Procurement #: 49337>

CITY OF PROVIDENCE, RHODE ISLAND

Department: Public Property

RFP Title: GENERAL CONTRACTOR SERVICES FOR DAVEY LOPES RECREATION CENTER CPF IMPROVEMENTS

Opening Date: 06/02/2025

Addendum #: 2

Issue Date: 05/28/2025

The purpose of this addendum is to provide revised bidding specifications and drawings, and respond to bidder RFIs.

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Addendum #2 - Pre-Bid RFIs

to: All Plan Holders

date: May 28, 2025

project name & number: **Davey Lopes Recreation Center**
Providence, RI
BH+A Project No.3524

prepared by: Bargmann Hendrie + Archetype, Inc.
9 Channel Center Street, Suite 300
Boston, MA 02210

This Addendum forms part of the Contract Documents and modifies the original Bidding issued on April 18, 2025, as noted below.

Acknowledge receipt of this Addendum in the space provided in the appropriate space on the Form for General Bid. Failure to do so will subject the Bidder to disqualification.

This Addendum consists of ___7__ (x) pages and _5__ (x) attachments

attachments:

Section 102813 Toilet Accessories dated May 28, 2025
Section 230000 HVAC dated May 28, 2025
2023 Flooring Abatement Plan
BH+A Hazardous Materials Survey Report
Phasing and Logistics Plan

DLRC_Addendum #2 – Architectural dated May 28, 2025
Pages: A403, A404, A502, A610, D101
DLRC_Addendum #2 – Electrical dated May 28, 2025
Page: E300

Bentley Companies

1. Roofing - Roofing plans indicate 6" minimum insulation thickness, but then mimimum thickness at drain sumps is 2", please clarify.
   BH+A Response: See 3/A502 in Addendum #2. Minimum thickness of roof insulation is 6" except where additional slope is located at drains.
2. Roofing - Will 10 mil poly work on the concrete decks? If roof system is fully adhered, then you need to use a self-adhered vapor barrier. Please clarify.
   BH+A Response: See spec section 072713, sub-section 2.3 Self-Adhering Sheet Air Barrier for requirements.
3. HVAC - Who is the existing controls vendor for the building?
   Owner Response: There is no existing BAS – all systems and equipment will be new as specified.
4. Masonry / Steel - There are several new openings in CMU walls that aren't shown as receiving any lintels. Please clarify.
   BH+A Response: See 7/S200, 6/A600 in Addendum #1. See 1/A610 in Addendum #2 for clarity at new windows.
5. Demolition - Demo note D21 indicates cutting floor drain piping at exterior walls. Are we cutting up the slab to accomplish this? Or can drains not be capped and cut flush/below floor?
   BH+A Response: Revise Demolition Key Note 21 (D21) to state: Field locate connection point of existing floor drain waste lines and cut, cap, and make safe piping at sanitary main to avoid creating dead ends.

Collins Construction

1. Will there be Liquidated Damages on this project, and if so, how much will that be?
   Owner Response: Liquidated Damages will be assessed at $500/day past Substantial Completion.
2. What is the Substantial Completion Date on this project?
   Owner Response: June 30, 2026
3. Due to the change in scope in Addendum 1, will there be an extension of the Bid Due Date?
   Owner Response: Not at this time

Deslandes Construction

1. There is a note for the hardscape on C101 that states to R&D and replace existing sidewalk and reinstall, while on A004 shows the area to be plantings. Please clarify.

BH+A Response: Note on C101 Addendum #1 notes to refer to A004 for layout and materials. A004 is to take precedence and inform C101.

2. Please confirm that all lockers shown will receive the locker pad as shown in detail 7 on A510. Also, please confirm the furnish of install of lockers is part of the project, as it is noted as "by others" in the drawings.
   BH+A Response: All lockers within the locker rooms are to receive the pad as detailed in 7/A510 in the Construction Documents. A403 indicates the typical detail on elevations denoting lockers. Lockers are within construction scope. See architectural specifications for furnishing. See Addendum #1 Spec section 105126 for colors. Lockers outside of locker room are to be furnished with integral base.
3. Please clarify if the boy's locker room will receive slab demo similar to the girl's locker room due to the plumbing rework and underground piping.
   BH+A Response: Boy's locker room is over the basement and will not require slab demo to the extent the girl's room requires. Piping can be run vertically from the basement to the locations indicated on plumbing drawings.
4. Based on the site walk, please clarify the scope for the new bathroom and storage/mechanical room slab. The demo and construction plans do not depict what needs to be done.
   BH+A Response: Demolition scope is noted on D101 / D102. Slab infill is noted on A110 and S101 in the Construction Documents set.
5. Who are the existing controls by in the HVAC system.
   Owner Response: There is no existing BAS – all systems and equipment will be new as specified.
6. Can you confirm if it is required of all subcontractors on this project to participate in a documented apprenticeship program?
   Owner Response: Yes
7. Please provide a specification for the shower seats in the ADA showers.
   BH+A Response: See updated specification section: 102813. Insert paragraph N, TBA-12. See updated sheets A403 & A404.
8. The drawings show the exterior plaque to be bronze, where the new addendum calls out the exterior plaque to be galvanized steel. Please clarify the material for the exterior plaque.
   BH+A Response: See Addendum #1 4/A400 for plaque & 7/A004 for galvanized steel plates. Plaque is to be in the lobby. Galvanized steel plates at exterior concrete curbs are not plaques.

Dubon Masonry Construction

1. Will asbestos testing be provided by the City prior to bid?

Owner Response: Some testing and abatement has been performed to date. Those results are attached. GC is responsible to flag any potential hazardous materials for testing by Owner and Architect.

2. On sheet A100, no wall wags are shown on the walls for Storage B02. Please clarify.
   BH+A Response: See A100 Addendum #1 for wall type tags.
3. As detailed in the pre-bid, can you provide the phasing and logistic plans?
   Owner Response: See attached.

Tower Construction

1. Is a builder's risk policy required, if so, will the cost be the responsibility of the owner or the GC?
   Owner Response: Yes – to be provided by GC for the full value of the property.
2. This project has liquidated damages? If so, at time of award will the owner work with the contractor to establish an agreeable schedule based on long lead items, and the contractor will not be penalized by liquidated damages for any long lead items that we cannot control delivery on?
   Owner Response: Liquidated Damages will be assessed at $500/day past Substantial Completion. The executed contract will contain a provision that the contractor is not responsible for delays by suppliers.
3. Has the fire review been completed, and will the cost be paid by the owner or the GC?
   Owner Response: Fire review has not been completed. Permit and inspection fees are waived with the exception of State ADA/Levy fees.
4. Will permit fees be waived for this project?
   Owner Response: See above
5. Please confirm the MBE plan participation form are to be submitted within 5 business days of bid opening by the low bidder?
   Owner Response: MBE plan participation form and waiver (if required) are due at the time of bid.
6. Will any GC required testing costs be reimbursed by the owner?
   Owner Response: No
7. Will any utility connection fees/backcharges be reimbursed by the owner as they are unknown at time of bid?
   Owner Response: Yes
8. Please confirm there are no unit prices?
   BH+A Response: No unit pricing.
9. Who is the existing mechanical controls vendor in the building?
   Owner Response: There is no existing BAS – all systems and equipment will be new as specified.
10. Spec section 230000 lists file sub bid. Please confirm HVAC is not a file sub bid?

BH+A Response: Confirmed. No file sub-bid. See revised section 230000 with "filed sub-bid" verbiage deleted.

11. Please provide existing FA system manufacturer.
    Owner response: Existing FACP is Gamewell-FCI E3 series
12. The Lighting drawings E200 and E201 are a little confusing as the lighting fixtures are not typed on the drawings. Also there are no manufacturers shown for any of the fixtures except for the exits and battery units. Please advise.
    BH+A Response: See E300 Addendum #1 for light fixture schedule. See E300 Addendum #2 for addition of F-4 light in Storage / Mechanical spaces.
13. Which manufacturer was the main switch gear from pre purchased from?
    Owner Response: Eaton
14. Is there a hardware spec for the glass doors at the display cases on A511?
    BH+A Response: See spec section 088000 Glazing, 2.6 Display Case Glass Doors & Shelving, sub-section B / 2. Display Case Hardware.
15. What is the finish of MDF-1 and FP-1 as found at the reception desk on A515?
    BH+A Response: See A700 for finish schedule. MDF-1 is to be painted P-1.
16. Will the City of Providence accept a substitution for HDPE Lockers in lieu of plastic lockers?
    Owner Response: Yes
17. Please confirm the moisture vapor emission control is to only be installed at the resilient flooring?
    BH+A Response: MVE control is required at resilient flooring as well as the walk-off mat.
18. Can you clarify which windows will require film over the glass?
    BH+A Response: Windows at Locker rooms, shower rooms, restrooms, and zoom rooms are to receive film.
19. What is the schedule for the separate contract the owner has awarded for the new electrical? Will it be completed by June 2026?
    Owner Response: Yes the separate electrical contract will be complete well short of the June 2026 completion date for this contract.
20. Who is the contractor performing the electrical work hired by the owner?
    Owner Response: ANJ Electric Eye LLC
21. Will a temporary electrical service be required for this project?
    Owner Response: No, the existing service can be used up until the new main switch, transformer, and generator are installed and the service is changed over.
22. Is a temporary owners trailer be required?
    Owner Response: No
23. Who is responsible for removing the existing boxing ring from the interior pool location?
    Owner Response: The existing boxing ring will be removed outside of this contract.
24. Can you confirm if the BDA System as in Note #19 on Drawing E100 is a new system or is it existing?

BH+A Response: BDA is to be provided by Electrical Contractor. See note 19 on E100 for acceptable manufacturer.

25. Who is responsible to F&I raised planter beds shown on A004, is this part of the allowance?
    BH+A Response: Planter beds are to be part of the contracted work. Size and location to be coordinated with owner.
26. Looking for sizing of fan coil ductwork shown on H101.
    BH+A Response: See H101 Addendum #1 for ductwork sizing.
27. What is key value D22 on drawing D101?
    BH+A Response: Key Value D22 is to be deleted.
28. Can you clarify who is responsible for moving the existing furniture and equipment? Demo spec section 024119 1.6 B states "Before selective demolition, Owner will remove the following items: Loose furniture, Building equipment, Athletic equipment." And Drawing D101 Keynote D40 says "Remove existing furniture and equipment. Coordinate disposal/salvaging with owner"
    BH+A Response: The City of Providence will remove any items to be salvaged for reuse. All other items are the responsibility of the contractor.
29. The louvers are specified in both architectural and mechanical sections. Can you tell us who owns them?
    BH+A Response: Louvers at exterior walls are owned by spec Division 23. See detail on H300. Louvers in Doors are owned by spec Division 08.
30. The apprenticeship/first source ordinances. Can you please confirm the 15% of labor hours apply to field physical work on the project, not supervision?
    Owner Response: Correct, 15% applies to field physical labor only. Supervisors or managers who are not performing work onsite are not included in the project data for Apprentice Utilization Program (AUP) purposes. General foremen are included in the journey worker fields in the AUP data system.
31. How is the15% determined. Is it at the end of the project?
    Owner Response: Apprenticeships rates will be monitored throughout the project, but the 15% requirement will be measured against the total labor hours at the end of the project. Note that the 15% requirement is applied by subcontractor and by trade unless a waiver has been submitted and approved. The AUP data system will provide real-time AU percentages as project data is entered. The Building Futures team will provide monthly reports to the City and will pull additional reports upon request.
32. Is Building Futures the monitoring company affiliated with any unions?
    Owner Response: Building Futures partners with the RI Building Construction Trades Council, but bidders are not required to participate in a Building Futures or RIBCTC apprenticeship program. Bidders must have an apprenticeship program recognized by the State of RI.
33. Wil this monitoring agent be onsite for the duration of the project?

Owner Response: Apprenticeship rates are self-reported by GC and Subs and based on Certified Payroll reports.

34. What is the project budget? Is the project funded?

    Owner Response: The project is funded for a total project cost of $7,651,000.00

35. Is this project federally funded? If so what is the funding source?

    Owner Response: The project is fully funded by the US Department of Treasury Capital Projects Fund, FAIN #CPFFN0169 through the Pandemic Recovery Office within the State of Rhode Island Department of Administration.

36. Can the bid date be extended?

    Owner Response: There is no plan to extend the bid date at this time.

SECTION 102813 - TOILET ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:
   1. Toilet accessories

B. Products furnished by this Section installed by others"
   1. Warm Air Dryers installed by Section 260000 Electrical

C. RELATED SECTIONS
   1. Section 10 21 13.19 – Plastic Toilet Compartments mounting of toilet tissue dispensers, grab bars, purse shelves, and similar accessories.
   2. Section 220000-Plumbing for shower accessories that are integral to shower unit

1.2 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
   2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
   3. Include electrical characteristics.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
   1. Identify locations using room designations indicated.
   2. Identify accessories using designations indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For accessories to include in maintenance manuals.

1.6 WARRANTY

A. Manufacturer's Warranty for Washroom Accessories: Manufacturer's standard 1 year warranty for materials and workmanship.

B. Manufacturer's Warranty for Electric Hand Dryers: Manufacturer's standard 5 year warranty on parts, except 3 year warranty on motor brushes from date of purchase.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering accessories that may be incorporated into the Work include, but are not limited to, the following:
   1. Toilet Accessories:
      a. Bobrick Washroom Equipment, Inc. (Basis of Design)
      b. Bradley Corporation.
      c. World Dryer, www.worlddrryer.com is an acceptable manufacturer for hand dryers
      d. Or approved equal

B. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to those indicated in the Toilet and Bath Accessory Schedule at the end of Part 3.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units' level, plumb, and firmly anchored in locations and at heights indicated.
   1. Remove temporary labels and protective coatings.

B. Grab Bars: Install to comply with specified structural-performance requirements.

C. Shower Seats: Install to comply with specified structural-performance requirements.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Clean and polish exposed surfaces in accordance with manufacturer's written instructions.

3.3 TOILET ACCESSORY SCHEDULE

A. TBA-1A Mirror Custom
1. Basis-of-Design: Bobrick 2436
2. Frameless, Stainless Steel Mirrors:
3. Size: 23-1/2 inches (597mm) W x 35-1/2 inches H.
4. Mirror: 18-8, Type 304, 20 Gauge (0.9mm) stainless steel polished to a No. 8 mirror finish, 1/4-inch (6 mm) return. Four corner countersunk holes to provide flush fit of mounting screws with mirror surface.
5. Backing: 1/4 inch (6mm) thick tempered Masonite.
6. Mounting Hardware: Four countersunk sheet metal screws included with unit.

B. TBA—1B Mirror
1. Basis-of-Design: Bobrick 2460
2. Frameless, Stainless Steel Mirrors:
3. Size: 23-1/2 inches (597mm) W x 59-1/2 inches (902mm) H.
4. Mirror: 18-8, Type 304, 20 Gauge (0.9mm) stainless steel polished to a No. 8 mirror finish, 1/4-inch (6 mm) return. Four corner countersunk holes to provide flush fit of mounting screws with mirror surface.
5. Backing: 1/4 inch (6mm) thick tempered Masonite.
6. Mounting Hardware: Four countersunk sheet metal screws included with unit.

C. TBA-2 Toilet Paper Dispenser
1. Owner Provided

D. TBA-3 Trash Receptacle
1. Recessed Mounted Waste Receptacles:
2. Basis of Design: Bobrick Trim Line Model B-35639.
3. Description: Door conceals flange from view.
4. Cabinet: 18-8, Type 304, heavy-gauge stainless steel. All-welded construction.
5. Door: 18-8, Type 304, 18 gauge (1.2mm) stainless steel with satin finish; 3/4 inch (19mm) 90 degree return edges; Secured to cabinet with a concealed, full-length stainless steel piano-hinge. Equipped with a stainless steel cable door-swing limiter and one tumbler lock keyed like other Bobrick washroom accessories. Self-closing push door mounted on continuous stainless steel piano hinge.
6. Disposal Door: 18-8, Type 304, heavy-gauge stainless steel with satin finish. Secured to cabinet with spring-loaded, full length stainless steel piano hinge. Equipped with International graphic symbol identifying waste disposal.
7. Receptacle: 18-8, Type 304, heavy gauge stainless steel. All-welded construction. Removable for servicing. Capacity: 3 gallons (11.3 L).

E. TBA- 4 Soap Dispenser
1. Owner Provided

F. TBA-5 Sanitary Napkin Disposal Unit: Where this designation is indicated, provide unit serving two toilet compartments complying with the following:
1. WALL AND PARTITION MOUNTED : As follows:
   a. Basis-of-Design Product: Bobrick B-5270 “Matrix Series” or approved equal.
   b. Mounting: Back to Back through partition
   c. Material: Stainless steel.
   d. Door or Cover: Self-closing.

G. TBA-6; Grab Bar Toilets: Where this designation is indicated, provide stainless-steel grab bar complying with the following:
1. Products: Bobrick model B.6806 x 42 inch or approved equal.
2. Material: Stainless-Steel Nominal Thickness: 18 gage
3. Mounting: Concealed with manufacturer's standard flanges and anchors
4. Gripping Surfaces: Manufacturer's standard slip-resistant "peened" texture
5. Outside Diameter: 1-1/2 inches (38 mm) for heavy-duty applications

G.1 TBA-6B; Grab Bar Showers: Where this designation is indicated, provide stainless-steel grab bar complying with the following:
6. Products: Bobrick model B-58616 or approved equal.
7. Description: Two-Wall Grab-Bar 24 inch by 36 inch
8. Material: Stainless-Steel Nominal Thickness: 18 gage
9. Mounting: Concealed with manufacturer's standard flanges and anchors
10. Gripping Surfaces: Manufacturer's standard slip-resistant "peened" texture
11. Outside Diameter: 1-1/4 inches (32 mm) for heavy-duty applications

H. TBA-7- Electric Hand Dryer
1. Basis of Design: Bobrick Trim Dry Model B-7128 115V.
2. Cover: 22-gauge galvanized steel with exposed surface, Type 304 stainless steel with vertical grain No. 4 satin finish.
3. Power: 115V AC, 15 amp, 1725 watts, 50/60 Hz, single phase, cULus Listed.

I. TBA-8 Shower Curtain Rods With Concealed Mounting:
1. Basis of Design: Bobrick Model B-207 x 36.
2. Basis of Design: Bobrick Model B-207 x 72.
3. Length: 72 inch (1830mm).
4. Curtain Rod: 18-8, Type 304, 20 gauge (1.0mm) stainless steel tubing with satin finish.
5. Outside Diameter: 1 inch (25mm).

J. TBA-9A- Hook Strip
1. Basis of Design: Bradley SA41- Security Tension Towel Hook Strip
2. Towel Hook Strip for Security applications is surface mounted and includes 4 breakaway hooks.
3. Hooks will release item when 20 lbs. of force or more is applied.
4. Unit is made from satin finish stainless steel
5. Front mounted

K. TBA-9B- Hook-Single

1. Basis of Design: Bradley SA35- Security Tension Towel Hook Strip
2. Towel Hook Strip for Security applications is surface mounted and includes 1 breakaway hooks.
3. Hooks will release item when 20 lbs. of force or more is applied.
4. Unit is made from satin finish stainless steel
5. Front mounted

L. TBA-10 Shelf
1. Basis of Design: Bradley 9094-18
2. Surface-Mounted - Concealed Mounting
3. Stainless Steel- satin finish
4. Vandal-Resistant Escutcheons
5. 5" Deep
6. Size: 18-inch.

M. TBA-11 PAPER TOWEL DISPENSER
1. Provided by Owner

N. TBA-12 FOLDING SHOWER SEAT
1. Basis of Design: Bobrick Reversible Folder Shower Seat; B-5181
2. ADA compliant “L” shaped folding shower seat mounted on wall of shower compartment.
3. Seat: One piece, ½-inch thick, compact-grade laminate with matte finish.
4. Color: Ivory top surface with black phenolic core and exposed edges.
5. Frame: 18-8, Type 304 stainless steel. 16 gage square tubing and 18-gage seamless tubing, with integral stainless steel spring and guide brackets.
6. Mounting: 18-8, Type 304, 3/16-inch thick stainless steel.
7. Handing: Reversible left or right

END OF SECTION 102813

SECTION 230000

HVAC

PART 1 – GENERAL

1.1 GENERAL PROVISIONS

A. The BIDDING REQUIREMENTS, CONTRACT FORMS, and Contract Conditions as listed in the Table of Contents, and applicable parts of Division 1 - GENERAL REQUIREMENTS, shall be included in and made a part of this Section.

B. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this Section. The listing of Contract Drawings above does not limit Subcontractor's responsibility to determine full extent of work of this Section as required by all Drawings listed in the Drawing List on the Drawing Title Sheet, as modified by Addenda.

C. Refer to Section 01 23 00 - Alternates, for alternates which may affect the scope of Work of this Section.

1.2 WORK INCLUDED

A. The work included in the Heating, Ventilating and Air Conditioning specifications consists of furnishing all materials, labor, equipment and appurtenances to perform, and leave in satisfactory operating condition the new systems.

B. It is the intention of these specifications to call for finished work, fully tested and ready for continuous operation. Any apparatus, equipment, material or work not mentioned in the specifications or incidental accessories to make the work completely balanced, perfect in all respects and ready for operation, even if not specifically mentioned, shall be furnished, tested, adjusted or balanced at no additional expense to the Owner. Should there appear to be discrepancies or questions of intent, the Sub-Contractors shall refer the matter to the Architect for decision before start of any related work.

C. The drawings, where applicable, show equipment and device locations, required flows at those devices and locations of new thermostats and controls. In addition, the drawings identify routing for new ducting and new piping as well as their respective sizes. The HVAC Sub-Contractor shall field verify that the routing is free of obstacles and other trades work.

D. The Contractor shall confer and cooperate with all other building trades so that all work will be installed in the proper relationship to all other work.

E. The Contractor shall provide and maintain all staging, scaffolding, ladders and hoisting equipment required for the execution of the work by his personnel. Remove same from premises when no longer required.

1. Coordinate with Division 1 for which staging will be provided by the General Contractor.

F. The work under this section shall include furnishing all motor starters and components for installation by the electrical sub-contractor.

G. The work under this section shall include all labor, materials, accessories, services, and equipment necessary to furnish and install:

1. All pipe guides, supports, hangers and anchors.
2. All vibration isolation equipment, bases and devices.

a. Unless otherwise noted on the equipment schedule, all mechanical equipment shall be mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure. Vibration isolators shall be selected in accordance with the weight distribution so as to produce reasonably uniform deflection. Deflections shall be as noted on the equipment schedule or those required to provide 98% isolation efficiency.

3. All insulation of all parts of the condensate system including all pipe, fittings, pipe flanges, valves, expansion joints, vents, drains, etc. which may be subject to thermal losses adverse to the operation of the various systems, or which may sweat.
4. All insulation of all parts of the supply and outdoor air intake duct systems including all duct, fittings, flanges, dampers, etc. which may be subject to thermal losses adverse to the operation of the various systems, or which may sweat.
5. All refrigeration piping and insulation.
6. All filters and air cleaning equipment.
7. All ductwork.
8. All duct fittings.
9. All ductwork accessories.
10. All motorized dampers.
11. All constant volume regulators.
12. All air inlet and outlet equipment.
13. All louvers.
14. All fan coil units.
15. All variable refrigerant volume heat pump systems.
16. All energy recovery units.
17. All air handling units.
18. All fans.
19. All air curtains.
20. All electric heating devices.
21. All control system components to provide a fully operational automatic temperature control system.
22. All Testing, Adjusting and Balancing of all components of the HVAC systems.
23. All HVAC commissioning requirements in Section 019113 – General Commissioning Requirements.
24. All requirements for the project's participation in the Eversource Path 1 Net Zero Equivalent (NZE) rebate program for new buildings.
25. All firestopping.

H. The following work is not included in this section and will be provided under other sections, except as specified herein:

1. Electrical wiring for all equipment
2. Structural supports necessary to distribute loading equipment to roof or floor
3. Temporary light, power, water, heat, gas and sanitary facilities for use during construction and testing. Refer to Division I, General Conditions.
4. Excavation and backfill

5. Concrete work including concrete housekeeping pads and blocks for vibrating and rotating equipment, and cast-in-place manholes
6. Flashing roof and wall penetrations
7. Painting

I. The Contractor shall coordinate their scope of work with requirements as noted on architectural drawings.

1.3 DEFINITIONS

A. Where used in this specification, the following definitions shall apply:

1. "Test" means to determine quantitative performance of HVAC equipment.
2. "Adjust" means to produce the specified fluid at the terminal equipment.
3. "Balance" means to establish the specified air flows within the distribution systems.
4. "Procedure" is the standardized approach and execution of sequence of work operations to yield reproducible results.
5. Report forms shall be test data sheets arranged for collection of test data in logical order for submission and review. These data shall form the permanent record which shall be used as the basis for any future testing, adjusting, and balancing required.
6. The testing, adjusting, and balancing Sub-Contractor shall hereinafter be referred to as "The TAB Sub-Contractor", who shall be a subcontractor to the HVAC sub-contractor.
7. Where specifications refer to SMACNA standards, the SMACNA standards shall be considered as the minimum acceptable. If local codes require other standards than the local codes shall govern.
8. "Work" shall mean all labor, materials, equipment, apparatus, controls, accessories and all other items required for a proper and complete installation.
9. "Concealed" shall mean hidden from sight in chases, furred in spaces, shafts, embedded in construction, in a crawl space, and above hung ceilings.
10. "Exposed" shall mean not installed underground or concealed as defined above.
11. "Furnish" shall mean purchase and deliver to the project site, complete with every necessary appearance and support.
12. "Install" shall mean unload at the delivery point at the site and perform all work necessary to establish secure mounting, proper location and operation in the project.
13. "Provide" shall mean furnish and install.
14. "Piping" shall mean, in addition to pipe or tubing, all fittings, flanges, unions, valves, strainers, drains, hangers and other accessories relative to such piping.
15. "Furnished by others" shall mean materials or equipment purchased and set in place under other sections of the general contract and connected to the systems covered by this section of the specifications by the HVAC Sub-Contractor.
16. "Coordinate" shall mean all work provided under this section of the specification shall be in compliance with the work of other trades.
17. "HVAC Subcontractor," "Subcontractor," or "Installing Contractor" shall be the Subcontractor responsible for the work of this section of the specifications, and shall be responsible for coordination of the work of this section.
18. "ATC" shall mean Automatic Temperature Controls, and shall be interchangeable with Building Automation System (BAS) and Building Management System (BMS).

19. "Owner's Representative" shall be the party responsible to make decisions regarding all contractual obligations in reference to the Scope of Work for the Owner.
20. The "Sheetmetal Sub-Contractor" shall herein after be responsible for the sheetmetal work of this section.
21. The "TAB Sub-Contractor" shall herein after be responsible for the balancing work of this section.
22. The "ATC Sub-Contractor" shall herein after be responsible for the ATC work of this section.

1.4 GENERAL REQUIREMENTS FOR SHEETMETAL DUCTWORK

A. Where specifications refer to SMACNA standards, the SMACNA standards shall be considered as the minimum acceptable. If local codes require other standards, then the local codes shall govern.

B. All ductwork indicated on the drawings is to be considered as shown in schematic. Changes in duct size to clear obstructions or to accommodate field conditions caused by the work of other trades, not shown on the drawings, shall be made, where necessary to conform to the actual space conditions and shall be provided at no additional cost to the owner. No duct changes shall be fabricated until after written approval of the modified or original shop drawings by the Engineer.

C. It shall be the Sub-Contractor's responsibility to field verify all dimensions and to coordinate his work with the work of other trades. Locations and placement of ducts shall be coordinated with the work of the other trades before any ductwork is fabricated or installed.

D. Each duct system shall be constructed for the specific duct pressures and/or pressure classifications shown on or required by the contract drawings. Where no specific duct pressure or class designation is shown the SMACNA 2" W.G. pressure class is the basis for compliance with these standards.

1.5 EXAMINATION OF SITE AND DOCUMENTS

A. Bidders are expected to examine and to be thoroughly familiar with all contract documents and with the conditions under which work will be carried out. The Awarding Authority (Owner) will not be responsible for errors, omissions and/or charges for extra work arising from General Contractor's or subcontractor's failure to familiarize themselves with the Contract Documents or existing conditions. By submitting a bid, the Bidder agrees and warrants that he has had the opportunity to examine the site and the Contract Documents, that he is familiar with the conditions and requirements of both and where they require, in any part of the work a given result to be produced, that the Contract Documents are adequate and that he will produce the required results.

1.6 RELATED WORK IN OTHER SECTIONS

A. The following is a list of related work to be performed or furnished by other trades under other sections of the specifications:

1. Electrical power wiring.
2. Grillage and miscellaneous structural elements to fully support and/or suspend the HVAC equipment.

3. Access Panels (other than duct access panels) – subcontractor to provide sizes to General Contractor. General Contractor to purchase and install.

1.7 PRODUCTS FURNISHED, BUT NOT INSTALLED UNDER THIS SECTION

A. Furnish line voltage fan speed control switches and line voltage thermostats for installation by the Electrical Subcontractor.

B. All motors for HVAC equipment shall be furnished and set under this section. All motor starters shall be provided by the HVAC Sub-Contractor for installation by the Electrical Contractor. All controls shall be provided and installed by the ATC Sub-Contractor. All control wiring shall be provided and installed by the ATC Sub-Contractor in accordance with the applicable provisions of the electrical specifications.

1.8 INSTALLED, BUT NOT FURNISHED UNDER THIS SECTION

A. N/A

1.9 CODES AND STANDARDS

A. Materials, installation of systems and equipment provided under this section shall be done in strict accordance with the latest governing edition of the following standards, codes, specifications, requirements, and regulations, and any ‘other Codes-and Regulations having jurisdiction including but not limited to:

1. All applicable NFPA Standards
2. State and Local Building, Mechanical, Electrical and Energy Codes
3. American Society of Mechanical Engineers (ASME)
4. American Society of Testing and Materials (ASTM)
5. American National Standards Institute (ANSI)
6. Underwriters Laboratories, Inc. (UL)
7. Occupational Safety and Health Administration (OSHA)
8. Any other ‘local codes’ or authorities having jurisdiction

B. Heating, pumping, sheetmetal and refrigeration systems shall be installed by contractors and personnel appropriately licensed in the State (Installing Contractor).

C. Electrical and automatic temperature control wiring shall be done in accordance with applicable codes by licensed electricians.

D. All equipment shall meet the more efficient requirements:

1. As shown on bid documents, or
2. Minimum efficiencies stated in the governing Energy Code.

E. Unless otherwise specified or indicated, materials, workmanship and equipment performance shall conform with the latest governing edition of the following standards, codes, specifications, requirements and regulations, except when more rigid requirements are specified or are required by applicable codes but not limited to:

1. Air Conditioning and Refrigeration Institute (ARI)
2. Air Diffusion Council (ADC)
3. Air Movement and Control Association (AMCA)
4. American Boiler Manufacturers Association (ABMA)

5. American National Standards Institute (ANSI)
6. American Petroleum Institute (API)
7. American Society of Heating, Refrigeration and Air Conditioning (ASHRAE)
8. American Society of Mechanical Engineers (ASME)
9. American Society of Testing and Materials (ASTM)
10. American Welding Society, Inc. (AWS)
11. Associated Air Balance Council (AABC)
12. Copper Development Association (CDA)
13. Expansion Joint Manufacturers Association, Inc. (EJMA)
14. Factory Mutual System (FM)
15. Institute of Electrical and Electronics Engineers (IEEE)
16. Manufacturer's Standardization Society of the Valve & Fitting Industry (MSS)
17. National Electric Manufacturers-Association (NEMA)
18. National Environmental Balancing Bureau (NEBS)
19. The Hydronics Institute (HI)

F. The date of the code or standard is that in effect at the Bid Date.

G. Give all notices, file all plans, obtain all permits and licenses, and obtain all necessary approvals from authorities having jurisdiction. Deliver all certificates of inspection to the authorities having jurisdiction. No work shall be covered before examination and approval by the Owner's Representative, inspectors, and authorities having jurisdiction. Replace imperfect or condemned work to conform to requirements, satisfactory to Owner's Representative, and without extra cost to the owner. If work is covered before inspection and approval, the HVAC Sub-Contractor shall pay costs of uncovering and reinstalling the covering, whether it meets contract requirements or not.

1.10 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS

A. It is the intention of the Specifications and Drawings to call for complete, finished work, tested and ready for continuous operation. Any apparatus, appliance, material or work not shown on the Drawings, but mentioned in the Specifications or vice versa, or any incidental accessories necessary to make the work complete in all respects and ready for operation, even if not particularly specified, shall be provided by the HVAC Sub-Contractor or his/her Sub-subcontractors, without additional expense to the Owner.

B. The drawings are generally diagrammatic. The locations of all items that are not definitely fixed by dimensions are approximate only. The exact locations must be determined at the site and shall have the approval of the Architect-before being installed. The HVAC Sub-Contractor and related Sub-Contractors shall follow Drawings, including shop drawings, in laying out work and shall check the Drawings of other trades to verify spaces in which work will be installed. Maintain maximum headroom and space conditions. Where space conditions appear inadequate, notify the Architect before proceeding with the installation. The HVAC Sub-Contractor and related Sub-Contractors shall, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with the work of other trades or for proper execution of the work.

C. Sizes of ducts and pipes and routing are shown, but it is not intended to show every offset and fitting, nor every structural difficulty that may be encountered. To carry out the

intent and purpose of the Drawings, all necessary parts to make complete approved working systems ready for use, shall be furnished without extra charge.

1.11 SURVEY AND MEASUREMENTS

A. Base all required measurements, horizontal and vertical, from referenced points established with the Owner's Representative and be responsible for correctly laying out the Work required under this Section of the Specification.

B. In the event of discrepancy between actual measurements and those indicated, notify the Owner's Representative in writing and do not proceed with the related work until instructions have been issued.

1.12 COORDINATION WITH OTHER BUILDING TRADES

A. Structural members and building openings for HVAC equipment, ducts, piping, fans, etc., for use by the HVAC Sub-Contractor shown on the architectural or structural plans are the coordination responsibility of the HVAC Sub-Contractor.

B. The work shall be so performed that the progress of the entire building construction, including all other trades, shall not be delayed or interfered with. Materials and apparatus shall be installed as fast as conditions of the building will permit and must be installed promptly when and as required.

C. Confer with all other trades relative to location of all apparatus and equipment to be installed and select locations so as not to conflict with work of other sections. Any conflicts shall be referred immediately to the Owner's Representative for decision to prevent delay in installation of work. All work and materials placed in violation of this clause shall be readjusted to the Owner's Representative's satisfaction at no expense to the Owner.

D. Where work of this section will be installed in close proximity to work of other sections or where there is evidence that the work of this section may interfere with work of other sections, assist in working out space conditions to make satisfactory adjustment. Prepare and submit for approval 3/8" scale or larger working drawings and sections, clearly showing how the work is to be installed in relation to the work of other sections. If the work of this section is installed before coordinating with other trades or so as to cause interference with work of other trades, make changes necessary to protect conditions without extra charge.

E. Keep fully informed as to the shape, size and position of all opening s required for all apparatus, piping, ductwork, etc., and give information in advance to build openings into the work. Furnish all sleeves, pockets, supports and incidentals, and coordinate with the Owner's Representative for the proper setting of same.

F. All distribution systems which require pitch or slope such as condensate drains and water piping shall have the right of way over those which do not.

G. The HVAC Sub-Contractor shall, with the approval of the Architect and without extra charge, make reasonable modifications in his work as required by normal structural interferences, or by interference with work of other trades, or for proper execution of the work.

H. Keep fully informed as to the size, shape and location of all openings required for the work of this Section and give full information to all Contractors and Sub-Contractors and the Owner's Representative.

I. Structural Concrete Coordination Drawings

1. Contractor shall prepare and submit ¼" scale plan slab layout drawings clearly dimensioning all openings, sleeves, inserts, embedded pipes and conduits, embedded plates, etc. required for the mechanical, electrical and plumbing trades.
2. Where embedded items are to be placed in column or wall pours, similar elevation drawings shall also be submitted.
3. Submittals shall be made for review by both the Architect and Structural engineer and made not less than six weeks prior to the date of concrete placement for a given slab level or column wall story level.

1.13 GENERAL REQUIREMENTS

A. Nameplates

1. Each item of equipment shall have a nameplate bearing the manufacturer's name, address, type or style, model number, catalog number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

B. Maintenance Information

1. Systems and equipment which require periodic maintenance to maintain efficient operation shall be furnished with complete necessary maintenance information. Required routine maintenance actions, as specified by the manufacturer, shall be stated clearly and incorporated on a readily accessible label on the equipment. Such label may be limited to identifying, by title or publication number, the operation and maintenance manual for that particular model and type of product.

C. Equipment Guards

1. Belts, pulleys, chains, gears, couplings, projecting setscrews, keys and other rotating parts so located that any person may come in close proximity thereto shall be completely enclosed or guarded. High-temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be guarded or covered with insulation of type specified for service.

1.14 FEES AND PERMITS

A. The HVAC Sub-Contractor and related Sub-Contractors shall apply for, obtain and pay for all required permits, inspections, certificates, and incidental charges required for proper performance of the work, and shall furnish the Architect with copies of applications and all correspondence.

1.15 MATERIAL AND EQUIPMENT STANDARDS

A. Where equipment or materials are specified with the name of a manufacturer, such specifications shall be deemed to be used for the purpose of establishing a standard for that particular item. No equipment or material shall be used unless previously approved by the Owner's Representative.

B. Substitutions (approved equals) may be offered for review provided the material, equipment or process offered for consideration, is equal in every respect to that indicated or specified. In order for requests for substitution to be considered, all must be submitted for pre-approval of manufacturer within 30 days of award of contract. All requests must be accompanied by a list of minimum 5-year-old successful installations of similar scope (with owner contact and phone number), complete specifications together with drawings or samples to properly appraise the materials, equipment or process. Allow 30 days for Owner's Representative's review.

C. If a substitution of materials or equipment in whole or in part is made, this HVAC Sub-Contractor shall bear the cost of any changes necessitated by any other trade as a result of said substitution.

D. All materials, equipment and accessories provided under this section shall be new and unused products of recognized manufacturers as approved.

1.16 SHOP DRAWINGS AND SUBMITTALS

A. Conform to the requirements of Division I, General Conditions, for schedule and form of all submittals unless specifically noted otherwise in this section. Coordinate this submittal with submittals for all other finishes. Shop drawings and design layouts shall be prepared by licensed installing contractors and shall note the name(s), license number(s) and license expiration date(s) of the contractor(s) installing the heating, piping, and refrigeration systems.

B. Provide any additional submittals not noted below that may be required for confirmation of conformance with the requirements of all applicable Energy Rebate programs.

C. Definitions:

1. Shop drawings are information prepared by the HVAC Sub-Contractor to illustrate portions of the work in more detail than indicated in the Contract Documents.
2. Acceptable Manufacturers: The mechanical design for each product is based on the single manufacturer listed in the schedule or shown on the drawings. In Part 2 of the specifications certain Alternate Manufacturers are listed as being acceptable. In addition, the MATERIAL AND EQUIPMENT STANDARDS paragraph potentially allows for substitutions as being acceptable. These are acceptable only if, as a minimum, they:
   a. Meet all performance criteria listed in the schedules and outlined in the specifications. For example, to be acceptable, a fan coil unit must deliver equal CFM against equal external static pressure (with the allowed pressure drop of dirty filters) using equal or less horsepower as the fan coil unit listed in the schedules.
   b. Fit within the available space it was designed for, including space for maintenance and component removal, with no modification to either the space or the product. Clearances to walls, ceilings, and other equipment will be at least equal to those shown on the design drawings. The fact that a manufacturer's name appears as acceptable shall not be taken to mean the Engineer has determined that the manufacturer's products will fit within the available space this determination is solely the responsibility of the HVAC Sub-Contractor.
   c. For rooftop mounted equipment and equipment mounted in areas where

structural matters are a concern, the products must have a weight no greater than the product listed in the schedules or specifications.

d. Products must adhere to all architectural considerations including, but not limited to: being of the same color as the product scheduled or specified, fitting within the architectural enclosures and details, and for diffusers – being the same size and of the same physical appearance as scheduled or specified products.

3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

D. Submittal Procedures, Format and Requirements

1. Shop drawings showing manufacturer's product data shall contain detailed dimensional drawings (minimum ¼" scale) including plans and sections (where physical clearance could be an issue). Provide larger scale details as necessary. Sheet metal drawings shall show elements of Architect's reflected ceiling plan, exposed ductwork, walls and partitions (highlighting fire walls and smoke partitions), diffusers, registers, grilles, fire and smoke dampers, sleeves and other aspects of construction as necessary for coordination.
2. Submit accurate and complete description of materials of construction, manufacturer's published performance characteristics, sizes, weights, capacity ratings (performance data, alone, is not acceptable), electrical requirements, starting characteristics, wiring diagrams, and acoustical performance for complete assemblies. Drawings shall clearly indicate location (terminal block or wire number), voltage and function for all field terminations, and other information necessary to demonstrate compliance with all requirements of Contract Documents.
3. If shop drawings showing connection details are not submitted and connections are found to be installed incorrectly, the HVAC Sub-Contractor shall reinstall them within the original contract price.
4. Provide complete data for all auxiliary services and utilities required by submitted equipment. This shall include power, condenser or cooling water, condensate and compressed air requirements and points of connection.
5. Provide a complete description of all controls and instrumentation required, including electrical power connection drawing for all components and interconnection wiring to starters, detailed information on starters, control diagrams, termination diagrams, and all control interfaces with a central control system.
6. Provide installation and erection information including; lifting requirements, and any special rigging or installation requirements for all equipment.
7. The Owner's Representative shall approve all materials before commitment for materials is made.

E. Product Data: Submit complete manufacturer's product description and technical information including:

1. Piping and Fittings (all systems, types and joining methods)
2. Pipe Hangers and Supports
3. Fan Coil units
4. Variable refrigerant volume heat pump systems
5. Energy recovery units

6. VAV boxes
7. Ceiling exhaust fans
8. Identification
9. Sleeves
10. Firestopping materials
11. Valves and Accessories (all types)
12. Pipe Insulation
13. Electric Motors and Starters
14. Refrigerant and Oil
15. Equipment Nameplates
16. Vibration Isolation equipment
17. Complete ductwork, equipment layout, and shop drawings, construction details and construction standards
18. Motorized dampers
19. Duct Insulation
20. Diffusers, Registers and Grilles
21. Air Filters
22. Fans
23. Electric heating devices
24. Operating and maintenance instructions and manuals
25. HVAC Control Systems
    a. See additional requirements in section 3.27 - Sequences of Operation.
26. Color selection charts and samples for equipment and systems in finished areas. (Provide six (6) original hard copies from manufacturer, electronic files are not acceptable.)

F. Submit shop drawings and product data grouped to include complete submittals of related systems, products and accessories in an individual (combined) submittal with a screwed together post binding system. Three-ring binders shall not be accepted.

G. Substitution Requests: Submit four copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution: A submittal shall be considered a substitution when the Engineer/Architect does not accept the product or material as an “equivalent” or where one of the listed manufacturers is not submitted.
2. Substitution Requirements: Substitutions shall meet the requirements of “Comparable Products.”
3. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    a. Statement indicating why specified material or product cannot be provided.
    b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
    c. Detailed comparison of significant qualities of proposed substitution with those

of the Project scope of work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.

d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.

e. Samples, where applicable or requested.

f. Cost information, including a proposal of change, if any, in the Contract Sum.

g. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.

h. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

i. Statement indicating why the requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations.

H. Deviations

1. Proposed deviations from the Contract Documents, other than substitutions, shall be requested individually in writing whether deviations result from field conditions, standard shop practice, or other cause. Submit letter with transmittal of Shop Drawings which flags the deviation to the attention of the Architect.

2. Without letters flagging the deviation, it is possible that the Architect may not notice such deviation or may not realize its ramifications. Therefore, if such letters are not submitted to the Owner’s Representative, the Seller shall hold the Architect, his consultants and the Owner harmless for any and all adverse consequences resulting from the deviations being implemented. This shall apply regardless of whether the Architect has reviewed or approved shop drawings containing the deviation, and will be strictly enforced.

3. Approval of proposed deviations, if any, will be made at discretion of Architect.

I. Schedule: Incorporate shop drawing review period into construction schedule so that work is not delayed. The HVAC Sub-Contractor shall assume full responsibility for delays caused by not incorporating the following shop drawing review time requirements into his project schedule:

1. Allow at least 10 working days, exclusive of transmittal time, for review each time shop drawing is submitted or resubmitted with the exception that 20 working days, exclusive of transmittal time are required for the following:

a. HVAC temperature control submittals

b. HVAC balancing report

c. Coordination drawings

d. If more than five shop drawings of a single trade are received in one calendar week.

2. All roof mounted equipment submittals shall be considered a critical path item for coordination with structural shop drawings.

J. Responsibility

1. Intent of submittal review is to check for capacity, rating and certain construction features. HVAC Sub-Contractor shall ensure that work meets requirements of Contract Documents regarding information that pertains to fabrication processes’ or

means, methods, techniques, sequences and procedures of construction; and for coordination of work of this and other sections. Work shall comply with approved submittals to extent that they agree with Contract Documents. Submittal review shall not diminish responsibility under this Contract for dimensional coordination, quantities, installation, wiring, supports and access for service, nor the shop drawing errors or deviations from requirements of Contract Documents. The Engineer's noting of some errors while overlooking others will not excuse the HVAC Sub-Contractor from proceeding in error. Contract Documents requirements are not limited, waived nor superseded in any way by review.

2. Inform sub-contractors, manufacturer's suppliers, etc. Of scope and limited nature of review process and enforce compliance with contract documents.

K. In the event that the HVAC Sub-Contractor fails to provide Shop Drawings for any of the products specified herein:

1. The HVAC Sub-Contractor shall furnish and install all materials and equipment herein specified in complete accordance with these Specifications.
2. If the HVAC Sub-Contractor furnishes and installs material and/or equipment that are not in complete accordance with these Specifications, he shall be responsible for the removal of this material and/or equipment. He shall also be responsible for the replacement of this material and/or equipment with material and/or equipment that is in complete accordance with these Specifications, at the direction of the Owner's Representative.
3. Removal and replacement of materials and/or equipment that are not in complete compliance with these Specifications shall be done at no extra cost to the Owner.
4. Removal and replacement of materials and/or equipment that are not in complete compliance with these Specifications shall not be allowed as a basis for a claim of delay of completion of the Work.

L. Mark dimensions and values in units to match those specified.

M. Submit Material Safety Data Sheets (MSD) on each applicable product with submittal.

1.17 APPROVAL OF SUBMITTALS

A. The Architect will return signed and approved or disapproved submittals to the Contractor within the time allowed by other sections of the specifications. Any submittals, which have been disapproved, shall be resubmitted by the Contractor within the time allowed by other sections of the specifications.

1.18 RESPONSIBILITY FOR ACCURACY OF SUBMITTALS

A. The HVAC Sub-Contractor is solely responsible for the accuracy and completeness of all submittals, regardless of corrections made in, or approval given to, such submittals. When the Architect makes comments and returns the submittals, it is incumbent upon the HVAC Sub-Contractor to thoroughly review the comments and notations made by the Architect. When, in the HVAC Sub-Contractor's opinion, the notes made by the Architect are in error or in conflict with other elements of the system, it is incumbent upon the HVAC Sub-Contractor to promptly notify the Architect of his findings or opinion along with substantiating data, in writing to preclude misunderstanding or expensive alterations caused by a review error or oversight. The submittals are intended to provide detailed documentation of the system design and its components. The responsibility for their correctness rests completely, totally and solely with the HVAC Sub-Contractor.

1.19 SUBSTITUTION OF MATERIALS OR EQUIPMENT

A. Named manufacturers for any equipment specified herein or identified on the drawings are identified for the purpose of identifying quality standards, performance information or type. Any substitution as “or equal” shall be considered. The Architect shall determine whether or not the offered equipment is equal to the specified. Where dimensional constraints exist the HVAC Sub-Contractor shall be responsible for any extra costs associated with extra work required to make the “or equal” equipment fit.

B. After approval of the submittals, substitution of materials or equipment of makes other than those specifically named in the submittals will be approved by the Architect only if the material or equipment proposed for substitution is equal to and/or superior to material or equipment named in construction, efficiency, utility and accuracy; and further that the material or equipment named in the submittals cannot be delivered to the job in proper sequence due to conditions beyond the control of the HVAC Sub-Contractor.

C. To receive consideration, requests for substitution shall be accompanied by documentary proof of equality or difference of both proposed equipment to be substituted and equipment named in the approved submittals. Substitution by the HVAC Sub-Contractor of other materials or processes than those named in the approved submittals shall be done only upon written authorization from the Architect.

D. Substitutions of fans shall have noise ratings that are equal to or better than the specified units. The substituted equipment shall be provided with the sound power data for both the substituted and specified equipment graphed on an NC curve chart for review with the submittal.

E. The requirements of Sections 013300 & 013301 shall be followed.

1.20 PRODUCT INTEROPERABILITY REQUIREMENTS

A. Interoperability Coordination Meeting: Attend coordination meetings to coordinate interoperability between all systems and equipment. Meetings shall be scheduled by the construction manager.

B. General Networking and Protocol Interoperability Requirements: Provide products that are fully BACNet interoperable.

1. All systems and equipment shall interface with the primary building management network provided under "Instrumentation and Controls for HVAC” using Ethernet standards and BACNet protocol.
2. Equipment that is native BACNet may connect directly to a BACNet MS/TP subnet that is provided by "Instrumentation and Controls for HVAC” when coordinated with that Section Contractor.
3. Communication involving control components (i.e., all types of controllers and operator interfaces) shall conform to the most current ANSI/ASHRAE Standard 135, BACnet.
4. The MS/TP trunks support all of the ASHRAE 135 approved baud rates.
5. All MS/TP devices support all baud rates of the ASHRAE 135.
6. All MS/TP devices shall be BTL approved (BACnet Testing Lab).
7. All BACnet routers must support B-BC (BIBB) and support BBMD routing.

8. Lonworks and Modbus subnets may be utilized where no BACNet protocol is available provided full 2-way compatibility is provided through a gateway.
    a. Exception: Fire alarm systems shall be 1-way, read only communication.
9. Each individual system and/or equipment manufacturer/installer shall provide all necessary gateways/translators Provide Gateway with all products as required facilitating full BACNet interoperability with BACNet Protocol.
10. It must be possible to read and display the value of any property, including all required properties, supported optional properties, and proprietary extensions of very object of every networked device.
11. Operating setpoints and parameters must be available for modification via BACnet services via a graphical user interface (GUI).
12. An operator shall be able to display at any time the operational status of any device on the BACnet internetwork. An operator shall be able to display at any time any property of any BACnet object. An operator shall also be able to display property values of objects grouped by object type, object location, building system, and by user defined parameters.
13. An operator shall have the ability to issue re-initialization commands to any device that supports remote re-initialization.
14. An operator shall have the ability to backup and restore all BACnet devices on the network.
15. It shall be each contractor's responsibility to configure each router using the network numbering scheme for the project. Each router shall be configured such that all network layer error messages shall be directed to a specific workstation using the BACnet Confirmed Text Message service. It shall be the contractor's responsibility to initially configure each router with routing tables containing all network numbers that are part of the project's internet. The router shall be able to receive messages at each port of any length that is valid for the LAN technology connected to that port, and to forward the message to any directly-connected network that can convey a message of that size.
16. Legacy Systems: Bi-directional gateways shall be provided for systems and equipment operating on a legacy/proprietary system. The operator workstation shall display information from both the BACnet and non-BACnet devices. Any information specified or required for system functionality shall be made readable and modifiable. Gateways shall have 10% expansion capacity. Gateways shall support archiving, uploading, trending, scheduling, and alarm/event detection, notification and acknowledgement.
17. Systems and equipment shall have full 2- way communications and interoperability.
    a. Exception: Fire safety systems and equipment shall have only read access to outside systems:
        1 Fire alarm.
18. Coordinate with "Instrumentation and Controls for HVAC" and other building operational systems for specific interoperability requirements.

C. Communications Standard: Coordinate communications standards requirements with other Sections and Divisions.

1. MS/TP LAN: RS 485

2. Systems with dedicated network(s) shall connect on the BACNet Ethernet LAN: utilizing a switch and shall meet standard Ethernet requirements.
   a. Utilize RJ-45 terminations.
   b. Utilize CAT 6 cabling.
   c. Meet IEEE Standard 802.3 standards and requirements.
   d. Speed: 100 Mbps.
3. Equipment without dedicated networks shall connect to the BACNet MS/TP LAN.
   a. RS 485 communications standard.
   b. Speed: 1 Mbps.

D. Information Availability: Make all product information, points, variables, setpoints, etc., available for access of building operational systems upon request.

1. Provide bi-directional point mapping/addressing instructions.
2. Provide on-site technicians as required to ensure proper information exchange.

E. Factory Provided Equipment Controllers: Provide all information, points, variables, setpoints, etc., indicated and referenced in all documentation, including "Instrumentation and Controls for HVAC." Products shall have full interoperability as indicated in this Section, in BACNet standards and elsewhere.

1.21 COORDINATION DRAWINGS

A. Before materials are purchased or work is begun, prepare coordination drawings showing the size and location of equipment, piping, etc., in the manner described under SUPPLEMENTARY CONDITIONS.

B. Coordination drawings are for the General Contractor's and the Architect's use during construction and shall not be construed as replacing any shop, "as-built" or record drawings required elsewhere in these contract documents.

C. The HVAC Sub-Contractor shall be responsible for initiating the preparation of the coordination drawings and passing the drawings to other trades through the General Contractor for addition of the other trade’s work.

1. Coordinated reflected ceiling plans showing ceiling mounted fan coil locations shall be included.

D. HVAC Coordination drawings shall show the following:

1. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
2. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
3. Fire-rated enclosures around ductwork.

E. Before work progresses, and in addition to the shop drawings listed herein, submit coordination drawings at a suitable scale of not less than 3/8 inches equals one foot.

F. Coordination Digital Data Files: Prepare coordination digital data files in accordance with the following requirements:

1. File Preparation Format: Autodesk Revit .rvt file format in Microsoft Windows operating system and Autodesk AutoCAD .dwg file format in Microsoft Windows operating system.
2. File Submittal Format: Submit or post coordination digital data files in the file preparation format and in Adobe .pdf format.
3. Upon receipt of a signed release form, Engineer/Architect will furnish to the Contractor one set of digital data files for use in preparing coordination digital data files.
   a. Engineer/Architect makes no representations as to the accuracy or completeness of digital data files as they relate to the drawings.
   b. Contractor shall execute a data licensing agreement

G. Provide composite systems coordination drawings showing HVAC duct, piping and equipment, fire protection piping and equipment, plumbing pipe and equipment and electrical conduit, cable, lights and other equipment.

H. All trades are required to coordinate with the other trades and revise the composite systems coordination drawings to eliminate interferences.

1.22 RECORD DRAWINGS

A. The Architect will furnish the HVAC Sub-Contractor electronic files of the mechanical drawings as issued for this contract in AutoCAD format and current Revit model file (if available). The HVAC Sub-Contractor shall change these drawings to indicate accurately and neatly the actual duct routing and duct sizes. At the end of the project the HVAC Sub-Contractor shall deliver to the Architect one set of reproducible As-built drawings and two (2) Compact Disks or USB flash drives with As-Built drawing files in the current AutoCAD version format and the current Revit version for the owner's permanent record.

B. The “As-Built” drawings shall show:

1. The actual location of all air volume dampers and actuators.
2. The actual location of all control valves and isolation valves with valve tag numbers
3. Valve tag charts
4. The actual location of all thermostats and control sensors.
5. The actual location of all access panels
6. Equipment schedules of the installed equipment.

1.23 OPERATION AND MAINTENANCE INSTRUCTIONS

A. Commence preparation of the Operating and Maintenance manuals immediately upon receipt of “Approved” or “Approved as Noted” shop drawings and submit each section within one month. The last submission shall be no later than two months prior to the date of Substantial Completion of the project.

B. The manual shall consist of (3) sets of manuals and include (3) CDs, which shall contain the scanned content of the entire manual. The manual shall be submitted for review prior to creation of the CDs.

C. The manual shall contain the following:

1. Operations Manual
   a. Systems description including all-relevant information needed for day-to-day

operations and management including start-up and shut-down instructions.

b. Wiring diagrams, schematics, logic diagrams and sequence of operations that accurately depict the controls system.

c. Depiction of each interface screen where programmable logic and visual displays are provided. Descriptors shall be provided to define displayed data; alarms, etc.

d. A single sheet (for ease of removal) of all access codes and passwords necessary to access all levels of control and programming.

e. Trouble shooting guide defining common alarms/problems with possible cause and effect.

2. Maintenance Manual

a. Define all maintenance activities required to ensure system operation within manufacturers' specified parameters. Provide table of all required activities plotted vs. interval with adequate fill-in-space for "activity completion date" and "comments". Where multiple instrument readings are required, provide data sheet formatted to accommodate activity.

b. Provide as part of each package, lubricating charts indicating equipment tag number, location, equipment service, greasing and lubricating requirements, lubricants, and intervals.

c. Provide as part of each package, a valve and system chart that corresponds to the valve tags. Provide directions for normal positions and positions for equipment failure modes.

d. The HVAC Sub-Contractor shall furnish spare-parts data for each different item of equipment furnished. The data shall include a complete list of: parts and supplies, with current unit prices, lead time, and source of supply; a list of parts and supplies that are either normally furnished at no extra cost with the purchase of the equipment, or specified herein after to be furnished as part of the contract; and a list of additional items recommended by the manufacturer to assure efficient operation for a period of 360 days at the particular installation. The foregoing shall not relieve the HVAC Sub-Contractor of any responsibilities under the guarantees specified herein.

e. Provide copy of all warranty information with associated date of substantial completion (commencement of warranty) and end date of coverage. Define all components/subsystems specifically included and excluded.

D. Provide O&M manuals for each of the following as a minimum:

1. Electric Motors and Starters
2. Energy recovery units
3. Fan coil units
4. Variable refrigerant volume systems
5. VAV Boxes
6. Constant volume regulators
7. Vibration Isolation
8. Air Filters
9. Fans
10. Electric heating devices

11. Equipment support stands
12. Vibration isolation devices
13. Control Systems and components

1.24 WARRANTIES

A. Submit manufacturers standard replacement warranties for material and equipment furnished under this Section. Such warranties shall be in addition to and not in lieu of all liabilities which the manufacturer and the HVAC Sub-Contractor and related Sub-Contractors may have by law or by provisions of the Contract Documents.

B. Guarantee that all elements of each system meet the specified performance requirements as set forth herein or as indicated on the Drawings.

C. Upon receipt of notice from the Owner of the failure of any part of the systems during the guarantee period, the affected parts shall be replaced. Any equipment requiring excessive service shall be considered defective and shall be replaced.

1.25 SYSTEM TRAINING

A. The HVAC Sub-Contractor shall provide on-site training on the mechanical systems for the building. The amount of time provided shall be as indicated below. Training times and dates shall be coordinated with the Owner. The training shall be video recorded by the HVAC Sub-Contractor and a DVD shall be provided to the Owner with each of the O&M Manuals.

B. Training shall include but not be limited to:

1. A general overview of the operation of each system (provide 4 hours)
2. The Variable refrigerant volume heat pump system and controls (provide 4 hours)
3. The energy recovery ventilators and fresh air system (provide 4 hours)
4. The ATC system and scheduling. (provide 4 hours)
5. Any other topics related to the mechanical system as requested by the Owner (provide 4 hours).

C. The variable refrigerant volume heat pump system shall include training by a manufacturer approved representative, a minimum of four hours and 4 hours of standard structured off-site training at the manufacturer’s or manufacturer’s representative’s facility. The training shall be as is typically provided for Contractor certification in maintenance of the systems and shall include any information requested by the Owner.

D. Training time is exclusive of travel time, breaks, lunch, etc.

1.26 TESTING AND CHECKOUT

A. After completion of any work installed under this section, field tests shall be performed and checkout of the system accomplished. The tests shall include functional and operational tests where applicable on all equipment under all conditions that exist at the time. All defects of new equipment disclosed by tests shall be rectified without additional cost to the Owner. The installing Sub-Contractor shall be required to make all adjustments to equipment and accessory material to provide a thoroughly functional installation. All new equipment shall be installed, tested and checked before the HVAC Sub-Contractor tests, adjusts or balances the system as a whole.

B. The TAB Sub-Contractor shall perform the services of testing, adjusting, and balancing of the heating, ventilating, and air conditioning systems. The TAB Sub-Contractor shall check and adjust all HVAC systems to produce the performance specified by the construction documents and to achieve total system balance. The Tab Sub-Contractor shall be certified by an appropriate air balance council, such as the Associated Air Balance Council (AABC), National Environmental Balancing Bureau (NEBB), or other approved agency, or shall employ technicians certified by an appropriate air balance council, such as the Associated Air Balance Council (AABC), National Environmental Balancing Bureau (NEBB), or other approved agency to perform the air balancing procedures. All work done by the TAB Sub-Contractor shall be by qualified technicians under the direct supervision of a certified test and balance engineer. The TAB Sub-Contractor shall furnish all certified engineers, instruments, and provide personnel, trained and experienced, to test, adjust and balance all airside systems and related automatic temperature control systems, and shall submit system performance reports.

C. The work to be performed by the TAB Sub-Contractor shall include, but not be limited to:

1. Adjustment of the airside performance of the HVAC systems to provide design air quantities and temperatures.
2. Electrical measurement.
3. The balance of all air and water distribution systems.
4. Verification of performance of all equipment, thermostats and controls.

D. The TAB Sub-Contractor shall accomplish these objectives by:

1. Checking installations for conformity to design.
2. Measurement and establishment of the air distribution quantities of the systems as required to meet the design specifications.
3. Adjusting and balancing all HVAC systems to meet the design specifications.
4. Recording and reporting all results in a format approved by the Architect.

E. All work shall be completed in accordance with the standards set by AABC, NEBB, or other approved testing and balancing organizations. In general, all equipment, materials, and balancing procedures shall comply with all applicable standards.

F. The qualifications of the TAB Sub-Contractor shall include current membership in AABC, or certification by NEBB, or the TAB Sub-Contractor shall submit proof to the satisfaction of the Architect that the TAB Sub-Contractor meets the certification requirements of the AABC or NEBB.

G. Submit for approval samples, shop drawings, certificates, literature and data with information sufficient to evaluate the submission in compliance with the requirements of a completely adjusted and balanced system. Testing, adjusting and balancing procedures shall equal those of approved submittals and shall not be completed or incorporated in the work until approved. Approval or acceptance of submittal items will not preclude rejection of these items upon discovery of defects in them prior to final acceptance of completed work.

H. All work shall be performed in compliance with the approved submittals. The work schedule shall include the proposed procedures, proposed forms, diagrams, and reports for documenting the work. The TAB Sub-Contractor shall establish an approved systematic and uniform set of procedures in compliance with the AABC or NEBB.

I. All test instruments shall be accurately calibrated and maintained in good working order. If requested, calibration tests of equipment to be used shall be performed in the presence of the Owner.

J. The equipment and systems shall be tested, adjusted and balanced in accordance with the approved submittals. Wherever the TAB Sub-Contractor deviates from the original procedures, he shall be responsible for the new procedures being a better method. Any changes made necessary by the above shall be brought to the attention of the Architect and shall be subject to his approval prior to making such change. The procedural changes shall not be made a basis for additional compensation by the Owner, but shall be made at the TAB Sub-Contractor's own expense.

1.27 DUCT CLEANLINESS

A. The Sheetmetal Sub-Contractor shall be responsible for the requirements of this section.

B. All ductwork shall be protected from dust and debris with plastic wrap on each end until installation. After installation, unfinished ends or grilles shall be covered until the system is in operation.

C. Any equipment connected to ductwork shall not be operated until construction progress has reached a point where minimal dust is being created as determined by the Architect.

D. If any equipment is to be used prior to the point of minimal dust creation, all return or exhaust intakes shall be covered with filter material and all filters in the equipment shall be changed on a daily basis.

1.28 IDENTIFICATION OF MECHANICAL SERVICES

A. Ductwork: Identify all ductwork with plastic adhesive labels identifying the system, supply, exhaust or return, and flow arrows.

B. Volume damper location flags

1. Flags: Yellow one-inch wide tape, minimum 18 inches long.

C. Piping: Identify all piping with plastic adhesive labels identifying the system, supply or return, and flow arrows.

1. Labels shall be located at all changes of direction, wall and floor penetrations, every 20 feet on long pipe runs, at valves and close to points of branch takeoffs.
2. Refrigerant piping shall identify fan coil unit served.

D. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme approved by Owner.

1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass beaded chain

E. 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. Valve Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
3. Frame: Extruded aluminum.
4. Glazing: ASTM C 1036, Class 1, glazing quality B, 2.5 mm, single thickness glass.

F. Valve Schedule on Electronic Media:

1. In addition to the framed paper schedule, provide valve schedule on electronic media, type specified by Owner.
2. All valve tag locations shall be identified points on as-built drawings.

G. Equipment: Identify all energy recovery units, make up air units, controls, starters and similar equipment with white lamacoid engraved nameplates with black letters. Firmly secure with self-tapping screws.

1. Energy Recovery Unit identification shall be 6”x4” and shall indicate the following information:
   a. Tag number
   b. Design exhaust and supply airflow
   c. Design exhaust and supply external static pressure
   d. DX heating and cooling coil capacities
   e. Electric heat capacity
   f. Motor horsepower
   g. Power (volts/phase/hz)
2. Fan coil unit identification shall be 3”x2” and shall include the following information:
   a. Tag number
   b. Nominal cooling capacity (Btu/h)
   c. Nominal heating capacity (Btu/h)
   d. Rooms Served (ducted units only)
   e. Power (volts/phase/hz)
3. Variable refrigerant volume heat pump system identification shall be 6”x4” and shall include the following information:
   a. Tag number
   b. Nominal cooling capacity (Btu/h)
   c. Nominal heating capacity (Btu/h)
   d. Power (volts/phase/hz)
4. Fan identification shall be 3”x2” and shall include the following information:
   a. Tag number.
   b. Design airflow (CFM)
   c. Design external static pressure (IN WC)
   d. Motor horsepower
   e. Power (volts/phase/hz)

1.29 DELIVERY, STORAGE AND HANDLING

A. No materials shall be delivered or stored on site until Shop Drawings have been approved.

B. All manufactured material shall be delivered to the site in original packages or containers bearing the manufacturer's labels and product identification.

C. Protect materials against dampness. Store off floors, under cover, and adequately protected from damage.

D. Inspect all equipment and materials, upon receipt at the job site, for damage and conformance to approved shop drawings.

