TAB & Miscellaneous HVAC Repairs

Various Buildings

for

Worcester Public Schools

September 9, 2022

DOCUMENTS PREPARED BY

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SECTION 00.11.10

TABLE OF CONTENTS

END OF SECTION
00.01.10

SECTION 01.11.00

SUMMARY OF WORK

I PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. This section supplements the Conditions of the Contract, Prime Requirements, Drawings, and all other parts of the Contract Documents.

B. This Contractor must be familiar with all other Divisions and Sections of the Specifications which affect the work of this Section.

1.02 REQUIREMENTS INCLUDED

A. Work under this Contract.
B. Examination of Site and Documents.
C. Contract Method.
D. Work Sequence.
E. Supervision of Work.
F. Prime Contractor's Use of Premises.
G. Coordination.
H. Project Meetings.
I. Permits, Inspection, and Testing Required by Governing Authorities.
J. Cutting, Coring, Patching, Unless Otherwise Indicated.
K. Debris Removal.
L. Field Measurements.
M. Safety Regulations.
N. OSHA Safety and Health Course Documentation.
O. Damage Responsibility.
P. Owner Furnished Products.
Q. Asbestos and Hazardous Materials Discovery.
R. Special Requirements.
S. List of Drawings.

1.03 WORK UNDER THIS CONTRACT

A. The work to be done under this contract consists of HVAC upgrades and related items at various WPD buildings.

B. The scope of work, without limiting the generality thereof, includes all labor, materials, equipment and services required to perform the work described fully in the Drawings and Specifications and includes, but is not limited to the following major work:

1. Replacement of select existing filters with MERV 13 Filters and ERV-P with MERV 8 filters.
2. Provide and install MERV 13 filter racks at select locations.
3. Replacement and adjustment of select drive belts and re-balancing.
4. Balancing of select supply fans to the listed CFM.
5. Balancing of OA to listed CFM
6. Provide return air dampers in select return dusts.
7. Provide adjustable motor sheaves at select locations.
8. Replacement of drive motors at select locations.
9. Provide new return air flexible connections at select locations
10. Wash and Clean select coils.
11. Replacement of select missing air damper blades.
12. Diagnose operational issues select no-functioning units and report findings.
13. Furnish and install new man door into mixing chamber.

14. Vacuum / clean select supply air fan wheels and fan rooms.
15. Repair select operational controls to allow units to run in auto-mode.
16. Provide new EMS controls for select fans, coils and damper controls.
17. Provide new OA hoods and dampers to select wired controls.
18. Replacement of select roof-top ductwork and insulation of new ductwork.
19. Provide new EMS controls for select supply and exhaust fans, coils and damper controls.
20. New rated door and frame at a select location
21. New ceiling access panels at select locations.

C. The following major elements will be performed by the Owner, under separate contracts, for which the Prime Contractor has a coordinating responsibility:
   1. *The Owner will not be performing any work on the project.*

D. The following major elements will be furnished by the Owner, for installation by the Contractor or sub-contractors:
   1. None. The Contractor shall furnish all materials and labor required for the execution of this project.

E. Reference to Drawings: *The work to be done under this Contract is shown on the Drawings listed at the end of this Project Manual.*

F. Prevailing Wage: The Massachusetts Standard Labor Wage rates, as outlined in the exhibits, will be used in the construction of this project

G. **Start of Work: Work can began as soon as contracts are complete and shall be complete (90) calendar days from the Notice to Proceed.**

1.04 EXAMINATION OF SITE AND DOCUMENTS

A. **A pre-bid meeting will be held at (3) of the project building, the date, the time, the locations / order will be included in the Invitation to Bid.**

B. Bidders may also visit the sites on a non-holiday weekday acceptable to the Owner, between the hours of 9:00 AM and 3:00 PM to visually inspect the location of the work and existing conditions that may affect new work provided that coordinate the visit with WPS and the main office.

C. The bidders are expected to examine and to be thoroughly familiar with all contract documents and with the conditions under which the work is to be carried out. The Owner and Designers will not be responsible for errors, omissions, and/or charges for extra work arising from the Contractor's or Subcontractor's failure to familiarize themselves with the contract documents. The Contractor and Subcontractors acknowledge that they are familiar with the conditions and requirements of the contract documents where they require, in any part of the work a given result to be produced, and that the contract documents are adequate and will produce the required results.

1.05 CONTRACT METHOD

A. Work under this contract shall be lump sum price, for the scopes of work as described in these specifications and shown on the Drawings.

1.06 WORK SEQUENCE

A. The Work will be conducted in the following sequence of demolition/construction:

   1. Actual sequence of the work will be left to the discretion of the Contractor, who will prepare a construction schedule showing the sequence and duration of work, for review and approval by the Owner. Work at more that one school at a time is permitted, provided that proper staffing is on site at each location to complete the work in a timely fashion

B. **Once the contract has been awarded, the Prime Contractor will be sent floor plans for each building for coordination / sequencing of the work.**

1.07 SUPERVISION OF WORK

A. The Contractor shall be held directly responsible for the correct installation of all work performed under this Contract. The Contractor must make good repair, without expense to the Owner, of any part of the new work, or existing work to remain, which may become inoperative on account of leaving the work unprotected or unsupervised during construction of the system or which may break or give out in any manner by reason of poor workmanship, defective materials or any lack of space to allow for expansion and contraction of the work during the Contractor's warranty period, from the date of final acceptance of the work by the Owner.

B. The Contractor shall furnish a competent Massachusetts Licensed Supervisor satisfactory to the Owner and to the Designer. The licensed superintendent shall supervise all work under this contract and who shall remain on duty at the site throughout the Contract period while work is in progress.

1. Submit the name and resume of the superintendent for approval to the Architect. Include experience with projects of equal size and complexity.

2. If more than one building is receiving work on the same day, a licenced supervisor is required at each location.

1.08 CONTRACTOR'S USE OF PREMISES

A. Use of the Site: Confine operations to areas within the project scope. Do not disturb portions of the site beyond the areas in which the Work is indicated.

1. Owner Occupancy: Allow for Owner occupancy and use by the public (if applicable).

2. Driveways and Entrances: Keep driveways and entrances serving the premises clear and available to the Owner, the Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

B. Schedule and perform work to afford minimum of interruption to normal and continuous operation of utility systems. Submit for approval, a proposed schedule for performing work; including construction of new utilities, re-routing of existing utilities and final connection of new work to existing work. Schedule shall indicate shutdown time required for each operation.

C. The Contractor shall schedule as per Section 01.50.00 - Temporary Facilities and Controls, the shutting down or interrupting any utilities, services or facilities which may affect the operation of the building outside the area of work or other buildings, services or facilities.

D. The Contractor can gain access to the premises during the hours specified below. In addition the Contractor and his personnel will limit themselves only within the working premises during working hours. If work needs to be scheduled during times other than those listed below, Contractor shall inform the Owner one week prior to work.

1. **The acceptable work / access hours for all of the building are 3PM - 11M and all deliveries must be made with the contractor on site.**

2. **As stated above, if the contractor would like to perform work outside of the 3PM-11PM window of time, it must be approved by the owner and ALL costs resulting for this request will be the responsibility of the contractor.**

3. If the project extends past the specified completions date, due to unforseen conditions or supply chain

issues and work is required to continue during school breaks, the follow are the required access hours:

(a) Deliveries: **7:00 AM to 3:00 PM**, but only when the contractor is present on site.

(b) Work on site:

(i) **7:00 AM to 3:00PM** while school is in session.

(ii) During school vacation / holiday times / Summer break, work can occur **7:00AM to 3:00PM**, but must be co-ordinated with the owner.

(iii) *If the contractor chooses to work during times when the school is not staffed, weekends or after 11PM, and it is approved by the owner, the contractor shall be responsible for all additional overtime / oversight charges that will be incurred.*

(iv) The contractor may work longer shifts than noted above, but the timing will need to be coordinated with WPS and the school, and any additional cost incurred for this work will be the responsibility of the contractor.

(c) Weekends: At contractor's discretion and as allowed by Owner. No additional compensation for overtime will be granted.

(d) Holidays: As coordinated with the owner.

E. The Contractor shall verify that Subcontractors have visited the site and included all costs associated with the location of the project, and any restriction or limitations the location of the project may pose.

F. All contractors shall at all times conduct their operations in a courteous, professional manner while on the project or in the vicinity of the project. Harassment, offensive language or behavior will not be permitted on the site.

G. The Owner can neither accept nor assume responsibility for the security of the Contractor's material or equipment which is lost, stolen or vandalized. The Contractor is advised to exert caution in placement and storage of his equipment and material.

H. Parking: Work is anticipated to start while school is not in session, but be completed after the school is back in session, and Contractor's will have use of the school parking lot as approved by the school. Some continued use of the building by WPS staff or custodians is anticipated, and contractors shall cooperate with the Owner and the staff, and park where directed.

I. Radios, tape players, "boom boxes", or other audio entertainment equipment, including personal entertainment devices, shall not be allowed on the project site.

J. The Contractor shall not permit smoking within the building. Locate smoking areas away from entries, outdoor intakes, and operable windows, including adjacent buildings.

K. The Contractor shall not allow the use of intoxicating beverages or non-prescription controlled substance drugs upon or about the work site.

L. The Contractor shall provide and maintain in good serviceable condition at all times, warning signs and barriers, approved by the Owner, suitable for the purpose, and installed adjacent to each work area. Barriers shall be barrier tape and/or sawhorses as a means of such access protection.

1.09 COORDINATION

A. The Contractor shall be responsible for the proper fitting of all the work and for the coordination of the operations of all Subcontractors or material and persons engaged upon the work. The Contractor shall do, or cause his agents to do, all cutting, fitting, adjusting, and repair necessary in order to make the several parts of the work come together properly.

1. Examine Contract Documents in advance of start of construction and identify in writing questions, irregularities or interference to the designer in writing. Failure to identify and address such issues in advance becomes the sole responsibility of the Contractor. A conflict that would cause the reduction of the normal ceiling height of any occupied space is considered to be an interference.

B. Execute the work in an orderly and careful manner with due regard to the occupants of the facility, the

public, the employees, and the normal function of the facility.

C. The work sequence shall follow planning and schedule established by the Contractor as approved by the Designer and the Owner. The work upon the site of the project shall commence promptly and be executed with full simultaneous progress. Work operations which require the interruption of utilities, service, and access shall be scheduled so as to involve minimum disruption and inconvenience, and to be expedited so as to insure minimum duration of any periods of disruption or inconvenience.

D. The Contractor shall review the tolerances established in the specifications for each type of work and as established by Subcontractor organizations. The Contractor shall coordinate the various Subcontractors and resolve any conflicts that may exist between Subcontractor tolerances without additional cost to the Owner. The Contractor shall provide any chipping, leveling, shoring or surveys to ensure that the various materials align as detailed by the Designer and as necessary for smooth transitions not noticeable in the finished work.

1.10 PROJECT MEETINGS

A. Project meetings shall be held on site at intervals appropriate to the progress of the Work and as required subject to the discretion of the Owner.

1. Attendees: In addition to the Project Manager and Designer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

B. In order to expedite construction progress on this project, the Contractor shall order all materials immediately after the approval of Submittal and shop drawings and shall obtain a fixed date of delivery to the project site for all materials ordered which shall not impede or otherwise interfere with construction progress. The Contractor shall present a list and written proof of all materials and equipment ordered (through purchase orders). Such list shall be presented at the meetings and shall be continuously updated.

C. Scheduling shall be discussed with all concerned parties, and methods shall be presented by the Contractor, which shall reflect construction completion not being deferred or foreshortened. Identify critical long-lead items and other special scheduling requirements. The project schedule is to include time for submission of shop drawing submittals, time for review, and allowance for resubmittal and review.

1.11 PERMITS, INSPECTION, AND TESTING REQUIRED BY GOVERNING AUTHORITIES

A. If the Contract Documents, laws, ordinances, rules, regulations or orders of any public authority having any jurisdiction require any portion of the Work to be inspected, tested, or approved, the Contractor shall give the Designer, the Owner or his/her designated representative, and such Authority timely notice (5 business days minimum) of its readiness so the Designer may observe such inspecting, testing, or approval.

B. Prior to the start of construction, the Contractor shall complete application to the applicable Building Code enforcement authority for a Building Permit. Such Permit shall be displayed in a conspicuous location at the project site. The building permit fee shall be paid by the Contractor.

C. Unless otherwise specified under the Sections of the Specifications, the Contractor shall pay such proper and legal fees to public officers and others as may be necessary for the due and faithful performance of the work and which may arise incidental to the fulfilling of this Contract. As such, all fees, charges, and assessments in connection with the above shall be paid by the Contractor.

D. Contractor and specialized Subcontractors as applicable shall identify all permits (other than building permit) required from Authorities having jurisdiction over the Project for the construction and occupancy of the work. The Contractor shall prepare the necessary applications and submit required plans and documents to obtain such permits in a timely manner, and shall furnish the required information to the Building Official and obtain the required permits as early as practicable after award of the Contract.

E. Prior to the start of construction, the Contractor shall complete applicable applications, permits, and

notifications to the MADEP, such as the Demolition/Construction form BWP AQ-06, and pay the required fees. These forms must be submitted at least 10 working days in advance of any regulated activity on the site. Demolition permits must be submitted for any work involving demolition, new construction and renovation.

1.12 CUTTING, CORING, AND PATCHING, UNLESS OTHERWISE INDICATED

A. The Contractor shall coordinate that the work of the Subcontractor is not endangered by any cutting, coring, excavating, or otherwise altering of the work and shall not allow the cutting or altering the work of any Subcontractor except with the written consent of the Designer.

B. Performance:

1. Execute cutting and patching by methods which will prevent damage to other work, and will provide proper surfaces to receive installation of repairs.

(a) In general, where mechanical cutting is required, cut work with sawing and grinding tools, not with hammering and chopping tools.

2. Employ original installer or fabricator to perform cutting and patching for:
(a) Weather-exposed or moisture-resistant elements.
(b) Sight-exposed finished surfaces.

3. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances, and finishes.

4. Restore work which has been cut or removed; install new products matching existing to provide completed Work in accordance with requirements of Contract Documents.

5. Fit work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

6. Patch with seams which are durable and as invisible as possible. Flash and seal all penetrations of exterior work. Comply with specified tolerances for the work.

7. Restore exposed finishes of patched areas; and, where necessary extend finish restoration onto retained work adjoining, in a manner which will eliminate evidence of patching.
(a) Where patch occurs in a smooth painted surface, extend final paint coat over the entire unbroken surface containing the patch.

8. Refinish entire surfaces as necessary to provide an even finish to match adjacent finishes:
(a) For continuous surfaces, refinish to nearest intersection.
(b) For an assembly, refinish entire unit.

C. Existing Utilities Services:

1. Interruptions to critical existing utility services will not be allowed except as scheduled per Section 01.50.00 - Temporary Facilities and Controls.

2. All exposed conduits, wires, and/or cables shall be provided with sufficient protection and support to prevent failure, fraying, or damage due to backfilling or other construction operations.

1.13 DEBRIS REMOVAL

A. The Contractor shall coordinate the removal of all demolition and construction waste including waste by all Subcontractors from the job site on a daily basis.

B. Debris shall be legally disposed of in a D.E.P. approved disposal site.

C. The Contractor shall bear responsibility for maintaining the building and site clean and free of debris, leaving all work in clean and proper condition satisfactory to the Owner and the Designer. The Contractor shall ensure that each of the Subcontractors clean up during and immediately upon completion of their work. Clean up includes the following tasks:

1. Remove all rubbish, waste, tools, equipment, appurtenances caused by and used in the execution of work.

D. Prevent the accumulation of debris at the construction site, storage areas, parking areas, and along access roads and haul routes.

E. Provide containers for deposit of debris and schedule periodic collection and disposal of debris.

F. Prohibit overloading of trucks to prevent spillage on access and haul routes.

G. The Contractor shall be responsible for proper disposal of all construction debris leaving the site.

1.14 FIELD MEASUREMENTS

A. Although care has been taken to ensure their accuracy, the dimensions shown for existing items and structures are not guaranteed. It is the responsibility of the Contractor to verify these dimensions in the field before fabricating any construction component. No claims for extra payment due to incorrect dimensions will be considered by the Owner.

1.15 SAFETY REGULATIONS

A. This project is subject to compliance with Public Law 91 596 "Occupational Safety and Health Act" latest edition (OSHA 29 CFR 1926), with respect to all rules and regulations pertaining to construction, including Volume 36, numbers 75 and 105, of the Federal Register, as amended, and as published by the U.S. Department of Labor.

B. Hazardous Waste Generation: Any work generating Hazardous or so-called Universal Wastes will comply with all requirements of 310 CMR 30.000. The proper storage, use and disposal of any hazardous chemicals or substances brought on site by the Contractor are the responsibility of Contractor. The Owner will not be responsible for any hazardous materials left on site, the cost to remove these materials will be the Contractor's responsibility. All hazardous wastes generated as a result of demolition and remodeling shall be contained, collected, segregated, labeled per all applicable federal EPA, Massachusetts DEP, and Federal DOT regulations or other applicable local, state or federal hazardous waste regulations, pending the appropriate disposition.

1.16 OSHA SAFETY AND HEALTH COURSE DOCUMENTATION

A. OSHA Safety and Health Course Documentation Records: Chapter 306 of the Massachusetts Acts of 2004 requires that everyone employed at the jobsite must complete a minimum 10-hour long course in construction safety and health approved by the U.S. Occupational Safety and Health Administration (OSHA) prior to working at the jobsite. Compliance is required of Contractors' and Subcontractors' on-site employees at all levels whether stationed in the trailer or working in the field. Unless the Massachusetts Attorney General's office indicates otherwise, this requirement does not apply to home-office employees visiting the site or to suppliers' employees who are making deliveries.

B. OSHA 10 cards for anyone working on site are to be submitted prior to the first requisition.

C. Documentation records shall be initially compiled by the Contractor and Subcontractors, and the Contractor shall create and maintain a copy of the documentation on site at all times.

1.17 DAMAGE RESPONSIBILITY

A. The Contractor shall repair, at no cost to the Owner, any damage to building elements, site appurtenances,

landscaping, utilities, etc. caused during demolition operation and work of this Contract.

1.18 OWNER FURNISHED PRODUCTS

A. None.

1.19 ASBESTOS AND HAZARDOUS MATERIALS DISCOVERY

A. If unanticipated asbestos-containing materials or other Hazardous Materials not included in Contract are discovered at any time during the course of work, the Contractor shall cease work in the affected areas only and continue work in other areas, at the same time notify the Designer of such discovery. Do not proceed with work in such affected areas until written instructions are received. If removal is required, payment will be made in accordance with the contract unit prices bid for each respective material. In the absence of unit prices, costs shall be negotiated or otherwise established prior to commencement of removal, in accordance with provisions of the Contract.

B. The Owner or Designer will work with the Contractor to initiate removal or encapsulation of the asbestos. An extension of the completion date may be granted equal to the time lost. Proper notification must be made to the MADEP through the ANF-001 form, and the Owner.

1.20 LEAD-CONTAINING PAINT

A. The Contractor and all Subcontractors (including Filed Sub Bidders) who work on the project shall be made aware that lead-containing paint is present on architectural and structural components to be disturbed by construction activities on the project. With regards to renovation work performed under this contract, abatement of lead-containing paint by a licensed Lead Abatement Contractor is NOT required since the building is not a residence where a child under the age of six resides. However, each Contractor performing the work that disturbs lead paint shall be required to comply with the following:
   1. OSHA "Lead in Construction Standard at 29 CFR 1926.62
   2. Applicable state and federal regulations regarding proper transport and disposal of waste debris.

1.21 LIST OF DOCUMENTS

A. All Drawings are included in Appendix A of this Project Manual.

B. Summary of Work Schedule is included in Appendix B of the Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION
01.11.00

SECTION 01.31.00

PROJECT MANAGEMENT AND COORDINATION

I. PART I - GENERAL

1.01 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.02 SUMMARY

A. The Contractor shall be solely responsible for the management, scheduling and sequencing of all work and inspections required to meet this deadline.

B. Description:

1. Coordinate scheduling, submittals, and work of the various trades and elements of the Work to assure efficient and orderly sequence of installation of construction elements, with provisions for accommodating items to be installed later.

2. Coordinate sequence of the Work to accommodate Partial (Beneficial) Occupancy.

C. Meetings:

1. In addition to progress meetings, hold coordination meetings and pre-installation conferences with personnel and Sub-Contractors to assure coordination of the Work. The coordination meetings are to be separate from the commissioning or commissioning meetings.

D. Coordination of Submittals:

1. Schedule and coordinate submittals.

2. Coordinate work of various trades having interdependent responsibilities for installing, connecting to, and placing in service such equipment.

3. Coordinate requests for substitutions to assure compatibility of space, of operating elements, and effect on work of other trades.

4. Contractor’s mark-up will be excluded from change orders caused by lack of coordination during design.

E. Commissioning:

1. Not applicable.

1.03 FIELD COORDINATION

A. Project scopes of limited complexity or limited utility installation will not require coordination drawings. The Contractor remains responsible for field coordinating the work of all trades, to see that it comes together without conflict or loss of functionality.

1. Where field coordination is performed, the Contractor shall advise the Designers of any conflict or field condition which results in the system being installed other than as designed.

2. In such instances, contractors are expected to propose alternative routes based on field conditions revealed through the performance of the demolition. Rerouting shall not be performed, however, until first approved by the Designers. No additional compensation will be due for field coordination efforts.

3. Where rerouting of utilities differently than designed creates a conflict with another trade, which was not forseen or properly coordinated between the contractors, the conflicting utility shall be revised at no expense to the Owner, to eliminate the conflict.

1.04 MEP COORDINATION DRAWINGS

A. Not applicable.

II. PRODUCTS (Not Used)

III. EXECUTION (Not Used)

END OF SECTION
01.31.00

SECTION 01.32.00

CONSTRUCTION PROGRESS DOCUMENTATION

I. PART I - GENERAL

1.01 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.02 REQUIREMENTS INCLUDED

A. Procedures and requirements for submission and review of progress schedules and reports.

1.03 RELATED SECTIONS

A. Section 01.10.00 – SUMMARY

1. Project meetings.

B. Section 01.31.00 - PROJECT MANAGEMENT AND COORDINATION

1. Progress and coordination meetings.

C. Section 01.33.00 - SUBMITTAL REQUIREMENTS

1. Project reports.
2. Schedule of values.
3. Shop drawings, product data, and samples.

1.04 CONSTRUCTION SCHEDULE

A. Contractor shall prepare and submit for Designer and Owner's information, a Construction Schedule for the work of the project. Said schedule shall include sequencing of the project work and shall be submitted within 2 weeks of pre-construction meeting.

B. In addition, the Contractor shall prepare and submit at each project meeting, a two-week look-ahead schedule. The schedule shall identify:

1. Major elements of the work which were complete since the last project meeting, organized by room or by trade.

2. Major elements of the work to be performed in the next two weeks, to be able to track short-term conformance to the overall project schedule.

3. A projection of any upcoming required service interruption notices

1.05 CRITICAL PATH METHOD SCHEDULING

A. The Contractor remains responsible for identifying the critical path of all project activities and milestones, and will not be entitled to any additional compensation or any additional days related to Change Order work unless it can be demonstrated that latent conditions impact the critical path.

B. The critical path schedule shall be updated and resubmitted with each Application for Payment, and shall be considered a prerequisite for payment.

C. Additional Requirements

1. Provide a list of every submittal of shop drawings, product data, samples and other submittals required by the contract, General Conditions, Supplementary Conditions and/or technical specifications of the construction contract. The list shall identify every long lead item required by the contract.

II. PRODUCTS (Not Used)

III. EXECUTION (Not Used)

END OF SECTION
01.32.00

SECTION 01.33.00

SUBMITTALS

I. PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.02 RELATED DOCUMENTS

A. This Section supplements the General Conditions.

B. Consult the individual sections of the specifications for the specific submittals required under those sections and for further details and descriptions of the requirements

1.03 GENERAL PROCEDURES FOR SUBMITTALS

A. Timeliness - The Contractor shall transmit each submittal to the Architect sufficiently in advance of performing related work or other applicable activities so that the installation is not delayed by processing times, including disapproval and resubmittal (if required), coordination with other submittals, testing, purchasing, fabrication, delivery, and similar sequenced activities. No extension of time will be authorized because of the Contractor's failure to transmit submittals to the Architect in advance of the Work. Allow (14) calendar days for Architect's review.

B. Sequence - The Contractor shall transmit each submittal in a sequence which will not result in the Architect's approval having to be later modified or rescinded by reason of subsequent submittals which should have been processed earlier or concurrently for coordination.

C. Contractor's Review and Approval - Only submittals received from and bearing the stamp of approval of the Contractor will be considered for review by the Architect. Submittals shall be accompanied by a transmittal notice stating name of Project, date of submittal, "To", "From" (Contractor, Subcontractor, Installer, Manufacturer, Supplier), Specification Section, or Drawing No. to which the submittal refers, purpose (first submittal, resubmittal), description, remarks, distribution record, and signature of transmitter.

D. Architect's Action - The Architect will review the Contractor's submittals and return them with one of the following actions recorded thereon by appropriate markings:

1. Final Unrestricted Release: Where marked "No Exceptions Taken" the Work covered by the submittal may proceed provided it complies with the requirements of the Contract Documents.

2. Final-But-Restricted Release: When marked "Note Markings" or "Comments Attached" the Work may proceed provided it complies with the Architect's notations or corrections on the submittal and complies with the requirements of the Contract Documents. Acceptance of the Work will depend on these compliances.

3. Returned for Resubmittal: When marked "Resubmit" or "Rejected" the Work covered by the submittal (such as purchasing, fabrication, delivery, or other activity) should not proceed. The submittal should be revised or a new submittal resubmitted without delay, in accordance with the Architect's notations stating the reasons for returning the submittal.

E. Processing - All costs for printing, preparing, packaging, submitting, resubmitting, and mailing, or delivering submittals required by this contract shall be included in the Contract Sum.

1.04 OR EQUALS

A. Definition - Whenever a specification section names one or more brands for a given item, and the Contractor wishes to submit, for consideration, another brand, the submission shall be considered an "or-equal" or a "material substitution". For the purposes of this Contract, the terms "or-equal" and "material substitution" shall be considered synonymous.

B. In no case may an item be furnished on the Work other than the item named or described, unless the Architect, with the Owner's written concurrence, shall consider the item equal to the Item so named or described.

C. The equality of items offered as "equal" to items named or described shall be proved to the satisfaction of the Architect at the expense of the Contractor submitting the substitution.

1.05 SUBMISSION OF PRODUCT DATA

A. The Contractor shall submit an electronic copy of Product Data, in Adobe Acrobat (PDF) format to the Architect. All such data shall be specific and identification of material or equipment submitted shall be clearly marked or highlighted. Data of general nature will not be accepted.

