

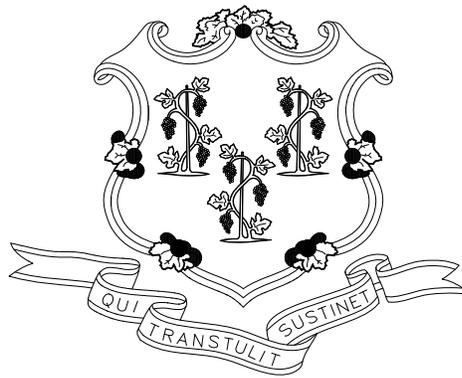
PROJECT MANUAL

CHILLER REPLACEMENT AT

BETHEL MIDDLE SCHOOL

600 Whittlesey Drive

BETHEL, CT 06801



TOWN OF BETHEL

December 3, 2019

**SALAMONE & ASSOCIATES, P.C.
CONSULTING ENGINEERS
116 NORTH PLAINS INDUSTRIAL ROAD
WALLINGFORD, CT 06492**

INVITATION TO BID

Town of Bethel
County of Fairfield
State of Connecticut

Request for **Qualification/Request for Proposal Bid # 2019-304**

Notice is hereby given that sealed bids will be received at the Office of the Purchasing Agent, Clifford J. Hurgin Municipal Center, 1 School Street, Bethel, CT 06801 until 9:45AM on January 8, 2020. The bids will be opened at 10:00AM on January 8, 2020 in Meeting Room A of the Municipal Center. The Town seeks a mechanical contactor for the **Chiller Replacement at Bethel Middle School**. There is a mandatory site walk on December 11, 2019 at 3:00 PM. Details for the project requirements and scope of services may be obtained at the Office of the Purchasing Agent at 203-794-8512 or the homepage of our website: bethel-ct.gov

The Board of Selectman upon recommendation of the Procurement Committee reserves the right to accept and/or reject any portion of said bid, to waive any technicality in any bid or part thereof and to accept any bid as provided in Section 8-13c of the Charter of the Town of Bethel.

Dated at Bethel, Connecticut, this December 2019.

Town of Bethel Procurement Committee
Matthew S. Knickerbocker, First Selectman
Robert V. Kozlowski, Comptroller
Lauren J Cunningham, Purchasing Agent

**REQUEST FOR QUALIFICATIONS AND
PROPOSALS FOR**

Chiller Replacement at Bethel Middle School

**Town of Bethel Procurement Committee/Town Finance
1 School Street, Bethel, CT 06801**

Request for Qualifications/Request for Proposals “RFQ/RFP BID 2019-304”

Project Summary: Town of Bethel seeks bids from a mechanical contactor to remove and replace two (2) indoor water-cooled chillers and one exterior cooling tower.

RFQ/RFP Release Date: December 4, 2019

Mandatory Site Visit: December 11, 2019 at 3:00 PM

Response Deadline: January 8, 2020 at 9:45 AM

Owner: The Town of Bethel (“Town”)

Issued By: Town of Bethel Procurement Committee/Town Finance Department (“BPC/TFD”)

Project Name: Chiller Replacement at Bethel Middle School

Project Location: Bethel Middle School, 600 Whittlesey Dr, Bethel, CT 06801

Town Contacts:

- Lauren Cunningham, Town of Bethel Purchasing Agent (203) 794-8512
- Ms. Theresa Yonsky, Board of Education Director of Fiscal Services (203) 794-8603
- Mr. Robert Germinaro, BOE Supervisor of Facility & Security Operations (203) 794-8603

Engineering Consultant to Town:

- Mr. Joseph Salamone, Project Manager (203) 281-6895

PROJECT REQUIREMENTS

- A. This project will replace an end-of-life water cooled chiller plant at the Bethel Middle School, located at 600 Whittlesey Drive in Bethel CT. The primary objective is to restore functionality and reliability to the school's air conditioning system.

B. PROPOSAL REQUIREMENTS

A. Mandatory Site Visit

All interested companies must participate in a mandatory walk through of the site. This walk through will take place on December 11, 2019 at 3:00 p.m. at Bethel Middle School. Questions regarding the walk through can be directed to Mr. Bob Germinaro at (203) 794-8603.

B. Questions

Questions can be submitted in writing to Theresa D. Yonsky at yonskyt@bethel.k12.ct.us through December 31, 2019. Responses will be supplied to all interested firms via email. No direct or indirect contact with selection panel members is allowed and will be grounds for immediate rejection of the proposal; all questions must be submitted as described in this paragraph.

C. Proposal Submission Deadline and Format

All RFQ & RFP submissions must be received by the Town by 9:45 a.m. on January 8, 2020.

Request for Qualifications and Request for Proposals must be submitted in a sealed envelope clearly marked "**Bethel RFQ/P BID 2019-304**". Five (5) copies should be submitted. The responses must be submitted to the office of Purchasing Agent, Town of Bethel, 1 School Street, Bethel, CT 06801.

Any information or materials submitted as a response to this RFQ and RFP shall become property of the Town of Bethel and will not be returned. Any expense incurred for the submission of this RFQ and RFP is the responsibility of the firm submitting and no expense will be reimbursed by the Town/BPC/TFD. All submitted materials will be available for public review.

D. Cover Letter/Executive Summary.

Proposals shall include a Letter of Introduction on firm letterhead explaining the firm's interest in the project and why your firm is the most qualified for these projects. An officer of the company must sign this letter of introduction and intent. Include any information pertinent to the projects or selection process that is not requested in the following.

E. Qualifications Package

Minimum information to be included:

Firm Overview.

- Name of firm and firm's representative and his/her contact information
- Location of principal and branch offices that would work on these projects

- Length of time in business

Experience. List similar size and scope projects you have completed in the last three (3) years and highlight if you have done work for a CT Public School District. *Submission of these projects shall constitute your permission for the Owner to contact those entities for references.*

Capacity of the Firm. Describe firm's experience with similar size projects and available capacity of key staff required to perform the work within the required time frame.

Past Claims or Disputes.

- Please list any claims, disputes, or arbitration proceedings that have occurred on any school projects you firm has been involved with in the last five (5) years. Indicate who they were with and give a status of each even if they are pending.
- Please list any school building projects in the last five (5) years in CT for which your firm was removed or chose to leave during the project.
- Information concerning any suits filed, judgments entered or claims made against your firm during the last five (5) years with respect to services provided by your firm, or any declaration of default or termination for cause against your firm with respect to such services. In addition, state whether during the past five (5) years your firm or your proposed consultant(s) or subcontractors has been suspended from bidding or entering into any government contract.

Affirmative Action.

- Include statement of Affirmative Action compliance. If you need a sample, one can be provided.
- Also, as this is a Bethel Public School Project, adherence to Bethel Board of Education's Non-discrimination clause is required and is listed here:

The Bethel Public Schools are committed to a policy of equal opportunity/affirmative action for all qualified persons. The Bethel Public Schools do not discriminate in any employment practice, education program, or educational activity on the basis of race, color, religious creed, sex, age, national origin, ancestry, marital status, sexual orientation, gender identity or expression, disability (including, but not limited to, intellectual disability, past or present history of mental disorder, physical disability or learning disability), genetic information, or any other basis prohibited by Connecticut State and/or Federal nondiscrimination laws and provides equal access to the Boy Scouts and other designated youth groups. The Bethel Public Schools do not unlawfully discriminate in employment and licensing against qualified persons with a prior criminal conviction. Inquiries regarding the Bethel Public Schools nondiscrimination policies should be directed to:

Dr. Kristen Brooks (Title IX District Coordinator)
Assistant Superintendent of the Bethel Public Schools

1 School Street, Box 253
 Bethel, CT 06801
 Phone: [\(203\) 794-8613](tel:(203)794-8613)
 email: brooksk@bethel.k12.ct.us

Mrs. Susan Budris (Section 504 District Coordinator)
 Director of Special Education and Pupil Services
 1 School Street, Box 253
 Bethel, CT 06801
 Phone: [\(203\) 794-8616](tel:(203)794-8616)
 email: budriss@bethel.k12.ct.us

F. Proposed Project Approach

Minimum information to be included:

Discussion of Key Milestones. Provide a description of how you will accomplish key milestones (including, but not limited to: project kick-off; design development, review, and approval; ordering of equipment; demolition; construction; startup; commissioning)

Schedule. Include a high-level project schedule for key milestones that results in project completion by the May 8, 2020 deadline.

Staffing. Identify key staff to be assigned, including managers, with roles and responsibilities.

Sub-Contractors. Identify any subcontractors to be used, their roles and responsibilities, your prior experience working with these sub-contractors, and sub-contractor qualifications to assume assigned tasks.

Periodic Progress Meetings. Describe how you propose to update Town on project progress and next steps.

Pricing. Complete and submit the attached Pricing Proposal form.

G. Additional Requirements

Proposal shall confirm the following in writing:

1. Insurance coverage

The Contractor shall purchase the following types of insurance, and maintain all insurance coverage for the life of the contract, from an insurance company or companies with an A.M. Best rating of A- (VII) or better. Such insurance shall protect and indemnify Town of Bethel and Bethel Board of Education from all claims which may arise out of or result from the Contractor's obligations under this Agreement, whether caused by the Contractor or by a subcontractor or any person or entity directly or indirectly employed by said Contractor or by anyone for whose acts said Contractor may be liable.

As to the insurance required, the insurer(s) and/or their authorized agents shall provide Town of Bethel and Bethel Board of Education with certificates of insurance prior to commencement of the work, describing the coverage and providing that the insurer shall give Town of Bethel and Bethel Board of Education written notice at least ten (10) days in advance of any termination, expiration or changes in coverage.

Worker's Compensation

Contractor shall provide worker's compensation and employer's liability insurance that complies with the regulations of the State of Connecticut with limits no less than \$1,000,000 each accident by bodily injury; \$1,000,000 each accident by disease; and a policy limit of \$1,000,000. Such policy shall contain a "waiver of our right to recover from others endorsement" in favor of the Town of Bethel and Bethel Board of Education.

Commercial General Liability Insurance

Contractor shall provide a commercial general liability insurance policy that includes products, operations and completed operations. Limits should be at least: Bodily injury & property damage with an occurrence limit of \$1,000,000; Personal & advertising injury limit of \$1,000,000 per occurrence; General aggregate limit of \$2,000,000 (other than products and completed operations); Products and completed operations aggregate limit of \$2,000,000. Such coverage will be provided on an occurrence basis and will be primary and shall not contribute in any way to any insurance carried by the Town of Bethel and Bethel Board of Education. Such Policy shall name the Town of Bethel and Bethel Board of Education as an Additional Insured with respect to claims arising out of the Contractor's negligence or for the negligence of those for whom the Contractor is responsible, by endorsement, ISO Forms CG2010 and CG 2037 or their equivalent.

Commercial Automobile Insurance

Contractor shall provide commercial automobile insurance for any owned autos (symbol 1 or equivalent) in the amount of \$1,000,000 each accident covering bodily injury and property damage on a combined single limit basis. Such coverage shall also include hired and non-owned automobile coverage.

Umbrella Liability Insurance

Contractor shall provide an umbrella liability policy in excess (without restriction or limitation) of those limits and coverage described in items (A) through (C). Such policy shall contain limits of liability in the amount of \$5,000,000 each occurrence and \$5,000,000 in the aggregate.

Engineers Professional Liability Insurance

Contractor shall purchase and maintain a policy covering their errors & omissions with limits no less than \$2,000,000 each claim and \$2,000,000 in the aggregate. If written on a claims made basis, such insurance shall be maintained for no less than three years after completion of the work.

2. Independent Contractor

All activities performed by the Contractor and its agents, employees or representatives are, for all purposes under this Agreement, performed as an independent contractor and not as an employee of Town of Bethel and Bethel Board of Education and neither the Contractor nor its employees shall be entitled to any benefits to which employees of Town of Bethel and Bethel Board of Education are entitled including, but not limited to, worker's compensation, overtime, retirement benefits, health care benefits, vacation pay or sick leave.

3. Indemnification

The contractor shall indemnify and hold harmless the Town of Bethel & Bethel Board of Education and its agents and Employees from and against all claims, damages, losses and expenses, including Attorney's fees arising out of, or resulting from the performance of the work.

H. Exceptions to RFQ/RFP Requirements Herein

Provide a detailed list with explanations of any and all exceptions being made in the proposal.

PROPOSAL REVIEW AND CONTRACTOR SELECTION PROCESS

A. Selection

The BPC/TFD will review the responses for compliance with the required documentation to determine responsiveness. The responsive submittals will then be evaluated based on the responses to specifics outlined in this RFP/RFQ, including but not limited to the following criteria:

- Price
- Experience with work of similar size and scope with successful outcomes
- Past performance/ References
- Project schedule
- Warranty offered on equipment and labor
- Capability to support utility incentive applications
- Other criteria specific to the project

The BPC/TFD may narrow the list of applicants and schedule follow up questions as they deem necessary. Public Law 08-169 requires the Selection Committee to make an award “...from a pool of not more than the four most responsible qualified proposers...” The “most responsible qualified proposer” is the proposer “...who is qualified by the awarding authority when considering price and the factors necessary for faithful performance of the work based on the criteria and scope of work included in the request for proposals.”

B. Right to Reject Submissions

The Town/BPC/TFD may at any time prior to the selection of a respondent reject any and all proposals and cancel this RFQ/RFPP, without liability therefore, when doing so is deemed to be in the Town’s best interests. Further, regardless of the number and quality of proposals submitted, the Town/BPC/TFD shall under no circumstances be responsible for any respondent’s cost, risk and expenses. The Town accepts no responsibility for the return of successful or unsuccessful proposals. This RFQ/RFP in no way obligates the Town/BPC/TFD to select a respondent.

Schedule A: PRICE PROPOSAL FORM**Company Name:** _____**Company Address:** _____**Company Phone #:** _____**Company email:** _____**Allowance**

All Bidders shall provide as part of their Base Bid a Fifteen Thousand Dollar (\$15,000.00) Direct Digital Controls Allowance. SNE Building Systems shall remove the existing controls on the Chillers and Cooling Tower, reconnect new Chillers via BACnet to the existing BMS, provide and wire DDC controls points for the new Cooling Tower VFD and update Sequence of Operations/graphic display for the New Chilled Water Plant.

Allowance shall be deducted from to provide Scope of Work indicated on the Drawings and Specifications. Any amount remaining from said allowance shall be returned to owner via a Deduct Change Order.

Base Bid \$ _____**Alternates**Deduct Alternate #1:

Deduct cost for not providing materials and labor associated with the cooling tower. \$ _____

Signature _____**Date** _____**Title** _____

TABLE OF CONTENTS

TECHNICAL SPECIFICATIONS

- 01051 Working Procedures During Construction
- 01300 Submittal, Products, Substitutions
- 02070 Selective Demolition
- 15010 Basic Mechanical Requirements
- 15050 Basic Mechanical Materials and Methods
- 15100 Valves
- 15135 Meters and Gauges
- 15140 Supports and Anchors
- 15190 Mechanical Identification
- 15246 Vibration Isolation and Seismic Restraints
- 15250 Mechanical Insulation
- 15510 Hydronic Piping
- 15650 Cooling Tower
- 15685 Helical Rotary Screw Chiller
- 15990 Testing and Balancing
- 16010 Basic Electrical Requirements
- 16050 Basic Electrical Materials and Methods
- 16110 Raceways
- 16120 Wires and Cables
- 16135 Cabinets, Boxes and Fittings
- 16143 Wiring Devices
- 16170 Circuit and Motor Disconnects
- 16190 Supporting Devices
- 16195 Electrical Identification
- 16452 Grounding
- 16475 Overcurrent Protective Devices

DRAWINGS

Cover

DM-1 Partial First Floor Mechanical Demolition Plan

DE-1 Partial First Floor Electrical Demolition Plan

M-1 Partial First Floor Mechanical Plan

M-2 Mechanical Details and Control Schematics

M-3 Mechanical Schedules, Symbols, Notes and Abbreviations

E-1 Partial First Floor Electrical Plan

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section discusses the minimum requirements necessary for general coordination and precautionary measures which are to be undertaken by the Contractor during the progression of work generally specified as follows.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.1 PROJECT COORDINATION AND SCHEDULING

- A. The Contractor shall coordinate all construction activities with the Owner, including but not limited to demolition and window and siding installation, as necessary to minimize disruption with facility operations. Sufficient notice shall be provided by the Contractor as necessary for the Owner to make the necessary arrangements to relocate personnel and tenants surrounding areas of work.
- B. Prior to the commencement of work, the Contractor shall submit a construction schedule to the Owner establishing the sequencing of work. Construction operations shall be scheduled in such a manner to accommodate the Owner and minimize disruption to facility operations.

3.2 PRECAUTIONARY MEASURES

- A. The Contractor shall undertake all necessary precautions to avoid interference and/or disturbance of existing construction to remain resulting from, but not limited to, the demolition of windows and synthetic stucco finish. Any damage resulting from this work, shall be repaired at the Contractor's expense.

3.3 PROTECTION AND CLEANING

- A. The Contractor shall maintain an uninterrupted means of building egress and roadway access at all times until completion of the work.
- B. The contractor shall attend weekly job progress meetings with the Owner to discuss construction scheduling.

END OF SECTION 01051

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Work of this Section shall be governed by the Contract Documents. Provide materials and services necessary to furnish and deliver the work of this Section as specified herein, and/or as required by job conditions.

1.2 SHOP DRAWINGS AND PRODUCT DATA

A. Definitions

- 1. Shop Drawings are drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or any Subcontractor, Manufacturer, Supplier or Distributor to illustrate some portion of the work.
- 2. Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate a material, product or system for some portion of the work.
- 3. Samples are physical examples which illustrate materials, equipment or workmanship and establish standards by which the work will be judged. See Schedule of Samples under each Section of the Specifications.

- B. The Contractor shall review, approve and submit, within seven (7) days after receipt thereof and in such sequence as to cause no delay in the Work or in the Work of the Owner or any separate contractor, all Shop Drawings, Product Data, Samples and Certificates required by the Contract Documents.

- C. By approving and submitting Shop Drawings, Product Data Samples, the Contractor represents that he has determined and verified all materials, field measurements, and field construction criteria related thereto, or will do so, and that he has checked and coordinated with information contained within such submittal with the requirements of the Work of the Contract Documents.

- D. The Contractor shall "not be relieved of responsibility" for any deviation from the requirements of the Contract Documents by the Engineers review of Shop Drawings, Product Data or Samples unless the Contractor has specifically informed the Engineer in writing of such deviation at the time of submission and the Engineer has given written notice to the specific deviation. The Contractor shall not be relieved from responsibility for errors or omissions in the Shop Drawings, Product Data or Samples by the Engineer's review thereof Contract Documents indicate the work to be performed.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 01300
SUBMITTALS, PRODUCTS, AND SUBSTITUTIONS

- E. The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data or Samples to revisions other than those requested by the Engineer on previous submittal.
- F. No portion of the Work requiring submission of a Shop Drawing, Product Data or Samples shall be commenced until the submittal has been reviewed by the Engineer. All such portions of the Work shall be in accordance with reviewed submittal.

1.3 SUBMISSION PROCEDURES

- A. After the date specified for commencement of work the Contractor, within a mutually agreed to time with Engineer and Owner, -shall submit a shop Drawing Schedule to the Engineer, This schedule shall be broken down into the various items of work and shall list a "Begin" date and a "Complete" date for Shop Drawing Submission.
- B. Submit to the Engineer Shop Drawings, Product Data and Samples in sufficient time to allow at least fifteen **(15)** working days for review. Submittal **shall be** checked and signed **by** the Contractor prior to submission to indicate that the Contractor has coordinated the work and that it conforms to the Contract Documents.
- C. When catalog cuts, brochures, product data or other printed data are sent to the Engineer for review, a minimum of four **(4)** copies **of** each shall **be** submitted.
- D. The quantities and types of samples are listed in each Section of the Specifications.
- E. Each Shop Drawing shall contain a title block with provisions for the following:
 - 1. Number and title of drawing.
 - 2. Date of drawing and revision
 - 3. Name of project building or facility.
 - 4. Name of Contractor or Subcontractor submitting drawing.
 - 5. Specification Section title and number,
 - 6. Space for Engineer's stamp and received stamps (511x51').
- F. Each Shop Drawing shall have listed on it all contract reference drawing numbers plus shop drawing numbers on related work by other Subcontractors if available. The Engineer's drawings may not be reproduced and submitted as Shop Drawings, unless consent is obtained from the Engineer in writing prior to such use.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 01300
SUBMITTALS, PRODUCTS, AND SUBSTITUTIONS

- G. Each Shop Drawing submission shall have indicated on the Drawing a submission number (whether first, second, third, etc.) and each submission after the first submission shall be clear of all previous stamps.
- H. Shop Drawings for work of one trade shall be checked by Subcontractors of related trades if available, and shall have received their stamp of approval, before being submitted to the Engineer.
- I. Shop Drawings which involve change or variances with Contract Documents shall be so noted by the Contractor, and the Owner and Engineer shall be advised in writing of the recommended change and reasons for such changes.

1.3 ENGINEER'S ACTION

- A. After the completion of his checking, the Engineer will return the (2) two copies of shop drawings to Contractor marked in one of the following ways. As explained below.

With notation as follows:

corrections or comments made on the shop drawings during this review do not relieve contractor from compliance with requirements of the drawings and specifications. This check is only for review of general conformance with the design concept of the project and general compliance with the information given in the Contract Documents, The Contractor is responsible for confirming and correlating all quantities and dimensions- selecting fabrication processes and techniques of construction; coordinating his work with that of all other trades-, and performing his work in a safe and satisfactory manner.

B. EXPLANATION OF COMMENTS

- 1. No Exceptions Taken: No corrections, contractor may proceed with the work; only these drawings should be used for fabrication and in the field.
- 2. Comment Attached, Resubmit: minor amount of corrections; all items can be fabricated in accordance with notes; review is completed; record copy incorporating the minor changes, must be submitted and shall not be considered as a re-submission.
- 3. Rejected: Drawings and/or catalogs are rejected as not in accordance with design concept of the project and information given in the contract documents.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 01300
SUBMITTALS, PRODUCTS, AND SUBSTITUTIONS

4. Remarks: See note on shop drawings review stamp. Changes in shop drawings, other than those noted by Engineer shall be brought to Engineer's attention in writing.
- C. Shop Drawings that are returned: "Revise and Resubmit" or "Rejected" shall be corrected and resubmitted to the **Engineer** promptly.
- D. The review of a specific item shall not imply review of an entire assembly of which the item is a component unless the whole assembly is submitted and approved.
- E. Engineer may withhold review on any Shop Drawing until Shop Drawings indicating all related items have been submitted. Submit (and Resubmit) Shop Drawings for such related items as approximately the same date to permit coordinating checking,

1.4 SAMPLES

- A. Submit for review, to the Engineer, samples of materials listed under each Section of the Specification. Samples shall be properly labeled for identification, consisting of the following information-. Job Titles, Sample No, and Submission No.
- B. Do not commence work under Sections of the Specifications until the Engineer's review in writing is obtained for all listed samples.
- C. Do not construe review of advance samples as total guarantee of acceptance of materials. Materials will be submitted to field inspections, from time to time, as work progresses.
- D. Samples of Specific manufactured product shall be accomplished with appropriate manufacturers literature at time of submission.

1.5 PROGRESS SCHEDULE

- A. The Contractor shall prepare a construction schedule in a form acceptable to the Engineer and Owner within two (2) weeks from the execution date of the Contract for the Engineer's and Owner approval.
- B. The progress schedule shall be in the form of a network schedule chart.
- C. The progress schedule shall be updated at least once a month or more frequently, if necessary, should the Project be faced with the threat of delay for any reason. Should changes that have occurred since previous submission of updated schedule, indicate progress of activity, show completion dates.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 01300
SUBMITTALS, PRODUCTS, AND SUBSTITUTIONS

- D. Furnish the Engineer and the Owner with sufficient copies of the original schedules and all updated schedules as the Owner or Engineer may require.
- E. After approval of the schedule, the Contractor shall be responsible for seeing that it is adhered to, and for ascertaining that proper coordination is maintained between all work of the Contract.

1.6 SCHEDULE OF VALUES

- A. The Contractor shall submit to the Engineer and Owner a Schedule of Values, on form supplied by Owner, at least ten (10) days prior to submitting the first application for payment
- B. The Schedule of Values shall list the breakdown of the work generally following the Table of Contents of this Specification, with identification of project, issue date, Contractors name and address.
- C. Each item shall be accompanied by a dollar value rounded off to the nearest ten dollars. As requested by the Engineer support values given with data that will substantiate their correctness.
- D. The use of the Schedule of Values shall be only as a basis for Contractor's Application for Payment.
- E. Sum total of all costs of items listed in the Schedule shall be equal to the total contract sum.
- F. The Schedule of Values shall be submitted each month along with the Application for the payment.

1.7 MATERIAL AND EQUIPMENT LIST

- A. Within appropriate time after the date of award of the Contract, the Contractor shall submit for approval a complete list of suppliers, materials and equipment proposed for use in connection with the Project.
- B. After a material piece of equipment has been approved, no change in brand or make will be permitted unless satisfactory written evidence is presented and approved by the Engineer that the manufacturer cannot make scheduled delivery of approved material, or that material delivered has been rejected and the substitution of a suitable material is an urgent necessity, or that other conditions have become apparent which indicate that the approval of such other material is in the best interest of the Owner.

1.8 PRODUCT ACCEPTANCE STANDARDS

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 01300
SUBMITTALS, PRODUCTS, AND SUBSTITUTIONS

- A. Where the words "or and acceptable equal" or other synonymous terms are used, it is expressly understood that they shall mean that the acceptance of any such submission is vested in the Engineer, whose decision shall be final and binding upon all concerned. All submissions are subject to such review.
- B. The intent of this article is to encourage and permit competition on qualified products by reputable and qualified Contractors, suppliers and manufacturers, whose product, reputation and performance warrant review for the conditions, intent of design and performance considerations.
- C. When descriptive catalog designations including manufacturers name, product brand name, or model number are referred to in the Contract Documents, such designations shall be considered as being those found in industry publications of current issue at date of first invitation to bid.
- D. When standards of the Federal Government, Trade Societies, or Trade Associations are referred to in the Contract Documents by specific date of issue, these shall be considered a part of this contract. When such references do not bear a date of issue, the current published edition at date of first invitation to bid shall be considered as part of this contract, Suppliers need not be a member of such trade societies or associations referred to in the Specifications.
- E. Whenever any product is specified or shown by describing proprietary items, model numbers, catalog numbers, manufacturer, trade names or similar reference, the bidder obligates himself to submit proposals and accepts awards of contract based upon the use of such products. Use of such reference is intended to establish the measure of quality which the Engineer has determined as requisite and necessary for this project, Where two or more products are chosen or specified, the bidder has his option of which to use, provided the product used meets all requirements of specifications and design criteria. The right is reserved to review proposed deviations of design, function, construction or similar differences which will effect the design intent

1.9 SUBSTITUTIONS

- A. Requests for substitution will NOT be considered prior to Bid.
- B. After the Contract has been executed, the Engineer will consider a formal request for the substitution of products in place of those specified under the following conditions:
 - 1. The request is accompanied by complete data an the proposed substitution substantiating compliance with the Contract Documents including product identification and description, performance and test data, references and samples where applicable, and an itemized

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 01300
SUBMITTALS, PRODUCTS, AND SUBSTITUTIONS

- comparison of the proposed substitution with the products specified or named by addenda, with data relating to Contract time schedule, design and artistic effect where applicable.
2. The request is accompanied by accurate cost data on the proposed, substitution in comparison with the product specified, whether or not modification of the Contract Sum is to be a consideration.
- C. Requests for substitution based on paragraph (1) above, when forwarded by the Contractor to the Engineer and Owner, are understood to mean that the Contractor.
1. Represents that he has personally investigated the proposed substitute product and determined that it is equal or superior in all respects to that specified.
 2. Will provide the same guarantee for the substitution that he would for that specified.
 3. Certified that the cost data presented is complete and Includes all related costs under this contract, and that he waives all claims for additional costs related to thin substitution which subsequently become apparent and
 4. Will coordinate the installation of the accepted substitute, making such changes as may be required for the work to be complete in all respects, at no additional cost to the Owner and at no extension of the contract completion date.
- D. Substitutions will not be considered if:
1. They are indicated or implied on shop drawings submissions without the formal request required in paragraph (1) above; or
 2. for their implementation they require a substantial revision of the Contract Documents in order to accommodate their use,

END OF SECTION 01300

Chiller Replacement at
Bethel Middle School
Bethel, CT

01300-7

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section requires the selective removal and subsequent offsite disposal of all items on the contract drawings as required to complete the work.

1.2 SUBMITTALS

- A. Submit schedule indicating proposed sequence of operations for selective demolition work to the Owner for review prior to start of work.
- B. Take photographs of existing conditions of building surfaces, equipment, and adjacent improvements that might be misconstrued as damage related to the removal operations. File with the Owner prior to start of work.

1.3 JOB CONDITIONS

- A. Occupancy: The units will be occupied during this project. Conditions satisfactory to the building tenants and the Owner must be maintained throughout the work.
- B. Condition of Structures: Owner assumes no responsibility for actual condition of items or structures to be demolished.
 - 1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner insofar as practical.
- C. Partial Demolition and Removal: Items indicated to be removed, but not salvaged but of salvageable value to the Contractor may be removed as the work progresses. Transport salvaged items from site as they are removed.
 - 1. Extended storage or sale of removed items on site will not be permitted.
- D. Protections: Provide temporary barricades and other forms of protection to protect building tenants and the general public from injury due to selective demolition work.
 - 1. Provide protective measures as required to provide free and safe passage of building tenants and the general public to the occupied portions of the buildings.
 - 2. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of any element to be demolished and adjacent facilities or work to remain.
 - 3. Protect from damage existing finish work that is to remain in place and becomes exposed during demolition operations.

4. Remove protections at completion of the work.
- E. Damages: Promptly repair damages caused to adjacent facilities by demolition work
- F. Traffic: Conduct selective demolition operations and debris removal to ensure minimum interference with roads, streets, walks, or other occupied or used facilities.
 1. 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.
- G. Utility Services: Maintain existing utilities indicated to remain in service and protect them against damage during demolition operations.
- H. Environmental Controls: Use water sprinkling, temporary enclosures, and other methods to limit dust and dirt migration. Comply with governing regulations pertaining to environmental protection.
 1. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 PREPARATION

- A. General:
 1. Cease operations and notify the Engineer immediately if safety of the structure appears to be endangered. Take precautions to support structure until determination is made as to continuing operations.
 2. Locate, identify, stub off, and disconnect utility services that are to be removed.

