circuit breaker.
15. cd: Candela, the SI fundamental unit of luminous intensity.
16. CO/ALR: Copper-aluminum, revised.
17. COPS: Critical operations power system.
18. CU or Cu: Copper.
19. CU-AL or AL-CU: Copper-aluminum.
20. dB: Decibel, a unitless logarithmic ratio of two electrical, acoustical, or optical power values.
21. dB(A-weighted) or dB(A): Decibel acoustical sound pressure level with A-weighting applied in accordance with IEC 61672-1.
22. dB(adjusted) or dBa: Decibel weighted absolute noise power with respect to 3.16 pW (minus 85 dBm).
23. dBm: Decibel absolute power with respect to 1 mW.
24. DC or dc: Direct current.
25. DCOA: Designated critical operations area.
26. DDC: Direct digital control (HVAC).
27. EGC: Equipment grounding conductor.
28. ELV: Extra-low voltage.
29. EMF: Electromotive force.
30. EMI: Electromagnetic interference.
31. EPM: Electrical preventive maintenance.
32. EPS: Emergency power supply.
33. EPSS: Emergency power supply system.
34. ESS: Energy storage system.
35. EV: Electric vehicle.

36. EVPE: Electric vehicle power export equipment.
37. EVSE: Electric vehicle supply equipment.
38. fc: Footcandle, an internationally recognized unit of illuminance equal to one lumen per square foot or 10.76 lx. The simplified conversion 1 fc = 10 lx in the Specifications is common practice and considered adequate precision for building construction activities. When there are conflicts, lux is the primary unit; footcandle is specified for convenience.
39. FLC: Full-load current.
40. ft: Foot.
41. ft-cd: Foot-candle, the antiquated U.S. Standard unit of illuminance, equal to one international candle measured at a distance of one foot, that was superseded in 1948 by the unit "footcandle" after the SI unit candela (cd) replaced the international candle; see "fc,"
42. GEC: Grounding electrode conductor.
43. GFCI: Ground-fault circuit interrupter.
44. GFPE: Ground-fault protection of equipment.
45. GND: Ground.
46. HACR: Heating, air conditioning, and refrigeration.
47. HDPE: High-density polyethylene.
48. HID: High-intensity discharge.
49. HP or hp: Horsepower.
50. HVAC: Heating, ventilating, and air conditioning.
51. Hz: Hertz.
52. IBT: Intersystem bonding termination.
53. inch: Inch. To avoid confusion, the abbreviation "in." is not used.
54. IP: Ingress protection rating (enclosures); Internet protocol (communications).
55. IR: Infrared.
56. IS: Intrinsically safe.
57. IT&R: Inspecting, testing, and repair.
58. ITE: Information technology equipment.
59. kAIC: Kiloampere interrupting capacity.
60. kcmil or MCM: One thousand circular mils.
61. kV: Kilovolt.
62. kVA: Kilovolt-ampere.
63. kVAr or kVAR: Kilovolt-ampere reactive.
64. kW: Kilowatt.
65. kWh: Kilowatt-hour.
66. LAN: Local area network.
67. lb: Pound (weight).
68. lbf: Pound (force).
69. LCD: Liquid-crystal display.
70. LCDI: Leakage-current detector-interrupter.
71. LED: Light-emitting diode.
72. Li-ion: Lithium-ion.
73. lm: Lumen, the SI derived unit of luminous flux.
74. LNG: Liquefied natural gas.
75. LP-Gas: Liquefied petroleum gas.
76. LRC: Locked-rotor current.
77. LV: Low voltage.
78. lx: Lux, the SI derived unit of illuminance equal to one lumen per square meter.
79. m: Meter.
80. MCC: Motor-control center.
81. MDC: Modular data center.
82. MG set: Motor-generator set.
83. MIDI: Musical instrument digital interface.
84. MLO: Main lugs only.

85. MV: Medium voltage.
86. MVA: Megavolt-ampere.
87. mW: Milliwatt.
88. MW: Megawatt.
89. MWh: Megawatt-hour.
90. NC: Normally closed.
91. Ni-Cd: Nickel-cadmium.
92. Ni-MH: Nickel-metal hydride.
93. NIU: Network interface unit.
94. NO: Normally open.
95. NPT: National (American) standard pipe taper.
96. OCPD: Overcurrent protective device.
97. ONT: Optical network terminal.
98. PC: Personal computer.
99. PCS: Power conversion system.
100. PCU: Power-conditioning unit.
101. PF or pf: Power factor.
102. PHEV: Plug-in hybrid electric vehicle.
103. PLC: Programmable logic controller.
104. PLFA: Power-limited fire alarm.
105. PoE: Power over Ethernet.
106. PV: Photovoltaic.
107. PVC: Polyvinyl chloride.
108. pW: Picowatt.
109. RFI: (electrical) Radio-frequency interference; (contract) Request for interpretation.
110. RMS or rms: Root-mean-square.
111. RPM or rpm: Revolutions per minute.
112. SCADA: Supervisory control and data acquisition.
113. SCR: Silicon-controlled rectifier.
114. SPD: Surge protective device.
115. sq.: Square.
116. SWD: Switching duty.
117. TCP/IP: Transmission control protocol/Internet protocol.
118. TEFC: Totally enclosed fan-cooled.
119. TR: Tamper resistant.
120. TVSS: Transient voltage surge suppressor.
121. UL: (standards) Underwriters Laboratories, Inc.; (product categories) UL, LLC.
122. UL CCN: UL Category Control Number.
123. UPS: Uninterruptible power supply.
124. USB: Universal serial bus.
125. UV: Ultraviolet.
126. V: Volt, unit of electromotive force.
127. V(ac): Volt, alternating current.
128. V(dc): Volt, direct current.
129. VA: Volt-ampere, unit of complex electrical power.
130. VAR: Volt-ampere reactive, unit of reactive electrical power.
131. VFC: Variable-frequency controller.
132. VOM: Volt-ohm-multimeter.
133. VPN: Virtual private network.
134. VRLA: Valve regulated lead acid; also called "sealed lead acid (SLA)" or "valve regulated sealed lead acid."
135. W: Watt, unit of real electrical power.
136. Wh: Watt-hour, unit of electrical energy usage.
137. WPT: Wireless power transfer.
138. WPTE: Wireless power transfer equipment.

139. WR: Weather resistant.

B. Abbreviations and Acronyms for Electrical Raceway Types:

1. EMT: Electrical metallic tubing.
2. EMT-A: Aluminum electrical metallic tubing.
3. EMT-S: Steel electrical metallic tubing.
4. EMT-SS: Stainless steel electrical metallic tubing.
5. ENT: Electrical nonmetallic tubing.
6. EPEC: Electrical HDPE underground conduit.
7. EPEC-40: Schedule 40 electrical HDPE underground conduit.
8. EPEC-80: Schedule 80 electrical HDPE underground conduit.
9. EPEC-A: Type A electrical HDPE underground conduit.
10. EPEC-B: Type B electrical HDPE underground conduit.
11. ERMC: Electrical rigid metal conduit.
12. ERMC-A: Aluminum electrical rigid metal conduit.
13. ERMC-S: Steel electrical rigid metal conduit.
14. ERMC-S-G: Galvanized-steel electrical rigid metal conduit.
15. ERMC-S-PVC: PVC-coated-steel electrical rigid metal conduit.
16. ERMC-SS: Stainless steel electrical rigid metal conduit.
17. FMC: Flexible metal conduit.
18. FMC-A: Aluminum flexible metal conduit.
19. FMC-S: Steel flexible metal conduit.
20. FMT: Steel flexible metallic tubing.
21. FNMC: Flexible nonmetallic conduit. See "LFNC."
22. HDPE: See EPEC.
23. IMC: Steel electrical intermediate metal conduit.
24. LFMC: Liquidtight flexible metal conduit.
25. LFMC-A: Aluminum liquidtight flexible metal conduit.
26. LFMC-S: Steel liquidtight flexible metal conduit.
27. LFMC-SS: Stainless steel liquidtight flexible metal conduit.
28. LFNC: Liquidtight flexible nonmetallic conduit.
29. LFNC-A: Layered (Type A) liquidtight flexible nonmetallic conduit.
30. LFNC-B: Integral (Type B) liquidtight flexible nonmetallic conduit.
31. LFNC-C: Corrugated (Type C) liquidtight flexible nonmetallic conduit.
32. PVC: Rigid PVC conduit.
33. PVC-40: Schedule 40 rigid PVC conduit.
34. PVC-80: Schedule 80 rigid PVC Conduit.
35. PVC-A: Type A rigid PVC concrete-encased conduit.
36. PVC-EB: Type EB rigid PVC concrete-encased underground conduit.
37. RGS: See ERMC-S-G.
38. RMC: See ERMC.
39. RTRC: Reinforced thermosetting resin conduit.
40. RTRC-AG: Low-halogen, aboveground reinforced thermosetting resin conduit.
41. RTRC-AG-HW: Heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
42. RTRC-AG-SW: Standard wall, low-halogen, aboveground reinforced thermosetting resin conduit.
43. RTRC-AG-XW: Extra heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
44. RTRC-BG: Low-halogen, belowground reinforced thermosetting resin conduit.

C. Abbreviations and Acronyms for Electrical Single-Conductor and Multiple-Conductor Cable Types:

1. AC: Armored cable.
2. CATV: Coaxial general-purpose cable.
3. CATVP: Coaxial plenum cable.
4. CATVR: Coaxial riser cable.
5. CI: Circuit integrity cable.
6. CL2: Class 2 cable.
7. CL2P: Class 2 plenum cable.
8. CL2R: Class 2 riser cable.
9. CL2X: Class 2 cable, limited use.
10. CL3: Class 3 cable.
11. CL3P: Class 3 plenum cable.
12. CL3R: Class 3 riser cable.
13. CL3X: Class 3 cable, limited use.
14. CM: Communications general-purpose cable.
15. CMG: Communications general-purpose cable.
16. CMP: Communications plenum cable.
17. CMR: Communications riser cable.
18. CMUC: Under-carpet communications wire and cable.
19. CMX: Communications cable, limited use.
20. DG: Distributed generation cable.
21. FC: Flat cable.
22. FCC: Flat conductor cable.
23. FPL: Power-limited fire-alarm cable.
24. FPLP: Power-limited fire-alarm plenum cable.
25. FPLR: Power-limited fire-alarm riser cable.
26. IGS: Integrated gas spacer cable.
27. ITC: Instrumentation tray cable.
28. ITC-ER: Instrumentation tray cable, exposed run.
29. MC: Metal-clad cable.
30. MC-HL: Metal-clad cable, hazardous location.
31. MI: Mineral-insulated, metal-sheathed cable.
32. MTW: (machine tool wiring) Moisture-, heat-, and oil-resistant thermoplastic cable.
33. MV: Medium-voltage cable.
34. NM: Nonmetallic sheathed cable.
35. NMC: Nonmetallic sheathed cable with corrosion-resistant nonmetallic jacket.
36. NMS: Nonmetallic sheathed cable with signaling, data, and communications conductors, plus power or control conductors.
37. NPLF: Non-power-limited fire-alarm circuit cable.
38. NPLFP: Non-power-limited fire-alarm circuit cable for environmental air spaces.
39. NPLFR: Non-power-limited fire-alarm circuit riser cable.
40. NUCC: Nonmetallic underground conduit with conductors.
41. OFC: Conductive optical fiber general-purpose cable.
42. OFCG: Conductive optical fiber general-purpose cable.
43. OFCP: Conductive optical fiber plenum cable.
44. OFCR: Conductive optical fiber riser cable.
45. OFN: Nonconductive optical fiber general-purpose cable.
46. OFNG: Nonconductive optical fiber general-purpose cable.
47. OFNP: Nonconductive optical fiber plenum cable.
48. OFNR: Nonconductive optical fiber riser cable.
49. P: Marine shipboard cable.
50. PLTC: Power-limited tray cable.
51. PLTC-ER: Power-limited tray cable, exposed run.
52. PV: Photovoltaic cable.
53. RHH: (high heat) Thermoset rubber, heat-resistant cable.
54. RHW: Thermoset rubber, moisture-resistant cable.

55. SA: Silicone rubber cable.
56. SE: Service-entrance cable.
57. SER: Service-entrance cable, round.
58. SEU: Service-entrance cable, flat.
59. SIS: Thermoset cable for switchboard and switchgear wiring.
60. TBS: Thermoplastic cable with outer braid.
61. TC: Tray cable.
62. TC-ER: Tray cable, exposed run.
63. TC-ER-HL: Tray cable, exposed run, hazardous location.
64. THW: Thermoplastic, heat- and moisture-resistant cable.
65. THHN: Thermoplastic, heat-resistant cable with nylon jacket outer sheath.
66. THHW: Thermoplastic, heat- and moisture-resistant cable.
67. THWN: Thermoplastic, moisture- and heat-resistant cable with nylon jacket outer sheath.
68. TW: Thermoplastic, moisture-resistant cable.
69. UF: Underground feeder and branch-circuit cable.
70. USE: Underground service-entrance cable.
71. XHH: Cross-linked polyethylene, heat-resistant cable.
72. XHHW: Cross-linked polyethylene, heat- and moisture-resistant cable.

D. Definitions:

1. Basic Impulse Insulation Level (BIL): Reference insulation level expressed in impulse crest voltage with a standard wave not longer than 1.5 times 50 microseconds and 1.5 times 40 microseconds.
2. Cable: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "cable" is (1) a conductor with insulation, or a stranded conductor with or without insulation (single-conductor cable); or (2) a combination of conductors insulated from one another (multiple-conductor cable).
3. Communications Jack: A fixed connecting device designed for insertion of a communications cable plug.
4. Communications Outlet: One or more communications jacks, or cables and plugs, mounted in a box or ring, with a suitable protective cover.
5. Conductor: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "conductor" is (1) a wire or combination of wires not insulated from one another, suitable for carrying an electric current; (2) (National Electrical Safety Code) a material, usually in the form of wire, cable, or bar, suitable for carrying an electric current; or (3) (general) a substance or body that allows a current of electricity to pass continuously along it.
6. Designated Seismic System: A system component that requires design in accordance with Ch. 13 of ASCE/SEI 7 and for which the Component Importance Factor is greater than 1.0.
7. Direct Buried: Installed underground without encasement in concrete or other protective material.
8. Enclosure: The case or housing of an apparatus, or the fence or wall(s) surrounding an installation, to prevent personnel from accidentally contacting energized parts or to protect the equipment from physical damage. Types of enclosures and enclosure covers include the following:

    a. Cabinet: An enclosure that is designed for either surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.
    b. Concrete Box: A box intended for use in poured concrete.
    c. Conduit Body: A means for providing access to the interior of a conduit or tubing system through one or more removable covers at a junction or terminal point. In

the United States, conduit bodies are listed in accordance with outlet box requirements.

d. Conduit Box: A box having threaded openings or knockouts for conduit, EMT, or fittings.
e. Cutout Box: An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the enclosure.
f. Device Box: A box with provisions for mounting a wiring device directly to the box.
g. Extension Ring: A ring intended to extend the sides of an outlet box or device box to increase the box depth, volume, or both.
h. Floor Box: A box mounted in the floor intended for use with a floor box cover and other components to complete the floor box enclosure.
i. Floor-Mounted Enclosure: A floor box and floor box cover assembly with means to mount in the floor that is sealed against the entrance of scrub water at the floor level.
j. Floor Nozzle: An enclosure used on a wiring system, intended primarily as a housing for a receptacle, provided with a means, such as a collar, for surface-mounting on a floor, which may or may not include a stem to support it above the floor level, and is sealed against the entrance of scrub water at the floor level.
k. Junction Box: A box with a blank cover that joins different runs of raceway or cable and provides space for connection and branching of the enclosed conductors.
l. Outlet Box: A box that provides access to a wiring system having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for the entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting an outlet box cover, but without provisions for mounting a wiring device directly to the box.
m. Pedestal Floor Box Cover: A floor box cover that, when installed as intended, provides a means for typically vertical or near-vertical mounting of receptacle outlets above the floor's finished surface.
n. Pull Box: A box with a blank cover that joins different runs of raceway and provides access for pulling or replacing the enclosed cables or conductors.
o. Raised-Floor Box: A floor box intended for use in raised floors.
p. Recessed Access Floor Box: A floor box with provisions for mounting wiring devices below the floor surface.
q. Recessed Access Floor Box Cover: A floor box cover with provisions for passage of cords to recessed wiring devices mounted within a recessed floor box.
r. Ring: A sleeve, which is not necessarily round, used for positioning a recessed wiring device flush with the plaster, concrete, drywall, or other wall surface.
s. Ring Cover: A box cover, with raised center portion to accommodate a specific wall or ceiling thickness, for mounting wiring devices or luminaires flush with the surface.
t. Termination Box: An enclosure designed for installation of termination base assemblies consisting of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors, or both.

9. Emergency Systems: Those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction that are designed to ensure continuity of lighting, electrical power, or both, to designated areas and equipment in the event of failure of the normal supply for safety to human life.
10. Essential Electrical Systems: (healthcare facilities) Those systems designed to ensure continuity of electrical power to designated areas and functions of a healthcare facility during disruption of normal power sources, and also to minimize disruption within the internal wiring system.
11. Fault Limited: Providing or being served by a source of electrical power that is limited to not more than 100 W when tested in accordance with UL 62368-1.

a. The term "fault limited" is intended to encompass most Class 1, 2, and 3 power-limited sources complying with Article 725 of NFPA 70; Class ES1 and ES2 electrical energy sources that are Class PS1 electrical power sources (e.g., USB); and Class ES3 electrical energy sources that are Class PS1 and PS2 electrical power sources (e.g., PoE). See UL 62368-1 for discussion of classes of electrical energy sources and classes of electrical power sources.

12. Jacket: A continuous nonmetallic outer covering for conductors or cables.
13. Luminaire: A complete lighting unit consisting of a light source such as a lamp, together with the parts designed to position the light source and connect it to the power supply. It may also include parts to protect the light source or the ballast or to distribute the light.
14. Multi-Outlet Assembly: A type of surface, flush, or freestanding raceway designed to hold conductors, receptacles, and switches, assembled in the field or at the factory.
15. Plenum: A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.
16. Receptacle: A fixed connecting device arranged for insertion of a power cord plug. Also called a power jack.
17. Receptacle Outlet: One or more receptacles mounted in a box with a suitable protective cover.
18. Sheath: A continuous metallic covering for conductors or cables.
19. UL Category Control Number (CCN): An alphabetic or alphanumeric code used to identify product categories covered by UL's Listing, Classification, and Recognition Services.
20. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:

    a. Control Voltage: Having electromotive force between any two conductors, or between a single conductor and ground, that is supplied from a battery or other Class 2 or Class 3 power-limited source.
    b. Line Voltage: (1) (controls) Designed to operate using the supplied low-voltage power without transformation. (2) (transmission lines, transformers, SPDs) The line-to-line voltage of the supplying power system.
    c. Extra-Low Voltage (ELV): Not having electromotive force between any two conductors, or between a single conductor and ground, exceeding 30 V(ac rms), 42 V(ac peak), or 60 V(dc).
    d. Low Voltage (LV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 30 V but not exceeding 1000 V.
    e. Medium Voltage (MV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated about 1 kV but not exceeding 69 kV.
    f. High Voltage: (1) (circuits) Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 69 kV but not exceeding 230 kV. (2) (safety) Having sufficient electromotive force to inflict bodily harm or injury.

21. Wire: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "wire" is a slender rod or filament of drawn metal. A group of small wires used as a single wire is properly called a "stranded wire." A wire or stranded wire covered with insulation is properly called an "insulated wire" or a "single-conductor cable." Nevertheless, when the context indicates that the wire is insulated, the term "wire" will be understood to include the insulation.

1.3 COORDINATION

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions:

1. Notify Tenant no fewer than seven days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Tenant's written permission.
3. Coordinate interruption with systems impacted by outage including, but not limited to, the following:

a. Exercising generators.
b. Emergency lighting.
c. Elevators.
d. Fire-alarm systems.

B. Arrange to provide temporary electrical service or power in accordance with requirements specified in Division 01.

1.4 SEQUENCING

A. Conduct and submit results of power system studies before submitting Product Data and Shop Drawings for electrical equipment.

1.5 ACTION SUBMITTALS

A. Coordination Drawings for Structural Supports: Show coordination of structural supports for equipment and devices, including restraints and bracing for control of seismic and wind loads, with other systems, equipment, and structural supports in the vicinity.

B. Coordination Drawings for Ceiling Areas: Where indicated on drawings, provide reflected ceiling plan(s), supplemented by sections and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which equipment and suspension systems will be attached.
3. Size and location of access panels on ceilings.
4. Elevation, size, and route of sprinkler piping.
5. Elevation, size, and route of plumbing piping.
6. Elevation, size, and route of ductwork.
7. Elevation, size, and route of cable tray.
8. Elevation, size, and route of conduit.
9. Elevation and size of wall-mounted and ceiling-mounted equipment.
10. Access panels.
11. Sprinklers.
12. Air inlets and outlets.
13. Control modules.
14. Luminaires.
15. Communications devices.
16. Speakers.
17. Security devices.
18. Fire-alarm devices.

19. Indicate clear dimensions for maintenance access in front of equipment.
20. Indicate dimensions of fully-open access doors.

C. Coordination Drawings for Cable Tray Routing: Reflected ceiling plan(s), supplemented by sections and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Elevation, size, and route of cable trays.
2. Relationships between components and adjacent structural, electrical, and mechanical elements.
3. Vertical and horizontal offsets and transitions.
4. Elevation and size of sleeves for wall, ceiling, and floor cable penetrations.
5. Elevation of ceilings and size of ceiling tiles.
6. Locations of access panels on ceilings.
7. Locations where cable tray crosses or parallels sprinkler piping.
8. Locations where cable tray crosses plumbing piping.
9. Locations where cable tray crosses or parallels ductwork.
10. Locations of access panels on ductwork.
11. Locations where cable tray crosses conduit.
12. Items blocking access around cable trays, including the following:

    a. Light fixtures.
    b. Speakers.
    c. Fire-alarm devices.
    d. Power outlets.
    e. Wall-mounted equipment.
    f. Equipment racks.
    g. Furniture.
    h. Door swings.
    i. Building features.

13. Indicate clear dimension between cable tray and walls or obstructions that are closer than 10 ft (3 m).
14. Highlight locations where cable tray is greater than 3 ft (1 m) above ceilings. Explain how personnel access will be accommodated for cable tray maintenance.

D. Coordination Drawings for Conduit Routing: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

E. Coordination Drawings for Large Equipment Indoor Installations:

1. Location plan, drawn to scale, showing heavy equipment or truck access paths to loading dock or other freight access into building. Indicate available width and height of doors or openings.
2. Floor plan for entry floor and floor where equipment is located, drawn to scale, showing heavy equipment access paths for maintenance and replacement, with the following items shown and coordinated with each other, based on input from installers of the items involved:

a. Dimensioned concrete bases, outlines of equipment, conduit entries, and grounding equipment locations.
b. If freight elevator must be used, indicate width and height of door and depth of car. Indicate if large equipment must be tipped to use elevator.
c. Dimensioned working clearances and dedicated areas below and around electrical equipment where obstructions and tripping hazards are prohibited.

3. Reflected ceiling plans for entry floor and floor where equipment is located, drawn to scale, on which the following items shown and coordinated with each other, based on input from installers of the items involved:

a. Support locations, type of support, and weight on each support. Locate structural supports for structure-supported raceways.
b. Location of lighting fixtures, sprinkler piping and sprinklers, ducts and diffusers, and other obstructions, indicating available overhead clearance.
c. Dimensioned working clearances and dedicated areas above and around electrical equipment where foreign systems and equipment are prohibited.

F. Coordination Drawings for Large Equipment Outdoor Installations:

1. Utilities site plan, drawn to scale, showing heavy equipment or truck access paths for maintenance and replacement, with the following items shown and coordinated with each other, based on input from installers of the items involved:

a. Fences and walls, dimensioned concrete bases, outlines of equipment, conduit entries, and grounding and bonding locations.
b. Indicate clear dimensions for fence gates and wall openings.
c. Indicate depth and type of ground cover, and locations of trees, shrubbery, and other obstructions in access path.
d. Indicate clear height below tree branches, overhead lines, bridges, and other overhead obstructions in access path, or where cranes and hoists will be needed to handle large electrical equipment.
e. Support locations, type of support, and weight on each support. Locate structural supports for structure-supported raceways.
f. Dimensioned working clearances and dedicated areas around electrical equipment.

G. Coordination Drawings for Duct Banks:

1. Show duct profiles and coordination with other utilities and underground structures.
2. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.

1.6 INFORMATIONAL SUBMITTALS

A. Electrical Installation Schedule: At preconstruction meeting, and periodically thereafter as dates change, provide schedule for electrical installation Work to Owner and Architect including, but not limited to, milestone dates for the following activities:

1. Submission of power system studies.
2. Submission of specified coordination drawings.
3. Submission of action submittals specified in Division 26.
4. Orders placed for major electrical equipment.
5. Arrival of major electrical equipment on-site.

6. Utility service inspection and activation.
7. Closing of walls and ceilings containing electrical Work.
8. System startup, testing, and commissioning activities for major electrical equipment.
9. System startup, testing, and commissioning activities for emergency lighting.
10. System startup, testing, and commissioning activities for automation systems (SCADA, BMS, lighting, HVAC, fire alarm, fire pump, etc.).
11. Pouring of concrete housekeeping pads for electrical equipment and testing of concrete samples.
12. Requests for special inspections.
13. Requests for inspections by authorities having jurisdiction.

B. Delegated Design Drawings for Structural Masonry Wall Penetrations: Where indicated on Drawings, provide reflected ceiling plan(s), supplemented by elevations, sections, and other details, drawn to scale, signed and sealed by a qualified structural professional engineer, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Location and dimensions of structural members supporting wall.
2. Location and dimensions of columns near penetrations.
3. Location and dimension of headers and lintels.
4. Doors and windows near penetrations.
5. Location and dimensions of penetrating cuts.
6. Sprinkler piping and sleeves.
7. Plumbing piping and sleeves.
8. Ductwork and sleeves.
9. Cable tray and sleeves.
10. Conduit and sleeves.
11. Firestopping assemblies for rated penetrations.
12. Structural supports for piping, ductwork, and conduit on both sides of wall.

C. Certificates:

Retain "Welding certificates" Subparagraph below if retaining "Welder" Paragraph in "Qualifications" Article.

1. Welding certificates.
2. Seismic-Load Performance Certificates: Provide special certification for designated seismic systems as indicated in Paragraph 13.2.2 "Special Certification Requirements for Designated Seismic Systems" of [ASCE/SEI 7-05] [ASCE/SEI 7-10] [ASCE/SEI 7-16] for all designated seismic-load systems identified on Drawings or in the Specifications.

    a. Include the following information:

        1) Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
        2) Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
        3) Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
        4) Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.
        5) Provide equipment manufacturer's written certification for each designated active electrical seismic device and system, stating that it will remain operable following the design earthquake. Certification must be based on requirements of ASCE/SEI 7, including shake table testing per ICC-

ES AC156 or a similar nationally recognized testing standard procedure acceptable to authorities having jurisdiction[, or experience data as permitted by][ASCE/SEI 7-05][ASCE/SEI 7-10][ASCE/SEI 7-16].

6) Provide equipment manufacturer's written certification that components with hazardous contents maintain containment following the design earthquake by methods required in [ASCE/SEI 7-05] [ASCE/SEI 7-10] [ASCE/SEI 7-16].
7) Submit evidence demonstrating compliance with these requirements for approval to authorities having jurisdiction after review and acceptance by qualified structural professional engineer.

Retain first subparagraph only if Designated Seismic Systems are not scheduled on Drawings.

b. The following systems and components are Designated Seismic Systems and require written special certification of seismic qualification by manufacturer:

1) Hangers and supports specified in Section 260529 "Hangers and Supports for Electrical Systems."
2) Raceways, enclosures, cabinets, boxes, and their mounting provisions specified in Section 260533 "Raceway and Boxes for Electrical Systems."
3) Seismic restraints specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
4) Equipment, accessories, and components specified in Section 262413 "Switchboards."
5) Equipment, accessories, and components specified in Section 262416 "Panelboards."
6) Equipment, accessories, and components specified in Section 262816 "Enclosed Switches and Circuit Breakers."
7) Equipment, accessories, and components specified in Section 263213.16 "Gas-Engine-Driven Generator Sets."
8) Equipment, accessories, and components specified in Section 263600 "Transfer Switches."
9) Luminaires, accessories, and components specified in Section 265119 "LED Interior Lighting."
10) Luminaires, accessories, and components specified in Section 265213 "Emergency and Exit Lighting."
11) Luminaires, accessories, and components specified in Section 265619 "LED Exterior Lighting."

3. Wind-Load Performance Certificates: Provide special certification for systems and components designated on Drawings or in the Specifications to be subject to high wind exposure and impact damage.

a. Include the following information:

1) Provide equipment manufacturer's written certification for each designated system and component, stating that it will remain in place and operable following the design wind event and comply with requirements of authorities having jurisdiction.
2) Certification must be based on ICC-ES or similar nationally recognized testing standard procedures acceptable to authorities having jurisdiction.

D. Qualification Statements:

1. For qualified regional manufacturer.
2. For structural professional engineer.

3. For electrical professional engineer.
4. For lighting professional engineer.
5. For EPM specialist.
6. For welder.
7. For switchboard Installer.
8. For generator set Installer.
9. For lightning protection system Installer.
10. For low-voltage electrical testing agency and on-site electrical testing supervisor.
11. For structural testing and inspecting agency.
12. For outdoor pole testing and inspecting agency.
13. For luminaire photometric testing laboratory.
14. For lighting testing and inspecting agency.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. Provide emergency operation, normal operation, and preventive maintenance manuals for each system, equipment, and device listed below:

   a. ATS.

   b. Switchboards.

   c. Electrical Generator.

2. Include the following information:

   a. Manufacturer's operating specifications.
   b. User's guides for software and hardware.
   c. Schedule of maintenance material items recommended to be stored at Project site.
   d. Detailed instructions covering operation under both normal and abnormal conditions.
   e. Time-current curves for overcurrent protective devices and manufacturer's written instructions for testing and adjusting their settings.
   f. List of load-current and overload-relay heaters with related motor nameplate data.
   g. List of lamp types and photoelectric relays used on Project, with ANSI and manufacturers' codes.
   h. Manufacturer's instructions for setting field-adjustable components.
   i. Manufacturer's instructions for testing, adjusting, and reprogramming microprocessor controls.
   j. EPSS: Manufacturer's system checklists, maintenance schedule, and maintenance log sheets in accordance with NFPA 110.
   k. Exterior pole inspection and repair procedures.

1.8 QUALIFICATIONS

A. Qualified Regional Manufacturer: Manufacturer, possessing qualifications specified in Section 014000 "Quality Requirements," that maintains a service center capable of providing training, parts, and emergency on-site repairs to Project site with response time less than eight hours.

B. Structural Professional Engineer: Professional engineer possessing active qualifications specified in Section 014000 "Quality Requirements," with expertise in structural engineering, including seismic- and wind-load modeling and analysis.

C. Electrical Professional Engineer: Professional engineer possessing active qualifications specified in Section 014000 "Quality Requirements," with expertise in electrical engineering, including electrical power system modeling and analysis of electrical safety in accordance with NFPA 70E.

D. Lighting Professional Engineer: Professional engineer possessing active qualifications in accordance with Section 014000 "Quality Requirements" and the following:

1. Expertise in electrical engineering, lighting design, and structural requirements for exterior poles and standards.
2. Lighting Certified (LC) Professional by the National Council on Qualifications for the Lighting Professions (NCQLP).

E. Medium-Voltage Cable Installer: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with training and manufacturer certification to install, splice, and terminate medium-voltage cable in accordance with electrical utility service provider's requirements.

1. Medium-voltage cable Installer must be approved by electrical utility service provider.

F. Medium-Voltage Duct Installer: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with documented training and experience with installation of medium-voltage duct banks in accordance with electrical utility service provider's requirements.

1. Medium-voltage duct Installer must be approved by electrical utility service provider.

G. Generator Set Installers: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," and able to present unexpired certified Installer credentials issued by generator set manufacturer prior to starting installation.

H. Lightning Protection System Installers: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," and able to present unexpired UL-Listed Installer, UL Category Control Number OWAY, credentials or unexpired LPI Master Installer credentials prior to starting installation.

I. Low-Voltage Electrical Testing and Inspecting Agency: Entities possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.

1. On-site electrical testing supervisors must have documented certification and experience with testing electrical equipment in accordance with NETA testing standards.

J. Structural Testing and Inspecting Agency: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with documented training and experience with testing structural concrete, seismic controls, and wind-load controls.

K. Outdoor Pole Testing and Inspecting Agency: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with documented training and experience in accordance with ASTM C1093 for foundation testing and inspections.

L. Luminaire Photometric Testing Laboratory: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" accredited under the NVLAP for Energy Efficient Lighting Products, and complying with applicable IES testing standards.

M. Lighting Testing and Inspecting Agency: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with documented training and experience with testing and inspecting lighting installations in accordance with IES LM-5.

PART 2 - PRODUCTS

2.1 SUBSTITUTION LIMITATIONS FOR ELECTRICAL EQUIPMENT

A. Substitution requests for electrical equipment will be entertained under the following conditions:

1. Substitution requests may be submitted for consideration prior to the Electrical Preconstruction Conference if accompanied by value analysis data indicating that substitution will comply with Project performance requirements while significantly increasing value for Owner throughout life of facility.
2. Substitution requests may be submitted for consideration concurrently with submission of power system study reports when those reports indicate that substitution is necessary for safety of maintenance personnel and facility occupants.
3. Contractor is responsible for sequencing and scheduling power system studies and electrical equipment procurement. After the Electrical Preconstruction Conference, insufficient lead time for electrical equipment delivery will not be considered a valid reason for substitution.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL WORK

A. Unless more stringent requirements are specified in the Contract Documents or manufacturers' written instructions, comply with NFPA 70 and NECA NEIS 1 for installation of Work specified in Division 26. Consult Architect for resolution of conflicting requirements.

3.2 SYSTEM STARTUP

A. Commissioning Activities:

1. See Section 260800 “Commissioning of Electrical Systems”.

3.3 FIELD QUALITY CONTROL

A. Administrant for Low-Voltage Electrical Tests and Inspections:

1. Tenant will engage qualified low-voltage electrical testing and inspecting agency to administer and perform tests and inspections.

B. Administrant for Power-Limited Electrical Tests and Inspections:

1. Tenant will engage qualified power-limited electrical testing and inspecting agency to administer and perform tests and inspections.

C. Administrant for Field Tests and Inspections of Lighting Installations:

1. Tenant will engage qualified lighting testing and inspecting agency to administer and perform tests and inspections.

END OF SECTION 260010

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper building wire.
2. Metal-clad cable, Type MC.
3. Armored cable, Type AC.
4. Connectors and splices.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: Indicate type, use, location, and termination locations.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Manufacturers

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. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

E. Conductor Insulation:

1. Type RHH and Type RHW-2: Comply with UL 44.
2. Type USE-2 and Type SE: Comply with UL 854.
3. Type THHN and Type THWN-2: Comply with UL 83.
4. Type XHHW-2: Comply with UL 44.

2.2 METAL-CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1569.

C. Circuits:

Retain first option in first subparagraph below for single-circuit Type MC cable. Retain second option to allow multiple circuits per cable. If retaining both options, indicate where used on Drawings.

1. Single circuit.
2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

E. Ground Conductor: Insulated.

F. Conductor Insulation:

1. Type TFN/THHN/THWN-2: Comply with UL 83.
2. Type XHHW-2: Comply with UL 44.

G. Armor:Steel, interlocked.

H. Jacket: PVC applied over armor.

2.3 ARMORED CABLE, TYPE AC

A. Description: A factory assembly of insulated current-carrying conductors with or without an equipment grounding conductor in an overall metallic sheath.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 4.

C. Circuits:

Retain first option in first subparagraph below for single-circuit Type AC cable. Retain second option to allow multiple circuits per cable. If retaining both options, indicate where used on Drawings.

1. Single circuit.
2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

E. Ground Conductor: Insulated.

F. Conductor Insulation: Type THHN/THWN-2. Comply with UL 83.

G. Armor: Steel, interlocked.

2.4 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Manufacturers:

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. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

1. Material: Copper.
2. Type: One hole with standard barrels.
3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders:

1. Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits:

1. Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.

B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway, Armored cable, Type AC, Metal-clad cable, Type MC.

C. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway, Armored cable, Type AC, Metal-clad cable, Type MC.

3.3 INSTALLATION, GENERAL

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. 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.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports 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-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inch (300 mm)] of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
2. After installing conductors and cables and before electrical circuitry has been energized, test feeder conductors and conductors feeding the following critical equipment and services for compliance with requirements:

    a. Panelboard.

3. Perform each of the following visual and electrical tests:

    a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
    b. Test bolted connections for high resistance using one of the following:

        1) A low-resistance ohmmeter.
        2) Calibrated torque wrench.
        3) Thermographic survey.

    c. Inspect compression-applied connectors for correct cable match and indentation.
    d. Inspect for correct identification.
    e. Inspect cable jacket and condition.
    f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500 V(dc) for 300 V rated cable and 1000 V(dc) for 600 V rated cable for a one-minute duration.
    g. Continuity test on each conductor and cable.
    h. Uniform resistance of parallel conductors.

4. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.

    a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

B. Cables will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Grounding and bonding conductors.
2. Grounding and bonding clamps.
3. Grounding and bonding bushings.
4. Grounding and bonding hubs.
5. Grounding and bonding connectors.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product indicated.

B. Field Quality-Control Submittals:

1. Field quality-control reports.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. In addition to items specified in Section 260010 "Supplemental Requirements for Electrical," include the following:

a. Plans showing locations of grounding features described in "Field Quality Control" Article, including the following:
1) Grounding arrangements.
2) Ground bars.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

A. Equipment Grounding Conductor:

1. General Characteristics: 600 V, THHN/THWN-2, copper wire or cable, green color, in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. ASTM - Bare Copper Grounding and Bonding Conductor:
1. Referenced Standards: Complying with one or more of the following:

a. Soft or Annealed Copper Wire: ASTM B3
b. Concentric-Lay Stranded Copper Conductor: ASTM B8.
c. Tin-Coated Soft or Annealed Copper Wire: ASTM B33.
d. 19-Wire Combination Unilay-Stranded Copper Conductor: ASTM B787/B787M.

C. UL KDER - Armored Grounding Wire:

1. Description: Single corrosion-resistant copper, aluminum, or copper-clad aluminum conductor within helically formed steel armor.
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. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

D. UL KDSH - Protector Grounding Conductor:

1. Description: Conductors intended to be used for grounding primary protector or metallic members of cable sheath in accordance with Chapters 7 and 8 of NFPA 70.
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. Listing Criteria:

a. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

4. Options:

a. Color: green.

2.2 GROUNDING AND BONDING CLAMPS

A. Description: Clamps suitable for attachment of grounding and bonding conductors to grounding electrodes, pipes, tubing, and rebar. Grounding and bonding clamps specified in this article are also suitable for use with communications applications; see Section 270526 "Grounding and Bonding for Communications Systems," for selection and installation guidelines.

B. Source Limitations: Obtain products from single manufacturer.

C. Performance Criteria:

1. 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.

2. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

D. UL KDER - Beam Grounding and Bonding Clamp:
1. General Characteristics: Mechanical-type, terminal, ground wire access from four directions; with dual, tin-plated or silicon bronze bolts.

E. UL KDER - Exothermically Welded Connection:
1. General Characteristics: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING AND BONDING BUSHINGS

A. Description: Bonding bushings connect conduit fittings, tubing fittings, threaded metal conduit, and unthreaded metal conduit to metal boxes and equipment enclosures, and have one or more bonding screws intended to provide electrical continuity between bushing and enclosure. Grounding bushings have provision for connection of bonding or grounding conductor and may or may not also have bonding screws.

B. Source Limitations: Obtain products from single manufacturer.

C. Performance Criteria:

1. 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.

2. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

D. UL KDER - Bonding Bushing:
1. General Characteristics: Threaded bushing with insulated throat.

E. UL KDER - Grounding Bushing:
1. General Characteristics: Threaded bushing with insulated throat and mechanical-type wire terminal.

2.4 GROUNDING AND BONDING HUBS

A. Description: Hubs with certified grounding or bonding locknut.

B. Source Limitations: Obtain products from single manufacturer.

C. Performance Criteria:

1. 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.

2. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

D. UL KDER - Grounding and Bonding Hub:
1. General Characteristics: Insulated, gasketed, watertight hub with mechanical-type wire terminal.

2.5 GROUNDING AND BONDING CONNECTORS

A. Source Limitations: Obtain products from single manufacturer.

B. Performance Criteria:

1. 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.

2. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

C. UL KDER - Pressure-Type Grounding and Bonding Busbar Cable Connector:
1. General Characteristics: Copper or copper alloy, for compression bonding of one or more conductor directly to copper busbar. Listed for direct burial.

D. UL KDER - Lay-In Lug Mechanical-Type Grounding and Bonding Busbar Terminal:
1. General Characteristics: Mechanical-type, copper rated for direct burial terminal with set screw.

E. UL KDER - Crimped Lug Pressure-Type Grounding and Bonding Busbar Terminal:
1. General Characteristics: Cast silicon bronze, solderless compression-type wire terminals; with long barrel and two holes spaced on 5/8 or 1 inch (16 or 25 mm) centers for two-bolt connection to busbar.

F. UL KDER - Split-Bolt Service-Post Pressure-Type Grounding and Bonding Busbar Terminal:
1. General Characteristics: Bolts that surround cable and bond to cable under compression when nut is tightened after assembly is screwed into busbar opening.

G. UL KDER - Crimped Pressure-Type Grounding and Bonding Cable Connector:

1. General Characteristics: Crimp-and-compress connectors that bond to conductor when connector is compressed around conductor.

    a. Copper, Copper alloy, Tinned copper, C and H shaped.

H. UL KDER - Split-Bolt Pressure-Type Grounding and Bonding Cable Connector:
1. General Characteristics: Bolts that surround cable and bond to cable under compression when nut is tightened.

    a. Copper, Copper alloy, Tinned copper.

I. UL KDER - Signal Reference Grid Grounding and Bonding Connector:
1. General Characteristics: Combination of compression wire connectors, access floor grounding clamps, bronze U-bolt grounding clamps, and copper split-bolt connectors, designed for the purpose.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine facility's grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of electrical system.

B. Inspect test results of grounding system measured at point of electrical service equipment connection.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with connection of electrical service equipment only after unsatisfactory conditions have been corrected.

3.2 SELECTION OF GROUNDING AND BONDING CONDUCTORS

A. Conductors: Install solid conductor for 8 AWG and smaller, and stranded conductors for 6 AWG and larger unless otherwise indicated.

B. Custom-Length Insulated Equipment Bonding Jumpers: 6 AWG, 19-strand, Type THHN.

C. Bonding Cable: 28 kcmil, 14 strands of 17 AWG conductor, 1/4 inch (6 mm) in diameter.

D. Bonding Conductor: 4 AWG or 6 AWG, stranded conductor.

E. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch (41 mm) wide and 1/16 inch (1.6 mm) thick.

F. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch (41 mm) wide and 1/16 inch (1.6 mm) thick.

3.3 SELECTION OF CONNECTORS

A. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Connections to Structural Steel: Welded connectors.

3.4 INSTALLATION

A. Comply with manufacturer's published instructions.

B. Reference Standards:

1. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
2. Consult Architect for resolution of conflicting requirements.

C. Special Techniques:

1. Conductors:

a. 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.

2. 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.

a. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
b. Make connections with clean, bare metal at points of contact.
c. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.
d. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
e. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
f. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1) Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate adjacent parts.
2) Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3) Use exothermic-welded connectors for outdoor locations; if disconnect-type connection is required, use bolted clamp.

g. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.
h. Grounding for Steel Building Structure: Install driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 ft (18 m) apart.

3. Equipment Grounding:

a. Install insulated equipment grounding conductors with feeders and branch circuits.
b. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1) Feeders and branch circuits.
2) Lighting circuits.
3) Receptacle circuits.
4) Single-phase motor and appliance branch circuits.
5) Three-phase motor and appliance branch circuits.
6) Flexible raceway runs.
7) Armored and metal-clad cable runs.
8) Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

3.5 FIELD QUALITY CONTROL

A. Field tests and inspections must be witnessed by authorities having jurisdiction.

B. 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 calibrated torque wrench in accordance with manufacturer's published instructions.

C. Nonconforming Work:

1. Grounding system will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective components and retest.

D. Collect, assemble, and submit test and inspection reports.

1. Report measured ground resistances that exceed the following values:

a. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 Ω.
b. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 Ω.

3.6 PROTECTION

A. After installation, protect grounding and bonding cables and equipment 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 260526

SECTION 260529 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Support, anchorage, and attachment components.
2. Fabricated metal equipment support assemblies.

1.2 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 the following:

a. Slotted support systems, hardware, and accessories.
b. Clamps.
c. Hangers.
d. Sockets.
e. Eye nuts.
f. Fasteners.
g. Anchors.
h. Saddles.
i. Brackets.

2. Include rated capacities and furnished specialties and accessories.

B. Delegated Design Submittal: For hangers and supports for electrical systems.

1. Include design calculations and details of hangers.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified structural professional engineer to design hanger and support system.

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 Rating: Class 1.
2. Self-extinguishing according to ASTM D635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32 inch (10 mm) diameter holes at a maximum of 8 inch (200 mm) on center in at least one surface.
   1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
   2. Material for Channel, Fittings, and Accessories: Galvanized steel.
   3. Channel Width: Selected for applicable load criteria.
   4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
   5. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs must have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body must be made of malleable iron.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

   1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

   2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

   3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
   4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
   5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325 (Grade A325M).
   6. Toggle Bolts: All steel springhead type.
   7. Hanger Rods: Threaded steel.

PART 3 - EXECUTION

3.1 SELECTION

A. Comply with the following standards for selection and installation of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA NEIS 101

B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceway and Boxes for Electrical Systems."

D. Provide vibration and seismic controls with hangers and supports in accordance with requirements specified in "Section 260548 "Vibration and Seismic Controls for Electrical Systems."

E. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and ERMC as required by NFPA 70. Minimum rod size must be 1/4 inch (6 mm) in diameter.

F. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 50 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

3.2 INSTALLATION OF SUPPORTS

A. Comply with NECA NEIS 101 for installation requirements except as specified in this article.

B. 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 must be weight of supported components plus 200 lb (90 kg).

C. 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 Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inch (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inch (100 mm) thick.

6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.
9. .

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 PAINTING

A. Touchup:

1. 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.

    a. 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 A780.

END OF SECTION 260529

SECTION 260533.13 – CONDUITS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Type EMT-S duct raceways and elbows.
2. Type ERMC-S duct raceways, elbows, couplings, and nipples.
3. Type FMC-S duct raceways.
4. Type FMT duct raceways.
5. Type IMC duct raceways.
6. Type LFMC duct raceways.
7. Fittings for conduit, tubing, and cable.
8. Electrically conductive corrosion-resistant compounds for threaded conduit.

1.2 DEFINITIONS

A. Conduit: A structure containing one or more duct raceways.

B. Duct Raceway: A single enclosed raceway for conductors or cable.

C. Duct Bank: An arrangement of conduit providing one or more continuous duct raceways between two points.

1.3 ACTION SUBMITTALS

Action submittals are submittals requiring responsive action and return of reviewed documents to Contractor.

A. Product Data:

Retain one or more of 17 subparagraphs below as needed to verify compliance of Work with Project requirements.
1. Type EMT-S duct raceways and elbows.
2. Type FMC-S duct raceways.
3. Type FMT duct raceways.
4. Type IMC duct raceways.
5. Type LFMC duct raceways.
6. Fittings for conduit, tubing, and cable.
7. Electrically conductive corrosion-resistant compounds for threaded conduit.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturers' Published Instructions:
1. Type EMT-S duct raceways and elbows.
2. Type ERMC-S duct raceways, elbows, couplings, and nipples.
3. Type FMC-S duct raceways.

4. Type FMT duct raceways.
5. Type IMC duct raceways.
6. Type LFMC duct raceways.
7. Fittings for conduit, tubing, and cable.
8. Electrically conductive corrosion-resistant compounds for threaded conduit.

PART 2 - PRODUCTS

2.1 TYPE EMT-S DUCT RACEWAYS AND ELBOWS

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 FJMX; including UL 797.

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.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL FJMX - Steel Electrical Metal Tubing (EMT-S) and Elbows:

1. Manufacturers:

AFC Cable Systems, Inc.
Allied Tube & Conduit; a Tyco International Ltd. Co.
Anamet Electrical, Inc.
Electri-Flex Company.
O-Z/Gedney; a brand of EGS Electrical Group.
Picoma Industries, a subsidiary of Mueller Water Products, Inc.
Republic Conduit.
Robroy Industries.
Southwire Company.
Thomas & Betts Corporation.
Western Tube and Conduit Corporation.
Wheatland Tube Company; a division of John Maneely Company.

2. Material: Steel.
3. Options:

a. Exterior Coating: Zinc.
b. Interior Coating: Zinc.
c. Minimum Trade Size: trade size 3/4.
d. Colors: As indicated on Drawings.

2.2 TYPE ERMC-S DUCT RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

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 DYIX; including UL 6.

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.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL DYIX - Galvanized-Steel Electrical Rigid Metal Conduit (ERMC-S-G), Elbows, Couplings, and Nipples:
1. Exterior Coating: Zinc.
2. Options:

a. Interior Coating: Zinc.
b. Minimum Trade Size: trade size 3/4.
c. Colors: As indicated on Drawings.

D. UL DYIX - PVC-Coated-Steel Electrical Rigid Metal Conduit (ERMC-S-PVC), Elbows, Couplings, and Nipples:
1. Options:

a. Exterior Coating: PVC complying with NEMA RN 1.
b. Interior Coating: Zinc.
c. Minimum Trade Size: trade size 3/4.
d. Colors: As indicated on Drawings.
e. Conduit Fittings for Hazardous (Classified) Locations: UL 1203.
f. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.

2.3 TYPE FMC-S DUCT RACEWAYS

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 DXUZ; including UL 1.

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.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL DXUZ - Steel Flexible Metal Conduit (FMC-S):

1. Material: Steel.
2. Options:

    a. Minimum Trade Size: trade size 3/4.
    b. Colors: As indicated on Drawings.

2.4 TYPE FMT DUCT RACEWAYS

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 ILJW; including UL Subject 1652.

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.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL ILJW - Steel Flexible Metallic Tubing (FMT):
1. Options:

    a. Minimum Trade Size: trade size 3/4.
    b. Colors: As indicated on Drawings.

2.5 TYPE IMC DUCT RACEWAYS

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 DYBY; including UL 1242.

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.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL DYBY - Steel Intermediate Metal Conduit (IMC):
1. Options:

    a. Exterior Coating: Zinc.
    b. Interior Coating: Zinc.
    c. Minimum Trade Size: trade size 3/4.
    d. Colors: As indicated on Drawings.

2.6 TYPE LFMC DUCT RACEWAYS

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 DXHR; including UL 360.

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.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL DXHR - Steel Liquidtight Flexible Metal Conduit (LFMC-S):
1. Material: Steel.
2. Options:

a. Minimum Trade Size: trade size 3/4.
b. Colors: As indicated on Drawings.

2.7 FITTINGS FOR CONDUIT, TUBING, AND CABLE

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.

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.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL DWTT - Fittings for Type ERMC, Type IMC, Type PVC, and Type HDPE Duct Raceways:
1. Listing Criteria: UL CCN DWTT; including UL 514B.
2. Options:

a. Material: Steel.
b. Coupling Method: Compression coupling.
c. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.

D. UL FKAV - Fittings for Type EMT Duct Raceways:
1. Listing Criteria: UL CCN FKAV; including UL 514B.
2. Options:

a. Material: Steel.
b. Coupling Method: Compression coupling.
c. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.

E. UL ILNR - Fittings for Type FMC Duct Raceways:
   1. Listing Criteria: UL CCN ILNR; including UL 514B.

F. UL DXAS - Fittings for Type LFMC and Type LFNC Duct Raceways:
   1. Listing Criteria: UL CCN DXAS; including UL 514B.

2.8 ELECTRICALLY CONDUCTIVE CORROSION-RESISTANT COMPOUNDS FOR THREADED CONDUIT

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 FOIZ; including UL Subject 2419.

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.
   2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL FOIZ - Electrically Conductive Corrosion-Resistant Compound for Threaded Conduit:

   1. Send to engineer for review.

PART 3 - EXECUTION

3.1 SELECTION OF CONDUITS FOR ELECTRICAL SYSTEMS

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of duct raceways. Consult Architect for resolution of conflicting requirements.

B. Special Instructions Regarding HDPE Conduits: Although Article 353 of NFPA 70 permits use of HDPE conduits where encased in concrete aboveground, UL CCN EAZX listing requirements state that HDPE underground conduits are intended only for use where direct buried with or without being encased in concrete. Specified Type HDPE underground conduits are not permitted to be used aboveground on Project.

C. Indoors:

   1. Hazardous Classified Locations: ERMC.
   2. Exposed and Subject to Severe Physical Damage: ERMC. Locations include the following:

      a. Loading docks.
      b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
      c. Mechanical rooms.
      d. Gymnasiums.

3. Exposed and Subject to Physical Damage: ERMC. Locations include the following:

    a. Locations less than 2.5 m (8 ft) above finished floor.
    b. Stub-ups to above suspended ceilings.

4. Exposed and Not Subject to Physical Damage: ERMC, IMC, EMT.
5. Concealed in Ceilings and Interior Walls and Partitions: ERMC, IMC, EMT.
6. Damp or Wet Locations: ERMC.
7. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

D. Duct Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.

1. ERMC and IMC: Provide threaded-type fittings unless otherwise indicated.

3.2 INSTALLATION OF CONDUITS 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. Type EMT-S: Article 358 of NFPA 70 and NECA NEIS 101.
2. Type ERMC-S: Article 344 of NFPA 70 and NECA NEIS 101.
3. Type FMC-S: Article 348 of NFPA 70 and NECA NEIS 101.
4. Type FMT: Article 360 of NFPA 70 and NECA NEIS 101.
5. Type IMC: Article 342 of NFPA 70 and NECA NEIS 101.
6. Type LFMC: Article 350 of NFPA 70 and NECA NEIS 101.
7. Expansion Fittings: NEMA FB 2.40.
8. Consult Engineer for resolution of conflicting requirements.

C. Special Installation Techniques:

1. General Requirements for Installation of Duct Raceways:

    a. Complete duct raceway installation before starting conductor installation.
    b. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 ft (0.6 m) above finished floor.
    c. Install no more than equivalent of three 90-degree bends in conduit run except for control wiring conduits, for which no more than equivalent of two 90-degree fewer bends are permitted. Support within 12 inch (300 mm) of changes in direction.
    d. Make bends in duct raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
    e. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
    f. Support conduit within 12 inch (300 mm) of enclosures to which attached.
    g. Install duct sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed duct raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install duct sealing fittings in accordance with NFPA 70.

h. Install devices to seal duct raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of duct raceways at the following points:

1) Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2) Where an underground service duct raceway enters a building or structure.
3) Conduit extending from interior to exterior of building.
4) Conduit extending into pressurized duct raceway and equipment.
5) Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
6) Where otherwise required by NFPA 70.

i. Do not install duct raceways or electrical items on "explosion-relief" walls or rotating equipment.
j. Do not install conduits within 2 inch (50 mm) of the bottom side of a metal deck roof.
k. Keep duct raceways at least 6 inch (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal duct raceway runs above water and steam piping.
l. Cut conduit perpendicular to the length. For conduits metric designator 53 (trade size 2) and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.
m. Install (2) pull wires in empty duct raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb (90 kg) tensile strength. Leave at least 12 inch (300 mm) of slack at both ends of pull wire. Cap underground duct raceways designated as spare above grade alongside duct raceways in use.
n. Install duct raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.

1) Termination fittings with shoulders do not require two locknuts.

o. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to metric designator 35 (trade size 1-1/4) and insulated throat metal bushings on metric designator 41 (trade size 1-1/2) and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

2. Types ERMC and IMC:

a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of duct raceway and fittings before making up joints. Follow compound manufacturer's published instructions.

3. Type ERMC-S-PVC:

a. Follow manufacturer's installation instructions for clamping, cutting, threading, bending, and assembly.
b. Provide PVC-coated sealing locknut for exposed male threads transitioning into female NPT threads that do not have sealing sleeves, including transitions from PVC couplings/female adapters to Type ERMC-S-PVC elbows in direct-burial applications. PVC-coated sealing locknuts must not be used in place of conduit hub. PVC-coated sealing locknut must cover exposed threads on Type ERMC-S-PVC duct raceway.

c. Coat field-cut threads on PVC-coated duct raceway with manufacturer-approved corrosion-preventing conductive compound prior to assembly.

4. Types FMC and LFMC:

a. Provide a maximum of 36 inch (915 mm) of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

5. Duct Raceway Terminations at Locations Subject to Moisture or Vibration:

a. Provide insulating bushings to protect conductors, including conductors smaller than 4 AWG. Install insulated throat metal grounding bushings on service conduits.

6. Duct Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.

a. ERMC-S-PVC: Provide only fittings listed for use with this type of conduit. Patch and seal joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Provide sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
b. EMT: Provide compression, steel fittings. Comply with NEMA FB 2.10.
c. Flexible Conduit: Provide only fittings listed for use with flexible conduit type. Comply with NEMA FB 2.20.

7. Duct Raceways Penetrating Rooms or Walls with Acoustical Requirements: Seal duct raceway openings on both sides of rooms or walls with acoustically rated putty or firestopping.
8. Identification: Provide labels for conduit assemblies, duct raceways, and associated electrical equipment.

a. Provide warning signs.

3.3 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533.13

SECTION 260533.16 – BOXES AND COVERS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metallic outlet boxes, device boxes, rings, and covers.
2. Junction boxes and pull boxes.
3. Cover plates for device boxes.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Metallic outlet boxes, device boxes, rings, and covers.
2. Junction boxes and pull boxes.
3. Cover plates for device boxes.
4. Hoods for outlet boxes.

B. Shop Drawings:

1. Shop drawings for floor boxes.

PART 2 - PRODUCTS

2.1 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

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 QCIT; including UL 514A.

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 QCIT - Metallic Outlet Boxes and Covers:

1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.
2. Options:

a. Material: Sheet steel.
b. Sheet Metal Depth: Minimum 1.5 inch (38 mm).

D. UL QCIT - Metallic Conduit Bodies:

1. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.

E. UL QCIT - Metallic Device Boxes:

1. Description: Box with provisions for mounting wiring device directly to box.
2. Options:

a. Material: Sheet steel.
b. Sheet Metal Depth: minimum 1.5 inch (38 mm).

2.2 JUNCTION BOXES AND PULL BOXES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. Listing Criteria: UL CCN BGUZ; including UL 50 and UL 50E.

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.

2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL BGUZ - Indoor Sheet Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Options:

a. Degree of Protection: Type 1.

D. UL BGUZ - Outdoor Sheet Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Options:

a. Degree of Protection: Type 3R.

E. UL BGUZ - Outdoor Polymeric Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.

2. Options:

a. Degree of Protection: Type 3R.

2.3 COVER PLATES FOR DEVICES BOXES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. Listing Criteria: UL CCN QCIT or UL CCN QCMZ; including UL 514D.
3. Wallplate-Securing Screws: Metal with head color to match wallplate finish.

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 QCIT or QCMZ - Metallic Cover Plates for Device Boxes:

1. Options:

a. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
b. Wallplate Material: Galvanized steel.

PART 3 - EXECUTION

3.1 PREPARATION

A. Shop Drawings: Prepare and submit the following:

1. Shop Drawings for Floor Boxes: Show that floor boxes are located to avoid interferences and are structurally allowable. Indicate floor thickness where boxes are embedded in concrete floors and underfloor clearances where boxes are installed in raised floors.

3.2 SELECTION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Architect for resolution of conflicting requirements.

B. Degree of Protection:

1. Outdoors:

a. Type 3R unless otherwise indicated.
b. Locations Aboveground Where Mechanism Must Operate When Ice Covered: Type 3S.
c. Locations in-Ground or Exposed to Corrosive Agents: Type 4X.

2. Indoors:

    a. Type 1 unless otherwise indicated.
    b. Damp or Dusty Locations: Type 12.
    c. Surface Mounted in Kitchens and Other Locations Exposed to Oil or Coolants: Type 12.
    d. Locations Exposed to Corrosive Agents: Type 4X.