B. Product Data shall be accompanied by a transmittal notice. The Contractor's stamp of approval shall appear on the printed information itself, in a location which will not impair legibility.

C. Product Data returned by the Architect as "Rejected" shall be resubmitted until the Architects approval is obtained.

D. When the Product Data are acceptable, the Architect will stamp them “No Exceptions Taken”, and return 1 copy to the Contractor. The Contractor shall provide and distribute additional copies as may be required to complete the Work.

E. The Contractor shall maintain one full set of approved, original, Product Data at the site.

1.06 SUBMISSION OF SHOP DRAWINGS

A. Shop Drawings shall be complete, giving all information necessary or requested in the individual section of the specifications. They shall also show adjoining Work and details of connection thereto.

B. Shop Drawings shall be for whole systems. Partial submissions will not be accepted.

C. The Architect reserves the right to review and approve shop drawings only after approval of related product data and samples.

D. Shop drawings shall be properly identified and contain the name of the project, name of the firm submitting the shop drawings, shop drawing number, date of shop drawings and revisions, Contractor's stamp of approval, and sufficient spaces near the title block for the Architect's stamp.

E. The Contractor shall submit to the Architect three (3) black line prints of each shop drawing or one electronic copy in Adobe Acrobat (pdf) format, at the Architect’s discretion. Prints may be mailed, delivered in roll form or emailed. Each submittal shall be accompanied by a transmittal notice bearing the Contractor's approval stamp.

F. When the Architect returns a marked submittal with the stamp "Resubmit" or "Confirm", the Contractor shall correct the original drawing or prepare a new drawing and resubmit three prints or an electronic version thereof to the Architect for approval. This procedure shall be repeated until the Architect's approval is obtained.

G. When the Architect returns submittal with the stamp "No Exceptions Taken", the Contractor shall provide and distribute the prints for all Contractor and Subcontractors use.

H. The Contractor shall maintain one full set of approved shop drawings at the site.

1.07 SUBMISSION OF SAMPLES

A. Unless otherwise specified in the individual section, the Contractor shall submit two specimens of each sample to the owner.

B. A transmittal notice with the Contractors stamp of approval shall be included with all sample submittals.

C. Samples shall be of adequate size to permit proper evaluation of materials. Where variations in color or in other characteristics are to be expected, samples shall show the maximum range of variation. Materials exceeding the variation of approved samples will not be approved on the Work.

D. Samples that can be conveniently mailed shall be sent directly to the Architect, accompanied by a transmittal notice. All transmittals shall be stamped with the Contractor's approval stamp of the material submitted.

E. All other samples shall be delivered at the field office of the Project Representative with sample identification tag attached and properly filled in.

F. If a sample is rejected by the Architect, a new sample shall be resubmitted in the specified manner. This procedure shall be repeated until the Architect approves the sample.

G. Samples will not be returned unless return is requested at the time of submission. The right is reserved to require submission of samples whether or not particular mention is made in the specifications, at no additional cost to the Owner.

END OF SECTION
01.33.00

SECTION 01.50.00

TEMPORARY FACILITIES AND CONTROLS

I. PART I - GENERAL

1.01 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.02 REQUIREMENTS INCLUDED

A. Temporary Facilities and Controls including the following:

1. Temporary Water.
2. Weather Protection.
3. Heating During Construction.
4. Temporary Power.
5. Hoisting Equipment and Machinery.
6. Staging.
7. Maintenance of Access.
8. Dust Control.
9. Noise Control.
10. Indoor Air Quality (IAQ) Management.
11. Enclosures.
12. Cleaning During Construction.
13. Field Offices.
14. Telephone Service.
15. Sanitary Facilities.
16. Construction Barriers.
17. Parking.
18. Debris Control and Removal.
19. Safety Protection.
20. Vehicle and Equipment Protection.
21. Shoring.
22. Construction Fence.
23. Project Identification Sign.
24. Delivery of Materials.
25. Shut Down Notice.
26. Construction Cores.
27. Covered Walkways
28. Excavations and Field Survey Requirements

1.03 TEMPORARY WATER

A. Water available within the project area may be used by Contractors for construction purposes, provided it is not use wastefully. The Owner reserves the right to revoke this privilege is water is not used responsibly.

B. Connection to the building water supply shall be made from the adjacent boiler/mechanical room. Connection in the toilet rooms may be made with the Owner's approval, and provided hoses are protected and oriented so as to avoid trip hazards.

C. Contractors shall furnish their own hoses for temporary water. When water is not in use, hoses shall be disconnected, rolled up and stored out of the way of the occupants.

D. The General Contractor shall provide an adequate supply of drinking water from approved sources of acceptable quality, satisfactorily cooled, for his employees and those of his Subcontractors.

E. Use of the water may be discontinued by the Owner if, in their opinion, it is wastefully used.

1.04 WEATHER PROTECTION

A. Although the scope of work is primarily interior, contractors are reminded that M.G.L. Chapter 149, Section 44D(G) requires that the General Contractor shall provide temporary enclosures and heat to permit construction work to be carried on during the months of November through March in compliance with M.G.L. Chapter 149, Section 44D(G) if required. Under no circumstances shall the General Contractor suspend any work during the months of November through March because of their reluctance to provide and pay for temporary weather protection. These Specifications are not to be construed as requiring enclosures or heat for operations that are not economically feasible to protect in the judgment of the Designer. Included in the preceding category, without limitation, are such items as site work, excavation, steel erection, erection of certain "exterior" wall panels, roofing, and similar operations.

B. "WEATHER PROTECTION" shall mean the temporary protection of that work adversely affected by moisture, wind, and cold, by covering, enclosing and/or heating. This protection shall provide adequate working areas during the months of November through March as determined by the Designer and consistent with the approved construction schedule to permit the continuous progress of all work necessary to maintain an orderly and efficient sequence of construction operations. The General Contractor shall furnish and install all "weather protection" material and be responsible for all costs, including heating required to maintain a minimum temperature of 50 degrees F. at the working surface. This provision does not supersede any specific requirements for methods of construction, curing of materials or the applicable general conditions set forth in the Contract Articles with added regard to performance obligations of the General Contractor.

1. Within 30 calendar days after his award of contract, the General Contractor shall submit in writing to the Designer for approval, three copies of his proposed methods for "Weather Protection."
2. Installation of weather protection and heating devices shall comply with all safety regulations including provisions for adequate ventilation and fire protection devices. Heating devices which may cause damage to finish surfaces shall not be used.
3. The General Contractor shall furnish and install one accurate Fahrenheit thermometer at each work area as designated by the Designer. However, one additional accurate Fahrenheit thermometer shall be provided for every 2,000 square feet of floor space where the work areas exceed 2,000 square feet.

1.05 HEATING DURING CONSTRUCTION

A. If the heating system is disrupted / off line during a period of time when the temperature requires heating in the building, the Contractor shall be responsible for providing temporary heat in that spaces affected.

1.06 TEMPORARY POWER

A. Contractors may utilize electrical power where available in or around the Work Area, and the Owner shall pay the cost of electricity used.

1. The use of cordless tools is strongly encouraged.

2. Contractors shall provide their own electrical cords, and cords shall not be run through, across or draped within corridors or circulation spaces used by the public. If running electrical cords across circulation spaces is unavoidable, cords shall be secured to the floor with readily visible colored duct tape, and shall be removed as soon as power is no longer needed.

B. Modification of electrical panels is not permitted.

C. Generators for temporary power which cannot be provided through outlets within or around the project area, will be permitted.
1. Equip generators with mufflers or silencers and position outside the building, where directed by the Owner. If generator noise adversely affects building occupants, the Owner may ask for the location to be changed or the use of generators to be suspended.

2. Do not idle generators when power is not required for the work being performed.

1.07 MAINTENANCE OF ACCESS

A. The General Contractor shall maintain for the duration of his contract, a means of access to, around and within the site, as indicated on the Contract Drawings, for vehicular traffic and authorized personnel. Driveways and loading areas shall not be blocked by contractor's equipment, vehicles or dumpsters.

1.08 DUST CONTROL

A. The General Contractor shall provide adequate means for the purpose of preventing dust caused by construction operations from creating a hazard, nuisance, and from entering adjacent occupied areas throughout the period of the construction contract.

B. This provision does not supersede any specific requirements for methods of construction or applicable general conditions set forth in the Contract Articles with added regard to performance obligations of the General Contractor.

1.09 NOISE CONTROL

A. Contractors shall anticipate limited use of the building by the Owner during the performance of the Work.

B. Work must be scheduled and performed in such a manner as to not interfere with the operations of the Owner. Construction work that is deemed by the Owner to be excessively noisy may be required to be done during non-normal working hours and at no additional expense.

C. Comply with requirements of authorities having jurisdiction. Develop and maintain a noise-abatement program and enforce strict discipline over all personnel to keep noise to a minimum.

D. Execute construction work by methods and by use of equipment which will reduce excess noise.
   1. Equip air compressors with silencers, and power equipment with mufflers.
   2. Manage vehicular traffic and scheduling to reduce noise.
   3. No heavy equipment may be started or idled before 7A.M.

1.10 INDOOR AIR QUALITY (IAQ) MANAGEMENT

A. Minimize exposure of building occupants, indoor surfaces, and ventilation air distribution systems to environmental tobacco smoke. At a minimum, take the following measures:
   1. Prohibit smoking in the building.
   2. Locate exterior designated smoking areas away from entries, outdoor air intakes, and operable windows.

B. During Construction:
   1. Provide negative air machines, ducted to existing windows through polyethelyne ducting, to contain dust within the project area and exhaust it to the exterior. Locate exhaust away from doors and windows. Where windows are present above the exhaust location, check to ensure that they are closed.

C. Before Occupancy:

   1. Conduct a baseline indoor air quality testing procedure consistent with the United States Environmental Protection Agency's "Compendium of Methods for the Determination of Air Pollutants in Indoor Air."

1.11 ENCLOSURES

A. Provide temporary, insulated, weather tight closures of openings in exterior surfaces for providing acceptable working conditions and protection for materials, allowing for heating during construction, and preventing entry of unauthorized persons.

B. All utilities including electric ducts, conduits, telephone lines, sprinklers, and other utilities shall be protected against damage from construction activity. The General Contractor shall be responsible for all damage to the utilities from construction and shall repair all such damage at no additional cost to Owner.

C. Provide temporary partitions and/or ceiling as required to separate work areas from occupied areas, to prevent penetration of dust and moisture into occupied areas, to prevent damage to existing areas and equipment. Construction shall be framing and sheet materials with closed joints and sealed edges at intersections with existing surfaces; (STC rating 35 in accordance with ASTM E900. Flame Spread Rating of 25 in accordance with ASTM E84.)

1.12 CLEANING DURING CONSTRUCTION

A. Unless otherwise specified under the various Sections of the Specifications, the General Contractor shall perform clean-up operations during construction as herein specified.

B. Control accumulation of waste materials and rubbish; periodically dispose of off-site in a legal manner. The General Contractor shall bear all costs, including fees resulting from such disposal.

C. Clean interior areas prior to start of finish work and maintain areas free of dust and other contaminants during finish operations.

D. Clean all dirt and debris tracked into other buildings by construction personnel, to the satisfaction of the Owner.

E. Maintain project in accordance with all local and Federal Regulatory Requirements.

F. Store volatile wastes in covered metal containers, and remove from premises.

G. Prevent accumulation of wastes which create hazardous conditions.

H. Provide adequate ventilation during use of volatile or noxious substances.

I. Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.
   1. Do not burn or bury rubbish and waste materials on site.
   2. Do not dispose of volatile wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.
   3. Do not dispose of wastes into streams or waterways.
   4. Identify potential sources of cleaning water runoff and propose abatement procedures.

J. Use only those materials which will not create hazards to health or property and which will not damage surfaces.

K. Use only those cleaning materials and methods recommended by manufacturer of surface materials to be cleaned.

L. Execute cleaning to ensure that the buildings, the sites, and adjacent properties are maintained free from accumulations of waste materials and rubbish and windblown debris, resulting from construction operations.

M. Provide on-site containers for collection of waste materials, debris, and rubbish.

N. Remove waste materials, debris and rubbish form the site periodically and dispose of at legal disposal dump site (DEP approved). Recycle where possible.

O. Handle material in a controlled manner with as few handlings as possible. Do not drop or throw materials from heights.

P. Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not damage surrounding surfaces.

1.13 FIELD OFFICES

A. Not Required.

1.14 TELEPHONE SERVICE

A. All Designers, Superintendents and Project Managers shall maintain cellular telephones and be reachable Monday - Friday between 8AM and 5PM, and after hours for emergency calls. Phone numbers shall be listed on a Project Directory, to be submitted at the pre-construction meeting.

1.15 SANITARY FACILITIES

A. Use of toilet facilities within the building will be permitted, provided the Contractors maintain the facilities in clean condition and are using locations approved by the building working in. The General Contractor shall take responsibility for maintenance and cleaning of such areas and shall leave them in first class condition equal to the accepted conditions of toilet facilities not used for construction personnel.

1.16 CONSTRUCTION BARRIERS

A. Proper construction barriers shall be provided around the contract work areas as defined by the Contract Drawings or as directed by the Owner.

B. Construction barriers shall consist of traffic cones, ribbons, tapes, secure fencing, trench covers, wood barriers, warning signs, directional signs, and other traffic materials to keep traffic and people from area of construction and maintain ongoing operations.

C. Barriers shall be erected at such approved locations as are necessary, sufficiently cross-braced and supported adequately from floors and ceilings as required.

1.17 PARKING

A. Parking will be permitted within the school's parking lot, where directed by the Owner. Contractors shall move vehicles when requested by the Owner.
   1. Access to loading docks, driveways, staff, faculty, visitor or tenant parking shall not be blocked by construction vehicles.
   2. Parking in handicapped accessible spaces will not be permitted.

B. Idling of vehicles on site will not be permitted.

C. If the Owner authorizes parking on lawns, the Prime Contractor shall be responsible for repairing any damage to lawns or curbs from parked vehicles.

1.18 DEBRIS CONTROL AND REMOVAL

A. Debris shall not be permitted to accumulate or migrate and the work shall at all times be kept satisfactorily clean. Facility trash receptors shall not be used for the disposal of debris. Dumpster shall be provided by the General Contractor for removal of debris for all Subcontractors.

B. Remove debris from the work site on a daily basis and dispose of same at any (private or public) DEP approved dump that the General Contractor may choose providing that the General Contractor shall make all arrangements and obtain all approvals and permits necessary from the owner or officials in charge of such dumps. During disposal process, copies of daily receipts from dump site shall be submitted on a regular basis.

1.19 SAFETY PROTECTION

A. At no time shall the work be left unattended without proper safety protection and shall not be left unprotected to the weather and accessible to the public. It is the responsibility of the General Contractor to maintain proper safety protection for the public while work is in progress or unattended.

1.20 VEHICLE AND EQUIPMENT PROTECTION

A. All construction activities shall be performed in such a manner so as not to dust, stain or damage any building elements, equipment, vehicles, etc. within general vicinity of the construction work area. Any damage to these items shall be cleaned and repaired at the expense of the General Contractor.

1. All construction vehicles and equipment on site shall be effectively disabled and secured when not in use.

1.21 CONSTRUCTION FENCE

A. Not required.

1.22 PROJECT IDENTIFICATION

A. No project sign is required by the Owner.

1.23 DELIVERY OF MATERIALS

A. All Materials shall be delivered to the Contractor's or Sub-Contractor's warehouse or may be delivered to the site if the Contractor's representative is present to receive them.

B. No materials will be received by the Owner's personnel.

1.24 SHUT DOWN NOTICE

A. The Contractor shall notify the Owner, at least fourteen (14) calendar days in advance, of the need for any utility shut down to install or modify any utilities or building systems. The shutdown request shall indicate:
   1. The utility to be shutdown.
   2. The duration of the shutdown.
   3. The spaces anticipated to be affected by the shutdown.

B. Investigation of the existing systems to determine the areas served, the location of isolation valves or sub-panels, etc., is to be anticipated and included in the bid scope.

C. Shutdowns involving sprinkler systems or fire alarm systems, for which the Authority Having Jurisdiction (AHJ) requires a fire watch, the contractor performing the shutdown shall provide and pay for the fire watch at no additional cost to the Owner.

D. Utility shutdowns affecting other buildings will be limited to occur after normal working hours. No additional compensation will be paid for overtime.

1.25 EXCAVATIONS AND FIELD SURVEY REQUIREMENTS

A. Not applicable.

II. PART II - PRODUCTS (Not Used)

III. PART III - EXECUTION (Not Used)

IV.

END OF SECTION
01.50.00

SECTION 01.73.29

CUTTING AND PATCHING

I. PART-1 GENERAL

1.01 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made a part of this section of the specifications.

1.02 SCOPE OF WORK

A. The General Contractor shall coordinate the work to ensure that all embedded or concealed items are placed prior to the closing of construction. Where opening up construction is required to install any aspect of the work, the General Contractor shall be solely responsible for the cutting and patching of such materials.

1.03 SUMMARY

A. This Section specifies administrative and procedural requirements for cutting and patching.

B. Refer to other Sections for specific requirements and limitations applicable to cutting and patching.

1.04 QUALITY ASSURANCE

A. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would reduce their load-carrying capacity or load-deflection ratio.

B. Obtain approval of the cutting and patching proposal from the Designer before cutting and patching structural elements.

C. Operational and Safety Limitations: Do not cut and patch operating elements or safety related components in a manner that would result in reducing their capacity to perform as intended, or result in increased maintenance, or decreased operational life or safety.

D. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces, in a manner that would, in the Designer's opinion, reduce the building's esthetic qualities, or result in visual evidence of cutting and patching. Remove and replace Work cut and patched in a visually unsatisfactory manner.

1.05 RELATED SECTIONS

A. Section 4.13 - General Conditions of the Contract, Article 3.

II. PART 2 - PRODUCTS

2.01 MATERIALS

A. Use materials that are identical to existing materials. If identical materials are not available or cannot be used where exposed surfaces are involved, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect. Use materials whose installed performance will equal or surpass that of existing materials.

B. Concrete, where used to spot patch abandoned penetrations in floors, shall be:

1. Normal weight concrete proportioned in accordance with ACI 211.1 and ACI 30 for 4,000 psi compressive strength @ 28 days.

2. At openings over 6" wide, provide ASTM A 615/A 615M, Grade 60, deformed reinforcing bars doweled into to the existing slab 48" on center, both sides, staggered.

3. At horizontal openings less than 6" wide, chip out the top of the opening to enlarge it, creating a tapered or conical hole to patch, such that the patch material cannot drop trough the hole.

C. Grout, where used to close annular space around floor or wall penetrations, shall be:

1. non-shrink type, prepackage and preproportioned, requiring only the addition of potable water before use, meeting or exceeding the following standards:
   (a) General Properties: ASTM C 1107-02
   (b) Compressive strength: ASTM C 109
   (c) Bond Strength: ASTM C 882

D. Lumber: where cutting of lumber is required for the installation of utilities or recessed items, or for the incidental replacement of damaged or unsuitable framing materials, new materials used to patch, sister, header or box out openings shall be kiln dried, stud grade S-P-F dimensional lumber with a dressed size of 1½" x the depth of the members receiving the work.

1. Use pressure treated lumber when in contact with ground, masonry, concrete or for roof blocking, with CCA preservative and a minimum retention rate of 0.25 pcf. Treat all cut ends by touching up in field with preservative. Use only galvanized fasteners and separate from materials which will react with preservative by using a separation sheet of peel-and-stick bituminous flashing tape.

III. PART 3 - EXECUTION

3.01 PROTECTION

A. Protect existing trees, plants, roads, walls etc. to remain. Special protection of any lawns and planting around buildings is the responsibility of the Contractor. Contractor will replace any planting killed or damaged by construction operations.

3.02 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.

1. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

2. Take all precautions necessary to avoid cutting existing pipe, conduit or duct work serving the building, but scheduled to be removed or relocated until provisions have been made to bypass them.

C. Furnish drop cloths, erect dust partitions and take other measures as required to control dust generated by cutting activities and prevent its spread to adjacent areas

3.03 LEAD-CONTAINING PAINT (Elm Park Community School Ceiling)

A. The Contractor and all Subcontractors (including Filed Sub Bidders) who work on the project shall be made aware that lead-containing paint is present on architectural and structural components to be disturbed by construction activities on the project. With regards to renovation work performed under this contract, abatement of lead-containing paint by a licensed Lead Abatement Contractor is NOT required since the

building is not a residence where a child under the age of six resides. However, each Contractor performing the work that disturbs lead paint shall be required to comply with the following:

1. OSHA "Lead in Construction Standard at 29 CFR 1926.62
2. Applicable state and federal regulations regarding proper transport and disposal of waste debris.

3.04 PERFORMANCE

A. The General Contractor shall be responsible for all cutting and patching, including all cutting and patching required by sub contractors.

1. Before cutting existing surfaces, examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. Take corrective action before proceeding, if unsafe or unsatisfactory conditions are encountered.

2. Before proceeding, meet at the site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

B. Firestopping, where required, shall be performed by the trade penetrating the wall, floor or ceiling. At all other areas requiring firestopping, work shall be performed by the General Contractor.

C. General: Employ skilled workmen to perform cutting and patching. Where required to maintain an existing product or system warranty, such as a roof warranty, employ a manufacturer's approved and warranted Contractor to perform the cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.

1. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.

D. Cutting: Cut existing construction using methods least likely to damage elements to be retained or adjoining construction. Where possible review proposed procedures with the original installer; comply with the original installer's recommendations.

1. In general, where cutting is required use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

2. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.

3. Cut through concrete and masonry using a cutting machine such as a Carborundum saw or diamond core drill.

E. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.

1. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

2. Where removal of walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space to provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary to achieve uniform color and appearance.

3. Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken surface containing the patch, after the patched area has received primer and second coat. Touch-up painting may stop at a corner, pilaster or other visual break in the repaired surface.

4. Patch, repair or re-hang existing ceilings as necessary to provide an even plane surface of uniform appearance.

F. Site Repair:

1. Restore all lawns, plantings, trees to their original condition.

2. Repair all walkways and driveways that were damaged due to construction.

3.05 CLEANING

A. Thoroughly clean areas and spaces where cutting and patching is performed or used as access. Remove completely paint, mortar, oils, putty and items of similar nature.

B. Clean any portions of the building which were affected by dirt or dust generated by cutting, sanding or other construction activities.

END OF SECTION
01.73.29

SECTION 01.77.00

CLOSEOUT PROCEDURES

I. PART 1 - GENERAL

1.01 GENERAL

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.02 DESCRIPTION OF WORK

A. This section lists the procedures required for the proper completion of this project including processing the Release of Retainage and making the Final Payment to the Contractor.

B. Consult the Individual sections of the specifications for requirements affecting Project Close Out.

1.03 RELATED DOCUMENTS

A. This section supplements the General Conditions.

B. Consult the individual sections of the specifications for specific items required under those sections.

1.04 SUBSTANTIAL COMPLETION

A. Prior to requesting Substantial Completion the Contractor shall make a thorough inspection of the Work. During this inspection the Contractor shall prepare a comprehensive list of all items remaining to be completed or corrected. This list shall include all remaining Contractor and Subcontractor items to be provided under the Contract Documents.

B. Upon completion of the items noted on the Contractor's list the Contractor shall notify the Architect that the Work is Substantially Complete. The Architect shall then conduct a similar thorough inspection. If the Architect agrees that the Work is Substantially Complete, the Architect will promptly make a thorough inspection and prepare a punch list, setting forth in accurate detail any items on the Contractor's list and additional items that are not acceptable or incomplete. The Contractor shall coordinate all Subcontractors to achieve prompt completion of the punch list.

C. The Contractor shall not be relieved of the responsibility to provide Contract items left off of the Architect's punch list.

D. If the Architect determines that the Work is not Substantially Complete, the Architect shall inform the Contractor of those items that must be completed before the Architect will prepare a punch list. Upon completion of those items, the Contractor shall again request the Architect to prepare a punch list.

E. When the punch list has been prepared, the Architect will arrange a meeting with the Contractor and Subcontractors to identify and explain all punch list items and answer questions on work which must be done before final acceptance.

F. The Architect may revise the punch list, from time to time, to ensure that all items of Work are properly completed.

G. The Architect shall prepare the Certificate of Substantial Completion in accordance with the General Conditions.

H. The Contractors shall correct the items noted on the punchlist(s). The General Contractor shall check the work of his forces, and of all sub-contractors to verify that the work has been corrected, and notify the architect that the project is ready for reinspection. The Architect and Engineers may, at their discretion, check the work to confirm the punchlist has been completed, and advise the Owner.

1. If the Contractor calls for reinspection, and the Project is not actually ready or punchlist items have not been corrected and subsequent re-inspections are required, the Architect reserves the right to bill the Owner for the re-inspections, and such monies will be deducted from the balance due to the Contractor.

1.05 RECORD DRAWINGS

A. As-built Drawings shall consist of all the Contract Drawings. As-built Drawings shall be kept up-to-date. Information from on-going Work shall be recorded on As-built Drawings within 48 hours of Work being performed.

B. The General Contractor and each Subcontractor shall be required to maintain one set of As-built Drawings, as the work relates to their Sections of the Specifications, at the site.

C. The As-built Drawings shall be stored and maintained in the General Contractor's field office or a secure location apart from other documents used for construction. The As-built Drawings shall be maintained in a clean, dry, and legible condition and shall not be used for construction purposes.

D. As-built Drawings, as submitted by the General Contractor shall be verified in the field by the Designer or his Consultants. Verification by the Designer shall occur during the construction process and prior to the related work being completed and covered up.

E. The As-built Drawings shall be available at all time for inspection by the Project Manager or Designer. All deficiencies noted shall be promptly corrected.

F. At the end of each month and before payment for materials installed, the General Contractor, each Subcontractor, the Architect and Project Manager shall review the As-built Drawings for purpose of payment.

1. If the changes in location of all installed elements are not shown on the As-Built Drawings and verified in the field, then the material shall not be considered as installed and payment will be withheld.

G. Prior to the installation of all finish materials, a review of the As-built Drawings shall be made to confirm that all changes have been recorded. All costs to investigate such conditions shall be borne by the applicable party as determined by the Designer.

H. At the completion of the contract, each Subcontractor shall submit to the General Contractor a complete set of his respective As-built Drawings indicating all changes. After checking the above drawings, the General Contractor shall certify in writing on the title sheet of the drawings that they are complete and correct and shall submit the As-built Drawings to the Designer.

I. The original hand-noted as-Built Drawings shall be scanned in color to Adobe Acrobat (*.pdf) format and submitted on CD or DVD to the Designer, to be added to the complete plans as constructed.

1.06 RECORD SURVEYS

A. Not required.

1.07 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Consult the individual sections of the specifications for the specific requirements for those sections and for further details and descriptions of the requirements.