3.2 DEMOLITION

- A. General: Perform selective demolition work in a systematic manner. Use such methods as required to complete work indicated on the Contract Drawings in accordance with governing regulations.

3.3 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove from the building site, all debris, rubbish, and other materials resulting from demolition operations, on a daily basis. Transport and legally dispose off site.

SECTION 02070
SELECTIVE DEMOLITION

1. If hazardous materials are encountered during demolition operations, comply with applicable regulations, laws, and ordinances concerning removal, handling, and protection against exposure or environmental pollution.
2. Burning of removed materials is not permitted on the project site.

3.4 CLEANUP AND REPAIR

- A. General: Upon completion of demolition work, remove tools, equipment, and demolished materials from site. Remove protections and leave interior areas broom clean. Return elements of construction and surfaces to remain too a condition existing prior to the start of operations. Repair adjacent construction or surfaces soiled or damaged by the selective demolition work.

END OF SECTION 02070

PART 1 - GENERAL

1.1 DESCRIPTION

- A. General: Materials and methods for performance of all mechanical work.
- B. Provide complete and operational mechanical systems including, but not limited to, all required materials, parts, equipment, labor, tools, and accessories.

1.2 SUMMARY

- A. This Section includes general administrative and procedural requirements for mechanical installations.
 - 1. Codes & standards.
 - 2. Submittals.
 - 3. Quality control.
 - 4. Permits, fees, and inspections.
 - 5. Schedule and sequence.
 - 6. Project and site conditions.
 - 7. Delivery, storage, and handling.
 - 8. Record documents.
 - 9. Operation and Maintenance manuals.
 - 10. Warranties and guaranties.
 - 11. Rough-ins.
 - 12. Mechanical installations.
 - 13. Cutting, patching, and firestopping.
 - 14. Mechanical identification.

1.3 CODES AND STANDARDS

- A. Except as modified by governing codes, comply with applicable provisions and recommendations of the following:
 - 1. ANSI Standards.
 - 2. Owner's Insurance Company.
 - 3. Current Connecticut Laws and Statutes.

1.4 SUBMITTALS

- A. Increase, by the quantity listed below, the number of mechanical related shop drawings, product data, and samples submitted, to allow for required distribution.
 - 1. Shop Drawings: Initial Submittal: 1 additional blue- prints.
 - 2. Product Data: 1 additional copy of each item.
 - 3. Samples: 1 addition as set.

SECTION 15010
BASIC MECHANICAL REQUIREMENTS

- B. Additional copies may be required by individual sections of these Specifications.
- C. Shop Drawings:
 - 1. Submit for review, detailed shop drawings and product data of all the equipment and material required to complete the work. No material or equipment may be delivered to the jobsite or installed until accepted shop drawings for the particular material or equipment have been approved by the Owner or his authorized representative.
 - 2. Failure to submit shop drawings in ample time for checking will not entitle Contractor to claim extension of Contract time, or increase in contract cost.
 - 3. The proposed piping layout for the Boiler system is required.
- D. Tests & Certificates:
 - 1. As specified in other sections.

1.5 QUALITY ASSURANCE

- A. Drawings:
 - 1. Drawings are diagrammatic. They indicate the general arrangement of systems and work included in the contract. Drawings are not to be scaled. Site and Architectural drawings and details shall be examined for exact location of fixtures and equipment. Where they are not definitely located, this information shall be obtained from the Owner or authorized representative.
 - 2. Surveys and Measurements:
 - a. Before submitting bid, visit site, become familiar with conditions under which work will be installed. Contractor will be held responsible for assumptions, omissions, and errors made as a result of failure to become familiar with site and contract documents.
 - b. Base all measurements, both horizontal and vertical, from established bench marks. All work shall agree with established lines and levels. Verify all measurements at site and check the correctness of same.
 - c. Notify the Engineer promptly of discrepancies between actual measurements and those indicated, which prevents following good practice or intent of drawings and specifications. Do not proceed with work until Contractor has received instructions from Engineer.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15010
BASIC MECHANICAL REQUIREMENTS

B. Labor:

1. Cooperation with Other Trades:
 - a. Give full cooperation to other trades; furnish in writing to General Contractor, with copies to the Engineer, information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.
 - b. Where work will be installed in close proximity to, or will interfere with work of other trades, assist in working out space conditions to make a satisfactory adjustment. If directed by the Engineer, prepare composite working drawings and sections at a suitable scale not less than $1/4" = 1'0"$, clearly showing how work is to be installed in relation to the work of other trades. If work under this division is installed before coordinating with other trades, or to cause any interference with work of other trades, make necessary changes to correct the condition without additional cost.
 - c. Furnish to other trades all necessary templates, patterns, setting plans, and shop details for the proper installation of work and for the purpose of coordinating adjacent work.
2. Materials & Workmanship:
 - a. Materials and apparatus required for the work shall be new and of first class quality. Furnished, delivered, erected, connected and finished in every detail. Select and arrange to fit properly into the building spaces. Where no specific kind or quality of material is given, furnish first class standard article as accepted by Engineer.
 - b. Furnish the services of an experienced superintendent who shall be in constant charge of the work, together with skilled craftsmen and labor required to unload, transfer, erect, connect-up, adjust, start, operate, and test each system.
 - c. All equipment and materials to be installed with the acceptance of the Engineer in accordance with the recommendations of the manufacturer. This includes the performance of such test as the manufacturer recommends.
3. Protection of Materials:

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15010
BASIC MECHANICAL REQUIREMENTS

- a. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
- b. Welding: Before any welding is performed, submit a copy of the Welding Procedure Specification (WPS) together with the Procedure Qualification Record as required by Section IX of the ASME Boiler and Pressure Vessel Code. Obtain a fire permit from the local town official as required.
 - 1) Before any welder performs any welding, submit a copy of the Manufacturer's Record of Welder or Welding Operator Qualification Tests as required by Section IX of the ASME Boiler and Pressure Vessel Code. The letter or symbol (as shown on the qualification test form) shall be used to identify the work of that welder and shall be affixed, in accordance with appropriate construction code, to each completed weld.
 - 2) The types and extent of non-destructive examinations required for pipe welds are shown in Table 136.4 of the Code for Pressure Piping, ASNI/ASME B31.1.
- c. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the Engineer prior to the installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

1.6 PERMITS, FEES, & INSPECTIONS

- A. Give all necessary notices, obtain and pay for all permits, and pay all government sales taxes, fees, and other costs, including utility connections or extensions in connection with work. File necessary approvals of governmental departments having jurisdiction. Obtain required certificates of inspection for work and deliver a copy to the Owner or his authorized representative before requesting acceptance for final payment.

1.7 SCHEDULE & SEQUENCE

- A. Temporary Services:
 - 1. Refer to the General Conditions and Special Conditions for a full description of the temporary services to be provided.
- B. Temporary Openings:

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15010
BASIC MECHANICAL REQUIREMENTS

1. Ascertain from examination of the drawings any special temporary openings in the building required for the admission of apparatus provided under this Division. Notify the Owner accordingly. Contractor shall assume all costs of providing such openings thereafter.

C. Sequencing:

1. Contractor shall coordinate sequence of work with owner's representative.

1.8 PROJECT & SITE CONDITIONS

A. Cutting, Patching, and Firestopping:

1. Furnish all cutting, drilling and patching. Furnish sketches showing the locations and sizes of openings, chases, etc., required for the installation of work. Furnish the Contractor with an approximation of the number and size of openings, chases, etc., required.

B. Waterproofing:

1. Where any work pierces existing waterproofing, re-waterproof. The method of installation to be reviewed by Owner or his authorized representative before work is done. Furnish all sleeves, caulking, and flashing required to make openings watertight.

C. Fireproofing:

1. Where any work penetrates a fire rated assembly, provide UL listed, firestopping with hourly rating equal to that of the penetrated assembly. Fireproofing shall be compatible with the pipe or equipment doing the penetration so that fire rating of the assembly is maintained.

1.9 DELIVERY, STORAGE, & HANDLING

A. Delivery & Receipt:

1. Contractor is responsible for the delivery and storage of all materials, parts, equipment, etc. required for this project.

B. Storage:

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15010
BASIC MECHANICAL REQUIREMENTS

1. The Contractor shall store all material, parts, and equipment required for this project in accordance with supplier's and manufacturer's recommendations, and Owner's requirements.

C. Handling, Hoisting, Rigging, & Scaffolding:

1. Furnish all scaffolding, rigging, hoisting, and services necessary for erection and delivery into the premises of any equipment and apparatus furnished under this Division. Remove same from premises when no longer required.

1.10 RECORD DOCUMENTS

- A. Maintain at the job site a record set of drawings on which any changes in location of equipment, piping, ducts, valves, cleanouts, panels, and major conduits shall be recorded. These shall be clearly marked on a clean set of prints at the completion of work for record drawings and turned over to the Owner.
- B. Prepare record documents in accordance with the requirements below:
 1. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, tanks, etc.). Valve location diagrams, complete with valve tag chart.
 2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 3. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
 4. Contract Modifications, actual equipment and materials installed.

1.11 OPERATION & MAINTENANCE MANUALS FOR MECHANICAL SYSTEMS

- A. Bind Operation & Maintenance Manual for Mechanical System in a hard-backed binder. Spine of each binder shall have the following lettering done in typeset:

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15010
BASIC MECHANICAL REQUIREMENTS

OPERATION
AND
MAINTENANCE
MANUAL
For

CHILLER REPLACEMENT AT THE
BETHEL MIDDLE SCHOOL
BETHEL, CT

1. Provide a master index at beginning of Manual showing items included. Use plastic tab indexes for sections of Manual.
 2. First section shall consist of name, address, and phone number of Architect, Mechanical & Electrical Engineers, General Contractor and Mechanical, Plumbing, Sheet Metal, Refrigeration, Temperature Control & Electrical Contractors. Also include a complete list of equipment installed with name, address, and phone number of vendor.
 3. Provide section for each type of item of equipment.
 4. Submit three copies of Operation & Maintenance Manual to Engineer for his approval. Use one of these approved copies during final inspection and leave with building maintenance personnel.
- B. Include descriptive literature (Manufacturer's catalog data) of each manufactured item. Literature shall show capacities and size of equipment used and be marked indicating each specific item with applicable data underlined.
- C. Operating instructions shall include:
1. General description of each mechanical system.
 2. Step by step procedure to follow in putting each piece of mechanical equipment into operation.
 3. Provide schematic control diagrams for each separate fan system, refrigeration system, heating system, control panel, etc. Each diagram shall show locations of start-stop switches, insertion thermostats, room thermostats, thermometers, firestats, pressure gauges, automatic valves, and refrigeration accessories. Mark correct operating setting for each control instrument on these diagrams.
 4. Provide diagram for electrical control system showing wiring of related electrical control items such as firestats, fuses, interlock, electrical switches, and relays.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15010
BASIC MECHANICAL REQUIREMENTS

5. Provide drawing of each temperature control panel system.
- D. Prepare maintenance manuals to include the following information for equipment items:
1. Manufacturer's maintenance equipment installed in Project. Instructions shall include name of vendor, installation instructions, parts numbers & lists, operation instructions of equipment and maintenance & lubrication instructions.
 2. Summary list of mechanical equipment requiring lubrication showing name of equipment, location and type, and frequency of lubrication.
 3. List of mechanical equipment used indicating name, model, serial number, and name plate data of each item together with number and name associated with each system item.
 4. List spare parts and quantities to be maintained in ready inventory at project site.
 5. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
 6. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
 7. Servicing instructions and lubrication charts and schedules.
- E. Air Balance and Water Balance Test Run Reports

1.12 WARRANTIES AND GUARANTIES

- A. Guarantee all material and workmanship under this Division for a period of one year, from the date of final acceptance by the Owner.
- B. During guarantee period, all defects developing through materials and/or workmanship shall be replaced immediately without expense to the owner. Make such repairs or replacements to the satisfaction of the Owner.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15010
BASIC MECHANICAL REQUIREMENTS

- A. As specified under other related sections.
- B. As specified on drawings.

2.2 MATERIALS

- A. As specified under other related sections.
- B. As specified on drawings.

2.3 EQUIPMENT DEVIATIONS

- A. Where the Contractor proposed to use an item of equipment other than that specified or detailed on the drawings which requires the redesign of the structure, partitions, foundations, piping, wiring or any other part of the mechanical layout, all such redesign, and all new drawings and detailing required therefore, shall be prepared at the Contractor's expense and are subject to the review and approval of the Engineer. Owner reserves the right to have the Engineer prepare any redesign work.
- B. Where such accepted deviation requires a different quantity and arrangement of materials or equipment from that specified or indicated on the drawings, the Contractor will provide additional equipment and materials required at no additional cost to the Owner.
- C. When equipment or methods deviate from original plans or specifications, the Contractor must submit a written request to deviate to the Engineer. At a minimum the request will address the following:
 - equipment which is different than specified
 - name and data related to the proposed deviation
 - reason for deviation
 - advantageous or disadvantageous to the Owner
 - credit or increase in cost to the Owner
 - guarantees or warranties offered (if any)
 - acceptance of liability for equivalent performance.

2.4 ELECTRICAL REQUIREMENTS

- C. Motors:
 - 1. Electric motors furnished as a component part of equipment furnished under this Division shall conform to the requirements of IEEE, NEMA, UL, ANSI C50, and ANSI CI. Motors to be suitable for required load, duty voltage, phase, frequency, service and location.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15010
BASIC MECHANICAL REQUIREMENTS

2. Motors to be suitable for continuous duty at rated horsepower with temperature rise not to exceed 40oC for dripproof motors, 50oC for splashproof motors, and 55oC for totally enclosed motors. Motors to be capable of withstanding momentary overloads of 25 percent without injurious overheating.
 3. Motors to have nameplates giving Manufacturer's name, serial number, horsepower, speed and current characteristics.
 4. Motor leads shall be permanently identified and supplied with connectors.
 5. Each motor to be selected for quiet operation in accordance with NEMA standards.
 6. NEMA premium efficiency rated motors to be furnished with all new equipment.
- D. Motor Starters:
1. Electric motor starters shall conform to requirements of IEEE, NEMA, UL, ANSI, CI and shall be suitable for the required load, duty, voltage, phase, frequency, service, and location.
 2. When interlocking or automatic control of single phase motors is required, motors to be furnished with full voltage, across-the-line starters.
- E. Connections:
1. All wiring to be furnished and installed under Division 16.
 2. Power wiring to be furnished and installed complete from power source to motor or equipment junction box, including power wiring through the starters. Starters not factory mounted on equipment shall be furnished and installed under Division 16.

2.5 MECHANICAL REQUIREMENTS

- A. Bases & Supports:
1. Provide necessary foundations, supports, pads, bases and piers required for equipment, tanks, and other equipment furnished under this Division. Submit drawings to Engineer for review before purchase, fabrication, or construction.
 2. For Boilers/Tanks and for equipment where foundations are indicated, provide 3500 psi concrete pads. Extend pads six (6) inches beyond machine base in all directions with top edge chamfered. Insert steel dowel rods into floors to anchor

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15010
BASIC MECHANICAL REQUIREMENTS

pads. Submit shop drawings of foundations and pads to Owner for review before construction.

3. Construction of foundations, supports, pads, bases, and piers where mounted on the floor to be of the same materials and same quality of finish as the adjacent surrounding flooring material.

B. Lubrication:

1. Lubricate all equipment having moving parts and requiring lubrication according to manufacturer's recommendations prior to testing and operation. Equipment discovered to have been operated before lubrication is subject to rejection and replacement at no cost to the Owner.

C. Accessibility:

1. Be responsible for the sufficiency of the size of shafts and chases, adequate clearance in double partitions and hung ceilings for proper installation of work. Cooperate with the Contractor and other contractors whose work is in the same space. Advise the Contractor of requirements. Such spaces and clearances shall be kept to the minimum size required.
2. Locate all equipment which requires servicing in fully accessible positions. Equipment shall include but not be limited to, valves, traps, clean-outs, motors, controllers, switchgear, and drain points. Any change shall be submitted to the Owner or his authorized representative for review.

D. Connection to Existing Structures:

1. Before cutting, drilling, attaching, or any work involving building elements, coordinate work with others and Owner to avoid damage to building elements.

2.6 FIRESTOPPING

- A. Firestopping shall be UL listed, and tested in accordance with ASTM E814, E119, and E84.
- B. Hourly rating shall be equal to that of the assembly being penetrated.
- C. Firestopping shall be compatible with pipe or equipment penetrating the assembly fire rating of the assembly must be maintained.

PART 3 - EXECUTION

Chiller Replacement at
Bethel Middle School
Bethel, CT

3.1 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications in Divisions 2 through 16 for rough-in requirements.

3.2 MECHANICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:
 - 1. Coordinate mechanical systems, equipment, and materials installation with other building components.
 - 2. Verify all dimensions by field measurements.
 - 3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.
 - 4. Coordinate the installation of required supporting devices and sleeves to be set in structural components, as they are constructed.
 - 5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work.
 - 6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
 - 7. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
 - 8. Install systems, materials, and equipment to conform with approved submittal data, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Engineer.
 - 9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

SECTION 15010
BASIC MECHANICAL REQUIREMENTS

10. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
11. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

3.3 CUTTING, PATCHING, AND FIRESTOPPING

- A. General: Perform cutting and patching in accordance with the following requirements apply:
 1. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
- B. Perform cutting, fitting, and patching of mechanical equipment and materials required to:
 1. Remove and replace defective Work.
 2. Remove and replace Work not conforming to requirements of the Contract Documents.
 3. Remove samples of installed Work as specified for testing.
 4. Install equipment and materials in existing structures.
 5. Upon written instructions from the Engineer, uncover and restore Work to provide for Engineer observation of concealed Work.
- C. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including but not limited to removal of mechanical piping, heating units, plumbing fixtures and trim, and other mechanical items made obsolete by the Work.
- D. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
 1. Patch finished surfaces and building components using materials specified for the original installation and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.
- E. Firestop all pipe and equipment that penetrates fire rated assembly. Follow manufacturer's instructions to provide fire rating equal to that of the assembly.

3.4 FIELD QUALITY CONTROL

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15010
BASIC MECHANICAL REQUIREMENTS

- A. Perform field tests as specified under other sections.
- B. Arrange for local inspection authorities to inspect work performed prior to burial, closing-in behind wall and above ceiling or encase in concrete. Also arrange for final inspection of work and obtain Final Inspection Certificate before final inspection by Owner or his representative.

3.5 PAINTING

- A. See Division 9 for painting in finished areas.
- B. Materials shipped to the job site under this Division to have prime coat and standard manufacturer's finish.

3.6 TESTING & BALANCING: See Section 15990

3.7 CLEANING

- B. Any part of a system stopped by foreign matter after being placed in operation, to be disconnected, cleaned, and reconnected to locate and remove obstructions. Work damaged in the course of removing obstructions will be repaired or replaced at no additional cost to the Owner.
- C. Cap all pipes to protect against entrance of foreign matter.
- D. Remove rubbish, debris, and excess materials. Remove oil and grease stains on floor areas.

END OF SECTION 15010

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General Conditions apply to this Section.

1.2 SUMMARY

- A. This Section includes the following basic mechanical materials and methods to complement other Division 15 Sections.
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Concrete equipment base construction requirements.
 - 3. Equipment nameplate data requirements.
 - 4. Nonshrink grout for equipment installations.
 - 5. Field-fabricated metal and wood equipment supports.
 - 6. Installation requirements common to equipment specification sections.
 - 7. Mechanical demolition.
 - 8. Cutting and patching.
 - 9. Touch-up painting and finishing.
- B. Pipe and pipe fitting materials are specified in piping system Sections.

1.3 DEFINITIONS

- A. Pipe, pipe fittings, and piping include tube, tube fittings, and tubing.
- B. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below the roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
- C. Exposed Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- D. Exposed Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- E. Concealed Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- F. Concealed Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract.
- B. Product data for following piping specialties:
 - 1. Mechanical sleeve seals.
 - 2. Identification materials and devices.
- C. Samples of color, lettering style, and other graphic representation required for each identification material and device.
- D. Shop drawings detailing fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.
- E. Coordination drawings for access panel and door locations.
- F. Prepare coordination drawings to a 1/4 inch equals 1 foot scale or larger. Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Show where sequence and coordination of installations are important to the efficient flow of the Work. Include the following:
 - 1. Proposed locations of piping, ductwork, equipment, and materials. Include the following:
 - a. Planned piping layout, including valve and specialty locations and valve stem movement.
 - b. Planned duct systems layout, including elbows radii and duct accessories.
 - c. Clearances for installing and maintaining insulation.
 - d. Clearances for servicing and maintaining equipment, including space for equipment disassembly required for periodic maintenance.
 - e. Equipment service connections and support details.
 - f. Exterior wall and foundation penetrations.
 - g. Fire-rated wall and floor penetrations.
 - h. Sizes and location of required concrete pads and bases.
 - 2. Scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
 - 3. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
 - 4. Reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communication systems components, sprinklers, and other

Chiller Replacement at
Bethel Middle School
Bethel, CT

ceiling-mounted items.

- G. Welder certificates signed by Contractor certifying that welders comply with requirements specified under "Quality Assurance" Article of this Section.

1.5 QUALITY ASSURANCE

- A. Qualify welding processes and operators for structural steel according to AWS D1.1 "Structural Welding Code - Steel."
- B. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions of ASME B31 Series "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current.
- C. ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.
- D. Equipment Selection: Equipment of greater or larger power, dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. No additional costs will be approved for these increases, if larger equipment is approved. If minimum energy ratings or efficiencies of the equipment are specified, the equipment must meet the design requirements and commissioning requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.
- B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. When stored inside, do not exceed structural capacity of the floor.
- C. Protect flanges, fittings, and piping specialties from moisture and dirt.
- D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 SEQUENCING AND SCHEDULING

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15050
BASIC MECHANICAL MATERIALS AND METHODS

- A. Coordinate mechanical equipment installation with other building components.
- B. Arrange for chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.
- C. Coordinate the installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.
- D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning prior to closing in the building.
- E. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- F. Coordinate requirements for access panels and doors where mechanical items requiring access are concealed behind finished surfaces.
- G. Coordinate installation of identifying devices after completion of covering and painting, where devices are applied to surfaces. Install identifying devices prior to installation of acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 PIPE AND PIPE FITTINGS

- A. Refer to individual piping system specification Sections for pipe and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual piping system specification Sections in Division 15 for special joining materials not listed below.
- B. Pipe Flange Gasket Materials: Suitable for the chemical and thermal conditions of the piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, except where thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125 cast-iron and cast-bronze flanges.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15050
BASIC MECHANICAL MATERIALS AND METHODS

- b. Narrow-Face Type: For raised-face, Class 250 cast-iron and steel flanges.
- 2. ASME B16.20 for grooved, ring-joint, steel flanges.
- 3. AWWA C110, rubber, flat face, 1/8-inch thick, except where other thickness is indicated; and full-face or ring type, except where type is indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, except where other material is indicated.
- D. Plastic Pipe Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, except where other type or material is indicated.
- E. Solder Filler Metal: ASTM B 32.
 - 1. Alloy Sn95 or Alloy Sn94: Tin (approximately 95 percent) and silver (approximately 5 percent), having 0.10-percent lead content.
 - 2. Alloy Sn50: Tin (50 percent) and lead (50 percent).
 - 3. Alloy E: Tin (approximately 95 percent) and copper (approximately 5 percent), having 0.10-percent maximum lead content.
 - 4. Alloy HA: Tin-antimony-silver-copper-zinc, having 0.10-percent maximum lead content.
 - 5. Alloy HB: Tin-antimony-silver-copper-nickel, having 0.10-percent maximum lead content.
 - 6. Alloy Sb5: Tin (95 percent) and antimony (5 percent), having 0.20-percent maximum lead content.
- F. Brazing Filler Metals: AWS A5.8.
 - 1. BCuP Series: Copper-phosphorus alloys.
 - 2. BAg1: Silver alloy.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements: Manufacturer's standard solvents complying with the following:
 - 1. Acrylonitrile-Butadiene-Styrene (ABS): ASTM D 2235.
 - 2. Chlorinated Poly(Vinyl Chloride) (CPVC): ASTM F 493.
 - 3. Poly(Vinyl Chloride) (PVC): ASTM D 2564.
 - 4. PVC to ABS Transition: Made to requirements of ASTM D 3138, color other than orange.
- I. Plastic Pipe Seals: ASTM F 477, elastomeric gasket.
- J. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon steel bolts and nuts.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15050
BASIC MECHANICAL MATERIALS AND METHODS

- K. Couplings: Iron body sleeve assembly, fabricated to match outside diameters of plain-end, pressure pipes.
1. Sleeve: ASTM A 126, Class B, gray iron.
 2. Followers: ASTM A 47, Grade 32510 or ASTM A 536 ductile iron.
 3. Gaskets: Rubber.
 4. Bolts and Nuts: AWWA C111.
 5. Finish: Enamel paint.

2.3 PIPING SPECIALTIES

- A. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type, where required to conceal protruding fittings and sleeves.
1. Inside Diameter: Closely fit around pipe, tube, and insulation of insulated piping.
 2. Outside Diameter: Completely cover opening.
 3. Cast Brass: One-piece, with set-screw.
 - a. Finish: Rough brass.
 - b. Finish: Polished chrome plate.
 4. Cast Brass: Split casting, with concealed hinge and set-screw.
 - a. Finish: Rough brass.
 - b. Finish: Polished chrome plate.
 5. Stamped Steel: One-piece, with set-screw and chrome plated finish.
 6. Stamped Steel: One-piece, with spring clips and chrome plated finish.
 7. Stamped Steel: Split plate, with concealed hinge, set-screw, and chrome plated finish.
 8. Stamped Steel: Split plate, with concealed hinge, spring clips, and chrome plated finish.
 9. Stamped Steel: Split plate, with exposed-rivet hinge, set-screw, and chrome plated finish.
 10. Stamped Steel: Split plate, with exposed-rivet hinge, spring clips, and chrome plated finish.
 11. Cast-Iron Floor Plate: One-piece casting.
- B. Dielectric Fittings: Assembly or fitting having insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
1. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld neck end types and matching piping system materials.
 2. Insulating Material: Suitable for system fluid, pressure, and temperature.
 3. Dielectric Unions: Factory-fabricated, union assembly, for 250 psig minimum working pressure at 180 deg F temperature.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15050
BASIC MECHANICAL MATERIALS AND METHODS

4. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150 or 300 psig minimum pressure to suit system pressures.
 5. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - a. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig minimum working pressure to suit system pressures.
 6. Dielectric Couplings: Galvanized-steel coupling, having inert and non-corrosive, thermoplastic lining, with threaded ends and 300 psig minimum working pressure at 225 deg F temperature.
 7. Dielectric Nipples: Electroplated steel nipple, having inert and non-corrosive, thermoplastic lining, with combination of plain, threaded, or grooved end types and 300 psig working pressure at 225 deg F temperature.
- C. Mechanical Sleeve Seals: Modular, watertight, mechanical type. Components include interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve. Connecting bolts and pressure plates cause rubber sealing elements to expand when tightened.
- D. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:
1. Steel Sheet-Metal: 24 gage or heavier, galvanized sheet metal, round tube closed with welded longitudinal joint.
 2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.
 3. Cast-Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, having plain ends and integral water stop, except where other features are specified.
 4. Wall Penetration Systems: Wall sleeve assembly, consisting of housing, gaskets, and pipe sleeve, with 1 mechanical-joint end conforming to AWWA C110 and 1 plain pipe-sleeve end.
 - a. Penetrating Pipe Deflection: 5 percent without leakage.
 - b. Housing: Ductile-iron casting having waterstop and anchor ring, with ductile-iron gland, steel studs and nuts, and rubber gasket conforming to AWWA C111, of housing and gasket size as required to fit penetrating pipe.
 - c. Pipe Sleeve: AWWA C151, ductile-iron pipe.
 - d. Housing-to-Sleeve Gasket: Rubber or neoprene, push-on type, of manufacturer's design.
 5. Cast-Iron Sleeve Fittings: Commercially-made, sleeve having integral clamping flange, with clamping ring, bolts, and nuts for membrane flashing.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15050
BASIC MECHANICAL MATERIALS AND METHODS

- a. Underdeck Clamp: Clamping ring with set-screws.
6. PVC Plastic: Manufactured, permanent, with nailing flange for attaching to wooden forms.
7. PE Plastic: Manufactured, reusable, tapered, cup-shaped, smooth outer surface, with nailing flange for attaching to wooden forms.

2.4 IDENTIFYING DEVICES AND LABELS

- A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 15 Sections. Where more than single type is specified for listed application, selection is Installer's option, but provide single selection for each product category.
- B. Equipment Nameplates: Metal nameplate with operational data engraved or stamped; permanently fastened to equipment.
 1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data.
 2. Location: An accessible and visible location.
- C. Stencils: Standard stencils, prepared for required applications with letter sizes conforming to recommendations of ASME A13.1 for piping and similar applications, but not less than 1-1/4-inches-high letters for ductwork and not less than 3/4-inch-high letters for access door signs and similar operational instructions.
 1. Material: Fiberboard.
 2. Material: Brass.
 3. Stencil Paint: Standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.
 4. Identification Paint: Standard identification enamel of colors indicated or, if not otherwise indicated for piping systems, comply with ASME A13.1 for colors.
- D. Snap-On Plastic Pipe Markers: Manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, conforming to ASME A13.1.
- E. Pressure-Sensitive Pipe Markers: Manufacturer's standard pre-printed, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, conforming to ASME A13.1.
- F. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core,

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15050
BASIC MECHANICAL MATERIALS AND METHODS

with white (letter color) melamine subcore, except when other colors are indicated.

1. Fabricate in sizes required for message.
2. Engraved with engraver's standard letter style, of sizes and with wording to match equipment identification.
3. Punch for mechanical fastening.
4. Thickness: 1/16 inch, except as otherwise indicated.
5. Thickness: 1/8 inch, except as otherwise indicated.
6. Thickness: 1/16 inch, for units up to 20 square inches or 8-inches long; 1/8 inch for larger units.
7. Fasteners: Self-tapping stainless-steel screws or contact-type permanent adhesive.