1.30 PROTECTION OF WORK AND PROPERTY

A. The HVAC Sub-Contractor shall be responsible for the care and protection of all work included under this section until the completion and final acceptance of this Contract.

B. Protect all equipment and materials from damage from all causes; including, but not limited to, fire, vandalism and theft. All materials and equipment damaged or stolen shall be repaired or replaced with equal material or equipment at no additional cost to the Owner.

C. Protect all equipment, outlets and openings with temporary plugs, caps and covers. Protect work and materials of other trades from damage that might be caused by work or workmen under this section and make good damage thus caused.

D. Damaged materials are to be removed from the site; no site storage of damaged materials will be allowed.

1.31 SAFETY PRECAUTIONS

A. Life safety and accident prevention shall be a primary consideration. Comply with all of the safety requirements of the owner and OSHA throughout the entire construction period of the project.

1.32 SCHEDULE

A. Construct work in sequence under provisions of Division I and as coordinated with the Owner's Representative.

1.33 HAZARDOUS MATERIALS

A. Dispose of all hazardous materials in accordance with Federal and State laws. All handling shall conform to EPA requirements. A uniform hazardous waste manifest shall be prepared for all, disposals and returned with all applicable signoffs, prior to application for final payment. Provide breakout cost for this scope.

B. Recovered refrigerant shall be recycled by a licensed facility approved by the Owner's Representative.

C. Removed equipment or fluids containing any hazardous materials such as ethylene glycol, oil or chromate shall be recycled by a licensed facility approved by the Owner's Representative.

1.34 ACCESSIBILITY

A. All work provided under this section of the specification shall be installed so that parts requiring periodic inspection, maintenance and repair are readily accessible. Work of this trade shall not infringe upon clearances required by equipment of other trades, especially code required clearances to electrical gear. Minor deviations from the drawings may be made to accomplish this, but changes of substantial magnitude shall not be made prior to written approval from the Owner's Representative.

1.35 ELECTRICAL WORK

A. All electrical apparatus and controls furnished, and the installation thereof, as a part of the HVAC work, equipment and controls shall conform to applicable requirements under specification 260000 – Electrical.

1.36 PROJECT CLOSEOUT

A. Certificates of Approval

1. Upon completion of all work, provide certificates of inspections from the following equipment manufacturers stating that the authorized factory representatives have inspected and tested the operation of their respective equipment and found the equipment to be in satisfactory operating condition and installed per the manufacturer's installation instructions and requirements.
   a. Automatic Temperature Controls
   b. Variable Refrigerant Volume Heat Pump System

B. Construction Observations by the Engineer

1. The engineer is contracted to make progress site visits during construction, one substantial completion (punch list) site visit for determining substantial completion and one Final inspection visit to determine if all work is complete.
2. The HVAC Sub-Contractor and the General Contractor are required to inspect their own work and make any corrections to the work to comply with the specifications and the contract documents. It is not the responsibility of the engineer to develop lists of incomplete work items.
3. Progress Site Visits
   a. The purpose of the progress site visit by the engineer is to observe if the work is proceeding in accordance with the contract documents.
   b. The engineer will prepare a field report which will note in general the work completed since the last observation visit, work found not to be in accordance with the contract documents and work not corrected since the previous observation visit.

C. Substantial Completion

1. When the HVAC Sub-Contractor considers the work under this Section is substantially complete, the HVAC Sub-Contractor shall submit written notice, through the General Contractor, with a detailed list of items remaining to be completed or corrected and a schedule of when each remaining work item will be completed. Should the engineer determine the list of remaining work does not constitute substantial completion, the engineer will notify the Architect and/or Owner and he will not make a substantial completion site visit.

2. The following items shall be submitted and approved by the Engineer prior to the written request for substantial completion inspection:
   a. Certification of successful operation of all systems
   b. Training of the Owner's personnel in the operation of the systems.
   c. Record Drawings in accordance with the contract specifications.
   d. Operation and Maintenance Manuals
   e. Testing reports
   f. Balancing reports
   g. Manufacturers certificates of approvals
   h. Emergency contact list for reporting of malfunctioning equipment during the warrantee period
   i. Contractors project completion certificate in accordance with the building code requirements.
3. Should the engineer, during the substantial completion visit, observe that the work is substantially complete, s/he will provide a written listing of the observed deficiencies referred herein as the Punch List. The Punch List will provide for a place for the HVAC Sub-Contractor and general contractor to sign off and date each item and individually indicating that the observed deficiency item has been corrected.
4. Should the Engineer, during the substantial completion site visit, observe that the work is not substantially complete, s/he will provide a written list of the major deficiencies and a reason for the work not being considered substantially complete.
5. If the work is found not to be substantially complete, then the engineer shall be reimbursed for his time to re-observe the work. A re-observation fee shall be charged to the Subcontractor through the Contractual Agreement for any further observations by the engineer.
6. The HVAC Sub-Contractor shall remedy all deficiencies listed in the punch list within the time frame required by the contract.

D. Engineers Construction Completion Certificate

1. Where required by the applicable code, the Engineers Construction Completion Certification will be issued by the Engineer when all life safety and health related issues are complete, all required functional tests are complete and all reports are complete. The following is a minimum listing of the required systems to be tested with reports generated indicating they are complete and ready for use:
   a. Air Balancing
   b. Variable Refrigerant Volume Heat Pump System Start up
   c. Pipe Pressure Test
   d. Ductwork
2. There shall be NO outstanding items identified on the punch list for scope within any of these categories.

E. Final Completion

1. The following items shall be submitted prior to the written request for Final completion:
   a. Revised substantial completion items to be resubmitted in accordance with the review process comments

b. Warranties commencing the date of substantial completion

c. Individual signed and dated punch list acknowledging completion of all punch list items

2. When the HVAC Sub-Contractor considers all of the punch list work items complete, the HVAC Sub-Contractor shall submit written notice through the General Contractor that all punch list items are complete and resolved and the work is ready for final inspection. The signature lines for completion of each punch list item shall be signed by the HVAC Sub-Contractor indicating the work is complete and signed by the General contractor indicating site has inspected the work and found it to be complete. Should the Engineer find the work to be finally complete and all Punch list items are complete, the engineer will make a recommendation to the Architect or Owner. If the Engineer has found the punch list work to be incomplete during the final inspection, a written listing of the observed deficiencies will be prepared by the Engineer.

3. If the work is not fully complete then the engineer shall be reimbursed for his time to re-observe the work. A re-observation fee shall be charged to the HVAC Sub-Contractor through the contractual agreement for any re-observations by the engineer.

F. Re-Observation Fees

1. The re-observation fee shall be $1,800 per visit.

G. HVAC Sub-Contractor's Project Completion Certificate

1. Upon completion of work and prior to request for Certificate of Occupancy, the HVAC Sub-Contractor shall issue a certificate stating that work has been installed generally consistent with construction documents and all applicable codes. The certificate shall certify:

a. Execution of all work has been installed in accordance with the approved construction documents.

b. Execution and control of all methods of construction was in a safe and satisfactory manner in accordance with all applicable local, state and federal statutes and regulations.

2. The certificate shall include the following information:

a. Project

b. Permit Number

c. Location

d. Construction Documents

e. Date on Plans and Specifications submitted for approval and issuance of the Building Permit

f. Addendum(a) and Revision Dates

3. The certificate shall be signed by the HVAC Sub-Contractor and include the following:

a. Signature

b. Date

c. Company

d. License Number

e. License Expiration Date

1.37 SEQUENCING

A. Phasing: Refer to Section 01 10 00 - Summary, and Drawings for phasing and milestone completion requirements which affect the Construction Manager's Work and the Work of the HVAC Sub-Contractor and related Sub-Contractors.

B. Coordinate work of this Subcontract with that of other trades, affecting or affected by this work, and cooperate with the other trades as is necessary to assure the steady progress of work.

C. Do not order or deliver any materials until all submittals, required in the listed Specification Sections included as part of this Subcontract, have been received and approved by the Architect.

D. Before proceeding with installation work, inspect all project conditions and all work of other trades to assure that all such conditions and work are suitable to satisfactorily receive the work of this Section and notify the Architect in writing of any which are not. Do not proceed further until corrective work has been completed or waived.

1.38 COMMISSIONING OF HVAC EQUIPMENT AND SYSTEMS

A. RELATED DOCUMENTS

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections.
2. An outside commissioning authority will commission the building at the completion of construction. Refer to SECTION 01 81 00 commissioning specifications for systems affected and contractor interface required.

B. SUMMARY

1. Section includes commissioning process requirements for HVAC&R systems, lighting control systems, and hot water heaters.
2. During Functional Testing, it is anticipated that the equipment will function as intended. Failure of an item includes excessive noise, failure to perform the intended function, or a deviation of more than 10 percent from the intended performance.
3. The CxA will choose specific pieces of equipment at random for testing.
4. A representative sample of large-volume equipment items of a similar nature (such as VAV terminals or heat pumps) may be chosen for testing. Failure of 10 percent (or 1, whichever is greater) of selected items shall result in stopping the Functional testing. The contractor shall remedy the deficiency and notify the CxA so that re-testing of failed portions can be performed.
5. Failure during retesting of any of the previously-failed items, or 10 percent (or 1, whichever is greater) of an additional sample roughly equal in size to the original sample, shall constitute failure, and shall necessitate testing of 100% of the installed equipment.
6. For small-volume or critical equipment (such as chillers or air handlers), every unit will be functionally tested.
7. At the CxA's sole discretion, many or all units of a similar nature (for example, heat pumps or fan coils) may be tested simultaneously in order to apply a thermal or electrical load on major contributing systems, such as chillers, boilers, cooling towers, or air handlers.

8. First-round testing is included in the CxA's budget. Any testing necessitated by above-described failures shall be at extra cost, and may be borne by the contractor.

C. DEFINITIONS

1. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
2. CxA: Commissioning Authority.
3. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.
4. BMS: Building Management System, a computer-based system intended to monitor and control the operation of the HVAC equipment
5. TAB: Testing and Balancing
6. EOR: Engineer of Record
7. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

D. CONTRACTOR'S RESPONSIBILITIES

1. Allow sufficient time in the construction schedule, presented as a task in all project schedules, for on-site Functional Testing of equipment that is within the scope of work. CxA shall be consulted as early as possible to determine the appropriate amount of time necessary for testing. This time shall commence after all work is complete, TAB reports have been submitted, reviewed, and approved by the EOR, and equipment start-up sheets have been submitted and approved by the EOR. It will end prior to occupancy of the space. The time allotted for Commissioning SHALL NOT coincide with building flushing, balancing, or other testing or operations without the specific approval of the CxA.
2. Allow sufficient time in the schedule for repair of any faulty systems or components revealed during Functional Testing. One week is recommended.
3. Allow 5 working days minimum, prior to occupancy of the building, and after any repairs or reprogramming as per the previous item, for follow-up Functional Testing to prove that equipment and systems are operating and reporting properly
4. Perform all equipment inspections and testing prior to commissioning. Submit a complete manufacturer-recommended start-up checklist for all major equipment at least 2 weeks prior to commissioning.
5. Assure that the Testing and balancing work (TAB) work is complete, and that the TAB report is sent to the Engineer of Record for approval no later than 2 weeks prior to commissioning. A draft of the report is to be sent simultaneously to the CxA.
6. The Building Controls Contractor shall submit a complete controls submittal for review by the CxA, which shall include at a minimum operating sequences and sample graphics. This must be submitted with enough lead time to consider any recommendations by the CxA.
7. The Building Controls Contractor shall submit point-to-point checklists and calibration sheets at least two weeks prior to functional testing.
8. Submittals for any controls that are provided with equipment, such as proprietary boiler or air handler controls, must be provided to the CxA at least 2 weeks prior to functional testing

9. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
10. Provide information requested by the CxA for final commissioning documentation.
11. Provide a technician that is thoroughly familiar with the programming and operation of the BMS and other controls for assistance during functional testing.
12. Provide personnel as necessary to assist in the Functional Testing of the HVAC equipment.
13. Repair, reprogram, or otherwise correct any deficiencies that are revealed during functional testing, and report the corrections in the forma agreed to with the CxA and Project Management.
14. Assist as necessary in any retesting that is necessitated by failure of equipment or systems to perform as per the design intent.
15. Provide material for inclusion in the commissioning report. For example, as-built drawings, all testing, balancing, and start-up reports, water treatment reports, submittals for major equipment, and control system submittals.

E. CxA'S RESPONSIBILITIES

1. Include CxA responsibilities in this article that have an impact on Contractor's activities and responsibilities.
2. Provide Project-specific commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.
3. Approved start-up reports, balancing reports, and control system point-to-point checklists and calibration reports shall serve as pre-functional testing. The CxA may choose to participate in this work.
4. Direct commissioning testing.
5. Verify testing, adjusting, and balancing of Work are complete.
6. The CxA shall judge whether equipment or systems function in a manner consistent with the design intent. A report shall be produced that lists any discrepancies.
7. Testing of any systems or equipment that fails the initial functional test will be repeated until all systems perform in accordance with the design intent and the intended operating sequences. Retesting may be additional to the contract value, and the cost may be passed through to the contractor responsible for the non-performing system.
8. A final commissioning report will be generated after all functional testing is complete. This report will contain as-built drawings, all testing, balancing, and start-up reports, water treatment reports, submittals for major equipment, and control system submittals.

F. COMMISSIONING DOCUMENTATION

1. Provide the following information to the CxA for inclusion in the commissioning plan:
   a. Plan for delivery and review of submittals, systems manuals, and other documents and reports, including BMS, lighting control devices and systems, leak detection submittals.
   b. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.

c. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
d. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
e. TAB reports for both air and hydronic systems.
f. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
g. Test and inspection reports and certificates.
h. As-built drawings
i. Corrective action documents.
j. Verification of testing, adjusting, and balancing reports.
k. Maintenance requirements or recommendations for all equipment provided by the Contractor.
l. Recommended spare parts list
m. Contact names and phone number for warranty or maintenance during the warranty period, as well as a 24-hour emergency contact.

G. SUBMITTALS

1. Paragraphs below are "Informational Submittals." See Division 01 Section "Submittal Procedures" for definition of "Informational Submittals."
2. Certificates of completion of installation, prestart, and startup activities.
3. Control system submittals
4. Point-to-point checklists and instrument calibration records.
5. TAB Report
6. Start-up/checkout checklists and reports
7. As-built drawings

2 PART 2 - PRODUCTS

2.1 MATERIALS

A. All materials, except as otherwise specified, shall be new, of current production, first quality and the best of each class specified.

B. Required materials not covered by detailed specifications shall be of a suitable class, grade, quality and type and shall be subject to the approval of the Architect. Where two or more units of the same class of equipment are required, these units shall be the products of a single manufacturer.

C. All equipment shall be installed and constructed to operate safely, as designed, without leakage, undue wear, noise, vibration or corrosion.

2.2 ELECTRIC MOTORS AND RELAYS

A. Design, type and ratings of electric motors shall comply with the National Electrical Code, NEMA and Underwriter's Laboratory.

B. Unless otherwise noted or required for special applications, motors shall be open drip-proof with sealed ball bearings.

C. All electric motors shall be of the voltage, type and frame as specified in the electrical portion of the specifications.

2.3 ACROSS-THE-LINE STARTERS

A. All motor starters shall be across-the-line start with magnetic contactors and thermal overloads properly sized for the motor nameplate data.

B. All motor starters shall be furnished with a Hand-Off-Auto (HOA) switch mounted on the cover of the enclosure.

C. All motor starters shall be furnished with a fused 120 volt control power transformer rated at a minimum of 2 amps.

D. All motor starters shall be furnished mounted in a NEMA 1 enclosure suitable for the mounting location.

E. All motor starters shall be provided with magnetic contactors having one normally open and one normally closed auxiliary contactor.

2.4 HANGERS AND SUPPORTS

A. Pipe hanger or stanchion support assemblies shall include turnbuckles or other means of vertical adjustment.

B. Trapeze hangers may be used in lieu of separate hangers for closely spaced, parallel lines. Pipe hanger components shall be as per MSS SP-58.

C. Hangers shall have steel rods with two nuts and shall be suspended from suitable beam clamps or concrete inserts. Rod sizes shall be as recommended by the hanger manufacturer and at least the following:

Pipe to 2".....3/8" diameter
2½" - 3".....1/2" diameter
4- 5" .....5/8" diameter

D. Maximum hanger or stanchion support spacing for copper or steel pipe shall be as follows:

PIPE SIZE	MAX SPACING	PIPE SIZE	MAX SPACING	PIPE SIZE	MAX SPACING
3/4” or less	5 feet	2 ½"	9 feet	6"	14 feet
1”	6 feet	3"	10 feet	8"	16 feet
1¼"	7 feet	3 ½"	11 feet	10"	18 feet
1½"	8 feet	4"	12 feet	12"	19 feet
2”	8 feet	5"	13 feet	14"	25 feet

E. Hangers or stanchion supports for copper tubing shall be copper plated where they contact the copper tubing.

F. Hangers or stanchion supports for insulated pipe shall have insulation shields.

G. All rigid piping attached to the building and serving equipment subject to vibration shall be hung or supported on vibration isolators for the first 20 feet.

H. Vertical rises shall be supported from stands at the bottom of the rise or hangers at the top of the rise as shown on the drawings per the HVAC Sub-Contractor's option.

I. All hangers on insulated piping to be sized to fit around the insulation.

2.5 ANCHORS

A. Anchor points as shown on the drawings or as required shall be located and constructed to permit the piping system to take up its expansion and contraction freely in opposite directions away from the anchored points.

2.6 VIBRATION ISOLATORS

A. Double deflection neoprene mountings shall have a minimum static deflection of 0.35". All metal surfaces shall be neoprene covered to avoid corrosion and have friction pads both top and bottom so they need not be bolted to the floor. Bolt holes shall be provided for these areas where bolting is required.

B. Spring type isolators shall be free standing and laterally stable without any housing and complete with ½" neoprene acoustical friction pads between the baseboard and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 80% of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include spring diameters, deflections, compressed spring height and solid spring height.

C. Vibration hangers for piping and mechanical equipment shall contain a steel spring and 0.3" deflection neoprene element in series. The neoprene element shall be molded with a rod isolation bussing that passes through the hanger box. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through an arc of 30° before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include a scale drawing showing the 30° swing capability. For locations requiring precise elevation during installation the hanger shall be precompressed to the rated deflection and the released after completion of the installation.

D. Vibration hangers for duct systems shall contain a steel spring located in a neoprene cup manufactured with a grommet to prevent short circuiting of the hanger rod. The cup shall contain a steel washer designed to properly distribute the load on the neoprene and prevent its extrusion. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through an arc of 30° before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include a scale drawing showing the 30° swing capability.

E. Horizontal thrust restraints shall be provided on equipment subject to excessive displacement. The horizontal thrust restraint shall consist of a spring element in series with a neoprene pad. The spring element shall be contained within a steel frame and designed so that it can be preset for thrust and adjusted to allow for a maximum of ¼" movement when the equipment starts or stops. The assembly shall

be furnished with one rod and angle brackets for attachment to the equipment and the ductwork. Horizontal thrust restraints shall be attached at the centerline of the thrust and symmetrically on each side of the unit.

2.7 CONDENSATE PIPING

A. Condensate piping shall be type-L copper with soldered joints. All 90° changes in direction shall be made with 45° elbows and tee-wyes with cleanouts, not with straight tees.

B. Solder shall be 95/5 non-lead solder.

2.8 REFRIGERANT PIPING

A. All refrigeration system piping shall be as follows:

Construction	Hard brazed joints
Piping	Copper tubing type ACR, hard drawn, cleaned, dehydrated and capped for refrigeration service, ANSI B70.1 ASTM A-280
Fittings	Wrought copper, Brazed joint type, ANSI B16.22
Coupling	Same as above
Brazing Alloy	Easy Flo, Silfos, Phos Co., Minimum 1100 °F melting temperature, ASTM 280

B. Soft drawn copper tubing may be used in sizes acceptable to the refrigeration equipment manufacturer.

2.9 PIPING INSULATION MATERIALS

A. Insulation for pipe shall be glass fiber with a K factor of .24 at 100° F mean temperature with a factory applied kraft reinforced foil all service vapor barrier jacket with a factory applied double pressure sensitive adhesive sealing system.

B. Insulation for concealed fittings and valves shall be glass fiber blanket with a K factor of .24 at 75° F mean temperature with a factory applied kraft reinforced foil all service vapor barrier jacket.

C. Exposed fittings, valves and flanges shall be insulated with molded fitting covers or fabricated segments of pipe insulation.

D. Insulation, jacket, covers and sealant shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less per UL 723.

E. Insulation shall be Owens-Corning Fiberglass ASJ/SSL-II or approved equal.

F. All refrigerant piping (suction and liquid lines) shall be insulated with flexible foamed plastic, minimum 5.0 lb. per cubic foot density, thermal conductivity not greater than 0.27 Btu-in/sq. ft/°F/hour at mean temperature difference of 75°F.

G. Multiple layers of refrigerant piping insulation shall be provided to achieve the overall required thickness.

H. All outdoor exposed refrigerant piping shall be encased in Zeston PVC Jacketing as manufactured by Johns Mansville or pre-approved equal. All seams shall be located

on the lower half of the pipe. Fittings shall be covered using PVC fitting supplied by the manufacturer.

1. All refrigerant support and mounting clips shall be installed on the outside of the insulation and/or jacketing.

I. Insulation thickness shall be as follows:

SYSTEM	**PIPE SIZE**	**THICKNESS or R-value**
Refrigerant Piping (suction and liquid)	7/8" and smaller 1" and up	½" 1"
Condensate Drain Piping	1¼" and smaller 1½" and up	½" 1"

2.10 PVC INSULATION JACKET

A. High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; 25/50 flame-spread/smoke developed rating; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

B. Products: Subject to compliance with requirements, provide one of the following:

1. Johns Manville; Zeston.
2. P.I.C. Plastics, Inc.; FG Series.
3. Proto Corporation; LoSmoke.

C. Adhesive: As recommended by jacket material manufacturer.

1. Color: White.

D. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

E. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Johns Manville: Z-Tape
   b. ABI, Ideal Tape Division; 370 White PVC tape.
   c. Venture Tape; 1506 CW NS.
2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

F. The following piping shall be jacketed:

1. All refrigerant piping located outdoors.

2.11 VALVES

A. All valves shall be first quality of an approved manufacturer, shall be installed with the proper clearances and shall be tight at the specified pressures.

B. Valves shall be of minimum working pressure and materials as fittings specified for the service, however, in no case shall valves be designed for less than 125 PSI working pressure.

C. Where a specific manufacturer, brand and/or figure number is specified, an equivalent figure from an approved manufacturer shall be acceptable.

D. For shut off service the HVAC Sub-Contractor shall use ball valves with full open ID.

E. For throttling or modulating service the HVAC Sub-Contractor shall use a butterfly valve or another type of valve if a specific valve is specified on the drawings.

F. Check Valves

1. Check valves shall be bronze 2." and smaller; Cast iron or cast steel with bronze trim for 3" and larger.
2. All check valves shall have removable caps and regrindable disc and seat ring.
3. Bronze check valves shall be rated 125 PSI SWP, 200 PSI WOG as NIBCO figure T-413 or S-413.
4. Iron Check valves shall be 125 PSI SWP, 200 PSI WOG as NIBCO figure F-918.

G. Ball Valves.

1. Ball valves shall be bronze 2½" and smaller equal to Apollo Ball Valves 70 series.
2. Ball valves shall be rated for 200 PSI @ 250°F.

2.12 PIPE LABELS

A. All refrigerant piping shall be labeled with plastic adhesive labels. Labels shall indicate the piping system (refrigerant suction, refrigerant liquid, etc.), and shall indicate the direction of flow. Piping shall be labeled every 20 feet minimum on straight runs, within 2 feet of access panels and shall be labeled within five feet of changes of direction. Labels shall be applied to the insulation jacket.

1. All refrigerant branch circuits shall be labelled with the fan coil tag number served.

2.13 SLEEVES

A. Provide Schedule 40 galvanized steel pipe sleeves for each pipe passing through a wall, floor, partition or roof.

2.14 FIRE-STOPPING

A. Seal annular spaces between sleeves and penetrating materials in fire-rated floors, ceilings, and walls with fireproof and waterproof silicone elastomer applied in accordance with the manufacturers published instructions. Multiple penetrations

shall be sealed with silicone foam; single penetrations may be sealed with silicone caulking. Seal material shall be UL classified for use in fire-rated penetration seals, and shall be applied in the manufacturer's recommended thickness for the fire rating of the penetrated structure in accordance with ASTM-E-814 requirements.

B. Acceptable Manufacturers: Dow Corning, General Electric, 3M.

2.15 WATERPROOFING

A. Seal penetrations of wet or potentially wet structures, floors, exterior walls, etc., other than those requiring fire stopping, with sealant to prevent moisture leakage. Apply sealing material (caulking) in accordance with manufacturer's published instructions.

B. Product Research and Chemical Co. "Poly-Sulphide Sealant" PRC-5000.

2.16 FILTERS

A. Refer to equipment schedules and specifications for filter requirements.

B. Unless otherwise noted panel filters shall be 1" MERV 8 filters.

C. Provide one (1) set of spare filters for each piece of equipment.

2.17 RECTANGULAR DUCTS

A. All ductwork shall be fabricated of G-60 coated galvanized steel of lockforming grade and conforming to ASTM standards A-525 and A-527, unless otherwise noted, and shall be constructed in accordance with the latest SMACNA standards.

B. Duct sizes shown on the drawings are the clear inside dimensions, after any lining has been applied.

C. Ductwork for ERV-1, RTU-1 & 2, exhaust fan and fan coils shall be constructed to 2” static pressure class requirements.

2.18 RECTANGULAR DUCT FITTINGS

A. All ductwork shall be fabricated of G-60 coated galvanized steel of lockforming grade and conforming to ASTM standards A-525 and A-527, unless otherwise noted, and shall be constructed in accordance with the latest SMACNA standards.

2.19 ROUND DUCTS

A. All round ductwork shall be fabricated of G-60 coated galvanized steel of lockforming grade and conforming to ASTM standards A-525 and A-527, unless otherwise noted, and shall be constructed in accordance with the latest SMACNA standards.

B. All round spiral duct and fittings shall be manufactured from G-90 galvanized steel, conforming to ASTM and SMACNA standards. Standard elbows will have 1.5 centerline radius. Other radii and vaned elbows are available as needed. Elbows through 12” shall be die formed, with stitch welded joints. Elbows 14” through 30” shall be gore-locked construction. All elbows above 32” shall also be gored, but with tack weld and sealed construction for use to 4” w.g., or solid welded for use to 10” w.g.

2.20 FLEXIBLE DUCTS

A. All flexible ducts shall be constructed of a trilaminate of aluminum foil, fiberglass and aluminized polyester mechanically locked to a galvanized steel helix. No adhesives shall be used to lock the fabric to the helix.

B. All flexible ducts must conform to NFPA 90A and 90B requirements and be tested in accordance with UL-181 and bear a UL label and be installed in accordance with their listing by UL. Flexible ducts shall have a flame spread rating or 25 or less and a smoke developed rating or 50 or less per UL 723.

C. Insulated flexible duct shall have a block fire retardant polyethylene outer jacket with a ½ lb. density 1-1/2" thick fiberglass insulation jacket.

D. Flexible ducts 12" diameter and smaller shall be rated at 12" positive pressure and 10" negative pressure. Flexible ducts 14" and 16" diameter shall be rated at 5" positive and negative pressure and flexible ducts 18" diameter and larger shall be rated at 1" positive and negative pressure.

E. Flexible ducts shall not exceed 5 feet in length.

2.21 FLEXIBLE CONNECTORS

A. All connections between vibrating or rotating equipment and ductwork shall be made with a flexible connection consisting of a heavy fiberglass fabric, double coated with neoprene and shall be fireproof conforming to NFPA 90A, waterproof and airtight. The flexible connection shall be a minimum of 6" long and held in place with heavy metal bands.

2.22 DUCT INSULATION MATERIALS - DUCT WRAP

A. Insulation for ducts and fittings shall be glass fiber with a K factor of .25 at 75° F mean temperature with a factory applied kraft reinforced foil all service vapor barrier jacket with a 2" stapling flange.

B. Insulation, jacket and sealant shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less per UL 723.

C. Insulation for concealed ductwork shall be Owens-Corning Fiberglass Type 150 or approved equal.

D. Exposed exterior ductwork insulation shall be protected with a waterproof EPDM membrane with all seams sealed water tight and all longitudinal seams located on the bottom of the duct.

E. The following ducts shall be insulated:

1. All exterior ERV-200 system supply and return ducts.

2.23 SPIRAL DUCT LINING

A. Basis of design is Johns Manville Spiracoustic Plus fiberglass spiral duct liner. Alternate manufacturers are Owens Corning and CertainTeed.

B. Materials: All supply ducts, return ducts, and fittings insulated with Spiracoustic Plus System round duct liners, meeting the following requirements:

1. Minimum thermal conductance of 0.23 at 75°F based on 1" material thickness.
2. Noise reduction coefficient of 0.75 for 1" board, 0.85 for 1.5" board, and 0.95 for 2" board when tested in accordance with ASTM C423 when using a type "A" mounting.
3. Maximum rated velocity of 6000 FPM when tested in accordance with UL 181.
4. Fiber shed shall not be detectable as determined by electron microscopy analysis of isokinetic sampling at maximum rated velocity.
5. Duct liner shall have a FHC rating of 25/50 and be classified as meeting the requirements of limited combustibility.
6. The air stream surface shall have a 100% coverage coating of acrylic polymer formulated with an immobilized EPA registered anti-microbial agent proven resistant to microbial growth as determined by ASTM G21.
7. Material shall be certified by GreenGuard.
8. Shall not contain asbestos, lead, mercury, or mercury compounds.

C. Accessories

1. Joint closure tape meeting the requirements of UL 181A, as identified by imprinting on the tape foil surface.
2. SuperSeal® coating products for coating exposed edges, connections or minor surface damage not requiring replacement of insulation.
3. Duct liner adhesive, when required, meeting the requirements of ASTM C9l6.
4. Duct liner pins, when required, meeting the requirements of Johns Manville Spiracoustic Plus Installation Guide, Sections 5 and 6.

D. The following ducts shall be lined:

1. All exposed supply and return ductwork in the Gymnasium shall be lined with 1" in its entirety.

E. Duct dimensions shown on the drawings are the clear inside dimensions, after the lining has been applied.

2.24 ACOUSTICAL DUCT LINING

A. Acoustical duct lining shall be constructed of a semi-rigid board of glass fiber with a black-pigmented, fire resistant coating on the side toward the airstream. The duct lining shall comply with the requirements of NFPA 90 and ASTM C 1071.

B. Duct lining shall have a thermal conductivity of 0.25 Btu*in/hr*ft^2*^oF.

C. The following ducts shall be lined:

1. All ERV supply and return/exhaust duct connections to the unit shall have 1" lining for the first 10 feet or past the second elbow, whichever is further.

D. Duct dimensions shown on the drawings are the clear inside dimensions, after the lining has been applied.

2.25 VOLUME DAMPERS

A. Furnish and install, where indicated on the drawings or where required for balancing, air splitter dampers, butterfly dampers, or opposed blade dampers with indicating and locking quadrants or push rods and pillow blocks.

B. Opposed blade dampers shall be manually operated multi-blade type with sleeve bearings, galvanized steel interlocking blades and a galvanized steel frame. In ducts over 19" in depth and 12" in height, use multiple opposed blade type, gang operated dampers with a maximum blade width of 8". Fabricate the damper blades of 10-gauge steel with hemmed edges, and a maximum length of 48". Damper operating rods shall be the full blade length and shall extend through the duct to externally mounted bearing plates. On insulated ductwork, bearing plates shall be flush with insulation finish and fastened to the duct. The operating lever shall be of the indicating type with locking quadrant. Splitter dampers shall be sufficiently long to extend the full width of the branch duct to which they are attached. Where necessary they shall curve to scoop branch duct air out of the main duct air stream. The dampers shall be constructed in accordance with the latest SMACNA standards and shall be at least two gauges heavier than the ducts in which they are installed.

2.26 CONTROL DAMPERS & ACTUATORS

A. Control dampers based on Greenheck series VCD-34 low leakage insulated blade or approved equal.

B. General:

1. Blade action shall be opposed.
2. Dampers shall meet or exceed the IECC (International Energy Conservation Code) requirements for damper leakage ratings of 3 cfm/ sq. ft @ 1 in. wg or 8 cfm/sq. ft. @ 4in. wg or less when integral to the building envelope.
3. The Damper Manufacturer's submittal data shall certify that all pressure drop data is licensed in accordance with the AMCA Certified Ratings Program for Test Figures 5.2, 5.3, and 5.5. Damper air performance data shall be developed in accordance with the latest edition of AMCA Standard 500-D. Dampers shall be labeled with the AMCA Air Performance Seal. AMCA certified pressure drop for a 24 in. wide x 24 in. high damper shall not exceed 0.04 in. wg when subjected to an airflow velocity of 1500 fpm according to AMCA Test Figure 5.3.
4. Dampers shall bear the AMCA Certified Ratings Seal for Air Performance in accordance with AMCA 511 (VCD-20, VCD-23, VCD-33, VCD-34, SEVCD-23 and SEVCD-33).
5. Dampers shall bear the AMCA Certified Ratings Seal for Air Performance Air Leakage in accordance with AMCA 511 (VCD-23, VCD-33, VCD-34, SEVCD-23 and SEVCD-33).

C. Construction:

1. Damper frame shall be 16 ga. galvanized steel formed into a 5” x 1” structural hat channel. Top and bottom frame members on dampers less than 17” high shall be low profile design to maximize the free area of these smaller dampers. Frame shall be 4-piece construction with 1 ½” (minimum) integral overlapping gusset reinforcements in each corner to assure square corners and provide maximum resistance to racking. Stainless steel frame is optional.
2. Damper blades shall be airfoil shape, galvanized steel double skin construction (14 ga. equivalence) filled with ½ in. polystyrene on each blade shall be symmetrical relative to its axle pivot point, presenting identical performance characteristics with air flowing in either direction through the damper. Provide

symmetrical blades of varying size as required to completely fill the damper opening. Blade orientation is horizontal. Stainless steel blade is optional.

3. Linkage shall be plated steel.
4. Axles shall be plated steel.
5. Axle bearings shall be synthetic (acetal) sleeve rotating in polished extruded holes in the damper frame.
6. Mill galvanized finish is standard.

D. Actuator

1. Electric, 24V DC, 2-position
2. External (outside of duct)

2.27 DRIP PANS

A. Examine the drawings and in cooperation with the Electrical Contractor confirm the final location of all electrical equipment to be installed in the vicinity of piping. Plan and arrange all overhead piping no closer than two feet from a vertical line to electric motors and controllers, switchboards, or similar equipment. Piping is not permitted in electric equipment, transformer, switch gear and telephone gear rooms.

B. Where the installation of piping does not comply with the requirements of foregoing paragraph, where feasible the piping shall be relocated.

C. Where relocation of piping is not feasible, furnish gutters as follows:

1. Provide and erect a gutter of 16 ounce cold rolled copper or 18 gauge galvanized steel, under every pipe which is within 2 feet from a vertical line to any motor, electrical controllers, switchboards, panelboards or the like.
2. Each gutter shall be reinforced, rimmed, soldered and made watertight, properly suspended and pitched to a point outside of the electrical room.

2.28 ACCESS PANELS

A. Hinged access panels shall be provided at locations of volume dampers, control dampers, and elsewhere as required to service the duct systems. Access doors shall be fully gasketed for airtight seal at the rated working pressures of the systems in which they are installed. Access doors shall be adequately sized for their intended purpose and equipped with a minimum of two sash locks. Access doors in insulated ducts shall be double wall and insulated.

B. Access panels shall be provided at locations of the variable refrigerant volume systems if located above hard ceilings.

C. Coordinate with requirements of Specifications Section 083110.

2.29 REGISTERS, GRILLES AND DIFFUSERS

A. The types, sizes and airflow patterns of the registers, grilles and diffusers as specified and as shown on the plans have been selected to accomplish the intent and purpose of the system. Any substitutions proposed for items scheduled, shown or specified must provide the same air flow patterns, at the same air volumes and must have the same acoustical characteristics as the specified elements.

B. All interiors of all ducts in back of all registers, grilles and diffusers shall be painted with one coat of flat black nonflammable paint.

C. Duct connections to supply devices shall be made inside the collars, if any, and, duct connections to return or exhaust devices shall be made outside the collars, if any.

D. All registers, grilles and diffusers shall have a baked enamel, white, semi-gloss finish.

E. Square and rectangular diffusers shall have removable cores with opposed blade dampers, gasketed borders and concealed fastenings.

F. Frame types of diffusers shall be as appropriate for the type of ceiling in which they are to be installed.

G. Supply, return and exhaust air registers shall have opposed blade dampers and gasketed borders.

2.30 CONSTANT AIRFLOW REGULATOR

A. Constant airflow regulators basis of design is American Aldes.

B. Refer to plans and schedules for models, accessories and quantities.

C. Model CAR3 Constant Airflow Regulator

1. Airflow regulator shall be capable of maintaining constant airflow within +/-10% of the scheduled flow rates, within the operating range of 0.12 to 1.2 in. w.g. differential pressure for low-pressure models (CAR3-L), or 0.4 to 2.8 in. w.g. with high-pressure models (CAR3-H).
2. CAR3 solely operate on duct pressure and require no external power supply or sensors, and shall be rated for use in air temperatures ranging from -25°F to 140°F (-32°C to 60°C).
3. CAR3 must be equipped with double lip gasket to provide a secure, leak free installation into rigid round duct, take-offs, collars, etc.
4. Each regulator shall feature dual-side adjustment dial to allow changes in airflow setpoint while installed in either the supply or exhaust direction without removing the regulator from the duct.
5. Each CAR3 must be calibrated to match the airflows indicated on the schedule or drawings.
6. Regulator must be classified per UL 2043 and carry the UL mark indicating compliance.
7. Constant Airflow Regulator shall be enhanced with antimicrobial, anti-static, and flame retardant additives for increased durability and safety, and covered under warranty for a period of no less than seven years.
8. Constant Airflow Regulator shall be installed in accordance with local code and manufacturer’s instructions.

D. Model ZRT-PDIL Parallel Damper In-Line Zone Terminals

1. The terminal casing shall be minimum 24-gauge G90 galvanized steel with duct flange that allows attachment of rectangular rigid ducting in a slip-type duct connection.

2. Each terminal shall include integral, pressure-independent Constant Airflow Regulators (CAR) that provide the capability of automatically regulating airflow in both a continuous and boost setting. Each regulator shall automatically respond to changes in duct pressure to maintain specified flow rates at a constant level.
3. The low-volume continuous and on-demand boost Constant Airflow Regulators (CAR) shall be factory calibrated to the specified set points. Both regulators shall be capable of being adjusted in the field to any desired airflow within their noted minimum and maximum setpoints.
4. The continuous CAR will automatically control the amount of air any time the central fan is operating.
5. The boost CAR shall be located in series with a motorized single-blade damper operated by a long-life synchronous-drive motor with normally closed spring-return closure. When the ZRT-PDIL is powered, the motorized damper will open allowing air through the boost regulator, automatically adding the prescribed boost rate to the continuous rate during central fan operation. The damper blade shall rotate on a solid one-piece damper that pivots on permanently lubricated bearings. A permanently fixed perimeter gasket seal shall be provided to prevent air noise and leakage at the closed position.
6. The entire damper assembly and all operable parts shall be capable of being removed from the terminal housing from below without disconnecting duct or removing the housing. Access to all regulator and damper components shall be through an integral screw-on access plate.
7. All terminals and/or pertinent components must be listed per UL standards and carry the UL, UR or ETL mark indicating compliance.
8. Each ZRT-PDIL shall include all necessary mounting brackets and hardware.
9. Installation shall be per all applicable codes and manufacturer’s instructions.

2.31 CEILING MOUNTED EXHAUST FANS

A. General:

1. Base fan performance at standard conditions (density 0.075 Lb/ft3)
2. Ceiling mounted applications
3. Maximum operating temperature is 130 Fahrenheit (54.4 Celsius)
4. Sound levels as low as 0.7 AMCA sones
5. UL/cUL listed for above bathtub exhaust
6. Fans are UL/cUL listed 507 - Electric Fans
7. Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number
8. Fans shall be manufactured by Greenheck (basis of design) or approved equal.

B. Wheel:

1. Forward curved centrifugal wheel
2. Constructed of galvanized steel or calcium carbonate filled polypropylene
3. Statically and dynamically balanced in accordance to AMCA Standard 204-05

C. Motors:

1. AC Induction Motor
    a. Motor enclosures: Totally enclosed air over: (TEAO)- designed to be used solely in the airstream, constructed with a dust tight cover and an aerodynamic body which relies upon the strong airflow of the fan to cool the motor, not suitable for hazardous environments.
    b. Motors shall be permanently lubricated sleeve bearing type to match with the fan load and furnished at the specific voltage and phase.
    c. Motor shall be mounted on vibration isolators and be accessible for maintenance
    d. Thermal overload Protection

D. Housing:

1. Constructed of heavy gauge galvanized steel
2. Interior shall be lined with 0.5 inches of acoustical insulation
3. Profile as low as 10 1/2 inches

E. Spring Loaded Aluminum Backdraft Damper:

1. Prevents air from entering back into the building when fan is off
2. Eliminates rattling or unwanted backdrafts

F. Outlet:

1. Type of outlet: Round
2. Field rotatable from horizontal to vertical discharge
3. Shall include an aluminum backdraft damper

G. Mounting Brackets:

1. Fully adjustable for multiple installation conditions

H. Options/Accessories:

1. Thermostat:
    a. Type: Cooling
    b. Control the fan based on temperature of the space
    c. Contacts close on temperature change
2. Transformer:
    a. Type: T-2.0 - UL listed, Rated for 230/277v to 115, 2.0 amps max at 120 volts
    b. Available for applications requiring voltage reduction
    c. All transformers are shipped loose
3. Vibration Isolation:
    a. Available for suspended installations
    b. Includes pre-punched hole for ease of installation and shall have all hardware to mount one unit

2.32 DESTRATIFICATION FANS

A. Destratification fans basis of design is Airius, ONYX series.

B. General

1. Performance: Coordinated design of housing, stator and motor shall provide columnar laminar airflow to produce a minimum of 100 fpm at center of column at grade level when installed within 2'-0" of ceiling. Refer to manufacturer's airflow velocity profiles for jet pattern and throw data.
2. Housing: The fan housing shall be made of PC/ABS resin, rated 5VA for flame resistance.
3. Housing color:
    a. PMS Cool Gray 2C (off white)
    b. Black
    c. As scheduled
4. Safety Cable: Supplied with 6'-0" steel cable fastened to seismic restraint point integrated into the fan housing. Safety restraint attached to primary mounting handle will not be accepted.
5. Motor Mounting: Enclosed in housing, above stator.
6. Stator: The fan shall be equipped with a patented curved multiple-vane stator coordinated with fan design for maximizing columnar laminar flow.
7. Bypass Technology: The fan shall be equipped with multiple bypass vents within the outer housing to maximize air entrainment through the housing to maximize volume output.
8. Certification: UL Standard 507 for Safety Electric Fans, CAN//CSA-C22.2 No. 1113 and UL 94 5VA as certified by nationally recognized testing laboratory. Acceptable laboratories include ETL, UL or other nationally recognized testing laboratories.
9. Identification: Permanently affixed manufacturer's nameplate including the following: Model Number, Serial Number, Motor Power Specifications, Country of Manufacture and Safety Marks: ETL (US & CA) & CE (EU).
10. Power Cord: 6 foot, 300-volt AC, UL rated. Motors within the range of 100-130VAC are provided with a standard 3-prong plug. Motors within the range of 200-277VAC are not provided with a plug.
11. Motor:
    a. Electrically commutated motor, up to 92% efficient. Plastic blades bolted to steel hub. Ball bearings shall be permanently lubricated and shielded. Up to 1422 cfm, 1732 rpm,. Thermally protected motor with an operating range of -40° F (-40° C) to +176° F (80° C).
    b. Recommended ceiling height up to 50 feet (15.2 m) and area coverage up to 2000 sq. ft (185.8 sq. m); 25 feet (7.6 m) from the fan's center in all directions.
12. Electrical Requirements:
    a. 100-130V AC, single phase, 50/60 Hz.; 1.32 Amps; 90 watts
    b. 200-240V AC, single phase, 50/60 Hz.; 0.8 Amps; 98 watts
13. Controls shall be coordinated with motor electrical requirements.
    a. Shall be controlled directly by 0-10VDC control signal from BAS. Uses low voltage control circuit separate from mains power. See wiring diagram.
    b. Provide with BACnet MS/TP card for individual fan control and status integration with BAS.

2.33 DIRECT DRIVE INLINE FANS

A. Inline fans basis of design is Greenheck.

B. General

1. Base fan performance at standard conditions (density 0.075 Lb/ft3)
2. Performance capabilities up to 27,800 cubic feet per minute (cfm) and static pressure to 3.0 inches of water gauge
3. Fans are available in twenty-four sizes with nominal wheel diameters ranging from 7 inches through 33 inches
4. Continuous operating temperature range of -10º Fahrenheit (-23.3º Celsius) to 130º Fahrenheit (54.4º Celsius)
5. Applications include: supply, exhaust, return, or make-up air systems
6. UL-705 certified for indoor (standard) and outdoor applications (must configure fan for outdoor use to allow outdoor installation)
7. Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number

C. Wheel:

1. Non-overloading, backward inclined centrifugal wheel
2. Constructed of Aluminum
3. Statically and dynamically balanced in accordance to AMCA Standard 204-05
4. The wheel cone and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency
5. Single thickness blades are securely riveted or welded to a heavy gauge back plate and wheel cone

D. Motors:

1. Electronically Commutated Motor
2. Motor enclosure: Open drip proof
3. Motor to be a DC electronic commutation type motor (ECM) specifically designed for fan applications. AC induction type motors are not acceptable. Examples of unacceptable motors are: Shaded Pole, Permanent Split Capacitor (PSC), Split Phase, Capacitor Start and 3 phase induction type motors
4. Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase
5. Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor
6. Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal
7. Motor shall be a minimum of 85% efficient at all speeds

E. Housing/Cabinet Construction:

1. Square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars

2. Housing and bearing supports shall be constructed of heavy gauge bolted and welded steel construction to prevent vibration and to rigidly support the shaft and bearing assembly.
3. Galvanized Construction material

F. Housing Supports and Drive Frame:

1. Housing supports are constructed of structural steel with formed flanges
2. Drive frame is welded steel which supports the motor

G. Disconnect Switches:

1. NEMA rated: NEMA 1: indoor application no water. Factory standard.
2. Positive electrical shut-off
3. Wired from fan motor to junction box

H. Duct Collars:

1. Square design to provide a large discharge area
2. Inlet and discharge collars provide easy duct connection

I. Access Panel:

1. Two sided access panels, permit easy access to all internal components
2. Located perpendicular to the motor mounting panel

J. Options/Accessories:

1. Dampers:
   a. Type: BD-330, Gravity
   b. Galvanized frames with prepunched mounting holes
   c. Balanced for minimal resistance to flow
2. Insulated Housing:
   a. 1 inch thick insulated housing
   b. For noise reduction and condensation control
   c. Constructed of fiberglass liner
3. Motor Cover:
   a. Constructed of galvanized steel
   b. Covers motor and drives for safety
   c. Standard on unit specified with UL

2.34 VARIABLE REFRIGERANT VOLUME HEAT PUMP SYSTEM

A. General

1. Per the equipment schedule, the variable capacity, heat pump heat recovery air conditioning system basis of design is Mitsubishi Electric CITY MULTI VRF (Variable Refrigerant Flow) zoning system(s).
2. Acceptable alternative manufacturers, assuming compliance with these equipment specifications, are Trane, Panasonic, and Hitachi. Contractor bidding an alternate manufacturer does so with full knowledge that that manufactures product may not be acceptable or approved and that contractor is responsible for all specified items and intents of this document without further compensation.

3. Simultaneous heating/cooling (heat recovery) systems shall consist of an outdoor unit, BC (Branch Circuit) Controller (or comparable branch devices), multiple indoor units, and an integral DDC (Direct Digital Controls) system. Each indoor unit or group of indoor units shall be capable of operating in any mode independently of other indoor units or groups. System shall be capable of changing mode (cooling to heating, heating to cooling) with no interruption to system operation. To ensure owner comfort, each indoor unit or group of indoor units shall be independently controlled and capable of changing mode automatically when zone temperature strays 1.8 degrees F from set point for ten minutes.
4. No additional branch circuit controllers (or comparable branch devices) than shown on the drawings/schedule may be connected to any one outdoor unit. Contractors proposing alternate systems requiring more branch devices than those included as the basis of design are responsible for additional piping & electrical costs and are required to identify additional costs & installation time required of other trades with their bid.
5. The units shall be listed by Electrical Testing Laboratories (ETL) and bear the ETL label.
6. All wiring shall be in accordance with the National Electrical Code (N.E.C.).
7. The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).
8. All units must meet or exceed the 2010 Federal minimum efficiency requirements and the ASHRAE 90.1 efficiency requirements for VRF systems. Efficiency shall be published in accordance with the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 1230.
9. System start-up supervision shall be a required service to be completed by the manufacturer or a duly authorized, competent representative that has been factory trained in system configuration and operation. The representative shall provide proof of manufacturer certification indicating successful completion within no more than two (2) years prior to system installation. This certification shall be included as part of the equipment and/or controls submittals.

B. System Start-Up

1. The manufacturer or manufacturer's representative shall provide start-up services for the system and shall provide a report on the start-up procedure and provide documentation that the system is installed and functioning per the manufacturer's specifications.
2. The manufacturer or manufacturer's representative shall provide integration system assistance as required to assist the ATC sub-contractor in integrating the VRV system with the DDC system.

C. System Training

1. The manufacturer or manufacturer's representative shall provide training for the Owner or Owner's representative. Training shall be a minimum of 4 hours and shall be conducted at the same time as the training for the other HVAC systems.
2. The manufacturer shall also provide 16 hours of structured off-site training for the Owner's personnel.

D. Warranty

1. The CITY MULTI units shall be covered by the manufacturer's limited warranty for a period of one (1) year parts and seven (7) year compressor to the original owner from date of installation.
2. Installing contractor shall meet manufacturer requirements to obtain extended manufacturer's limited parts and compressor warranty for a period of ten (10) years to the original owner from date of installation. This warranty shall not include labor.
3. All manufacturer's requirements to obtain the limited warranty shall be met, including but not limited to: designed by a certified City Multi Diamond Designer, installation by a contractor that has completed the Mitsubishi service course, and submission of a completed commissioning report that is approved by Mitsubishi.
4. All manufacturer technical and service manuals must be readily available for download by any local contractor should emergency service be required. Registering and sign-in requirements which may delay emergency service reference are not allowed.
5. The CITY MULTI VRF system shall be installed by a contractor with extensive CITY MULTI install and service training. The mandatory contractor service and install training should be performed by the manufacturer.

E. System Efficiency

1. The systems shall have the following minimum efficiencies in order to comply with the Eversource Path 1 Net Zero Equivalent (NZE) rebate program for new buildings program requirements.
2. Units shall be ASHRAE 90.1 rated in accordance with AHRI 1230.
3. Minimum efficiencies for Units =>135,000<240,000 BTUH:
    a. EER – 10.6
    b. IEER – 11.8
    c. COP - 3.2
4. Minimum efficiencies for Units =>240,000 BTUH:
    a. EER – 9.5
    b. IEER – 10.6
    c. COP – 3.2

F. High Efficiency Y-Series Air Cooled Heat Pump

1. General
    a. The outdoor unit modules shall be air-cooled, direct expansion (DX), multi-zone units used specifically with VRF components described in this section and Controls section. The outdoor unit modules shall be equipped with a single compressor which is inverter-driven and multiple circuit boards—all of which must be manufactured by the branded VRF manufacturer. Each outdoor unit module shall be completely factory assembled, piped, and wired and run tested at the factory.
    b. Outdoor unit systems may be comprised of multiple modules with differing capacity if a brand other than basis of design is proposed. All units requiring a factory supplied twinning kits shall be piped together in

the field, without the need for equalizing line(s). If an alternate manufacturer is selected, any additional material, cost, and labor to install additional lines shall be incurred by the contractor. Contractor responsible for ensuring alternative brand compatibility in terms of availability, physical dimensions, weight, electrical requirements, etc.

c. Outdoor unit shall have a sound rating no higher than 68 dB(A) individually or 70 dB(A) twinned. Units shall have a sound rating no higher than 52 dB(A) individually or 55 dB(A) twinned while in night mode operation. Units shall have 5 levels sound adjustment via dip switch selectable fan speed settings. If an alternate manufacturer is selected, any additional material, cost, and labor to meet published sound levels shall be incurred by the contractor.

d. Refrigerant lines from the outdoor unit to the indoor units shall be insulated in accordance with the installation manual.

e. The outdoor unit shall have the capability of installing the main refrigerant piping through the bottom of the unit.

f. The outdoor unit shall have an accumulator with refrigerant level sensors and controls. Units shall actively control liquid level in the accumulator via Linear Expansion Valves (LEV) from the heat exchanger.

g. The outdoor unit shall have a high pressure safety switch, over-current protection, crankcase heater and DC bus protection.

h. VRF system shall meet performance requirements per schedule and be within piping limitations & acceptable ambient temperature ranges as described in respective manufacturers' published product catalogs. Non-published product capabilities or performance data are not acceptable.

i. The outdoor unit shall be capable of operating in heating mode down to -25ºF ambient temperatures or cooling mode up to 126ºF ambient temperatures, without additional restrictions on line length & vertical separation beyond those published in respective product catalogs. Models with capacity data for required temperature range published as "for reference only" are not considered capable of guaranteed operation and are not acceptable. If an alternate manufacturer is selected, any additional material, cost, and labor to meet ambient operating range and performance shall be incurred by the contractor.

j. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained. Oil return sequences must be enabled only during extended periods of reduced refrigerant flow to ensure no disruption to correct refrigerant flow to individual zones during peak loads. Systems which might engage oil return sequence based on hours of operation risk oil return during inopportune periods are not allowed. Systems which rely on sensors (which may fail) to engage oil return sequence are not allowed.

k. Unit must defrost all circuits simultaneously in order to resume full heating more quickly during extreme low ambient temperatures (below 23F). Partial defrost, also known as hot gas defrost which allows reduced heating output during defrost, is permissible only when ambient temperature is above 23F.

l. While in hot gas defrost the system shall slow the indoor unit fan speed

down to maintain a high discharge air temperature, systems that keep fan running in same state shall not be allowed as they provide an uncomfortable draft to the indoor zone due to lower discharge air temperatures.

m. The outdoor unit shall be provided with a manufacturer supplied 20 gauge hot dipped galvanized snow /hail guard. The snow/hail guard protects the outdoor coil surfaces from hail damage and snow build-up in severe climates.

2. Unit Cabinet
   a. The casing(s) shall be fabricated of galvanized steel, bonderized and finished.
   b. The outdoor unit shall be tested in compliance with ISO9277 such that no unusual rust shall develop after 960 hours of salt spray testing.
   c. Panels on the outdoor unit shall be scratch free at system startup. If a scratch occurs the salt spray protection is compromised and the panel should be replaced immediately.
3. Fan
   a. Each outdoor unit module shall be furnished with direct drive, variable speed propeller type fan(s) only. Fans shall be factory set for operation at 0 in. WG. external static pressure, but capable of normal operation with a maximum of 0.32 in. WG. external static pressure via dipswitch.
   b. All fan motors shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.
   c. All fan motors shall be mounted for quiet operation.
   d. All fans shall be provided with a raised guard to prevent contact with moving parts.
   e. The outdoor unit shall have vertical discharge airflow.
4. Refrigerant & Refrigerant Piping
   a. Refrigerant shall be R410A.
   b. Polyolester (POE) oil—widely available and used in conventional domestic systems—shall be required. Prior to bidding, manufacturers using alternate oil types shall submit material safety data sheets (MSDS) and comparison of hygroscopic properties for alternate oil with list of local suppliers stocking alternate oil for approval at least two weeks prior to bidding.
   c. Refrigerant piping shall be phosphorus deoxidized copper (copper and copper alloy seamless pipes) of sufficient radial thickness as defined by the VRF equipment manufacturer and installed in accordance with manufacturer recommendations.
   d. All refrigerant piping must be insulated with minimum ½" closed cell, CFC-free foam insulation with flame-Spread Index of less than 25 and a smoke-development Index of less than 50 as tested by ASTM E 84 and CAN / ULC S-102. R value of insulation must be at least 3.
   e. Refrigerant line sizing shall be in accordance with manufacturer specifications.
   f. Contractor shall submit refrigerant piping diagrams with piping sized by

Manufacturer's electronic selection software. Piping lengths shall be based on installed conditions.

5. Coil
    a. Outdoor Coil shall be constructed to provide equal airflow to all coil face surface are by means of a 4-sided coil
    b. Outdoor Coil shall be elevated at least 12" from the base on the unit to protect coil from freezing and snow build up in cold climates. Manufacturer's in which their coil extends to within a few inches from the bottom of their cabinet frame shall provide an additional 12" of height to their stand or support structure to provide equal protection from elements as Mitsubishi Electric basis of design. Any additional support costs, equipment fencing, and tie downs required to meet this additional height shall be responsibility of Mechanical Contractor to provide.
    c. The outdoor heat exchanger shall be of zinc coated aluminum construction with turbulating flat tube construction. The coil fins shall have a factory applied corrosion resistant finish. Uncoated aluminum coils/fins are not allowed.
    d. The coil shall be protected with an integral metal guard.
    e. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.
    f. Unit shall have prewired plugs for optional panel heaters in order to prevent any residual ice buildup from defrost. Panel heaters are recommended for operating environments where the ambient temperature is expected to stay below -1F for 72 hours.
    g. Condenser coil shall have active hot gas circuit direct from compressor discharge on lowest coil face area to shed defrost condensate away from coil and protect from Ice formation after returning to standard heat pump operation. While in Heat Pump operation this lower section of the Outdoor Evaporator coil shall continually run hot gas from the compressor discharge to protect the coil from ice buildup and coil rupture. Manufacturers who do not have an active hot gas circuit in the lower section of the Outdoor coil to protect coil from freezing shall not be allowed to bid on project in markets where the outdoor unit will see temperatures below freezing.
6. Compressor
    a. Each outdoor unit module shall be equipped with only inverter driven scroll hermetic compressors. Non inverter-driven compressors, which may cause inrush current (demand charges) and require larger generators for temporary power shall not be allowed.
    b. Each compressor shall be equipped with a multi-port discharge mechanism to eliminate over compression at part load. Manufacturer's that rely on a single compressor discharge port and provide no means of eliminating over compression and energy waste at part load shall not be allowed.
    c. Crankcase heat shall be provided via induction-type heater utilizing eddy currents from motor windings. Energy-wasting "belly-band" type crankcase heaters are not allowed. Manufacturers that utilize belly-band crankcase heaters will be considered as alternate only.
    d. Compressor shall have an inverter to modulate capacity. The capacity for

each compressor shall be variable with a minimum turndown not greater than 15%.

e. The compressor shall be equipped with an internal thermal overload.

f. Field-installed oil equalization lines between modules are not allowed. Prior to bidding, manufacturers requiring equalization must submit oil line sizing calculations specific to each system and module placement for this project.

g. Manufacturers that utilize a compressor sump oil sensor to equalize compressor oil volume within a single module shall not be allowed unless they actively shut down the system to protect from compressor failure.

7. Controls

a. The unit shall be an integral part of the system & control network described in Controls section and react to heating/cooling demand as communicated from connected indoor units over the control circuit. Required field-installed control voltage transformers and/or signal boosters shall be provided by the manufacturer.

b. Each outdoor unit shall have the capability of 4 levels of demand control based on external input

8. Electrical

a. The outdoor unit electrical power shall be 208/230 or 460 volts, 3-phase, 60 hertz.

b. The outdoor unit shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz), 207-253V (230V/60Hz) or 414-506V (460V/60Hz).

c. The outdoor unit shall be controlled by integral microprocessors.

d. The control circuit between the indoor units, BC Controller and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

G. Indoor Unit – 4-Way Ceiling Cassette Type with Grille for 2’x2’ Grid

1. General

a. The indoor unit shall be a four-way cassette style indoor unit that recesses into the ceiling with a ceiling grille. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory. The unit shall be suitable for use in plenums in accordance with UL1995 ed 4.

2. Unit Cabinet:

a. The cabinet shall be a compact 22-7/16” wide x 22-7/16” deep so it will fit within a standard 24” square suspended ceiling grid.

b. The cabinet panel shall have provisions for a field installed filtered outside air intake.

c. Four-way grille shall be fixed to bottom of cabinet allowing two, three or

four-way blow.

3. Fan
    a. The indoor fan shall be an assembly with a turbo fan direct driven by a single motor.
    b. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
    c. The indoor unit shall include an AUTO fan setting capable of maximizing energy efficiency by adjusting the fan speed based on the difference between controller set-point and space temperature. The indoor fan shall be capable of five (4) speed settings, Low, Mid, High and Auto.
    d. The indoor unit shall have an adjustable air outlet system offering 4-way airflow, 3-way airflow, or 2-way airflow.
    e. The indoor unit vanes shall have 5 fixed positions and a swing feature that shall be capable of automatically swinging the vanes up and down for uniform air distribution.
    f. Grille shall include a factory-installed “i-see” sensor, or equal, to work in conjunction with indoor unit control sequence to prevent unnecessary cooling or heating in unoccupied areas of the zone without decreasing comfort levels. Sensor must detect occupancy (not simply motion) and location of occupants by measuring size & temperature of objects within a 39’ detecting diameter (based on 8.8ft mounting height) with 1,856 or more measuring points.
4. Filter:
    a. Return air shall be filtered by means of a long-life washable filter.
    b. Provide a spare filter for each unit.
5. Coil:
    a. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy.
    b. The coils shall be pressure tested at the factory.
    c. The unit shall be provided with an integral condensate lift mechanism that will be able to raise drain water 19-3/4” inches above the condensate pan.
6. Electrical:
    a. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
    b. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).
7. Controls
    a. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.
    b. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.

c. Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.

d. Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

e. A factory-installed drain pan sensor shall provide protection against drain pan overflow by sensing a high condensate level in the drain pan. Should this occur, the control shuts down the indoor unit before an overflow can occur. A thermistor error code will be produced should the sensor activate indicating a fault which must be resolved before the unit re-starts.

H. Indoor Unit – Medium Static Ceiling Concealed Horizontal Ducted

1. General:
   a. The ceiling-concealed ducted indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory. The unit shall be suitable for use in plenums in accordance with UL1995 ed 4.
2. Unit Cabinet:
   a. The unit shall be ceiling-concealed, ducted—with a 2-position, field adjustable return and a fixed horizontal discharge supply.
   b. The cabinet panel shall have provisions for a field installed filtered outside air intake.
3. Fan:
   a. Indoor unit shall feature multiple external static pressure settings ranging from 0.14 to 0.60 in. WG.
   b. The indoor unit fan shall be an assembly with statically and dynamically balanced Sirocco fan(s) direct driven by a single motor with permanently lubricated bearings.
   c. The indoor fan shall consist of three (3) speeds, High, Mid, and Low plus the Auto-Fan function
4. Filter:
   a. Return air shall be filtered by means of a standard factory installed return air filter.
   b. Provide optional return filter box (rear or bottom placement) with high-efficiency filter for all PDFY indoor units.
   c. Provide a spare filter for each unit.
5. Coil:
   a. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy.
   b. The coils shall be pressure tested at the factory.
   c. Coil shall be provided with a sloped drain pan. Units without sloped drain

pans which must be installed cockeyed to ensure proper drainage are not allowed.

d. The unit shall be provided with an integral condensate lift mechanism able to raise drain water 27 inches above the condensate pan.

6. Electrical:
   a. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
   b. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).
7. Controls:
   a. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.
   b. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.
   c. Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.
   d. Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

I. Multi-poise fan coil

1.

J. Controls

1. General:
   a. The control system shall consist of a low voltage communication network and a web-based interface. The controls system shall gather data and generate web pages accessible through a conventional web browser on each PC connected to the network. Operators shall be able to perform all normal operator functions through the web browser interface.
   b. Furnish energy conservation features such as optimal start, request-based logic, and demand level adjustment of overall system capacity as specified in the sequence.
   c. System shall be capable of email generation for remote alarm annunciation.
2. Electrical Characteristics:
   a. General
      1 Controller power and communications shall be via a common non-polar communications bus and shall operate at 30VDC.
   b. Wiring:
      1 Control wiring shall be installed in a daisy chain configuration from indoor unit to indoor unit, to the BC controller (main and subs, if applicable) and to the outdoor unit. Control wiring to remote controllers shall be run from the indoor unit terminal block to the controller associated with that unit.

2 Control wiring for centralized controllers shall be installed in a daisy chain configuration from outdoor unit to outdoor unit, to the system controllers (centralized controllers and/or integrated web based interface), to the power supply.

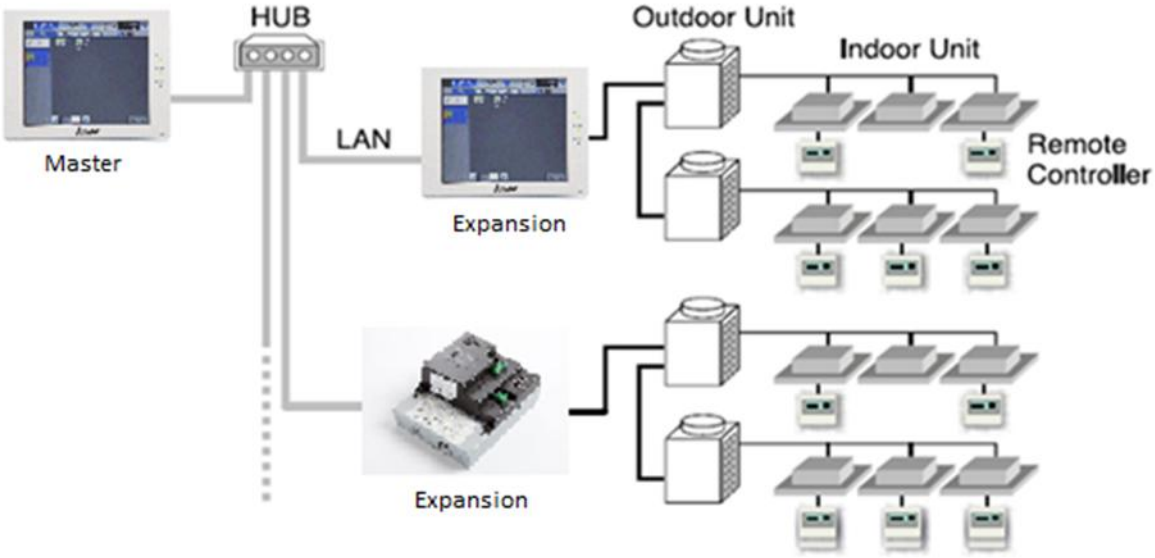
c. Wiring type:

1 Wiring shall be 2-conductor (16 AWG), twisted, stranded, shielded wire as defined by the Diamond System Builder output.