B. Prior to final payment and completion the Contractor shall provide all Operating Manuals and Maintenance Instructions as required by the Contract Documents.

C. Operating Instructions and Manuals:

1. Subcontractors, installers, and suppliers shall furnish to the Contractor two sets of operating and maintenance instructions of all mechanical, electrical, and manually operated equipment furnished and installed by them. Mechanical and electrical subcontractors shall furnish instructions as specified in their respective sections.

2. The Contractor shall collect all of the above instructions, bind them into two complete sets, and submit them to the Architect who will deliver them to the Owner.

3. The Contractor shall prepare a CD of all O&M items and approved submittals and deliver to the Owner.

4. Submission of operating and maintenance instructions shall be a condition precedent to final payment

D. Instruction of Owner's Personnel

1. Where specified in the individual sections of the specifications, the Contractor and Subcontractor shall instruct the Owner's personnel at the site, in the use and maintenance of equipment installed under the Contract.

2. Submission to the Architect of a certificate of compliance to this requirement, signed by the Contractor and the Owner's Representative, shall be a condition precedent to final payment.

1.08 PARTIAL RELEASE OF RETAINAGE

A. If within 65 days after Substantial Completion, any of the items on the Architect's punch list are not complete or if the Contractor has not provided the appropriate marked up As Built Drawings, Operating Manuals, Warranties, Guarantees, or Spare Parts the Architect shall assign a monetary value for each incomplete item as well as any other items as provided by M.G.L. c.30 §39K, and the Architect shall prepare a Certificate for Partial Release of Retainage

B. If the Architect is required to prepare a Certificate for Partial Release of Retainage the Contractor shall complete all remaining Work in accordance with the provisions of the General Conditions.

C. The Contractor's signature on this Certificate shall be notarized.

D. The Contractor may make a request for additional releases of retainage when portions of the Work listed on the Architect's punch list have been satisfactorily completed. Each request shall be accompanied by a new application for payment and a new signed and notarized Certificate for Partial Release of Retainage.

E. The Architect's inspections, required to complete the additional payment applications described above, are subject to provisions of the General Conditions.

F. If the Owner has required Performance and Payment Bonds, then prior to the partial release of retainage, the General Contractor shall submit to the Owner Consent of Surety to Partial Release of Retainage using AIA Document G707A or an equivalent document.

1.09 FINAL RELEASE OF RETAINAGE

A. Prior to the final release of retainage, the General Contractor shall submit to the Owner:

1. Consent of Surety, using AIA Document G707 or similar document, if performance and payment bonds were required for the project.

2. Contractor's Affidavit of Release of Liens, using AIA Document G706A or equivalent. This document shall be accompanied by certified statements from all sub-contractors working on the project, that they have received all monies due, and have paid all suppliers and sub-sub contractors accordingly.

   (a) Should any payments be outstanding and contingent upon receipt of the retainage in order to be paid, the General Contractor shall submit AIA Document 706, itemizing those items which have not been paid.

END OF SECTION
01.77.00

SECTION 02.41.00

SELECTIVE DEMOLITION

I. PART 1 - GENERAL

1.01 GENERAL

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.02 WORK INCLUDES

A. Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following major items:

1. Demolish / cut section of CMU wall for installation of lintel and door frame.

2. Cut section of ceiling to install new access panels.

1.03 SUBMITTALS

A. Refer to SECTION 01.33.00 - SUBMITTALS for submittal provisions and procedures.

B. Schedule: Provide detailed sequence of demolition and removal work.

1.04 JOB CONDITIONS

A. Condition of Structures: Owner assumes no responsibility for actual condition of items or structures to be demolished.

B. Protections: Provide temporary barricades and other forms of protection as required to protect Owner's personnel and general public from injury due to selective demolition work.

1. Provide protective measures as required0 to provide free and safe passage of Owner's personnel.

2. Protect from damage existing finish work that is to remain in place and becomes exposed during demolition operations. Protect site with suitable coverings when necessary.

3. Remove protections at completion of work.

C. Damages: Promptly repair damages caused to adjacent facilities by demolition work at no cost to Owner.

D. Traffic: Conduct selective demolition operations and debris removal in a manner to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities.

E. Do not close, block or otherwise obstruct streets, walks or other occupied or used facilities without written permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

F. Utility Services: Maintain existing utilities indicated to remain, keep in service, and protect against damage during demolition operations.

G. Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by the Owner. Provide temporary services during interruptions to existing utilities, as acceptable to governing authorities.

H. Environmental Controls: Use temporary enclosures, and other suitable methods to limit dust and dirt rising and scattering in air to lowest practical level. Comply with governing regulations pertaining to environmental protection. Provide negative air equipment throughout demolition as a means of dust and odor control.

II. PART II - PRODUCTS (Not Applicable)

III. PART III - EXECUTION

3.01 ASBESTOS ADVISORY

A. If hazardous materials are encountered during demolition operations, stop work immediately and notify the Owner and Architect. If work cannot be stopped safely, comply with applicable regulations, laws, and ordinances concerning removal, handling and protection against exposure or environmental pollution.

3.02 INSPECTION

A. Prior to commencement of demolition work, inspect areas in which work will be performed. Photograph existing conditions to structure surfaces, equipment or to surrounding properties which could be misconstrued as damage resulting from selective demolition work; file with Architect prior to starting work.

B. Contractors are advised that although school is not in session at the beginning of the project, the building will remain partially occupied over break the School will be in full operation for the duration of the project.

3.03 PREPARATION

A. Submit a demolition plan and schedule under the provisions of Section 01.33.00 - Submittals, prior to performing any demolition work. Adjust schedule as required to accommodate ongoing research in occupied areas. In some cases, work after hours may be required.

B. File all appropriate paperwork and obtain all required permits prior to the start of demolition, including but not limited to:
   1. AQ-06 demolition permit.
   2. Dumpster permit.

C. Sequence work in occupied areas so as to minimize disruption, and to allow continued use of spaces.

D. Cease operations and notify the Owner's Representative immediately if safety of structure appears to be endangered. Take precautions to support structure until determination is made for continuing operations.

E. Areas to be renovated will be emptied of loose contents prior to the start of demolition, by the Owner. Where demolition of utilities and other items is required on other floors, the general contractors shall cover and protect furniture, equipment and fixtures from soiling or damage when demolition work is performed, remove said protection after the work is complete, and clean room to original condition prior to returning to occupants.

F. Erect and maintain dust-proof partitions and closures, and other means as required to prevent spread of dust or fumes to occupied portions of the building, as specified in Section 01.50.00. Temporary partitions at corridors shall not restrict access of egress through the corridor, and shall not reduce the clear width to less than what is required by Code.

G. Coordinate temporary building HVAC shutdowns in the event dust-generating demolitions is to be performed adjacent to building air intake points. The general contractor shall provide temporary ventilation through fans, to control the spread of dust through the building and maintain a negative pressure in the project area, relative to the remainder of the building.

H. Extra care and precaution shall be taken by the GC to protect any live utilities from damage until such time as they can be demolished by the appropriate sub-trade. The GC will be responsible for the correction or replacement any and all damages to materials scheduled to remain.

3.04 GENERAL DEMOLITION

A. Perform selective demolition work in a systematic manner. Use such methods as required to complete work indicated on Drawings in accordance with demolition schedule and governing regulations.

B. Provide services for effective air and water pollution controls as required by local authorities having jurisdiction.

C. If unanticipated mechanical, electrical or structural elements which conflict with intended function or design are encountered, investigate and measure both nature and extent of the conflict. Submit report to Designer in written, accurate detail. Pending receipt of directive from Designer, rearrange selective demolition schedule as necessary to continue overall job progress without delay.

D. Notify Architect immediately if materials scheduled to remain are found to be unsuitable for the installation of the new work, or if existing conditions deviate substantially from those shown on the drawings. Remove and replace, or make good, any existing materials unsuitable for installation of new work.

E. Sequence work in accordance with requirements of Section 01.31.00. Schedule new work to coincide with demolition work, to minimize amount of disruption.

3.05 WALL DEMOLITION

A. Support and saw-cut existing CMU wall to accept the new lentil, metal door and frame.

B. Remove sections of wall carefully, to maintain the integrity of the remaining portion of walls.

3.06 CEILING DEMOLITION

A. Support existing ceiling to remain, cut plaster / lath and framing as required to install new access panel / frame. Coordinate location with existing MEP for best access and least disruption.

B. Remove sections of ceiling carefully, to maintain the integrity of the remaining sections of MEP above.

3.07 DISPOSAL OF DEMOLISHED MATERIALS

A. All demolished materials may be conveyed to dumpsters at grade by carts through the building. Carts shall be covered at all times while being transported, and contractors shall sweep and damp mop dust and debris from transportation route at the end of each work day.

1. Follow the shortest route to the exterior. Transporting debris through finished portions of the building, particularly portions not receiving work, is discouraged and shall be minimized.

B. Remove debris, rubbish and other materials resulting from demolition operations from building site. Transport and legally dispose of materials off site.

C. Burning of removed materials is not permitted on project site.

3.08 DISPOSAL, CLEAN-UP AND REPAIR

A. Upon completion of demolition work, remove tools, equipment and demolished materials from site.

1. The general contractor shall provide dumpsters for all project debris. One 30-yard dumpster will be permitted, where directed by WPS. The dumpster shall not obstruct access, and shall be emptied in a timely manner.

B. Remove protections and leave interior areas broom clean. Where demolition was performed in occupied areas, all surfaces shall be vacuumed and wiped down free of dust.

C. Repair demolition performed in excess of that required. Return structures and surfaces to remain to condition existing prior to commencement of selective demolition work. Repair adjacent construction or surfaces soiled or damaged by selective demolition work.

D. Any damages to existing furnishings and/or equipment, shall be reimbursed by the general contractor, who shall recoup costs from other contractors as appropriate.

END OF SECTION
02.41.00

SECTION 08.11.13

HOLLOW METAL DOORS AND FRAMES

I. PART I - GENERAL

1.01 GENERAL

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.02 DESCRIPTION OF WORK

A. **Work included:** Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Standard hollow-metal steel door frames.
2. Steel interior doors.
3. Door hardware
4. Steel Lintel

B. **Alternates:** Not Applicable.

C. **Items to Be Installed Only:** Not Applicable.

D. **Items to Be Furnished Only:** Furnish the following items for installation by the designated Sections:

1. None.

E. **Related Work Specified Elsewhere:** The following items are not included in the Section, and will be performed under the designated Sections:

1. N/A

1.03 SUBMITTALS

A. Product Data: Include construction details, material descriptions, core descriptions, label compliance, fire-resistance rating, temperature-rise ratings, and finishes for each type of steel door and frame specified.

B. Shop Drawings:

1. Elevations of each door design.
2. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
3. Details of anchorages, joints, and connections.
4. Details of accessories.

C. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

D. Qualification Data: For Installer.

E. Product Test Reports: Based on evaluation of comprehensive fire tests performed by a qualified testing agency, for each type of steel door and frame.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Source Limitations: Obtain standard steel doors and frames through one source from a single manufacturer.

C. Fire-Rated Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings and temperature-rise limits indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

D. Fire-Rated, Borrowed-Light Assemblies (Including Sidelights and Transoms): Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch-high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.06 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.07 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

II. PART II - PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Amweld International.
2. Ceco Door Products; an ASSA ABLOY Group Company.
3. CURRIES Company; an ASSA ABLOY Group Company.
4. De LaFontaine.
5. Mesker Door Inc.
6. Pioneer Industries, Inc.
7. Republic Builders Products Company.

8. Steelcraft, an Ingersoll Rand Company.

2.02 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 metallic coating.

D. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

F. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.

G. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.

H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

I. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.03 STEEL DOORS

A. General: Provide doors and transoms of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces, unless otherwise indicated. Comply with ANSI A250.8.

1. Design: Flush or raised panel, as indicated.

2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, mineral-board, or vertical steel-stiffener core that produces doors complying with ANSI A250.8.

(a) Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
(b) Thermal-Rated (Insulated) Exterior Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 4.0 degrees F x h x sq. ft./Btu when tested according to ASTM C 1363. Provide polyurethane cores with a minimum density of 1.0 pounds per cubic foot.

3. Top and Bottom Edges: Closed with flush 0.042-inch-thick end closures or channels of same material as face sheets.

4. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

B. Interior Doors: Face sheets fabricated from cold-rolled steel sheet, unless otherwise indicated to comply with

exterior door requirements. Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:

1. Level 2 and Physical Performance Level B (Heavy Duty), Model 2 (Seamless), 1-3/4 inches thick.

C. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

D. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.04 STEEL FRAMES

A. General: Comply with ANSI A250.8 and with details indicated for type and profile.

B. Interior Frames: Fabricated from cold-rolled steel sheet, unless otherwise indicated to comply with exterior frame requirements.

1. Fabricate frames with mitered or coped and welded face corners and seamless face joints at all new walls. Frames at existing walls may be knock-down with miters field welded and filled.
2. Frames for Level 2 Steel Doors: 0.053-inch-thick (16 gauge) steel sheet.
3. Sidelights, borrowed lites and transom frames shall be fabricated from material matching the door frame associated with it.

C. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

2.05 FRAME ANCHORS

A. Jamb Anchors:

1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.

2. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.

3. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

2.06 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.

C. Hollow Metal Doors:

1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape.

Seal joints in top edges of doors against water penetration.

2. Glazed Lites: Factory cut openings in doors.

3. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.

D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and not visible.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
4. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
5. Jamb Anchors: Provide number and spacing of anchors as follows:
   (a) Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      (i) Three anchors per jamb up to 60 inches high.
      (ii) Four anchors per jamb from 60 to 90 inches high.
      (iii) Five anchors per jamb from 90 to 96 inches high.
      (iv) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
      (v) Two anchors per head for frames above 42 inches wide and mounted in metal-stud partitions.
   (b) Compression Type: Not less than two anchors in each jamb.
6. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.
   (a) Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
   (b) Double-Door Frames: Drill stop in head jamb to receive two door silencers.

E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.

F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Section 087100 - DOOR HARDWARE.

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26.

2.07 STEEL FINISHES

A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

III. PART III - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:

1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.03 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
   (a) At fire-protection-rated openings, install frames according to NFPA 80.
   (b) Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
   (c) Install frames with removable glazing stops located on secure side of opening.
   (d) Install door silencers in frames before grouting.
   (e) Remove temporary braces necessary for installation only after frames have been properly set and secured.
   (f) Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
   (g) Field apply bituminous coating to backs of frames that are filled with grout.
2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
   (a) Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
4. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
5. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
6. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each

jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.

7. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
   (a) Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   (b) Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
   (c) Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   (d) Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Fire-Rated Standard Steel Doors:
   (a) Jambs and Head: 1/8 inch plus or minus 1/16 inch.
   (b) Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
   (c) Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
   (d) Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

3.04 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION
08.11.13

Section 23 00 00

HVAC

TABLE OF CONTENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the documents identified in Division 00 Procurement and Contracting Requirements and Division 01 General Requirements. All of

the Contract Documents, including General and Supplementary Conditions and Division 1 General Requirements, apply to the work of this section. Where paragraphs of this Section conflict, the more stringent requirements shall govern.

B. All work shall comply with all federal, state and local codes and any other authorities having jurisdiction.

C. Division 23 0000 contractor shall be considered the “prime contractor” for this project. This contractor shall be responsible for providing all labor and materials necessary to provide a fully functional and complete system including related work such as electrical, wall repair, coring, cutting & patching, finish work, etc... Contractor shall hire properly licensed and qualified subcontractors to perform work outside their scope of their expertise such as but not limited to licensed electricians for electrical work, license roofer for roofing work and General Contractors for required cutting, patching, etc…

1.02 SUMMARY OF WORK

A. Provide all materials, labor and equipment required to perform the work of this section, as shown on the Contract Drawings and as specified herein, to include the following. When the word “provide” is used in this specification it shall mean to furnish & install. Provide the following:

1. Refer attachments and sketches for scope of work descriptions.
2. HVAC ductwork, dampers, etc...
3. Miscellaneous steel, dunnage, supports, hangers, pads, etc., as shown, and as required.
4. Insulation, thermal and/or acoustic, for ductwork and piping.
5. Automatic temperature controls.
6. Motor starters and drives.
7. Instruction manuals and startup instructions.
8. Testing and balancing.
9. Equipment bases and supports.
10. All rigging and hoisting of equipment as required.
11. Coring, sleeving and firestopping all holes required of the respective work.
12. Access doors on sheet metal ductwork, sheet metal panels and enclosures.
13. Prefabricated or field erected curbs.
14. Obtain and pay for all permits, fees and approvals required for work under this Section.

B. Drawing of the existing buildings (as available) shall be made available to the awarded contractor. The schools involved with this project are as follows:
- Accelerated Learning Lab (All School)
- Burncoat High School
- Chandler Magnet School
- Cantebury Elementary School
- Doherty High School
- Durkin Administration Building
- Elm Park Comm. Elementary School
- Forest Grove Middle School
- Heard Street Discovery Academy
- Jacob Hiatt Magnet Elementary School
- Norrback Elementary School
- North High School

- Quinsigamond Elementary School
- Rice Square Elementary School
- Roosevelt Elementary School
- Sullivan Middle School
- Thorndyke Road Elementary School – 1
- Worcester Technical High School

C. Related Work Specified Under Other Divisions

1. Contractor must coordinate with other trades for all related work including but not limited to housekeeping pads, electrical interface, roofing, coring, firestopping, painting, electrical, commissioning, etc…

D. Cutting, Patching and Fire-stopping:
1. For cutting and patching, this contractor shall refer to and conform to the requirements of 01 73 29 - Cutting and Patching. All penetrations through the structure shall be sealed air and watertight.

2. Where penetrating a fire rated element must be firestopped by the HVAC subcontractor. All penetrations of the floors and ceiling and other fire rated walls and assemblies shall be firestopped by the HVAC contractor. Fire-stopping of all rated wall, floor, and ceiling penetrations used by this trade-contractor for any work completed under this Section. See Section 07 84 13, Firestopping for required methods and procedures.

E. Reference To Drawings & Attachments: Work specified is shown on the HVAC sketches SKH-1, SKH-2, SKH-3 & SKH-4 as well as the all the Summary of Work spreadsheets included as part of the bid set.

F. ALTERNATES:

Special attention is called to the fact that it shall be the responsibility of all the General and Trade contractors to thoroughly examine all the alternates and evaluate for themselves as to whether or not these alternates in any way affect their respective sections. In the event that a contractor feels that any alternate(s) do reflect a cost difference, additional or a deduction, in his bid proposal, then he shall stipulate his sum and/or sums under the proper alternate(s) as provided for in the bid proposals. Failure to do so will in no way relieve the herein before stated contractors of their responsibilities regardless of what alternate(s) are selected and no extra cost will be charged to the Owner.

G. Air Filters: See 2.03 Air Filters and Assemblies.

H. Belts & Spare Stock:
It is the intent of this specification that all equipment requiring or specified with belt drives (i.e. fans, RTU's, AHU's, MAU's, exhaust fans, etc…) shall be furnished with two (2) spare sets of belts for each piece of equipment in addition to the set installed at time of install or service.

I. Electrical Equipment Requirement:
All HVAC equipment shall have a minimum Short Circuit Current Rating (SCCR) of 20,000 AMP

1.03 SUBMITTALS

A. Refer to Section 01 33 00, SUBMITTALS for submittal provisions and procedures. Contractor must also refer too and comply with Section 018113 - Sustainable Design Requirements.

B. Product data: within 30 calendar days after the HVAC Trade Contractor has received the Owner's Notice to Proceed, submit (7) copies of the following:

1. Coordinated shop drawings, showing proposed layout of equipment, piping, ducts, registers, grilles, controls and other components of the system. All heights, transitions, dimensions, etc… shall be clearly shown.
2. Manufacturers catalog cuts, Samples and other items needed to fully demonstrate the quality of the proposed materials and equipment. In addition to the submittals formerly mention herein submit equipment specification sheets and dimensional data on all equipment including but not limited to the following:
   - Ductwork, dampers, etc..
   - Insulation, thermal and/or acoustic, for ductwork and piping.
   - Automatic temperature controls.
   - Motor starters and drives.
   - Instruction manuals and startup instructions.
   - Testing and balancing.
   - Water treatment.
   - Automatic Temperature Controls

B. Record Drawings

1. Include a copy of the Record Drawings in each copy of the operation and maintenance manual described below. A reproducible set of as-built drawings shall be updated continually through the project and delivered to the Architect at project completion. Record drawings shall also be delivered in both ACAD format and PDF format on a CD.

C. Testing and Balancing Reports

1. Submit electronic copies of a certified testing and balancing report to the Architect & Engineer for review and approval. Include all air flow, water flow and temperature readings as outlined herein.

D. Operating Instructions

1. Prior to the completion of all work and the final inspection of the installation by the owner, four (4) copies of a complete Instruction Manual, bound in booklet form and suitably indexed, shall be submitted to the Architect for review and approval. All written material contained in the manual shall be typewritten. In addition, provide a copy of the manual in an index PDF format on a CD.

1.04 INSTRUCTION OF OWNER'S PERSONNEL

A. After completion of all work and all tests and at such time as designated by the owner, provide the necessary skilled personnel to operate the entire installation for a period of forty (40) hours. This 40 hours is in addition to those equipment specific training hours specified elsewhere within this specification. Training shall be broken up into multiple four (4) hour periods at the direction of the Owner.

B. During the operating period, fully instruct the owner's representative in the complete operation, adjustment and maintenance of the entire installation.

C. It shall be division 23 00 00 responsibility to provide all personnel as required to make for a fully operational system. The hours of training and instruction outlined in division 23 00 00 and the Testing and Balancing requirements shall be in addition to those tests and requirements required to start-up and verify proper system operation.

1.05 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. The HVAC Contractor's superintendent shall conduct all coordination between the Architect, the Engineers, etc., and shall fully represent the HVAC Contractor's position in his absence. All decisions by the superintendent shall become the responsibility of the Contractor and binding to the Contract. The Contractor shall be responsible for the drawings, and that which is written or implied in the specifications.

C. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

D. Completely coordinate with work of other trades and provide for complete and fully functional installation. Although not specifically shown, provide supplementary or miscellaneous items, devices, appurtenances, and materials incidental to or necessary for sound, secure and complete installation.

E. Before submitting the final proposal examine the site of the proposed work to determine existing conditions that may effect the work, as this section will be help responsible for any assumption in regard thereto.

F. All equipment, ductwork, piping and materials utilized for this project must be protected from exposure to weather until installed. Interior equipment and materials shall not be installed unless the area in which they are being installed is adequately weather tight.

G. Contractor must comply with requirements of Section – Construction Indoor Air Quality (IAQ) Management as well as the SMACNA IAQ Guidelines defined in paragraph 3.02 of this section.

H. Condensate evaporation trays are expressly forbidden on all HVAC equipment.

I. To assure uniformity and compatibility of piping components in grooved end piping systems, all grooved products utilized shall be supplied be a single manufacturer. Grooving tools shall be supplied by the same manufacturer as the grooved components.

1.06 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 the Contractor'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.

1.07 WARRANTY

A. The HVAC Trade Contractor shall guarantee every component part of each system for a minimum of one-year parts and labor from date of substantial completion. The HVAC Trade Contractor shall also provide the Owner with factory warranties for all equipment. For equipment with compressors such as packaged rooftop provide extended five-year warranty on compressors. Refer to extended warranty below and respective specification sections herein for additional warranty requirements.

B. For the following pieces of equipment provide extended 3-year full warranty starting from the date of substantial completion:
   - New RTU’s
   - New AHU’s

   Warranty shall cover all parts and labor including both factory and field installed control components.

1.08 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 this Trade Contractor.

B. Coordinate work of this Trade Contract 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 Trade Contract, 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.

E. Refer to the Construction Managers Supplemental Instructions to bidders, section 00 73 00, Project Phasing Requirements Section 01 12 00, for summary of partial work that has been completed, and this contractors coordination and work responsibilities for the remaining scope, briefly summarized as follows:

   a. Coordination drawings have progressed setting some ductwork and riser/chase locations.

PART 2 - PRODUCTS

2.01 DUCTWORK

A. All duct runs shall be checked for clearances before installation of any ductwork. Above hung ceilings, duct locations, and elevations must be coordinated with work of other trades to avoid conflicts with structure, piping, conduit, light fixtures, and cable trays.

B. All sheet metal ducts shall be constructed of galvanized iron sheet G-60 galvanized steel meeting ASTM A924 and A653 of bend forming quality.

C. Duct construction shall be in accordance with best practices and latest SMACNA requirements for metal gauges, joints, reinforcing, and supports. Ductwork within 20 feet of an air handler (AHU), rooftop unit (RTU) or energy recovery unit (ERU) supply and return or exhaust fan shall be minimum 16 gauge or 2 gauges heavier than SMACNA standard, whichever is greater (heavier gauge), to reduce breakout noise. All ductwork shall be rated for a minimum pressure classification of 3”w.g. where located upstream of VAV terminals or used for the smoke control system, kitchen hood exhaust or elevator shaft exhaust. Elsewhere the ductwork shall be rated for 2” w.g. or higher rating as recommended by SMACNA standards. All exposed ductwork shall be constructed and hung to provide a neat, smooth, finished appearance. Cadmium plated sheet metal screws shall be used on all exposed ductwork. Ducts shall be free from expansion or contraction noises or rattling when fans are turned on or off.

D. Round ductwork shall be spiral formed galvanized steel of standard gauge as manufactured by United Sheet Metal, Spiramatic, Semco, or equal. Refer to Articles on Spiral Round and Double Wall Spiral Round for additional information.

E. Duct sizes change in shape or dimensions and offset as required to clear structural members and to coordinate with other trades. All changes must maintain the same friction loss as the original duct (i.e. similar free area) and must meet the latest ASHRAE and SMACNA standards.

F. The centerline radius of all duct elbows where shown on Drawings shall be at least one and one-half the width of the duct. Where building conditions do not allow for this radius, provide double wall airfoil turning vanes or, if in a sound attenuated duct, provide acoustical attenuating turns.

G. Duct sections 1 ft. 6 in. wide or less shall be butted together and jointed with flat drive cleats 2-1/8 in. wide. Top and bottom cleats shall be cut flush with duct and side cleats bent over to make a tight joint. Standing bar slips as specified for ducts over 18 in. may be used at the HVAC Trade contractor's option.

H. Ducts from 18 in. to 30 in. wide shall be jointed with 1/8 in. standing bar slips made of metal the same as or heavier than duct sheets. Joints in ducts with either dimension over 30 in. shall have 1 in. standing bar slips on those sides over 30 in. Where sides are over 42 in., the standing bar slips will be reinforced with 1-1/2 in. by 1-1/2 in. by 1/8 in. angles. Additional angle stiffeners not over 60 in. apart shall be provided between joints. Ducts over 60 in. in width shall be jointed with 1-1/2 in. by 1/8 in. angle irons riveted to ductwork on all sides with 1/8 in. rivets at not more than 4-1/2 in. on centers, sections bolted with 3/16 in. stove bolts at not over 6 in. centers, sheets turned over angles into joint at least 1/4 in.