G. Plastic Equipment Markers: Laminated-plastic, color-coded equipment markers. Conform to following color code:

1. Yellow: Heating equipment and components.
2. Brown: Energy reclamation equipment and components.
3. Blue: Equipment and components that do not meet any of above criteria.
4. For hazardous equipment, use colors and designs recommended by ASME A13.1.
5. Nomenclature: Include following, matching terminology on schedules as closely as possible:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and rpm.
6. Size: Approximate 2-1/2 by 4 inches for control devices, dampers, and valves; and 4-1/2 by 6 inches for equipment.

H. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in mechanical identification, with corresponding designations indicated. Use numbers, lettering, and wording indicated for proper identification and operation/maintenance of mechanical systems and equipment.

1. Multiple Systems: Where multiple systems of same generic name are indicated, provide identification that indicates individual system number as well as service such as "Boiler No. 3," "Air Supply No. 1H," or "Standpipe F12."

2.5 GROUT

A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.

1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout,
Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15050
BASIC MECHANICAL MATERIALS AND METHODS

nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.

2. Design Mix: 5000 psi, 28-day compressive strength.
3. Packaging: Premixed and factory-packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. General: Install piping VALVES as described below, except where system Sections specify otherwise. Individual piping system specification Sections in Division 15 specify piping installation requirements unique to the piping system.
- B. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate general location and arrangement of piping systems. Install piping as indicated, except where deviations to layout are approved on coordination drawings.
- C. Install piping at indicated slope.
- D. Install components having pressure rating equal to or greater than system operating pressure.
- E. Install piping free of sags and bends.
- F. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, except where indicated.
- G. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
- H. Install piping to allow application of insulation plus 1-inch clearance around insulation.
- I. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- J. Install fittings for changes in direction and branch connections.
- K. Install couplings according to manufacturer's printed instructions.
- L. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:
 1. Chrome-Plated Piping: Cast-brass, one-piece, with set-screw, and polished chrome-plated finish. Use split-casting escutcheons where required, for existing piping.
 2. Uninsulated Piping Wall Escutcheons: Cast-brass or stamped-steel, with set-screw.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15050
BASIC MECHANICAL MATERIALS AND METHODS

3. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
 4. Insulated Piping: Cast-brass or stamped-steel, with concealed hinge, spring clips, and chrome-plated finish.
 5. Piping in Utility Areas: Cast-brass or stamped-steel, with set-screw or spring clips.
- M. Sleeves are not required for core drilled holes.
- N. Permanent sleeves are not required for holes formed by PE plastic (removable) sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls, concrete floor and roof slabs, and where indicated.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, concrete floor and roof slabs, and where indicated.
1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring where specified.
 2. Build sleeves into new walls and slabs as work progresses.
 3. Install large enough sleeves to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. PVC Pipe Sleeves: For pipes smaller than 6 inches.
 - b. Steel Pipe Sleeves: For pipes smaller than 6 inches.
 - c. Steel Sheet-Metal Sleeves: For pipes 6 inches and larger, penetrating gypsum-board partitions.
 - d. Cast-Iron Sleeve Fittings: For floors having membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Flashing is specified in Division 16 Section "Basic Electrical Materials and Methods."
 - 1) Seal space outside of sleeve fittings with nonshrink, nonmetallic grout.
 4. Except for below-grade wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants specified in Division 7 Section "Joint Sealants."
- Q. Above Grade, Exterior Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installation of mechanical seals.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15050
BASIC MECHANICAL MATERIALS AND METHODS

1. Install steel pipe for sleeves smaller than 6 inches.
 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger.
 3. Assemble and install mechanical seals according to manufacturer's printed instructions.
- R. Below Grade, Exterior Wall, Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installation of mechanical seals.
- S. Below Grade, Exterior Wall, Pipe Penetrations: Install ductile-iron wall penetration system sleeves according to manufacturer's printed installation instructions.
- T. Fire Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestopping sealant material.
- U. Verify final equipment locations for roughing-in.
- V. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- W. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping system specification Sections.
1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 3. Soldered Joints: Construct joints according to AWS "Soldering Manual," Chapter 22 "The Soldering of Pipe and Tube."
 4. Brazed Joints: Construct joints according to AWS "Brazing Manual," Chapter 28 "Pipe and Tube."
 5. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full inside diameter. Join pipe fittings and valves as follows:
 - a. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 - b. Apply appropriate tape or thread compound to external pipe threads (except where dry seal threading is specified).
 - c. Align threads at point of assembly.
 - d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15050
BASIC MECHANICAL MATERIALS AND METHODS

- e. Damaged Threads: Do not use pipe or pipe fittings having threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- 6. Welded Joints: Construct joints according to AWS D10.12 "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe" using qualified processes and welding operators according to "Quality Assurance" Article.
- 7. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
- 8. Plastic Pipe and Fitting Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following standards:
 - a. Comply with ASTM F 402 for safe handling practice of solvent-cement and primers.
 - b. Acrylonitrile-Butadiene-Styrene (ABS): ASTM D 2235 and ASTM D 2661.
 - c. Chlorinated Poly(Vinyl Chloride) (CPVC): ASTM D 2846 and ASTM F 493.
 - d. Poly(Vinyl Chloride) (PVC) Pressure Application: ASTM D 2672.
 - e. Poly(Vinyl Chloride) (PVC) Non-Pressure Application: ASTM D 2855.
 - f. PVC to ABS (Non-Pressure) Transition: Procedure and solvent cement described in ASTM D 3138.
- 9. Plastic Pipe and Fitting Heat-Fusion Joints: Prepare pipe and fittings and join with heat-fusion equipment, according to manufacturer's printed instructions.
 - a. Plain-End Pipe and Fittings: Butt joining.
 - b. Plain-End Pipe and Socket-Type Fittings: Socket-joining.
- X. Piping Connections: Except as otherwise indicated make piping connections as specified below.
 - 1. Install unions, in piping 2 inches and smaller, adjacent to each valve and at final connection to each piece of equipment having 2-inches or smaller threaded pipe connection.
 - 2. Install flanges, in piping 2-1/2-inches and larger, adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.
 - 3. Dry Piping Systems (Gas, Compressed Air, and Vacuum): Install dielectric unions and flanges to connect piping materials of dissimilar metals.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15050
BASIC MECHANICAL MATERIALS AND METHODS

4. Wet Piping Systems (Water and Steam): Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.2 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to provide the maximum possible headroom, where mounting heights are not indicated.
- B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to the Engineer.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, except where otherwise indicated.
- D. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
- E. Install equipment giving right-of-way to piping systems installed at a required slope.

3.3 LABELING AND IDENTIFYING

- A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.
 1. Stenciled Markers: Complying with ASME A13.1.
 2. Plastic markers, with application systems. Install on pipe insulation segment where required for hot non-insulated pipes.
 3. Locate pipe markers as follows wherever piping is exposed in finished spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.
 - a. Near each valve and control device.
 - b. Near each branch, excluding short take-offs for fixtures and terminal units. Mark each pipe at branch, where flow pattern is not obvious.
 - c. Near locations where pipes pass through walls, floors, ceilings, or enter non-accessible enclosures.
 - d. At access doors, manholes, and similar access points that permit view of concealed piping.
 - e. Near major equipment items and other points of origination and termination.
 - f. Spaced at a maximum of 50 feet intervals along each run. Reduce intervals to 25 feet in congested areas of piping and equipment.
 - g. On piping above removable acoustical ceilings, except omit intermediately

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15050
BASIC MECHANICAL MATERIALS AND METHODS

spaced markers.

- B. Equipment: Install engraved plastic laminate sign or equipment marker on or near each major item of mechanical equipment.
 - 1. Lettering Size: Minimum 1/4-inch-high lettering for name of unit where viewing distance is less than 2 feet, 1/2-inch-high for distances up to 6 feet, and proportionately larger lettering for greater distances. Provide secondary lettering 2/3 to 3/4 of size of principal lettering.
 - 2. Text of Signs: Provide text to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to name of identified unit.
- C. Duct Systems: Identify air supply, return, exhaust, intake, and relief ducts with duct markers; or provide stenciled signs and arrows, showing duct system service and direction of flow.
 - 1. Location: In each space where ducts are exposed or concealed by removable ceiling system, locate signs near points where ducts enter into space and at maximum intervals of 50 feet.
- D. Adjusting: Relocate identifying devices which become visually blocked by work of this Division or other Divisions.

3.4 PAINTING AND FINISHING

- A. Damage and Touch-Up: Repair marred and damaged factory painted finishes with materials and procedures to match original factory finish.

3.5 CONCRETE BASES

- A. Construct concrete equipment bases of dimensions indicated, but not less than 6 inches larger in both directions than supported unit. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 4500 psi, 28-day compressive strength concrete and reinforcement.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Field Welding: Comply with AWS D1.1 "Structural Welding Code - Steel."

3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15050
BASIC MECHANICAL MATERIALS AND METHODS

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage to support and anchor mechanical materials and equipment.
- B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.8 DEMOLITION

- A. Disconnect, demolish, and remove Work specified under Division 15 and as indicated.
- B. Where pipe, ductwork, insulation, or equipment to remain is damaged or disturbed, remove damaged portions and install new products of equal capacity and quality.
- C. Accessible Work: Remove indicated exposed pipe and ductwork in its entirety.
- D. Abandoned Work: Cut and remove buried pipe abandoned in place, 2 inches beyond the face of adjacent construction. Cap and patch surface to match existing finish.
- E. Removal: Remove indicated equipment from the project site.
- F. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.

3.9 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of the trades involved.
- B. Repair cut surfaces to match adjacent surfaces.

END OF SECTION 15050

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to this section.
- B. Requirements of the following Division 15 Sections apply to this section:
 - 1. "Basic Mechanical Requirements."
 - 2. "Basic Piping Materials and Methods."

1.2 SUMMARY

- A. This Section includes general duty valves common to most mechanical piping systems.
 - 1. Special purpose valves are specified in individual piping system specifications.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data, including body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions.

1.4 QUALITY ASSURANCE

- A. Single Source Responsibility: Comply with the requirements specified in Division 1 Section "MATERIALS AND EQUIPMENT."
- B. American Society of Mechanical Engineers (ASME) Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.
- C. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Compliance: Comply with the various MSS Standard Practices referenced.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Preparation For Transport: Prepare valves for shipping as follows:
 - 1. Ensure valves are dry and internally protected against rust and corrosion.
 - 2. Protect valve ends against damage to threads, flange faces, and weld-end preps.
 - 3. Set valves in best position for handling. Set globe and gate valves closed to prevent

Chiller Replacement at
Bethel Middle School
Bethel, CT

rattling; set ball and plug valves open to minimize exposure of functional surfaces; set butterfly valves closed or slightly open; and block swing check valves in either closed or open position.

- B. Storage: Use the following precautions during storage:
1. Do not remove valve end protectors unless necessary for inspection; then reinstall for storage.
 2. Protect valves from weather. Store valves indoors. Maintain valve temperature higher than the ambient dew point temperature. If outdoor storage is necessary, support valves off the ground or pavement in watertight enclosures.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers:
1. Engineer approved equal

2.2 VALVE FEATURES, GENERAL

- A. Valve Design: Rising stem or rising outside screw and yoke stems as indicated.
1. Nonrising stem valves may be used where indicated.
- B. Pressure and Temperature Ratings: As required to suit system pressures and temperatures.
- C. Sizes: Same size as upstream pipe, unless otherwise indicated.
- D. Operators: Provide the following special operator features:
1. Handwheels, fastened to valve stem, for valves other than quarter turn.
 2. Lever handles, on quarter-turn valves 6-inch and smaller, except for plug valves.
- E. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.
- F. Bypass and Drain Connections: Comply with MSS SP-45 bypass and drain connections.
- G. End Connections: As indicated in the valve specifications.
1. Threads: Comply with ANSI B1.20.1.

2. Flanges: Comply with ANSI B16.1 for cast iron, ANSI B16.5 for steel, and ANSI B16.24 for bronze valves.
3. Solder-Joint: Comply with ANSI B16.18.
 - a. Caution: Where soldered end connections are used, use solder having a melting point below 840 deg F for gate, globe, and check valves; below 421 deg F for ball valves.

2.3 GATE VALVES

- A. Gate Valves, 2-Inch and Smaller: MSS SP-80; Class 125, body and bonnet of ASTM B 62 cast bronze; with threaded or solder ends, solid disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing, and malleable iron handwheel. Provide Class 150 valves meeting the above where system pressure requires.
- B. Gate Valves, 2-1/2-Inch and Larger: MSS SP-70; Class 125 iron body, bronze mounted, with body and bonnet conforming to ASTM A 126 Class B; with flanged ends, "Teflon" impregnated packing, and two-piece backing gland assembly.

2.4 BALL VALVES

- A. Ball Valves, 1 Inch and Smaller: Rated for 150 psi saturated steam pressure, 400 psi WOG pressure; two-piece construction; with bronze body conforming to ASTM B 62, standard (or regular) port, chrome-plated brass ball, replaceable "Teflon" or "TFE" seats and seals, blowout-proof stem, and vinyl-covered steel handle. Provide solder ends for domestic hot and cold water service; threaded ends for heating hot water.
- B. Ball Valves, 1-1/4-Inch to 2-Inch: Rated for 150 psi saturated steam pressure, 400 psi WOG pressure; 3-piece construction; with bronze body conforming to ASTM B 62, conventional port, chrome-plated brass ball, replaceable "Teflon" or "TFE" seats and seals, blowout proof stem, and vinyl-covered steel handle. Provide solder ends for domestic hot and cold water service; threaded ends for heating hot water.

2.5 PLUG VALVES

- A. Plug Valves, 2-Inch and Smaller: Rated at 150 psi WOG; bronze body, with straightaway pattern, square head, and threaded ends.
- B. Plug Valves, 2-1/2-Inch and Larger: MSS SP-78; rated at 175 psi WOG; lubricated plug type, with semisteel body, single gland, wrench operated, and flanged ends.

2.6 GLOBE VALVES

- A. Globe Valves, 2-Inch and Smaller: MSS SP-80; Class 125; body and screwed bonnet of ASTM B 62 cast bronze; with threaded or solder ends, brass or replaceable composition

disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing, and malleable iron handwheel. Provide Class 150 valves meeting the above where system pressure requires.

- B. Globe Valves, 2-1/2-Inch and Larger: MSS SP-85; Class 125 iron body and bolted bonnet conforming to ASTM A 126, Class B; with outside screw and yoke, bronze mounted, flanged ends, and "Teflon" impregnated packing, and two-piece backing gland assembly.

2.7 BUTTERFLY VALVES

- A. Butterfly Valves, 2-1/2-Inch and Larger: MSS SP-67; rated at 200 psi; cast-iron body conforming to ASTM A 126, Class B. Provide valves with field replaceable EPDM sleeve, nickel-plated ductile iron disc (except aluminum bronze disc for valves installed in condenser water piping), stainless steel stem, and EPDM O-ring stem seals. Provide lever operators with locks.

2.8 CHECK VALVES

- A. Swing Check Valves, 2-Inch and Smaller: MSS SP-80; Class 125, cast-bronze body and cap conforming to ASTM B 62; with horizontal swing, Y-pattern, and bronze disc; and having threaded or solder ends. Provide valves capable of being reground while the valve remains in the line. Provide Class 150 valves meeting the above specifications, with threaded end connections, where system pressure requires or where Class 125 valves are not available.
- B. Swing Check Valves, 2-1/2-Inch and Larger: MSS SP-71; Class 125 cast iron body and bolted cap conforming to ASTM A 126, Class B; horizontal swing, and bronze disc or cast-iron disc with bronze disc ring; and flanged ends. Provide valves capable of being refitted while the valve remains in the line.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior through the end ports for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks used to prevent disc movement during shipping and handling.
- B. Actuate valve through an open-close and close-open cycle. Examine functionally significant features, such as guides and seats made accessible by such actuation. Following examination, return the valve closure member to the shipping position.
- C. Examine threads on both the valve and the mating pipe for form (i.e., out-of-round or

local indentation) and cleanliness.

- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.
- E. Prior to valve installation, examine the piping for cleanliness, freedom from foreign materials, and proper alignment.
- F. Replace defective valves with new valves.

3.2 VALVE ENDS SELECTION

- A. Select valves with the following ends or types of pipe/tube connections:
 - 1. Copper Tube Size, 2-Inch and Smaller: Solder ends, except provide threaded ends for heating hot water and low-pressure steam service.
 - 2. Steel Pipe Sizes, 2-Inch and Smaller: threaded ends.
 - 3. Steel Pipe Sizes 2-1/2 Inch and Larger: flanged ends.

3.3 VALVE INSTALLATIONS

- A. General Application: Use gate, ball, and butterfly valves as indicated.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves and unions for each fixture and item of equipment arranged to allow equipment removal without system shutdown. Unions are not required on flanged devices.
- D. Install valves in horizontal piping with stem at the center of the pipe.
- E. Install valves in a position to allow full stem movement.
- F. Installation of Check Valves: Install for proper direction of flow as follows:
 - 1. Swing Check Valves: Horizontal position with hinge pin level.

3.4 SOLDER CONNECTIONS

- A. Cut tube square and to exact lengths.
- B. Clean end of tube to depth of valve socket with steel wool, sand cloth, or a steel wire brush to a bright finish. Clean valve socket in same manner.
- C. Apply proper soldering flux in an even coat to inside of valve socket and outside of tube.

- D. Open gate and globe valves to full open position.
- E. Remove the cap and disc holder of swing check valves having composition discs.
- F. Insert tube into valve socket, making sure the end rests against the shoulder inside valve. Rotate tube or valve slightly to ensure even distribution of the flux.
- G. Apply heat evenly to outside of valve around joint until solder will melt upon contact. Feed solder until it completely fills the joint around tube. Avoid hot spots or overheating valve. Once the solder starts cooling, remove excess amounts around the joint with a cloth or brush.

3.5 THREADED CONNECTIONS

- A. Note the internal length of threads in valve ends, and proximity of valve internal seat or wall, to determine how far pipe should be threaded into valve.
- B. Align threads at point of assembly.
- C. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).
- D. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

3.6 FLANGED CONNECTIONS

- A. Align flange surfaces parallel.
- B. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.
- C. For dead-end service, butterfly valves require flanges both upstream and downstream for proper shutoff and retention.

3.7 FIELD QUALITY CONTROL

- A. Tests: After piping systems have been tested and put into service, but before final adjusting and balancing, inspect valves for leaks. Adjust or replace packing to stop leaks; replace valves if leak persists.

3.8 ADJUSTING AND CLEANING

SECTION 15100
VALVES

- A. Cleaning: Clean mill scale, grease, and protective coatings from exterior of valves and prepare valves to receive finish painting or insulation.

3.9 VALVE PRESSURE/TEMPERATURE CLASSIFICATION SCHEDULES

VALVES, 2-INCH AND SMALLER

SERVICE	GATE	GLOBE	BALL	CHECK
Domestic Hot and Cold Water	125	125	150	125
Heating Hot Water	150	150	150	150
Chilled Water	150	150	150	150

VALVES, 2-1/2-INCH AND LARGER

SERVICE	GATE	GLOBE	BUTTERFLY	CHECK
Domestic Hot and Cold Water	125	125	200	125
Heating Hot Water	125	125	200	125
Chilled Water	125	125	200	125

END OF SECTION 15100

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following types of meters and gages:
 - 1. Temperature gages and fittings.
 - 2. Pressure gages and fittings.
 - 3. Flow meters.
- B. Meters and gages furnished as part of factory-fabricated equipment are specified as part of equipment assembly in other Division 15 sections.

1.2 SUBMITTALS

- A. General: Submit the following:
 - 1. Product data for each type of meter and gage. Include scale range, ratings, and calibrated performance curves, certified where indicated. Submit meter and gage schedule showing manufacturer's figure number, scale range, location, and accessories for each meter and gage.
 - 2. Product certificates signed by manufacturers of meters and gages certifying accuracies under specified operating conditions and products' compliance with specified requirements.

1.3 QUALITY ASSURANCE

- A. UL Compliance: Comply with applicable UL standards pertaining to meters and gages.
- B. ASME and ISA Compliance: Comply with applicable portions of ASME and Instrument Society of America (ISA) standards pertaining to construction and installation of meters and gages.

PART 2 - PRODUCTS

2.1 THERMOMETERS, GENERAL

- A. Accuracy: Plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span.
- B. Scale range: Temperature ranges for services listed as follows:
 - 1. Domestic Hot Water: 30 to 240 deg with 2-degree scale divisions (0 to 115 deg C with 1-degree scale divisions).

Chiller Replacement at
Bethel Middle School
Bethel, CT

2. Domestic Cold Water: 0 to 100 deg F with 2-degree scale divisions (minus 18 to 38 deg C with 1-degree scale divisions).
3. Hot Water: 30 to 300 deg with 2-degree scale divisions (0 to 150 deg C with 1-degree scale divisions).

2.2 DIRECT-MOUNT FILLED-SYSTEM DIAL THERMOMETERS

- A. Type: Vapor actuated, universal angle.
- B. Case: Drawn steel or cast aluminum, glass lens, 4-1/2-inch diameter.
- C. Adjustable Joint: Finish to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.
- D. Thermal Bulb: Copper with phosphor bronze bourdon pressure tube.
- E. Movement: Brass, precision geared.
- F. Scale: Progressive, satin faced, nonreflective aluminum, permanently etched markings.
- G. Stem: Copper-plated steel, aluminum, or brass, for separable socket, length to suit installation.

2.3 REMOTE-READING FILLED-SYSTEM DIAL THERMOMETERS

- A. Type: Vapor actuated.
- B. Case: Drawn steel or cast aluminum, glass lens, 4-1/2-inch diameter.
- C. Movement: Brass, precision geared.
- D. Scale: Progressive, satin faced, nonreflective aluminum, permanently etched markings.
- E. Tubing: Bronze double-braided armor over copper capillary, length to suit installation.
- F. Bulb: Copper with separable socket for liquids, averaging element for air.

2.4 BIMETAL DIAL THERMOMETERS

- A. Type: Direct mounted, bimetal, universal angle.

- B. Case: Stainless steel, glass lens, 5-inch diameter.
- C. Adjustable Joint: Finish to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.
- D. Element: Bimetal coil.
- E. Scale: Satin faced, nonreflective aluminum, permanently etched marking.
- F. Stem: Stainless steel for separable socket, length to suit installation.

2.5 DIAL-TYPE INSERTION THERMOMETERS

- A. Type: Bimetal, stainless steel case and stem, 1-inch-diameter dial, dust- and leakproof, 1/8-inch-diameter tapered-end stem with nominal length of 5 inches.

2.6 THERMOMETER WELLS

- A. Thermometer Wells: Brass or stainless steel, pressure rated to match piping system design pressure; with 2-inch extension for insulated piping and threaded cap nut with chain permanently fastened to well and cap.

2.7 PRESSURE GAGES

- A. Type: General use, ASME B40.1, Grade A, phosphor bronze bourdon- tube type, bottom connection.
- B. Case: Drawn steel or brass, glass lens, 4-1/2-inches diameter.
- C. Connector: Brass, 1/4-inch NPS.
- D. Scale: White coated aluminum, with permanently etched markings.
- E. Accuracy: Plus or minus 1 percent of range span.
- F. Range: Conform to the following:
 - 1. Vacuum: 30 inches Hg to 15 psi.
 - 2. All fluids: 2 times operating pressure.

2.8 PRESSURE GAGE ACCESSORIES

- A. Syphon: 1/4-inch NPS straight coil constructed of brass tubing with threads on each end.

- B. Snubber: 1/4-inch NPS brass bushing with corrosion-resistant porous metal disc. Disc material shall be suitable for fluid served and rated pressure.

2.9 FLOW METERS, GENERAL

- A. Flow rate of elements and meters shall be same as connected equipment or system.

2.10 WAFER ORIFICE-TYPE FLOOD ELEMENTS

- A. Type: Differential-pressure wafer-type orifice insert flow elements designed for installation between pipe flanges.
- B. Construction: Cast-iron body, brass valves with integral check valves and caps, and calibrated nameplate. Elements shall be pressure rated for 300 psig and 250 deg F (120 deg C).

2.11 VENTURI-TYPE FLOW ELEMENTS

- A. Type: Differential-pressure venturi type, designed for installation in piping.
- B. Construction: Bronze or cadmium-plated steel with brass fittings and attached tag with flow conversion data. Ends shall be threaded for 2 inches and smaller elements and flanged or welded for 2-1/2 inches and larger elements.

2.12 PITOT TUBE-TYPE FLOW ELEMENTS

- A. Type: Differential-pressure pitot tube-type design with probe for insertion into piping.
- B. Construction: Stainless steel probe of length to span inside of pipe, with brass fittings and attached tag with flow conversion data. Elements shall be pressure rated for 150 psig and 250 deg F (120 deg C).

2.13 METERS

- A. Permanently Mounted Meters: Suitable for mounting on wall or bracket, 6-inch dial or equivalent with fittings and copper tubing for connecting to flow element.
- B. Scale shall be in gpm unless otherwise indicated.
- C. Accuracy: Plus or minus 1 percent between 20 to 80 percent of range.
- D. Portable Meters: Differential-pressure gage and two 12-foot hoses in carrying case with handle.
- E. Scale: In inches of water unless otherwise indicated.

- F. Accuracy: Plus or minus 2 percent between 20 to 80 percent of range.
- G. Each meter shall be complete with operating instructions.

2.14 WINDOW-TYPE FLOW METERS

- A. Type: Window-type flow meters designed for installation on hydronic piping and measure flow directly in gpm.
- B. Construction: Bronze body and impact tube, integral self-closing valve, glass calibrated tube with indicator ball, and protection shield. Meters shall be pressure rated for 150 psig and temperature rated for 240 deg F (116 deg C).
- C. Accuracy: Plus or minus 5 percent.

2.15 BTU METERS

- A. Type: BTU meters consisting of turbine wheel flow meter, 2 temperature sensors, solid-state calculator with integral battery pack, integral stop valves, strainer, and magnetic trap.
- B. Construction: Bronze housing, 125 psig rating.
- C. Temperature Ranges: 40 to 250 deg F (5 to 120 deg C).
- D. Data Output: 6-digit electromechanical counter with readout in KWH or BTU.
- E. Accuracy: Plus or minus 1 percent.
- F. Battery Pack: 5-year lithium battery.

2.16 TEST PLUGS

- A. Test Plugs shall be nickel-plated brass body, with 1/2-inch NPS fitting and 2 self-sealing valve-type core inserts, suitable for inserting a 1/8-inch O.D. probe assembly from a dial-type thermometer or pressure gage. Test plug shall have gasketed and threaded cap with retention chain and body of length to extend beyond insulation. Pressure rating shall be 500 psig.
- B. Core Material: Conform to the following for fluid and temperature range:
 - 1. Air, Water, Oil, and Gas, 20 to 200 deg F (minus 7 to 93 deg C): Neoprene.
 - 2. Air and Water, minus 30 deg to 275 deg F (minus 35 to 136 deg C): EPDM.

- C. Test Kit: Provide test kit consisting of 1 pressure gage, gage adapter with probe, 2 bimetal dial thermometers, and carrying case.
- D. Ranges of pressure gage and thermometers shall be approximately 2 times systems operating conditions.

PART 3 - EXECUTION

3.1 THERMOMETERS INSTALLATION

- A. Install thermometers in vertical and tilted positions to allow reading by observer standing on floor.
- B. Install in the following locations and elsewhere as indicated:
 - 1. At inlet and outlet of each hydronic zone.
 - 2. At inlet and outlet of each hydronic boiler.
 - 3. At inlet and outlet of each indirect water heater.
- C. Remote-Reading Dial Thermometers: Install in control panels, with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.
- D. Thermometer Wells: Install in piping tee where thermometers are indicated, in vertical position. Fill well with oil or graphite and secure cap.

3.2 INSTALLATION OF PRESSURE GAGES

- A. Install pressure gages in piping tee with pressure gage valve, located on pipe at most readable position.
- B. Install in the following locations, and elsewhere as indicated:
 - 1. At suction and discharge of each pump.
 - 2. At discharge of each pressure-reducing valve.
 - 3. At building water service entrance.
- C. Pressure Gage Needle Valves: Install in piping tee with snubber. Install syphon in lieu of snubber for steam pressure gages.

3.3 INSTALLATION OF TEST PLUGS

- A. Test Plugs: Install in piping tee where indicated, located on pipe at most readable position. Secure cap.

3.4 INSTALLATION OF FLOW-MEASURING ELEMENTS AND METERS

- A. General: Install flow meters for piping systems located in accessible locations at most readable position.
- B. Locations: Install flow measuring elements and meters in the following locations and elsewhere as indicated.
 - 1. At discharge of each pump.
 - 2. At inlet of each hydronic coil in built-up central systems.
- C. Differential-Pressure-Type Flow Elements: Install minimum straight lengths of pipe upstream and downstream from element as prescribed by the manufacturer's installation instructions.
- D. Install wafer orifice-type element between 2 Class 125 pipe flanges, ANSI B16.1 (cast iron) or ANSI B16.24 (bronze).
- E. Install connections for attachment to portable flow meters in a readily accessible location.
- F. Meters For Use With Flow Elements: Install meters on wall or bracket in accessible location.
- G. Install connections, tubing, and accessories between flow elements and meters as prescribed by the manufacturer's installation instructions.
- H. Window Flow Meters: Install in vertical upward position with impact tube mounted in bushing centered on pipe with 10 pipe diameters upstream and 5 pipe diameters downstream of straight unrestricted piping for 1-1/4 inches and smaller, 20 pipe diameters upstream and 10 pipe diameters downstream for 1-1/2 inches and larger. Calibrate meter after installation in accordance with manufacturer's installation instructions.

3.5 ADJUSTING AND CLEANING

- A. Adjusting: Adjust faces of meters and gages to proper angle for best visibility.
- B. Cleaning: Clean windows of meters and gages and factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer's touch-up paint.

END OF SECTION 15135

Chiller Replacement at
Bethel Middle School
Bethel, CT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawing and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Requirements of the following Division 15 Sections apply to this section:
 - 1. "Basic Mechanical Requirements."
 - 2. "Basic Piping Materials and Methods."