C. Exposed Boxes Installed Less Than 2.5 m (8 ft) Above Floor:

1. Provide cast-metal boxes. Boxes with knockouts or unprotected openings are prohibited.

3.3 INSTALLATION OF BOXES AND COVERS 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. Outlet, Device, Pull, and Junction Boxes: Article 314 of NFPA 70.
2. Consult Architect for resolution of conflicting requirements.

C. Special Installation Techniques:

1. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.
2. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to top of box unless otherwise indicated.
3. 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. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box, whether installed indoors or outdoors.
4. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
5. Locate boxes so that cover or plate will not span different building finishes.
6. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.
7. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.
8. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
9. Set metal floor boxes level and flush with finished floor surface.
10. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.
11. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.
12. Boxes and Enclosures in Areas or Walls with Acoustical Requirements:

    a. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty.
    b. Provide gaskets for wallplates and covers.

13. Identification: Provide labels for boxes and associated electrical equipment.

a. Identify field-installed conductors, interconnecting wiring, and components.
b. Provide warning signs.
c. Label each box with engraved metal or laminated-plastic nameplate.

3.4 CLEANING

A. Remove construction dust and debris from boxes before installing wallplates and covers.

3.5 PROTECTION

A. After installation, protect boxes 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 260533.16

SECTION 260553 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Labels.
2. Bands and tubes.
3. Tapes and stencils.
4. Tags.
5. Signs.
6. Cable ties.
7. Miscellaneous identification products.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

B. Identification Schedule: For each piece of electrical equipment and electrical system components to be index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1 and IEEE C2.

B. Comply with 29 CFR 1910.144 for color identification of hazards; 29 CFR 1910.145 for danger, caution, warning, and safety instruction signs and tags; and the following:

1. Fire-protection and fire-alarm equipment, including raceways, must be finished, painted, or suitably marked safety red.
2. Ceiling-mounted hangers, supports, cable trays, and raceways must be finished, painted, or suitably marked safety yellow where less than 7.7 ft (2.3 m) above finished floor.

C. Signs, labels, and tags required for personnel safety must comply with the following standards:

1. Safety Colors: NEMA Z535.1.
2. Facility Safety Signs: NEMA Z535.2.
3. Safety Symbols: NEMA Z535.3.
4. Product Safety Signs and Labels: NEMA Z535.4.
5. Safety Tags and Barricade Tapes for Temporary Hazards: NEMA Z535.5.

D. Comply with NFPA 70E and Section 260573.19 "Arc-Flash Hazard Analysis" requirements for arc-flash warning labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, must comply with UL 969.

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 1000 V or Less:

1. Black letters on orange field.
2. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase- and Voltage-Level Identification, 1000 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.

1. Color must be factory applied.
2. Colors for 208Y/120 V Circuits:

    a. Phase A: Black.
    b. Phase B: Red.
    c. Phase C: Blue.

3. Colors for 240 V Circuits:

    a. Phase A: Black.
    b. Phase B: Red.

4. Colors for 480Y/277 V Circuits:

    a. Phase A: Brown.
    b. Phase B: Orange.
    c. Phase C: Yellow.

5. Color for Neutral: White.
6. Color for Equipment Grounds: Green.

C. Warning Label Colors:

1. Identify system voltage with black letters on orange background.

D. Warning labels and signs must include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 3 FEET MINIMUM."

E. Equipment Identification Labels:

1. Black letters on white field.

2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

B. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.

C. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3 mil (0.08 mm) thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
   1. Minimum Nominal Size:
      a. 1-1/2 by 6 inch (37 by 150 mm) for raceway and conductors.
      b. 3-1/2 by 5 inch (76 by 127 mm) for equipment.
      c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

A. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inch (50 mm) long, with diameters sized to suit diameters and that stay in place by gripping action.

B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at maximum of 200 deg F (93 deg C). Comply with UL 224.

2.5 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mil (0.08 mm) thick by 1 to 2 inch (25 to 50 mm) wide; compounded for outdoor use.

C. Tape and Stencil: 4 inch (100 mm) wide black stripes on 10 inch (250 mm) centers placed diagonally over orange background and are 12 inch (300 mm) wide. Stop stripes at legends.

D. Floor Marking Tape: 2 inch (50 mm) wide, 5 mil (0.125 mm) pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

E. Underground-Line Warning Tape:
   1. Tape:
      a. Recommended by manufacturer for method of installation and suitable to identify and locate underground electrical and communications utility lines.
      b. Printing on tape must be permanent and may not be damaged by burial operations.

c. Tape material and ink must be chemically inert and not be subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

2. Color and Printing:

a. Comply with APWA Uniform Color Code using NEMA Z535.1 safety colors.
b. Inscriptions for Red Tapes: "CAUTION BURIED ELECTRIC LINE BELOW".
c. Inscriptions for Orange Tapes: "CAUTION BURIED COMMUNICATION LINE BELOW".

F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height must be 1 inch (25 mm).

2.6 TAGS

A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.

2.7 SIGNS

A. Metal-Backed Butyrate Signs:
1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396 inch (1 mm) galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
2. 1/4 inch (6.4 mm) grommets in corners for mounting.
3. Nominal Size: 10 by 14 inch (250 by 360 mm).

2.8 CABLE TIES

A. 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) in accordance with 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.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, 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) in accordance with 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.

C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.

1. Minimum Width: 3/16 inch (5 mm).

2. Tensile Strength at 73 deg F (23 deg C) in accordance with ASTM D638: 7000 psi (48.2 MPa).
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
5. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless steel screws or stainless steel machine screws with nuts and flat and lock washers.

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. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. System Identification for Raceways and Cables under 1000 V: Identification must 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.

H. System Identification for Raceways and Cables over 1000 V: Identification must completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

J. Emergency Operating Instruction Signs: Install instruction signs with white legend on red background with minimum 3/8 inch (10 mm) high letters for emergency instructions at equipment used for power transfer.

K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from floor.

L. Accessible Fittings for Raceways: Identify cover of junction and pull box of the following systems with wiring system legend and system voltage. System legends must be as follows:

1. "EMERGENCY POWER."
2. "POWER."
3. "UPS."
4. Others.

M. Vinyl Wraparound Labels:

1. Secure tight to surface of raceway or cable at location with high visibility and accessibility.
2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to location and substrate.

N. Snap-Around Labels: Secure tight to surface at location with high visibility and accessibility.

O. Self-Adhesive Wraparound Labels: Secure tight to surface at location with high visibility and accessibility.

P. Self-Adhesive Labels:

1. Install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
2. Unless otherwise indicated, provide 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 inch (50 mm) high.

Q. Snap-Around Color-Coding Bands: Secure tight to surface at location with high visibility and accessibility.

R. Heat-Shrink, Preprinted Tubes: Secure tight to surface at location with high visibility and accessibility.

S. Marker Tapes: Secure tight to surface at location with high visibility and accessibility.

T. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

U. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's instructions.

V. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inch (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in common trench exceeds 16 inch (400 mm) overall.
2. Install underground-line warning tape for direct-buried cables and cables in raceways.

W. Metal Tags:

1. Place in location with high visibility and accessibility.
2. Secure using general-purpose and plenum-rated cable ties.

X. Write-on Tags:

1. Place in location with high visibility and accessibility.
2. Secure using general-purpose and plenum-rated cable ties.

Y. Metal-Backed Butyrate Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
2. Unless otherwise indicated, provide single line of text with 1/2 inch (13 mm) high letters on 1-1/2 inch (38 mm) high sign; where two lines of text are required, use labels 2 inch (50 mm) high.

Z. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

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 and Metal-Clad Cables, 1000 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50 ft (15 m) maximum intervals in straight runs, and at 25 ft (7.6 m) maximum intervals in congested areas.

D. Accessible Fittings for Raceways and Cables within Buildings: Identify cover of junction and pull box of the following systems with self-adhesive labels containing wiring system legend and system voltage. System legends must be as follows:

1. "EMERGENCY POWER."
2. "POWER."
3. "UPS."

E. For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with conductor or cable designation, origin, and destination.

F. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with conductor designation.

G. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

H. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

I. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in direction of access to live parts. Workspace must comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

J. Instructional Signs: Self-adhesive labels, including color code for grounded and ungrounded conductors.

K. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: self-adhesive labels.

1. Apply to exterior of door, cover, or other access.
2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:

a. Power-transfer switches.
b. Controls with external control power connections.
c. Others.

L. Arc Flash Warning Labeling: Self-adhesive labels.

M. Operating Instruction Signs: Self-adhesive labels.

N. Emergency Operating Instruction Signs: Self-adhesive labels with white legend on red background with minimum 3/8 inch (10 mm) high letters for emergency instructions at equipment used for power transfer.

O. Equipment Identification Labels:

1. Indoor Equipment: Self-adhesive label.
2. Outdoor Equipment: Stenciled legend 4 inch (100 mm) high.
3. Equipment to Be Labeled:

a. Panelboards: Typewritten directory of circuits in location provided by panelboard manufacturer. Panelboard identification must be in form of self-adhesive, engraved, laminated acrylic or melamine label.
b. Enclosures and electrical cabinets.
c. Access doors and panels for concealed electrical items.
d. Switchgear.

e. Switchboards.
f. Transformers: Label that includes tag designation indicated on Drawings for transformer, feeder, and panelboards or equipment supplied by secondary.
g. Substations.
h. Emergency system boxes and enclosures.
i. Motor-control centers.
j. Enclosed switches.
k. Enclosed circuit breakers.
l. Enclosed controllers.
m. Variable-speed controllers.
n. Push-button stations.
o. Power-transfer equipment.
p. Contactors.
q. Remote-controlled switches, dimmer modules, and control devices.
r. Battery-inverter units.
s. Battery racks.
t. Power-generating units.
u. Monitoring and control equipment.
v. UPS equipment.

END OF SECTION 260553

SECTION 260573.13 – SHORT-CIRCUIT STUDIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Computer-based, fault-current study to determine minimum interrupting capacity of circuit protective devices.

1.2 DEFINITIONS

A. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

B. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.

C. SCCR: Short-circuit current rating.

D. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

E. Single-Line Diagram: See "One-Line Diagram."

1.3 ACTION SUBMITTALS

A. Product Data:

1. For power system analysis software to be used for studies.

B. Short-Circuit Study Report:

1. Submit the following after approval of system protective devices submittals. Submittals must be in digital form.

a. Short-circuit study input data, including completed computer program input data sheets.
b. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
c. Revised one-line diagram, reflecting field investigation results and results of short-circuit study.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

1.5 QUALITY ASSURANCE

A. Study must be performed using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms must comply with requirements of standards and guides specified in this Section.

C. Manual calculations are unacceptable.

PART 2 - PRODUCTS

2.1 POWER SYSTEM ANALYSIS SOFTWARE

A. Comply with IEEE 399 and IEEE 551.

B. Analytical features of power systems analysis software program must have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

C. Computer software program must be capable of plotting and diagramming time-current-characteristic curves as part of its output.

D. Computer program must be designed to perform short-circuit studies or have function, component, or add-on module designed to perform short-circuit studies.

E. Computer program must be developed under supervision of licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

A. Executive summary of study findings.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

C. One-line diagram of modeled power system, showing the following:

1. Protective device designations and ampere ratings.
2. Conductor types, sizes, and lengths.
3. Transformer kVA and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
6. Derating factors and environmental conditions.
7. Any revisions to electrical equipment required by study.

D. Comments and recommendations for system improvements or revisions in written document, separate from one-line diagram.

E. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to available short-circuit currents. Verify that equipment withstand ratings exceed available short-circuit current at equipment installation locations.
2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
3. For 600 V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in standards to 1/2-cycle symmetrical fault current.
5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

F. Short-Circuit Study Input Data:

1. One-line diagram of system being studied.
2. Power sources available.
3. Manufacturer, model, and interrupting rating of protective devices.
4. Conductors.
5. Transformer data.

G. Short-Circuit Study Output Reports:

1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

    a. Voltage.
    b. Calculated fault-current magnitude and angle.
    c. Fault-point X/R ratio.
    d. Equivalent impedance.

2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

    a. Voltage.
    b. Calculated symmetrical fault-current magnitude and angle.
    c. Fault-point X/R ratio.
    d. Calculated asymmetrical fault currents:

        1) Based on fault-point X/R ratio.
        2) Based on calculated symmetrical value multiplied by 1.6.
        3) Based on calculated symmetrical value multiplied by 2.7.

3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

    a. Voltage.
    b. Calculated symmetrical fault-current magnitude and angle.
    c. Fault-point X/R ratio.

d. No AC Decrement (NACD) ratio.
e. Equivalent impedance.
f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on symmetrical basis.
g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on total basis.

PART 3 - EXECUTION

3.1 POWER SYSTEM DATA

A. Obtain data necessary for conduct of study.

1. Verify completeness of data supplied on one-line diagram. Call discrepancies to Architect's attention.
2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.

B. Gather and tabulate required input data to support short-circuit study. Record data on Record Document copy of one-line diagram. Comply with recommendations in IEEE 551 as to amount of detail that is required to be acquired in field. Field data gathering must be by, or under supervision of, qualified electrical professional engineer. Data include, but are not limited to, the following:

1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance at service.
3. Power sources and ties.
4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
8. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
9. Motor horsepower and NEMA MG 1 code letter designation.
10. Conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
11. Derating factors.

3.2 SHORT-CIRCUIT STUDY

A. Perform study following general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on device characteristics supplied by device manufacturer.

D. Extent of electrical power system to be studied is indicated on Drawings.

E. Begin short-circuit current analysis at service, extending down to system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 5 kA or less.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. Include ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for fault-current dc decrement to address asymmetrical requirements of interrupting equipment.

H. Calculate short-circuit momentary and interrupting duties for three-phase bolted fault and single line-to-ground fault at each equipment indicated on one-line diagram.

1. For grounded systems, provide bolted line-to-ground fault-current study for areas as defined for three-phase bolted fault short-circuit study.

I. Include in report identification of protective device applied outside its capacity.

END OF SECTION 260573.13

SECTION 260573.16 – COORDINATION STUDIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.

1.2 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled. Existing to remain items must remain functional throughout construction period.

B. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when abnormal current flow exists and then removes the affected portion of the circuit from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

F. Single-Line Diagram: See "One-Line Diagram."

1.3 ACTION SUBMITTALS

A. Product Data:

1. For power system analysis software to be used for studies.

B. Coordination Study Report:

1. Submit the following after approval of system protective devices submittals. Submittals must be in digital form.

a. Coordination-study input data, including completed computer program input data sheets.
b. Study and equipment evaluation reports.
c. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient

study data to ensure that selection of devices and associated characteristics is satisfactory.

d. Revised one-line diagram, reflecting field investigation results and results of coordination study.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For overcurrent protective device coordination study software, certifying compliance with IEEE 399.

1.5 QUALITY ASSURANCE

A. Studies must be performed using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms must comply with requirements of standards and guides specified in this Section.

C. Manual calculations are unacceptable.

1.6 REGULATORY AGENCY APPROVALS

A. Submittals for coordination study requiring approval by authorities having jurisdiction must be signed and sealed by qualified electrical professional engineer responsible for their preparation.

B. Submittals for coordination study require action by Architect prior to submitting for approval by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 POWER SYSTEM ANALYSIS SOFTWARE

A. Comply with IEEE 242 and IEEE 399.

B. Analytical features of device coordination study computer software program must have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

C. Computer software program must be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program must report device settings and ratings of overcurrent protective devices and must demonstrate selective coordination by computer-generated, time-current coordination plots.

1. Optional Features:

a. Arcing faults.
b. Simultaneous faults.
c. Explicit negative sequence.
d. Mutual coupling in zero sequence.

D. Computer program must be designed to perform coordination studies or have function, component, or add-on module designed to perform coordination studies.

E. Computer program must be developed under supervision of licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

2.2 COORDINATION STUDY REPORT CONTENTS

A. Executive summary of study findings.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

C. One-line diagram of modeled power system, showing the following:

1. Protective device designations and ampere ratings.
2. Conductor types, sizes, and lengths.
3. Transformer kVA and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations.
6. Revisions to electrical equipment required by study.
7. Study Input Data: As described in "Power System Data" Article.

    a. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."

D. Protective Device Coordination Study:

1. Report recommended settings of protective devices, ready to be applied in field. Use manufacturer's data sheets for recording recommended setting of overcurrent protective devices when available.

    a. Phase and Ground Relays:

        1) Device tag.
        2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
        3) Recommendations on improved relaying systems, if applicable.

    b. Circuit Breakers:

        1) Adjustable pickups and time delays (long time, short time, and ground).
        2) Adjustable time-current characteristic.
        3) Adjustable instantaneous pickup.
        4) Recommendations on improved trip systems, if applicable.

    c. Fuses: Show current rating, voltage, and class.

E. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices.

Prepare separate sets of curves for switching schemes and for emergency periods where power source is local generation. Show the following information:

1. Device tag and title, one-line diagram with legend identifying portion of system covered.
2. Terminate device characteristic curves at point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
3. Identify device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
4. Plot the following listed characteristic curves, as applicable:

    a. Power utility's overcurrent protective device.
    b. Medium-voltage equipment overcurrent relays.
    c. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
    d. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
    e. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
    f. Cables and conductors damage curves.
    g. Ground-fault protective devices.
    h. Motor-starting characteristics and motor damage points.
    i. Generator short-circuit decrement curve and generator damage point.
    j. Largest feeder circuit breaker in each motor-control center and panelboard.

5. Maintain selectivity for tripping currents caused by overloads.
6. Maintain maximum achievable selectivity for tripping currents caused by overloads on series-rated devices.
7. Provide adequate time margins between device characteristics such that selective operation is achieved.
8. Comments and recommendations for system improvements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance of the Work. Devices to be coordinated are indicated on Drawings.

1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

A. Obtain data necessary for conduct of overcurrent protective device study.

1. Verify completeness of data supplied in one-line diagram on Drawings. Call discrepancies to Architect's attention.
2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.

B. Gather and tabulate required input data to support coordination study. List below is guide. Comply with recommendations in IEEE 551 for amount of detail required to be acquired in field. Field data gathering must be by, or under supervision of, qualified electrical professional engineer. Data include, but are not limited to, the following:

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Electrical power utility impedance at service.
3. Power sources and ties.
4. Short-circuit current at each system bus (three phase and line to ground).
5. Full-load current of loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Maximum demands from service meters.
13. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
14. Motor horsepower and NEMA MG 1 code letter designation.
15. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
16. Medium-voltage cable sizes, lengths, conductor material, cable construction, metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).
17. Data sheets to supplement electrical distribution system one-line diagram, cross-referenced with tag numbers on diagram, showing the following:

    a. Special load considerations, including starting inrush currents and frequent starting and stopping.
    b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
    c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
    d. Generator thermal-damage curve.
    e. Ratings, types, and settings of utility company's overcurrent protective devices.
    f. Special overcurrent protective device settings or types stipulated by utility company.
    g. Time-current-characteristic curves of devices indicated to be coordinated.
    h. Manufacturer, frame size, interrupting rating in amperes root mean square (rms) symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
    i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
    j. Switchgear, switchboards, motor-control centers, and panelboards ampacity, and SCCR in amperes rms symmetrical.

k. Identify series-rated interrupting devices for condition where available fault current is greater than interrupting rating of downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

3.3 COORDINATION STUDY

A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.

B. Comply with IEEE 399 for general study procedures.

C. Base study on device characteristics supplied by device manufacturer.

D. Begin analysis at service, extending down to system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 5 kA or less.

E. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

F. Transformer Primary Overcurrent Protective Devices:

1. Device must not operate in response to the following:

a. Inrush current when first energized.
b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device settings must protect transformers according to IEEE C57.12.00, for fault currents.

G. Motor Protection:

1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
2. Select protection for motors served at voltages more than 600 V according to IEEE 620.

H. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands maximum short-circuit current for time equivalent to tripping time of primary relay protection or total clearing time of fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

I. Generator Protection: Select protection according to manufacturer's instructions and to IEEE 242.

J. Include ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for fault-current dc decrement, to address asymmetrical requirements of interrupting equipment.

K. Calculate short-circuit momentary and interrupting duties for three-phase bolted fault and single line-to-ground fault at each equipment indicated on one-line diagram.

1. For grounded systems, provide bolted line-to-ground fault-current study for areas as defined for three-phase bolted fault short-circuit study.

L. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.
3. Include in report identification of protective device applied outside its capacity.

3.4 LOAD-FLOW AND VOLTAGE-DROP STUDY

A. Perform load-flow and voltage-drop study to determine steady-state loading profile of system. Analyze power system performance two times as follows:

1. Determine load flow and voltage drop based on full-load currents obtained in "Power System Data" Article.
2. Determine load flow and voltage drop based on 80 percent of design capacity of load buses.
3. Prepare load-flow and voltage-drop analysis and report to show power system components that are overloaded, or might become overloaded; show bus voltages that are less than as prescribed by NFPA 70.

3.5 MOTOR-STARTING STUDY

A. Perform motor-starting study to analyze transient effect of system's voltage profile during motor starting. Calculate significant motor-starting voltage profiles and analyze effects of motor starting on power system stability.

B. Prepare motor-starting study report, noting light flicker for limits proposed by IEEE 141, and voltage sags so as not to affect operation of other utilization equipment on system supplying motor.

3.6 FIELD ADJUSTING

A. Adjust relay and protective device settings according to recommended settings provided by coordination study. Field adjustments must be completed by engineering service division of equipment manufacturer under "Startup and Acceptance Testing" contract portion.

B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.

C. Testing and adjusting must be by qualified low-voltage electrical testing and inspecting agency.

END OF SECTION 260573.16

SECTION 260573.19 – ARC-FLASH HAZARD ANALYSIS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Computer-based, arc-flash study to determine arc-flash hazard distance and incident energy to which personnel could be exposed during work on or near electrical equipment.

1.2 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. p.u.: Per unit. The reference unit, established as a calculating convenience, for expressing all power system electrical parameters on a common reference base.

E. SCCR: Short-circuit current rating.

F. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

G. Single-Line Diagram: See "One-Line Diagram."

1.3 ACTION SUBMITTALS

A. Product Data:

1. For power system analysis software to be used for studies.

B. Study Submittals:

1. Submit the following after approval of system protective devices submittals. Submittals must be in digital form:

a. Arc-flash study input data, including completed computer program input data sheets.
b. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient

study data to ensure that selection of devices and associated characteristics is satisfactory.

c. Revised one-line diagram, reflecting field investigation results and results of arc-flash study.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.5 QUALITY ASSURANCE

A. Study must be performed using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms must comply with requirements of standards and guides specified in this Section.

C. Manual calculations are unacceptable.

1.6 REGULATORY AGENCY APPROVALS

A. Submittals for arc-flash hazard analysis requiring approval by authorities having jurisdiction must be signed and sealed by qualified electrical professional engineer responsible for their preparation.

B. Submittals for arc-flash hazard analysis require action by Architect prior to submitting for approval by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE

A. Comply with IEEE 1584 and NFPA 70E.

B. Analytical features of device coordination study computer software program must have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

C. Computer program must be designed to perform arc-flash analysis or have function, component, or add-on module designed to perform arc-flash analysis.

D. Computer program must be developed under supervision of licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

2.2 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary of study findings.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Conductor types, sizes, and lengths.
3. Transformer kVA and voltage ratings, including derating factors and environmental conditions.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, panelboard designations, and ratings.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output Data: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."

F. Protective Device Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260573.16 "Coordination Studies."

G. Arc-Flash Study Output Reports:

1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each equipment location included in report:

a. Voltage.
b. Calculated symmetrical fault-current magnitude and angle.
c. Fault-point X/R ratio.
d. No AC Decrement (NACD) ratio.
e. Equivalent impedance.
f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on symmetrical basis.
g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on total basis.

H. Incident Energy and Flash Protection Boundary Calculations:

1. Arcing fault magnitude.
2. Protective device clearing time.
3. Duration of arc.
4. Arc-flash boundary.
5. Restricted approach boundary.
6. Limited approach boundary.
7. Working distance.
8. Incident energy.
9. Hazard risk category.
10. Recommendations for arc-flash energy reduction.

I. Fault study input data, case descriptions, and fault-current calculations including definition of terms and guide for interpretation of computer printout.

2.3 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce 3.5 by 5 inch (76 by 127 mm) self-adhesive equipment label for each work location included in analysis.

B. Label must have orange header with wording, "WARNING, ARC-FLASH HAZARD," and must include the following information taken directly from arc-flash hazard analysis:

1. Location designation.
2. Nominal voltage.
3. Protection boundaries.

    a. Arc-flash boundary.
    b. Restricted approach boundary.
    c. Limited approach boundary.

4. Arc flash PPE category.
5. Required minimum arc rating of PPE in Cal/cm squared.
6. Available incident energy.
7. Working distance.
8. Engineering report number, revision number, and issue date.

C. Labels must be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Preparatory Studies: Perform Short-Circuit and Protective Device Coordination studies prior to starting Arc-Flash Hazard Analysis.

1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."
2. Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260573.16 "Coordination Studies."

C. Calculate maximum and minimum contributions of fault-current size.

1. Maximum calculation must assume maximum contribution from utility and must assume motors to be operating under full-load conditions.

2. Calculate arc-flash energy at 38 percent of maximum short-circuit current in accordance with NFPA 70E recommendations.
3. Calculate arc-flash energy with utility contribution at minimum and assume no motor contribution.

D. Calculate arc-flash protection boundary and incident energy at locations in electrical distribution system where personnel could perform work on energized parts.

E. Include medium- and low-voltage equipment locations, except equipment fed from transformers smaller than 75 kVA.

F. Calculate limited, restricted, and prohibited approach boundaries for each location.

G. Incident energy calculations must consider accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations must take into account changing current contributions, as sources are interrupted or decremented with time. Fault contribution from motors and generators must be decremented as follows:

1. Fault contribution from induction motors must not be considered beyond three to five cycles.
2. Fault contribution from synchronous motors and generators must be decayed to match actual decrement of each as closely as possible (for example, contributions from permanent magnet generators will typically decay from 10 p.u. to 3 p.u. after 10 cycles).

H. Arc-flash energy must generally be reported for maximum of line or load side of circuit breaker. However, arc-flash computation must be performed and reported for both line and load side of circuit breaker as follows:

1. When circuit breaker is in separate enclosure.
2. When line terminals of circuit breaker are separate from work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.3 POWER SYSTEM DATA

A. Obtain data necessary for conduct of arc-flash hazard analysis.

1. Verify completeness of data supplied on one-line diagram on Drawings. Call discrepancies to Architect's attention.
2. For new equipment, use characteristics from approved submittals under provisions of action submittals and information submittals for this Project.
3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys conducted by qualified technicians and engineers.

3.4 LABELING

A. Apply one arc-flash label on front cover of each section of equipment and on side or rear covers with accessible live parts and hinged doors or removable plates for each equipment included in study. Base arc-flash label data on highest values calculated at each location.

B. Each piece of equipment listed below must have arc-flash label applied to it:
   1. Low-voltage switchgear.
   2. Switchboards.
   3. Panelboards.
   4. Motor-control centers.
   5. Low voltage transformers.
   6. Safety switches.
   7. Control panels.
   8. ATS.

C. Note on record Drawings location of equipment where personnel could be exposed to arc-flash hazard during their work.

   1. Indicate arc-flash energy.
   2. Indicate protection level required.

3.5 APPLICATION OF WARNING LABELS

A. Install arc-flash warning labels under direct supervision and control of qualified electrical professional engineer.

END OF SECTION 260573.19

SECTION 262416 – PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Power panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Disconnecting and overcurrent protective devices.

1.2 DEFINITIONS

A. GFEP: Ground-fault equipment protection.

B. MCCB: Molded-case circuit breaker.

C. VPR: Voltage protection rating.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Power panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Disconnecting and overcurrent protective devices.
4. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
5. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of listing, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for SPD as installed in panelboard.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include wiring diagrams for power, signal, and control wiring.
9. Key interlock scheme drawing and sequence of operations.
10. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include

selectable ranges for each type of overcurrent protective device. Include Internet link for electronic access to downloadable PDF of coordination curves.

C. Field Quality-Control Submittals:

1. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

A. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

B. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Warranty documentation.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts: Furnish to Owner spare parts, for repairing panelboards, that are packaged with protective covering for storage on-site and identified with labels describing contents. Include the following:

1. Keys: Two spares for each type of panelboard cabinet lock.
2. Circuit Breakers Including GFCI and GFEP Types: Two spares for each panelboard.
3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation in accordance with NEMA PB 1.

1.8 WARRANTY

A. Special Installer Extended Warranty: Installer warrants that fabricated and installed panelboards 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.

B. Special Manufacturer Extended Warranty: Manufacturer warrants that panelboards perform in accordance with specified requirements and agrees to provide repair or replacement of components or products that fail to perform as specified within extended-warranty period.

1. Initial Extended-Warranty Period: Three years from date of Substantial Completion; full coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

B. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing agency recognized by authorities having jurisdiction, and marked for intended location and application.

C. Comply with NEMA PB 1.

D. Comply with NFPA 70.

E. Enclosures: Surface-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: UL 50E, Type 1.
b. Outdoor Locations: UL 50E, Type 3R.

2. Height: 7 ft (2.13 m) maximum.
3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims must cover live parts and may have no exposed hardware.
4. Finishes:

a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
b. Back Boxes: Galvanized steel.

F. Incoming Mains:

1. Location: Convertible between top and bottom.
2. Main Breaker: Main lug interiors up to 400 A must be field convertible to main breaker.

G. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.

a. Plating must run entire length of bus.
b. Bus must be fully rated for entire length.

2. Interiors must be factory assembled into unit. Replacing switching and protective devices may not disturb adjacent units or require removing main bus connectors.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure.

H. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Terminations must allow use of 75 deg C rated conductors without derating.
3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
4. Main and Neutral Lugs: Compression type, with lug on neutral bar for each pole in panelboard.
5. Ground Lugs and Bus-Configured Terminators: Compression type, with lug on bar for each pole in panelboard.
6. Feed-Through Lugs: Compression type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
7. Subfeed (Double) Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
8. Gutter-Tap Lugs: Compression type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.
9. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

I. Future Devices: Panelboards or load centers must have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

1. Percentage of Future Space Capacity: 10 percent.

J. Panelboard Short-Circuit Current Rating:

1. Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by qualified electrical testing laboratory recognized by authorities having jurisdiction. Include label or manual with size and type of allowable upstream and branch devices listed and labeled, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for series-connected short-circuit rating.

    a. Panelboards rated 240 V or less must have short-circuit ratings as shown on Drawings, but not less than 10 000 A(rms) symmetrical.
    b. Panelboards rated above 240 V and less than 600 V must have short-circuit ratings as shown on Drawings, but not less than 14 000 A(rms) symmetrical.

2. Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for 100 percent interrupting capacity.

    a. Panelboards and overcurrent protective devices rated 240 V or less must have short-circuit ratings as shown on Drawings, but not less than 10 000 A(rms) symmetrical.
    b. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V must have short-circuit ratings as shown on Drawings, but not less than 14 000 A(rms) symmetrical.

K. Surge Suppression: Factory installed as integral part of indicated panelboards, complying with UL 1449 SPD Type 2.

2.2 POWER PANELBOARDS

A. Listing Criteria: NEMA PB 1, distribution type.

B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inch (914 mm) high, provide two latches, keyed alike.

C. Mains: Circuit breaker.

D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Listing Criteria: NEMA PB 1, lighting and appliance branch-circuit type.

B. Mains: Circuit breaker.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

D. Doors: Door-in-door construction with concealed hinges; secured with flush latch with tumbler lock; keyed alike.

E. Column-Type Panelboards: Single row of overcurrent devices.

1. Column-Type Panelboard Doors: Concealed hinges secured with multipoint latch with tumbler lock; keyed alike.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. MCCB: Comply with UL 489, with series-connected rating to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers:

a. Inverse time-current element for low-level overloads.
b. Instantaneous magnetic trip element for short circuits.
c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic Trip Circuit Breakers:

a. RMS sensing.

b. Field-replaceable rating plug or electronic trip.
c. Digital display of settings, trip targets, and indicated metering displays.
d. Multi-button keypad to access programmable functions and monitored data.
e. Ten-event, trip-history log. Each trip event must be recorded with type, phase, and magnitude of fault that caused trip.
f. Integral test jack for connection to portable test set or laptop computer.
g. Field-Adjustable Settings:

1) Instantaneous trip.
2) Long- and short-time pickup levels.
3) Long and short time adjustments.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6 mA trip).
6. GFEP Circuit Breakers: Class B ground-fault protection (30 mA trip).
7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240 V, single-pole configuration.
8. Subfeed Circuit Breakers: Vertically mounted.
9. MCCB Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles.
b. Breaker handle indicates tripped status.
c. UL listed for reverse connection without restrictive line or load ratings.
d. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.

B. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

1. Fuses and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."
2. Fused Switch Features and Accessories:

a. Standard ampere ratings and number of poles.
b. Mechanical cover interlock with manual interlock override, to prevent opening of cover when switch is in on position. Interlock must prevent switch from being turned on with cover open. Operating handle must have lock-off means with provisions for three padlocks.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards in accordance with NEMA PB 1.1.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's published instructions.

B. Special Techniques:

1. Equipment Mounting:
   a. Attach panelboard to vertical finished or structural surface behind panelboard.

2. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
3. Mount top of trim 7ft above finished floor unless otherwise indicated.
4. Mount panelboard cabinet plumb and rigid without distortion of box.
5. Install overcurrent protective devices and controllers not already factory installed.

   a. Set field-adjustable, circuit-breaker trip ranges.
   b. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver in accordance with manufacturer's published instructions.

6. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
7. Install filler plates in unused spaces.
8. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
9. Mount spare fuse cabinet in accessible location.

C. Interfaces with Other Work:

1. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."

B. Panelboard Nameplates: Label each panelboard with nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

C. Device Nameplates: Label each branch circuit device in power panelboards with nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

E. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles must be located on interior of panelboard door.

F. Breaker Labels: Faceplate must list current rating, UL and IEC certification standards, and AIC rating.

G. Circuit Directory:

1. Provide directory card inside panelboard door, mounted in transparent card holder.

    a. Circuit directory must identify specific purpose with detail sufficient to distinguish it from other circuits.

2. Provide computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.

    a. Circuit directory must identify specific purpose with detail sufficient to distinguish it from other circuits.

3. Create directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

3.4 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Field tests and inspections must be witnessed by Tenant.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers and low-voltage surge arrestors stated in NETA ATS, Paragraph 7.6 Circuit Breakers and Paragraph 7.19.1 Surge Arrestors, Low-Voltage. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.

b. Instruments and Equipment:

1) Use infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

D. Nonconforming Work:

1. Panelboards will be considered defective if they do not pass tests and inspections.
2. Remove and replace defective units and retest.

E. Collect, assemble, and submit test and inspection reports, including certified report that identifies panelboards included and that describes scanning results, with comparisons of two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.

1. Measure loads during period of normal facility operations.
2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
4. Tolerance: Maximum difference between phase loads, within panelboard, may not exceed 20 percent.

3.6 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature in accordance with manufacturer's published instructions.

END OF SECTION 262416

SECTION 262726 – WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. General-use switches, dimmer switches, and fan-speed controller switches.
2. General-grade duplex straight-blade receptacles.
3. Receptacles with arc-fault and ground-fault protective devices.

1.2 ACTION SUBMITTALS

A. Product Data:
1. Duplex straight-blade receptacles.
2. Receptacles with GFCI device.

B. Field Quality-Control Submittals:

1. Field quality-control reports.

1.3 INFORMATIONAL SUBMITTALS

A. Manufacturers' Instructions: Record copy of official installation instructions issued to Installer by manufacturer for the following:
1. Duplex straight-blade receptacles.
2. Receptacles with GFCI device.

B. Sample warranties.

1.4 WARRANTY FOR DEVICES

A. Special Manufacturer Extended Warranty: Manufacturer warrants that devices perform in accordance with specified requirements and agrees to provide repair or replacement of devices that fail to perform as specified within extended warranty period.

1. Initial Extended Warranty Period: Three years from date of Substantial Completion; full coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 GENERAL-USE SWITCHES, DIMMER SWITCHES, AND FAN-SPEED CONTROLLER SWITCHES

2.2 GENERAL-GRADE DUPLEX STRAIGHT-BLADE RECEPTACLES

A. Duplex Straight-Blade Receptacle:
1. 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.

2. General Characteristics:

a. Reference Standards: UL CCN RTRT and UL 498.

3. Options:

a. Device Color: As indicated on architectural Drawings.
b. Configuration:
1) Extra-heavy-duty, NEMA 5-20R.

B. Tamper-Resistant Duplex Straight-Blade Receptacle:
1. 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.

2. General Characteristics:

a. Reference Standards: UL CCN RTRT and UL 498.

3. Options:

a. Device Color: As indicated on architectural Drawings.
b. Configuration:
1) Extra-heavy-duty, NEMA 5-20R.

C. Tamper-Resistant Duplex Straight-Blade Receptacle with USB Outlet to Power Class 2 Equipment:
1. 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.

2. General Characteristics:

a. Reference Standards: UL CCN RTRT and UL 498.

2.3 RECEPTACLES WITH ARC-FAULT AND GROUND-FAULT PROTECTIVE DEVICES

A. General-Grade, Weather-Resistant, Tamper-Resistant Duplex Straight-Blade Receptacle with GFCI Device:
1. 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.

2. General Characteristics:

a. Reference Standards: UL CCN KCXS, UL 498, and UL 943.

3. Options:

a. Device Color: As indicated on architectural Drawings.
b. Configuration: Heavy-duty, NEMA 5-20R.

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. 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. 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. Identification:

1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL OF SWITCHES

A. Field tests and inspections must be witnessed by Tenant.

B. Tests and Inspections:

1. Perform tests and inspections in accordance with manufacturers' instructions.

C. Nonconforming Work:

1. Unit will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

D. Assemble and submit test and inspection reports.

3.6 FIELD QUALITY CONTROL OF STRAIGHT-BLADE RECEPTACLES

A. Field tests and inspections must be witnessed by Tenant.

B. 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.

C. Nonconforming Work:

1. Device will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

D. Assemble and submit test and inspection reports.

3.7 FIELD QUALITY CONTROL OF LOCKING RECEPTACLES

A. Field tests and inspections must be witnessed by Tenant.

B. 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.

C. Nonconforming Work:

1. Device will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

D. Assemble and submit test and inspection reports.

3.8 SYSTEM STARTUP FOR SWITCHES

A. Perform startup service.

1. Complete installation and startup checks for momentary switches, dimmer switches, and fan-speed controller switches in accordance with manufacturer's instructions.

3.9 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

EXHIBIT A

Nassau County Supreme Court Building
100 Supreme Court Drive
Mineola, NY

VERTICAL TRANSPORTATION RECOMMENDATION REPORT

May 7, 2025

Prepared for:
The LiRo Group

MetLife Building
200 Park Ave, 11th Fl.
New York, NY 10166

TABLE OF CONTENTS

I. EXECUTIVE SUMMARY 3

II. GENERAL DESCRIPTION OF ELEVATOR COMPONENTS.....4

III. VERTICAL TRANSPORTATION DESCRIPTION 6

A. OVERVIEW.....6
B. EQUIPMENT DETAILS.....10

IV. CONCLUSIONS AND RECOMMENDATIONS 11

V. RELATED BUILDING WORK.....13

A. RELATED ANCILLARY DETAILS 13
B. RELATED ANCILLARY AREAS OF CONCERN 14

VI. BUDGETS FOR ELEVATOR WORK 15

A. ELEVATOR BUDGET ESTIMATE.....15
B. GENERAL NOTES REGARDING BUDGET ESTIMATES 15

APPENDIX A – PHOTOGRAPHS.....16

I. EXECUTIVE SUMMARY

A. BOCA Group recently conducted a survey of Public Passenger Elevator Nos. 3-5 at the Nassau County Supreme Court Building located at 100 Supreme Court Drive, Mineola, NY. The purpose of the visit was to evaluate the condition of the existing elevator equipment in order to document our findings and prepare recommendations for the continued upgrade of the elevator equipment.

B. This site visit and report is a follow up from the visit performed on and report dated September 7, 2023. The purpose of this visit and report was to document any changes in condition since the last visit and obtain the necessary dimensions to create drawing for Elevator Nos. 3-5.

C. Based on public records, the Supreme Court Building was built in 1963. The elevators also appeared to have been installed in 1963 by Armor Elevator. Based on our visual survey, no modernization or major upgrades, other than door operator upgrades to the public elevator nos. 5 have been performed in the meantime.

D. At the time of our visual survey, the condition of the equipment appeared to be fair in line with their age, however, Elevator Nos. 3 & 4 were out of service. The maintenance being performed on the elevator appears to be in need of improvement.

E. The elevator controller equipment is not manufactured anymore, and the manufacturer is defunct. The installation currently have mechanical relay type controllers. The design of the existing controllers has been superseded by state-of-the-art solid state equipment, which is driven by a system of microprocessors, in lieu of relay logic. Although they are still maintainable, these are increasingly difficult to maintain and repair. It is unknown as to how long certain parts will continue to be manufactured and production could stop at any point. Rebuilding and refurbishing components are a possibility; however, they are typically less reliable as a long-term solution.

F. The equipment is now approximately sixty (60) years old. This equipment has reached its typical life expectancy, which is estimated to be twenty (20) to twenty-five (25) years.

G. More details such as the recommended scope and estimated budgets are outlined in the Scope Recommendations and Budgets for Elevator Work sections of this report.

II. GENERAL DESCRIPTION OF ELEVATOR COMPONENTS

A. Hoist Machine: Traction hoist machines drive the elevator by rotating the drive sheave, which in turn drives the hoist ropes that lift or lower the elevator car. The ropes are driven by the traction between grooves in the rotating drive sheave and the ropes. Traction machines also house the brake assembly, which holds the elevator in place while it is stopped. Brakes do not stop the elevators, except when the elevator has obsolete single speed or two-speed AC controls. In the case of a geared traction machine, the motor rotates a worm gear, which engages a ring gear that rotates the sheave.

B. Hoist Motor: The motor converts electrical energy to mechanical energy in the hoist machine. In a geared machine, the motor is a separate unit that rotates a worm gear, which engages a ring gear that turns the drive sheave. In a gearless hoist machine, the motor is integrated into the machine itself and directly rotates the drive sheave.

C. Governor: An elevator governor is a rotating device that uses mechanical means to monitor speed. The governor on an elevator does not directly act to limit the running speed of an elevator. Instead, it provides a mechanical means to measure the running speed of the elevator, and if a code-determined maximum safe speed is exceeded when the car is running in the down direction, the governor grabs a rope that travels with the car, which then activates the safety device under the car that grabs the rails. Modern codes require that governors also have a switch that tells the controller if the elevator is overspeeding in the up direction.

D. Controller: Controllers are the operational center of the elevator. They receive inputs, control the motion of the elevator car, signal the door operator when to open and close the doors, operate signaling devices, etc. Types of elevator controllers range from old relay-logic controllers to modern solid state microprocessor based controllers.

E. Drives: The drive converts the incoming electrical power to the proper power needed to drive the motor. Typical types of drives are for traction elevators are VVVF.

F. Dispatcher: When there is more than one elevator operating together, the dispatcher receives the hall and car call inputs, and decides which elevator will answer which call. Sometimes the dispatcher is integrated directly with the controllers, sometimes it is a separate unit. Dispatchers can be relay logic or microprocessor based.

G. Door operators: Door operators are on top of the elevator car and control the opening and closing of the car door. Door operators can be open loop, meaning that there is no feedback to the controller telling it what is actually happening, and closed loop, which allows the operator to use feedback and adjust the closing power according to conditions.

H. Hoistway door equipment: Hoistway door equipment typically refers to door tracks, which the doors slide on; Hangers, on which the doors hang from the tracks; interlocks, which are electro-mechanical devices that let the elevator controller know when the doors are safely closed, and also mechanically prevent the opening of the doors when the elevator is not in the landing zone; closers, which close the hoistway doors using spring tension independent of the car door; gibs, which are the guides that slide in the sill and keep the door from being pushed into the hoistway.

I. Fixtures: Fixtures include all of the button and signaling device panels, such as hall button stations, hall lanterns, car button stations, etc. In this report, our primary concern is that they are ADA compliant, as

fixtures do not have a reliable life expectancy and are generally only replaced for aesthetic reasons if they are ADA compliant.

J. Traveling cable: The traveling cable carries power and signal information to the elevator cab and back to the machine room. Traveling cables are either cloth or neoprene. Cloth is more susceptible to failures and is recommended for replacement. Neoprene will last far longer, and is generally not needed to be replaced. However, with a modernization, it may be necessary to add additional cables.

III. VERTICAL TRANSPORTATION DESCRIPTION

A. Overview

Passenger elevator nos. 3-5 are overhead traction installations with DC gearless machines manufactured by Armor Elevator. These elevators have rated capacities of 3,500 lbs. and rated speed of 400 feet per minute. Elevators 3 and 4 serve levels *1, 2-4 with front entrances only; Elevator 5 serves levels B, *1, 2-4 with front entrances only. The elevators have automatic door operation with both the hoistway and car doors being the center opening type.

We have evaluated all necessary elevator equipment areas, and grouped them as follows:

1. Machine Room

The machine room for passenger elevator nos. 3-5 is located above the 5th Floor level directly above the elevator hoistways and is accessed via two ships ladders from the 5th Floor level. The machine room has a heater and louvers appear in the walls of the room. The means of disconnect are located next to the entrance of the machine room, but not within the line-of-sight of the installation of the elevators.

a. *Machines:*

The original hoisting machines manufactured by GE remain. The hoist machines are in fair condition in line with their age. The machines are DC overhead traction gearless machines. We recommend replacement with new hoist machines with a planned modernization project, with provisions for unintended car movement and ascending car overspeed protection.

b. *Ropes:*

The gearless machines are roped 2:1 double wrap and are furnished with six 1/2" hoist ropes. The age of hoist ropes for are unknown and are in fair condition. New hoist ropes will need to be provided for the new traction machines as part of a modernization.

c. *Motors:*

The elevator utilize DC hoist motors that are integral to the machine and manufactured by General Electric. With the replacement of the machine, a new AC hoist motor will need to be provided as part of the new machine.

d. *Controllers:*

The original controllers manufactured by Armor Elevator remain. They are all relay logic type. Although functional, the controllers are at the end of their useful life expectancy and are an obsolete design. Parts are increasingly harder to obtain for these types of controllers. We recommend replacement of the controllers with new non-proprietary state-of-the-art microprocessor controls as part of a modernization.

e. *Motion Control:*

The elevator have motor generator sets. With the replacement of the elevator controllers, hoist machines/motors, new Variable Voltage Variable Frequency (VVVF) drives should be provided with regenerative capabilities.

f. *Selector:*

The original Armor selector consists of a chain driven unit and a sheave installed in the machine room with perforated steel tape loops installed in the hoistway. The units are in fair condition in line with their age. A new selector system compatible with the proposed microprocessor-based controller should be provided with the modernization.

2. Secondary Space

The secondary space for passenger elevators #3-5 is located above the 5th Floor Level directly above the hoistway and is accessed via a ships ladder from the 5th Floor level.

a. *Deflector Sheaves:*

The original deflector sheaves for the elevators manufactured by Armor remain. The deflector sheaves are in fair condition in line with their age. We recommend the replacement of the deflector with the new machine.

b. *Governors:*

The original Armor overspeed governors remain and are in fair condition. We recommend the replacement of the governors and governor ropes with a planned modernization.

3. Pits and Hoistway

a. *Buffers:*

The original car and counterweight oil buffers remain for the elevators and are in fair condition. The oil buffers for the elevators should be replaced as part of a planned modernization.

b. *Pit Stop Switches:*

Pit stop switches are provided for all elevators. Some of the existing pit stop switch for the elevators are not within reach from the access door. The switches are in fair condition. New pit stop switches with watertight boxes should be provided as part of a modernization for all elevators during a planned modernization.

c. *Safeties:*

The original type B are in fair condition for the elevators. They should be replaced during a planned modernization.

d. *Wiring:*

Hoistway wiring, conduit, traveling cables and junction boxes for the elevators appear to be in fair condition, consistent with their age. All new wiring, conduit and traveling cables should be provided in order to accommodate and be compatible with new control and fixture equipment as part of a planned modernization.

e. *Car and Counterweight Frames:*

The original car and counterweight frames for the elevators remain and are in fair-to-good condition. The car and counterweight frames for the elevators should be cleaned, painted and secured (all connections) in order to be retained.

f. *Car and Counterweight Guides:*

The car and counterweight frames of are provided with roller guides which are in fair condition in line with their age. We recommend the replacement of the car and counterweight roller guides with a planned modernization

g. *Car and Counterweight Rails:*

The car guide rails are 15 lbs. steel T type and counterweight guide rails are 8 lbs. steel T type. The guide rails are in satisfactory condition. All rails should be cleaned, overhauled, and realigned where necessary with a planned modernization.

i. *Governor Tension Weights:*

The original governor tension weights for remain and are in fair condition. We recommend the replacement of the tension weights with a planned modernization.

j. *Pit Ladder:*

Elevator No. 5 does not have a pit ladder, New pit ladders should be provided in conjunction with a planned elevator modernization. Elevator Nos, 3-4 have walk-in style pits.

4. Cabs and Car Fixtures

The passenger elevator cabs consist of laminate applied wall panels with stainless steel trim. The cabs have stainless steel fixtures, transoms, doors, handrails, and returns. They have diffuser style drop ceilings with stainless trim and fluorescent light fixtures. The flooring is laminate tile. There are three handrails in each passenger elevator cab. The cabs are in good fair.

a. *Car Operating Panels:*

Each passenger elevator cab has one (1) main car operating panel and one (1) auxiliary car operating panel and are in fair condition consistent with their age. We recommend all car operating panels be replaced with the modernization.

b. *Travel Lanterns:*

Traveling lanterns are provided in either the strike or return jamb of each of the cabs. We recommend the car lanterns be replaced as part of a planned modernization.

c. *Door Protection:*

The existing door protection devices for the elevators appear to be in fair condition, consistent with their age. New door protection devices should be provided with a planned modernization.

d. *Communication:*

Two-way communications (phone) is currently provided in the elevator cars.

An emergency two-way communication system with visible text and audible modes should be provided with a planned elevator modernization (as required by 2020 New York State Building Code).

5. Door Equipment and Entrances

   a. *Hoistway Door Equipment:*

      The public passenger elevators hoistway doors are of the single speed center opening horizontal side slide type. The hoistway entrances are original and are in fair condition. It is recommended that all the entrance frame assemblies, door panels and sills be retained while all hardware, tracks and hangers, and spring sill closers be replaced during the modernization.

   b. *Car Door Equipment:*

      Elevators no. 5 have been provided with new G.A.L. MOVFR II door operators, tracks and hangers, and clutches. Elevator no. 3-4 have not been upgraded. We recommend for the car door operators for the elevators be replaced with new operators and assemblies.

6. Lobbies

   a. *Hall Stations:*

      The hall push-button stations are provided at each entrance / landing and are located approximately 42" centerline above the finished floor. The hall push button stations are in fair condition consistent with their age. We recommend hall stations be replaced with hall stations with digital position indicators during a planned modernization.

   b. *Lobby Hall Lanterns:*

      There are currently hall lanterns located at each level for the Public passenger elevators (#3-5), with a combination lantern/in-line (light up) position indicator located at the main egress (1st) floor.

      We recommend new hall lanterns be provided with the modernization at each landing, with a combination lantern/digital position indicator at the main egress (1st) floor.

   c. *Lobby Panel:*

      There is currently lobby starter panel located next to the elevator in the main lobby. The panel contains. We recommend the lobby panel be replaced with the proposed modernization.

7. Compliance

   a. *ADA:*

      The existing elevators meet ADA requirements with respect to communications, signals and size.

   b. *Firefighters' Emergency Service:*

      The elevators are provided with Firefighters' Emergency Operation. New Firefighter's Emergency Operation will be provided with the modernization per the latest applicable code requirements.

B. Equipment Details

	Public Passenger Elevators Nos. 3-5
Number of Elevators:	Three (3)
Installation Type:	Overhead Traction
Machine Type:	Gearless
Machine Manufacturer:	Armor Elevator
Machine Year:	1963
Brake Type:	Single-Plunger Drum
Emergency Brake Type:	None
Roping:	2:1 Double Wrap 6 @ 1/2”
Motor Type:	DC
Floors Served- Front:	Elevator No. 3-4: *1, 2-4 Elevators Nos. 5: B, *1, 2-4
Number of Entrances:	Elevator No. 3-4: 4 – Front Only Elevator No. 5: 5 – Front Only
Capacity:	3,500 lbs.
Speed:	400 fpm
Door Opening Size:	42” W by 84” H
Door Style:	Center Parting
Door Operation:	Automatic
Dispatch Operation:	Group
Controller Manufacturer:	Armor Elevator
Controller Type:	Relay Logic
Controller HP:	29.6 HP
Controller Year:	1963
Buffer Type:	Oil

IV. CONCLUSIONS AND RECOMMENDATIONS

1. The elevator equipment at this development was installed in 1963, making the equipment approximately sixty (60) years old. The design of the controller and several other major components of the elevator systems are obsolete, and at this point, the elevator equipment is at or approaching the end of its typical reliable life expectancy, and therefore should be planned for modernization. A modernization will help improve long-term reliability, safety, and performance of the elevator equipment.

2. Scope Recommendation Breakdown:

Component		Retain	Refurb.	New	Comments
Machine Room	Geared/Gearless Machines			X	
	Motor			X	
	Brake			X	
	Governor			X	
	Controller			X	
	Drive			X	
	Selector			X	
Hoistway and Pit	Tension Sheave / Weight			X	
	Wire Ropes			X	
	Hoistway Entrances		X		
	Hoistway Door Panels		X		
	Guide Rails	X			
	Hoistway Limits			X	
	Travelers and Wiring			X	
	Alarm Bells			X	
	Buffers			X	
	Hoistway Door Equipment			X	

Car Equipment	Car Door Equipment			X	
	Car Guides			X	
	Car Frame		X		
	Car Safety			X	
	Car Platform		X		
	Toe Guard			X	
	Car Top Railing			X	
	Escape Hatch Switch			X	
	Top of Car Run Box			X	
	Cab Enclosures		X		
	Car Button Station			X	
	Communication			X	
	Reopening Device			X	
Counterweight Equipment	Counterweight		X		
	CWT Guides			X	
Lobbies	Hall Buttons			X	
	Hall Position Indicators			X	
	Hall Lanterns			X	
	Lobby Panel			X	

V. RELATED BUILDING WORK

A. Related Ancillary Details

	Public Passenger Elevators Nos. 3-5
Power Supply:	480 Volts Three Phase AC
Mainline Lockable "On":	No
Mainline Fused:	Yes
Mainline Grounded:	No
Cab Disconnect:	None
MR Smoke Detector:	Yes
MR Heat Detector:	None
MR Sprinklers:	None
Shunt Protection:	NA
MR Heating and Cooling:	Heater / Exhaust Only (No Cooling)
MR Ventilation:	Louvers
MR Lighting:	Yes
MR GFCI Outlets:	No
Emergency Power:	Building to Confirm Emergency Power Capabilities.
MR Communication:	Yes
Pit Ladders:	Yes
Pit Smoke Detector:	None
Pit Heat Detector:	None
Pit Sprinklers:	None
Pit Lighting:	Yes (No Light Switch)
Pit GFCI Outlets:	No
Pit Sump Pump/Pit:	None
Hoistway Ventilation:	Vents to Secondary/EMR above
Hoistway Smoke Detector:	None
Hoistway Heat Detector	None
Hoistway Sprinkler:	None
Hoistway Construction:	Concrete Masonry Unit (CMU) block

B. Related Ancillary Areas of Concern

1. Machine Room Heating Ventilation and Air Conditioning

The machine room for the elevators 3-6 has a heater but has ducting that is for exhaust only (no cooling).

It appears like means will need to be added to effectively condition the machine rooms. Required mechanical ventilation in the machine room will need to maintain ambient temperature between 45 and 90 degrees Fahrenheit with relative humidity not to exceed 85%.

2. Non-elevator equipment in Elevator Machine Room

Large non-elevator water lines are present in the machine room for elevators #3-6. The line goes directly over the back of Service Elevator #6 overhead geared traction machine. This line appears like it will need to be separated (boxed out) from the elevator machine room with a fire-rated partition. Some jurisdictions with grandfather these items therefore requiring no further action.

VI. BUDGETS FOR ELEVATOR WORK

A. Elevator Budget Estimate

1. Listed below are the elevator budget estimates for the recommended work:

   Estimated Elevator Budget Cost:

   Public Passenger Elevators Nos. 3-5: **$450,000.00 per elevator**

B. General Notes Regarding Budget Estimates

1. The budgets provided in this report are based on a visual site survey performed specifically for the purpose of generating this report. A more complete survey performed for the purpose of creating specification documents may reveal conditions or additional recommended scope items that can affect the estimated budgets.
2. All budget estimates are in 2025 dollars. Due to labor cost increases in the vertical transportation industry, and the uncertainty of material cost variations, this budget number should be increased by 5% per year after 2025.
3. Modernization budgets do not include any aesthetic renovations of the cab interiors. The typical allowance for cab upgrades in similar buildings would be $40,000 per elevator. However, this cost can be substantially higher depending on the selected cab design, finishes, and materials.
4. Budgets are for elevator contractor work only. Budgets do not include any work required by other trades, even if that work will be required as a result of the recommended elevator work, including but not limited to fire and life safety upgrades, electrical upgrades, HVAC upgrades, structural requirements, general construction, etc.
5. The budget estimates do not include soft costs for elevator consulting, or for engineering consultants that may be required for other disciplines.

END OF REPORT
(APPENDICES TO FOLLOW)

APPENDIX A – PHOTOGRAPHS



Photo 1. Elevators #3-6 – Main Line Disconnects



Photo 2. Elevator #3-6 – EMR is not self-closing



Photo 3. EMR #3-6: Non-Elevator related pipe

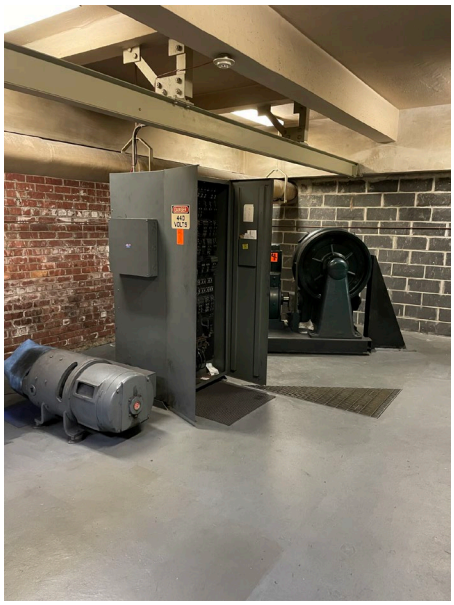


Photo 3. SE #3: Non-elev. related pipe above mach.



Photo 5. Elevator #3: Gearless Traction Machine

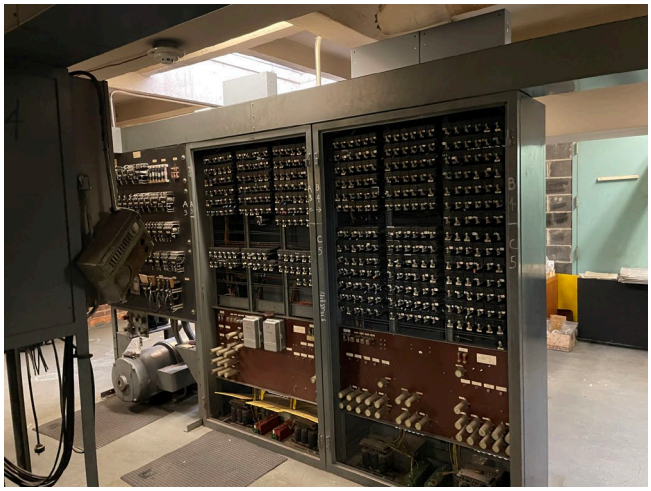


Photo 6. PE #3: Generator & Relay Logic Control



Photo 7. Elevator #3: Reel Selector and GL Machine



Photo 8. PE #3-5 – Water Line above Controllers



Photo 9. PE #3-5: Exhaust Only Duct above Controls



Photo 10. PE#4 Secondary: Dead End Hitches/Gov.