I. Sheet metal screws 3/4 in. No. 10 may be used to attach stiffener angles to ductwork to secure seams, spaced not over 12 in. on centers and not less than two (2) per side of

12 in. or more, except where specified otherwise. Button punching shall not be used, except for pre-erection attachment of fittings.

J. Provide hinged galvanized steel access and inspection doors opposite each motorized & gravity damper, at each fire damper, and at every duct mounted control device. In addition, provide access doors of sufficient quantity and location to allow for complete internal access of all ductwork systems for future cleaning and inspection but in no case less than every 20 feet and at every change in direction. Doors shall be of rigid construction with cast type rotary latches. Where space limitations do not allow full swing of the access door, two (2) rotary type latches shall be used. Doors located in insulated ducts shall be furnished with extended frames to serve as a stop for insulation. Insulate doors located in insulated ductwork. All doors shall be gasketed. Door shall be 10 in. by 12 in. minimum except where limited by duct width and shall be larger where necessary for access to fire damper fusible links or other devices. Access on exposed ductwork shall be located so as to conceal them from obvious view from building occupants (i.e. top side of ductwork).

K. Hangers for all rectangular ducts 4 sq. ft. in area or above shall be round bar type fastened to 1-1/4 in. by 1-1/4 in. by 1/8 in. angles under the ducts.
   1. Ducts less than 4 sq. ft. in area shall be hung with black 1 in. by l/8 in. strap iron bent 1 in. under bottom side of the duct and fastened to the duct with sheet metal screws, using not less than two (2) screws per side and as many more so that they are not greater than 6 in. centers.

L. Supports for round and oval ductwork shall be 1 in. by 1/8 in. black strap iron rolled to the perimeter of the duct with ends bent on top of duct and bolted. Hangers at supply diffusers shall be similar but separated at bottom and riveted to ductwork as required for adequate support.

M. Hangers for the round ductwork shall be 1 in. by 1/8 in. black strap iron bolted to supports and lagged into the ceiling construction. Hangers over 24 in. long shall be 3/8 in. rod type with bolted and threaded ends and angle bracket at ceiling.

N. Hangers are to be placed on not greater than 8 ft. 0 in. centers or closer where required so that the ductwork can support the weight of a 200 pound man at any point.

O. Wherever sound insulation lining is called for, the sheet metal duct size shown on the Drawings must be increased to provide the clear inside dimensions or cross sectional area shown on the Drawings. Dimensions shown on the drawings are clear inside.

P. Duct joint sealing, reinforcing, flanges, etc. for square sheet metal ducts shall be based on maintaining airtight ducts at 3 in. w.g upstream of VAV or used for smoke control system and 2 in. w.g. elsewhere maximum static pressure with maximum of 5 percent leakage of total fan capacity, 1/2 of one percent for round and oval ducts. All joints in round and rectangular ductwork shall be sealed with UL classified NFPA approved duct sealer. Off gasing of sealer must comply with LEED requirements for the construction of this building. Seal all ductwork at joists and seams with LEED EQ. Credit compliant water based duct sealer DuctMate® EZ-Seal or approved equal. All ductwork shall be pressure tested as required by code.

Q. Upon completion of construction and before testing, the interior of all plenums shall be vacuum cleaned. When unit is first turned on, open duct access doors and blow out all foreign matter. Do not run fan without filter.

R. At branch ducts, provide manually operated dampers of the type and arrangement shown on the Drawings, two gages heavier that the duct in which installed and equipped with locking quadrants. All branch take-offs shall be made with 45° or full Bellmouth type fittings. Spin-in, stick-on and straight taps take-offs shall not be allowed.

S. Volume dampers, provide single and multi blade manually adjustable dampers as shown on drawings in all duct splits and branch connection of supply and exhaust air systems.

T. Acoustic insulation: All new supply, return, and exhaust air ducts shall be lined internally with 1.5" inch thick acoustical liner equal to Owens Corning QuietR® Type R-6 or Knauf Insulation Rigid Plenum Liner Board manufactured with ECOSE® Technology or equal, k=0.25 at 75 degree F. mean temperature for rectangular ductwork and Owens Corning QuietZone® 1.5"thick spiral duct liner, k+0.25 at 75 degree F. mean temperature for spiral and round ductwork. Minimum installed R Value shall be 6.0. Liner shall extend for a minimum of 10 feet (or more if indicated on drawings) from all air moving equipment (AHU's RTU's and Fans). Liner shall clipped and cemented to the inside of the duct. All seams and edges of liner shall be sealed to prevent fraying in the airstream. Liner shall have an acrylic polymer fiberglass reinforced facing with an antimicrobial coating. Liner shall conform to NFPA and U.L. and ASTM C1071 & ASTM C1104 requirements and have a 25/50 flame/smoke rating.

U. SOUND ATTENUATING UNITS

1. Casing gage weight shall be no less as schedule but not less than 20 gage galvanized sheet steel or heavier than 10 gage galvanized sheet metal as reflected on the schedules, with suitable flanges to make clean airtight connections to ductwork. Sound-absorbent material faced with glass fiber cloth and covered with not less than 22 gage or heavier galvanized perforated sheet steel or perforated aluminum. Perforations shall not exceed 4 mm (5/32-inch) diameter, approximately 25 percent free area. Sound absorbent material shall be long glass fiber acoustic blanket meeting requirements of NFPA 90A with microbial coating. Sound absorbent material shall conform to NFPA and U.L. and ASTM C1071 & ASTM C1104 requirements and have a 25/50 flame/smoke rating.
2. Entire unit shall be completely airtight and free of vibration and buckling at internal static pressures up to 2000 Pa (8 inches W.G.) at operating velocities.
3. Pressure drop through each unit: Not to exceed indicated value at design air quantities indicated.
4. Submit complete independent laboratory test data showing pressure drop and acoustical performance.
5. Cap open ends of attenuators at factory with plastic and heavy-duty paper, cardboard, or other appropriate material to prevent entrance of dirt, water, or any other foreign matter to inside of attenuator. Caps shall not be removed until attenuator is installed in duct system.

2.02 AIR FILTERS & ASSEMBLIES

a. Where indicated on the drawings, provide custom factory-fabricated modular filter rack assemblies simile to FastFrame as manufactured by Camfil or approved equal by Flanders Precision Aire or American Air Filter (AAF). Racks shall be constructed of heavy gauge galvanized steel with gasketed tracks and intermediate galvanized steel angle frames as required. Racks shall have easy access tracks to allow for simple filter change. Provide

fixed filter block offs as required to prevent air bypass around filters. Block offs shall not need to be removed during filter replacement.

b. Filter frames shall include centering dimples, pre & final filter compression tabs and a replaceable ¾" sealing gasket. Frames shall be fabricated of 16 gauge galvanized steel and have multiple mounting holes on the frame for frame assembly. Frames larger than 4' wide or 4' high shall include field provided galvanized angle iron stiffeners running the full length and height of the filter array and anchored to the surrounding structure. Filters shall be raised a minimum of 6" above the floor in all filter chambers and include 16 gauge sheetmetal filler panels around the filter frame to ensure no air bypasses the filter assembly.

c. It is the intent of this specification that all new RTU and AHU equipment as well as all existing equipment noted as having required filter changes shall be furnished with two (2) spare sets of filters (both pre and final) for each piece of equipment in addition to those initial sets replaced in the current equipment or supplied with the new equipment. After initial filter install Owner shall be left with two (2) full spare sets per system. All filters shall have a minimum efficiency of MERV 8 or MERV 13 or higher as specified elsewhere in this specification. Filters for all new equipment shall be no less than MERV 13 rated.

d. All air filters shall be pleated style with low air resistant not exceeding a clean pressure drop of 0.16" at 300 FPM for MERV 13 filters and 0.12" for MERV 8 filters. MERV 13 filters shall be AAF PREpleat® M13 or approved equal. MERV 8 filters shall be AAF PerfectPleat® HC M8 or approved equal.

2.03 INSULATION

A. General

1. Provide materials complying with NFPA Bulletin 90-A, as determined by UL method 723,NFPA 225-ASTM E 84, and complying with the governing code, with flame spread rating under 25 and smoke developed rating under 50.
2. Insulation properties must meet or exceed the minimum R-values required by the IMC 2015, IECC 2018 and the applicable Stretch Energy Code adopted by the City/Town as applicable and those indicated herein.
3. Where vapor barriers are used, provide intact and continuous throughout.
4. Minimum post-consumer recycled content of 58.5%.
5. Acceptable manufacturers:
   - Owes/Corning Fiberglass
   - Knauf
   - Manville
   - Certainteed

B. New and Repaired Supply, Return & Relief Air Ductwork

1. The following ductwork shall be insulated:
   - All new and repaired supply air, return air and mixed air ductwork shall be insulated. Supply and mixed air ductwork located within a return air ceiling plenum must be insulated and are not exempt from insulation. Return air ductwork located within a ceiling cavity within the building thermal envelope, where a conditioned area matching the air conditions of the conveying duct is located above and below this ceiling cavity need not be insulated.
   - Relief and exhaust air ductwork from the discharge point to the backdraft or isolation damper (see outdoor air ductwork).

- All supply air duct and exhaust air ductwork connecting to an energy recovery unit. This includes recovery unit exhaust air ductwork from the unit to the building envelope discharge point.

2. Above ductwork shall be insulated with 2.2-inch-thick flexible blanket duct insulation with vapor barrier, 0.75 lbs. per cu. ft. density glass fiber with maximum K factor of 0.25 at 75 degree F. mean temperature with fire retardant foil/Kraft (FSK) vapor barrier facing. Product shall be Owens Corning SOFTR™ Type 075 or equal with an installed R-value of 6.0 or greater. All seams and joints shall be taped with matching fiberglass reinforced foil vapor barrier tape. Exposed supply and return ductwork located within the conditioned it serves need not be insulated. Duct indicated as being internally lined need not be externally insulated except when located on the roof or within an unconditioned space.

3. Ductwork located outside the building thermal envelope but not exposed to the exterior weather (see Exterior Ductwork paragraph) shall be insulated as noted above but with 4"+ thick insulation having and installed R-value of 12.

C. New and Repaired Outdoor Air Ductwork

1. All new and repaired outdoor air ductwork including combustion air ductwork and outdoor and relief/exhaust air louver plenums shall be insulated with 4.4 inch thick flexible blanket duct insulation with vapor barrier, 0.75 lbs. per ft. density glass fiber with maximum K factor of 0.24 at 75 degree F mean temperature with fire retardant foil/Kraft (FSK) vapor barrier facing with a minimum installed R value of 12. Ductwork within mechanical rooms shall be rigid type insulation with equivalent R value. Product shall be Owens Corning SOFTR™ Type 075 or equal. All seams and joints shall be taped with matching kraft paper vapor barrier tape.

D. New and Repaired Exterior Ductwork

1. Exterior Supply & Return Air Ductwork: All new and repaired supply air and return air ductwork located outside the heated building envelope shall be insulated with 2" thick polyisocyanurate closed-cell rigid duct insulation, ASTM C 591, type IV, K=0.19), for use at temperatures up to 149 degree C (300 degree F) regardless of whether internal lining is present. Insulation shall be sloped so as to pitch water towards edge of ductwork.

2. Provide covering on all exterior insulated ductwork and equipment. Product shall be field-applied or pre-applied protective finishing and/or vapor sealing, operating within the range of -94°F (-70°C) and 300°F (149°C), jacketed with laminated, flexible, self-adhering, protective jacketing, vapor barrier and weather proofing membrane, having a high performance acrylic adhesive capable of installation with no additional mechanical attachment. Material is to be VentureClad 1577CW (5ply) Natural, White (White Membrane "WM"), or approved equal finish selected based on availability and desired final appearance of insulated system. Jacketing material is to have a maximum flame spread/smoke developed index of 10/20 per UL 723 test, a .000 water vapor permeance rating per ASTM E-96, and mold inhibitors incorporated. All products are UV stable. Fabrication and installation shall conform to the manufacturer's installation instructions and Midwest Insulation Contractors Association National Insulation Standards Manual. If there is conflicting information, manufacturer's installation instructions are to be followed.

E. New and Repaired Ductwork in Mechanical Rooms:

1. All new and repaired ductwork exposed within the mechanical room shall be insulated with rigid duct insulation (1.5" thick for supply and return and heat reclaimed exhaust and 2" thick for outdoor air ductwork) with vapor barrier, 3.0 lbs. per ft. density glass fiber with maximum K factor of 0.23 at 75 degree F mean temperature with fire retardant foil/Kraft (FSK) vapor barrier facing with a minimum R value of 6. Duct indicated as being internally lined need not be externally insulated (except when located on roof) or if conveying outside air or part of an outdoor air or relief air plenum. For outdoor air duct and outdoor air and relief air louvers insulate with 4" of insulation with an installed R-value of 12.

F. Refer to Ductwork Article for internal acoustical insulation.

2.10 HANGERS AND SUPPORTS

A. Rooftop ductwork shall be supported on a rail support system by Roof-Pro model #RP-D or equal by Uni-Strut.

2.11 VIBRATION ISOLATION AND FLEXIBLE CONNECTIONS

A. At duct connections to equipment, provide glass-fabric flexible neoprene (Hypalon if exposed to the exterior) connections with a minimum of 6 inch full length and approved by the governmental agencies having jurisdiction. Product shall be similar to Proflex^{TM} by Ductmate or approved equal.

B. At pipe connections to air handler coils, rooftop units, fan coil units and hot water unit heaters, provide braided stainless steel flexible pipe connectors as manufactured by Mercer Rubber Co. model #BSS or equal.

2.12 ACCESS PANELS

A. Furnish and install access panels for access to all parts of the HVAC systems that require accessibility for the proper operation and maintenance of the system.

B. Size shall be sufficient for the purpose, but no less than 12 inches by 18 inches. Particular attention shall be exercised in the selection of doors for masonry walls in order that frame sizes used will match the courses of brick or block. Refer to section 08 31 00 for products.

C. Access doors shall be prime coated of rust inhibitive paint, continuous hinge and manufactured by Inland Steel Products Company "Milcor", Acudor, Mifab, Miami-Carey or Walsh-Hannon-Galdwin, Incorporated "Way Loctor". Type shall be based upon "Milcor" as follows:

1. Suspended Drywall Ceilings: Style ATR with 16 gauge frame, 18 gauge panel and flush screwdriver operated cam locks.

2. Plastered Walls and Ceilings: Style K with 16 gauge frame, 14 gauge panel and flush screwdriver operated cam locks.

3. Masonry Non-Rated Walls: Style M with 16 gauge frame, 14 gauge panel and flush screwdriver operated cam locks.

4. Masonry Non-Rated Wall: Fire rated with UL 1-1/2 hour “B” rating, 16 gauge frame, 20 gauge sandwich type insulated panel, self-latching lock having interior release mechanism, and key operated cylinder lock keyed as required to suit requirements of the Architect.

5. Non-Rated Dry Walls: Style DW with 16 gauge frame, 14 gauge panel screwdriver operated cam locks.

2.13 ELECTRICAL WORK

A. The Heating, Ventilating and Air Conditioning Contractor shall provide all wiring for the Automatic Temperature Controls, air handlers, duct smoke detectors (fan interlock and control loop power), condensers, etc.. except as otherwise specified herein.

B. The HVAC contractor shall hire a licensed electrician to perform all control wiring as required by code. Minimum gauge of all control wiring is 18 AWG and shall be plenum rated.

C. The Electrical Contractor shall install and do all power wiring for all motor starters and unmounted motors, furnished to him at the job site by other trades.

D. For all low voltage motors, temperature control wiring and motor control wiring, including wiring for interlocking, shall be provided by the Section providing the motors, including the installation of all control devices.

E. Furnish all starters and all other motor control devices for motor driven equipment required for the work. The Electrical Contractor shall provide all code required disconnect switches for all motors, except where otherwise noted. The setting of all motors required for mechanical equipment shall be included as part of the mechanical work.

F. Equipment which includes a number of correlated electrical control devices mounted in a single enclosure or on a common base with equipment, shall be supplied for installation completely wired as a unit with terminal boxes and ample leads ready for external wiring.

G. All electrical items called for as part of the mechanical work shall conform to NEMA Standards, to the requirements of the National Fire Protection Association and to the requirements of any local electrical code authority having jurisdiction, any field modifications required to ensure such conformance shall be included as part of the mechanical work.

2.14 ELECTRIC MOTORS & SHEAVES

A. This Contractor shall provide all electric motors necessary for driving all motor driven equipment required to be furnished under this section of the Specifications.

B. All motors shall be designed for 3 phase, 60 cycle alternating current operation with 208 or 460 (site dependent) volts across the motor terminals, except that, unless otherwise specified herein, all motors 1/3 HP and smaller shall be designed for single phase, 60 cycle alternating current at 120 volts across the terminals. Motor RPM shall be 1750 RPM or other to match the needs of the equipment it is being installed in.

C. The speed, horsepower, type and other essential data for each motor, if not given under paragraphs describing the various motor driven apparatus, or in schedules on the drawings

shall be submitted to the Engineer for his review. All motors shall be premium efficiency type and any connected to a VFD shall have a shaft grounding ring.

D. Contractor shall furnish premium efficient motors eligible for rebate by the local electric utility, when applicable.

E. For all new motors not on VFD drives, provide adjustable motor sheaves sized for the application with the number of beltways matching the existing blower sheave.

2.15 SCAFFOLDS AND STAGING

A. General: Contractor 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 Contractor 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 Trade Contract requiring such scaffolding.

2. Contractor 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 Construction Manager pursuant to MGL (Refer to Section 01 50 00 – TEMPORARY FACILITIES AND CONTROLS and as additionally required for dust control).

a. Construction Manager 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 Trade Contractor.

2.16 HOISTING MACHINERY AND EQUIPMENT

A. All hoisting equipment, rigging equipment, crane services and lift machinery required for the work by this Contractor shall be furnished, installed, operated and maintained in safe conditions by this Contractor.

2.17 AUTOMATIC TEMPERATURE CONTROLS

A. Furnish and install all control components necessary to obtain a fully functional control system as described herein. The contractor is responsible for providing all controls, relays, etc. necessary to accomplish the Sequence of Operations and performance specified, whether or not the items are specifically identified herein. This shall include all the points shown in the control diagrams and on the drawings. Wherever a setpoint is referred to, this implies that the setting is adjustable by the user. Contractor shall hire the project electrician to provide additional power supplies to support the control devices as required. All controls operating equipment and systems configured to run off emergency stand-by power must be wired to the emergency stand-by power circuit.

B. The specified DDC system shall be based the most recent generation of products by Alerton, as provided by Automated Building Systems, Inc. the Owners current energy management system provider. No alternates shall be allowed. Owner's front-end graphics

must be updated to include any modifications made to systems as part of this project. The project graphics and software must be programmed into the existing city-wide Alerton server. New controls installed must seamlessly integrate into the existing Alerton system front-end graphics for trending and alarm reporting. The control system shall operate on a central network bus and shall web based access via password protection to any remote computer. This control system shall be referred to as the DDC, EMS or ATC system throughout this specification. EMS system must be Bacnet and Open Protocol compatibility for direct communication with boilers, VFD's & RTU's, etc… to obtain operation status of systems including real time energy consumption.

It is the intent of this project that any new packaged rooftop equipment shall come with factory controllers with communication card for interface and control by building EMS. Although equipment may come with many local devices and sensors provided by the equipment manufacturer the EMS contractor must still provide external sensors and devices (i.e. duct smoke detector and damper connections, duct static and space static sensors, return and/or space CO2 sensors, etc…) as required to achieve the sequence of operation and comply with the bid documents. Controls subcontractor must review specifications and clarify with respective mechanical sub-bidders to verify mechanical contractor is proposing to provide the equipment specified with communication interface specified

C. The BMS contractor shall be regularly engaged in the installation and maintenance of BMS systems and shall meet the following qualifications:

i. A minimum of ten (10) years of demonstrated technical expertise and experience in the installation and maintenance of BMS systems similar in size and complexity to this project.
ii. A minimum of ten (10) years' experience installing the control system of the manufacturer that is to be proposed.
iii. Shall be a certified-to-install, direct representative of a control system manufacturer that has a minimum of ten (10) years experience producing control systems similar to that which is to be proposed.
iv. A maintained service organization consisting of at least eight (8) competent servicemen, within 60 miles of the project site, for a period of not less than ten years.
v. Tech support available 24 hrs / per 365 day's per year.
vi. The Bidder shall not be considered qualified to bid this project unless they can provide a list of 10 projects, similar in size and scope to this project, completed within the last four years.
7. The system manufacturer/installer shall provide an experienced project manager for this work from beginning of control installation until final completion. The project manager is responsible for direct supervision of the design, installation, start-up and testing of the BMS as well as attending of project meetings whenever directed by the owner, construction manager, and/or mechanical contractor. It shall not be acceptable to change the project manager after the project has begun and before final completion. If the BMS manufacturer wishes to change the project manager, the construction manager and/or owner's representative must be notified immediately and both the new project manager and the previous project manager shall spend 3 consecutive business days together on-site performing a project management switchover. Exceptions may be allowed for small projects as determined by the construction manager and/or owner's representative.

D. The entire system, materials & devices as well as installing contractor and associated work shall comply with all current governing codes, ordinances and regulations including UL, NFPA, NEC, IBC, IMC, local AHJ, etc…

E. The system shall have a documented history of compatibility by design for a minimum of 15 years. Future compatibility shall be supported for no less than 10 years. Compatibility shall be defined as the ability for any existing control system component including but not limited to Primary Control Panels, Secondary Control Panels, personal operator workstations, and portable operator's terminals, to be connected and directly communicate with any new BMS system equipment without bridges, routers or protocol converters.

F. All control wiring shall be shielded plenum rated minimum 18 AWG (unless lighter gauge or heavier gauge is required due to impedance or current demands) and shall be run concealed above ceilings or within walls. When the wiring must run exposed it shall be run in EMT conduit in unfinished service spaces and in Wiremold® or equal conduit system product in finished occupiable spaces.

G. It shall be division 23 00 00 responsibility to provide all personnel as required to fully coordinate with the testing and balancing of the systems.

H. General

1. The automatic temperature control system shall include, but not be limited to, the following components:
   - Front-end computer with graphic software showing all building HVAC systems. Real-time interface with controlled components. Modify existing to reflect all changes and additions.
   - Several stand-alone DDC control unit(s) networked together on a local LAN to control the environment in the entire building
   - Expansion modules for the controllers, if required, shall provide for the capability of additional DDC points.
   - End devices such as sensors, actuators, dampers and valves.
   - Control transformers and relays.
   - Control wiring between duct smoke detectors and the respective fan starters.
2. The failure of any single component shall not interrupt the control strategies of other operational devices.

I. OPERATOR INTERFACE / STATION

1. Modify existing school department front-end to reflect the modifications and additions made to the HVAC system for this project.

J. INPUT/OUTPUT INTERFACE

1. Digital Inputs (DI) shall allow the monitoring of on/off signals from remote devices. The digital inputs shall provide a wetting current of 12mA at 12 vdc to be compatible with commonly available control devices.

2. Analog Inputs (AI) shall allow the monitoring of low voltage current or resistance signals and shall have a minimum resolution of 0.1% of the sensing range. Analog inputs shall be compatible with and field configurable to commonly available sensing devices.

3. Digital Outputs (DO) shall provide a continuous low voltage signal for on/off control of remote devices. Where specified in the sequences of operations or indicated on the

points list, digital outputs shall have 3-position (on/off/auto) override switches, status lights, and shall be selectable for either normally open or normally closed positions.

4. Analog Outputs (AO) shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0 to 10vdc or a 4 to 20 mA signal as required to provide proper control of the output device.

K. AUXILIARY CONTROL DEVICES

1. Control Valves

   a. Valve bodies shall be 2-way or 3-way mixing as shown on the drawings and as specified herein. Valve bodies 2" and under shall be bronze, screwed type, rated for 125 psig. Valve bodies 2-1/2" and over shall be iron, flanged and rated at 125 psig, except where otherwise noted. Valves shall have stainless steel stems and allow for servicing including packing, stem and disk replacement. Valve shall be sized for a pressure drop equal to 2 psig.

2. Valve Actuators

   a. Valve actuators shall be electronic, spring return, low voltage (24v) and properly selected for the valve body and service. Actuators shall be fully proportioning. All heating valves including radiation shall be fail open style to open fully upon power loss however during summer months when the heating plant is off, the ATC shall disable power to the valves.

3. Dampers and Actuators

   a. Dampers shall be opposed blade type except where installed in round ductwork where single blade type is acceptable. All damper blades shall be low leakage type with neoprene gasketed edge seals rated for no more than 3 CFM/SF leakage at 1" w.g.. Actuators shall be electronic, spring return, low voltage (24v) and properly selected for the required torque and speed. Actuators shall be fully proportioning with the exception of those dampers specified as being 2-position open & closed. All actuators shall include end switches.

   b. For the Thorndyke school replace the existing 24"x72" (V.I.F., actual approx. 23"x71") return air damper, the existing 24"x70" (V.I.F., actual approx. 24"x69") and the existing 36"x36" (V.I.F.) damper with new opposed blade type with actuator(s).

4. Temperature Sensors

   a. Temperature sensors shall be Resistance Temperature Detector (RTD) type or thermistors, as dictated by the requirements of this specification. Final location of all space sensors shall be coordinated with the Owner and Engineer. Space sensors in classrooms, offices, teacher lounges and non-public spaces shall be wall mounted type with a user adjustable access allowing deviation of +/- 3 deg. of computer defined setpoint and push button occupied override. Space sensors in public areas such as in the Gymnasium, Locker Rooms, Cafeteria, Lobby, etc… shall be non-adjustable type with push button occupied override. Sensors in gymnasium and locker room shall be stainless steel plate type with push-button override. Sensors in restrooms shall be stainless steel plate type with no override.

b. Duct sensors shall be rigid or averaging as specified in the sequence of operations. Averaging sensors shall be a minimum of 20 feet in length. Freeze protection sensor shall have a 20 foot sensor crossing back and forth across the air exit face of the water heating coil. Immersion sensors shall be provided with a separable stainless steel well

c. Sensor accuracy's and operating ranges shall be as follows:
- Space temp. +/- 1 deg. F, 0 to 130 deg. F range
- Duct temp. +/- 1 deg. F, 30 to 160 deg. F range
- O.A. Duct temp. +/- 1 deg. F, -30 to 160 deg. F range
- Water +/- 1 deg. F, 0 to 200 deg. F range

5. Relative Humidity Sensors

a. Relative humidity sensors shall be thin film capacitor type with an accuracy of +/- 2% with a range of 10% to 90%. For enthalpy calculations provide on North wall for outdoor air sensing and one in each RTU and AHU main return air duct and elsewhere as shown on the control drawings or indicated herein. Final location of all space sensors shall be coordinated with the Owner and Engineer. Space sensors shall be wall-mounted type.