1.2 SUMMARY

- A. This section includes the following:
 - 1. Horizontal-piping hangers and supports.
 - 2. Vertical-piping clamps.
 - 3. Hanger-rod attachments.
 - 4. Building attachments.
 - 5. Saddles and shields.
 - 6. Spring hangers and supports.
 - 7. Miscellaneous materials.
 - 8. Equipment supports.
- B. Related sections: The following sections contain requirements that relate to this section:
 - 1. Division 15 Section "Mechanical Insulation" for pipe insulation.

1.3 DEFINITIONS

- A. Terminology used in this section is defined in MSS SP-90.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with conditions of contract and Division 1 specification sections.
 - 1. Product data, including installation instructions for each type of support and anchor. Submit pipe hanger and support schedule showing Manufacturer's figure number, size, location, and features for each required pipe hanger and support.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15140
SUPPORTS AND ANCHORS

2. Product certificates signed by the manufacturer of hangers and supports certifying that their products meet the specified requirements.
3. Assembly-type shop drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly of components.

1.5 QUALITY ASSURANCE

- A. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."
 1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- B. Regulatory Requirements: Comply with applicable BOCA plumbing code pertaining to product materials and installation of supports and anchors.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Hangers and support components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-58 and MSS SP-69.
 1. Pipe attachments shall have nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.

2.2 MISCELLANEOUS MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substates and conditions under which supports and anchors are to be installed. Do not proceed with installing until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF HANGERS AND SUPPORTS

- A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69 and SP-89. Install supports with

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15140
SUPPORTS AND ANCHORS

maximum spacings complying with Boca Plumbing and Mechanical Codes. Where piping of various sizes is supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe as specified above for individual pipe hangers.

- B. Install building attachments within concrete or to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping.
- C. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- D. Install hangers and supports to allow controlled movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.
- E. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
- F. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ASME B31.9 Building Services Piping Code is not exceeded.
- G. Insulated Piping: Comply with the following installation requirements.
 - 1. Shields: Install protective shields MSS Type 40 on cold water piping that has vapor barrier. Shields shall span an arc of 180 degrees and shall have dimensions in inches not less than the following:

<u>NPS</u> _____	<u>LENGTH</u>	<u>THICKNESS</u>
1/4 THROUGH 3-1/2	12	0.048
4	12	0.060

- 2. Insert material shall be at least as long as the protective shield.
- 3. Thermal Hanger Shields: Install where indicated, with insulation of same thickness as piping.

3.3 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for pipe anchors and equipment supports. Install and align fabricated anchors in indicated locations.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15140
SUPPORTS AND ANCHORS

- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so that no roughness shows after finishing, and so that contours welded surfaces to match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

END OF SECTION 15140

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

- A. Identification devices specified in this section include the following:
 - 1. Painted Identification Materials.
 - 2. Plastic Pipe Markers.
 - 3. Plastic Tape.
 - 4. Underground-Type Plastic Line Marker.
 - 5. Plastic Duct Markers.
 - 6. Valve Tags.
 - 7. Valve Schedule Frames.
 - 8. Engraved Plastic-Laminate Signs.
 - 9. Plastic Equipment Markers.
 - 10. Plasticized Tags.
- B. Mechanical identification furnished as part of factory-fabricated equipment, is specified as part of equipment assembly in other Division-15 sections.
- C. Refer to other Division-15 sections for identification requirements at central-station mechanical control center; not work of this section.
- D. Refer to Division-16 sections for identification requirements of electrical work; not work of this section.

1.2 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
 - 1. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.3 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.
- B. Samples: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15190
MECHANICAL IDENTIFICATION

- C. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8-1/2" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule. In addition to mounted copies, furnish extra copies for Maintenance Manuals as specified in Division 1.
- D. Maintenance Data: Include product data and schedules in maintenance manuals; in accordance with requirements of Division 1.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering mechanical identification materials:
 - 1. Engineer approved equal.

2.1 MECHANICAL IDENTIFICATION MATERIALS:

- A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division-15 sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.2 PAINTED IDENTIFICATION MATERIALS:

- A. Stencils: Standard fiberboard stencils, prepared for required applications with letter sizes generally complying with recommendations of ANSI A13.1 for piping and similar applications, but not less than 1-1/4" high letters for ductwork and not less than 3/4" high letters for access door signs and similar operational instructions.
- B. Stencil Paint: Standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.
- C. Identification Paint: Standard identification enamel of colors indicated or, if not otherwise indicated for piping systems, comply with ANSI A13.1 for colors.

2.3 PLASTIC PIPE MARKERS:

- A. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15190
MECHANICAL IDENTIFICATION

- B. Pressure-Sensitive Type: Provide manufacturer's standard pre- printed, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, complying with ANSI A13.1

- C. Insulation: Furnish 1" thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125 degrees F (52 degrees C) or greater. Cut length to extend 2" beyond each end of plastic pipe marker.

- D. Small Pipes: For external diameters less than 6" (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
 - 1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
 - 2. Adhesive lap joint in pipe marker overlap.
 - 3. Laminated or bonded application of pipe marker to pipe (or insulation).
 - 4. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4" wide; full circle at both ends of pipe marker, tape lapped 1-1/2".

- E. Large Pipes: For external diameters of 6" and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height (and of required length), fastened by one of the following methods:
 - 1. Laminated or bonded application of pipe marker to pipe (or insulation).
 - 2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2" wide; full circle at both ends of pipe marker, tape lapped 3".
 - 3. Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel bands.

- F. Lettering: Manufacturer's standard pre-printed nomenclature which best describes piping system in each instance, as selected by Owner/Owner's Representative in cases of variance with names as shown or specified.

- G. Lettering: Comply with piping system nomenclature as specified, scheduled or shown, and abbreviate only as necessary for each application length.
 - 1. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as a separate unit of plastic.

2.4 PLASTIC TAPE:

- A. General: Provide manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.

Chiller Replacement at
Bethel Middle School
Bethel, CT

- B. Width: Provide 1-1/2" wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6", 2-1/2" wide tape for larger pipes.
- C. Color: Comply with ANSI A13.1, except where another color selection is indicated.

2.5 UNDERGROUND-TYPE PLASTIC LINE MARKER:

- A. General: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide tape with printing which most accurately indicates the type of service of buried pipe.
 - 1. Provide multi-ply tape consisting of solid aluminum foil core between 2-layers of plastic tape.

2.6 VALVE TAGS:

- A. Brass Valve Tags: Provide 19-gage polished brass valve tags with stamp-engraved piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 5/32" hole for fastener.
 - 1. Provide 1-1/2" diameter tags, except as otherwise indicated.
 - 2. Provide size and shape as specified or scheduled for each piping system.
 - 3. Fill tag engraving with black enamel.
- B. Plastic Laminate Valve Tags: Provide manufacturer's standard 3/32" thick engraved plastic laminate valve tags, with piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 5/32" hole for fastener.
 - 1. Provide 1-1/2" sq. black tags with white lettering, except as otherwise indicated.
 - 2. Provide size, shape and color combination as specified or scheduled for each piping system.
- C. Plastic Valve Tags: Provide manufacturer's standard solid plastic valve tags with printed enamel lettering, with piping system abbreviation in approximately 3/16" high letters and sequenced valve numbers approximately 3/8" high, and with 5/32" hole for fastener.
 - 1. Provide 1-1/8" sq. white tags with black lettering.
 - 2. Provide size, shape and color combination as specified or scheduled for each piping system.
- D. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

- E. Access Panel Markers: Provide manufacturer's standard 1/16" thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8" center hole to allow attachment.

2.7 VALVE SCHEDULE FRAMES:

- A. General: For each page of valve schedule, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.

2.8 ENGRAVED PLASTIC-LAMINATE SIGNS:

- A. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
- B. Thickness: 1/16", except as otherwise indicated.
- C. Thickness: 1/8", except as otherwise indicated.
- D. Thickness: 1/16" for units up to 20 sq. in. or 8" length; 1/8" for larger units.
- E. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.9 PLASTIC EQUIPMENT MARKERS:

- A. General: Provide manufacturer's standard laminated plastic, color coded equipment markers. Conform to the following color code:
 - 1. Yellow: Heating equipment and components.
 - 2. Blue: Equipment and components that do not meet any of the above criteria.
 - 3. For hazardous equipment, use colors and designs recommended by ANSI A13.1.
- B. Nomenclature: Include the following, matching terminology on schedules as closely as possible:
 - 1. Name and plan number.
 - 2. Equipment service.
 - 3. Design capacity.

4. Other design parameters such as pressure drop, entering and leaving conditions, rpm, etc.
- C. Size: Provide approximate 2-1/2" x 4" markers for control devices, dampers, and valves; and 4-1/2" x 6" for equipment.

2.10 PLASTICIZED TAGS:

- A. General: Manufacturer's standard pre-printed or partially pre-printed accident-prevention tags, of plasticized card stock with matt finish suitable for writing, approximately 3-1/4" x 5-5/8", with brass grommets and wire fasteners, and with appropriate pre-printed wording including large-size primary wording (as examples; DANGER, CAUTION, DO NOT OPERATE).

2.11 LETTERING AND GRAPHICS:

- A. General: Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.
 1. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; Boiler No. 3, Air Supply No. 1H, Standpipe F12).

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS:

- A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.2 DUCTWORK IDENTIFICATION:

- A. General: Identify air supply, return, exhaust, intake and relief ductwork with duct markers; or provide stenciled signs and arrows, showing ductwork service and direction of flow, in black or white (whichever provides most contrast with ductwork color).

SECTION 15190
MECHANICAL IDENTIFICATION

- B. Location: In each space where ductwork is exposed, or concealed only by removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures (shaft, underground or similar concealment), and at 50' spacings along exposed runs.
- C. Access Doors: Provide duct markers or stenciled signs on each access door in ductwork and housings, indicating purpose of access (to what equipment) and other maintenance and operating instructions, and appropriate safety and procedural information.
- D. Concealed Doors: Where access doors are concealed above acoustical ceilings or similar concealment, plasticized tags may be installed for identification in lieu of specified signs, at Installer's option.

3.3 PIPING SYSTEM IDENTIFICATION:

- A. General: Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow:
 - 1. Stenciled markers, including color-coded background band or rectangle, and contrasting lettering of black or white. Extend color band or rectangle 2" beyond ends of lettering.
 - 2. Stenciled markers, with lettering color complying with ANSI A13.1.
 - 3. Plastic pipe markers, with application system as indicated under "Materials" in this section. Install on pipe insulation segment where required for hot non-insulated pipes.
 - 4. Stenciled markers, black or white for best contrast, wherever continuous color-coded painting of piping is provided.
- B. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.
 - 1. Near each valve and control device.
 - 2. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
 - 3. Near locations where pipes pass through walls or floors/ ceilings, or enter non-accessible enclosures.
 - 4. At access doors, manholes and similar access points which permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced intermediately at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment.
 - 7. On piping above removable acoustical ceilings, except omit intermediately

Chiller Replacement at
Bethel Middle School
Bethel, CT

spaced markers.

3.4 UNDERGROUND PIPING IDENTIFICATION:

- A. General: During back-filling/top-soiling of each exterior underground piping systems, install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16", install single line marker. For tile fields and similar installations, mark only edge pipe lines of field.

3.5 VALVE IDENTIFICATION:

- A. General: Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibs, and shut-off valves at plumbing fixtures, HVAC terminal devices and similar rough-in connections of end-use fixtures and units. List each tagged valve in valve schedule for each piping system.
 - 1. Tagging Schedule: Comply with requirements of "Valve Tagging Schedule" at end of this section.
- B. Mount valve schedule frames and schedules in machine rooms where indicated or, if not otherwise indicated, where directed by Architect/Engineer.
 - 1. Where more than one major machine room is shown for project, install mounted valve schedule in each major machine room, and repeat only main valves which are to be operated in conjunction with operations of more than single machine room.

3.6 MECHANICAL EQUIPMENT IDENTIFICATION:

- A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:
 - 1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - 2. Meters, gages, thermometers and similar units.
 - 3. Fuel-burning units including boilers, furnaces, heaters, stills and absorption units.
 - 4. Pumps, compressors, chillers, condensers and similar motor- driven units.
 - 5. Fans, blowers, primary balancing dampers and mixing boxes.
 - 6. Tanks and pressure vessels.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15190
MECHANICAL IDENTIFICATION

7. Strainers, filters, humidifiers, water treatment systems and similar equipment.

- B. Optional Sign Types: Where lettering larger than 1" height is needed for proper identification, because of distance from normal location of required identification, stenciled signs may be provided in lieu of engraved plastic, at Installer's option.

- C. Lettering Size: Minimum 1/4" high lettering for name of unit where viewing distance is less than 2'-0", 1/2" high for distances up to 6'-0", and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of size of the principal lettering.

- D. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

- E. Optional Use of Plasticized Tags: At Installer's option, where equipment to be identified is concealed above acoustical ceilings or similar concealment, plasticized tags may be installed within concealed space to reduce amount of text in exposed sign (outside concealment).
 1. Operational valves and similar minor equipment items located in non-occupied spaces (including machine rooms) may, at Installer's option, be identified by installation of plasticized tags in lieu of engraved plastic signs.

3.7 ADJUSTING AND CLEANING:

- A. Adjusting: Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.

- B. Cleaning: Clean face of identification devices, and glass frames of valve charts.

3.8 EXTRA STOCK:

- A. Furnish minimum of 5% extra stock of each mechanical identification material required, including additional numbered valve tags (not less than 3) for each piping system, additional piping system identification markers, and additional plastic laminate engraving blanks of assorted sizes.
 1. Where stenciled markers are provided, clean and retain stencils after completion of stenciling and include used stencils in extra stock, along with required stock of stenciling paints and applicators.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15190
MECHANICAL IDENTIFICATION

END OF SECTION 15190

Chiller Replacement at
Bethel Middle School
Bethel, CT

PART 1 GENERAL

1.1 SUMMARY

- A. The work of this section includes but is not limited to the following:
 - 1. Vibration isolation elements.
 - 2. Equipment isolation bases.
 - 3. Piping flexible connections.
 - 4. Seismic restraints for isolated and non-isolated mechanical and electrical items.

1.2 REFERENCES

- A. State of Connecticut Building Code.
- B. NFPA 13 - Installation of Sprinkler Systems.
- C. ASHRAE-A Practical Guide to Seismic Restraint.
- D. Mason Industries, Inc. Seismic Restraint Guidelines

1.3 QUALIFICATIONS

- A. Qualifications: Only firms having five years experience designing and manufacturing seismic devices shall be capable of work in this specification.

1.4 SUBMITTALS

- A. The submittal material shall include copies of descriptive data for all products and materials including but not limited to the following:
 - 1. Descriptive Data:
 - a. Catalog cuts and data sheets.
 - b. An itemized list showing the items to be isolated and/or seismically restrained, product type or model number to be used and loading and deflection data.
 - c. Seismic restraint calculations.
 - d. (Structural or civil engineer's State of Connecticut professional engineer's seal verifying design and calculations for seismic restraining system used.)
 - 2. Shop Drawings:
 - a. Drawings showing equipment base construction for each machine, including dimensions, structural member sizes, and support point locations.
 - b. Drawings showing methods of suspension, support guides for conduit, piping and ductwork.

SECTION 15246
VIBRATION ISOLATION AND SEISMIC RESTRAINTS

- c. Drawings showing methods for isolation of conduits, pipes and ductwork penetrating walls and floor slabs.
- d. Concrete and steel details for bases including anchor bolt locations.
- e. Number location of seismic restraints and anchors for each piece of equipment.
- f. Specific details of restraints including anchor bolts for mounting and maximum loading at each location, for each piece of equipment and/or pipe and duct locations.

1.5 GENERAL (MANUFACTURER) RESPONSIBILITIES

- A. Design Builder shall have the following responsibilities:
 - 1. Determine vibration isolation and seismic restraint sizes and locations per specifications.
 - 2. Provide and install isolation systems and seismic restraints as scheduled or specified.
 - 3. Guarantee specified isolation system deflection.
 - 4. Provide installation instructions, drawings and field supervision to assure proper installation and performance.
 - 5. Substitution of “Internally Isolated” mechanical equipment in lieu of the specified isolation of this section may be acceptable provided that all specified deflections and stamped seismic calculations are supplied by the equipment manufacturer.

1.6 PROJECT RECORD DOCUMENTS

- A. Record actual locations and installation of vibration isolators and seismic restraints including attachment points.

PARTS 2 PRODUCTS

2.1 MANUFACTURERS

- A. Mason Industries Inc. models listed below.
- B. Other approved manufacturers providing equivalent products include:
 - 1. Vibration Eliminator Co.
 - 2. Amber/Booth Co.

2.2 SEISMIC RESTRAINT TYPES

- A. General: Installations shall be designed to safely accept external forces of one-half “G” load in any direction for all rigidly supported equipment without failure and

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15246
VIBRATION ISOLATION AND SEISMIC RESTRAINTS

permanent displacement of the equipment. Life safety equipment such as (fire pumps, sprinkler piping and emergency generators) shall be capable of safely accepting external forces up to one “G” load in any direction without permanent displacement of the supported equipment. Seismic restraints shall not short circuit vibration isolation systems or transmit objectionable vibration or noise.

- B. Type I (spring mount): Shall comply with general characteristics of spring isolators having a minimum o.d. to o.h. of .8 to 1 and minimum runout of 50% to solid. Shall incorporate snubbing restraint in all directions. Shall be capable of supporting equipment at a fixed elevation during equipment erection. Cast housings shall be ductile iron or aluminum. System to be field bolted or welded to deck with 1 G acceleration capability. Mason Type SSLFH or as approved.
- C. Type II (snubber): Each corner of side shall incorporate a seismic restraint having a minimum 5/8” thick resilient pad limit stops working in all directions. Restraints shall be made of plate, structural members, or square metal tubing concentric within a welded assembly incorporated resilient pads. Angle bumpers are not acceptable. System to be field bolted or welded to a deck with 1 G acceleration capability. Mason Type Z-1011 and Z-1225.
- D. Type III (cable braces): Metal cable type with approved end fastening devices to equipment and structure. System to be field bolted to deck or overhead structural members using two sided beam clamps to steel or appropriately designed insert for concrete. All parts of system including cables, clamps, excluding fastenings are to be single vendor furnished to assure seismic compliance. Mason Type SCB.
- E. Type IV (neoprene mount): Double deflection neoprene isolator encased in ductile iron or steel casing minimum .30 static deflection. System to be field bolted or welded to deck with 1 G acceleration capacity. Mason Type BR, RBA.
- F. Type V: Non-isolated equipment to be field bolted or welded (powder shots not acceptable) to resist seismic forces unless under 100 lb. Shear force required. Mason Type SAS, SAB.

2.3 VIBRATION ISOLATION - GENERAL

- A. Vibration Isolation shall control excessive noise and vibration in the building due to the operation of machinery or equipment, and/or due to interconnected piping, ductwork, or conduit. (The installation of all vibration isolation units, and associated hangers and bases, shall be under the direct supervision of the vibration isolation manufacturer’s representative.)
- B. All vibration isolators shall have either known non-deflected heights or calibration markings so that, after adjustment, when carrying their load, the deflection can be verified.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15246
VIBRATION ISOLATION AND SEISMIC RESTRAINTS

- C. All isolators shall operate in the linear portion of their load versus deflection curve. Load versus deflection curves shall be furnished by the manufacturer and must be linear over a deflection range of not less than 50% above the design deflection.
- D. The theoretical vertical natural frequency for each support point, bases upon load per isolator and isolator stiffness, shall not differ from the design objectives for the equipment as a whole by more than +/- 10%.
- E. All neoprene mountings shall have a Shore hardness of 30 to 60 +/- 5, after minimum aging of 20 days or corresponding oven aging.

2.4 VIBRATION ISOLATOR TYPES:

- A. Type A: Spring isolators:
 - 1. Minimum diameter of 0.8 of the loaded operating height.
 - 2. Corrosion resistance where exposed to corrosive environment with:
 - a. Springs cadmium plated or electro-galvanized.
 - b. Hardware cadmium plated.
 - c. All other metal parts hot-dip galvanized.
 - 3. Reserve deflection (from loaded to solid height) of 50% of rated deflection.
 - 4. Minimum ¼” thick neoprene acoustical base pad on underside, unless designated otherwise.
 - 5. Designed and installed so that ends of springs remain parallel and all springs installed with adjustment bolts.
 - 6. Non-resonant with equipment forcing frequencies or support structure natural frequencies.
 - 7. Mason Type SLF.
 - 8. When used in conjunction with seismic bracing, seismic restraint Type II shall be installed.
- B. Type B: Spring isolators shall be same as Type A, except:
 - 1. Provide built-in vertical limit stops with minimum ¼” clearance under normal operation.
 - 2. Tapped holes in top plate for bolting to equipment when subject to wind load.
 - 3. Capable of supporting equipment at a fixed elevation during equipment erection. Installed and operating heights shall be identical.
 - 4. Adjustable and removable spring pack with separate neoprene pad isolation.
 - 5. Capable of accepting 1 G of acceleration.
 - 6. Mason Type SLR.
- C. Type C: Spring hanger rod isolators:
 - 1. Spring element seated on a steel washer within a neoprene cup incorporating a rod isolation bushing.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15246
VIBRATION ISOLATION AND SEISMIC RESTRAINTS

2. Steel retainer box encasing the spring and neoprene cut.
 3. When used in conjunction with seismic bracing, seismic restraint Type III shall be installed.
 4. Mason Type HS.
- D. Type D: Seismic Restraint, Type IV: Double deflection neoprene isolator encased in ductile iron or steel casing minimum .30 static deflection. System to be field bolted or welded to deck with 1 G acceleration capacity.
1. Mason Type BR, RBA.
- E. Type E: Elastomer hanger rod isolators:
1. Molded unit type neoprene element with projecting bushing lining rod clearance hole.
 2. Neoprene element to be minimum 1-3/4" thick.
 3. Steel retainer box encasing neoprene mounting.
 4. Clearance between mounting hanger rod and neoprene bushing shall be minimum of 1/8".
 5. Minimum static deflection of 0.35".
 6. When used in conjunction with seismic bracing, seismic restraint Type III shall be installed.
 7. Mason Type HD.
- F. Type F: Combination spring/elastomer hanger rod isolators:
1. Spring and neoprene isolator elements in a steel box retainer. Neoprene double deflection type. Single deflection is unacceptable. Spring seated in a neoprene cup with extended rod bushing.
 2. Characteristics of spring and neoprene as described in Type A and Type E isolators.
 3. When used in conjunction with seismic bracing, seismic restraint Type III shall be installed.
 4. Mason Type DNHS.
- G. Type G: Pad type elastomer mountings:
1. 3/4" Minimum thickness.
 2. 50 PSI maximum loading.
 3. Waffled design.
 4. Deflection per pad thickness.
 5. Galvanized steel plate between multiple layers or pad thickness.
 6. Suitable bearing plate to distribute load.
 7. Mason Type Super W.
- H. Type H: Grommet type elastomer bushings:
1. One piece molded bridge bearing neoprene.
 2. Washer / bushing shall surround the anchor bolt.
 3. Flat washer face to avoid metal to metal contact.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15246
VIBRATION ISOLATION AND SEISMIC RESTRAINTS

4. Mason type HG.
- I. Type K: Pipe Anchors: All-directional acoustical pipe anchor consisting of a telescopic arrangement of two sizes of steel tubing separated by a minimum one-half inch thickness of heavy-duty neoprene and duck or neoprene isolation material. Vertical restraints shall be provided by similar material arranged to prevent vertical travel in either direction.
- J. Allowable loads on the isolation material travel in either direction. Allowable loads on the isolation material shall not exceed 500 psi and the design shall be balanced for equal resistance in any direction. Isolation to be bolted or welded depending on structure.
 1. Mason Type ADA.

2.5 EQUIPMENT BASES

- A. Integral Structural Steel Base, Type B-1:
 1. Reinforced as required to prevent base flexure at start-up and misalignment of drive and driven units. Centrifugal fan bases complete with motor slide rails.
 2. Drills for drive and driven unit mounting template.
 3. Must be utilized with seismic restraint Type I, II, or IV.
 4. Mason Type M, WFB.
- B. Concrete Inertia Base, Type B-2:
 1. Vibration isolator manufacturer shall furnish rectangular structural concrete forms for floating foundation. Bases for split case pumps shall be large enough to provide support for suction and discharge base ells. The base depth shall be a minimum of 1/10 of the longest dimension of the base but not less than 6" or greater than 14". Forms shall include minimum concrete reinforcement consisting of 1/2" bars or angles welded in place in 6" centers running both ways in a layer 1-1/2" above the bottom and a top layer of reinforcing steel as above for all bases exceeding 120" in one direction. Isolators shall be set into pocket housings which are an integral part of the base construction and set at the proper height to maintain a 1" clearance below the base. Bases shall be furnished with templates and anchor bolt sleeves as part of this system.
 2. Must be utilized with seismic restraint Type I, II or IV.
 3. Mason Type K, BMK.
- C. Isolated Curb, Type B-3:
 1. Curb mounted rooftop equipment shall be mounted on structural spring isolation curbs that directly sit on roof construction and are flashed and waterproofed into roof's membrane waterproofing system. Manufacturer's curb shall not be used.
 2. All spring locations shall have removable waterproof covers to allow for spring adjustment and/or removal.
 3. Curbs shall have a provision for an optional sound barrier kit

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15246
VIBRATION ISOLATION AND SEISMIC RESTRAINTS

4. All spring mounts shall be as Isolator Type A.
 5. Curbs shall have static deflection as detailed on the isolation / seismic schedule
 6. Curbs shall be rated for 1 G of acceleration and shall be wind restrained for 110 mph wind loads.
 7. Curbs shall have California OSHPD approval.
 8. Sound barrier package, SBC-3. Two layers of waterproof sheetrock shall be supplied and installed by Design Builder.
 9. Curbs to be welded to building steel or bolted to concrete decks to attain acceleration criteria.
 10. Mason Type RSC.
- D. Roof Isolation Rail System, Type B-4: Rooftop fans, condensing units, exterior ducted handling units, etc., shall be installed on continuous equipment support piers which shall combine a regular equipment support and an isolation system into one assembly. The system shall be designed with 2" or 3" static deflection steel springs which are both adjustable, removable, and interchangeable after equipment has been installed. The system shall maintain the same operating and installed height both with and without the equipment load and shall be fully restrained during wind load conditions allowing no more than 1/4" motion in any direction. The isolation pier shall be designed to accept the membrane waterproofing. The entire assembly shall be cold spray galvanized or plastic coated. System design permits minimum 1 G of acceleration. Curbs to be welded to building steel or bolted to concrete decks to attain acceleration criteria. Mason Industries Model RSR.
- E. Non-isolated seismic roof curbs, Type B-5:
1. Curb sections shall be either structural steel channels or 12GA. sheet metal
 2. Field assembled joints shall include a minimum of 2 rows of three bolts at each connection.
 3. Curb to have a factory installed wood nailer.
 4. System to be bolted or welded to deck.
 5. System shall be designed for minimum 1/2G. of acceleration.
 6. Mason Type RRC.
- F. Dunnage steel mounted rooftop equipment. Type B-6:
1. Rooftop equipment shall be mounted on structural tubular steel boxed rail assembly.
 2. Tubular steel rails shall be attached to seismic rated spring vibration isolators.
 3. Isolators shall be bolted or welded to dunnage steel to meet seismic criteria of 1/2G acceleration.
 4. Entire assembly shall be hot dipped galvanized.
 5. Mason Type RSLR.

2.6 FLEXIBLE CONNECTORS

- A. Elastomer Type FC-1:

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15246
VIBRATION ISOLATION AND SEISMIC RESTRAINTS

1. Manufactured of Kevlar reinforcement and EPDM, both molded and cured with hydraulic presses.
 2. Straight connectors to have two spheres reinforced with a molded-in external ductile iron ring between spheres.
 3. Elbows shall be long radius type.
 4. Rated 250 psi at 170 degrees F. Dropping in a straight line to 170 psi at 250 degrees F for sizes 1-1/2" to 12" elbows. Elbows shall be rated no less than 90% of straight connections.
 5. Sizes 10" to 12" to employ control cables with neoprene end fittings isolation from anchor plates by means of 1/2" bridge bearing neoprene bushings.
 6. Minimum safety factor, 4:1 at maximum pressure ratings.
 7. Systems bolted to victaulic type couplings or gate, butterfly, or check valves to have a minimum 5/8" flange spacer installed between conductor and coupling on flange.
 8. Submittals to include test reports.
 9. Mason Type Safeflex SFDEJ.
- B. Flexible Stainless Hose, Type FC-2:
1. Type 321 stainless steel braided flexible metal hose.
 2. 2" pipe size and smaller: threaded carbon steel fittings.
 3. 1-1/2" pipe size and larger: Class 150 carbon steel flanges.
 4. Suitable for operating pressure with 4:1 minimum safety factor.
 5. Flexible Metal Hose Company type DFC and MFC.
- C. Unbraided Exhaust Hose, Type FC-3:
1. Low pressure stainless steel annularly corrugated.
 2. Fitted with flanged ends.
 3. Maximum temperature 1,500 degrees F.
 4. Mason Type SDL-RF.