Photo 11. PE #3 – Deflector Sheave and Rope Guards

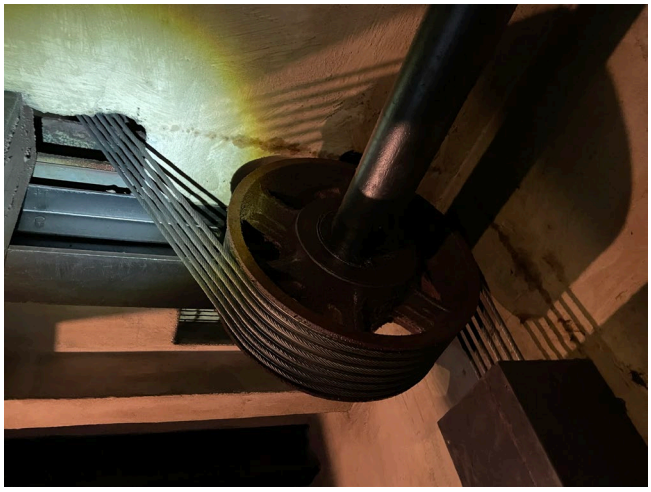


Photo 12. PE #5 – Deflector Sheave and Rope Guards

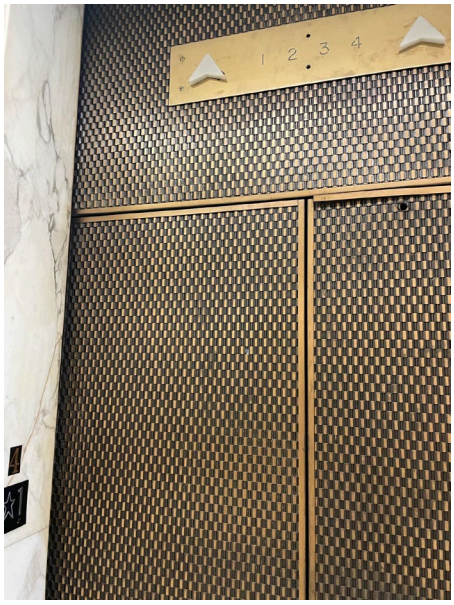


Photo 13. PE #4 – Lobby Doors/Combo Lantern-PI



Photo 14. PE #5 – GAL MOVFR operator



Photo 15. Elevator #5 – Car 2:1 Sheave

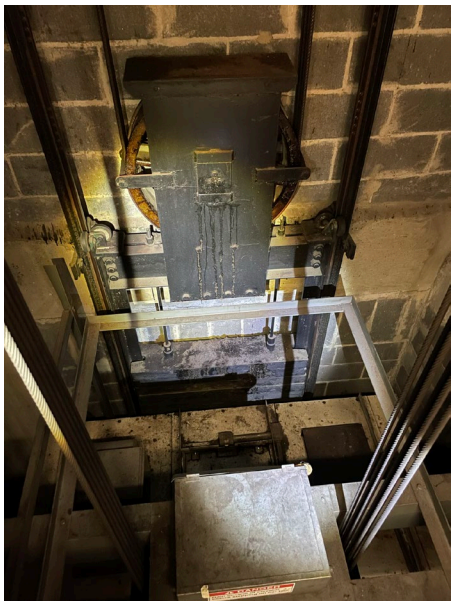


Photo 16. Elevator #5 – Counterweight 2:1 Sheave

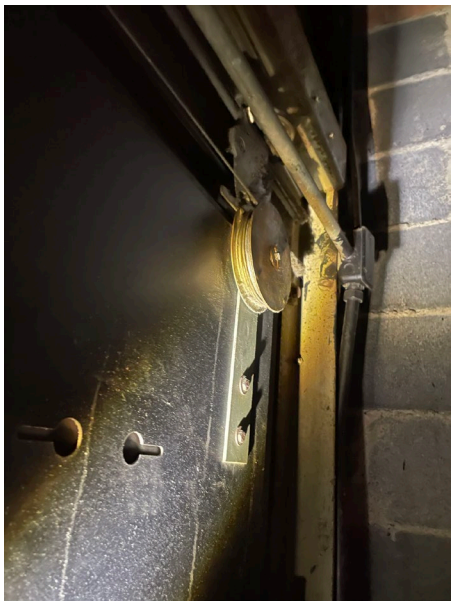


Photo 17. PE #5 – Hoistway Reel Closer (Spirator)



Photo 18. Elevator #5 – Car Operating Station



Photo 19. PE #5 – Inline Car PI & Traveling Lantern

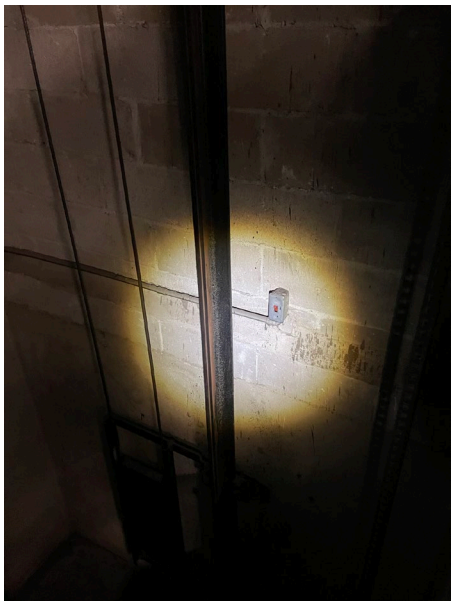


Photo 20. Elevator #5 – Pit Stop Switch



Photo 21. Elevator #5 – Wind Up Gradual Safety

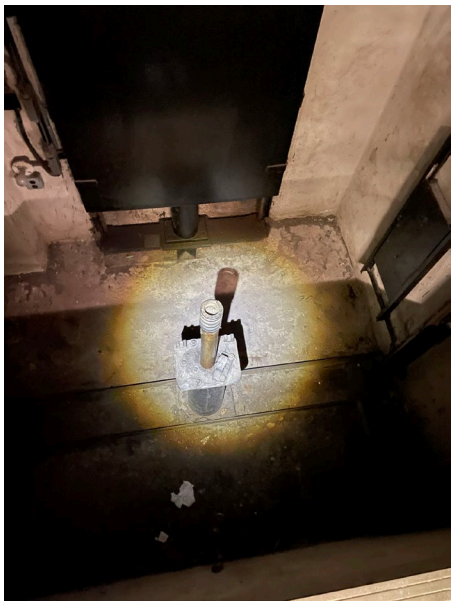
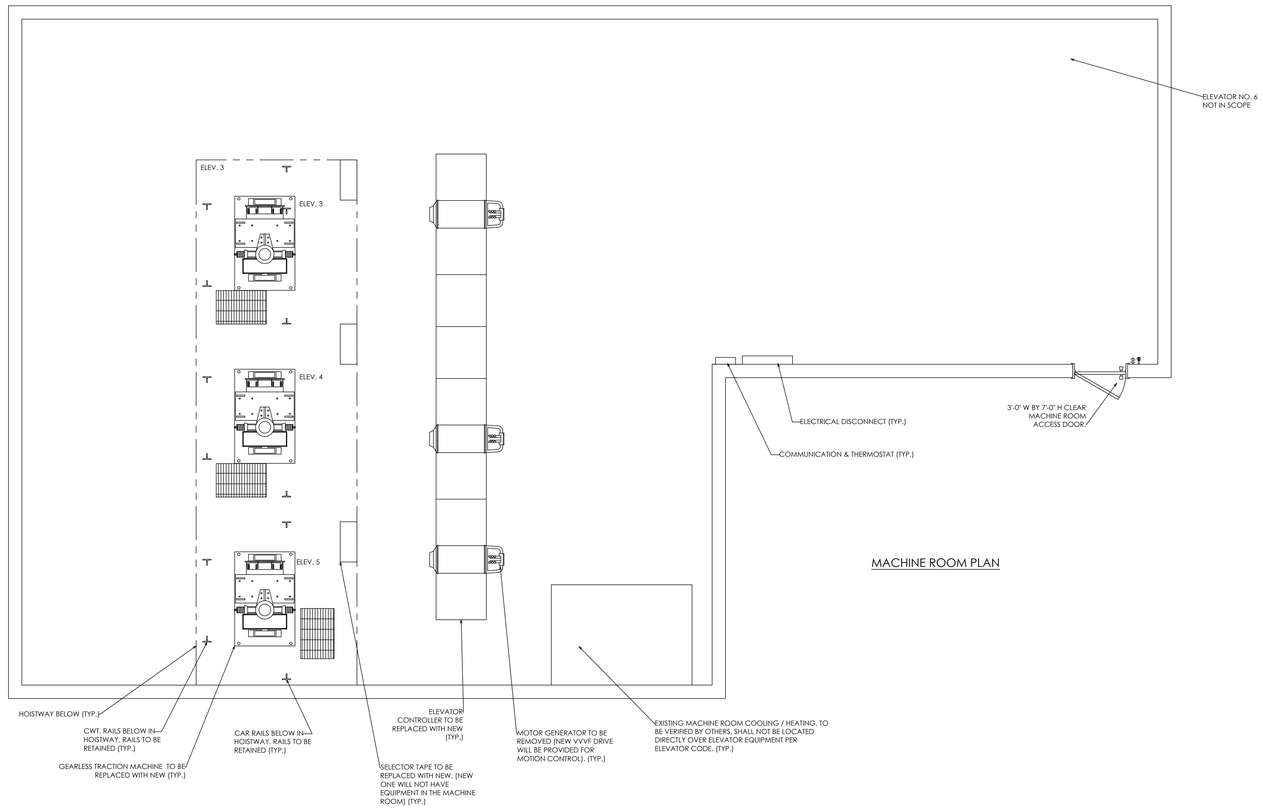


Photo 22. PE 5 – Oil Buffers & Counterweight Guard

END OF APPENDIX A

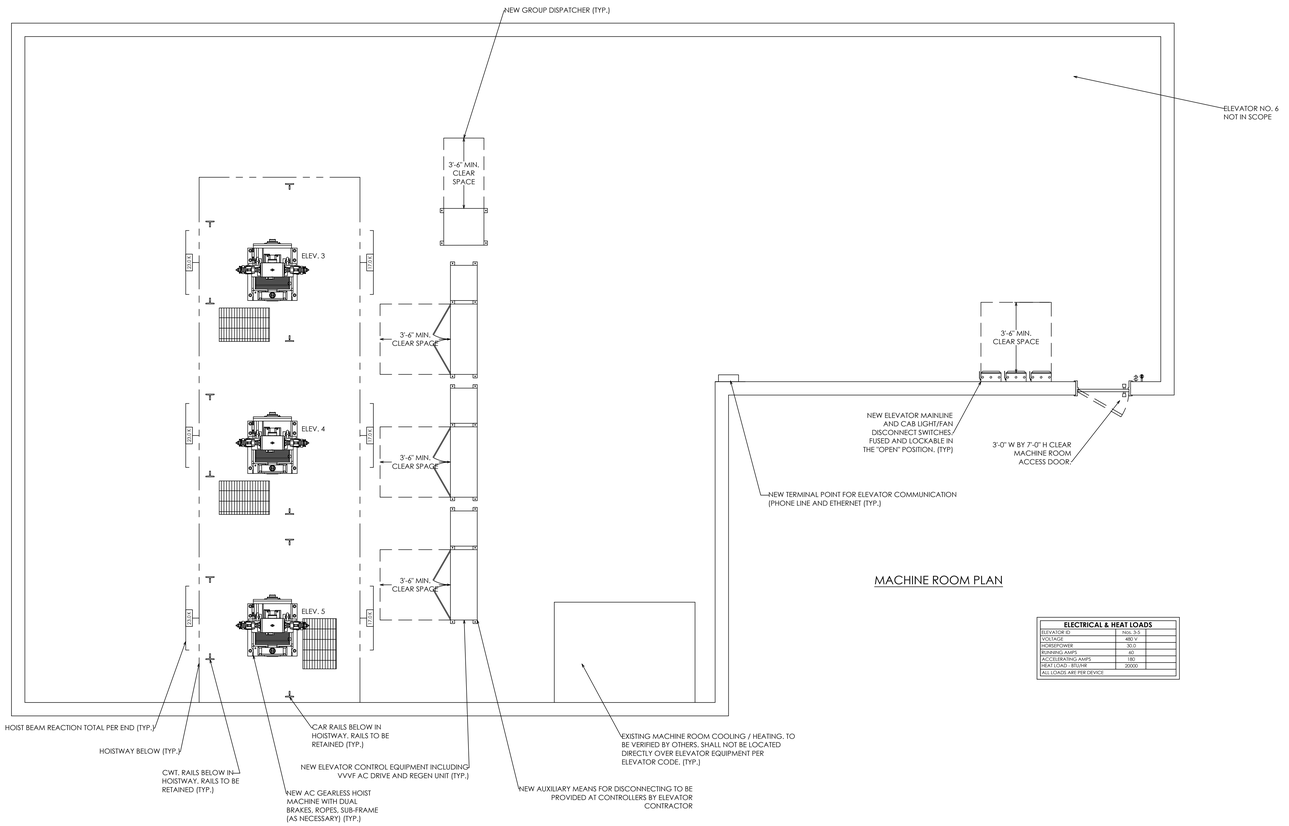
EXHIBIT B

EXISTING



MACHINE ROOM PLAN

PROPOSED



MACHINE ROOM PLAN

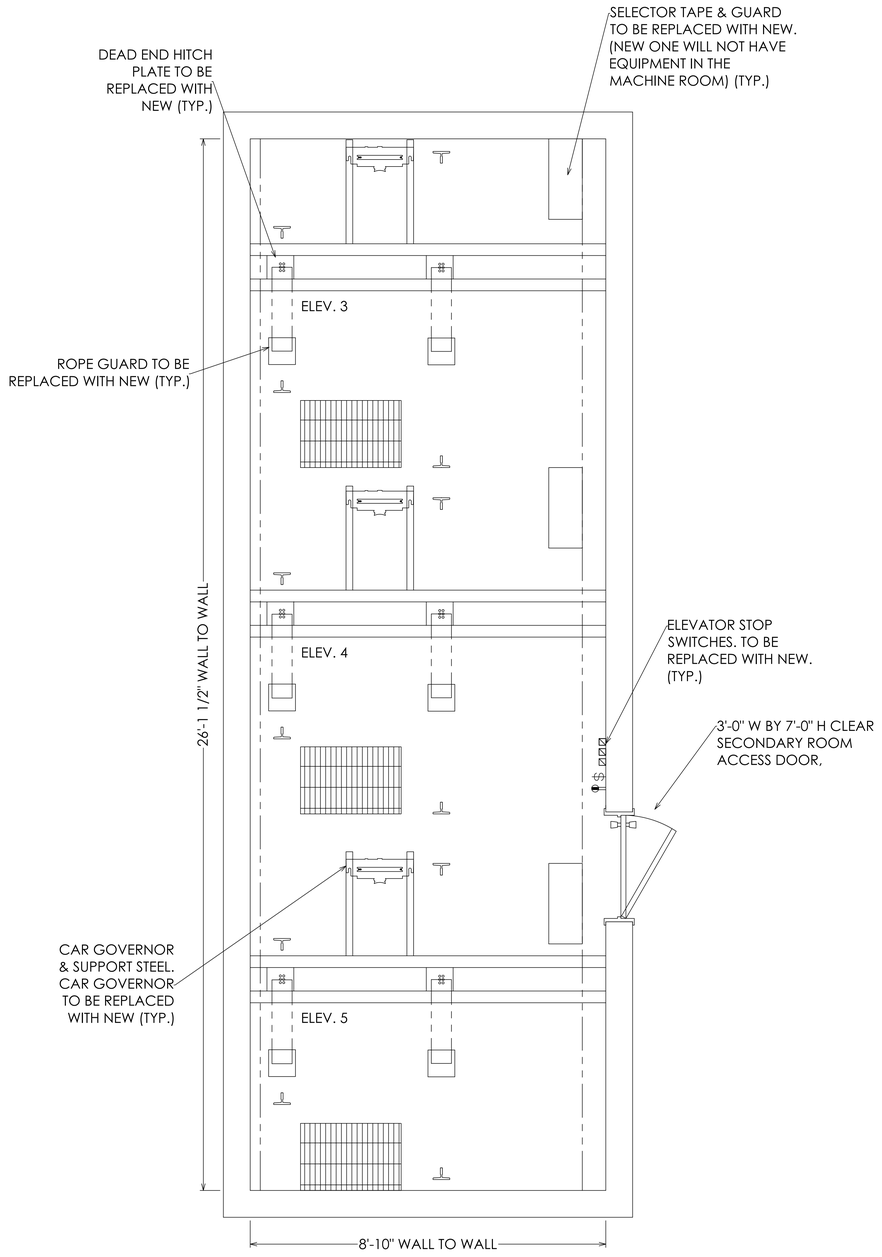
ELECTRICAL & HEAT LOADS	
ELEVATOR ID	Nos. 3-5
VOLTAGE	480 V
HORSEPOWER	30.0
RUNNING AMPS	60
ACCELERATING AMPS	180
HEAT LOAD - BTU/HR	20000
ALL LOADS ARE PER DEVICE	

BOCA GROUP

MetLife Building - 200 Park Avenue
New York, N.Y. 10166
Phone: 212.983.7010
WWW.BOCAGROUP.COM

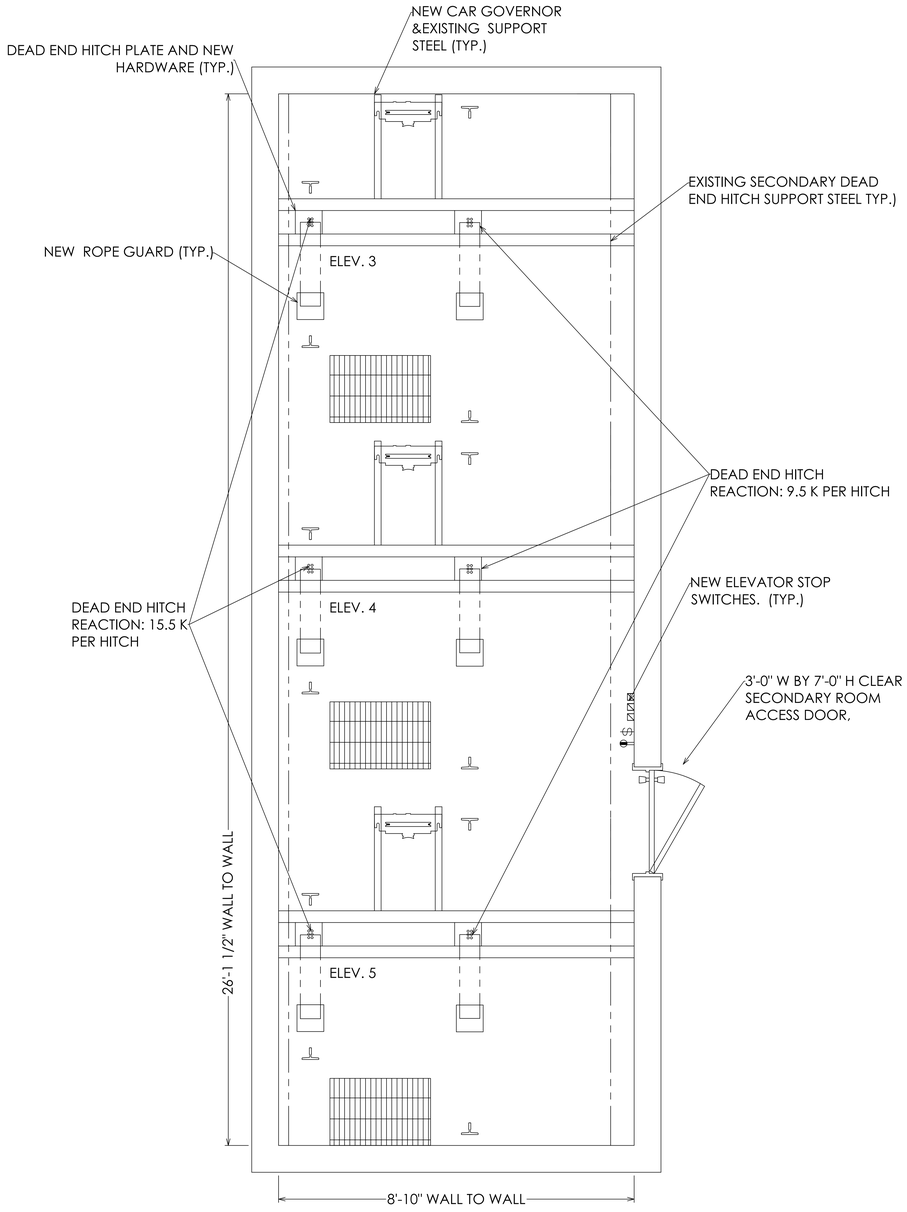
Project: 100 SUPREME COURT DRIVE, MINEOLA, NY	Submission: 100% CD	Date: 2025.12.12	Drawing ID: VT-101
Title: Passenger Elevator Nos. 3-5 Modernization - Machine Room Plan	Revision No.: R.1	Scale: 3/8" : 1'-0"	Drawn By: J.F.Z.

EXISTING



SECONDARY LEVEL PLAN

PROPOSED

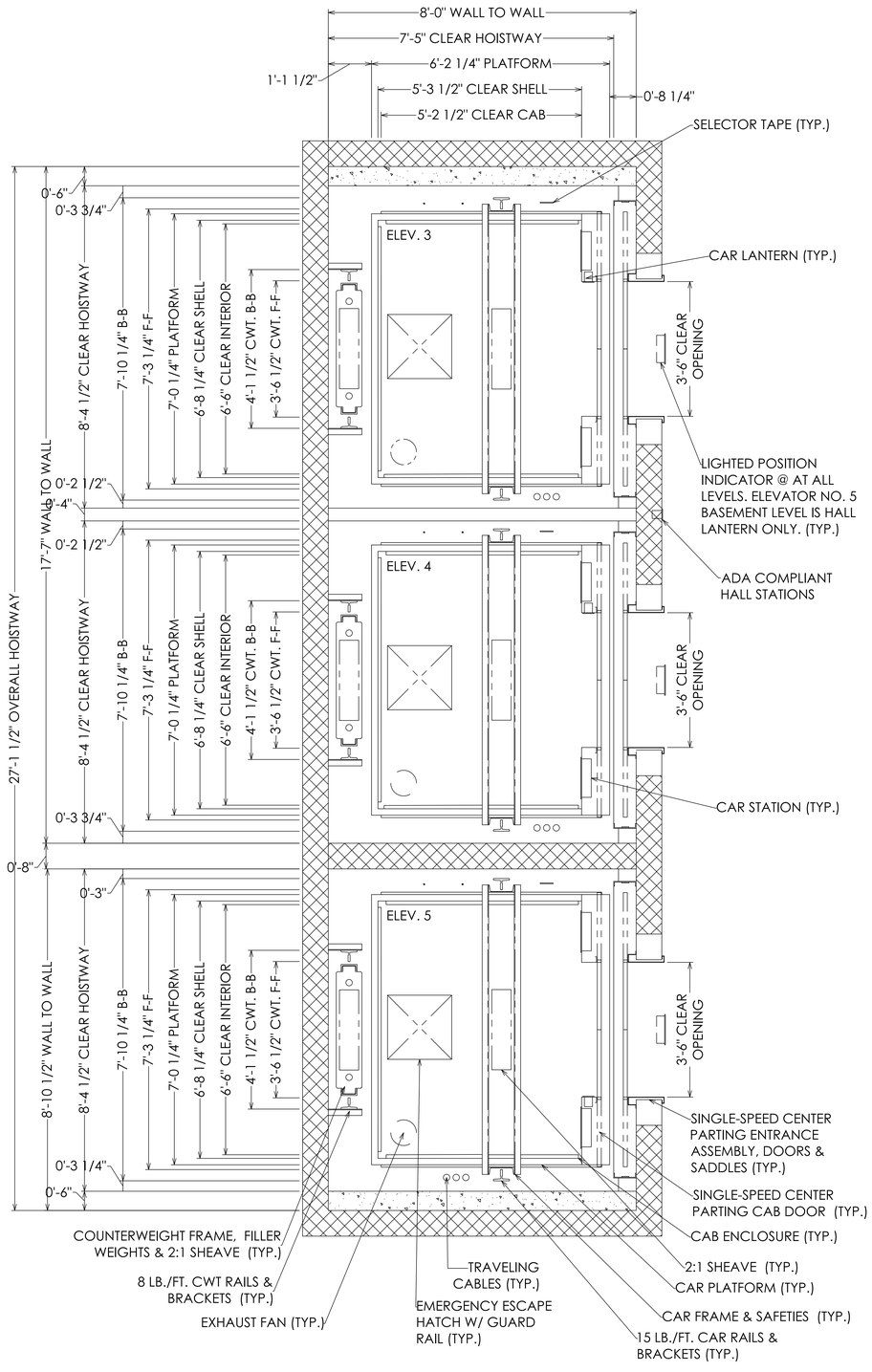


SECONDARY LEVEL PLAN

BOCA GROUP
MetLife Building - 200 Park Avenue
New York, N.Y. 10166
Phone: 212.983.7010
WWW.BOCAGROUP.COM

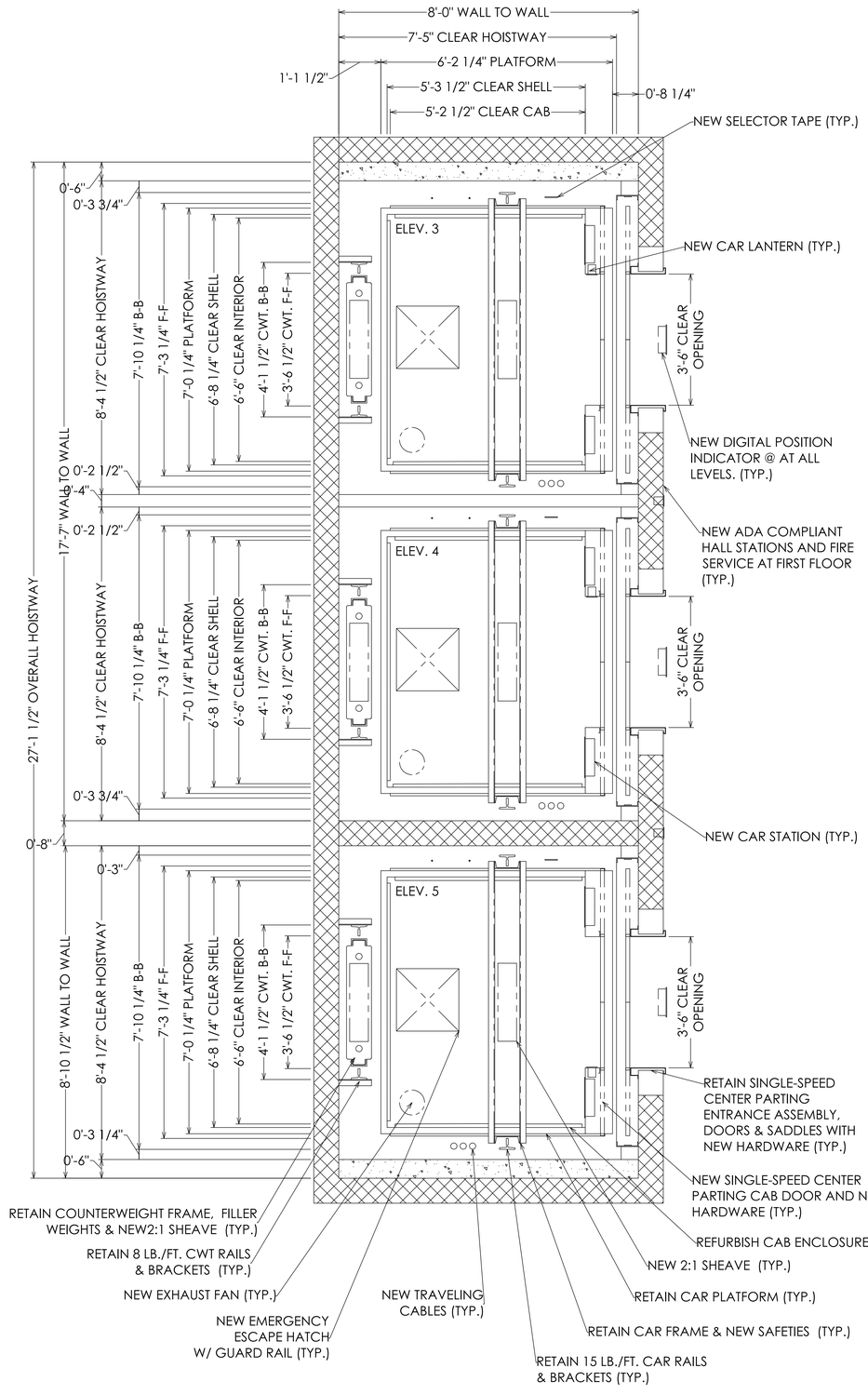
Project: 100 SUPREME COURT DRIVE, MINEOLA, NY	Submission: 100% CD	Date: 2025.12.12	Drawing ID: VT-102
Title: Passenger Elevator Nos. 3-5 Modernization - Secondary Plan	Revision No.: R.1	Scale: 3/4" : 1'-0"	Drawn By: J.F.Z.

EXISTING



HOISTWAY PLAN

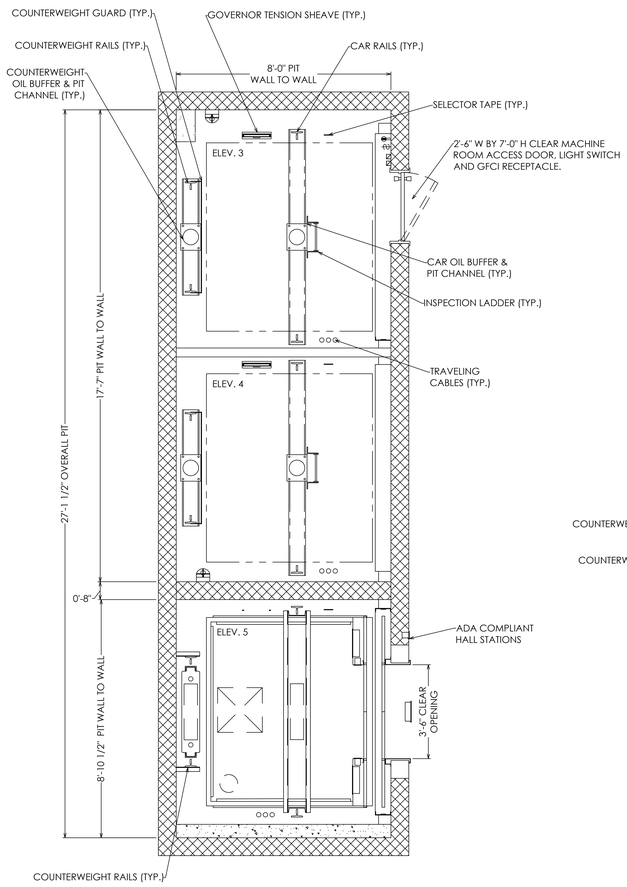
PROPOSED



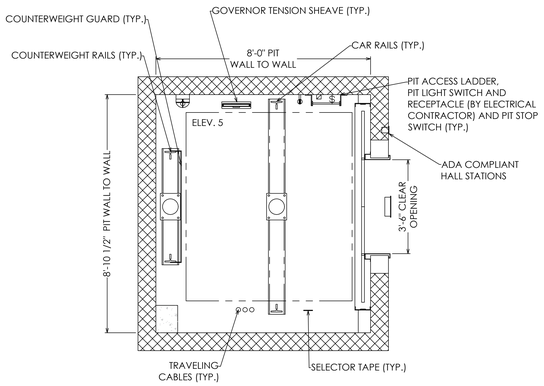
HOISTWAY PLAN

BOCA GROUP MetLife Building - 200 Park Avenue New York, N.Y. 10166 Phone: 212.983.7010 WWW.BOCAGROUP.COM	Project: 100 SUPREME COURT DRIVE, MINEOLA, NY	Submission: 100% CD	Date: 2025.12.12	Drawing ID: VT-103
	Title: Passenger Elevator Nos. 3-5 Modernization - Hoistway Plan	Revision No.: R.1	Scale: 3/4" : 1'-0"	Drawn By: J.F.Z.

EXISTING

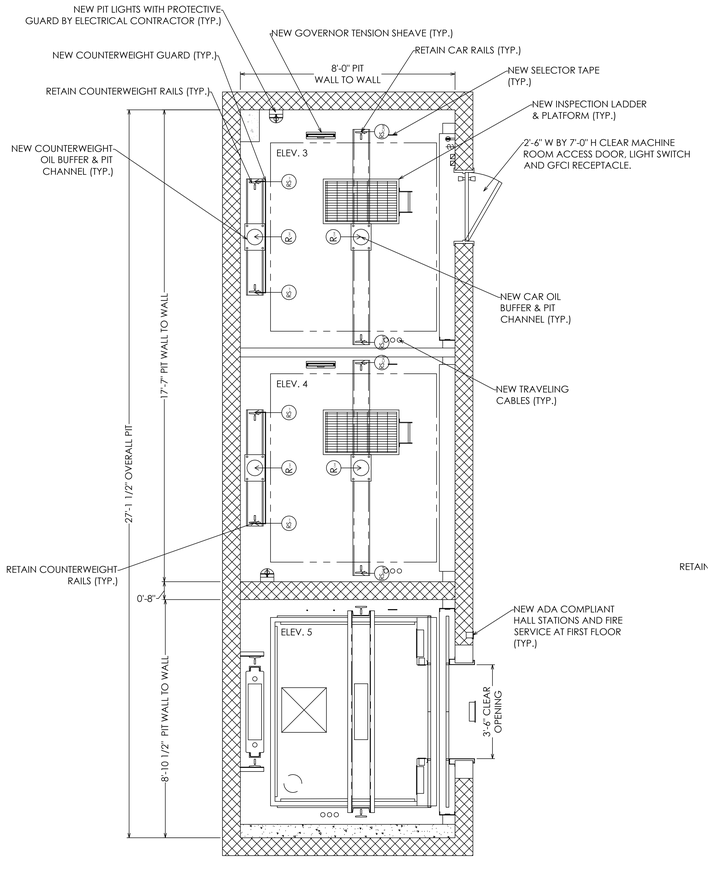


PIT PLAN ELEVATORS NOS. 3-4



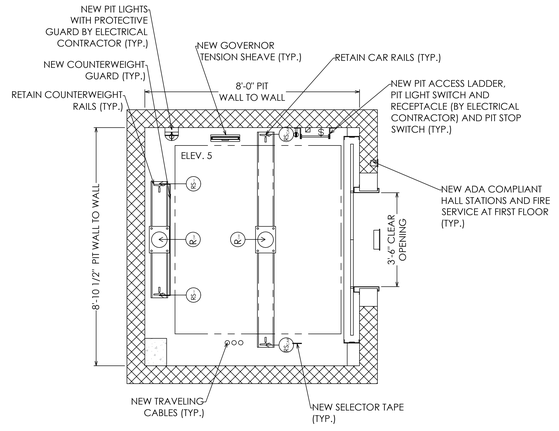
PIT PLAN ELEVATOR NO. 5

PROPOSED



PIT PLAN ELEVATORS NOS. 3-4

PIT LOADS			
ELEVATOR ID	Nos. 3-5		
CAR BUFFER REACTION (R_{CAR})	45.0 K		
CWT. BUFFER REACTION (R_{CWT})	35.0 K		
CAR RAIL SIZE	15 #/FT.		
CWT. RAIL SIZE	8 #/FT.		
WGT. PER CAR RAIL STACK	1800 #		
WGT. PER CWT. RAIL STACK	1000 #		
PIT & RAIL REACTIONS DO NOT OCCUR SIMULTANEOUSLY. BUFFER REACTIONS ARE DOUBLED FOR IMPACT			

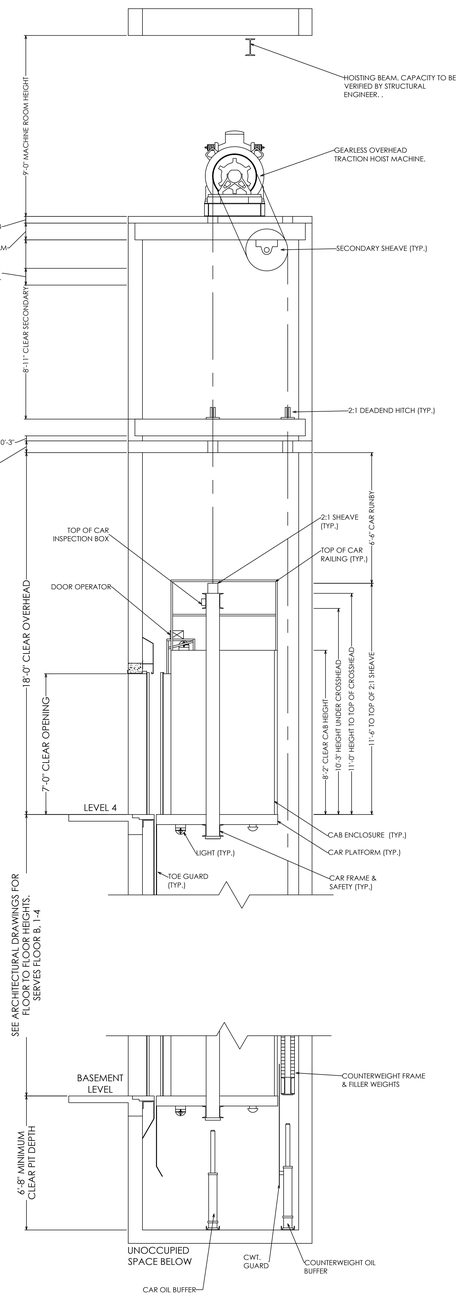


PIT PLAN ELEVATOR NO. 5

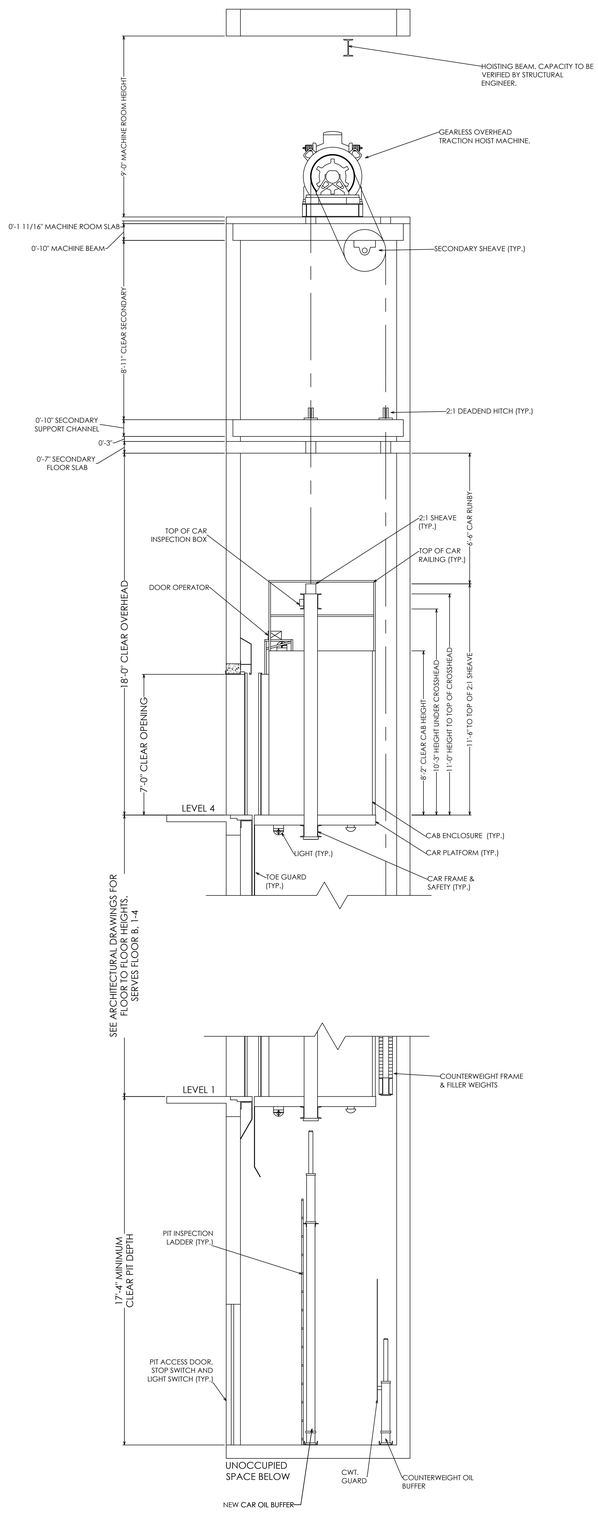
BOCA GROUP
MetLife Building - 200 Park Avenue
New York, N.Y. 10166
Phone: 212.983.7010
WWW.BOCAGROUP.COM

Project:	Submission:	Date:	Drawing ID:
100 SUPREME COURT DRIVE, MINEOLA, NY	100% CD	2025.12.12	VT-104
Title:	Revision No.:	Scale:	Drawn By:
Passenger Elevator Nos. 3-5 Modernization - Pit Plan	R.1	1/2" : 1'-0"	J.F.Z.

EXISTING



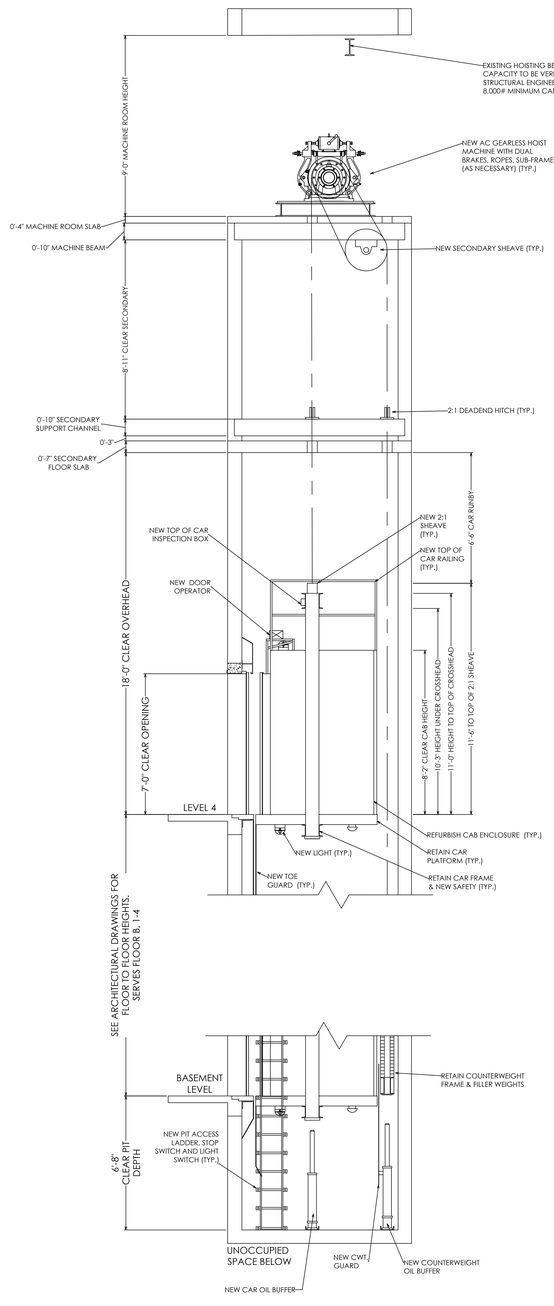
HOISTWAY SECTION ELEVATOR NO. 5



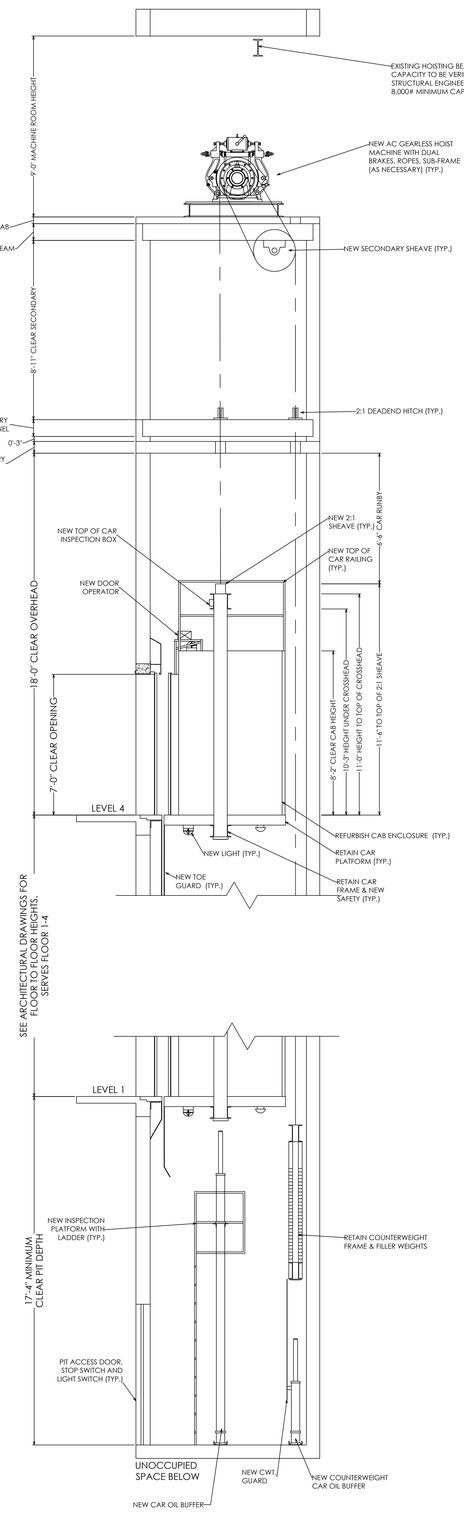
HOISTWAY SECTION ELEVATORS NOS. 3-4

PROPOSED

RAIL LOADS			
ELEVATOR ID:	Nos. 3-5		
SEISMIC ZONE	1		
LOADING CLASS	PASSENGER		
CAR RAIL SIZE	T 8 #17		
CWT. RAIL SIZE	T 8 #10		
LOAD PER RAIL	Type	28-06	
	RUNNING (RL)	250 #	
	LOADING (RL)	140 #	
MAX. VERT. RAIL BRACKET SPAN	EXISTING		
BRACKET SPACING SHALL MATCH EXISTING.	$R_{EXISTING}$		
PIT AND RAIL REACTIONS DO NOT OCCUR SIMULTANEOUSLY.	R_A		



HOISTWAY SECTION ELEVATOR NO. 5



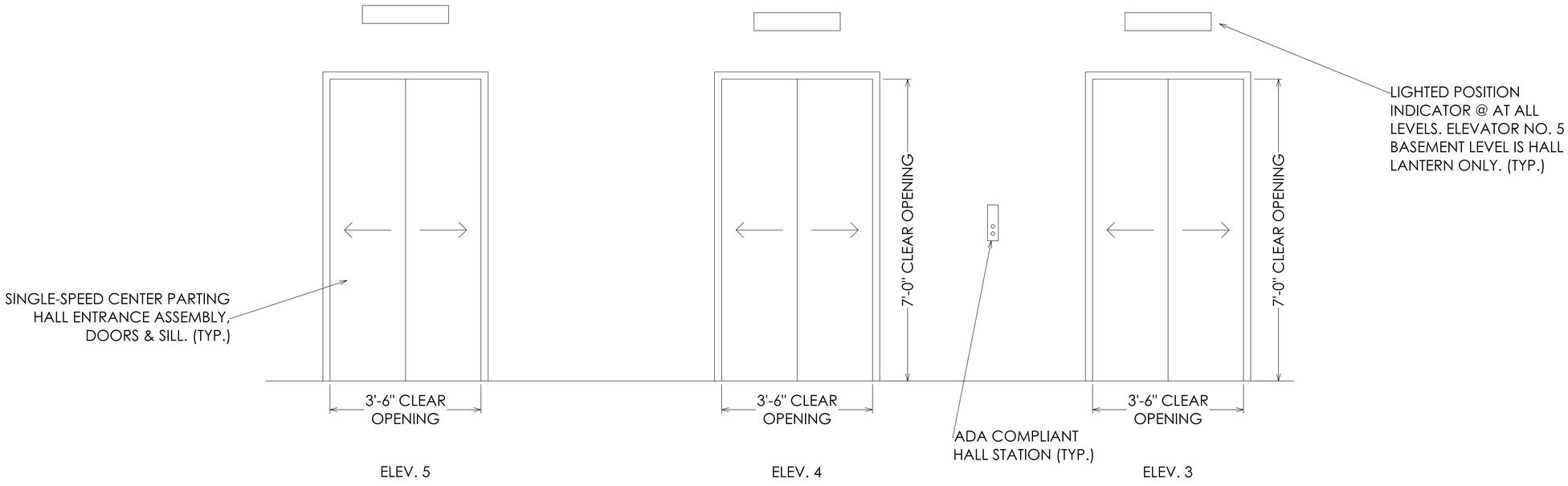
HOISTWAY SECTION ELEVATORS NOS. 3-4

BOCA GROUP

MetLife Building - 200 Park Avenue
New York, N.Y. 10166
Phone: 212.983.7010
WWW.BOCAGROUP.COM

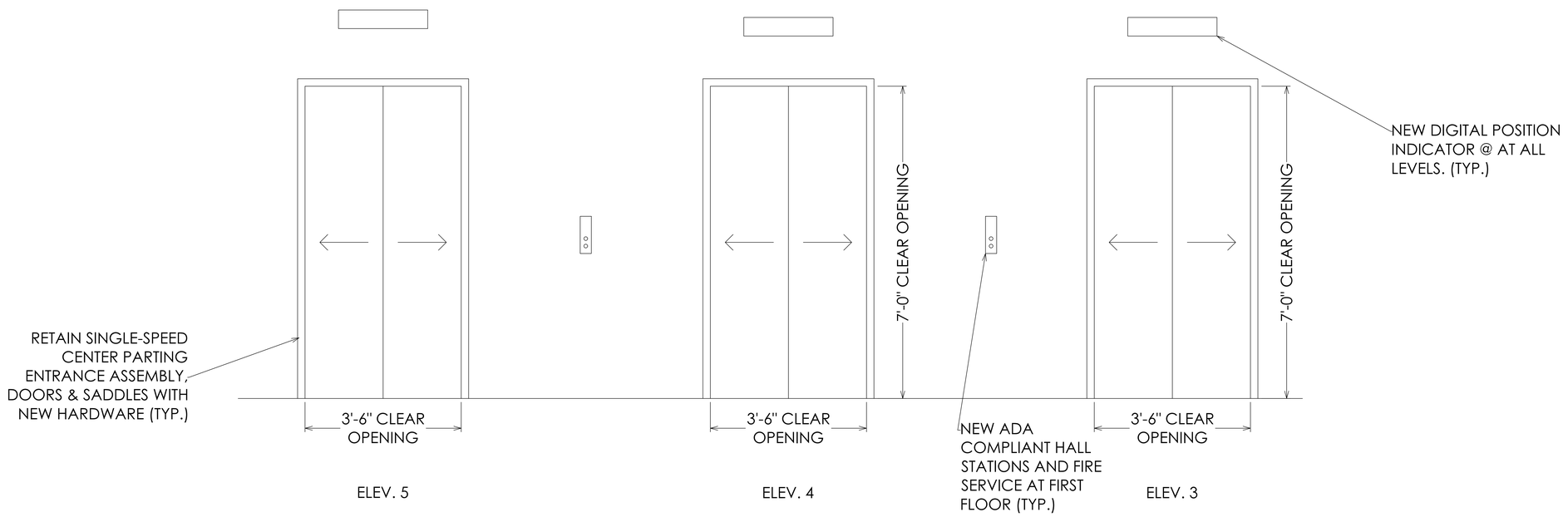
Project: 100 SUPREME COURT DRIVE, MINEOLA, NY	Submission: 100% CD	Date: 2025.12.12	Drawing ID: VT-105
Title: Passenger Elevator Nos. 3-5 Modernization - Hoistway Elevation	Revision No.: R.1	Scale: 3/8" : 1'-0"	Drawn By: J.F.Z.

EXISTING



ENTRANCE ELEVATION

PROPOSED



ENTRANCE ELEVATION

BOCA GROUP
MetLife Building - 200 Park Avenue
New York, N.Y. 10166
Phone: 212.983.7010
WWW.BOCAGROUP.COM

Project: 100 SUPREME COURT DRIVE, MINEOLA, NY	Submission: 100% CD	Date: 2025.12.12	Drawing ID: VT-106
Title: Passenger Elevator Nos. 3-5 Modernization - Entrance Elevation	Revision No.: R.1	Scale: 3/8" : 1'-0"	Drawn By: J.F.Z.

LiRo Engineers, Inc.
GISI Consulting Group Company
235 East Jericho Tpke, Mineola, NY 11501 Telephone 516.746.2350 www.liro-hill.com

EXHIBIT C

100% CONSTRUCTION DOCUMENTS DATE: 11/07/2025

LiRo Architects + Planners, P.C. (LAP) was engaged by the Nassau County Department of Public Works (NCDPW) to provide rehabilitation and modernization services to elevators #3, #4 and #5 at the Nassau County Supreme Court Building located at 100 Supreme Court Drive, in Mineola NY.

LiRo Engineers, Inc. (LE), an affiliate firm, was engaged to provide engineering services. Part of the engineering services was the evaluation of the existing structure and elevator shafts for the new elevator equipment loads and attachments. The existing building structure is a steel framed building with concrete slabs. The steel framing was noted at some location to be encased in concrete, especially at the elevator machine room.

The structural assessment of the elevator shafts included:

1. Review and evaluation of existing pit construction for the new loads as provided by the elevator subconsultant.
2. Review and evaluation of new machine loads imposed on the existing structural framing.
3. Review and evaluation of new rail loads imposed on the existing structural framing, along with existing rail span evaluation.
4. Review and evaluation of existing hoist beam rating for the new loads imposed as provided by the elevator subconsultant.

Existing pit construction

The existing pits are 1'-0" thick slabs on grade (See figures 1 & 2). The concrete strength as indicated on the drawings is 2500 pounds per square inch (See figure 3). The new loads, as provided by the elevator sub consultant, are created during impact. The car buffer reaction is provided as 45 kips, and the counterweight buffer reaction is provided as 35 kips (See figures 4,5 & 6).

Since the existing slab is on grade, our evaluation consisted of punching shear calculations for the reactions provided. The base supporting each of the elements above, was assumed to be a minimum of 9" x 9". Based on our calculations, the slab has sufficient capacity for the loads provided.

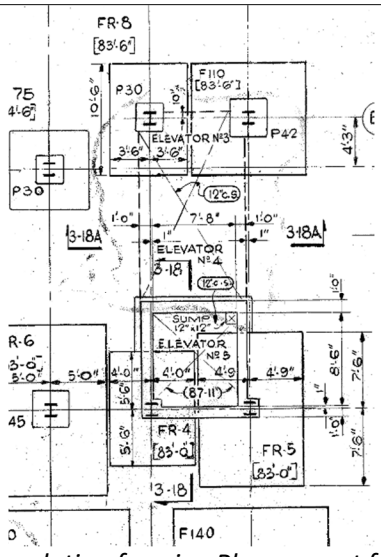


Figure 1 – Elevator Foundation framing Plan excerpt from existing drawings

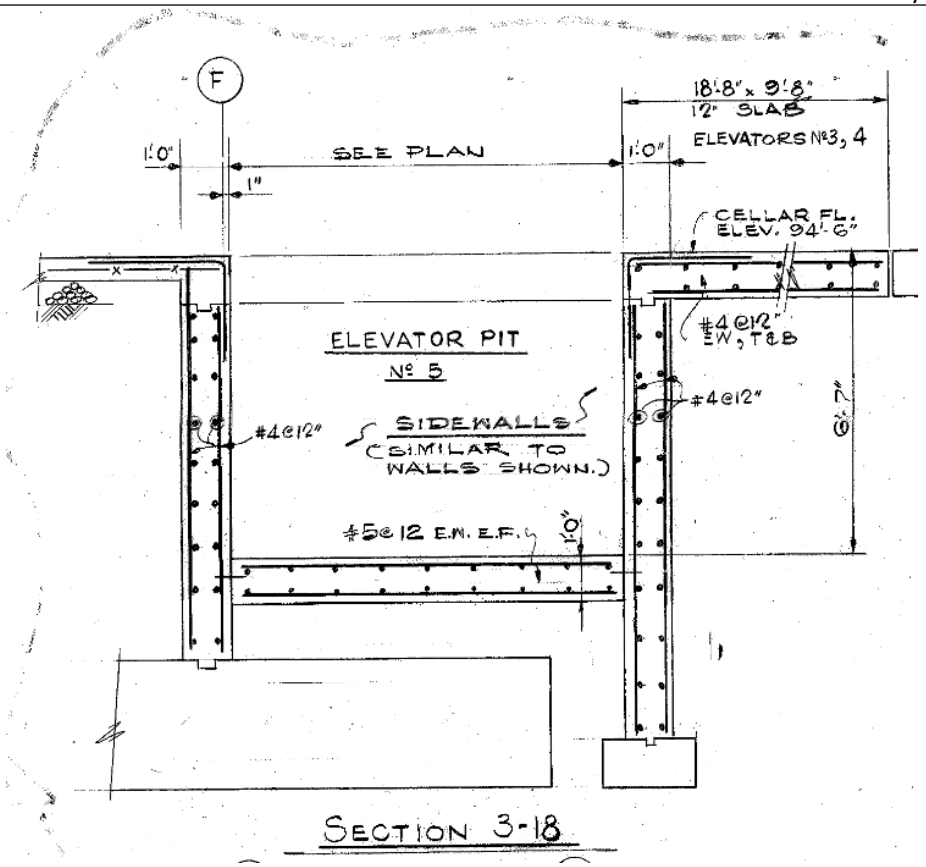


Figure 2 – Elevator pit section excerpt from existing drawings

b CONCRETE

1. ALL CONCRETE WORK FOR FOUNDATIONS AND SUPER-STRUCTURE TO BE CONTROLLED STONE CONCRETE.
2. CONTROLLED STONE CONCRETE SHALL HAVE A MINIMUM ULTIMATE COMPRESSIVE STRENGTH OF 2,500 P.S.I. AT 28 DAYS.

c. REINFORCING STEEL

1. ALL REINFORCING BARS SHALL CONFORM TO THE STANDARD SPECIFICATION OF THE A.S.T.M., DESIGNATION A-15.
2. ALL REINFORCING BARS SHALL BE ROLLED FROM INTERMEDIATE GRADE NEW STEEL BILLETS AND DEFORMED IN ROLLING WITH DEFORMATIONS CONFORMING TO STANDARD SPECIFICATION OF THE A.S.T.M., DESIGNATION A-305.
3. CONTRACTOR SHALL FURNISH CERTIFIED MILL REPORTS OF PHYSICAL AND CHEMICAL ANALYSIS OF REINFORCING BARS FOR APPROVAL.
4. MESH REINFORCING SHALL BE ELECTRIC WELDED GALVANIZED WIRE FABRIC WITH AN ULTIMATE TENSILE STRENGTH OF AT LEAST 70,000 P.S.I. FURNISH MILL REPORTS OF ANALYSIS

Figure 3 – Concrete and reinforcing steel notes excerpt from existing drawings

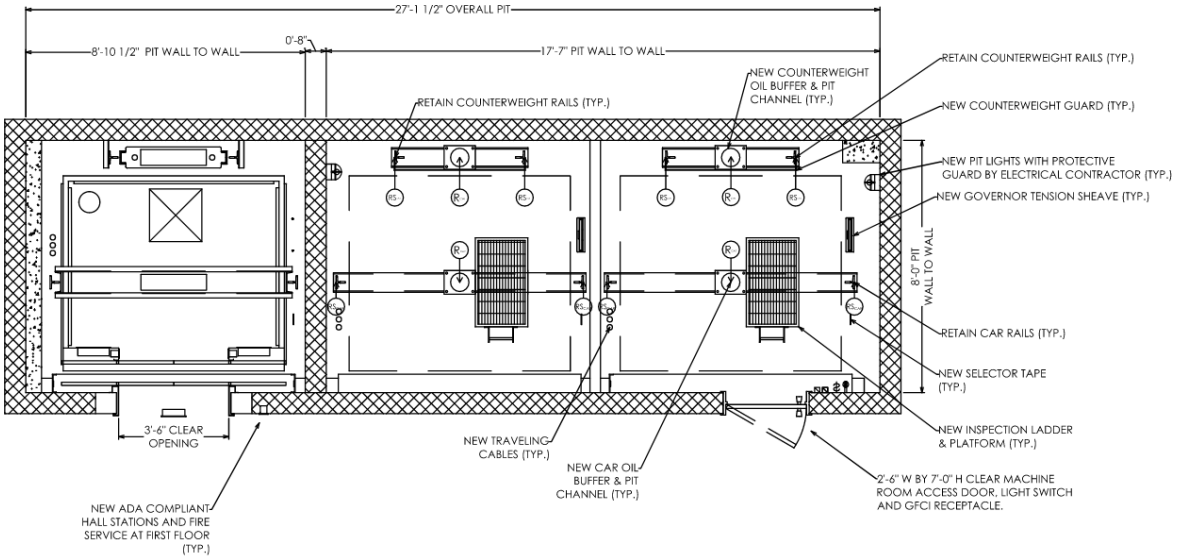


Figure 4 – Elevators 3 & 4 pit excerpt from NEW elevator drawings (from BOCA Group)

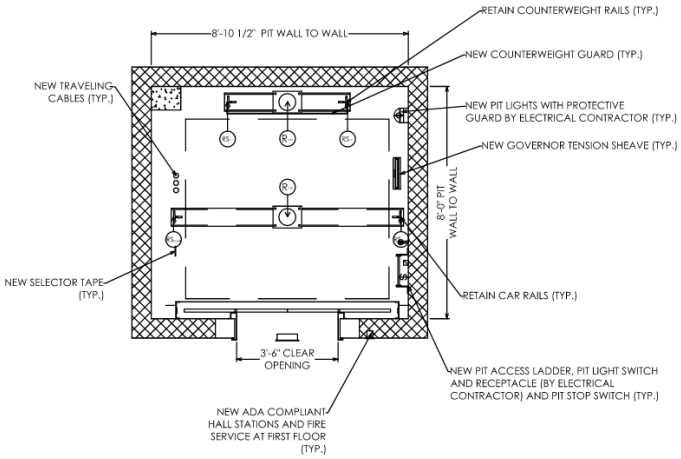


Figure 5 – Elevator 5 pit excerpt from NEW elevator drawings (from BOCA Group)

PIT LOADS			
ELEVATOR ID	Nos. 3-5		
CAR BUFFER REACTION (R_{CAR})	45.0 K		
CWT. BUFFER REACTION ($R_{CWT.}$)	35.0 K		
CAR RAIL SIZE	15 #/FT.		
CWT. RAIL SIZE	8 #/FT.		
WGT. PER CAR RAIL STACK	1800 #		
WGT. PER CWT. RAIL STACK	1000 #		
PIT & RAIL REACTIONS DO NOT OCCUR SIMULTANEOUSLY. BUFFER REACTIONS ARE DOUBLED FOR IMPACT			

Figure 6 – Elevator pit reactions excerpt from NEW elevator drawings (from BOCA Group)

100% CONSTRUCTION DOCUMENTS DATE: 11/07/2025

Existing elevator machine room framing

The existing elevator machine room framing was evaluated for the new forces. The new forces were found to be acceptable as compared to the original elevator machine reactions shown on the existing structural drawings. The existing framing was designed for 21.6kips versus 23kips and 16.1kips vs 17kips. See figures 7 & 8 showing the design reactions on the existing drawings and a plan showing the new elevator reactions. Please note that the new drawings indicate combined reaction force for the lettered reactions noted on the existing drawings. The increase in the elevator machine reactions were found to be within the reserve capacity of the existing steel framing and thus acceptable.