6. CO2 sensors: Shall be self-calibrating duct or wall-mounting type as specified capable of measuring a CO2 range between 100 and 2000 PPM as manufactured by Mamac or approved equal.

7. Flow Switches

b. Differential pressure switches shall be provided at filters and fans. Paddle type switch shall be provided at boilers unless otherwise noted or if boiler flow turn down is below range of paddle sensor. Current sensing run indicators shall be provided at each fan and pump. Sensor shall be able to differentiate between belt loss and motor failure and report to the workstation as such.

8. Air Flow Measuring Stations: Provide multi-point cross grid hot wire flow measuring station at outdoor air and exhaust air locations as specified herein in the following systems and locations. Devices shall be similar to Ebtron Gold series with multiple sampling points to effectively measure airflow per manuf. recommendation.

- Worcester Technical High School: In RTU-2A, 3B & 4B at each unitary outdoor air intake typical of two (2) per unit. Multi-point, multi-grid flow stations shall be installed across the intake face of each of the two (2) existing 30"x92" (V.I.F.) OA dampers, typical of 3 units. Units have a unit manufacturers (Mammoth) control system. EMS must contact manuf. Mammoth, and coordinate sending the unit an OA demand signal for control of its OA dampers as required to support the sequence of operation as described herein.
- Rice Square Elementary School: In the central air handler system outdoor air intake and in the central exhaust fan at the fan inlet cone. Provide new controls on existing air handling system to support the sequence of operation and points as described herein.
- Thorndyke Road Elem. School 1: Square Elementary School: In the central air supply air fan at the fan inlet cone. Provide new controls on existing air handling system to support the sequence of operation and points as described herein

9. Duct Smoke Detectors: HVAC contractor shall install duct smoke detectors in ductwork as well as interlock with respective fan circuits and EMS system. Electrical contractor shall furnish duct smoke detector, power wire and wire to fire alarm system.

10. Fire/Smoke Dampers: Coordinate control of fire/smoke fire smoke dampers with electrical contractor. When a fire/smoke damper closes in an area the respective unit serving that area shall shutdown. Electrical contractor shall wire fire/smoke dampers to the fire alarm system.

L. OPERATOR INTERFACE SOFTWARE

1. Alarms

a. The stand-alone DDC unit shall provide visual notification of equipment failures, program failures, hardware failures or sensor failures. In addition, each sensor and point shall be individual alarmed for values in excess of their respective high/low limits or status. When an alarm is detected, it shall be automatically stored and the user notified by displaying a message on the front display panel.

c. Filter Alarms:

If filter differential static pressure sensor detects a filter pressure drop of greater than a setpoint of 0.7" a dirty filter maintenance alarm shall be reported by the front-end. Typical for all system with filter monitoring as indicated on the control drawings and/or scope or work.

2. Scheduling

a. The scheduling program in the stand-alone DDC unit shall provide daily, weekly and calendar scheduling capability. The master schedule shall be capable of being individually edited for each day of the week and holidays.

3. Communications

a. The controller shall communicate on a network bus. In addition, the system shall communicate to the internet via a Ethernet connection. Coordinate with Owner for Ethernet interface port. Contractor shall program system to dial out and email alarms to predefined parties and send alarms to the Owner's security monitoring company.

M. SEQUENCE OF OPERATION MODIFICATION – Worcester Tech High School RTU-2A, 3B and 4B

1. Units have a unit manufacturers (Mammoth) control system. EMS must contact manuf. Mammoth, and coordinate sending the unit an OA demand signal for control of its OA dampers as required to support the sequence of operation as described herein.

2. Revise the OA damper control to include the following logic:

During scheduled occupied periods the OA dampers shall modulate as required to maintain the minimum schedule OA airflow across the variable supply air operating range of the unit. OA percentage shall be reset from the maximum level of the

scheduled minimum OA CFM down as required to support ASHRAE 62.1 6.2.5 control for multi-zone VAV system polling all VAV zones for airflow and calculating ventilation rates and fractions. In no case shall the OA be reset above the scheduled minimum outdoor air unless economizer cooling is required. Control shall not prohibit the economizer logic if more OA is required to achieve the desired supply air setpoint.

3. Control vendor shall test units heating discharge air control and freeze protection pump and safety controls to ensure proper operation and protection of equipment.

4. DDC Added Points – RTU- 2A, 3B and 4B

   a. The EMS contractor shall provide the following added points for each of the units. Consult with RTU unit manufacturer for EMS interface.

Inputs	Outputs
Outdoor air volume AI (mult.)	OA reset signal AO

N. SEQUENCE OF OPERATION – Thorndyke Elem. School AHU & Heard Street School

1. General

   a. Units have limited controls. This project shall provide all new controllers, dampers and damper actuators, valve and valve actuators, sensors and devices to fully automate the air handling system and connect to the City's central school dept. EMS.

   b. AHU is a constant volume air handling unit that provides heating and ventilation air to the respective areas of the building.

2. Supply & Exhaust Fan Control

   a. The EMS system shall compare the outdoor conditions, the space conditions and the buildings historical warm-up/cool-down profile to determine the optimum start time required to achieve space setpoint conditions by the scheduled occupied start time. The supply fan shall run continuous during the occupied time period. During morning warm-up mode the outdoor air dampers shall remain closed, the return air dampers open and the system shall supply air reset off the return air temperature to bring the spaces up to space heating setpoint (Refer to Heating Coil Control).

   b. The exhaust fan shall be enabled once the OA reaches 50% or more of the specified air volume to prevent building over-pressurization.

   c. The EMS shall index from the occupied mode to the unoccupied mode based on a time schedule furnished by the owner. This schedule may be temporary overridden for a predetermined time period by sensor mounted override switches.

3. Occupied Mode

   a. At the commencement of occupied mode, the outdoor air damper shall open to its respective position with the return/recirculation air dampers going to their respective positions. The supply fan shall run continuously throughout the occupied time period (see exhaust fan enable herein).

b. The exhaust fan shall run when the outdoor airflow volume exceeds 50% (adj.) of the scheduled minimum OA CFM. Outdoor airflow quantity shall be calculated by using the OA airflow station. Space pressure shall be monitored and a low level alarm reported if space pressure exceeds an initial setpoint of +0.01" with respect to outdoors.

c. Outdoor air flow and associated return air dampers shall modulate to maintain outdoor air quantity constant.

d. Main return air carbon dioxide levels shall be monitored and if levels exceed a maximum CO2 setpoint level of 1000 ppm (adj.) or greater a low-level alarm shall be reported by the EMS.

4. Unoccupied Mode

a. At the commencement of unoccupied mode the outdoor air dampers shall close and the fans shall cycle off. If required, the supply fan shall cycle on (and exh. of OA is over 50%) to maintain unoccupied space cooling and heating setpoints initially set for 88°F and 60°F respectively.

5. Cooling Control

a. The total enthalpy of the return air and outdoor air streams shall be compared and, if advantageous, outdoor air economizer cycle shall be enabled either partially in conjunction with mechanical cooling or exclusively to maintain supply air temperature setpoint. In economizer mode, the outdoor air and return air dampers shall modulate as a first stage to satisfy supply air setpoint.

c. Supply air discharge setpoint shall be reset between 55°F and 90°F based on an average of the space temperature demand.

d. Morning Cool-Down: If the average space temperature is above cooling setpoint and the outdoor air conditions are favorable for cooling and it is within 2-hours (adj.) of a scheduled occupied period the EMS shall calculate an optimized start-time to achieve space setpoint and enable the unit into morning cool-down mode. The supply air temperature shall be reset down to no less than 55°F until the average space temperature reaches cooling setpoint or the return air temperature reaches 75°F whichever comes first at which time the unit shall drop out of morning cool-down mode and enter normal occupied operation at the schedule time.

6. Heating Control

a. Presuming the plant is in the heating mode, the normally open steam heating coil valve shall modulate as required to maintain a minimum preheat discharge temperature of 55 deg. F reset as indicated in the cooling control section. Maximum supply air temperature shall be 90°F.

b. When outdoor air temperature is below 38 degrees F. and the system is operating, the steam coil valve shall be 50% open and the valve shall modulate first followed by the face and bypass dampers to maintain supply air setpoint. When outdoor air temperature is above 38 degrees F., the face and bypass dampers shall be full open to coil flow and the valve shall modulate to maintain supply air setpoint.

During unoccupied periods when the fans are off the steam coil valve shall modulate from 0 to 10% open to maintain a averaging coil discharge temp of 70°F. The Face & Bypass and coil valve shall modulate to insure discharge air temperature does not exceed 90 degrees F. (adjustable).

During morning warm-up the supply air reset schedule shall be overridden and the coil valve shall modulate to satisfy the reset schedule indicated herein:

Morning Warm-up Reset Schedule:

R.A. Temp.	S.A. Temp.
60	90
70	75

Once the return air temperature reaches 70 deg. F. the system shall drop out of morning warm-up mode and enter normal occupied operation.

7. System Safeties & Misc.:

   a. If the steam coil averaging discharge air sensor detects a leaving air temperature below 45°F for longer than 60 seconds, or if the system discharge air temperature drops below 45°F for longer than 60 seconds the air unit shall report a low temperature alarm and close the OA dampers and open the return air dampers.

   b. If the steam coil freeze stat detects a leaving air temperature below 38°F for longer than 60 seconds, the system shall report a freeze alarm, the fans shall shutdown and the OA dampers shall close and RA dampers open.

   c. If the system discharge air temperature drops below 45°F for longer than 120 seconds, the ATC shall report a freeze condition to the EMS and the following shall occur:
   Disable supply air and exhaust air fans.
   Close the outdoor and exhaust air dampers and open the return air damper.
   Open steam coil valve 100%
   Annunciate a local alarm

   d. Normal damper positions are as follows:
   O.A. damper – normally closed
   R.A. damper – normally open

   e. Smoke Alarm – Upon a smoke detector activation or if any smoke damper in the system is in a position other than fully open, the unit and fans shall shutdown and the dampers shall go to their normal position (i.e. O.A.-Closed). An alarm shall be reported to the EMS system and the building fire alarm system.

8. DDC Point List – Thondyke Elem. School AHU & Heard Street School

   a. As a minimum the following points being monitored and controlled for the system:

Inputs	Outputs
Filter Diff. Pressure AI (3)	Supply fan S/S DO
Outdoor air volume AI	Exhaust fan S/S DO
Mixed air temp. AI	O.A. damper AO

Coil Avg Disch Temp AI
Supply fan status
amp. AI
Exhaust fan status/
amp. AI
Freezestat DI
Duct Smoke Det. DI (mult)
Discharge air temperature AI
R.A. temperature AI
R.A. humidity AI
R.A. CO2 AI
O.A. temperature AI
O.A. humidity AI

Return Air damper AO
Steam Coil Valve(s) AO
Face & Bypass Dampers AO

O. SEQUENCE OF OPERATION – Rice Square Elem. School AHU

1. General

   a. Unit has limited controls. This project shall provide all new controllers, damper actuators, valve and actuators, sensors and devices to fully automate the air handling system and connect to the City's central school dept. EMS.

   b. AHU is a constant volume air handling unit that provides tempered ventilation air to the respective areas of the building.

2. Supply Fan Control

   a. The EMS system shall compare the outdoor conditions, the space conditions and the buildings historical warm-up/cool-down profile to determine the optimum start time required to achieve space setpoint conditions by the scheduled occupied start time. The supply fan shall run continuous during the occupied time period.

   b. The EMS shall index from the occupied mode to the unoccupied mode based on a time schedule furnished by the owner. This schedule may be temporary overridden for a predetermined time period by sensor mounted override switches.

3. Occupied Mode

   a. At the commencement of occupied mode, the outdoor air damper (if present) shall open. The supply fan shall run continuously throughout the occupied time period.

   b. Main return air carbon dioxide levels shall be monitored and if levels exceed a maximum CO2 setpoint level of 1000 ppm (adj.) or greater a low-level alarm shall be reported by the EMS.

4. Unoccupied Mode

   a. At the commencement of unoccupied mode the outdoor air dampers (if present) shall close and the fan shall cycle off and the face and bypass dampers shall close to coil airflow.

5. Cooling Control

a. Supply air discharge setpoint shall be reset between 55°F and 80°F based on an average of the space temperature demand.

b. Morning Cool-Down: If the average space temperature is above cooling setpoint and the outdoor air conditions are favorable for cooling and it is within 2-hours (adj.) of a scheduled occupied period the EMS shall calculate an optimized start-time to achieve space setpoint and enable the unit into morning cool-down mode. The supply air temperature shall be reset down to no less than 55°F until the average space temperature reaches cooling setpoint or the return air temperature reaches 75°F whichever comes first at which time the unit shall drop out of morning cool-down mode and enter normal occupied operation at the schedule time.

6. Heating Control

a. Presuming the plant is in the heating mode, the normally open steam heating coil valve shall modulate as required to maintain a minimum preheat discharge temperature of 55 deg. F reset as indicated in the cooling control section. Maximum supply air temperature shall be 80°F.

b. When outdoor air temperature is below 38 degrees F. and the system is operating, the steam coil valve shall be 50% open (adj) and the valve shall modulate first followed by the face and bypass dampers to maintain supply air setpoint. When outdoor air temperature is above 38 degrees F., the face and bypass dampers shall be full open to coil flow and the valve shall modulate to maintain supply air setpoint. During unoccupied periods when the fans are off the steam coil valve shall remain modulate from 0 to 10% open to maintain a fan entering air temp. of 70°F. The Face & Bypass and coil valve shall modulate to ensure discharge air temperature does not exceed 80 degrees F. (adjustable).

During morning warm-up the supply air reset schedule shall be overridden and the coil valve shall modulate to satisfy the reset schedule indicated herein:

Morning Warm-up Reset Schedule:

Space Temp.	S.A. Temp.
60	80
70	70

Once the space temperature reaches 70 deg. F. the system shall drop out of morning warm-up mode and enter normal occupied operation.

7. System Safeties & Misc.:

a. If the steam coil freeze stat detects a leaving air temperature below 38°F for longer than 60 seconds, the system shall report a freeze alarm, the fan shall shutdown and the face & bypass dampers shall close to coil flow. If an outdoor air damper is present in the system it shall close.

d. If the system discharge air temperature drops below 45°F for longer than 120 seconds, the ATC shall report a freeze condition to the EMS and the following shall occur:
Disable supply air fan.
Close the outdoor damper.

Open steam coil valve 100%
Annunciate a local alarm

d. Normal damper positions are as follows:
O.A. damper – normally closed
R.A. damper – normally open

e. Smoke Alarm – Upon a smoke detector activation or if any smoke damper in the system is in a position other than fully open, the unit and fans shall shutdown and the dampers shall go to their normal position (i.e. O.A.-Closed). An alarm shall be reported to the EMS system and the building fire alarm system.

8. DDC Point List – Rice Square Elem. School AHU

a. As a minimum the following points being monitored and controlled for the system:

Inputs	Outputs
Filter Diff. Pressure AI (3)	Supply fan S/S DO
Discharge air temp. AI	O.A. damper AO
Freezestat DI (on active coil sec. only)	Face & Bypass Dampers AO
Supply fan status	Steam Coil Valve(s) AO
amp. AI	
Duct Smoke Det. DI (mult.)	
O.A. temperature AI	
O.A. humidity AI	

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of heating, ventilating and air conditioning system will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Install equipment ductwork, piping and controls where shown with recognized industry standards and practices, to ensure that installation complies with requirements and serves intended purposes.

B. Coordinate with other work as necessary to interface installation of ductwork, piping and equipment with other components of systems.

C. Installation of Ductwork

1. Installation of ductwork shall be coordinated with other work as necessary to interface installation or ductwork with other components of systems. Duct sizes shown on the drawings at connection to fans or other equipment may vary in actual installation. Contractor shall provide transition pieces as required. Ducts, casings and hangers shall be installed straight and level and shall be free of vibration and noise when fans are operating. All ducts shall be protected and sealed during construction to prevent

moisture and dust entry. After installation duct segments and systems shall be pressure tested per SMACNA standards.

2. Provide fire safing to close all floor and wall (where fire rated) openings around ductwork - pack annular space with rockwool and 18 gauge sheet metal safing.

3. Seal the ductwork at joists and seams with LEED EQ. Credit compliant water-based duct sealer DuctMate® EZ-Seal or approved equal.

4. When ductwork penetrates an insulated joist bay in the attic area, maintain insulation integrity. Support ductwork to prevent movement and secure insulation and fill all gaps.

5. 1/8" thick galvanized steel angle irons shall be used to support ductwork mounted on the roof. Angles shall be securely fastened to the ductwork and the roof before installation of the roofing membrane. Roofer shall flash in angle supports.

6. This contractor is responsible for sleeving all duct penetrations before pouring of slab. If additional holes are required this contractor shall have pay for the coring of such holes in coordination with the general contractor and with prior consent of the Architect.

7. Fabrication, installation, sealing, protecting and testing of all ductwork and duct liner shall comply with the most recent publications from the Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) including but not limited to the following. All smoke control ductwork must be pressure tested as well as all other ductwork required by code and/or otherwise required by SMACNA standards described herein:
   - SMACNA IAQ Guidelines for Occupied Buildings under Construction with special emphasis placed on the section regarding Duct Cleanliness and Protection for New Construction.
   - SMACNA Duct Cleanliness for New Construction Guideline.
   - This project must comply with SMACNA Duct Cleanliness Guidelines Advanced Level.
   - SMACNA HVAC Duct Construction Standards – Metal and Flexible
   - SMACNA Air Duct Leakage Test Manual

8. Duct pressure tests shall take place after all takeoffs and wall penetrations are in place and before applying exterior insulation. Correct any leaks found. Pressure test all high-pressure ductwork (duct rated for over 3"w.g.) as well as all kitchen hood exhaust ductwork, all dust collector ductwork, all smoke control ductwork (i.e. stair pressurization) and 25% of all medium and low pressure ductwork (ductwork rated for under 3" w.g.) on the project at 150% of its duct construction class pressure in accordance with SMACNA standards.

9. Duct leakage testing shall be per SMACNA HVAC Air Duct Leakage Test Manual. Provide orifice assembly including straightening vanes, orifice plate mounted in straight tube with properly located pressure taps, and U-tube manometer or other device as specified by SMACNA. Submit leak test report in SMACNA format along with ductwork drawings for designer review.

10. All new ductwork shall be shipped to the site with protective film on all open connections to prevent dust from entering. In addition, if existing duct is opened, film

shall be applied to maintain protection. Film shall be reapplied to all open ends as the duct is installed until such time as building is clean and system is ready for start-up

E. Installation of Equipment

1. Contractor shall examine location where equipment is to be installed and determine space conditions and notify Architect, in writing, of conditions detrimental to proper and timely completion of work.

2. Install equipment where shown in accordance with manufacturer's written instructions.

3.03 FIELD QUALITY CONTROL

A. Upon completion of installation of the automatic temperature control system and after motors have been energized with normal power source, test system to demonstrate compliance with requirements. When possible, field correct malfunctioning controls then retest to demonstrate compliance. Replace controls, which cannot be satisfactorily corrected. Refer to Section - Test and Balancing. The balancing contractor (TAB) and the controls contractor shall submit written reports of testing procedures and findings.

3.04 SERVICE

1. After completion of the control system installation, the controls contractor shall regulate and adjust all thermostats, control valves, damper motors, etc., and place in complete operating condition, subject to the approval of the Owner. Complete instructions shall be given to the operating personnel. There shall be 40 hours of instruction given on the operation of the entire system at a training schedule determined by the Owner.

2. Start-Up and Commissioning

For all air handlers, rooftop units, etc… that were modified as part of this project, provide factory service/start-up technician to check, test and start equipment. Technician shall coordinate mapping of all control points with EMS contractor and commissioning of unit. In coordination with the mechanical contractor and control contractor the factory technician shall provide Owner training of unit controls, maintenance, etc…

3.05 TESTING, ADJUSTING AND BALANCING (TAB)

A. General

1. Section Includes
   a. Testing, adjusting, and balancing of Air Systems.
   b. Testing, adjusting, and balancing of Hydronic Systems.
   c. Measurement of final operating conditions of HVAC Systems.
2. Related Documents
   a. Drawings and General Provisions of Contract, including General and Supplementary Conditions, apply to work of this section.
   b. Reference 220000 Plumbing for related flow meters, switches, etc… the HVAC monitors.
3. References
   a. ASHRAE - Standard 111 - 1988 Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air Conditioning, and Refrigeration Systems.

b. ASHRAE - 2007 HVAC Applications Handbook: Chapter 37, Testing, Adjusting and Balancing.
c. AABC- National Standards for Total System Balance.
d. NEBB - Procedural Standards for Testing, Balancing and Adjusting of Environmental System.
e. SMACNA - HVAC System Testing, Adjusting and Balancing.
f. Sheet Metal Industry - Certification of Testing, Adjusting and Balancing Technicians.
g. ASHRAE 110 Methods of Testing and Performance of Laboratory Fume Hoods.

4. Quality Assurance
   a. Agency shall be a firm specializing in the adjusting and balancing of systems
      specified in this Section with minimum three years documented experience, acceptable to the Designer.
   b. Perform the work under the supervision of one of the following:
      1) AABC Certified Test and Balancing Engineer.
      2) NEBB Certified Testing, Balancing, and Adjusting Supervisor.
      3) TABB Certified Contractor.
   c. Work shall be performed only by a Balancing Sub-Sub Contractor which employs
      Certified Testing, Adjusting and balancing Technicians as listed by the Sheet Metal Industry National Certification Board for TAB Technicians.
   d. The work must be performed by a Certified Testing, Adjusting and Balancing Technician who may be assisted by other TAB Technicians. The Certified Testing, Adjusting and Balancing Technician is responsible for:
      1) Procedures to follow.
      2) Accuracy of all testing.
      3) Integrity of recorded data
      4) Entering all data and any abnormal or notable conditions in report forms.
      5) Initialing and dating each sheet.
   e. The General Section of the Balance Report shall include the names, signatures, and registration numbers of the Technicians who were assigned to the project.

5. Submittals
   a. Submit name of the Balancing Sub-Sub Contractor for approval within 30 days after award of contract.
   b. Submit for review, prior to commencement of work, a list of equipment and procedures to be used in balancing the systems.
   c. Submit reports of preconstruction plan check and periodic mechanical construction review.
   d. Submit draft copies of report for review prior to final acceptance of project. Provide final copies to the Designer and for inclusion in operating and maintenance manuals.

6. Procedures, General
   a. All Air and Hydronic Systems shall be balanced using a procedure which results in minimum restrictions being imposed.
      1) At Completion of balancing:
         a) At least one damper for an outlet/inlet shall be fully open on every branch duct.
         b) At least one branch duct balancing damper shall be fully open on every trunk duct.
         c) At least on trunk (zone) balancing damper shall be fully open in each Air System.

d) Supply/exhaust fan RPM shall be set so the static pressure at the terminal which is most difficult to supply/exhaust is adequate, but not excessive.
e) At least one hydronic terminal unit balancing valve in each piping branch shall be fully open.
f) At least one branch line balancing valve in each Hydronic System shall be fully open.

7. Final Reports
   a. Submit reports on previously approved Test Data Forms
   b. Forms shall include the following information:
      1) Title Page:
         a) Company name
         b) Company address
         c) Company telephone number
         d) Name, signature, and registration number of each technician
         e) Project name
         f) Project location
         g) Project Architect
         h) Project Engineer
         i) Project Contractor
         j) Project altitude
         k) Date of report
      2) Instrument List:
         a) Instrument
         b) Manufacturer
         c) Model
         d) Serial number
         e) Range
         f) Calibration date
      3) Air Moving Equipment
         a) Designation
         b) Location
         c) Manufacturer
         d) Model
         e) Airflow, specified and actual
         f) Return airflow, specified and actual
         g) Outside airflow, specified and actual
         h) Total static pressure (total external), specified and actual
         i) Inlet pressure
         j) Discharge pressure
         k. Fan RPM
      4) Return\ Exhaust Fan Data:
         a) Designation
         b) Location
         c) Manufacturer
         d) Model
         e) Airflow, specified and actual
         f) Total static pressure (total external), specified and actual
         g) Inlet pressure
         h) Discharge pressure
         i) Fan RPM, initial and final
      5) Electric Motor:
         a) Manufacturer

b) HP
c) Frame
d) Phase, voltage, amperage; nameplate and actual
e) RPM
f) Service factor
g) Starter size, rating, heater elements

6) V-Belt Drive:
a) Identification
b) Driven sheave, diameter
c) Belt, size and quantity
d) Motor sheave, diameter
e) Center to center distance, maximum, minimum, and actual
f) Final components

7) 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
j) Air correction factor

8) Air Monitoring Station Data:
a) Identification/location
b) System
c) Size
d) Area
e) Design velocity
f) Design airflow
g) Test velocity
h) Test airflow

9) Air Distribution Test sheet:
a) Air terminal number
b) Room number/location
c) Terminal type
d) Terminal Size
e) Area factor
f) Design velocity
g) Design airflow
h) Test velocity, initial and final
i) Test airflow, final
j) Percent of design airflow, initial and final

10) VAV Terminal Data:
a) Designation
b) Location
c) Manufacturer
d) Type
e) Model
f) Size
g) Design airflow
h) Actual airflow

i) Design Water Flow
j) Actual Water Flow

11) Cooling Coil Data:
a) Designation
b) Location
c) Service
d) Manufacturer
e) Size, face area, and fins/inch
f) Airflow, design and actual
g) Entering Air DB temperature, design and actual
h) Entering air WB temperature, design and actual
i) Leaving air DB temperature, design and actual
j) Leaving air DB temperature, design and actual
k) Air pressure drop, design and actual

12) Heating Coil Data:
a) Designation
b) Location
c) Service
d) Manufacturer
e) Size, face area, and fins/inch
f) Airflow, design and actual
g) Water flow, design and actual
h) Water pressure drop, design and actual
i) Entering water temperature, design and actual
j) Leaving water temperature, design and actual
k) Entering air temperature, design and actual
l) Leaving air temperature, design and actual
m) Air pressure drop, design and actual.