2 Network wiring shall be CAT-5 with RJ-45 connection.

3. CITY MULTI Controls Network:

a. The CITY MULTI Controls Network (CMCN) consists of remote controllers, centralized controllers, and/or integrated web based interface communicating over a high-speed communication bus. The CITY MULTI Controls Network shall support operation monitoring, scheduling, occupancy, error email distribution, personal web browsers, tenant billing, online maintenance support, and integration with Building Management Systems (BMS) using either LonWorks® or BACnet® interfaces. The below figure illustrates a sample CMCN System Configuration.



CMCN System Configuration

K. Simple MA Remote Controllers

1. The Backlit Simple MA Remote Controller shall be capable of controlling up to 16 indoor units (defined as 1 group).
2. The Backlit Simple MA Remote Controller shall only be used in same group with Wireless MA Remote Controllers or with other Backlit Simple MA Remote Controllers, with up to two remote controllers per group.

Simple MA Remote Controller			
Item	**Description**	**Operation**	**Display**
ON/OFF	Run and stop operation for a single group	Each Group	Each Group
Operation Mode	Switches between Cool/Drying/Auto/Fan/Heat/Setback. Operation modes vary depending on the air conditioner unit. Auto and Setback mode are available for the R2/WR2-Series only.	Each Group	Each Group
Temperature Setting	Sets the temperature from 40°F – 95°F depending on operation mode and indoor unit. Separate COOL and HEAT mode set points available depending on central controller and connected mechanical equipment.	Each Group	Each Group
Fan Speed Setting	Available fan speed settings depending on indoor unit.	Each Group	Each Group
Air Flow Direction Setting	Air flow direction settings vary depending on the indoor unit model.	Each Group	Each Group
Permit / Prohibit Local Operation	Individually prohibit operation of each local remote control function (Start/Stop, Change operation mode, Set temperature, Reset filter). *1: Centrally Controlled is displayed on the remote controller for prohibited functions.	N/A	Each Group *1
Display Indoor Unit Intake Temp	Measures and displays the intake temperature of the indoor unit when the indoor unit is operating.	N/A	Each Group
Display Backlight	Pressing the button lights up a backlight. The light automatically turns off after a certain period of time. (The brightness settings can be selected from Bright, Dark, and Light off.)	N/A	Each Unit
Error	When an error is currently occurring on an air conditioner unit, the afflicted unit and the error code are displayed	N/A	Each Unit
Test Run	Operates air conditioner units in test run mode. *2 The display for test run mode will be the same as for normal start/stop (does not display “test run”).	Each Group	Each Group *2
Ventilation Equipment	Up to 16 indoor units can be connected to an interlocked system that has one LOSSNAY unit.	Each Group	N/A
Set Temperature Range Limit	Set temperature range limit for cooling, heating, or auto mode.	Each Group	Each Group

L. Centralized Controller (Web-Enabled)

1. Master Centralized Controller

a. The Master Centralized Controller shall be capable of controlling a maximum of two hundred (200) indoor units across multiple CITY

MULTI outdoor units with the use of three expansion controllers. The Master Centralized Controller shall be approximately 11-5/32" x 7-55/64" x 2-17/32" in size and shall be powered with an integrated 100-240 VAC power supply. The Master Centralized Controller shall support system configuration, daily/weekly scheduling, monitoring of operation status, night setback settings, free contact interlock configuration and malfunction monitoring. When being used alone without the expansion controllers, the Master Centralized Controller shall have five basic operation controls which can be applied to an individual indoor unit, a collection of indoor units (up to 50 indoor units), or all indoor units (collective batch operation). This basic set of operation controls for the Master Centralized Controller shall include on/off, operation mode selection (cool, heat, auto (R2/WR2-Series only), dry, setback (R2/WR2-Series only) and fan), temperature setting, fan speed setting, and airflow direction setting. Since the master provides centralized control, it shall be able to enable or disable operation of local remote controllers. In terms of scheduling, the Master Centralized Controller shall allow the user to define both daily and weekly schedules (up to 24 scheduled events per day) with operations consisting of ON/OFF, mode selection, temperature setting, air flow (vane) direction, fan speed, and permit/prohibit of remote controllers.

Master Centralized Controller			
Item	**Description**	**Operation**	**Display**
ON/OFF	Run and stop operation.	Each Block, Group or Collective	Each Group or Collective
Operation Mode	Switches between Cool/Dry/Auto/Fan/Heat. (Group of Lossnay unit: automatic ventilation/vent-heat/interchange/normal ventilation) Operation modes vary depending on the air conditioner unit. Auto mode is available for the R2/WR2-Series only.	Each Block, Group or Collective	Each Group
Temperature Setting	Sets the temperature from 57°F – 87°F depending on operation mode and indoor unit.	Each Block, Group or Collective	Each Group
Fan Speed Setting	Available fan speed settings depending on indoor unit.	Each Block, Group or Collective	Each Group
Air Flow Direction Setting	Air flow direction settings vary depending on the indoor unit model. *1. Louver cannot be set.	*1 Each Block, Group or Collective	Each Group

Master Centralized Controller			
Item	**Description**	**Operation**	**Display**
Schedule Operation	Annual/weekly/today schedule can be set for each group of air conditioning units. Optimized start setting is also available. *2. The system follows either the current day, annual schedule, or weekly, which are in the descending order of overriding priority. Twenty-four events can scheduled per day, including ON/OFF, Mode, Temperature Setting, Air Direction, Fan Speed and Operation Prohibition. Five types of weekly schedule (seasonal) can be set. Settable items depend on the functions that a given air conditioning unit supports.	*2 Each Block, Group or Collective	Each Group
Optimized Start	Unit starts 5 - 60 minutes before the scheduled time based on the operation data history in order to reach the scheduled temperature at the scheduled time.	Each Block, Group or Collective	Each Block, Group or Collective
Night Setback Setting	The function helps keep the indoor temperature in the temperature range while the units are stopped and during the time this function is effective.	Each Group	Each Group
Permit / Prohibit Local Operation	Individually prohibit operation of each local remote control function (Start/Stop, Change operation mode, Set temperature, Reset filter). *3. Centrally Controlled is displayed on the remote controller for prohibited functions.	Each Block, Group or Collective	*3 Each Group
Room Temp	Displays the room temperature of the group. Space temperature displayed on the indoor unit icon on the touch screen interface.	N/A	Each Group
Error	When an error is currently occurring on an air conditioner unit, the afflicted unit and the error code are displayed *4. When an error occurs, the LED flashes. The operation monitor screen shows the abnormal unit by flashing it. The error monitor screen shows the abnormal unit address, error code and source of detection. The error log monitor screen shows the time and date, the abnormal unit address, error code and source of detection	N/A	*4 Each Unit or Collective
Outdoor Unit Status	Compressor capacity percentage and system pressure (high and low) pressure (excludes S-Series)	Each ODU	Each ODU
Connected Unit Information	MNET addresses of all connected systems	Each IDU, ODU and BC	Each IDU, ODU and BC
Ventilation Equipment	This interlocked system settings can be performed by the master system controller. When setting the interlocked system, use the ventilation switch the free plan LOSSNAY settings between “Hi”, “Low” and “Stop”. When setting a group of only free plan LOSSNAY units, you can switch between “Normal ventilation”, “Interchange ventilation” and “Automatic ventilation”.	Each Group	Each Group

Master Centralized Controller			
Item	**Description**	**Operation**	**Display**
Multiple Language	Other than English, the following language can be chosen. Spanish, French, Japanese, Dutch, Italian, Russian, Chinese, and Portuguese are available.	N/A	Collective
External Input / Output	By using accessory cables you can set and monitor the following. Input By level: "Batch start/stop", "Batch emergency stop" By pulse: "batch start/stop", "Enable/disable remote controller" Output: "start/stop", "error/Normal" *5. Requires the external I/O cables (PAC-YG10HA-E) sold separately.	*5 Collective	*5 Collective

b. All Master Centralized Controllers shall be equipped with two RJ-45 Ethernet ports to support interconnection with a network PC via a closed/direct Local Area Network (LAN) or to a network switch for IP communication to up to three expansion controllers for display of up to two hundred (200) indoor units on the main master centralized controller interface.

c. The Master Centralized Controller shall be capable of performing initial settings via the high-resolution, backlit, color touch panel on the controller or via a PC browser using the initial settings.

d. Standard software functions shall be available so that the building manager can securely log into each master centralized controller via the PC's web browser to support operation monitoring, scheduling, error email, interlocking and online maintenance diagnostics. Additional optional software functions of personal browser for PCs and MACs and Energy shall be available but are not included. The Energy Apportionment function shall require a LIC-Charge software license

2. Expansion Controller

a. The Expansion Controller shall serve as a standalone centralized controller or as an expansion module to the Master Centralized Controller for the purpose of adding up to 50 indoor units to the main touch screen interface of the master centralized controller. Up to three (3) expansion controllers can be connected to the master via a local IP network (and their IP addresses assigned on the master) to the master to allow for up to two hundred (200) indoor units to be monitored and controlled from the master interface.

b. The expansion controllers have all of the same capabilities to monitor and control their associated indoor units as the features specified above. Even when connected to the master and configured to display their units on the main controller, the individual indoor units connected to the expansion can still be monitored and controlled from the interface of the expansion. The last command entered will take precedence, whether at the wall controller, the expansion or the master Centralized Controller.

3. Non Touch Screen, Networked Centralized Controller:

a. The Non Touch Screen, Networked Centralized Controller shall be capable

of controlling a maximum of 50 indoor units across multiple CITY MULTI outdoor units. The controller shall be approximately 8-1/2"x10" in size and shall be powered by its internal power supply. The controller shall support system configuration, daily/weekly scheduling, monitoring of operation status, free contact interlock configuration and malfunction monitoring. The controller shall have five basic operation controls which can be applied to an individual indoor unit, a group of indoor units (up to 50 indoor units), or all indoor units (collective batch operation). This basic set of operation controls for the controller shall include on/off, operation mode selection (cool, heat, auto (R2/WR2-Series only), dry, temperature setting, fan speed setting, and airflow direction setting. Since the controller provides centralized control, it shall be able to enable or disable operation of local remote controllers. In terms of scheduling, the controller shall allow the user to define both daily and weekly schedules with operations consisting of ON/OFF, mode selection, temperature setting, air flow (vane) direction, fan speed, and permit/prohibit of remote controllers.

Non Touch Screen, Networked Centralized Controller			
Item	**Description**	**Operation**	**Display**
ON/OFF	Run and stop operation.	Each Block, Group or Collective	Each Group or Collective
Operation Mode	Indoor unit modes: COOL/DRY/FAN/AUTO/HEAT. Lossnay unit modes: HEAT RECOVERY/BYPASS/AUTO Air to water (PWFY) modes: HEATING/HEATING ECO/HOT WATER/ANTI-FREEZE/COOLING *Operation modes vary depending on the unit model connected. ** Auto mode is available for the R2/WR2-Series only.	Each Block, Group or Collective	Each Group
Temperature Setting	Sets the temperature from 40°F – 95°F depending on operation mode and indoor unit model. Separate COOL and HEAT mode set points available depending on remote controller and connected mechanical equipment.	Each Block, Group or Collective	Each Group
Set Temperature Range Limit	The range of room temperature setting can be limited by the initial setting depending on the indoor unit connected.	Each Group	Each Group
Fan Speed Setting	Available fan speed settings depend on indoor unit model.	Each Block, Group or Collective	Each Group
Air Flow Direction Setting	*Air flow direction settings vary depending on the indoor unit model. *1. Louver cannot be set.	*1 Each Block, Group or Collective	Each Group

Non Touch Screen, Networked Centralized Controller			
Item	**Description**	**Operation**	**Display**
Schedule Operation	Annual/weekly/today schedule can be set for each group of air conditioning units. Optimized start setting is also available. *2. The system follows either the current day, annual schedule, or weekly, which are in the descending order of overriding priority. Twenty-four events can scheduled per day, including ON/OFF, Mode, Temperature Setting, Air Direction, Fan Speed and Operation Prohibition. Five types of weekly schedule (seasonal) can be set. Settable items depend on the functions that a given air conditioning unit supports.	*2 Each Block, Group or Collective	Each Group
Hold	Disables scheduled functions for indoor unit groups and their associated remote controller timers. *not available for general equipment	Each Block, Group or Collective	Each Group
Optimized Start	Unit starts 5 - 60 minutes before the scheduled time based on the operation data history in order to reach the scheduled temperature at the scheduled time.	Each Block, Group or Collective	Each Block, Group or Collective
Permit / Prohibit Local Operation	Individually prohibit operation of each local remote control function (Start/Stop, Change operation mode, Set temperature, Fan Speed, Air Direction and Reset filter). *3. Centrally Controlled is displayed on the remote controller for prohibited functions.	Each Block, Group or Collective	*3 Each Group
Room Temp	Displays the room temperature of the group.	N/A	Each Group
Room Humidity	Displays the percent relative humidity in the space as sensed by the Smart ME Remote Controller	N/A	Each Group
Occupancy Sensor	Displays the occupancy icon on the group icon in the condition list page when the room is occupied (blue) or vacant (gray). *The Smart ME Remote Controller Occupancy sensor is required.	N/A	Each Group
Brightness Sensor	Displays the brightness icon on the group icon in the condition list when the space is determined to be bright (yellow) or dark (gray). *The Smart ME Remote Controller Brightness sensor is required.	N/A	Each Group
Error	When an error is currently occurring on an air conditioner unit, the afflicted unit and the error code are displayed *4. When an error occurs, the LED flashes. The operation monitor screen shows the abnormal unit by flashing it. The error monitor screen shows the abnormal unit address, error code and source of detection. The error log monitor screen shows the time and date, the	N/A	*4 Each Unit or Collective

Non Touch Screen, Networked Centralized Controller			
Item	**Description**	**Operation**	**Display**
	abnormal unit address, error code and source of detection		
Ventilation Equipment	This interlocked system settings can be performed by the master system controller. When setting the interlocked system, use the ventilation switch the free plan LOSSNAY settings between "Hi", "Low" and "Stop". When setting a group of only free plan LOSSNAY units, you can switch between "Normal ventilation", "Interchange ventilation" and "Automatic ventilation".	Each Group	Each Group
Multiple Language	Other than English, the following languages can be selected: Spanish, French, Japanese, German, Italian, Russian, Chinese, and Portuguese.	N/A	N/A
External Input / Output	By using accessory cables you can set and monitor the following. Input: By level: "Batch start/stop", "Batch emergency stop"; By pulse: "batch start/stop", "Enable/disable remote controller" Output: "start/stop", "error/Normal" *5. Requires the external I/O cables (PAC-YG10HA-E) sold separately.	*5 Collective	*5 Collective
M-Net	The "M-NET" LED lights, when AC power supply is turned ON. The LED blinks while M-NET is communicating.	N/A	Each Group (LED)
Collective ON/OFF	All the units can be operated / stopped with a DIP switch.	Collective	N/A
Measurement	Displays the Temperature and Humidity inputs of the AI Board. Supports graph display and data export.	N/A	Each Unit
AHC Status	Displays the status of the of the inputs and outputs of each Advanced HVAC Controller (DC-A2IO)	N/A	Each Unit
Free Contact Status	Displays the input/output status of the Free Contacts on the indoor units	N/A	Each Unit
Free Contact Interlock Control	Operation of indoor groups, general equipment or free contact outputs based on group(s) conditions or free contact(s) input states.	Each Group, Output or Collective	N/A
Data Back-up (PC)	Initial setting data can be exported to a PC.	Collective	N/A

b. All Non Touch Screen, Networked Centralized Controller shall be equipped with two RJ-45 Ethernet port to support interconnection with a network PC and BACnet/IP communication via a closed/direct Local Area Network (LAN). The controller shall be capable of performing initial settings online via a PC using the controller's initial setting browser or online/offline with the Initial Setting Tool.

c. Standard software functions shall be available so that the building manager can securely log into each controller via the PC's web browser to support operation monitoring, scheduling, error email, interlocking and online maintenance diagnostics. Standard software functions shall not expire.

Additional optional software functions of personal browser for PCs and MACs and Energy Allocation shall be available. The Energy Allocation function shall require Master Centralized Controller Energy Allocation Integrated System in conjunction with Non Touch Screen, Networked Centralized Controller.

M. Graphical User Interface

1. Front End Computer:
   a. The Graphical User Interface (Integrated Centralized Web Control) shall require a filed supplied PC or Tablet.
   b. Contractor to include the provision of this computer or tablet.
2. ICCW
   a. The Integrated Centralized Control Web System (ICCW) interface shall enable the user to control multiple networked central controllers and shall provide additional functions such as energy apportionment from a single network PC configured with the Charge Calculation Tool. The ICCW shall be capable of controlling up to forty networked Centralized Controllers with a maximum of 2,000 indoor units across multiple CITY MULTI outdoor units. The ICCW shall be required if the user wants to simultaneously control more than 1 Centralized Controllers from a single PC or tablet using a single web browser session. Licensing per function, per Centralized Controller shall be required for the ICCW. Optional software features shall be available through the ICCW including energy apportionment and personalized web. These optional software features shall require the ICCW, advance purchase from the customer, and licensing from ICCW.

ICCW (Integrated System Software)	
Item	**Details**
ON/OFF	The units can turn ON and OFF for all floors or in a block, floor, or group of units.
Operation Modes	The operation mode can be switched between COOL, DRY, FAN, AUTO, and HEAT for all floors or in a block, floor, or group of units
Temperature Setting	Sets the temperature for a single group. Range of Temperature setting from 57°F – 87°F depending on operation mode and indoor unit model. Separate COOL and HEAT mode set points available depending on remote controller and connected mechanical equipment.
Fan Speed	The fan speed can be set to four stages for all floors or in a block, floor, or group of units
Air Direction	The air direction can be set in four vertical directions or to swing for all floors or in block, floor, or group of units. (The selectable air direction differs according to the model.)
Interlocked Unit ON/OFF LOSSNAY	If there is an interlocked unit (LOSSNAY), then the unit can be turned ON (strong/weak) or OFF for all floors or in a block, floor, or group of units. (Note that the ventilation mode cannot be selected for interlocked units.)
Local Operation Prohibit	The items for which operation with the local remote controller are to be prohibited can be selected for all floors or in a block, floor, or group of units. (The items that can be prohibited are ON/OFF, operation mode, set temperature and filter sign reset.)

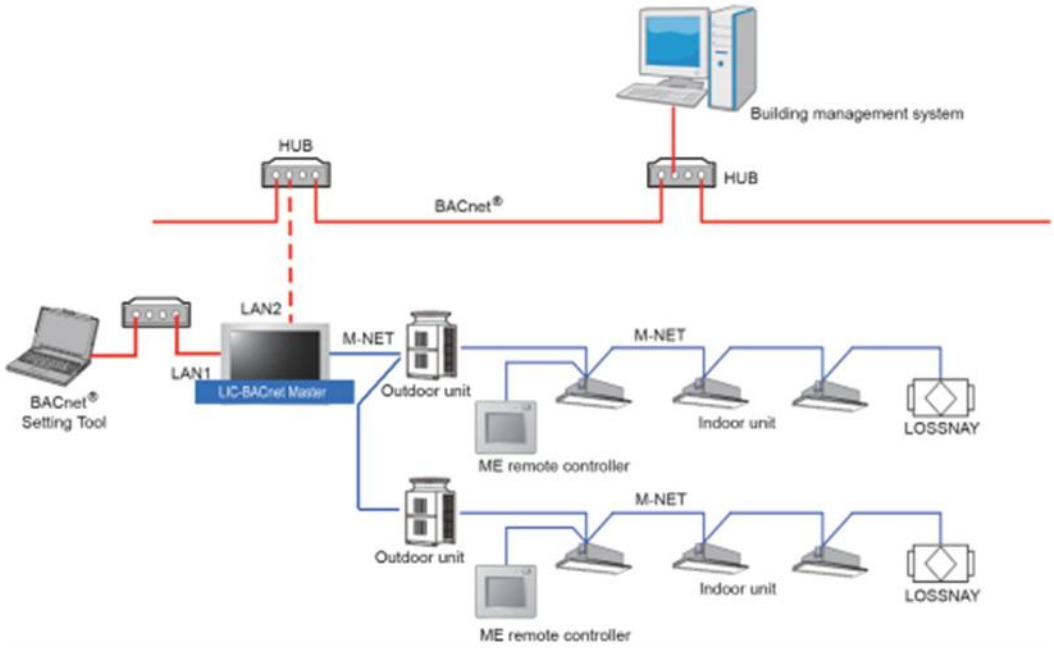
ICCW (Integrated System Software)	
Item	**Details**
Annual / Weekly Schedule	The annual/weekly schedule function can be used by registering the license. Two settings, such as seasonal settings for summer and winter, can be saved.
Power Rate Apportion-ment Charg-ing	A watt-hour meter (WHM) with kWH pulse output is connected to calculate the air conditioning charges based on the amount each tenant's air-conditioner has operated. Five charging rates can be applied per day. ***OPTIONAL ENERGY APPORTIONMENT SOFTWARE (LIC-CHARGE) and PI Controller (PAC-Y60MCA) REQUIRED
History	Up to 3,000 items for the error history and up to 10,000 items for operation history can be saved. Each history file can be output as a daily report or monthly report in CSV format. (The operation history consists only of the operations carried out with the ICCW and is limited to some limited operation items.)
Operation Time Moni-tor	The cumulative operation time of each indoor unit can be viewed or output as a CSV format file. (This function is valid only when the charging function license is registered.)
Filter Sign Display Mask	The filter sign display at the remote controllers can be disabled.
Set Temper-ature Limit	The set temperature lower limit can be set for cooling and the upper limit for heating. (ME remote controller required)

N. CMCN: System Integration

1. BACnet® Integration:
    a. The Mitsubishi Electric Cooling & Heating BACnet® hardware, which is built into all networked central controllers, shall be compliant with BACnet® Protocol (ANSI/ASHRAE 135-2010) and be Certified by the (BTL) BACnet® Testing Laboratories. The BACnet® interface shall support BACnet Broadcast Management (BBMD). The BACnet® interface shall support a maximum of 50 indoor units. Operation and monitoring points include, but are not limited to, on/off, operation mode, fan speed, prohibit remote controller, filter sign reset, alarm state, error code, and error address.
2. Licenses:
    a. LIC-BACnet Master: Master Controller license for Master Centralized Controller and Non Touch Screen, Networked Centralized Controller
    b. LIC-BACnet Expansion: Expansion Controller license for Expansion Controller and Non Touch Screen, Networked Centralized Controller
3. LIC-BACnet Specifications:
    a. Control up to 50 groups
    b. 1 to 16 indoor units can be collectively controlled in a group
    c. Supports dual set point functionality (connected model dependent)
    d. BTL Compliant
    e. BACnet communication specifications are based on ANSI/ASHRAE Standards 135-2010
4. PC Requirements:
    a. CPU: 1GHz or higher

b. Memory: 1GB or more
c. HDD Space: 100 MB or more
d. Screen Resolution: 1024 x 768 or higher
e. OS: Microsoft Windows 7 32-bit/64-bit, Microsoft 8.1 32-bit/64-bit. Not compatible with Windows Vista
f. Execution Environment: Microsoft .NET Framework 4.5 or later
g. Others: Pointing device such as a mouse, internet connection (required when installing a .NET Framework)

5. LIC-BACnet – System Example



6. BACnet Point List

Object List
On Off Setup
On Off State, Number of ON/OFF, Cumulative operation time
Alarm Signal (4-digit error code)
Error Code
Operational Mode Setup
Operational Mode State
Fan Speed Setup
Fan Speed State
Room Temp [Water Temp]
Set Temp [Set Water Temp]
Set Temp Cool
Set Temp Heat
Set Temp Auto
Filter Sign [Circulating Water Exchange Sign]
Filter Sign Reset [Circulating Water Exchange Sign Reset]
Prohibition On Off

Prohibition Mode
Prohibition Filter Sign Reset [Prohibition Circulating Water Exchange Sign Reset]
Prohibition Set Temperature
M-NET Communication State
System Forced Off
Air Direction Setup
Air Direction State
Set High Limit Setback Temp
Set Low Limit Setback Temp
Ventilation Mode Setup
Ventilation Mode State
Air To Water Mode Setup
System Alarm Signal (4-digit error code)
PI Controller Alarm Signal (4-digit error code)
Group Apportioned Electric Energy
Interlocked Units Apportioned Electric Energy
PI controller Electric Energy 1–4
Pulse Input Electric Energy 1–4
Group Apportionment Parameter
Interlocked Units Apportionment Parameter
Night Purge State
Thermo On Off State
Trend Log Room Temp
Trend Log Group Apportioned Electric Energy
Trend Log Interlocked Units Apportioned Electric Energy
Trend Log PI controller Electric Energy 1–4
Trend Log Pulse Input Electric Energy 1–4
Trend Log Group Apportionment Parameter
Trend Log Interlocked Units Apportionment Parameter

2.35 ROOF MOUNTED AIR HANDLER (Gymnasium)

A. General

1. This section includes units with split DX heat pump heating and cooling for outdoor installation. Integral Energy Recovery device shall be a rotary air-to-air total enthalpy wheel. Airflow arrangement shall be Outdoor Air with Recirculation. Each unit shall be constructed in a horizontal configuration and shall incorporate additional product requirements as listed in this specification.

B. Manufacturers

1. Available Manufacturers: Subject to compliance with specifications contained within this document, manufacturers offering products that may be incorporated into the work include, but are not limited to:
   a. Mitsubishi Electric US, Inc.
   b. Greenheck Fan Corporation
   c. AAON

C. Manufactured Units

1. Unit shall be fully assembled at the factory and consist of an insulated metal cabinet, downturn outdoor air intake with 2" aluminum mesh filter assembly, exhaust air blower, evaporator coil, energy wheel, phase and brownout protection, motorized dampers, motorized recirculating damper, curb assembly, filter assembly intake air, supply air blower assembly, exhaust/relief blower assembly, filter assembly for exhaust air, and an electrical control center. All specified components and internal accessories factory installed are tested and prepared for single-point high voltage connection.
    a. Option to field install DX coil.

D. Cabinet

1. Materials: Formed, double wall insulated metal cabinet, fabricated to permit access to internal components for maintenance.
    a. Unit's exterior shall be supplied from the manufacturer using G60 galvanneal steel with proprietary pre-painted material in the following finish color; Concrete Gray-RAL 7023. This has been subjected to a salt spray test per ASTM-B117 and evaluated using ASTM-D714 and ASTM-D610 showing no observable signs of rust or blistering until reaching 2,500 hours. Uncoated galvanized steel exterior is not acceptable.
    b. Internal assemblies: 22 gauge, galvanized (G90) steel except for motor supports which shall be minimum 14 gauge galvanized (G90) steel.
2. Cabinet Insulation: Comply with NFPA 90A and NFPA 90B and erosion requirements of UL 181.
    a. Materials: Rigid urethane injected foam. Foam board not acceptable.
        1 Thickness: 2 inch (50.8 mm)
        2 Thermal Resistance R13
        3 Thermally broken
        4 Meets UL94HF-1 flame requirements.
        5 Location and application: Full coverage of entire cabinet exterior to include walls, roof of unit, unit base, and doors.
    b. Materials: Fiberglass insulation. If insulation other than fiberglass is used, it must also meet the Fire Hazard Classification shown below.
        1 Thickness: 2 inch (50.8 mm)
        2 Thermal Resistance R8
        3 Fire Hazard Classification: Maximum flame spread of 25 and smoke developed of 50, when tested in accordance with ASTM C 411.
        4 Location and application: Divider panels between outdoor air and return air/exhaust air streams.
3. Roof Insulation:
    a. 2 inch (50.8 mm) fiberglass located above the 1 inch (25.4 mm) foam panel.
4. Access panels / doors:
    a. Unit shall be equipped with insulated, hinged doors to provide easy access to all major components. Doors and access panels shall be fabricated of 18 gauge galvanized G90 steel or painted galvannealed steel.
5. Supply Air blower assemblies:

a. Blower assembly shall consist of an electric motor and direct-drive fans. Assembly shall be mounted on heavy gauge galvanized steel rails and further mounted on 1.125 inch thick neoprene vibration isolators. Blower motors shall be capable of continuous speed modulation and controlled by a VFD.

6. Exhaust Air blower assemblies:
   a. Blower assembly shall consist of an electric motor and a direct-drive fan. Assembly shall be mounted on heavy gauge galvanized steel rails and further mounted on 1.125 inch thick neoprene vibration isolators. Blower motor shall be capable of continuous speed modulation and controlled by a VFD.
7. VRF Heat Pump unit
   a. Refer to Mitsubishi heat pump specification for requirements for this unit.
8. Evaporator Coil:
   a. Evaporator coil shall be sized and provided by the VRF heat pump manufacturer.
9. Control panel / connections:
   a. Units shall have an electrical control center where all high and low voltage connections are made. Control center shall be constructed to permit single-point high voltage power supply connections. RTU shall be equipped with a Unit Disconnect Switch.
10. Condensate drain pan:
    a. Drain Pan shall be an integral part of the unit. Pan shall be formed of welded austenitic stainless steel sheet material and provided with a welded stainless steel drain connection at the front for connection to a P trap. Drain pan shall be sloped in two directions to provide positive draining and drain connector shall be sealed at penetration through cabinet wall.
11. P trap:
    a. If the unit is equipped with a condensate drain pan, contractor shall provide, or fabricate, and install an appropriate P trap, in accordance with all local and area codes and Best Practices.
12. Energy wheel:
    a. Unit energy wheel shall be sized for the full volume of outdoor and exhaust air without an energy wheel bypass damper(s). Bypass dampers are only acceptable during economizer operation – they cannot be used during normal operation.
    b. Energy wheel shall be of total enthalpy, rotary air-to-air type and shall be an element of a removable energy wheel cassette. The cassette shall consist of a galvanized steel framework (designed to produce laminar air flow through the wheel), an energy wheel as specified and a motor and drive assembly. The cassette shall incorporate a pre-tensioned urethane drive belt or a link style belt with a five-year warranty. The wheel media shall be a polymer film matrix in a stainless-steel framework and be comprised of individual segments that are removable for servicing. Non-segmented energy wheels are not acceptable. Silica gel desiccant shall be permanently bonded to the polymer film and is designed and constructed to permit cleaning and servicing. The energy wheel is to have a five-year

warranty. Performance criteria are to be as specified in AHRI Standard 1060, complying with the Combined Efficiency data in the submittal.

13. Modulating frost control.
    a. Control system shall include an outdoor air thermostat and pressure sensor on the wheel assembly to initiate frost control sequence.
14. Electric Post-heater
    a. Post-heater shall be SCR control and shall include a temperature sensor with field adjustable set point, located in the outdoor air stream. Heat output of the post-heater shall be infinitely variable. Electric post-heater shall be able to simultaneously operate with the air-source heat pump for dehumidification mode reheat.
15. Phase and brownout protection: Unit shall have a factory-installed phase monitor to detect electric supply phase loss and voltage brown-out conditions. Upon detection of a fault, the monitor shall disconnect supply voltage to all motors.
16. Motorized dampers / Intake Air, Motorized dampers of low leakage type shall be factory installed.
17. Motorized Recirculating Air Damper designed to permit 100% recirculation of exhaust air shall be factory installed.
18. Curb Assembly:
    a. Refer to vibration isolation roof curb requirements.
    b. Base of unit shall be minimum 12” above roof line (top of insulation).
19. UV Lights:
    a. UV-C lights are factory-mounted and access door kill switches are included.

E. Blower

1. Blower section construction, Supply Air: direct drive motor and blower shall be assembled on a 14 gauge galvanized steel platform and shall be equipped with 1.125 inch thick neoprene vibration isolation devices.
2. Blower assemblies: Shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.
3. Fan: Direct drive, airfoil plenum fan with aluminum wheel statically and dynamically balanced. Prop or belt-drive fan not acceptable due to low static capabilities.
4. Blades: Welded aluminum blades only.
5. Blower section motor source quality control: Blower performance shall be factory tested for flow rate, pressure, power, air density, rotation speed and efficiency. Ratings are to be established in accordance with AMCA 210, "Laboratory Methods of Testing Fans for Rating".

F. Motors

1. General: Blower motors greater than 1/2 horsepower shall be "NEMA Premium" unless otherwise indicated. Compliance with EPAct minimum energy-efficiency standards for single speed ODP and TE enclosures is not acceptable. Motors shall be heavy-duty, permanently lubricated type to match the fan load and furnished at the specified voltage, phase and enclosure.
2. Motors shall be 60 cycle, 3 phase 208 volts.

G. Unit Controls

1. The unit shall be constructed so that it can be operated as a heating and cooling system controlled by a Building Management System (BMS). This unit shall be controlled by a factory-installed microprocessor programmable controller (DDC) that is connected to various optional sensors.
2. Unit shall incorporate a DDC controller with integral LCD screen that provides text readouts of status. DDC controller shall have a built-in keypad to permit operator to access read-out screens without the use of ancillary equipment, devices or software. DDC controllers that require the use of equipment or software that is not factory-installed in the unit are not acceptable. Alarm readouts consisting of flashing light codes are not acceptable. Owner-specified ventilating conditions can be input by means of pushbuttons.
3. Unit supply fan shall be configured for Constant Volume (ON/OFF).
4. Unit exhaust fan shall be configured for damper tracking.
5. Room thermostat shall be provided as a shipped loose item. The room thermostat shall have an LCD display to adjust the room temperature set point from within the space. The room thermostat shall average four (4) temperature sensors and one (1) relative humidity sensor.
6. Outside Air / Return Air damper control shall be CO2 sensor by DDC Contractor.
7. Economizer control shall be temperature / enthalpy.
8. Dirty filter sensor shall be factory installed.
9. Variable Frequency Drive (VFD): unit shall have factory installed variable frequency drive for modulation of the supply and exhaust air blower assemblies. The VFD shall be factory-programmed for unit-specific requirements and shall not require additional field programming to operate.
10. Airflow monitoring required in the outdoor airstreams.
11. A web user-interface (web UI) must be available for the manufacturer installed controls. The interface can be accessed via a web browser (when an Ethernet cable is connected to the building network) or to a laptop plugged in directly to the controller. Web UI must have the following features available which allow simple access to the unit, improved startup / commissioning and provide quick troubleshooting capabilities:
    a. Graphical overview screen for easy access to current conditions and set point changes
    b. All sensor values, set point and control outputs recorded each minute with 1 week of history stored on the controller for simple troubleshooting
    c. Refrigeration details screen with compressor status, temperature and pressure readings
    d. Access to current alarms and alarm history
    e. Service override capabilities to manually change I/O and verify proper operation of the unit.

H. Filters

1. Unit shall have permanent metal filters located in the outdoor air intake and shall be accessible from the exterior of the unit.

2. MERV 8 disposable pleated filters shall be provided in the supply air stream.
3. MERV 8 and MERV 13 disposable pleated filters shall be provided in the supply final air stream and MERV 8 filters in the exhaust air stream.

I. Start-up Service

1. Engage a factory authorized service representative to perform startup service. Clean entire unit, comb coil fins as necessary, install clean filters. Measure and record electrical values for voltage and amperage. Refer to Division 23 "Testing, Adjusting and Balancing" and comply with provisions therein.

J. Demonstration and Training

1. Engage a factory authorized service representative to train owner's maintenance personnel to adjust, operate and maintain the entire unit. Refer to Division 01 Section Closeout Procedures and Demonstration and Training.

2.36 HIGH EFFICIENCY SPLIT HEAT PUMP, AIR COOLED

A. Heat pumps shall provide heating and cooling to the Energy Recovery Ventilators. Refer to plans for quantity, capacity and ERV served.

B. General

1. Per the equipment schedule, the variable capacity, heat pump air conditioning system basis of design is Mitsubishi Electric CITY MULTI VRF (Variable Refrigerant Flow) zoning system(s).
2. Acceptable alternative manufacturers, assuming compliance with these equipment specifications, are Trane, Panasonic, and Hitachi. Contractor bidding an alternate manufacturer does so with full knowledge that that manufactures product may not be acceptable or approved and that contractor is responsible for all specified items and intents of this document without further compensation.
3. The outdoor unit modules shall be air-cooled, direct expansion (DX), multi-zone units used specifically with VRF components described in this section and Part 5 (Controls). The outdoor unit modules shall be equipped with a single compressor which is inverter- driven and multiple circuit boards—all of which must be manufactured by the branded VRF manufacturer. Each outdoor unit module shall be completely factory assembled, piped and wired and run tested at the factory.
4. Outdoor unit systems may be comprised of multiple modules with differing capacity if a brand other than basis of design is proposed. All units requiring a factory supplied twinning kits shall be piped together in the field, without the need for equalizing line(s). If an alternate manufacturer is selected, any additional material, cost, and labor to install additional lines shall be incurred by the contractor. Contractor responsible for ensuring alternative brand compatibility in terms of availability, physical dimensions, weight, electrical requirements, etc.
5. Outdoor unit shall have a sound rating no higher than 68 dB(A) individually or 69.5 dB(A) twinned. Units shall have a sound rating no higher than 55 dB(A) individually or
6. 55.5 dB(A) twinned while in night mode operation. Units shall have 5 levels sound adjustment via dip switch selectable fan speed settings. If an alternate

manufacturer is selected, any additional material, cost, and labor to meet published sound levels shall be incurred by the contractor.

7. Refrigerant lines from the outdoor unit to the indoor units shall be insulated in accordance with the installation manual.
8. The outdoor unit shall have the capability of installing the main refrigerant piping through the bottom of the unit.
9. The outdoor unit shall have an accumulator with refrigerant level sensors and controls. Units shall actively control liquid level in the accumulator via Linear Expansion Valves (LEV) from the heat exchanger.
10. The outdoor unit shall have a high pressure safety switch, over-current protection, crankcase heater and DC bus protection.
11. VRF system shall meet performance requirements per schedule and be within piping limitations & acceptable ambient temperature ranges as described in respective manufacturers' published product catalogs. Non-published product capabilities or performance data are not acceptable.
12. The outdoor unit shall be capable of guaranteed operation in heating mode down to - 25F ambient temperatures and cooling mode up to 126□F without additional restrictions on line length & vertical separation beyond those published in respective product catalogs. Models with capacity data for required temperature range published as "for reference only" are not considered capable of guaranteed operation and are not acceptable. If an alternate manufacturer is selected, any additional material, cost, and labor to meet ambient operating range and performance shall be incurred by the contractor.
13. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained. Oil return sequences must be enabled only during extended periods of reduced refrigerant flow to ensure no disruption to correct refrigerant flow to individual zones during peak loads. Systems which might engage oil return sequence based on hours of operation risk oil return during inopportune periods are not allowed. Systems which rely on sensors (which may fail) to engage oil return sequence are not allowed.
14. Unit must defrost all circuits simultaneously in order to resume full heating more quickly during extreme low ambient temperatures (below 23F). Partial defrost, also known as hot gas defrost which allows reduced heating output during defrost, is permissible only when ambient temperature is above 23F.
15. While in hot gas defrost the system shall slow the indoor unit fan speed down to maintain a high discharge air temperature, systems that keep fan running in same state shall not be allowed as they provide an uncomfortable draft to the indoor zone due to lower discharge air temperatures.

C. Unit Cabinet

1. The casing(s) shall be fabricated of galvanized steel, bonderized and finished.
2. The outdoor unit shall be tested in compliance with ISO9277 such that no unusual rust shall develop after 960 hours of salt spray testing.
3. Panels on the outdoor unit shall be scratch free at system startup. If a scratch occurs the salt spray protection is compromised and the panel should be replaced immediately.

D. Fan:

1. Each outdoor unit module shall be furnished with direct drive, variable speed propeller type fan(s) only. Fans shall be factory set for operation at 0 in. WG external static pressure, but capable of normal operation with a maximum of 0.32 in. WG external static pressure via dipswitch.
2. All fan motors shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.
3. All fans shall be provided with a raised guard to prevent contact with moving parts.

E. Refrigerant and Refrigerant Piping

1. R410A refrigerant shall be required for systems.
2. Polyolester (POE) oil—widely available and used in conventional domestic systems— shall be required. Prior to bidding, manufacturers using alternate oil types shall submit material safety data sheets (MSDS) and comparison of hygroscopic properties for alternate oil with list of local suppliers stocking alternate oil for approval at least two weeks prior to bidding.
3. Refrigerant piping shall be phosphorus deoxidized copper (copper and copper alloy seamless pipes) of sufficient radial thickness as defined by the VRF equipment manufacturer and installed in accordance with manufacturer recommendations.
4. All refrigerant piping must be insulated with ½" closed cell, CFC-free foam insulation with flame-Spread Index of less than 25 and a smoke-development Index of less than 50 as tested by ASTM E 84 and CAN / ULC S-102. R value of insulation must be at least 3.
5. Refrigerant line sizing shall be in accordance with manufacturer specifications

F. Coil

1. Outdoor Coil shall be constructed to provide equal airflow to all coil face surface are by means of a 4-sided coil.
    a. Outdoor Coil shall be elevated at least 12" from the base on the unit to protect coil from freezing and snow build up in cold climates. Manufacturer's in which their coil extends to within a few inches from the bottom of their cabinet frame shall provide an additional 12" of height to their stand or support structure to provide equal protection from elements as Mitsubishi Electric basis of design. Any additional support costs, equipment fencing, and tie downs required to meet this additional height shall be responsibility of Mechanical Contractor to provide.
    b. The outdoor heat exchanger shall be of zinc coated aluminum construction with turbulating flat tube construction. The coil fins shall have a factory applied corrosion resistant finish. Uncoated aluminum coils/fins are not allowed.
    c. The coil shall be protected with an integral metal guard.
    d. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.
    e. Unit shall have prewired plugs for optional panel heaters in order to prevent any residual ice buildup from defrost. Panel heaters are recommended for operating environments where the ambient temperature is expected to stay below -1F for 72 hours.

f. Condenser coil shall have active hot gas circuit direct from compressor discharge on lowest coil face area to shed defrost condensate away from coil and protect from Ice formation after returning to standard heat pump operation. While in Heat Pump operation this lower section of the Outdoor Evaporator coil shall continually run hot gas from the compressor discharge to protect the coil from ice buildup and coil rupture. Manufacturers who do not have an active hot gas circuit in the lower section of the Outdoor coil to protect coil from freezing shall not be allowed to bid on project in markets where the outdoor unit will see temperatures below freezing.

G. Compressor:

1. Each outdoor unit module shall be equipped with only inverter driven scroll hermetic compressors. Non inverter-driven compressors, which may cause inrush current (demand charges) and require larger generators for temporary power shall not be allowed.
2. Each compressor shall be equipped with a multi-port discharge mechanism to eliminate over compression at part load. Manufacturer's that rely on a single compressor discharge port and provide no means of eliminating over compression and energy waste at part load shall not be allowed.
3. Crankcase heat shall be provided via induction-type heater utilizing eddy currents from motor windings. Energy-wasting "belly-band" type crankcase heaters are not allowed. Manufacturers that utilize belly-band crankcase heaters will be considered as alternate only.
4. Compressor shall have an inverter to modulate capacity. The capacity for each compressor shall be variable with a minimum turndown not greater than 15%.
5. The compressor shall be equipped with an internal thermal overload.
6. Field-installed oil equalization lines between modules are not allowed. Prior to bidding, manufacturers requiring equalization must submit oil line sizing calculations specific to each system and module placement for this project.
7. Manufacturers that utilize a compressor sump oil sensor to equalize compressor oil volume within a single module shall not be allowed unless they actively shut down the system to protect from compressor failure.

H. Controls

1. The unit shall be an integral part of the system & control network described in Part 5 (Controls) and react to heating/cooling demand as communicated from connected indoor e control circuit. Required field-installed control voltage transformers and/or signal boosters shall be provided by the manufacturer.
2. The outdoor unit shall have the capability of 4 levels of demand control for each refrigerant system based on external input.

I. Electrical:

1. The outdoor unit electrical power shall be 208/230 volts, 3-phase, 60 hertz or 460 volts, 3-phase, 60 hertz per equipment schedule.
2. The outdoor unit shall be controlled by integral microprocessors.
3. The control circuit between the indoor units and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

J. System Start-Up

1. The manufacturer or manufacturer's representative shall provide start-up services for the system and shall provide a report on the start-up procedure and provide documentation that the system is installed and functioning per the manufacturer's specifications.
2. The manufacturer or manufacturer's representative shall provide integration system assistance as required to assist the ATC sub-contractor in integrating the VRV system with the DDC system.

K. System Training

1. The manufacturer or manufacturer's representative shall provide training for the Owner or Owner's representative. Training shall be a minimum of 4 hours and shall be conducted at the same time as the training for the other HVAC systems.
2. The manufacturer shall also provide 16 hours of structured off-site training for the Owner's personnel.

L. Warranty

1. The CITY MULTI units shall be covered by the manufacturer's limited warranty for a period of one (1) year parts and seven (7) year compressor to the original owner from date of installation.
2. Installing contractor shall meet manufacturer requirements to obtain extended manufacturer's limited parts and compressor warranty for a period of ten (10) years to the original owner from date of installation. This warranty shall not include labor.
3. All manufacturer's requirements to obtain the limited warranty shall be met, including but not limited to: designed by a certified City Multi Diamond Designer, installation by a contractor that has completed the Mitsubishi service course, and submission of a completed commissioning report that is approved by Mitsubishi.
4. All manufacturer technical and service manuals must be readily available for download by any local contractor should emergency service be required. Registering and sign-in requirements which may delay emergency service reference are not allowed.
5. The CITY MULTI VRF system shall be installed by a contractor with extensive CITY MULTI install and service training. The mandatory contractor service and install training should be performed by the manufacturer.

2.37 DX COILS FOR AHU-111

A. DX coils for ERV's shall be designed and provided by the VRF air source heat pump unit provider for installation in the ERV units. Refer to the plans and schedules for quantities, capacities and circuiting requirements.

1. Basis of design is Heatcraft (Modine) as provided by Mitsubishi.

B. DESIGN PRESSURES AND TEMPERATURES

1. Coils shall be designed to withstand 250 psi maximum operating pressures and a maximum temperature of 300°F for standard duty copper tube coils with standard headers. Higher limits are available, depending on coil construction and / or materials used.

C. FACTORY TESTING REQUIREMENTS

1. Coils are to be pressurized and then completely submerged in warm water containing special wetting and final cleaning agents for leak testing and tested with a minimum of 320 psi air pressure for standard copper tube coils. A hydrostatic leak test is available upon request. Certified hydrostatic leak test and Certificate of Conformance are also available upon request. Coils must display a tag with the inspector's identification as proof of testing. Upon request, after the coils have been tested they can receive a 5 lb. Nitrogen charge assuring the coil as received remains leak free and clear of internal contamination.

D. FINS

1. Coils shall be of plate fin type construction providing uniform support for all coil tubes. Coils are to be manufactured with die-formed aluminum, copper, cupro-nickel, stainless steel or carbon steel fins with self-spacing collars, which completely cover the entire tube surface. Any manufacturer not capable of offering the full range of these materials shall be considered as unacceptable.
2. Fin corrugations available shall include: Flat, Rippled and “Hi-F” Sine Wave for coils built with 0.625” OD tubes and utilizing a 1.5” equilateral tube pattern; Flat, Rippled and “Hi-F” Sine Wave for coils built with 0.50” OD tubes and utilizing a 1.25” equilateral tube pattern; “Hi-F” Sine Wave for coils built with 0.50” OD tubes and utilizing a 1.5” equilateral tube pattern; Rippled and “Hi-F” Sine Wave for coils built with 0.375” OD tubing and utilizing a 1.0” equilateral tube pattern; “Hi-F” Sine Wave for coils built with 0.375” OD tubes and utilizing a 1.25” equilateral tube pattern; Raised Lance for coils built with 0.375” OD tubing and utilizing a 1.0” equilateral tube pattern. Manufacturers not capable of producing the full range of these fin surface styles, corrugations and tube patterns shall be considered as unacceptable.
3. Standard fin thickness’ available shall include: 0.0060” +/- 5% for aluminum and copper; 0.0075” +/- 5% for aluminum, copper, and cupro-nickel, carbon steel and stainless steel; 0.0095” +/- 5% for aluminum, copper, carbon steel and stainless steel; 0.016” +/- 5% for aluminum and copper. Manufacturers not capable of providing the full range of these fins thicknesses shall be considered as unacceptable.
4. Fins are to be formed with full collar on all of available materials, corrugation styles, tube diameters and tube patterns. Manufacturers unable of providing full collars on the full range of fin offerings shall be considered as unacceptable.
5. Fin spacing available shall include: 6-14 fins / inch on coils supplied with 0.625” OD tubing; 7-18 fins / inch on coils supplied with 0.50” OD tubing; 6-24 fins / inch on coils supplied with 0.375” OD tubing. Manufacturers with tooling not capable of providing full collar, die formed fins, accurately space with a tolerance of +/- 4% and not offering the full range fin spacing for the appropriate tube diameter shall be considered as unacceptable.

E. TUBING

1. All tubing and return bends shall be fabricated from UNS 12200 seamless copper conforming to ASTM B75 for standard pressure and temperature applications. Elevated duty and special application construction tube cores shall be available in seamless 90/10 Cupro-Nickel Alloy #706, Stainless Steel ASTM #A249

grade 304L or 316L and Carbon Steel ASTM #A214 welded or #A179 Seamless.

2. Core tubes (excluding hot dipped galvanized steel coils) shall be mechanically expanded to form an interference fit within the fin collars. Expansion shall not decrease the tube wall thickness.
3. Coils shall be manufactured using return bends of the same material as the core tubing. Return bend wall thickness, at the outside circumference of the bend, shall be no less than the core tube wall thickness.
4. Available tube size and wall thickness shall be as follows:

Material	0.375" O.D.	0.50" O.D.	0.625" O.D.
Copper	0.013, .016, .020, 0.025, 0.030	0.016, 0.022, 0.030	0.020, 0.025, 0.035, 0.049
Cupro-Nickel			0.020, 0.035, 0.049
Carbon Steel			0.035, 0.049, 0.065
Stainless Steel			0.035, 0.049, 0.065
Admiralty Brass			0.049

5. Coils shall be made available with copper tubes utilizing internally enhanced Rifled Surfacing when required. As a quality control measure, Coil Manufacturer shall be capable of providing copper rifled tubing, enhanced within it's own facility, and not supplied by an outside source.
6. Available distributor tube size and wall thicknesses shall be as follows:

Material	0.188" O.D.	0.25" O.D.	0.312" O.D.
Copper	0.028	0.028	0.030
Stainless Steel		0.035	0.035
Carbon Steel		0.035	

F. HEADERS

1. Headers shall be constructed from UNS 12200 seamless copper conforming to ASTM B75 and B251 with an H55 temper for standard applications. Other option for headers for high-pressure construction shall incorporate seamless 90/10 Cupro-Nickel Alloy #706 conforming to ASTM B111, Carbon Steel conforming to ASTM A53A or A135A, Stainless Steel conforming to ASTM A249, at Sch. 10 or Sch. 40, per the application requirements.
2. Headers shall be manufactured using a Pierce and Flare die-punch method when possible. This shall insure that the tube-to-header tube hole intrusions into the header are such that the landed surface area contact length for joint brazing approximates three times the core tube wall thickness. Manufacturers not

capable of providing headers of the Pierce and Flare design shall be considered as unacceptable.

3. Standard construction shall be such that the core tubes will penetrate directly into the header without the use of intermediate adapter tube studs, except when necessary. Each of the tubes shall extend evenly within the inside diameter of the header between 0.12" and 0.75" depending on OD of tubes. In addition, on 0.375" OD tube coils, each tube shall pass through an oversized hole in the sheet metal casing of no less than 25% larger than the outside diameter of the core tube. This will prevent metal to metal contact between the tube and the sheet metal casing, allowing the header and core tubes to "float" and eliminating the possibility of premature failure caused by excess vibration. Manufacturers not capable of providing such floating headers shall be considered as unacceptable.
4. End caps shall be precision die-formed and positioned inside the header so that the thickness of the brazed fillet joint approximates three times that of the header wall thickness. Manufacturers using standard copper tube end caps, which are brazed over the outside of the end of the headers, shall be considered as unacceptable.

G. CONNECTIONS

1. Standard construction of copper tube condenser coils shall allow for copper sweat connections for type L or K wall copper. Other materials shall be made available dependent upon the materials of construction of the tube core.

H. BRAZING & WELDING

1. Oxyfuel gas brazing, using fillet rod material of minimum 5% silver shall be used for all non-ferrous tube joints to headers and connections. Ferrous to non-ferrous joints shall contain as much as 35% silver or may be Tobin bronze.
2. Gas shielded arc welding shall be used for all stainless steel joints and also for non-ferrous tube joints made to compatible or alike material headers and connections.

I. CASING

1. Coil casing and endplate shall be fabricated from Galvanized steel, as a standard construction, meeting ASTM and UL G90U requirements. Casing materials available shall include: aluminum, copper, carbon steel and stainless steel. All materials are available at different gauges. Double-flange casing shall be provided when coils are specified as vertical stacking.
2. Standard coil intermediate tube sheets (center tube supports) shall be fabricated from 16 gauge sheet stock and same material as the end plates, and to the following schedule:

Finned Length (inches)	**Number of Tube Sheets**
6.00 – 48.00	0
48.01 – 96.00	1
96.01 – 144.00	2
144.01 and greater	4

J. CERTIFICATIONS

1. Coil manufacturer shall be certified and registered with the Air Conditioning, Heating and Refrigeration Institute (AHRI) and shall be an active and current member of the AHRI Standard 410 Air-Cooling and Air-Heating Coils certification program and shall have original coil line certifications and computerized selections dating back a minimum of 30 years, as proof of overall company performance, stability and longevity. Manufacturers not capable of meeting this requirement shall be considered as unacceptable.

K. AGENCY APPROVAL Coil manufacturer shall be registered by UL to ISO 9000 (ANSI/ASQC Q92). Applicable commercial coil models shall be UL Standard 207 and registered as Refrigerant Containing Components and Accessories; non-electrical. CRN (Canadian Registration Numbers) shall be provided for all coils shipping into Canada as requested. Coil manufacturer shall also possess ASME Section VIII Division 1, U and UM stamping certification as proof of acceptable quality control methods. Manufacturers unable to meet the above listed agency approvals shall be considered as unacceptable.

2.38 ROOF EQUIPMENT AND PIPING SUPPORTS

A. Support Variable Refrigerant Flow (VRF) Heating Ventilation and Air Conditioning equipment on roof with an engineered system designed for installation without penetrating roof membrane. The engineered support system shall consist of injection molded glass fiber filled nylon support feet, recycled rubber bound by polyurethane pre-polymer anti-vibration mat, hot dipped galvanized mild steel framework and fittings. System shall be factory designed to fit VRF equipment in service conditions.

B. Support piping on roof with an engineered system designed for installation without penetrating roof membrane. The engineered support system shall consist of injection molded glass fiber filled nylon support feet, recycled rubber bound by polyurethane pre-polymer anti-vibration mat, hot dipped galvanized mild steel framework and fittings. System shall be factory designed to fit equipment in service conditions.

C. Systems shall be Big Foot Systems from the RectorSeal Corp., Quicksling or equal.

D. General

1. Galvanized steel engineered framework support with injection molded glass fiber reinforced nylon foot assemblies with recycled rubber anti-vibration mats.
2. Material: Steel, nylon, rubber.
3. Finish: Hot Dip Galvanized.
4. Rail system shall be specifically design for the equipment it is supporting.

E. Support feet shall be mechanically attached to the structure.

1. Connection point shall be sealed weathertight.
2. Coordinate with Structural Contract for attachment points to structural support elements.

2.39 CONDENSATE PUMPS

A. Condensate pumps shall be fully automatic.

B. Basin shall be constructed of ABS plastic.

C. Volute and propeller shall be polypropylene.

D. Shaft shall be stainless steel.

E. Cover shall be ABS with 3 drain holes.

F. Unit shall be provided with a discharge check valve.

G. Thermal overload protection shall be provided.

H. Unit shall have a six foot power cord with plug.

I. Provide Blue Diamond or equal mini split style condensate pumps for all Mitsubishi wall cassette style units.

J. Provide condensate pumps where required by structure, where gravity drainage is not possible.

2.40 ELECTRIC UNIT HEATER

A. The electric ceiling heating panel shall be as manufactured by Berko (or equal).

B. The sizes, capacities and voltages shall be as per the schedules on the drawings.

C. Commercial grade construction and ceiling mounting brackets for horizontal or vertical flow mounting or any position in between.

D. Copper-brazed steel fins with steel sheathed tubular elements for uniform heating and longevity.

E. Adjustable louvers to control air throw direction.

2.41 ELECTRIC WALL HEATER

A. The electric fan powered wall heater shall be designed for recessed mounting and shall be as manufactured by Berko (or equal).

B. The heater shall be designed for surface or recessed wall mounting in any position. For surface mounting, a surface mounting box shall be used. For semi-recessed installation a semi-recessed sleeve shall be used.

C. The back box shall be designed for duty as a recessed rough-in box in either masonry or frame. The back box shall be 20-gauge cold rolled steel and shall contain knock outs through which field wiring leads are brought and connected to pigtails of the preinstalled female disconnect receptacle. Connecting of the male plug of the inner frame completes the wiring of the heater.

D. The inner frame assembly shall consist of a 20-gauge steel chassis on which are mounted the heating element, fan motor and blade, thermostat, fan control and thermal cut out. The inner frame assembly shall be completely prewired with the leads terminating in a male plug, thus facilitating positive disconnect and easy removal for service without disturbing the back box or field wiring.

E. The heating element shall be of nonglowing design consisting of a special resistance wire enclosed in a steel sheath to which steel plate fins are brazed. The element shall cover the entire air discharge area to ensure uniform heating of all discharge air.

F. The fan motor shall be impedance protected, permanently lubricated and with totally enclosed rotor.

G. Fan control shall be bimetallic, snap-action type and shall activate fan after heating element reaches operating temperature, and continue to operate the fan after the thermostat is satisfied and until all heated air has been discharged. The thermostat shall be of bimetallic, snap-action, two-pole type with enclosed contacts and with positive "off" on all models. Thermal cutout shall be bimetallic, snap-action type designed to automatically shut off heater in the event of overheating and reactivate the heater when temperatures return to normal.

H. The louvered front cover shall be of 20-gauge cold rolled steel finished in desert tan baked enamel or chrome finish, with four mounting holes, mounting screws, and plug button to match finish.

I. Unit shall be supplied with front covers without the hole for the thermostat knob to provide full tamper-proof installation.

J. All sheet metal parts, except chrome finished front covers, shall be phosphatized, then completely painted as determined by the architect by an electrostatic, baked enamel, painting process.

2.42 LOUVERS

A. General:

1. Furnish and install louvers, bird screens, blank-off panels, supports and mounting brackets. Refer to plans for sizes and quantities. Basis of design is Greenheck ESD-403 (or equal).

B. Frame:

1. Type: Channel
2. Frame Depth: 4 inches.
3. Material: Extruded aluminum, Alloy 6063-T5.
4. Wall Thickness: 0.063 inch, nominal.
5. Construction: Welded

C. Blades:

1. Style: Drainable.
2. Material: Formed aluminum, Alloy 6063-T5.
3. Wall Thickness: 0.063 inch, nominal.
4. Angle: 45 degrees.
5. Centers: 3 inches, nominal.

D. Gutters: Drain gutter in head frame and each blade.

E. Downspouts: Downspouts in jambs to drain water from louver for minimum water cascade from blade to blade.

F. Fabrication: Mullion/Hidden Intermediate Support Style – Design incorporates visible mullions or frames at the perimeter of the louver and at section joints only. Rear-mounted hidden blade supports are utilized where required and do not interrupt the louver blade sightlines. The rear-mounted blade support depth varies depending on louver height and the design wind load.

G. Factory assembled louver components. Mechanically fastened construction.

H. Performance Data:

1. Performance Ratings: AMCA licensed. Based on testing 48 inch by 48 inch size unit in accordance with AMCA 500.
2. Free Area: 37 percent, nominal.
3. Maximum Recommended Air Flow through Free Area: 800 feet per minute
4. Maximum Pressure Drop (Intake): 0.10 inches w.g.
5. Water Penetration: Maximum of 0.01 ounces per square foot of free area at an air flow of 1250 feet per minute free area velocity when tested for 15 minutes.

I. Finish

1. AAMA 2605 compliant coating
2. 3-Coat 70% Kynar (PVDF).
3. Color: By Architect

2.43 AIR CURTAIN

A. The unheated air curtain shall be manufactured by Powered Aire (Basis of Design), Mars Air Systems , Schwank or Berner International.

B. Motor Fan Assembly: Design for easy removal, assembly, repair, and maintenance.

1. Motor: Totally enclosed air over (TEAO) cooled motor with sealed lifetime pre-lubricated ball bearings, motor starter and thermal overload protection.
   a. Wired for single speed operation.
   b. Wired for two speed operation.
   c. Wired for three speed operation.
   d. Provide wash down type motors, NEC IP-54 for the locations indicated.
   e. Provide explosion proof type motors, NEC Class 1, Division 1, Group D for the locations indicated.
   f. Meets NEC. ETL Listed to conform to UL 507 (US) and CSA22.2 (Canada) Standards. AMCA 211 Certified.
   g. Electrical Characteristics: 115V AC, single phase; 5.1 Amp full load per motor/fan.

C. Fans: Forward curved centrifugal type, double width, and double inlet design, directly driven to an electric motor.

1. Provide resilient isolation dampening mountings between motor frame and motor mounting pan.
2. Factory balanced blower wheel assembly statically and dynamically.

D. Housing: Self-contained one-piece type for units up to 72 inches in length with sufficient strength for mounting from pre-punched mounting holes at both ends to

ceiling without intermediate support. Units longer than 72” are two units tandem mounted next to each other

1. Size:
    a. Unheated: 26 inches deep by 15-1/2 inches high by width of unit.
2. Mounting:
    a. Unheated Inside Mount.
3. Material:
    a. Provide T5052 20 gage aluminum conforming to ASTM B 209 and 20-gauge electro or hot dipped galvanized steel sheet housing conforming to ASTM A 591 and/or ASTM A 653.
4. Air Inlet Grille and/or Filters: Provide air inlet grille and/or filters specified.
5. Discharge: Provide integral discharge nozzle specified.
6. Finish and Color: Provide with, no VOC, corrosion resistant polyurethane powder coated finish for sheet metal housings. Color selection by Architect.
    a. Pearl White.
    b. Obsidian Black.
    c. Titanium Silver.
    d. Stainless Steel.

E. Environmental Air Curtains: Internal mounted models for heights up to 12 feet (3658 mm) for Environmental Separation and Temperature Control and up to 10 feet (3048 mm) for Flying Insect Control.

1. Discharge Nozzle: Adjustable air foil vanes with a plus/minus 40-degree sweep front to back.
2. Air Velocity at Nozzle:
    a. PH10 36-1: 36 Inch (915 mm) Wide Units: 1947 feet/min (9.9 m/s) single 1/2HP motor/fan assembly.
    b. PH10 42-1: 42 Inch (1065 mm) Wide Units: 1806 feet/min (9.2 m/s) single 1/2HP motor/fan assembly.

F. Air Speed at Floor: Minimum of 400 fpm (2 m/s) at 3 feet (914 mm) from the floor.

G. Air Inlet Grille and Filters:

1. Location: Bottom/
    a. Filter: Cleanable polyester filter, 1 inch (25.4 mm).
2. Type: Fixed air intake grille
    a. Filter: Aluminum mesh, 1/4 inch (6.4 mm), washable.
3. Type: Filter Only as follows:
    a. Filter: Flat bank 1 inch, disposable.
    b. Filter: Aluminum mesh, 1/4 inch (6.4 mm), washable
4. Speed: 2550 cu ft/min (1200 L/s), minimum, per motor/fan assembly
5. Sound Pressure Level At 10 feet (3 m) From Nozzle:
    a. Single Motor/Fan Units: 66 dBA.
    b. Two Motor/Fan Units: 68 dBA.

H. Motor Control Panels for Unheated Units: Recommended for all three-phase units and single-phase units with combined motor capacities of more than 1 HP whenever a door limit switch is used to automatically start and stop the air curtain. Provide motor control panels as follows:

1. Mounting: Factory mounted on right hand side of air curtain housing.
2. Mounting: Factory mounted on left hand side of air curtain housing.
3. Electrical components UL/CUL listed.
4. Optional Digital Programmable Controller:
5. Remote Mounted High Resolution 5" Color LCD Display with Capacitive Touch technology
6. Fully programmable controller
7. Pre-set and fully customizable programs
8. Time delay (Passive & Adaptive)
9. 24/7 timer
10. Maintenance schedule alerts
11. Status display showing date, time, temperature, and air curtain mode
12. Multi-unit control capability
13. English (IP) or Metric (SI) display readings
14. Password protected
15. Auto Lock display
16. Emergency shut-off button
17. Low voltage control signal for door activation
18. Integrated BMS controls
19. VFD compatible with 0-10VDC output
20. Optional BACnet option
21. Optional adaptive fan speed control based on existing

I. Door-Activated Limit switch(s): Provide, field installed 250-Volts, 20 amps limit switch to control air curtain(s) as follows; Automatic on/off control, activates air curtain when door is opened and turns off when door is closed. Provide limit switch for direct control one 1 HP or up to two 1/2 HP single phase motors without a separate control panel. Provide a separate control panel for three-phase motors and/or units exceeding 1 HP, 250-Volts or 20 amps controlled by a limit switch.

1. Type: Combination plunger/roller switch for swing and sliding doors.
    a. Provide limit switches with NEMA 1 (20 amps) ratings in locations indicated.
2. Operation for Unheated Units: Automatic on/off control, on when door is opened, off when door is closed.

J. Provide mounting hardware as required for the opening.

2.44 DIRECT DIGITAL CONTROL SYSTEM

A. NOTE: CONTRACTOR IS REQUIRED TO PROVIDE ALL COMPONENTS, WIRING, LABOR, APPURTENANCES, AND COORDINATION SERVICES TO DELIVER A FULLY-FUCNTIONAL BUILDING AUTOMATION SYSTEM.