At the secondary level, a similar increase was noted in the new reactions when compared to the existing design reactions. The existing framing is designed for 14kips versus 15.5kips and 8.2kips versus 9.5kips. See figures 9 & 10 for the existing drawing reactions and the new reactions as reported on the existing and new drawings.

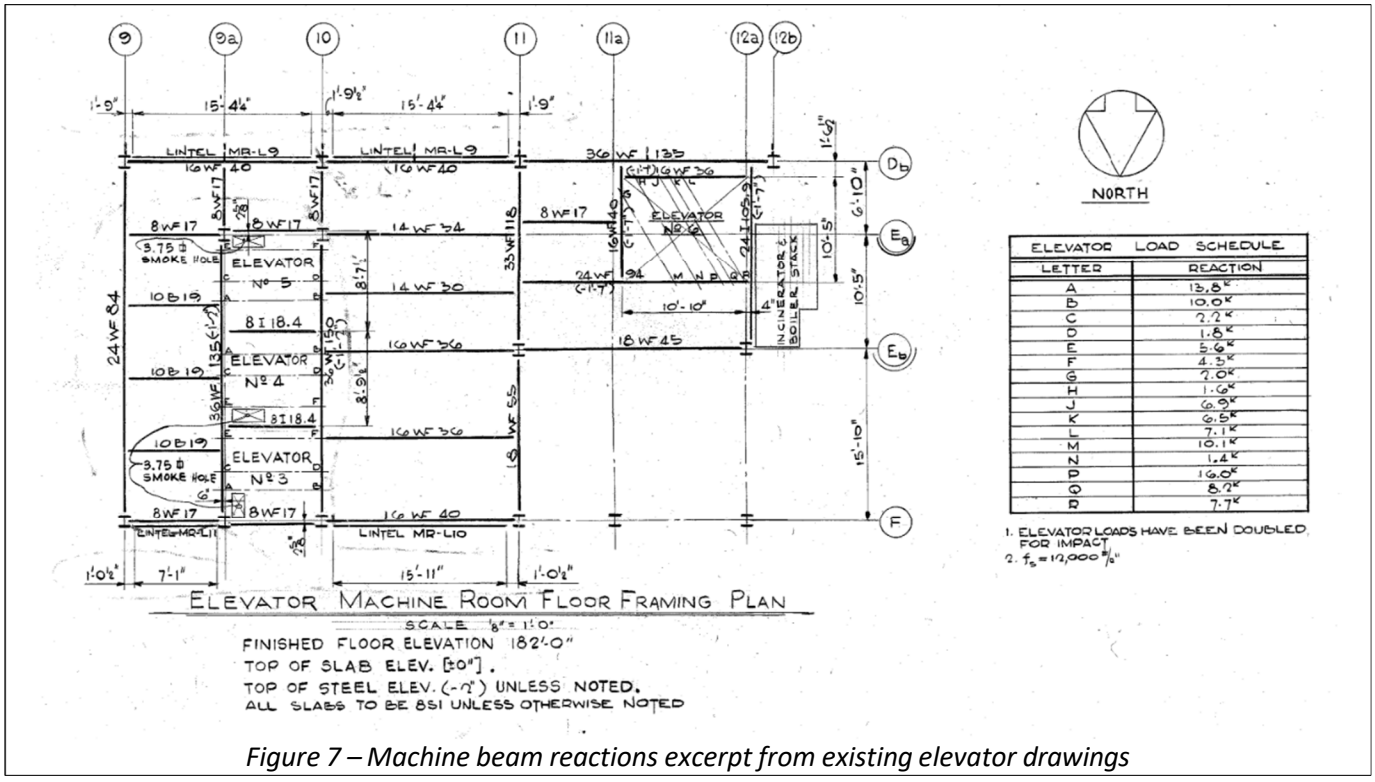


Figure 7 – Machine beam reactions excerpt from existing elevator drawings

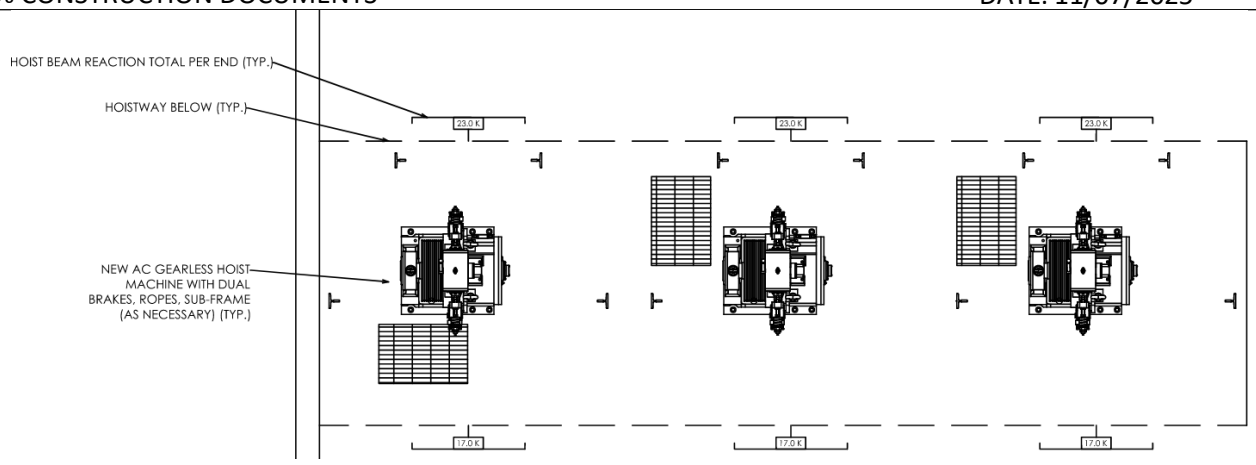


Figure 8 – Machine beam reactions excerpt from NEW elevator drawings (from BOCA Group)

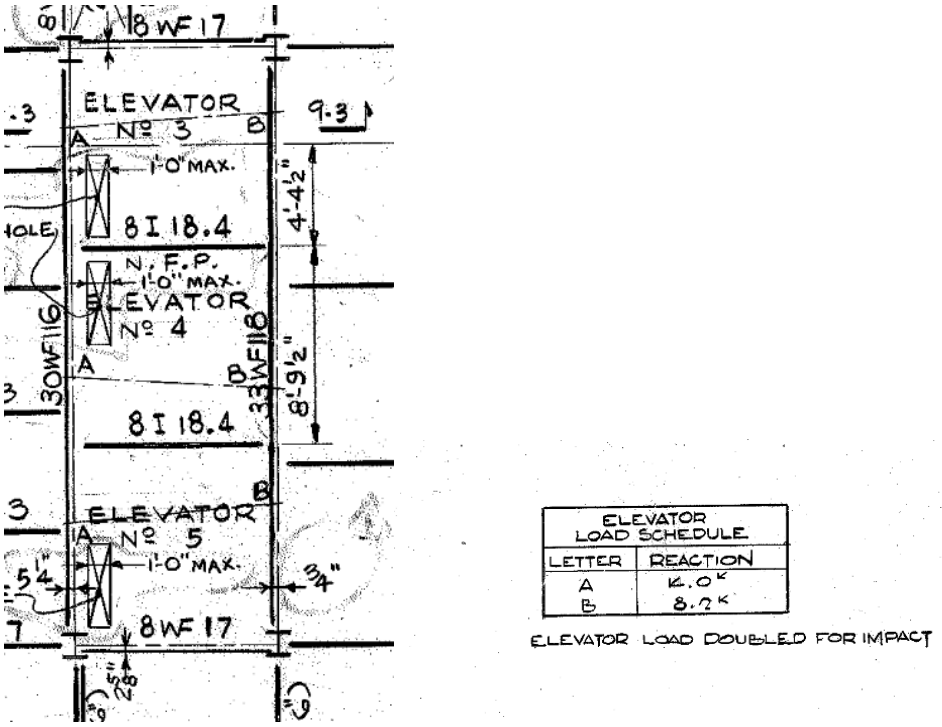


Figure 9 – Dead end hitch reactions excerpt from existing elevator drawings

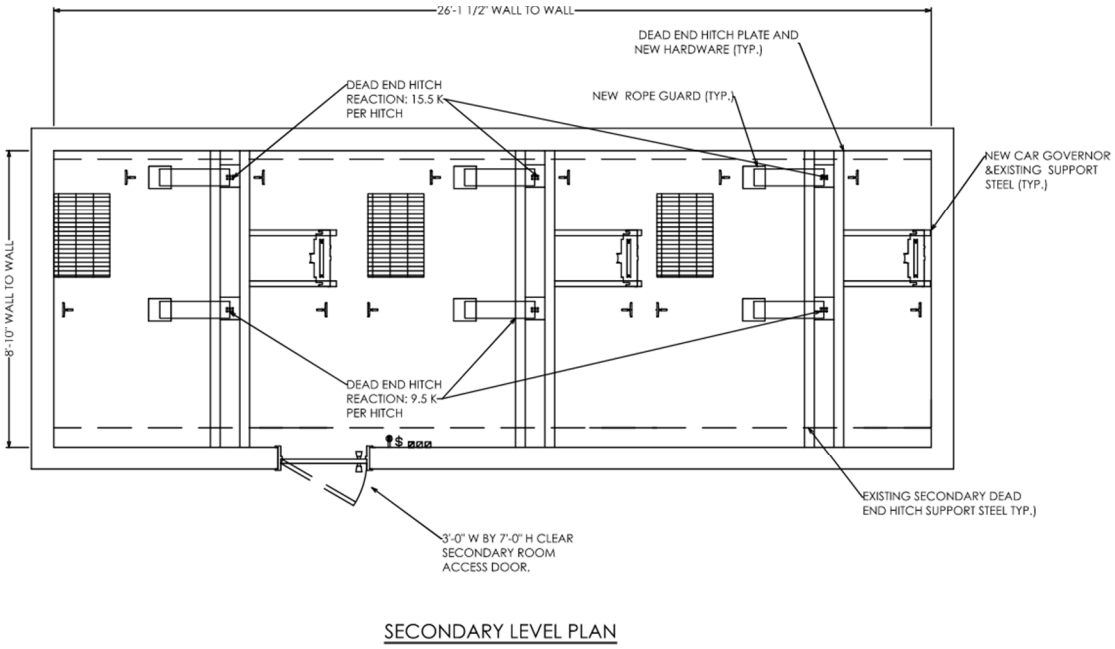


Figure 10 – Dead end hitch reactions excerpt from NEW elevator drawings (from BOCA Group)

Existing rail reactions and span

The existing rails will be reused and remain in place without any structural modifications. The new loads provided by the elevator subconsultant were reviewed for their magnitude. Their magnitude does not impose structural concerns on the existing steel framing and thus are acceptable. Figure 11 below provides the reported rail reactions. Also, the rail spans are to match the existing spans as they are currently installed.

RAIL LOADS

ELEVATOR ID		Nos. 1-7		
SEISMIC ZONE		1		
LOADING CLASS		PASSENGER		
CAR RAIL SIZE		15 #/FT.		
CWT. RAIL SIZE		8 #/FT.		
LOAD PER RAIL	F_{CAR}	28.0K		
	RUNNING (R_X)	250 #		
	LOADING (R_Y)	140 #		
MAX. VERT. RAIL BRACKET SPAN		EXISTING		

BRACKET SPACING SHALL MATCH EXISTING.

PIT AND RAIL REACTIONS DO NOT OCCUR SIMULTANEOUSLY.

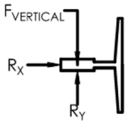


Figure 11 – Rail reactions at each support excerpt from NEW elevator drawings (from BOCA Group)

Existing hoist beam

The existing hoist beam, per existing drawings, was designed for a 5000-lb point load (See Figure 12). For our evaluation purposes, we used a section of W8x18, which is close to the existing section properties of the listed 8I18.4 historic section, and a conservative 30ksi yield strength to evaluate the section for an 8000-lb point load as required per the new elevator drawings (see Figure 13). Based on these criteria, the beam has adequate capacity to support the 8000-lb point load with a 0.71 demand over capacity ratio which is less than 1.0. The existing framing supporting the hoist beam was reviewed and it was determined that there is no concern about supporting the temporary hoist loads for the elevator installation.

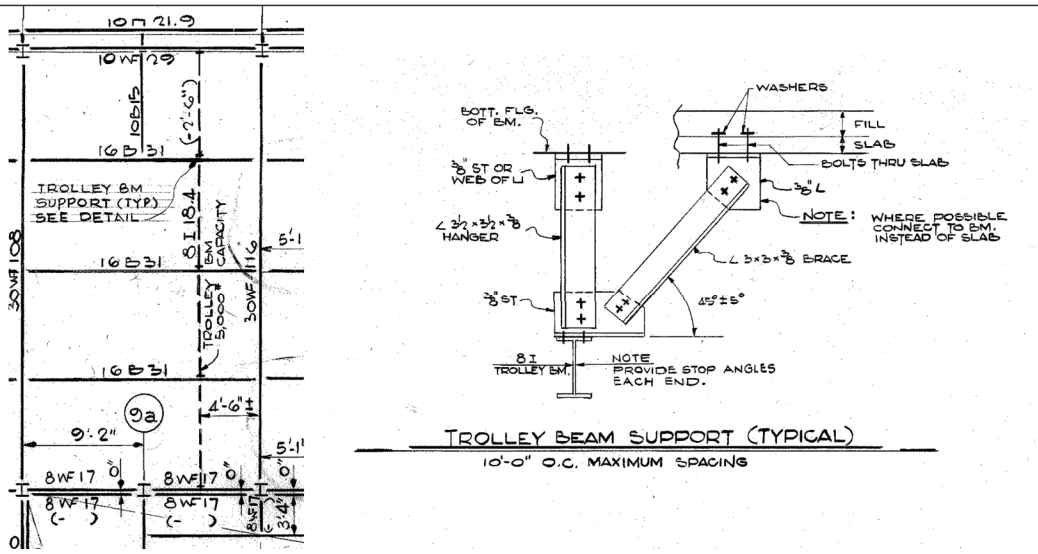


Figure 12 – Hoist beam existing load capacity excerpt from existing elevator drawings

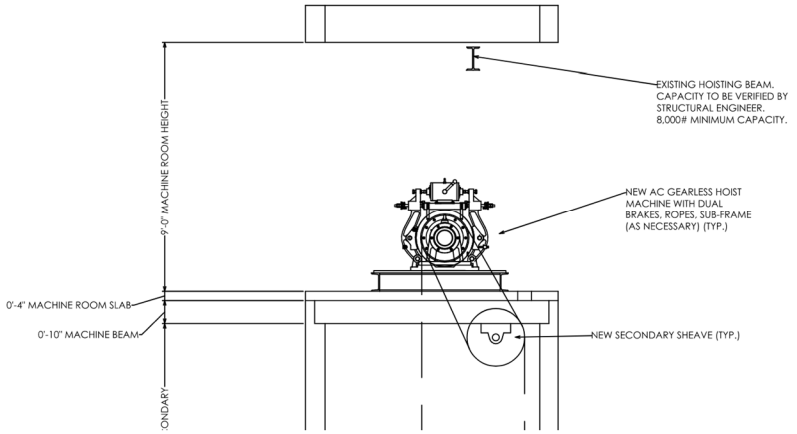


Figure 13 – Hoist beam new load requirement excerpt from NEW elevator drawings (from BOCA Group)

100% CONSTRUCTION DOCUMENTS DATE: 11/07/2025

Conclusions

Based on the existing information provided in the existing drawings and the new requirements as provided by the elevator subconsultant (Boca Group), the existing building structure has sufficient capacity to carry the new elevator loads without the need for structural reinforcement.

Sincerely,

Ioannis Giannakou, PE

Associate Structural Engineer

CC: Philip Georgakopoulos, PE

EXHIBIT D

J.C. Broderick & Associates, Inc.

Environmental / Construction Consulting & Testing

1775 Expressway Drive North
Hauppauge, NY 11788
631.584.5492
Fax: 631.584.3395
www.jcbroderick.com

October 22, 2025

Mr. Rob Exner
Nassau County Department of Public Works
1194 Prospect Avenue
Westbury New York 11590

Re: Pre-Construction Survey, Bulk Sampling & Analysis of
Suspect Asbestos Containing Materials at
Nassau County Supreme Court Building – Mission 21 Elevator Modernization
100 Supreme Court Drive, Mineola, New York, 11501
Sampling Date: June 3 & 4, 2025

JCB#: 25-61512

Dear Mr. Exner:

J.C. Broderick & Associates, Inc. (JCB) performed bulk sampling and analysis of suspect asbestos containing materials (ACM) that may be disturbed by the following proposed scope of work. The proposed scope of work was identified by the county's representative and was understood by JCB to be limited to the following:

Scope of Work:

- Renovations to Elevators, Elevator Shaft, Pit, & Machine Room.

Additional testing will be required if the scope of work changes or is different than reported above.

Inspection:

The inspection and subsequent bulk sampling were conducted by a New York State Department of Labor (NYS DOL) Licensed Consulting Firm by a certified asbestos inspector. The suspect materials identified were classified into homogenous material areas and then representative sampling of these materials was performed in accordance with the United States Environmental Protection Agency (US EPA) 40 CFR Part 763.86 (AHERA). Copies of JCB's license and certification information are included in the attachment of this report.

Chain of custody forms were prepared for the samples collected. The samples were delivered to EMSL Analytical Laboratories, Inc. (EMSL) for analysis. EMSL is an independent environmental laboratory accredited by the New York State Department of Health, Environmental Laboratory Approval Program and the United States Department of Commerce, National Voluntary Laboratory Approval Program. Copies of EMSL's certifications are included in the attachment of this report. Technical information regarding the methods of analysis is available upon request.

NYS DOL Industrial Code Rule 56-2.1(p) (ICR 56) and US EPA 40 CFR Part 763.8 (AHERA) define an asbestos containing material (ACM) as any material or product which contains more

than one percent (1%) of asbestos. In accordance with this definition, the table below summarizes the results of the laboratory analysis reported by EMSL.

Table. 1.0 Suspect Asbestos Containing Building Materials			
ID	**Material Description**	**Scope of Work Location**	**Asbestos**
Confirmed ACBM Expected to be Impacted by the Proposed Scope of Work			
A	**White Cloth Electric Wire Insulation**	**Elevator Machine Room**	**ASBESTOS**
B	**Circuit Board Material**	**Elevator Machine Room**	**ASBESTOS**
C	**2nd Layer Floor Tile**	**Interior of Elevator Cars**	**ASBESTOS**
Assumed Present ACBM Expected/Potential to be Impacted by Proposed Scope of Work (Inaccessible for sampling without significant damage to building/materials)			
D	Elevator Insulation Material	Concealed Within Elevator Wall Panels	Assumed Asbestos*
E	Marble Wall Panels & Mastic	Elevator Lobbies	Assumed Asbestos*
F	2x2 Spline Ceiling Tiles	Elevator Lobbies	Assumed Asbestos*
Non-ACBM Expected/Potential to be Impacted by Proposed Scope of Work			
G	Brick & Mortar	Elevator Machine Room	Not Asbestos
H	Concrete Block & Mortar	Elevator Pit & Elevator Machine Room	Not Asbestos
I	Concrete Flooring	Elevator Machine Room	Not Asbestos
J	Tar Paper on Elevator Electrical Component	Elevator Machine Room	Not Asbestos
K	Tar Material on Elevator Motors	Elevator Machine Room	Not Asbestos
L	Vibration Reducer Cloth	Elevator Machine Room	Not Asbestos
M	Beige 12x12 Floor Tile & Mastic (confirmed asbestos lower layer floor tile)	Elevators	Not Asbestos (asbestos contaminated)
N	Tan Terrazzo Flooring	1st Floor Elevator Lobby, 2nd Floor Elevator Lobby, 3rd Floor Elevator Lobby, & 4th Floor Elevator Lobby	Not Asbestos
*Materials ASSUMED to be asbestos. Assumed building materials need to be sampled prior to being impacted by the proposed work if present.			

Limitations of Inspection:

Although JCB took great care to identify and sample all suspect asbestos containing materials that may be impacted by the proposed scope of work, areas (spaces) and or suspect building materials may not have been accessible for inspection and/or sampling without causing significant damage to the existing building materials or due to physical access. Such areas and or materials that may not have inspected and or sampled due to these circumstances include, but are not limited to, the following

- Non-fiberglass pipe and pipe fitting insulation in plenum spaces such as ceilings, walls, chases, crawl spaces, etc.
- Plenums above plaster ceilings and behind plaster walls.
- Plenums above spline ceiling tile systems.
- Waterproofing membrane in building cavities and below flooring systems (i.e. slabs, ceramic tile, wood, etc.).
- Mastic behind panels/chalkboards/tack boards/mirrors.
- Flooring materials below existing walls/obstructions.

- Inaccessible gasket material associated with mechanical systems and duct work.

It is recommended that these materials should be presumed to be present or if possible, access be provided to JCB to inspect these spaces/materials.

Conclusions & Recommendations:

The intent of this asbestos containing materials survey was to sample and analyze only the suspect ACM that will be impacted by the proposed scope of work. This survey was not intended to identify all ACMs associated with the subject building and or the referenced subject spaces. If any other suspect ACM are encountered during the performance of the work, that are not referenced in the attachment of this report, these materials must be assumed as being asbestos containing until sampling and analysis is performed and determined otherwise.

Therefore, the contractor shall be advised that during demolition if any suspicious or suspect asbestos material is encountered during demolition, work shall stop immediately, and the contractor shall notify the architect and the material shall be sampled by the school district's environmental consultant for asbestos.

No determination was made by JCB if the materials listed in the table are homogenous throughout the remaining portions of the building. That is, the findings of this inspection are limited to information specifically indicated in the table.

The intent of the table above was to report the building materials that are "asbestos-containing" in accordance with the US EPA and NYS DOL. This report was not intended for compliance with the United States Occupational Safety & Health Administration (OSHA) standards. The contractor is responsible for their own compliance to OSHA and shall refer directly to the laboratory reports. All confirmed asbestos containing materials that are not scheduled to be removed should be implemented into an asbestos management plan.

Any disturbance of any confirmed asbestos or assumed asbestos containing materials must be performed by a licensed contractor and certified handlers in accordance with New York State Industrial Code Rule 56 (NYS ICR 56) and 40 CFR Part 763 and all other applicable federal, state and local regulations. General contractors shall also have properly trained and/or certified workers to work in regulated areas. Regulated areas, include crawl spaces, plenums, fan rooms and boiler rooms and any other area where damaged ACM exists or areas where ACM is likely to be disturbed.

It is recommended the district architect consider including an additional allowance for asbestos abatement work. The allowance shall be used to cover the cost of asbestos abatement work resulting from unforeseen conditions discovered during demolition and beyond the scope of the contract documents.

All contractors are responsible for the proper handling, staging and disposal of all hazardous and regulated wastes generated because of the work being performed.

The following project information has been included in the attachments section of this report.

1. Drawings & Photologs
2. Chain of Custody and Laboratory Analysis
3. Laboratory Certifications
4. JCB Certifications

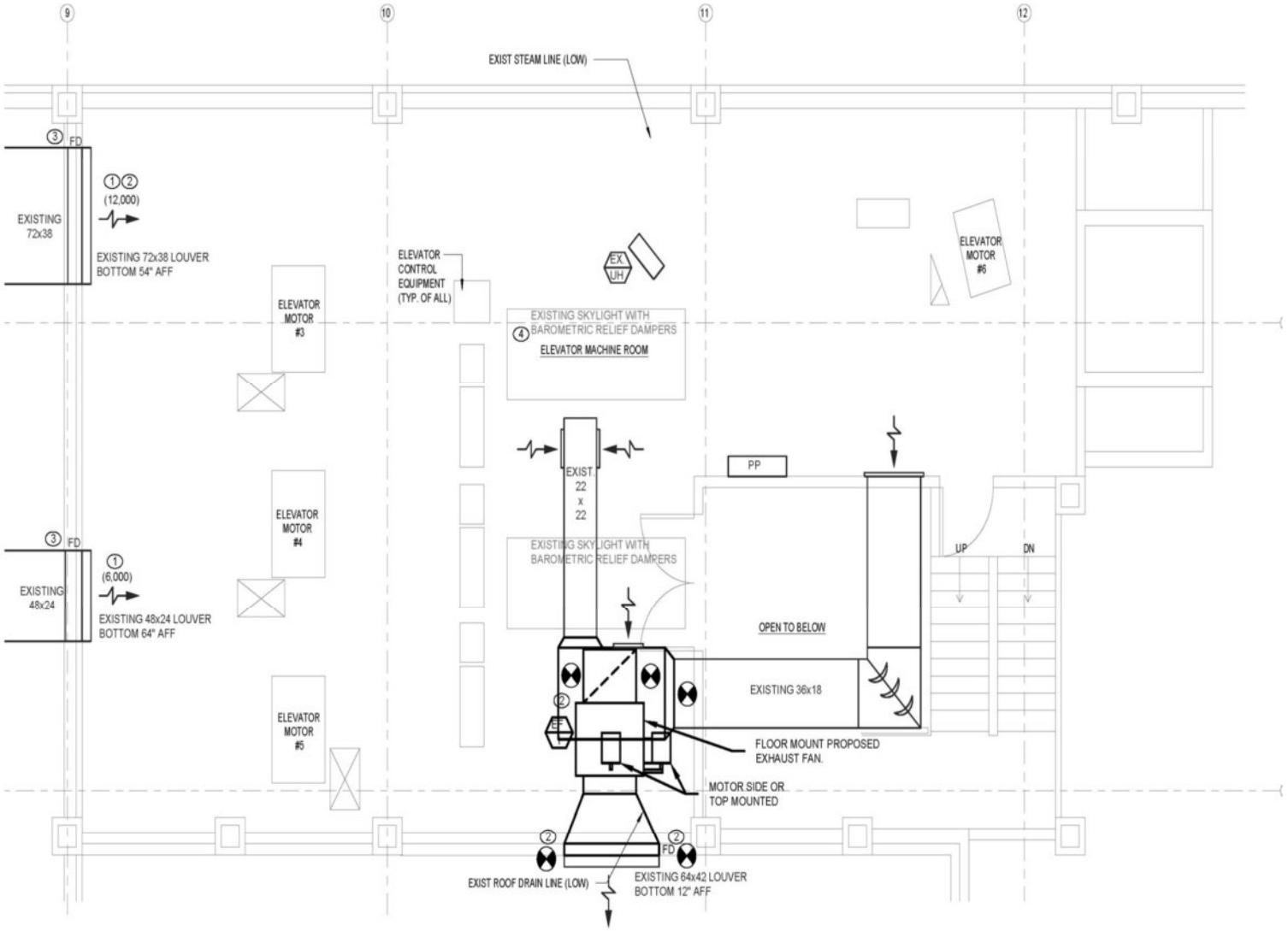
If there are any questions or if more information is needed, please feel free to call.

Sincerely,
Paul Fazio
Paul Fazio
J.C. BRODERICK & ASSOCIATES, INC.

Drawings & Photologs



J.C. Broderick & Associates, Inc.
Environmental Consulting & Testing
1775 Expressway Drive North
Hauppauge, New York 11788
631.584.5492 fax 631.584.3395



1 **ELEVATOR MACHINE ROOM**
SCALE: 1/4"=1'-0"

J.C. BRODERICK
& Associates

ENVIRONMENTAL CONSULTING & TESTING

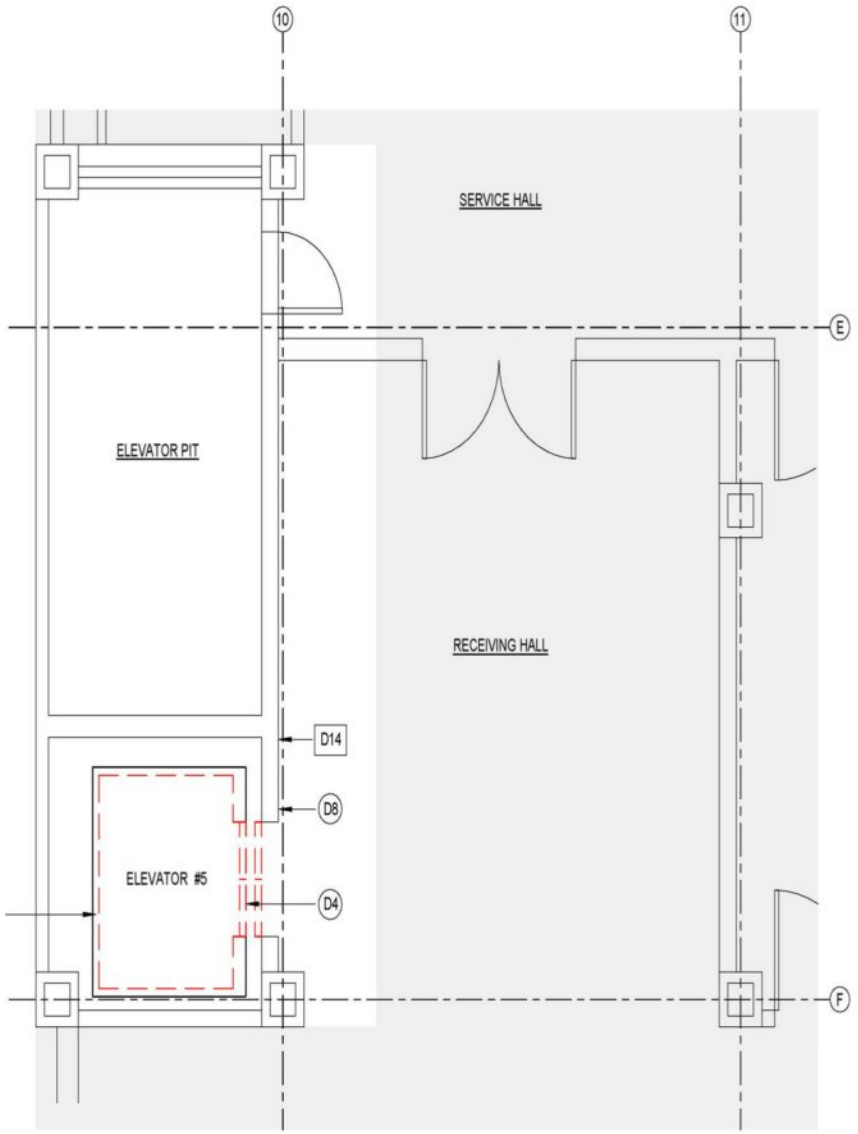
1775 Expressway Drive North
Hauppauge, New York 11788

631.584.5492 fax 631.584.5913

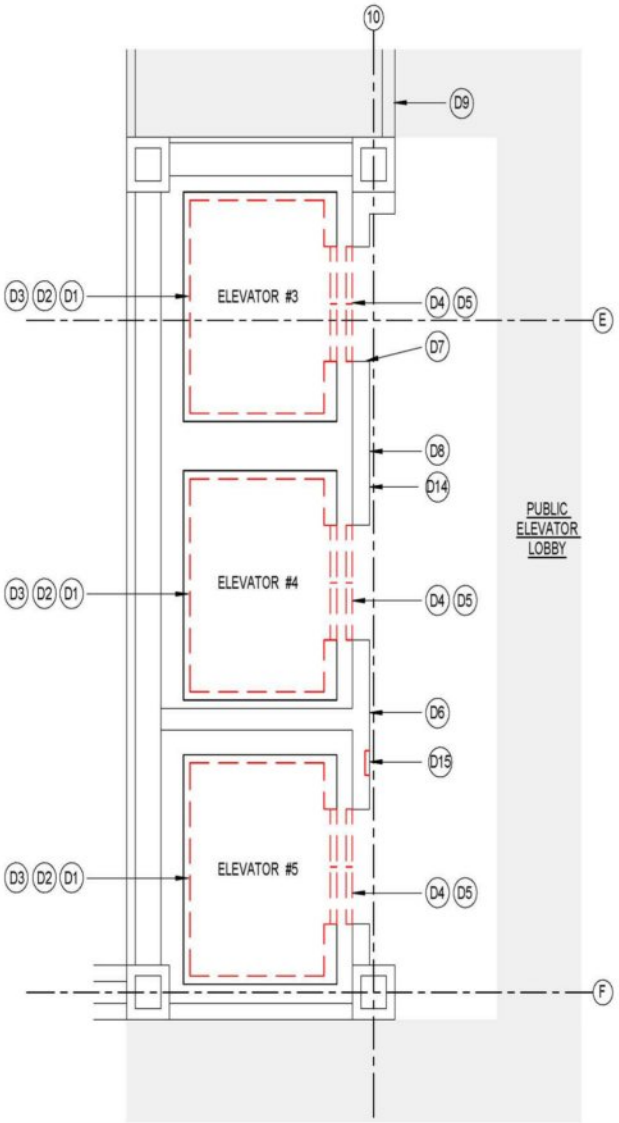
Project No:
25-61512

Building Name:
Supreme Court Building

Scope of Work Locations



1 DEMO CELLAR FL LOBBY PLAN
1/4" = 1'-0"



2 DEMO FIRST FL LOBBY PLAN
1/4" = 1'-0"

J.C. BRODERICK
& Associates

ENVIRONMENTAL CONSULTING & TESTING

1775 Expressway Drive North
Hauppauge, New York 11788

631.584.5492 fax 631.584.5913

Project No:
25-61512

Building Name:
Supreme Court Building

Scope of Work Locations

Table. 1.0 Suspect Asbestos Containing Building Materials			
ID	**Material Description**	**Scope of Work Location**	**Asbestos**
Confirmed ACBM Expected to be Impacted by the Proposed Scope of Work			
A	**White Cloth Electric Wire Insulation**	**Elevator Machine Room**	**ASBESTOS**
B	**Circuit Board Material**	**Elevator Machine Room**	**ASBESTOS**
C	**2nd Layer Floor Tile**	**Elevators**	**ASBESTOS**
Assumed Present ACBM Expected/Potential to be Impacted by Proposed Scope of Work (Inaccessible for sampling without significant damage to building/materials)			
D	Elevator Insulation Material	Concealed Within Elevator Wall Panels	Assumed Asbestos*
E	Marble Wall Panels & Mastic	Elevator Lobbies	Assumed Asbestos*
F	2x2 Spline Ceiling Tiles	Elevator Lobbies	Assumed Asbestos*

J.C. BRODERICK
& Associates

ENVIRONMENTAL CONSULTING & TESTING

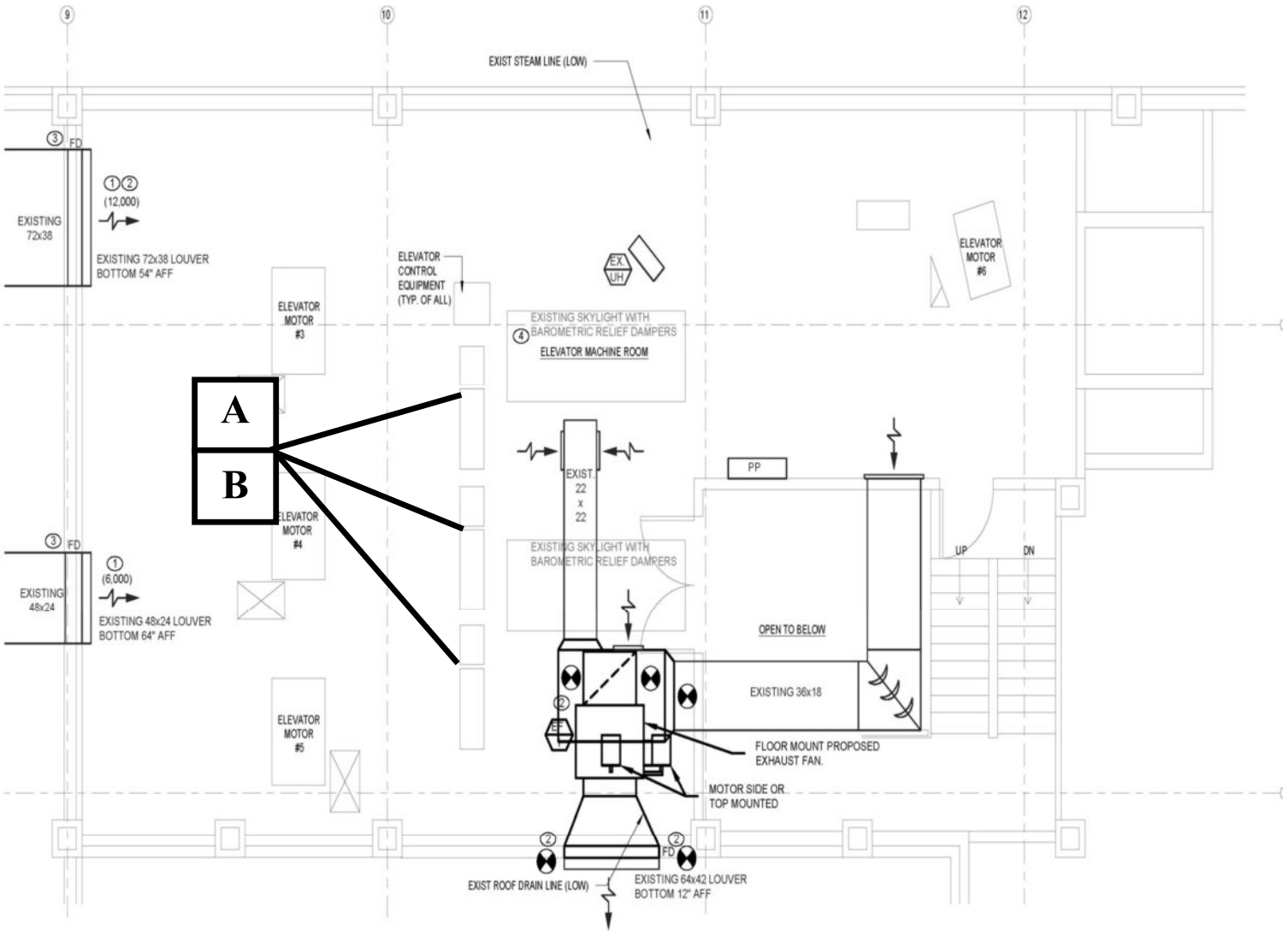
1775 Expressway Drive North
Hauppauge, New York 11788

631.584.5492 fax 631.584.5913

Project No:
25-61512

Building Name:
Supreme Court Building

Asbestos Containing Materials



1 **ELEVATOR MACHINE ROOM**
SCALE: 1/4"=1'-0"

J.C. BRODERICK
& Associates

ENVIRONMENTAL CONSULTING & TESTING

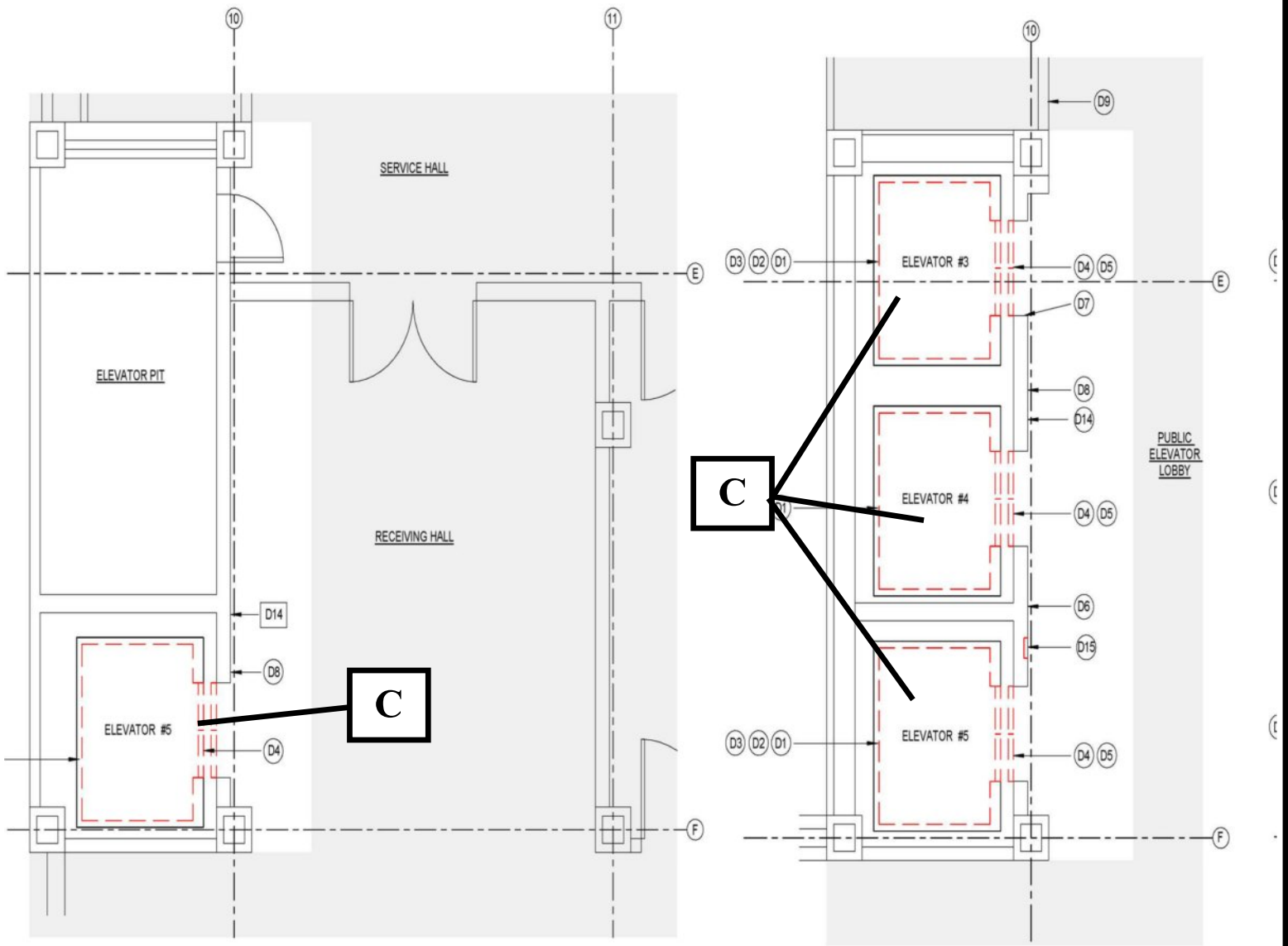
1775 Expressway Drive North
Hauppauge, New York 11788

631.584.5492 fax 631.584.5913

Project No:
25-61512

Building Name:
Supreme Court Building

Asbestos Materials Location Plan



J.C. BRODERICK
& Associates

ENVIRONMENTAL CONSULTING & TESTING

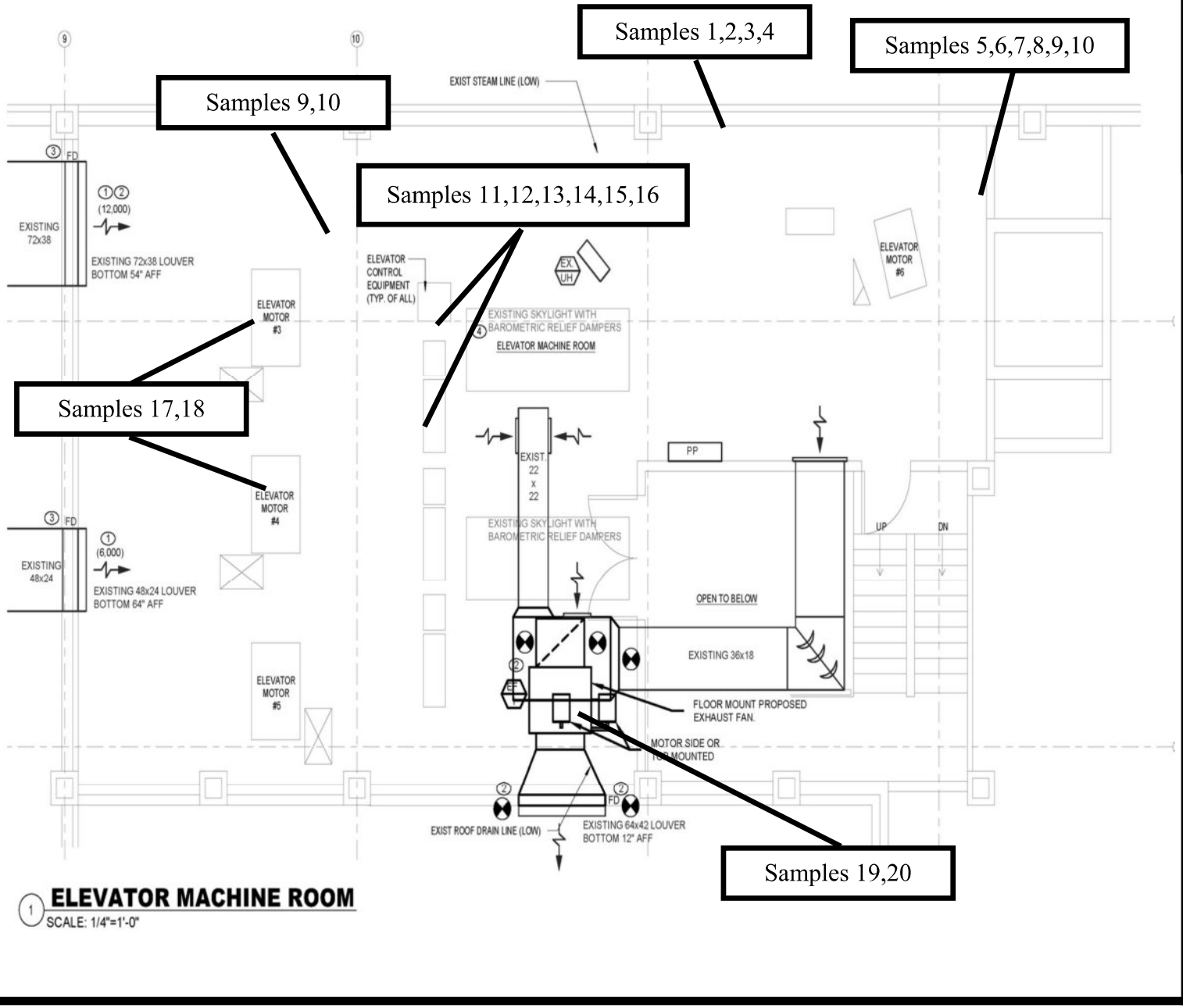
1775 Expressway Drive North
Hauppauge, New York 11788

631.584.5492 fax 631.584.5913

Project No:
25-61512

Building Name:
Supreme Court Building

Asbestos Materials Location Plan



J.C. BRODERICK
& Associates

ENVIRONMENTAL CONSULTING & TESTING

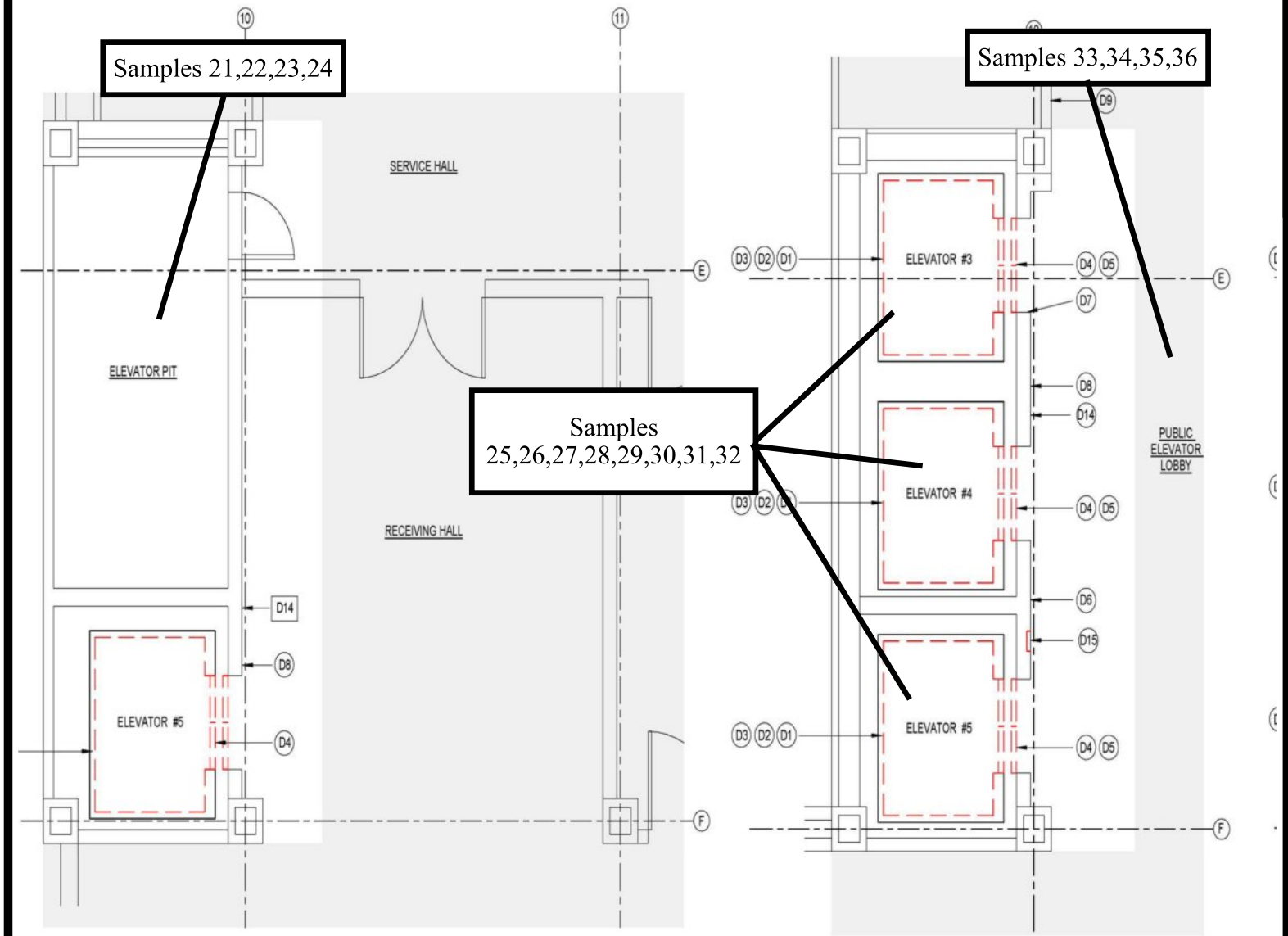
1775 Expressway Drive North
Hauppauge, New York 11788

631.584.5492 fax 631.584.5913

Project No:
25-61512

Building Name:
Supreme Court Building

Sample Locations



J.C. BRODERICK
& Associates

ENVIRONMENTAL CONSULTING & TESTING

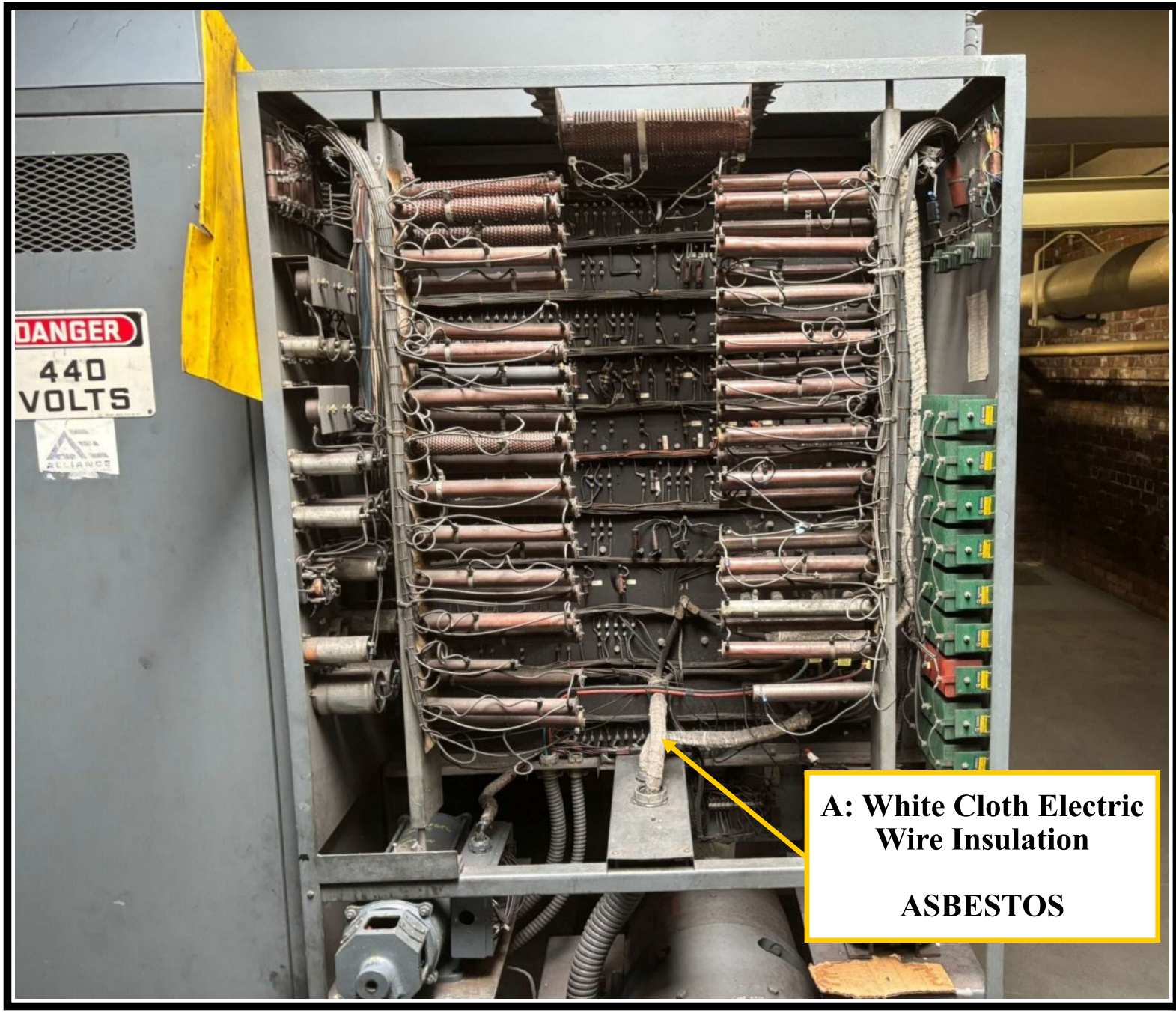
1775 Expressway Drive North
Hauppauge, New York 11788

631.584.5492 fax 631.584.5913

Project No:
25-61512

Building Name:
Supreme Court Building

Sample Locations



J.C. BRODERICK
& Associates

ENVIRONMENTAL CONSULTING & TESTING

1775 Expressway Drive North
Hauppauge, New York 11788

631.584.5492 fax 631.584.5913

Project No:
25-61512

Building Name:
Supreme Court Building

Photo Log



B: Circuit Board Material

ASBESTOS

J.C. BRODERICK
& Associates

ENVIRONMENTAL CONSULTING & TESTING

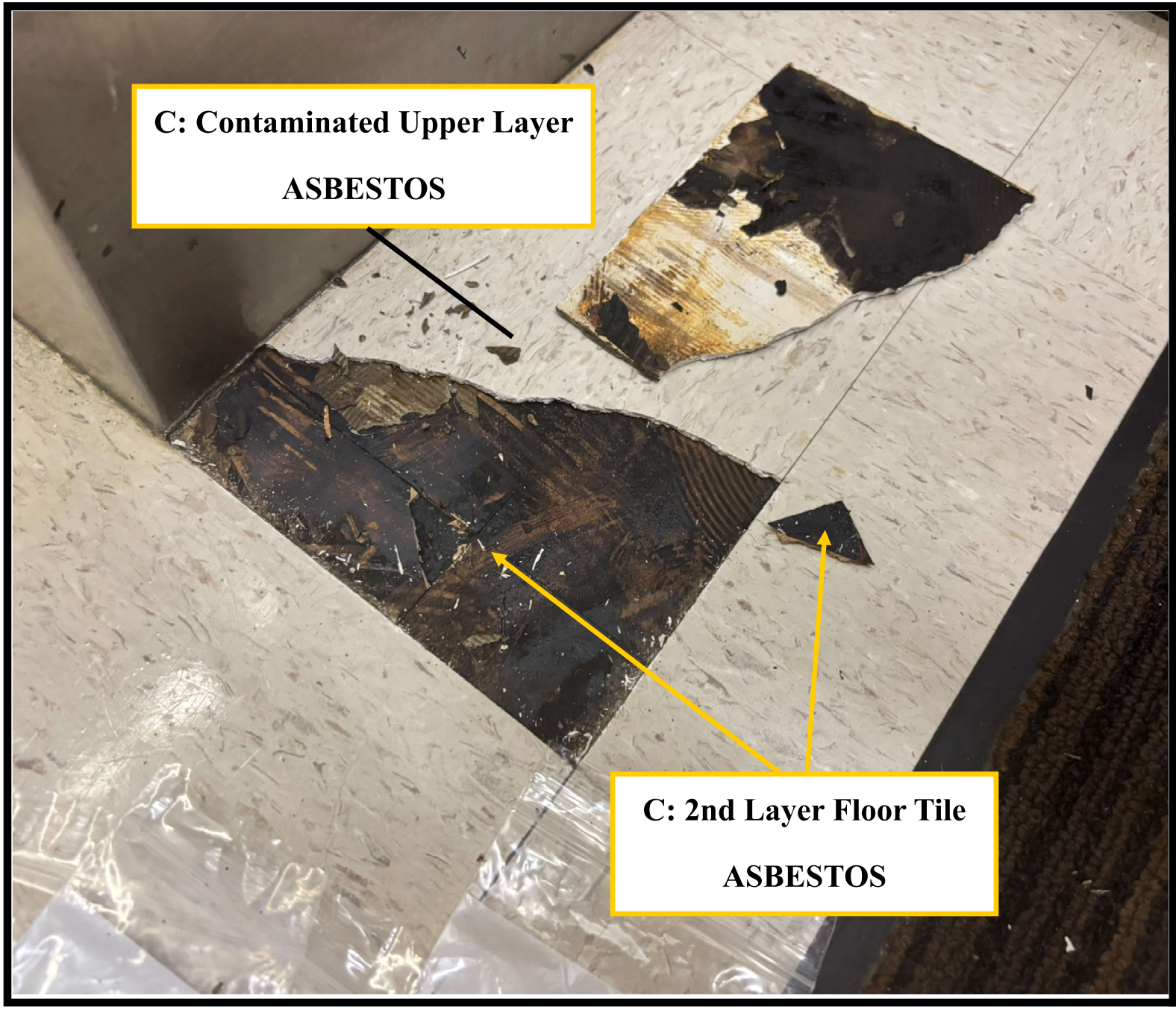
1775 Expressway Drive North
Hauppauge, New York 11788

631.584.5492 fax 631.584.5913

Project No:
25-61512

Building Name:
Supreme Court Building

Photo Log



J.C. BRODERICK
& Associates

ENVIRONMENTAL
CONSULTING & TESTING

1775 Expressway Drive North
Hauppauge, New York 11788

631.584.5492 fax 631.584.5913

Project No:
25-61512

Building Name:
Supreme Court Building

Photo Log

Chain of Custody
&
Laboratory Analysis



J.C. Broderick & Associates, Inc.
Environmental Consulting & Testing
1775 Expressway Drive North
Hauppauge, New York 11788
631.584.5492 fax 631.584.3395

0625061 84

BULK SAMPLING CHAIN OF CUSTODY RECORD

SITE: Supreme Court Building
ADDRESS: 100 Supreme Court Drive, Mineola, NY, 11501
DATE: June 5, 2025
CLIENT: Nassau County Department of Public Works
PROJECT #: 25-61512

☐ **ANALYZE EACH MATERIAL TO 1ST POSITIVE**

SAMPLER'S NAME: Quinlan Crossley
SAMPLER'S SIGN: Quinlan Crossley
LABORATORY: EMSL
TURNAROUND TIME (CIRCLE ONE): 24 HOUR | 48 HOUR | (72 HOUR) | RUSH | OTHER
MANAGER: Paul Fazio

RECEIVED
EMSL ANALYTICAL, INC.
Carle Place, NY
JUN 05 25, PM02:23
OrderID: 062506184

SAMPLE #	HM #	MATERIAL DESCRIPTION	SPACE ID / LOCATION	ANALYSIS METHOD
1.	1	Fire Brick	Elevator Machine Room	Asbestos
2.	1	Fire Brick	Elevator Machine Room	Asbestos
3.	2	Mortar to Fire Brick	Elevator Machine Room	Asbestos
4.	2	Mortar to Fire Brick	Elevator Machine Room	Asbestos
5.	3	Concrete Block	Elevator Machine Room	Asbestos
6.	3	Concrete Block	Elevator Machine Room	Asbestos
7.	4	Mortar to Concrete Block	Elevator Machine Room	Asbestos
8.	4	Mortar to Concrete Block	Elevator Machine Room	Asbestos
9.	5	Concrete Flooring	Elevator Machine Room	Asbestos
10.	5	Concrete Flooring	Elevator Machine Room	Asbestos
11.	6	White Cloth Electric Wire Insulation	Elevator Machine Room	Asbestos
12.	6	White Cloth Electric Wire Insulation	Elevator Machine Room	Asbestos
13.	7	Tar Paper on Elevator Electrical Component	Elevator Machine Room	Asbestos
14.	7	Tar Paper on Elevator Electrical Component	Elevator Machine Room	Asbestos
15.	8	Circuit Board Material	Elevator Machine Room	Asbestos
16.	8	Circuit Board Material	Elevator Machine Room	Asbestos
17.	9	Tar Material on Elevator Motors	Elevator Machine Room	Asbestos
18.	9	Tar Material on Elevator Motors	Elevator Machine Room	Asbestos

SUBMITTED BY (PRINT)	SIGNATURE	DATE	TIME	RECEIVED BY (PRINT)	SIGNATURE	DATE	TIME
Jordan Migliore	J. Migliore	6/5/25	14:24	Gabriella Razza	Gabriella Razza	6/5/25	2:23 PM
COMMENTS				ANALYST (PRINT)	SIGNATURE	DATE	TIME
				Jimmy Encalada	Jimmy Encalada	6/9/25	1:38pm

J.C. BRODERICK & ASSOCIATES
1775 Expressway Drive North ♦ HAUPPAUGE ♦ NEW YORK, 11788 ♦ PHONE: (631) 584-5492 ♦ FAX: (631) 584-3395

6/9/25

062506184

BULK SAMPLING CHAIN OF CUSTODY RECORD

SITE: Supreme Court Building
ADDRESS: 100 Supreme Court Drive, Mineola, NY, 11501
DATE: June 5, 2025
CLIENT: Nassau County Department of Public Works
PROJECT #: 25-61512

SAMPLER'S NAME: Quinlan Crossley
SAMPLER'S SIGN: Quinlan Crossley
LABORATORY: EMSL
TURNAROUND TIME (CIRCLE ONE): 24 HOUR | 48 HOUR | 72 HOUR | RUSH | OTHER

☐ ANALYZE EACH MATERIAL TO 1ST POSITIVE

MANAGER: Paul Fazio

SAMPLE #	HM #	MATERIAL DESCRIPTION	SPACE ID / LOCATION	ANALYSIS METHOD
19.	10	Vibration Reducer Cloth	Elevator Machine Room	Asbestos
20.	10	Vibration Reducer Cloth	Elevator Machine Room	Asbestos
21.	11	Concrete Block	Elevator Pit	Asbestos
22.	11	Concrete Block	Elevator Pit	Asbestos
23.	12	Mortar to Concrete Block	Elevator Pit	Asbestos
24.	12	Mortar to Concrete Block	Elevator Pit	Asbestos
25.	13	Beige 12x12 Floor Tile	Elevator	Asbestos
26.	13	Beige 12x12 Floor Tile	Elevator	Asbestos
27.	14	Masatic to Beige 12x12 Floor Tile	Elevator	Asbestos
28.	14	Masatic to Beige 12x12 Floor Tile	Elevator	Asbestos
29.	15	2nd Layer Floor Tile	Elevator	Asbestos
30.	15	2nd Layer Floor Tile	Elevator	Asbestos
31.	16	Mastic to 2nd Layer Floor Tile	Elevator	Asbestos
32.	16	Mastic to 2nd Layer Floor Tile	Elevator	Asbestos
33.	17	Tan Terrazzo Flooring	1st Floor Elevator Lobby	Asbestos
34.	17	Tan Terrazzo Flooring	2nd Floor Elevator Lobby	Asbestos
35.	17	Tan Terrazzo Flooring	3rd Floor Elevator Lobby	Asbestos
36.	17	Tan Terrazzo Flooring	4th Floor Elevator Lobby	Asbestos

SUBMITTED BY (PRINT)	SIGNATURE	DATE	TIME	RECEIVED BY (PRINT)	SIGNATURE	DATE	TIME
				Gabriella Razza	Gabriella Razza	6/5/25	2:23 PM
COMMENTS				ANALYST (PRINT)	SIGNATURE	DATE	TIME
				Jimmy Encalada		6/9/25	1:37 pm

J.C. BRODERICK & ASSOCIATES
1775 Expressway Drive North ♦ HAUPPAUGE ♦ NEW YORK, 11788 ♦ PHONE: (631) 584-5492 ♦ FAX: (631) 584-6316

RECEIVED
EMSL ANALYTICAL, INC.
Cinnaminson Place, NY
JUN 05 25, PM02:23

6/9/25

OrderID: 062506184

EMSL Analytical, Inc.