PART 3 EXECUTION

3.1 GENERAL SEISMIC RESTRAINT REQUIREMENTS

- A. Install seismic restraints in accordance with manufacturers recommendations.
- B. Seismic restraining system Type III: Install taut for non-isolated equipment and slack with 1/2" cable deflection for isolated systems.
- C. Seismically restrain all piping, conduit and ductwork with Type III or Type V seismic restraint in accordance with guidelines outlined below. Restraints which are to be used in conjunction with vibration isolators shall be Type III.
 1. Carbon steel piping shall be braced at maximum 40' intervals and at turns of more than 4'. Lateral bracing at maximum 80' intervals. No-hub piping to be

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15246
VIBRATION ISOLATION AND SEISMIC RESTRAINTS

- braced at maximum 20' intervals or maximum 40' using 1/2 G acceleration rated couplings.
2. Ductwork shall be braced at maximum 30' and at every turn and duct run end. Lateral bracing at maximum 60'.
- D. Equipment mounted on housekeeping pads: Pads shall be properly doweled or expansion shielded to deck to meet acceleration criteria. Mason Type HPA.
- E. Seismic Restraints are not required for the following:
1. Piping in boiler or mechanical rooms or penthouses less than 1-1/4" O.D. except gas piping and fire protection piping.
 2. Piping in other areas less than 2-1/2" O.D., except gas piping and fire protection piping.
 3. Ducts which have a cross sectional area less than 6 square feet.
 4. All piping suspended by individual hanger 12" or less in length from the top of the pipe to the bottom of the support for the hanger, except gas piping and fire protection piping.
 5. Fire protection feed mains and cross mains suspended by individual hangers 6" or less in length from the top of the pipe to the bottom of the support for the hanger.
 6. All top supported ducts suspended by hangers 12" or less in length from the top of the duct to the bottom of the support for the hanger.
 7. Electrical conduit less than 1-1/2" I.D.
- F. (Chimneys and stacks passing through floors are to be bolted at each floor level or secured above and below each floor with riser clamps.)
- G. (Chimneys and stacks running horizontally to be braced every 30' with Type III restraining system.)
- H. For overhead supported equipment, over stress of the building structure must not occur. Bracing can occur from:
1. Flanges to structural beams.
 2. Upper or lower truss chords in bar joist construction at panel points.
 3. Cast-in-place inserts or drilled and shielded inserts in concrete structures.
- I. Building seismic expansion joints: Install hinged joints at piping crossing expansion joints and anchor the piping either side per the detail provided on the contract drawings. Anchors on each end are to be capable of accepting 1.5 times the operating pressure multiplied by the projected area of the pipe. Offset shall be accomplished by the annular motion of a double sphere connector (TYPE FC-1) bolted to each end of an intermediate steel pipe. Bracket each joint with hinged steel connections. Hinges shall have a pin / slot assembly on both sides. The completed assembly shall be Mason Type Safeflex SFDEJ-HE.

Chiller Replacement at
Bethel Middle School
Bethel, CT

3.2 GENERAL VIBRATION ISOLATION REQUIREMENTS

- A. Install isolators in accordance with manufacturer's recommendations. Vibration isolators shall not cause any change of position resulting in stresses or misalignment.
- B. Mechanical equipment shall be isolated from the building structure by means of noise and vibration isolators.
- C. Each fan and motor assembly shall be supported on a single structural steel frame (where noted on the isolation and seismic schedule). Flexible duct connections shall be provided at inlet and discharge ducts.
- D. Provide pairs of horizontal limit springs (Thrust restraints) on fans with more than 6.0 inch static pressure, and on hanger supported, horizontally mounted axial fans where indicated
- E. Provide resiliently mounted equipment, piping, and ductwork with seismic snubbers. Each inertia base shall have minimum of four seismic snubbers located close to isolators. Snub equipment designated for post disaster use to 0.05 inch (1.5 mm) maximum clearance. Other snubbers shall have clearance between 0.15 inch (4 mm) and 0.25 inch (7 mm).
- F. Ductwork connected to rotating equipment shall be supported with Type C or Type F isolators for the first three support points.
- G. Installation of piping vibration isolators:
 - 1. All piping, except fire protection standpipe systems, is included under this section.
 - 2. Vibration isolators shall be installed on all piping outside the shafts as follows:
 - a. Piping in boiler or mechanical rooms.
 - b. Piping where exposed on roof.
 - c. Piping connected to rotating equipment and pressure reducing stations.
 - d. Horizontal suspended pipe 2" and smaller and all steam piping shall be suspended by Type E isolator with a minimum 3/8" deflection. Water pipe larger than 2" shall be supported by Type C or Type F isolator with minimum 1" whichever is greater.
 - e. Horizontal pipe floor supported at slab shall be supported via Type A with a minimum static deflection of 1" or same deflection as isolated equipment to which pipe connects, whichever is greater.
 - f. Vertical riser pipe supports under 2" diameter shall utilize Type G isolation pads.
 - g. Vertical riser guides, if required, shall avoid direct contact of piping with building.

SECTION 15246
VIBRATION ISOLATION AND SEISMIC RESTRAINTS

- h. Pipe anchors or guides, where required, shall utilize resilient pipe anchors, Mason Industries Type ADA, or equivalent, to avoid direct contact of piping with building.
- i. Isolated piping which requires sway bracing shall utilize two neoprene elements, Type G to accommodate tension and compression forces.
- j. Pipe extension and alignment connectors: Provide connectors at riser takeoffs, cooling and heating coils, and elsewhere as required, to accommodate thermal expansion and misalignment.

H. Pipe Isolation Schedule

PIPE SIZE - INCH (MM)	ISOLATED DISTANCE FROM EQUIPMENT
1 (25)	120 diameters (3.0m)
2 (50)	90 diameters (4.5m)
3 (80)	80 diameters (6.0m)
4 (100)	75 diameters (7.5m)
6 (150)	60 diameters (9.0m)
8 (200)	60 diameters (12.0m)
10 (250)	54 diameters (13.5m)
12 (300)	50 diameters (15.0m)
16 (400)	45 diameters (18.0m)
24 (600)	38 diameters (23.0m)

3.3 EQUIPMENT INSTALLATION

- A. Requirements for installation on concrete inertia bases shall be as follows:
 - 1. Minimum operating clearance between concrete inertia and base and housekeeping pad or floor shall be 1”.
 - 2. The equipment structural steel or concrete inertia base shall be placed in position and supported temporarily by blocks or shims, as appropriate, prior to the installation of the machine or isolators.
 - 3. The isolators shall be installed without raising the machine and frame assembly.
 - 4. After the entire installation is complete and under full operational load, the isolators shall be adjusted so that the load is transferred from the blocks to the isolators. When all isolators are properly adjusted, the blocks or shims shall be barely free and shall be removed.
 - 5. Install equipment with flexibility in wiring connection.
 - 6. Verify that all installed isolator and mounting systems permit equipment motion in all directions. Adjust or provide additional resilient restraints to flexibly limit start-up equipment lateral motion to ¼”.
 - 7. Prior to start-up, clean out all foreign matter between bases and equipment. Verify that there are no isolation short circuits in the base, isolators, or seismic restraints.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15246
VIBRATION ISOLATION AND SEISMIC RESTRAINTS

3.4 INSPECTION

- A. Upon completion of the installation of all vibration isolation and seismic restraints, the manufacturer's local representative shall visit the project jobsite, visibly inspect all installations and report, in writing, any and all deficiencies from the specifications. Any additional corrective measures required to put the system in total compliance shall be the responsibility of the installing Design Builder.

Vibration Isolation and Seismic Restraint Schedule

EQUIPMENT	BASE	ISOLATOR	SEISMIC RESTRAINT	DEFLECTION
CH-1		B/H	IV	2"

END OF SECTION 15246

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

- A. Extent of mechanical insulation required by this section is indicated by requirements of this section.
- B. Types of mechanical insulation specified in this section include the following:
 - 1. Piping Systems Insulation:
 - a. Fiberglass.
 - b. Cellular Glass.
 - c. Calcium Silicate.
 - d. Flexible Unicellular.
- C. Refer to Division-15 section "Supports and Anchors" for protection saddles, protection shields, and thermal hanger shields; not work of this section.
- D. Refer to Division-15 section "Low Pressure Ductwork" for duct linings; not work of this section.
- E. Refer to Division-15 section "Mechanical Identification" for installation of identification devices for piping, ductwork, and equipment; not work of this section.

1.2 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required, whose products have been in satisfactory use in similar services for not less than 3 years.
- B. Installer's Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for this project.
- C. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.
 - 1. Exception: Outdoor mechanical insulation may have flame spread index of 75 and smoke developed index of 150.
 - 2. Exception: Industrial mechanical insulation that will not affect life safety egress of building may have flame spread index of 75 and smoke developed index of 150.

1.3 SUBMITTALS:

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15250
MECHANICAL INSULATION

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each mechanical system requiring insulation.
- B. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product data in maintenance manual.
- C. Samples: Submit manufacturer's sample of each piping insulation type required, and of each duct and equipment insulation type required. Affix label to sample completely describing product.

1.4 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.
- B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:
- B. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
 - 1. Certainteed Corp.
 - 2. Knauf
 - 3. Manville Products Corp.
 - 4. Owens-Corning Fiberglas Corp.

2.2 PIPING INSULATION MATERIALS:

- A. Fiberglass Piping Insulation: ASTM C 547, Class 1 unless otherwise indicated. **K-factor maximum of 0.25 at 75 degrees F.**

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15250
MECHANICAL INSULATION

- B. Jackets for Piping Insulation: ASTM C 921, Type I for piping with temperatures below ambient, Type II for piping with temperatures above ambient. Type I may be used for all piping at Installers option.
 - 1. Encase pipe fittings insulation with one-piece premolded PVC fitting covers, fastened as per manufacturer's recommendations.
 - 2. Encase exterior piping insulation with aluminum jacket with weather-proof construction.
- C. Staples, Bands, Wires, and Cement: As recommended by insulation manufacturer for applications indicated.
- D. Adhesives, Sealers, and Protective Finishes: As recommended by insulation manufacturer for applications indicated.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 PLUMBING PIPING SYSTEM INSULATION:

- A. Cold Piping:
 - 1. Application Requirements: Insulate the following cold plumbing piping systems:
 - a. Domestic cold water piping.
 - 2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:
 - a. Fiberglass: Per current IECC requirements.

3.3 HVAC PIPING SYSTEM INSULATION:

- A. Cold Piping (40 degrees F (4.4 degrees C) to ambient):
 - 1. Application Requirements: Insulate the following cold HVAC piping systems:

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15250
MECHANICAL INSULATION

- a. HVAC chilled water supply and return piping.
 - b. HVAC make-up water piping.
 - c. Air conditioner condensate drain piping.
2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:
 - a. Fiberglass: Per current IECC requirements.
- C. Hot Low Pressure Piping (to 250 degrees F (121 degrees C)):
1. Application Requirements: Insulate the following hot low pressure HVAC piping systems (steam piping up to 15 psi, water piping up to 250 degrees F (121 degrees C)).
 - a. HVAC hot water supply and return piping.
 - b. Low pressure steam and condensate piping
 - c. Condenser water supply and return piping.
 - d. Heated fuel piping.
 - e. Hot gas refrigerant piping.
 2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:
 - a. Fiberglass: Per current IECC requirements.

3.4 INSTALLATION OF PIPING INSULATION:

- A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.
- B. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing, and acceptance of tests.
- C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete run. Do not use cut pieces or scraps abutting each other.
- D. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.
- E. Maintain integrity of vapor-barrier jackets on pipe insulation, and protect to prevent puncture or other damage.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15250
MECHANICAL INSULATION

- F. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.
- G. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.
- H. Butt pipe insulation against pipe hanger insulation inserts. For hot pipes, apply 3" wide vapor barrier tape or band over the butt joints. For cold piping apply wet coat of vapor barrier lap cement on butt joints and seal joints with 3" wide vapor barrier tape or band.

3.5 EXISTING INSULATION REPAIR:

- A. Repair damaged sections of existing mechanical insulation, both previously damaged or damaged during this construction period. Use insulation of same thickness as existing insulation, install new jacket lapping and sealed over existing.

3.6 PROTECTION AND REPLACEMENT:

- A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- B. Protection: Insulation Installer shall advise Design Builder of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION 15250

Chiller Replacement at
Bethel Middle School
Bethel, CT

PART 1 - GENERAL

1.1 SUMMARY

- A. Scope: Extent of hydronic piping, fittings, valves and accessories is indicated on the drawings, in schedules and by the requirements of this Section.
- B. Types: Types of hydronic piping systems specified in this Section include the following:
 - 1. Supply and return piping.
- C. Related Sections: Refer to other Division 15 sections for the following:
 - 1. Meters and Gauges.
 - 2. Supports and Anchors.
 - 3. Mechanical Insulation.
 - 4. Firestopping.
 - 5. Testing, Adjusting, and Balancing.
 - 6. Valves

1.2 QUALITY ASSURANCE

- A. Codes and Standards: Provide piping conforming to the requirements of the following:
 - 1. American National Standards Institute (ANSI):
 - a. B16.3 Malleable Iron Threaded Fittings
 - b. B16.5 Pipe Flanges and Flanged Fittings
 - c. B16.9 Factory-Made Wrought Steel Buttwelding Fittings
 - d. B16.11 Forged Steel Fittings, Socket-Welding and Threaded
 - e. B16.18 Cast Copper Alloy Solder Joint Pressure Fittings
 - f. B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
 - g. B16.39 Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
 - h. B31 Code for Pressure Piping
 - i. B31.1 Power Piping
 - 2. American Society of Mechanical Engineers (ASME): Installation of piping shall conform to the requirements of ANSI B31.1 "Power Piping."
 - 3. American Society for Testing and Materials (ASTM):
 - a. A 47 Standard Specification for Ferritic Malleable Iron Castings
 - b. A 53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded Seamless

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15510
HYDRONIC PIPING

- c. A 106 Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
 - d. A 126 Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
 - e. A 183 Standard Specification for Carbon Steel Track Bolts and Nuts
 - f. A 193/
A 193M Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
 - g. A 194/
A 194M Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
 - h. A 307 Standard Specification for Carbon Steel Bolts and Studs, 60 000 psi Tensile Strength
 - i. A 536 Standard Specifications for Ductile Iron Castings
 - j. B 16 Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines
 - k. B 32 Standard Specification for Solder Metal
 - l. B 61 Standard Specification for Steam or Valve Bronze Castings
 - m. B 62 Standard Specification for Composition Bronze or Ounce Metal Castings
 - n. B 88 Standard Specification for Seamless Copper Water Tube
 - o. D 2000 Standard Classification System for Rubber Products in Automotive Applications
- 4. American Society of Testing Materials (ASTM) Standard Specification for Crosslinked Polyethylene (PEX) Tubing B Designation: F876
 - 5. American Society of Testing Materials (ASTM) Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems B Designation: F877
 - 6. National Sanitation Foundation (NSF) and American National Standards Institute (ANSI) Standard 14 B Plastic Piping System Components and Related Materials.
 - 7. German Standard B Pipelines of Plastic Materials used in Warm Water Floor Heating Systems; General Requirements B Designation: DIN 4726.
 - 8. Plastic Pipe Institute (PPI) Technical Report TR-3B Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials.
 - 9. Plastic Pipe Institute (PPI) Technical Report TR-4 B Recommended Hydrostatic Strength and Design Stresses for Thermoplastic Pipe and Fitting Compounds.
- B. Qualification of Welders: Welders performing work under this Contract shall be certified and qualified in accordance with tests prescribed by the National Certified Welding Bureau (NCWB) or by other approved test procedures using methodology and procedures covered in the ASME Boiler and Pressure Vessel Code, Section IX,

Chiller Replacement at
Bethel Middle School
Bethel, CT

"Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators."

1. Submit for approval the names, identification, and welder's assigned number, letter or symbol of welders assigned to this project.
2. The assigned identification symbol shall be used to identify the work of each welder and shall be indelibly stamped immediately upon completion of each weld.
3. Welders shall be tested and certified for all positions.
4. Submit identifying stencilled test coupons made by each operator.
5. Any or all welders may be required to retake welding certification tests without additional expense.
6. When so requested, a welder shall not be permitted to work as a welder on this project until he has been recertified in accordance with NCWB.
7. Recertification of the welder shall be made after the welder has taken and passed the required tests.
8. Where piping 1-1/2 inches and smaller is butt or socket welded, submit 3 samples of test welds for approval.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's standard technical product data indicating conformance to the stipulated reference specifications, construction materials, construction details, and test and operating pressures. Submit manufacturer's product data on the following:
 1. Pipe materials.
 2. Unions and flanges.
 3. Welding fittings.
 4. Valves.
 5. Strainers.
 6. Equipment.
- B. Shop Drawings: Provide piping layout drawings, drawn to a scale of not less than 1/4-inch to one foot showing the proposed layout of piping systems including valves, fittings, equipment, pumps, hangers, grading, high points, low points, drain points, anchors, expansion devices, installation details, hydraulic requirements, wiring diagrams, and control scenario. Provide shop drawings for the following locations:
 1. Mechanical Room.

1.4 STORAGE AND PROTECTION

SECTION 15510
HYDRONIC PIPING

- A. Storage: Store piping on the project site so as to preclude the entrance of construction dirt and debris into the open ends of piping. Do not install piping fouled with construction dirt.
- B. Storage of Fittings: Store fittings under cover, protected from construction dirt and rain.
- C. Storage of Valves: Store valves under cover with blind or protective wood flanges secured to valve openings. Valves fouled with construction dirt shall be removed from the project site and replaced with new.

1.5 OPERATION AND MAINTENANCE DATA

- A. Submit operations and maintenance data, including manufacturer's descriptive literature, installation instructions, operating instructions and maintenance and repair data.

1.6 WARRANTY

- A. Brass fittings and accessories will have a 5 year warranty.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Pipe 2-1/2-inch Diameter and Smaller: Provide piping as follows:
 - 1. Copper, Type K or L, conforming to ASTM B 88.
- B. Pipe 3 inches Diameter and Larger: Provide piping as follows:
 - 1. Schedule 40 black steel conforming ASTM A 53 or A 106.
 - 2. Use A 53 or A 106 for expansion loops, expansion bends or stresses in excess of 12,000 psig.

2.2 PIPE FITTINGS: 125 PSIG MAXIMUM WORKING PRESSURE

- A. Fittings 2-inch and Smaller: Pipe fittings for piping 2 inches and smaller shall be tested and permanently stamped for 125 psig water working pressure and conform to the following:
 - 1. Provide threaded cast iron elbows, tees, caps and plugs conforming to ANSI B16.4, Class 125.
 - 2. Threaded galvanized malleable iron elbows, tees, plugs and caps conforming to

Chiller Replacement at
Bethel Middle School
Bethel, CT

ANSI B16.3, Class 150.

3. Provide cast iron flanges conforming to ANSI B16.1, Class 125.
 4. Provide galvanized malleable iron unions, with bronze facings conforming to ANSI B16.39.
 5. Provide bolts and nuts conforming to ASTM A 307, Grade B up to 125 pounds per square inch working pressure.
- B. Fittings 2-1/2-inch Diameter and Larger: For working pressures not exceeding 125 psig water pressure provide fittings as follows:
1. Provide butt welding tees long radius pattern, long radius elbows and caps conforming to ANSI B16.9, each stamped by the manufacturer for conformance and working pressure.
 2. Provide steel flanges conforming to ANSI B16.5, standard or welding neck pattern.
 3. Provide cast iron flanged tees, flanged long radius elbows, flanged reducers and blank flanges conforming to ANSI B16.1, 125 psig class.
- C. Fittings for Copper Pipe: Provide fittings for copper piping 2-1/2-inch diameter and smaller as follows:
1. Provide cast or wrought copper solder joint fittings conforming to ANSI B16.18 or ANSI B16.22. Solder shall be composition ASTM B 32 Grade 95TA, Tin-Antimony or ASTM B 32 95TS Silver Solder.
 2. The use of lead-tin solder is not permitted.
- D. Fittings
1. Fittings will be constructed from brass.
 2. Fittings will be selected from the BRHC Product Catalog.
 3. All fittings will meet the dimensional requirements for copper sweat and pipe threads in accordance with ASME B16.22 and B1.20.
 4. Sweat fittings will be made up with solder that meets the requirements of ASTM B32-95b
 5. Installation accessories will not conflict with local building codes.

2.3 SHAPED NIPPLES

- A. Welded Shaped Nipples: On hydronic piping systems operating at less than 125 pounds per square inch water working pressure, factory made shaped welding nipples may be used under the following conditions:
1. Thickness of the fitting at any point shall not be less than the thickness of adjacent piping.
 2. Tapping holes shall be drilled or ground smooth and of a diameter to match

Chiller Replacement at
Bethel Middle School
Bethel, CT

- nipple bell.
- 3. Branch pipe diameter does not exceed 50 percent of the diameter of the main.
- 4. Field cut pipe or standard threaded coupling will not be permitted.

2.4 STRAINERS

- A. Types: Provide strainers of the "Y" or basket types as indicated on the drawings or required to suit the field conditions.
- B. Strainers 1-1/2-Inch Diameter and Smaller: Provide strainers with bronze bodies conforming to ASTM B 62, Grade C or cast iron bodies conforming to ASTM A 126, Class B.
 - 1. End connections shall be threaded.
 - 2. Screens shall be 18-8 stainless steel with 1/32-inch diameter perforations or openings.
- C. Strainers 2-Inch and Larger: Provide strainers with cast iron bodies conforming ASTM A 126, Class B with flanged end connections.
 - 1. Screens shall be bronze, monel metal or 18-8 stainless steel.
 - 2. Sizes 2-inch to 6-inch shall have 1/16-inch diameter perforations.
 - 3. Sizes 8-inch to 12-inch shall have 1/8-inch diameter perforations.
 - 4. Sizes larger than 12-inch shall have 5/32-inch diameter perforations.
- D. Design Pressure: Provide strainers designed for 125 pounds per square inch working pressure on systems less than 125 pounds per square inch.
- E. Strainer Free Area: The free area of each strainer screen shall be not less than three times the area of the strainer inlet pipe.
- F. Drain Valves: For each strainer 1-1/2-inch diameter and larger, provide a plugged minimum 1/2-inch diameter gate or ball valve, bronze body, working pressure to match the strainer, threaded with a plugged outlet.

2.5 BALANCING DEVICES

- A. Types: Wherever "Balancing Valves", "Balancing Cocks", or similar words are used on the Contract Drawings, provide globe valves, resilient face eccentric plug valves, multi-purpose plug valves or butterfly valves for balancing purposes.
- B. Butterfly Valves: Provide butterfly valves conforming to MSS SP 67 with single flange or lug type end connections which will anchor the valve body in place when either one or the adjacent flanged connection is unbolted.

- C. Ball Valves: Provide ball valves conforming to MSS SP 72.
 - 1. Provide one piece bodies on sizes 1-inch and smaller.
 - 2. Provide top entry or split body type on sizes 1-1/2-inch and larger.
- D. Locking Device: On each balancing valve size 1-1/2-inch and larger provide a locking device, with indicator, to secure the valve in the balanced position. If standard with the manufacturer, the locking device may be arranged so that the valve may be closed and then returned to its original balanced position.
- E. Stems and Hand Operators: Design valves with stems and hand operators of sufficient length to project outside of 2-inch thick insulation. Indicators and locking devices shall be exposed.
- F. Precision Plug Valve: In lieu of other balancing valves specified, at the Contractor's option precision all brass or bronze plug valves may be furnished.
 - 1. Provide internal "O" ring or teflon seals to prevent leakage.
 - 2. Machined orifice or low loss Venturi shall be calibrated and provided with four laminated pressure-flow charts for any valve position between fully opened and fully closed.
 - 3. Provide a calibrated plate and pointer mounted on the valve to indicate the degree of valve opening.
 - 4. Provide a quick disconnect gauge connection of bronze or stainless steel.
- G. Balancing Fittings: On pipe sizes 3/4-inch diameter and smaller, provide balancing fittings on runouts to fan coil units, fin tube radiation, convectors and reheat coils.
 - 1. Fittings shall be of the combination balancing and shut-off type with the balancing device positioned by an Allen set screw or other approved method which permits closing of the valves without disturbing its balanced position.
 - 2. Bodies may be of the globe or "Y" type with contour flow plug or approved equivalent.
 - 3. Provide a graduated dial or other device to indicate the valve setting.
 - 4. Gland shall permit packing under pressure.
 - 5. Materials and construction shall be as specified for water valves sizes 1-1/2-inch and smaller.
 - 6. On sizes 3/4-inch and smaller ends may be sweat or compression type.
- H. Circuit setters provide as required on drawings.

2.6 EXPANSION TANK: DIAPHRAGM PRE-PRESSURIZED TYPE

- A. Type: Provide pre-pressurized diaphragm-type expansion tanks of sizes indicated on the drawings.

- B. Construction: Construct tanks of steel in accordance with section 8 of the ASME Code. Test and stamp tanks for the working pressure.
- C. Supports: Support tanks on 2-inch diameter steel pipe legs with cross bracing and floor plates or suspend on steel saddles with all-thread rod anchored to the structure.
- D. Manufacturer's Qualifications and Warranty: The tanks shall be the product of a manufacturer who certifies that his tanks have been a standard production model for five years prior to opening bids and warrants the diaphragm material unconditionally, against failure or leakage for a period of five years from the date of project acceptance.

2.7 AIR SEPARATORS

- A. Type: Provide air separators of tangential type constructed of steel and tested and stamped in accordance with section 8 of the ASME Code for a working pressure of 125 psig.
 - 1. Pressure drop through the separator and flow rate shall be as shown on the drawings.
 - 2. Provide separators on hydronic systems capable of separating not less than 80 percent of the entrained air on the first passage of water and not less than 30 percent of residual air on each subsequent passage through the separator.
 - 3. Provide flanged inlet and outlet connections, 3/4-inch diameter valve drain connection and 1-inch diameter top air eliminator connection.
 - 4. Provide 1-inch diameter pipe from the top air eliminator point to a 5 gallon, steel, ASME stamped 125 pound working pressure air receiver vessel with automatic float vent.
 - 5. Provide 1-inch diameter globe valve between the air separator and the air receiver.

2.8 PIPE ANCHORS

- A. General: Provide pipe anchors where indicated on the drawings or where required to restrain the movement of piping systems.
 - 1. See Section 15140,"Supports and Anchors"
 - 2. Anchors shall be suitable for the location of installation and shall be designed to withstand all forces and movements acting on the anchor.
 - 3. Design anchors with a safety factor of four.
 - 4. Anchor vertical piping with steel clamps welded to the piping and secured to the wall or floor construction.

2.9 END SUCTION DIFFUSERS

- A. Provide at each pump a suction diffuser of size and type noted on drawings. Units shall consist of angle type body with straightening vanes and combination diffuser-strainer-orifice cylinder with 3/16" diameter openings for pump protection. A permanent magnet shall be equipped with a disposable fine mesh for cleaning. The orifice cylinder shall be equipped with a disposable fine mesh strainer which shall be removed after system start-up. Orifice cylinder shall be designed to withstand pressure differential equal to pump shut-off head and shall have a free area equal to five times cross section area of pump suction opening. Straightening vanes shall extend the full length of the orifice cylinder and shall be replaceable. Unit shall be provided with adjustable support foot to carry weight of suction piping.

2.10 CONTROLS

- A. Controls will be approved by local codes.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Sizes: Provide piping systems of sizes indicated on the drawings. Systems shall be installed complete.
- B. Codes: Install piping systems in conformance with ANSI B31.
- C. Expansion: Install piping to allow for expansion and contraction of the piping systems. Provide offsets and swing joint connections at coils, pumps and other equipment to eliminate undue strain to the equipment connections.
 - 1. Connect flanges and tack weld piping systems in place before full circumferential welds are made.
 - 2. Springing of piping at equipment connections will not be permitted.
 - 3. The use of "cold-spring" is not permitted.
- D. Branch Connections: Branch connections to up feed systems shall be made at the top or at a 45 degree angle above the centerline. Branch connections for down feed systems shall be made at the bottom or at a 45 degree angle below the centerline.
- E. Pitch: Install water piping with a pitch or slope of not less than 1-inch in 40 feet.
 - 1. Provide 3/4-inch diameter plugged drain valves at each low point in mechanical rooms.
- F. High Points: At each high point of the piping system provide a 3/8-inch diameter plugged globe valve.

1. Where high points are located in an inaccessible position, provide a 3/8-inch diameter bleed line from the high point of the piping system and extend to an approved location, with access. Anchor bleed piping and provide 3/8-inch diameter globe valve.
- G. Vibration and Flexibility: Support, anchor, and guide piping systems to preserve piping flexibility and the isolation effects of sound and vibration isolation hangers.
- H. Welding: Conform to the welding and welder qualification requirements of "Quality Assurance" paragraph of this Section.
1. Perform welding in conformance with ANSI B31.1.
 2. Perform welding in ambient temperatures above 0 degrees F.
 3. Ream and clean ends of piping.
 4. Support piping, align and tack weld making allowance for pipe pitch and insulation. Temporarily block piping at hangers.
 5. Use welding pipe clamps on piping 4-inch diameter and larger, and verify alignment before welding.

3.2 HYDRONIC SPECIALTIES INSTALLATION.

- A. Install manual air vents at high points in the system, and elsewhere as required for system air venting.

3.3 CLEANING

- A. Pipe Exterior: Wash and wipe pipe exterior to remove construction dirt, loose scale and flux.
- B. Pipe Interior: Flush pipe interior with clean water. Continue flushing until the piping system runs clean. After flushing inspect strainer screens, refrigeration machine water boxes, piping low points, and tank drains to determine the presence of construction debris. If debris is found, disassemble equipment and remove debris. Reflush the system and re-inspect.
1. Do not operate centrifugal pumps until system has been cleaned and flushed.

3.4 TESTING

- A. 125-Pound Systems: Test hydronic piping systems at not less than 150 pounds per square inch gauge or 1-1/2 times the maximum working pressure of devices connected to the piping system, whichever is greater, measured at the low point of the system.
- B. Test Procedures: Test system as follows:

SECTION 15510
HYDRONIC PIPING

1. Gauge safety valves during testing.
2. Fill the system and remove all air.
3. Apply test pressure when water and ambient temperature are approximately equal and constant.
4. Maintain test pressure for one hour without adding any additional fluid to the system.
5. If the system shows loss in pressure, determine and repair leaks and retest the system. System shall show no loss in pressure for one hour.
6. Leaks in screw fittings shall be corrected by remaking the joints.
7. Leaks in welded joints shall be cut out and rewelded. Caulking will not be permitted.

END OF SECTION 15510

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes factory assembled and tested, open circuit mechanical induced-draft vertical discharge cooling tower.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, pressure drop, performance curves with selected points indicated, furnished specialties, and accessories.

B. Shop Drawings: Complete set of manufacturer's prints of equipment assemblies, control panels, sections and elevations, and unit isolation. Include the following:

1. Assembled unit dimensions.
2. Weight and load distribution.
3. Required clearances for maintenance and operation.
4. Sizes and locations of piping and wiring connections.
5. Wiring Diagrams: For power, signal, and control wiring. Differentiate between manufacturer installed and field installed wiring.

C. Operation and Maintenance Data: Each unit to include operation and maintenance manual.

1.4 QUALITY ASSURANCE

A. Verification of Performance:

1. The thermal performance shall be certified by the Cooling Technology Institute in accordance with CTI Certification Standard STD-201. Lacking such certification, a field acceptance test shall be conducted within the warranty period in accordance with CTI Acceptance Test Code ATC-105, by a Certified CTI Thermal Testing Agency. The Evaporative Heat Rejection Equipment shall comply with the energy efficiency requirements of ASHRAE Standard 90.1.