B. General

1. Automatic temperature control field monitoring and control system using field programmable micro-processor based units as an expansion of the existing city-wide building automation system.
2. The BAS contractor shall provide all interconnecting wiring, interfaces, and programming required to completely integrate any VRF or packaged HVAC systems into the building automation system and achieve full read / write capability of all system points from the BAS operator workstation as available at the system control workstation. The BAS contractor is responsible for achieving the specified sequences of operations.
3. Base system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.
4. Include computer software and all hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators.
5. Controls for variable refrigerant flow (VRF) system, packaged rooftop units, packaged unit ventilators, radiation, reheat coils, unit heaters, fan coils, blower coils, and the like when directly connected to the control units. Individual terminal unit control requirement is specified in its equipment section.
6. Provide control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment, power transformers and electrical feeds, and other apparatus and accessories required to operate mechanical systems, and to perform functions specified.
7. Include installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

C. MANUFACTURERS

1. Honeywell International, Inc; Niagara/Tridium: www.honeywell.com/#sle.
2. Johnson Controls, Inc; Tridium Based FX-Series: www.johnsoncontrols.com/#sle.
3. KMC Controls; Niagara/Tridium: www.kmccontrols.com/#sle.
4. Substitutions: Not Permitted

D. CONTROLLERS

1. BUILDING LEVEL CONTROLLERS
    a. General:
        1 Manage global strategies by one or more, independent, standalone, microprocessor based controllers.
        2 Provide sufficient memory to support controller's operating system, database, and programming requirements.
        3 Share data between networked controllers.
        4 Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.
        5 Utilize real-time clock for scheduling.
        6 Continuously check processor status and memory circuits for abnormal

operation.

7 Controller to assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.

8 Communication with other network devices to be based on assigned protocol.

b. Communication:

1 Controller to reside on a BACnet network using ISO 8802-3 (ETHERNET) Data Link/Physical layer protocol.

2 Perform routing when connected to a network of custom application and application specific controllers.

3 Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.

c. Anticipated Environmental Ambient Conditions:

1 Outdoors and/or in Wet Ambient Conditions:

a)Mount within waterproof enclosures.

b)Rated for operation at 40 to 150 degrees F.

2 Conditioned Space:

a)Mount within dustproof enclosures.

b)Rated for operation at 32 to 120 degrees F.

d. Provisions for Serviceability:

1 Diagnostic LEDs for power, communication, and processor.

2 Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.

e. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.

f. Power and Noise Immunity:

1 Maintain operation at 90 to 110 percent of nominal voltage rating.

2 Perform orderly shutdown below 80 percent of nominal voltage.

3 Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.

E. CUSTOM APPLICATION CONTROLLERS

1. General:

a. Provide sufficient memory to support controller's operating system, database, and programming requirements.

b. Share data between networked, microprocessor based controllers.

c. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.

d. Utilize real-time clock for scheduling.

e. Continuously check processor status and memory circuits for abnormal operation.

f. Controller to assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.

g. Communication with other network devices to be based on assigned protocol.

2. Communication:
   a. Controller to reside on a BACnet network using MS/TP Data Link/Physical layer protocol.
   b. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
3. Anticipated Environmental Ambient Conditions:
   a. Outdoors and/or in Wet Ambient Conditions:
      1 Mount within waterproof enclosures.
      2 Rated for operation at 40 to 150 degrees F.
   b. Conditioned Space:
      1 Mount within dustproof enclosures.
      2 Rated for operation at 32 to 120 degrees F.
4. Provisions for Serviceability:
   a. Diagnostic LED's for power, communication, and processor.
   b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
5. Memory: In the event of a power loss, maintain all BIOS and programming information for minimum of 72 hours.
6. Power and Noise Immunity:
   a. Maintain operation at 90 to 110 percent of nominal voltage rating.
   b. Perform orderly shutdown below 80 percent of nominal voltage.
   c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.

F. APPLICATION SPECIFIC CONTROLLERS

1. General:
   a. Not fully user programmable, microprocessor based controllers dedicated to control specific equipment.
   b. Customized for operation within the confines of equipment served.
   c. Communication with other network devices to be based on assigned protocol.
2. Communication:
   a. Controller to reside on a BACnet network using MS/TP Data Link/Physical layer protocol.
   b. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
3. Anticipated Environmental Ambient Conditions:
   a. Outdoors and/or in Wet Ambient Conditions:
      1 Mount within waterproof enclosures.
      2 Rated for operation at 40 to 150 degrees F.
   b. Conditioned Space:
      1 Mount within dustproof enclosures.

2 Rated for operation at 32 to 120 degrees F.

4. Provisions for Serviceability:
   a. Diagnostic LEDs for power, communication, and processor.
   b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
6. Power and Noise Immunity:
   a. Maintain operation at 90 to 110 percent of nominal voltage rating.
   b. Perform orderly shutdown below 80 percent of nominal voltage.
   c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 3 feet.

G. INPUT/OUTPUT INTERFACE

1. Hardwired inputs and outputs tie into the DDC system through building, custom application, or application specific controllers.
2. All Input/Output Points:
   a. Protect controller from damage resulting from any point short-circuiting or grounding and from voltage up to 24 volts of any duration.
   b. Provide universal type for building and custom application controllers where input or output is software designated as either binary or analog type with appropriate properties.
3. Binary Inputs:
   a. Allow monitoring of On/Off signals from remote devices.
   b. Provide wetting current of 12 mA minimum, compatible with commonly available control devices and protected against the effects of contact bounce and noise.
   c. Sense dry contact closure with power provided only by the controller.
4. Pulse Accumulation Input Objects: Conform to all requirements of binary input objects and accept up to 10 pulses per second.
5. Analog Inputs:
   a. Allow for monitoring of low voltage 0 to 10 VDC, 4 to 20 mA current, or resistance signals (thermistor, RTD).
   b. Compatible with and field configurable to commonly available sensing devices.
6. Binary Outputs:
   a. Used for On/Off operation or a pulsed low-voltage signal for pulse width modulation control.
   b. Outputs provided with three position (On/Off/Auto) override switches.
   c. Status lights for building and custom application controllers to be selectable for normally open or normally closed operation.
7. Analog Outputs:
   a. Monitoring signal provides a 0 to 10 VDC or a 4 to 20 mA output signal for end device control.
   b. Provide status lights and two position (AUTO/MANUAL) switch for

building and custom application controllers with manually adjustable potentiometer for manual override on building and custom application controllers.

c. Drift to not exceed 0.4 percent of range per year.

8. Tri State Outputs:
   a. Coordinate two binary outputs to control three point, floating type, electronic actuators without feedback.
   b. Limit the use of three point, floating devices to the following zone and terminal unit control applications:
      1 VAV or duct terminal units.
      2 Duct mounted heating coils.
      3 Zone dampers.
      4 Radiation.
   c. Control algorithms run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.
9. System Object Capacity:
   a. System size to be expandable to twice the number of input output objects required by providing additional controllers, including associated devices and wiring.
   b. Hardware additions or software revisions for the installed operator interfaces are not to be required for future, system expansions.

H. POWER SUPPLIES AND LINE FILTERING

1. Power Supplies:
   a. Provide UL listed control transformers with Class 2 current limiting type or over-current protection in both primary and secondary circuits for Class 2 service as required by the NEC.
   b. Limit connected loads to 80 percent of rated capacity.
   c. Match DC power supply to current output and voltage requirements.
   d. Unit to be full wave rectifier type with output ripple of 5.0 mV maximum peak to peak.
   e. Regulation to be 1 percent combined line and load with 100 microsecond response time for 50 percent load changes.
   f. Provide over-voltage and over-current protection to withstand a 150 percent current overload for 3 seconds minimum without trip-out or failure.
   g. Operational Ambient Conditions: 32 to 120 degrees F.
   h. EM/RF meets FCC Class B and VDE 0871 for Class B and MIL-STD 810 for shock and vibration.
   i. Line voltage units UL recognized and CSA approved.
2. Power Line Filtering:
   a. Provide external or internal transient voltage and surge suppression component for all workstations and controllers.
   b. Minimum surge protection attributes:
      1 Dielectric strength of 1000 volts minimum.

2 Response time of 10 nanoseconds or less.

3 Transverse mode noise attenuation of 65 dB or greater.

4 Common mode noise attenuation of 150 dB or greater at 40 to 100 Hz.

I. CONTROL UNITS

1. Units: Modular in design and consisting of processor board with programmable RAM memory, local operator access and display panel, and integral interface equipment.
2. Battery Backup: For minimum of 48 hours for complete system including RAM without interruption, with automatic battery charger.
3. Control Units Functions:
   a. Monitor or control each input/output point.
   b. Completely independent with hardware clock/calendar and software to maintain control independently.
   c. Acquire, process, and transfer information to operator station or other control units on network.
   d. Accept, process, and execute commands from other control unit's or devices or operator stations.
   e. Access both data base and control functions simultaneously.
   f. Record, evaluate, and report changes of state or value that occur among associated points. Continue to perform associated control functions regardless of status of network.
   g. Perform in stand-alone mode:
      1 Start/stop.
      2 Duty cycling.
      3 Automatic Temperature Control.
      4 Demand control via a sliding window, predictive algorithm.
      5 Event initiated control.
      6 Calculated point.
      7 Scanning and alarm processing.
      8 Full direct digital control.
      9 Trend logging.
      10 Global communications.
      11 Maintenance scheduling.
4. Global Communications:
   a. Broadcast point data onto network, making that information available to all other system control units.
   b. Transmit any or all input/output points onto network for use by other control units and utilize data from other control units.
5. Input/Output Capability:
   a. Discrete/digital input (contact status).
   b. Discrete/digital output.
   c. Analog input.
   d. Analog output.

e. Pulse input (5 pulses/second).

f. Pulse output (0-655 seconds in duration with 0.01 second resolution).

6. Monitor, control, or address data points. Mix shall include analog inputs, analog outputs, pulse inputs, pulse outputs and discrete inputs/outputs, as required. Install control unit's with minimum 30 percent spare capacity.

7. Point Scanning: Set scan or execution speed of each point to operator selected time from 1 to 250 seconds.

8. Upload/Download Capability: Download from or upload to operator station. Upload/Download time for entire control unit database maximum 10 seconds on hard wired LAN, or 60 seconds over voice grade phone lines.

9. Test Mode Operation: Place input/output points in test mode to allow testing and developing of control algorithms on line without disrupting field hardware and controlled environment. In test mode:

   a. Inhibit scanning and calculation of input points. Issue manual control to input points (set analog or digital input point to operator determined test value) from work station.

   b. Control output points but change only data base state or value; leave external field hardware unchanged.

   c. Enable control actions on output points but change only data base state or value.

10. Local display and adjustment panel: Portable control unit, containing digital display, and numerical keyboard. Display and adjust:

    a. Input/output point information and status.

    b. Controller set points.

    c. Controller tuning constants.

    d. Program execution times.

    e. High and low limit values.

    f. Limit differential.

    g. Set/display date and time.

    h. Control outputs connected to the network.

    i. Automatic control outputs.

    j. Perform control unit diagnostic testing.

    k. Points in "Test" mode.

J. LOCAL AREA NETWORK (LAN)

1. Provide communication between control units over local area network (LAN).

2. LAN Capacity: Not less than 100 stations or nodes.

3. Break in Communication Path: Alarm and automatically initiate LAN reconfiguration.

4. LAN Data Speed: Minimum 19.2 Kb.

5. Communication Techniques: Allow interface into network by multiple operation stations and by auto-answer/auto-dial modems. Support communication over telephone lines utilizing modems.

6. Transmission Median: Fiber optic or single pair of solid 24 gauge twisted, shielded copper cable.

7. Network Support: Time for global point to be received by any station, shall be less than 3 seconds. Provide automatic reconfiguration if any station is added or lost. If transmission cable is cut, reconfigure two sections with no disruption to system's operation, without operator intervention.

K. SYSTEM SOFTWARE

1. Operating System:
   a. Concurrent, multi-tasking capability.
      1 Common Software Applications Supported: Microsoft Excel.
   b. System Graphics:
      1 Allow up to 10 graphic screens, simultaneously displayed for comparison and monitoring of system status.
      2 Animation displayed by shifting image files based on object status.
      3 Provide method for operator with password to perform the following:
        a)Move between, change size, and change location of graphic displays.
        b)Modify on-line.
        c)Add, delete, or change dynamic objects consisting of:
          (a) Analog and binary values.
          (b) Dynamic text.
          (c) Static text.
          (d) Animation files.
   c. Custom Graphics Generation Package:
      1 Create, modify, and save graphic files and Visio format graphics in PCX formats.
      2 HTML graphics to support web browser compatible formats.
      3 Capture or convert graphics from AutoCAD.
   d. Standard HVAC Graphics Library:
      1 HVAC Equipment:
        a)Air Handlers.
        b)Terminal HVAC Units.
        c)Fan Coil Units.
        d)VRF Fan Coils.
        e)VRF Heat Pumps.
        f) Energy Recovery Ventilators with Electric Duct Heating Coils.
        g) Packaged Rooftop Units.
      2 Ancillary Equipment:
        a)Fans.
        b)Pumps.
        c)Coils.
        d)Valves.
        e)Piping.
        f)Dampers.
        g)Ductwork.

3 File Format Compatible with Graphics Generation Package Program.

L. Workstation System Applications:

1. Automatic System Database Save and Restore Functions:
   a. Current database copy of each Building Controller is automatically stored on hard disk.
   b. Automatic update occurs upon change in any system panel.
   c. In the event of database loss in any system panel, the first workstation to detect the loss automatically restores the database for that panel unless disabled by the operator.
2. Manual System Database Save and Restore Functions by Operator with Password Clearance:
   a. Save database from any system panel.
   b. Clear a panel database.
   c. Initiate a download of a specified database to any system panel.
3. Software provided allows system configuration and future changes or additions by operators under proper password protection.
4. On-line Help:
   a. Context-sensitive system assists operator in operation and editing.
   b. Available for all applications.
   c. Relevant screen data provided for particular screen display.
   d. Additional help available via hypertext.
5. Security:
   a. Operator log-on requires user name and password to view, edit, add, or delete data.
   b. System security selectable for each operator.
   c. System supervisor sets passwords and security levels for all other operators.
   d. Operator passwords to restrict functions accessible to viewing and/or changing system applications, editor, and object.
   e. Automatic, operator log-off results from keyboard or mouse inactivity during user-adjustable, time period.
   f. All system security data stored in encrypted format.
6. System Diagnostics:
   a. Operations Automatically Monitored:
      1 Workstations.
      2 Printers.
      3 Modems.
      4 Network connections.
      5 Building management panels.
      6 Controllers.
   b. Device failure is annunciated to the operator.
7. Alarm Processing:
   a. All system objects are configurable to "alarm in" and "alarm out" of normal

state.

b. Configurable Objects:
   1 Alarm limits.
   2 Alarm limit differentials.
   3 States.
   4 Reactions for each object.

8. Alarm Messages:
   a. Descriptor: English language.
   b. Recognizable Features:
      1 Source.
      2 Location.
      3 Nature.
9. Configurable Alarm Reactions by Workstation and Time of Day:
   a. Logging.
   b. Printing.
   c. Starting programs.
   d. Displaying messages.
   e. Dialing out to remote locations.
   f. Paging.
   g. Providing audible annunciation.
   h. Displaying specific system graphics.
10. Custom Trend Logs:
   a. Definable for any data object in the system including interval, start time, and stop time.
   b. Trend Data:
      1 Sampled and stored on the building controller panel.
      2 Archivable on hard disk.
      3 Retrievable for use in reports, spreadsheets and standard database programs.
      4 Archival on LAN accessible storage media including hard disk, tape, Raid array drive, and virtual cloud environment.
      5 Protected and encrypted format to prevent manipulation, or editing of historical data and event logs.
11. Alarm and Event Log:
   a. View all system alarms and change of states from any system location.
   b. Events listed chronologically.
   c. Operator with proper security acknowledges and clears alarms.
   d. Alarms not cleared by operator are archived to the workstation hard disk.
12. Object, Property Status and Control:
   a. Provide a method to view, edit if applicable, the status of any object and property in the system.
   b. Status Available by the Following Methods:

1 Menu.
2 Graphics.
3 Custom Programs.

13. Reports and Logs:
    a. Reporting Package:
        1 Allows operator to select, modify, or create reports.
        2 Definable as to data content, format, interval, and date.
        3 Archivable to hard disk.
    b. Real-time logs available by type or status such as alarm, lockout, normal, etc.
    c. Stored on hard disk and readily accessible by standard software applications, including spreadsheets and word processing.
    d. Set to be printed on operator command or specific time(s).
14. Reports:
    a. Standard:
        1 Objects with current values.
        2 Current alarms not locked out.
        3 Disabled and overridden objects, points and SNVTs.
        4 Objects in manual or automatic alarm lockout.
        5 Objects in alarm lockout currently in alarm.
        6 Logs:
            a)Alarm History.
            b)System messages.
            c)System events.
            d)Trends.
    b. Custom:
        1 Daily.
        2 Weekly.
        3 Monthly.
        4 Annual.
        5 Time and date stamped.
        6 Title.
        7 Facility name.
    c. Tenant Override:
        1 Monthly report showing total, requested, after-hours HVAC and lighting services on a daily basis for each tenant.
        2 Annual report showing override usage on a monthly basis.
    d. Electrical, Fuel, and Weather:
        1 Electrical Meter(s):
            a)Monthly showing daily electrical consumption and peak electrical demand with time and date stamp for each meter.
            b)Annual summary showing monthly electrical consumption and peak

demand with time and date stamp for each meter.

2 Fuel Meter(s):

a)Monthly showing daily natural gas consumption for each meter.

b)Annual summary showing monthly consumption for each meter.

3 Weather:

a)Monthly showing minimum, maximum, average outdoor air temperature and heating/cooling degree-days for the month.

M. Workstation Applications Editors:

1. Provide editing software for all system applications at the PC workstation.
2. Downloaded application is executed at controller panel.
3. Full screen editor for each application allows operator to view and change:
   a. Configuration.
   b. Name.
   c. Control parameters.
   d. Set-points.
4. Scheduling:
   a. Monthly calendar indicates schedules, holidays, and exceptions.
   b. Allows several related objects to be scheduled and copied to other objects or dates.
   c. Start and stop times adjustable from master schedule.
5. Custom Application Programming:
   a. Create, modify, debug, edit, compile, and download custom application programming during operation and without disruption of all other system applications.
   b. Programming Features:
      1 English oriented language, based on BASIC, FORTRAN, C, or PASCAL syntax allowing for free form programming.
      2 Alternative language graphically based using appropriate function blocks suitable for all required functions and amenable to customizing or compounding.
      3 Insert, add, modify, and delete custom programming code that incorporates word processing features such as cut/paste and find/replace.
      4 Allows the development of independently, executing, program modules designed to enable and disable other modules.
      5 Debugging/simulation capability that displays intermediate values and/or results including syntax/execution error messages.
      6 Support for conditional statements (IF/THEN/ELSE/ELSE-F) using compound Boolean (AND, OR, and NOT) and/or relations (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
      7 Support for floating-point arithmetic utilizing plus, minus, divide, times, square root operators; including absolute value; minimum/maximum value from a list of values for mathematical functions.

8 Language consisting of resettable, predefined, variables representing time of day, day of the week, month of the year, date; and elapsed time in seconds, minutes, hours, and days where the variable values cab be used in IF/THEN comparisons, calculations, programming statement logic, etc.

9 Language having predefined variables representing status and results of the system software enables, disables, and changes the set points of the controller software.

N. CONTROLLER SOFTWARE

1. All applications reside and operate in the system controllers and editing of all applications occurs at the operator workstation.
2. System Security:
   a. User access secured via user passwords and user names.
   b. Passwords restrict user to the objects, applications, and system functions as assigned by the system manager.
   c. User Log On/Log Off attempts are recorded.
   d. Automatic Log Off occurs following the last keystroke after a user defined delay time.
3. Object or Object Group Scheduling:
   a. Weekly Schedules Based on Separate, Daily Schedules:
      1 Include start, stop, optimal stop, and night economizer.
      2 10 events maximum per schedule.
      3 Start/stop times adjustable for each group object.
   b. Exception Schedules:
      1 Based on any day of the year.
      2 Defined up to one year in advance.
      3 Automatically discarded and replaced with standard schedule for that day of the week upon execution.
   c. Holiday or Special Schedules:
      1 Capability to define up to 99 schedules.
      2 Repeated annually.
      3 Length of each period is operator defined.
4. Provide standard application for equipment coordination and grouping based on function and location to be used for scheduling and other applications.
5. Alarms:
   a. Binary object is set to alarm based on the operator specified state.
   b. Analog object to have high/low alarm limits.
   c. All alarming is capable of being automatically and manually disabled.
   d. Alarm Reporting:
      1 Operator determines action to be taken for alarm event.
      2 Alarms to be routed to appropriate workstation.
      3 Reporting Options:
         a)Start programs.

b)Print.

c)Logged.

d)Custom messaging.

e)Graphical displays.

f)Dial out to workstation receivers via system protocol.

6. Demand Limiting:
   a. Building power consumption monitored from signals generated by a pulse generator, mounted at the building power meter.
   b. Demand limit controlled via load shedding or load restoration in a predetermined and predictive manner.
   c. Demand Reduction Methods:
      1 Supply air temperature reset.
      2 Space temperature set-point reset.
      3 Equipment off/on prioritization.
   d. Relevant variables that influence demand limiting control are based on the power company methodology for computing demand charges.
   e. Operator On-Line Changes Allowed:
      1 Addition and deletion of loads controlled.
      2 Changes in demand intervals.
      3 Changes in demand limit for meter(s).
      4 Maximum equipment shutoff time.
      5 Minimum equipment shutoff time.
      6 Select rotational or sequential shedding and restoring.
      7 Shed/restore priority.
   f. Information and Reports available Hourly, Daily, and Monthly:
      1 Total electric consumption.
      2 Peak demand.
      3 Date and time of peak demand.
      4 Daily peak demand.
7. Maintenance Management: System monitors equipment status and generates maintenance messages based upon user-designated run-time limits.
8. Sequencing: Application software based upon specified sequences of operation in Section 23 09 93.
9. PID Control Characteristics:
   a. Direct or reverse action.
   b. Anti-windup.
   c. Calculated, time-varying, analog value, positions an output or stages a series of outputs.
   d. User selectable controlled variable, set-point, and PED gains.
10. Staggered Start Application:
    a. Prevents all controlled equipment from simultaneously restarting after power outage.

b. Order of equipment startup is user selectable.

11. Energy Calculations:
    a. Accumulated instantaneous power or flow rates are converted to energy use data.
    b. Algorithm calculates a rolling average and allows window of time to be user specified in minute intervals.
    c. Algorithm calculates a fixed window average with a digital input signal from a utility meter defining the start of the window period that in turn synchronizes the fixed-window average with that used by the power company.
12. Anti-Short Cycling:
    a. All binary output objects protected from short-cycling.
    b. Allows minimum on-time and off-time to be selected.
13. On-Off Control with Differential:
    a. Algorithm allows binary output to be cycled based on a controlled variable and set-point.
    b. Algorithm to be direct-acting or reverse-acting incorporating an adjustable differential.
14. Run-Time Totalization:
    a. Totalize run-times for all binary input objects.
    b. Provides operator with the capability to assign high run-time alarm.

O. OPERATING SYSTEM SOFTWARE

1. Input/Output Capability From Operator Station:
    a. Request display of current values or status in tabular or graphic format.
    b. Command selected equipment to specified state.
    c. Initiate logs and reports.
    d. Change analog limits.
    e. Add, delete, or change points within each control unit or application routine.
    f. Change point input/output descriptors, status, alarm descriptors, and engineering unit descriptors.
    g. Add new control units to system.
    h. Modify and set up maintenance scheduling parameters.
    i. Develop, modify, delete or display full range of color graphic displays.
    j. Automatically archive select data even when running third party software.
    k. Provide capability to sort and extract data from archived files and to generate custom reports.
    l. Support two printer operations.
        1 Alarm printer: Print alarms, operator acknowledgements, action messages, system alarms, operator sign-on and sign-off.
        2 Data printer: Print reports, page prints, and data base prints.
    m. Select daily, weekly or monthly as scheduled frequency to synchronize time and date in digital control units. Accommodate daylight savings time adjustments.
    n. Print selected control unit data base.
2. Operator System Access: Via software password with minimum 30 access levels at work station and minimum 3 access levels at each control unit.

3. Data Base Creation and Support: Changes shall utilize standard procedures. Control unit shall automatically check work station data base files upon connection and verify data base match. Minimum capability shall include:
    a. Add and delete points.
    b. Modify any point parameter.
    c. Change, add, or delete English language descriptors.
    d. Add, modify, or delete alarm limits.
    e. Add, modify, or delete points in start/stop programs, trend logs, etc.
    f. Create custom relationship between points.
    g. Create or modify DDC loops and parameters.
    h. Create or modify override parameters.
    i. Add, modify, and delete any applications program.
    j. Add, delete, develop, or modify dynamic color graphic displays.
4. Dynamic Color Graphic Displays:
    a. Utilizes custom symbols or system supported library of symbols.
    b. Sixteen (16) colors.
    c. Sixty (60) outputs of real time, live dynamic data per graphic.
    d. Dynamic graphic data.
    e. 1,000 separate graphic pages.
    f. Modify graphic screen refresh rate between 1 and 60 seconds.
5. Operator Station:
    a. Accept data from LAN as needed without scanning entire network for updated point data.
    b. Interrogate LAN for updated point data when requested.
    c. Allow operator command of devices.
    d. Allow operator to place specific control units in or out of service.
    e. Allow parameter editing of control units.
    f. Store duplicate data base for every control unit and allow down loading while system is on line.
    g. Control or modify specific programs.
    h. Develop, store and modify dynamic color graphics.
    i. Provide data archiving of assigned points and support overlay graphing of this data utilizing up to four (4) variables.
6. Alarm Processing:
    a. Off normal condition: Cause alarm and appropriate message, including time, system, point descriptor, and alarm condition. Select alarm state/value and which alarms shall cause automatic dial-out.
    b. Critical alarm or change-of-state: Display message, stored on disk for review and sort, or print.
    c. Print on line changeable message, up to 100 characters in length, for each alarm point specified.
    d. Display alarm reports on video. Display multiple alarms in order of occurrence.
    e. Define time delay for equipment start-up or shutdown.

f. Allow unique routing of specific alarms.
g. Operator specifies if alarm requires acknowledgement.
h. Continue to indicate unacknowledged alarms after return to normal.
i. Alarm notification:
    1 Automatic print.
    2 Display indicating alarm condition.
    3 Selectable audible alarm indication.

7. Event Processing: Automatically initiate commands, user defined messages, take specific control actions or change control strategy and application programs resulting from event condition. Event condition may be value crossing operator defined limit, change-of-state, specified state, or alarm occurrence or return to normal.
8. Automatic Restart: Automatically restart field equipment on restoration of power. Provide time delay between individual equipment restart and time of day start/stop.
9. Messages:
    a. Automatically display or print user-defined message subsequent to occurrence of selected events.
    b. Compose, change, or delete any message.
    c. Display or log any message at any time.
    d. Assign any message to any event.
10. Reports:
    a. Manually requested with time and date.
    b. Long term data archiving to hard disk.
    c. Automatic directives to download to transportable media such as floppy diskettes for storage.
    d. Data selection methods to include data base search and manipulation.
    e. Data extraction with mathematical manipulation.
    f. Data reports shall allow development of XY curve plotting, tabular reports (both statistical and summary), and multi-point timed based plots with not less than four (4) variables displayed.
    g. Generating reports either normally at operator direction, or automatically under work station direction.
    h. Reports may either manually displayed or printed, or may be printed automatically on daily, weekly, monthly, yearly or scheduled basis.
    i. Include capability for statistical data manipulation and extraction.
    j. Provide capability to generate four types of reports: Statistical detail reports, summary reports, trend graphic plots, x-y graphic plots.
11. Parameter Save/Restore: Store most current operating system, parameter changes, and modifications on disk or diskette.
12. Data Collection:
    a. Automatically collect and store in disk files.
    b. Daily electrical energy consumption, peak demand, and time of peak demand for up to electrical meters over 2 year period.
    c. Daily consumption for up to 30 meters over a 2 year period.
    d. Daily billable electrical energy consumption and time for up to 1024 zones over a

10 year period.

e. Provide archiving of stored data for use with system supplied custom reports.

13. Graphic Display: Support graphic development on work station with software features:
    a. Page linking.
    b. Generate, store, and retrieve library symbols.
    c. Single or double height characters.
    d. Sixty (60) dynamic points of data per graphic page.
    e. Pixel level resolution.
    f. Animated graphics for discrete points.
    g. Analog bar graphs.
    h. Display real time value of each input or output line diagram fashion.
14. Maintenance Management:
    a. Run time monitoring, per point.
    b. Maintenance scheduling targets with automatic annunciation, scheduling and shutdown.
    c. Equipment safety targets.
    d. Display of maintenance material and estimated labor.
    e. Target point reset, per point.
15. Advisories:
    a. Summary which contains status of points in locked out condition.
    b. Continuous operational or not operational report of interrogation of system hardware and programmable control units for failure.
    c. Report of power failure detection, time and date.
    d. Report of communication failure with operator device, field interface unit, point, programmable control unit.

P. LOAD CONTROL PROGRAMS

1. General: Support inch-pounds and SI (metric) units of measurement.
2. Demand Limiting:
    a. Monitor total power consumption per power meter and shed associated loads automatically to reduce power consumption to an operator set maximum demand level.
    b. Input: Pulse count from incoming power meter connected to pulse accumulator in control unit.
    c. Forecast demand (kW): Predicted by sliding window method.
    d. Automatically shed loads throughout the demand interval selecting loads with independently adjustable on and off time of between one and 255 minutes.
    e. Demand Target: Minimum of 3 per demand meter; change targets based upon (1) time,
    f. (2) status of pre-selected points, or (3) temperature.
    g. Load: Assign load shed priority, minimum "ON" time and maximum "OFF" time.
    h. Limits: Include control band (upper and lower limits).

i. Output advisory if loads are not available to satisfy required shed amount, advise shed requirements and requiring operator acknowledgement.

3. Duty Cycling:
4. Periodically stop and start loads, based on space temperature, and according to various On/Off patterns.
5. Modify off portion of cycle based on operator specified comfort parameters. Maintain total cycle time by increasing on portion of cycle by same amount that off portion is reduced.
6. Set and modify following parameters for each individual load.
   a. Minimum and maximum Off time.
   b. On/Off time in one minute increments.
   c. Time period from beginning of interval until load can be cycled.
   d. Manually override the DCC program and place a load in an On or Off state.
   e. Cooling Target Temperature and Differential.
   f. Heating Target Temperature and Differential.
   g. Cycle off adjustment.
7. Automatic Time Scheduling:
   a. Self-contained programs for automatic start/stop/scheduling of building loads.
   b. Support up to seven (7) normal day schedules, seven (7) "special day" schedules and two
   c. (2) temporary day schedules.
   d. Special days schedule shall support up to 30 unique date/duration combinations.
   e. Any number of loads assigned to any time program; each load can have individual time program.
   f. Each load assigned at least 16 control actions per day with 1 minute resolution.
   g. Time schedule operations may be:
      1 Start.
      2 Optimized Start.
      3 Stop.
      4 Optimized Stop.
      5 Cycle.
      6 Optimized Cycle.
   h. Minimum of 30 holiday periods up to 100 days in length may be specified for the year.
   i. Create temporary schedules.
   j. Broadcast temporary "special day" date and duration.
8. Start/Stop Time Optimization:
   a. Perform optimized start/stop as function of outside conditions, inside conditions, or both.
   b. Adaptive and self-tuning, adjusting to changing conditions unattended.
   c. For each point under control, establish and modify:
      1 Occupancy period.
      2 Desired temperature at beginning of occupancy period.

3 Desired temperature at end of occupancy period.

9. Night Setback/Setup Program: Reduce heating space temperature setpoint or raise cooling space temperature setpoint during unoccupied hours; in conjunction with scheduled start/stop and optimum start/stop programs.
10. Calculated Points: Define calculations and totalization computed from monitored points (analog/digital points), constants, or other calculated points.
    a. Employ arithmetic, algebraic, Boolean, and special function operations.
    b. Treat calculated values like any other analog value, use for any function that a "hard wired point" might be used.
11. Event Initiated Programming: Event may be initiated by any data point, causing series of controls in a sequence.
    a. Define time interval between each control action between 0 to 3600 seconds.
    b. Output may be analog value.
    c. Provide for "skip" logic.
    d. Verify completion of one action before proceeding to next. If not verified, program shall be able to skip to next action.
12. Direct Digital Control: Each control unit shall provide Direct Digital Control software so that the operator may customize control strategies and sequences of operation by defining the appropriate control loop algorithms and choosing the optimum loop parameters.
    a. Control loops: Defined using "modules" that are analogous to standard control devices.
    b. Output: Paired or individual digital outputs for pulse-width modulation, and analog outputs, as required.
    c. Firmware:
        1 PID with analog or pulse-width modulation output.
        2 Floating control with pulse-width modulated outputs.
        3 Two-position control.
        4 Primary and secondary reset schedule selector.
        5 Hi/Lo signal selector.
        6 Single pole double throw relay.
        7 Single pole double throw time delay relay with delay before break, delay before make and interval time capabilities.
    d. Direct Digital Control loops: Downloaded upon creation or on operator request. On sensor failure, program shall execute user defined failsafe output.
    e. Display: Value or state of each of the lines which interconnect DDC modules.
13. Fine Tuning Direct Digital Control PID or floating loops:
    a. Display information:
        1 Control loop being tuned
        2 Input (process) variable
        3 Output (control) variable
        4 Setpoint of loop
        5 Proportional band
        6 Integral (reset) Interval

7 Derivative (rate) Interval

b. Display format: Graphic, with automatic scaling; with input and output variable superimposed on graph of "time" vs "variable".

14. Trend logging:
    a. Each control unit will store samples of control unit's data points.
    b. Update file continuously at discretely assignable intervals.
    c. Automatically initiate upload request and then store data on hard disk.
    d. Time synchronize sampling at operator specified times and intervals with sample resolution of one minute.
    e. Co-ordinate sampling with on/off state of specified point.
    f. Display trend samples on work station in graphic format. Automatically scale trend graph with minimum 60 samples of data in plot of time vs data.

Q. HVAC CONTROL PROGRAMS

1. General:
    a. Support Inch-pounds and SI (metric) units of measurement.
    b. Identify each HVAC Control system.
2. Optimal Run Time:
    a. Control start-up and shutdown times of HVAC equipment for both heating and cooling.
    b. Base on occupancy schedules, outside air temperature, seasonal requirements, and interior room mass temperature.
    c. Start-up systems by using outside air temperature, room mass temperatures, and adaptive model prediction for how long building takes to warm up or cool down under different conditions.
    d. Use outside air temperature to determine early shut down with ventilation override.
    e. Analyze multiple building mass sensors to determine seasonal mode and worse case condition for each day.
    f. Operator commands:
        1 Define term schedule
        2 Add/delete fan status point.
        3 Add/delete outside air temperature point.
        4 Add/delete mass temperature point.
        5 Define heating/cooling parameters.
        6 Define mass sensor heating/cooling parameters.
        7 Lock/unlock program.
        8 Request optimal run time control summary.
        9 Request optimal run time mass temperature summary.
        10 Request HVAC point summary.
        11 Request HVAC saving profile summary.
    g. Control Summary:
        1 HVAC Control system begin/end status.

2 Optimal run time lock/unlock control status.
3 Heating/cooling mode status.
4 Optimal run time schedule.
5 Start/Stop times.
6 Selected mass temperature point ID.
7 Optimal run time system normal start times.
8 Occupancy and vacancy times.
9 Optimal run time system heating/cooling mode parameters.

h. Mass temperature summary:
1 Mass temperature point type and ID.
2 Desired and current mass temperature values.
3 Calculated warm-up/cool-down time for each mass temperature.
4 Heating/cooling season limits.
5 Break point temperature for cooling mode analysis.

i. HVAC point summary:
1 Control system identifier and status.
2 Point ID and status.
3 Outside air temperature point ID and status.
4 Mass temperature point ID and point.
5 Calculated optimal start and stop times.
6 Period start.

3. Supply Air Reset:
a. Monitor heating and cooling loads in building spaces, terminal reheat systems, both hot deck and cold deck temperatures on dual duct and multizone systems, single zone unit discharge temperatures.
b. Adjust discharge temperatures to most energy efficient levels satisfying measured load by:
1 Raising cooling temperatures to highest possible value.
2 Reducing heating temperatures to lowest possible level.
c. Operator commands:
1 Add/delete fan status point.
2 Lock/unlock program.
3 Request HVAC point summary.
4 Add/Delete discharge controller point.
5 Define discharge controller parameters.
6 Add/delete air flow rate.
7 Define space load and load parameters.
8 Request space load summary.
d. Control summary:
1 HVAC control system status (begin/end).
2 Supply air reset system status.
3 Optimal run time system status.

4 Heating and cooling loop.
5 High/low limits.
6 Deadband.
7 Response timer.
8 Reset times.

e. Space load summary:
1 HVAC system status.
2 Optimal run time status.
3 Heating/cooling loop status.
4 Space load point ID.
5 Current space load point value.
6 Control heat/cool limited.
7 Gain factor.
8 Calculated reset values.
9 Fan status point ID and status.
10 Control discharge temperature point ID and status.
11 Space load point ID and status.
12 Air flow rate point ID and status.

f. Enthalpy Switchover:

g. Calculate outside and return air enthalpy using measured temperature and relative humidity; determine energy expended and control outside and return air dampers.

h. Operator commands:
1 Add/delete fan status point.
2 Add/delete outside air temperature point.
3 Add/delete discharge controller point.
4 Define discharge controller parameters.
5 Add/delete return air temperature point.
6 Add/delete outside air dew point/humidity point.
7 Add/delete return air dew point/humidity point.
8 Add/delete damper switch.
9 Add/delete minimum outside air.
10 Add/delete atmospheric pressure.
11 Add/delete heating override switch.
12 Add/delete evaporative cooling switch.
13 Add/delete air flow rate.
14 Define enthalpy deadband.
15 Lock/unlock program.
16 Request control summary.
17 Request HVAC point summary.

i. Control summary:

1. HVAC control system begin/end status.
2. Enthalpy switchover optimal system status.
3. Optimal return time system status.
4. Current outside air enthalpy.
5. Calculated mixed air enthalpy.
6. Calculated cooling cool enthalpy using outside air.
7. Calculated cooling cool enthalpy using mixed air.
8. Calculated enthalpy difference.
9. Enthalpy switchover deadband.
10. Status of damper mode switch.

R. PROGRAMMING APPLICATION FEATURES

1. Trend Point:
   a. Sample up to 150 points, real or computed, with each point capable of collecting 100 samples at intervals specified in minutes, hours, days, or month.
   b. Output trend logs as line graphs or bar graphs. Output graphic on terminal, with each point for line and bar graphs designated with a unique pattern, vertical scale either actual values or percent of range, and horizontal scale time base. Print trend logs up to 12 columns of one point/column.
2. Alarm Messages:
   a. Allow definition of minimum of 100 messages, each having minimum length of 100 characters for each individual message.
   b. Assign alarm messages to system messages including point's alarm condition, point's off-normal condition, totalized point's warning limit, hardware elements advisories.
   c. Output assigned alarm with "message requiring acknowledgement".
   d. Operator commands include define, modify, or delete; output summary listing current alarms and assignments; output summary defining assigned points.
3. Weekly Scheduling:
   a. Automatically initiate equipment or system commands, based on preselected time schedule for points specified.
   b. Provide program times for each day of week, per point, with one minute resolution.
   c. Automatically generate alarm output for points not responding to command.
   d. Provide for holidays, minimum of 366 consecutive holidays.
   e. Operator commands:
      1. System logs and summaries.
      2. Start of stop point.
      3. Lock or unlock control or alarm input.
      4. Add, delete, or modify analog limits and differentials.
      5. Adjust point operation position.
      6. Change point operational mode.
      7. Open or close point.
      8. Enable/disable, lock/unlock, or execute interlock sequence or computation

profile.

9 Begin or end point totalization.

10 Modify totalization values and limits.

11 Access or secure point.

12 Begin or end HVAC or load control system.

13 Modify load parameter.

14 Modify demand limiting and duty cycle targets.

f. Output summary: Listing of programmed function points, associated program times, and respective day of week programmed points by software groups or time of day.

4. Interlocking:

a. Permit events to occur, based on changing condition of one or more associated master points.

b. Binary contact, high/low limit of analog point or computed point shall be capable of being utilized as master. Same master may monitor or command multiple slaves.

c. Operator commands:

1 Define single master/multiple master interlock process.

2 Define logic interlock process.

3 Lock/unlock program.

4 Enable/disable interlock process.

5 Execute terminate interlock process.

6 Request interlock type summary.

2.45 INSTRUMENTATION AND CONTROL DEVICES

A. General

1. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

B. Input/Output Sensors

1. Temperature Sensors:

a. Sensor range shall provide a resolution of no worse than .4°F (unless noted otherwise).

b. Room temperature sensor shall be an element contained within a ventilated cover, suitable for wall mounting with digital output. Sensors located in mechanical areas, plenums, garages, gymnasiums, or corridors shall be a flat plate sensor with no possible adjustment or shall be provided with aesthetically-pleasing lockable protective cover. Security screws shall be used in institutional settings as deemed necessary by the design engineer. ATC contractor shall coordinate requirements with the design engineer during the submittal process. Provide insulated base. Following sensing elements are acceptable:

1 Sensing element - Platinum RTD, Thermistor, or integrated circuit, +/- 0.8°F accuracy at calibration point.

2 Units shall be capable of +/- 2 degrees (F) adjustment by the occupant, with display showing current temperature and setpoint.

c. Single point duct temperature sensor shall consist of sensing element, junction box for wiring connections and gasket to prevent air leakage or vibration noise. Temperature range as required for resolution indicated in paragraph A. Sensor probe shall be 316 stainless steel.
   1 Sensing element - Platinum RTD, Thermistor, or integrated circuit, +/- 0.8°F accuracy at calibration point.

d. Averaging duct temperature sensor shall consist of an averaging element, junction box for wiring connections and gasket to prevent air leakage. Provide enough sensors to give one lineal foot of sensing element for each square foot of cooling coil face area. Temperature range as required for resolution indicated in paragraph A.
   1 Sensing element - Platinum RTD, Thermistor, or integrated circuit, +/- 0.8°F accuracy at calibration point.

e. Liquid immersion temperature sensor shall include stainless steel thermowell, sensor and connection head for wiring connections.
   1 Sensing element for chilled water applications - Platinum RTD, Thermistor, or integrated circuit, +/- 0.8°F accuracy at calibration point. Temperature range shall be as required for resolution indicated in paragraph A.
   2 Sensing element for non-chilled water applications - Platinum RTD, +/- 0.2°F accuracy at calibration point. Temperature range shall be as required for resolution of no worse than 0.1°F.

2. Humidity Sensors:
   a. Elements: Accurate within 5 percent full range with linear output.
   b. Room Sensors: With locking cover , span of 10 to 60 percent relative humidity.
   c. Duct and Outside Air Sensors: With element guard and mounting plate, range of 0 – 100 percent relative humidity.
3. Building Static Pressure Transmitters:
   a. Manufacturers:
      1 Dwyer Instruments Inc; : www.dwyer-inst.com/#sle.
      2 Johnson Controls International, PLC; : www.johnsoncontrols.com/#sle.
      3 Setra Systems, Inc; : www.setra.com/#sle.
      4 Veris Industries; : www.veris.com/#sle.
      5 Substitutions: See Section 01 60 00 - Product Requirements.
   b. Single port for direct or tubing connection into wall or ceiling static pressure tip, direct acting, double bell, scale range 0.01 to 6.0 in-wc positive or negative, and sensitivity of 0.0005 in-wc. Transmit electronic signal to receiver with matching scale range.
4. Carbon Monoxide Sensors:
   a. Gas sensing module that holds fixed or replaceable carbon monoxide gas-sensor cartridge.
   b. Form Factor: IEC 60529, IP20 enclosure, single-gang electrical box mounted.
   c. Electromechanical sensor with 0 to 500 ppm measurement range.
   d. Accuracy: Plus/minus Five percent of range with 1 ppm resolution.
   e. Hardwired Output: Three-wire, 4 to 20 mA, loop powered.
   f. Alarm: Auxiliary dry contact relay driven by setpoint adjustable between 25 to

180 ppm.

5. Equipment Operation Sensors:
   a. Status Inputs for Fans: Differential pressure switch with adjustable range of 0 to 5 inches wg.
   b. Status Inputs for Electric Motors: Current sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.

C. Thermostats

1. Line Voltage Thermostats:
   a. Integral manual On/Off/Auto selector switch, single or two pole as required.
   b. Dead band: Maximum 2 degrees F.
   c. Cover: Locking with set point adjustment, with thermometer.
   d. Rating: Motor load.
2. Outdoor Reset Thermostat:
   a. Remote bulb or bimetal rod and tube type, proportioning action with adjustable throttling range, adjustable setpoint.
   b. Scale range: -10 to 70 degrees F.
3. Immersion Thermostat:
   a. Remote bulb or bimetallic rod and tube type, proportional action with adjustable setpoint and adjustable throttling range.
4. Airstream Thermostats:
   a. Remote bulb or bimetallic rod and tube type, proportional action with adjustable setpoint in middle of range and adjustable throttling range.
   b. Averaging service remote bulb element: 7.5 feet.
5. Electric Low Limit Duct Thermostat:
   a. Snap acting, single pole, single throw, manual reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below setpoint,
   b. Bulb length: Minimum 20 feet.
   c. Provide one thermostat for every 20 sq ft of coil surface.
6. Electric High Limit Duct Thermostat:
   a. Snap acting, single pole, single throw, manual reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above setpoint,
   b. Bulb length: Minimum 20 feet.
   c. Provide one thermostat for every 20 sq ft of coil surface.
7. Fire Thermostats:
   a. UL labeled, factory set in accordance with NFPA 90A.
   b. Normally closed contacts, manual reset.
8. Heating/Cooling Valve Top Thermostats:
   a. Proportional acting for proportional flow, molded rubber diaphragm, remote bulb liquid filled element, direct and reverse acting at differential pressure to 25 psig, cast housing with position indicator and adjusting knob.

2.46 SCAFFOLDS AND STAGING

A. General: subcontractors shall obtain required permits for, and provide scaffolds, staging, and other similar raised platforms, required to access their Work as specified in Section 01 50 00 - Temporary Facilities and Controls and herein.

1. Scaffolding and staging required for use by this subcontractor pursuant to requirements of Section 01 50 00 - Temporary Facilities and Controls shall be furnished, erected, maintained in a safe condition, and dismantled when no longer required, by this Subcontract requiring such scaffolding.
2. Each subcontractor is responsible to provide, maintain and remove at dismantling, all tarpaulins and similar protective measures necessary to cover scaffolding for inclement weather conditions other than those required to be provided, maintained and removed by the General Contractor pursuant to MGL (Refer to Section 01 50 00 - Temporary Facilities and Controls and as additionally required for dust control).
   a. General Contractor is responsible to provide enclosures required for temporary heat from November 1 to March 31; refer to Section 01 50 00 - Temporary Facilities and Controls.
3. Furnishing portable ladders and mobile platforms of all required heights, which may be necessary to perform the work of this trade, are the responsibility of this subcontractor.

2.47 HOISTING MACHINERY AND EQUIPMENT

A. All hoisting equipment, rigging equipment, crane services and lift machinery required for the work by this subcontractor shall be furnished, installed, operated and maintained in safe conditions by this subcontractor, as referenced under Section 01 50 00 - Temporary Facilities and Controls.

2.48 TEXTILE AIR DISPERSION SYSTEM *(Addendum #1)*

A. Refer to the plans and this specification for the requirements of the non-metal ductwork systems.

B. The basis of design is DuctSox Corporation.

1. Alternate manufactures:
   a. Hero FabriDuct, LLC
   b. KE Fibetec NA, Inc.

C. Hoops (IHS) System: Air diffusers shall be constructed with internal retention system.

1. System shall consist of an internal 360 degree hoop system, spaced 5’ on center.
2. System shall be installed with a one row suspension system located 1.5” above top-dead-center of the textile system.
3. System attachment to cable or U-Track shall be made using Gliders spaced 12 inches.
4. Available for diameters from 8” – 60”.
5. One row suspension options (must specify if multiple on same project)
   a. U-Track suspension hardware to include 8’ sections of aluminum track, aluminum splice connectors, track endcaps and vertical cable support kits – consisting of a length of cable with cable connectors. Radius aluminum track must be included for all horizontal/flat radius sections.

1 U-Track suspension options (must specify if multiple on same project)
a)Galvanized steel cable
b)Stainless steel cable
c)Impregnated steel cable (required for natatorium applications)
2 Support lengths available in 5'(standard), 10', 15', & 30'

D. Textile: Verona Np

1. Textile Construction: Filament/spun plain weave polyester, fire retardant in accordance with UL 2518. Also Classified by UL-C (Canada) S102.2 and AS/NZS 1530.3.
2. Air Permeability: 0.7 (+/-0.25) CFM/ft2 per ASTM D737, Frazier
   a. The air permeability of the fabric must NOT be created by perforating the fabric.
   b. The air permeability must be confirmed be third party testing to eliminate the formation of condensate on the fabric.
3. Weight: 6.5 oz. /yd2 per ASTM D3776
4. Warranty: 10 years
5. Textile Color
   a. Standard: blue, white, tan, red, green, silver, black
   b. Custom
   c. *Color to be selected by the Architect.*

E. Textile System Fabrication Requirements:

1. Textile system to be constructed in modular lengths (zippered) with proper radial securing clips along the length of the system.
2. Integrated air dispersion shall be specified and approved by manufacturer. (select only those that apply)
   a. Orifices
      1 Air dispersion and extended throws are accomplished by orifices. Dispersion orifice sizing, up to 5 inch diameter (design dependent).
      2 Diameter, quantity, and location of orifices to be specified and approved by manufacturer.
3. Inlet connection to metal duct via fabric draw band with anchor patches as supplied by manufacturer. Anchor patches to be secured to metal duct via. zip screw fastener – supplied by contractor.
4. Inlet connection includes zipper for easy removal / maintenance.
5. Lengths to include required intermediate zippers as specified by manufacturer.
6. System to include Adjustable Flow Devices to balance turbulence, airflow and distribution as needed. Flow restriction device shall include ability to adjust the airflow resistance from 0.06 – 0.60 in w.g. static pressure.
7. End cap includes zipper for easy maintenance.
8. Each section of the textile shall include identification labels documenting order number, section diameter, section length, piece number, code certifications and other pertinent information.

F. Design Parameters:

1. Textile air diffusers shall be designed from 0.25” water gage minimum to 3.1” maximum, with 0.5” as the standard.
2. Textile air diffusers shall be limited to design temperatures between 0 degrees F and 180 degrees F (-17.8 degrees C and 82 degrees C).
3. System overall design: diameter, length, airflow, operating static pressure and dispersion shall be designed or approved by the manufacturer.
4. Do not use textile diffusers in concealed locations.
5. Use textile air dispersion systems only for positive pressure air distribution components of the mechanical ventilation system.

G. Warranty

1. Manufacturer must provide a 10 Year Product Warranty for products supplied for the fabric portion of this system as well as a Design and Performance Warranty.

3 PART 3 - EXECUTION

3.1 WORKMANSHIP

A. All work shall be coordinated with the work to be installed by other sections of these specifications.

B. All work shall be executed in a workmanlike manner by workmen skilled in this type of work and shall present a neat appearance when completed.

C. All duct supports, structural members, hangers and other apparatus necessary to support firmly and substantially the various components of the systems shall be provided under this section.

D. Nameplates, catalog numbers, and rating identifications shall be securely attached to equipment.

E. The work shall be performed in a timely manner so as to cause no delay in the overall job progress. The HVAC Sub-Contractor shall cooperate with the other trades so that the work is installed in the most beneficial sequence for expeditious project completion.

3.2 CLEANING OF SYSTEMS AND PREMISES

A. Before the systems are tested and balanced, all ducts serving the area under construction shall be cleaned so that no dirt, dust or other foreign matter will be carried through or deposited in the systems or the space served by the duct systems.

B. At all times keep the premises clear of rubbish.

C. Upon completion of the work in an area, remove all debris and rubbish resulting from the execution of this contract, and dispose of same. At any time should the General Contractor be dissatisfied with the performance of the HVAC Sub-Contractor's clean up responsibilities, he may elect after notifying the HVAC Sub-Contractor to undertake this operation and to backcharge the HVAC Sub-Contractor accordingly.

3.3 HVAC SUB-CONTRACTOR'S WARRANTY

A. The HVAC Sub-Contractor shall provide a one year warranty against failure of the installed materials for any reason. The warranty shall cover the full costs of parts and labor required to remedy the defect, including, if necessary, replacement at the site, and

shall run from the date of the Architect's acceptance of the system. The warranty shall also include provision for field inspection at no charge to the Owner, to verify failure, establish probable cause, and determine corrective action required. The HVAC Sub-Contractor shall furnish all service during the first year of operation. Any material, that in the opinion of the architect, requires excessive service during the first year of operation shall be considered defective and will be replaced by the HVAC Sub-Contractor at no charge to the Owner.

B. The HVAC Sub-Contractor shall provide a listing of all manufacturers' commercial warranties provided by those manufacturers on their Materials. The list of these warranties must include the time period of each warranty. One copy each of those warranties shall be submitted with the listing.

C. The HVAC Sub-Contractor shall be responsible for warranting the testing, adjusting and balancing work for a period of one year after final date of completion. The HVAC Sub-Contractor shall also be responsible for all damage to existing systems as a result of the work performed. All damaged systems shall be repaired or replaced at the option of the Owner at no additional cost to the Owner. All such repair or replacement work shall be done immediately upon finding.

D. Warranty response to any malfunction shall be on a next day, normal working hour basis.

E. Work under warranty shall be performed by fully qualified workmen and/or technicians.

F. All guarantees and warranties required to be provided for the work in this Section shall begin their term on the date of final written acceptance of the entire system by the Owner.

3.4 SUBMITTALS

A. The capacity of each HVAC unit shall be substantiated by computer generated selection data or other detailed selection data provided by the manufacturer, for the specific conditions defined on the drawings.

1. The selection data shall clearly show the entering and leaving fluid conditions, the fluid flow volume and the fluid pressure drop through the unit, the ambient conditions, the heat rejection media entering and leaving conditions, the available external static pressure, the unit total static pressure, the airside pressure drops, the refrigerant and the saturated suction temperature, the required RPM of the unit, the motor horsepower, the motor voltage, the motor efficiency, the motor RPM, the motor type, the fuel efficiency, the fuel consumption rate, the maximum capacity, the part load performance data of the anticipated operation of the system, and the radiated sound ratings at design conditions as may be appropriate for any specific piece of equipment.

B. HVAC Sub-Contractor shall submit shop drawings indicating the method of supporting all units.

3.5 PERFORMANCE

A. The drawings are diagrammatic and the final arrangement of the work shall suit the existing and field conditions, the characteristics of the materials used and the instructions of the Engineer and/or the Architect.

B. The HVAC Sub-Contractor shall be responsible for repair of damaged or disturbed existing work or the work of other trades caused by his work, testing of his work or repair to his work.

C. All devices shall be installed in accordance with the manufacturer's recommendations, the Engineer's instructions and so as to provide all required access for cleaning, operation, repair and maintenance.

3.6 START UP

A. All equipment, systems, controls and units shall be started as part of a heating, ventilating and air conditioning system, in accordance with all manufacturers' recommendations.

B. Copies of startup sheets shall be included in Operations & Maintenance Manuals.

3.7 VIBRATION ISOLATION

A. All equipment, piping, etc. shall be mounted on or suspended from approved foundations and supports, as specified herein or as shown on the drawings.

B. Mounting sizes shall be determined by the mounting manufacturer and the mountings shall be installed in accordance with the manufacturer's recommendations. The HVAC Sub-Contractor shall be responsible for the adequacy of the mountings to provide the minimum isolation efficiency required by these specifications or as specifically noted on the drawings.

C. Suspended centrifugal fans shall be installed on vibration isolation hangers.

3.8 RECTANGULAR DUCTS

A. General

1. All ductwork shall be installed in accordance with the best trade practices and SMACNA standards shall be the minimum requirements.
2. The Sheet Metal Sub-Contractor shall follow the application recommendations of the manufacturer of all hardware and accessory items and make selections of such consistent with the duct classification and services.

B. Sealing

1. All ductwork shall be sealed in accordance with the following table:

SMACNA SEAL CLASS	SEALING REQUIRED	SMACNA STATIC PRESSURE CONSTRUCTION CLASS
A	All transverse joints All longitudinal seams All duct wall penetrations	4" W.G. and up
B	All transverse joints All longitudinal seams	3" W.G.
C	All transverse joints	2" W.G. and down

2. For the purposes of these specifications sealing shall mean the following:
   a. The use of adhesives, gaskets, liquids, mastics, hot melt sealant, pressure sensitive tape or combinations thereof to close openings in the surface of the

ductwork and field erected plenums and casings through which air leakage would occur.

b. The requirements to seal apply to both positive and negative pressure modes.

3. Pressure sensitive tape shall only be acceptable for sealing ductwork which operates at a static pressure of ½" or less.
4. Liquid sealant shall only be acceptable for slip joints where metal clearances do not exceed 1/16".
5. Gaskets shall be used for all flanged connections and shall have an adhesive backing to adhere to the flange during assembly of the joint.

C. Reinforcement

1. Unless specified otherwise on the drawings rectangular ductwork shall be constructed and reinforced per the following "Rectangular Duct Reinforcement" tables, where the duct wall thickness, the reinforcement spacing and the rigidity class are specified by duct size and pressure classification. Rigidity class designations are based on the SMACNA standards for "Intermediate Reinforcement" and "Transverse Joint Reinforcement" as published in the SMACNA "HVAC DUCT CONSTRUCTION STANDARDS - Metal and Flexible".
2. Duct sides that are 19" and over and are 20 gauge or less with more than 10 square feet of unbraced panel shall be cross broken or beaded unless they are lined or externally insulated.
3. Fittings shall be reinforced similarly to sections of straight duct. On size change fittings the greater fitting dimension determines the duct gauge. Where fitting curvature or internal members provide equivalent rigidity, such features may be credited as reinforcement.
4. The duct side with the largest dimension shall determine the duct gauge.
5. Holes made in the duct walls for the passage of tie rods shall be of minimum size and shall be sealed in accordance with the required duct seal classification.
6. Where used tie rods shall be evenly spaced in the width of the duct dimension.

D. Transverse Joints

1. Transverse joints shall be selected and used consistent with the static pressure class, sealing requirements and duct support intervals for proper assembly.
2. Where bar or angle stock is incorporated in a joint it shall be secured.
3. Fasteners shall be steel and may be zinc or cadmium coated. They shall not project into duct more than ½".
4. Where bolts or welds are specified other types of fasteners shall not be used.

E. Seams

1. Seams shall be suitably selected for the material and pressure classification of the duct.
2. Seams shall be formed and assembled with proper dimension and proportion for tight and secure fit.

3.9 RECTANGULAR DUCT FITTINGS

A. General

1. All ductwork shall be installed in accordance with the best trade practices and SMACNA standards shall be the minimum requirements.
2. The Sheet Metal Sub-Contractor shall follow the application recommendations of the manufacturer of all hardware and accessory items and make selections of such consistent with the duct classification and services.

3.10 ROUND DUCTS

A. General

1. All ductwork shall be installed in accordance with the best trade practices and SMACNA standards shall be the minimum requirements.
2. The Sheet Metal Sub-Contractor shall follow the application recommendations of the manufacturer of all hardware and accessory items and make selections of such consistent with the duct classification and services.

B. Duct Gauge

1. Round ducts shall be constructed of the galvanized steel with duct walls in accordance with ”SMACNA” standards.

3.11 ROUND DUCT FITTINGS

A. Elbows larger than 8" shall be five piece welded construction.

B. Branch and take-off fittings shall be conical tee or conical reducing tee fittings.

C. Final connections to the individual terminal supply units shall be by means of flexible duct.

3.12 BALANCING DAMPERS

A. Balancing dampers shall be located as shown on the drawings and in the following locations as a minimum:

1. All supply and return air branches from the trunks and all sub-branches from the mains shall have balancing dampers.
2. Branch duct connections from low pressure ducts to diffusers shall be made with dampered spin collars.

B. Locate dampers as far as possible from air outlets.

3.13 FLEXIBLE DUCTS

A. Use

1. Flexible ducts shall not exceed 5 feet in length.
2. All flexible duct used on the supply air system shall be insulated with 1½" thick vinyl jacketed fiberglass insulation.

B. Length

1. The minimum length of flexible duct shall be used.
2. The maximum length of flexible duct in any single duct run shall be four feet.
3. Flexible duct shall not be used on supply air systems.

C. Bends

1. Bends shall be made with not less than one and one half duct diameter centerline radius.
2. Maximum bend shall be 90°.

D. Fastening

1. Secure flexible duct to collar or sleeve by peeling back jacket and insulation at end of flexible duct. Fit duct over collar or sleeve and clamp with ½" wide galvanized steel or stainless steel bands or clamps and matching seals. Pull jacket and insulation back in place and secure it with two wraps of pressure sensitive sealing tape. Clamping device shall be two inches back from end of flexible duct. Seal with two wraps of duct tape.

E. Installation

1. Flexible duct is to be installed as straight as possible and as tight as possible.
2. Submittals shall include product data sheets as well as the manufacturer's recommended installation practices.

3.14 SUSPENSION OF DUCTWORK

A. Rigid round and rectangular ducts shall be installed with support systems as required to maintain alignment. Horizontal ducts shall have a support within two feet of each elbow and within four feet of each branch intersection.

B. Strap hangers on rectangular ducts may be used on ducts less than 60" wide if they are secured to the bottom of the duct with an approved fastener and with a minimum 1" tab below the duct, or with no fasteners if the strap is a single continuous loop.

C. Multiple trapeze hangers may be suspended from rod hangers to support ducts directly above and below each other if the rods are sized to support the combined load.

D. Round ducts less than 10" in diameter may be suspended by wire.

E. All hangers and trapezes shall be sized, spaced and selected in accordance with Section IV of SMACNA "HVAC DUCT CONSTRUCTION STANDARDS".

3.15 MISCELLANEOUS DUCT WORK REQUIREMENTS

A. Ductwork connected to intake or discharge louvers shall be painted inside for the first ten feet with bitumastic and pitched to a low point. The low point is to be provided with a 1½" copper drain piped by this trade to a building drain.

B. A gasket type joint shall be used where dissimilar metals are joined.

3.16 DUCT INSULATION - DUCT WRAP

A. All work shall be in strict accordance with applicable codes and ordinances and the manufacturers recommendations.

B. All completed work shall be smooth in appearance.

C. Seams shall be stapled 6" on center with outward clinching staples and sealed with pressure sensitive aluminum foil tape.

D. All seams, joints punctures and tears shall be sealed with pressure sensitive aluminum, foil tape.

E. All make-up air ductwork, air conditioning supply ductwork, and ductwork connected to SF-1 shall be insulated. All exterior insulated ductwork shall be weather proofed per Section 2.7.

3.17 TEXTILE AIR DISPERSION SYSTEM (Addendum #1)

A. Installation Of Textile Air Dispersion System:

1. Install chosen suspension system in accordance with the requirements of the manufacturer. Instructions for installation shall be provided by the manufacturer with product.

B. Cleaning And Protection:

1. Clean air handling unit and ductwork prior to the DuctSox system unit-by-unit as it is installed. Clean external surfaces of foreign substance which may cause corrosive deterioration of facing.
2. Temporary Closure: At ends of ducts which are not connected to equipment or distribution devices at time of ductwork installation, cover with polyethylene film or other covering which will keep the system clean until installation is completed.
3. If DuctSox systems become soiled during installation, they should be removed and cleaned following the manufacturers standard terms of laundry.

3.18 PIPE HANGERS, SUPPORTS, ANCHORS AND GUIDES

A. The HVAC Sub-Contractor shall submit shop drawings indicating the method of supporting all piping furnished by this trade.

B. The Structural Engineer or Architect must approve the method of hanging before work commences.

C. Shop drawings of anchors shall be submitted before work commences.

D. Shop drawings of guides shall be submitted before work commenced.

E. Sleeves of the specified type shall be installed wherever pipe lines penetrate walls, roofs, floors or partitions.

F. Sleeves shall be installed in accordance with the requirements of NFPA and the Massachusetts State Building Code.

3.19 PIPING SYSTEM INSTALLATION AND ASSEMBLY

A. All piping shall be installed at right angles to building surfaces, supports and structures.

B. Pipe welding shall performed by a certified welder with oxy-acetylene or electric arc in accordance with the latest revision of the applicable code, ASME Boiler Construction Code, ASA Code for Pressure Piping, or state and/or local codes which may supersede codes mentioned.

C. Threaded joints shall be made with Teflon tape only applied to male threads and care being taken to insure that the tape does not reach the interior of the pipe. All burrs and/or cuttings shall be removed and the pipe shall be reamed or filed out to not less than the original diameter. Piping shall be kept free from scale and dirt.

D. All pipes shall be straight, true and round without obstructions and with sharp, full cut threads or with ends beveled for welding.

E. Provide drain valves with hose connections at all low points and at the bottoms of all risers to allow for complete drainage of the system.

F. All openings shall be capped or plugged during construction to prevent dirt and/or rubbish from entering the piping.

G. Unions or flanged connections shall be placed wherever necessary to permit easy dismantling of the piping and equipment.

H. Where possible, piping shall be grouped together and supported in a neat and orderly manner.

I. Insulating bushings or dielectric nipples shall be provided between steel piping and copper piping on equipment.

J. Air vents shall be provided where indicated on the drawings and at all high points in the water systems.

K. Pipe must be supported before and after expansion compensation devices.

L. Mount all pressure gauges to be read from the floor.

M. Install pressure gauges on the suction and discharge of pumps.

N. Provide two spare pressure gauges of each pressure range and type.

O. Mount all thermometers to be read from the floor.

P. Install thermometers on the supply and return of the chill water system.

Q. Provide two spare thermometers of each range and type.

3.20 SEISMIC RESTRAINTS

A. Seismic restraints shall be provided in accordance with 780 CMR 1612.0 EARTHQUAKE LOADS. This specification does not require any additional seismic restraints beyond those of 780 CMR.

B. Seismic restraints are required for:

1. The energy recovery ventilator.
2. Make Up Air Unit

C. The HVAC Sub-Contractor shall be responsible for the design of the seismic restraints. The HVAC Sub-Contractor shall have the seismic restraint shop drawings stamped by a registered structural engineer.