528 Mineola Avenue Carle Place, NY 11514
Tel/Fax: (516) 997-7251 / (516) 997-7528
http://www.EMSL.com / carleplacelab@emsl.com

EMSL Order:	062506184
Customer ID:	NASS50
Customer PO:	BPNC19000166
Project ID:	BPNC19000166

Attention:	Paul Fazio	**Phone:**	(516) 571-6919
	County of Nassau Office of Purchasing	**Fax:**	(516) 571-6956
	Office of Purchasing	**Received Date:**	06/05/2025 2:23 PM
	1 West Street, 1st Floor	**Analysis Date:**	06/09/2025
	Mineola, NY 11501	**Collected Date:**	06/05/2025

Project: Supreme Court Building, 100 Supreme Court Drive, Mineola, NY, 11501; Nassau County Department of Public Works; Project #: 25-61512 (BPNC19000166)

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 1-1		**Description**	Elevator Machine Room - Fire Brick		
062506184-0001		**Homogeneity**	Homogeneous		
PLM NYS 198.1 Friable	06/09/2025	Red		15.00% Ca Carbonate 57.00% Non-fibrous (other) 28.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 1-2		**Description**	Elevator Machine Room - Fire Brick		
062506184-0002		**Homogeneity**	Homogeneous		
PLM NYS 198.1 Friable	06/09/2025	Red		38.00% Ca Carbonate 47.00% Non-fibrous (other) 15.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 2-3		**Description**	Elevator Machine Room - Mortar to Fire Brick		
062506184-0003		**Homogeneity**	Homogeneous		
PLM NYS 198.1 Friable	06/09/2025	Gray		30.00% Ca Carbonate 15.00% Non-fibrous (other) 55.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 2-4		**Description**	Elevator Machine Room - Mortar to Fire Brick		
062506184-0004		**Homogeneity**	Homogeneous		
PLM NYS 198.1 Friable	06/09/2025	Gray	3.00% Cellulose	30.00% Ca Carbonate 12.00% Non-fibrous (other) 55.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**

Initial report from: 06/09/2025 15:51:22

EMSL Analytical, Inc.
528 Mineola Avenue Carle Place, NY 11514
Tel/Fax: (516) 997-7251 / (516) 997-7528
http://www.EMSL.com / carleplacelab@emsl.com

EMSL Order:	062506184
Customer ID:	NASS50
Customer PO:	BPNC19000166
Project ID:	BPNC19000166

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 3-5 *062506184-0005*		**Description** Elevator Machine Room - Concrete Block **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	06/09/2025	Gray	3.00% Cellulose	30.00% Ca Carbonate 12.00% Non-fibrous (other) 55.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 3-6 *062506184-0006*		**Description** Elevator Machine Room - Concrete Block **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	06/09/2025	Gray	3.00% Cellulose	30.00% Ca Carbonate 12.00% Non-fibrous (other) 55.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 4-7 *062506184-0007*		**Description** Elevator Machine Room - Mortar to Concrete Block **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	06/09/2025	Gray/ White		30.00% Ca Carbonate 15.00% Non-fibrous (other) 55.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 4-8 *062506184-0008*		**Description** Elevator Machine Room - Mortar to Concrete Block **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	06/09/2025	Gray/ White	3.00% Cellulose	30.00% Ca Carbonate 12.00% Non-fibrous (other) 55.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 5-9 *062506184-0009*		**Description** Elevator Machine Room - Concrete Flooring **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	06/09/2025	Gray		30.00% Ca Carbonate 15.00% Non-fibrous (other) 55.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**

Initial report from: 06/09/2025 15:51:22

EMSL Analytical, Inc.
528 Mineola Avenue Carle Place, NY 11514
Tel/Fax: (516) 997-7251 / (516) 997-7528
http://www.EMSL.com / carleplacelab@emsl.com

EMSL Order:	062506184
Customer ID:	NASS50
Customer PO:	BPNC19000166
Project ID:	BPNC19000166

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 5-10 *062506184-0010*		**Description** Elevator Machine Room - Concrete Flooring **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	06/09/2025	Gray		30.00% Ca Carbonate 4.00% Mica 11.00% Non-fibrous (other) 55.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 6-11 *062506184-0011*		**Description** Elevator Machine Room - White Cloth Electric Wire Insulation **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	06/09/2025	White	33.00% Cellulose	43.00% Non-fibrous (other)	**24.00% Chrysotile**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 6-12 *062506184-0012*		**Description** Elevator Machine Room - White Cloth Electric Wire Insulation **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	06/09/2025	White	38.00% Cellulose	33.00% Non-fibrous (other)	**29.00% Chrysotile**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 7-13 *062506184-0013*		**Description** Elevator Machine Room - Tar Paper on Elevator Electrical Component **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	06/09/2025	Tan/ Black		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	06/09/2025	Tan/ Black		100.00% Other	**None Detected**
Sample ID 7-14 *062506184-0014*		**Description** Elevator Machine Room - Tar Paper on Elevator Electrical Component **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	06/09/2025	Tan/ Black		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	06/09/2025	Tan/ Black		100.00% Other	**None Detected**
Sample ID 8-15 *062506184-0015*		**Description** Elevator Machine Room - Circuit Board Material **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	06/09/2025	Brown/ Black	None	66.00% Non-fibrous (other) 15.00% Quartz	**19.00% Chrysotile**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**

Initial report from: 06/09/2025 15:51:22

EMSL Analytical, Inc.
528 Mineola Avenue Carle Place, NY 11514
Tel/Fax: (516) 997-7251 / (516) 997-7528
http://www.EMSL.com / carleplacelab@emsl.com

EMSL Order:	062506184
Customer ID:	NASS50
Customer PO:	BPNC19000166
Project ID:	BPNC19000166

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 8-16 *062506184-0016*		**Description** Elevator Machine Room - Circuit Board Material **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	06/09/2025	Brown/ Black	None	62.00% Non-fibrous (other) 18.00% Quartz	**20.00% Chrysotile**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 9-17 *062506184-0017*		**Description** Elevator Machine Room - Tar Material on Elevator Motors **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	06/09/2025	Black		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	06/09/2025	Black		100.00% Other	**None Detected**
Sample ID 9-18 *062506184-0018*		**Description** Elevator Machine Room - Tar Material on Elevator Motors **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	06/09/2025	Black		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	06/09/2025	Black		100.00% Other	**None Detected**
Sample ID 10-19 *062506184-0019*		**Description** Elevator Machine Room - Vibration Reducer Cloth **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	06/09/2025	Gray/ White		12.00% Ca Carbonate 65.00% Gypsum 23.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 10-20 *062506184-0020*		**Description** Elevator Machine Room - Vibration Reducer Cloth **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	06/09/2025	White/ Black	3.00% Cellulose 65.00% Glass	12.00% Ca Carbonate 20.00% Non-fibrous (other)	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 11-21 *062506184-0021*		**Description** Elevator Pit - Concrete Block **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	06/09/2025	Gray	3.00% Cellulose	30.00% Ca Carbonate 12.00% Non-fibrous (other) 55.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**

Initial report from: 06/09/2025 15:51:22

EMSL Analytical, Inc.
528 Mineola Avenue Carle Place, NY 11514
Tel/Fax: (516) 997-7251 / (516) 997-7528
http://www.EMSL.com / carleplacelab@emsl.com

EMSL Order: 062506184
Customer ID: NASS50
Customer PO: BPNC19000166
Project ID: BPNC19000166

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 11-22 *062506184-0022*		**Description** Elevator Pit - Concrete Block **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	06/09/2025	Gray		30.00% Ca Carbonate 15.00% Non-fibrous (other) 55.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 12-23 *062506184-0023*		**Description** Elevator Pit - Mortar to Concrete Block **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	06/09/2025	Gray		30.00% Ca Carbonate 4.00% Mica 11.00% Non-fibrous (other) 55.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 12-24 *062506184-0024*		**Description** Elevator Pit - Mortar to Concrete Block **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	06/09/2025	Gray		25.00% Ca Carbonate 15.00% Non-fibrous (other) 60.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 13-25 *062506184-0025*		**Description** Elevator - Beige 12x12 Floor Tile **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	06/09/2025	Beige		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	06/09/2025	Beige		100.00% Other	**None Detected**
Sample ID 13-26 *062506184-0026*		**Description** Elevator - Beige 12x12 Floor Tile **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	06/09/2025	Beige		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	06/09/2025	Beige		100.00% Other	**None Detected**
Sample ID 14-27 *062506184-0027*		**Description** Elevator - Mastic to Beige 12x12 Floor Tile **Homogeneity** Heterogeneous			
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	06/09/2025	Black		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	06/09/2025	Black		100.00% Other	**None Detected**

Initial report from: 06/09/2025 15:51:22

EMSL Analytical, Inc.
528 Mineola Avenue Carle Place, NY 11514
Tel/Fax: (516) 997-7251 / (516) 997-7528
http://www.EMSL.com / carleplacelab@emsl.com

EMSL Order: 062506184
Customer ID: NASS50
Customer PO: BPNC19000166
Project ID: BPNC19000166

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 14-28 *062506184-0028*		**Description**	Elevator - Mastic to Beige 12x12 Floor Tile		
		Homogeneity	Heterogeneous		
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	06/09/2025	Black		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	06/09/2025	Black		100.00% Other	**None Detected**
Sample ID 15-29 *062506184-0029*		**Description**	Elevator - 2nd Layer Floor Tile		
		Homogeneity	Homogeneous		
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	06/09/2025	Tan	None	98.00% Other	**2.00% Chrysotile**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 15-30 *062506184-0030*		**Description**	Elevator - 2nd Layer Floor Tile		
		Homogeneity	Homogeneous		
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	06/09/2025	Tan	None	98.40% Other	**1.60% Chrysotile**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 16-31 *062506184-0031*		**Description**	Elevator - Mastic to 2nd Layer Floor Tile		
		Homogeneity	Heterogeneous		
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	06/09/2025	Black		100.00% Other	**Inconclusive: None Detected**
TEM NYS 198.4 NOB	06/09/2025	Black		100.00% Other	**None Detected**
Sample ID 16-32 *062506184-0032*		**Description**	Elevator - Mastic to 2nd Layer Floor Tile		
		Homogeneity	Heterogeneous		
PLM NYS 198.1 Friable					**Not Analyzed**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB	06/09/2025	Black	None	100.00% Other	**Inconclusive : <1% Chrysotile**
TEM NYS 198.4 NOB	06/09/2025	Black	None	100.00% Other	**<1% Chrysotile**
Sample ID 17-33 *062506184-0033*		**Description**	1st Floor Elevator Lobby - Tan Terrazzo Flooring		
		Homogeneity	Homogeneous		
PLM NYS 198.1 Friable	06/09/2025	Tan		68.00% Ca Carbonate 20.00% Non-fibrous (other) 12.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**

Initial report from: 06/09/2025 15:51:22

EMSL Analytical, Inc.
528 Mineola Avenue Carle Place, NY 11514
Tel/Fax: (516) 997-7251 / (516) 997-7528
http://www.EMSL.com / carleplacelab@emsl.com

EMSL Order: 062506184
Customer ID: NASS50
Customer PO: BPNC19000166
Project ID: BPNC19000166

Test Report:Asbestos Analysis of Bulk Material

Test	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos
Sample ID 17-34 *062506184-0034*		**Description** 2nd Floor Elevator Lobby - Tan Terrazzo Flooring **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	06/09/2025	Tan	3.00% Cellulose	48.00% Ca Carbonate 24.00% Non-fibrous (other) 25.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 17-35 *062506184-0035*		**Description** 3rd Floor Elevator Lobby - Tan Terrazzo Flooring **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	06/09/2025	Gray		60.00% Ca Carbonate 18.00% Non-fibrous (other) 22.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**
Sample ID 17-36 *062506184-0036*		**Description** 4th Floor Elevator Lobby - Tan Terrazzo Flooring **Homogeneity** Homogeneous			
PLM NYS 198.1 Friable	06/09/2025	Tan/ White	3.00% Cellulose	49.00% Ca Carbonate 28.00% Non-fibrous (other) 20.00% Quartz	**None Detected**
PLM NYS 198.6 VCM					**Not Analyzed**
PLM NYS 198.6 NOB					**Not Analyzed**
TEM NYS 198.4 NOB					**Not Analyzed**

Initial report from: 06/09/2025 15:51:22

EMSL Analytical, Inc.
528 Mineola Avenue Carle Place, NY 11514
Tel/Fax: (516) 997-7251 / (516) 997-7528
http://www.EMSL.com / carleplacelab@emsl.com

EMSL Order:	062506184
Customer ID:	NASS50
Customer PO:	BPNC19000166
Project ID:	BPNC19000166

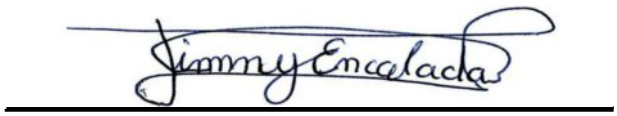
Test Report:Asbestos Analysis of Bulk Material

The samples in this report were submitted to EMSL for analysis by Asbestos Analysis of Bulk Materials via NYS ELAP Approved Methods. The reference number for these samples is the EMSL Order ID above. Please use this reference number when calling about these samples.

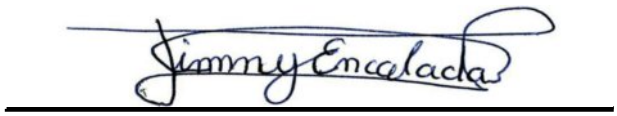
Report Comments:

Sample Receipt Date:	6/5/2025	Sample Receipt Time:	2:23 PM
Analysis Completed Date:	6/9/2025	Analysis Completed Time:	10:22 AM

Analyst(s):



Jimmy Encalada PLM NYS 198.1 Friable (24)



Jimmy Encalada PLM NYS 198.6 NOB (12)



Rosemary Ortega TEM NYS 198.4 NOB (10)

Samples reviewed and approved by:



Daniel Clarke, Asbestos Laboratory Manager
or Other Approved Signatory

EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This report relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted. Estimation of uncertainty available upon request. This report is a summary of multiple methods of analysis, fully compliant reports are available upon request. All samples examined for the presence of vermiculite when analyzed via NYS 198.1. A combination of PLM and TEM analysis may be necessary to ensure consistently reliable detection of asbestos. Polarized-light microscopy is not consistently reliable in detecting asbestos in floor coverings and similar non-friable organically bound materials. This report must not be used to claim product endorsement by NVLAP of any agency or the U.S. Government . Quantitative transmission electron microscopy is currently the only method that can be used to determine if this material can be considered or treated as non-asbestos containing. NOB= Non friable organically bound; N/A= Not applicable VCM= Vermiculite containing material.

Samples analyzed by EMSL Analytical, Inc. Carle Place, NY NYS ELAP 11469, NVLAP Lab Code 101048-10

Initial report from: 06/09/2025 15:51:22

Laboratory Certifications



J.C. Broderick & Associates, Inc.
Environmental Consulting & Testing
1775 Expressway Drive North
Hauppauge, New York 11788
631.584.5492 fax 631.584.3395

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2026
Issued April 01, 2025

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. DANIEL CLARKE
EMSL ANALYTICAL, INC.
528 MINEOLA AVE.
CARLE PLACE, NY 11514

NY Lab Id No: 11469

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
Asbestos-Vermiculite-Containing Mate	Item 198.8 of Manual
Lead in Dust Wipes	EPA 7000B
Lead in Paint	EPA 7000B

Sample Preparation Methods

	EPA 3051A

Serial No.: 70485

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.

United States Department of Commerce
National Institute of Standards and Technology

Certificate of Accreditation to ISO/IEC 17025:2017

NVLAP LAB CODE: 101048-10

EMSL Analytical, Inc.

Carle Place, NY

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

Asbestos Fiber Analysis

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique on ISO/IEC 17025).

2025-07-01 through 2026-06-30

Effective Dates

For the National Voluntary Laboratory Accreditation Program

National Voluntary Laboratory Accreditation Program

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

EMSL Analytical, Inc.
528 Mineola Ave.
Carle Place, NY 11514
Mr. Daniel Clarke
Phone: 516-997-7251
Email: dclarke@emsl.com
http://www.emsl.com

ASBESTOS FIBER ANALYSIS **NVLAP LAB CODE 101048-10**

Bulk Asbestos Analysis

Code	*Description*
18/A01	EPA -- 40 CFR Appendix E to Subpart E of Part 763, Interim Method of the Determination of Asbestos in Bulk Insulation Samples
18/A03	EPA 600/R-93/116: Method for the Determination of Asbestos in Bulk Building Materials

Airborne Asbestos Analysis

Code	*Description*
18/A02	U.S. EPA's "Interim Transmission Electron Microscopy Analytical Methods-Mandatory and Nonmandatory-and Mandatory Section to Determine Completion of Response Actions" as found in 40 CFR, Part 763, Subpart E, Appendix A.

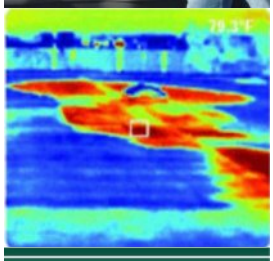
For the National Voluntary Laboratory Accreditation Program

JCB
Certifications










J.C. Broderick & Associates, Inc.

Environmental Consulting & Testing

1775 Expressway Drive North

Hauppauge, New York 11788

631.584.5492 fax 631.584.3395

WE ARE YOUR DOL

NEW YORK STATE | Department of Labor

DIVISION OF SAFETY & HEALTH LICENSE AND CERTIFICATE UNIT, STATE OFFICE CAMPUS, BLDG. 12, ALBANY, NY 12226

ASBESTOS HANDLING LICENSE

J.C. Broderick & Associates Inc.
1775 Expressway Drive No., Hauppauge, NY, 11788

License Number: 28731
License Class: RESTRICTED
Date of Issue: 04/15/2025
Expiration Date: 05/31/2026
Duly Authorized Representative: Edward McGuire

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

Name	Certification	Expiration Month	Expiration Year	Certificate#
Adrian Faustino	Air Sampling Technician	08 August	2025	24-6AX6F-SHAB
Aileen McNamee	Inspector	08 August	2025	25-6TLXD-SHAB
Aileen McNamee	Air Sampling Technician	08 August	2025	25-6TLXD-SHAB
Aileen McNamee	Project Monitor	08 August	2025	25-6TLXD-SHAB
Alexander Campos	Air Sampling Technician	10 October	2025	24-6AVGG-SHAB
Alexandria Orlassino	Air Sampling Technician	12 December	2025	24-6LIUB-SHAB
Alexandria Orlassino	Project Monitor	12 December	2025	24-6LIUB-SHAB
Alexandria Orlassino	Inspector	12 December	2025	24-6LIUB-SHAB
Andrew Schreck	Air Sampling Technician	09 September	2025	24-6AX9E-SHAB
Andy Carbajal	Inspector	10 October	2025	24-6TIRY-SHAB
Andy Carbajal	Air Sampling Technician	10 October	2025	24-6TIRY-SHAB
Andy Carbajal	Project Monitor	10 October	2025	24-6TIRY-SHAB
Annosha Mubasher	Project Monitor	05 May	2025	24-6TIR6-SHAB
Anthony Lombardo	Air Sampling Technician	06 June	2026	25-6TIGT-SHAB
Anthony Lombardo	Project Monitor	06 June	2026	25-6TIGT-SHAB
Anthony Lombardo	Inspector	06 June	2026	25-6TIGT-SHAB
Anthony Lombardo	Management Planner	06 June	2026	25-6TIGT-SHAB
Asif Syed	Air Sampling Technician	11 November	2025	24-6A0YR-SHAB
Brandon Wolmer	Air Sampling Technician	06 June	2025	24-6AX64-SHAB
Brendan Broderick	Inspector	08 August	2025	24-61DNV-SHAB
Brendan Broderick	Air Sampling Technician	08 August	2025	24-61DNV-SHAB
Brendan Broderick	Project Monitor	08 August	2025	24-61DNV-SHAB
Brendan Keane	Air Sampling Technician	12 December	2025	24-6AX9X-SHAB
Bryan Ezelius	Air Sampling Technician	08 August	2025	24-6TI6G-SHAB
Bryan Ezelius	Project Monitor	08 August	2025	24-6TI6G-SHAB
Bryan Ezelius	Inspector	08 August	2025	24-6TI6G-SHAB
Bryan Ezelius	Management Planner	08 August	2025	24-6TI6G-SHAB
Bryan Ezelius	Project Designer	08 August	2025	24-6TI6G-SHAB
Christian Saby	Air Sampling Technician	09 September	2025	24-6A0Y4-SHAB
Cody Dateno	Inspector	10 October	2025	24-6LO64-SHAB
Conor Malanaphy	Inspector	12 December	2025	24-6ZPYO-SHAB
Conor Malanaphy	Air Sampling Technician	12 December	2025	24-6ZPYO-SHAB
Conor Malanaphy	Project Monitor	12 December	2025	24-6ZPYO-SHAB
Daniel Dore	Air Sampling Technician	07 July	2025	24-6AVFR-SHAB
Daniel Smalls	Inspector	02 February	2026	25-6IGF8-SHAB
Daniel Smalls	Air Sampling Technician	02 February	2026	25-6IGF8-SHAB
Daniel Smalls	Project Monitor	02 February	2026	25-6IGF8-SHAB
Danielle Bolognini	Air Sampling Technician	11 November	2025	24-6IG8F-SHAB
Danielle Bolognini	Project Monitor	11 November	2025	24-6IG8F-SHAB
Danielle Bolognini	Inspector	11 November	2025	24-6IG8F-SHAB
Donald Wallace	Contractor Supervisor	07 July	2025	24-6TZIK-SHAB
Edward McGuire	Project Designer	09 September	2025	24-6TIY3-SHAB
Edward McGuire	Contractor Supervisor	09 September	2025	24-6TIY3-SHAB
Edward McGuire	Inspector	09 September	2025	24-6TIY3-SHAB
Edward McGuire	Project Monitor	09 September	2025	24-6TIY3-SHAB
Edward McGuire	Management Planner	09 September	2025	24-6TIY3-SHAB
Erin Todzia	Project Monitor	04 April	2025	24-6ZJYN-SHAB
Erin Todzia	Air Sampling Technician	04 April	2025	24-6ZJYN-SHAB
Erin Todzia	Inspector	04 April	2025	24-6ZJYN-SHAB

Name	Certification	Expiration Month	Expiration Year	Certificate#
Erin Todzia	Management Planner	04 April	2025	24-6ZJYN-SHAB
Ethan Burgos	Air Sampling Technician	12 December	2025	24-6AX7X-SHAB
Finn Love	Project Monitor	12 December	2025	24-6TIB4-SHAB
Fiona Yuan	Air Sampling Technician	04 April	2025	24-6AVFV-SHAB
Gardy Ilderice	Air Sampling Technician	01 January	2026	24-6AVGL-SHAB
George Greve	Air Sampling Technician	11 November	2025	24-61EP1-SHAB
George Greve	Project Monitor	11 November	2025	24-61EP1-SHAB
George Greve	Inspector	11 November	2025	24-61EP1-SHAB
George Greve	Management Planner	11 November	2025	24-61EP1-SHAB
Harrison Bohrer	Air Sampling Technician	09 September	2025	24-6AX7P-SHAB
Jacek Mrozek	Air Sampling Technician	05 May	2026	25-6ZJY9-SHAB
Jacek Mrozek	Project Monitor	05 May	2026	25-6ZJY9-SHAB
Jacek Mrozek	Inspector	05 May	2026	25-6ZJY9-SHAB
Jack Rzepecki	Air Sampling Technician	09 September	2025	24-6A0YZ-SHAB
Jacky Chen	Air Sampling Technician	01 January	2026	24-6AX9R-SHAB
Jake Volovar	Air Sampling Technician	05 May	2025	24-6AX66-SHAB
Jarett Boniface	Air Sampling Technician	10 October	2025	24-61E6O-SHAB
Jarett Boniface	Project Monitor	10 October	2025	24-61E6O-SHAB
Jarett Boniface	Inspector	10 October	2025	24-61E6O-SHAB
Jeevan George	Project Monitor	04 April	2025	24-6AT89-SHAB
Jeffrey Nannini	Inspector	08 August	2025	24-6LUZE-SHAB
Jelili Okunola	Air Sampling Technician	06 June	2025	24-6AX99-SHAB
Jelili Okunola	Inspector	06 June	2025	24-6AX99-SHAB
Jelili Okunola	Inspector	06 June	2026	24-6AX99-SHAB
Jordan Miglino	Inspector	05 May	2026	25-6TIK9-SHAB
Jordan Miglino	Project Monitor	05 May	2026	25-6TIK9-SHAB
Jordan Miglino	Air Sampling Technician	05 May	2026	25-6TIK9-SHAB
Joshua D'Souza	Air Sampling Technician	06 June	2025	24-6AV8C-SHAB
Juan Gonzalez	Air Sampling Technician	11 November	2025	24-61E6K-SHAB
Juan Gonzalez	Project Monitor	11 November	2025	24-61E6K-SHAB
Juan Gonzalez	Inspector	11 November	2025	24-61E6K-SHAB
Lasha Zaridze	Air Sampling Technician	05 May	2025	24-6ANVS-SHAB
Lasha Zaridze	Project Monitor	05 May	2025	24-6ANVS-SHAB
Luke Coulter	Inspector	08 August	2025	24-6TID7-SHAB
Luke Coulter	Project Monitor	08 August	2025	24-6TID7-SHAB
Maisha Yaseen	Air Sampling Technician	01 January	2026	24-6AVGV-SHAB
Maisha Yaseen	Inspector	01 January	2026	24-6AVGV-SHAB
Maisha Yaseen	Inspector	01 January	2026	24-6AVGV-SHAB
Malaysha Covington	Air Sampling Technician	10 October	2025	24-6AV8E-SHAB
Maria Grigoryeva	Air Sampling Technician	05 May	2025	24-6AVGR-SHAB
Matthew Lane	Air Sampling Technician	11 November	2025	24-6AX6Z-SHAB
Matthew Lane	Inspector	11 November	2025	24-6AX6Z-SHAB
Matthew Martin	Project Monitor	05 May	2025	24-6ZR91-SHAB
Matthew Martin	Inspector	05 May	2025	24-6ZR91-SHAB
Matthew Urban	Air Sampling Technician	05 May	2025	24-6ZJH9-SHAB
Matthew Urban	Project Monitor	05 May	2025	24-6ZJH9-SHAB
Matthew Urban	Inspector	05 May	2025	24-6ZJH9-SHAB
Max Wenzel	Air Sampling Technician	07 July	2025	24-6AVGN-SHAB
Meghan Gwynn	Inspector	04 April	2026	25-6SAKP-SHAB

Name	Certification	Expiration Month	Expiration Year	Certificate#
Meghan Gwynn	Management Planner	04 April	2026	25-6SAKP-SHAB
Meghan Gwynn	Air Sampling Technician	04 April	2026	25-6SAKP-SHAB
Meghan Gwynn	Project Monitor	04 April	2026	25-6SAKP-SHAB
Michael Malanga	Air Sampling Technician	07 July	2025	24-6ZH70-SHAB
Michael Malanga	Project Monitor	07 July	2025	24-6ZH70-SHAB
Michael Malanga	Inspector	07 July	2026	24-6ZH70-SHAB
Mohamed Khalil El Hachimi	Air Sampling Technician	03 March	2025	24-6AV81-SHAB
Molly Miller	Project Monitor	01 January	2026	24-6TLXB-SHAB
Molly Miller	Air Sampling Technician	01 January	2026	24-6TLXB-SHAB
Molly Miller	Inspector	01 January	2026	24-6TLXB-SHAB
Narinderpal Singh	Air Sampling Technician	04 April	2025	24-6AVRI-SHAB
Patrick Slattery	Air Sampling Technician	05 May	2025	24-6AV8K-SHAB
Paul Fazio	Air Sampling Technician	09 September	2025	24-6TI8R-SHAB
Paul Fazio	Project Monitor	09 September	2025	24-6TI8R-SHAB
Paul Fazio	Project Designer	09 September	2025	24-6TI8R-SHAB
Paul Fazio	Inspector	09 September	2025	24-6TI8R-SHAB
Paul Fazio	Management Planner	09 September	2025	24-6TI8R-SHAB
Quinlan Crossley	Inspector	01 January	2026	24-6IGJJ-SHAB
Quinlan Crossley	Air Sampling Technician	01 January	2026	24-6IGJJ-SHAB
Quinlan Crossley	Project Monitor	01 January	2026	24-6IGJJ-SHAB
Raul Ramdeholl	Air Sampling Technician	02 February	2026	24-6AX97-SHAB
Robert Manzella	Air Sampling Technician	03 March	2026	25-6I3IR-SHMO
Robert Manzella	Project Monitor	03 March	2026	25-6I3IR-SHMO
Robert Manzella	Project Designer	03 March	2026	25-6I3IR-SHMO
Robert Manzella	Inspector	03 March	2026	25-6I3IR-SHMO
Robert Manzella	Investigator	03 March	2026	147658
Robert Milinis	Project Monitor	06 June	2025	24-6ANXO-SHAB
Robert Milinis	Air Sampling Technician	06 June	2025	24-6ANXO-SHAB
Robert Milinis	Inspector	06 June	2025	24-6ANXO-SHAB
Robert Milinis	Investigator	06 June	2026	162747
Rosemarie Russo	Air Sampling Technician	10 October	2025	24-6A1BI-SHAB
Ryan Eid	Investigator	10 October	2026	118732
Ryan Eid	Project Monitor	10 October	2025	24-61JIO-SHAB
Ryan Eid	Management Planner	10 October	2025	24-61JIO-SHAB
Ryan Eid	Inspector	10 October	2025	24-61JIO-SHAB
Ryan Eid	Project Designer	10 October	2025	24-61JIO-SHAB
Ryan Lin	Air Sampling Technician	05 May	2025	24-6AX9V-SHAB
Sarhail Khadim	Air Sampling Technician	05 May	2025	24-6AVG7-SHAB
Shangkun Xiao	Inspector	05 May	2025	24-6ZVIB-SHAB
Shangkun Xiao	Project Monitor	05 May	2025	24-6ZVIB-SHAB
Sophia Dimont	Air Sampling Technician	08 August	2025	24-6AX6E-SHAB
Steve Muller	Inspector	06 June	2025	24-6ZEBC-SHAB
Steven Lalicata	Project Monitor	10 October	2025	24-61E3S-SHAB
Tara Ricker	Air Sampling Technician	11 November	2025	24-61JBS-SHAB
Tara Ricker	Project Monitor	11 November	2025	24-61JBS-SHAB
Tara Ricker	Management Planner	11 November	2025	24-61JBS-SHAB
Tara Ricker	Inspector	11 November	2025	24-61JBS-SHAB
Thomas Gallant	Air Sampling Technician	07 July	2025	24-6A0YH-SHAB
Valeria Reyes	Air Sampling Technician	08 August	2025	24-6AVFH-SHAB

Name	Certification	Expiration Month	Expiration Year	Certificate#
Vinson Zheng	Air Sampling Technician	11 November	2025	24-6AVR3-SHAB
Willow Mercer	Air Sampling Technician	08 August	2025	24-6A0YN-SHAB
Wiston Ariza	Project Monitor	10 October	2025	24-61E4Y-SHAB
Wiston Ariza	Air Sampling Technician	10 October	2025	24-61E4Y-SHAB
Yaneli Amaya	Air Sampling Technician	08 August	2025	24-6AX78-SHAB
Youyang Ni	Inspector	03 March	2026	24-6A0BY-SHAB
Youyang Ni	Air Sampling Technician	03 March	2025	24-6A0BY-SHAB

EXHIBIT E

J.C. Broderick & Associates, Inc.

Environmental / Construction Consulting & Testing

1775 Expressway Drive North
Hauppauge, NY 11788
631.584.5492
Fax: 631.584.3395
www.jcbroderick.com

October 22, 2025

Mr. Rob Exner
Nassau County Department of Public Works
1194 Prospect Avenue
Westbury New York 11590

Re: Pre-Construction Survey, Testing & Analysis of
Suspect Lead Containing Materials Utilizing XRF Technology at
Nassau County Supreme Court Building - Mission 21 Elevator Modernization
100 Supreme Court Drive, Mineola, New York, 11501
Inspection Date: June 3 & 4, 2025

JCB#: 25-61512

Dear Mr. Exner:

J. C. Broderick & Associates, Inc. (JCB) was retained to perform testing and analysis of suspect lead containing building materials that may be impacted or disturbed by the following proposed scope of work. The proposed scope of work was identified to JCB by the building's site representative as follows:

Scope of Work:

- Renovations to Elevators, Elevator Shaft, Pit, & Machine Room.

Additional testing will be required if the scope of work changes or is different than reported above.

Inspection:

The testing and analysis were performed by a United States Environmental Protection Agency (EPA) certified Lead Based Paint Inspector or Risk Assessor. The suspect surfaces were sampled utilizing a portable X-ray fluorescence analyzer (XRF) in accordance with the manufacturer's performance characteristic sheet. Information pertaining to JCB's licenses & certifications are included in the attachment of this report.

The XRF is a non-destructive device used to determine the lead concentration in the tested materials. The XRF determines the concentration by measuring the fluorescent X-ray emitted from a sample when it is excited by a primary X-ray source. Lead (Pb) produces a unique fluorescent X-ray which allows the analyzer to quantify its concentration in the material composition. Results from the XRF testing and analysis are downloaded into a custom computer program which produces a report which can be referenced in the attachments. Technical information regarding the XRF is available upon request.

Lead based paint is defined by the EPA, in 40 CFR Part 745, as any paint or other surface coatings that contain lead equal to or in excess of 1.0 milligram per square centimeter (mg/cm2). Paint or surface coatings less than this concentration is reported as Non-Lead. The table below summarizes the testing and results performed:

Table 1.0 Summary of Positive XRF Testing Results		
Location	**General Description of Material/Component Tested**	**Result**
Basement Elevator Pit	**Orange Painted Metal Ladder**	**LEAD**
*Reference attachments for exact description of which surfaces tested positive.		

The intent of this lead-based paint survey was to sample only the suspect surfaces that will be impacted by the proposed scope of work. This survey was not intended to identify all leaded surfaces associated with the subject building and or the referenced subject spaces. If other surfaces are expected to be disturbed during the performance of this work that are not listed in the attached XRF report these materials must be assumed as being lead containing until sampling is performed.

These results shall not be relied upon for determining lead content of similar components or coatings in any other locations. That is, the findings of this inspection are limited to those surfaces and areas specifically indicated in the table.

All work and disturbance of the confirmed or assumed lead containing materials must be performed in accordance with all applicable federal, state, and local regulations and guidelines. This includes but is not limited to the United States Department of Housing and Urban Development (US HUD) Guidelines for the Evaluation and Control of Lead Based Paint Hazards in Housing, 40 CFR Part 745 (US EPA), and 6 NYCRR Parts 370-376 (NYS DEC Hazardous Waste Disposal).

The intent of this inspection was to report only the surfaces that are lead containing in accordance with the US EPA, and US HUD. This report was not intended for compliance with the United States Occupational Safety & Health Administration (OSHA) regulations. For this project, the contractor shall assume all painted surfaces to contain some concentration of lead and are responsible for their own compliance to OSHA.

The following project information is included in the attachments section of this report.

1. Drawings & Photologs
2. XRF Reports
3. Lead Certifications

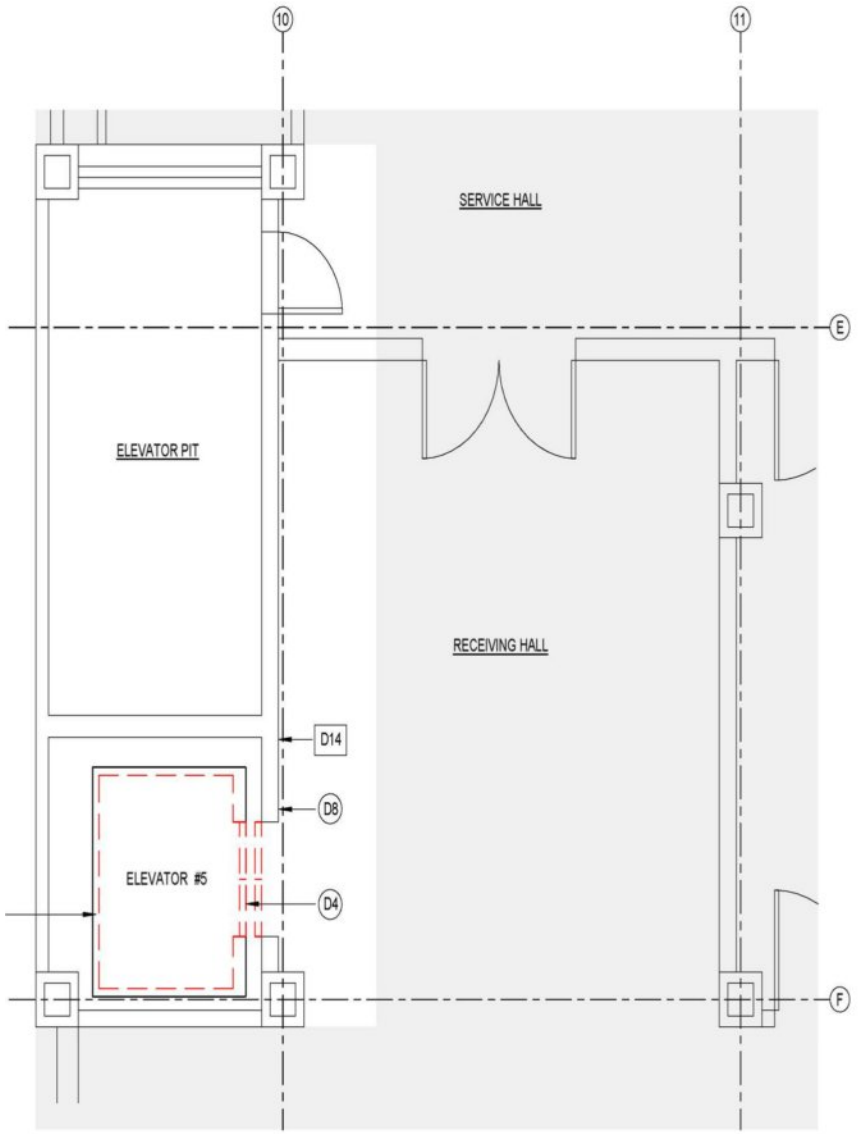
If you have any questions, if additional information is needed, or if a clearance examination is requested, please contact our office.

Sincerely,
Paul Fazio
Paul Fazio
J.C. BRODERICK & ASSOCIATES, INC.

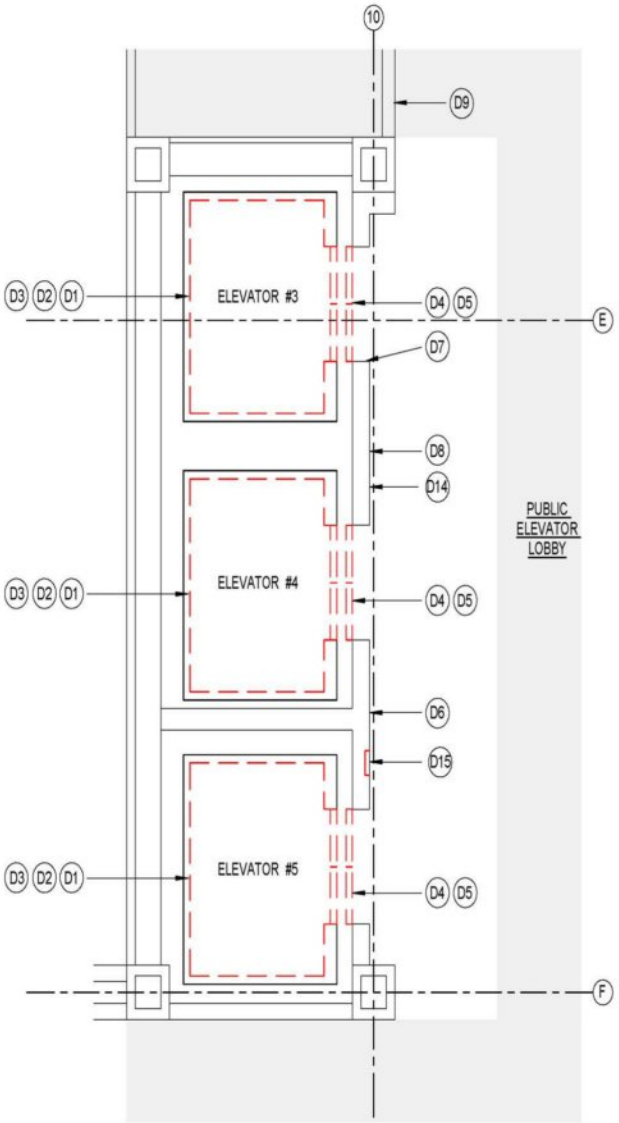
Drawings
&
Photologs



J.C. Broderick & Associates, Inc.
Environmental Consulting & Testing
1775 Expressway Drive North
Hauppauge, New York 11788
631.584.5492 fax 631.584.3395



1 DEMO CELLAR FL LOBBY PLAN
1/4" = 1'-0"



2 DEMO FIRST FL LOBBY PLAN
1/4" = 1'-0"

J.C. BRODERICK
& Associates

ENVIRONMENTAL CONSULTING & TESTING

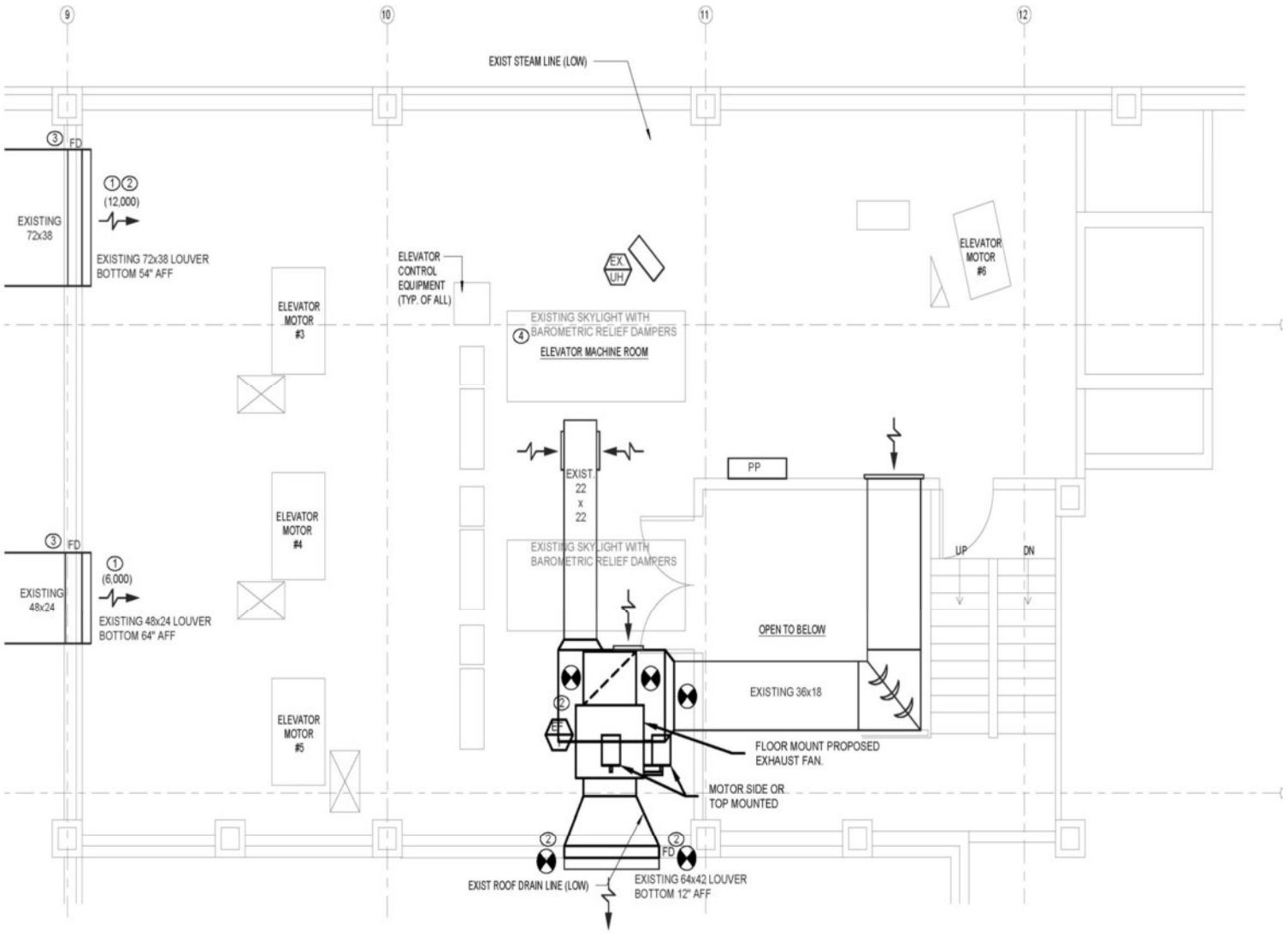
1775 Expressway Drive North
Hauppauge, New York 11788

631.584.5492 fax 631.584.5913

PROJECT NO. :
25-61512

BUILDING:
SUPREME COURT BUILDING

Scope of Work Location



1 **ELEVATOR MACHINE ROOM**
SCALE: 1/4"=1'-0"

J.C. BRODERICK
& Associates

ENVIRONMENTAL CONSULTING & TESTING

1775 Expressway Drive North
Hauppauge, New York 11788

631.584.5492 fax 631.584.5913

PROJECT NO. :
25-61512

BUILDING:
SUPREME COURT BUILDING

Scope of Work Location

Table 1.0 Summary of Positive XRF Testing Results		
Location	**General Description of Material/Component Tested**	**Result**
Basement Elevator Pit	**Orange Painted Metal Ladder**	**LEAD**
*Reference attachments for exact description of which surfaces tested positive.		

J.C. BRODERICK
& Associates

ENVIRONMENTAL CONSULTING & TESTING

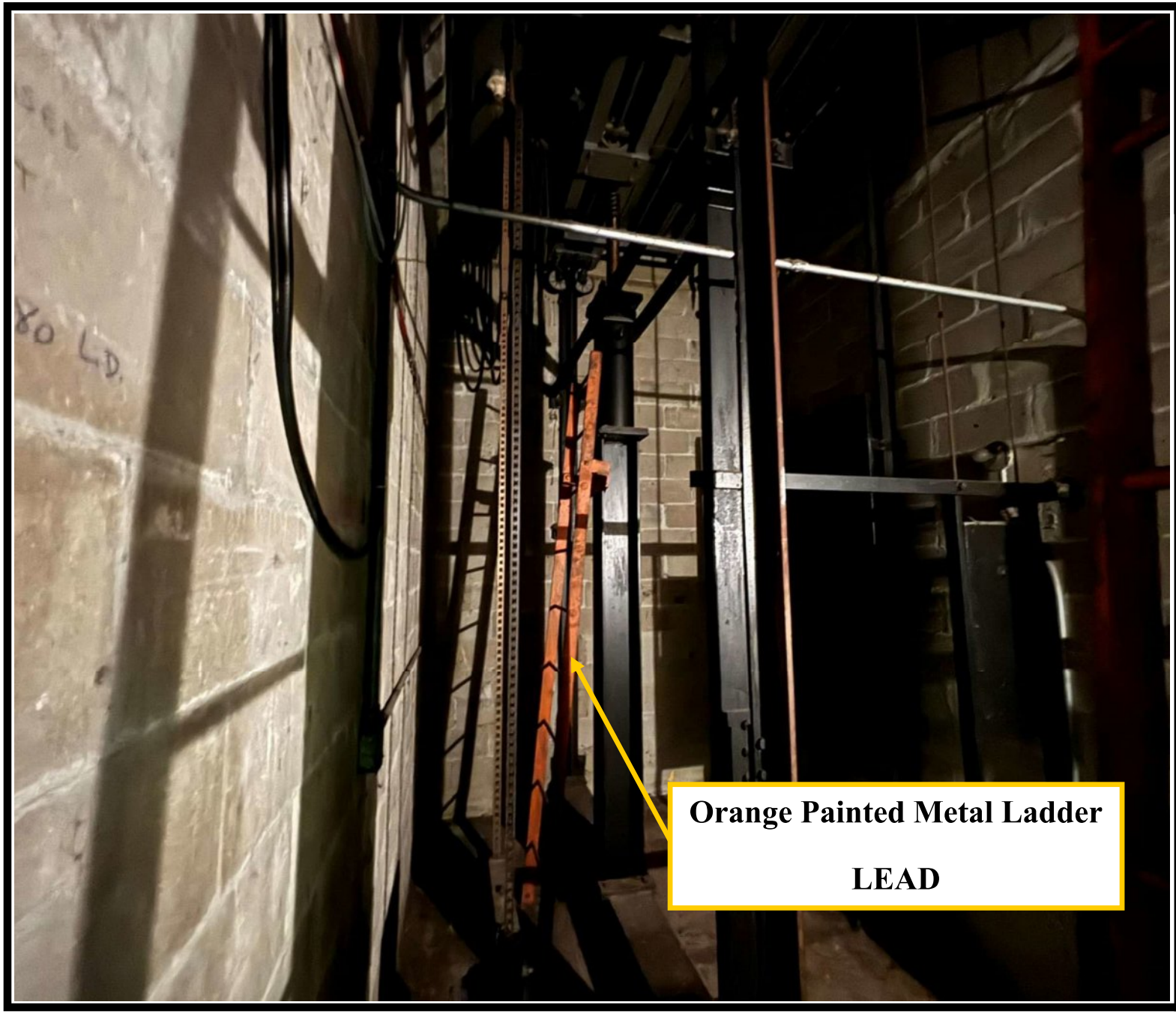
1775 Expressway Drive North
Hauppauge, New York 11788

631.584.5492 fax 631.584.5913

PROJECT NO. :
25-61512

BUILDING:
SUPREME COURT BUILDING

Lead Containing Materials



J.C. BRODERICK
& Associates

ENVIRONMENTAL
CONSULTING & TESTING

1775 Expressway Drive North
Hauppauge, New York 11788

631.584.5492 fax 631.584.5913

PROJECT NO. :
25-61512

BUILDING:
SUPREME COURT
BUILDING

Lead Containing Components (Typical)

Basement Elevator Pit

XRF
Reports



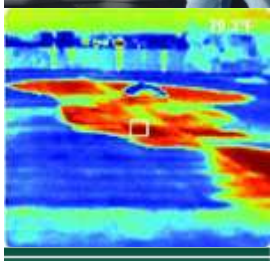
J.C. Broderick & Associates, Inc.
Environmental Consulting & Testing
1775 Expressway Drive North
Hauppauge, New York 11788
631.584.5492 fax 631.584.3395

XRF
POSITIVE RESULTS







J.C. Broderick & Associates, Inc.
Environmental Consulting & Testing
1775 Expressway Drive North
Hauppauge, New York 11788
631.584.5492 fax 631.584.3395

XRF POSITIVE RESULTS

J. C. BRODERICK AND ASSOCIATES, INC.
1775 Expressway North
Hauppauge, NY 11788
FAX: (631) 584-3395
TEL: (631) 584-5492

JCB #: 25-61512

Inspection Site: Supreme Court Building
Address: 100 Supreme Court Drive
Mineola New York 11501

XRF Operator(s): Other
Inspection Date(s): 6/4/2025 - 6/4/2025

XRF Serial No 25245
XRF Device: XLp 303
XRFManufacturer: NITON Corporation

93 samples were collected within the above identified building. Lead in quantities greater than the HUD standard was found in the 10 samples listed below. A reading of greater than or equal to 1.0 mg/cm² in the Pbc column is considered a positive result. All results are listed in mg/cm², unless otherwise noted.