2. Unit Sound Performance ratings shall be tested according to CTI ATC-128 standard, Test Code for Measurement of Sound from Water-Cooling Towers, by an Independent CTI-licensed sound test agency. Sound ratings shall not exceed specified ratings.

B. Unit shall meet or exceed energy efficiency per ASHRAE 90.1

1.5 WARRANTY

A. Submit a written warranty executed by the manufacturer, agreeing to repair or replace components of the unit that fail in materials and workmanship within the specified warranty period.

1. The Entire Unit shall have a comprehensive five (5) year warranty against defects in materials and workmanship from date of shipment.

2. Fan Motor/Drive System: Warranty Period shall be Five (5) years from date of unit shipment from Factory (fan motor(s), fan(s), fan shaft(s), bearings, mechanical support, sheaves, bushings and belt(s)).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide cooling towers manufactured by one of the following:

1. Evapco
2. Baltimore Air Coil
3. Marley

2.2 THERMAL PERFORMANCE

A. Each unit shall be capable to cool 590.0 GPM of water entering at 95.0° F leaving at 85.0° F at a design entering wet bulb of 78.0° F.

2.3 IBC COMPLIANCE

A. The unit structure shall be designed, analyzed, and constructed in accordance with the latest edition of International Building Code (IBC) for: IP = 1.0, SDS = 1.34; z/h = 0, P = 119 psf.

2.4 COMPONENTS

A. Description: Factory assembled and tested, induced draft counter flow cooling tower complete with fan, fill, louvers, accessories and rigging supports

B. Materials of Construction

1. All cold water basin components including vertical supports, air inlet louver frames and panels up to rigging seam shall be constructed of Type 304 Stainless Steel. All factory cold water basin seams shall be welded for water tight construction. "Series 300" stainless steel shall not be acceptable as equivalent to Type 304 Stainless Steel.

2. Upper Casing, channels and angle supports shall be constructed of heavy gauge mill hot-dip galvanized steel. Fan cowl and guard shall be constructed of galvanized steel. All galvanized steel shall be coated with a minimum of 2.35 ounces of zinc per square foot of area (G-235 Hot-Dip Galvanized Steel designation). During fabrication, all galvanized steel panel edges shall be coated with a 95% pure zinc-rich compound.

C. Fan(s):

1. Fan(s) shall be high efficiency axial propeller type with aluminum wide chord blade construction. Each fan shall be dynamically balanced and installed in a closely fitted cowl with venturi air inlet for maximum fan efficiency.

D. Drift Eliminators

1. Drift eliminators shall be constructed entirely of Polyvinyl Chloride (PVC) in easily handled sections. Design shall incorporate three changes in air direction and limit the water carryover to a maximum of 0.001% of the recirculating water rate.

E. Water Distribution System

Chiller Replacement at
Bethel Middle School
Bethel, CT

1. Spray nozzles shall be precision molded ABS, large orifice nozzles utilizing fluidic technology for superior water distribution over the fill media. Nozzles shall be designed to minimize water distribution system maintenance. Spray header and branches shall be Schedule 40 Polyvinyl Chloride (PVC) for corrosion resistance with a steel connection to attach external piping.

F. Heat Transfer Media

1. Fill media shall be constructed of Polyvinyl Chloride (PVC) of cross-fluted design and suitable for inlet water temperatures up to 130° F. The bonded block fill shall be bottom supported and suitable as an internal working platform. Fill shall be self-extinguishing, have a flame spread of 5 under A.S.T.M. designation E-84-81a, and shall be resistant to rot, decay and biological attack.

G. Air Inlet Louvers

1. The air inlet louver screens shall be constructed from UV inhibited polyvinyl chloride (PVC) and incorporate a framed interlocking design that allows for easy removal of louver screens for access to the entire basin area for maintenance. The louver screens shall have a minimum of two changes in air direction and shall be of a non-planar design to prevent splash-out and block direct sunlight & debris from entering the basin.

H. Electronic Water Level Control

1. Electronic water level control package shall have three (3) stainless steel water level sensors (one (1) high level, one (1) low level and one (1) ground) with a NEMA 4x enclosure mounted in a cleanable Schedule 40 PVC external standpipe with slow closing solenoid valve(s) and "y" strainer(s). Wiring is not included and components must be field mounted. Valves shall be sized for 25 psi minimum to 125 psi maximum pressure. Standpipe may require heat tracing by others in cold weather applications.

I. Pan Strainer

1. Pan Strainer(s) shall be all Type 304 Stainless Steel construction with large area removable perforated screens.

2.5 MOTORS AND DRIVES

A. General requirements for motors are specified in Division 23 Section "Motors"

B. Fan Motor

1. Fan motor(s) shall be totally enclosed, ball bearing type electric motor(s) suitable for moist air service. Motor(s) are Premium Efficient, Class F insulated, 1.15 service factor design. Inverter rated per NEMA MG1 Part 31.4.4.2 and suitable for variable torque applications and constant torque speed range with properly sized and adjusted variable frequency drives.

2. Fan motor(s) shall include strip-type space heaters with separate leads brought to the motor conduit box.

C. Fan Drive

1. The fan drive shall be multigroove, solid back V-belt type with QD tapered bushings designed for 150% of the motor nameplate power. The belt material shall be neoprene reinforced with polyester cord and specifically designed for evaporative equipment service. Fan sheave shall be aluminum alloy construction. Belt adjustment shall be accomplished from the exterior of the unit.

D. Fan Shaft

1. Fan shaft shall be solid, ground and polished steel. Exposed surface shall be coated with rust preventative.

E. Fan Shaft Bearings

1. Fan Shaft Bearings shall be heavy-duty, self-aligning ball type bearings with extended lubrication lines to grease fittings located on access door frame. Bearings shall be designed for a minimum L-10 life of 100,000 hours.

2.6 MAINTENANCE ACCESS

A. Fan Section

1. Access door shall be hinged and located in the fan section for fan drive and water distribution system access. Swing away motor cover shall be hinged for motor access.

B. Basin Section

1. Framed removable louver panels shall be on all four (4) sides of the unit for pan and sump access.

C. Internal Working Platform

1. Internal working platform shall provide easy access to the fans, belts, motors, sheaves, bearings, all mechanical equipment and complete water distribution system. The fill shall be an acceptable means of accessing these components.

2.7 ACCESSORIES

A. Basin Heater Package

1. Cold water basin shall be fitted with copper element, electric immersion heater(s) with a separate thermostat and low water protection device. Heaters shall be selected to maintain +40° F pan water at 0° F ambient temperature.
2. Electric immersion heater package shall include a factory-supplied NEMA 4x enclosure containing a magnetic contactor with 120 VAC control circuit, transformer, and main power disconnect. Control package wired by others.

2.8 COOLING TOWER CONTROL PANEL

A. Variable Frequency Drive

1. The cooling tower control panel shall include complete Variable Frequency Drive (VFD) fan control and incorporate control of spray pumps and basin heaters when applicable.
2. A single point power connection for all controlled motors will be included. UL 489 breaker shall include thermal and magnetic trip mechanisms.
3. The VFD shall be capable of controlling the cooling tower fan motor over a range of 10% to 100% of the motor's base frequency.
4. The control panel shall include manual bypass functionality which isolates the VFD.
5. VFD operator controls shall include a VFD/Off/Bypass switch and HOA switch mounted on the enclosure door.
6. The control panel shall include all necessary terminal inputs to control the sequence of operations from a Building Management System including at a minimum: VFD start command, VFD reference speed, spray pump operation, basin heater operation.
7. In the absence of a Building Management System, the control panel shall include a solid state PID temperature controller to adjust the VFD frequency to maintain water temperature. The cold water temperature shall be displayed on the PID controller.

8. The control panel must also include a Full Voltage Non-Reversing Starter for a Spray Pump if present. HOA switch to be included and mounted on the enclosure door.
9. If Basin Heater is Present, the control panel shall also include a basin heater contactor with Off/Auto switch installed and mounted on the enclosure door.
10. Terminal inputs shall be provided for Vibration Cut Out Switch.
- 11 All internal power and control wiring to be installed and tested in the factory.
12. A Five Year Warranty shall be provided as a standard option by panel manufacturer.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Installation shall be the responsibility of the mechanical contractor. The contractor shall install the drive-in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.
- B. Power wiring shall be completed by the electrical contractor. The contractor shall complete all wiring in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.

3.02 START-UP

- A. Remote VFD Start-up assistance and training shall be available by factory and/or VFD provider at no additional charge. Start-up technician is not required to be factory certified to preserve factory warranty. A factory supplied start-up form shall be filled out for each drive with a copy provided to the owner, and a copy sent to be kept on file at the manufacturer.

3.03 PRODUCT SUPPORT

- A. Factory trained application engineering and service personnel that are thoroughly trained with the supplied VFD and optional packages shall be available via factory remote technical assistance at both the specifying and installation locations. Additional local support to be available through VFD supplier or referred technician for hire or pre-negotiated service terms. Servicing technician does not need to be factory certified to preserve warranty.

END OF SECTION 15650

Chiller Replacement at
Bethel Middle School
Bethel, CT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Chiller package.
- B. Charge of refrigerant and oil.
- C. Controls and control connections.
- D. Chilled water connections.
- E. Starters.
- F. Electrical power connections.

1.2 REFERENCES

- A. ANSI/ARI 550/590-2003 - Standard for Water Chilling Packages using the Vapor Compression Cycle.
- B. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.
- C. ANSI/ASHRAE 90.1 - Energy Efficient Design of New Buildings.
- D. ANSI/ASME SEC 8 - Boiler and Pressure Vessel Code
- E. ANSI/NEMA MG 1 - Motors and Generators.
- F. ANSI/UL 1995 - Central Cooling Air Conditioners.
- G. ANSI/UL 984 - Safety Standard for Hermetic Motor Compressors.
- H. ANSI/AFBMA 9-1978 - Load Ratings and Fatigue Life for Ball Bearings. Bearings must have life of not less than L10 200,000 hours.
- I. California Administrative Code - Title 24
- J. ASTM B117 - Standard Method of Salt Spray (Fog) Testing
- K. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- L. ASTM A525 - Zinc (Hot-Dip Galvanized) Coatings on Sheet Steel Products
- M. ASTM D1654 - Evaluation of Painted or Coated Specimens, Subjected to Corrosive Environments.

1.3 SUBMITTALS

- A. Submit drawings indicating components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Indicate accessories where required for complete system.
- B. Submit product data indicating rated capacities, weights, specialties and accessories, electrical requirements and wiring diagrams.
- C. Submit manufacturer's installation instructions.

1.4 OPERATION AND MAINTENANCE DATA

Chiller Replacement at
Bethel Middle School
Bethel, CT

- A. Submit operation data.
- B. Include start-up instructions, maintenance data, controls, and accessories.
- C. Submit maintenance data.

1.5 REGULATORY REQUIREMENTS

- A. Conform to AHRI Standard 550/590 for rating and certified testing of Water Chilling Packages using the Vapor Compression Cycle.
- B. Conform to UL 1995 - Standard for Heating and Cooling Equipment, Safety Standard. In the event the unit is not UL approved, the manufacturer shall, at manufacturer expense, provide for a field inspection by an UL representative to verify conformance to UL standards. If necessary, contractor shall perform modifications to the unit to comply with UL, as directed by the UL representative.
- C. Conform to ASME SECTION VIII Boiler and Pressure Vessel Code for construction and testing of unfired pressure vessels.
- D. Conform to ANSI/ASHRAE STANDARD 15 safety code for mechanical refrigeration.
- E. Unit shall bear the AHRI Certification Label for the specific type of water chiller as applicable.
- F. Chiller manufacturer shall provide LEED-NC EA Credit Calculation for each chiller utilizing the factors specified by the U.S. Green Building Council based upon equipment life of 23 years.

1.6 STORAGE AND HANDLING

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- B. Protect units from physical damage. Factory coil shipping covers shall be kept in place until installation.
- C. Unit controls shall be capable of withstanding 203 Deg F (95 Deg C) storage temperatures in the control compartment for an indefinite period of time.

1.7 WARRANTY

Chiller Replacement at
Bethel Middle School
Bethel, CT

- A. A 1-year Parts and Labor Warranty shall be provided on each chiller and associated accessories.

1.8 MAINTENANCE SERVICE

- A. Furnish service and maintenance of complete assembly for one year from Date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, the following:
 1. Trane
 2. JCI/York
 3. Carrier

2.2 COMPRESSOR AND MOTOR

- A. Construct chiller using semi-hermetic helical rotary screw compressors with independent circuits
 1. Statically and dynamically balance rotating parts.
 2. Provide oil lubrication system with oil charging valve and oil filter to ensure adequate lubrication during starting, stopping and normal operation.
 3. Provide compressor with automatic capacity reduction equipment consisting of capacity control slide valve (rotary). Compressor must start unloaded for soft start on motors.
 4. Provide crankcase heater and/or oil sump heater to evaporate refrigerant returning to crankcase during shut down. Energize heater when compressor is not operating.
- B. Chiller should be able to unload to 25 percent of full load tonnage with constant entering condenser water temperature.

2.3 EVAPORATOR

- A. The evaporator shall be built in accordance with ANSI/ASHRAE 15- Safety Code for

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15685
HELICAL ROTARY SCREW CHILLER

Mechanical Refrigeration. Design, test, and stamp evaporator refrigerant side for 200 psig (1379 kPa) working pressure in accordance with ANSI/ASME SEC VIII.

- B. Evaporator tubes shall be internally and externally enhanced. The tubes shall be securely supported at intermediate supports and physically expanded into both ends of the tube sheets. The evaporator tubes must also be removable from both ends to provide easy access for tube cleaning. The minimum evaporator tube wall thickness, root-to-root across the entire tube length shall be 0.025". It is unacceptable to provide this thickness at the intermediate supports only.
- C. Water boxes shall be designed for 150 psig maximum waterside working pressure and shall be flanged and gasketed for easy removal and access to the tubes. The water boxes shall have grooved-type water connections for easy field chilled water and condenser water connections and have proper orientation as referenced in the scheduled drawings.
- D. Adjustable or float type refrigerant metering devices and thermal expansion valves (TXV) shall be inspected and adjusted by the manufacturer annually for the first five years of operation to assure equivalent reliability to an electronic expansion valve (EXV) system. A written report shall be forwarded to the owner each year over the first five years to confirm completion of calibration.
- E. Units with multi-stage compressors shall incorporate an interstage flash vessel economizer in the refrigerant cycle.

2.4 WATER-COOLED CONDENSER

- A. The water-cooled condenser shall be built in accordance with ANSI/ASHRAE 15 Safety Code for Mechanical Refrigeration. Design, test, and stamp condenser refrigerant side for 300 psig (2068 kPa) working pressure in accordance with ANSI/ASME SEC VIII.
- B. Condenser tubes shall be internally and externally enhanced. The tubes shall be securely supported at intermediate supports and physically expanded into both ends. The condenser tubes must also be removable from both ends to provide easy access for tube changeouts or tube cleaning. The minimum condenser tube wall thickness, root-to-root across the entire tube length shall be [0.025"] [0.028"]. It is unacceptable to provide this thickness at the intermediate supports only.
- C. Water boxes shall be designed for 150 psig maximum waterside working pressure and shall be flanged and gasketed for easy removal and access to the tubes. The water boxes shall have grooved-type water connections for easy field chilled water and condenser water connections and have proper orientation as referenced in the scheduled drawings.

Chiller Replacement at
Bethel Middle School
Bethel, CT

2.5 REFRIGERANT CIRCUIT

- A. All units shall have 2 independent refrigerant circuits, each with a separate single compressor. If manifolded compressors are provided on a circuit, then individual compressor warranties must be provided for each compressor on the circuit.
- B. Chiller shall be able to unload to 25% of capacity with AHRI relief and constant entering condenser water temperature.
- C. Provide for each refrigerant circuit:
 - 1. Suction service valve
 - 2. Discharge service valve
 - 3. Liquid line shutoff valve
 - 4. Refrigerant pressure relief valves for low side and high side
 - 5. Electronic expansion valve
 - 6. Removable core filter
 - 7. Charging port
 - 8. Sight glass
 - 9. Oil separator

2.6 CONTROLS

- A. The chiller(s) shall be controlled by a microprocessor-based, proportional and integral controller to show water and refrigerant temperatures, refrigerant pressures and diagnostics. A dedicated chiller control panel with a non-coded display is to be supplied with each chiller by the chiller manufacturer. The controller shall provide chiller capacity control in response to the leaving chilled water temperature.
- B. Digital communications to building automation system by SNE Building Systems shall consist of a BACnet open standard communication protocol. BACnet shall be capable of communicating MS/TP using RS-485 hardware. Coordinate with SNE Building Systems as required.
- C. If the chiller runs in any of the abnormal operating conditions, the chiller will continue to run, in an unloaded state, and will continue to produce chilled water in an attempt to

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15685
HELICAL ROTARY SCREW CHILLER

meet the cooling load. However, if the chiller reaches the trip-out limits, the chiller controls will take the chiller off line for protection, and a manual reset is required. Once the "near trip" condition is corrected, the chiller will return to normal operation and can then produce full load cooling.

- D. The chiller control panel shall provide control of chiller operation and monitoring of chiller sensors, actuators, relays, and switches. The panel shall be a complete system for stand-alone chiller control and include controls to safely and efficiently operate the chiller.
- E. Manufacturer shall provide a compressor that is capable of unloading to an infinite amount of positions in order to provide water temperature accuracy of +/- 0.5F°. In the event that the compressor unloads to finite steps, the manufacturer shall provide eight (8) or more steps of unloading on each compressor or provide hot gas bypass (HGBP).
- F. The chiller control panel is to be provided with the following digital type pressure readouts:
 - 1. Evaporator refrigerant pressure
 - 2. Condenser refrigerant pressure
- G. The front of the chiller control panel shall be capable of displaying the following clear language as standard:
 - 1. Entering and leaving evaporator water temperature
 - 2. Entering and leaving condenser water temperature
 - 3. Chilled water setpoint
 - 4. Electrical 3 phase current limit and percent RLA setpoint
 - 5. Electrical 3 phase amp draw
 - 6. Chiller operating mode
 - 7. Condenser refrigerant temperature
 - 8. Elapsed time and number-of-starts counter
 - 9. Chiller compressor run status relay

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15685
HELICAL ROTARY SCREW CHILLER

10. Diagnostics with time and date stamp
 11. A relay output to start the condenser water pump and/or enable the cooling tower temperature controls.
 12. The control panel display shall identify the fault, indicate date, time, and operating mode at time of occurrence, and provide type of reset required and a help message. The historic diagnostic report shall display the last 20 diagnostics with their times and dates of occurrence
- H. The chiller control panel shall provide a programmable soft load to prevent the chiller from achieving full capacity during the pulldown period by imposing a ramped current limit, or a temperature pulldown rate. Either can be adjusted to limit how fast the chiller can load after an initial startup.
- I. The chiller control panel shall provide leaving chilled water temperature reset based upon return water temperature.
- J. The chiller shall have factory mounted and tested controls that provide dual chilled water setpoint control for ice-making application.
- K. The chiller control panel shall provide a chilled water pump output relay that closes when the chiller is given a signal to start.
- L. The chiller control panel shall have the ability to operate in variable evaporator flow applications. The chiller control must be able to operate with evaporator flow rate changes up to 10% during a 1 minute time period while maintaining 0.5°F water temperature accuracy. The chiller control must also be able to operate with evaporator flow rate changes up to 30% during a 1 minute time period while maintaining 2°F water temperature accuracy.
- M. The chiller control panel shall have the ability to control the leaving condenser fluid temperature setpoint through the user interface or via a 0-10 Vdc signal from a building automation system.

2.7 STARTERS (LOW VOLTAGE)

- A. Starters shall be unit mounted with ventilating louvers.
- B. Motor starters shall include incoming line provisions for the number and size cables shown on the drawings. Incoming line lugs shall be copper mechanical type. Connection directly to the contactors is not permissible.
- C. Contactors shall be sized properly to the chiller full load and locked rotor currents.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15685
HELICAL ROTARY SCREW CHILLER

Contactors shall have double break main contacts with weld resistant silver cadmium faces. Auxiliary interlocks that interface with the control panel shall be low resistance having palladium silver contacts.

- D. Each motor starter shall include a control power transformer with fused primary and secondary. Current transformers of the proper size, ratio and burden capacity shall be provided to provide a signal to the control panel and optional devices. Control relays shall be provided within the motor starter to interface with the control panel.
 - 1. Factory installed control power transformer shall also be capable of providing 115V power for optional field-installed water regulating valve (water-cooled condenser only)

- E. Each starter shall include an advanced motor protection system incorporating electronic three phase overloads and current transformers. This electronic motor protection system shall monitor and protect against the following conditions:
 - 1. Three phase overload protection
 - 2. Overload protection during start-up
 - 3. Phase imbalance
 - 4. Phase loss
 - 5. Phase reversal
 - 6. Low voltage
 - 7. Under/over voltage protection (optional)

- F. Alternately the advanced motor protection system can be furnished in the chiller control panel.

- G. Each starter/control shall be designed and able to operate in temperatures up to 104 F (40 C).

- H. All field supplied wires, bus bars, and fittings shall be copper only.

- I. Provide in the starter panel:
 - 1. Circuit Breaker - Starter shall contain a circuit breaker. The disconnect handle shall be capable of being padlocked in the off position.

Chiller Replacement at
Bethel Middle School
Bethel, CT

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in strict accordance with manufacturer's requirements, shop drawings, and contract documents.
- B. A 20 mesh strainer shall be placed in the supply water line just prior to the inlet of the evaporator. Care shall be exercised when welding pipe or flanges to the evaporator to prevent any slag from entering the vessel.
- C. Adjust and level chiller in alignment on supports.
- D. Coordinate electrical installation with electrical contractor.
- E. Coordinate controls with control contractor.
- F. Provide all appurtenances required to insure a fully operational and functional chiller.

3.2 MANUFACTURER'S FIELD SERVICES

- A. Supply service of factory trained representative for a period of one days to supervise testing, start-up, and instruction on operation and maintenance to Owner.
- B. Supply initial charge of refrigerant and oil.

END OF SECTION 15685

PART 1 GENERAL

1.1 SUMMARY

- A. Scope: Extent of testing, adjusting and balancing work required by this Section.
- B. Systems: Testing, adjusting and balancing specified in this Section includes the following systems.
 - 1. Chiller.
 - 2. Chilled/Condenser water.
 - 3. Verify temperature control system operations

1.2 QUALITY ASSURANCE

- A. Tester's Qualifications: A specialist certified by the National Environmental Balancing Bureau (NEBB) or Associated Air Balance Council (AABC) with at least 3 years of experience in those testing, adjusting and balancing requirements similar to those required for this project, who is not the installer of the system to be tested and is otherwise independent of the project.
- B. Codes and Standards: Provide testing, adjusting and balancing conforming to American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), American National Standards Institute (ANSI), and either NEBB or AABC the following:
 - 1. American National Standards Institute (ANSI): Comply with the following:
 - a. S1.4 Specification For Sound Level Meters
 - b. S1.11 Specification for Octave-Band and Fractional-Octave-Band Analog and Digital Filters
 - 2. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE): Comply with ASHRAE recommendations pertaining to measurements, instruments, and testing, adjusting, and balancing.
 - 3. NEBB or AABC: Comply with NEBB'S "Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems" or comply with AABC MN-1 "National Standards," as applicable to mechanical air and hydronic distribution systems, and associated equipment and apparatus.
- C. Penalty: The Contractor shall submit the name of the organization he proposes to employ for approval within 45 days after contract award. If the Contractor fails to submit the name of an acceptable agency within the specified time, a firm may be selected to accomplish the work, and this selection shall be binding upon the Contractor at no additional cost.
- D. Calibration of Testing Instruments: All measurement instruments used for testing,

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15990
TESTING, ADJUSTING, AND BALANCING

adjusting, balancing, and commissioning shall be calibrated. The time between the most recent calibration data and the final test report date shall not be over 3 years.

1.3 SUBMITTALS

- A. Test Reports: Provide certified test reports, signed by the test and balance supervisor who performed the work. In addition, have the reports certified by a Professional Engineer who is familiar with testing and balancing and the project, and is registered in the jurisdiction where testing is being conducted. The final reports shall include identification and types of instruments used, and their most recent calibration date and calibration date.
- B. Standards: The Contractor shall deliver a copy of either NEBB or AABC standards for testing and balancing work associated with the project. This document shall serve as specific guidance to construction engineers as to minimum requirements.
- C. Maintenance Data: Include, in maintenance manuals, copies of certified test reports and identification of instruments.
- D. Qualifications: The Contractor shall submit the certified individual qualifications of all persons responsible for supervising and performing the actual work, the name of the certifying engineer, and the qualifications of the independent Registered Professional Engineer certifying the report.

1.4 AGENDA

- A. Agenda: A preliminary report and agenda shall be submitted and approved prior to the start of testing and balancing work.
 - 1. Review plans and specifications prior to installation of any of the affected systems, and submit a report indicating any deficiencies in the systems that would preclude the proper adjusting, balancing, and testing of the systems.
 - 2. The agenda shall include a general description of each air and water system with its associated equipment and operation cycles for heating, intermediate, and cooling.
 - 3. The agenda shall include a list of all air and water flow and air terminal measurements to be performed.
 - 4. The agenda shall incorporate the proposed selection points for sound measurements, including typical spaces as well as sound sensitive areas like conference rooms.
 - 5. The agenda shall also include specific test procedures and parameters for determining specified quantities (e.g. flow, drafts, sound levels) from the actual field measurements to establish compliance with contract requirements. Samples of forms showing application of procedures and calculations to typical systems shall be submitted.
 - 6. Specific test procedures for measuring air quantities at terminals shall specify type

Chiller Replacement at
Bethel Middle School
Bethel, CT

of instrument to be used, method of instrument application (by sketch) and factors for:

- a. Air terminal configuration.
 - b. Flow direction (supply or exhaust).
 - c. Velocity corrections.
 - d. Effective area applicable to each size and type of air terminal.
 - e. Density corrections.
7. The agenda shall include identification and types of measurement instruments to be used, and their most recent calibration date and calibration date.

1.5 JOB CONDITIONS

- A. General: Do not proceed with testing, adjusting and balancing work until the following conditions have been met.
1. Work has been completed and is operable. Ensure that there is no latent residual work yet to be completed on the tested equipment.
 2. Work scheduled for testing, adjusting and balancing is clean and free from debris, dirt and discarded building materials.
 3. All architectural openings (doors, windows, and other openings) which may affect the operation of the system to be tested, adjusted, and balanced shall at their normal states.
 4. All related mechanical systems which may affect the operation of the system to be tested, adjusted, and balanced shall be at their normal operating conditions.

PART 2 PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 PATCHING MATERIALS

- A. Material: Seal, patch and repair ductwork, piping and equipment drilled or cut for testing purposes.
1. Plastic plugs with retainers may be used to patch drilled holes in ductwork and housings.
 2. Piping shall be capped with materials the same as the piping system.
 3. Insulation shall be neatly hemmed with metal or plastic edging, leaving test points visible for future testing.

2.3 TEST INSTRUMENTS

- A. Standards: Utilize instruments and equipment of type, precision, and capacity as recommended in the following standards:

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15990
TESTING, ADJUSTING, AND BALANCING

1. NEBB "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
 2. AABC Manual MN-1.
- B. Test Instruments: All instruments used for measurements shall be accurate and calibration histories for each instrument shall be available for examination. Each test instrument shall be calibrated by an approved laboratory or by the manufacturer. A representative has the right to request instrument recalibration, or the use of other instruments and test methodology, where accuracy of readings is questionable.
- C. Additional Instruments: Permanently installed measuring instruments, such as temperature and pressure gauges, shall be checked against transfer standard instruments. Any instrument which does not meet specification requirement shall be replaced or recalibrated.
- D. Cone Instruments: The Contractor shall employ manufactured enclosure type cones, capable of air volume direct readings, for all diffuser air flow measurements. The readout meters shall meet calibration requirements.

PART 3 EXECUTION

3.1 PROCEDURES AND INSTRUMENTS, GENERAL

- A. Requirements: All systems and components thereof shall be adjusted to perform as required.
- B. Test Duration: Operating tests of heating and cooling coils, fans, and other equipment shall be of not less than four hours duration after stabilized operating conditions have been established. Capacities shall be based on temperatures and air and water quantities measured during such tests.
- C. Instrumentation: Method of application of instrumentation shall be in accordance with the approved agenda.
1. All instruments shall be applied in accordance with the manufacturer's certified instructions.
 2. All labor, instruments, and appliances required shall be furnished by the Design Builder. Permanently installed instruments used for the tests (e.g., flow meters and Btu meters) shall not be installed until the entire system has been cleaned and ready for operation.
 3. See Section 15130, "Meters and Gauges" for thermometer accuracy requirements.

Chiller Replacement at
Bethel Middle School
Bethel, CT

3.2 WATER SYSTEM PROCEDURES

- A. Adjustment: All heating and cooling water systems shall be adjusted to provide required quantity to or through each component.
- B. Metering: Water quantities and pressures shall be measured with calibrated meters.
 - 1. Venturi tubes, orifices, or other metering fittings and pressure gauges shall be used to measure water flow rates and balance systems. Systems shall be adjusted to provide the approved pressure drops through the heat transfer equipment (coils, converters, etc.) prior to the capacity testing.
 - 2. Where flow metering fittings are not installed, in air/water type heat transfer equipment, flow balance shall be determined by measuring the air side energy differential across the heat transfer equipment. Measurement of water temperature differential shall be performed with the air system, adjusted as described herein, in operation.
- C. Automatic Controls: Automatic control valves shall be positioned for full flow through the heat transfer equipment of the system during tests.
- D. Flow: Flow through bypass circuits at three-way valves shall be adjusted to equal that through the supply circuit, when the valve is in the bypass position.
- E. Distribution: Adjustment of distribution shall be affected by means of balancing devices (cocks, valves, and fittings) and automatic flow control valves as provided; service valves shall not be used.
 - 1. Where automatic flow control valves are utilized in lieu of Venturi tubes, only pressure differential need be recorded, provided that the pressure is at least the minimum applicable to the tag rating.
- F. Special Procedures: Where available pump capacity (as designed) is less than total flow requirements of individual heat transfer units of system served, full flow may be simulated by the temporary restriction of flow to portions of the system; specific procedures shall be delineated in the agenda.
- G. Existing Chilled Water: Existing balancing valve to be in the fully open position and use the existing chilled water pump VFD internal max speed setting to balance the system.