3.21 VRF SYSTEM

A. General

1. The installing contractor shall have been certified by the manufacturer to install VRF systems, having attended a minimum 3- day VRF Service & Installation course at an

authorized training center. A copy of this certificate shall be presented as part of the VRF equipment submittal process

2. Upon completion of the Equipment Start-Up, the VRF manufacturer or VRF representative shall provide a formal report outlining the status of the system, in electronic format only. Contained within this report shall be a close-out letter, manufacturer's design software as-built file, and all recorded system information.

B. Pre Start-Up Inspection

1. Contractor shall employ the services of the VRF manufacturer or representative whose primary job responsibilities are to provide direct technical support of VRF products; sales staff or in-house support staff are not permitted to complete this scope of work, to provide a comprehensive physical startup of equipment. The following shall be completed prior to the startup of equipment:
2. The installing contractor shall provide a copy of the as-built electronic design file used in the installation of the system being inspected. This electronic design file shall have been completed on software approved by the specified VRF manufacture and shall have been updated to reflect as-built conditions.
3. Prior to start-up, all systems components shall be in a final state of readiness having been fully installed and awaiting start-up. Manufacturer's pre-startup checklist shall be completed and provided to engineer.
4. The installing contractor shall have prepared the refrigeration piping systems per equipment installation and service manuals. All refrigerant piping systems, upon completion of assembly, shall have been pressurized to a minimum 600 PSI, using dry nitrogen, and held for a consecutive 24HR period. A record of the pressure check process shall be recorded and tagged at the outdoor unit. The tag shall contain information for two events: start & stop. Each event shall include: date, time, fill pressure, outdoor temperature, and the person's full name completing each task.
5. Upon completion of the 600 PSI pressure check, the system shall be evacuated to a level of 500 microns, where it will be held for a period of 1HR with no deflection. The installing contractor shall utilize the triple evacuation method per the equipment install and service manuals. Evacuation start & stop dates, times, and persons involved shall be recorded and tagged at the outdoor equipment.
6. Upon the completion of the 500 micron hold, the calculated additional refrigerant charge can be added. The calculated refrigerant charge shall have been calculated using the manufactures design software. Total refrigerant charge of the system shall be recorded and displayed at the outdoor unit by permanent means.
7. A review of the equipment settings shall be completed, with recommendations provided to improve system performance, if applicable. Physical changes of system settings will be completed by the contractor.
8. All pressure check and evacuation tags shall be reviewed by the Mechanical Engineer before physical start-up begins.
9. Engineer must be notified (1) week before physical system start-up date. Manufacturer's pre start-up checklist must be provided with this notification.

C. Physical Start-Up of Equipment

1. Upon proper equipment start up by the contractor, following the manufacturer's guidelines and specifications, The representative shall complete a review of the system performance and complete the following tasks:

a. Check and confirm all communication addressing of system components.
b. Check and confirm each indoor unit, individually, is properly piped and wired by commanding the indoor unit on, in either heat or cool mode.
c. Electronically record a minimum of one-hour of operational data per refrigeration system.
d. Electronically record dip switch positions on all indoor and outdoor equipment.

D. VRF Equipment Warranty

1. Contractor is responsible for successfully completing the Start-Up & Extended Warranty processes and fulfilling all requirements, as outlined by the manufacturer. The equipment shall be provided with the following warranty period:
   a. Compressor: 10-year
   b. Parts: 10-years

E. Close-Out Information

1. The Manufacturer or VRF representative shall issue a system close out document at the completion of all field work. Contained within this report shall be an overview of the system performance, recommendations, all electronic data, and as-built design file.
2. Contractor shall submit proof of extended warranty registration.

F. Owner Turnover

1. The VRF manufacturer or representative shall provide the owner's representative with a minimum [4]-hour operation and maintenance training class covering systems installed under this scope of work. Training is to be provided at the time of owner occupancy.

3.22 ENERGY RECOVERY VENTILATORS

A. Examination

1. Prior to start of installation, examine area and conditions to verify correct location for compliance with installation tolerances and other conditions affecting unit performance. See unit IOM.
2. Examine roughing-in of plumbing, electrical and HVAC services to verify actual location and compliance with unit requirements. See unit IOM.
3. Proceed with installation only after all unsatisfactory conditions have been corrected.

B. Installation

1. Installation shall be accomplished in accordance with these written specifications, project drawings, manufacturer's installation instructions as documented in manufacturer's IOM, Best Practices and all applicable building codes.

C. Connections

1. In all cases, industry Best Practices shall be incorporated. Connections are to be made subject to the installation requirements shown above.
2. Piping installation requirements are specified in Division 22 (Plumbing). Drawings indicate general arrangement of piping, fittings and specialties.
3. Duct installation and connection requirements are specified in Division 23 of this document.

4. Electrical installation requirements are specified in Division 26 of this document.

D. Field Quality Control

1. Manufacturer's Field Service: Engage a factory authorized service representative to inspect field assembled components and equipment installation, to include electrical and piping connections. Report results to A / E in writing. Inspection must include a complete startup checklist to include (as a minimum) the following: Completed Start-Up Checklists as found in manufacturer's IOM.

E. Start-up Service

1. Engage a factory authorized service representative to perform startup service. Clean entire unit, comb coil fins as necessary, install clean filters. Measure and record electrical values for voltage and amperage. Refer to Division 23 "Testing, Adjusting and Balancing" and comply with provisions therein.

F. Demonstration and Training

1. Engage a factory authorized service representative to train owner's maintenance personnel to adjust, operate and maintain the entire unit.

3.23 AUTOMATIC TEMPERATURE CONTROLS

A. Installation Standards

1. Comply with BICSI TCI, TIA/EIA-568-B.1, TIA/EIA-568-B.2, TIA/EIA-568-B.3, and TIA/EIA-569-A.

B. TAB Support

1. Pre-TAB Meeting: Approximately 2 weeks prior to the initiation of Division 23 "Testing, Adjusting and Balancing for HVAC" services on site, schedule a meeting giving notice to the Construction Manager, Architect and Engineer and facilities representative(s).
   a. Publish an agenda with a minimum of the following discussion items:
      1 “Instrumentation and Controls for HVAC" sequence of upcoming construction.
      2 "Testing, Adjusting and Balancing for HVAC" sequence of upcoming construction.
      3 TAB for support from "Instrumentation and Controls for HVAC."
      4 "Instrumentation and Controls for HVAC" requirements for support from TAB.
      5 Timing, support and documentation procedures.
      6 Operation, diversities and setpoints of systems and equipment.
   b. Division 23 "Testing, Adjusting and Balancing for HVAC" shall fully support Division 23 "Instrumentation and Controls for HVAC" in the testing and calibration of all devices with fluid flow, motor transformers, static pressures and the like and shall coordinate work so as to not interfere with instrumentation and controls installation and setup activities.
   c. Division 23 "Instrumentation and Controls for HVAC" shall fully support Division 23 "Testing, Adjusting and Balancing for HVAC" in the operation, start and stop of all systems as well as the setting of values required for proper balancing and shall coordinate work so as to not interfere with TAB activities.

C. Construction/Commissioning Access Account

1. Individual read/view only web based access accounts shall be provided to the Engineer and to the Commissioning Agent. Account shall be set up once on-site server/workstation is active and pertinent access username, password, information and instructions shall be emailed to the Engineer and to the Commissioning Agent as early in the project as possible. Minimum read/view only access shall be provided to the following:
   a. Graphics.
   b. Programming.
   c. Trend Data.
   d. Alarms.

D. Examination

1. Verify that power supply is available for control units and operator workstation.
2. Verify that duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.
3. Examine pathway elements intended for cables.
   a. Verify proposed routes of pathways. Check raceways, cable trays, and other elements for compliance with space allocations, clearances, installation tolerances, hazards to cable installation, and other conditions affecting installation. Verify that cabling can be installed complying with EMI clearance requirements.
   b. Prepare wall penetrations and verify that penetrations of rated fire walls are made using products labeled for type of wall penetrated.
   c. Identify plan to support cables and raceways in suspended ceilings. Verify weight of individual types and sizes of cables. Verify that load capacity of cable support structures is adequate for each pathway.
   d. Proceed with installation only after unsatisfactory conditions have been corrected.

E. Installation

1. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.
2. Connect and configure equipment and software to achieve sequence of operation specified.
3. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 60 inches above the floor.
   a. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
4. Install guards on thermostats, if the functionality cannot be disabled, in the following locations
   a. Entrances.
   b. Public areas.
   c. Where indicated.
5. Install automatic dampers according to Division 23 Section "Air Duct Accessories."

6. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
7. Install labels and nameplates to identify control components according to Division 23 requirements.
8. Install refrigerant instrument wells, valves, and other accessories according to Division 23 requirements.
9. Install duct volume-control dampers according to Division 23 requirements.
10. Install electronic and fiber-optic cables according to Division 27 Section requirements.

F. Application of Media

1. Backbone Cable for Data Service: Use UTP Category 6 for runs between cabinets.
2. Horizontal Cable for Data Service: Use UTP Category 5e cable for runs between cabinets and peripheral equipment.

G. Electrical Wiring And Connection Installation

1. Comply with NECA 1.
2. Wiring Method: Install wiring and optical fiber in raceway within the following areas: mechanical rooms, electrical rooms, exposed areas, within walls and above inaccessible ceilings. Conceal raceway except in mechanical rooms and areas where other raceway and piping are exposed.
3. Wiring Method: Install wiring and optical fiber in raceway except consoles, cabinets, desks, and counters, and except in accessible ceiling spaces where unenclosed wiring method may be used for systems that are not part of life safety systems, including but not limited to, smoke exhaust systems, stair pressurization systems, smoke control systems, or hazardous exhaust systems, or systems on emergency/standby power, or main communications systems cable. Use UL listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in mechanical rooms and areas where other raceway and piping are exposed.
4. Cable Installation:
   a. Install exposed cables parallel and perpendicular to surfaces or exposed structural members and follow surface contours where possible.
   b. Make splices, taps, and terminations only at indicated outlets, terminals, and cross-connect and patch panels.
   c. Pulling Cable: Do not exceed manufacturer’s written recommended pulling tensions. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
   d. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.
   e. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
   f. Install UTP cables using techniques, practices, and methods that are consistent with Category 5e or 6 rating of components and that ensure Category 5e or 6 performance of completed and linked signal paths, end to end.
      1 Do not untwist more than 1/2 inch of Categories 5e and 6 cables at connector terminations.

5. Separation from EMI Sources: Comply with BICSI TDM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment. Comply with the following minimum separation distances from possible sources of EMI:
   a. Separation between unshielded power lines or electrical equipment in proximity to open cables or cables in nonmetallic raceways is as follows:
      1 Electrical Equipment Rating Less Than 2 kVA: 5 inches.
      2 Electrical Equipment Rating Between 2 and 5 kVA: 12 inches.
      3 Electrical Equipment Rating More Than 5 kVA: 24 inches.
   b. Separation between unshielded power lines or electrical equipment in proximity to cables in grounded metallic raceways is as follows:
      1 Electrical Equipment Rating Less Than 2 kVA: 2-1/2 inches.
      2 Electrical Equipment Rating Between 2 and 5 kVA: 6 inches.
      3 Electrical Equipment Rating More Than 5 kVA: 12 inches.
   c. Separation between power lines and electrical equipment located in grounded metallic conduits or enclosures in proximity to cables in grounded metallic raceways is as follows:
      1 Electrical Equipment Rating Less Than 2 kVA: No requirement.
      2 Electrical Equipment Rating Between 2 and 5 kVA: 3 inches.
      3 Electrical Equipment Rating More Than 5 kVA: 6 inches.
   d. Electrical Motors and Transformers, 5 kVA or HP and Larger: 48 inches.
   e. Fluorescent Fixtures: 5 inches.
6. Conduit:
   a. Comply with TIA/EIA-569-A for maximum length of conduit and bends between pull points, and for pull-box sizing.
   b. Use manufactured conduit sweeps and long-radius ells whenever possible.
   c. In mechanical rooms, position conduit ends adjacent to a corner on backboard (in case of a single piece of plywood) or in the corner of room (where multiple sheets of plywood are installed around perimeter walls of room). Use cable trays to route cables if conduits cannot be located in these positions. Secure conduits to backboard when entering room from overhead. Extend conduits 1 to 3 inches in finished floor.
   d. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
   e. Install exposed cable in raceway.
   f. Install concealed cable in raceway.
   g. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
   h. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
   i. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
   j. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

7. Install raceways, boxes, and cabinets according to Division 26 requirements.
8. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
9. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

H. Grounding

1. Comply with Division 26 Section "Grounding and Bonding for Electrical Systems" and with TIA/EIA 607.
2. Grounding Points:
   a. Locate grounding terminals in each equipment room, wiring closet, rack, and cabinet.
   b. Telecommunications Grounding Busbars: Mount on wall of equipment room and closet, with standoff insulators.

I. Bonding Conductors:

1. Extend from telecommunications entrance facility to grounding busbars.
2. Extend from grounding busbars to ground terminals in cabinets.

J. Special Requirements:

1. Bonding conductors shall be insulated copper, No. 6 AWG minimum.
2. Install only in nonmetallic conduit, unless specifically required for protection of conductor. Metallic conduit, if used, shall be RMC. For RMC that exceeds 36 inches in length, conductors shall be bonded at each end of conduit.
3. Bonding conductors shall be installed without splices unless approved by Architect because of special circumstances. Where splices are necessary, they shall be accessible and shall be located in telecommunications spaces. Splices shall be by irreversible compression connectors or by exothermic welding.

K. Field Quality Control

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections. Report results in writing.
2. Perform the following field tests and inspections and prepare test reports:
   a. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
   b. Test and adjust controls and safeties.
   c. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
   d. Test each point through its full operating range to verify that safety and operating control set points are as required.
   e. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
   f. Test each system for compliance with sequence of operation.
   g. Test software and hardware interlocks.

3. DDC Verification:
    a. Verify that instruments are installed before calibration, testing, and loop or leak checks.
    b. Check instruments for proper location and accessibility.
    c. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
    d. Check instrument tubing for proper fittings, slope, material, and support.
    e. Check installation of air supply for each instrument.
    f. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
    g. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
    h. Check temperature instruments and material and length of sensing elements.
    i. Check control valves. Verify that they are in correct direction.
    j. Check DDC system as follows:
        1 Verify that DDC controller power supply is from emergency power supply, if applicable.
        2 Verify that wires at control panels are tagged with their service designation and approved tagging system.
        3 Verify that spare I/O capacity has been provided.
        4 Verify that DDC controllers are protected from power supply surges.
4. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.
5. In addition to requirements in this Article, comply with TIA/EIA-606-A and with applicable requirements in Division 26 requirements.
    a. Administration class for this Project shall be Class 2 or 3.
    b. Color-code cross-connect fields. Apply colors to service backboards, connections, covers, and labels.
6. Using cable and asset management software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable, and label cable, jacks, connectors, and terminals to which it connects with same designation. Use logical and systematic designations for facility's architectural arrangement. At completion, cable and asset management software shall reflect as-built conditions.
7. Use logical and systematic designations for facility's architectural arrangement and nomenclature, and a consistent color-coded identification of individual conductors.
8. Cable and Wire Identification:
    a. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
    b. Label each terminal strip and screw terminal in each cabinet.
        1 All wiring conductors connected to terminal strips shall be individually numbered, and each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
        2 Label each unit and field within distribution racks and frames.

9. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

L. GRAPHICS ORGANIZATION

1. General:
   a. Graphics shall be full color with motion utilizing floor plans wherever possible to indicate location of applicable information and fully accessible through the web-based software.
   b. A general color scheme shall be utilized to indicate status of equipment and information.
      1 BLUE: Equipment/system normal, off; point normal.
      2 GREEN: Equipment/system normal, on.
      3 YELLOW: Equipment/system alarm, operating; point minor alarm.
      4 RED: Equipment failure; point major alarm.
      5 PURPLE: Operator override.
   c. Provide the following links in a block in the same general location on every graphic:
      1 Primary graphic.
      2 All screens associated with the current graphic.
      3 As-Built Sequence of Operation
      4 Back to previous.
      5 Forward to next.
   d. Organize graphics in easily understandable levels to minimize search time for desired information.
      1 There shall be at least 2 levels and no more than 4 levels.
      2 Smaller systems can have one primary graphic with links to all other graphics.
      3 Larger systems can be organized with one primary graphic, a secondary set of categorized graphics to organize like specific graphics (i.e., zones, air systems, chilled water systems, hot water systems, etc.), then a third layer to take the user to specific graphics.
2. Primary Graphic:
   a. The primary graphic will show well organized links to all other graphic levels with short descriptive labels.
   b. Import the Owner’s logo and clearly show the project name.
3. Zone Graphics:
   a. Provide floor plan based graphics to show zones. Organize in a similar fashion to Contract Drawings and provide a sufficient scale so all information is easily readable and understandable.
   b. Provide links to all other zone graphics.
   c. Provide links to all individual zone terminal equipment.
   d. Show all zone terminal equipment information with blocks in the associated zone. Each block shall change color to indicate normal/alarm modes.

4. System Graphics:
    a. Each discreet system shall have a single graphic organized in schematic form accurately representing the installation configuration.
    b. Each system or piece of equipment that has been provided with 2-way communications such as through an RS 485 connection shall be provided with a dedicated graphic regardless of which contract it was provided under or if it was Owner/tenant provided.
    c. Provide links to all associated graphics (i.e., AHU to other AHU's and to exhaust systems, chilled water system to cooling tower system and hot water system).
    d. Locate pertinent information next to its associated graphic representation.
    e. Provide a link to a separate page that displays the system as-built sequence of operation.
5. Monitoring Graphics:
    a. Where equipment is monitored for specific information and no 2-way communication is available, it may be grouped on a floor plan or multiple plans.
6. Energy Usage Graphics:
    a. Provide separate graphics pages for the ongoing accountability of building energy usage and consumption over time. Building energy usage graphics shall be provided with hyperlinks to the main building graphics homepage to facilitate "user friendly" operations.
    b. Provide dynamic historical trending and totalization of each piece of equipment (energy use of each component). Totalize data for the continuous monitoring of metering equipment for constant and variable motor loads, VFD operation, cooling loads, AHU energy usage (air-side), air and water-side economizers, air distribution static pressure and air ventilation volumes.
    c. Monitor electrical system power and lighting system power consumption through each switchboard circuit breaker connection. Provide dynamic historical trending and totalization of each circuit.
    d. Coordinate data (run-time hours, electrical consumption, kW hours, kW/ton, kWH/year, $savings/year, etc.) with building energy model and the Commissioning Agent.
7. Show the block in its general location with an equipment label and normal and alarm color changing.
8. Custom Graphics: Custom graphic files shall be created with the use of a graphics generation package furnished with the system. The graphics generation package shall be a graphically based system that uses the mouse to create and modify graphics that are saved in industry standard formats such as PCX, TIFF, and GEM. The graphics generation package also shall provide the capability of capturing or converting graphics from other programs such as Designer or AutoCAD.
9. Graphics Library: Furnish a complete library of standard HVAC equipment graphics such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. This library also shall include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. The library shall be furnished in a file format compatible with the graphics generation package program.

M. Programming

1. Provide sufficient internal memory for the specified sequences of operation and trend logging. There shall be a minimum of 25% of available memory free for future use.
2. Point Naming: System point names shall be modular in design, allowing easy operator interface without the use of a written point index. Use the following naming convention: AA.BBB.CCDDE where AA is used to designate the location of the point within the building, such as mechanical room, wing, or level, or the building itself in a multi-building environment, BBB is used to designate the mechanical system with which the point is associated (e.g., A01, HTG, CLG, LTG), CC represents the equipment or material referenced (e.g., SF for supply fan, RW for return water, EA for exhaust air, ZN for zone), D or DD may be used for clarification or for identification if more than one CC exists (e.g., SF10, ZNB), E represents the action or state of the equipment or medium (e.g., T for temperature, H for humidity, C for control, S for status, D for damper control, I for current).
3. Software Programming:
   a. Provide programming for the system and adhere to the sequences of operation provided. All other system programming necessary for the operation of the system, but not specified in this document, also shall be provided by the Contractor. Imbed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequences of operation. Use the appropriate technique based on the following programming types:
      1 Text-based:
      2 Organized in single purpose blocks of programming.
      3 Must provide actions for all possible situations.
      4 Must be modular and structured.
      5 Must be commented with a description and purpose.
   b. Graphic-based:
      1 Organized in single purpose functional blocks.
      2 Must provide actions for all possible situations.
      3 Organize blocks in a neat flowing structure.
      4 Blocks must be annotated with a description and purpose in a text block.
      5 Must be documented.
4. Operator Interface:
   a. Standard Graphics: Provide graphics for all mechanical systems and floor plans of the building. This includes each chilled water system, hot water system, chiller, boiler, air handler, and all terminal equipment. Point information on the graphic displays shall dynamically update. Show on each graphic all input and output points for the system. Also show relevant calculated points such as set points.
   b. Show terminal equipment information on a "graphic" summary table. Provide dynamic information for each point shown.
   c. The Contractor shall provide all the labor necessary to install, initialize, start up, and troubleshoot all operator interface software and its functions as described in this Section. This includes any operating system software, the operator interface database, and any third party software installation and integration required for successful operation of the operator interface.

N. Adjusting

1. Calibrating and Adjusting:
   a. Coordinate onsite time and integration of services with Division 23 Section "Testing, Adjusting, and Balancing of HVAC" to utilize and mutually support activities. Air and water devices requiring flow information for calibration (i.e., VAV box, flow station/meters, etc.) shall be calibrated in conjunction with TAB activities and shall not interfere with the work and general schedule of construction.
   b. Calibrate instruments.
   c. Make single-point calibration test for accuracy, plus testing of full span for each analog instrument.
   d. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
   e. Control System Inputs and Outputs:
      1 Check analog inputs at 0, 50, and 100 percent of span.
      2 Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
      3 Check digital inputs using jumper wire.
      4 Check digital outputs using ohmmeter to test for contact making or breaking.
      5 Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
   f. Flow:
      1 Set differential pressure flow transmitters for 0 and 100 percent values with single-point calibration accomplished at approximately mid-point of span, and check full span with an artificial signal generator.
      2 Manually operate flow switches to verify that they make or break contact.
   g. Pressure:
      1 Calibrate pressure transmitters at approximately mid-point of span, and check full span with an artificial signal generator.
      2 Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
   h. Temperature:
      1 Calibrate resistance temperature transmitters at approximately mid-point of span using a precision-resistance source, and check full span with an artificial signal generator.
      2 Calibrate temperature switches to make or break contacts.
   i. Stroke and adjust control valves and dampers, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
   j. Provide diagnostic and test instruments for calibration and adjustment of system.
   k. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

2. Adjust initial temperature and humidity set points.
3. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

O. Field Quality Testing

1. Perform the following field tests and inspections and prepare test reports:
   a. Category 5e UTP Cabling Tests:
      1 Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in Annex I, complying with measurement accuracy specified in Annex H. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
      2 Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
      3 Wire-map test that reports open circuits, short circuits, crossed pairs, reversed pairs, split pairs, and improper terminations.
      4 Channel and permanent link tests for cable length, insertion loss, near-end crosstalk loss, power sum near-end crosstalk loss, equal-level far-end crosstalk loss, power sum equal-level far-end crosstalk, return loss, propagation delay, and delay skew. Performance shall comply with minimum criteria in TIA/EIA-568-B.2.
   b. Category 6 UTP Cabling Tests:
      1 Tests shall include all tests of Category 5e, conducted from 1 to 250 MHz.
      2 Channel and permanent link tests shall be performed with at ester that complies with performance requirements in TIA/EIA-568-B.2, Level III. Include tests for longitudinal or transverse conversion loss.
      3 Performance shall comply with minimum criteria in TIA/EIA-568-B.2.
2. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
3. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
4. Retest and inspect cabling to determine compliance of replaced or additional work with specified requirements.

P. STABILITY TRENDING SET-UP

1. Set up trending of points for confirmation of stability and control.
2. Trend three weeks of data as follows:
   a. Trend all analog input values on a 30 minute basis.
   b. Trend all digital input points on a change of value basis.
   c. Trend all analog virtual points on a 60 minute basis.
3. Test network capacity according to standards indicated during trending tests.

4. When trending indicates system instability for certain points, set-up additional trending for one week as follows to facilitate tuning and trouble-shooting:
   a. Trend all associated analog input points on a 10 minute basis.
   b. Trend all associated digital input points on a change of value basis.
   c. Trend all associated analog outputs on a 10 minute basis.
   d. Trend all associated digital outputs on a change of value basis.
   e. Trend all associated virtual analog points on a 10 minute basis.
   f. Trend all associated virtual digital points on a change of value basis.
5. Reporting system shall automatically email trend reports to the Engineer and the Commissioning Agent on a daily basis.
6. Continue trending as long as required to enable system stability and trouble shooting. Owner's representative must sign off.
7. Leave trending of point as directed by Owner's representative for long term information gathering.

Q. DEMONSTRATION

1. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 01 for additional requirements.
2. Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new outlets. Refer to Division 01 for additional requirements.

3.24 FINAL ACCEPTANCE

A. The HVAC Sub-Contractor shall leave all system components in proper working order, such as belt guards in place, access doors closed, doors to electrical switch boxes closed, thermostats restored to specified setting. All recorded data shall represent a true, actually measured, or observed condition. Any abnormal conditions in the mechanical systems or conditions that prevent total system balance shall be reported to the Architect immediately upon finding. The HVAC Sub-Contractor shall permanently mark all dampers and other adjustment devices in a manner that will allow the settings to be restored.

B. The HVAC Sub-Contractor shall verify control system operation as specified, and shall report all system problems and malfunctions. The verification and checkout of the control system shall be accomplished during the heating and cooling cycles of operation for an appropriate period of time to assure control response and overall stability.

C. The HVAC Sub-Contractor shall verify that all air systems are in compliance with all standards, such as ASHRAE minimum outside air, and all other applicable codes and requirements.

D. All filters shall be replaced by the HVAC Sub-Contractor before commencing.

E. The HVAC Sub-Contractor shall make any necessary changes in fan speed, and shall realign all belts when necessary.

3.25 AIR BALANCING

A. The HVAC Subcontractor shall employ an independent TAB Sub-Contractor, acceptable to and approved by the Architect/Engineer, to balance and adjust the air systems.

B. Balancing and adjusting shall not begin until all HVAC systems have been installed and are in full working order. Prior to the start of balancing, the following shall be checked:

1. Rotation of all fans.
2. Dampers are free to open and close
3. Clean filters are in place.

C. Upon completion of balancing and adjusting of the systems hereinafter specified, submit six (6) copies of the data for review and approval by the Architect/Engineer.

D. The TAB Sub-Contractor shall be procured early enough in the project to allow for him/her to review the project documents and determine if sufficient components are in place to balance and adjust the systems. The TAB Sub-Contract shall provide a list of any deficient are he/she identifies.

E. TAB Sub-Contractor shall provide all testing instruments, manpower, temporally connections and materials needed for balancing and adjusting of the air systems. All test instruments should have been calibrated within the last six (6) months. The TAB Sub-Contractor shall provide verification of calibration upon request.

F. Architect/Engineer and Owner shall be notified a minimum of five (5) days prior to balancing commencing so that a representative can be available to witness the balancing work. In addition, the TAB Sub-Contractor shall (upon completion of the balancing work and report submittal), at the request of the Architect/Engineer or Owner's representative, verify the balancing readings at four (4) locations. The locations shall be chosen by the Architect/Engineer or Owner's representative.

G. All balancing and adjusting of air systems shall be done in accordance with the latest edition of the NEBB procedural Standards for Testing, Adjusting and Balancing of Environmental systems or the latest edition of SMACNA's HVAC Systems Testing, Adjusting and Balancing.

1. Balancing of air systems with Constant Airflow Regulators shall follow the recommendations of the manufacturer American Aldes or approved substitute product.

H. Balancing of the cooling systems shall be performed in the air conditioning season, heating systems in the heating season.

I. Prior to balancing of the air systems, and as part of the balancing report, the TAB Sub-Contractor shall prepare ductwork schematics of the systems to be balanced. Schematics shall be similar to those indicated in the NEBB and SMACNA publications previously identified.

J. Air Balancing Report forms shall be similar to the standard NEBB and SMACNA forms found in the previously identified manuals. The following information shall be provided at minimum (reports for equipment and systems not indicated shall be obtained from the NEBB/SMACNA manuals or prepared by the TAB Sub-Contractor. Reports prepared by the TAB Sub-Contractor shall be submitted for review and approval prior to final Balancing Report submittal):

1. Air Apparatus Test Report
    a. Location.
    b. System Number.
    c. Manufacturer.
    d. Airflow - design and actual.
    e. Total CFM.
    f. Total Static pressure.
    g. Discharge Static Pressure.
    h. Suction Static Pressure.
    i. Coil pressure drops (static pressure).
    j. Filter pressure drops.
    k. Motor volts and amps.
    l. Outside Air and Return Air CFM.
    m. Drive data.
2. Fan Test Report
    a. System Number.
    b. Location.
    c. Manufacturer.
    d. Airflow - design and actual.
    e. Total static pressure - design and actual.
    f. Inlet static pressure.
    g. Discharge static pressure.
    h. Motor and Drive data.
    i. Fan RPM.
    j. Voltage and Amperage.
3. Duct Traverse
    a. System zone/branch.
    b. Duct Size.
    c. Area.
    d. Design Velocity.
    e. Design Airflow.
    f. Test Velocity.
    g. Test Airflow.
    h. Duct Static Pressure.
    i. Air temperature.
4. Air Outlet Report
    a. Area Served.
    b. Outlet Number.
    c. Type.
    d. Size.
    e. AK factor.

f. Velocity - design and actual.
g. Airflow - design and actual.

K. The TAB Sub-Contractor shall balance and adjust air systems to meet design requirements. ±5%. Balancing shall be accomplished by adjusting dampers, drives, etc. to obtain design requirements.

L. The HVAC Sub-Contractor shall cooperate and make provisions for the TAB Sub-Contractor as needed to accommodate the air balancing. As part of this Contract, the HVAC Sub-Contractor shall provide and/or change pulleys, belts and sheaves, and dampers, at no additional cost, in order to properly balance the systems to design requirements.

3.26 START UP AND TESTING OF COOLING AND HEATING EQUIPMENT

A. All cooling equipment shall be tested to verify that the equipment operates mechanically and electrically as specified.

B. All heating equipment shall be tested to verify that the equipment operates mechanically and electrically as specified.

C. The HVAC Sub-Contractor shall verify that all operating and safety controls are correctly adjusted.

D. The HVAC Sub-Contractor shall verify that the cooling equipment controls are operating properly.

E. Tests shall be made to verify that the capacity control is fully modulating according to the required load. Tests shall be made at minimum load, 50% load, 100% load and various other loads throughout the modulating cycle.

F. The HVAC Sub-Contractor shall record the following non-test data:

1. Equipment designation number.
2. Equipment manufacturer.
3. Model number.
4. Serial number.
5. Rated input.
6. Rated output.
7. All other pertinent data.

G. The HVAC Sub-Contractor shall perform and record the following to meet minimum requirements:

1. Verify proper system operation.
2. Verify that the cooling system controls are operating according to design specifications.
3. All other measurements required for complete system testing.

H. The HVAC Sub-Contractor shall calculate the system coefficient of performance as measured. All calculations made using the measured data shall be included in the report. In general, the HVAC Sub-Contractor shall complete all tests necessary for complete cooling and heating systems analysis.

3.27 COMMISSIONING OF HVAC EQUIPMENT AND SYSTEMS

A. TESTING PREPARATION

1. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
2. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
3. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.
4. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
5. Inspect and verify the position of each device and interlock identified on checklists.
6. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
7. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

B. TESTING AND BALANCING VERIFICATION

1. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.
2. Notify the CxA at least 10 days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.
3. During Functional Testing the CxA shall spot-check airflows and equipment operation. The TAB contractor shall be required to re-calibrate if any of the following instances occur:
   a. Any diffuser, grille, or other air flow device is excessively loud.
   b. Any item is observed to be operating improperly.
   c. A discrepancy between the recorded information on the TAB report and field observations during functional testing.

C. GENERAL TESTING REQUIREMENTS

1. Provide control system technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
2. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.
3. Test operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
4. The CxA shall prepare detailed functional testing plans, for HVAC&R systems, subsystems, controls, and equipment.
5. Tests will be performed using design conditions whenever possible.

6. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. In most cases the artificial loads will be simulated by adjusting setpoints and manipulating controls. In some cases the contractor may be required to provide equipment to simulate loads.
7. The CxA may direct that set points be altered when simulating conditions is not practical.
8. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
9. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
10. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.
11. If, in the CxA's sole judgment the systems or equipment fail to perform according to the design intent, a list of deficiencies will be generated which, when remedied, shall result in retesting of the deficiency, as well as the system as a whole.

3.28 SEQUENCES OF OPERATION *(Addendum #1)*

A. Refer to HVAC floor plans and Piping Schematics located on the drawings for equipment designations and locations.

B. Sequence Of Operation Documentation:

1. Submit written sequence of operation for the entire HVAC system and each piece of equipment.
   a. Preface: 1 or 2 paragraph overview narrative of the system describing its purpose, components and function.
   b. State each sequence in small segments and give each segment a unique number for referencing in Functional Test procedures; provide a complete description regardless of the completeness and clarity of the sequences specified in the contract documents.
   c. Include at least the following sequences:
      1 Start-up.
      2 Warm-up mode.
      3 Normal operating mode.
      4 Unoccupied mode.
      5 Shutdown.
      6 Capacity control sequences and equipment staging.
      7 Temperature and pressure control, such as setbacks, setups, resets, etc.
      8 Detailed sequences for all control strategies, such as economizer control, optimum start/stop, staging, optimization, demand limiting, etc.
      9 Effects of power or equipment failure with all standby component functions.
      10 Sequences for all alarms and emergency shut downs.
      11 Seasonal operational differences and recommendations.
      12 Interactions and interlocks with other systems.
   d. Include initial and recommended values for all adjustable settings, setpoints and

parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.

e. For packaged controlled equipment, include manufacturer's furnished sequence of operation amplified as required to describe the relationship between the packaged controls and the control system, indicating which points are adjustable control points and which points are only monitored.

f. Include schedules, if known.

2. Control System Diagrams: Submit graphic schematic of the control system showing each control component and each component controlled, monitored, or enabled.

a. Label with settings, adjustable range of control and limits.

b. Include flow diagrams for each control system, graphically depicting control logic.

c. Include the system and component layout of all equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.

d. Include draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.

e. Include all monitoring, control and virtual points specified in elsewhere.

f. Include a key to all abbreviations.

3. Points List: Submit list of all control points indicating at least the following for each point.

a. Name of controlled system.

b. Point abbreviation.

c. Point description; such as dry bulb temperature, airflow, etc.

d. Display unit.

e. Control point or setpoint (Yes / No); i.e. a point that controls equipment and can have its setpoint changed.

f. Monitoring point (Yes / No); i.e. a point that does not control or contribute to the control of equipment but is used for operation, maintenance, or performance verification.

g. Intermediate point (Yes / No); i.e. a point whose value is used to make a calculation which then controls equipment, such as space temperatures that are averaged to a virtual point to control reset.

h. Calculated point (Yes / No); i.e. a “virtual” point generated from calculations of other point values.

4. Project Record Documents: Record actual locations of components and setpoints of controls, including changes to sequences made after submission of shop drawings.

C. Common Requirements for Sequences of Operation: The following items are common requirements that apply unless noted otherwise:

1. All setpoints shall be program adjustable at the operator workstation.

2. All high and low limits shall be alarmed.

3. All cooling coils located in or over occupied spaces shall have a condensate pan high level alarm.

4. All fan proof of operation shall be by high and low current sensors.
5. All unit smoke detection, freeze protection, high condensate level and other emergency shutdown shall be done by hardwired relay interlock and shall not rely on control system programming.
6. All dampers shall have open and close status indication through end switches or integral actuator feature.
7. All dampers shall have an independent control point. Multiple dampers of different applications (i.e., outdoor, return, relief) controlled from a single point are not acceptable.
8. All air handling systems with ducted outdoor air shall be provided with freeze protection.

D. All spaces shall have the capability of being individually scheduled for Occupied and Unoccupied periods.

E. Variable Refrigerant Volume Heat Pump (VRV) System

1. The variable refrigerant volume heat pump system will have a manufacturer provided control system.
2. The ATC sub-contractor shall provide all required control wiring between air handlers, condensing units, control panels, etc., per the manufacturer's recommendations and requirements.
3. The HVAC sub-contractor shall provide the set-up of the VRV system manufacturer provided control system. The ATC sub-contractor shall assist the HVAC sub-contractor in identifying any requirements of the system for integration with the DDC system.
4. The variable refrigerant volume heat pump system shall operate on internal controls to modulate the compressors to provide heating or cooling as required.
5. Indoor Fan Coil Units
   a. The indoor units shall be controlled by MA controllers.
   b. During occupied periods, the indoor units shall operate to maintain the space controller heating and cooling setpoints.
   c. The space controller setpoint shall be determined by the central control system unless overridden at the space controller.
   d. During unoccupied periods, the indoor units shall operate to maintain the unoccupied setpoint temperature.
   e. Rooms with multiple indoor units shall have all units controlled from a single controller unless multiple controllers are indicated on the drawings.

F. Air Handler with Heating, Cooling and Energy Recovery (Gymnasium)

1. ERV's shall be provided with a communication card to allow interface with the DDC system.
2. ERV's shall be energized and run continuously during occupied hours as determined by a schedule in the DDC system.
3. When an ERV is energized:
   a. The supply and exhaust fans shall be energized and run continuously.
      1 The exhaust fan shall modulate as required to maintain the space at 0.05" SP above outdoors.

b. The ERV heating mode supply discharge air temperature setpoint shall be determined by the space demand. If the SAT is below the heating supply air temperature setpoint and the enthalpy wheel is energized, the heat pump and DX coil with associated LEV kits shall modulate to maintain the supply air temperature setpoint.
   1 If the ERV supply discharge air temperature is greater than the supply air heating mode temperature setpoint, the heat pump shall be de-energized.
c. The ERV cooling mode supply discharge air temperature setpoint shall be determined by the space demand. If the SAT is above the cooling supply air temperature setpoint and the enthalpy wheel is energized, the heat pump and DX coil with associated LEV kits shall modulate to maintain the supply air temperature setpoint.
   1 If the ERV supply discharge air temperature is less than the supply air cooling mode temperature setpoint, the heat pump shall be de-energized.
d. If the space RH level is greater than 55%RH (adjustable) the ERV shall operate in dehumidification mode, the heat pump and DX coil with associated LEV kits shall be energized at 100% and the reheat coil shall modulate to maintain the space cooling supply air temperature setpoint.
   1 When the space RH level drops to below 50% RH (adjustable) the dehumidification mode shall be disabled.

4. Enthalpy Wheel
   a. When the outdoor air temperature is between 65ºF and 75ºF (adjustable), the enthalpy wheel shall be de-energized.
5. When ERV is de-energized:
   a. The supply and exhaust fans shall be de-energized.
   b. The supply and exhaust dampers shall be closed.

G. Energy Recovery Ventilator (Locker Rooms)
1. ERV's shall be provided with a communication card to allow interface with the DDC system.
2. ERV's shall be energized and run continuously during occupied hours as determined by a schedule in the DDC system.
3. When an ERV is energized:
   a. The supply and exhaust fans shall be energized and run continuously.
      1 The exhaust fan shall be balanced to maintain the space at 0.05" SP above outdoors.
4. Enthalpy Wheel
   a. When the outdoor air temperature is between 65ºF and 75ºF (adjustable), the enthalpy wheel shall be de-energized.
5. When the ERV is de-energized:
   a. The supply and exhaust fans shall be de-energized.
   b. The supply and exhaust dampers shall be closed.

H. Energy Recovery Ventilator (Multipurpose Room)
1. ERV's shall be provided with a communication card to allow interface with the DDC system.

2. ERV's shall be energized and run continuously during occupied hours as determined by a schedule in the DDC system.
3. When an ERV is energized:
   a. The supply and exhaust fans shall be energized and run continuously.
      1 The supply fan shall modulate to maintain the supply air duct static pressure setpoint, initially 0.50" SP (final setpoint to be determined during balancing).
      2 The exhaust fan shall be balanced to maintain the space at 0.05" SP above outdoors.
4. Enthalpy Wheel
   a. When the outdoor air temperature is between 65ºF and 75ºF (adjustable), the enthalpy wheel shall be de-energized.
5. When the ERV is de-energized:
   a. The supply and exhaust fans shall be de-energized.
   b. The supply and exhaust dampers shall be closed.

I. Constant Volume Regulators (CVR)

1. Two stage regulators shall have the first stage open at all times. The second stage (booster) damper shall be interlocked with the associated space's occupancy sensor (room or lighting fixture) and shall open the second stage damper when occupancy is sensed. The damper shall close when the occupancy period ends.
2. Multi-Purpose Room
   a. The space mounted CO2 sensors shall control operation of the associated outside air CVR damper.
   b. During Occupied periods the supply CVR damper shall open to the minimum airflow.
   c. On a rise in space CO2 above 900 ppm (adjustable) the CVR damper shall modulate open.
   d. On a drop in space CO2 below 600 ppm (adjustable) the CVR damper shall modulate to the minimum airflow position.
   e. The exhaust CVR damper shall track the supply CVR damper.

J. Electric Heating Devices

1. Electric heating devices shall be controlled by their integral or space mounted thermostats.
2. On a demand for space heating the fan and heating element shall be energized.
   a. When the space temperature is satisfied the fan and the heating element shall be deenergized.

K. Air Curtain

1. The air curtain shall be controlled by a door switch. When the door is open the unit shall be energized and run continuously.

L. Exhaust Fans

1. Exhaust fan EF-B01 & EF-B02 shall be controlled by the associated temperature & humidity sensor.
   a. If the space temperature rises above 80°F (adjustable) or the space humidity level

rises above 55% RH (adjustable) the fan shall be energized and run continuously and the outside air intake louver motor operated damper shall open.

b. When the space temperature drops below 75°F (adjustable) or the space RH level drops to below 50% RH (adjustable) the fan shall be deenergized.

2. Destratification Fans (DF)
   a. If the associated heat/cool system is in heating mode and the temperature at the DF is 10°F (adjustable) above the space temperature (measured at the thermostat/sensor) the fan shall be energized and run continuously.
3. Data Closet
   a. If the space temperature rises above 80°F (adjustable) the fan shall be energized and run continuously.
      1 When the space temperature drops below 75°F (adjustable) the fan shall be deenergized.
4. Restrooms
   a. If the lights are turned on the fan shall be energized and run continuously.
      1 When the lights are turned off the fan shall continue to run for 10 minutes (adjustable) and then be deenergized.

- END OF SECTION -

Rhode Island Department of Health

3 Capitol Hill
Providence, RI 02908-5097

TTY: 711
www.health.ri.gov

February 24, 2023

City of Providence
Ben Lobaugh
25 Dorrance St
Providence, RI 02903

Plan No.: *195603*

Dear Owner/Agent:

The Rhode Island Department of Health (RIDOH) reviewed and approved the Asbestos Abatement Plan you submitted for Davey Lopes Recreation Center, 227 Dudley St Providence. The plan will expire 12 months from the date of this letter and the work must begin within six months of this approval date.

The asbestos abatement work must be performed by a RIDOH-licensed Asbestos Contractor in accordance with all other requirements of the Rules and Regulations for Asbestos Control (216-RICR-50-15-1). A Start Work Notification (ASB-22) must be submitted to RIDOH at least 10 business days before the work begins. In addition, the Asbestos Supervisor must notify RIDOH at 401-222-7796 when site preparation begins. Clearance air sample results and confirmation of disposal of asbestos must also be submitted to RIDOH in accordance with 216-RICR-50-15-1.

Please contact Jenny Brear, 4012227749 or doh.asbestos@health.ri.gov if you have any questions regarding these requirements.

Sincerely,

Bonnie Cassani-Brandt
Asbestos & Radon Program Manager
Center for Healthy Homes & Environment
Division of Environmental Health

Cc: Asbestos Consultant

RHODE ISLAND DEPARTMENT OF HEALTH

NOTARIZED CERTIFICATION OF ASBESTOS ABATEMENT PLAN

Facility/Building: Davey Lopes Recreation Center

Address: 227 Dudley Street

City/Town: Providence ZIP: 02907 Amendment Phase No: _____

Abatement Plan Prepared By: Joseph M. Lepore RIDOH License No.: APD00661

Summary of specific waivers/variances being requested:

Abatement Information

Abatement Method: (Check all that apply)

- [x] Removal
- [ ] Encapsulation
- [ ] Enclosure
- [ ] Other (specify): _____
- [ ] Demolition
- [ ] Glovebag
- [ ] Asphalt Roofing

Asbestos Contractor: TBD RIDOH License No.: TBD

Estimated Starting Date: April 2023

Pre-Abatement Sampling Information

Bulk samples collected by: Danny Mullen RIDOH License No.: AI000963

Bulk samples analyzed by: RI Analytical RIDOH License No.: PLM00142

Air samples collected by: ECM Inc. RIDOH License No.: PCM00131

Air samples analyzed by: ECM Inc. RIDOH License No.: PCM00131

Clearance Air Sampling Information

Air samples to be collected by: ECM Inc.

Air samples to be analyzed by: ECM Inc. RIDOH License No.: PCM00131

CERTIFICATION

I certify that: this asbestos abatement plan is prepared and submitted under the provisions of Rhode Island General Laws Chapter 23-24.5 and the Rules and Regulations for Asbestos Control (216-RICR-50-15-1); all abatement/ management activities performed in conjunction with this plan will be in compliance with the specifications prescribed in this plan (when approved) and the most current revision of all applicable federal and state regulations; and the asbestos abatement/management activities described in this plan will be performed by a Rhode Island licensed asbestos abatement contractor.

State of Rhode Island, County of Providence. On this 14th day of February, 2023 before me, the undersigned notary public, personally appeared Jonathan R. Martin (name of document signer), and proved to me through satisfactory evidence of identification to be the person whose name is signed on the preceding or attached document, and acknowledged that they signed it voluntarily for its stated purpose.

_____ Jonathan Martin

Signature of Building Owner or Agent Printed Name of Building Owner or Agent

_____

(official signature and stamp of notary)

Amanda Pontarelli My Commission expires: 2/25/26

Printed Name, ID Number Notary Public

AMANDA PONTARELLI NOTARY PUBLIC My Commission Expires February 25, 2026 STATE OF RHODE ISLAND

RHODE ISLAND DEPARTMENT OF HEALTH
Center for Healthy Homes and Environment – Asbestos Program

ABATEMENT PLAN APPLICATION

1. Owner/Contact Name: City of Providence/Mr. Ben Lobaugh
   Title: Capital Improvements Project Manager
   If owned by an organization, organization name: _____
   Address: 25 Dorrance Street
   City/State: Providence, RI ZIP: 02903
   Phone: 401-680-5548 Email: blobaugh@providenceri.gov

---

2. Application prepared by:
   Name: Joseph M. Lepore RIDOH License No.: APD00661
   Phone: 401-304-6614 Email: jlepore@ecmne.com

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4. Location of abatement work:
   Facility/Building Name: Davey Lopes Recreation Center
   Street Address: 227 Dudley Street
   City/Town: Providence ZIP: 02907

---

5. Reason for Application: (Check all that apply)
   ☐ Emergency Plan No. _____
   ☑ Standard Plan
   ☐ Annual Plan
   ☐ Response to a Notice or Order (attach copy)

---

6. Asbestos contractor (if known):
   Name: TBD RIDOH License No.: TBD

---

7. Estimated Abatement Work Dates

Start Date: April 2023 Completion Date: April 2024

8. Abatement Method: **(Check all that apply)**

- [x] Removal
- [ ] Encapsulation
- [ ] Enclosure
- [ ] Demolition
- [ ] Other (Specify): _____
- [ ] Glovebag
- [ ] Asphalt Roofing
- [ ] Operations & Maintenance Only

9. Facility Type: **(Check one)**

- ( ) Child Care Facility
- ( ) College/University
- ( ) Hospital
- (•) Other (Specify): Recreation Center
- ( ) Private Residential Dwelling
- ( ) Public Housing
- ( ) School/School Building

10. Building Access: **(Check one)**

- (•) Public Access
- ( ) Limited Public Access
- ( ) No Public Access
- ( ) Other (specify)_____

11. Bulk Sampling:

A. Samples collected by:
Name: Danny Mullen RIDOH License No.: AI000963

B. Sampling Methodology: (**Check one)**
EPA AHERA Sampling requirements [40 CFR 763.86].
Other (Specify): _____

C. Analytical Service:
Name: RI Analytical RIDOH License No.: PLM00142

D. Analytical Method: (**Check one)**

- (•) PLM (Phase Light Microscopy)
- ( ) TEM (Transmission Electron Microscopy)
- ( ) Other (Specify): _____

12. Pre-Abatement Air Sampling:
    A. Samples collected by:
    Name: Joseph M. Lepore RIDOH License No.: PCM00131
    Affiliation: ECM Inc.
    B. Analytical Service:
    Name: ECM Inc. RIDOH License No.: PCM00131
    C. Analytical Method: (**Check one)**
    (●) PCM (Phase Contrast Microscopy)
    ( ) TEM (Transmission Electron Microscopy)
    ( ) Other (Specify): _____

---

13. Removal and Disposal of Asbestos-Containing Material (ACM):
    A. How will ACM be removed from the abatement site? If a hauler or broker will be used to transport the ACM to a disposal site, they must also be identified.

    TBD

    B. Provide the name and location of the authorized asbestos waste facility where the ACM will be transferred for disposal (if known).

    TBD

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14. Project Monitor: **(not required)**
    Name: _____ RIDOH License No.: _____
    Affiliation: _____

---

15. In-Process & Clearance Air Sampling:
    A. Describe in an attachment the type, number and location of air samples that will be collected outside the work area during the abatement project.

    B. Describe in an attachment the plan of action to be followed if the Indoor Non-Occupational Air Exposure Standard for Asbestos (0.01 fibers per cubic centimeter) is exceeded outside the work area during the abatement project.

    C. Describe in an attachment the type, number and location of air samples that will be collected as part of the final clearance testing.

    D. Describe in an attachment the plan of action to be followed if the Indoor Non-Occupational Air Exposure Standard for Asbestos (0.01 fiber per cubic centimeter) is exceeded during final clearance testing.

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16. A separate and fully completed Form ASB-16A must be submitted for ***each area*** to be abated. List below the entry in Item 1 from each attached ASB-16A.

Area 1-Interior Hallways and Rooms Off Hallway

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17. Asbestos Abatement Plan Application Fee:

☐	State Agency, fee waived	$0
☐	Operation & Maintenance Program Only	$75
☐	Up to One (1) NESHAP Unit	$75
☐	Between One (1) & Ten (10) NESHAP Units	$300
☑	Between Ten (10) & Fifty (50) NESHAP Units	$600
☐	Over Fifty (50) NESHAP Units	$900
☐	Annual Plan	N/A

One (1) NESHAP Unit = 260 linear feet or 160 square feet or 35 cubic meters

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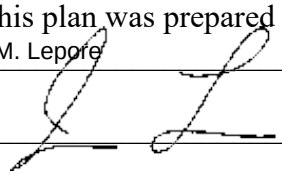
18. I certify that this plan was prepared by me, and I am responsible for its content.

Name: Joseph M. Lepore RIDOH License No.: APD00661

Signature:  Date: 02-10-2023

Affiliation: ECM Inc.

Email: jlepore@ecmne.com Phone: 401-304-6614

RHODE ISLAND DEPARTMENT OF HEALTH
Center for Healthy Homes and Environment – Asbestos Program

ASBESTOS ABATEMENT PLAN APPLICATION

Supplemental Information: Area Description and Proposed Plan

Facility/Building: Davey Lopes Recreation Center

INSTRUCTIONS:
A separate and fully completed Form ASB-16A must be submitted for ***each area*** to be abated. All items on this form must be addressed. All references to attachments must be clearly identified. All attachments must be marked with the specific item numbers on this form to which they pertain.

1. Area Location/Identification (Room Name/No., etc.):
   Area 1- Interior Hallways and Rooms Off Hallway

2. Attach a description of each type (e.g., pipe, ceiling, etc.) of asbestos-containing material (ACM) in this area, including condition, location, quantity, and asbestos content. Attach a copy of the laboratory report(s) for all samples. All laboratory reports must include the name of the building(s) and the location(s) of the sample(s).

3. Attach a current scale drawing of this area, showing direction of North and East, which has been clearly annotated to show the type, location, and quantity of all ACM in this area. This drawing must include a legend which acts as a guide to the scale, symbols and nomenclature used in the drawing. If a master plan or multiple drawings are provided, indicate the specific location(s) and drawing number(s) which depict this area. The location of the decontamination chamber must also be so indicated on the appropriate drawing(s).

4. Proposed Plan:
   A. Attach a description of the interim Operations and Maintenance Plan that will be implemented in accordance with 1.17.2(B).

   B. Will any portion of this area be abated by use of 1.14 work procedures?
   (●) Yes ( ) No

   If yes, indicate below which ACM in this area will be abated by use of the following 1.14 work procedures: **(Check all that apply)**

   ☑ 1.14.2 & 1.14.3 Removal 12 Inch VFT and Black Mastic

☐ 1.14.2 & 1.14.4 Encapsulation _____

☐ 1.14.2 & 1.14.5 Enclosure _____

☐ 1.14.6 Demolition _____

☐ 1.14.7 Glovebag _____

☐ 1.14.8 Asphalt Roofing _____

☐ Other (Specify) _____

C. Are you requesting any waivers to the above selected 1.14 procedure for any of the abatement activities in this area?

◯ Yes ◉ No

If yes, attach a detailed description of the waivers requested you are proposing to utilize. ***All items must be keyed to the specific section(s) of the regulations for which waivers are requested.***

D. Are you proposing alternative procedures under 1.16 for any of the abatement activities in this area?

◯ Yes ◉ No

If yes, attach a detailed description of the alternate procedures requested you are proposing to utilize. ***Alternate procedures must include a justification for not following specific section(s) of the regulations and be as protective of public health.***

E. Will any ACM remain in this area after abatement?

◯ Yes No ◉ Beyond scope of inspection

If yes, attach a description of the ACM that will remain and the details of the on-going Operations and Maintenance Plan that will be implemented in accordance with 1.17.2(B).

ATTACHMENT #1

In Process and Clearance Air Sampling

A. If requested by the building owner, ECM will be on site for part time monitoring and will collect one compliance air sample outside of each containment area daily for the duration of asbestos removal operations inside this building. The sample will be collected outside the decontamination unit.

B. Any deviation in proper procedures on the part of the contractor shall be reported to the building owner. This includes inadequate paperwork on site, disagreement and/or any deviation from previously outlined work procedures, or if compliance samples in the work area vicinity exceed 0.01 f/cc. The contractor's work shall then be stopped, without repercussion to the building owner or the project-monitoring firm until any conflicts and/or problems have been resolved.

C. After the interior areas have passed the consultant's visual inspection, he or his authorized representative will collect:

Area 1 – A minimum of 2 PCM Clearance Air Samples per 1000sf of contained area. One (1) additional PCM Clearance Air sample will be collected per 1000sf of the containment area.

D. If clearance monitoring after clean-up results in fiber concentrations in excess of the RI rules and regulation clearance air requirements, the project area shall be wet-cleaned, misted with water, and encapsulated with a liquid encapsulant. A period of no less than 24 hours shall elapse before the next set of clearance air samples can be collected. The sampling process shall be repeated until a satisfactory clearance air level is attained.

The asbestos contractor is held responsible for any costs associated with the re-cleaning and re-sampling of an area should clearance air samples exceed 0.01 f/cc.

ATTACHMENT #2

ASB-16A-2

Description of Asbestos Containing Material

Hallways: There is approximately **770 sf** of asbestos containing floor tile over asbestos containing black mastic located throughout the hallways of the facility. Hallway tile is worn and will be abated as asbestos containing due to positive underlying mastic.

Rooms off Hallway: The Computer Room, Office, Concession Area, Activity Room and Storage Room are all located off of the flanking hallways. These rooms contain floor tile with asbestos containing black mastic. If money and time allow these areas will be abated under this application as part of the total project. There is approximately **1030 sf** of this material present in the above mentioned areas.

ATTACHMENT #2 (Cont.)

Laboratory Analysis Reports:

1 Pre Abatement Air Samples
2 RI Analytical Asbestos Report

Environmental Consulting
& Management Inc.
181 Amaral Street
Riverside, RI 02915
401-438-1360

Certificate of Analysis

Asbestos PCM Air Analysis by NIOSH 7400

Client: City of Providence
Project Location: 227 Dudley Street, Providence, RI
Sample Type: Background Airs & Blanks

Project Number: 230090
Collected By: JML
Date: 2-8-2023
PCM Lot #:

Sample	Identification	Start	End	Flow (LPM)	Volume (L)	Fibers / Fields	Fiber Density (f/mm²)	Concentration (f/cc)
1	Blank	-	-	-	-	0 / 100	<7	< -
2	Blank	-	-	-	-	0 / 100	<7	< -
3	Interior Hallway	13:34	14:48	15	1110	1 / 100	<7	< 0.0024

Analyzed By: Joseph M. Lepore

Date Analyzed: 2-9-2023

Reviewed By: Daniel J. Simas

Standards

Clearance Criteria: <0.01 f/cc
OSHA Permissible Exposure Limit (8 hour TWA): 0.1 f/cc
OSHA 30 Minute Excursion Limit: 1.0 f/cc
Limit of Detection fibers/100 fields: 5.5
Limit of Detection fiber density: 7 f/mm
Relative Standard Deviation:0.45

WO#23000097

Lab Certifications: RI AAL-0131
MA AA000247

R.I. ANALYTICAL
41 Illinois Avenue - Warwick, RI 02888
P: (401) 737-8500 F: (401) 732-8034

December 13, 2022

Mr. Benjamin Lobaugh
Capital Improvement Project Manager
Department of Public Property
Providence City Hall
25 Dorrance Street
Providence, RI 02903

C: 401.680.5548 C:401.749.6320
E: **blobaugh@providenceri.gov**

RE: Report - Limited Inspection and Sampling of Materials Suspected of Containing Asbestos
Site: Davey Lopes Recreation Center, 227 Dudley St., Providence, RI 02907
RI Analytical Laboratories, Inc. Project #2022211 - PO #574788-0-PO

Dear Mr. Lobaugh:

RI Analytical Laboratories, Inc. (**RI Analytical**), Exposure Assessment and Management (EAM) Division would like to thank you for the opportunity to provide **City of Providence, Department of Public Property** (the "**Client**") with environmental consulting services.

BACKGROUND

RI Analytical conducted a limited asbestos inspection and sampling of building materials suspected of containing asbestos ("Suspect Materials") in the following areas at the above-referenced Site on December 6, 2022.

- 1st floor Southwest and Southeast (SW/SE) halls – floor and cove base materials.
- 1st floor Northwest and Northeast (NW/NE) halls – floor and cove base materials.
- 1st floor NE entry vestibule – carpet glue materials.

The inspection and sampling was completed by a **RIDOH**[1]-certified and **EPA**[2]-accredited Asbestos Inspector, Mr. Danny Mullen (RIDOH #AI00963).

The purpose of this limited asbestos inspection and sampling was to identify whether specific, Suspect Materials at the Site designated by Client to be impacted during renovation, contain asbestos.

The asbestos inspection and sampling was limited in scope to the materials designated by Client and was not intended to be a comprehensive asbestos inspection of all types and quantities of Suspect Materials within the building, which may be required for compliance with **EPA NESHAP**[3], **OSHA**[4] and **RIDOH** asbestos regulations, as applicable.

[1] **RIDOH** = State of Rhode Island Department of Health
[2] **EPA** = United State Environmental Protection Agency
[3] **NESHAP** = National Emission Standards for Hazardous Air Pollutants, 40 CFR 61, Subpart M
[4] **OSHA** = US Dept. of Labor, Occupational Health and Safety Administration, 29 CFR 1926.1101 (Asbestos in Construction Std.).

METHODOLOGY

Suspect Materials were classified into **Homogeneous Material (HM) groups**[5] to be sampled and analyzed for asbestos content by **PLM**[6]. In addition, **NOB**[7] materials were analyzed using PLM with gravimetric preparation. Samples were analyzed by RI Analytical, a RIDOH-certified Asbestos Analytical Laboratory (#PLM00142).

OBSERVATIONS AND RESULTS

The subject building is a 2-story, commercial building. The foundation is concrete. Exterior building materials include brick facade and metal framed windows. Interior building materials include wood, carpet, VFT (Vinyl Floor Tile) and CFT (Ceramic Floor Tile) floors, gypsum board walls with smooth plaster skim coats and gypsum board ceilings with smooth plaster skim coats.

The EPA, OSHA, and the RIDOH, define a material that contains greater than one percent (>1%) asbestos utilizing PLM, as an **ACM**[8]. Material found to contain ≤1% asbestos by PLM laboratory analysis are defined as **ACWM**[9] and must be handled appropriately. Materials that are identified as "Not Detected" are specified as not containing asbestos.

The laboratory analytical results for samples collected and analyzed are summarized in **Table 1** below. Materials determined to be ACM are highlighted in **yellow** and to be ACWM are highlighted in **green**. The laboratory analytical report and chain-of-custody form are attached.

Table 1 - Work Order #2212-20535
Suspect ACM - Laboratory Analytical Data Summary

Line#	HM/ Sample#	Material	Sample Location	Asbestos Content
1	1A	12"x12" Vinyl Floor Tile (VFT) (Dark brown with light brown flecks)	Northeast hall floor	Not Detected
2	1B	12"x12" VFT (Dark brown with light brown flecks)	Northwest hall floor	Not Detected
3	**2A**	**Black mastic under #1A on concrete**	**Northeast hall floor**	**5-15% Chrysotile**
4	**2B**	**Black mastic under #1B on concrete**	**Northwest hall floor**	**5-15% Chrysotile**
5	**2C**	**Black mastic under #3A on concrete**	**Southeast hall floor**	**5-15% Chrysotile**
6	3A	12"x12" VFT (Green with gray flecks)	Southeast hall floor	Not Detected
7	3B	12"x12" VFT (Green with gray flecks)	Southwest hall floor	Not Detected
8	4A	6" Vinyl Cove Base (VCB) (black)	Northwest hall wall	Not Detected
9	4B	6" VCB (black)	Southwest hall wall	Not Detected
10	5A	Yellow glue under #4A on wood baseboard molding	Northwest hall wall	Not Detected
11	5B	Yellow glue under #4B on wood baseboard molding	Southwest hall wall	Not Detected
12	6A	Yellow carpet glue on concrete	Northeast entry vestibule floor	Not Detected
13	6B	Yellow carpet glue on concrete	Northeast entry vestibule floor	Not Detected

Note: The ACM black mastic is adhered onto the underside of the 12"x12" VFT.

[5] **Homogeneous Material groups** = Groups of materials similar in color, texture, and typically application
[6] **PLM** = Polarized Light Microscopy, EPA/600/R-93/116 (1993) "Method for the Determination of Asbestos in Bulk Building Materials"
[7] **NOB** = Non-Friable, Organically-Bound
[8] **ACM** = Asbestos-Containing Material
[9] **ACWM** = Asbestos-Containing Waste Materials

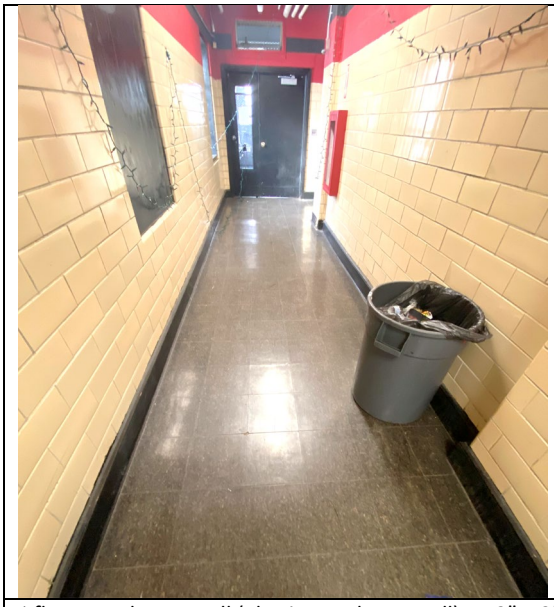
Utilizing the EPA, OSHA, and RIDOH protocol and criteria, laboratory analyses identified homogeneous materials noted in **Table 2** as ACM. No ACWM was identified.

Table 2 - ACM Inventory Summary

HM #	ACM Type (showing layers)	ACM Location(s)	Sample # / Asbestos Content	Condition	Estimated Quantity
2	12”x12” VFT – two different colors - dark brown with light brown flecks in NW/NE Hall & green with gray flecks in SW/SE Hall **Black mastic under both colors of 12”x12” VFT** **Concrete**	**1st floor Northwest & Northeast Hallway and Southwest & Southeast Hall floor**	**2A, 2B, 2C** **5-15% Chrysotile**	**(D)(NF)**	**1,000 SF The ACM black mastic is adhered to the underside of the 12”x12” VFT, therefore, the VFT is contaminated with ACM black mastic and must be removed and disposed as ACM.**

HM = Homogenous Material; F = **Friable**[10]; NF = Non-Friable; I = Intact; D = Damaged (i.e. <10% of the material is damaged); SD = Significantly Damaged (i.e. >10% of the material is damaged); EA = Each; LF = Linear Feet; SF = Square Feet

Representative Site photographs.



1st floor Northwest Hall (also in Northeast Hall) – 12”x12” VFT (Dark brown with light brown flecks) with adhered ACM black mastic beneath on concrete

1st floor Southwest Hall (also in Southeast Hall) – 12”x12” VFT (green with gray flecks) with adhered ACM black mastic beneath on concrete

[10] **Friable** = Material that, when dry, can be crumbled, shattered, pulverized or reduced to powder by hand pressure

CONCLUSIONS AND RECOMMENDATIONS

Based on visual observations, sample collection from materials designated by Client, and laboratory analysis, ACM were identified at the Site as identified in **Table 2** above.

- ACM = 12”x12” VFT (two different colors - dark brown with light brown flecks in NW/NE Hall & green with gray flecks in SW/SE Hall) with adhered ACM black mastic beneath on concrete.

- No asbestos was detected in the glue under carpet on concrete in the Northeast entry vestibule.

The Site is a regulated facility under EPA NESHAP and RIDOH Rules and Regulations for Asbestos Control. Therefore, prior to any work that may disturb the VFT and black mastic, and prior to commencement of asbestos abatement activities, an Asbestos Abatement Plan must be prepared by a licensed Asbestos Project Designer, such as RI Analytical, signed by the Owner’s representative and submitted to RIDOH for review. The OSHA asbestos in construction standard (29CFR1926.1101) also applies to this project.