Test No.	Room	Component	Substrate	Feature	Color	Condition	Side	Floor	Depth Index	Pbc	Pbc Error
131340	Elevator Machine Room	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	ALIBRA	5	3	1.04	0.03
131341	Elevator Machine Room	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	ALIBRA	5	3	1.16	0.03
131342	Elevator Machine Room	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	ALIBRA	5	3	1.18	0.03
131343	Elevator Machine Room	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	ALIBRA	5	3	1.12	0.02
131387	Elevator Pit	Other	Metal	No Selection	Orange	Fair	Other	Basement	3	1.24	0.08
131397	Elevator Pit	Other	Metal	No Selection	Orange	Fair	Other	Basement	3	3.09	0.13
131425	Elevator	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	ALIBRA		3	1.06	0.03
131426	Elevator	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	ALIBRA		3	1.11	0.03
131427	Elevator	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	ALIBRA		3	1.17	0.03
131428	Elevator	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	ALIBRA		3	1.11	0.02

XRF RESULTS



J.C. Broderick & Associates, Inc.
Environmental Consulting & Testing
1775 Expressway Drive North
Hauppauge, New York 11788
631.584.5492 fax 631.584.3395

ALL XRF RESULTS

J. C. BRODERICK AND ASSOCIATES, INC.
1775 Expressway North Hauppauge, NY 11788
TEL: (631) 584-5492 FAX: (631) 584-3395

Supreme Court Building, 100 Supreme Court Drive, Mineola New York 11501 JCB # 25-61512

No.	Room	Component	Substrate	Feature	Color	Condition	Side	Floor	Date/Time	Depth Index	Pbc	Result
131340	Elevator Machine Room	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	ALIBRA	5	6/4/2025 1:50:00 PM	3	1.04	Positive
131341	Elevator Machine Room	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	ALIBRA	5	6/4/2025 1:50:00 PM	3	1.16	Positive
131342	Elevator Machine Room	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	ALIBRA	5	6/4/2025 1:50:00 PM	3	1.18	Positive
131343	Elevator Machine Room	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	ALIBRA	5	6/4/2025 1:50:00 PM	3	1.12	Positive
131344	Elevator Machine Room	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	ALIBRA	5	6/4/2025 1:50:00 PM	3	0	Negative
131345	Elevator Machine Room	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	ALIBRA	5	6/4/2025 1:50:00 PM	3	0	Negative
131346	Elevator Machine Room	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	ALIBRA	5	6/4/2025 1:50:00 PM	3	0	Negative
131347	Elevator Machine Room	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	ALIBRA	5	6/4/2025 1:50:00 PM	3	0	Negative
131348	Elevator Machine Room	Door	Metal	External Casing	Teal	Fair	A	5	6/4/2025 1:52:00 PM	3	0.01	Negative
131349	Elevator Machine Room	Door	Metal	Jamb	Teal	Fair	A	5	6/4/2025 1:52:00 PM	3	0.01	Negative
131350	Elevator Machine Room	Door	Metal	Casing	Teal	Fair	A	5	6/4/2025 1:52:00 PM	3	0.02	Negative
131351	Elevator Machine Room	Wall	Concrete	Upper	Beige	Fair	D	5	6/4/2025 1:55:00 PM	3	0	Negative
131352	Elevator Machine Room	Structural Beam	Metal	No Selection	Beige	Fair	Other	5	6/4/2025 1:56:00 PM	3	0.16	Negative
131353	Elevator Machine Room	Structural Beam	Metal	No Selection	Beige	Fair	Other	5	6/4/2025 1:56:00 PM	3	0.24	Negative
131354	Elevator Machine Room	Structural Beam	Metal	No Selection	Beige	Fair	Other	5	6/4/2025 1:57:00 PM	3	0.69	Negative
131355	Elevator Machine Room	Structural Beam	Metal	No Selection	Beige	Fair	Other	5	6/4/2025 1:57:00 PM	3	0.67	Negative
131356	Elevator Machine Room	HVAC System	Metal	No Selection	Beige	Peeling	Other	5	6/4/2025 1:57:00 PM	3	0.05	Negative
131357	Elevator Machine Room	HVAC System	Metal	Casing	Beige	Fair	Other	5	6/4/2025 1:58:00 PM	3	0.05	Negative
131358	Elevator Machine Room	HVAC System	Metal	Casing	Beige	Fair	Other	5	6/4/2025 1:58:00 PM	3	0.05	Negative
131359	Elevator Machine Room	HVAC System	Metal	Casing	Brown	Fair	Other	5	6/4/2025 1:59:00 PM	3	0.02	Negative
131360	Elevator Machine Room	Painted Pipe	Metal	No Selection	Beige	Fair	Other	5	6/4/2025 1:59:00 PM	3	0.05	Negative
131361	Elevator Machine Room	Painted Pipe	Metal	No Selection	Beige	Fair	Other	5	6/4/2025 2:00:00 PM	3	0.18	Negative

XRF Operator: Other

Lead Results (Pbc) in mg/cm2, EPA/HUD >1.0 mg/cm² considered Positive

ALL XRF RESULTS

J. C. BRODERICK AND ASSOCIATES, INC.
1775 Expressway North Hauppauge, NY 11788
TEL: (631) 584-5492 FAX: (631) 584-3395

Supreme Court Building, 100 Supreme Court Drive, Mineola New York 11501 JCB # 25-61512

No.	Room	Component	Substrate	Feature	Color	Condition	Side	Floor	Date/Time	Depth Index	Pbc	Result
131362	Elevator Machine Room	Painted Pipe	Metal	Casing	Beige	Fair	Other	5	6/4/2025 2:05:00 PM	3	0.15	Negative
131363	Elevator Machine Room	Painted Pipe	Metal	Casing	Beige	Fair	Other	5	6/4/2025 2:06:00 PM	3	0.06	Negative
131364	Elevator Machine Room	Structural Beam	Metal	No Selection	Beige	Fair	Other	5	6/4/2025 2:06:00 PM	3	0.63	Negative
131365	Elevator Machine Room	Door	Metal	No Selection	Teal	Fair	B	5	6/4/2025 2:13:00 PM	3	0.01	Negative
131366	Elevator Machine Room	Door	Metal	Casing	Teal	Fair	B	5	6/4/2025 2:13:00 PM	3	0.01	Negative
131367	Elevator Machine Room	Ceiling	Concrete	No Selection	Beige	Fair	Ceiling	5	6/4/2025 2:15:00 PM	3	0.03	Negative
131368	Elevator Machine Room	Ceiling	Concrete	No Selection	Beige	Fair	Ceiling	5	6/4/2025 2:16:00 PM	3	0.02	Negative
131369	Elevator Machine Room	Floor	Concrete	No Selection	Gray	Fair	Floor	5	6/4/2025 2:32:00 PM	3	0.04	Negative
131370	Elevator Machine Room	Other	Metal	No Selection	Dark Green	Fair	Other	5	6/4/2025 2:37:00 PM	3	0.53	Negative
131371	Elevator Machine Room	Other	Metal	No Selection	Dark Green	Fair	Other	5	6/4/2025 2:38:00 PM	3	0.3	Negative
131372	Elevator Machine Room	Other	Metal	No Selection	Dark Green	Fair	Other	5	6/4/2025 2:38:00 PM	3	0.25	Negative
131373	Elevator Machine Room	Other	Metal	No Selection	Dark Green	Fair	Other	5	6/4/2025 2:38:00 PM	3	0.35	Negative
131374	Elevator Machine Room	Other	Metal	No Selection	Dark Green	Fair	Other	5	6/4/2025 2:38:00 PM	3	0.37	Negative
131375	Elevator Machine Room	Other	Metal	No Selection	Gray	Fair	Other	5	6/4/2025 2:40:00 PM	3	0.02	Negative
131376	Elevator Machine Room	Other	Metal	No Selection	Gray	Fair	Other	5	6/4/2025 2:40:00 PM	3	0.09	Negative
131377	Elevator Machine Room	Other	Metal	No Selection	Gray	Fair	Other	5	6/4/2025 2:41:00 PM	3	0.01	Negative
131378	Elevator Machine Room	Other	Metal	No Selection	Gray	Fair	Other	5	6/4/2025 2:42:00 PM	3	0.03	Negative
131379	Elevator Machine Room	Other	Metal	No Selection	Dark Green	Fair	Other	5	6/4/2025 2:50:00 PM	3	0.45	Negative
131380	Elevator Machine Room	Other	Metal	No Selection	Dark Green	Fair	Other	5	6/4/2025 2:50:00 PM	3	0.14	Negative
131381	Elevator Machine Room	Other	Metal	Electric Panel Box	Dark Green	Fair	Other	5	6/4/2025 3:08:00 PM	3	0.11	Negative
131382	Elevator Machine Room	Other	Metal	Electric Panel Box	Gray	Fair	Other	5	6/4/2025 3:09:00 PM	3	-0.01	Negative
131383	Elevator Pit	Door	Metal	External Casing	Teal	Fair	Other	Basement	6/4/2025 3:27:00 PM	3	0.01	Negative
131384	Elevator Pit	Door	Metal	Jamb	Teal	Fair	Other	Basement	6/4/2025 3:27:00 PM	3	0.01	Negative

XRF Operator: Other

Lead Results (Pbc) in mg/cm2, EPA/HUD >1.0 mg/cm² considered Positive

ALL XRF RESULTS

J. C. BRODERICK AND ASSOCIATES, INC.
1775 Expressway North Hauppauge, NY 11788
TEL: (631) 584-5492 FAX: (631) 584-3395

Supreme Court Building, 100 Supreme Court Drive, Mineola New York 11501 JCB # 25-61512

No.	Room	Component	Substrate	Feature	Color	Condition	Side	Floor	Date/Time	Depth Index	Pbc	Result
131385	Elevator Pit	Door	Metal	Casing	Teal	Fair	Other	Basement	6/4/2025 3:27:00 PM	3	0.01	Negative
131386	Elevator Pit	Door	Metal	No Selection	Teal	Fair	Other	Basement	6/4/2025 3:27:00 PM	3	0.01	Negative
131387	Elevator Pit	Other	Metal	No Selection	Orange	Fair	Other	Basement	6/4/2025 3:28:00 PM	3	1.24	Positive
131388	Elevator Pit	Structural Beam	Metal	No Selection	Black	Fair	Other	Basement	6/4/2025 3:30:00 PM	3	0.09	Negative
131389	Elevator Pit	Structural Beam	Metal	No Selection	Black	Fair	Other	Basement	6/4/2025 3:30:00 PM	3	0.13	Negative
131390	Elevator Pit	Structural Beam	Metal	No Selection	Black	Fair	Other	Basement	6/4/2025 3:31:00 PM	3	0.16	Negative
131391	Elevator Pit	Other	Metal	No Selection	Black	Fair	Other	Basement	6/4/2025 3:32:00 PM	3	0.11	Negative
131392	Elevator Pit	Other	Metal	No Selection	Black	Fair	Other	Basement	6/4/2025 3:32:00 PM	3	0.09	Negative
131393	Elevator Pit	Other	Metal	No Selection	Black	Fair	Other	Basement	6/4/2025 3:32:00 PM	3	0.15	Negative
131394	Elevator Pit	Other	Metal	No Selection	Black	Fair	Other	Basement	6/4/2025 3:33:00 PM	3	0.07	Negative
131395	Elevator Pit	Other	Metal	No Selection	Black	Fair	Other	Basement	6/4/2025 3:34:00 PM	3	0.05	Negative
131396	Elevator Pit	Other	Metal	No Selection	Black	Fair	Other	Basement	6/4/2025 3:36:00 PM	3	0.1	Negative
131397	Elevator Pit	Other	Metal	No Selection	Orange	Fair	Other	Basement	6/4/2025 3:36:00 PM	3	3.09	Positive
131398	Elevator Pit	Structural Beam	Metal	No Selection	Black	Fair	Other	Basement	6/4/2025 3:38:00 PM	3	0.22	Negative
131399	Elevator Pit	Structural Beam	Metal	No Selection	Black	Fair	Other	Basement	6/4/2025 3:38:00 PM	3	0.17	Negative
131400	Elevator Lobby	Wall	Other	No Selection	Various	Fair	Other	4	6/4/2025 3:52:00 PM	3	0	Negative
131401	Elevator Lobby	Floor	Other	No Selection	Various	Fair	Other	4	6/4/2025 3:52:00 PM	3	0	Negative
131402	Elevator Lobby	Cove Base	Other	No Selection	Black	Fair	Other	4	6/4/2025 3:52:00 PM	3	0	Negative
131403	Elevator Lobby	Wall	Other	No Selection	Various	Fair	A	4	6/4/2025 3:53:00 PM	3	0	Negative
131404	Elevator Lobby	Wall	Other	No Selection	Various	Fair	A	3	6/4/2025 3:54:00 PM	3	0	Negative
131405	Elevator Lobby	Wall	Other	No Selection	Various	Fair	A	3	6/4/2025 3:54:00 PM	3	0	Negative
131406	Elevator Lobby	Cove Base	Other	No Selection	Black	Fair	A	3	6/4/2025 3:55:00 PM	3	0	Negative
131407	Elevator Lobby	Floor	Other	No Selection	Various	Fair	Floor	3	6/4/2025 3:56:00 PM	3	0	Negative
131408	Elevator Lobby	Ceiling	Other	No Selection	White	Fair	Ceiling	3	6/4/2025 3:58:00 PM	3	0	Negative
131409	Elevator Lobby	Wall	Other	No Selection	Various	Fair	A	2	6/4/2025 4:02:00 PM	3	0	Negative
131410	Elevator Lobby	Wall	Other	No Selection	Various	Fair	A	2	6/4/2025 4:02:00 PM	3	0	Negative
131411	Elevator Lobby	Cove Base	Other	No Selection	Black	Fair	A	2	6/4/2025 4:02:00 PM	3	0	Negative
131412	Elevator Lobby	Floor	Other	No Selection	Various	Fair	Floor	2	6/4/2025 4:03:00 PM	3	0	Negative
131413	Elevator Lobby	Floor	Other	No Selection	Various	Fair	Floor	1	6/4/2025 4:04:00 PM	3	0	Negative
131414	Elevator Lobby	Wall	Other	No Selection	Various	Fair	A	1	6/4/2025 4:04:00 PM	3	0	Negative
131415	Elevator Lobby	Wall	Other	No Selection	Various	Fair	A	1	6/4/2025 4:04:00 PM	3	0.01	Negative
131416	Elevator Lobby	Cove Base	Other	No Selection	Black	Fair	A	1	6/4/2025 4:05:00 PM	3	0	Negative
131417	Elevator Lobby	Door	Metal	No Selection	Gold	Fair	A	1	6/4/2025 4:06:00 PM	3	0	Negative
131418	Elevator	Floor	Vinyl	No Selection	Various	Fair	Floor		6/4/2025 4:23:00 PM	3	0	Negative
131419	Elevator	Ceiling	Metal	No Selection	White	Fair	Floor		6/4/2025 4:23:00 PM	3	0.01	Negative
131420	Elevator	Ceiling	Metal	Electric Box	White	Fair	Floor		6/4/2025 4:24:00 PM	3	0	Negative
131421	Elevator	Wall	Wood	No Selection	Varnish	Fair	B		6/4/2025 4:25:00 PM	3	0	Negative

XRF Operator: Other

Lead Results (Pbc) in mg/cm2, EPA/HUD >1.0 mg/cm² considered Positive

ALL XRF RESULTS

J. C. BRODERICK AND ASSOCIATES, INC.
1775 Expressway North Hauppauge, NY 11788
TEL: (631) 584-5492 FAX: (631) 584-3395

Supreme Court Building, 100 Supreme Court Drive, Mineola New York 11501 JCB # 25-61512

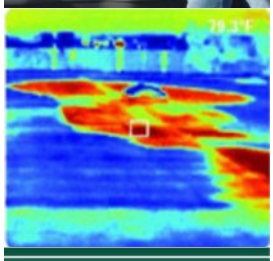
No.	Room	Component	Substrate	Feature	Color	Condition	Side	Floor	Date/Time	Depth Index	Pbc	Result
131422	Elevator	Wall	Wood	No Selection	Varnish	Fair	C		6/4/2025 4:25:00 PM	3	0	Negative
131423	Elevator	Wall	Wood	No Selection	Varnish	Fair	D		6/4/2025 4:25:00 PM	3	0	Negative
131424	Elevator	Ceiling	Metal	Door	White	Fair	Ceiling		6/4/2025 4:26:00 PM	3	0	Negative
131425	Elevator	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	ALIBRA		6/4/2025 4:33:00 PM	3	1.06	Positive
131426	Elevator	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	ALIBRA		6/4/2025 4:33:00 PM	3	1.11	Positive
131427	Elevator	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	ALIBRA		6/4/2025 4:33:00 PM	3	1.17	Positive
131428	Elevator	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	ALIBRA		6/4/2025 4:33:00 PM	3	1.11	Positive
131429	Elevator	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	ALIBRA		6/4/2025 4:33:00 PM	3	0	Negative
131430	Elevator	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	ALIBRA		6/4/2025 4:33:00 PM	3	0	Negative
131431	Elevator	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	ALIBRA		6/4/2025 4:33:00 PM	3	0	Negative
131432	Elevator	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	CALIBRATE	ALIBRA		6/4/2025 4:33:00 PM	3	0	Negative

Lead Certifications








J.C. Broderick & Associates, Inc.
Environmental Consulting & Testing
1775 Expressway Drive North
Hauppauge, New York 11788
631.584.5492 fax 631.584.3395

United States Environmental Protection Agency

This is to certify that

J.C. Broderick & Associates, Inc.

has fulfilled the requirements of the Toxic Substances Control Act (TSCA) Section 402, and has received certification to conduct lead-based paint activities pursuant to 40 CFR Part 745.226

In the Jurisdiction of:

All EPA Administered Lead-based Paint Activities Program States, Tribes and Territories

This certification is valid from the date of issuance and expires May 28, 2027

LBP-2159-3

Certification #

April 05, 2024

Issued On

Marc Edmonds, Chief

Risk Assessment Management Branch 2.

J.C. BRODERICK & ASSOCIATES, INC.
1775 EXPRESSWAY DRIVE NORTH
HAUPPAUGE, NEW YORK 11788
(631) 584-5492 Fax: (631) 584-3395

NAME	CERTIFICATION NUMBER	CERTIFICATION	EXPIRATION MONTH	EXPIRATION DAY	EXPIRATION YEAR
Ezelius, Bryan	LBP-R-17439-2	Risk Assessor	August	31	2026
Milinis, Robert	LBP-R-126803-3	Risk Assessor	August	31	2026
Ricker, Tara	LBP-R-129030-2	Risk Assessor	August	31	2026
Beekman, Mark	LPB-I-7633-2	Inspector	August	28	2024
Broderick, Brendan	LBP-R-4224-2	Risk Assessor	November	13	2024
Broderick, Lynn	R-I-22009-20-00272	Lead Renovator	September	3	2025
Broderick, Michael	LBP-I-4640-2	Inspector	November	11	2024
Eid, Ryan	LBP-R-19842-2	Risk Assessor	April	4	2025
JCB Company License	**LBP-2159-2**	**Company**	**May**	**28**	**2024**
Mrozek, Jacek	LBP-R-I206679-2	Risk Assessor	September	17	2025
Lombardo, Anthony	LBP-R-I165904-1	Risk Assessor	September	3	2024
Manzella, Robert	LBP-R-I165011-2	Risk Assessor	April	4	2025
Martin, Matthew J	LBP-R-I210715-1	Risk Assessor	September	1	2024
McNamee, Aileen	LBP-R-I210698-1	Risk Assessor	September	5	2024
Peet, Justin	LBP-R-I169548-1	Risk Assessor	September	6	2024
Greve, George	LBP-R-129021-2	Risk Assessor	August	31	2026
Gwynn, Meghan	LBP-R-129019-3	Risk Assessor	August	31	2026
Todzia, Erin	LBP-R-I210577-1	Risk Assessor	August	22	2024
McGuire, Edward	LBP-R-I210694-1	Risk Assessor	August	20	2024
Smalls, Daniel	LBP-R-I21582-1	Risk Assessor	September	8	2024
Wilson, John	LBP-I-I203373-2	Inspector	July	26	2025
Urban, Matthew	LBP-R-I207635-2	Risk Assessor	November	5	2025
Spina, Kera	LBP-I-I19043-2	Inspector	August	28	2024

SECTION 020000

ASBESTOS REMOVAL

PART 1 GENERAL

1.1 SUMMARY

A. This asbestos abatement Project will consist of the removal and disposal of asbestos-containing materials (ACMs) and presumed asbestos-containing materials (PACMs) as regulated asbestos-containing material (RACM) at Nassau County Supreme Court building – Mission 21 Elevator Modernization, 100 Supreme Court Drive, Mineola, NY 11501.

Floor/Level /Location	Work Area Designation	Description of Asbestos Materials	Removal Method(s)	Approximate Quantity (SF/Unit)
Phase 1				
Elevator Car 3	1	2nd Layer Floor Tile	ICR 56-7.11	40.0 SF
		Assumed Concealed Elevator Insulation Material within Elevator Wall Panels		160.0 SF
Elevator Car 4		2nd Layer Floor Tile		40.0 SF
		Assumed Concealed Elevator Insulation Material within Elevator Wall Panels		160.0 SF
1st Floor - Elevator Lobby		Assumed Marble Wall Panels and Mastic		2.0 SF
		Assumed 2x2 Spline Ceiling Tiles at Car 3		4.0 SF
		Assumed 2x2 Spline Ceiling Tiles at Car 4		4.0 SF
2nd Floor - Elevator Lobby	2	Assumed Marble Wall Panels and Mastic	ICR 56-11.3	2.0 SF
		Assumed 2x2 Spline Ceiling Tiles at Car 3	ICR 56-11.3	4.0 SF
		Assumed 2x2 Spline Ceiling Tiles at Car 4	ICR 56-11.3	4.0 SF
3rd Floor - Elevator Lobby	3	Assumed Marble Wall Panels and Mastic	ICR 56-11.3	2.0 SF
		Assumed 2x2 Spline Ceiling Tiles at Car 3	ICR 56-11.3	4.0 SF
		Assumed 2x2 Spline Ceiling Tiles at Car 4	ICR 56-11.3	4.0 SF
4th Floor - Elevator Lobby	4	Assumed Marble Wall Panels and Mastic	ICR 56-11.3	2.0 SF
		Assumed 2x2 Spline Ceiling Tiles at Car 3	ICR 56-11.3	4.0 SF
		Assumed 2x2 Spline Ceiling Tiles at Car 4	ICR 56-11.3	4.0 SF
Phase 2				
Elevator Car 5	5	2nd Layer Floor Tile	ICR 56-7.11	40.0 SF
		Assumed Concealed Elevator Insulation Material within Elevator Wall Panels		160.0 SF
1st Floor - Elevator Lobby		Assumed 2x2 Spline Ceiling Tiles at Car 5		4.0 SF
2nd Floor - Elevator Lobby	6	Assumed 2x2 Spline Ceiling Tiles at Car 5	ICR 56-11.3	4.0 SF
3rd Floor - Elevator Lobby	7	Assumed 2x2 Spline Ceiling Tiles at Car 5	ICR 56-11.3	4.0 SF
4th Floor - Elevator Lobby	8	Assumed 2x2 Spline Ceiling Tiles at Car 5	ICR 56-11.3	4.0 SF

Floor/Level /Location	Work Area Designation	Description of Asbestos Materials	Removal Method(s)	Approximate Quantity (SF/Unit)
Elevator Machine Room	9	Circuit Board Material	ICR 56-7.11	90.0 SF
		White Cloth Electric Wire Insulation		30.0 SF
			Total Quantity (SF/LF/Units)	776.0 SF

1. 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. Failure to do so shall not relieve the Contractor of its obligation to furnish all labor and materials necessary to perform the Work.
2. All Work shall be performed in strict accordance with the Project Documents and all governing codes, rules, and regulations. Where conflicts occur between the Project Documents and applicable codes, rules, and regulations, the more stringent shall apply.
3. 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.

1.2 SPECIAL JOB CONDITIONS

A. Any special job conditions, including Variances obtained by the owner, are described below:

1. All work shall be performed in strict accordance with the project documents and NYS ICR 56, where conflicts occurs between the project documents and applicable codes, rules and regulations, the most stringent shall apply.

2. The abatement contractor is responsible for confirming the location and quantity of all ACM in the project scope of work. Abatement contractor shall be responsible for all project filings, including NYS DOL and US EPA Filings.

3. The contractor shall coordinate locations of decontamination units, egress routes, and waste container with the owner's representative (s). In case locations that are more appropriate for the decontamination unit are determined at any time during the abatement, they may be relocated.

4. The contractor shall define, as part of their project specific work plan, the location of accessible temporary power and water supply in coordination with the owner's representative. Abatement Contractor may be responsible for supplying 55-gallon drums for water supply and generators for electric supply. Temporary connections shall extend from the source to the work area at the ceiling height, disconnect water between work shifts.

5. All ACM shall be removed completely down to the substrate, to a surface that is free and clear of all residues and made suitable for replacement materials. Abatement Contractor shall leave clean demarcations at the borders of removals to facilitate replacement materials.

6. The abatement contractor shall coordinate with the facility for assistance to connect electrical panel for temporary power needed for the abatement. All lock-out-tag-out procedures shall be followed in accordance with OSHA regulations.

7. Prior to abatement in the elevator machine room, the abatement contractor shall receive written verification that electrical equipment targeted by the abatement has been disconnected and all lock-out tag-out protocols have been observed.

8. No waste shall be stored inside the work area or inside the waste decontamination unit between work shifts. A temporary waste holding area may be required.

9. The Contractor shall use barrier tape to extend the limits of the active, regulated work areas closed to the public and other non-abatement trades.

10. Alternate means of egress shall be made available to the public during the abatement work.

11. Any assumed ACM may be tested during construction by the owner's environmental consultant to assess its true asbestos content, if any.

1.3 PERMITS AND COMPLIANCE

A. The Contractor shall assume full responsibility and liability for compliance with all applicable Federal, State, and local laws, rules, and regulations pertaining to Work practices, protection of Workers, authorized visitors to the site, persons, and property adjacent to the Work.

B. Perform asbestos related Work in accordance with New York State Industrial Code Rule 56 (herein referred to as Code Rule 56), 40 CFR 61, and 29 CFR 1926. Where more stringent requirements are specified, adhere to the more stringent requirements.

C. The Contractor must maintain current licenses pursuant to New York State Department of Labor, New York City Department of Environmental Protection Asbestos Control Program, New York City Department of Sanitation, and New York State Department of Environmental Conservation for all Work related to this Project, including the removal, handling, transport, and disposal of asbestos-containing materials.

D. The Contractor must have and submit proof upon request that any persons employed by the Contractor to engage in or supervise Work on any asbestos Project have valid NYS asbestos handling and supervisor certificates pursuant to Code Rule 56 regulations.

G. The Contractor shall be responsible for obtaining all other Variances as may be required for the Project or as requested by the owner, including variances necessary to obtain NYC Department of Buildings Work Permits prior to completion of all asbestos abatement activities. Approval of the owner is required prior to submission of a Variance application to any regulatory agency. Failure to obtain the owner approval may result in the owner not permitting variance to be used on the Project.

H. The Contractor shall be responsible for compliance with The New York State Uniform Fire Prevention and Building Code, or its successor during all Work at the site.

I. Failure to adhere to the Project Documents shall constitute a breach of the Contract and the owner shall have the right to and may terminate the contract provided, however, the failure of the owner to so terminate shall not relieve the Contractor from future compliance.

1.4 SUBMITTALS

A. Pre-Work Submittals: Within seven (7) days prior to the pre-construction conference, the Contractor shall submit an electronic copy of the documents listed below to the owner Project Manager and the Environmental Consultant for review and approval prior to the commencement of asbestos abatement activities:
   1. Contractor license issued by New York State Department of Labor.

2. A list of Projects performed within the past two (2) years and include the dollar value of all Projects. Provide Project references to include owner, Environmental Consultant, and air monitoring firm's name, contact persons, address, and phone number.
3. Progress Schedule:
   a. Show the complete sequence of abatement activities for each work area and the sequencing of Work within each building or building section listed in the contract.
   b. Show the dates and hours of work for the beginning and completion of each major element of Work for all work areas including substantial completion dates for each Work Area, building, or phase.
4. Project Notifications (original and all amendments in chronological order): As required by Federal and State, regulatory agencies together with proof of transmittal (i.e. certified mail return receipts). NYS DOL Site Specific Variance or Applicable Variance, if applicable.
5. Building Occupant Notification: Provide the following information, as required by regulatory agencies:
   a. Owner, Project Number, Site Name and Address, Building, Asbestos Project Location at Building, Start and End Dates.
   b. Quantity and type of material to be removed.
   c. Asbestos Contractor Name, Address, Contact Name and Phone Number, NYSDOL License Number.
   d. Third Party Air Monitor Name, Address, Contact Name and Phone Number, NYSDOL License Number.
   e. Air Monitoring Laboratory Name, Address, Contact Name and Phone Number, New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP) Number.
   f. NYSDOL Regional Office Phone Number.
   g. Project Manager Name and Phone Number.
   h. General Contractor Project Manager Name and Phone Number, if applicable
6. Abatement Work Plan and Drawing(s): Provide a written work plan description of work and drawing(s) that clearly indicates the following:
   a. All work areas/containments numbered sequentially.
   b. Locations and types of all decontamination enclosures for each work area.
   c. Entrances and exits to each work area/containment.
   d. Type of abatement activity/technique for each work area/containment.
   e. Number and location of negative air units and exhaust for each work area, when applicable. Also provide calculations for determining number of negative air pressure units.
   f. Proposed location and construction of storage facilities and field office.

   Location of water and electrical connections to building services for each work area/containment.

   Waste transport routes through the building, or exterior to the waste storage container for each work area/containment.
7. Disposal Site/Landfill Permit from applicable regulatory agency.
8. Transfer Facility Permit (if used) from applicable regulatory agency.
9. Valid Waste Transporter NYS DEC Part 364 permit for all transporters.
10. Valid State Waste Transport vehicle permit for all transporters for each State the waste is being transported through to reach the Disposal Facility/Landfill.
11. Valid US DOT vehicle number / permits for all Transporters.
12. Special Waste Characterization Profile, if required by the disposal site/landfill.
13. Current ELAP Certificate for laboratory performing analysis of OSHA personal air monitoring samples. Refer to Section 1.09.

B. On-Site Submittals: Refer to Part 3.01.B, C, D and E for all submittals, documentation, and postings required to be maintained on-site during abatement activities.

C. Project Close-out Submittals: Within 30 days of the completion of each abatement phase, the **Abatement Contractor** shall submit an electronic copy of the documents listed below to THE

OWNER and the Environmental Consultant for review and approval prior to Contractor's final payment. Once THE OWNER approves the close-out submittal, the Contractor shall provide 3 hard copy sets of the approved close-out documents (double-sided and bound) to THE OWNER Project Management for appropriate distribution, including 1 set to be distributed to the facility and 1 set (with original waste records, Contractor's Acknowledgement Statements and any signed notarized documents required) to THE OWNER.

1. All Waste Shipment Records and Waste Shipment Record Logs (**Original** Waste Shipment Record(s) shall be sent to THE OWNER).
2. OSHA compliance air monitoring records (laboratory reports and chain of custodies) conducted during the Work (compiled in chronological order).
3. Daily progress log, and the Work Area entry/exit log (s).
4. Contractor's Acknowledgement Statement (Appendix C) that lists all Workers used in the performance of the Project, including name, NYS DOL certification numbers and type of certification (i.e. supervisor, asbestos handler, etc.). The Statement shall be notarized (**Original** notarized statement shall be sent to THE OWNER).
5. Supervisor and Handlers/Workers NYS DOL Asbestos (current at time of asbestos abatement) Certifications.
6. Contractor licensed issued by New York State Department of Labor.
7. Disposal Site/Landfill Permit from applicable regulatory agency.
8. Transfer Facility Permit (if used) from applicable regulatory agency.
9. Valid Waste Transporter NYS Part 364 permit for all transporters.
10. Valid State Waste Transport vehicle permit for all transporters for each State the waste is being transported through to reach the Disposal Facility/Landfill.
11. Valid US DOT vehicle permits for all Transporters.
12. Special Waste Characterization Profile, if required by the disposal site/landfill.
13. Current ELAP Certificate for laboratory performing analysis of OSHA personal air monitoring samples. Refer to Section 1.09.
14. EPA, NYS DOL Regulatory Project notifications, amended notifications, along with proof of transmittals and NYS DOL Site-Specific Variances/Applicable Variances, if applicable.

D. Project Close-out Submittals: Within 30 days of the completion of the abatement phase, the **Environmental Consultant** shall submit 1 electronic copy of the closure report, including the documents listed below to THE OWNER for review and approval. Once THE OWNER approves the final closeout submittals, the Environmental Consultant shall provide 3 hard copy sets of the approved submittals (double-sided and bound) to THE OWNER Project Management for appropriate distribution.

1. Upon completion of the Project, the Environmental Consultant shall certify to THE OWNER, in writing, that the work is complete, acceptable and was performed in compliance with the Project Documents and all Local, State and Federal Regulations in an Executive Summary of the work.
2. The Environmental Consultant shall review and approve or disapprove all necessary guarantees, certificates of compliance, and all other close-out documentation, which the Asbestos Contractor is required to submit.
3. The Environmental Consultant shall provide to THE OWNER the final/closeout project report which must include
    a. Consultant license issued by New York State Department of Labor.
    b. Project Monitor(s) Certificate issued by New York State Department of Labor.
    c. All daily logs and daily worker/handler rosters.
    d. Summary of all visual inspections with the date of inspection and the date of signoff on the supervisor's log.
    e. Air sampling logs, final lab reports (no drafts-must be signed by analyst and reviewer), chain of custody forms, and sample location plans.
    f. Copies of Waste Shipment Records and Waste Shipment Record Logs.
    g. EPA, NYS DOL Regulatory Project notifications, amended notifications, along with proof of transmittals and NYS DOL Site-Specific Variances/Applicable Variances,

h. All pertinent correspondence related to the Project, including re-occupancy letters and elevated air results submission to NYS DOL documentation per 56-4.10 (a).

1.5 PRE-CONSTRUCTION CONFERENCE

A. Prior to start of preparatory Work under this Contract, the Contractor shall attend a pre-construction conference attended by THE OWNER, Facility Personnel, and Environmental Consultant.

B. Agenda for this conference shall include but not necessarily be limited to:
1. Contractor's scope of Work, Work plan, and schedule to include number of workers and shifts.
2. Contractor's safety and health precautions including protective clothing and equipment and decontamination procedures.
3. Environmental Consultant's duties, functions, and authority.
4. Contractor's Work procedures including:
   a. Methods of job site preparation and removal methods.
   b. Respiratory protection.
   c. Disposal procedures.
   d. Cleanup procedures.
   e. Fire exits and emergency procedures.
5. Contractor’s required pre-work and on-site submittals, documentation, and postings.
6. Contractor's plan for twenty-four (24) hour Project security both for prevention of theft and for barring entry of unauthorized personnel into Work Areas.
7. Temporary utilities.
8. Handling of furniture and other movable objects.
9. Storage of removed asbestos-containing materials.
10. Waste disposal requirements and procedures.

C. In conjunction with the conference the Contractor shall accompany the THE OWNER and Environmental Consultant on a pre-construction walk-through documenting existing condition of finishes and furnishings, reviewing overall Work plan, location of fire exits, fire protection equipment, water supply and temporary electric tie-in.

1.6 APPLICABLE STANDARDS AND REGULATIONS

A. The Contractor shall comply with the following codes and standards, except where more stringent requirements are shown or specified:

B. Federal Regulations:
1. 29 CFR 1910.1001, "Asbestos" (OSHA)
2. 29 CFR 1910.1200, "Hazard Communication" (OSHA)
3. 29 CFR 1910.134, "Respiratory Protection" (OSHA)
4. 29 CFR 1910.145, "Specification for Accident Prevention Signs and Tags" (OSHA)
5. 29 CFR 1926, "Construction Industry" (OSHA)
6. 29 CFR 1926.1101, "Asbestos, Tremolite, Anthophyllite, and Actinolite" (OSHA)
7. 29 CFR 1926.500 "Guardrails, Handrails and Covers" (OSHA)
8. 40 CFR 61, Subpart A, "General Provisions" (EPA)
9. 40 CFR 61, Subpart M, "National Emission Standard for Asbestos" (EPA)
10. 49 CFR 171-172, Transportation Standards (DOT)

C. New York State Regulations:
1. 12 NYCRR, Part 56, "Asbestos", Industrial Code Rule 56 (DOL) (amended March 21, 2007).
2. 6 NYCRR, Parts 360, 364, Disposal and Transportation (DEC)
3. 10 NYCRR, Part 73, "Asbestos Safety Program Requirements" (DOH)

D. Standards and Guidance Documents:
1. American National Standards Institute (ANSI) Z88.2, Practices for Respiratory Protection
2. ANSI Z9.2-79, Fundamentals Governing the Design and Operation of Local Exhaust Systems
3. EPA 560/585-024, Guidance for Controlling Asbestos-containing Materials in Buildings (Purple Book)
4. EPA 530-SW-85-007, Asbestos Waste Management Guidance
5. ASTM Standard E1368 “Standard Practice for Visual Inspection of Asbestos Abatement Projects.”

1.7 NOTICES

A. The Contractor shall provide notification of intent to commence asbestos abatement activities as indicated below.

1. At least ten (10) Working days prior to beginning abatement activities, send written notification to:

U.S. Environmental Protection Agency Region 2
National Emissions Standards for Hazardous Air Pollutants (NESHAPS) Coordinator
Air Branch
290 Broadway, 21st Floor
New York, NY 10007-1866

2. At least ten (10) calendar days prior to beginning abatement activities send written notification to:

New York State Department of Labor
Division of Safety and Health, Asbestos Control Program
State Office Campus
Building 12 - Room 161B
Albany, NY 12240

B. The Contractor is required to send notifications to U.S. Environmental Protection Agency and New York State Department of Labor via mail, package delivery service that will provide proof of delivery and receipt.

C. The Contractor shall be responsible for maintaining current project filings with regulatory agencies for the duration of the project.

D. The Contractor shall post and/or provide Building Occupant Notification at least 10 calendar days prior to beginning abatement activities as required by Code Rule 56.

1.8 PROJECT MONITORING AND AIR SAMPLING

A. THE OWNER shall engage the services of an Environmental Consultant who shall serve as THE OWNER's Representative in regard to the performance of the asbestos abatement Project and provide direction as required throughout the entire abatement Project period. The Environmental Consultant and all subconsultants shall not have any contractual relationship with the Contractor for the duration of the asbestos project.

B. The Contractor is required to ensure cooperation of its personnel with the Environmental Consultant for the air sampling and Project monitoring functions described in this section. The Contractor shall comply with all direction given by the Environmental Consultant during the course of the Project.

C. The Environmental Consultant shall provide the following administrative services:
   1. Review and approve or disapprove all submittals, shop drawings, schedules, and samples.
   2. Assure that all notifications to governmental agencies by the Contractor are submitted in a timely manner and are correct in content.

D. The Environmental Consultant shall staff the Project with a trained and certified person(s) to act on THE OWNER's behalf at the job site. This individual shall be designated as the Abatement Project Monitor (APM).
   1. The APM shall be on-site at all times the Contractor is on-site. The Contractor shall not be permitted to conduct any Work unless the APM is on-site (except for inspection of barriers and negative air system during non-working days).
   2. The APM shall have the authority to direct the actions of the Contractor verbally and in writing to ensure compliance with the Project documents and all regulations. The APM shall have the authority to Stop Work when gross Work practice deficiencies or unsafe practices are observed, or when ambient fiber concentrations outside the removal area are equal to or greater than 0.01 f/cc or background level, whichever is greater.
      a. Such Stop Work order shall be effective immediately and remain in effect until corrective measures have been taken and the situation has been corrected.
      b. Standby time, re-cleaning time, and air sample collection time and analysis cost required to resolve the situation shall be at the Contractor's expense.
      c. The APM shall track and provide a summary of standby, re-cleaning, and/or air sampling time to achieve satisfactory clearance, as well as a summary of any equipment used. These summaries shall be provided to the THE OWNER Project Manager.
   3. The APM shall provide the following services:
      a. Inspection of the Contractor's Work, practices, and procedures, including temporary protection requirements, for compliance with all regulations and Project specifications including provisions required by Variances.
      b. Provide abatement Project air sampling as required by applicable regulations and THE OWNER. Sampling will include background, work area preparation, asbestos handling, final cleaning and aggressive clearance air sampling.
      c. Verify daily that all Workers used in the performance of the Project are certified by the appropriate regulatory agency and include a worker roster in the daily log.
      d. Monitor the progress of the Contractor's work and report any deviations from the schedule to THE OWNER.
      e. Monitor, verify, and document all waste load-out operations.
      f. Verify that the Contractor is performing personal air monitoring daily, and that results are being returned and posted at the site as required.
      g. The APM shall maintain a daily log on site that documents all project related and APM and Contractor actions, activities, and occurrences.
      h. Verify landfill to be used for waste disposal with waste transporter (driver) and Contractor prior to waste trailer/hardtop dumpster leaving site. Confirm the waste transporter firm and landfill are listed on the regulatory notifications for the project and the waste transport vehicle license number is listed on the current NYS DEC Waste Transporter permit.
   4. The following minimum inspections shall be conducted by the APM, accompanied by the Contractor’s supervisor. Additional inspections shall be conducted as required by Project conditions and/or at THE OWNER’s direction. Progression from one (1) phase of Work to the next by the Contractor is only permitted with the written approval of the APM.

a. Pre-Construction Inspection: The purpose of this inspection is to verify the existing conditions of the Work Areas and to document these conditions.
b. Pre-Commencement Inspection: The purpose of this inspection is to verify the integrity of each containment system prior to disturbance of any asbestos-containing material. This inspection shall take place only after the Work Area is fully prepped for removal.
c. Work Inspections: The purpose of this inspection is to monitor the Work practices and procedures employed on the Project and to monitor the continued integrity of the containment system. Inspections within the removal areas shall be conducted by the APM during all preparation, removal, and cleaning activities at least twice every Work shift. Additional inspections shall be conducted as warranted.
d. Pre-Encapsulation Inspection: The purpose of this inspection is to ensure the complete removal of Asbestos-Containing Material (ACM), from all surfaces in the Work Area prior to encapsulation.
e. Visual Clearance Inspection: The purpose of this inspection is to verify that: all materials in the scope of work have been properly removed; no visible asbestos debris/residue remains; no pools of liquid or condensation remains; and all required cleanings are complete. This inspection shall be conducted before final air clearance testing.
f. Post-Clearance Inspection: The purpose of this inspection is to ensure the complete removal of ACM, including debris, from the Work Area after satisfactory final clearance sampling and removal of all isolation and critical barriers and equipment from the Work Area.
g. Punch List Inspection: The purpose of this inspection is to verify the Contractor's certification that all Work has been completed as contracted and the existing condition of the area prior to its release to THE OWNER.

E. The APM shall provide abatement Project air sampling and analysis as required by applicable regulations. Sampling will include, but is not limited to, background, work area preparation, asbestos handling, and final cleaning and clearance air sampling.
1. Unless otherwise required by applicable regulations, the APM shall have samples analyzed by Phase Contrast Microscopy (PCM). Results shall be available at the Project site within 24 hours of completion of sampling.
2. Samples shall be collected as required by applicable regulations and these specifications. If Transmission Electron Microscopy (TEM) clearance air sampling is utilized by THE OWNER, the clearance criteria and sampling protocols must be in compliance with AHERA. If PCM air sample analysis results exceed the satisfactory clearance criteria, then TEM analysis of the entire set of clearance air samples may be used, provided that a standard NIOSH/ELAP accepted laboratory analysis method is utilized that shall report each air sample result in fibers per cubic centimeter.
3. If the air sampling during any phase of the abatement project reveals airborne fiber levels at or above 0.01 fibers/cc or the established background level, whichever is greater, outside the regulated Work Area, Work shall stop immediately and corrective measures required by applicable regulations shall be initiated. Notify THE OWNER project personnel, as well as all employers and occupants in adjacent areas. The Contractor shall bear the burden of any and all costs incurred by this delay.
4. The APM shall submit copies of all elevated air sampling results collected during abatement and all elevated final air clearance results to the Commissioner of Labor, as required by regulation.

1.09 CONTRACTOR AIR SAMPLING

A. In addition to the requirements of OSHA 1926.1101, the Contractor shall be required to perform personal air monitoring **every Work shift in each Work Area** during which abatement activities occur in order to determine that appropriate respiratory protection is adequate and is being worn

and utilized. **Negative Exposure Assessments are not allowed to be used in lieu of personal air monitoring.**

B. The Contractor shall conduct air sampling that is representative of both the 8-hour time weighted average and 30-minute short-term excursion level exposures to indicate compliance with the OSHA Permissible Exposure Limits (PELs).

C. The Contractor's laboratory analysis of air samples shall be conducted by a NYS DOH ELAP approved laboratory. The Environmental Consultant shall not collect, ship, transport or analyze the Contractor's air samples.

D. Results of personal air sample analyses shall be available, verbally, within twenty-four 24 hours of sampling and results with associated chains of custody shall be posted upon receipt and documented in the supervisor's daily log book. Written laboratory reports shall be delivered and posted at the Work site within five (5) days. Failure to comply with these requirements may result in all work being stopped until compliance is achieved.

1.10 PROJECT SUPERVISOR

A. The Contractor shall designate a full-time Project Supervisor who shall meet the following qualifications:
   1. The Project Supervisor shall hold New York State DOL certification as an Asbestos Supervisor.
   2. The Project Supervisor shall meet the requirements of a "Competent Person" as defined by OSHA 1926.1101 and shall have a minimum of one (1) year experience as a supervisor.
   3. The Project Supervisor must be able to speak, read, and write English fluently, as well as communicate in the primary language of the Workers.

B. If the Project Supervisor is not on-site at any time whatsoever, all Work shall be stopped. The Project Supervisor shall remain on-site until the Project is complete. The Project Supervisor cannot be removed from the Project without the written consent of THE OWNER and the Environmental Consultant. The Project Supervisor shall be removed from the Project if so requested by THE OWNER.

C. The Project Supervisor shall maintain the bound Daily Project Log and separate work area entry/exit logs for each work area, as required by applicable regulations and section 2.03 of the specifications and the Waste Shipment Record Log required by section 4.03 of the specifications.

D. The Project Supervisor shall be responsible for the performance of the Work and shall represent the Contractor in all respects at the Project site. The Supervisor shall be the primary point of contact for the Abatement Project Monitor.

1.11 MEDICAL REQUIREMENTS

A. Before exposure to airborne asbestos fibers, provide Workers with a comprehensive medical examination as required by 29 CFR 1910.1001, and 29 CFR 1926.1101.
   1. This examination is not required if adequate records show the employee has been examined as required by 29 CFR 1910.1001, and 29 CFR 1926.1101 within the past year.
   2. The same medical examination shall be given on an annual basis to employees engaged in an occupation involving asbestos fibers and within thirty 30 calendar days before or after the termination of employment in such occupations.

1.12 TRAINING

A. As required by applicable regulations, prior to assignment to asbestos Work instruct each employee with regard to the hazards of asbestos, safety and health precautions, and the use and requirements of protective clothing and equipment.

B. Establish a respirator program as required by ANSI Z88.2 and 29 CFR 1910.134, and 29 CFR 1926.1101. Provide respirator training and fit testing.

1.13 RESPIRATORY PROTECTION

A. Select respirators from those approved by the National Institute for Occupational Safety and Health (NIOSH).

B. Respirators shall be individually fit-tested to personnel under the direction of an Industrial Hygienist on a yearly basis. Fit-tested respirators shall be permanently marked to identify the individual fitted, and use shall be limited to that individual. Fit-test records shall be maintained on site for each employee.

C. Where fiber levels permit, and in compliance with regulatory requirements, Powered Air Purifying Respirators (PAPRs) are the minimum allowable respiratory protection permitted to be utilized during gross removal operations of OSHA Class I or OSHA Class II friable ACM.

D. No respirators shall be issued to personnel without such personnel participating in a respirator training program.

E. High Efficiency Particulate Air (HEPA) respirator filters shall be approved by NIOSH and shall conform to the OSHA requirements in 29 CFR 1910.134 and 29 CFR 1926.1101.

F. A storage area for respirators shall be provided by the Contractor in the clean room side of the personal decontamination enclosure where they will be kept in a clean environment.

G. The Contractor shall provide and make available a sufficient quantity of respirator filters so that filter changes can be made as necessary during the work day. Filters will be removed and discarded during the decontamination process. Filters cannot be reused. Filters must be changed if breathing becomes difficult.

H. Filters used with negative pressure air purifying respirators shall not be used any longer than one eight (8) hour work day. Any loose respirator filters found within the regulated area, must be disposed of as RACM asbestos waste.

I. Any authorized visitor, worker, or supervisor found in the Work Area not wearing the required respiratory protection shall be removed from the Project site and shall not be permitted to return.

J. The Contractor shall have at least two (2) Powered Air Purifying Respirators stored on site designated for authorized visitors use. Appropriate respirator filters for authorized visitors shall be made available by the Contractor.

1.14 DELIVERY AND STORAGE

A. Deliver all materials to the job site in original packages with containers bearing manufacturer's name and label.

B. Store all materials at the job site in a suitable and designated area.
   1. Store materials subject to deterioration or damage away from wet or damp surfaces and under cover.

2. Protect materials from unintended contamination and theft.
3. Storage areas shall be kept clean and organized.

C. Remove damaged or deteriorated materials from the job site. Materials contaminated with asbestos shall be disposed of as asbestos debris as herein specified.

1.15 TEMPORARY UTILITIES

A. Shut down and lock out all electrical power to the asbestos Work Areas, including lighting circuits. Any electrical power passing through the Work Areas that can't be shut down due to health and safety reasons, shall be protected as per the requirements of applicable regulations and shall not be utilized within the work area.

B. Provide temporary 120-240 volt, single phase, three (3) wire, 100 amp electric service with Ground Fault Circuit Interrupters (GFCIs) for all electric requirements within the asbestos Work Area.
1. Where available, obtain from Owner's existing system. Otherwise provide power from other sources (i.e. generator).
2. Provide temporary wiring and "weatherproof" receptacles in sufficient quantity and location to serve all HEPA equipment and tools.
3. Provide wiring and receptacles as required by the APM for air sampling equipment.
4. All power to the Work Area shall be brought in from outside the area through GFCIs at the source.

C. Provide temporary lighting with "weatherproof" fixtures for all Work Areas including decontamination chambers.
1. The entire Work Area shall be kept illuminated at all times.
2. Provide lighting as required by the APM for the purposes of performing required inspections.

D. All temporary devices and wiring used in the Work Area shall be capable of decontamination procedures including HEPA vacuuming and wet-wiping.

E. Utilize domestic water service, if available, from Owner's existing system. Provide hot water heaters with sufficient capacity to meet Project demands.

PART 2 PRODUCTS

2.1 PROTECTIVE CLOTHING

A. Provide personnel utilized during the Project with disposable protective whole body clothing, head coverings, gloves and foot coverings. Provide disposable plastic or rubber gloves to protect hands. Cloth gloves may be worn inside the plastic or rubber for comfort, but shall not be used alone. Make sleeves secure at the wrists and make foot coverings secure at the ankles by the use of tape, or provide disposable coverings with elastic wrists or tops.

B. Provide sufficient quantities of protective clothing to assure a minimum of four (4) complete disposable outfits per day for each individual performing abatement Work.

C. Eye protection and hard hats shall be provided and made available for all personnel entering any Work Area.

D. Authorized visitors shall be provided with suitable protective clothing, headgear, eye protection, and footwear whenever they enter the Work Area.

2.2 SIGNS AND LABELS

A. Provide bilingual (English-Spanish) warning signs and barrier tapes at all approaches to asbestos Work Areas. Locate signs at such distance that personnel may read the sign and take the necessary protective steps required before entering the area.

1. Provide danger signs in vertical format conforming to 29 CFR 1926.1101, minimum 20" x 14" displaying the following legend.

DANGER
ASBESTOS
MAY CAUSE CANCER
CAUSES DAMAGE TO LUNGS
AUTHORIZED PERSONNEL ONLY
WEAR RESPIRATORY PROTECTION AND
PROTECTIVE CLOTHING IN THIS AREA

2. Provide 3" wide red barrier tape printed with black lettered, "DANGER ASBESTOS REMOVAL". Locate barrier tape across all corridors, entrances and access routes to asbestos Work Area. Install tape 3' to 4' above finished floor (AFF).

B. Provide asbestos danger labels affixed to all asbestos materials, scrap, waste, debris and other products contaminated with asbestos.

1. Provide asbestos danger labels of sufficient size to be clearly legible, displaying the following legend:

DANGER
CONTAINS ASBESTOS FIBERS
MAY CAUSE CANCER
CAUSES DAMAGE TO LUNGS
DO NOT BREATHE DUST
AVOID CREATING DUST

2. Provide the following asbestos labels, of sufficient size to be clearly legible, for display on waste containers (bags or drums) which will be used to transport asbestos contaminated material in accordance with United States Department of Transportation 49 CFR Parts 171 and 172:

RQ, NA2212, RACM ASBESTOS, 9, PGIII

3. Generator identification information shall be affixed to each waste container or any packaging used to containerize RACM asbestos waste indicating the following printed in indelible ink:

Generator Name
Facility Name
Facility Address
Date

2.3 DAILY PROJECT LOG & WORK AREA (Worker Decontamination Unit) ENTRY/EXIT LOG

A. Provide a bound Daily Project Log. The log shall contain on title page the Project name and THE OWNER project number, name, address and phone number of Owner; name, address and phone number of Environmental Consultant; name, address and phone number of Abatement Contractor; emergency numbers including, but not limited to local Fire/Rescue department and all other regulatory requirements.

B. All entries into the log shall be made in non-washable, permanent ink and such pen shall be strung to or otherwise attached to the log to prevent removal from the log-in area. Under no circumstances shall pencil entries be permitted.

C. All persons entering and exiting the Work Area shall sign the Work Area (entry/exit log located in the decontamination unit clean room or airlock to the work area) and include name, certification number, and time.

D. The Project Supervisor shall document all work performed daily and note all regulatory required inspections, maintain entry log records and ensure that they are recorded in accordance with the provisions of all applicable regulations.

2.4 SCAFFOLDING AND LADDERS

A. Provide all scaffolding and/or staging as necessary to accomplish the Work of this Contract. Scaffolding may be of suspension type or standing type such as metal tube and coupler, tubular welded frame, pole or outrigger type or cantilever type. All scaffolding shall be designed and constructed in accordance with OSHA, New York City Building Code, and any other applicable federal, state and local government regulations. Whenever there is a conflict or overlap of the above references the most stringent provisions are applicable.

B. Provide scaffolding and ladders as required by the APM for the purposes of performing required inspections.

2.5 SURFACTANT (AMENDED WATER)

A. Wet all asbestos-containing materials prior to removal with surfactant mixed and applied in accordance with manufacturer's printed instructions.

2.6 ENCAPSULANT

A. Encapsulant shall be tinted or pigmented so that application when dry is readily discernible.

B. The encapsulant solvent or vehicle shall not contain a volatile hydrocarbon.

2.7 FOAM/VISCOUS LIQUID

A. Foam or viscous liquid shall be non-toxic, shall not require special respirator protection for handling, and shall not affect the handling and disposal of the asbestos waste

B. Foam or viscous liquid shall leave an identifiable colored residue when it dissipates.

C. Foam or viscous liquid may be used for non-friable ACM roofing and/or flooring removals consistent with all applicable regulations.

2.8 WASTE DISPOSAL BAGS, DRUMS, AND CONTAINERS

A. Provide 6 mil polyethylene disposal bags printed with asbestos caution labels. Bags shall also be imprinted with U.S. Department of Transportation required markings.

B. Provide 30 or 55 gallon capacity fiber, plastic, or metal drums capable of being sealed air and water tight if asbestos waste has the potential to damage or puncture disposal bags. Affix asbestos caution labels on lids and at one-third points around drum circumference to assure ready identification.

C. Containers and bags must be labeled in accordance with 40 CFR Part 61 NESHAPS and applicable regulations. When the bags/containers are moved to the lockable hardtop dumpster

from the waste decontamination system washroom, the bags must also be appropriately labeled with the date they are moved on the bag/container in waterproof markings.

D. Labeled ACM waste containers or bags shall not be used for non-ACM waste or trash. Any material placed in labeled containers or any material placed in bags, whether the bag is turned inside out or not, shall be handled and disposed of as RACM waste.

2.9 HEPA VACUUM EQUIPMENT

A. All vacuuming performed under this contract shall be performed with High Efficiency Particulate Air (HEPA) filter equipped industrial vacuums conforming to ANSI Z9.2.

B. Provide tools and specialized equipment including scraping nozzles with integral vacuum hoods connected to a HEPA vacuum with flexible hose.

2.10 POWER TOOLS

A. Any power tools used to drill, cut into, or otherwise disturb asbestos material shall be manufacturer equipped with HEPA filtered local exhaust ventilation

2.11 FIRE RETARDANT POLYETHYLENE SHEETING

A. All polyethylene (plastic) sheeting used on the Project (including but not limited to sheeting used for critical and isolation barriers, fixed objects, walls, floors, ceilings, and waste container) shall be at least 6 mil fire retardant sheeting.

B. Decontamination enclosure systems shall utilize at least 6 mil opaque fire retardant plastic sheeting. At least two (2) layers of 6 mil reinforced fire retardant plastic sheeting shall be used for the flooring.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

A. Should visible emissions or water leaks be observed outside the Work Area, immediately stop Work and institute emergency procedures per applicable regulations. Should there be elevated fiber levels outside the Work Area, immediately stop Work and institute emergency procedures per applicable regulations. All costs incurred in decontaminating such non-Work Areas and the contents thereof shall be borne by the Contractor, at no additional cost to THE OWNER.

B. Current medical surveillance approval, fit test reports, Contractor’s Worker Acknowledgments, and valid NYS DOL Asbestos Handler certification cards shall be on site prior to admittance of any Contractor’s employees to the asbestos Work Area.

C. Hard Copies of the following submittals, documentation, and postings shall be maintained on-site by the Contractor during abatement activities at a location approved by the Abatement Project Monitor:
   1. Valid Contractor license issued by New York State Department of Labor.
   2. Certification, Worker Training, Medical Surveillance, Acknowledgment(s):
      a. NYS DOL Asbestos Handler certification cards for each person employed in the removal, handling, or disturbance of asbestos.
      b. Evidence that Workers have received proper training required by the regulations and the medical examinations required by OSHA 29 CFR 1926.1101.
      c. Documentation that Workers have been fit tested specifically for respirators used on the Project.

d. Contractor's Workers Acknowledgments (Appendix C): Statements listing all the employees and signed by the supervisor stating that the employee has received training in the proper handling of asbestos-containing materials; understands the health implications and risks involved; and understands the use and limitations of the respiratory equipment to be used.

3. Daily OSHA personal air monitoring results.
4. NYS Department of Health ELAP certification for the laboratory that will be analyzing the OSHA personal air samples.
5. Disposal Site/Landfill Permit from applicable regulatory agency.
6. Transfer Facility Permit (if used) from applicable regulatory agency.
7. Valid Waste Transporter NYS Part 364 permit for all transporters.
8. Valid State Waste Transport vehicle permit for all transporters for each State the waste is being transported through to reach the Disposal Facility/Landfill.
9. Valid US DOT vehicle permits for all Transporters.
10. Special Waste Characterization Profile, if required by the disposal site/landfill.
11. Regulatory Project notifications and amended notifications.
12. Applicable regulations.
13. Safety Data Sheets of supplies/chemicals used on the Project.
14. Approved Abatement Work Plan.
15. List of emergency telephone numbers.
16. Magnahelic manometer semi-annual calibration certification.
17. Waste Shipment Record Log.
18. Daily Project Log.
19. Work Area Entry/Exit Logs, for each personal decontamination unit.
20. Contract documents (environmental survey report, specifications and drawings).

D. A floor plan showing the areas of the building under abatement and the location of all fire exits in said areas shall be prominently posted in the building lobby or comparable location, along with a notice stating the location within the building of the negative air cutoff switch required under applicable regulations.

E. Hard Copies of the following documentation shall be maintained on-site by the Abatement Project Monitor during abatement activities:
1. Valid Contractor license issued by New York State Department of Labor.
2. Air Sample Log.
3. Air sample laboratory results with chain of custody and sample location plans.
4. ACP15 Project Monitors Reports, if applicable.
5. Project monitor daily log and a daily list of workers/supervisors onsite.
6. A copy of ASTM Standard E1368 "Standard Practice for Visual Inspection of Asbestos Abatement Projects".
7. Calibration Chart for rotometer(s) used on-site.
8. Project documents (environmental survey report, specifications and drawings).

F. The Work Area must be vacated by building occupants prior to decontamination enclosure construction and Work Area preparation.

G. All demolition necessary to access asbestos-containing materials for removal must be conducted within negative pressure enclosures by licensed asbestos handlers. Demolition debris may be disposed of as construction and demolition debris provided the Abatement Project Monitor determines that it is not contaminated with asbestos and there has been no disturbance of ACM within the enclosure. If the demolition debris is determined to be contaminated or ACM has been disturbed, porous materials must be disposed of as RACM asbestos waste.

3.2 PERSONAL DECONTAMINATION ENCLOSURE

A. Provide personal decontamination enclosure contiguous to the Work Area or as per Variance. The decontamination enclosure shall be attached to the Work Area and not located within it unless isolation barriers are installed. If the decontamination chamber is accessible to the public it shall be fully framed and sheathed to prevent unauthorized entry.

B. Access to the Work Area will be from the clean room through an airlock to the shower and through an airlock to the equipment room. Each airlock shall be a minimum of three (3) feet from door to door. Additional airlocks shall be provided as required by applicable regulations for remote decontamination enclosures.