3.3 HEAT EXCHANGER CAPACITY VERIFICATION

- A. Air coil capacities shall be verified from air side measurement data. Capacities of coils shall be the difference of the energy carried by the air between the up stream and down stream of the coils.

SECTION 15990
TESTING, ADJUSTING, AND BALANCING

- B. The measured air flow rate for the fan may be used for air coil capacity calculations providing no ducted bypassing of coil is occurring.
- C. Capacity verifications shall be performed after air and water systems have been balanced.
- D. False load shall be applied if the upstream air or water does not meet the specified conditions at the time of test.

3.4 SOUND TEST PROCEDURES

- A. Scope: Tests of sound levels shall be made at each selection point included in the agenda.
- B. Timing: Sound level measurements shall be taken at times when the building is unoccupied, or when activity in surrounding areas and background noise level in areas tested are at a minimum and relatively free from sudden changes in noise levels.
 - 1. Measurements shall be taken with all equipment turned off, except that being tested.
 - 2. The required sound levels shall be measured at any point within a room not less than 6 feet from an air terminal or room unit, and not closer than 3 feet from any floor, wall, or ceiling surface.
- C. Meters: Sound levels shall be measured with a sound meter complying with ANSI S1.4. The "A" scale shall be used to measure over all sound levels. To determine the specified octave band levels, the above sound level meter, set on "C" scale, shall be supplemented by an octave band analyzer complying with ANSI S1.11.
- D. Equipment Components: The "Equipment Component" of room sound equals LPt-C. The "Equipment Component" of room sound (noise) levels shall be determined for each of eight octave bands as follows.
 - 1. Measure room sound pressure level "LPb" with equipment to be tested shut off.
 - 2. Measure room sound pressure level "LPt" with equipment to be tested turned on.
 - 3. Calculate LPt-LPb; if this value is less than 1, applicable test must be rerun with lower background level (LPb) unless LPt is within sound pressure level specified for equipment.
 - 4. Determine "c" from the table below:

LPt-LPb (db)	c (db)
1	7
2	4
3	3
4 to 4-1/2	2

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15990
TESTING, ADJUSTING, AND BALANCING

5 to 5-1/2	1-1/2
6 to 7-1/2	1
8 to 12	1/2
over 12	0

3.5 CERTIFIED REPORTS

- A. Submittals: Three copies of the reports described herein, covering air and water system performance, air motion (fpm), and sound pressure levels, shall be submitted prior to final tests and inspection.
- B. Instrument Records: Types, serial numbers, and dates of calibration of all instruments shall be included.
- C. Reports: Reports shall conspicuously identify items not conforming to contract requirements, or obvious maloperation and design deficiencies.
- D. Certification: The reports shall be certified by an independent Registered Professional Engineer who is versed in the field of air and water balancing and who is not affiliated with any firm involved in the design or construction phases of the project. Certification shall include checking of adherence to agenda, of calculations, of procedures, and evaluation of final summaries.

3.6 WATER SYSTEM DATA

- A. Report: The certified report for reach water system shall include the data listed below.
 - 1. Pumps:
 - a. Installation data
 - (a) Manufacturer and model
 - (b) Size
 - (c) Type drive
 - (d) Motor hp, voltage, phase, and full load amps
 - b. Design data
 - (a) gpm
 - (b) Head
 - (c) rpm, bhp, and amps
 - c. Recorded data
 - (a) Discharge pressures (full-flow and no-flow)
 - (b) Suction pressures (full-flow and no-flow) operating head
 - (c) Operating gpm (from pump curves if metering is not provided) no-load amps (where possible)
 - (d) Full-flow amps
 - (e) No-flow amps

Chiller Replacement at
Bethel Middle School
Bethel, CT

2. Chillers:
 - a. Installation data
 - (a) Manufacturer, model, and type
 - (b) gpm
 - (c) Inlet (entering) and outlet (leaving) temperatures
 - (d) Water pressure drop
 - b. Recorded data
 - (a) gpm (if metered)
 - (b) Entering and leaving water temperatures - system
 - (c) Water pressure drop
 - (d) Heating (or cooling) media (conditions) - entering and leaving water temperature
 - (e) Heating (or cooling) media - flow (gpm)
 - c. Recorded data
 - (a) Type of equipment and identification (location or number designation)
 - (b) Entering and leaving water temperatures
 - (c) gpm (if metered) Temperature rise or drop

3.7 SOUND DATA

- A. Report: The certified report shall record data on sound levels, taken at each selected location, as follows.
 1. Source of sound and location
 2. Diagram or description of relationship of sound source to measuring instrument
 3. "A" scale readings equipment being tested turned off (ambient) equipment being tested turned on (operating conditions)
 4. Readings at each specified octave band frequency equipment being tested turned off (ambient) equipment being tested turned on (operating conditions)
 5. "Equipment Components" of sound (noise) levels with applicable calculations per "Sound Test Procedures"
 6. Graph showing relationship between pressure levels specified and recorded readings
- B. Retest: Subsequent to any correctional construction work, such as acoustic corrections, measurement shall be made to verify that associated air and water quantities, as previously measured, have not been disrupted.
 1. Certified report shall record all sound data, and their locations, after final adjustments of air and water systems involves.

3.8 FINAL COMMISSIONING TESTS, INSPECTIONS AND ACCEPTANCE

- A. Scope: Test shall be made to demonstrate that capacities and performance of air and water systems comply with contract requirements.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 15990
TESTING, ADJUSTING, AND BALANCING

1. At the time of final inspection, the Design Builder shall recheck, random selection of data (water and air quantities, air motion, and sound levels) recorded in the certified report.
 2. Points and areas for recheck shall be selected by the commissioning team.
 3. Measurement and test procedures shall be the same as approved for work forming basis of certified report.
 4. Selections for recheck (specific plus random), in general, will not exceed 25 percent of the total number tabulated in the report, except that special air systems may require a complete recheck for safety reasons.
- B. Retests: If random tests elicit a measured flow deviation of 10 percent or more from, or a sound level of 2 db or more greater than, that recorded in the certified report listings, as 10 percent or more of the rechecked selections, the report shall be automatically rejected. In the event the report is rejected, all systems shall be readjusted and tested, new data recorded, new certified reports submitted, and new inspection tests made, all at no additional cost. Retainage time shall be based on the date of the final acceptance of the certified report.
- C. Marking of Settings: Following final acceptance of certified reports, the settings of all valves, splitters, dampers, and other adjustment devices shall be permanently marked by the Design Builder so that adjustment can be restored if disturbed at any time. Devices shall not be marked until after final acceptance.

END OF SECTION 15990

Chiller Replacement at
Bethel Middle School
Bethel, CT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 16.

1.2 SUMMARY

- A. This Section includes general administrative, procedural, and other requirements for electrical installations. The following requirements are included in this Section to expand the requirements specified in Divisions 1 through 16:
 - 1. Submittals.
 - 2. Quality control.
 - 3. Definitions and abbreviations.
 - 4. Scheduling.
 - 5. Coordination drawings.
 - 6. Record documents.
 - 7. Maintenance manuals.
 - 8. Delivery, storage, and handling.
 - 9. Products.
 - 10. Rough-ins.
 - 11. Electrical installations.
 - 12. Permits and instructions.
 - 13. Field quality control.
 - 14. Protection.
 - 145. Additional work.
 - 156. Electrical schedules.
 - 167. Cutting and patching.

1.3 SUBMITTALS

- A. General: Follow the procedures specified in Division 1.
- B. Increase, by the quantity listed below, the number of electrical related shop drawings, product data, and samples submitted, to allow for required distribution plus two copies of each submittal required, which will be retained by the Electrical Consulting Engineer.
 - 1. Shop Drawings - Initial Submittal: 1 additional blue- or black-line prints.
 - 2. Shop Drawings - Final Submittal: 1 additional blue- or black-line prints.
 - 3. Product Data: 1 additional copy of each item.
 - 4. Samples: 1 addition as set.
- C. Additional copies may be required by individual sections of these Specifications.

1.4 QUALITY CONTROL

- A. Functional and Operational Test Procedure:
 - 1. Test procedure to completely test all systems as to their functional and sequential operation.
 - 2. Submit two (2) draft copies for review before conducting test.
 - 3. Certify that the test procedure was used and testing completed, and that all systems are operational and functioning properly.
 - 4. Submit certified Test Procedure for review prior to the date of final inspection.
 - 5. Systems to be covered by test procedure:
 - a. Power Distribution
 - b. Equipment shut-down requirements
- B. Other Tests and Certifications for:
 - 1. Grounding System: As specified under Section 16452.

1.5 DEFINITIONS AND ABBREVIATIONS

- A. Electrical Definitions: As defined by NEC, Article 100.
- B. The term "indicated" shall mean "as shown on contract documents (specifications, drawings, and related attachments)".
- C. The term "provide" shall mean "to furnish, install and connect completely".
- D. The term "size" shall mean one or more of the following: "length, current and voltage rating, number of poles, NEMA size, and other similar electrical characteristics".
- E. The term "space" on panelboard and switchboard schedules shall mean "provide space to install the number of poles and size of the protective device indicated with all the necessary buss and fittings to install the device at some future date".

1.6 SCHEDULING

- A. Coordinate electrical work with other divisions of this project.
- B. Coordinate electrical work with Owner.
- C. Written requests for approval for planned shutdowns or interruption of Owner's operation or equipment shall be made 72 hours prior to the start of the requested periods.
- D. Written notification for on site training of Owner's personnel shall be made 1 week prior to the start of the requested training period.

1.7 COORDINATION DRAWINGS

- A. Prepare coordination drawings in accordance with Division 1 to a scale of 1/4"=1'-0" or larger; detailing major elements, components, and systems of electrical equipment

and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

1. Indicate the proposed locations of major raceway systems, equipment, and materials. Include the following:
 - a. Clearances for servicing equipment, including space for equipment disassembly required for periodic maintenance.
 - b. Fire-rated wall and floor penetrations.
 - c. Equipment connections and support details.
2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
4. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, raceway systems components, Exhaust/Kitchen hoods, and other ceiling-mounted devices.

1.8 RECORD DOCUMENTS

- A. Prepare record documents in accordance with the requirements in Division 1. In addition to the requirements specified in Division 1, indicate installed conditions for:
 1. Major raceway systems, size and location, for both exterior and interior; locations of control devices; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.
 2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 3. Approved substitutions, Contract Modifications, and actual equipment and materials installed.

1.9 MAINTENANCE MANUALS

- A. Prepare maintenance manuals in accordance with Division 1. In addition to the requirements specified in Division 1, include the following information for equipment items:
 1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
 2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
 3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

4. Servicing instructions and lubrication charts and schedules.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Unless otherwise indicated, all electrical equipment has been based on General Electric products.
- B. As specified under other RELATED SECTIONS. Comparable manufacturers may be utilized, and include the following:
 1. Eaton Corp.
 2. Schneider Electric, Square D
 3. Siemens
- C. As specified on Drawings.

2.2 MATERIAL

- A. General:
 1. Unless otherwise indicated, all raceways for service, feeders, branch and control wiring are RSC or IMC. See Section 16110.
 2. Unless otherwise indicated, wiring to equipment and motors may be installed in liquid tight flexible conduit, or in interior locations in flexible metal conduit, with a maximum length of six (6) feet.
 3. Unless otherwise indicated, all conductors to be copper THHN/THWN-2.
 4. Unless otherwise indicated, all outlet and switch boxes to be cast iron with threaded hubs.
 5. In interior protected locations, where recessed in ceiling and walls, outlet and switch boxes may be stamped steel.
 6. Unless otherwise indicated, provide white, heavy duty grade, 20 ampere, receptacles and switches. Plates shall be 302 stainless steel, satin finish. Plates for surface mounted interior boxes may be stamped steel. Plates exposed to weather or water to be metal, weatherproof type.
- B. As specified under RELATED SECTIONS.
- C. As specified on Drawings.

2.3 EQUIPMENT

- A. General:

1. Unless otherwise indicated, externally operated safety switches are unfused, solid neutral, heavy duty, and selected to meet the load requirements.
- B. As specified under RELATED SECTIONS.
- C. As specified on Drawings.

2.4 FABRICATION

- A. General:
 1. Unless otherwise indicated, all enclosures are NEMA Type 1. NEMA Type 3R shall be used for wet/damp locations.
- B. As specified under RELATED SECTIONS.
- C. As specified on Drawings.

PART 3 EXECUTION

3.1 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications in Divisions 2 through 16 for rough-in requirements.
- C. Contractor is to provide connections, both power and control as noted and as required for respective equipment.

3.2 ELECTRICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:
 1. Coordinate electrical systems, equipment, and materials installation with other building components. Electrical plans and details do not show all interferences and conditions, visible and/or hidden, that may exist. Before selecting material and equipment, and proceeding with work, inspect areas where material and equipment are to be installed to insure suitability, and check needed space for placements, clearances and interconnections. Before cutting or drilling into building elements inspect and layout work to avoid damaging structural elements or building utilities.
 2. Electrical plans, details, and diagrams show the general location and arrangement of electrical systems. They are diagrammatic and do not show all conduit bodies, connectors, bends, fittings, hangers, and additional pull and

SECTION 16010
BASIC ELECTRICAL REQUIREMENTS

- junction boxes which the Contractor must provide to complete the electrical system.
3. Verify all dimensions by field measurements.
 4. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.
 5. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
 6. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building. Verify dimensional constraints of building door openings and passageways, and the maximum floor loadings, for the movement of selected material and equipment. Order equipment and material, broken down as may be required, to meet these constraints.
 7. Measurement from above finished floor (AFF) shall be taken from the finished floor surface to the top of wall receptacles and switch boxes, to the centerline of wall lighting outlet boxes, to the top of wall mounted equipment enclosures, to the centerline of top most switch handle, or to the lowest surface of ceiling lighting fixtures and other ceiling mounted equipment.
 - a. Unless otherwise indicated, wall switch boxes shall be 46 inches AFF.
 - b. Unless otherwise indicated, receptacle boxes shall be 18 inches AFF. Receptacle mounted above counter and at furniture locations shall be coordinated with architectural elements. Coordinate with Architect.
 - c. Verify connection mounting heights with kitchen equipment.
 - d. Surface raceway heights shall be coordinated with Architectural requirements.
 8. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible. Switch and receptacle heights shall meet handicap accessible code requirements.
 9. Coordinate connection of electrical systems with incoming utilities and services. Comply with requirements of governing regulations, power, telephone, and data service companies, and controlling agencies. Provide required connection for each service. Provide power connection to equipment. Coordinate with other Divisions.
 10. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Engineer.

Chiller Replacement at
Bethel Middle School
Bethel, CT

11. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
12. Conduit Sizing:
 - a. Unless otherwise indicated, conduit size for indicated conductor shall be based on Chapter 9 of NEC.
 - b. Conduit: 1/2 inch minimum size.
13. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Measure and locate placement of equipment and materials in relation to building structure and surfaces, and between equipment to be installed and wired. Maintain required minimum access spacing for equipment and enclosures.
14. Install access panel or doors where units are concealed behind finished surfaces. Access panels and doors are specified elsewhere.
15. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
16. Unless otherwise noted, individual raceway runs are required for each kitchen equipment component. Connection shall be routed down existing walls exposed, concealed in new walls, and/or under slab to the respective area as noted.

3.3 PERMITS AND INSPECTIONS

- A. Obtain and pay for all required permits and arrange for all required inspections in accordance with state and local governing authorities.
- B. Final Electrical Inspection Certificate from inspection agency or governing authority.

3.4 FIELD QUALITY CONTROL

- A. Perform field tests as specified under other electrical sections.
- B. Arrange for local Inspection Authorities to inspect work performed prior to burial, closing-in behind wall and above ceiling, or encased in concrete. Also arrange for final inspection of work and obtain Final Inspection Certificate before final inspection of work by Owner or his representative.

3.5 PROTECTION

- A. Protect personnel from coming in contact with live parts.
- B. During remodeling or alteration work, maintain fire ratings of walls, floors and ceilings when work is left unattended.

- C. Protect from damage and theft equipment and materials provided or supplied by others in accordance with manufacturer's recommendation and warranties, and with electrical standards and practices.

3.6 ADDITIONAL WORK

- A. Provide connections for power and controls to mechanical equipment being supplied under other divisions.

3.7 ELECTRICAL SCHEDULES

- A. As specified in related sections or shown on drawings.

3.8 CUTTING AND PATCHING

- A. General: Perform cutting and patching in accordance with Division 1. In addition to the requirements specified in Division 1, the following requirements apply:
 - 1. Perform cutting, fitting, and patching of electrical equipment and materials required to:
 - a. Uncover Work to provide for installation of ill-timed Work.
 - b. Remove and replace defective Work.
 - c. Remove and replace Work not conforming to requirements of the Contract Documents.
 - d. Remove samples of installed Work as specified for testing.
 - e. Install equipment and materials in existing structures.
 - f. Upon written instructions from the Engineer, uncover and restore Work to provide for Engineer observation of concealed Work.
 - 2. Cut, remove, and legally dispose of selected electrical equipment, components, and materials as indicated, including but not limited to removal of electrical items indicated to be removed and items made obsolete by the new Work.
 - 3. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
 - 4. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
 - 5. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
 - 6. Patch existing finished surfaces and building components using new materials matching existing materials and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.
 - 7. Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.

END OF SECTION 16010

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 16050
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Requirements specified in other Division 16 Sections apply to this section.

1.2 SUMMARY

- A. This Section includes limited scope general construction materials and methods for application with electrical installations as follows:
 - 1. Selective demolition including:
 - a. Nondestructive removal of materials and equipment for reuse or salvage as indicated.
 - b. Dismantling electrical materials and equipment made obsolete by these installations.
 - 2. Miscellaneous metals for support of electrical materials and equipment.
 - 3. Fire rated wood grounds, nailers, blocking, fasteners, and anchorage for support of electrical materials and equipment.
 - 4. Joint sealers for sealing around electrical materials and equipment; and for sealing penetrations in fire and smoke barriers, floors, and foundation walls.
 - 5. Access panels and doors in walls, ceilings, and floors for access to electrical materials and equipment.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for the following products:
 - 1. Access panels and doors.
 - 2. Joint sealers.
- C. Shop drawings detailing fabrication and installation for metal fabrications, and wood supports and anchorage for electrical materials and equipment.
- D. Coordination drawings for access panel and door locations in accordance with Division 16 Section "Basic Electrical Requirements."
- E. Samples of joint sealer, consisting of strips of actual products showing full range of colors available for each product.
- F. Welder certificates, signed by Contractor, certifying that welders comply with requirements specified under "Quality Assurance" article of this Section.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 16050
BASIC ELECTRICAL MATERIALS AND METHODS

- G. Schedules indicating proposed methods and sequence of operations for selective demolition prior to commencement of Work. Include coordination for shut-off of electrical service, and details for dust and noise control.
 - 1. Coordinate sequencing with construction phasing and Owner occupancy specified in Division 1.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer for the installation and application of joint sealers, access panels, and doors.
- B. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."
 - 1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- C. Fire-Resistance Ratings: Where a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in the UL "Building Materials Directory" for rating shown.
 - 1. Provide UL Label on each fire-rated access door.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver joint sealer materials in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.
- B. Store and handle joint sealer materials in compliance with the manufacturers' recommendations to prevent their deterioration and damage.

1.6 PROJECT CONDITIONS

- A. Conditions Affecting Selective Demolition: The following project conditions apply:
 - 1. Protect adjacent materials indicated to remain or in the other phases of the proposed construction. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
 - 2. Locate, identify, and protect electrical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.
 - 3. Arrange for electric service change-overs during periods when the building is not occupied. This may include week-ends and evening hours. Coordinate with Owner's representatives.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 16050
BASIC ELECTRICAL MATERIALS AND METHODS

- B. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits permitted by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.

1.7 SEQUENCE AND SCHEDULING

- A. Coordinate the shut-off and disconnection of electrical power with the Owner.
- B. Notify the Engineer at least 5 days prior to commencing demolition operations.
- C. Perform demolition in sequencing/phases as noted and as required.

PART 2 PRODUCTS

2.1 MISCELLANEOUS METALS

- A. Steel plates, shapes, bars, and bar grating: ASTM A 36.
- B. Cold-Formed Steel Tubing: ASTM A 500.
- C. Hot-Rolled Steel Tubing: ASTM A 501.
- D. Steel Pipe: ASTM A 53, Schedule 40, welded.
- E. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout, recommended for interior and exterior applications.
- F. Fasteners: Zinc-coated, type, grade, and class as required.

2.2 MISCELLANEOUS LUMBER

- A. Framing Materials: Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPA rules, or Number 3 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent.
- B. Construction Panels: Plywood panels; APA C-D PLUGGED INT, with exterior glue; thickness as indicated, or if not indicated, not less than 3/4 inches.

2.3 JOINT SEALER

- A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.
- B. Colors: As selected by the Architect from manufacturer's standard colors.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 16050
BASIC ELECTRICAL MATERIALS AND METHODS

- C. Elastomeric Joint Sealers: Provide the following types:
1. One-part, nonacid-curing, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer.
 2. One-part, mildew-resistant, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, and nonporous joint substrates; formulated with fungicide; intended for sealing interior joints with nonporous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes.
 3. Available Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:
 - a. One-Part, Nonacid-Curing, Silicone Sealant:
 - 1) Bostik - "Chem-Caulk 2000"
 - 2) Dow Corning - "Dow Corning 790"
 - 3) Pecora Corp - "864NST"
 - b. One-Part, Mildew-Resistant, Silicone Sealant:
 - 1) Dow Corning - "Dow Corning 786"
 - 2) GE - "SCS 1702"
 - 3) Pecora Corp. - "898"
- D. Acrylic-Emulsion Sealants: One-part, nonsag, mildew-resistant, paintable complying with ASTM C 834 recommended for exposed applications on interior and protected exterior locations involving joint movement of not more than plus or minus 5 percent.
1. Available Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:
 - a. Bostik - "Chem-Caulk 600"
 - b. Pecora Corp. - "AC-20"
 - c. Tremco - "Tremflex 834"
- E. Fire-Resistant Joint Sealers: Two-part, foamed-in-place, silicone sealant formulated for use in through-penetration fire-stopping around cables, conduit, pipes, and duct penetrations through fire-rated walls and floors. Sealants and accessories shall have fire-resistance ratings indicated, as established by testing identical assemblies in accordance with ASTM E 814, by Underwriters' Laboratories, Inc., or other testing and inspection agency acceptable to authorities having jurisdiction.
1. Available Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:
 - a. Dow Corning - "Dow Corning Fire Stop Foam"
 - b. GE - "Pensil 851"
 - c. Hilti - "CP-620 Fire Stop Foam"

Chiller Replacement at
Bethel Middle School
Bethel, CT

2.4 ACCESS DOORS

- A. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.

- B. Frames: 16-gage steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.
 - 1. For installation in masonry, concrete, ceramic tile, or wood paneling: 1 inch-wide-exposed perimeter flange and adjustable metal masonry anchors.
 - 2. For gypsum wallboard or plaster: perforated flanges with wallboard bead.
 - 3. For full-bed plaster applications: galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame.

- C. Flush Panel Doors: 14-gage sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.
 - 1. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.

- D. Locking Devices: Flush, screwdriver-operated cam locks.

- E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the Work include, but are not limited to, the following:
 - 1. Bar-Co., Inc.
 - 2. J.L. Industries.
 - 3. Karp Associates, Inc.
 - 4. Milcor Div. Inryco, Inc.
 - 5. Nystrom, Inc.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting installation and application of joint sealers and access panels. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION FOR JOINT SEALER

- A. Surface Cleaning for Joint Sealers: Clean surfaces of joints immediately before applying joint sealers to comply with recommendations of joint sealer manufacturer.

SECTION 16050
BASIC ELECTRICAL MATERIALS AND METHODS

- B. Apply joint sealer primer to substrates as recommended by joint sealer manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.

3.3 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Field Welding: Comply with AWS "Structural Welding Code."

3.4 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.
- D. Do not install wood materials in areas being utilized as air plenum or other spaces where a potential combustible hazard exists.

3.5 APPLICATION OF JOINT SEALERS

- A. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
 - 1. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.
 - 2. Comply with recommendations of ASTM C 790 for use of acrylic- emulsion joint sealants.
- B. Tooling: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.
- C. Installation of Fire-Stopping Sealant: Install sealant, including forming, packing, and other accessory materials, to fill openings around electrical services penetrating floors and walls, to provide fire-stops with fire-resistance ratings indicated for floor or wall assembly in which penetration occurs. Comply with installation requirements established by testing and inspecting agency.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 16050
BASIC ELECTRICAL MATERIALS AND METHODS

3.6 INSTALLATION OF ACCESS DOORS

- A. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.

- B. Adjust hardware and panels after installation for proper operation.

END OF SECTION 16050

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Requirements specified in other Division 16 Sections apply to this Section.

1.2 SUMMARY

- A. This Section includes raceways for electrical wiring. Types of raceways in this section include the following:
 - 1. Rigid metal conduit.
 - 2. Intermediate metal conduit.
 - 3. Liquidtight flexible conduit.
 - 4. Flexible metal conduit.
 - 5. Electrical Metallic Tubing (EMT).
 - 6. Rigid nonmetallic conduit.
 - 7. Wireways.
- B. Related Sections: The following Division 16 Sections contain requirements that relate to this Section:
 - 1. "Wires and Cables" for other wiring methods.
 - 2. "Supporting Devices" for raceway supports.
 - 3. "Cabinets, Boxes, and Fittings" for boxes used with conduit and tubing systems.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product Data for the following products:
 - 1. Raceway system.
- C. Installation Instructions: Manufacturer's written installation instructions for wireway, and raceway products.

1.4 QUALITY ASSURANCE

- A. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."
- B. NEMA Compliance: Comply with applicable requirements of NEMA standards pertaining to raceways.

- C. UL Compliance and Labeling: Comply with applicable requirements of UL standards pertaining to electrical raceway systems. Provide raceway products and components listed and labeled by UL, ETL, or CSA.

1.5 SEQUENCING AND SCHEDULING

- A. Coordinate with other Work, including metal and concrete deck installation, as necessary to interface installation of electrical raceways and components with other Work.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - B. Conduit Bodies:
 1. Appleton Electric Co.
 2. Carlon
 3. Killark Electric Mfg. Co.
 4. O-Z/Gedney
 5. Spring City Electrical Mfg. Co.
 - C. Wireways:
 1. Erickson Electric Equipment Co.
 2. GS Metals Corp.
 3. Hoffman Engineering Co.

2.2 METAL CONDUIT AND TUBING

- A. Rigid Steel Conduit: ANSI C80.1.
- B. Intermediate Steel Conduit: UL 1242.
- C. Electrical Metallic Tubing and Fittings: ANSI C80.3
- D. Flexible Metal Conduit: UL 1, zinc-coated steel.
- E. Liquid-tight Flexible Metal Conduit and Fittings: UL 360. Fittings shall be specifically approved for use with this raceway.

2.3 NONMETALLIC CONDUIT AND DUCTS

- A. Rigid Nonmetallic Conduit: NEMA TC 2 and UL 651, Schedule 40 or 80 PVC.

- B. PVC Conduit and Tube Fittings: TC 3; match to conduit or conduit/tube type and material.
- C. Conduit, Tubing and Duct Accessories: Types, sizes and materials complying with manufacturer's published product information. Mate and match to raceway.

2.4 CONDUIT BODIES

- A. General: Types, shapes, and sizes as required to suit individual applications and NEC requirements. Provide matching gasketed covers secured with corrosion-resistant screws.
- B. Metallic Conduit and Tubing: Use metallic conduit bodies. Use bodies with threaded hubs for threaded raceways.
- C. Conduit Bodies 1 Inch and Smaller: Use bodies with compression- type threaded connectors.

2.5 WIREWAYS

- A. General: Electrical wireways shall be of types, sizes, and number of channels indicated. Fittings and accessories including but not limited to couplings, offsets, elbows, expansion joints, adapters, hold-down straps, and end caps shall match and mate with wireway as required for completed system. Where features are not indicated, select to fulfill wiring requirements and comply with applicable provisions of NEC.
- B. Wireway covers to be hinged type.

PART 3 EXECUTION

3.1 WIRING METHOD

- A. Outdoors: Use the following wiring methods:
 - 1. Exposed / Concealed: Rigid metal conduit, Intermediate metal conduit.
 - 2. Underground: Rigid metal conduit, Rigid nonmetallic conduit.
 - 2. Connection to Vibrating Equipment: Including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment: liquidtight flexible metal conduit. Maximum length six (6) feet.
- B. Indoors: Use the following wiring methods:
 - 1. Connection to Vibrating Equipment: Including transformers and hydraulic, pneumatic or electric solenoid or motor-operated equipment: Flexible metal conduit. Maximum length six (6) feet.
 - 2. Exposed/Concealed in unfinished areas: branch circuits: EMT.
 - 3. Connection to vibrating equipment and hydraulic, pneumatic, or electric solenoid or motor-driven equipment in moist or humid location or corrosive

Chiller Replacement at
Bethel Middle School
Bethel, CT

atmosphere, or where subject to water spray or dripping oil, grease, or water:
Liquidtight flexible metal conduit. Maximum length six (6) feet.

4. In finished areas where conduit cannot be concealed: Wiremold surface raceway.

3.2 INSTALLATION

- A. General: Install electrical raceways in accordance with manufacturer's written installation instructions, applicable requirements of NEC, and as follows:
- B. Conceal Conduit, unless indicated otherwise, within finished walls, ceilings, and floors. Keep raceways at least 6 inches away from parallel runs of flues and hot water pipes. Install raceways level and square and at proper elevations.
- C. Elevation of Raceway: Where possible, install horizontal raceway runs above water and sanitary piping.
- D. Complete installation of electrical raceways before starting installation of conductors within raceways.
- E. Provide supports for raceways as specified elsewhere in Division 16.
- F. Prevent foreign matter from entering raceways by using temporary closure protection.
- G. Protect stub-ups from damage where conduits rise from floor slabs. Arrange so curved portion of bends is not visible above the finished slab.
- H. Make bends and offsets so the inside diameter is not effectively reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel.
- I. Use raceway fittings that are of types compatible with the associated raceway and suitable for the use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings except as otherwise indicated.
- J. Run concealed raceways with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions except as otherwise indicated.
- K. Install exposed raceways parallel and perpendicular to nearby surfaces or structural members and follow the surface contours as much as practical.
- L. Run exposed, parallel, or banked raceways together. Make bends in parallel or banked runs from the same center line so that the bends are parallel. Factory elbows may be used in banked runs only where they can be installed parallel. This requires

Chiller Replacement at
Bethel Middle School
Bethel, CT

that there be a change in the plane of the run such as from wall to ceiling and that the raceways be of the same size. In other cases provide field bends for parallel raceways.