All asbestos abatement work (repair, removal, enclosure or encapsulation) work must be performed by an EPA-accredited and RIDOH-licensed Asbestos Abatement Contractor in accordance with all federal, state, and local rules and regulations, including those of OSHA, as required. Storage, transportation, and disposal of ACM must also comply with EPA, OSHA, and RIDOH regulations.

In addition, project monitoring with in-process air sampling during abatement work, and post-abatement visual inspection and clearance air sampling must be performed by a licensed asbestos consultant *who is independent of the asbestos abatement contractor*, such as RI Analytical.

If Suspect Materials should be encountered during renovation activities that are not identified in this report as not containing asbestos, they should be assumed to be ACM until sample collection and laboratory analyses indicate otherwise.

LIMITATIONS

RI Analytical does not consider this to be a complete and comprehensive asbestos inspection, but rather a directed inspection and sampling of selected building materials designated by Client. No attempt was made to inspect and sample all building materials suspected of containing asbestos. Other materials in the building may contain asbestos and must be sampled for laboratory analysis prior to being impacted in any way. This was clearly indicated to Client.

All observations documented in this report were made under the conditions existing at the time of this investigation. Should changes from existing conditions occur in the future, warranting chemical analysis, they should be brought to the attention of RI Analytical.

This report was prepared at the request of Client. We further confirm that Client, its affiliates and subsidiaries, and their successors, assigns and grantees may rely on the report within the limitations and recommendations contained therein, as if it were prepared for the benefit of and addressed to them.

This report should not be represented, reproduced, or disseminated without the written approval of RI Analytical or Client. No warranties other than those expressed in the contract for this project are expressed or implied.

Please do not hesitate to contact our EAM Division at 401-737-8500 if you have any questions concerning this report or if we may be of further assistance.

Sincerely,

RI Analytical Laboratories, Inc.
Exposure Assessment and Management Division

Danny Mullen
Environmental Science Consultant
Project Manager, EAM Division
RIDOH #AI00963

Kenneth Davis
Senior Environmental Scientist
Manager, EAM Division
RIDOH #AI00510

Doc: rpt-asb-dept.ofpublicproperty-daveylopesrec.center-227dudleyst,prov,ri02907_drm_kd

Attachments: Laboratory Analytical Report and Chain-of-Custody Form

Laboratory Analytical Report and Chain-of-Custody Form

LABORATORY REPORT

R.I. Analytical Laboratories
Attn:
E.A.M. Division
15 Lark Industrial Parkway
Smithfield, RI 02828

Date Received: 12/6/2022
Date Reported: 12/7/2022
Work Order #: 2212-20535

Site Location:PROJECT # 2022211 DEPT. OF PUBLIC PROPERTY 227 DUDLEY ST

Enclosed please find your sample(s) analysis results for asbestos content. The six asbestos types include amosite, chrysotile, crocidolite, anthophyllite, tremolite, and actinolite.

Analysis by Polarized Light Microscopy (PLM) was performed in accordance with EPA 40 CFR Appendix E to Subpart E of Part 763 and/or EPA 600/R-93/116.

R.I. Analytical Laboratories, Inc. maintains bulk asbestos fiber NVLAP accreditation under Lab Code 101440-0. This report does not serve as a product certification, approval, and/or endorsement by NVLAP, NIST, or any federal agency.

The sample(s) submitted for analysis were accepted by R.I. Analytical unless otherwise noted in the report. If a sample is found to be inhomogeneous, individual components will be analyzed separately. If individual components cannot be separated, the sample will be homogenized and a single result will be provided. These results only pertain to the samples submitted for this Work Order # and this report shall not be reproduced except in its entirety.

In accordance with EPA guidelines, vermiculite materials should be assumed to contain asbestos even if PLM analysis reports asbestos not detected. All NOB (Non-Friable Organically Bound) materials such as vinyl floor tile, vinyl sheet flooring, glues, and mastics, that test as <1% asbestos, trace asbestos and no asbestos detected, should be further analyzed by TEM (Transmission Electron Microscopy).

Samples submitted for analysis will be retained for three months for future reference.

We certify that the following results are true and accurate to the best of our knowledge. If you have questionsor need further assistance, please contact our Customer Service Department.

Approved by:

Asbestos Signatory

R.I. Analytical Laboratories, Inc.

LABORATORY REPORT

R.I. Analytical Laboratories
Date Received: 12/6/2022
Work Order #: 2212-20535
Site Location:PROJECT # 2022211 DEPT. OF PUBLIC PROPERTY 227 DUDLEY ST

METHOD: EPA 600/R-93/116

SAMPLE NO.	SAMPLE DESCRIPTION	PARAMETER	SAMPLE RESULTS / UNITS		DATE ANALYZED	ANALYST
001	1A 12"x12" VINYL FLOOR TILE (DARK BROWN WITH LIGHT BROWN	PLM Fiber Analysis				
		Asbestos	Not Detected		12/7/2022	KMG
		Non-fibrous	100	%	12/7/2022	KMG
		Sample Color	Brown		12/7/2022	KMG
002	1B 12"x12" VINYL FLOOR TILE (DARK BROWN WITH LIGHT BROWN	PLM Fiber Analysis				
		Asbestos	Not Detected		12/7/2022	KMG
		Non-fibrous	100	%	12/7/2022	KMG
		Sample Color	Brown		12/7/2022	KMG
003	2A BLACK MASTIC ON CONCRETE	PLM Fiber Analysis				
		Asbestos	Detected		12/7/2022	KMG
		Chrysotile	5-15	%	12/7/2022	KMG
		Non-fibrous	85-95	%	12/7/2022	KMG
		Sample Color	Black		12/7/2022	KMG
004	2B BLACK MASTIC TO 1B ON CONCRETE	PLM Fiber Analysis				
		Asbestos	Detected		12/7/2022	KMG
		Chrysotile	5-15	%	12/7/2022	KMG
		Non-fibrous	85-95	%	12/7/2022	KMG
		Sample Color	Black		12/7/2022	KMG
005	2C BLACK MASTIC TO 3A ON CONCRETE	PLM Fiber Analysis				
		Asbestos	Detected		12/7/2022	KMG
		Chrysotile	5-15	%	12/7/2022	KMG
		Non-fibrous	85-95	%	12/7/2022	KMG
		Sample Color	Black		12/7/2022	KMG
006	3A 12"x12" VINYL FLOOR TILE (GREEN WITH GRAY FLECKS) WITH	PLM Fiber Analysis				
		Asbestos	Not Detected		12/7/2022	KMG
		Non-fibrous	100	%	12/7/2022	KMG
		Sample Color	Green		12/7/2022	KMG

R.I. Analytical Laboratories, Inc.

LABORATORY REPORT

R.I. Analytical Laboratories
Date Received: 12/6/2022
Work Order #: 2212-20535
Site Location:PROJECT # 2022211 DEPT. OF PUBLIC PROPERTY 227 DUDLEY ST

METHOD: EPA 600/R-93/116

SAMPLE NO.	SAMPLE DESCRIPTION	PARAMETER	SAMPLE RESULTS / UNITS		DATE ANALYZED	ANALYST
007	3B 12"x12" VINYL FLOOR TILE (GREEN WITH GRAY FLECKS) WITH	PLM Fiber Analysis				
		Asbestos	Not Detected		12/7/2022	KMG
		Non-fibrous	100	%	12/7/2022	KMG
		Sample Color	Green		12/7/2022	KMG
008	4A 6" BLACK COVE BASE WITH YELLOW GLUE ON WOOD BASEBOARD	PLM Fiber Analysis				
		Asbestos	Not Detected		12/7/2022	KMG
		Non-fibrous	100	%	12/7/2022	KMG
		Sample Color	Black		12/7/2022	KMG
009	4B 6" BLACK COVE BASE WITH YELLOW GLUE ON WOOD BASEBOARD	PLM Fiber Analysis				
		Asbestos	Not Detected		12/7/2022	KMG
		Non-fibrous	100	%	12/7/2022	KMG
		Sample Color	Black		12/7/2022	KMG
010	5A YELLOW GLUE TO 6A	PLM Fiber Analysis				
		Asbestos	Not Detected		12/7/2022	KMG
		Non-fibrous	100	%	12/7/2022	KMG
		Sample Color	Yellow		12/7/2022	KMG
011	5B YELLOW GLUE TO 6B	PLM Fiber Analysis				
		Asbestos	Not Detected		12/7/2022	KMG
		Non-fibrous	100	%	12/7/2022	KMG
		Sample Color	Yellow		12/7/2022	KMG
012	6A YELLOW CARPET GLUE ON CONCRETE	PLM Fiber Analysis				
		Asbestos	Not Detected		12/7/2022	KMG
		Non-fibrous	100	%	12/7/2022	KMG
		Sample Color	Yellow		12/7/2022	KMG

R.I. Analytical Laboratories, Inc.

LABORATORY REPORT

R.I. Analytical Laboratories
Date Received: 12/6/2022
Work Order #: 2212-20535
Site Location:PROJECT # 2022211 DEPT. OF PUBLIC PROPERTY 227 DUDLEY ST

METHOD: EPA 600/R-93/116

SAMPLE NO.	SAMPLE DESCRIPTION	PARAMETER	SAMPLE RESULTS / UNITS		DATE ANALYZED	ANALYST
013	6B YELLOW CARPET GLUE ON CONCRETE	PLM Fiber Analysis				
		Asbestos	Not Detected		12/7/2022	KMG
		Non-fibrous	100	%	12/7/2022	KMG
		Sample Color	Yellow		12/7/2022	KMG

PROJECT # 2022211
CLIENT PO# 574788-0-PO
DEPARTMENT OF PUBLIC PROPERTY
227 DUDLEY ST
PROVIDENCE, RI 02907
DAVEY LOPES RECREATION CENTER

R.I. ANALYTICAL
41 Illinois Avenue - Warwick, RI 02888
P: (401) 737-8500 F: (401) 732-8034

SAMPLE DATA SHEET & CHAIN OF CUSTODY

Project: Department of Public Property.		**Client PO #:**	574788-0-PO
Address: 227 Dudley St., Providence, RI 02907		**RI Analytical EAM Project #:**	2022211
Area: Davey Lopes Recreation Center		**RI Analytical Work Order #:**	12-20535
Sampled By: Danny Mullen	**License #** AI00963	**Inspection date:** 12/6/22	Page 1 of 1

Line	Sample #	Description	Location	Notes
1	1A	12"x12" vinyl floor tile (Dark brown with light brown flecks) on concrete	Northeast hall floor	
2	1B	12"x12" vinyl floor tile (Dark brown with light brown flecks) with black mastic on concrete	Northwest hall floor	
3	2A	Black mastic on concrete	Northeast hall floor	
4	2B	Black mastic to 1B on concrete	Northwest hall floor	
5	2C	Black mastic to 3A on concrete	Southeast hall floor	
6	3A	12x12 vinyl floor tile (Green with gray flecks) with black mastic on concrete	Southeast hall floor	
7	3B	12x12 vinyl floor tile (Green with gray flecks) on concrete	Southwest hall floor	
8	4A	6" black cove base with yellow glue on wood baseboard molding	Northwest hall wall	
9	4B	6" black cove base with yellow glue on wood baseboard molding	Southwest hall wall	
10	5A	Yellow glue to ~~6A~~ #4A - *DRM*	Northwest hall wall	
11	5B	Yellow glue to ~~6B~~ #4B - *DRM*	Southwest hall wall	
12	6A	Yellow carpet glue on concrete	Northeast vestibule floor	Possible black mastic under yellow glue.
13	6B	Yellow carpet glue on concrete	Northeast vestibule floor	
14				
15				
16				
17				
18				
19				
20				

COMMENTS: Email report to: Name: Danny Mullen ; Email to: dmullen & jjencks & kdavis @rianalytical.com
A. (1) Analysis = ☒ PLM, Asbestos (EPA 600/R-93/116); ☒ PLM NOB as needed; ☐ 400 point count if friable and <10% ASB; ☐ TEM NOB
(2) TAT = 5 Day; (3) No. samples submitted = 13 ; (4) ☐ Y or ☒ N - Positive stop by Homogeneous # shown.
Notes:

RELINQUISHED BY: (SIGNATURE) Danny R. Mullen	**DATE/TIME** 12/6/22 16:10	**RECEIVED BY:** (SIGNATURE)	**DATE/TIME** 12/7/22
RELINQUISHED BY: (SIGNATURE)	**DATE/TIME**	**RECEIVED BY:** (SIGNATURE)	**DATE/TIME**

ATTACHMENT #3

Interim Operations & Maintenance Plan

The contractors, maintenance personnel and staff associated with Davey Lopes Recreation Center are aware of ACM in the above stated areas. They have been instructed not to disturb the material due to the potential health hazards if fibers become airborne.

1. Notification

All building occupants, also any contractors entering the building and/or premises to perform work, shall be notified of the presence and location of asbestos-containing material(s) and cautioned regarding disturbance of the material(s). Also, the building occupants must be notified regarding the occurrence of asbestos abatement activities. If an emergency fiber release occurs, the following procedures shall be initiated.

2. Fiber Release Episodes

A. Minor Release Episode

If a minor fiber release episode occurs (release of less than 10 linear feet or 25 square feet of material), trained maintenance staff may perform the cleaning. Access to the area shall be restricted during clean-up. All debris shall be thoroughly wetted using amended water and placed in labeled, double six-mil polyethylene bags. The area shall then be cleaned using HEPA filtered vacuums and/or wet cleaning methods. Damaged material must be cleaned and repaired with non-asbestos-containing material. The area shall then be evaluated to decide if further action is necessary.

B. Major Release Episode

If a major fiber release episode occurs (falling or dislodging of more than 10 linear feet or 25 square feet of ACBM), the cleaning must be carried out and directed by persons accredited to conduct and design response actions. After such an episode, the area shall be immediately restricted and entry to the area prevented. Warning signs shall be posted to caution people other than those qualified to deal with the problem. Air handling units in the area shall be shut down to prevent the spread of fibers beyond the problem area. A response action shall be designed and carried out by qualified personnel.

3. Training

Any employee who, because of their work, may disturb asbestos- containing material shall be trained and certified as a Competent Person as described by the R.I. Rules and Regulations for Asbestos Control. The program coordinator shall ensure that the procedures described above to protect the building occupants shall be followed for any operations and maintenance activities disturbing or involving ACBM.

ATTACHMENT #4

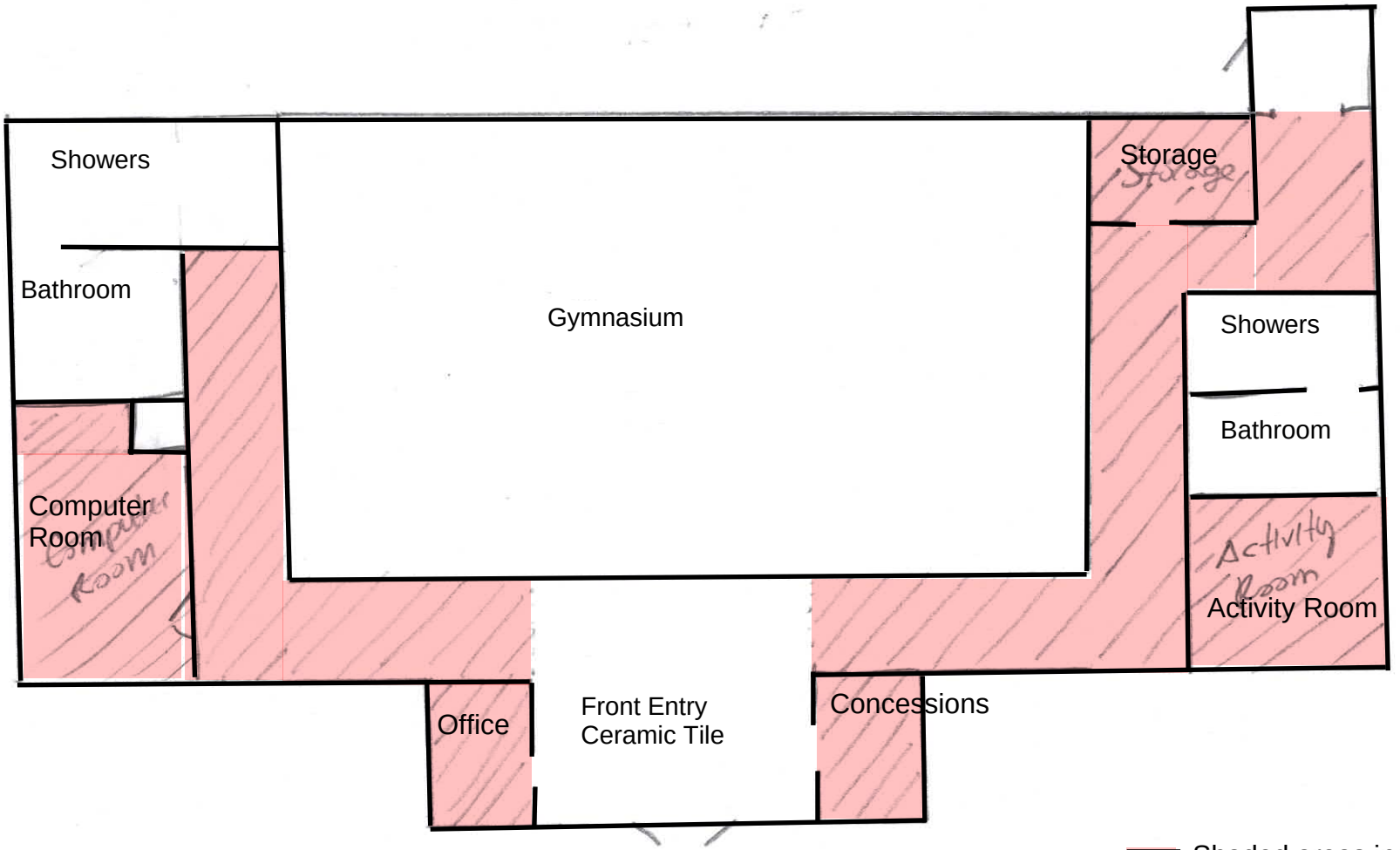
Scope of Work / Description of Waivers

It is the contractor's responsibility to verify material locations and quantities.

All proper OSHA, federal, state, and local safety regulations shall be followed.

Area 1: Asbestos mastic under 12 inch floor tile located in the hallways and various rooms will be abated utilizing 1.14.2 and 1.14.3 removal procedures.

Davey Lopes Recreation Center
Asbestos Abatement Diagram



HAZARDOUS MATERIALS SUMMARY REPORT

Davey Lopes Recreation Center
227 Dudley Street
Providence, RI

Prepared for:

Bargmann Hendrie + Archetype, Inc.
9 Channel Center Street, Suite 300
Boston, MA 02210

CDW Project #2171.10

4 California Ave, Framingham MA 01701
508-875-2657
www.cdwconsultants.com

TABLE OF CONTENTS

Appendices

1.0 INTRODUCTION

CDW Consultants, Inc. (CDW) is pleased to present this report summarizing the findings of the hazardous building materials (HBM) inspection of subject property at 227 Dudley Street in Providence, Rhode Island (Site). The scope of work was to conduct an inspection to identify and quantify suspect asbestos containing material (ACM), lead based paint (LBP), and visually identify hazardous materials located in the building. The inspection was conducted in support of construction documents for site renovation. In September of 2024, Ms. Susan Cahalan, Rhode Island Asbestos Inspector #AAC-1023, conducted the asbestos survey sampling following procedures generally accepted and recommended by the United States Environmental Protection Agency (USEPA), the United States Occupational Safety Health Administration (OSHA) and the Rhode Island Department of Health (RIDOH).

An inspection is required by the USEPA National Emission Standards for Hazardous Air Pollutants (NESHAP), prior to scheduled building/structure renovations. Additionally, the RIDOH and Rhode Island Department of Environmental Management (RIDEM) regulate ACM associated with renovation, demolition, and asbestos abatement projects. Samples of suspect materials were collected to confirm the presence or absence of ACM and LBP. Suspect materials were grouped into homogenous areas. A homogenous area is an area that is similar in color, texture, and date of application. Hand tools were used to collect bulk samples which were promptly placed in sealed plastic bags using a unique numbering system. Samples were not collected of non-suspect materials, including wood, fiberglass, plastic, ceramic, concrete, neoprene/rubber, glass, and carpeting.

2.0 PROJECT UNDERSTANDING

The hazardous materials survey was conducted via field investigation and research to identify the existence of hazardous materials in support of renovations to renovate the one-story recreation center. The renovation includes roof replacement and repairs; select window replacement; reconfiguration and finishes replacement of the locker rooms; new engineered systems such as fire suppression; and pool plumbing systems.

3.0 GENERAL SITE CONDITIONS

The Davey Lopes Recreation Center is a one-story, 15,100 square foot building. The recreation center building contains a main lobby, a basketball court gymnasium, locker rooms, computer rooms, offices, storage rooms, a former indoor pool (now containing a boxing gym), a boiler room, and a pool pump room. The exterior of the property contains green space, a playground, and an empty pool. The exterior of the building is constructed with brick. Throughout the interior, the floors consist of concrete, epoxy flooring, ceramic tiles, and wood flooring. The walls are mainly constructed with CMU block and ceramic tiles. The ceilings throughout the building consist of white painted concrete panels. Located directly beneath the ceiling, piping and HVAC duct work runs throughout the building. The basketball gymnasium has an approximately 50-foot-high ceiling that contains steel trusses. The walls are CMU black and ceramic wall tiles, covered with padding. Within the wall openings in the corners of the gym, fire brick is located. The boxing gym contains wood panels for the ceiling. The walls are concrete and CMU block. The floor and old pool are constructed with concrete. The walls and flooring are painted yellow and black.

4.0 ASBESTOS SURVEY

4.1 Methods

The investigative work for the asbestos survey included conducting a visual inspection of physically accessible areas of the structure. This survey included minor destructive sampling, such as coring and repairing roofs, removing, and replacing brick facades to inspect for vapor barrier, looking under carpets and hardwood floors and behind handrails etc. Once the inspection was completed, the building components were categorized into homogeneous areas. These homogeneous areas included: surfacing materials, thermal system insulation, and miscellaneous materials. CDW collected bulk samples of different homogeneous suspect materials for asbestos analysis. The bulk samples were delivered under chain of custody to Asbestos Identification Laboratory, Inc. (AIL), of Woburn, Massachusetts, fully accredited asbestos analytical laboratory. The bulk samples were analyzed utilizing Polarized Light Microscopy (PLM) in accordance with the requirements of 40 CFR Part 763, Subpart F. Samples analyzed to contain greater than 1% asbestos are to be treated as ACM as defined by the USEPA. A positive stop method was used – if one sample in a homogeneous group is positive then additional samples of the same material are not analyzed. The asbestos analytical reports are provided in Appendix A.

4.2 Findings

Findings of the ACM sampling are presented in the below table:

Sample ID	Material	Location	Asbestos%
1A,B,C,D,E	White Wall Covering over Concrete	Pump Room	ND
2A,B,C	TSI	Pump Room	ND
3A,B,C	TSI Mud End	Pump Room	ND
4A,B,C	Gray Door Caulk (Entrance)	Exterior of Pump Room	ND
5A,B,C	Gray Expansion Caulk Behind Entrance Door	Exterior of Pump Room	ND
6A,B,C	Sheetrock	Boxing Gym Office	ND

Sample ID	Material	Location	Asbestos%
7A,B,C	Sheetrock Covering	Boxing Gym Office	ND
8A,B,C	Gray (Thick) Expansion Joint	Boxing Gym Office Floor	ND
9A,B,C	Black Coating under Expansion Joint	Boxing Gym Office Floor	ND
10A,B,C	Gray Expansion Joint Around Exterior of Pool	Boxing Gym	ND
11A,B,C	Black Coating under Expansion Joint	Boxing Gym	ND
12A,B,C	Gray Expansion Joint Around Interior of Pool	Boxing Gym	ND
13A,B,C	Black Coating under Expansion Joint	Boxing Gym	ND
14A,B,C	Gray Expansion Joint at Base of Wall	Boxing Gym	ND
15A,B,C	Black Coating under Expansion Joint	Boxing Gym	ND
16A,B,C	Black Paint	Boxing Gym Walls	ND
17A,B,C	Yellow Paint	Boxing Gym Walls	ND
18A,B,C	Yellow Paint	Boxing Gym Pool Floor	ND
19A,B,C	Black Paint	Boxing Gym Pool Floor	ND
20A,B,C	White Paint	Boxing Gym Pool Floor	ND
21A,B,C	TSI	Boiler Room	ND
22A,B,C	TSI Mud Ends	Boiler Room	ND
23A	Duct Pin	Boiler Room	ND
24A,B,C	Fire Brick	Gym (Behind Wall in Openings)	ND

Sample ID	Material	Location	Asbestos%
25A,B,C	Black Cove Molding	Gym	ND
26A,B,C	Tan Mastic Behind Cove	Gym	ND
27A,B,C	Brown Penetration Caulk	Hallways	ND
28A,B,C	Red Penetration Caulk	Hallways	ND
29A,B,C	Maroon Expansion Joint Caulk	Exterior – Pool Side	ND
30A,B,C	Dark Gray/Black Caulk	Exterior Door to Men's Locker Room	ND
31A,B,C	Dark Gray/Black Caulk	Exterior, Base of Building near First Aid	Chrysotile 3%
32A,B,C	Black Caulk	Exterior Door @ First Aid	ND
33A,B,C,D,E	Gray Caulk	Exterior Base of Building + Concrete Pool Side	ND
34A,B,C	Thick Black Caulk	Exterior Base of Building + Concrete Pool Side	ND
35A,B,C	Dark Gray/Black Caulk	Large windows @ Front	ND
36A,B,C	Thin Layer Caulk Dark Gray/Brown	Under Aluminum Exterior Windows Frames	Chrysotile 5%
37A,B,C	Dark Gray Black Exterior Window Caulk	Frosted Glass Windows	Chrysotile 5%
38A,B,C	Black Glaze	Exterior Windows w/ Frosted Glass	Chrysotile 10%
39A,B,C	Dark Gray/ Black Caulk	Door Main Entrance	ND

Sample ID	Material	Location	Asbestos%
40A,B,C	Black Caulk	Inner Bead Front Door Exterior Frame to Door	ND
41A,B,C	Brown-Blue Paint	Behind Wood Cove Base Trim Lobby Area	ND
42A,B,C	Old Mortar w/ Black Coating	Behind Wall in Lobby	ND
43A,B	Yellow Brown Paint	On Steel Pipes Janitor Rooms	ND
44A,B,C	Black Painted Gray Caulk	Top of CMU – Computer Room	ND
45A,B	Dark Gray/Black Glaze	Interior Window on Door to Computer Room	Chrysotile 10%
Roof-1A	Brown Glue Under Rubber Roof	Roof Core	ND
Roof-1B	Black Tar Paper	Top + Bottom Roof Foam over Wood Deck	ND
Roof-2A	Brown Glue	Under Rubber Roof	ND
Roof-2B	Black Paper	Top + Bottom Roof Foam – 2 Layers	ND
Roof-3A	Brown Glue	Under Rubber Roof	ND
Roof-3B	Black Paper	Top + Bottom Roof Foam	ND
46A,B,C	Black Tar	Dripping from Roof on Interior Hallway	ND
47A,B	Tan Caulk	Around Men's Urinals	ND

Sample ID	Material	Location	Asbestos%
48A,B,C	Dark Gray Grout	In Between Red Quarry Tile – Main Entrance	ND
49A,B,C	Gray-Tan Mastic	On Red Quarry Tile - Main Entrance	ND
50A,B,C,D,E	Gray, Tan Levelastic	Under Acrylic Floors – Primary Halls	ND
51A,B	Dark Gray HVAC Flex Connector	Boiler Room	ND
52A,B,C	Tan Skim/Levelastic	Under Wood Gym Floor	ND
53A,B,C	Gray Mastic	Under Ceramic Floor Tiles – Women's Room	ND
54A,B,C	Gray Grout	Women's Room Between Ceramic Floor Tile	ND
55A,B,C	Gray Mastic	Under Ceramic Floor Tiles – Men's Room	ND
56A,B	Gray Floor Tile Grout	Between Ceramic Floor Tile – Men's Locker Room	ND
57A,B,C	Gray Setting Bed	Under Glazed Wall Tiles – Men's Locker Room	ND
58A,B,C	Yellow over Black Paint	Old Pool Boxing Ring	ND
59A,B,C	White Paint	On Steel Beams Throughout Interior	ND
60A,B	White Layer	On steel Duct Pins – Boiler Room	ND

ND = Not Detected
Chrysotile = Asbestos Mineral

ACM and presumed ACM quantities and costs are provided in the table below.

Material	Location	Quantity	Units	Unit Price	Total
Dark Gray/Black Caulk	Exterior, Base of Building near First Aid	30	LF	$20	$600
Thin Layer Caulk Dark Gray/Brown	Under Aluminum Exterior Windows Frames	16	EA	$150	$2,400
Dark Gray Black Exterior Window Caulk	Frosted Glass Windows	16	EA	$200	$3,200
Black Glaze	Exterior Windows w/ Frosted Glass	16	EA	$200	$3,200
Dark Gray Black Exterior Window Caulk and Glaze	Three Large Windows in Front	3	EA	$1000	$3,000
Dark Gray/Black Glaze	Interior Window on Door to Computer Room	1 (Door)	EA	$150	$150
Remnant Roof Materials	Patches etc.	500	SF	$25	$12,500
Gaskets	On Pipe Connections and Valves	50	EA	$150	$7,500
ACM Pipe Insulation and Fittings	Behind Fixed Walls/Chases	1,000	LF	$25	$25,000
				TOTAL	**$57,550**

LF = Linear Feet
EA = Each

4.3 Recommendations

Prior to disturbance, any work must be conducted in accordance with a project design as prepared by a licensed Asbestos Abatement Project Designer. This report is not intended for use as an abatement design. The ACM identified must be abated by a Rhode Island licensed asbestos abatement contractor following all federal, state & local regulations governing asbestos abatement. A copy of the asbestos Waste Shipment record must be received within 30 days of removal from the Site. Asbestos air quality

sampling must be conducted under USEPA regulations following asbestos abatement and prior to re-occupancy of the spaces.

During the course of renovation or demolition work, it is possible that additional suspect ACM will be encountered. Contractors should be apprised to conduct any such work in a controlled manner. If suspect materials that have not been sampled are encountered, they should be assumed to contain asbestos, unless appropriate sampling and analysis indicates otherwise. If any identified ACM will remain in place, then the ACM should be managed under an Operations and Maintenance Plan (O&M Plan) so that they are not inadvertently disturbed. The O&M Plan would include establishing a Program Manager, recordkeeping, employee and contractor notifications, periodic surveillance, and training requirements.

5.0 LEAD-BASED PAINT

5.1 Methods

CDW performed a visual inspection of painted surfaces. CDW collected samples from different color paints on various types of building component substrates. Samples were submitted to Aerobiology Laboratory Associates, Inc. in Woburn Massachusetts and EMSL Analytical, Inc. in Carle Park, New York. for analysis via atomic absorption spectrometry (AAS). The lead paint analytical reports are provided in Appendix B.

5.2 Findings

The results of the laboratory analysis are provided in the below tables:

Samples analyzed by Aerobiology Laboratory Associates, Inc.

Sample ID	Sample Description/Location	Lead Concentration (% Weight)
LBP – 1	White Wall Cover – Pump Room	<RL
LBP – 2	Gray Paint on Railings – Pump Room	0.385
LBP – 3	Black Paint on Railings – Pump Room (Exterior)	<RL
LBP – 4	Black Paint – Boxing Gym Walls	<RL
LBP – 5	Yellow Paint – Boxing Gym Walls	<RL
LBP – 6	Yellow Paint – Boxing Gym Pool Floor	<RL
LBP – 7	Black Paint – Boxing Gym Pool Floor	0.041
LBP – 8	White Paint – Boxing Gym Pool Floor	<RL

*<RL = Less than the laboratory reporting limit

Samples analyzed by EMSL Analytical, Inc.

Sample ID	Sample Description/Location	Lead Concentration (% Weight)
LBP – 10A	White Paint on Steel – Throughout Interior Hallways and Rooms	0.008
LBP – 10B	White Paint on Steel – Throughout Interior Hallways and Rooms	0.008
LBP – 10C	White Paint on Steel – Throughout Interior Hallways and Rooms	0.008
LBP – 11A	Black over Yellow – Boxing Ring	0.014
LBP – 11B	Black over Yellow – Boxing Ring	0.010
LBP – 11C	Black over Yellow – Boxing Ring	0.018
LBP – 12A	Brown-Blue Paint behind Wood Cove Base – Lobby Area	0.45
LBP – 12B	Brown-Blue Paint behind Wood Cove Base – Lobby Area	0.31
LBP – 12C	Brown-Blue Paint behind Wood Cove Base – Lobby Area	0.49

*<RL = Less than the laboratory reporting limit

The USEPA defines LBP as any paint or surface coating that contains lead equal to exceeding one milligram per square centimeter (1.0 mg/cm2) or 0.5% by weight. The OSHA lead-in-construction standard defines lead containing paint (LCP) as a paint or coating containing any detectable level of lead. 17 total paint samples were collected for lead analysis. 11 samples reported lead concentrations, which means those samples are considered LCP. None of the 11 LCP samples reported a concentration over 0.5% by weight, therefore, no samples collected can be considered LBP.

5.3 Recommendations

Based on the conclusions of this testing, the following recommendations are offered:

- Removal of the LBP is not required. However, in accordance with the EPA Lead Renovation, Repair, and Painting (RRP) Rule 40 CFR 745, workers, visitors and the public must be protected from lead dust generated during the demolition of LBP or LCP coated surfaces.

- Components identified to contain the presence of lead should not be disturbed in an uncontrolled manner. Disturbance of these materials should only be done by properly trained personnel in a controlled and documented manner to allow for the safety of the workers, bystanders and disposal of waste materials.

- During demolition or renovation, paint materials containing lead should not be sanded, scraped, drilled, or otherwise altered unless proper engineering controls are used to prevent migration of fugitive lead containing dust from the work area. Under OSHA regulations, any demolition or renovation to be performed at a structure where lead in paint and dust is present must be performed in accordance with a worker protection policy, including, but not limited to, appropriate training, medical monitoring, respiratory protection, and other protective equipment.

- Renovation or demolition activities that disturb surfaces that contain lead must be conducted in accordance with the OSHA regulation 29 CFR 1926.62 "Lead Exposure in Construction: Interim Final Rule." This regulation requires that a site-specific health and safety plan be prepared before conducting activities that create airborne lead emissions. Such a plan should include the identification of lead components, an exposure assessment, and, if applicable, the required work procedures and personnel protection to be used.

- In addition to the worker protection requirements stipulated by OSHA, RIDEM and the USEPA regulate the disposal of wastes that are potentially hazardous. Such wastes may include paint chips and residue generated during abatement or repainting work, or whole components, such as wood windows, doors, and trim that are coated with LBP and that are disposed of as the result of renovation or demolition work. To determine the required method for disposing of permeable items coated with LBP, the RIDEM and the USEPA require representative sampling of the debris to determine the quantity of lead that would be expected to leach into the environment if the debris were disposed of in a landfill. The representative sample(s) must be analyzed by the Toxicity Characteristic Leaching Process (TCLP) to determine the proper disposal method.

- Those components/colors not tested, or in locations not inventoried in this report, should be sampled for lead content prior to disturbance that may cause airborne release of lead.

6.0 HAZARDOUS MATERIALS SURVEY

6.1 Methods

OHM Visual Inspection

CDW visually inspected the Site building for universal, special and hazardous wastes associated with building materials. These included but were not limited to the following:

- Mercury-containing devices (fluorescent light tubes, thermostats, gauges, etc.);
- Polychlorinated bi-phenyl (PCB)-containing articles, equipment and devices (light ballasts, electrical switches, etc.);
- Chlorofluorocarbon (CFC)-containing equipment (refrigerants, air conditioners/HVAC

equipment, water bubblers, etc.)

- Tritium-containing devices (exit signs);
- Lead-Acid batteries (emergency lights, etc.)

6.2 Findings

The visual survey for hazardous materials identified mercury-containing compact fluorescent light bulbs and tubes, electronic ballasts, mercury containing thermostats and switches, lead and tritium batteries, and refrigerants. No hazardous materials sampling or analysis was conducted as part of this survey. A list OHMs identified are listed below.

OHM

The visual survey for hazardous materials identified mercury-containing light tubes, PCB-containing light ballasts, mercury containing thermostats and switches, lead and tritium batteries, refrigerants and other hazardous materials. No hazardous materials sampling or analysis was conducted as part of this survey. Quantities were collected during the survey and assessment performed by CDW in September 2024. A list of identified OHMs are included in the following table**.**

Material Description (Hazard)	Material Location	Estimated Quantity	Units
Fluorescent Light (4') Tubes	Throughout Hallways and Rooms	120	Each
Fluorescent Light Ballasts	Throughout Hallways and Rooms	60	Each
Hanging Lights	Basketball Gymnasium	30	Each
Light Ballasts	Basketball Gymnasium	15	Each
LED Light (2') Tubes	Boxing Gym and Pump Room	48	Each
LED Light Ballasts	Boxing Gym and Pump Room	24	Each
Emergency Lights	Throughout Hallways	12	Each
Exterior Lights	Exterior of Building	20	Each
Exit Signs	Throughout Hallways and Rooms	20	Each
Thermostats (Mercury)	Throughout Hallways and Rooms	30	Each
Fire Extinguishers	Throughout Hallways and Rooms	10	Each
Fire Alarms	Throughout Hallways and Rooms	30	Each
Heat/Smoke Detectors	Throughout Hallways and Rooms	40	Each

6.3 Additional Information

Items listed in the OHM table will be recycled or disposed of in accordance with state and federal regulations. Any additional hazardous materials which may be present at the time of work which were not present and inventoried by CDW at the time of the survey should also be subject to these regulations.

Limitations

The conclusions are limited to the information available at the time of the field survey and the scope of services, as defined. Where access to portions of the Site or to structures on the site was unavailable or limited, CDW renders no opinion as to the presence of hazardous material or the presence of indirect evidence related to hazardous material in that portion of the site or structure. This report cannot be solely relied upon for renovation or demolition. The sampling performed forms the basis for conclusions expressed and areas inaccessible for testing limits those conclusions. No other conclusions, interpretations or recommendations are contained or implied in this report other than those expressed. While CDW followed industry standards during the inspection, we do not warrant that all suspect hazardous building materials were identified in or on the buildings and shall not be held liable related to future abatement costs related to hazardous materials that are either not discovered or not appropriately characterized. This is due in part to inherent problems with every building inspection, such as, but not limited to:

- Seemingly homogeneous materials that are not in fact homogeneous;
- Seemingly representative locations that are not in fact representative;
- Layered materials that are not uniformly present or are isolated;
- Materials that are present and accessible but were not considered to be hazardous;
- Materials that are present in an isolated and limited quantity; and
- Material that is present in locations that are unsafe or otherwise difficult to access.

Client acknowledges that CDW's inspection is limited and all hazardous materials may only become apparent during future demolition. Additional hazardous materials or materials suspected of being hazardous should be assumed to be hazardous unless appropriate evaluation or sampling and analysis demonstrate otherwise. No other use of this report is warranted without the written consent of CDW Consultants, Inc.

CDW appreciates the opportunity to provide our services to you on this project.

Should you have any questions please do not hesitate to contact us at (508) 875-2657.

APPENDIX A

Asbestos Identification Laboratory.

165 New Boston St., Ste 227
Woburn, MA 01801
781-932-9600

Web: www.asbestosidentificationlab.com Email: mikemanning@asbestosidentificationlab.com

NVLAP® Testing Lab Code: 200919-0

Batch: 123674

Bryant Dana
CDW Consultants, Inc.
6 Huron Drive
Natick, MA 01760

Project Information
#2171.10
Davey Lopes

Method: BULK PLM ANALYSIS, EPA/600/R-93/116

Dear Bryant Dana,

Asbestos Identification Laboratory has completed the analysis of the samples from your office for the above referenced project. The Analysis Method is BULK PLM ANALYSIS, EPA/600/R-93/116The information and analysis contained in this report have been generated using the EPA /600/R-93/116 Method for the Determination of Asbestos in Bulk Building Materials. Materials or products that contain more than 1% of any kind or combination of asbestos are considered an asbestos containing building material as determined by the EPA. This Polarized Light Microscope (PLM) technique may be performed either by visual estimation or point counting. Point counting provides a determination of the area percentage of asbestos in a sample. If the asbestos is estimated to be less than 10% by visual estimation of friable material, the determination may be repeated using the point counting technique. The results of the point counting supersede visual PLM results. Results in this report only relate to the items tested. This report may not be used by the customer to claim product endorsement by NVLAP or any other U.S. Government Agency.
Laboratory results represent the analysis of samples as submitted by the customer. Information regarding sample location, description, area, volume, etc., was provided by the customer. Information provided by the customer can affect the validity of results. Asbestos Identification Laboratory is not responsible for sample collection activities or analytical method limitations. Unless notified in writing to return samples, Asbestos Identification Laboratory discards customer samples after 30 days. Samples containing subsamples or layers will be analyzed separately when applicable. Reports are kept at Asbestos Identification Laboratory for three years. All customer information will be maintained in confidentiality. This report shall not be reproduced, except in full, without the written consent of Asbestos Identification Laboratory.

- NVLAP Lab Code: 200919-0
- Massachusetts Certification License: AA000208
- State of Connecticut, Department of Public Health Approved Environmental Laboratory Registration Number: PH-0142
- State of Maine, Department of Environmental Protection Asbestos Analytical Laboratory License Number: LB-0078(Bulk) LA-0087(Air)
- State of Rhode Island and Providence Plantations. Department of Health Certification: AAL-121
- State of Vermont, Department of Health Environmental Health License AL934461

Thank you Bryant Dana for your business.

Michael Manning
Owner/Director

Bryant Dana
CDW Consultants, Inc.
6 Huron Drive
Natick, MA 01760

Project Information
#2171.10
Davey Lopes

Method: BULK PLM ANALYSIS, EPA/600/R-93/116

FieldID LabID	Material	Location	Color	Non-Asbestos %	Asbestos %
1A 1369896	White Wall Covering over Concrete	Pump Room	white	Non-Fibrous 100	None Detected
1B 1369897	White Wall Covering over Concrete	Pump Room	white	Non-Fibrous 100	None Detected
1C 1369898	White Wall Covering over Concrete	Pump Room	white	Non-Fibrous 100	None Detected
1D 1369899	White Wall Covering over Concrete	Pump Room	white	Non-Fibrous 100	None Detected
1E 1369900	White Wall Covering over Concrete	Pump Room	white	Non-Fibrous 100	None Detected
2A 1369901	TSI	Pump Room	multi	Fiberglass 30 Mineral Wool 30 Cellulose 20 Non-Fibrous 20	None Detected
2B 1369902	TSI	Pump Room	multi	Fiberglass 30 Mineral Wool 30 Cellulose 20 Non-Fibrous 20	None Detected
2C 1369903	TSI	Pump Room	multi	Fiberglass 30 Mineral Wool 30 Cellulose 20 Non-Fibrous 20	None Detected
3A 1369904	TSI Mud End	Pump Room	white	Fiberglass 5 Mineral Wool 5 Non-Fibrous 90	None Detected
3B 1369905	TSI Mud End	Pump Room	white	Fiberglass 5 Mineral Wool 5 Non-Fibrous 90	None Detected
3C 1369906	TSI Mud End	Pump Room	white	Fiberglass 5 Mineral Wool 5 Non-Fibrous 90	None Detected
4A 1369907	Gray Door Caulk (Entrance)	Exterior of Pump Room	gray	Non-Fibrous 100	None Detected
4B 1369908	Gray Door Caulk (Entrance)	Exterior of Pump Room	gray	Non-Fibrous 100	None Detected
4C 1369909	Gray Door Caulk (Entrance)	Exterior of Pump Room	gray	Non-Fibrous 100	None Detected
5A 1369910	Gray Expansion Caulk Behind Entrance Door	Exterior of Pump Room	gray	Non-Fibrous 100	None Detected

Sampled: September 13, 2024 **Received:** September 20, 2024 **Analyzed:** September 24, 2024

Tuesday 01 October 2024

Analyzed by: 

Batch: 123674

Bryant Dana
CDW Consultants, Inc.
6 Huron Drive
Natick, MA 01760

Project Information
#2171.10
Davey Lopes

Method: BULK PLM ANALYSIS, EPA/600/R-93/116

FieldID / LabID	Material	Location	Color	Non-Asbestos %	Asbestos %
5B / 1369911	Gray Expansion Caulk Behind Entrance Door	Exterior of Pump Room	gray	Non-Fibrous 100	None Detected
5C / 1369912	Gray Expansion Caulk Behind Entrance Door	Exterior of Pump Room	gray	Non-Fibrous 100	None Detected
6A / 1369913	Sheetrock	Boxing Gym Office	gray	Fiberglass 2 Cellulose 3 Non-Fibrous 95	None Detected
6B / 1369914	Sheetrock	Boxing Gym Office	gray	Fiberglass 2 Cellulose 3 Non-Fibrous 95	None Detected
6C / 1369915	Sheetrock	Boxing Gym Office	gray	Fiberglass 2 Cellulose 3 Non-Fibrous 95	None Detected
7A / 1369916	Sheetrock Covering	Boxing Gym Office	gray	Fiberglass 60 Other 10 Non-Fibrous 30	None Detected
7B / 1369917	Sheetrock Covering	Boxing Gym Office	gray	Fiberglass 60 Other 10 Non-Fibrous 30	None Detected
7C / 1369918	Sheetrock Covering	Boxing Gym Office	gray	Fiberglass 60 Other 10 Non-Fibrous 30	None Detected
8A / 1369919	Gray (Thick) Expansion Joint	Boxing Gym Office Floor	gray	Non-Fibrous 100	None Detected
8B / 1369920	Gray (Thick) Expansion Joint	Boxing Gym Office Floor	gray	Non-Fibrous 100	None Detected
8C / 1369921	Gray (Thick) Expansion Joint	Boxing Gym Office Floor	gray	Non-Fibrous 100	None Detected
9A / 1369922	Black Coating Under Expansion Joint	Boxing Gym Office Floor	black	Non-Fibrous 100	None Detected
9B / 1369923	Black Coating Under Expansion Joint	Boxing Gym Office Floor	black	Non-Fibrous 100	None Detected
9C / 1369924	Black Coating Under Expansion Joint	Boxing Gym Office Floor	black	Non-Fibrous 100	None Detected
10A / 1369925	Gray Expansion Joint Around Exterior of Pool	Boxing Gym	gray	Non-Fibrous 100	None Detected
10B / 1369926	Gray Expansion Joint Around Exterior of Pool	Boxing Gym	gray	Non-Fibrous 100	None Detected

Sampled: September 13, 2024 **Received:** September 20, 2024 **Analyzed:** September 24, 2024

Tuesday 01 October 2024

Analyzed by: 

Batch: 123674

Bryant Dana
CDW Consultants, Inc.
6 Huron Drive
Natick, MA 01760

Project Information
#2171.10
Davey Lopes

Method: BULK PLM ANALYSIS, EPA/600/R-93/116

FieldID / LabID	Material	Location	Color	Non-Asbestos %	Asbestos %
10C / 1369927	Gray Expansion Joint Around Exterior of Pool	Boxing Gym	gray	Non-Fibrous 100	None Detected
11A / 1369928	Black Coating Under Expansion Joint	Boxing Gym	black	Non-Fibrous 100	None Detected
11B / 1369929	Black Coating Under Expansion Joint	Boxing Gym	black	Non-Fibrous 100	None Detected
11C / 1369930	Black Coating Under Expansion Joint	Boxing Gym	black	Non-Fibrous 100	None Detected
12A / 1369931	Gray Expansion Joint Around Interior of Pool	Boxing Gym	gray	Non-Fibrous 100	None Detected
12B / 1369932	Gray Expansion Joint Around Interior of Pool	Boxing Gym	gray	Non-Fibrous 100	None Detected
12C / 1369933	Gray Expansion Joint Around Interior of Pool	Boxing Gym	gray	Non-Fibrous 100	None Detected
13A / 1369934	Black Coating Under Expansion Joint	Boxing Gym	black	Non-Fibrous 100	None Detected
13B / 1369935	Black Coating Under Expansion Joint	Boxing Gym	black	Non-Fibrous 100	None Detected
13C / 1369936	Black Coating Under Expansion Joint	Boxing Gym	black	Non-Fibrous 100	None Detected
14A / 1369937	Gray Expansion Joint at Base of Wall	Boxing Gym	gray	Non-Fibrous 100	None Detected
14B / 1369938	Gray Expansion Joint at Base of Wall	Boxing Gym	gray	Non-Fibrous 100	None Detected
14C / 1369939	Gray Expansion Joint at Base of Wall	Boxing Gym	gray	Non-Fibrous 100	None Detected
15A / 1369940	Black Coating Under Expansion Joint	Boxing Gym	black	Non-Fibrous 100	None Detected
15B / 1369941	Black Coating Under Expansion Joint	Boxing Gym	black	Non-Fibrous 100	None Detected
15C / 1369942	Black Coating Under Expansion Joint	Boxing Gym	black	Non-Fibrous 100	None Detected
16A / 1369943	Black Paint	Boxing Gym Walls	black	Non-Fibrous 100	None Detected

Sampled: September 13, 2024 **Received:** September 20, 2024 **Analyzed:** September 24, 2024

Tuesday 01 October 2024

Analyzed by: 

Batch: 123674

Bryant Dana
CDW Consultants, Inc.
6 Huron Drive
Natick, MA 01760

Project Information
#2171.10
Davey Lopes

Method: BULK PLM ANALYSIS, EPA/600/R-93/116

FieldID LabID	Material	Location	Color	Non-Asbestos %	Asbestos %
16B 1369944	Black Paint	Boxing Gym Walls	black	Non-Fibrous 100	None Detected
16C 1369945	Black Paint	Boxing Gym Walls	black	Non-Fibrous 100	None Detected
17A 1369946	Yellow Paint	Boxing Gym Walls	yellow	Non-Fibrous 100	None Detected
17B 1369947	Yellow Paint	Boxing Gym Walls	yellow	Non-Fibrous 100	None Detected
17C 1369948	Yellow Paint	Boxing Gym Walls	yellow	Non-Fibrous 100	None Detected
18A 1369949	Yellow Paint	Boxing Gym Pool Floor	yellow	Non-Fibrous 100	None Detected
18B 1369950	Yellow Paint	Boxing Gym Pool Floor	yellow	Non-Fibrous 100	None Detected
18C 1369951	Yellow Paint	Boxing Gym Pool Floor	yellow	Non-Fibrous 100	None Detected
19A 1369952	Black Paint	Boxing Gym Pool Floor	black	Non-Fibrous 100	None Detected
19B 1369953	Black Paint	Boxing Gym Pool Floor	black	Non-Fibrous 100	None Detected
19C 1369954	Black Paint	Boxing Gym Pool Floor	black	Non-Fibrous 100	None Detected
20A 1369955	White Paint	Boxing Gym Pool Floor	white	Non-Fibrous 100	None Detected
20B 1369956	White Paint	Boxing Gym Pool Floor	white	Non-Fibrous 100	None Detected
20C 1369957	White Paint	Boxing Gym Pool Floor	white	Non-Fibrous 100	None Detected
21A 1369958	TSI	Boiler Room	multi	Fiberglass 60 Cellulose 20 Non-Fibrous 20	None Detected
21B 1369959	TSI	Boiler Room	multi	Fiberglass 60 Cellulose 20 Non-Fibrous 20	None Detected

Sampled: September 13, 2024 **Received:** September 20, 2024 **Analyzed:** September 24, 2024

Tuesday 01 October 2024

Analyzed by: 

Batch: 123674

Bryant Dana
CDW Consultants, Inc.
6 Huron Drive
Natick, MA 01760

Project Information
#2171.10
Davey Lopes

Method: BULK PLM ANALYSIS, EPA/600/R-93/116

FieldID LabID	Material	Location	Color	Non-Asbestos %	Asbestos %
21C 1369960	TSI	Boiler Room	multi	Fiberglass 60 Cellulose 20 Non-Fibrous 20	None Detected
22A 1369961	TSI Mud Ends	Boiler Room	multi	Fiberglass 60 Cellulose 10 Non-Fibrous 30	None Detected
22B 1369962	TSI Mud Ends	Boiler Room	multi	Fiberglass 60 Cellulose 10 Non-Fibrous 30	None Detected
22C 1369963	TSI Mud Ends	Boiler Room	multi	Fiberglass 60 Cellulose 10 Non-Fibrous 30	None Detected
23A 1369964	Duct Pin	Boiler Room	multi	Fiberglass 60 Non-Fibrous 40	None Detected
24A 1369965	Fire Brick	Gym (Behind Wall in Opening)	tan	Non-Fibrous 100	None Detected
24B 1369966	Fire Brick	Gym (Behind Wall in Opening)	tan	Non-Fibrous 100	None Detected
24C 1369967	Fire Brick	Gym (Behind Wall in Opening)	tan	Non-Fibrous 100	None Detected
25A 1369968	Black Cove Molding	Gym	black	Non-Fibrous 100	None Detected
25B 1369969	Black Cove Molding	Gym	black	Non-Fibrous 100	None Detected
25C 1369970	Black Cove Molding	Gym	black	Non-Fibrous 100	None Detected
26A 1369971	Tan Mastic Behind Cove	Gym	tan	Non-Fibrous 100	None Detected
26B 1369972	Tan Mastic Behind Cove	Gym	tan	Non-Fibrous 100	None Detected
26C 1369973	Tan Mastic Behind Cove	Gym	tan	Non-Fibrous 100	None Detected
27A 1369974	Brown Penetration Caulk	Hallways	multi	Non-Fibrous 100	None Detected
27B 1369975	Brown Penetration Caulk	Hallways	multi	Non-Fibrous 100	None Detected

Sampled: September 13, 2024 **Received:** September 20, 2024 **Analyzed:** September 24, 2024

Tuesday 01 October 2024

Analyzed by: 

Batch: 123674

Bryant Dana
CDW Consultants, Inc.
6 Huron Drive
Natick, MA 01760

Project Information
#2171.10
Davey Lopes

Method: BULK PLM ANALYSIS, EPA/600/R-93/116

FieldID LabID	Material	Location	Color	Non-Asbestos %	Asbestos %
27C 1369976	Brown Penetration Caulk	Hallways	multi	Non-Fibrous 100	None Detected
28A 1369977	Red Penetration Caulk	Hallways	red	Non-Fibrous 100	None Detected
28B 1369978	Red Penetration Caulk	Hallways	red	Non-Fibrous 100	None Detected
28C 1369979	Red Penetration Caulk	Hallways	red	Non-Fibrous 100	None Detected

Sampled: September 13, 2024 **Received:** September 20, 2024 **Analyzed:** September 24, 2024

Tuesday 01 October 2024

Analyzed by:  **Batch:** 123674

Client: CDW Consultants Inc.
Address: 4 California Ave Framingham MA 01701
Project Site & #: Davey Lopes / #2171.10
Phone / email address: bdana@cdwconsultants.com
Contact: Bryant + Dana
Relinquish by/date: [illegible] 9/13/24
Received by/date: POF 9/20/24
# of Samples Received: 84

CHAIN OF CUSTODY

EPA/600/R-93/116

Asbestos Identification Lab
165 New Boston St.
Suite 227
Woburn, MA 01801
(781)932-9600
www.asbestosidentificationlab.com

Date Sampled: 9/13/24

BATCH# 123674 Rev 01/24

Page 1 of 18

Turnaround Time		Sample Method	
☐	Less 3 Hrs	☒	Bulk
☐	Same Day	☐	Soil
☐	Next Day	☐	Wipe
☐	Two Day	☐	Point Count
☒	Three Day (NO RUSH)	☐	NOB

Stop on 1st Positive? (Yes)/No
Analyzed By: Liam Cochrane
Date: 9/24/24

Temp in Celsius = 23

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Material / Location	Stereo Scope: % of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Optical Properties: Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI: =	⊥	Non-Asbestos Percentage (%): Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
123674 96	1A	Material: White Wall Coating over Concrete Location: Pump Room	0	W	H	Gr	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
97	1B	Material: ^ " Location: ^ "	0	W	H	Gr	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
98	1C	Material: ^ " Location: ^ "	0	W	H	Gr	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Temp in Celcius = ___ / Material / Location	Stereomicroscope: % of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Optical Properties: Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI: ∥	RI: ⊥	Non-Asbestos Percentage (%): Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
99	1D	Material / Location	0	W	H	gr	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															4%
100	1E	Material / Location	0	W	H	gr	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															1%
01	2A	Material TSI / Location Pump Room	0	M	N	f	H	Chrysotile									3	15	R				
								Amosite															
								Crocidolite									1	1	1E				
								Tremolite															
								Anthophyllite															
								Actinolite									30	30	20				20
02	2B	Material / Location	0	M	N	f	H	Chrysotile									3	15	R				
								Amosite															
								Crocidolite									1	1	1E				
								Tremolite															
								Anthophyllite															
								Actinolite									30	30	20				20
03	2C	Material / Location	0	M	N	R	H	Chrysotile									3	15	R				
								Amosite															
								Crocidolite									1	1	1E				
								Tremolite															
								Anthophyllite															
								Actinolite									30	30	25				25

Temp in Celsius = ____

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Material / Location	Stereomicroscope: % of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Optical Properties: Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI: ∥	RI: ⊥	Non-Asbestos Percentage (%): Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
04	3A	Material TSI MUD END Location Pump Room	0	W	H	gr	N	Chrysotile									1	15					
								Amosite															
								Crocidolite									1	1					
								Tremolite															
								Anthophyllite															
								Actinolite									5	5					90
05	3B	Material ″ ″ Location ″ ″	0	W	H	gr	N	Chrysotile									5	15					
								Amosite															
								Crocidolite									1	1					
								Tremolite															
								Anthophyllite															
								Actinolite									5	5					95
06	3C	Material ″ ″ Location ″ ″	0	W	H	gr	N	Chrysotile									5	15					
								Amosite															
								Crocidolite									f	1					
								Tremolite															
								Anthophyllite															
								Actinolite									5	5					90
07	4A	Material Garage Door Caulk (Entrance) Location Exterior of Pump Room	0	gy	H	gr	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
08	4B	Material ″ ″ Location ″ ″	0	gy	H	gr	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Temp in Celcius = ____ / Material / Location	Stereomicroscope: % of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Optical Properties: Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI: ∥	RI: ⊥	Non-Asbestos Percentage (%): Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
09	4C	Material Location						Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
			0	gry	hg	gr	N	Actinolite															100
10	5A	Material Gray Expansion Caulk Behind Entrance Door Location Exterior of Pump Room						Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
			0	gry	hg	gr	N	Actinolite															100
11	5B	Material Location						Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
			0	gry	hg	gr	N	Actinolite															100
12	5C	Material Location						Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
			0	gry	hg	gr	N	Actinolite															100
13	6A	Material Sheetrock Location Boxing Gym Office						Chrysotile															
								Amosite									5		R				
								Crocidolite									1		12				
								Tremolite															
								Anthophyllite															
			0	gry	hg	gr	Y	Actinolite									2		3				95

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Temp in Celsius = ____ / Material / Location	Stereomicroscope: % of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Optical Properties: Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI: ∥	RI: ⊥	Non-Asbestos Percentage (%): Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
14	6B	Material Location	0	gy	h	gr	h	Chrysotile									5		A				
								Amosite															
								Crocidolite									1		12				
								Tremolite															
								Anthophyllite															
								Actinolite									2		3				95
15	6C	Material Location	0	gy	h	gr	h	Chrysotile									5		A				
								Amosite															
								Crocidolite											12				
								Tremolite									1						
								Anthophyllite															
								Actinolite									2		3				95
16	7A	Material Sheetrock Covering Location Boxing bay office	0	gy	h	gr/f	h	Chrysotile									5					B	
								Amosite															
								Crocidolite														+/-	
								Tremolite									1						
								Anthophyllite															
								Actinolite									6a					b	3a
17	7B	Material Location	0	gy	h	gr/f	h	Chrysotile									5					B	
								Amosite															
								Crocidolite														+/-	
								Tremolite									1						
								Anthophyllite															
								Actinolite									6a					b	3a
18	7C	Material Location	0	gy	h	gr/f	h	Chrysotile									5					B	
								Amosite															
								Crocidolite														+/-	
								Tremolite									1						
								Anthophyllite															
								Actinolite									6a					1a	3a

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Temp in Celcius = ____ / Material / Location	Stereomicroscope: % of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Optical Properties: Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI: ∥	RI: ⊥	Non-Asbestos Percentage (%): Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
19	8A	Material Gray (Thick) Expansion Joint Location Boxing Gym Office Floor	0	gy	y	gn	N	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite																hg
20	8B	Material Location	0	gy	y	gn	N	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite																hg
21	8C	Material Location	0	gy	y	gn	N	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite																hg
22	9A	Material Black Coating under Expansion Joint Location Boxing Gym Office Floor	0	BK	y	gn	N	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite																hg
23	9B	Material Location	0	BK	y	gn	N	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite																hg

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Temp in Celsius = ___ / Material / Location	Stereomicroscope: % of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Optical Properties: Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI: ∥	RI: ⊥	Non-Asbestos Percentage (%): Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
24	9C	Material Location	0	BK	Y	Gn	N	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite																100
25	10A	Material Gray Expansion Joint around Exterior of Roof Location Boxing Gym	0	Gy	Y	Gn	N	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite																100
26	10B	Material Location	0	Gy	Y	Gn	N	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite																100
27	10C	Material Location	0	Gy	Y	Gn	N	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite																100
28	11A	Material Black Coating Under Expansion Joint Location Boxing Gym	0	BK	Y	Gn	N	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite																100

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Temp in Celcius = ____ / Material / Location	Stereomicroscope: % of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Optical Properties: Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI: ∥	RI: ⊥	Non-Asbestos Percentage (%): Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
29	11B	Material Location	0	BK	S	Gr	N	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite															Lo
30	11C	Material Location	0	BK	S	Gr	N	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite															Lo
31	12A	Material Gray Expansion Joint around Interior of Pool Location Boxing Gym	0	Gy	S	Gr	N	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite															Lo
32	12B	Material Location	0	Gy	S	Gr	N	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite															Lo
33	12C	Material Location	0	Gy	S	Gr	N	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite															Lo

Temp in Celcius = ____

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Material / Location	Stereomicroscope: % of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Optical Properties: Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI: ∥	RI: ⊥	Non-Asbestos Percentage (%): Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
34	13A	Material Black Coating under Expansion Joint Location Boxing Gym	0	BK	H	Gr	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
35	13B	Material " Location "	0	BK	H	Gr	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
36	13C	Material " Location "	0	BK	H	Gr	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
37	14A	Material Gray Expansion Joint @ Base of Wall Location Boxing Gym	0	Gy	H	Gr	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
38	14B	Material " Location "	0	Gy	H	Gr	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100

Temp in Celcius = ____

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Material / Location	Stereomicroscope: % of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Optical Properties: Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI: ‖	RI: ⊥	Non-Asbestos Percentage (%): Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
39	14C	Material ~ ~ Location ~ ~	0	gy	~	gr	~	Chrysotile															100
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															
40	15A	Material Black Coating Under Expansion Joint Location Boxing Gym	0	Blk	~	gr	~	Chrysotile															100
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															
41	15B	Material ~ ~ Location " ~	0	Blk	~	gr	~	Chrysotile															100
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															
42	15C	Material " ~ Location ~ ~	0	Blk	~	gr	~	Chrysotile															100
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															
43	16A	Material Black Paint Location Boxing Gym Walls	0	Blk	~	gr	~	Chrysotile															100
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Temp in Celcius = ____ / Material / Location	Stereomicroscope: % of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Optical Properties: Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI: ∥	RI: ⊥	Non-Asbestos Percentage (%): Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
44	16B	Material Location	0	Blk	2	5	2	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite															100
45	16C	Material Location	0	Blk	2	5	2	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite															100
46	17A	Material Yellow Paint Location Boxing Gym Walls	0	5	2	5	2	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite															100
47	17B	Material Location	0	5	2	5	2	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite															100
48	17C	Material Location	0	5	2	5	2	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite															100

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Temp in Celcius = ____ / Material / Location	Stereomicroscope: % of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Optical Properties: Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI: ∥	RI: ⊥	Non-Asbestos Percentage (%): Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
49	18A	Material Yellow Paint Location Boxing Gym Pool Floor	0	y	~	gr	~	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
50	18B	Material ~ ~ Location ~ ~	0	y	~	gr	~	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
51	18C	Material ~ ~ Location ~ ~	0	y	~	gr	~	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
52	19A	Material Black Paint Location Boxing Gym Pool Floor	0	Blk	~	gr	~	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
53	19B	Material ~ ~ Location ~ ~	0	Blk	~	gr	~	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100

Temp in Celcius = ____

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Material / Location	Stereomicroscope: % of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Optical Properties: Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI: ∥	RI: ⊥	Non-Asbestos Percentage (%): Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
S4	19C	Material ~ ~ Location ~ ~	0	Blk	2	3	2	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
S5	20A	Material White Paint Location Boxing Gym Pool Floor	0	3	2	3	2	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
S6	20B	Material ~ ~ Location ~ ~	0	3	2	3	2	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
S7	20C	Material ~ ~ Location ~ ~	0	3	2	3	2	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
S8	21A	Material TSI Location Boiler Room	0	3	2	Fib	2	Chrysotile															
								Amosite									5		B				
								Crocidolite									1		1c				
								Tremolite															
								Anthophyllite									60		20				20
								Actinolite															

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Material / Location (Temp in Celsius = ____)	% of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI ∥	RI ⊥	Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
59	21B	Material ~ ~ Location ~ ~	0	mu	~	f/gr	~	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite									S/1 60		R/1e 20				20
60	21C	Material ~ ~ Location ~ ~	0	mu	~	f/gr	~	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite									S/1 60		R/1e 20				20
61	22A	Material TSi MUD ENDs Location Boiler Room	0	mu	~	f/gr	~	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite									S/1 60		R/1e 10				30
62	22B	Material ~ ~ Location ~ ~	0	mu	~	f/gr	~	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite									S/1 60		R/1e 10				30
63	22C	Material ~ ~ Location ~ ~	0	mu	~	f/gr	~	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite									S/1 60		R/1e 10				30

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Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Material / Location (Temp in Celsius = ____)	Stereomicroscope: % of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Optical Properties: Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI: ∥	RI: ⊥	Non-Asbestos Percentage (%): Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
64	23A	Material: Duct Pin Location: Boiler Room	0	m	~	f gr	~	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite									5 T 60						40
65	24A	Material: Fire Brick Location: Gym (Behind wall in opening)	0	T	~	gr	~	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite															100
66	24B	Material: ~ ~ Location: ~ ~	0	T	~	gr	~	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite															100
67	24C	Material: ~ ~ Location: ~ ~	0	T	~	gr	~	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite															100
68	25A	Material: Black Cove Molding Location: Gym	0	Blk	~	gr	~	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite															100

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Temp in Celcius = ____ / Material / Location	Stereomicroscope: % of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Optical Properties: Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI: ∥	RI: ⊥	Non-Asbestos Percentage (%): Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
69	25B	Material ~ ~ Location ~ ~	0	Blk	~	~	~	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
70	25C	Material ~ ~ Location ~ ~	0	Blk	~	~	~	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
71	26A	Material Tan Mastic behind Cove Location Gym	0	T	~	~	~	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
72	26B	Material ~ ~ Location ~ ~	0	T	~	~	~	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
73	26C	Material ~ ~ Location ~ ~	0	T	~	~	~	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Temp in Celcius = ____ / Material / Location	Stereomicroscope: % of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Optical Properties: Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI: ∥	RI: ⊥	Non-Asbestos Percentage (%): Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
74	27A	Material Brown Penetration Caulk Location Hallways	0	Brn	~	gr	~	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
75	27B	Material ~ ~ Location ~ ~	0	Mu	~	gr	~	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
76	27C	Material ~ ~ Location ~ ~	0	mu	~	gr	~	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
77	28A	Material Red Penetration Caulk Location Hallways	0	red	~	gr	~	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
78	28B	Material ~ ~ Location ~ ~	0	red	N	gr	~	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Temp in Celsius = ____ Material / Location	Stereomicroscope: % of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Optical Properties: Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI: ∥	⊥	Non-Asbestos Percentage (%): Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
79	28C	Material ~ ~						Chrysotile															
								Amosite															
								Crocidolite															
		Location ~ ~						Tremolite															
			0	red	~	gr	~	Anthophyllite															
								Actinolite															100
		Material						Chrysotile															
								Amosite															
								Crocidolite															
		Location						Tremolite															
								Anthophyllite															
								Actinolite															
		Material						Chrysotile															
								Amosite															
								Crocidolite															
		Location						Tremolite															
								Anthophyllite															
								Actinolite															
		Material						Chrysotile															
								Amosite															
								Crocidolite															
		Location						Tremolite															
								Anthophyllite															
								Actinolite															
		Material						Chrysotile															
								Amosite															
								Crocidolite															
		Location						Tremolite															
								Anthophyllite															
								Actinolite															

Asbestos Identification Laboratory.