C. The decontamination enclosure ceiling and walls shall be covered with one (1) layer of opaque 6 mil fire retardant polyethylene sheeting. Two (2) layers of reinforced 6 mil fire retardant polyethylene sheeting shall be used to cover the floor.

D. The entrance to the clean room shall have a lockable door along with adequate small openings for Work Area make-up air. Provide suitable lockers for storage of Worker's street clothes. Storage for respirators along with replacement filters and disposable towels shall also be provided.

E. Provide a temporary shower with individual hot and cold water supplies and faucets. Provide a sufficient supply of soap and shampoo. There shall be one (1) shower for every six Workers. The shower room shall be constructed in such a way so that travel through the shower chamber shall be through the shower. The shower shall not be able to be bypassed.

F. Shower water shall be drained, collected and filtered through a system with at least a 5.0 micron particle size collection capability containing a series of several filters with progressively smaller pore sizes to avoid rapid clogging of the system. The filtered waste water shall then be discharged in accordance with applicable codes and the contaminated filters disposed of as RACM asbestos waste.

G. The equipment room shall be used for the storage of tools and equipment. A walk-off pan filled with water shall be located in the Work Area outside the equipment room for Workers to clean foot coverings when leaving the Work Area. A labeled 6 mil plastic ACM waste bag for collection of contaminated clothing shall be located in this room.

H. The personal decontamination enclosure shall be cleaned and disinfected minimally at the end of each Work shift and as otherwise directed by the Abatement Project Monitor.

3.3 WASTE DECONTAMINATION ENCLOSURE

A. Provide a waste decontamination enclosure contiguous to the Work area or as per Variance. The decontamination enclosure shall be attached to the Work Area and not located within it unless isolation barriers are installed. If the decontamination chamber is accessible to the public it shall be fully framed and sheathed to prevent unauthorized entry.

B. The waste decontamination enclosure system shall consist of a holding area, airlock and washroom. The airlock shall be a minimum of three (3) feet from door to door. The entrance to the holding area shall have a lockable door.

C. The decontamination enclosure ceiling and walls shall be covered with one (1) layer of opaque 6 mil fire retardant polyethylene sheeting on walls and ceiling. Two (2) layers of reinforced 6 mil fire retardant polyethylene sheeting shall be used to cover the floor.

D. Where there is only one egress from the Work Area, the holding area of the waste decontamination enclosure system may branch off from the personal decontamination enclosure equipment room, which then serves as the waste wash room.

E. The waste wash room water shall be drained, collected, and filtered through a system with at least a 5.0 micron particle size collection capability containing a series of several filters with progressively smaller pore sizes to avoid rapid clogging of the system. The filtered waste water shall then be discharged in accordance with applicable codes and the contaminated filters disposed of as RACM asbestos waste.

F. In small asbestos Projects where only one (1) egress from the Work Area exists, the shower room may be used as a waste washroom. In this instance, the clean room shall not be used for waste storage, but shall be used for waste transfer to carts, which shall immediately be removed from this enclosure.

3.4 WORK AREA ENTRY AND EXIT PROCEDURES

A. Access to and from the asbestos Work Area is permitted only through the personal decontamination enclosure unless otherwise stipulated in a Variance.

B. Workers shall sign the Work Area entry/exit log (located in the decontamination clean room) upon every entry and exit.

C. The following procedures shall be followed when entering the Work Area:
1. Before entering the Work Area, Workers shall proceed to the clean room, remove all street clothes, and don protective clothing, equipment, and respirators.
2. Workers shall proceed from the clean room through the shower room and the equipment room and into the Work Area.

D. The following procedures shall be followed when exiting the Work Area:
1. Before leaving the Work Area, gross asbestos contamination will be removed by brushing, wet cleaning and/or HEPA vacuuming.
2. In the equipment room, Workers shall remove disposable clothing, but not respirators, and shall place clothing in plastic disposal bags for disposal as contaminated debris prior to entering the shower room.
3. Workers shall shower thoroughly while wearing respirators then wash respirator with soap and water prior to removal.
4. Upon exiting the shower, Workers shall don new disposable clothing if the Work shift is to continue or street clothes to exit area. Under no circumstances shall Workers enter public non-Work Areas in disposable protective clothing.

E. If remote decontamination enclosures are permitted by applicable regulations or a Variance, workers shall wear two disposable suits for all phases of Work. Workers exiting the work area shall HEPA vacuum the outer suit, enter the airlock, remove the outer suit and then place it back into the Work Area. A clean second suit shall be donned before exiting the airlock and proceeding to the decontamination enclosure or another work area via the designated pathway.

3.5 WORK AREA PREPARATION

A. Asbestos danger signs shall be posted at all approaches to the asbestos Work Area. Post all emergency exits as emergency exits only on the Work Area side; post with asbestos caution signs on the non-Work Area side. Provide all non-Work Area stairs and corridors accessible to

the asbestos Work Area with warning tapes at the base of stairs and beginning of corridors. Warning tapes shall be in addition to caution signs.

B. Shut down and lock out the building heating, ventilating, and air conditioning (HVAC) systems. Electrical systems and circuits shall also be shut down unless permitted to remain active per applicable regulations and appropriately protected and labeled. Existing lighting sources shall not be utilized. Provide temporary electric power and lighting as specified herein.

C. All non-ACM surfaces and objects within the Work Area shall be pre-cleaned using HEPA vacuuming and/or wet-wiping methods. Dry sweeping and any other methods that raise dust shall be prohibited. ACM shall not be disturbed during pre-cleaning.

D. Movable objects within the Work Area shall be HEPA vacuumed and/or wet-wiped and removed from the Work Area.

E. All non-movable equipment in the Work Area shall be completely covered with two (2) layers of fire retardant polyethylene sheeting, at least 6 mil in thickness, and secured in place with duct tape and/or spray adhesive. Active Fire Protection System components in the Work Area shall not be covered with fire retardant plastic sheeting or any other obstruction.

F. Provide enclosure of the asbestos Work Area necessary to isolate it from unsealed areas of the building in accordance with the approved asbestos Work plan and as specified herein.

G. Provide critical barriers by sealing off all openings including but not limited to windows, diffusers, grills, electrical outlets and boxes, doors, floor drains, and any other penetrations of the Work Area enclosure, using two (2) layers of at least 6 mil fire retardant polyethylene sheeting.

H. Provide isolation barriers by installing temporary framing and sheathing at openings larger than 32 square feet forming the limits of the asbestos Work Area. Sheathing thickness must be a minimum of 3/8 inch and all sheathing shall be caulked and the Work Area side sealed with two (2) layers of 6 mil fire retardant polyethylene sheeting.

I. Isolation barriers shall be installed at all elevator openings in the Work Area. Elevators running through the regulated abatement work area shall be shut down or isolated as per applicable regulations. Elevator controls shall be modified so that elevators bypass the Work Area.

J. Provide two (2) independent layers of 6 mil fire retardant polyethylene sheeting over all floor, wall, and ceiling surfaces. Each sheet/layer shall be individually applied and secured with tape, not folded over. Isolation barriers shall also be covered with two (2) independent layers (for a total of four (4) layers). Sheets shall be secured with duct tape. All joints in fire retardant polyethylene sheeting shall overlap 12" minimum. Carpeting left in place shall be covered with 3/8-inch plywood sheathing prior to plasticizing.

K. Unless otherwise specified for removal, the Contractor shall either protect all fiberglass insulation on piping, ductwork, tanks, etc. in the Work Area using two (2) layers of 6 mil fire retardant polyethylene or remove the insulation as asbestos-containing waste. If the Contractor elects to remove the fiberglass insulation, he/she shall be responsible for reinsulation, if piping is required to be insulated.

L. Frame out emergency exits. Provide double layer 6 mil fire retardant polyethylene sheeting and tape seal opening. Post as emergency exits only and mark with photoluminescent paint or signage. Provide a cutting tool on the Work Area side of exit.

M. Remove all items attached to or in contact with ACM only after the Work Area enclosure is in place. HEPA vacuum and wet wipe with amended water all removed items prior to their removal from the Work Area and before the start of asbestos removal operations.

N. Suspended ceiling tiles shall only be removed after Work Area preparation is complete. If possible, non-contaminated ceiling tiles shall be HEPA vacuumed and removed from the Work Area before asbestos removals begin. Contaminated ceiling tiles and porous ceiling tiles in work areas with ACM debris located above the ceiling shall be disposed of as RACM asbestos waste.

3.6 NEGATIVE AIR PRESSURE FILTRATION SYSTEM

A. Provide a portable asbestos filtration system that develops a minimum pressure differential of negative 0.02 inches of water column within all full enclosure areas relative to adjacent unsealed areas and that provides a minimum of four (4) air changes per hour in the Work Area during abatement and six (6) air changes for non-friable flooring and/or mastic removal.

B. Such filtration systems must be made operational after critical and isolation barriers are installed but before wall, floor, and ceilings are plasticized and shall be operated 24 hours per day during the entire Project until the final cleanup is completed and satisfactory results of the final air samples are received from the laboratory.

C. The system shall include a series of pre-filters and filters to provide High Efficiency Particulate Air (HEPA) filtration of particles down to 0.3 microns at 100% efficiency and below 0.3 microns at 99.9% efficiency. Provide sufficient replacement filters to replace pre-filters every 2 hours, secondary pre-filters every 24 hours, and primary HEPA filters every 600 hours of operation. HEPA filter sides shall be marked with the date of installation during all new HEPA filter installations on the Project.

D. A minimum of one (1) additional filtration unit of at least the same capacity as the primary unit(s) shall be installed and fully functional to be used during primary unit (s) filter changing and in case of primary failure.

E. If the containment area includes either the entire floor of the building or an area greater than 15,000 square feet on any floor, install a negative air cut off switch as required by NYC DEP regulations.

F. Upon electric power failure or shut-down of any filtration unit, all abatement activities shall stop immediately and only resume after power is restored and all filtration units are fully operating. For shut-downs longer than one-half hour, all openings into the Work Area, including the decontamination enclosures, shall be sealed.

G. The Contractor shall provide a manometer to verify negative air pressure. Manometers shall be read twice daily and recorded within the Supervisor’s Daily Project Log.

H. There shall be at least a four (4) hour settling period after the Work Area is fully prepared, small and large projects only, as defined by 12 NYCRR Part 56, and the negative filtration units have been started to ensure integrity of the barriers.

I. Once installed and operational, the Contractor’s Supervisor shall conduct daily inspections of the Work Area to ensure the airtight integrity of the enclosure and operation of the negative air system. Findings shall be recorded within the Daily Project Log. Inspections shall also be conducted on days when no abatement activities are in progress.

3.7 REMOVAL OF ASBESTOS-CONTAINING MATERIALS

A. If new (previously unidentified) suspect ACM is discovered during the course of a Project, THE OWNER or THE OWNER’s Representative shall be notified. The Contractor is prohibited from collecting bulk samples. The Designer of Record shall have bulk samples collected by a dually

certified NYS DOL asbestos inspector and NYC DEP asbestos investigator to determine asbestos content.

B. Definition of Substrate – The underlying support, foundation or base (e.g. wood lathe, wire screen, concrete, etc.) to which a single layer or multilayered system (e.g. plaster, roofing, etc.) is applied.

C. Asbestos-containing materials shall be removed in accordance with the Contract Documents and the approved Asbestos Work Plan. Only one (1) type of ACM shall be abated at a time within a Work Area. Where there are multiple types of ACM requiring abatement, applicable regulation procedures for sequential abatement shall be followed.

D. Sufficiently wet asbestos materials with a low pressure, airless fine spray of surfactant to ensure full penetration to substrate prior to material removal. Re-wet material that does not display evidence of saturation.

E. One (1) Worker shall continuously apply amended water while ACM is being removed. All layers of ACM shall be removed to the underlying substrate (e.g. concrete, roof deck, piping, etc.), unless stated otherwise in the contract documents.

F. Perform cutting, drilling, abrading, or any penetration or disturbance of asbestos-containing material in a manner to minimize the dispersal of asbestos fibers into the air. This may require a NYS DOL site specific variance. Use equipment and methods specifically designed to limit generation of airborne asbestos particles. All power operated tools used shall be provided with manufacturer equipped HEPA filtered local exhaust ventilation.

G. Upon removal of ACM from the substrate, the newly exposed surfaces shall be HEPA vacuumed and/or wet cleaned. Surfaces must be thoroughly cleaned using necessary methods and any required solvents to completely remove any adhesive, mastic, etc.

H. All removed material shall be placed into 6 mil plastic disposal bags or other suitable container upon detachment from the substrate. ACM is not permitted to lie on the floor for any period of time. Cleanup of accumulations of loose debris or waste shall be performed whenever there is enough accumulation to fill a single bag or container and minimally at the end of each workshift.

I. Large components shall be wrapped in two (2) layers of 6 mil polyethylene sheeting. Sharp components likely to tear disposal bags shall be placed in fiber drums or boxes and then wrapped with sheeting.

J. Power or pressure washers are not permitted for asbestos removal. Power or pressure washers are allowed during clean-up procedures only if stated in an approved Site-Specific Variance and allowed by THE OWNER.

K. All open ends of pipe and duct insulation not scheduled for removal shall be encapsulated using lag cloth.

L. All construction and demolition debris determined by the Environmental Consultant to be contaminated with asbestos shall be handled and disposed of as RACM asbestos waste.

M. The use of metal shovels, metal dust pans, etc. are not permitted inside the work area.

3.8 EQUIPMENT AND WASTE CONTAINER DECONTAMINATION AND REMOVAL PROCEDURES

A. External surfaces of contaminated containers and equipment shall be cleaned by wet cleaning and/or HEPA vacuuming in the Work Area before moving such items into the waste decontamination enclosure system airlock by persons assigned to this duty. The persons in the

Work Area shall not enter the airlock. No gross removal operations are permitted when waste transfer is in progress.

B. The containers and equipment shall be removed from the airlock by persons stationed in the washroom during waste removal operations. The external surfaces of containers and equipment shall be cleaned a second time by wet cleaning.

C. The cleaned containers of asbestos material and equipment are to be dried of any excessive pooled or beaded liquid, placed in uncontaminated 6 mil plastic bags or sheeting, as the item's physical characteristics demand, and sealed airtight.

D. The clean recontainerized items shall be moved into the airlock that leads to the holding area. Workers in the washroom shall not enter this airlock.

E. Containers and equipment shall be moved from the airlock and into the holding area by persons dressed in clean personal protective equipment, who have entered from the holding area.

F. The cleaned containers of asbestos material and equipment shall be placed in water tight carts with doors or tops that shall be closed and secured. These carts shall be held in the holding area until transfer to the waste trailer/container. The carts shall be wet cleaned and/or HEPA vacuumed at least once each day.

G. The exit from the decontamination enclosure system shall be secured to prevent unauthorized entry.

H. Where the waste removal enclosure is part of the personal decontamination enclosure, waste removal shall not occur during shift changes or when otherwise occupied. Precautions shall be taken to prevent short circuiting and cycling of air outward through the shower and clean room.

3.9 WORK AREA DECONTAMINATION, CLEANING, AND CLEARANCE PROCEDURES

A. Following completion of gross abatement and after all accumulations of asbestos waste materials have been containerized, the following decontamination procedures shall be followed unless modified by a Variance.

B. First Cleaning:
1. All bagged asbestos waste and unnecessary equipment shall be decontaminated and removed from the Work Area.
2. All surfaces in the Work Area shall be wet cleaned, except active fire protection system components that may be damaged by water. A wet-purpose shop vacuum may be used to pick up excess liquid, and may either be decontaminated prior to removal from the Work Area or disposed of as RACM asbestos waste.
3. The Abatement Project Monitor shall conduct a visual inspection of the Work Area for cleanliness and completion of abatement and document the results in the project log accordingly.
4. The Contractor shall then apply a thin coat of encapsulant to all surfaces in the Work Area that were not the subject of removal. In no event shall encapsulant be applied to any surface that was the subject of removal prior to obtaining satisfactory air monitoring results. Encapsulants shall be pigmented or tinted to provide an indication for completeness of coverage. The Abatement Project Monitor shall determine adequacy of coverage.
5. After the encapsulant has been applied and the required waiting/settling and drying time has elapsed, the first layer of fire retardant polyethylene sheeting shall then be removed and bagged as RACM asbestos waste.

C. Second Cleaning

1. All surfaces in the Work Area shall be HEPA vacuumed and then wet cleaned. Wet cleaning of active fire protection system components is not necessary if damage may occur.
2. The Abatement Project Monitor shall conduct a second visual inspection of the Work Area for cleanliness and document the results in the project log accordingly.
3. After the required waiting/settling and drying time has elapsed, the second layer of fire retardant polyethylene sheeting shall be removed and bagged as RACM asbestos waste.

D. Third Cleaning
1. All surfaces in the Work Area shall be HEPA vacuumed and then wet cleaned. Wet cleaning of active fire protection system components is not necessary if damage may occur.
2. After the required waiting/settling and drying time has elapsed, the Abatement Project Monitor shall conduct a third visual inspection of the Work Area for cleanliness and document the results in the project log accordingly.
3. After satisfactory APM visual inspection, aggressive final clearance air sampling shall then be conducted by the APM provided no visible asbestos debris/residue; pools of liquid, or condensation remains. NOTE: TEM samples should be used vs. PCM if demolition or other dust-generating evolutions are taking place in adjacent areas, as evident from excessive loading.
4. Upon receipt of satisfactory final clearance air sampling results, the negative air pressure equipment can be shut down and the isolation and critical barriers removed and bagged as RACM asbestos waste.

E. After isolation and critical barriers are removed, the Abatement Project Monitor and Contractor's Supervisor shall inspect the Work Area for cleanliness. If necessary, additional cleaning shall be performed by the Contractor as directed by the Abatement Project Monitor. Following the satisfactory inspections, the decontamination enclosures shall be removed.

F. As a result of any visual inspection by the Abatement Project Monitor or should air sampling results indicate high fiber levels, the Contractor will clean or reclean the affected areas at no additional expense to THE OWNER. Clearance air samples shall be collected again if previous results failed, at no additional expense to THE OWNER. The Contractor shall be back-charged for the additional clearance air sample collection and analysis.

3.10 TENT ENCLOSURES

A. Tent enclosures may only be used where specifically permitted by applicable regulations or a Variance.

B. The Contractor shall restrict access to the immediate area where tent removal procedures are taking place using barrier tape and/or construction barriers. Caution signs shall be posted.

C. Personal and waste decontamination enclosures shall be constructed. Configuration shall be as required by Project size. Remote personal decontamination enclosure may be allowed by variance.

D. The Work Area shall be precleaned. All objects and equipment that will remain in the restricted area during abatement shall be sealed with two (2) layers of six mil fire retardant polyethylene and tape.

E. The tent shall be a single use barrier constructed with a rigid frame and at least two (2) layers of 6 mil fire retardant polyethylene unless one (1) layer of 6 mil fire retardant polyethylene is otherwise permitted by applicable regulations. All seams shall be sealed airtight using duct tape and/or spray adhesive.

F. The tent shall be constructed with at least one (1) airlock for worker/waste egress.

G. A monometer shall be used for all enclosures.

H. Negative air shall be maintained at four (4) air changes per hour for non-friable and glovebag abatement tent enclosure work areas. Eight (8) air changes shall be maintained for friable gross removal tent enclosure work areas.

I. OSHA compliance air monitoring is required per section 1.09.

J. ACM removal shall follow procedures defined in section 3.07.

K. Waste material shall be placed in properly labeled 6 mil plastic bags or other appropriate containers. The outside of the bags or containers shall be wet wiped and/or HEPA vacuumed in the wash room and shall then be placed in a second bag/container before being transferred to the waste storage container. All transportation of waste bags and containers outside the Work Area shall be in watertight carts. These carts shall be held in the holding area until transfer to the waste storage container. The carts shall be wet cleaned and/or HEPA vacuumed at least once each day.

L. Following completion of gross abatement and after all accumulations of asbestos waste materials have been containerized, the following decontamination procedures shall be followed.
1. All bagged asbestos waste and unnecessary equipment shall be decontaminated and removed from the Work Area.
2. All surfaces in the Work Area shall be wet cleaned. A wet-purpose shop vacuum may be used to pick up excess liquid, and shall be decontaminated prior to removal from the Work Area.
3. The asbestos supervisor shall perform a visual inspection of the work area(s) followed by the APM prior to applying the encapsulation.
4. The Contractor shall then apply a thin coat of encapsulant to all non-removal surfaces covered with plastic in the Work Area. In no event shall encapsulant be applied to any surface that was the subject of removal prior to obtaining satisfactory air monitoring results. Encapsulants shall be pigmented or tinted to provide an indication for completeness of coverage. The APM shall determine adequacy of coverage.
5. After the waiting/settling/drying time requirements have elapsed, the Abatement Project Monitor shall conduct a visual inspection of the Work Area for cleanliness and completion of abatement. The APM shall document the results of the visual inspection in the Project Monitor Log and Contractor’s Daily Project Log.
6. After satisfactory APM visual inspection, aggressive final clearance air sampling shall then be conducted by the APM.
7. Upon receipt of satisfactory final clearance air sampling results, the tent shall be collapsed into itself, placed in suitable disposal bags, and transported to the waste decontamination enclosure. Isolation and critical barriers shall then be removed and bagged as RACM asbestos waste followed by satisfactory visual inspections by the project supervisor and the APM for cleanliness.

3.11 GLOVEBAG REMOVAL

A. Glovebag removals may only be used as specifically permitted by applicable regulations or a Variance. Glovebags may only be used on piping.

B. In addition to conformance with applicable regulations and Variances, glovebag removals are only permitted to be conducted within full containments or tent enclosures complying with these specifications.

C. The Contractor shall restrict access to the immediate area where tent/glovebag removal procedures are taking place using barrier tape and/or construction barriers. Caution signs shall be posted.

D. Personal and waste decontamination enclosures shall be constructed. Configuration shall be as required by Project size. Remote personal decontamination enclosure may be allowed by variance.

E. Glovebag removals shall utilize commercially available glovebags of at least 6 mil thickness. Use shall be in accordance with the manufacturer's instructions and the following minimum requirements:
   1. The sides of the glovebag shall be cut to fit the size pipe being removed. Tools shall be inserted into the attached tool pocket.
   2. The glovebag shall be placed around the pipe and the open edges shall be folded and sealed with staples and duct tape. The glovebag shall also be sealed at the pipe to form a tight seal.
   3. Openings shall be made in the glovebag for the wetting tube and HEPA vacuum hose. The opening shall be sealed to form a tight seal.
   4. All glovebags shall be smoke tested by the Abatement Project Monitor under negative pressure using the HEPA vacuum before removal operations commence. Glovebags that do not pass the smoke test shall be resealed and then retested.
   5. After first wetting the materials to be removed, removal may commence. ACM shall be continuously wetted. After removal of the ACM, the piping shall be scrubbed or brushed so that no visible ACM remains. Open ends of pipe insulation shall be encapsulated.
   6. After the piping is cleaned, the inside of the glovebag shall be washed down and the wetting tube removed. Using the HEPA vacuum, the glovebag shall be collapsed and then twisted and sealed with tape with the ACM at the bottom of the bag.
   7. A disposal bag shall be placed around the glovebag that is then detached from the pipe. The disposal bag is then sealed and transferred through the wash room to the waste storage container.

F. After glovebag removals are complete, containment/tent decontamination procedures shall be followed.

3.12 REMOVALS OF EXTERIOR NON-FRIABLE ACM

A. Except as modified by this section, removal of exterior non-friable ACM shall conform to all provisions of this specification.

B. Unless Variances have been otherwise obtained, removals shall be conducted in accordance with the provisions of applicable regulations.

C. The Work Area shall be the area from which ACM materials are being removed and shall extend 25 feet from the perimeter of the removal area.

D. Non-certified Workers are not allowed in the Work Area until the Work Area is cleared by the Abatement Project Monitor.

E. Personal and waste decontamination enclosures shall be constructed at a location in accordance with the approved Work Plan and applicable regulations. Unless located outside the Work Area, decontamination enclosures are not permitted to be constructed on the roof. Remote personal decontamination enclosure may be allowed by variance.

F. All openings (including but not limited to operable windows, doors, hatches, vents, ducts, and grilles) one (1) story above, one (1) story below, and within 25 feet of the work area shall be sealed with two (2) layers of 6 mil fire retardant polyethylene.

G. The removal of the ACM may require the use of scrapers, solvents, mastic removal chemicals, or other methods/procedures to ensure complete removal. Use of mechanical equipment without a tent containment, including, but not limited to chipping gun/hammer is prohibited without an approved NYS DOL site specific variance. Refer to Section 2.10 for other Power tool requirements.

H. The Contractor is required to provide temporary protection of the building (i.e. roof, window openings, construction joints, etc.) at the end of each Work shift so as to maintain the building in a watertight condition.

I. All asbestos waste generated shall be containerized in the work area, prior to transfer to waste storage trailer/container/dumpster. No waste shall remain in the work area at the end of each work shift. All waste shall be disposed of as RACM asbestos waste including projects where waste transfer procedures are modified by Site Specific Variance.

J. Waste Containers used for waste storage shall be lined with two (2) layers of six mil polyethylene and shall have a hard top (fully enclosed). Canvas cover or open topped dumpsters shall not be used to store asbestos waste unless permitted by a Site-Specific Variance.

K. Personal protective equipment, including respirators, shall be utilized and worn during all removal operations until the Work Area is cleared by the Abatement Project Monitor.

L. If air samples collected during abatement indicate any airborne asbestos fiber concentration(s) at or above 0.01 f/cc or the background level, whichever is greater, Work shall be stopped immediately and Work methods shall be altered to reduce the airborne asbestos fiber concentration(s).

M. Following completion of gross abatement and after all accumulations of asbestos waste materials have been containerized, the following decontamination procedures shall be followed:
   1. All surfaces in the Work Area shall be HEPA vacuumed and then wet cleaned.
   2. The Abatement Project Monitor shall conduct a visual inspection of the Work Area for cleanliness and completeness of abatement, prior to conducting final air clearance.
   3. Upon obtaining satisfactory clearance air sample results, the isolation and critical barriers shall be removed and bagged as RACM asbestos waste. Following this, the decontamination enclosures shall be removed.

3.13 NON-FRIABLE FLOORING AND/OR MASTIC REMOVALS

A. The following procedures may only be used for the removal of non-friable flooring and/or mastic materials using manual and chemical methods. These procedures shall not apply to beadblaster use or other abrasive abatement methods.

B. The Contractor shall restrict access to the immediate area where removals are taking place using barrier tape and/or construction barriers. Caution signs shall be posted.

C. Personal and waste decontamination enclosures shall be utilized and shall be constructed at a location in accordance with the approved Work Plan. Remote personal decontamination enclosure may be allowed by variance.

D. The Work Area shall be prepared per applicable regulations.

E. Negative air shall be maintained at six (6) air changes per hour.

F. OSHA compliance air monitoring is required per section 1.09.

G. ACM removal shall follow procedures defined in section 3.07.

H. Waste material shall be placed in properly labeled 6 mil plastic bags or other appropriate containers. The outside of the bags or containers shall be wet wiped and/or HEPA vacuumed before being passed into the wash room for double- bagging. The bags or containers shall then be transferred to the waste storage container. All transfer of waste bags and containers outside the Work Area shall be in watertight carts.

I. Following completion of gross abatement and after all accumulations of asbestos waste materials have been containerized, the following decontamination procedures shall be followed.
   1. All bagged asbestos waste and unnecessary equipment shall be decontaminated and removed from the Work Area.
   2. All surfaces in the Work Area shall be wet cleaned. A wet-purpose shop vacuum may be used to pick up excess liquid, and shall be decontaminated prior to removal from the Work Area.
   3. The Abatement Project Monitor shall conduct a visual inspection of the Work Area for cleanliness and completion of abatement.
   4. The Contractor shall then apply a thin coat of encapsulant to all non-removal surfaces covered with plastic in the Work Area. In no event shall encapsulant be applied to any surface that was the subject of removal prior to obtaining satisfactory air monitoring results. Encapsulants shall be pigmented or tinted to provide an indication for completeness of coverage. The Abatement Project Monitor shall determine adequacy of coverage.
   5. After the encapsulant has been applied and the required waiting/settling and drying time has elapsed, aggressive final clearance air sampling shall then be conducted by the APM.
   6. Upon receipt of satisfactory final clearance air sampling results, the isolation and critical barriers shall be removed. Following this, the decontamination enclosures shall be removed.

3.14 RESTORATION OF UTILITIES, FIRESTOPPING, AND FINISHES

A. After final clearance, remove locks and restore electrical and HVAC systems. All temporary power shall be disconnected, power lockouts removed and power restored. All temporary plumbing shall be removed.

B. Finishes damaged by asbestos abatement activities including, but not limited to, plaster/paint damage due to duct tape and spray adhesives, and floor tile lifted due to wet or humid conditions, 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.

C. All penetrations (including, but not limited to, pipes, ducts, etc.) through fire rated construction shall be firestopped using materials and systems tested in accordance with ASTM E814 on Projects where reinsulation is part of the required work.

PART 4 DISPOSAL OF ASBESTOS WASTE

4.1 TRANSPORTATION AND DISPOSAL SITE

A. The Contractor's Hauler and Disposal Site shall be approved by THE OWNER. All waste generated during the asbestos project shall be disposed of as RACM asbestos waste.

B. The Contractor shall give 24 hour notification prior to removing any waste from the site. Waste shall be removed from the site only during normal working hours unless otherwise specified. No waste may be taken from the site unless the Contractor and APM are present and the APM authorizes the release of the waste as described herein.

C. All waste generated as part of the asbestos project shall be removed from the site within ten (10) calendar days after successful completion of all asbestos abatement work.

D. Upon arrival at the Project Site, the Hauler must possess and present to the APM a valid US DOT Hazardous Waste Transporter Permit and New York State Department of Environmental Conservation Part 364 Asbestos Hauler's Permit and any New York City required permit/license. The APM may verify the authenticity of the hauler's permit with the proper authority.

E. The Hauler, with the Contractor and the APM, shall inspect all material in the transport container prior to taking possession and signing the Asbestos Waste Shipment Records.

F. Unless specifically approved by THE OWNER, the Contractor shall not permit any off-site transfers of the waste or allow the waste to be transported or combined with any other off-site asbestos material. The Hauler must travel directly to the disposal site as identified on the notifications with no unauthorized stops.

G. The APM shall verify the landfill to be used for waste disposal with the waste transporter (driver) and Contractor prior to the waste trailer/dumpster leaving the site. The APM shall confirm the waste transporter firm and landfill are listed on the regulatory notifications for the project and the waste transport vehicle license number is listed on the current NYS DEC Waste Transporter permit.

4.2 WASTE STORAGE CONTAINERS

A. All waste containers shall be fully enclosed with a hard top and be lockable (i.e. enclosed dumpster, trailer, etc.). No open containers will be permitted on-site (i.e. open dumpster with canvas cover, etc.) unless specifically permitted by a Variance. When asbestos contaminated waste must be kept on the work site overnight or longer, it shall be double bagged and stored in accordance with Federal, State, and local laws, including New York City Department of Sanitation Title 16, Chapter 8 of the Rules of New York City.

B. The APM shall verify that the waste storage container and/or truck tags (license plates) match the information listed on the New York State Department of Environmental Conservation Part 364 permit. Any container not listed on the permit shall be removed from the site immediately.

C. The container shall be plasticized and sealed with two (2) layers of 6 mil polyethylene. Once on site, it shall be kept locked at all times, except during load out. The waste container shall not be used for storage of equipment or contractor supplies.

D. While on-site, the container shall be labeled with EPA Danger signage:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD

E. The New York State Department of Environmental Conservation Asbestos Hauler's Permit number shall be displayed on both sides and back of the container. The permit number shall be at least 3 inches high and in a color that contrasts with the container / vehicle background color.

F. The container is not permitted to be loaded unless it is properly plasticized, has the appropriate danger signage affixed, and has the permit number appropriately displayed on the container.

G. Waste generated off-site or from a different, on-site non-THE OWNER project is not permitted to be brought onto the Project site and/or loaded into the waste container.

H. All asbestos waste removed from the Project site shall be transported directly to the disposal site without any additional waste being added to the container during transport.

I. THE OWNER may initiate random checks at the Disposal Site to ensure that the procedures outlined herein are complied with.

4.3 HAULER'S ASBESTOS WASTE SHIPMENT RECORDS

A. THE OWNER’s Waste Shipment Record and the Hauler's Waste Shipment Record shall be completed by the Contractor and verified by the APM that all the information and amounts are accurate and the proper signatures are in place.

A. The Waste Shipment Records shall have the appropriate signatures of the APM, the Contractor, and the Hauler representatives prior to any waste being removed from the site.

B. Copies of the completed Hauler's Waste Shipment Record shall be retained by the APM and the Contractor and shall remain on site for inspection.

D. The Contractor shall utilize the Waste Shipment Record Log provided by THE OWNER. This log shall be maintained by the Project Supervisor and shall be kept on site at all times. (See Appendix B.)

F. Upon arrival at the Disposal Site, the Hauler's Waste Shipment Record shall be signed by the Disposal Facility operator to certify receipt of ACM covered by the Waste Shipment Record.

G. The Disposal Facility operator shall return the original Hauler's Waste Shipment Record to the Contractor.

H. The Contractor shall forward copies of the Hauler's Waste Shipment Record to the APM within 14 days of the waste container being removed from the site. Failure to do so may result in payment being withheld from the Contractor.

I. Originals of all Waste Shipment Records, Contractor Acknowledgement Statements, and signed / notarized letters shall be submitted by the Contractor to THE OWNER with the final close-out documentation.

END OF SECTION

SECTION 020001

LCP/LBP DISTURBANCES USING OSHA LEAD SAFE WORK PRACTICES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. The work covered by this Specification shall consist of furnishing all labor, materials, tools, and equipment necessary to control and mitigate potential lead-based paint (LBP) and lead-containing paint (LCP) material hazards during demolition/renovation activities pertaining to the project at Nassau County Supreme Court building – Mission 21 Elevator Modernization, 100 Supreme Court Drive, Mineola, NY 11501.

This Specification shall be used as a guideline for Contractors who complete the demolition/renovation activities pertaining to this Project, as detailed within Section 1.1, B of this Specification. The intent of this Specification is to remain in conformance with Occupational Safety and Health Administration (OSHA) Regulation 29 CFR 1926.62 "Lead Exposure in Construction" and to maintain an airborne concentration of lead-dust below the Action Level. This Specification is written to outline the worst-case scenario regarding lead safe work practices.

B. The following is a detailed listing of identified LBP and/or LCP, above the laboratory and/or device detection limit:

Location	Component	Substrate	Concentration	Color	Condition
Basement Elevator Pit	Ladder	Metal	3.09	Orange	Fair
It should be noted that several components tested did contain minimal lead-concentrations below the EPA threshold level of 1.0 mg/cm^2 or 0.5% by weight for classification as LBP and are considered lead-containing paints or coatings by 29CFR 1926.62. OSHA does not recognize a minimum limit for lead concentration in paint for the purpose of disturbance. Personal Air monitoring of workers performing demolition/cleaning/disturbance of painted surfaces shall be completed to document personnel occupational exposure and reviewed by the Contractor's Competent Person. Items containing any amount of lead concentration are considered lead-containing paints or coatings per 29 CFR 1926.62. See project environmental survey report for lead paint reports. Lead paint summary information is located within the Appendices of this specification.					

C. Manual demolition, scraping and sanding of lead-based paint or lead containing paint coated surfaces, power tool cleaning with dust collection systems shall be performed in conjunction with engineering and work practice controls meeting the requirements of 29 CFR 1926.62(e)(1).

D. Components with LBP and LCP shall be removed intact to the extent practicable. A 6-mil polyethylene drop cloth shall be placed around and/or beneath the component, prior to its removal, to catch any paint chips that may become dislodged. Intact components shall be wrapped in a layer of clear 6-mil polyethylene prior to movement to the disposal container. The area around the component removal shall be wet wiped and high-efficiency particulate air (HEPA) filter vacuumed, including the tent enclosure (if applicable). The polyethylene sheeting shall be carefully folded in on itself and placed in a 6-mil disposal bag and sealed closed. All debris shall be properly disposed of in accordance with the respective waste stream Resource Conservation Recovery Act (RCRA) Toxicity Characteristic Leaching Procedure (TCLP) testing results.

E. Chemical stripping may be used for LBP and LCP removal on surfaces that will be subjected to welding, cutting, torch burning or where it is the only acceptable procedure. No chemical strippers containing methylene chloride shall be used by the Contractor on this project. SDS for stripping and neutralizing chemicals must be reviewed and approved by the Consultant prior to use and a copy shall be posted at the site.

F. The Contractor's use of a subcontractor (must be approved) shall not relieve the Contractor of full responsibility for the work to be performed.

G. If available and approved by the Competent Person, the Contractor may utilize exposure assessment data that is compliant with OSHA and was obtained within the last twelve (12) months from previous jobs conducted under similar conditions, control methods, work practices and environmental conditions to be used in this contract for LCP disturbances only. Other objective data may be used to demonstrate that work activities in this contract will not result in occupational exposures to airborne lead that exceeds the PEL for LCP disturbances only. The assessment shall include comparable lead concentrations (LCP only) in paint/coating materials, work practices, engineering controls and work schedules.

H. The Contractor must provide to his workers the following: Respiratory protection in accordance with the Contractor's Respiratory Protection Program, personal protective clothing, lead-free change areas, hand washing/shower facilities, blood lead level monitoring and training per 29 CFR 1926.62. **Respiratory Protection is required for all LBP disturbances**.

I. The Contractor shall ensure that any HVAC equipment intakes within and around the control areas are protected by shutting down the units. The Contractor shall alter the size and extent of the isolation barriers as necessary due to weather conditions, functional space use and density of building occupants in the vicinity, as required.

1.2 DEFINITIONS, REGULATIONS & REFERENCE STANDARDS

A. Definitions (excerpted from 29 CFR 1926.62)

1. **Action Level:** Employee exposure, without regard to the use of respirators, to an airborne lead concentration of 30 micrograms per cubic meter (30 ug/m^3) calculated as an 8-hour time-weighted average (TWA). Exceedance of the Action Level requires blood lead monitoring implementation.

2. **Competent Person:** One who is capable of identifying existing and predictable lead hazards in the surroundings or working conditions and who has the authorization to take prompt corrective measures to eliminate them. For LBP work, the Competent Person shall also be the on-site Supervisor/Foreman in-charge of the work crew.

3. **Exposure Assessment:** Each employer who has a workplace or operation covered by 29 CFR 1926.62 shall initially determine if any employee may be exposed to lead at or above the Action Level.

4. **Lead:** Metallic lead, all inorganic lead compounds, and organic lead soaps. Excluded from this definition are all other organic lead compounds.

5. **Lead-Based Paint (LBP):** Paint, varnish, shellac or other coatings on surfaces that contain 1.0 milligram per square centimeter (1.0 mg/cm^2) or more lead or 0.5% or more lead by weight. The concentration 0.5% is equivalent to:

   a. 5,000 parts per million (5,000 ppm) and;

   b. 5,000 milligrams per kilogram (5,000 mg/kg)

6. **Lead-Containing Paint (LCP):** Paint, varnish, shellac or other coatings on surfaces that contain measurable concentrations less than 1.0 milligrams per square centimeter (1.0 mg/cm^2) lead or less than 0.5% or more lead by weight including equivalents less

than 5,000 ppm and 5,000 mg/kg. This does not include paint, varnish, shellac or other coatings on surfaces where the concentration is below the detection limit of the respective laboratory method / device.

7. **LBP Inspection:** A surface by surface investigation to determine the presence of LBP. A report is then issued that identifies if there is LBP present and where it is located.

8. **Lead Risk Assessor:** EPA trained and certified to conduct LBP inspections and collect samples for the presence of lead in air, dust and soil for the purposes of abatement clearance testing as well as conduct risk assessments.

9. **Permissible Exposure Limit (PEL):** The limit above which the employer shall not expose workers to lead. The current PEL for lead is 50 ug/m^3 over an eight-hour time-weighted-average for all employees covered.

B. General Requirements

The Contractor is required to perform all work related to this project in strict accordance with all applicable Federal, State and Local regulations.

Where these requirements vary, the most stringent shall apply.

C. Specific Requirements

1. American National Standards Institute (ANSI)
ANSI Z9.2-79 – Fundamentals Governing the Design and Operation of Local Exhaust Systems.

2. Z88.2-80 – Practice for Respiratory Protection.

3. Code of Federal Regulations (CFR)

4. 29 CFR Part 1910.120 – Hazardous Waste Operations and Emergency Response.

5. 29 CFR Part 1910.134 – Respiratory Protection.

6. 29 CFR Part 1910.146 – Confined Space Entry Program.

7. 29 CFR Part 1910.1025 – Lead (General Industry Standard).

8. 29 CFR Part 1910.1200 – Hazard Communication.

9. 29 CFR Part 1926.55 – Gases, Vapors, Fumes, Dusts and Mists.

10. 29 CFR Part 1926.57 – Ventilation.

11. 29 CFR Part 1926.62 – Lead (Construction Industry Standard).

12. 40 CFR Part 260 – Hazardous Waste Management Systems: General.

13. 40 CFR Part 261 – Identification and Listing of Hazardous Waste.

14. 40 CFR Part 262 – Generators of Hazardous Wastes.

15. 40 CFR Part 263 – Transporters of Hazardous Waste.

16. 40 CFR Part 264 – Owners and Operators of Hazardous Waste Treatment, Storage & Disposal Facilities.

17. 40 CFR Part 265 – Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage & Disposal Facilities.

18. 40 CFR Part 268 – Land Disposal Restrictions.

19. 40 CFR Part 745 – Lead; Requirements for Lead-Based Paint Activities in Child Occupied Facilities

20. 49 CFR Parts 170-178 – Department of Transportation Regulations.

21. New York Codes of Rules and Regulations (NYCRR)
    a. 6 NYCRR Part 360 – Solid Waste Regulations.
    b. 6 NYCRR Part 364 – Waste Transporter Permits.
    c. 6 NYCRR Part 370-373 – Hazardous Waste Regulations.

22. Steel Structures Painting Council (SSPC)
    a. SSPC-Guide 6 – Guide for Containing Debris Generated During Paint Removal Operations.
    b. SSPC-Guide 7 – Guide for the Disposal of Lead-Contaminated Surface Preparation Debris.

23. Underwriters Laboratories. Inc. (UL)
    a. UL 586 – High Efficiency, Particulate Air Filter Units.

1.3 QUALITY ASSURANCE

The Contractor's Competent Person is required to maintain a copy of the following documents on-site:

A. Qualifications

1. Contractor: Documentation that the Contractor has prior experience on LBP and LCP activity projects similar in nature and extent to ensure the capability to perform the required work procedures in a satisfactory manner.

2. Competent Person: Certification that the Contractor's full-time on-site Competent Person meets the Competent Person requirements of 29 CFR Part 1926.62 and is experienced in administration and supervision of LBP and LCP activity projects, including work practices, protective measures for building and personnel, disposal procedures, etc. The Competent Person shall also be the project Supervisor.

3. Contractor's Testing Laboratory: Documentation that the laboratory performing the OSHA personal sample analysis is an EPA National Lead Laboratory Accreditation Program (NLLAP) accredited laboratory and that it is listed proficient in the NIOSH/EPA Environmental Lead Proficiency Analytical Testing Program (ELPAT), and is a New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP) certified laboratory. Certification shall include accreditation for heavy metal analysis, and a Quality Assurance and Quality Control Program. Currently, the American Association for Laboratory Accreditation (ASLA) and the American Industrial Hygiene Association (AIHA) are the EPA recognized laboratory accreditors. Documentation shall include the date of accreditation or reaccreditation.

4. Blood Lead Testing Laboratory: Adequate documentation that the laboratory is certified to perform blood lead analysis for the State where the work site is located.

B. Respiratory Protection Devices

Manufacturer's NIOSH certification for respiratory protection devices utilized on the site.

C. Cartridges, Filters, and Vacuum Systems

Manufacturer's NIOSH certification of approval of respirator cartridges (organic vapor, acid gas, mist, dust, high efficiency particulate); High Efficiency Particulate Air (HEPA) filtration capabilities for all cartridges, filters, and HEPA vacuum systems.

D. Medical Examination and Records

1. Certification that employees who are involved in LBP and LCP work have received medical examinations and will receive continued medical surveillance, including blood lead level monitoring, as required by 29 CFR Part 1926.62, 29 CFR Part 910.1200, 29 CFR Part 1910.120 and by the state and local regulations pertaining to such work. Records shall be retained, at Contractor expense, in accordance with 29 CFR Part 1910.20.

2. Provide medical surveillance to workers until exposure monitoring reveals that workers are not exposed to airborne lead at or above the Action Level of 30 ug/m^3. This consists of a blood test measuring the level of lead and zinc protoporphyrin by a licensed physician. Further testing and medical exams may be necessary depending on the results of initial blood tests and/or the initial exposure assessment.

E. Training

Training certification shall be maintained and posted at the site, prior to the start of work involving LBP and LCP work, for all of the Contractors' workers, supervisors and Competent Person. Training shall meet the requirements of 29 CFR Part 1926.62, 29 CFR Part 1926.59, 29 CFR Part 1910.1200 and 49 CFR 172. Training shall be provided prior to the time of job assignment and as required by the regulations thereafter. The project specific training shall, at a minimum, include the following.

1. Lead Paint Awareness Training as per 29 CFR 1926.62.
2. Specific nature of the operation, which could result in exposure to lead.
3. Purpose, proper selection, fitting, use and limitations of respirators.
4. Purpose and description of the medical surveillance program and the medical removal protection program, including information concerning the adverse health effects associated with excessive exposure to lead (with particular attention to the adverse reproductive effects on both males and females, hazards to the fetus and additional precautions for employees who are pregnant).
5. Relevant engineering controls and good work practices.
6. The contents of any compliance plan in effect.
7. Instructions to employees that chelating agents should not routinely be used to remove lead from their bodies and should not be used at all except under the direction of a licensed physician.
8. The employee's right of access to records under 29 CFR part 1910.20.

F. Respiratory Protection Program

1. Furnish each employee required to wear a negative pressure respirator or other appropriate type with a respirator fit test at the time of initial fitting and at least every 12 months thereafter as required by 29 CFR Part1910.134 and 29 CFR Part 1926.62.
2. Establish and implement a respiratory protection program as required by ANSI Z88.2, 29 CFR Part 1910.134 and 29 CFR Part 1926.62.
3. All workers are required to don respirator(s) with the appropriate level of protection commensurate with the airborne concentrations of lead in which they are working. The level of protection will be determined by the Contractor, based on objective air monitoring data.

1.4 ON-SITE SUBMITTALS

The Contractor's Competent Person is required to maintain a copy of the following documents on-site:

A. Certifications

Prior to the start of work, maintain the on-site, required certifications and licenses listed above in Section 1.03.

B. Equipment List

Maintain a list of equipment items to be used in the work, including brand names, model, capacity, performance characteristics, quantities, and other pertinent information.

C. LBP and LCP Safe Work Practice Compliance Plan

The contractor shall prepare a detailed LBP and LCP Safe Work Practice Compliance Plan that identifies the work procedures, health and safety measures to be used in LBP and LCP work procedures; and that addresses spill prevention, containment, and emergency response procedures. The Plan shall be maintained on-site. The plan shall address the methods to be undertaken during LBP and LCP disturbances to include all requirements of 1926.62(e)(2)(ii) including, but not limited to the following key elements:

1. LBP and LCP containment methods to control employee exposure to lead at or below the permissible exposure limit.
2. Training requirements as required by Federal, State, and Local regulations.
3. Unique problems associated with the LBP and LCP project.
4. Sketch of location and details of LBP and LCP control areas, decontamination procedures.
5. Eating, drinking, smoking, and rest room procedures.
6. Sequencing of LBP and LCP related work.
7. Personal protective equipment and respiratory protection program, including controls.
8. Engineering controls, containment structures and safety measures. Refer to 1.07, D of this Section for HEPA filtered negative air unit requirements, as applicable.
9. Worker exposure assessment procedures.
10. Work Practice controls.
11. Housekeeping.
12. Hygiene facilities and practice.

13. Medical surveillance, including medical removal procedures.
14. Sampling, testing and analytical methods for personal air sampling requirements of 29 CFR Part 1926.62. Procedures must include frequency, locations, sampling, and analytical methods to be used.
15. Contractor to include the segregation and minimization of lead waste streams from construction and demolition waste in their lead-based paint management plan.
16. Visual clearance log for each control area that is maintained by the Contractor's Competent Person.

D. Compliance Program

Contractor's Compliance Program prepared in accordance with 29 CFR Part 1926.62 (e) (2) shall be maintained on-site.

E. Sampling and Laboratory Analysis Reports

Maintain on-site all field sampling logs for all personal air samples taken, including copies of laboratory analysis reports and chain of custody records for all sample analyses.

F. Competent Person certification per Sections 1.02 and 1.03.

1.5 CLOSEOUT SUBMITTALS: At the conclusion of the LBP/LCP project, the Contractor shall provide the following closeout submittals:

1. Submit copies of all "Visual Clearance Logs" to the Project Manager for owner's reference.
2. Signed Certification from the Contractor's Competent Person that all required documentation has been provided.

1.6 POSTED WARNINGS & NOTICES

The following regulations, warnings and notices shall be posted at the work site in accordance with 29 CFR Part 1926.62.

A. Regulations

A copy of applicable Federal, State, and Local regulations shall be maintained at the work site.

B. Warning Signs

Warning signs shall be provided at approaches to LBP/LCP control areas. Signs shall be located at a distance from the LBP and LCP control areas that will allow personnel to read the sign and take the necessary protective actions required before entering the LBP/LCP control area. The signs shall comply with the requirements of 29 CFR Part 1926.62.

C. Worker Information

Right-to-know notices shall be placed in clearly visible areas of the work site in compliance with Federal, State and Local regulations.

D. Exposure Air Monitoring Results

Exposure air monitoring results shall be prepared in order to be easily understood by the workers and shall be placed in a clearly visible area of the work site.

E. Emergency Telephone Numbers

A list of telephone numbers shall be posted at the site. The list shall include numbers of the local hospital, emergency squad, police and fire departments, Government and Contractor representatives who can be reached 24 hours per day as well as professional consultants directly involved in the project.

1.7 EQUIPMENT & MATERIALS

Sufficient quantities of health and safety materials required by 29 CFR Part 1926.62, and other materials and equipment needed to complete the project, shall be available and kept on the site.

A. Respirators

Air-purifying respirators shall be approved by NIOSH for use with dust, fumes and mists having permissible exposure limits less than 0.05 milligrams per cubic meter (i.e. have high-efficiency particulate air [HEPA] filters) and for other hazardous airborne contaminants that may be encountered, as determined by the Competent Person. The Contractor shall furnish, at no cost to personnel/employees, respirators to provide protection from airborne concentrations of lead. Respirators shall comply with the requirements of 29 CFR Part 1926.62 and shall be used in accordance with 29 CFR Part 1926.62, 29 CFR Part 1926.103 and 29 CFR Part 1910.134.

B. Respirator Cartridges

A sufficient supply of respirator cartridges shall be maintained at the work site to provide new cartridges to employees and authorized visitors throughout the duration of the project. Cartridges shall be replaced according to the manufacturer’s recommendations, when breathing becomes difficult, or if the cartridges become wet.

C. Protective Clothing

1. The Contractor shall furnish, at no cost to personnel/employee, equipment/ clothing for protection from airborne and waterborne LBP and LCP debris. An adequate supply of these items shall be available for worker and authorized visitor use. Workers and visitors shall not take protective clothing and equipment off the work site at any time. Protective clothing includes:

   a. Coveralls (Whole Body Protective Coverings): Full-body coveralls and head covers shall be worn by workers in the control area as necessary. Sleeves shall be secured at the wrist and pants legs at the ankle with tape. Permeable clothing shall be provided in heat-stress conditions. Where non-disposable coveralls are provided, these coveralls shall be cleaned after each wearing and kept within the control area or decon/airlock (bagged). Cleaning of coveralls and other non-disposable clothing shall be in accordance with the provisions for cleaning in 29 CFR Part 1926.62.

   b. Boots: Work boots with nonskid soles or impermeable work boot covers shall be worn by workers. Where required by OSHA, safety boots (steel toe or steel toe and shank) shall be worn. Paint the uppers of boots red with waterproof enamel. Do not allow boots to be removed from the control area for any reason after being contaminated with LBP or LCP debris. Keep within control area or decon/airlock (bagged).

   c. Gloves: Inner gloves, appropriate for items and hazards encountered, and disposable outer work gloves shall be provided to each worker and shall be worn while the worker is in the control area. Glove material shall be appropriate for

the specific chemical exposure. Gloves shall not be removed from the control area and shall be disposed of as LBP or LCP contaminated waste at the end of the work.

d. Hard Hats: Head protection (hard hats) shall be provided as required by OSHA for workers and authorized visitors. Protective plastic-strap suspension hats shall be used. Hard hats shall be worn at all times when work is in progress. Hard hats shall remain in the control area until the project is completed. Hard hats shall be thoroughly cleaned, decontaminated, dried and bagged before being removed from the control area at the end of the project.

e. Eye Protection: Fog-proof goggles for personnel engaged in LBP and LCP operations shall be worn when the use of a full-face piece respirator is not required and kept within control area or decon/airlock (bagged) until completion of project.

D. Negative Air Pressure System

When a LBP or LCP control area requires the use of an airtight containment barrier, a negative air pressure system shall be used and pressure differential recordings taken. LBP and LCP shall not be removed from the LBP/LCP control area until the proper engineering controls and HEPA filtration systems are in place.

1. HEPA Filter Requirements

The negative air pressure system shall be equipped with approved HEPA filters per UL 586. Negative air pressure equipment shall be equipped with new HEPA filters, and shall be sufficient to maintain a minimum pressure differential of minus 5 Pascals (Pa), equivalent to 0.02 inch of water column relative to adjacent, unsealed areas. Negative air pressure system minimum requirements are listed below.

a. The unit shall be capable of delivering its rated volume of air with a clean first stage filter, an intermediate filter and a primary HEPA filter in place. The units shall be clean and sealed (intake & exhaust) at all times when not operating in a control area.

b. The HEPA filter shall be certified as being capable of removing particles as small as 0.3 micrometers at a minimum efficiency of 99.97 percent. 700 hours is the manufacturer life recommendation of a HEPA filter (approximately 1 month of continuous operating).

c. The unit shall be capable of continuing to deliver no less than 70 percent of rated capacity when the HEPA filter is 70 percent full or measures 620 Pa (2.5 inches of water) static pressure differential on a magnehelic gauge.

d. The unit shall be equipped with a manometer-type negative pressure differential monitor with minor scale division of 0.02 inch of water and accuracy within plus or minus 1.0 percent. The manometer shall be calibrated in accordance with the manufacturer’s recommendations. Record manually manometer readings of the pressure differential between the LBP control area and adjacent unsealed areas at the beginning and end of each work day.

e. The unit shall be equipped with a means for the operator to easily interpret the readings in terms of the volumetric flow rate of air per minute moving through the machine at any given moment.

f. The unit shall be equipped with an electronic mechanism that automatically shuts the machine off in the event of a filter breech or absence of a filter.

g. The unit shall be equipped with an audible horn that sounds an alarm when the machine has shut itself off.

h. The unit shall be equipped with an automatic safety mechanism that prevents a worker from improperly inserting the main HEPA filter.

i. The unit shall be ducted through the containment barrier wall to the exterior of the building. The unit shall not be exhausted into any interior areas. If exhausting to the exterior is not feasible, utilize an unoccupied area or room that is large enough to handle the volume of air with two units connected in series. Applicable warning signage shall be posted at this location. Prior approval is required if exhausting into the interior of the building.

2. Number of Units Required

The air within the containment barrier shall be changed at least once every 15 minutes by a continuously operating negative air pressure system, until the LBP/LCP control area barrier is removed. Filters shall be replaced as necessary to maintain the efficiency of the system. A back-up unit shall be maintained on-site.

3. Auxiliary Generator

If site conditions can't provide power, an auxiliary generator shall be provided. The generator shall not present a carbon monoxide hazard to workers.

4. Discontinuing Negative Air Pressure System

The negative air pressure system shall not be shut down during LBP/LCP work unless authorized by the third-party environmental consultant. At the completion of the LBP/LCP work procedures and disposal project, units shall be run until removal is completed satisfactorily and full cleanup has been completed and satisfactory clearance has been achieved. Dismantling of the negative air pressure systems shall conform to the written decontamination procedures. Prefilters shall be removed and properly disposed. The intake and exhaust of the machines shall be sealed with polyethylene to prevent environmental contamination.

E. Expendable Materials

1. Polyethylene Sheet and Bags - General

Polyethylene sheet and bags shall be minimum 6-mil thick. Bags shall have pre-printed labels, and 5-inch (minimum) long plastic ties, pointed and looped to secure the filled bags. Polyethylene sheets shall be in roll sizes to minimize seams.

2. Polyethylene Sheet - Flame Resistant

Where a potential for fire exists, flame-resistant polyethylene sheets shall be provided. Polyethylene film shall conform to the requirements of NFPA 701.

3. Polyethylene Sheet - Reinforced

Reinforced polyethylene sheet shall be provided where high skin strength is required such as where it constitutes the only barrier between the LBP control area and the indoor and outdoor environments. The sheet stock shall consist of translucent, nylon-reinforced or woven-polyethylene thread laminated between two layers of polyethylene film. Film shall meet flame resistant standards of NFPA 701.

4. Tape and Adhesive Spray

Tape and adhesive shall be capable of sealing joints between polyethylene sheets and for attachment of polyethylene sheets to adjacent surfaces. After dry application, tape or adhesive shall retain adhesion when exposed to wet conditions, including amended water. Tape shall be minimum 2 inches wide, industrial strength.

5. Containers

DOT approved impermeable containers shall be used to receive and retain LBP and LCP waste and debris and lead contaminated material until disposal. Containers shall be labeled in accordance with EPA, DOT and OSHA standards, as applicable for the type of waste. Waste streams shall be segregated in a manner to reduce the potential volume of hazardous waste generated.

6. Chemicals

Chemicals, including caustics and paint strippers, shall be properly labeled, stored in leak-tight containers and properly/safely secured from the general public.

F. Vacuum Systems

HEPA filtered vacuum systems shall be used during LBP/LCP operations which generate dust. The systems shall be suitably sized for the project, and filters shall be capable of removing particles as small as 0.3 micrometers at a minimum efficiency of 99.97 percent. Vacuum opening, wands and hoses shall be sealed at all times when not in a control area.

G. Chemical Paint Strippers

Chemical paint strippers shall contain no methylene chloride.

H. Chemical Paint Stripper Neutralizer

Neutralizers for paint strippers shall be compatible with the substrate and suitable for use with the chemical stripper that has been applied to the surface.

I. Storage of Materials

Materials shall be stored in an approved enclosed structure, which protects them from damage, rain, wind, etc. and contamination. During periods of cold weather, plastic materials shall be protected from the cold. Regularly inspect materials to identify damaged or deteriorating items. Damaged or deteriorated items shall not be used and shall be removed from the site as soon as they are discovered. Stored materials shall not present a hazard or an inconvenience to workers, visitors, employees and/or other building occupants.

PART 2 – EXECUTION

2.1 WORK PROCEDURES

LBP and LCP work procedures and related work shall be performed in accordance with the accepted Contractor's LBP and LCP Safe Work Practice Compliance Plan, 29 CFR Part 1926.62 and as specified herein. LBP/LCP waste and debris, lead contaminated debris and personal protective clothing and equipment shall be disposed of in compliance with Federal, State, and Local regulations and in accordance with the respective waste stream TCLP testing results.

A. Personal Protection Procedures

Respiratory Protection is required for all LBP disturbances. Personnel shall wear and use protective clothing and equipment as specified and required by 29 CFR Part 1926.62

and 29 CFR Part 1910.120. Eating, smoking, drinking, chewing tobacco, chewing gum, applying makeup and use of non-work-related walkie-talkies/phones shall not be permitted in the LBP and LCP control area. Personnel of trades not engaged in the LBP or LCP work procedures and disposal of LBP and LCP shall not be exposed at any time to airborne concentrations of lead equal to or in excess of 30 micrograms per cubic meter of air (30 ug/m^3). Electrical service shall be disconnected when wet removal is performed, and temporary electrical service protected by a ground fault circuit interrupter (GFCI) shall be provided.

B. Safety and Health Procedures

The Competent Person shall be present on the work site throughout the LBP and LCP project to supervise, monitor and document the project's health and safety provisions. A daily log shall be maintained showing the results of air sampling tests throughout the project area. LBP and LCP work being conducted within a LBP or LCP control area where an airtight barrier is required shall be stopped if measured airborne lead concentrations, collected during LBP or LCP work procedures, exceed the Action Level.