13) Heating Terminal, Pump, HX and Radiation Data:
a) Designation
b) Location
c) Service
d) Manufacturer
e) Size and fins/inch
f) Water flow, design and actual
g) Water pressure drop, design and actual
h) Temperature in and out (HX only)
i) Pump pressure and flow

c. Report is to include a listing of any abnormal or notable conditions not contained in the above.
d. Provide four copie of reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

8. HVAC Sub-Contractor Responsibilities
a. Prepare each system for testing and balancing
b. Cooperate with Balancing Sub-Sub Contractor, provide access to equipment and systems. Operate systems at designated times, and under conditions required for proper testing, adjusting, and balancing.
c. Notify Balancing Sub-Sub Contractor seven days prior to time system will be ready for testing, adjusting, and balancing.

d. Where fans (air handling units, supply fans, return fans, exhaust fans, etc.) are provided with variable pitch sheaves, HVAC Sub-Contractor shall adjust sheaves, as required, at no additional cost to the Owner, until desired Design Points (CFM and/or Static Pressure) are reached. If adjustment of the variable pitch sheaves is beyond the range of the sheaves, HVAC Sub-Contractor shall replace sheaves, as required, at no additional cost to the Owner, until the desired Design Points (CFM and/or Static Pressure) are reached. Where fans (air handling, supply, return, exhaust, etc.) are specified with fixed ratio sheaves, HVAC Sub-Contractor shall replace sheaves with new sheaves, at no additional cost to the Owner until desired Design Points (CFM and/or Static Pressure) are reached.

9. Sequencing and Scheduling
   a. Sequencing work to commence after completion of systems and schedule completion of work before Substantial Completion of Project.
10. Drawing and Construction Review
   a. Perform a pre-construction review of the following documents:
      1) Contract drawings.
      2) Contract specifications.
      3) Addenda.
      4) Submittal data.
      5) Shop drawings.
      6) Automatic Control drawings.
   b. Prepare a report of the preconstruction review list of recommended changes to
      allow most effective balancing.
   c. Perform two construction reviews of the mechanical installation during the progress of the project. Purpose of the reviews to be:
      1) Identify potential problems for performing balancing.
      2) Identify modifications which will aid balancing.
      3) Schedule and coordinate balancing with other work.
   d. Prepare a report of each construction review.
11. Equipment
   a. Provide all necessary tools, scaffolding and ladders.
   b. Provide all necessary instruments. Instruments shall be used and applied which are best suited to the system function being tested. Instruments shall be in first class state of repair and have been calibrated within a period of six months prior to starting the job. Calibration history of each instrument shall be available for examination. Instruments shall be re-calibrated upon completion of the job if required by the Designer to prove reliability.
12. Examination
   a. Before commencing work, verify that systems are complete and operable. Ensure the following:
      1) Equipment is operable an in safe and normal condition.
      2) Temperature control systems are installed complete and operable.
      3) Proper thermal overload protection is in place for electrical equipment.
      4) Final filters are clean and in place. If required, install temporary media in addition to final filters.
      5) Duct systems are clean of debris.
      6) Correct fan rotation.
      7) Fire and volume dampers are in place and open.
      8) Coil fins have been cleaned and combed.
      9) Access doors are closed and duct end caps are in place.
      10) Air outlets are installed and connected.
      11) Duct system leakage has been minimized.

12) Proper strainer baskets are clean and in place.
13) Correct pump rotation.
14) Hydronic systems have been flushed, filled, and vented.
15) Service and balance valves are open.

b. Report to the Designer any defects or deficiencies noted during performance of services.
c. Promptly report abnormal conditions in mechanical systems or conditions which prevent system balance.
d. If, for design reasons, system cannot be properly balanced, report as observed.
e. Beginning of work means acceptance of existing conditions.

13. Preparation
a. Provide instruments required for testing adjusting and balancing operations. Make instruments available to the Designer to facilitate spot checks during testing.

14. Installation Tolerances
a. Adjust Air Handling Systems to the following tolerances:
1) Supply systems shall be balanced so that:
a) The total quantity to each space is within -5% to +10% of design values.
b) If two outlets in space, each outlet is within -10% to +10% of design value.
c) If three or more outlets in space, each outlet is within -15% to +15% of design value.
2) Exhaust and return systems shall be balanced so the total quantity from each space is -10% to +10% of design values.
b. Adjust Hydronic Systems to the following tolerances:
1) Heating System:
a) Supply water temperature above 160°F: -10% to +10% of design value.

15. Adjusting
a. Recorded data shall represent actually measured or observed condition.
b. Permanently marked settings of valves, dampers, and other adjustment devices, allowing settings to be restored. Set and lock memory stops.
c. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
d. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

16. Air System Procedure
a. Measure and balance air quantities at air inlets an outlets.
b. Adjust Air Handling and Distribution Systems to provide design supply, return and exhaust air quantities at site altitude.
c. Make air quantity measurements in ducts by pitot tube traverse of entire cross sectional area duct.
d. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
e. Effect volume control at outlets by use of dampers installed in the ductwork. Do not use volume dampers that are integral with the outlets.
f. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
g. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

h. Measure temperature conditions across outside air, return air, and exhaust air dampers to check leakage.

i. Where modulating dampers are provided, take measurements and balance at extreme conditions. Set variable volume terminals at maximum airflow rate, full cooling with design diversity; read volumes at minimum airflow rate and full heating.

j. Measure building static pressure and adjustable supply, return and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.

17. Field Verification

a. The Designer may request verification of the data contained in the Balancing Report. If so, the TAB Technician who originally initialed the data sheets shall read outlets selected at random by the Designer who will compare the values with those in the report.

b. It is understood that the verification process shall take place within one week after delivery of the report. The operating mode of the system shall be the same for verification as it was during the balancing procedure.

c. The number of readings to be verified shall not exceed 10% of the total contained in the report.

d. If the field verification is not satisfactory, the firm doing the TAB work shall completely rebalance the system and a new report shall be prepared. The Designer may notify the Sheet Metal Industry Certification Board for TAB Technicians so that appropriate action can be taken.

B. It shall be division 23.00.00 responsibility to provide all personnel as required to fully coordinate with the control vendor and T&B vendor.

C. Certified Reports

1. For the reports required to be submitted within this section, provide certification by an independent balancing and testing contractor who is versed in the field of air balancing and who is not affiliated with any firm involved in the design or construction phases of this work.

2. Identify in the reports each item not complying with the Contract requirements, or obvious misoperation or design deficiencies of equipment or controls.

D. Additional Commissioning Coordination & Requirements

1. Furnish one-line, schematic system drawings for the Commissioning Agent review of the Duct System for the follows:
   a. Central HVAC system(s)
   b. General exhaust system(s)
2. Each air system drawing will be 1-line schematic representation of the system to be they are installed, indicating all louvers, dampers, filters, coils, fans, dampers, balancing valves, volume terminal devices, etc.
3. Each air system flow diagram shall indicate all pressure drops (design conditions and actual conditions) of each component, as well as associated flows, velocity, and temperatures (design and actual)

3.06 PAINTING

A. Equipment installed under this Section shall have shop coat of factory applied non-lead paint, unless otherwise specified. Touch-up any scratches with matching paint. Hangers and supports shall have one coat of non-lead primer.

3.07 SPARE STOCK

A. It is the intent of this specification that all equipment requiring or specified with air filters be furnished with two (2) spare sets of filters (both pre and final).

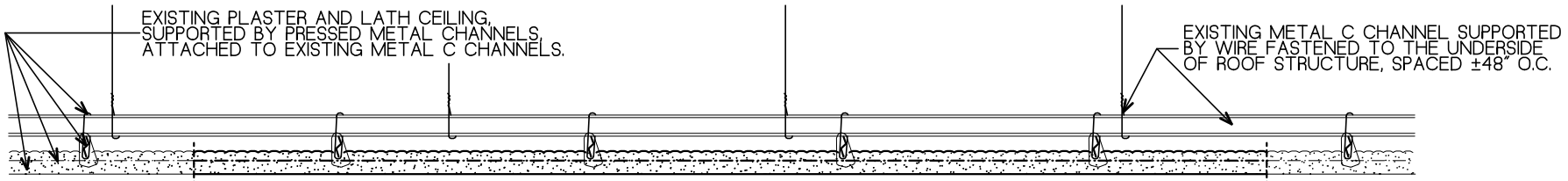
B. Belts & Spare Stock:

It is the intent of this specification that all equipment requiring or specified with belt drives (i.e. fans, RTU's, AHU's, exhaust fans, etc…) be furnished with two (2) spare sets of belts for each piece of equipment noted as requiring belts.

In addition, any items considered consumable or required for routine maintenance and service replacement within the first 18 months of an equipment's operation shall be supplied of adequate quantity to operate the equipment for a period of 24 months.

END OF SECTION 23 00 00

Appendix A:
Drawing Sheets

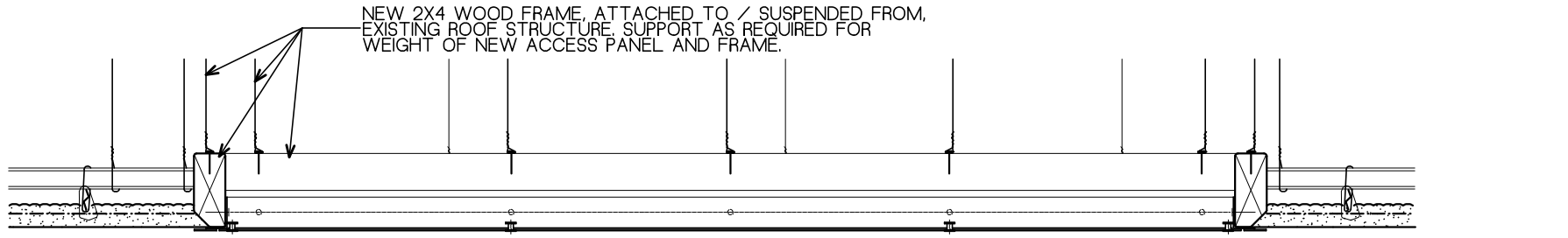


DEMO

REMOVE ±4' X ±4' SECTION OF PLASTER AND LATHE CEIING AND SUPPORT STRUCTURE

SUPPORT ADJACENT MEMBERS TO REMAIN AS REQUIRED TO PROPERLY SUPPORT REMAINING CEILING. COORDINATE LOCATION TO ACCESS EXISTING HVAC UNIT AND AVOID ALL OTHER ABOVE-CEILING MEP.

** SEE CUTTING AND PATCHING SECTION FOR LEAD DEMO REQUIREMENTS (AT CEILING).



NEW

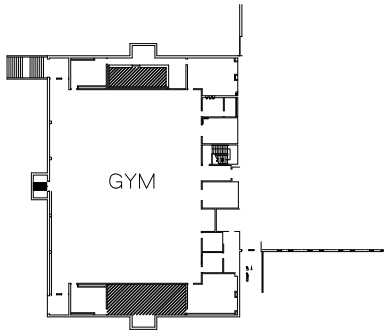
NEW 4' X 4' FULLY REMOVABLE ACCESS PANEL AND METAL FRAME.

PATCH / CAULK TO EXISTING CEILING FACE AND PAINT PANEL AND FRAME.

NEW 48" X 48" CEILING ACCESS PANEL WITH REMOVABLE DOOR:

MODEL: WB RP 110 48X48 (OR APPROVED EQUAL MEETING THE CRITERIA BELOW.
DOOR SIZE (W X H): 48" X 48"
ROUGH OPENING: 48 1/4" X 48 1/4"
NUMBER OF LATCHES: MINIMUM 12
DOOR: 14 GAUGE STEEL WITH RADIUS CORNERS
FRAME & TRIM: 18 GAUGE STEEL, 1 1/2" WIDE FRAME
FINISH: WHITE BAKED ENAMEL, PAINT ABLE
LATCHES: FLUSH, STAINLESS STEEL CAM LATCH (OPENS WITH SCREWDRIVER)
HINGES: NONE, REMOVABLE
RATED APPLICATIONS: WALLS AND CEILINGS

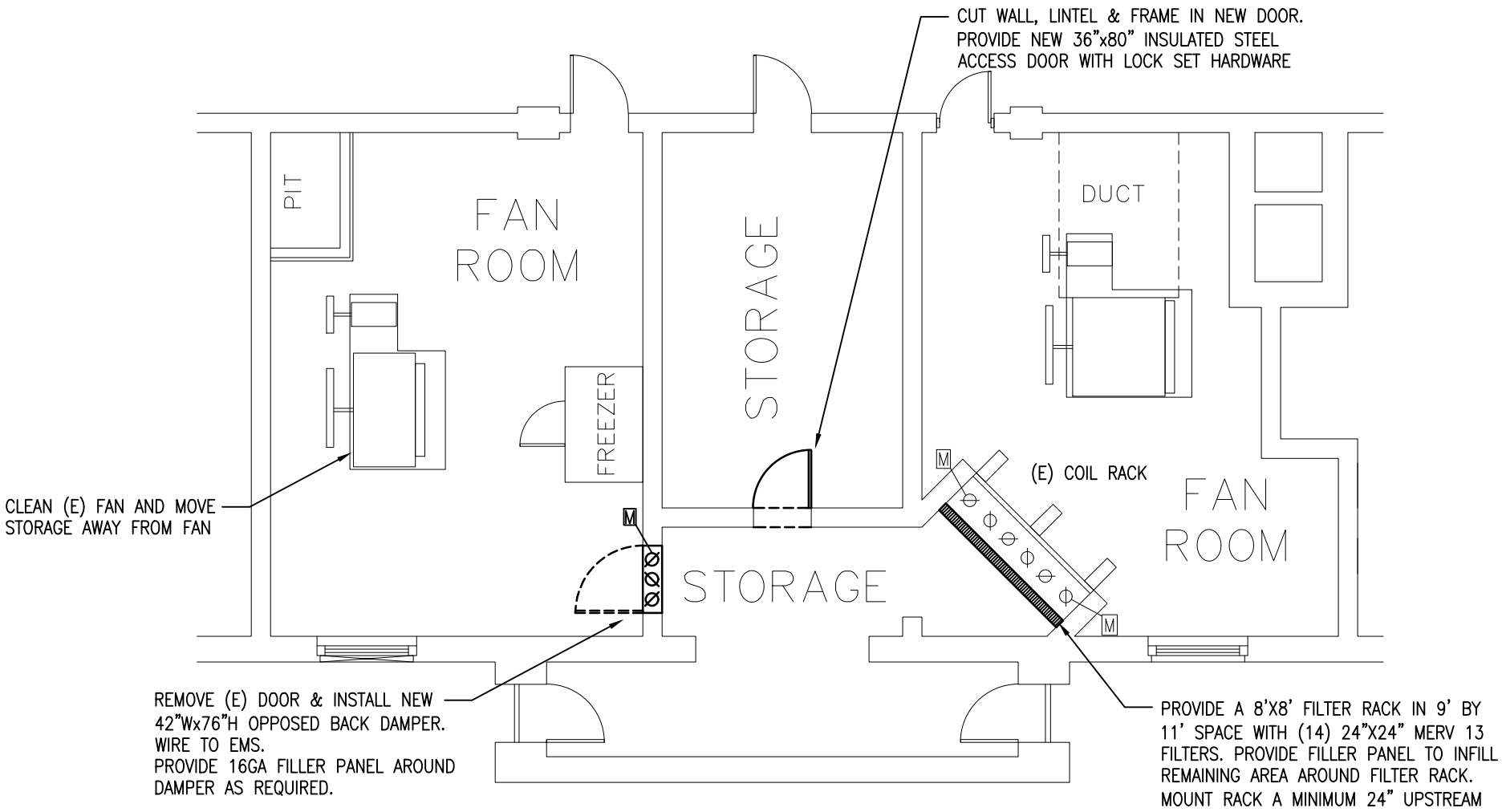
KEY PLAN:



NAULT ARCHITECTS, INC.
71 HOPE AVENUE
WORCESTER, MA 01603
TEL: (508)755-6134
FAX: (508) 754-4661

PROJECT: WPS – TAB & MISC.
DRAWING: ELM PARK COMMUNITY SCHOOL:
CEILING ACCESS HATCH INSTALLATION
SCALE: 1 1/2" = 1'-0"
DATE: 09/09/22

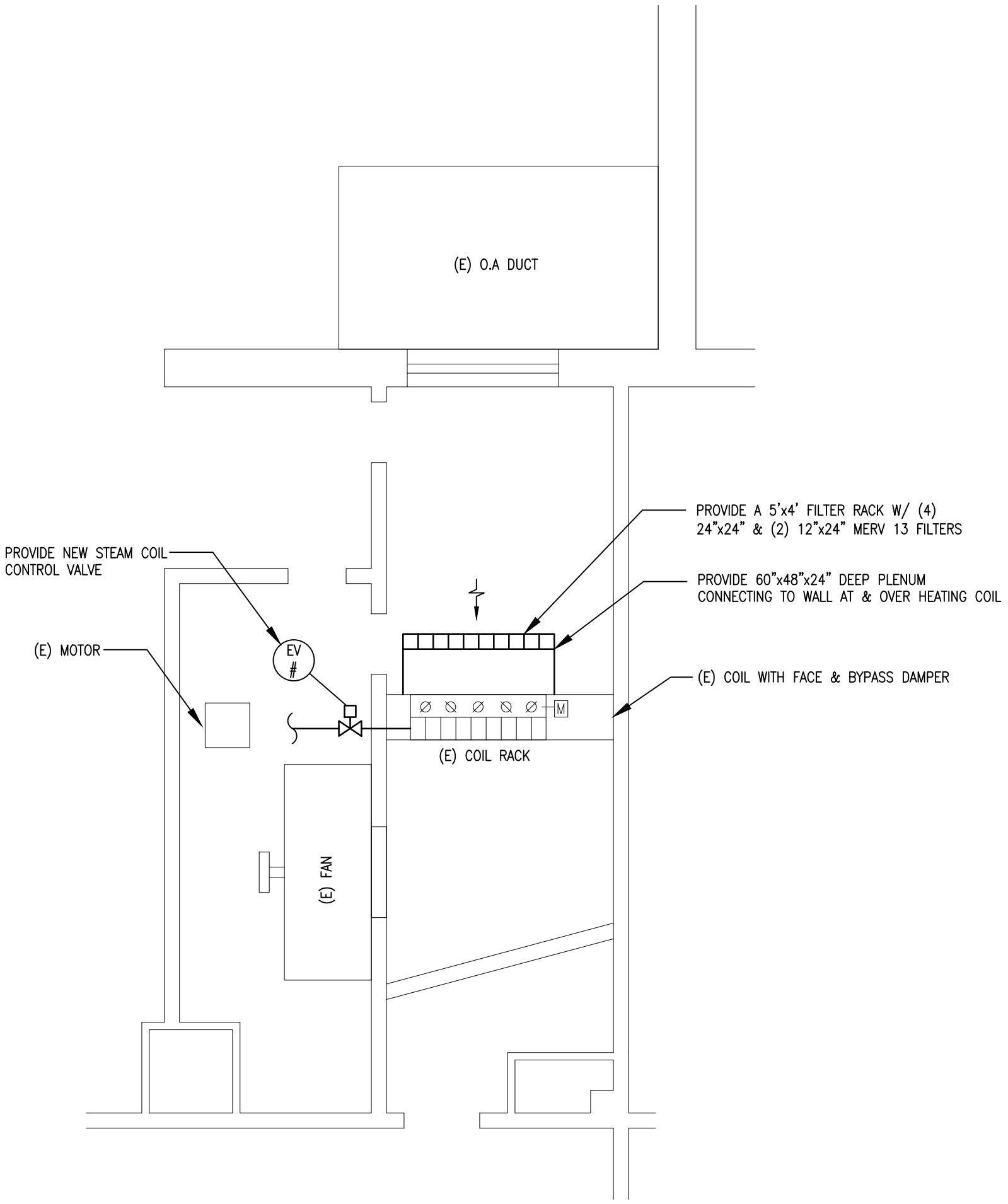
SKA-1



SKH-1	SCALE: 1/8"=1'-0"	DATE: 09/09/22

LANDLORD	PROJECT	SKETCH TITLE	
CITY OF WORCESTER PUBLIC SCHOOLS	WORCESTER PUBLIC SCHOOLS TAB & MISC. REPAIRS	HEARD ST SCHOOL PARTIAL BASEMENT LEVEL HVAC PLAN	SEAMAN ENGINEERING CORPORATION

22 West Street, Unit C ph:508-865-1400
Millbury, MA 01527 fx:508-865-1401



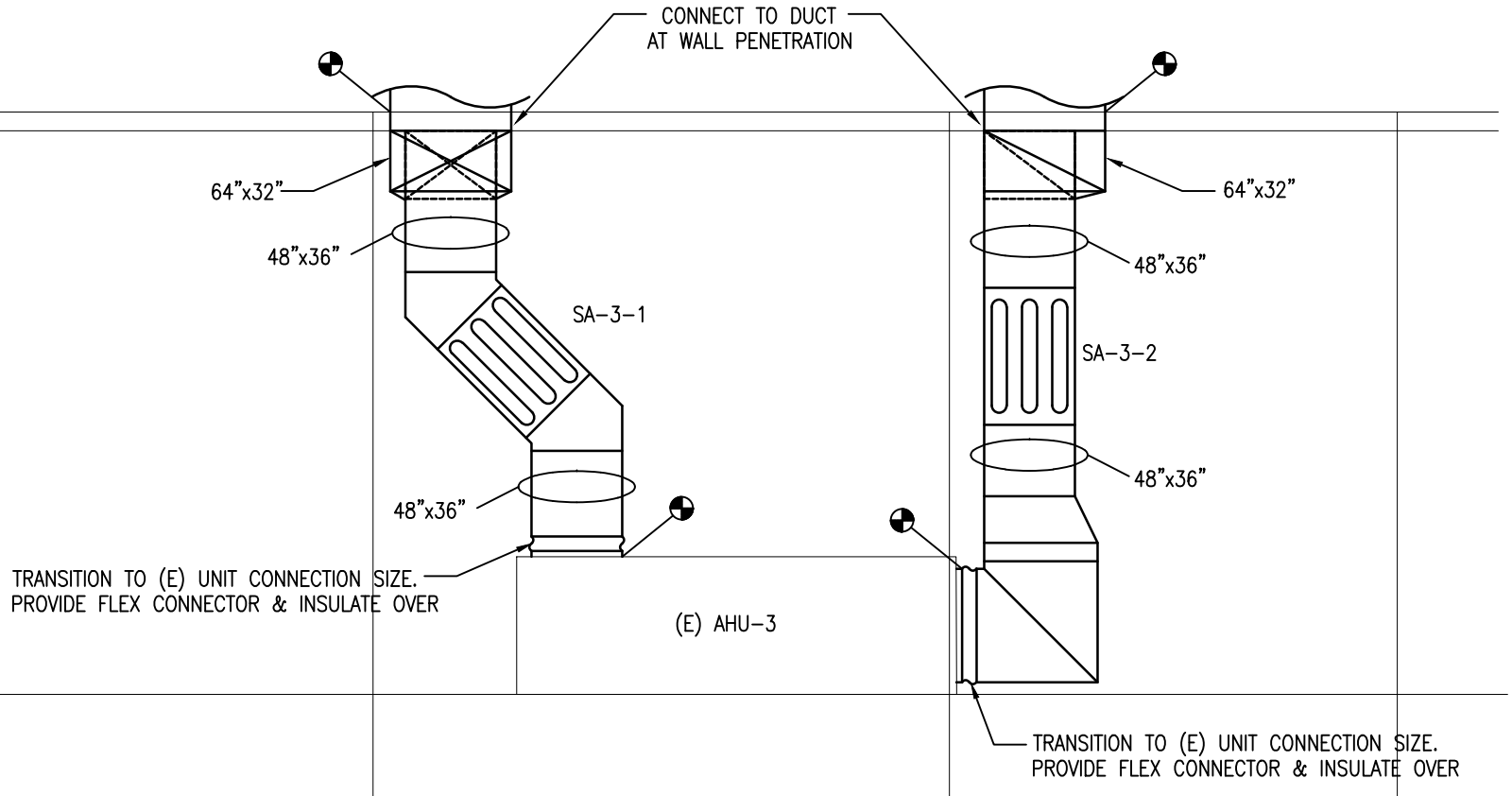
	SKH-2	SCALE: 1/4"=1'-0"	DATE: 09/09/22
OWNER CITY OF WORCESTER PUBLIC SCHOOLS	PROJECT WORCESTER PUBLIC SCHOOLS TAB & MISC. REPAIRS	SKETCH TITLE RICE SQUARE SCHOOL PARTIAL GROUND FLOOR HVAC PLAN	SEAMAN ENGINEERING CORPORATION 22 West Street, Unit C ph:508-865-1400 Millbury, MA 01527 fx:508-865-1401

SOUND ATTENUATOR SCHEDULE

Tag	Qty	Model	Location	Service	Width (in)	Height (in)	Length (in)	Air Direction	Flow (CFM)	Velocity (FPM)	PD (in. w.g.)	250	500
SA-3-1	1	ERMT60	See Plans	AHU-3 Supply	48	36	60	Forward	18900	-	0.13	15	28
SA-3-2	1	ERMT60	See Plans	AHU-3 Return	48	36	60	Reverse	17400	-	0.13	15	28

① ATTENUATORS SHALL BE SAME SIZE OF DUCTWORK, CONSTRUCTED OF 18GA GALVANIZED STEEL, 22GA PERF LINER, FIBERGLASS, POLYMER FILM; VERIFY ALL DIMENSIONS

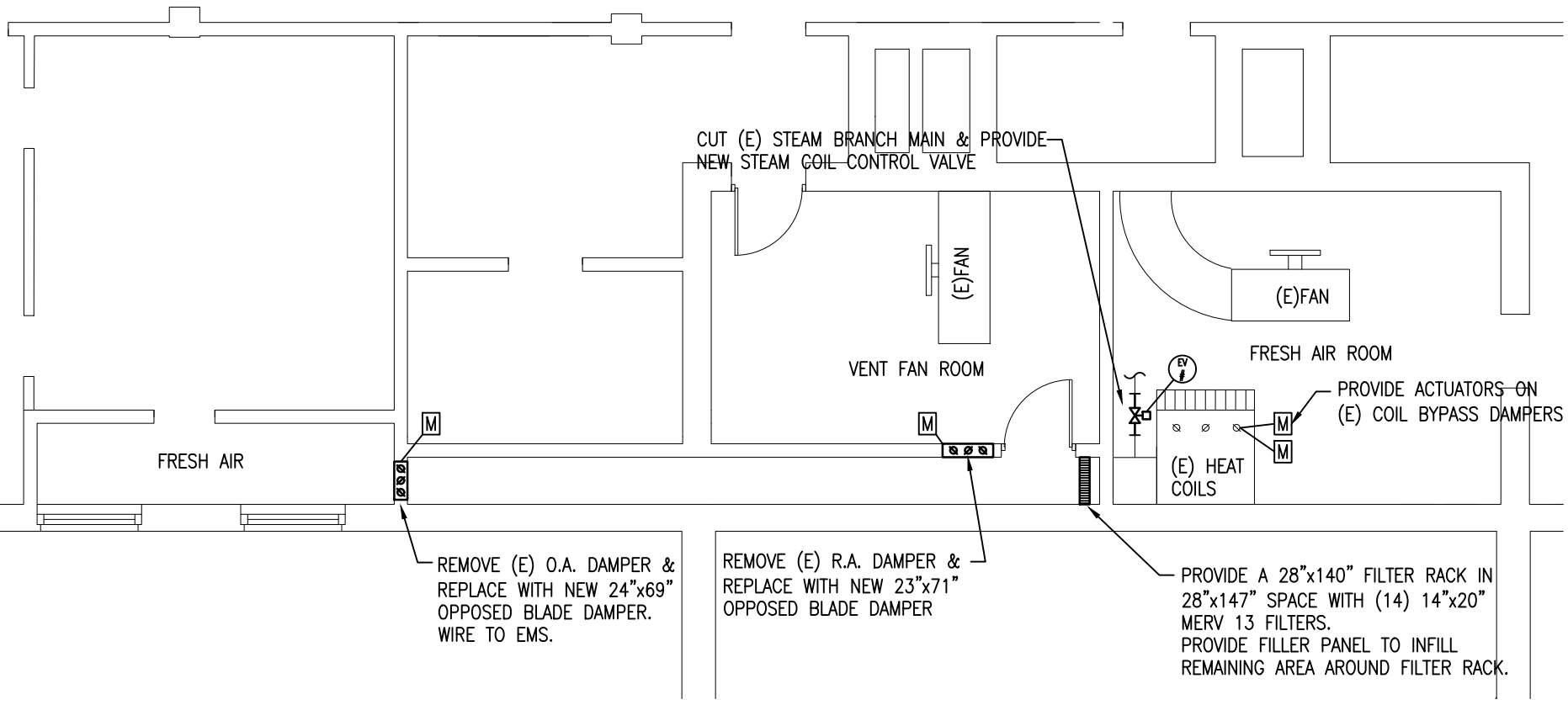
② SOUND ATTENUATOR MODELS LISTED ARE BY PRICE INDUSTRIES. ACCEPTABLE ALTERNATE MANUFACTURERS RUSKIN OR IAC ACOUSTICS.