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NVLAP® Testing Lab Code: 200919-0

Batch: 125317

Susan Cahalan
CDW Consultants, Inc.
6 Huron Drive
Natick, MA 01760

Project Information

Davey Lopes Rec Center,
227 Dudley St.,
Providence,
RI

Method: BULK PLM ANALYSIS, EPA/600/R-93/116

Dear Susan Cahalan,

Asbestos Identification Laboratory has completed the analysis of the samples from your office for the above referenced project. The Analysis Method is BULK PLM ANALYSIS, EPA/600/R-93/116The information and analysis contained in this report have been generated using the EPA /600/R-93/116 Method for the Determination of Asbestos in Bulk Building Materials. Materials or products that contain more than 1% of any kind or combination of asbestos are considered an asbestos containing building material as determined by the EPA. This Polarized Light Microscope (PLM) technique may be performed either by visual estimation or point counting. Point counting provides a determination of the area percentage of asbestos in a sample. If the asbestos is estimated to be less than 10% by visual estimation of friable material, the determination may be repeated using the point counting technique. The results of the point counting supersede visual PLM results. Results in this report only relate to the items tested. This report may not be used by the customer to claim product endorsement by NVLAP or any other U.S. Government Agency.
Laboratory results represent the analysis of samples as submitted by the customer. Information regarding sample location, description, area, volume, etc., was provided by the customer. Information provided by the customer can affect the validity of results. Asbestos Identification Laboratory is not responsible for sample collection activities or analytical method limitations. Unless notified in writing to return samples, Asbestos Identification Laboratory discards customer samples after 30 days. Samples containing subsamples or layers will be analyzed separately when applicable. Reports are kept at Asbestos Identification Laboratory for three years. All customer information will be maintained in confidentiality. This report shall not be reproduced, except in full, without the written consent of Asbestos Identification Laboratory.

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- State of Connecticut, Department of Public Health Approved Environmental Laboratory Registration Number: PH-0142
- State of Maine, Department of Environmental Protection Asbestos Analytical Laboratory License Number: LB-0078(Bulk) LA-0087(Air)
- State of Rhode Island and Providence Plantations. Department of Health Certification: AAL-121
- State of Vermont, Department of Health Environmental Health License AL934461

Thank you Susan Cahalan for your business.

Michael Manning
Owner/Director

Susan Cahalan
CDW Consultants, Inc.
6 Huron Drive
Natick, MA 01760

Project Information

Davey Lopes Rec Center,
227 Dudley St.,
Providence,
RI

Method: BULK PLM ANALYSIS, EPA/600/R-93/116

FieldID / LabID	Material	Location	Color	Non-Asbestos %	Asbestos %
29A / 1387694	Maroon Expansion Joint Caulk	Exterior - Pool Side	brown	Non-Fibrous 100	None Detected
29B / 1387695	Maroon Expansion Joint Caulk	Exterior - Pool Side	brown	Non-Fibrous 100	None Detected
29C / 1387696	Maroon Expansion Joint Caulk	Exterior - Pool Side	brown	Non-Fibrous 100	None Detected
30A / 1387697	Dark Gray/Black Caulk	Exterior Door to Men's Locker Room	gray	Non-Fibrous 100	None Detected
30B / 1387698	Dark Gray/Black Caulk	Exterior Door to Men's Locker Room	gray	Non-Fibrous 100	None Detected
30B / 1387699	Dark Gray/Black Caulk	Exterior Door to Men's Locker Room	gray	Non-Fibrous 100	None Detected
31A / 1387700	Dark Gray/Black Caulk	Exterior, Base of Bldg near First Aid	gray	Non-Fibrous 97	**Detected** Chrysotile 3
31B / 1387701	Dark Gray/Black Caulk	Exterior, Base of Bldg near First Aid			Not Analyzed
31C / 1387702	Dark Gray/Black Caulk	Exterior, Base of Bldg near First Aid			Not Analyzed
32A / 1387703	Black Caulk	Exterior Door @ First Aid	black	Non-Fibrous 100	None Detected
32B / 1387704	Black Caulk	Exterior Door @ First Aid	black	Non-Fibrous 100	None Detected
32C / 1387705	Black Caulk	Exterior Door @ First Aid	black	Non-Fibrous 100	None Detected
33A / 1387706	Gray Caulk	Exterior Base of Bldg + Concrete Pool Side	gray	Non-Fibrous 100	None Detected
33B / 1387707	Gray Caulk	Exterior Base of Bldg + Concrete Pool Side	gray	Non-Fibrous 100	None Detected
33C / 1387708	Gray Caulk	Exterior Base of Bldg + Concrete Pool Side	gray	Non-Fibrous 100	None Detected
33D / 1387709	Gray Caulk	Exterior Base of Bldg + Concrete Pool Side	gray	Non-Fibrous 100	None Detected

Sampled: September 19, 2024 **Received:** October 21, 2024 **Analyzed:** October 22, 2024

Wednesday 23 October

Analyzed by: Jonathan Chann **Batch:** 125317

Susan Cahalan
CDW Consultants, Inc.
6 Huron Drive
Natick, MA 01760

Project Information

Davey Lopes Rec Center,
227 Dudley St.,
Providence,
RI

Method: BULK PLM ANALYSIS, EPA/600/R-93/116

FieldID / LabID	Material	Location	Color	Non-Asbestos %	Asbestos %
33E / 1387710	Gray Caulk	Exterior Base of Bldg + Concrete Pool Side	gray	Non-Fibrous 100	None Detected
34A / 1387711	Thick Black Caulk	Base Bldg near Main Entrance	gray	Non-Fibrous 100	None Detected
34B / 1387712	Thick Black Caulk	Base Bldg near Main Entrance	gray	Non-Fibrous 100	None Detected
34C / 1387713	Thick Black Caulk	Base Bldg near Main Entrance	gray	Non-Fibrous 100	None Detected
35A / 1387714	Dk Gray/Black Caulk	Large Windows @ Front	gray	Non-Fibrous 100	None Detected
35B / 1387715	Dk Gray/Black Caulk	Large Windows @ Front	gray	Non-Fibrous 100	None Detected
35C / 1387716	Dk Gray/Black Caulk	Large Windows @ Front	gray	Non-Fibrous 100	None Detected
36A / 1387717	Thin Layer Caulk Dark Gray/Brown	Under Aluminum Exterior Window Frames	gray	Non-Fibrous 95	**Detected** Chrysotile 5
36B / 1387718	Thin Layer Caulk Dark Gray/Brown	Under Aluminum Exterior Window Frames			Not Analyzed
36C / 1387719	Thin Layer Caulk Dark Gray/Brown	Under Aluminum Exterior Window Frames			Not Analyzed
37A / 1387720	Dark Gray Black Exterior Window Caulk	Frosted Glass Windows	gray	Non-Fibrous 95	**Detected** Chrysotile 5
37B / 1387721	Dark Gray Black Exterior Window Caulk	Frosted Glass Windows			Not Analyzed
37C / 1387722	Dark Gray Black Exterior Window Caulk	Frosted Glass Windows			Not Analyzed
38A / 1387723	Black Glaze	Exterior Windows w/ Frosted Glass	black	Non-Fibrous 90	**Detected** Chrysotile 10
38B / 1387724	Black Glaze	Exterior Windows w/ Frosted Glass			Not Analyzed
38C / 1387725	Black Glaze	Exterior Windows w/ Frosted Glass			Not Analyzed

Sampled: September 19, 2024 **Received:** October 21, 2024 **Analyzed:** October 22, 2024

Wednesday 23 October

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6 Huron Drive
Natick, MA 01760

Project Information

Davey Lopes Rec Center,
227 Dudley St.,
Providence,
RI

Method: BULK PLM ANALYSIS, EPA/600/R-93/116

FieldID / LabID	Material	Location	Color	Non-Asbestos %	Asbestos %
39A / 1387726	Dark Gray/Black Caulk	Door Main Entrance	gray	Non-Fibrous 100	None Detected
39B / 1387727	Dark Gray/Black Caulk	Door Main Entrance	gray	Non-Fibrous 100	None Detected
39C / 1387728	Dark Gray/Black Caulk	Door Main Entrance	gray	Non-Fibrous 100	None Detected
40A / 1387729	Black Caulk	Inner Bead Front Door Exterior Frame to Door	black	Non-Fibrous 100	None Detected
40B / 1387730	Black Caulk	Inner Bead Front Door Exterior Frame to Door	black	Non-Fibrous 100	None Detected
40C / 1387731	Black Caulk	Inner Bead Front Door Exterior Frame to Door	black	Non-Fibrous 100	None Detected
41A / 1387732	Brown-Blue Paint	Behind Wood Cove Base Trim Lobby Area	multi	Non-Fibrous 100	None Detected
41B / 1387733	Brown-Blue Paint	Behind Wood Cove Base Trim Lobby Area	multi	Non-Fibrous 100	None Detected
41C / 1387734	Brown-Blue Paint	Behind Wood Cove Base Trim Lobby Area	multi	Non-Fibrous 100	None Detected
42A / 1387735	Old Mortar w/ Black Coating	Behind Wall in Lobby	multi	Non-Fibrous 100	None Detected
42B / 1387736	Old Mortar w/ Black Coating	Behind Wall in Lobby	multi	Non-Fibrous 100	None Detected
42C / 1387737	Old Mortar w/ Black Coating	Behind Wall in Lobby	multi	Non-Fibrous 100	None Detected
43A / 1387738	Yellow Brown Paint	on Steel Pipes Janitor Rooms	multi	Non-Fibrous 100	None Detected
43B / 1387739	Yellow Brown Paint	on Steel Pipes Janitor Rooms	multi	Non-Fibrous 100	None Detected
44A / 1387740	Black Painted Gray Caulk	Top of CMU - Computer Room	multi	Non-Fibrous 100	None Detected
44B / 1387741	Black Painted Gray Caulk	Top of CMU - Computer Room	multi	Non-Fibrous 100	None Detected

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Wednesday 23 October

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Project Information

Davey Lopes Rec Center,
227 Dudley St.,
Providence,
RI

Method: BULK PLM ANALYSIS, EPA/600/R-93/116

FieldID / LabID	Material	Location	Color	Non-Asbestos %	Asbestos %
44C / 1387742	Black Painted Gray Caulk	Top of CMU - Computer Room	multi	Non-Fibrous 100	None Detected
45A / 1387743	Dark Gray/Black	Interior Window Glaze on Door to Computer Room	gray	Non-Fibrous 90	**Detected** Chrysotile 10
45B / 1387744	Dark Gray/Black	Interior Window Glaze on Door to Computer Room			Not Analyzed
Roof-1A / 1387745	Brown Glue Under Rubber Roof	Roof Core	brown	Non-Fibrous 100	None Detected
Roof-1B / 1387746	Black Tar Paper	Top + Bottom Roof Foam over Wood Deck	black	Fiberglass 40 Cellulose 40 Non-Fibrous 20	None Detected
Roof-2A / 1387747	Brown Glue	Under Rubber Roof	brown	Non-Fibrous 100	None Detected
Roof-2B / 1387748	Black Paper	Top + Bottom Roof Foam - 2 Layers	black	Fiberglass 40 Cellulose 40 Non-Fibrous 20	None Detected
Roof-3A / 1387749	Brown Glue	Under Rubber Roof	brown	Non-Fibrous 100	None Detected
Roof-3B / 1387750	Black Paper	Top + Bottom Roof Foam	black	Fiberglass 40 Cellulose 40 Non-Fibrous 20	None Detected
46A / 1387751	Black Tar	Dripping from Roof on Interior Hallways	black	Non-Fibrous 100	None Detected
46B / 1387752	Black Tar	Dripping from Roof on Interior Hallways	black	Non-Fibrous 100	None Detected
46C / 1387753	Black Tar	Dripping from Roof on Interior Hallways	black	Non-Fibrous 100	None Detected
47A / 1387754	Tan Caulk	Around Men's Urinals	tan	Non-Fibrous 100	None Detected
47B / 1387755	Tan Caulk	Around Men's Urinals	tan	Non-Fibrous 100	None Detected
48A / 1387756	Dk Gray Grout	in Between Red Quarry Tile Main Entrance	gray	Non-Fibrous 100	None Detected
48B / 1387757	Dk Gray Grout	in Between Red Quarry Tile Main Entrance	gray	Non-Fibrous 100	None Detected

Sampled: September 19, 2024 **Received:** October 21, 2024 **Analyzed:** October 22, 2024

Wednesday 23 October

Analyzed by: Jonathan Chann **Batch:** 125317

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6 Huron Drive
Natick, MA 01760

Project Information

Davey Lopes Rec Center,
227 Dudley St.,
Providence,
RI

Method: BULK PLM ANALYSIS, EPA/600/R-93/116

FieldID / LabID	Material	Location	Color	Non-Asbestos %	Asbestos %
48C / 1387758	Dk Gray Grout	in Between Red Quarry Tile Main Entrance	gray	Non-Fibrous 100	None Detected
49A / 1387759	Gray-Tan Mastic	on Red Quarry Tile Main Entrance	tan	Non-Fibrous 100	None Detected
49B / 1387760	Gray-Tan Mastic	on Red Quarry Tile Main Entrance	tan	Non-Fibrous 100	None Detected
49C / 1387761	Gray-Tan Mastic	on Red Quarry Tile Main Entrance	tan	Non-Fibrous 100	None Detected
50A / 1387762	Gray-Tan Levelastic	Under Acrylic Floors - Primary Halls	multi	Non-Fibrous 100	None Detected
50B / 1387763	Gray-Tan Levelastic	Under Acrylic Floors - Primary Halls	multi	Non-Fibrous 100	None Detected
50C / 1387764	Gray-Tan Levelastic	Under Acrylic Floors - Primary Halls	multi	Non-Fibrous 100	None Detected
50D / 1387765	Gray-Tan Levelastic	Under Acrylic Floors - Primary Halls	multi	Non-Fibrous 100	None Detected
50E / 1387766	Gray-Tan Levelastic	Under Acrylic Floors - Primary Halls	multi	Non-Fibrous 100	None Detected
51A / 1387767	Dk Gray HVAC Flex Connector	Boiler Room	gray	Fiberglass 70 Non-Fibrous 30	None Detected
51B / 1387768	Dk Gray HVAC Flex Connector	Boiler Room	gray	Fiberglass 70 Non-Fibrous 30	None Detected
52A / 1387769	Tan Skim/Levelastic	Under Wood Gym Floor	tan	Non-Fibrous 100	None Detected
52B / 1387770	Tan Skim/Levelastic	Under Wood Gym Floor	tan	Non-Fibrous 100	None Detected
52C / 1387771	Tan Skim/Levelastic	Under Wood Gym Floor	tan	Non-Fibrous 100	None Detected
53A / 1387772	Gray Mastic	Under Ceramic Floor Tiles Women's Room	multi	Non-Fibrous 100	None Detected
53B / 1387773	Gray Mastic	Under Ceramic Floor Tiles Women's Room	multi	Non-Fibrous 100	None Detected

Sampled: September 19, 2024 **Received:** October 21, 2024 **Analyzed:** October 22, 2024

Wednesday 23 October

Analyzed by: Jonathan Chann **Batch:** 125317

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Natick, MA 01760

Project Information

Davey Lopes Rec Center,
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Providence,
RI

Method: BULK PLM ANALYSIS, EPA/600/R-93/116

FieldID / LabID	Material	Location	Color	Non-Asbestos %	Asbestos %
53C / 1387774	Gray Mastic	Under Ceramic Floor Tiles Women's Room	multi	Non-Fibrous 100	None Detected
54A / 1387775	Gray Grout	Women's Room Between Ceramic Floor Tile	gray	Non-Fibrous 100	None Detected
54B / 1387776	Gray Grout	Women's Room Between Ceramic Floor Tile	gray	Non-Fibrous 100	None Detected
54C / 1387777	Gray Grout	Women's Room Between Ceramic Floor Tile	gray	Non-Fibrous 100	None Detected
55A / 1387778	Gray Mastic	Under Ceramic Floor Tiles Men's Room	gray	Non-Fibrous 100	None Detected
55B / 1387779	Gray Mastic	Under Ceramic Floor Tiles Men's Room	gray	Non-Fibrous 100	None Detected
55C / 1387780	Gray Mastic	Under Ceramic Floor Tiles Men's Room	gray	Non-Fibrous 100	None Detected
56A / 1387781	Gray Floor Tile Grout	Between Ceramic Floor Tiles Men's Locker Room	gray	Non-Fibrous 100	None Detected
56B / 1387782	Gray Floor Tile Grout	Between Ceramic Floor Tiles Men's Locker Room	gray	Non-Fibrous 100	None Detected
57A / 1387783	Gray Setting Bed	Under Glazed Wall Tiles Boy's Locker Room	gray	Non-Fibrous 100	None Detected
57B / 1387784	Gray Setting Bed	Under Glazed Wall Tiles Boy's Locker Room	gray	Non-Fibrous 100	None Detected
57C / 1387785	Gray Setting Bed	Under Glazed Wall Tiles Boy's Locker Room	gray	Non-Fibrous 100	None Detected
58A / 1387786	Yellow over Black Paint	Old Pool Boxing Ring	multi	Non-Fibrous 100	None Detected
58B / 1387787	Yellow over Black Paint	Old Pool Boxing Ring	multi	Non-Fibrous 100	None Detected
58C / 1387788	Yellow over Black Paint	Old Pool Boxing Ring	multi	Non-Fibrous 100	None Detected
59A / 1387789	White Paint	on Steel Beams Interior Throughout	white	Non-Fibrous 100	None Detected

Sampled: September 19, 2024 **Received:** October 21, 2024 **Analyzed:** October 22, 2024

Wednesday 23 October

Analyzed by: Jonathan Chann **Batch:** 125317

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Natick, MA 01760

Project Information

Davey Lopes Rec Center,
227 Dudley St.,
Providence,
RI

Method: BULK PLM ANALYSIS, EPA/600/R-93/116

FieldID / LabID	Material	Location	Color	Non-Asbestos %	Asbestos %
59B / 1387790	White Paint	on Steel Beams Interior Throughout	white	Non-Fibrous 100	None Detected
59C / 1387791	White Paint	on Steel Beams Interior Throughout	white	Non-Fibrous 100	None Detected
60A / 1387792	White Layer	on Steel Duct Pins- Boiler Room	white	Fiberglass 5 Cellulose 20 Non-Fibrous 75	None Detected
60B / 1387793	White Layer	on Steel Duct Pins- Boiler Room	white	Fiberglass 5 Cellulose 20 Non-Fibrous 75	None Detected

Sampled: September 19, 2024 **Received:** October 21, 2024 **Analyzed:** October 22, 2024

Wednesday 23 October

Analyzed by: Jonathan Chann **Batch:** 125317

Client: CDM Consultants
Address: 1 California Ave Suite 304 Framingham MA
Project Site & #: Davey Lopes Rec Center
227 Dudley St Providence, RI
Phone / email address:
Scahalan@cdmconsultants.com
Contact: Susan Cahalan
Relinquish by/date: 10/18/2024
Received by/date: 10/21/24
# of Samples Received: 100

CHAIN OF CUSTODY

EPA/600/R-93/116

Asbestos Identification Lab
165 New Boston St.
Suite 227
Woburn, MA 01801
(781)932-9600
www.asbestosidentificationlab.com

Date Sampled: 9/19/2024

BATCH# 125317 Rev 07/24

Page 1 of 21

Turnaround Time

- [ ] Less 3 Hrs
- [ ] Same Day
- [ ] Next Day
- [ ] Two Day
- [x] Three Day

Sample Method

- [x] Bulk
- [ ] Soil Rug Roof Dumpster
- [ ] Wipe
- [ ] Point Count
- [ ] NOB

Stop on 1st Positive? Yes/No

Analyzed By: Jonathan Chann

Date: 10/22/24

Temp in Celsius = 23

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Material / Location	Stereomicroscope: % of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Optical Properties: Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI: ∥	RI: ⊥	Non-Asbestos Percentage (%): Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
1287694	29A	Material: Maroon expansion joint caulk Location: Exterior - pool side	0	Br	Y	G	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
95	29B	Material: 〃 Location: 〃	0	Br	Y	G	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
96	29C	Material: 〃 Location: 〃	0	Br	Y	G	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100

Davey Tapes

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Temp in Celcius = ____ / Material / Location	Stereomicroscope: % of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Optical Properties: Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI: =	RI: ⊥	Non-Asbestos Percentage (%): Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
97	30A	Material: Dark gray/Black Caulk Location: Exterior door to Mens Locker Room	0	Gy	N	G	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
98	30B	Material: " " Location: " "	0	Gy	N	G	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
99	30B	Material: " " Location: " "	0	Gy	N	G	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
700	31A	Material: Dark gray/Black Caulk Location: Exterior, base of building near First AID	0	Gy	Y	G	N	Chrysotile	3	W	P	+	L	N	1.538	1.551							
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															97
01	31B	Material: " " Location: " "						Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															

DMA

Davey Lopez

Temp in Celcius = ____

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Material / Location	Stereomicroscope: % of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Optical Properties: Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI: ∥	RI: ⊥	Non-Asbestos Percentage (%): Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
02	31C	Material 〃 〃 Location 〃 〃						Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															
03	32A	Material Black Caulk Location Exterior Door @ First Aid	0	Blk	Y	G	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
04	32B	Material 〃 〃 Location 〃 〃	0	Blk	Y	G	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
05	32C	Material 〃 〃 Location 〃 〃	0	Blk	Y	G	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
06	33A	Material Gray Caulk Location Exterior Base of Building + Pool Concrete Slab	0	Gry	Y	G	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100

DMA

Davey Lopez

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Material / Location	Stereomicroscope: % of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Optical Properties: Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI: ∥	RI: ⊥	Non-Asbestos Percentage (%): Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
07	33B	Material / Location	0	Gry	Y	G	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
08	33C	Material / Location	0	Gry	Y	G	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
09	33D	Material / Location	0	Gry	Y	G	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
10	33E	Material / Location	0	Gry	Y	G	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
11	34A	Material: Thick Black Caulk Location: Base building near main entrance	0	Gry	Y	G	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100

Dany Lopez

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Temp in Celcius = ____ / Material / Location	Stereomicroscope: % of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Optical Properties: Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI: ∥	RI: ⊥	Non-Asbestos Percentage (%): Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
12	34B	Material: " " / Location: " "	0	Gry	Y	G	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
13	34C	Material: " " / Location: " "	0	Gry	Y	G	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
14	35A	Material: Dk. Gray/Black caulk / Location: Large windows at front	0	Gry	Y	G	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
15	35B	Material: " " / Location: " "	0	Gry	Y	G	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
16	35C	Material: " " / Location: " "	0	Gry	Y	G	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100

Dovay Lopez

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Temp in Celcius = ____ / Material / Location	Stereomicroscope: % of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Optical Properties: Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI: ∥	RI: ⊥	Non-Asbestos Percentage (%): Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous	
17	36A	Material: Thin layer Caulk Dark Gray/Brown Location: Wall Exterior window Aluminum frames	0	Gy	Y	C	N	Chrysotile	5	W	P	+	L	N	1.557	1.551							95	
								Amosite																
								Crocidolite																
								Tremolite																
								Anthophyllite																
								Actinolite																
18	36B	Material: 〃 〃 Location: 〃 〃						Chrysotile																PLM
								Amosite																
								Crocidolite																
								Tremolite																
								Anthophyllite																
								Actinolite																
19	36C	Material: 〃 〃 Location: 〃 〃						Chrysotile																DUP
								Amosite																
								Crocidolite																
								Tremolite																
								Anthophyllite																
								Actinolite																
20	37A	Material: Dark gray Black exterior caulk Location: window Frosted Glass windows	0	Gy	Y	C	N	Chrysotile	5	W	P	+	L	N	1.558	1.55							95	
								Amosite																
								Crocidolite																
								Tremolite																
								Anthophyllite																
								Actinolite																
21	37B	Material: 〃 〃 Location: 〃 〃						Chrysotile																DUP
								Amosite																
								Crocidolite																
								Tremolite																
								Anthophyllite																
								Actinolite																

Darvey logo

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Temp in Celcius = ____ / Material / Location	Stereomicroscope: % of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Optical Properties: Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI: ∥	RI: ⊥	Non-Asbestos Percentage (%): Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous	
22	37C	Material: 〃 〃 / Location: 〃 〃						Chrysotile																
								Amosite																
								Crocidolite																
								Tremolite																
								Anthophyllite																
								Actinolite																DAA
23	38A	Material: Black Blaze / Location: Exterior windows With Frosted Glass	0	Bk	Y	G	N	Chrysotile	10	N	P	+	L	N	1.558	1.551								
								Amosite																
								Crocidolite																
								Tremolite																
								Anthophyllite																
								Actinolite																90
24	38B	Material: 〃 〃 / Location: 〃 〃						Chrysotile																
								Amosite																
								Crocidolite																
								Tremolite																
								Anthophyllite																
								Actinolite																DAA
25	38C	Material: 〃 〃 / Location: 〃 〃						Chrysotile																
								Amosite																
								Crocidolite																
								Tremolite																
								Anthophyllite																
								Actinolite																D1A
26	39A	Material: (SC) Dark gray Black caulk / Location: Door main entrance	0	Gy	Y	G	N	Chrysotile																
								Amosite																
								Crocidolite																
								Tremolite																
								Anthophyllite																
								Actinolite																60

Davey lopez

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Temp in Celcius = ____ / Material / Location	Stereomicroscope					Asbestos Minerals	Optical Properties						RI		Non-Asbestos Percentage (%)						
			% of Asbestos	Color	Homogeneity	Texture	Friable		Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	∥	⊥	Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
27	39B	Material 〃 〃 Location 〃 〃	0	Gy	Y	G	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
28	39C	Material 〃 〃 Location 〃 〃	0	Gy	Y	G	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
29	40A	Material Black Caulk Location Inner Bead front Door exterior frame to Door	0	Bk	Y	G	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
30	40B	Material 〃 〃 Location 〃 〃	0	Bk	Y	G	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
31	40C	Material 〃 〃 Location 〃 〃	0	Bk	Y	G	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100

Davey 1080

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Temp in Celcius = ____ / Material / Location	Stereomicroscope: % of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Optical Properties: Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI: ∥	RI: ⊥	Non-Asbestos Percentage (%): Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
32	41A	Material: Brown-Blue paint Location: Behind wood lobby credenza - Trim area	0	N	N	G	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
33	41B	Material: " " Location: " "	0	N	N	G	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
34	41C	Material: " " Location: " "	0	N	N	G	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
35	42A	Material: Old Mortar with Black Coating Location: Behind Wall in Lobby	0	N	N	G	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
36	42B	Material: " " Location: " "	0	N	N	G	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100

Dara Lopez

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Temp in Celcius = ____ / Material / Location	Stereomicroscope: % of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Optical Properties: Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI: ∥	RI: ⊥	Non-Asbestos Percentage (%): Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
37	A2C	Material: 〃 〃 / Location: 〃 〃	0	n	~	G	~	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
38	A3A	Material: Yellow Brown Paint / Location: on Steel Pipes Janitor room	0	n	~	G	~	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
39	A3B	Material: 〃 〃 / Location: 〃 〃	0	n	~	G	~	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
40	A4A	Material: Black painted gray Caulk / Location: Top of CMU - Computer room	0	n	~	G	~	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
41	A4B	Material: 〃 〃 / Location: 〃 〃	0	n	~	G	~	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100

Dave Lopez

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Temp in Celcius = ____ / Material / Location	Stereomicroscope: % of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Optical Properties: Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI: ∥	RI: ⊥	Non-Asbestos Percentage (%): Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
42	AAC	Material: 11 11 / Location: 11 11	O	M	N	G	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
43	45A	Material: Dark Gray Black / Location: Exterior window Door TO glaze on computer room	O	Gr	Y	G	N	Chrysotile	10	W	P	+	L	N	1.558	1.551							
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															90
44	45B	Material: 11 11 / Location: 11 11						Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															DMT
45	Roof 1A	Material: brown glue under Rubber / Location: Roof Roof Core	O	Br	Y	gn	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															10
46	Roof 1B	Material: Black Tar paper / Location: Top + Bottom Roof Foam Wood Deck	O	BK	Y	F	N	Chrysotile									5		R				
								Amosite															
								Crocidolite															
								Tremolite									1		15				
								Anthophyllite															
								Actinolite									10		45				20

Davey Lopez

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Temp in Celcius = ____ / Material / Location	Stereomicroscope: % of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Optical Properties: Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI: ∥	RI: ⊥	Non-Asbestos Percentage (%): Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
47	Roof- 2A	Material: Brown Glue Location: under Rubber Roof	0	B-	y	gr	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															1%
48	Roof- 2B	Material: Black Paper Location: Top + Bottom Roof foam - 2 Layers	0	BK	y	f	N	Chrysotile									5		R				
								Amosite															
								Crocidolite									1		LS				
								Tremolite															
								Anthophyllite															
								Actinolite									4%		4%				2%
49	Roof 3A	Material: Brown Glue Location: Under Rubber Roof	0	Br	y	gr	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															1%
50	Roof 3B	Material: Black Tar Location: Top + Bottom Roof foam	0	BK	y	f	N	Chrysotile															
								Amosite									5		R				
								Crocidolite									1		LE				
								Tremolite															
								Anthophyllite															
								Actinolite									4%		4%				2%
51	46A	Material: Black Tar Location: Dripping from Roof on Interior Hallway	0	BK	y	gr	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															1%

Dorey 1apo

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Temp in Celcius = ____ / Material / Location	Stereomicroscope: % of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Optical Properties: Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI: ∥	RI: ⊥	Non-Asbestos Percentage (%): Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
52	46B	Material: 〃 〃 / Location: 〃 〃	0	BK	y	gn	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
53	46C	Material: 〃 〃 / Location: 〃 〃	0	BK	y	gn	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
54	47A	Material: Tan Caulk / Location: Around Men's urinals	0	T	y	gn	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
55	47B	Material: 〃 〃 / Location: 〃 〃	0	T	y	gn	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
56	48A	Material: DK gray Grout / Location: In between red main quarry Tile entrance	0	gy	y	gn	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100

Davey Topes

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Material / Location (Temp in Celcius = ____)	% of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI ‖	RI ⊥	Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
57	48B	Material: 〃 〃 Location: 〃 〃	0	gy	y	gn	N	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite															100
58	48C	Material: 〃 〃 Location: 〃 〃	0	gy	y	gn	N	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite															100
59	49A	Material: Gray-Tan Mastic Location: on Red Quarry Tile Main entrance	0	T	y	gn	N	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite															100
60	49B	Material: 〃 〃 Location: 〃 〃	0	T	y	gn	N	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite															100
61	49C	Material: 〃 〃 Location: 〃 〃	0	T	y	gn	N	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite															100

Davey Lopp

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Temp in Celcius = ____ / Material / Location	Stereomicroscope: % of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Optical Properties: Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI: ∥	RI: ⊥	Non-Asbestos Percentage (%): Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
02	50A	Material: Gray-Tan Levelasric Location: Under Acrylic Floors-Primary Halls	0	m	N	gr	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															1
03	50B	Material: " " Location: " "	0	m	N	gr	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
04	50C	Material: " " Location: " "	0	m	N	gr	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															60
05	50D	Material: " " Location: " "	0	m	N	gr	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															10
06	50E	Material: " " Location: " "	0	m	N	gr	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															10

Dover 1980

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Temp in Celcius = ____ / Material / Location	Stereomicroscope: % of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Optical Properties: Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI: ∥	RI: ⊥	Non-Asbestos Percentage (%): Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
67	51A	Material: Dk Gray HVAC flex connector Location: Boiler Room	2	gy	s	gy/f	N	Chrysotile									5						
								Amosite															
								Crocidolite									1						
								Tremolite															
								Anthophyllite															
								Actinolite									7a						3a
68	51B	Material: 〃 〃 Location: 〃 〃	2	gy	s	gy/f	N	Chrysotile									5						
								Amosite															
								Crocidolite									1						
								Tremolite															
								Anthophyllite															
								Actinolite									7a						3a
69	52A	Material: Tan Skin/ Levelastic Location: Under wood Gym floor	0	t	y	gn	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
70	52B	Material: 〃 〃 Location: 〃 〃	0	t	y	gn	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
71	52C	Material: 〃 〃 Location: 〃 〃	0	t	y	gn	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100

Davey 10pm

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Temp in Celcius = ____ / Material / Location	Stereomicroscope: % of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Optical Properties: Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI: ∥	RI: ⊥	Non-Asbestos Percentage (%): Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
72	53A	Material: Gray Mastic Location: under Ceramic Floor Tiles Women Room	e	gr	w	gr	w	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															1%
73	53B	Material: " " Location: " "	o	gr	w	gr	w	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															1%
74	53C	Material: " " Location: " "	o	gr	w	gr	w	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															1%
75	54A	Material: Gray Grout Location: Women's Room between ceramic floor Tile	o	gy	y	gr	w	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															1%
76	54B	Material: " " Location: " "	o	gy	y	gr	w	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															1%

Dewey Labs

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Temp in Celcius = ____ / Material / Location	Stereomicroscope					Asbestos Minerals	Optical Properties						RI		Non-Asbestos Percentage (%)						
			% of Asbestos	Color	Homogeneity	Texture	Friable		Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	∥	⊥	Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
77	54C	Material: 〃 〃 Location: 〃 〃	0	gy	h	gr	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
78	55A	Material: Gray mastic Location: under ceramic floor tile men's locker room	0	gy	h	gr	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
79	55B	Material: 〃 〃 Location: 〃 〃	0	gy	h	gr	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
80	55C	Material: 〃 〃 Location: 〃 〃	0	gy	h	gr	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
81	56A	Material: Gray floor tile Grout Location: Between ceramic floor tiles men's locker room	0	gy	h	gr	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100

Darcy Lopez

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Temp in Celcius = ____ / Material / Location	Stereomicroscope: % of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Optical Properties: Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI: ∥	RI: ⊥	Non-Asbestos Percentage (%): Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
56	56B	Material: 〃 〃 / Location: 〃 〃	0	gy	h	gr	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
57	57A	Material: Gray Lifting Red / Location: under glazed tops Wall TILE locker room	0	gy	h	gr	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
58	57B	Material: 〃 〃 / Location: 〃 〃	0	gy	h	gr	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
59	57C	Material: 〃 〃 / Location: 〃 〃	0	gy	h	gr	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100
60	58A	Material: Yellow over Black paint / Location: Old pool Boxing Ring	0	mr	r	gr	N	Chrysotile															
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															100

Davey lopes

Page 20 of 21

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Material / Location (Temp in Celcius = ____)	% of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI ∥	RI ⊥	Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
87	58B	Material " " Location " "	0	gr	n	gn	N	Chrysotile															100
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															
88	58C	Material " " Location " "	0	gr	n	gn	N	Chrysotile															100
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															
89	59A	Material White Paint Location on Steel beams Interior Throughout	0	W	y	gn	N	Chrysotile															100
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															
90	59B	Material " " Location " "	0	W	y	gn	N	Chrysotile															100
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															
91	59C	Material " " Location " "	0	W	y	gn	N	Chrysotile															100
								Amosite															
								Crocidolite															
								Tremolite															
								Anthophyllite															
								Actinolite															

Dave Lopes

Lab ID# (Lab Use Only)	Field ID/ (Client Reference)	Material / Location (Temp in Celcius = ____)	% of Asbestos	Color	Homogeneity	Texture	Friable	Asbestos Minerals	Asbestos %	Morphology	Extinction	Sign of Elongation	Birefringence	Pleochroism	RI ∥	RI ⊥	Fiberglass	Mineral Wool	Cellulose	Hair	Synthetic	Other	Non-Fibrous
92	60A	Material: White layer Location: on Steel Duct Pins - Boiler room	0	W	Y	gn/k	N	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite									1 1 5		8 4 3				75
93	60B	Material: " " Location: " " " "	0	W	Y	gn/k	N	Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite									5 1 5		8 4 2				7
		Material Location						Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite															
		Material Location						Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite															
		Material Location						Chrysotile Amosite Crocidolite Tremolite Anthophyllite Actinolite															

APPENDIX B

EMSL Analytical, Inc.

528 Mineola Avenue, Carle Place, NY, 11514
Telephone: 516.997.7251 Fax:856-786-5974
EMSL-CP-06

EMSL Order ID: 062457071
LIMS Reference ID: EC57071
EMSL Customer ID: CDWC26

Attention: Susan Cahalan
CDW Consultants [CDWC26]
4 California Avenue, Suite 301
Framingham, MA 01701
(508) 875-2657
scahalan@cdwconsultants.com

Project Name: Davey Lopes Rec Center, 227 Dudley St. Providence, RI
Customer PO:
EMSL Sales Rep: David Prince
Received: 10/21/2024 08:59
Reported: 10/23/2024 08:37

Analytical Results

Analyte	Results	RL	Weight(g)	Prep Date & Tech	Prep Method	Analysis Date & Analyst	Analytical Method	Q	DF
Client Sample ID: LBP-10A/White Paint on Steel - Interior									**Date Sampled: 09/19/24**
Matrix: Chips									**LIMS Reference ID: EC57071-01**
Lead	0.008 % wt	0.008 % wt	0.2599	10/22/24 AP1	SW-846 3050B	10/22/24 KT1	SW 846-7000B		1
Sample Comments:									
Client Sample ID: LBP-10B/White Paint on Steel - Interior									**Date Sampled: 09/19/24**
Matrix: Chips									**LIMS Reference ID: EC57071-02**
Lead	<0.008 % wt	0.008 % wt	0.2676	10/22/24 AP1	SW-846 3050B	10/22/24 KT1	SW 846-7000B		1
Sample Comments:									
Client Sample ID: LBP-10C/White Paint on Steel - Interior									**Date Sampled: 09/19/24**
Matrix: Chips									**LIMS Reference ID: EC57071-03**
Lead	<0.008 % wt	0.008 % wt	0.2625	10/22/24 AP1	SW-846 3050B	10/22/24 KT1	SW 846-7000B		1
Sample Comments:									
Client Sample ID: LBP-11A/Black over yellow - Boxing Ring									**Date Sampled: 09/19/24**
Matrix: Chips									**LIMS Reference ID: EC57071-04**
Lead	0.014 % wt	0.008 % wt	0.2648	10/22/24 AP1	SW-846 3050B	10/22/24 KT1	SW 846-7000B		1
Sample Comments:									
Client Sample ID: LBP-11B/Black over yellow - Boxing Ring									**Date Sampled: 09/19/24**
Matrix: Chips									**LIMS Reference ID: EC57071-05**
Lead	0.010 % wt	0.008 % wt	0.2846	10/22/24 AP1	SW-846 3050B	10/22/24 KT1	SW 846-7000B		1
Sample Comments:									
Client Sample ID: LBP-11C/Black over yellow - Boxing Ring									**Date Sampled: 09/19/24**
Matrix: Chips									**LIMS Reference ID: EC57071-06**
Lead	0.018 % wt	0.008 % wt	0.2768	10/22/24 AP1	SW-846 3050B	10/22/24 KT1	SW 846-7000B		1
Sample Comments:									
Client Sample ID: LBP-12A/Brown blue paint behind wood covebase									**Date Sampled: 09/19/24**
Matrix: Chips									**LIMS Reference ID: EC57071-07**
Lead	0.45 % wt	0.070 % wt	0.2858	10/22/24 AP1	SW-846 3050B	10/22/24 KT1	SW 846-7000B	D	10
Sample Comments:									
Client Sample ID: LBP-12B/Brown blue paint behind wood covebase									**Date Sampled: 09/19/24**
Matrix: Chips									**LIMS Reference ID: EC57071-08**
Lead	0.31 % wt	0.008 % wt	0.256	10/22/24 AP1	SW-846 3050B	10/22/24 KT1	SW 846-7000B		1
Sample Comments:									
Client Sample ID: LBP-12C/Brown blue paint behind wood covebase									**Date Sampled: 09/19/24**
Matrix: Chips									**LIMS Reference ID: EC57071-09**
Lead	0.49 % wt	0.078 % wt	0.2551	10/22/24 AP1	SW-846 3050B	10/22/24 KT1	SW 846-7000B	D	10
Sample Comments:									

EMSL Analytical, Inc.

528 Mineola Avenue, Carle Place, NY, 11514
Telephone: 516.997.7251 Fax:856-786-5974
EMSL-CP-06

EMSL Order ID: 062457071
LIMS Reference ID: EC57071
EMSL Customer ID: CDWC26

Attention: Susan Cahalan
CDW Consultants [CDWC26]
4 California Avenue, Suite 301
Framingham, MA 01701
(508) 875-2657
scahalan@cdwconsultants.com

Project Name: Davey Lopes Rec Center, 227 Dudley St. Providence, RI

Customer PO:
EMSL Sales Rep: David Prince
Received: 10/21/2024 08:59
Reported: 10/23/2024 08:37

Certified Analyses included in this Report

Analyte	Certifications
SW 846-7000B in Chips	
Lead	06-AIHA LAP

List of Certifications

Code	Description	Number	Expires
06-AIHA LAP	EMSL Analytical, Inc. Carle Place, NY AIHA-LAP, LLC-ELLAP Accredited	102344	08/01/2026
06-NYSDOH	New York State Department of Health	11469	04/01/2025
06-NYSELAP	NY NYS ELAP	11469	04/01/2025
06-California ELAP	California Water Boards	2339	04/01/2025
06-CTDPH	Connecticut Department of Public Health	PH-0249	03/31/2025

Please see the specific Field of Testing (FOT) on www.emsl.com <http://www.emsl.com> for a complete listing of parameters for which EMSL is certified.

Notes and Definitions

Item	Definition
D	Analyte was reported from a dilution run.
(Dig)	For metals analysis, sample was digested.
[2C]	Reported from the second channel in dual column analysis.
DF	Dilution Factor
MDL	Method Detection Limit.
ND	Analyte was NOT DETECTED at or above the detection limit.
NR	Spike/Surrogate showed no recovery.
Q	Qualifier
RL	Reporting Limit
Wet	Sample is not dry weight corrected.

Measurement of uncertainty and any applicable definitions of method modifications are available upon request. Per EPA NLLAP policy, sample results are not blank corrected.

EMSL Analytical, Inc.

528 Mineola Avenue, Carle Place, NY, 11514
Telephone: 516.997.7251 Fax:856-786-5974
EMSL-CP-06

EMSL Order ID: 062457071
LIMS Reference ID: EC57071
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Attention: Susan Cahalan
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(508) 875-2657
scahalan@cdwconsultants.com

Project Name: Davey Lopes Rec Center, 227 Dudley St. Providence, RI

Customer PO:
EMSL Sales Rep: David Prince
Received: 10/21/2024 08:59
Reported: 10/23/2024 08:37

James Han Laboratory Manager or other approved signatory

Analysis following EMSL SOP for the Determination of Environmental Lead by FLAA. The laboratory has a reporting limit of 0.008% by wt., based upon a minimum sample weight of 0.25g submitted to the lab, and is not responsible for any result or reporting limit provided in mg/cm2 since it is dependent upon an area value provided by non-lab personnel. A "<" (less than) result signifies that the analyte was not detected at or above the reporting limit. Measurement of uncertainty and definitions of modifications are available upon request. Results in this report are not blank corrected unless specified.

EMSL ANALYTICAL, INC.
LABORATORY • PRODUCTS • TRAINING

Lead Chain of Custody

EMSL Order Number / Lab Use Only

EC57071

EMSL Analytical, Inc.
Carle Place, NY 11514
PHONE: (516) 997-7251
EMAIL: carleplacelab@emsl.com

FEDEX

Customer Information		Billing Information	
Customer ID:		Billing ID:	
Company Name:	CDW Consultants	Company Name:	CDW Consultants
Contact Name:	susan Cahalan	Billing Contact:	susan Cahalan
Street Address:	4 california ave	Street Address:	4 california ave
City, State, Zip:	Framingham MA 01756	City, State, Zip:	Framingham MA 01756
Country:	US	Country:	US
Phone:	5088752657	Phone:	5088752657
Email(s) for Report:	scahalan@cdwconsultants.com	Email(s) for Invoice:	

Project Information

Project Name/No: Davey Lopes Rec Center, 227 Dudley St. Providence, RI
Purchase Order:
EMSL LIMS Project ID: (If applicable, EMSL will provide)
US State where samples collected: MA
State of Connecticut (CT) must select project location: ☐ Commercial (Taxable) ☐ Residential (Non-Taxable)
Sampled By Name: Susan Cahalan
Sampled By Signature:
No. of Samples in Shipment

Turn-Around-Time (TAT)

☐ 3 Hour ☐ 6 Hour ☐ 24 Hour ☐ 32 Hour ☒ 48 Hour ☐ 72 Hour ☐ 96 Hour ☐ 1 Week ☐ 2 Week

Please call ahead for large projects and/or turnaround times 6 Hours or Less. *32 Hour TAT available for select tests only; samples must be submitted by 11:30am.

MATRIX	METHOD	INSTRUMENT	REPORTING LIMIT	SELECTION
CHIPS ☒ % by wt. ☐ ppm (mg/kg) ☐ mg/cm² *Chips reporting Limit based on a minimum 0.25g sample weight. Not appropriate for Ceramic Tiles - XRF is recommended. *Sample Area Required below for mg/cm²	SW 846-7000B	Flame Atomic Absorption	*Please select reporting limit on left. -0.008% -80 ppm -mg/cm² - RL is Variable	☒ BP
	SW 846-6010D*	ICP-OES	*Please select reporting limit. on left. -0.0004% -40 ppm -mg/cm² - RL is Variable	☐
AIR	NIOSH 7082	Flame Atomic Absorption	4µg/filter	☐
	NIOSH 7300M / NIOSH 7303M	ICP-OES	0.5µg/filter	☐
	NIOSH 7300M / NIOSH 7303M	ICP-MS	0.05µg/filter	☐
WIPE ☐ ASTM ☐ NON-ASTM *If no box is checked, non-ASTM Wipe is assumed	SW 846-7000B	Flame Atomic Absorption	10µg/wipe	☐
	SW 846-6010D*	ICP-OES	1.0µg/wipe	☐
TCLP	SW 846-1311 / 7000B / SM 3111B	Flame Atomic Absorption	0.4 mg/L (ppm)	☐
	SW 846-1311 / SW 846-6010D*	ICP-OES	0.1 mg/L (ppm)	☐
SPLP	SW 846-1312 / 7000B / SM 3111B	Flame Atomic Absorption	0.4 mg/L (ppm)	☐
	SW 846-1312 / SW 846-6010D*	ICP-OES	0.1 mg/L (ppm)	☐
TTLC	22 CCR App. II, 7000B	Flame Atomic Absorption	40mg/kg (ppm)	☐
	22 CCR App. II, SW 846-6010D*	ICP-OES	2mg/kg (ppm)	☐
STLC	22 CCR App. II, 7000B	Flame Atomic Absorption	0.4 mg/L (ppm)	☐
	22 CCR App. II, SW 846-6010D*	ICP-OES	0.1 mg/L (ppm)	☐
Soil	SW 846-7000B	Flame Atomic Absorption	40mg/kg (ppm)	☐
	SW 846-6010D*	ICP-OES	2mg/kg (ppm)	☐
Wastewater Unpreserved ☐ Preserved with HNO3 ☐ PH<2	SM 3111B / SW 846-7000B	Flame Atomic Absorption	0.4 mg/L (ppm)	☐
	EPA 200.7	ICP-OES	0.020 mg/L (ppm)	☐
Drinking Water Unpreserved ☐ Preserved with HNO3 ☐ PH<2	EPA 200.5	ICP-OES	0.003 mg/L (ppm)	☐
	EPA 200.8	ICP-MS	0.001 mg/L (ppm)	☐
TSP/SPM Filter	40 CFR Part 50	ICP-OES	12 µg/filter	☐
Other:				☐

RECEIVED
EMSL ANALYTICAL, INC.
Carle Place, NY
OCT 21 2024 AM08:59

Sample Number	Sample Location	Volume / Area	Date / Time Sampled
LBP-10A	White Paint on Steel - Interior	-	9/19/2024
LBP-10B	" " "	-	
LBP-10C	" " "	-	
LBP-11A	Black over yellow - Boxing Ring	-	
LBP-11B	" " "	-	

Method of Shipment:

Sample Condition Upon Receipt:

Relinquished by:	Date/Time:	Received by:	Date/Time
	10-18-24	Brianna Perez	10/21/24 8:59 AM
Relinquished by:	Date/Time:	Received by:	Date/Time

Controlled Document COC-25 Lead R19 08/19/2024

*6010C Available Upon Request

☒ AGREE TO ELECTRONIC SIGNATURE (By checking, I consent to signing this Chain of Custody document by electronic signature.)

EMSL Analytical, Inc.'s laboratory Terms and Conditions are incorporated into this Chain of Custody by reference in their entirety. Submission of samples to EMSL Analytical, Inc. constitutes acceptance and acknowledgment of all terms and conditions by Customer.

PB Kathwid Jones 10/22/24

Davey Lopez

EMSL ANALYTICAL, INC.
LABORATORY • PRODUCTS • TRAINING

Lead Chain of Custody

EMSL Order Number / Lab Use Only

EC57071

EMSL Analytical, Inc.

Carle Place, NY 11514
PHONE: (516) 997-7251
EMAIL: carleplacelab@emsl.com

Additional Pages of the Chain of Custody are only necessary if needed for additional sample information

Special Instructions and/or Regulatory Requirements (Sample Specifications, Processing Methods, Limits of Detection, etc.)

Sample Number	Sample Location	Volume / Area	Date / Time Sampled
LBP-11C	" " "	—	9/19/2024
LBP-12A	Brown blue Paint Behind wood cove base	—	
LBP-12B	" " "	—	
LBP-12C	" " "	—	

RECEIVED
EMSL ANALYTICAL, INC.
Carle Place, NY
OCT 21 2024 AM09:00

Method of Shipment:		Sample Condition Upon Receipt:	
Relinquished by:	Date/Time:	Received by: Brianna Pheasy	Date/Time 10/21/24 @ 9:00
Relinquished by:	Date/Time:	Received by: BP	Date/Time 10/21/24

Controlled Document COC-25 Lead R19 08/19/2024

☐ **AGREE TO ELECTRONIC SIGNATURE** (By checking, I consent to signing this Chain of Custody document by electronic signature.)

EMSL Analytical, Inc.'s Laboratory Terms and Conditions are incorporated into this Chain of Custody by reference in their entirety. Submission of samples to EMSL Analytical, Inc. constitutes acceptance and acknowledgment of all terms and conditions by Customer.

PB Kathryn Jones 10/22/24

AEROBIOLOGY LABORATORY ASSOCIATES, INCORPORATED
A Pace Analytical® Laboratory

Telephone: 781-935-3212
Facsimile: 781-932-4857
Email: boston@aerobiology.net

Laboratory Report

Contact: Bryant Dana
Client: CDW Consultants, Inc.
Address: 4 California Drive
Framingham, MA 01701

Batch #: C 318378
Date received: 9/20/2024
Date analyzed: 9/27/2024
Date of report: 9/27/2024

AIHA-LAP, LLC Lab ID: 102754

Project # #2171.10
P.O.# N/A
Project Site: Davey Lopes
Providence, RI

Lead Analysis In Paint Using SOP Based on SW846-7000B/3051
Results in weight percent on an "as received" weight basis

Lab ID	Client ID	Sample date	Description	Result	Reporting Limit	Comments
C 749181	LBP-1	9/15/24	White Wall Cover - Pump Room	<RL	0.013	
C 749182	LBP-2	9/15/24	Gray Paint on Railings - Pump Room	0.385	0.039	
C 749183	LBP-3	9/15/24	Black Paint on Railings - Pump Room (Ext.)	<RL	0.049	
C 749184	LBP-4	9/15/24	Black Paint - Boxing Gym Walls	<RL	0.025	
C 749185	LBP-5	9/15/24	Yellow Paint - Boxing Gym Walls	<RL	0.031	
C 749186	LBP-6	9/15/24	Yellow Paint - Boxing Gym Pool Floor	<RL	0.061	
C 749187	LBP-7	9/15/24	Black Paint - Boxing Gym Pool Floor	0.041	0.019	
C 749188	LBP-8	9/15/24	White Paint - Boxing Gym Pool Floor	<RL	0.024	

Sydney Strong, Technical Manager Chemistry
Aimee Cormier, Lab Director

Unless otherwise indicated, all samples were received in acceptable condition.
All results apply only to the samples tested and as received and are accurate to no more than three significant figures.
Unless otherwise indicated, all the quality control criteria for the method above have been met.
RL-Reporting Limit(% by weight) Note on units: mg/Kg is the same as ppm by weight.
RL-Reporting Limit; Defined as the lowest concentration the laboratory can accurately quantitate.

Please visit our website at www.aerobiology.net for the current accreditation status.

ProScience Analytical Services, Inc.
Chemistry Chain of Custody Record

LABORATORY/HEADQUARTERS
22 Cummings Park, Woburn, MA 01801
T:781-935-3212 F:781-932-4857

www.proscience.net
general@proscience.net

Turn Around Time Requested: Rush/<6 Hours ☐ | Same Day ☐ | Next Day ☐ | 2 Day ☐ | 3 Day ☐ | 5 Days ☒

Client: CDW Consultants Inc.

Address: Street 4 California Ave
Town: Framingham State/Zip: MA / 01701

Project Site: Line 1 Davey Lopes, Providence, RI. Project Number: # 2171.10
Line 2

PO:

Contact: Bryant Dana PH: 781-994-2868
bdana@cdwconsultants.com FAX:
Alt/Pager:

☐ NELAC analysis

TYPE OF ANALYSIS (circle)

DUST WIPES	PAINT (0.1 g)	SOIL (1 g)
AIR	TSP	TCLP (100 g)
(mic)	PM10	Other

Please use a separate form for each matrix.

Element: Pb Cd Cr As Fe Se Ag Ba Hg gravimetric

Other (please specify under Comments)

☐ QC

For Laboratory Use
BATCH NUMBER: C318378

☐ ASTM E1792

FOR LABORATORY USE ONLY

Date and Time Sampled	Field I.D.	Sample Description/Location	Air Sampling Information: Start Time	End Time	Start Flowrate	End Flowrate	Volume (liters)	Wipe Area: length (inch)	width (inch)	Area (sq in)	Weight (grams)	ANALYSIS: Dil'n	AA/ICP Reading	RESULT	Lab I.D.
	LBP-1	White Wall Cover – Pump Room													749181
	LBP-2	Gray Paint on Railings – Pump Room													82
	LBP-3	Black Paint on Railings – Pump Room (Ext.)													83
	LBP-4	Black Paint – Boxing Gym Walls													84
	LBP-5	Yellow Paint – Boxing Gym Walls													85
	LBP-6	Yellow Paint – Boxing Gym Pool Floor													86
	LBP-7	Black Paint – Boxing Gym Pool Floor													87
	LBP-8	White Paint – Boxing Gym Pool Floor													88

Relinquished By: [signature] Date: 9/13/24 Time: 1500
Received By: [signature] Date: 9/20/24 Time: 11:15

Comments:

ver 8.5

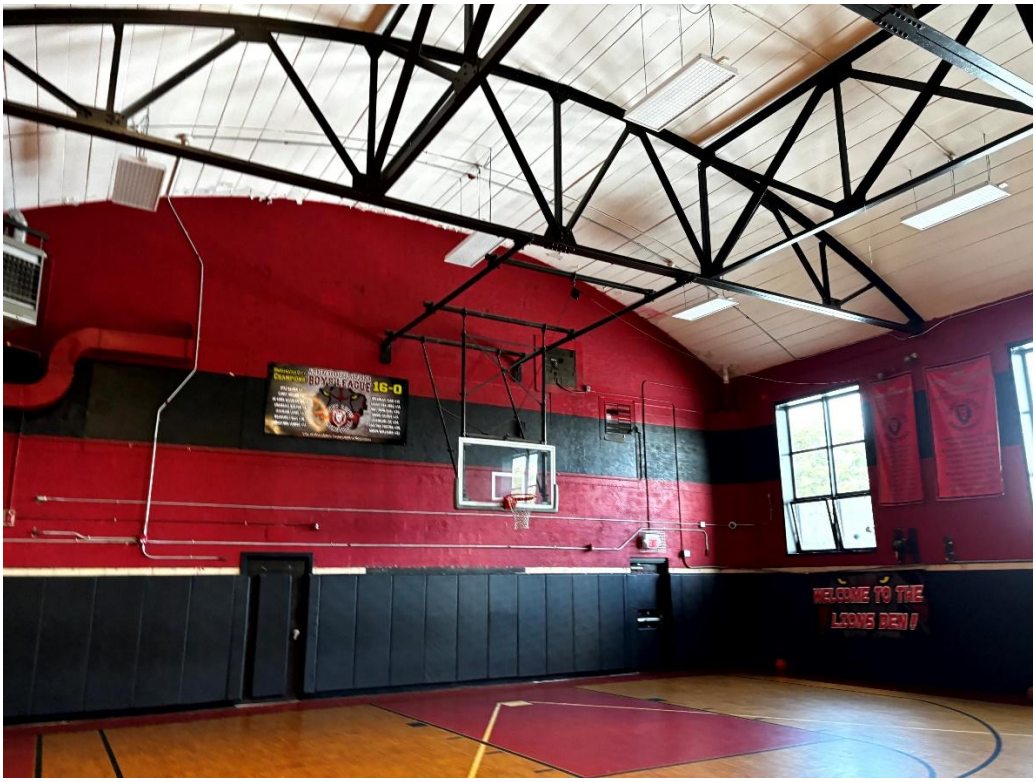
PAGE 1 OF 1

Field blanks are required for air and wipe samples per the sampling method and should be from the same source lot as was used for the collected field samples.
Proscience Analytical Services reserves the right to subcontract samples to an appropriately accredited laboratory when we are unable to perform the analysis in house.

APPENDIX C

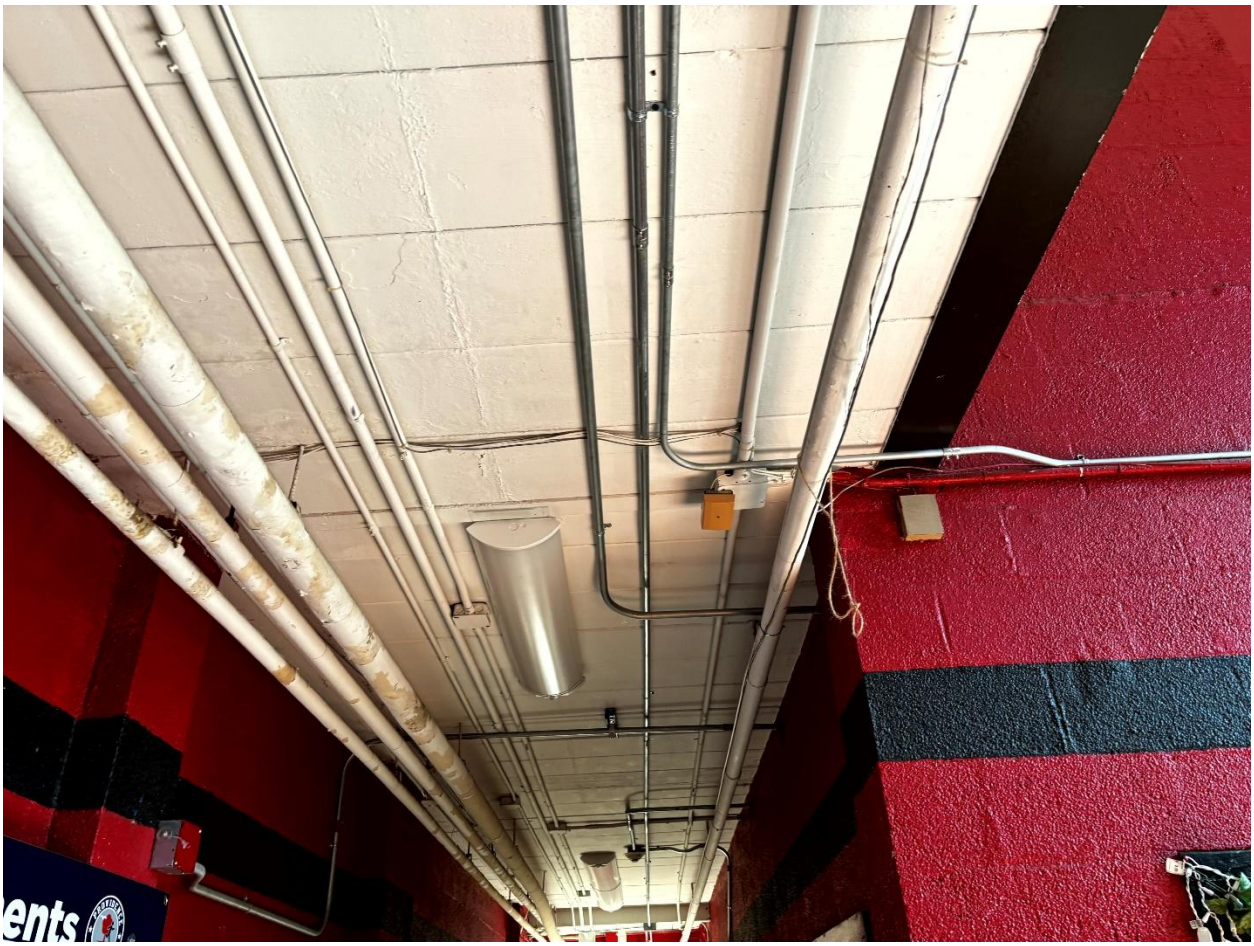
Davey Lopes Photo Log

This photo shows the main entrance.

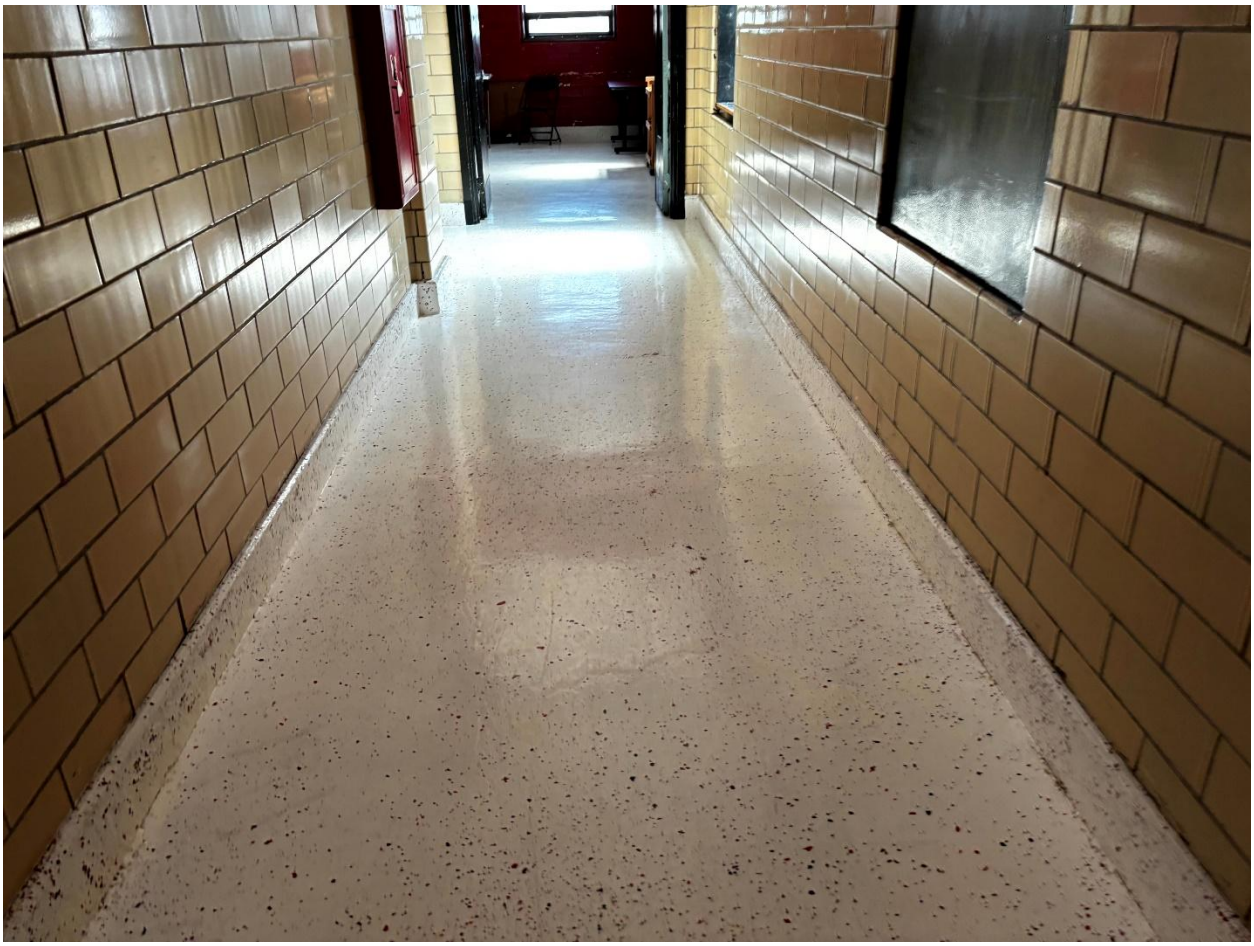


This photo shows the basketball gymnasium.