C. Safety and Health Responsibilities

The Competent Person shall:

1. Verify that training meets applicable requirements.
2. Review and approve LBP/LCP Safe Work Practice Compliance Plan for conformance to the applicable referenced standards.
3. Inspect LBP and LCP removal work for conformance with the accepted Safe Work Practice Compliance Plan.
4. Ensure that worker exposure air monitoring activities are in accordance with 29 CFR Part 1926.62.
5. Ensure work is performed in strict accordance with specifications.
6. Ensure hazardous exposure to personnel and to the environment are adequately controlled.
7. The Contractor's Competent Person shall be responsible for directing personal air monitoring and shall also perform visual inspections prior to the visual inspection conducted by third-Party Environmental Consultant (if applicable), to verify the control areas are free of all visible debris.
8. If required, the Contractor's Competent Person shall coordinate with the owner and the third-party environmental consultant for any control areas requiring final air/wipe testing clearance testing (Action Level/wipe) in accordance with OSHA and/or US Department of Housing and Urban Development (HUD) protocols.

D. Medical Surveillance Procedures

Medical surveillance shall be implemented in accordance with the accepted Contractor's LBP/LCP Safe Work Practice Compliance Plan and shall comply with the requirements of 29 CFR Part 1926.62, including the provisions for blood lead level monitoring, medical removal, protection and a physician's written opinion, signed by the physician performing the employee examination. The Contractor's Competent Person shall maintain on-site, a copy of the written opinion for Contractor's employees prior to each employee's commencement of work.

E. Engineering Controls and Containment Structures

Engineering and work practice controls are the primary means of maintaining exposures to lead below the PEL. Paint removal and surface preparation activities must keep dust levels at a minimum. Power tools must be equipped with manufacturer equipped vacuum shrouds including an attached HEPA filtered vacuum system.

1. LBP/LCP Control Area

   The control area is where LBP/LCP work procedures occur and as such shall be considered contaminated. The LBP/LCP control area shall be isolated to prevent LBP/LCP containing dust or debris from passing into adjacent areas. The control area shall be decontaminated at the completion of the LBP/LCP work procedures and disposal work.

2. Boundary Requirements.

   Physical boundaries along with Warning Signage shall be provided around exterior LBP/LCP control areas by taping off the area indicated in the Safe Work Practice Compliance Plan.

3. Control Barriers

   The LBP/LCP control area shall be designated and separated from other outside areas with control barriers. The polyethylene sheeting shall mask and seal all openings. The LBP/LCP control area shall be erected according to the Contractors LBP/LCP Safe Work Practice Compliance Plan. Polyethylene sheeting shall be mechanically supported, independent of duct tape or spray adhesive.

4. Exterior Masking and Sealing

   Exterior LBP/LCP control area requirements: Where the construction of a contained LBP/LCP control area is impractical or not required based on the method of lead work procedures, a taped-off perimeter shall be installed around the area where the LBP/LCP handling procedures are performed and other requirements for LBP/LCP control areas shall be maintained. Personal monitoring of airborne concentrations is still required and shall be conducted in accordance with 29 CFR Part 1926.62.

5. Hand Wash Station

   An operational hand washing station shall be provided to all workers adjacent to each LBP/LCP control area utilizing polyethylene sheeting as a drop cloth. Water shall be hot and cold or warm. Soap dish, continuing supply of soap, and clean towels shall be provided. The hand wash station shall be maintained in a sanitary condition. Waste water shall be collected and placed within 6-mil polyethylene bags and sealed. Bags shall be immediately placed within non-leaking, drums and sealed.

6. Equipment Decontamination

   An equipment decontamination area shall be installed at the entrance to each LBP/LCP control area to allow for the cleaning of all equipment utilized on the project. Polyethylene sheeting shall be utilized as a drop cloth, along with a utility tub to clean and capture debris/water during the cleaning process. Water shall be hot and cold or warm. Continuing supply of detergent, and clean towels shall be provided. The equipment decontamination area shall be maintained in a sanitary condition. Waste water shall be collected and placed within 6-mil polyethylene bags and sealed. Bags shall be immediately placed within non-leaking, drums and sealed.

F. Temporary Utilities

1. Temporary equipment as necessary to provide adequate power, light, heat, and water shall be installed, as needed, to accomplish the LBP/LCP operations properly and safely. The Contractor shall maintain the security and maintenance of the utility system in the LBP/LCP control areas. In the event of a failure of any utility system, the Owner will not

be responsible for any loss of time or other expense incurred by the Contractor. In addition to any site-specific temporary utility requirements, the Contractor shall provide:

a. Back-flow protection on all water connections. Fittings installed by the Contractor shall be removed after completion of work with no damage or alteration to existing water piping and equipment.

b. When applicable, heavy-duty abrasion-resistant hoses to provide water to each control area and decontamination area.

c. A hot water heater, if necessary, to provide warm water to the decontamination showers, hand wash station and equipment decontamination area.

d. Electrical service to control areas. Electrical service shall comply with National Electric Code, State and Local requirements and UL standards. Warning signs shall be posted at power outlets, which are other than 110-120 volt power. Only grounded extension cords connected into a GFCI shall be used. Incandescent lamps and light fixtures shall be of adequate wattage to provide good illumination in LBP/LCP control areas.

e. Temporary heating units, when needed, that have been tested and labeled by UL, FM, or another recognized trade association related to the fuel being consumed. Forced air or fan type units shall not be utilized inside a control area. Units shall have tip-over protection.

2.2 LEAD-BASED/CONTAINING PAINT WORK PRACTICES (Use methods as applicable)

A. Component Removal:

Components shall be removed intact to the extent practicable. A 6-mil polyethylene drop cloth shall be placed around and/or beneath the component, prior to its removal, to catch any paint chips that may become dislodged. The component shall be wrapped and sealed in a layer of clear 6-mil polyethylene prior to movement to the disposal container. Follow proper disposal requirements. The area around the component removal shall be wet wiped and HEPA vacuumed. The polyethylene sheeting shall be carefully folded in on itself and placed in a 6-mil disposal bag. Containment debris shall be properly stored of in accordance with respective waste stream as per the Contractor’s LBP/LCP Safe Work Practice Compliance Plan

B. Chemical Stripping:

Chemical stripping may be used for LBP and LCP removal on surfaces that will be subjected to welding, cutting, torch burning or where it is the only acceptable procedure. No chemical strippers or associated neutralizer chemicals containing methylene chloride shall be used by the Contractor on this project.

1. Horizontal surfaces directly below and in a radial direction from the area where chemical stripping is to be performed shall be covered with 6-mil plastic sheeting and shall also extend ten (10) feet on either side of the control area or to the furthest practical distance to catch any paint chips that may become dislodged.

2. All LBP/LCP on specified surfaces shall be removed to the bare substrate. The job is not considered complete until the substrate is dry, free of paint, debris, and LBP/LCP residue.

3. LBP/LCP stripping agents shall be brushed or troweled on the designated surfaces, or otherwise applied to a minimum thickness in accordance with manufacturer's specifications.

4. The required application/reaction time for stripping will depend upon the ambient temperature, humidity, and thickness of LBP/LCP. If LBP/LCP is not completely removed following the initial application of stripper, additional applications and wet scrapings may be required.

5. Removed LBP/LCP shall not be deposited on the polyethylene containment surfaces but shall be transferred directly into clear 6-mil polyethylene bags from the scraper and sealed. LBP/LCP shall be removed by wet scraping to the maximum extent feasible. If the substrate is to be reused, the removal activities shall not damage the substrate.

6. Any residue not removable by wet scraping shall be washed down to the bare metal substrate with an appropriate, pre-approved solution. LBP/LCP-contaminated wastewater shall be kept to a minimum using wet scrub brushes or sponges. These residues and disposable cleaning media shall also be directly transferred to 6-mil polyethylene bags and sealed. Bags shall be immediately placed within non-leaking, drums and sealed. Free standing water shall be eliminated by use of a drying agent. Contractor to include the segregation and minimization of lead waste from construction and demolition waste in their LBP/LCP Safe Work Practice Compliance Plan .

C. Manual Demolition/Scraping/Cleaning:

1. Manual demolition, scraping, sanding and power tool cleaning with dust collection systems shall be performed in conjunction with engineering and work practice controls meeting the requirements of 29 CFR 1926.62(e)(1).

2. Seal openings of HVAC ductwork and other penetrations (doors, windows, etc.) within the Control Area with two layers of 6-mil polyethylene sheeting. For work on vertical surfaces, place a layer of 6-mil polyethylene sheeting below the area prior to manual demolition/scraping/sanding/cleaning. The sheeting shall extend ten (10) feet on either side of the control area or to the furthest practical distance to catch any paint chips that may become dislodged.

3. Wet methods shall be used during manual scraping, sanding and power tool cleaning with dust collection systems. Local HEPA ventilation shall be utilized in conjunction with manual scraping, sanding and power tool cleaning with dust collection systems. In the case that local HEPA ventilation is not sufficient to control dust hazards, the Contractor shall be required to install engineering controls to meet requirements of specification section 1.06, D., “Negative Air Pressure System”.

4. Removed LBP/LCP shall not be allowed to accumulate on surfaces within the Control Area but shall be HEPA vacuumed or placed directly into 6-mil polyethylene bags. The Contractor shall maintain all surfaces as free as practicable of accumulated lead dust to prevent the dispersal of lead into the work places that are outside of the lead paint control areas. LBP/LCP shall be removed by manual methods to the maximum extent feasible.

5. Debris shall be bagged in 6-mil polyethylene bags, sealed, and secured in leak proof drums. The area around the surfaces subject to work shall be wet wiped and HEPA vacuumed, including the polyethylene sheeting. Upon a satisfactory clearance inspection by the owner’s Third-Party Environmental Consultant (if applicable) and the Contractor’s Competent Person, the cleaned polyethylene sheeting shall be carefully folded in on itself and placed in a 6-mil disposal bag. Containment debris shall be properly stored of in accordance with the respective waste stream as indicated in the contractor’s LBP/LCP Safe Work Practice Compliance Plan . The contractor shall coordinate with the owner’s third-party environmental consultant to test the waste streams for disposal.

D. Alternative Lead Work Procedures

1. Any work procedure deviating from the outlined procedures above shall be submitted to the owner and the Owner's third-party Environmental Consultant for review and approval prior to the start of the project. As there are many different components in different areas of the building(s), it is impractical to address every potential lead work procedure. The intent of alternative lead work procedures shall be to maintain compliance with 29 CFR 1926.62 and maintain airborne concentrations of lead dust below the Action Level of 30 ug/m^3.

2.3 PERSONAL AIR MONITORING, WASTE SAMPLING & CLEARANCE SAMPLING (If Required)

During all LBP/LCP removal and disposal operations, the Contractor's OSHA Competent Person shall be on-site inspecting the work to ensure that the health and safety requirements of this contract are satisfied. The owner may elect to have a Third-Party Environmental Consultant on-site to perform visual clearance inspections and/or clearance sampling.

A. Personal Air Monitoring (Provided by the Contractor, as necessary)

1. Personal air monitoring samples for airborne concentrations of lead shall be collected and analyzed in accordance with 29 CFR Part 1926.62. Results shall be reported in micrograms per cubic meter of air. The Competent Person shall use personal air monitoring results to determine the effectiveness of engineering controls, the adequacy of PPE and to determine if proper work practices are being employed. The owner's third-party environmental consultant shall be notified if any personal air monitoring result meets or exceeds 30 ug/m^3 of air. The Contractor shall stop work and take steps to reduce the concentration of lead in the air. Such corrective actions shall be documented in the daily log. Personal air sampling results shall be verbally available within 24-hours of sampling with hard copy reports available within five (5) calendar days of sampling.

B. Waste Sampling and Testing (Provided by the owner's Third Party Environmental Consultant)

1. Sampling and testing of all waste streams, shall be in accordance with 40 CFR Part 261, 6 NYCRR Part 371 and SW-846, Chapter 9, Sampling Plan. See Paragraph 2.05 C. of this specification section for waste sampling and analyses requirements.

C. Dust/Wipe Sampling (If Required)

1. Dust/wipe samples shall be taken after clean-up activities have been completed and the control areas passed a visual inspection. Refer to Section 2.01 C. 7. for visual inspection requirements.
2. Sampling for clearance criteria shall be performed in compliance with HUD Guidance document.
3. If clearance fails, the recleaning and any additional costs (dust/wipe sample analyses, etc.) to clear the control area shall be the responsibility of the Contractor. The control area shall remain in place until satisfactory clearance has been achieved.
4. Clearance Levels:
   a. Floors: 10 ug/ft^2
   b. Window Sills: 50 ug/ft^2
   c. Window Wells: 100 ug/ft^2

2.4 ADJACENT AREAS

Damage to adjacent areas shall be repaired by the Contractor to the approval of the Owner.

2.5 CLEAN-UP & DISPOSAL

A. Cleanup

1. Daily:
Surfaces in the LBP/LCP control area shall be maintained free of accumulations of paint chips, LBP/LCP debris and dust. Spread of dust and debris shall be restricted; waste shall not be distributed over the control area. Dry sweeping or compressed air shall not be used for cleanup. At the end of each shift, the area shall be cleaned of visible lead paint contamination by vacuuming with a HEPA filtered vacuum cleaner and wet wiping the area. LBP/LCP work procedures shall cease during the cleanup.

2. At completion of LBP/LCP work and a satisfactory visual inspection by the owner's Third Party Environmental Consultant (if applicable) and OSHA Competent Person, a clean-up shall be performed by the Contractor. This clean-up includes removal of any contaminated material, equipment or debris including polyethylene sheeting from the control area. The polyethylene sheeting shall be sprayed or misted with water for dust control, construction debris removed and polyethylene sheeting wet wiped. Then the sheeting shall be removed by folding it in upon itself.

   a. Lead-contaminated debris shall be containerized in accordance with the Contractor's LBP/LCP Safe Work Practice Compliance Plan Waste bags shall not be overloaded and shall be securely sealed and stored in the designated area.

   b. Removal of surface polyethylene sheeting shall begin from top to bottom. Removal of floor polyethylene sheeting shall begin at the corners and folded in the middle to contain the dust. Polyethylene shall be disposed of as per the Contractor's LBP/LCP Safe Work Practice Compliance Plan Cleaning Equipment. The Contractor shall decontaminate the lead abatement equipment and equipment used in the control area. The wastewater from cleaning shall be contained, sampled and disposed of as specified within Section 2.01 E. 6. and 2.02 B. 7 *and as per* contractor's LBP/LCP Safe Work Practice Compliance Plan.

B. Certification

1. The Contractor's Competent Person shall certify and sign within the log that the respiratory protection for the employees was adequate, the work procedures were performed in accordance with 29 CFR Part 1926.62 and that there was no visible accumulations of LBP/LCP paint/coating or dust on the worksite. Do not remove warning signs at the lead control area or roped-off boundary signs prior to the completion of the Competent Person's signed certification. If applicable, the Contractor's Competent Person's certification shall be forwarded to the Project Manager and the Third Party Environmental Consultant's for review prior to removing warning signs at the lead control area or roped-off boundary signs.

C. Waste Storage and Disposal (Provided by the Contractor) and Sampling/Analysis (Provided by Third Party Environmental Consultant).

1. LBP/LCP Wastes and Lead-Contaminated Water.

END OF SECTION 02 83 10

ASBESTOS ABATEMENT GENERAL NOTES, SCOPE OF WORK AND DETAILS

EXHIBIT H

PROJECT NOTES

1. All work shall be performed in strict accordance with the project documents and NYS ICR 56, where conflicts occurs between the project documents and applicable codes, rules and regulations, the most stringent shall apply.

2. The abatement contractor is responsible for confirming the location and quantity of all ACM in the project scope of work. Abatement contractor shall be responsible for all project filings, including NYS DOL and US EPA Filings.

3. The contractor shall coordinate locations of decontamination units, egress routes, and waste container with the owner's representative (s). In case locations that are more appropriate for the decontamination unit are determined at any time during the abatement, they may be relocated.

4. The contractor shall define, as part of their project specific work plan, the location of accessible temporary power and water supply in coordination with the owner's representative. Abatement Contractor may be responsible for supplying 55-gallon drums for water supply and generators for electric supply. Temporary connections shall extend from the source to the work area at the ceiling height, disconnect water between work shifts.

5. All materials shall be removed completely down to the substrate, to a surface that is free and clear of all residues and made suitable for replacement materials. Abatement Contractor shall leave clean demarcations at the borders of removals to facilitate replacement materials.

6. In the case of ACM floor tile abatement, abatement contractor shall be responsible for removing all layers of flooring down to the final substrate.

7. The abatement contractor shall coordinate with the facility for assistance to connect electrical panel for temporary power needed for the abatement. All lock-out-tag-out procedures shall be followed in accordance with OSHA regulations.

8. Abatement contractor shall develop a phasing plan and sequence to operations for all work areas.

9. Prior to abatement in the elevator machine room, the abatement contractor shall receive written verification that electrical equipment targeted by the abatement has been disconnected and all lock-out tag-out protocols have been observed.

10. No waste shall be stored inside the work area or inside the waste decontamination unit between work shifts. A temporary waste holding area may be required.

11. The Contractor shall use barrier tape to extend the limits of the active, regulated work areas closed to the public and other non-abatement trades.

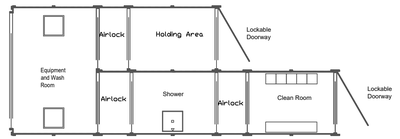
12. Alternate means of egress shall be made available to the public during the abatement work.

13. Any assumed ACM may be tested during construction by the owner's environmental consultant to assess its true asbestos content, if any.

FLOOR / LEVEL / LOCATION	WORK AREA DESIGNATION	DESCRIPTION OF ASBESTOS MATERIALS	REMOVAL METHOD(S)	APPROXIMATE QUANTITY (SF/UNIT)
PHASE 1				
ELEVATOR CAR 3	1	2ND LAYER FLOOR TILE	ICR 56-7.11	40.0 SF
		ASSUMED CONCEALED ELEVATOR INSULATION MATERIAL WITHIN ELEVATOR WALL PANELS		160.0 SF
ELEVATOR CAR 4		2ND LAYER FLOOR TILE		40.0 SF
		ASSUMED CONCEALED ELEVATOR INSULATION MATERIAL WITHIN ELEVATOR WALL PANELS		160.0 SF
1ST FLOOR ELEVATOR LOBBY		ASSUMED MARBLE WALL PANELS AND MASTIC		2.0 SF
		ASSUMED 2X2 SPLINE CEILING TILES AT CAR 3		4.0 SF
		ASSUMED 2X2 SPLINE CEILING TILES AT CAR 4		4.0 SF
2ND FLOOR ELEVATOR LOBBY	2	ASSUMED MARBLE WALL PANELS AND MASTIC	ICR 56-11.3	2.0 SF
		ASSUMED 2X2 SPLINE CEILING TILES AT CAR 3		4.0 SF
		ASSUMED 2X2 SPLINE CEILING TILES AT CAR 4		4.0 SF
3RD FLOOR ELEVATOR LOBBY	3	ASSUMED MARBLE WALL PANELS AND MASTIC	ICR 56-11.3	2.0 SF
		ASSUMED 2X2 SPLINE CEILING TILES AT CAR 3		4.0 SF
		ASSUMED 2X2 SPLINE CEILING TILES AT CAR 4		4.0 SF
4TH FLOOR ELEVATOR LOBBY	4	ASSUMED MARBLE WALL PANELS AND MASTIC	ICR 56-11.3	2.0 SF
		ASSUMED 2X2 SPLINE CEILING TILES AT CAR 3		4.0 SF
		ASSUMED 2X2 SPLINE CEILING TILES AT CAR 4		4.0 SF
PHASE 2				
ELEVATOR CAR 5	5	2ND LAYER FLOOR TILE	ICR 56-7.11	40.0 SF
		ASSUMED CONCEALED ELEVATOR INSULATION MATERIAL WITHIN ELEVATOR WALL PANELS		160.0 SF
1ST FLOOR - ELEVATOR LOBBY		ASSUMED 2X2 SPLINE CEILING TILES AT CAR 5		4.0 SF
2ND FLOOR - ELEVATOR LOBBY	6	ASSUMED 2X2 SPLINE CEILING TILES AT CAR 5	ICR 56-11.3	4.0 SF
3RD FLOOR ELEVATOR LOBBY	7	ASSUMED 2X2 SPLINE CEILING TILES AT CAR 5	ICR 56-11.3	4.0 SF
4TH FLOOR - ELEVATOR LOBBY	8	ASSUMED 2X2 SPLINE CEILING TILES AT CAR 5	ICR 56-11.3	4.0 SF
ELEVATOR MACHINE ROOM	9	CIRCUIT BOARD MATERIAL	ICR 56-7.11	90.0 SF
		WHITE CLOTH ELECTRIC WIRE INSULATION		30.0 SF
			TOTAL QUANTITY (SF/UNITS)	**776.0 SF**



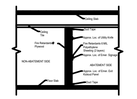
1 H100 MINOR PROJECT WASH STATION
NOT TO SCALE



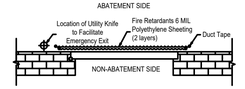
2 H100 LARGE PROJECT WORKER / WASTE DECONTAMINATION UNIT
NOT TO SCALE



3 H100 WORKER AIR LOCK
NOT TO SCALE



4 H100 TYPICAL HARD WALL BARRIER AT OPENINGS MORE THAN 32SF
Not To Scale



6 H100 TYPICAL SOFT WALL BARRIER AT OPENINGS LESS THAN 32SF (OPERABLE DOORWAYS)
Not To Scale



5 H100 SMALL PROJECT WORKER / WASTE DECONTAMINATION UNIT
NOT TO SCALE

NCDPW MISSION 21 ELEVATOR MODERNIZATION
CONTRACT No.

LiRo Architects + Planners P.C.
ARCHITECTURE
PLANNING
INTERIOR DESIGN
MINEOLA
235 East Jericho Turnpike
Mineola, NY 11501
516-746-2350 [P]

LiRo Engineers, Inc.
MEP
3 Aerial Way
Syosset, NY 11791
516.938.5476 [P]
516.937.5421 [F]
Structural
235 E Jericho Turnpike
Mineola, NY 11501
516.746.2350 [P]
(c) The LiRo Group All Rights Reserved

CONSULTANT:
BOCA GROUP
BOCA GROUP East, LLC
MetLife Building
200 Park Ave, 11th Fl.
East Mezzanine
New York, NY 10166
Nasco Construction Services
200 Business Park Drive
Armonk, NY 10504

ISSUED/REVISION:

Date	Description
6/13/25	100% DESIGN DEVELOPMENT
11/07/25	100% CONSTRUCTION DOCUMENT
12/12/25	ISSUE FOR BID

KEY PLAN: NASSAU COUNTY SUPREME COURT

100 SUPREME COURT DRIVE,
MINEOLA NY 11501

This plan is approved only for work indicated on the application specification sheet. All other matters shown are not to be relied upon, or to be considered as either being approved or in accordance with applicable codes.

DOB APP. #:

DOB APPROVAL STAMP:

DRAWING TITLE:

ASBESTOS ABATEMENT PLAN - GENERAL NOTES

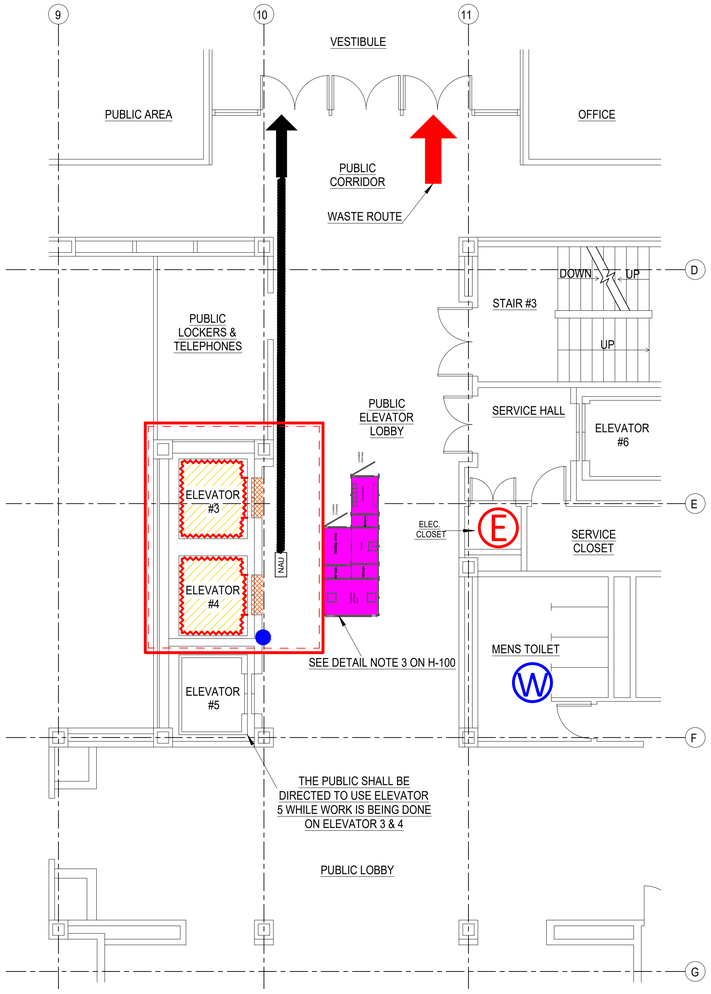
DRAWN BY: SY
CHECKED BY: SV
SCALE: AS NOTED
PROJECT NO.: 22-058-0248.08
SEAL:

DRAWING NO.:

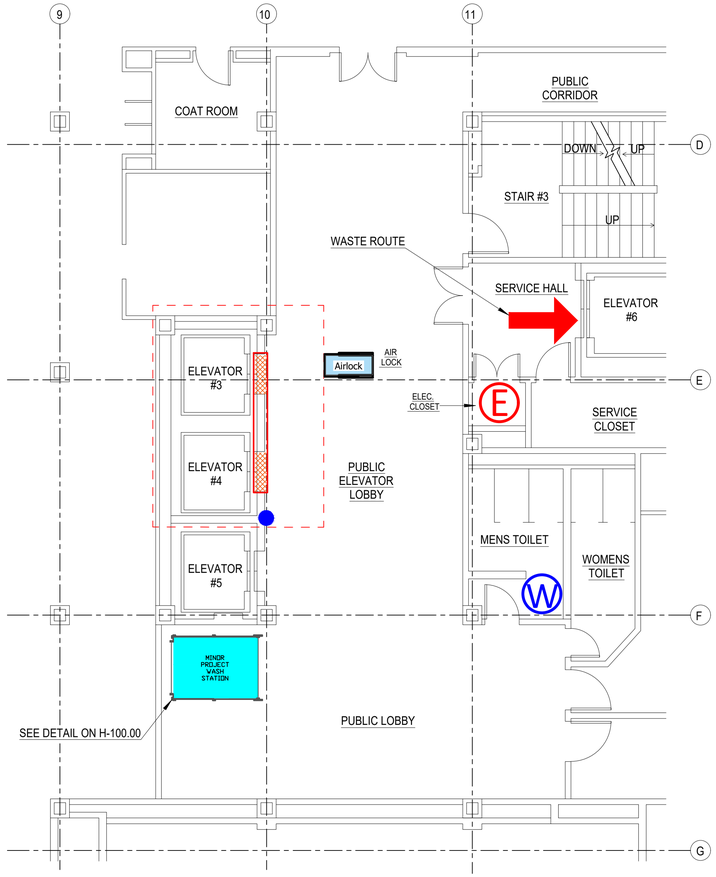
H-100.00

PROJECT LOCATION:
Autodesk Docs://NCDPW Mission 21 Elevator Project/NCDPW Mission 21 Elevator Project.rvt

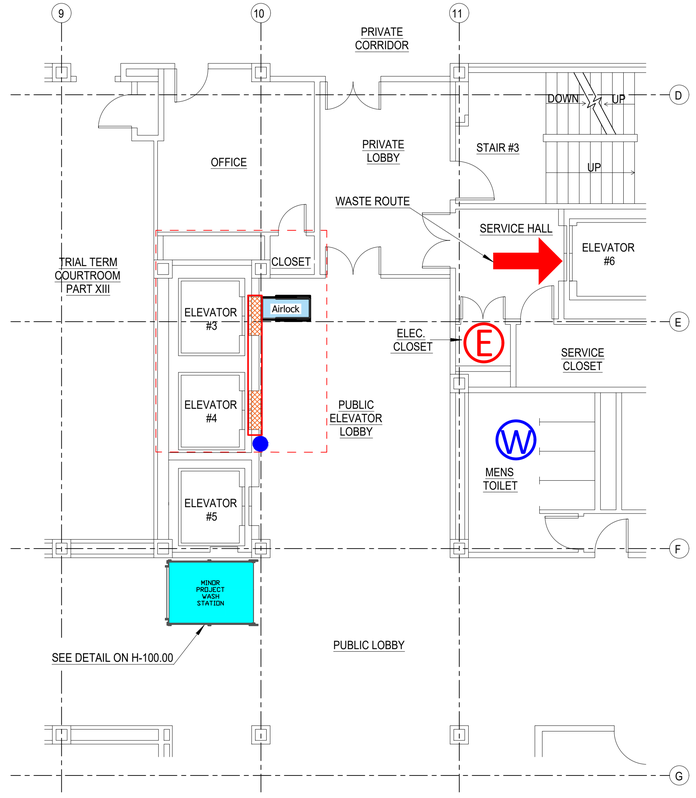
DATE & TIME PRINTED: 10/22/2025 12:30:28 PM



1 **FIRST FL LOBBY PLAN WORK AREA 1**
1/8" = 1'-0"



2 **SECOND FL LOBBY PLAN WORK AREA 2**
1/8" = 1'-0"



3 **THIRD FL LOBBY PLAN WORK AREA 3**
1/8" = 1'-0"

PHASE 1

LEGEND:

W	TEMPORARY WATER SOURCE (RECOMMENDED LOCATION)
E	TEMPORARY ELECTRICAL SOURCE (RECOMMENDED LOCATION)
NAU	NEGATIVE AIR PRESSURE UNIT & EXHAUST
	ACM 2ND LAYER FLOOR TILE – 40.0 SF
	LARGE PROJECT WORKER / WASTE DECONTAMINATION UNIT (RECOMMENDED LOCATION)
MINOR PROJECT WASH STATION	MINOR PROJECT WORKER WASH STATION
	WASTE ROUTE THROUGH FREIGHT ELEVATOR
	WORK AREA LIMITS
	ASSUMED 2X2 SPLINE CEILING TILES – 24.0 SF
	ASSUMED WALL MASTIC 6.0 SF
Airlock	AIR LOCK
	ASSUMED CONCEALED INSULATION

NCDPW MISSION 21 ELEVATOR MODERNIZATION
CONTRACT No.

LiRo Architects + Planners P.C.
ARCHITECTURE
PLANNING
INTERIOR DESIGN
MINEOLA
235 East Jericho Turnpike
Mineola, NY 11501
516-746-2350 [P]

LiRo Engineers, Inc.
MEP
3 Aerial Way
Syosset, NY 11791
516.938.5476 [P]
516.937.5421 [F]
Structural
235 E Jericho Turnpike
Mineola, NY 11501
516.746.2350 [P]

(c) The LiRo Group All Rights Reserved

CONSULTANT:

BOCA GROUP East, LLC
MetLife Building
200 Park Ave, 11th Fl.
East Mezzanine
New York, NY 10166

Nasco Construction Services
200 Business Park Drive
Armonk, NY 10504

ISSUED/REVISION:

Date	Description
6/13/25	100% DESIGN DEVELOPMENT
11/07/25	100% CONSTRUCTION DOCUMENT
12/12/25	ISSUE FOR BID

KEY PLAN: NASSAU COUNTY SUPREME COURT

100 SUPREME COURT DRIVE,
MINEOLA NY 11501

This plan is approved only for work indicated on the application specification sheet. All other matters shown are not to be relied upon, or to be considered as either being approved or in accordance with applicable codes.

DOB APP. #:

DOB APPROVAL STAMP:

DRAWING TITLE:

PHASE 1 - ABATEMENT PLAN

DRAWN BY: SY
CHECKED BY: SV
SCALE: AS NOTED
PROJECT NO.: 22-058-0248.08

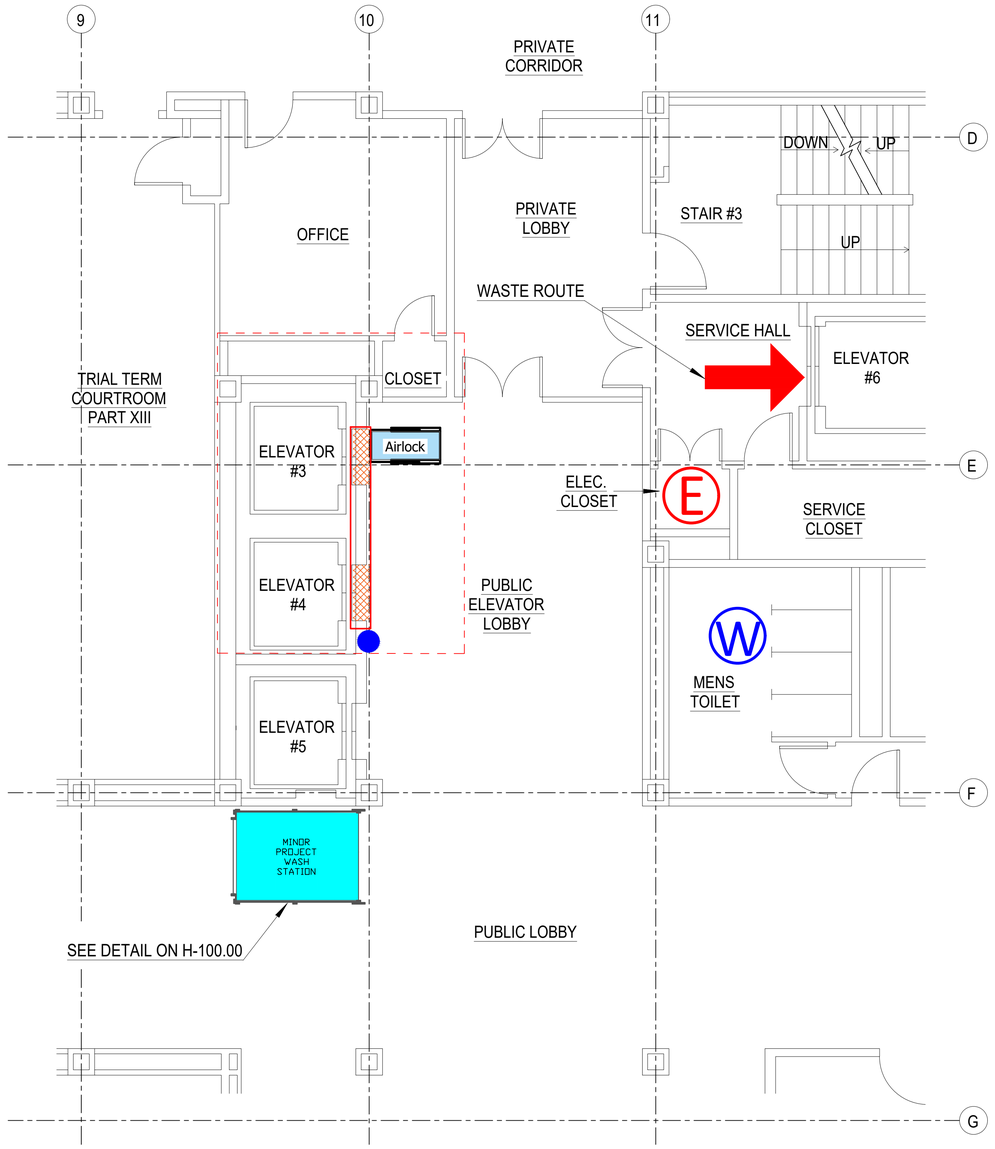
SEAL:

DRAWING NO.:

H-101.00

PROJECT LOCATION:
Autodesk Docs://NCDPW Mission 21 Elevator Project/NCDPW Mission 21 Elevator Project.rvt

DATE & TIME PRINTED: 10/22/2025 12:30:28 PM



1 **FORTH FL LOBBY PLAN WORK AREA 4**
1/8" = 1'-0"

PHASE 1

LEGEND:

W	TEMPORARY WATER SOURCE (RECOMMENDED LOCATION)
E	TEMPORARY ELECTRICAL SOURCE (RECOMMENDED LOCATION)
NAU	NEGATIVE AIR PRESSURE UNIT & EXHAUST
	ACM 2ND LAYER FLOOR TILE – 40.0 SF
	LARGE PROJECT WORKER / WASTE DECONTAMINATION UNIT (RECOMMENDED LOCATION)
	MINOR PROJECT WORKER WASH STATION
	WASTE ROUTE THROUGH FREIGHT ELEVATOR
	WORK AREA LIMITS
	ASSUMED 2X2 SPLINE CEILING TILES – 24.0 SF
	ASSUMED WALL MASTIC 6.0 SF
Airlock	AIR LOCK
	ASSUMED CONCEALED INSULATION

NCDPW MISSION 21 ELEVATOR MODERNIZATION
CONTRACT No.

LiRo Architects + Planners P.C.
ARCHITECTURE
PLANNING
INTERIOR DESIGN
MINEOLA
235 East Jericho Turnpike
Mineola, NY 11501
516-746-2350 [P]

LiRo Engineers, Inc.
MEP
3 Aerial Way
Syosset, NY 11791
516.938.5476 [P]
516.937.5421 [F]

Structural
235 E Jericho Turnpike
Mineola, NY 11501
516.746.2350 [P]

(c) The LiRo Group All Rights Reserved

CONSULTANT:

BOCA GROUP East, LLC
MetLife Building
200 Park Ave, 11th Fl.
East Mezzanine
New York, NY 10166

Nasco Construction Services
200 Business Park Drive
Armonk, NY 10504

ISSUED/REVISION:

Date	Description
6/13/25	100% DESIGN DEVELOPMENT
11/07/25	100% CONSTRUCTION DOCUMENT
12/12/25	ISSUE FOR BID

KEY PLAN: NASSAU COUNTY SUPREME COURT

100 SUPREME COURT DRIVE,
MINEOLA NY 11501

This plan is approved only for work indicated on the application specification sheet. All other matters shown are not to be relied upon, or to be considered as either being approved or in accordance with applicable codes.

DOB APP. #:

DOB APPROVAL STAMP:

DRAWING TITLE:

PHASE 1 - ABATEMENT PLAN

DRAWN BY: SY
CHECKED BY: SV
SCALE: AS NOTED
PROJECT NO.: 22-058-0248.08
SEAL:

DRAWING NO.:

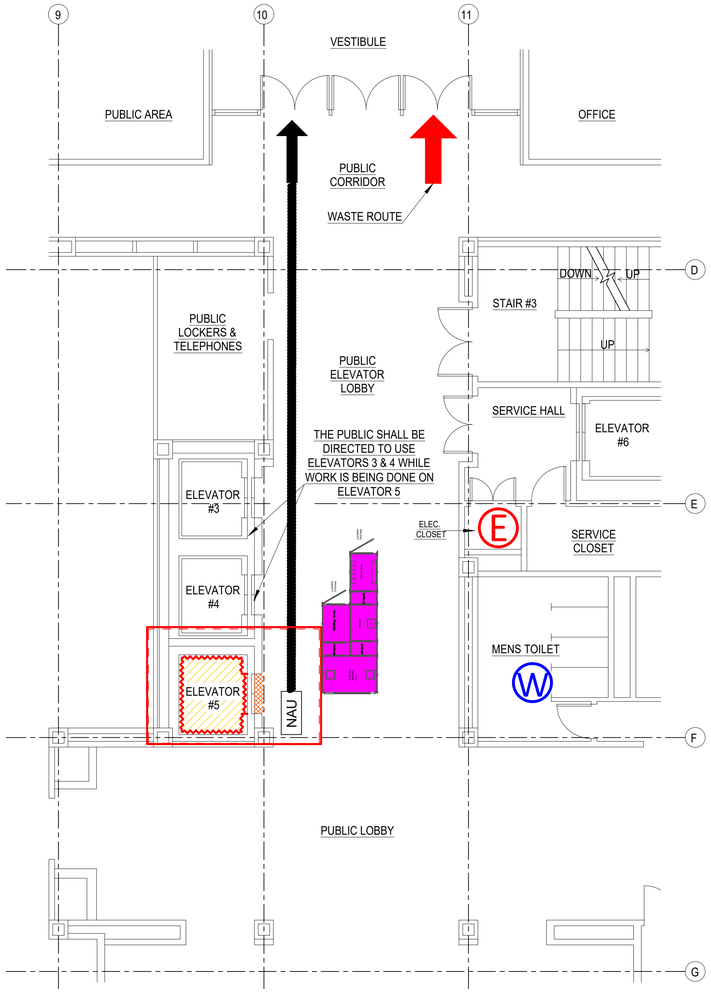
H-102.00

PROJECT LOCATION:
Autodesk Docs://NCDPW Mission 21 Elevator Project/NCDPW Mission 21 Elevator Project.rvt

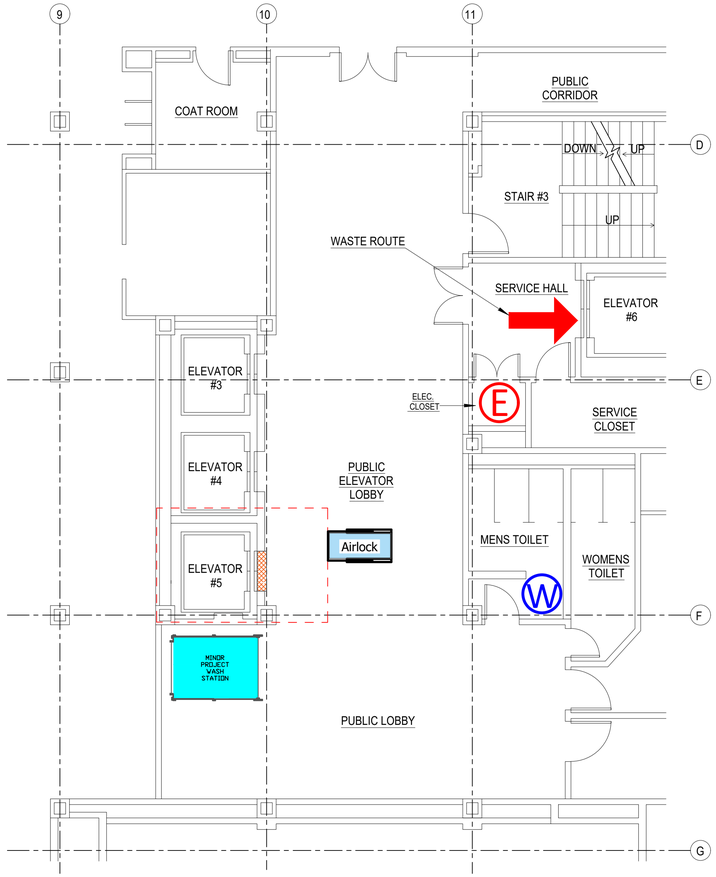
DATE & TIME PRINTED: 10/22/2025 12:30:28 PM

LEGEND:

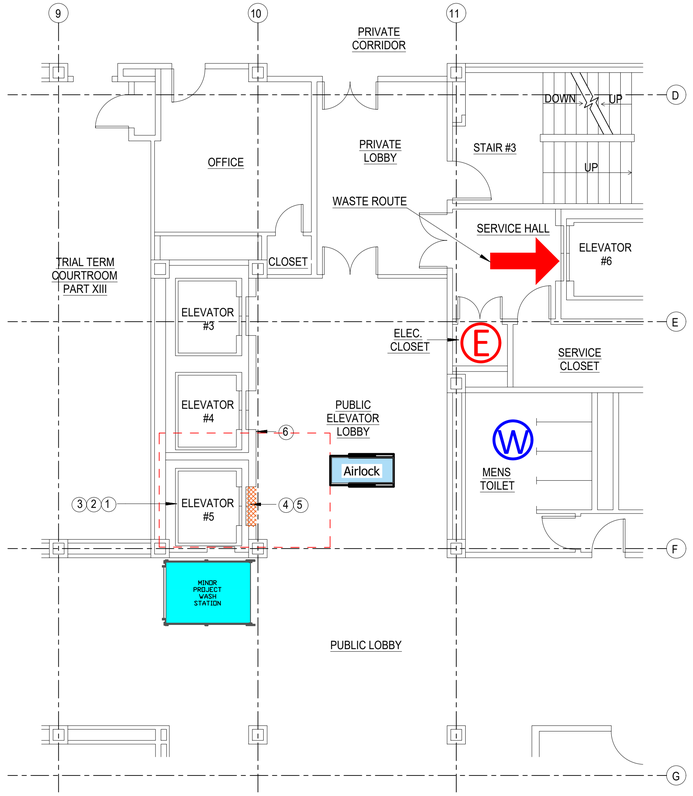
W	TEMPORARY WATER SOURCE (RECOMMENDED LOCATION)
E	TEMPORARY ELECTRICAL SOURCE (RECOMMENDED LOCATION)
NAU →	NEGATIVE AIR PRESSURE UNIT & EXHAUST
	ACM 2ND LAYER FLOOR TILE – 40.0 SF
LARGE PROJECT WORKER WASH STATION	LARGE PROJECT WORKER / WASTE DECONTAMINATION UNIT (RECOMMENDED LOCATION)
MINOR PROJECT WORKER WASH STATION	MINOR PROJECT WORKER WASH STATION
	WASTE ROUTE THROUGH FREIGHT ELEVATOR
	WORK AREA LIMITS
	ASSUMED 2X2 SPLINE CEILING TILES – 24.0 SF
	ASSUMED WALL MASTIC 6.0 SF
Airlock	AIR LOCK
	ASSUMED CONCEALED INSULATION



1 **FIRST FL LOBBY PLAN WORK AREA 5**
1/8" = 1'-0"



2 **SECOND FL LOBBY PLAN WORK AREA 6**
1/8" = 1'-0"



3 **THIRD FL LOBBY PLAN WORK AREA 7**
1/8" = 1'-0"

PHASE 2

NCDPW MISSION 21 ELEVATOR MODERNIZATION
CONTRACT No.

LiRo Architects + Planners P.C.
ARCHITECTURE
PLANNING
INTERIOR DESIGN
MINEOLA
235 East Jericho Turnpike
Mineola, NY 11501
516-746-2350 [P]

LiRo Engineers, Inc.
MEP
3 Aerial Way
Syosset, NY 11791
516.938.5476 [P]
516.937.5421 [F]
Structural
235 E Jericho Turnpike
Mineola, NY 11501
516.746.2350 [P]

(c) The LiRo Group All Rights Reserved

CONSULTANT:
BOCA GROUP

BOCA GROUP East, LLC
MetLife Building
200 Park Ave, 11th Fl.
East Mezzanine
New York, NY 10166

Nasco Construction Services
200 Business Park Drive
Armonk, NY 10504

ISSUED/REVISION:

Date	Description
6/13/25	100% DESIGN DEVELOPMENT
11/07/25	100% CONSTRUCTION DOCUMENT
12/12/25	ISSUE FOR BID

KEY PLAN: NASSAU COUNTY SUPREME COURT

100 SUPREME COURT DRIVE,
MINEOLA NY 11501

This plan is approved only for work indicated on the application specification sheet. All other matters shown are not to be relied upon, or to be considered as either being approved or in accordance with applicable codes.

DOB APP. #:

DOB APPROVAL STAMP:

DRAWING TITLE:

PHASE 2 - ABATEMENT PLAN

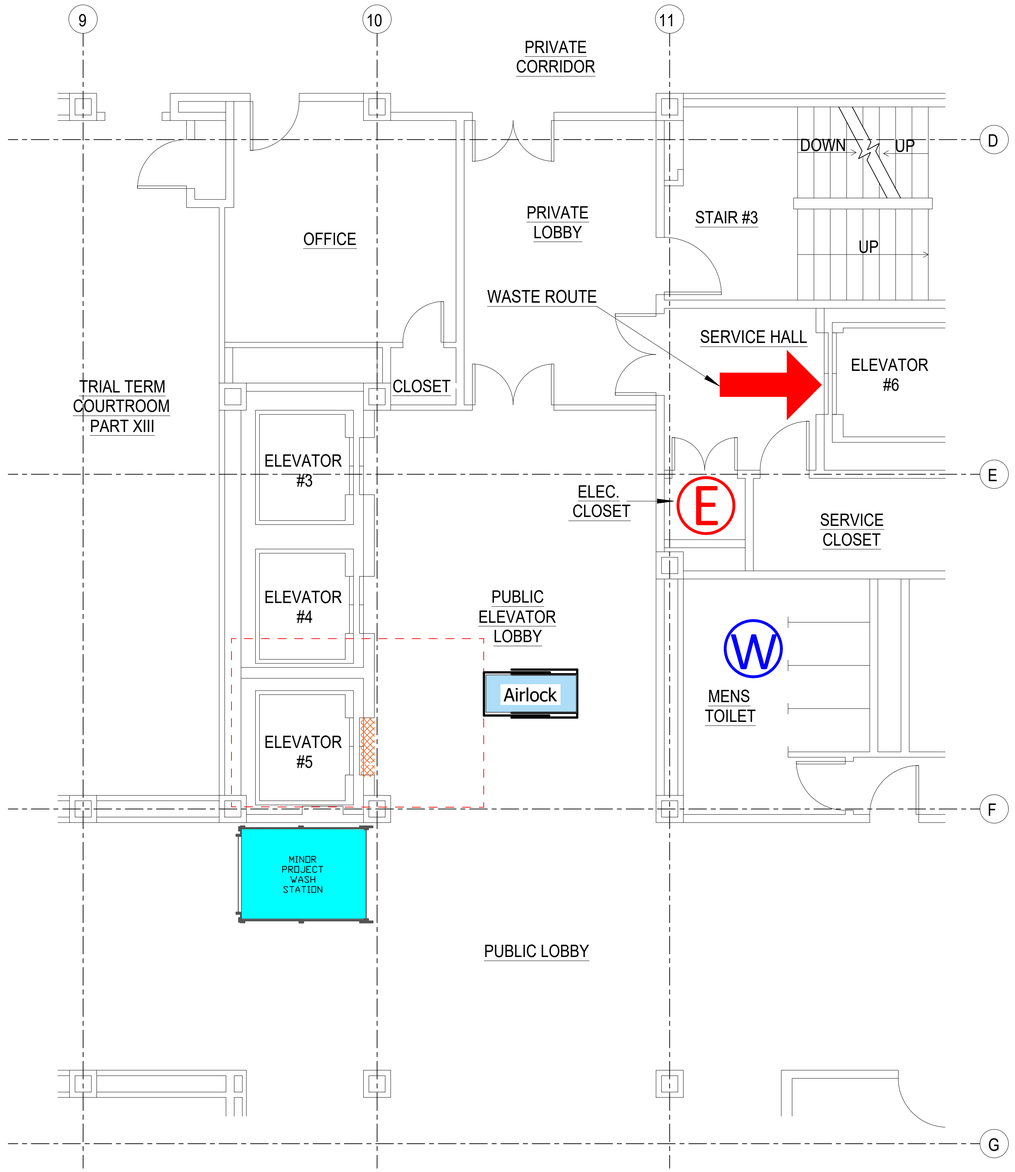
DRAWN BY: SY
CHECKED BY: SV
SCALE: AS NOTED
PROJECT NO.: 22-058-0248.08
SEAL:

DRAWING NO.:

H-103.00

PROJECT LOCATION:
Autodesk Docs://NCDPW Mission 21 Elevator Project/NCDPW Mission 21 Elevator Project.rvt

DATE & TIME PRINTED: 10/22/2025 12:30:28 PM



1 **THIRD FL LOBBY PLAN WORK AREA 8**
1/8" = 1'-0"

PHASE 2

LEGEND:

W	TEMPORARY WATER SOURCE (RECOMMENDED LOCATION)
E	TEMPORARY ELECTRICAL SOURCE (RECOMMENDED LOCATION)
NAU	NEGATIVE AIR PRESSURE UNIT & EXHAUST
	LARGE PROJECT WORKER / WASTE DECONTAMINATION UNIT (RECOMMENDED LOCATION)
	MINOR PROJECT WORKER WASH STATION
	WASTE ROUTE THROUGH FREIGHT ELEVATOR
	WORK AREA LIMITS
	ASSUMED 2X2 SPLINE CEILING TILES – 24.0 SF
Airlock	AIR LOCK

NCDPW MISSION 21 ELEVATOR MODERNIZATION
CONTRACT No.

LiRo Architects + Planners P.C.
ARCHITECTURE
PLANNING
INTERIOR DESIGN
MINEOLA
235 East Jericho Turnpike
Mineola, NY 11501
516-746-2350 [P]

LiRo Engineers, Inc.
MEP
3 Aerial Way
Syosset, NY 11791
516.938.5476 [P]
516.937.5421 [F]

Structural
235 E Jericho Turnpike
Mineola, NY 11501
516.746.2350 [P]

(c) The LiRo Group All Rights Reserved

CONSULTANT:
BOCA GROUP
BOCA GROUP East, LLC
MetLife Building
200 Park Ave, 11th Fl.
East Mezzanine
New York, NY 10166

Nasco Construction Services
200 Business Park Drive
Armonk, NY 10504

ISSUED/REVISION:

Date	Description
6/13/25	100% DESIGN DEVELOPMENT
11/07/25	100% CONSTRUCTION DOCUMENT
12/12/25	ISSUE FOR BID

KEY PLAN: NASSAU COUNTY SUPREME COURT

100 SUPREME COURT DRIVE,
MINEOLA NY 11501

This plan is approved only for work indicated on the application specification sheet. All other matters shown are not to be relied upon, or to be considered as either being approved or in accordance with applicable codes.

DOB APP. #:

DOB APPROVAL STAMP:

DRAWING TITLE:

PHASE 2 - ABATEMENT PLAN

DRAWN BY: SY
CHECKED BY: SV
SCALE: AS NOTED
PROJECT NO.: 22-058-0248.08
SEAL:

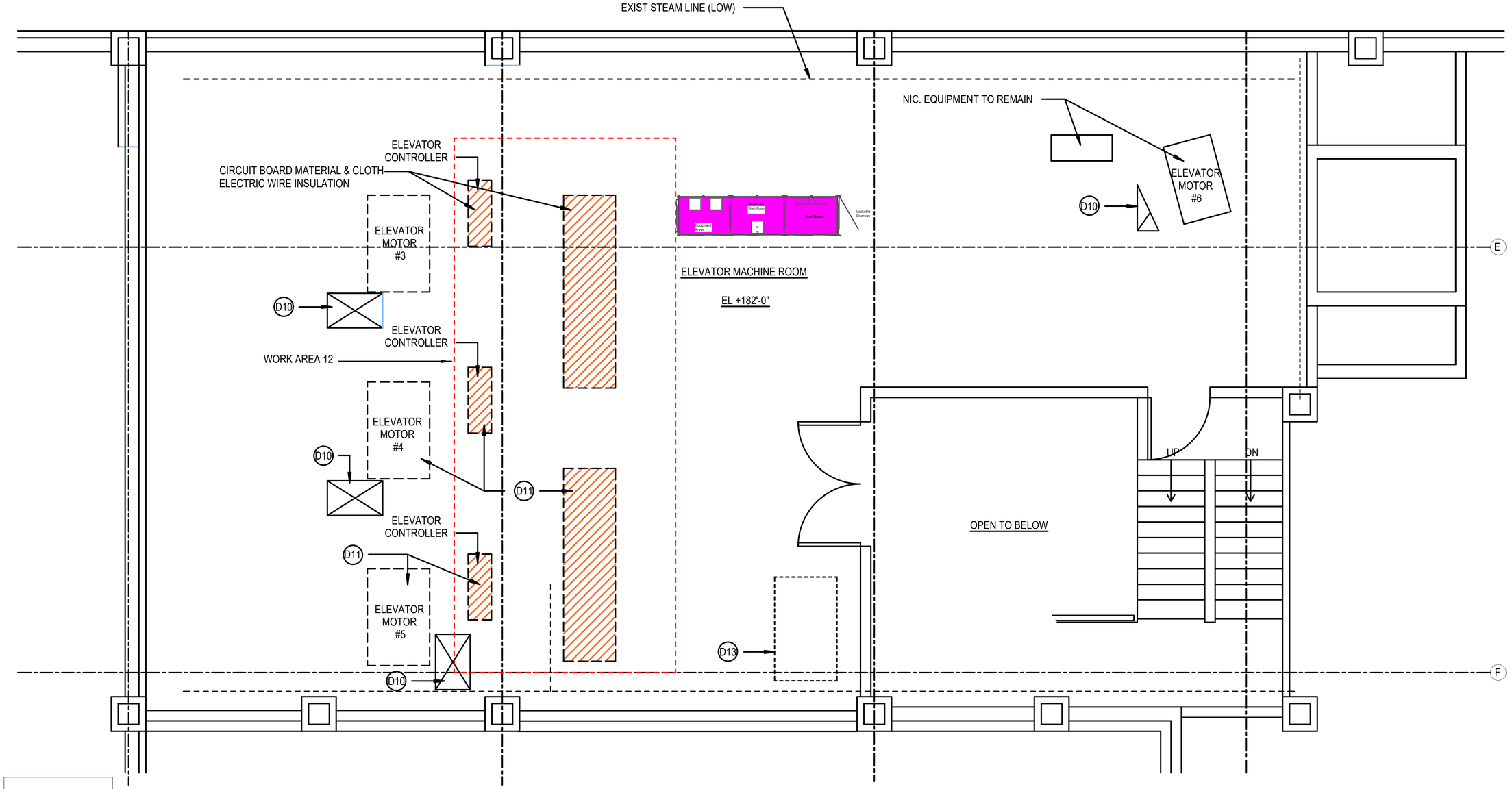
DRAWING NO.:

H-104.00

PROJECT LOCATION:
Autodesk Docs://NCDPW Mission 21 Elevator Project/NCDPW Mission 21 Elevator Project.rvt

DATE & TIME PRINTED: 10/22/2025 12:30:28 PM

LEGEND:	
W	TEMPORARY WATER SOURCE (RECOMMENDED LOCATION)
E	TEMPORARY ELECTRICAL SOURCE (RECOMMENDED LOCATION)
	CIRCUIT BOARD MATERIAL & CLOTH ELECTRIC WIRE INSULATION
	SMALL PROJECT WORKER / WASTE DECONTAMINATION UNIT (RECOMMENDED LOCATION)
	WORK AREA LIMITS



PHASE 2

1 **ELEVATOR MACHINE ROOM WORK AREA 9**
1/8" = 1'-0"

NCDPW MISSION 21 ELEVATOR MODERNIZATION
CONTRACT No.

LiRo Architects + Planners P.C.
ARCHITECTURE
PLANNING
INTERIOR DESIGN
MINEOLA
235 East Jericho Turnpike
Mineola, NY 11501
516-746-2350 [P]

LiRo Engineers, Inc.
MEP
3 Aerial Way
Syosset, NY 11791
516.938.5476 [P]
516.937.5421 [F]
Structural
235 E Jericho Turnpike
Mineola, NY 11501
516.746.2350 [P]

(c) The LiRo Group All Rights Reserved

CONSULTANT:
BOCA GROUP

BOCA GROUP East, LLC
MetLife Building
200 Park Ave, 11th Fl.
East Mezzanine
New York, NY 10166

Nasco Construction Services
200 Business Park Drive
Armonk, NY 10504

ISSUED/REVISION:

Date	Description
6/13/25	100% DESIGN DEVELOPMENT
11/07/25	100% CONSTRUCTION DOCUMENT
12/12/25	ISSUE FOR BID

KEY PLAN: NASSAU COUNTY SUPREME COURT

100 SUPREME COURT DRIVE,
MINEOLA NY 11501

This plan is approved only for work indicated on the application specification sheet. All other matters shown are not to be relied upon, or to be considered as either being approved or in accordance with applicable codes.

DOB APP. #:

DOB APPROVAL STAMP:

DRAWING TITLE:

PHASE 2 - ABATEMENT PLAN
ELEVATOR MACHINE ROOM

DRAWN BY: SY
CHECKED BY: SV
SCALE: AS NOTED
PROJECT NO.: 22-058-0248.08

SEAL:

DRAWING NO.:

H-105.00

PROJECT LOCATION:
Autodesk Docs://NCDPW Mission 21 Elevator Project/NCDPW Mission 21 Elevator Project.rvt

DATE & TIME PRINTED: 10/22/2025 12:30:28 PM