SKH-3	SCALE: 1/8"=1'-0"	DATE: 09/09/22

LANDLORD	PROJECT	SKETCH TITLE
CITY OF WORCESTER PUBLIC SCHOOLS	WORCESTER PUBLIC SCHOOLS TAB & MISC. REPAIRS	SULLIVAN MIDDLE SCHOOL PARTIAL ROOF HVAC PLAN

SEAMAN ENGINEERING CORPORATION
22 West Street, Unit C ph:508-865-1400
Millbury, MA 01527 fx:508-865-1401



SKH-4	SCALE: 1/8"=1'-0"	DATE: 09/09/22

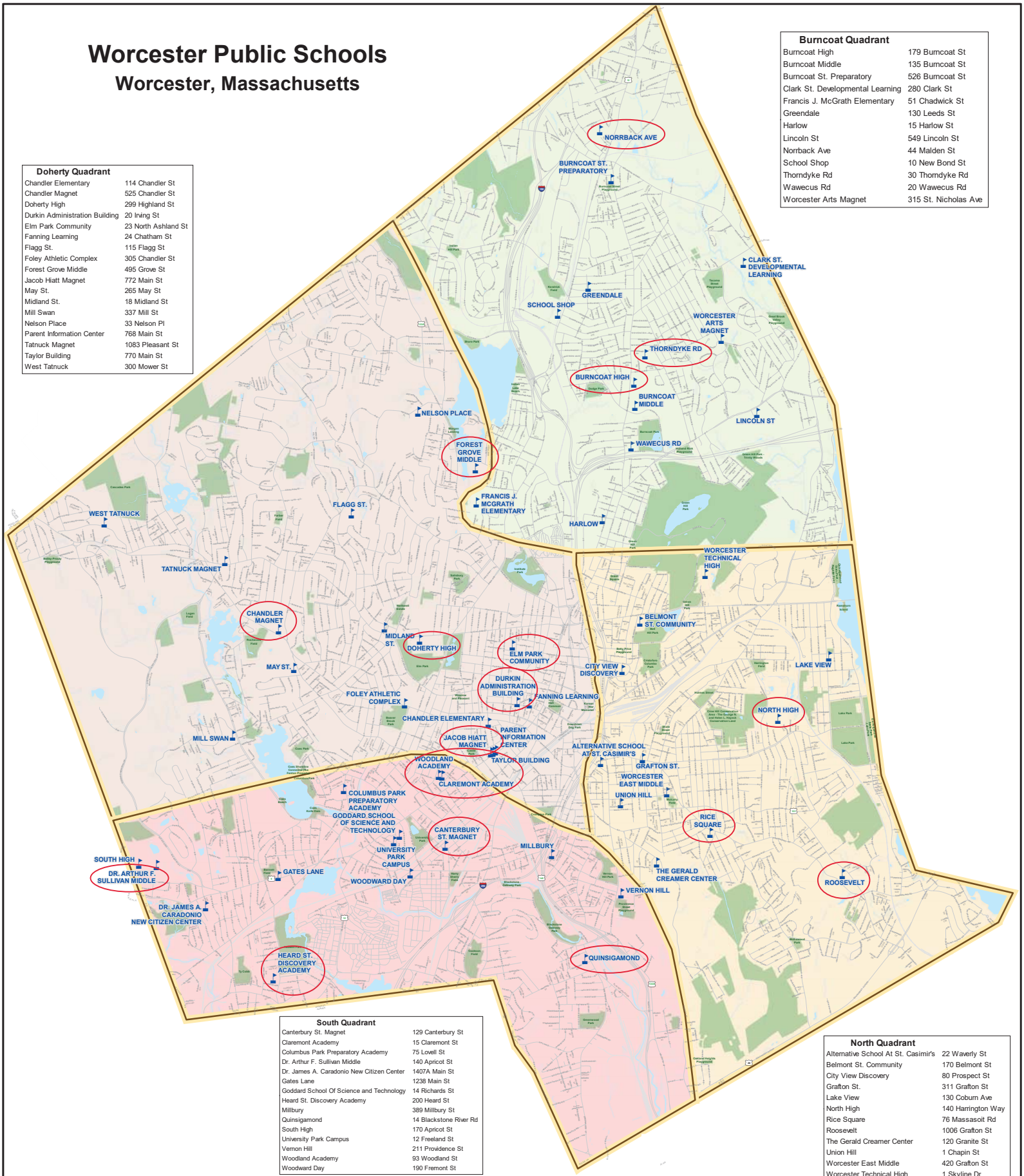
OWNER	PROJECT	SKETCH TITLE	
CITY OF WORCESTER PUBLIC SCHOOLS	WORCESTER PUBLIC SCHOOLS TAB & MISC. REPAIRS	THORNDYKE SCHOOL PARTIAL GROUND FLOOR HVAC PLAN	SEAMAN ENGINEERING CORPORATION

22 West Street, Unit C ph:508-865-1400
Millbury, MA 01527 fx:508-865-1401

Appendix B:
Locus Plan and Summary of Work Schedule

Worcester Public Schools

Worcester, Massachusetts



Burncoat Quadrant

Burncoat High	179 Burncoat St
Burncoat Middle	135 Burncoat St
Burncoat St. Preparatory	526 Burncoat St
Clark St. Developmental Learning	280 Clark St
Francis J. McGrath Elementary	51 Chadwick St
Greendale	130 Leeds St
Harlow	15 Harlow St
Lincoln St	549 Lincoln St
Norrback Ave	44 Malden St
School Shop	10 New Bond St
Thorndyke Rd	30 Thorndyke Rd
Wawecus Rd	20 Wawecus Rd
Worcester Arts Magnet	315 St. Nicholas Ave

Doherty Quadrant

Chandler Elementary	114 Chandler St
Chandler Magnet	525 Chandler St
Doherty High	299 Highland St
Durkin Administration Building	20 Irving St
Elm Park Community	23 North Ashland St
Fanning Learning	24 Chatham St
Flagg St.	115 Flagg St
Foley Athletic Complex	305 Chandler St
Forest Grove Middle	495 Grove St
Jacob Hiatt Magnet	772 Main St
May St.	265 May St
Midland St.	18 Midland St
Mill Swan	337 Mill St
Nelson Place	33 Nelson Pl
Parent Information Center	768 Main St
Tatnuck Magnet	1083 Pleasant St
Taylor Building	770 Main St
West Tatnuck	300 Mower St

South Quadrant

Canterbury St. Magnet	129 Canterbury St
Claremont Academy	15 Claremont St
Columbus Park Preparatory Academy	75 Lovell St
Dr. Arthur F. Sullivan Middle	140 Apricot St
Dr. James A. Caradonio New Citizen Center	1407A Main St
Gates Lane	1238 Main St
Goddard School Of Science and Technology	14 Richards St
Heard St. Discovery Academy	200 Heard St
Millbury	389 Millbury St
Quinsigamond	14 Blackstone River Rd
South High	170 Apricot St
University Park Campus	12 Freeland St
Vernon Hill	211 Providence St
Woodland Academy	93 Woodland St
Woodward Day	190 Fremont St

North Quadrant

Alternative School At St. Casimir's	22 Waverly St
Belmont St. Community	170 Belmont St
City View Discovery	80 Prospect St
Grafton St.	311 Grafton St
Lake View	130 Coburn Ave
North High	140 Harrington Way
Rice Square	76 Massasoit Rd
Roosevelt	1006 Grafton St
The Gerald Creamer Center	120 Granite St
Union Hill	1 Chapin St
Worcester East Middle	420 Grafton St
Worcester Technical High	1 Skyline Dr

DATA SOURCES:
All data: City of Worcester Geographic Information System
Original Data - Digitized at 1:480 scale (Data true resolution: 1 inch = 40 feet).
Updated Using Spring 2003 Photography at 1 inch = 100 feet scale
Further Updates Using City of Worcester Information.
School Quadrants & Buildings provided by Worcester Public Schools May 2014.

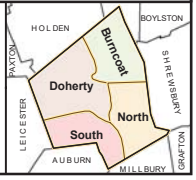
COORDINATE SYSTEM:
All map data is in the Massachusetts State Plane Coordinate system, North American Datum of 1983, Massachusetts Mainland Zone (4151). Units are measured in Feet.

N
W E
S

1:14,400
1 inch = 1,200 feet

0 1,200 2,400 4,800 7,200 9,600 Feet
0 0.25 0.5 1 1.5 2 Miles

Produced by
City of Worcester
Department of Technical Services
Geographic Information Systems Division
Worcester, Massachusetts



Produced by: BritIC Date: October 2018 File: SchoolQuadrants36x48_10_5.mxd

A.L.L. (Claremont) School

Unit Name	Supply CFM		Return/Exh. CFM		O.A CFM		Fan motor	F.L.A		Belt Size	Filter Size	Unit Location & General Notes	Corrective
	Listed	Tested	Listed	Tested	Listed	Tested	H.P	Listed	Tested				Action
AHU-1	2,110	2,589	1,910	2,065	200	524	1.5	3	2.6/2.5/2.6	1-BX50	N/A	Penthouse Unit suspended from roof Requires ladder to service	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
EF-1			1910				0.5	1.10	NOT TESTED	NA		Penthouse Unit suspended from roof Requires ladder to service	1. Replace belts and adjust. 2. Balance EA to listed CFM.
AHU-2	5,025	5,101	4,625	3091	400	2,070	3	6.8	6.7/6.4/6.8	1-AK70	N/A	Penthouse	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
EF-2			4625	3091			2	6.4	3	N/A		Penthouse Unit suspended from roof Requires ladder to service	1. Replace belts and adjust. 2. Balance EA to listed CFM.
AHU-3	9905	9,610	5905	6,664	4,000	2,946	7.5	12.6	10.6/11.0/10.8	6-BX52	(8) 16X25X2 (4) 16X20X2	Penthouse Unit suspended from roof Requires ladder to service	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
EF-3			5,905	6,664			0.5	14.5	9.0/9.7/10.0	2-A77		Penthouse Unit suspended from roof Requires ladder to service	1. Replace belts and adjust. 2. Balance EA to listed CFM.
AHU-4	700	710	500	221	200	489	0.75	1.5	1.2/1.2/1.2	1-A37	N/A	Penthouse Unit suspended from roof Requires ladder to service	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
EF-4			500	-			0.5	2.1	-	1-4L360		Penthouse Unit suspended from roof Requires ladder to service	1. Replace belts and adjust. 2. Balance EA to listed CFM.
AHU-5	700	-	500	-	200	-	0.75	4	-	1-4L310	24X12	Penthouse	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
EF-5	-	-	700	-	-	-	0.75	2.2	-	N/A	N/A	Penthouse Unit suspended from roof Requires ladder to service	1. Provide belts and adjust. 2. Balance EA to listed CFM.
AHU-6	1080	1306	880	1457	200	-2	1	1.8	1.3/1.4/1.3	1-A37	(2) 20X20X2	Penthouse	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Provide return air damper in return duct (approx. 14"x14", V.I.F.), connect to EMS to verify proper control. 4. Balance OA to listed CFM.
EF-6	-	-	1080	1457	-	-	0.5	2.4	1.6/1.8/1.8	1-AX46	-	Penthouse Unit suspended from roof Requires ladder to service	1. Provide belts and adjust. 2. Balance EA to listed CFM.
AHU-7	1080	1019	880	871	200	140	1	1.8	1.2/1.2/1.2	1-A37	(2) 20X20X2	Penthouse	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
EF-7			NL	871			0.5	2.2	1.6/1.7/1.6	1-AK34	-	Penthouse	1. Provide belts and adjust. 2. Balance EA to listed CFM.

A.L.L. (Claremont) School

AHU-8	880	934	630	763	250	171	0.75	1.5	1.3/1.2/1.2	1-A37	N/A	Penthouse	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
EF-8			NL	763			0.5	2.2	1.3/1.4/1.4	1-A37		Penthouse Unit suspended from roof Requires ladder to service	1. Provide belts and adjust. 2. Balance EA to listed CFM.
AHU-9	1010	1257	810	1106	200	151	1	1.8	2	1-A37	N/A	Penthouse	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
EF-9			NL	1106			0.5	2.1	1.7/1.5/1.4	1-AP39	-	Penthouse Unit suspended from roof Requires ladder to service	1. Provide belts and adjust. 2. Balance EA to listed CFM.
AHU-10	425	-	-	-	100	-	-	-	-	N/A	N/A	Penthouse	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
AHU-11	1300	-	900	-	400	-	1	1.8	-	1-A37	(2) 20X20X2	Penthouse Unit suspended from roof Requires ladder to service	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
EF-11			900	-			0.5	2.2	-	1-A40	-	Penthouse Unit suspended from roof Requires ladder to service	1. Provide belts and adjust. 2. Balance EA to listed CFM.
AHU-12	7260	10407	6460	5593	800	4814	7.5	9.5	9.9/10.3/10.0	1-BX46	(12) 16X20X2	Penthouse	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
EF-12	-	-	NL	5593	-	-	3	9.3	6.6/6.6/6.7	2-A69		Penthouse Unit suspended from roof Requires ladder to service	1. Provide belts and adjust. 2. Balance EA to listed CFM.
AHU-13	5745	3538	3445	2287	2300	1251	5	6.8	4.1/3.8/4.0	1-BX387	(6) 20X20X2	Penthouse	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
EF-13	-	-	3445	2287	-	-	NL	NL	3.4/3.7/3.6	N/A	-	Penthouse Unit suspended from roof Requires ladder to service	1. Provide belts and adjust. 2. Balance EA to listed CFM.
AHU-14	900	959	800	789	100	170	1	1.8	1.3/1.3/1.3	1-A37	16X25X2	Penthouse	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
EF-14	-	-	800	789	-	-	0.5	2.4/2.4/1.2	1.4/1.4/1.4	1-AX3A	-	Penthouse Unit suspended from roof Requires ladder to service	1. Provide belts and adjust. 2. Balance EA to listed CFM.
AHU-15	2320	2132	2120	310	200	1822	1.5	2.4	1.8/1.7/1.7	1-A43	N/A	Penthouse Unit suspended from roof Requires ladder to service	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
EF-15	-	-	NL	-	-	-	1.5	5	-	1-A42	-	Penthouse Unit suspended from roof Requires ladder to service	1. Provide belts and adjust. 2. Balance EA to listed CFM.

A.L.L. (Claremont) School

AHU-16	2110	2449	1910	1632	200	817	3	4.8*	2.4/2.5/2.5	1-BX50	(4) 20X20X2	Penthouse Unit suspended from roof Requires ladder to service	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
EF-16	-	-	1910	1632	-	-	3	6.8*	1.9/1.8/1.8	1-AX45	-	Penthouse Unit suspended from roof Requires ladder to service	1. Provide belts and adjust. 2. Balance EA to listed CFM.
AHU-17	720	765	620	623	100	142	1	1.8	1.4/1.3/1.3	1-A37	12X24X2	Penthouse	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
EF-17	-	-	620	623	-	-	0.5	2.1	1.3/1.3/1.3	1-AX34	-	Penthouse Unit suspended from roof Requires ladder to service	1. Provide belts and adjust. 2. Balance EA to listed CFM.
AHU-18	900	571	800	334	100	237	1	1.8	1.3/1.2/1.2	1-A37	(2) 24X12X2	Penthouse	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
EF-18	-	-	800	-	-	-	0.5	2.1	-	1-AX34	-	Penthouse Unit suspended from roof Requires ladder to service	1. Provide belts and adjust. 2. Balance EA to listed CFM.
RTU-1	9850	-	7350	-	2500	-	-	-	-	N/A	(15) 20X25X2 (5) 16X25X2	Roof	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
RTU-2	9850	-	7350	-	2500	-	7.5	9.3	-	1-B93	(15) 20X25X2 (5) 16X25X2	Roof	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.

Burncoat High School

Unit Name	Supply CFM		Return/Exh. CFM		O.A CFM		Fan motor	F.L.A		Belt Size	Filter Size	Unit Location & General Notes	Corrective Action
	Listed	Tested	Listed	Tested	Listed	Tested	H.P	Listed	Tested				
SF-B-1	36,400	23,319	36,400	33,435	10830	-	50	61	27.7/28.0/27.9	2-BX124	(25) 20X24X4	Below Grade Fan Room	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
RF-B-1	-	-	36,400	33435	-	-	10	13.80	6.5/6.5/6.5	2-BX132		Below Grade Fan Room	1. Replace belts and adjust. 2. Balance return fan to listed CFM.
SF-C-1	36,425	37,482	24,041	30198	12384	7,284	NL	NL	33.7/33.5/33.8	2-5VX1400	(20) 24X24X4 (5)12X24X4	Below Grade Fan Room	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
RF-C-1	-	-	36,425	30198	-	-	10	13.8	6.4/6.3/6.3	2-5VX1500		Below Grade Fan Room	1. Replace belts and adjust. 2. Balance return fan to listed CFM.
HV-A-1	17560	2,715	9970	2,147	7,590	560	5	6.4	3.5/3.4/3.4	2-B81	(8) 16X25X2	Below Grade Fan Room	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
HV-B-1	6250	3129	5,000	1,645	1250	1484	3	4.3	3.4/3.5/3.4	1-A68	(6) 16X25X2	Below Grade Fan Room	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
HV-C-1	4000	3556	0	1546	4000	2010	3	4.3	3.2/3.5/3.3	2-A69	(4) 16X25X2	Mechanical Room	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
HV-C3/D1	4000	1510	0	1091	4000	419	3	4.3	2.5/2.5/2.3	1-A70	(6) 16X24X2	Mechanical Room	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
HV-F1/D1	18700	19425	13950	18074	4750	1351	15	21*	10.6/10.5/10.6	3-B120	(20) 20X25X2 (4)16X25X2	Mechanical Room	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
HV-G/E1	9000	-	6750	-	2250	-	-	-	-	N/A	(20) 20X25X2	Suspended from ceiling in Gym Will require a lift or ladder to access	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM. 5. Provide new 5 H.p. 460 volt 3 phase 60 hz motor. 6. Provide ajustable motor sheave.
HV-G/E2	9000	4698	6750	3150	2250	1548	TESTED 5	6.6	3.6/3.4/3.5	1-B81	(20) 20X25X2	Suspended from ceiling in Gym Will require a lift or ladder to access	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
HV-G/E3	7000	-	5250	-	1750	-	3	4.3	-	(1) B85-A6	(8) 18X25X2	Storage Room	1. Unit not used.
HV-G/E4	7000	-	5250	-	1750	-	3	3.8	-	(1)B85-A6	(8) 18X25X2	Locker Room. Will require a ladder.	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.

Burncoat High School

HV-G/E5	5400	3313	4050	-	1350	1326	3	4.3	3.4/3.6/3.4	1-A77	(6) 18X25X2	Garage	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM. 5. Provide new retern air flexible connection.

Canterbury School

Unit Name	Supply CFM		Return/Exh. CFM		O.A CFM		Fan motor	F.L.A		Belt Size	Filter Size	Unit Location & Notes	Corrective Action
	Listed	Tested	Listed	Tested	Listed	Tested	H.P	Listed	Tested				
AHU-1	7,900	6,531	-	-	3800	4951	7.5	9	6	1-BX93	(3) 16X20X2 (6)20X25X2 (8)16X25X2	Roof	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM. 5. Mount EMS actuator on exhasut shaft. 6. EMS to repair control as OA dampers not responding to command.
EF-GYM	-	-	3800	1580	-	-	5	3.4*	2	1-B94		Roof	1. Replace belts and adjust. 2. Balance exhaust fan to listed CFM.
AHU-2	7,600	6,453	-	662	3050	662	5	6.2	4.3/4.2/4.0	2-AX78	(4)20X25X2 (8)20X20X2 (5)16X25X2	Roof	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM. 5. Balance return fan to listed CFM. 6. EMS to repair control as OA dampers not responding to command.
EF-CAFÉ	-	-	4550	-	-	-	1.5	2.2	1.15/1.3/1.3	2-A93		Roof	1. Replace belts and adjust. 2. Balance exhaust fan to listed CFM.
AHU-3	2485	889	1960	666	525	223	1	1.35	1	1-BX64,1-B64	(9) 16X20X2	Roof	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM. 5. Balance return fan to CFM listed. 6. Confirm proper return fan stater operaiton. Verify controls as return fan only runs in Hand mode andmust be operated in Auto mode.
AHU-4	1150	1485	860	962	290	496	0.5	1.1	1	1-4L400	N/A	2nd Floor Hallway above ceiling Will require a Ladder	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.

Chandler Magnet School

Unit Name	Supply CFM		Return CFM		O.A CFM		Fan motor	F.L.A		Belt Size	Filter Size	Unit Location & General Notes	Corrective Action
	Listed	Tested	Listed	Tested	Listed	Tested	H.P	Listed	Tested				
AHU-1	8,867	15,749	NA	12,441	2,600	3308	15	41	32.2/31.0/31.2	2-BX82	(8)20X20X2 (8)20X25X2	Basement Mech. Room	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
AHU-2	5000	-	NA	-	1,250	-	7.5	22.50	-	1-BX58	(4) 20X20X2	Basement Mech. Room	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
AHU-3	5,000	-	NA	2104	1,250	-	7.5	22.5	16.4/15.5/16.3	1-BX58	(4) 20X20X2	Basement Mech. Room	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.

Doherty High School

Unit Name	**Supply CFM**		**Return CFM**		**O.A CFM**		**Fan motor**	**F.L.A**		**Belt Size**	**Filter Size**	**Unit Location and General Notes**	**Corrective Action**
	Listed	**Tested**	**Listed**	**Tested**	**Listed**	**Tested**	**H.P**	**Listed**	**Tested**				
Auditorium AHU & ERV-P	ERV-P = 4,600 AHU = 10,000	-	0	-	4600	-	NL	7	6.9/6.7/7.1	2-bx82	(8) 16x20x2 (2)16x24x2	AHU on mezz. in boiler room. ERV-P on Roof	1. Replace Filters on AHU with MERV 13 and on ERV-P with MERV 8. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed.

Durkin Administration

Unit Name	Supply CFM		Return CFM		O.A CFM		Fan motor	F.L.A		Belt Size	Filter Size	Unit Location & General Notes	Corrective Action
	Listed	Tested	Listed	Tested	Listed	Tested	H.P	Listed	Tested				
AHU-1	7,000	3,386	-	-	7000	3386	5	15	6	1-BP60	(1)16x20x2,(2)16x25x2,(1)20x20x2,(2)20x25x2	Basement Boiler Room	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM. 5. Wash/clean coils.
AHU-2	6500	3633	1500	3667	5000	515	10	29.00	8	2-bx59,2-a64	(8) 16x25x2	Attic	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.

Elm Park School

Unit Name	Supply CFM		Return/Exh. CFM		O.A CFM		Fan motor	F.L.A		Belt Size	Filter Size	Unit Location & General Notes	Corrective Action
	Listed	Tested	Listed	Tested	Listed	Tested	H.P	Listed	Tested				
AHU-1	8,260	8,520	5,900	5,752	2360	2768	5	14	11.10	2-BX95, 1-A62	(6)16x25x2,(4)20x25x2	Roof Penthouse	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
AHU-2	6340	6046	5313	5390	1027	656	5	14.90	11.10	2-BX94	(6)16x25x2, (4)20x25x2	Roof Penthouse	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
AHU-3	7,620	8,015	6,350	6657	1270	1,358	5	6.7	6.80	2-B94, 1-A62	(6) 16x25x2, (4) 20x25x2	Roof Penthouse	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
AHU-4	4330	2434	3460	2364	870	70	NA	NA	3.70	1-A66, 1-A64	(4) 16x25x2, (2)20x25x2	Mechanical Room No belt guard Will require a ladder for access	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM. 5. Provide belt and sheave guard.
AHU-5	4425	2,337	3540	971	885	1,366	-	-	3.50	1-A66, 1-A64	(4) 16x25x2, (2)20x25x2	Mechanical Room No Belt Guard Will require a ladder for access	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM. 5. Provide belt and sheave guard.
AHU-6	4480	3909	3,620	1,668	860	1459	-	-	3.30	1-A66, 1-A64	(4) 16x25x2, (2)20x25x2	Mechanical Room No belt guard Will require a ladder for access	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM. 5. Provide belt and sheave guard.
AHU-7	4090	4782	3090	3321	1000	1461	2	5.5	6.0/6.1/6.0	1-BX81,1-A64	(4) 16x25x2, (2)20x25x2	Roof Penthouse	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
AHU-8	2400	905	1800	475	600	430	-	2.4	2.60	1-4L450	N/A	Above 2nd Floor Staff Bathrooms Supply Duct Disconnected from outlet Will Require a Ladder for access.	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM. 5. Reconect duct to supply outlet.
AHU-9	1530	1375	930	-	600	-	NA	-	-	1-4L410H	N/A	Above Offices Ceiling Damper stuck closed Will require a ladder for access	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM. 5. Repair dampers and control.
AHU-10	6200	-	3100	1450	3100	-	-	-	2.6/2.6/2.5	n/a	(8) 16x25x2	Above Gym Storage Room O.A. duct connction Broken Will Require a Ladder for access	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM. 5. Repair broken O.A. duct connection.
AHU-11	6200	-	3100	1824	3100	-	-	-	2.4/2.5/2.3	n/a	(8) 16x25x2	Above Gym Storage Room O.A. duct connction Broken Will require a ladder for access	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM. 5. Repair broken O.A. duct connection.