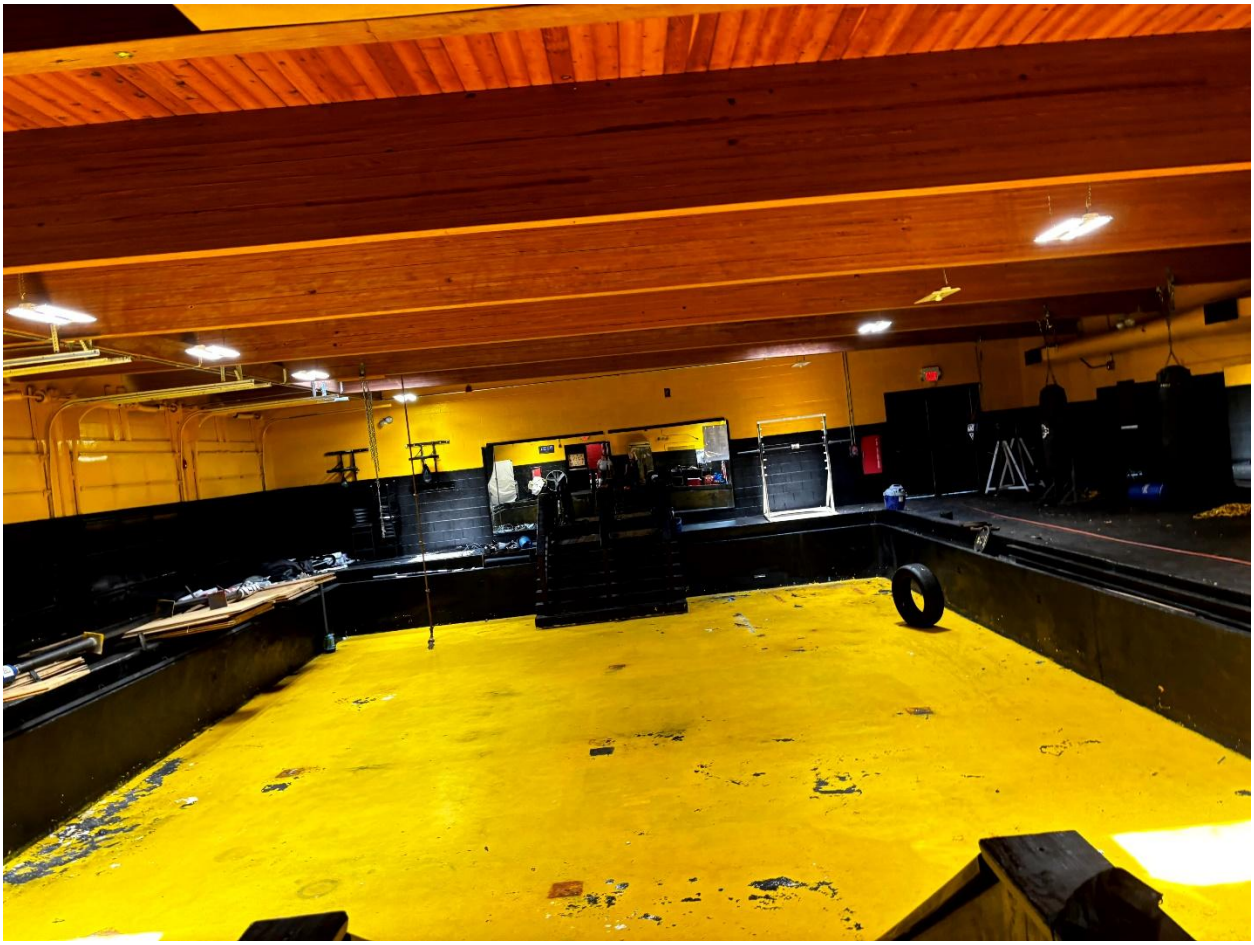
This photo also shows the basketball gymnasium.



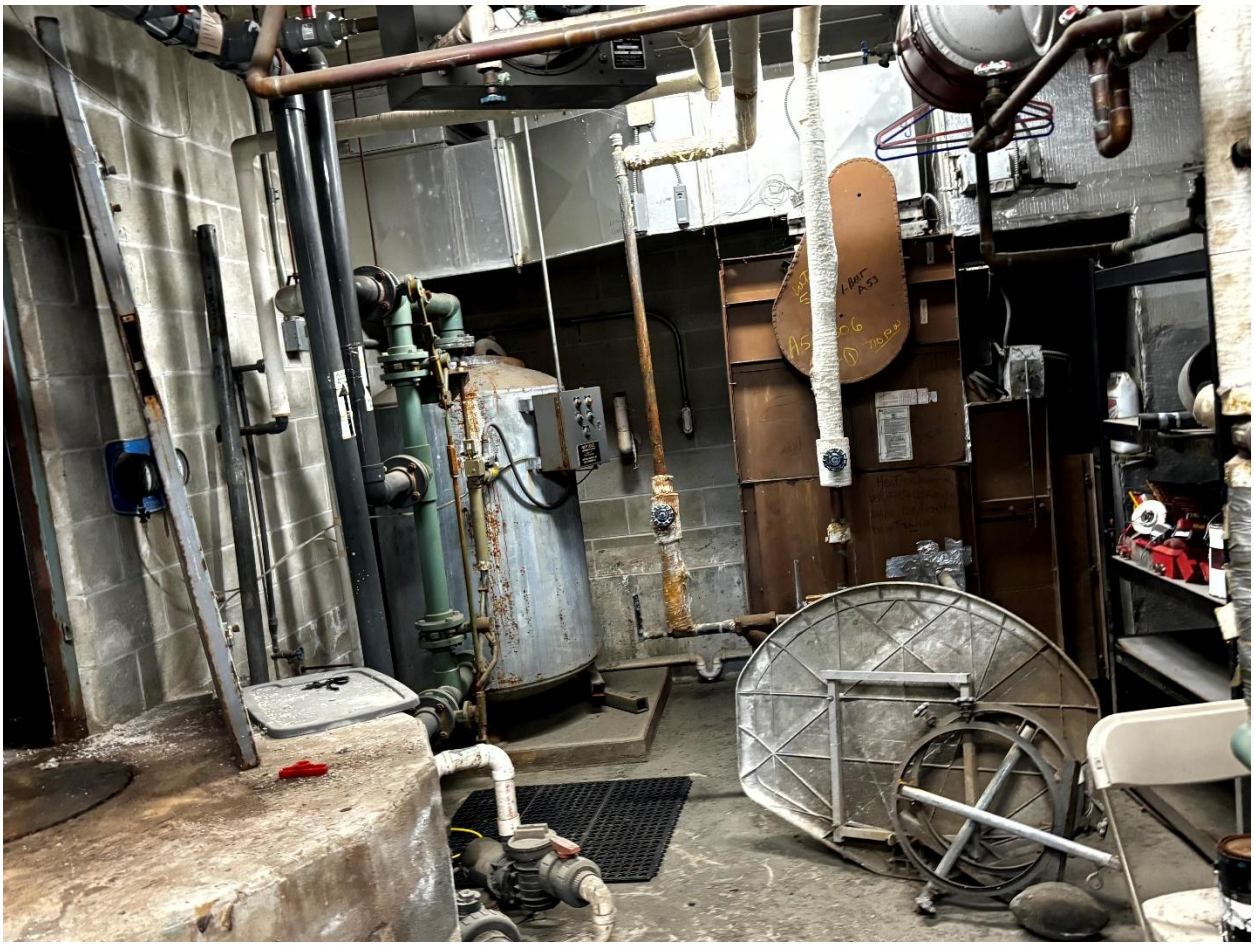
This photo shows the ceiling of the main hallway.



This photo shows the flooring of the hallways and most of the rooms.

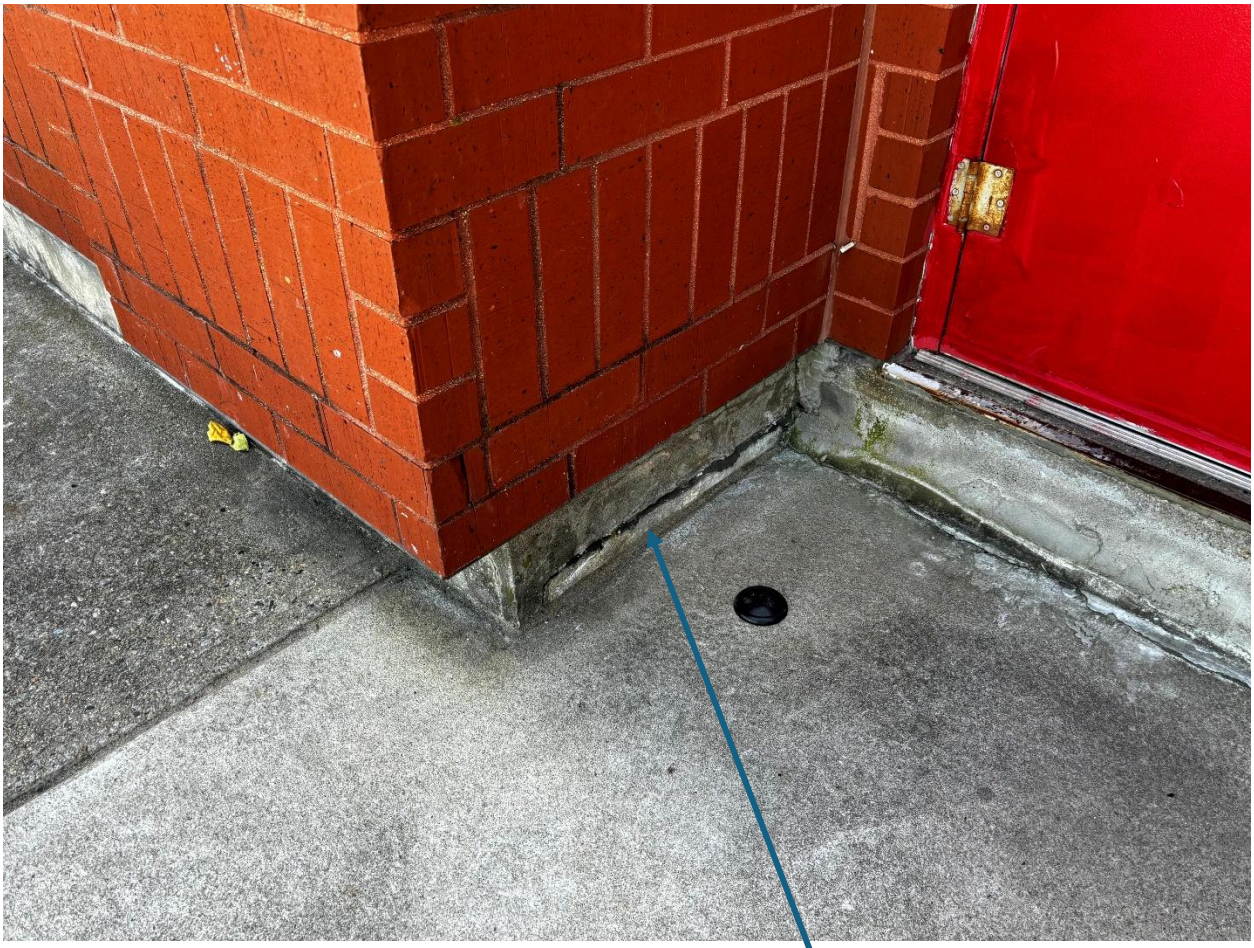


This photo provides an overview of the former pool, now boxing gym.



This photo provides an overview of the boiler room.

This photo provides and overview of the exterior of the building/pool area.



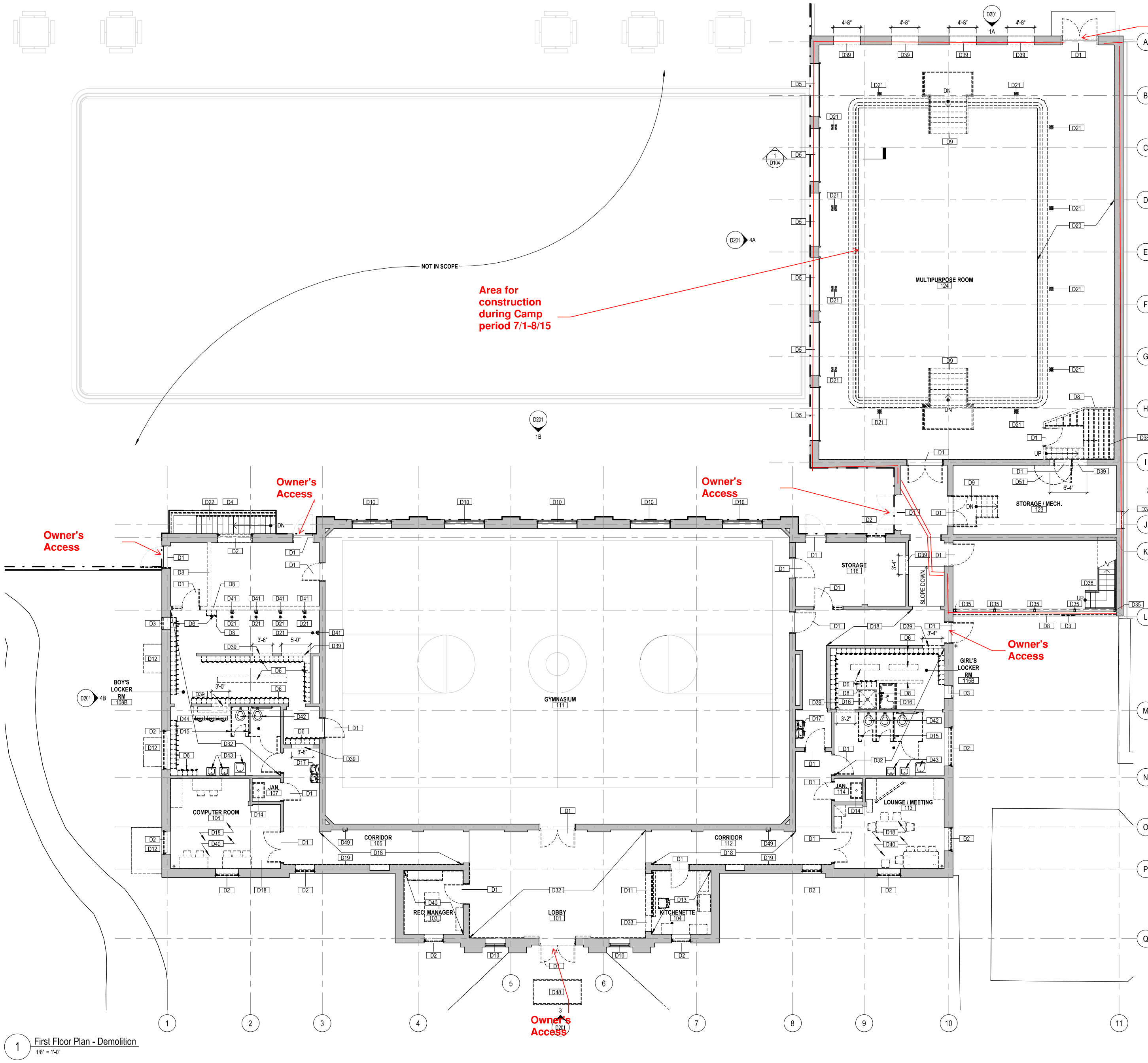
Black Caulk at Base of Building Near First Aid Contains ACM.

Thin caulk under exterior aluminum window sill contains ACM.

Exterior window caulk and glaze contain ACM.

Interior door glaze contains ACM.

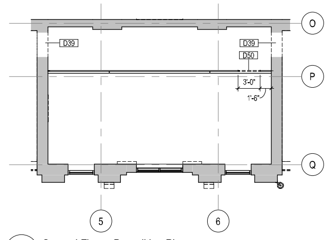

Remove/Replace
Section of Fence
Davey Lopes Skatepark
Relocate the Bleachers
Contractors Access to
Building
Dumpster
Owner's Access to
Building
Davey Lopes Recreation Center
Clear search results
Owner's Access to
Building



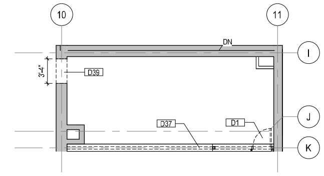
1 First Floor Plan - Demolition
1/8" = 1'-0"

DEMOLITION LEGEND

- EXISTING WALL TO BE REMOVED
- EXISTING TO REMAIN
- EXISTING DOOR AND FRAME TO BE REMOVED



2 Second Floor - Demolition Plan
1/8" = 1'-0"



3 Mezzanine - Demolition Plan
1/8" = 1'-0"

Keynote Schedule - Demolition

KEY VALUE	KEYNOTE
D1	REMOVE AND DISPOSE OF EXISTING DOOR, FRAME ANCHORAGES, AND GROUT.
D2	REMOVE AND DISPOSE OF EXISTING WINDOW, GLAZING, SECURITY SCREENS, AND ANCHORAGES.
D3	REMOVE AND DISPOSE OF EXISTING LOUVER, ASSOCIATED TRIM, AND FASTENERS.
D4	REMOVE EXISTING AREAWAY RAILINGS.
D5	REMOVE AND DISPOSE OF EXISTING OVERHEAD DOOR TRACKS. EXISTING DOORS AND MURALS TO REMAIN. PROTECT DURING DEMOLITION.
D6	REMOVE AND DISPOSE OF EXISTING LOCKERS AND BENCHES.
D8	REMOVE AND DISPOSE OF EXISTING WALL.
D9	REMOVE AND DISPOSE OF EXISTING STAIR, RAILINGS, AND ASSOCIATED STRUCTURE.
D10	EXISTING WINDOWS TO REMAIN. PROTECT DURING DEMOLITION.
D11	REMOVE AND DISPOSE EXISTING SHUTTER AND COUNTER WALL BELOW.
D12	REMOVE EXISTING WOOD AREAWAY COVERS.
D13	REMOVE AND DISPOSE OF EXISTING APPLIANCES, CASEWORK, AND KITCHEN EQUIPMENT.
D14	REMOVE AND DISPOSE OF EXISTING SLOP SINK.
D15	REMOVE AND DISPOSE OF EXISTING TOILET PARTITIONS, DOORS, GRAB BARS, AND ACCESSORIES.
D16	REMOVE AND DISPOSE OF EXISTING SHOWER PANS AND ASSOCIATED PLUMBING FIXTURES.
D17	REMOVE AND SALVAGE EXISTING WATER FOUNTAIN.
D18	REMOVE AND DISPOSE OF EXISTING EPOXY FLOORING AND WOOD BASE.
D19	REMOVE AND DISPOSE OF EXISTING WALL BASE THROUGHOUT EXCEPT IN GYMNASIUM
D20	REMOVE AND DISPOSE OF EXISTING POOL DECK SLAB AND GUTTER. CUT EXISITING POOL WALL 12" BELOW SLAB.
D21	REMOVE AND DISPOSE OF EXISTING FLOOR DRAINS AND ASSOCIATED PIPING. CUT AND CAP AT EXTERIOR WALL.
D22	EXISTING STAIR AND CURB TO REMAIN. PROTECT DURING DEMOLITION.
D32	REMOVE AND DISPOSE OF FLOOR TILE AND ASSOCIATED WALL BASE.
D33	REMOVE AND DISPOSE OF WALL INFILL.
D35	EXISTING STEEL FRAME TO REMAIN. PROTECT DURING DEMOLITION.
D36	EXISTING STAIR TO REMAIN. PROTECT DURING DEMOLITION.
D37	REMOVE AND DISPOSE OF PARTITION. LEAVE STRUCTURE IN PLACE.
D38	REMOVE AND DISPOSE OF EXISTING MEZZANINE FLOOR, STAIR, AND ASSOCIATED STRUCTURE.
D39	REMOVE AND DISPOSE OF EXISTING EXTERIOR MASONRY WALL.
D40	REMOVE EXISTING FURNITURE AND EQUIPMENT. COORDINATE DISPOSAL/SALVAGING WITH OWNER.
D41	REMOVE AND DISPOSE OF EXISTING SHOWER FIXTURES AND ASSOCIATED PIPING.
D42	EXISTING TOILETS TO REMAIN. PROTECT DURING DEMOLITION.
D43	EXISTING SINKS TO REMAIN. PROTECT DURING DEMOLITION.
D44	REMOVE AND SALVAGE EXISTING URINALS.
D48	REMOVE AND DISPOSE OF EXISITNG EXTERIOR PAVING AND PLANTER AT MAIN ENTRANCE.
D49	REMOVE AND SALVAGE EXISTING FEC.
D50	EXISTING MURALS TO REMAIN. PROTECT DURING DEMOLITIION.
D51	REMOVE AND DISPOSE OF MASONRY AND CONCRETE WELL.

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REVISIONS

DATE

DRAWING TITLE

First Floor Demolition Plan

DRAWING INFORMATION

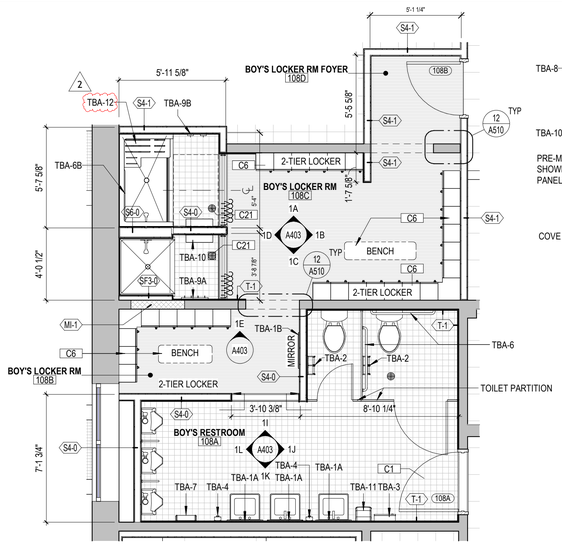
01/31/2025
DATE OF ISSUE

Design Development
DESCRIPTION

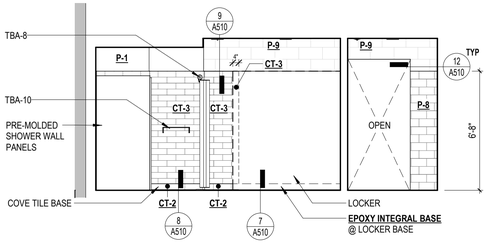
1/8" = 1'-0" — SCALE
Author — DRAWN BY
3524 — PROJECT #
3524 - Davey Lopes v24_Educational.rvt — FILE NAME

DRAWING NUMBER

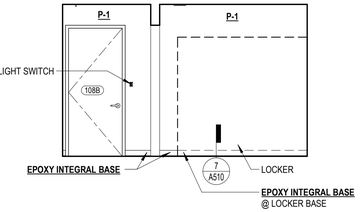
D101



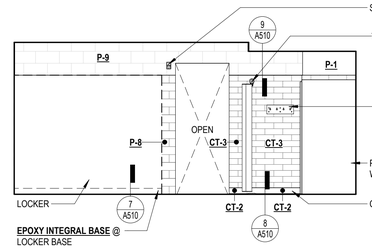
1 Boy's Locker Room 108 - Enlarged Plan
1/4" = 1'-0"



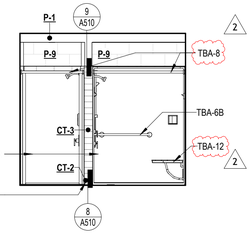
1A Boy's Locker Room 108 - Elevation - North
1/4" = 1'-0"



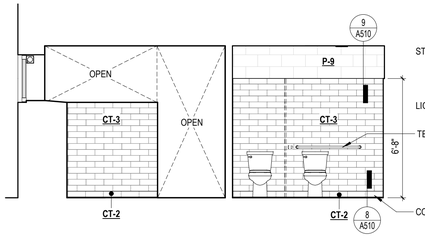
1B Boy's Locker Room 108 - Elevation - East
1/4" = 1'-0"



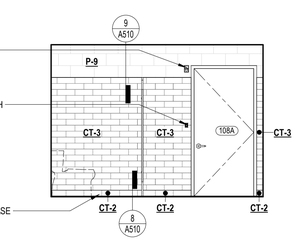
1C Boy's Locker Room 108 - Elevation - South
1/4" = 1'-0"



1D Boy's Locker Room 108 - Elevation - West
1/4" = 1'-0"



1I Boy's Restroom 108 - Elevation - North
1/4" = 1'-0"



1J Boy's Restroom 108 - Elevation - East
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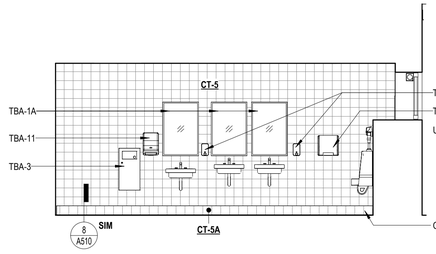
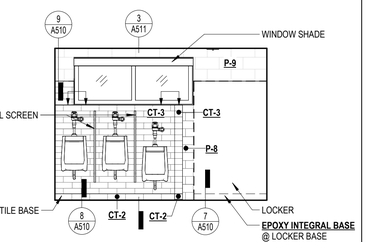


1K Boy's Restroom 108 - Elevation - South
1/4" = 1'-0"



1L Boy's Restroom 108 - Elevation - West
1/4" = 1'-0"

2 Girl's Locker Room 115 - Enlarged Plan
1/4" = 1'-0"

2A Girl's Locker Room 115 - Elevation - North
1/4" = 1'-0"

2B Girl's Locker Room 115 - Elevation - East
1/4" = 1'-0"

2C Girl's Locker Room 115 - Elevation - South
1/4" = 1'-0"

2D Girl's Locker Room 115 - Elevation - West
1/4" = 1'-0"

2E Girl's Restroom 115 - Elevation - North
1/4" = 1'-0"

2F Girl's Restroom 115 - Elevation - East
1/4" = 1'-0"

2G Girl's Restroom 115 - Elevation - South
1/4" = 1'-0"

2H Girl's Restroom 115 - Elevation - West
1/4" = 1'-0"

1E Boy's Locker Room 108 - Elevation - North 2
1/4" = 1'-0"

Keynote Schedule - New Construction

KEY VALUE	KEYNOTE
C1	NEW DOOR AND FRAME IN EXISTING/NEW OPENING.
C6	NEW LOCKERS AND BENCHES.
C21	NEW FLOOR DRAINS AND ASSOCIATED PIPING. SEE PLUMBING.

GENERAL NOTES

1. TILE BACKER BOARD @ NEW TILE WALLS. SEE PARTITION TYPE T-1.

2. REFER TO FINISH LEGEND A700 FOR FINISH DESIGNATIONS.

RESTROOM AND LOCKER ACCESSORIES	MODEL NUMBER
TBA-1A MIRROR (24" X 36")	BOBRICK - B-290
TBA-1B MIRROR (24" X 60")	BOBRICK - B-290
TBA-2 TOILET PAPER DISPENSER	OWNER FURNISHED OWNER INSTALLED
TBA-3 TRASH RECEPTACLE	BOBRICK - B-35639
TBA-4 SOAP DISPENSER	OWNER FURNISHED OWNER INSTALLED
TBA-5 SANITARY NAPKIN RECEPTACLE	BOBRICK - B-270
TBA-6 42" GRAB BAR	BOBRICK - B-5806
TBA-6B 24"X36" TWO-WALL GRAB BAR	BOBRICK - B-58616
TBA-7 HAND DRYER	BOBRICK - B-7128
TBA-8 SHOWER CURTAIN AND ROD	BOBRICK - B-207
TBA-9A HOOK STRIP	BRADLEY - SA41
TBA-9B TOWEL HOOK (SINGULAR)	BRADLEY - SA35
TBA-10 STAINLESS STEEL SHELF	BRADLEY - 9094-18
TBA-11 PAPER TOWEL DISPENSERS	OWNER FURNISHED OWNER INSTALLED
TBA-12 REVERSIBLE FOLDING SHOWER SEAT	BOBRICK - B-5181 2

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REVISIONS

1	Addendum 1	05/16/2025
2	Addendum 2	05/28/2025

DATE

DRAWING TITLE
Enlarged Views - Locker Rooms & Restrooms

DRAWING INFORMATION

05/27/2025
DATE OF ISSUE

Construction Documents
DESCRIPTION

As indicated
SCALE

SS
DRAWN BY

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DRAWING NUMBER
A403

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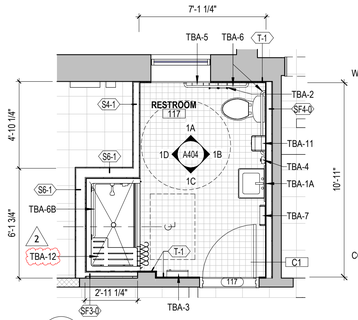
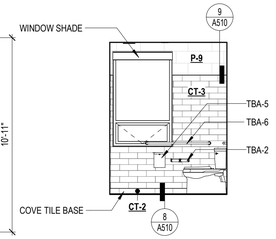
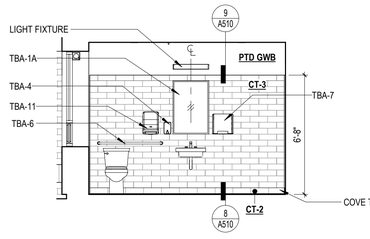


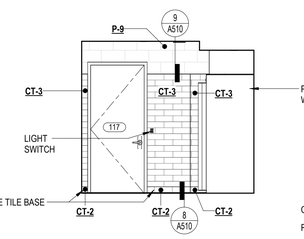
1 Restroom 117 - Enlarged Plan
1/4" = 1'-0"



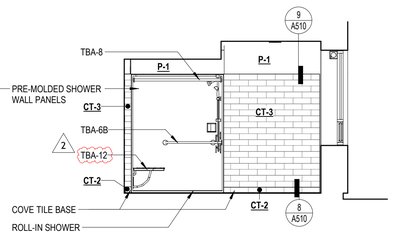
1A Restroom 117 - Elevation - North
1/4" = 1'-0"



1B Restroom 117 - Elevation - East
1/4" = 1'-0"



1C Restroom 117 - Elevation - South
1/4" = 1'-0"



1D Restroom 117 - Elevation - West
1/4" = 1'-0"

2 Restroom 122 - Enlarged Plan
1/4" = 1'-0"

2A Restroom 122 - Elevation - North
1/4" = 1'-0"

2B Restroom 122 - Elevation - East
1/4" = 1'-0"

2C Restroom 122 - Elevation - South
1/4" = 1'-0"

2D Restroom 122 - Elevation - West
1/4" = 1'-0"

RESTROOM AND LOCKER ACCESSORIES		MODEL NUMBER
TBA-1A	MIRROR (24" X 36")	BOBRICK - B-290
TBA-1B	MIRROR (24" X 60")	BOBRICK - B-290
TBA-2	TOILET PAPER DISPENSER	OWNER FURNISHED OWNER INSTALLED
TBA-3	TRASH RECEPTACLE	BOBRICK - B-35639
TBA-4	SOAP DISPENSER	OWNER FURNISHED OWNER INSTALLED
TBA-5	SANITARY NAPKIN RECEPTACLE	BOBRICK - B-270
TBA-6	42" GRAB BAR	BOBRICK - B-5806
TBA-6B	24"X36" TWO-WALL GRAB BAR	BOBRICK - B-58616
TBA-7	HAND DRYER	BOBRICK - B-7128
TBA-8	SHOWER CURTAIN AND ROD	BOBRICK - B-207
TBA-9A	HOOK STRIP	BRADLEY - SA41
TBA-9B	TOWEL HOOK (SINGULAR)	BRADLEY - SA35
TBA-10	STAINLESS STEEL SHELF	BRADLEY - 9094-18
TBA-11	PAPER TOWEL DISPENSERS	OWNER FURNISHED OWNER INSTALLED
TBA-12	REVERSIBLE FOLDING SHOWER SEAT	BOBRICK - B-5181 2

Keynote Schedule - New Construction

KEY VALUE	KEYNOTE
C1	NEW DOOR AND FRAME IN EXISTING/NEW OPENING.

ARCHITECT

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REVISIONS

1	Addendum 1	05/16/2025
2	Addendum 2	05/28/2025

DATE

DRAWING TITLE

Enlarged Views - Restrooms

DRAWING INFORMATION

05/27/2025
DATE OF ISSUE

Construction Documents
DESCRIPTION

1/4" = 1'-0" — SCALE
Author — DRAWN BY
3524 — PROJECT #
3524 - Davey Lopes v24_Educational.rvt — FILE NAME

DRAWING NUMBER

A404

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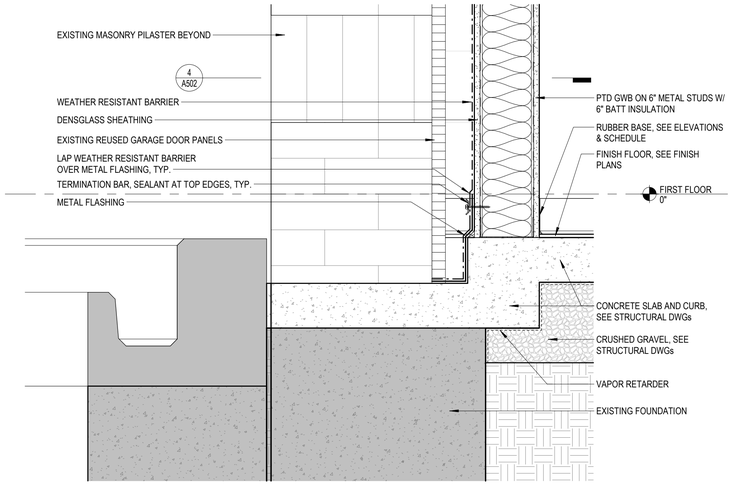
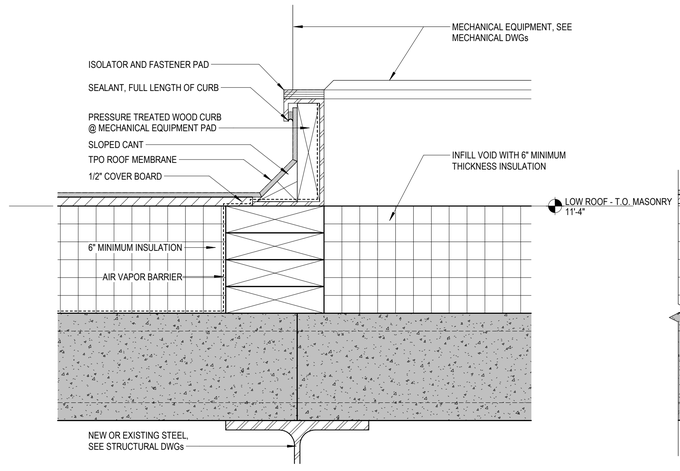
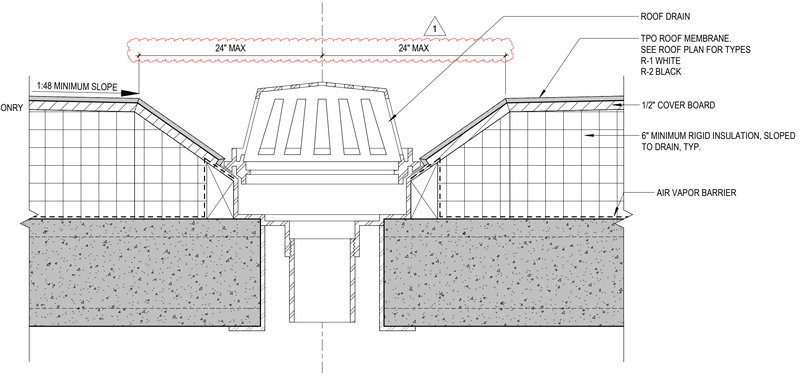


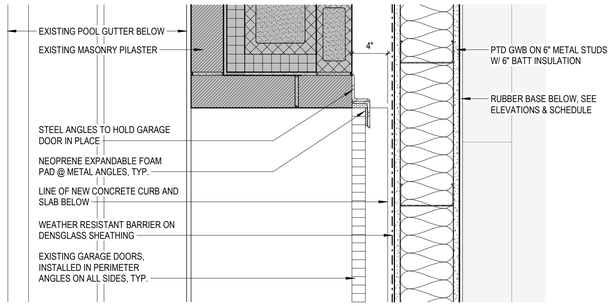
1 Detail Section @ Garage Door Sill & Curb
1 1/2" = 1'-0"



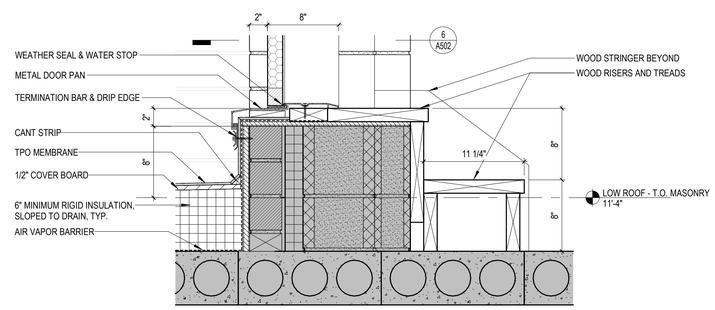
2 Typical Roof Detail @ Mechanical Pad
3" = 1'-0"



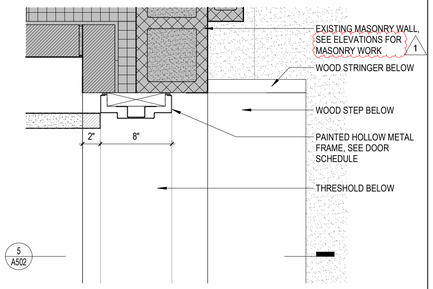
3 Typical Roof Drain Detail
3" = 1'-0"



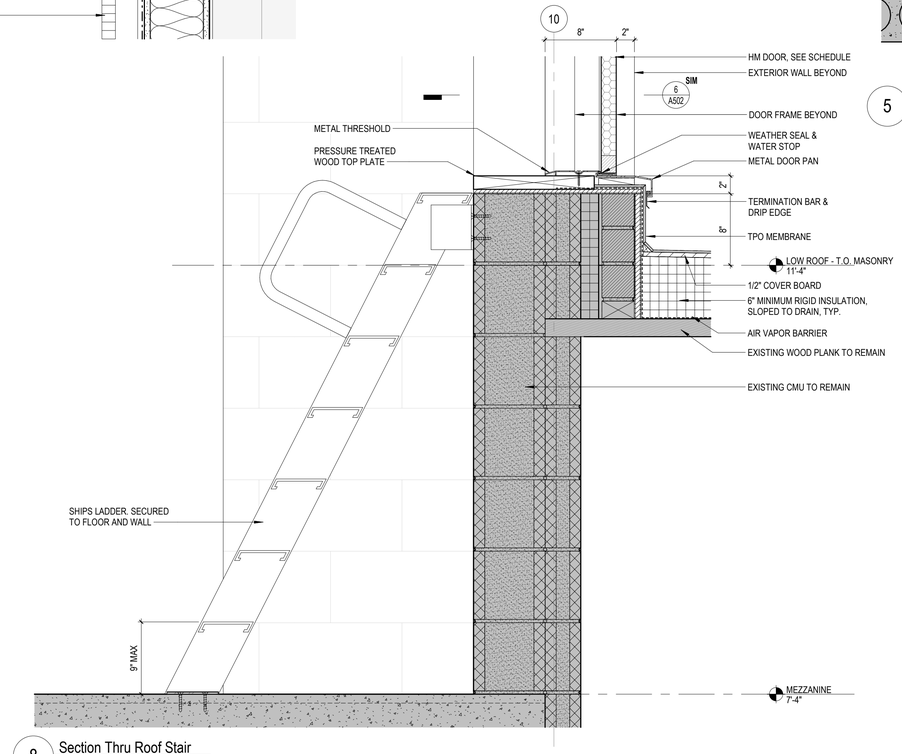
4 Detail Plan @ Garage Door Jamb
1 1/2" = 1'-0"



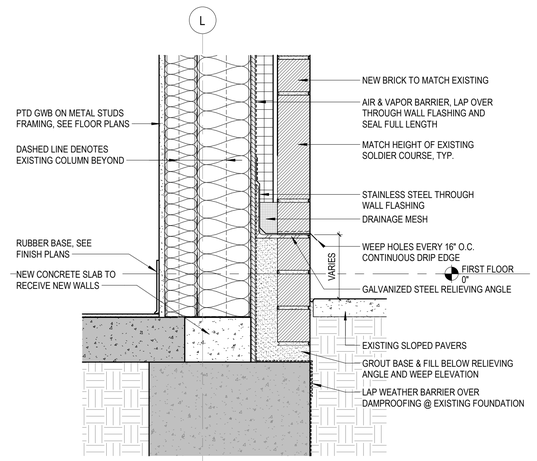
5 Detail @ Service Catwalk Door Threshold
1 1/2" = 1'-0"



6 Detail @ Service Catwalk Door Jamb
1 1/2" = 1'-0"



8 Section Thru Roof Stair
1 1/2" = 1'-0"



11 Detail @ Base of New Masonry Wall
1 1/2" = 1'-0"

ARCHITECT

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REVISIONS

1	Addendum 2	05/28/2025

DATE

DRAWING TITLE

Exterior Details

DRAWING INFORMATION

05/27/2025
DATE OF ISSUE

Construction Documents
DESCRIPTION

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SCALE

Author
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FILE NAME

DRAWING NUMBER

A502

V.2.1

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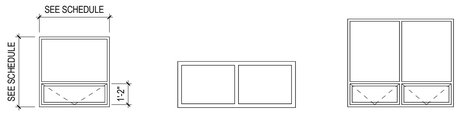
5/27/2025 10:35:22 AM Author

Window & Louver Schedule

Type Mark	Width	Height	Count	Comments
L1	2'-11"	2'-11"	2	VIF MASONRY OPENING
L2	2'-1"	1'-5"	2	VIF MASONRY OPENING
L3	4'-0"	1'-0"	2	VIF MASONRY OPENING
L4	2'-9"	3'-10"	2	VIF MASONRY OPENING
L5	2'-11"	2'-11"	1	VIF MASONRY OPENING
L6	2'-5"	1'-11"	1	
S1	4'-4"	4'-4"	4	VIF ROOF OPENING
W1	3'-11"	3'-11"	4	VIF MASONRY OPENING
W2	3'-3"	5'-3"	5	VIF MASONRY OPENING
W3	4'-11"	6'-3"	3	CUT NEW OPENING
W4	6'-7"	2'-7"	2	VIF MASONRY OPENING
W5	5'-11"	4'-11"	1	VIF MASONRY OPENING
W6	2'-6"	7'-0"	3	



WINDOW
W1, W2, W3

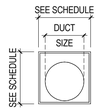
WINDOW
W4

WINDOW
W5

WINDOW
W6

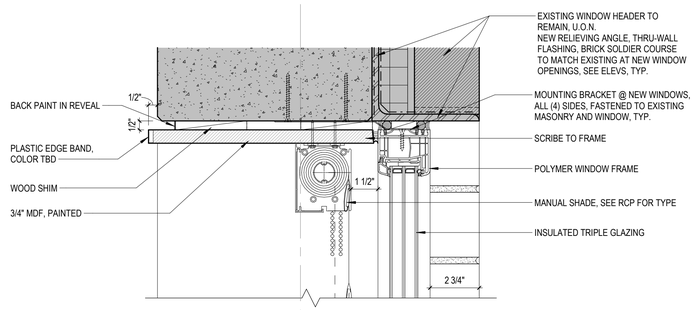
SKYLIGHT
S1

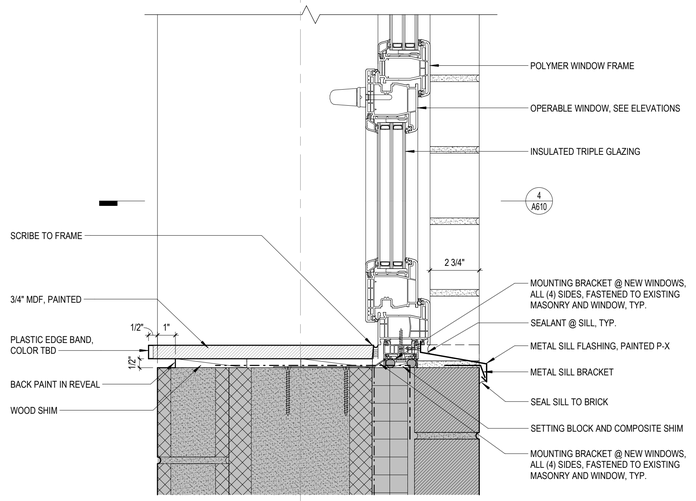
LOUVER
L1, L2, L3, L4, L6



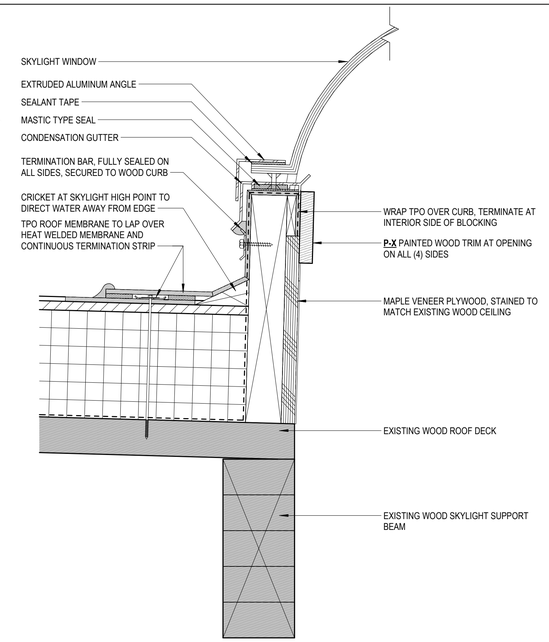
INFILL PANEL
L5

Window Types
1/4" = 1'-0"

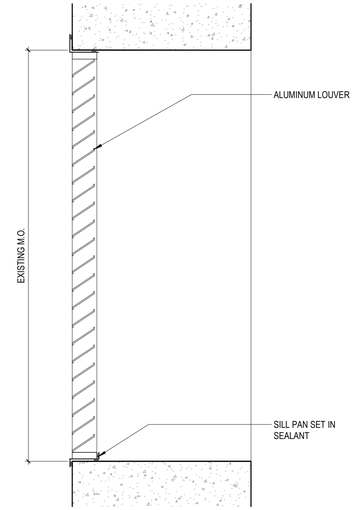




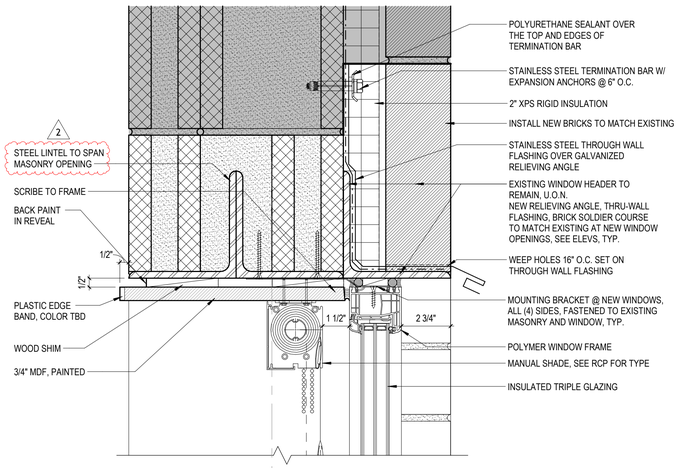
3 Typical Section Detail @ Window Head & Sill
3" = 1'-0"



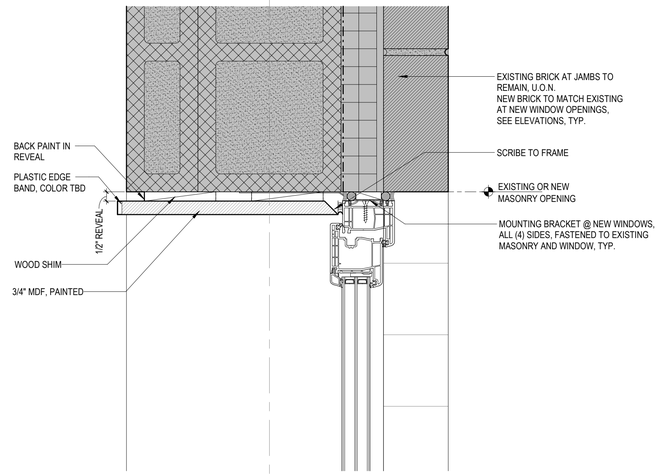
5 Window Detail @ Skylight
3" = 1'-0"



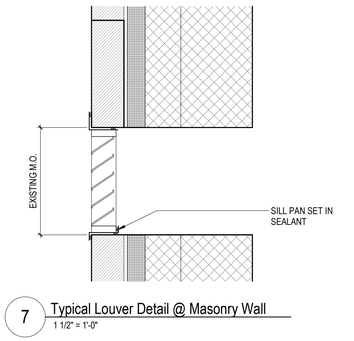
6 Typical Louver Detail @ Concrete Wall
1 1/2" = 1'-0"



1 Section Detail @ Window Head, New Brick
3" = 1'-0"



4 Typical Section Detail @ Window Jamb
3" = 1'-0"



7 Typical Louver Detail @ Masonry Wall
1 1/2" = 1'-0"

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5/27/2025 10:43:34 AM Author

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REVISIONS

1	Addendum 1	05/16/2025
2	Addendum 2	05/28/2025

DATE

DRAWING TITLE

Window Schedule & Details

DRAWING INFORMATION

05/27/2025
DATE OF ISSUE

Construction Documents
DESCRIPTION

As indicated
SCALE

Author
DRAWN BY

3524
PROJECT #

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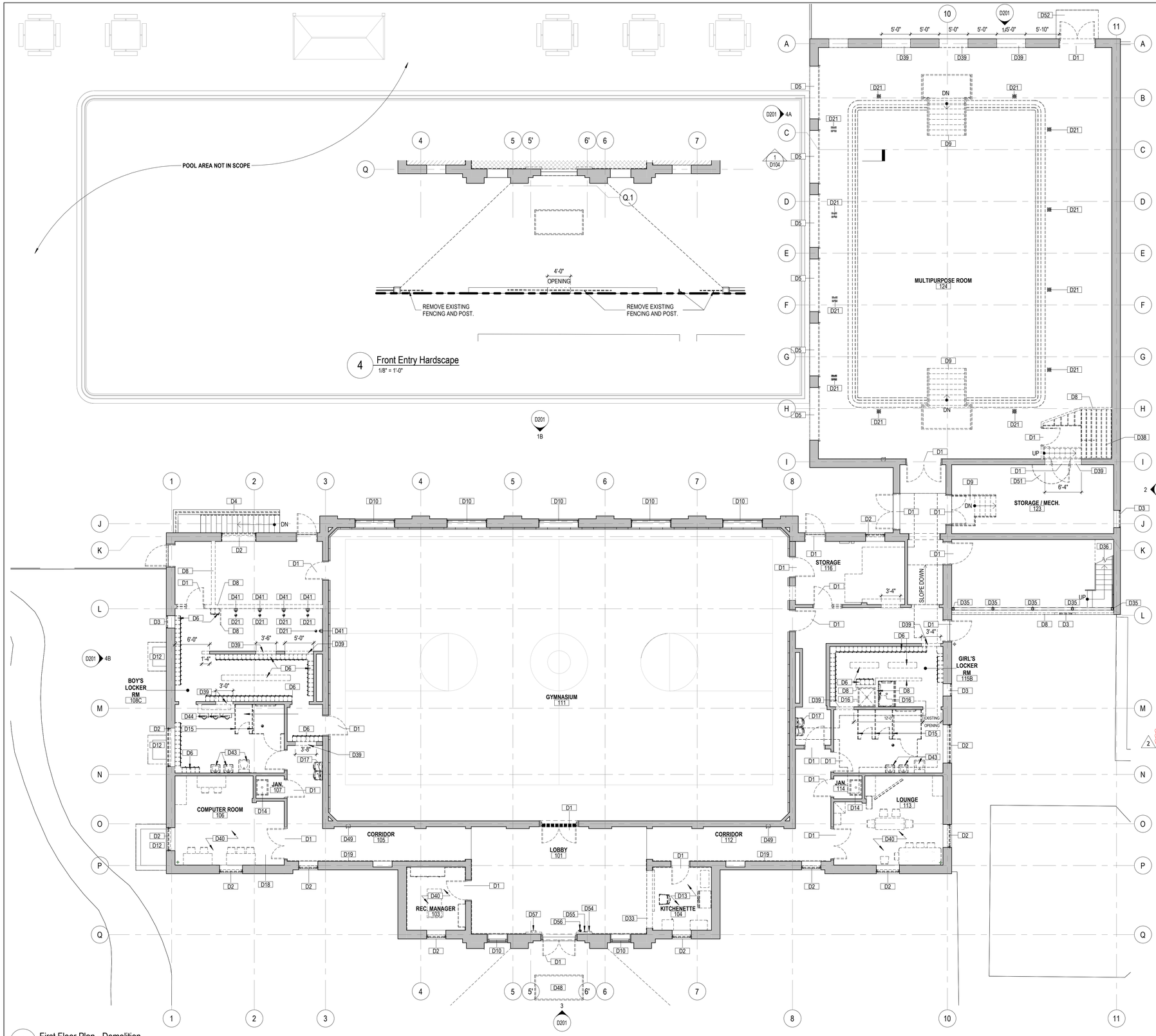
FILE NAME

DRAWING NUMBER

A610

 V.2.1

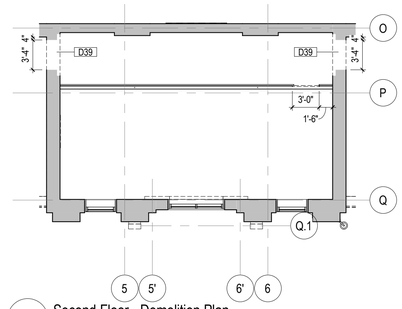


4 Front Entry Hardscape
1/8" = 1'-0"

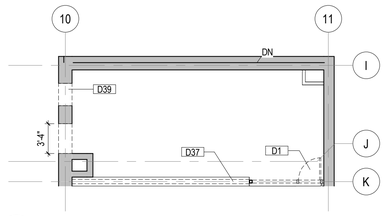
1 First Floor Plan - Demolition
1/8" = 1'-0"

DEMOLITION LEGEND

- EXISTING WALL TO BE REMOVED
- EXISTING TO REMAIN
- EXISTING DOOR AND FRAME TO BE REMOVED



2 Second Floor - Demolition Plan
1/8" = 1'-0"



3 Mezzanine - Demolition Plan
1/8" = 1'-0"

Keynote Schedule - Demolition

KEY VALUE	KEYNOTE
D1	REMOVE AND DISPOSE OF EXISTING DOOR, FRAME ANCHORAGES, AND GROUT.
D2	REMOVE AND DISPOSE OF EXISTING WINDOW, GLAZING, SECURITY SCREENS, AND ANCHORAGES.
D3	REMOVE AND DISPOSE OF EXISTING LOUVER, ASSOCIATED TRIM, AND FASTENERS.
D4	REMOVE EXISTING AREAWAY RAILINGS.
D5	REMOVE AND DISPOSE OF EXISTING OVERHEAD DOOR TRACKS. EXISTING DOORS AND MURALS TO REMAIN. PROTECT DURING DEMOLITION.
D6	REMOVE AND DISPOSE OF EXISTING LOCKERS AND BENCHES.
D8	REMOVE AND DISPOSE OF EXISTING WALL.
D9	REMOVE AND DISPOSE OF EXISTING STAIR, RAILINGS, AND ASSOCIATED STRUCTURE.
D10	EXISTING WINDOWS TO REMAIN. PROTECT DURING DEMOLITION.
D12	REMOVE EXISTING WOOD AREAWAY COVERS.
D13	REMOVE AND DISPOSE OF EXISTING APPLIANCES, CASEWORK, AND KITCHEN EQUIPMENT.
D14	REMOVE AND DISPOSE OF EXISTING SLOP SINK.
D15	REMOVE AND DISPOSE OF EXISTING TOILET PARTITIONS, DOORS, GRAB BARS, AND ACCESSORIES.
D16	REMOVE AND DISPOSE OF EXISTING SHOWER PANS AND ASSOCIATED PLUMBING FIXTURES.
D17	REMOVE AND SALVAGE EXISTING WATER FOUNTAIN.
D18	REMOVE AND DISPOSE OF EXISTING EPOXY FLOORING AND WOOD BASE.
D19	REMOVE AND DISPOSE OF EXISTING WALL BASE THROUGHOUT EXCEPT IN GYMNASIUM.
D21	FIELD LOCATE THE CONNECTION POINT OF EXISTING FLOOR DRAIN WASTE LINES AND CUT, CAP, AND MAKE SAFE PIPING AT SANITARY MAIN TO AVOID CREATING DEAD ENDS.
D33	REMOVE AND DISPOSE OF WALL INFILL.
D35	EXISTING STEEL FRAME TO REMAIN. PROTECT DURING DEMOLITION.
D36	EXISTING STAIR TO REMAIN. PROTECT DURING DEMOLITION.
D37	REMOVE AND DISPOSE OF PARTITION. LEAVE STRUCTURE IN PLACE.
D38	REMOVE AND DISPOSE OF EXISTING MEZZANINE FLOOR, STAIR, AND ASSOCIATED STRUCTURE.
D39	REMOVE AND DISPOSE OF EXISTING EXTERIOR MASONRY WALL.
D40	REMOVE EXISTING FURNITURE AND EQUIPMENT. COORDINATE DISPOSAL/SALVAGING WITH OWNER.
D41	REMOVE AND DISPOSE OF EXISTING SHOWER FIXTURES AND ASSOCIATED PIPING.
D43	EXISTING SINKS TO REMAIN. PROTECT DURING DEMOLITION.
D44	REMOVE AND SALVAGE EXISTING URINALS.
D48	REMOVE AND DISPOSE OF EXISITNG EXTERIOR PAVING AND PLANTER AT MAIN ENTRANCE.
D49	REMOVE AND SALVAGE EXISTING FEC.
D51	REMOVE AND DISPOSE OF MASONRY AND CONCRETE WELL.
D52	REMOVE AND DISPOSE OF SLAB ON GRADE
D54	REMOVE AND SALVAGE ANNUNCIATOR
D55	REMOVE AND SALVAGE PULL STATION
D56	REMOVE AND SALVAGE FIRE EXTINGUISHER
D57	REMOVE AND SALVAGE OPIOID RESCUE KIT

0' 4' 8' 16'

N

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REVISIONS

1	Addendum 1	05/16/2025
2	Addendum 2	05/28/2025

DATE

DRAWING TITLE

First Floor Demolition Plan

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05/27/2025
DATE OF ISSUE

Construction Documents
DESCRIPTION

1/8" = 1'-0"
SCALE

Author
DRAWN BY

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PROJECT #

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FILE NAME

DRAWING NUMBER

D101

V.2.1

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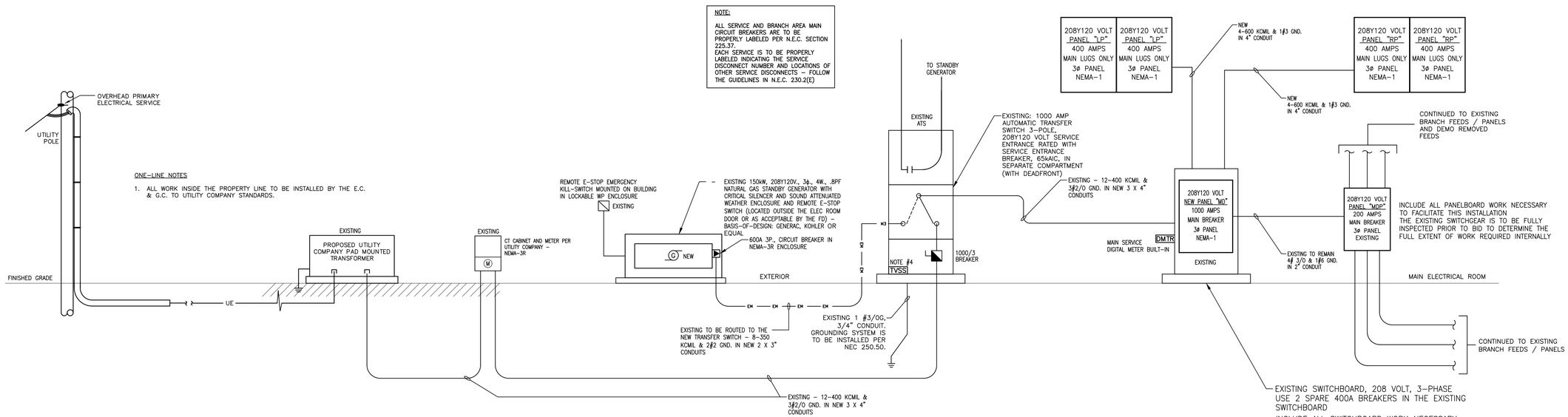
5/27/2025 1:18:19 PM Author

Label	Manufacturer	Catalog Number	Description
CP1	LUMENWERX	AE4CYP-D-4"-FINISH-BVLD-FINISH-SDL-SW-90-XX-80-35-XX-UNV-20W-DIMMING-XX-CANOPY-FINISH-SUSP-XX	AERA 4 Pendant Cylinder
CP2	LUMENWERX	AE4CYP-D-4"-FINISH-BVLD-FINISH-SDL-SW-90-XX-80-35-XX-UNV-20W-DIMMING-XX-CANOPY-FINISH-SUSP-XX	AERA 4 Pendant Cylinder
CR1	LUMENWERX	EC4RR-TRM-SW-XX-MOUNTING-UNV-14W-DIMMING-XX-EC4RRB-SW-90DEG-XX-80CRI-35K-XX-TRM-SDL-BAFFLE-TRIM-XX	ECANA 4" Downlight
CR2	LUMENWERX	EC4RR-TRM-SW-XX-MOUNTING-UNV-14W-DIMMING-XX-EC4RRB-SW-90DEG-XX-80CRI-35K-XX-TRM-SDL-BAFFLE-TRIM-WET	ECANA 4" Downlight - WET
CR3	LUMENWERX	EC4RR-TRM-SW-XX-MOUNTING-UNV-28W-DIMMING-XX-EC4RRB-SW-25DEG-XX-80CRI-35K-XX-TRM-SDL-BAFFLE-TRIM-XX	ECANA 4" Downlight - High Ceiling
DP1	Mercury	GSDI S6800/36 935 FINISH DRIVER U	LED RING LIGHT
ED1	Luminis	SN1100C-L1L25-35K-VOLTAGE-XX-XX-XX-FINISH	Scena - Ceiling Square 11in
EW1	Brownlee	7115-26-FINISH-H32-35K-XX	CAPSULE SQUARE
EW2	DesignPlan	SPT40210 2 4 N	FIXED M-01
EW3	Lithonia Lighting	WDGE2 LED P1 30K80CRI T3M	WDGE2 LED WITH P1 - PERFORMANCE PACKAGE, 3000K, 80CRI, TYPE 3 MEDIUM OPTIC
GR-12	ALW USA	LPX4 DWMRN S12 05 35 80 SL DRIVER N N N N N N N N N N FINISH-XXXX UNV	LightPlane+ 4" - LINEAR IN RESTROOMS
GR-13	ALW USA	LPX4 DWMRN S13 05 35 80 SL DRIVER N N N N N N N N N N FINISH-XXXX UNV	LightPlane+ 4" - LINEAR IN RESTROOMS
GR-16	ALW USA	LPX4 DWMRN S16 05 35 80 SL DRIVER N N N N N N N N N N FINISH-XXXX UNV	LightPlane+ 4" - LINEAR IN RESTROOMS
GR-8	ALW USA	LPX4 DWMRN S8 05 35 80 SL DRIVER N N N N N N N N N N FINISH-XXXX UNV	LightPlane+ 4" - LINEAR IN RESTROOMS
LP-4	Industrial Lighting Products Inc	HHB-18L-U-40-FRL-XX-XX	HIMALAYAN HIGH BAY
LP-8	3G LIGHTING	3Gi-1PSL-DI-OC4-ZB-S(8'0")-ZB-35D-BLV-H90-35K-UNV-DIM-60"-1C	3Gi -1PSL-DI -1.5" Integrated Pendant Direct/Indirect
LR-4	a.light	ACL5 4 LS35 U HE MOUNTING FINISH DIMMING XX	ACL5 - 4FT
LR-6	a.light	ACL5 6 LS35 U HE MOUNTING FINISH DIMMING XX	ACL5 - 6FT
LW1-2	Brownlee	5176-24-FINISH-H21-35K-XX	ZOOM-RD - 24"
LW1-4	Brownlee	5176-48-FINISH-H32-35K-XX	ZOOM-RD - 48"
SL1	LLIA	LLI-THN-SF-2.5W-30K-24V-LENGTH + POWER	Dry Location 2.5W/3000K LED tape w/ Thin Extrusion and Frosted Lens
F-4	Lithonia Lighting	CSVTL48 5000LM MVOLT 40K 80CRI	Vapor Tight Strip Light w/ emergency where noted

2

NOTE:
ALL SERVICE AND BRANCH AREA MAIN CIRCUIT BREAKERS ARE TO BE PROPERLY LABELED PER N.E.C. SECTION 225.37.
EACH SERVICE IS TO BE PROPERLY LABELED INDICATING THE SERVICE DISCONNECT NUMBER AND LOCATIONS OF OTHER SERVICE DISCONNECTS – FOLLOW THE GUIDELINES IN N.E.C. 230.2(E)



ONE LINE POWER DISTRIBUTION DIAGRAM (NEW)
N.T.S

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1 Addendum 1	05/16/2025
2 Addendum 2	05/28/2025

DATE

DRAWING TITLE
ELECTRICAL One-Line and Schedules

DRAWING INFORMATION

05/16/2025 DATE OF ISSUE
Construction Documents DESCRIPTION
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AP/RB DRAWN BY
64076 PROJECT #
64076-E300.dwg FILE NAME

DRAWING NUMBER
E300

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