Elm Park School

AHU-12	1800	571	-	-	n/a	-	-	-	-	n/a	n/a	In Ceiling Above Girls Showers Will require a ladder for access	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Provide 48" x 48" ceiling access panels to service unit.
AHU-13	1800	442	-	-	n/a	-	-	-	-	n/a	n/a	in Ceiling Above Boys Showers Will require a ladder for access	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Provide 48" x 48" ceiling access panels to service unit.
AHU-14	4000	857	3000	404	1000	453	1	3.7	1.80	1-A59	(6) 16x25x2	Above Gym Storage Room Will require a ladder for access	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
AHU-15	1400	-	-	-	1400	-	0.33	5.9	-	1?	n/a	Boiler Room	Not used
CRUV-1	1300	-	700	-	600	-	0.25	5	-	1-3L240	(1) 15x77x1	Classroom 136	Possibly Abandoned
CRUV-2	1300	1240	700	1139	600	101	0.25	4.6	3.40	1-2L220	(1) 15x77x1	Art Classroom Unit has no disconnect switch	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
RTU UNIT	1600	1518	NA	-	NA	-	1	4.9	3.60	1-A36	(2) 16x25x2	Roof Above Health Center	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.

Forest Grove Middle School

Unit Name	Supply CFM		Return CFM		O.A CFM		Fan motor	F.L.A		Belt Size	Filter Size	Unit Location & General Notes	Corrective Action
	Listed	Tested	Listed	Tested	Listed	Tested	H.P	Listed	Tested				
RTU-1	6,500	N/A	4,300	N/A	2200	N/A	5	7	N/A	1-BX42	(10) 16X25X2 (10) 16X20X2	Gym Roof	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
RTU-2	6,500	N/A	4300	N/A	2200	N/A	5	6.60	3.8/4.4/3.8	1-BX42	(10) 16X25X2 (10) 16X20X2	Gym Roof	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
RTU-3	11,000	10,778	5,750	9962	5250	816	10	12.6	9.7/9.2/9.9	1-BX71	(4) 16x25x2 (2) 20x25x2	Auditorium Roof	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
RTU-4	5000	n/a	2860	n/a	2140	n/a	10	13.4	11.8/12.1/11.9	2-B52	(10)16x25x2 (10)16x10x2	Admin Office Roof	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM. 5. Wash/clean coils.
RTU-5	7000	7,523	3600	6,959	3,400	564	7.5	10	8.4/7.8/8.1	1-BX75	(2) 20x25x2 (4) 16x25x2	Roof Serves Corridor Classrooms not on BMS	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM. 5. Replace return air damper which is mssing blade. Aaon model #RK-20-3-E0-750 serial number #200106-AXYN00528 (V.I.F.)
AC-1/RTU-7	9000	n/a	7,500	n/a	1500	n/a	7.5	9.7	n/a	1-BX46	(6) 20x25x2	Upper Roof Serves Art Room Unit nonoperational	1. Diagnose operational issue and report. McQuay model #RDS800CYY
AC-2/RTU-6	8000	n/a	7250	n/a	750	n/a	7.5	9.3	6.1/6.1/6.0	2-AX60	(6) 20x25x2	Roof Serves Media Center	1. Replace Filters with MERV 13. 2. Replace belts and adjust. Align sheaves. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.

Heard Street Elementary School

Unit Name	Supply CFM		Return/Exh. CFM		O.A CFM		Fan motor	F.L.A		Belt Size	Filter Size	Unit Location & General Notes	Corrective Action
	Listed	Tested	Listed	Tested	Listed	Tested	H.P	Listed	Tested				
AHU	20,000	25,034	NA	-	7,000	-	NL	9.50	6.10	5-B114	New Rack with (16) 24"x24"x2"	Unit in Mech./Electrical Room Exhaust Fan not Running	1. Provide filter rack with MERV 13 Filters. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM. 5. Provide filter rack and MERV 13 filters. 6. Provide return air dampers and control modifications for the AHU system. 7. Provide 36" wide insulated mandoor into mixing chamber. 8. Vacuum clean supply air fan wheel and fan room. 9. Wash down and clean steam coils.
AHU EF Fan	NA	NA	15,000	-	-	-	7.5	9.50	-	(4) B158	NA	Unit in mech. room	1. Clean exhaust fan wheel and housing. 2. Replace fan shaft bearings. 3. Balance EA to listed CFM. 4. Owner shall move storage materials away from fan.
RTU-1	1,200	979	NA	843	300	134	NL	6.00	0.09	DD	n/a	On Modular Roof	1. Replace Filters with MERV 8. 2. Balance supply fan to listed CFM. 3. Balance OA to listed CFM.
RTU-2	1,800	-	-	-	400	-	-	-	-	DD	n/a	Power off to RTU Not on BMS Unit on roof	1. Replace Filters with MERV 8. 2. Balance supply fan to listed CFM. 3. Balance OA to listed CFM.

Jacob Hiatt Magnet School

Unit Name	**Supply CFM**		**Return/Exh. CFM**		**O.A CFM**		**Fan motor**	**F.L.A**		**Unit Location & General Notes**	**Belt**	**Filter**	**Corrective Action**
	Listed	**Tested**	**Listed**	**Tested**	**Listed**	**Tested**	**H.P(LISTED:TESTED)**	**Listed**	**Tested**				
RTU-1	24,000	8,014	21,000	90	9,000	7,924	30	83.3		Roof Serves North Building	2-5VX960	(6) 12 x 24 x 2, (8) 24 x 24 x 2 and Bag filters	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
Return							10	29.00			1-BX108		
RTU-2	30,000	8,839	16,100	2,162	6,900	6,677	30	83.3		Roof Serves South Building	2-5VX960	(6) 12 x 24 x 2, (8) 24 x 24 x 2 and Bag filters	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
Return							10	29.50			1-BX106		

Norrback School

Unit Name	Supply CFM		Return CFM		O.A CFM		Fan motor	F.L.A		Unit Location & General Notes	Belt	Filter	Corrective Action
	Listed	Tested	Listed	Tested	Listed	Tested	H.P(LISTED:TESTED)	Listed	Tested				
AHU 1-1	7,950	6,669			7,950	6,669	2.5	5.5	4.3/4.1/4.2	Mechanical Room Serves Cafeteria Unit running in bypass	2-BX48	(12) 16 x 20 x 2	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM. 5. Repair operatonal controls to make unit run in auto mode.
AHU 2-1	3,200	3,604	2,300	2,577	900	1,027	3	4.0	3.5/3.5/3.6	Mechanical Room Serves Media Center Unit running in bypass	1-AX51	(4) 20x 20 x 2	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM. 5. Repair operatonal controls to make unit run in auto mode.
AHU 2-2	7,000	2,786	5,500	2,532	1,500	254	5	6.6	1.8/1.7/1.8	Gym Roof	1-BX42	(6) 20x 20 x 2	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
AHU 2-3	7,000	6,543	5,500	4,276	1,500	2,267	5	6.6	3.4/3.5/3.4	Gym Roof	1-BX42	(6) 20x 20 x 2	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.

North High School

Unit Name	Supply CFM		Return CFM		O.A CFM		Fan motor	F.L.A		Unit Location & General Notes	Belt	Filter	Corrective Action
	Listed	Tested	Listed	Tested	Listed	Tested	H.P(LISTED:TESTED)	Listed	Tested				
													**Design Data Not Available
ERU-1	**	11,592	-	-	**	-	20	25.0	23.40	Roof	2BX77	(8) 24 x 20 x 2	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
EXHAUST	-	-	**	7,174	**	-	15	18.60	11.50		2BX79		1. Replace Filters with MERV 8. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
ERU-2	**	-	-	-	**	21,665	40	48.2	30.60	Roof	2BX124	(15) 20 x 25 x 2	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
EXHAUST	-	-	**	10,989	**	-	25	29.9	15.20		3BX100		1. Replace Filters with MERV 8. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
ERU-3	**	6,168	-		**	561	15	18.6	13.20	Roof	2BX75	(8) 20 x 24 x 2	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
RETURN	-	-	**	5,607	-	-	15	18.6	11.60		2B80		1. Replace Filters with MERV 8. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
ERU-4	**	-	-	-	**	-	10:15	18.5		Roof VFD NONOPERATIONAL	2BX65	(16) 20 x 20 x 2	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
EXHAUST	-	-	**	-	-	-	15:10	12.2			2BX71		1. Replace Filters with MERV 8. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
RTU-L	**	7,539	-	-	**	2,932	5	6.4	5.9/6.1/6.1	Roof RF DOES NOT HAVE A BELT	1A62	(3) 24 x 24 x 4 , (3) 24 x 24 x 2 (4) 12 x 24 x 4 , (3) 12 x 24 x 2	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
RETURN(NO BELT)	-		NL	4,607		-	3	4.3		NO PERFORMANCE DATA			1. Provide belt and align.

North High School

RTU-C	**	17,106	-	-	**	-	20	24.8	14.90	Roof	15VX1060	NA	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
RETURN	-	-	**	-	-	-	7.5	9.7	5.80		2BX94		1. Replace belt and align.
RTU-H	**				**	-	5	6.4	2.75	Roof	1A64	(3) 24 x 24 x 4 , (3) 24 x 24 x 2 (4) 12 x 24 x 4 , (3) 12 x 24 x 2	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
RETURN	-	-	**	-		-	5	4.3	1.82	FAN MOVING AT LOWEST SETTING.	1A76		1. Confirm proper control.
RTU-A	**	16,772	NL	13,642	**	3,130	15	19.3	14.0/14.0/13.9	Roof	2BX90	(6) 24 x 24 x 5 , (5) 24 x 12 x 4 (6) 24 x 24 x 2 , (5) 24 x 12 x 2	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
HV-1	**	27,164	NL	3,583	**	3,583	15	17.7	17.1/16.7/15.9	Roof	3BX85	(12) 20 x 20 x 2 , (12) 20 x 24 x 2 (12) 20 x 20 x 1 , (12) 20 x 24 x 1	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
RETURN	-	-	-	23,581	**	-	10	12.5	8.9/8.5/9.1		1BVX-1000		1. Replace belt and align.

Quinsigamond School

Unit Name	Supply CFM		Return CFM		O.A CFM		Fan motor	F.L.A		Unit Location & General Notes	Belt	Filter	Corrective Action
	Listed	Tested	Listed	Tested	Listed	Tested	H.P(LISTED:TESTED)	Listed	Tested				
HV-1	11,500	6,898	-	-	2,000	NA	15	44.8	24.20	2nd Floor Mechanical Room Serves GYM	2-B61	NA	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
RETURN	-	-	9,700	10,679	-	-	3	9.50	7.40	2nd Floor Mechanical Room Serves GYM	2-A80		1. Replace belts, adjust and balance.
HV-2	3,500	NA	NA	NA	1,000	NA	3	9.0	NA	Roof	1-4L80	(2) 20"x25"x2" (2) 20"x20"x2"	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
HV-3	7,000	5,984	-	-	1,800	1,534	7.5	21.0	17.10	Roof	2-BX59	(1) 16"x25"x2" (1) 16"x20"x2" (4) 12"x25"x2" (4) 12"x20"x2"	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
RETURN 2	-	-	6,400	4,450	-	-	1.5	NA	3.28		NA		1. Replace belts, adjust and balance.
AHU-1	4,506	4,286	-	-	1,305	878	3	9.0	6.40	Attic	1-AX31	NA	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
RETURN	-	-	3,195	3,116	-	-	2	5.98	3.00		1-AX31		1. Replace belts, adjust and balance.

Rice Square School

Unit Name	Supply CFM		Return/Exh. CFM		O.A CFM		Fan motor	F.L.A		Location & General Notes	Belt	Filter	Corrective Action
	Listed	Tested	Listed	Tested	Listed	Tested	H.P(LISTED:TESTED)	Listed	Tested				
Central AHU	5,800	3,997	NA	NA	5,800	NA	3	9.3	7.10	Boiler Room	1-A52	NA	1. Provide new filter rack with MERV 13 filters. 2. Replace belts and adjust. 3. Balance supply fan / OA to listed CFM. 4. Vacuum clean fan wheel and housing. 5. Wash and clean steam coils. 6. Provide new EMS controls for fan, coil and damper control.
RTU-1	1,800	1,732	NA	1,732	400	NA	NA	NA	3.30	Modular Roof	NA	(2) 16 x 25 x 2	1. Replace Filters with MERV 13. 2. Balance supply fan to listed CFM. 3. Provide Trane minimum OA hood and damper wired to unit controller. Trane unit model #BWC060610 4. Balance OA to listed CFM.
RTU-2	1,800	NA	NA	NA	400	NA	NA	NA	NA	Modular Roof	NA	(2) 16 x 25 x 2	1. Replace Filters with MERV 13. 2. Balance supply fan to listed CFM. 3. Provide Trane minimum OA hood and damper and wire to unit controller. Trane unit model #BWC060610. 4. Balance OA to listed CFM.

Roosevelt School

Unit Name	Supply CFM		Return CFM		O.A CFM		Fan motor	F.L.A		Unit Location & General Notes	Belt	Filter	Corrective Action
	Listed	Tested	Listed	Tested	Listed	Tested	H.P(LISTED)	Listed	Tested				
AHU-B-1	7,000	3,936	5,500	1,582	1,500	2,354	5	6.5	4.0/4.0/4.1	Roof	1-B59	(8) 16 x 20 x 2	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
AHU-B-2	7,000	3,835	5,500	1,151	1,500	2,684	5	6.5	4.0/4.1/4.0	Roof	1-B59	(8) 16 x 20 x 2	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
AHU-B-3	2,006	-	1,960	-	40	-	1.5	2.1	-	Above Gym Office NO BELT. NONOPERATIONAL. Will require a ladder for access	14-L340	(3) 16 x 20 x 2	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
AHU-B-4	2,006	-	1,960	-	40	-	1.5	2.1	-	Above Gym Office NO BELT. NONOPERATIONAL. Will require a ladder for access	14-L340	(3) 16 x 20 x 2	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
AHU-C-1	5,000	4,149	1,250	1,404	3,750	2,745	3	4.0	2.9/2.7/2.8	Attic	14-L610	(6) 16 x 20 x 2	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
AHU-C-2	5,000	3,197	1,250	1,832	3,750	1,365	3	4.0	2.6/2.5/2.4	Attic	14-L610	(6) 16 x 20 x 2	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM. 5. Repair control of OA damper.

Sullivan Middle School

Unit Name	Supply CFM		Return CFM		O.A CFM		Fan motor	F.L.A		Unit Location & General Notes	Belt	Filter	Corrective Action
	Listed	Tested	Listed	Tested	Listed	Tested	H.P(LISTED:TESTED)	Listed	Tested				
AHU-1	37,425	42,903	-	-	14,970	10,585	40	46.0	27.90	Roof	3-5VX1500	(28) 20 x 25 x 2, (28) 16 x 25 x 2	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
RETURN	-	-	22,455	32,318	-	-	20	23.25	17.70		3-BX128		1. Replace belts and balance fan to airflow listed.
AHU-2	48,825	52,468	-	-	19,580	14,647	50	58.5	41.90	Roof	3-5VX1500	(28) 20 x 25 x 2, (28) 16 x 25 x 2	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
RETURN	-	-	29,245	37,821	-	-	30	34.5	24.90		3-5VX1500		1. Replace belts and balance fan to airflow listed.
AHU-3	18,300	20,189	-	-	5,670	13,249	15	25	18.30	Roof EXPOSED SUPPLY DUCTWORK RUSTED THROUGH. OPEN HOLE ON TOP OF DUCT.	2-B71	(21) 16 x 25 x 2, (7) 16 x 20 x 2	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM. 5. Replace supply and return air ductwork and silencers on roof and reinsulate.
RETURN	-	-	12,630	6,940	-	-	(10 : 7.5)	12.3	0.00	ONLY 1 BELT ON RETURN FAN WHICH IS NOT ATTACHED.	2-B72		1. Replace belts and balance fan to airflow listed.
AHU-4	11,000	9,885	-	-	11,000	5,611	15	18.8	108.00	Roof COIL HAS BEEN REMOVED. FILTER AND FAN ONLY.	2-BX64	(15) 16 x 25 x 2, (5) 16 x 20 x 2	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
RETURN	-	-	-	4,274	-	-	7.5	96	6.20		2-B59		1. Replace belts and balance fan to airflow listed.
AHU-5	11,000	10,791			3,240	6,178	10	12.2	9.00	Roof	2-BX60	(18) 16 x 25 x 2, (5) 16 x 26 x 2	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
RETURN			7,760	4,613			7.5	9	3.90	Existing belts different lengths. Use BX-57	2-BX57		1. Replace belts and balance fan to airflow listed.
AHU-6	6,600	5,118			1,000	4,203	10	12.4	11.60	Roof	2-BX58	(15) 16 x 25 x 2, (5) 16 x 20 x 2	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
RETURN			5,600	915			3	3.9	2.00		1-BX58		1. Replace belts and balance fan to airflow listed.
AHU-7	11,125	8,666			4,950	857	15	17.5	10.20	Roof	2-BX60	(15) 16 x 25 x 2, (5) 16 x 20 x 2	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
RETURN			6,175	7,809			5	6.2	2.90		1-BX92		1. Replace belts and balance fan to airflow listed.
AHU-8	11,650	11,219			3,500	4,911	10	12.2	8.30	Roof OA DAMPER IS STUCK 100% OPEN. Excessive vibraton on return fan.	2-BX56	(15) 16 x 25 x 2, (5) 16 x 20 x 2	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Reapir OA damper and Balance OA to listed CFM.

RETURN			8,150	6,308			3	3.9	3.30	Excessive vibration of return fan.	1-BX87		1. Diagnose fan vibration issue and report. 2. Replace belts and balance fan to airflow listed.	

Thorndyke Road School

Unit Name	Supply CFM		Return/Exh. CFM		O.A CFM		Fan motor	F.L.A		Notes	Belt	Filter	Corrective Action
	Listed	Tested	Listed	Tested	Listed	Tested	H.P(LISTED:TESTED)	Listed	Tested				
Central AHU	9,600	8,563	NA	5,228	3,500	3,335	5	24.0	17.5/17.6	Adjacent to Boiler Room OA damper broken.	3-BX90	(14) 14"x20"x2"	1. Provide new filter rack with MERV 13 filters. 2. Replace belts and adjust. 3. Balance supply fan / OA to listed CFM. 4. Vacuum clean fan wheel and housing. 5. Wash and clean steam coils. 6. Provide new OA and RA dampers and refurbish F&B dampers. 7. Provide new EMS controls for supply and exhaust fans, coil and damper controls.
Exhaust Fan			2800	2,774			2	9.4	8.8/8.5/8.8	Adjacent to supply fan room. RA damper linkage disconnected.	2-B108	NA	1. Replace belts and adjust. 2. Balance exhaust fan to listed CFM. 3. Vacuum clean fan wheel and housing.

Worcester Technical High School

Unit Name	Supply CFM		Return CFM		O.A CFM		Fan motor	F.L.A		Belt	Filter	Unit Location & General Notes	Corrective Action
	Listed	Tested	Listed	Tested	Listed	Tested	H.P(LISTED:TESTED)	Listed	Tested				
RTU-1-A	24,400		20,900		3,500		20	2.0		4-BX90	(12) 24 x 24 x 4	Roof	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
RETURN							7.5	18.1/9.03		2-BX100	(4) 12 x 24 x 4	Roof	1. Replace belts and adjust. 2. Balance return fan to SA CFM - 10%.
RTU-2-A	47,000	40,071	28,000		19,000		40	47.6		4-5VX1080	(20) 24 x 24 x 4	Roof	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM. 5. Add OA flow station and adjust outdoor air volume per ASHRAE 62.1 section 6.2.5 for VAV systems.
RETURN							20	50		2-BX128	(4) 12 x 24 x 4	Roof Signs of rust on frame at curb near evaporator.	1. Replace belts and adjust. 2. Balance return fan to SA CFM - 10%.
RTU-3-B	42,000	32,277	25,000	32,277	17,000	0	30	35.4		4-5VX160	(20) 24 x 24 x 4	Roof	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM. 5. Add OA flow station and adjust outdoor air volume per ASHRAE 62.1 section 6.2.5 for VAV systems.
RETURN			NL	32,277			20	25		2-BX133	(4) 12 x 24 x 4	Roof	1. Replace belts and adjust. 2. Balance return fan to SA CFM - 10%.
RTU-4-B	50,000	36,825	30,000		20,000		40	47.6		4-5VX1120	(20) 24 x 24 x 4	Roof	1. Replace Filters with MERV 8. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM. 5. Add OA flow station and adjust outdoor air volume per ASHRAE 62.1 section 6.2.5 for VAV systems.
RETURN							25	30		2-BX140	(4) 12 x 24 x 4	Roof	1. Replace belts and adjust. 2. Balance return fan to SA CFM - 10%.
RTU-5-D	50,000	43,890	30,000		20,000		40	47.6		4-5VX1120	(20) 24 x 24 x 4	Roof	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.

Worcester Technical High School

RETURN							25	29.9		2-BX140	(4) 12 x 24 x 4	Roof	1. Replace belts and adjust. 2. Balance return fan to SA CFM - 10%.
HV-2-C	6,310		3,785		2,525		7.5	9.7		1-VX46	(6) 20 x 20 x 2	Mezzanine	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
HV-3-C	8,710	8,347	0	8,347	8,710	0	10	12.3	10.7/10.8/10.4	2-B50	(12) 16 x 20 x 2	Environmental Room System is running at 100% RA, design is 100% OA. Requires laddor or lift to service	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
HV-4-C	6,470	4,846	3,880	4,406	2,590	440	7.5	9.7	7.8/7.9/8.1	1-5VX450	(6) 20 x 20 x 2	Carpentry Shop Requires laddor or lift to service	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
HV-5-C	4,500	5,738	2,700	4,004	1,800	1,734	5	6.8	5.4/5.5/5.5	1-BX54	(4) 20 x 20 x 2	HVAC Shop Requires laddor or lift to service	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
HV-6-C	7,600	8,725	4,560	5,880	3,040	2,845	10	12.6	9.3/9.3/9.4	2-B50	(12) 16 x 20 x 2	Interior Shop Requires laddor or lift to service	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
HV-7-C	7,280	9,928	4,365	7,135	2,915	2,793	10	12.6	10.8/10.4/10.7	2-B51	(12) 16 x 20 x 2	Electrical Shop Requires laddor or lift to service	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
HV-8-D	3,480	3,130	2,085	2,014	1,395	1,116	3	4.3	3.7/3.4/3.7	1-BX50	(4) 20 x 20 x 2	Construction Lab Requires laddor or lift to service	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
HV-9-D	7,590	11,488	4,550	593	3,040	10,895	10	12.6	10.8/10.3/10.6	2-5VX540	(12) 16 x 20 x 2	Auto Body Shop Belts are loose. RA damper is 100% closed. Requires laddor or lift to service	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM. 5. Confirm proper operation of dampers.

Worcester Technical High School

HV-10-D	10,200		6,120		4,080		10	12.6	7.6/7.3/7.4	1-5VX550	(8) 16 x 25 x 2, (4) 16 x 20 x 2	Auto Body Shop Belts are squealing. OA/RA Dampers are not opening. Requires laddor or lift to service	1. Replace Filters with MERV 13. 2. Replace belts and adjust. Align sheaves. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM. 5. Confirm proper operation of dampers.
HV-11-D	6,000	6,035	3,600	5,458	2,400	577	7.5	9.7	8.1/8.3/7.9	1-BX45	(6) 20 x 20 x 2	Machine Shop OA damper is 100% shut. Requires laddor or lift to service	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM. 5. Confirm proper operation of dampers.
HV-12-D	11,200		0		11,200		10	12.8		1-5VX550	(8) 16 x 25 x 2, (4) 16 x 20 x 2	Welding Shop Requires laddor or lift to service	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
HV-13-D	3,750	884	2,250	864	1,500	20	5		4.2/4.3/4.2	1-BX56	(4) 20 x 20 x 2	Welding Shop Requires laddor or lift to service	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
HV-14-D	10,000	1,186	NL	938	10,000	248	7.5	9.7	5.3/5.3/5.2	1-5VX540	(8) 16 x 25 x 2, (4) 16 x 20 x 2	Machine Shop Return Damper 100% Open. Belt Loose. Requires laddor or lift to service	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM. 5. Confirm proper operation of dampers.
HV-15-D	11,940		0		11,940		15	n/a	5.3/5.3/5.2	2-5VX500	(8) 16 x 25 x 2, (4) 16 x 20 x 2	Welding Shop Requires laddor or lift to service	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
HV-16-E	2,515	2,224	2,010	1,066	505	1,158	3	4.5	2.5/2.6/2.6	1-BX44	(4) 16 x 20 x 2	Storage Requires laddor or lift to service	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
HV-17-E	13,105	13,570	0	9,369	13,105	4,201	20	24.5	13.2/13.5/4.2	2-5VX630	(12) 20 x 20 x 2	Garage Requires laddor or lift to service	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan and OA to listed CFM.
HV-18-E	3,590	4,653	2,510	2,979	1,080	1,674	5	7	4.6/4.5/4.4	1-A57	(4) 20 x 20 x 2	Gym Storage	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.

Worcester Technical High School

HV-19-E	4,665	3,296	2,795	3,116	1,870	180	5	7	3.7/3.5/3.5	1-BX34	(4) 20 x 25 x 2	Gym Storage Requires laddor or lift to service	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
HV-20-E-(A)	15,000	14,808	7,500	458	7,500	14,350	20	24.5	12.6/11.8/12.1	2-B74	(12) 20 x 20 x 2, (4) 20 x 25 x 2	Mechanical Room Belt is Squeling. Sheaves out of alignment.	1. Replace Filters with MERV 13. 2. Replace belts and adjust. Align sheaves. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
HV-20-E-(B)	15,000	14,657	7,500	11,983	7,500	2,674	20	24.5	13.5/12.7/12.7	2-BX77	(12) 20 x 20 x 2, (4) 20 x 25 x 2	Mechanical Room Belt is Squeling. Sheaves out of alignment.	1. Replace Filters with MERV 13. 2. Replace belts and adjust. Align sheaves. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
HV-21-D	9,400		5,640		3,760		7.5	9.7		1-BX67	(8) 16 x 25 x 2, (4) 16 x 20 x 2	Auto Repair Shop Requires laddor or lift to service	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan to listed CFM. 4. Balance OA to listed CFM.
HV-24-D	13,000		0		13,000		NA	NA		NA	NA	Autobody Booth MAU Requires laddor or lift to service	1. Replace Filters with MERV 13. 2. Replace belts and adjust. 3. Balance supply fan amd OA to listed CFM.