- M. Join raceways with fittings designed and approved for the purpose and make joints tight. Where joints cannot be made tight, use bonding jumpers to provide electrical continuity of the raceway system. Make raceway terminations tight. Where terminations are subject to vibration, use bonding bushings or wedges to assure electrical continuity. Where subject to vibration or dampness, use insulating bushings to protect conductors.
- N. Tighten set screws of threadless fittings with suitable tool.
- O. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely and install the locknuts with dished part against the box. Where terminations cannot be made secure with one locknut, use two locknuts, one inside and one outside the box.
- P. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.
- Q. Install pull wires in empty raceways. Use no. 14 AWG zinc-coated steel or monofilament plastic line having not less than 200-lb tensile strength. Leave not less than 12 inches of slack at each end of the pull wire.
- R. Install raceway sealing fittings in accordance with the manufacturer's written instructions. Locate fittings at suitable, approved, accessible locations and fill them with UL- listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points and elsewhere as indicated:
 - 1. Where conduits pass from warm locations to cold locations, such as the boundaries of conditioned spaces and mechanical spaces.
 - 2. Where required by the NEC.
- S. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs and set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; flexible metal conduit may be used 6 inches above the floor.
- T. Flexible Connections: Use short length (maximum of 6 ft.) of flexible conduit for recessed and semirecessed lighting fixtures, for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquidtight flexible conduit in wet

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 16110
RACEWAYS

locations. Install separate ground conductor across flexible connections. Light fixture flexible connections shall not exceed 15 ft.

3.3 ADJUSTING AND CLEANING

- A. Upon completion of installation of raceways, inspect interiors of raceways; clear all blockages and remove burrs, dirt, and construction debris.
- B. Paint Finish: Repair damage using surface raceway manufacturer's touch-up paint.

END OF SECTION 16110

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Requirements of other specified Division 16 Sections apply to this section.

1.2 SUMMARY

- A. This Section includes wires, cables, and connectors for power, lighting, signal, control and related systems rated 600 volts and less.

1.3 SUBMITTALS

- A. Product Data for electrical wires, cables and connectors.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with provisions of the following code:
 - B. NFPA 70 "National Electrical Code."
 - 1. Conform to applicable codes and regulations regarding toxicity of combustion products of insulating materials.
 - C. UL Compliance: Provide components which are listed and labeled by UL under the following standards.
 - 1. UL Std. 83 Thermoplastic-Insulated Wires and Cables.
 - 2. UL Std. 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors.
 - 3. UL Std. 1569 Metal Clad Cable.
 - D. NEMA/ICEA Compliance: Provide components which comply with the following standards:
 - 1. WC-5 Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
 - E. IEEE Compliance: Provide components which comply with the following standard.
 - 1. Std. 82 Test procedures for Impulse Voltage Tests on Insulated Conductors.

PART 2 PRODUCTS

2.1 MANUFACTURERS

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 16120
WIRES AND CABLES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:
 - 1. Wire and Cable:
 - a. AFC Cable Systems
 - b. General Cable
 - c. Southwire Company
 - 2. Connectors for Wires and Cable Conductors:
 - a. AMP
 - b. 3M Company
 - c. O-Z/Gedney Co.
 - d. Square D Company.

2.2 WIRES AND CABLES

- A. General: Provide wire and cable suitable for the temperature, conditions and location where installed.
- B. Conductors: Provide solid conductors for power and lighting circuits no. 10 AWG and smaller. Provide stranded conductors for sizes no. 8 AWG and larger.
- C. Conductor Material: copper for all wires and cables.
- D. Conductor sizes indicated are based on copper.
- E. Insulation: Provide THHN/THWN-2 insulation for all conductors size 500MCM and larger, and no. 8 AWG and smaller. For all other sizes provide, THHN/THWN-2 or XHHW insulation as appropriate for the locations where installed.
- F. Color Coding for phase identification in accordance with Table 1 in Part 3 below.
- G. Jackets: Factory-applied nylon or PVC external jacketed wires and cables for pulls in raceways over 100-feet in length, for pulls in raceways with more than three equivalent 90 deg. bends, for pulls in conduits underground or under slabs on grade, and where indicated.
- H. Cables: Provide the following type(s) of cables in NEC approved locations and applications where indicated. Provide cable UL listed for particular application:
 - 1. Metal-Clad Cable: Type MC - limited to lighting fixtures and outlets concealed in gypsum wall partitions.
 - 2. Metal clad above ceilings to be limited to five (5) feet whips.

Chiller Replacement at
Bethel Middle School
Bethel, CT

2.3 CONNECTORS FOR CONDUCTORS

- A. Provide UL-listed factory-fabricated, solderless metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Use connectors with temperature ratings equal to or greater than those of the wires upon which used.

PART 3 EXECUTION

3.1 WIRING METHOD

- A. Use the following wiring methods as indicated:
 - 1. Wire: install all wire in raceway.
 - 2. Metal Clad Cable, Type MC: where wiring concealed in gypsum wall partitions, ceilings, for connections from raceway outlet boxes to lighting fixtures, unless otherwise noted.

3.2 INSTALLATION OF WIRES AND CABLES

- A. General: Install electrical cables, wires, and connectors in compliance with NEC.
- B. Coordinate cable installation with other Work.
- C. Pull conductors simultaneously where more than one is being installed in same raceway. Use UL listed pulling compound or lubricant, where necessary.
- D. Use pulling means including, fish tape, cable, rope, and basket weave wire/cable grips which will not damage cables or raceways. Do not use rope hitches for pulling attachment to wire or cable.
- E. Conceal all cable in finished spaces.
- F. Keep conductor splices to minimum.
- G. Install splice and tap connectors which possess equivalent or better mechanical strength and insulation rating than conductors being spliced.
- H. Use splice and tap connectors which are compatible with conductor material.
- I. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than no 10 AWG cabled in individual circuits. Make terminations so there is no bare conductor at the terminal.

SECTION 16120
WIRES AND CABLES

- J. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

- A. Prior to energizing, check installed wires and cables with megohm meter to determine insulation resistance levels to assure requirements are fulfilled.
- B. Prior to energizing, test wires and cables for electrical continuity and for short-circuits.
- C. Subsequent to wire and cable hook-ups, energize circuits and demonstrate proper functioning. Correct malfunctioning units, and retest to demonstrate compliance.
- D. TABLE 1: Color Coding for Phase Identification:
 - 1. Color code secondary service, feeder, and branch circuit conductors with factory applied color as follows:

<u>208Y/120Volts</u>	<u>Phase</u>	<u>480Y/277Volts</u>
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray
Green	Ground	Green w/yellow strip

END OF SECTION 16120

Chiller Replacement at
Bethel Middle School
Bethel, CT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Requirements specified in other Division 16 Sections apply to this section.

1.2 SUMMARY

- A. This section includes cabinets, boxes, and fittings for electrical installations and certain types of electrical fittings not covered in other sections. Types of products specified in this Section include:
 - 1. Outlet and device boxes.
 - 2. Pull and junction boxes.
 - 3. Cabinets.
 - 4. Hinged door enclosures.
- B. Conduit-body-type electrical enclosures and wiring fittings are specified in Division 16 Section "Raceways."

1.3 DEFINITIONS

- A. Cabinets: An enclosure designed either for surface or for flush mounting and having a frame, or trim in which a door or doors may be mounted.
- B. Device Box: An outlet box designed to house a receptacle device or a wiring box designed to house a switch.
- C. Enclosure: A box, case, cabinet, or housing for electrical wiring or components.
- D. Outlet Box: A wiring enclosure where current is taken from a wiring system to supply utilization equipment.
- E. Wiring Box: An enclosure designed to provide access to wiring systems or for the mounting of indicating devices or of switches for controlling electrical circuits.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections:
 - 1. Product data for cabinets and enclosures with classification higher than NEMA 1.
 - 2. Shop drawings for boxes, enclosures and cabinets that are to be shop fabricated, (nonstock items). For shop fabricated junction and pull boxes, show accurately scaled views and spatial relationships to adjacent equipment. Show box types, dimensions, and finishes.

Chiller Replacement at
Bethel Middle School
Bethel, CT

1.5 QUALITY ASSURANCE

- A. UL Listing and Labeling: Items provided under this section shall be listed and labeled by UL.
- B. Nationally Recognized Testing Laboratory Listing and Labeling (NRTL): Items provided under this section shall be listed and labeled by a NRTL. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.
- C. National Electrical Code Compliance: Components and installation shall comply with NFPA 70 "National Electrical Code."
- D. NEMA Compliance: Comply with NEMA Standard 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)."

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Cabinets:
 - a. Electric Panelboard, Inc.
 - b. Erickson Electrical Equipment Co.
 - c. Hoffman Engineering Co.
 - d. Parker Electrical Mfg. Co.
 - e. Spring City Electrical Mfg. Co.
 - f. Square D Co.

2.2 CABINETS, BOXES, AND FITTINGS, GENERAL

- A. Electrical Cabinets, Boxes, and Fittings: Of indicated types, sizes, and NEMA enclosure classes. Where not indicated, provide units of types, sizes, and classes appropriate for the use and location. Provide all items complete with covers and accessories required for the intended use. Provide gaskets for units in damp or wet locations. This applies to kitchen areas.

2.3 MATERIALS AND FINISHES

- A. Sheet Steel: Flat-rolled, code-gage, galvanized steel.
- B. Fasteners for General Use: Corrosion resistant screws and hardware including cadmium and zinc plated items.
- C. Fasteners for Damp or Wet Locations: Stainless steel screws and hardware.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 16135
CABINETS, BOXES AND FITTINGS

- D. Cast Metal for Boxes, Enclosures, and Covers; Copper-free aluminum except as otherwise specified.
- E. Exterior Finish: Gray baked enamel for items exposed in finished locations except as otherwise indicated.
- F. Painted Interior Finish: Where indicated, white baked enamel.
- G. Fittings for Boxes, Cabinets, and Enclosures: Conform to UL 514B. Malleable iron or zinc plated steel for conduit hubs, bushings and box connectors.

2.4 METAL OUTLET, DEVICE, AND SMALL WIRING BOXES

- A. General: Conform to UL 514A, "Metallic Outlet Boxes, Electrical," and UL 514B, "Fittings for Conduit and Outlet Boxes." Boxes shall be of type, shape, size, and depth to suit each location and application.
- B. Steel Boxes: Conform to NEMA OS 1, "Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports." Boxes shall be sheet steel with stamped knockouts, threaded screw holes and accessories suitable for each location including mounting brackets and straps, cable clamps, exterior rings and fixture studs.
- C. Cast-Iron Boxes: Iron alloy, waterproof, with threaded raceway entries and features and accessories suitable for each location, including mounting ears, threaded screw holes for devices and closure plugs.

2.5 PULL OR JUNCTION BOXES

- A. General: Comply with UL 50, "Electrical Cabinets and Boxes", for boxes over 100 cubic inches volume. Boxes shall have screwed or bolted on covers of material same as box and shall be of size and shape to suit application.
- B. Steel Boxes: Sheet steel with welded seams. Where necessary to provide a rigid assembly, construct with internal structural steel bracing.
- C. Hot-Dipped Galvanized Steel Boxes: Sheet steel with welded seams. Where necessary to provide a rigid assembly, construct with internal structural steel bracing. Hot-dip galvanized after fabrication. Cover shall be gasketed.
- D. Stainless-Steel Boxes: Fabricate of stainless steel conforming to Type 302 of ASTM A 167, "Specification for Stainless and Heat Resisting Chromium-Nickel Steel Plate, Sheet, and Strip." Where necessary to provide a rigid assembly, construct with internal structural stainless steel bracing. Cover shall be gasketed.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 16135
CABINETS, BOXES AND FITTINGS

- E. Cast-Iron Boxes: Molded of cast iron alloy with gasketed cover and integral threaded conduit entrances.

2.6 CABINETS

- A. Comply with UL 50, "Electrical Cabinets and Boxes."
- B. Construction: Sheet steel, NEMA 4 class except as otherwise indicated. Cabinet shall consist of a box and a front consisting of a one piece frame and a hinged door. Arrange door to close against a rabbet placed all around the inside edge of the frame, with a uniformly close fit between door and frame. Provide concealed fasteners, not over 24-inches apart, to hold fronts to cabinet boxes and provide for adjustment. Provide flush or concealed door hinges not over 24-inches apart and not over 6-inches from top and bottom of door. For flush cabinets, make the front approximately 3/4 inch larger than the box all around. For surface mounted cabinets make front same height and width as box.
- C. Doors: Double doors for cabinets wider than 24-inches.
- D. Locks: Combination spring catch and key lock, with all locks for cabinets of the same system keyed alike. Locks may be omitted on signal, power, and lighting cabinets located within wire closets and mechanical-electrical rooms. Locks shall be of a type to permit doors to latch closed without locking.

2.7 STEEL ENCLOSURES WITH HINGED DOORS

- A. Comply with UL 50, "Cabinets and Enclosures" and NEMA ICS 6,
- B. "Enclosures for Industrial Controls and Systems."
- C. Construction: Sheet steel, 16 gage, minimum, with continuous welded seams. NEMA class as indicated; arranged for surface mounting.
- D. Doors: Hinged directly to cabinet and removable, with approximately 3/4-inch flange around all edges, shaped to cover edge of box. Provide handle operated, key locking latch. Individual door width shall be no greater than 24-inches. Provide multiple doors where required.
- E. Mounting Panel: Provide painted removable internal mounting panel for component installation.
- F. Enclosure: NEMA 4 except as indicated. Where door gasketing is required, provide neoprene gasket attached with oil-resistant adhesive, and held in place with steel retaining strips. For all enclosures of class higher than NEMA 1, use hubbed raceway entrances.

Chiller Replacement at
Bethel Middle School
Bethel, CT

PART 3 EXECUTION

3.1 INSTALLATION, GENERAL

- A. Locations: Install items where indicated and where required to suit code requirements and installation conditions.
- B. Cap unused knockout holes where blanks have been removed and plug unused conduit hubs.
- C. Support and fasten items securely in accordance with Division 16 Section "Supporting Devices."
- D. Sizes shall be adequate to meet NEC volume requirements, but in no case smaller than sizes indicated.
- E. Remove sharp edges where they may come in contact with wiring or personnel.

3.2 APPLICATIONS

- A. Cabinets: Flush mounted, NEMA enclosure Type 1 except as otherwise indicated.
- B. Hinged Door Enclosures: NEMA Type 1 enclosure except as indicated.
- C. Hinged Door Enclosures Outdoors: Install drip hood, factory tailored to individual units.
- D. Outlet Boxes and Fittings: Install outlet and device boxes and associated covers and fittings of materials and NEMA types suitable for each location and in conformance with the following requirements:
 - 1. Interior Dry Locations: NEMA Type 1, sheet steel or as permitted by local code.
 - 2. Locations Exposed to Weather, Dampness, or Wet Locations: NEMA Type 3R enclosures.
- E. Pull and Junction Boxes: Install pull and junction boxes of materials and NEMA types suitable for each location except as otherwise indicated.

3.3 INSTALLATION OF OUTLET BOXES

- A. Outlets at Windows and Doors: Locate close to window trim.
- B. Column and Pilaster Locations: Locate outlet boxes for switches and receptacles on columns or pilasters so the centers of the columns are clear for future installation of partitions.

SECTION 16135
CABINETS, BOXES AND FITTINGS

- C. Locations in Special Finish Materials: For outlet boxes for receptacles and switches mounted in desks or furniture cabinets or in glazed tile, concrete block, marble, brick, stone or wood walls, use rectangular shaped boxes with square corners and straight sides. Install such boxes without plaster rings. Saw cut all recesses for outlet boxes in exposed masonry walls.
- D. Gasketed Boxes: At the following locations use cast metal, threaded hub type boxes with gasketed weatherproof covers:
 - 1. Exterior locations.
 - 2. Where surface mounted on unfinished walls, columns or pilasters. (Cover gaskets may be omitted in dry locations).
 - 3. Where exposed to moisture laden atmosphere.
 - 4. Where indicated.
 - 5. Kitchen Area.
- E. Cast-Iron Boxes: Iron alloy, waterproof, with threaded raceway entries and features and accessories suitable for each location, including mounting ears, threaded screw holes for devices and closure plugs.
- F. Mounting: Mount outlet boxes for switches with the long axis vertical or as indicated. Mount boxes for receptacles either vertically or horizontally but consistently either way. Three or more gang boxes shall be mounted with the long axis horizontal. Locate box covers or device plates so they will not span different types of building finishes either vertically or horizontally. Locate boxes for switches near doors on the side opposite the hinges and close to door trim, even though electrical floor plans may show them on hinge side.
- G. Ceiling Outlets: For fixtures, where wiring is concealed, use outlet boxes 4-inches square by 1-1/2-inches deep, minimum.
- H. Cover Plates for Surface Boxes: Use plates sized to box front without overlap.
- I. Protect outlet boxes to prevent entrance of plaster, and debris. Thoroughly clean foreign material from boxes before conductors are installed.

Chiller Replacement at
Bethel Middle School
Bethel, CT

3.4 INSTALLATION OF PULL OR JUNCTION BOXES

- A. Box Selection: For boxes in main feeder conduit runs, use sizes not smaller than 8-inches square by 4-inches deep. Do not exceed 6 entering and 6 leaving raceways in a single box. Quantities of conductors (including equipment grounding conductors) in pull or junction box shall not exceed the following:

Size of Largest Conductors in Box	Maximum no. of Conductors in Box
No. 4/0 AWG	30
250 MCM	20
500 MCM	15
Over 500 MCM	10

1. Cable Supports: Install clamps, grids, or devices to which cables may be secured. Arrange cables so they may be readily identified. Support cable at least every 30-inches inside boxes.
2. Mount pull boxes in inaccessible ceilings with the covers flush with the finished ceiling.
3. Size: Provide pull and junction boxes for telephone, signal, and other systems at least 50 percent larger than would be required by Article 370 of NEC, or as indicated. Locate boxes strategically and provide shapes to permit easy pulling of future wires or cables of types normal for such systems.

3.5 INSTALLATION OF CABINETS AND HINGED DOOR ENCLOSURES

- A. Mount with fronts straight and plumb.
- B. Install with tops 78-inches above floor.
- C. Set cabinets in finished spaces flush with walls.

3.6 GROUNDING

- A. Electrically ground metallic cabinets, boxes, and enclosures. Where wiring to item includes a grounding conductor, provide a grounding terminal in the interior of the cabinet, box or enclosure.

3.7 CLEANING AND FINISH REPAIR

- A. Upon completion of installation, inspect components. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, abrasions and weld marks.

SECTION 16135
CABINETS, BOXES AND FITTINGS

- B. Galvanized Finish: Repair damage using a zinc-rich paint recommended by the tray manufacturer.
- C. Painted Finish: Repair damage using matching corrosion inhibiting touch-up coating.

END OF SECTION 16135

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Requirements of the following Division 16 Sections apply to this section:
 - 1. Basic Electrical Requirements.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles
 - 2. Ground Fault Circuit Interrupter Receptacles
 - 3. Snap Switches
 - 4. Wall Plates
- B. Related Sections: The following sections contain requirements that relate to this section:
 - 1. Division 16 Section "Circuit and Motor Disconnects" for devices other than snap switches and plug/receptacle sets used as disconnects for motors.

1.3 SUBMITTALS

- A. Product data for each type of product specified.
- B. Samples of those products indicated for sample submission in Architect's comments on product data submittal. Include color and finish samples of device plates and other items per Architect's request.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with provisions of the following codes.
- B. NFPA 70 "National Electrical Code".
 - 1. UL and NEMA Compliance: Provide wiring devices which are listed and labeled by UL and comply with applicable UL and NEMA standards.

1.5 SEQUENCE AND SCHEDULING

- A. Schedule installation of finish plates after the surface upon which they are installed has received final finish.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 16143
WIRING DEVICES

- A. Available Manufacturers: Subject to specifications and compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:
 - 1. Cooper Wiring Devices
 - 2. Hubbell Inc.
 - 3. Leviton
 - 4. Legrand, Pass and Seymour

2.2 WIRING DEVICES:

- A. General: Provide wiring devices, in types, characteristics, grades, colors, and electrical ratings for applications indicated which are UL listed and which comply with NEMA WD 1 and other applicable UL and NEMA standards. Provide ivory color devices and wall plates except as otherwise indicated. Verify color selections with Architect.
- B. Receptacles: As scheduled in Table 1 in Part 3 below. Comply with UL 498 and NEMA WD 1.
- C. Ground-Fault Interrupter (GFI) Receptacles: as indicated in Table 1 in Part 3 below; provide "feed-thru" type ground-fault circuit interrupter, with integral heavy-duty NEMA 5-20R duplex receptacles arranged to protect connected downstream receptacles on same circuit. Provide unit designed for installation in a 2-3/4 inch deep outlet box without adapter, grounding type, Class A, Group 1, per UL Standard 94.3.
- D. Snap Switches: quiet type AC switches as indicated in Table 2 in Part 3 below. Comply with UL 20 and NEMA WD1.

2.3 WIRING DEVICE ACCESSORIES

- A. Wall plates: single and combination, of types, sizes, and with ganging and cutouts as indicated. Provide plates which mate and match with wiring devices to which attached. Provide metal screws for securing plates to devices with screw heads colored to match finish of plates. Provide wall plate color to match wiring devices except as otherwise indicated. Provide plates possessing the following additional construction features:
 - 1. Material and Finish: steel plate, galvanized, for building mechanical spaces.
 - 2. Material and Finish: plastic, smooth, for finished areas.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRING DEVICES AND ACCESSORIES:

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 16143
WIRING DEVICES

- A. Install wiring devices and accessories as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and in accordance with recognized industry practices to fulfill project requirements.
- B. Coordinate with other Work, including painting, electrical boxes and wiring installations, as necessary to interface installation of wiring devices with other Work.
- C. Install wiring devices only in electrical boxes which are clean; free from building materials, dirt, and debris.
- D. Install galvanized steel wallplates in unfinished spaces.
- E. Install wiring devices after wiring work is completed.
- F. Install wall plates after painting work is completed.
- G. Install telephone/cable tv and power service connections in accordance with final furnishings arrangement plan, plumb, true, and secure.
- H. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standard 486. Use properly scaled torque indicating hand tool.

3.2 PROTECTION

- A. Protect installed components from damage. Replace damaged items prior to final acceptance.

3.3 FIELD QUALITY CONTROL

- A. Testing: Prior to energizing circuits, test wiring for electrical continuity, and for short-circuits. Ensure proper polarity of connections is maintained. Subsequent to energizing, test wiring devices and demonstrate compliance with requirements, operating each operable device at least six times.
- B. Test ground fault interruptor operation with both local and remote fault simulations in accordance with manufacturer recommendations.

C. TABLE 1

Chiller Replacement at
Bethel Middle School
Bethel, CT

RECEPTACLES

<u>DESIG- NATION (1)</u>	<u>CURRENT RATING AMPS</u>	<u>VOLTAGE RATING</u>	<u>SINGLE/ DUPLEX</u>	<u>NEMA CONFIG- URATION</u>	<u>UL GRADE</u>	<u>NOTES</u>
-	20	125	DUPLEX	5-20R	SPECIFICATION GRADE	
WP	20	125	DUPLEX	5-20R	SPECIFICATION GRADE	WEATHER- PROOF
GFCI	20	125	DUPLEX	5-20R	SPECIFICATION GRADE	INTEGRAL GFCI

NOTES

(1) Letter designations are used where symbols alone do not clearly designate on plans locations where specific receptacle types are used.

D. TABLE 2

SNAP SWITCHES

<u>DESIG- NATION (1)</u>	<u>TYPICAL APPLICATION</u>	<u>VOLTAGE LOAD RATING (AC)</u>	<u>RATING (AC)</u>	<u>POLES</u>	<u>UL GRADE</u>	<u>NOTES</u>
S	CONTROL LIGHTS	20A	120/277	1	HEAVY DUTY	-
S3	CONTROL - LIGHTS	20A	120/277	3-way	HEAVY DUTY	
S	DISCONN. MOTOR	1HP	120/277	1	HEAVY DUTY	(2)
STOL	DISCONN. MOTOR	2HP	208/480	3	HEAVY DUTY	(2)

NOTES

(1) For snap switches, designation is the same as the symbol used on plans for the device. Type of switch is determined from plan context including type of device or circuit being controlled.

(2) With overload element in switch.

END OF SECTION 16143

Chiller Replacement at
Bethel Middle School
Bethel, CT

PART 1-GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Requirements specified in other Division 16 Sections apply to this section.

1.2 SUMMARY

- A. This Section includes circuit and motor disconnects.
- B. Related Sections: The following sections contain requirements that relate to this section:
 - 1. Division 16 Section "Wiring Devices" for snap switches used as motor disconnects.

1.3 SUBMITTALS

- A. Product data for each type of product specified.
- B. Maintenance data for circuit and motor disconnects, for inclusion in Operation and Maintenance Manual specified in Division 1 and Division 16 Section "Basic Electrical Requirements."

1.4 QUALITY ASSURANCE

- A. Electrical Component Standards: Provide components complying with NFPA 70 "National Electrical Code" and which are listed and labeled by UL. Comply with UL Standard 98 and NEMA Standard KS 1.

PART 2- PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:
 - 1. Eaton Corp.
 - 2. General Electric Co.
 - 3. Schneider Electric, Square D Company.

2.2 CIRCUIT AND MOTOR DISCONNECT SWITCHES

- A. General: Provide circuit and motor disconnect switches in types, sizes, duties, features ratings, and enclosures as indicated. Provide NEMA 1 enclosure except for outdoor switches and switches installed in wet/damp locations provide NEMA 3R enclosures with raintight hubs. For motor and motor starter disconnects, provide units with horsepower ratings suitable to the loads.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 16170
CIRCUIT AND MOTOR DISCONNECTS

- B. Fusible Switches: Heavy-duty switches, with fuses of classes and current ratings indicated. Where current limiting fuses are indicated, provide switches with non-interchangeable feature suitable only for current limiting type fuses.
- C. Non-fusible Disconnects: Heavy-duty switches of classes and current ratings as indicated.

2.3 ACCESSORIES

- A. Electrical Interlocks: Provide number and arrangement of interlock contacts in switches as indicated.
- B. Captive Fuse Pullers: Provide built-in fuse pullers arranged to facilitate fuse removal.

PART 3- EXECUTION

3.1 INSTALLATION OF CIRCUITS AND MOTOR DISCONNECTS

- A. General: Provide circuit and motor disconnect switches as indicated and where required by the above Code. Comply with switch manufacturers' printed installation instructions.

3.2 FIELD QUALITY CONTROL

- A. Testing: Subsequent to completion of installation of electrical disconnect switches, energize circuits and demonstrate capability and compliance with requirements. Except as otherwise indicated, do not test switches by operating them under load. However, demonstrate switch operation through six opening/closing cycles with circuit unloaded. Open each switch enclosure for inspection of interior, mechanical and electrical connections, fuse installation, and for verification of type and rating of fuses installed. Correct deficiencies then retest to demonstrate compliance. Remove and replace defective units with new units and retest.

END OF SECTION - 16170

Chiller Replacement at
Bethel Middle School
Bethel, CT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Requirements specified in other Division 16 Sections apply to this section.

1.2 SUMMARY

- A. This Section includes secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for each type of product specified.
 - 1. Hanger and support schedule showing manufacturer's figure number, size, spacing, features, and application for each required type of hanger, support, sleeve, seal, and fastener to be used.
- C. Shop drawings indicating details of fabricated products and materials.
- D. Engineered Design consisting of details and engineering analysis for supports for the following items:
 - 1. Fastener supporting systems.

1.4 QUALITY ASSURANCE

- A. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."
- B. Electrical components shall be listed and labeled by UL, ETL, CSA, or other approved, nationally recognized testing and listing agency that provides third-party certification follow-up services.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Slotted Metal Angle and U-Channel Systems:
 - a. Allied Tube & Conduit

Chiller Replacement at
Bethel Middle School
Bethel, CT

- b. B-Line Systems, Inc.
- c. GS Metals Corp.
- d. Unistrut Diversified Products
- 2. Conduit Sealing Bushings:
 - a. Bridgeport Fittings, Inc.
 - b. Cooper Industries, Inc.
 - c. O-Z/Gedney
 - d. Producto Electric Corp.
 - e. Raco, Inc.
 - f. Spring City Electrical Mfg. Co.
 - g. Thomas & Betts Corp.

2.2 COATINGS

- A. Coating: Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic. Products for use outdoors shall be hot-dip galvanized.

2.3 MANUFACTURED SUPPORTING DEVICES

- A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.
- B. Fasteners: Types, materials, and construction features as follows:
 - 1. Expansion Anchors: Carbon steel wedge or sleeve type.
 - 2. Toggle Bolts: All steel springhead type.
- C. Conduit Sealing Bushings: Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit, or tubing passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.
- D. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes as required to suit individual risers. Construct body of malleable-iron casting with hot-dip galvanized finish.
- E. U-Channel Systems: 16-gage steel channels, with 9/16-inch-diameter holes, at a minimum of 8 inches on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacture.

2.4 FABRICATED SUPPORTING DEVICES

- A. General: Shop- or field-fabricated supports or manufactured supports assembled from U-channel components.

Chiller Replacement at
Bethel Middle School
Bethel, CT

- B. Steel Brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.
- C. Pipe Sleeves: Provide pipe sleeves of one of the following:
 - 1. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate sleeves from the following gage metal for sleeve diameter noted:
 - a. 3-inch and smaller: 20-gage.
 - b. 4-inch to 6-inch: 16-gage.
 - c. over 6-inch: 14-gage.
 - 2. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.
- B. Coordinate with the building structural system and with other electrical installation.
- C. Raceway Supports: Comply with the NEC and the following requirements:
 - 1. Conform to manufacturer's recommendations for selection and installation of supports.
 - 2. Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four. Where this determination results in a safety allowance of less than 200 lbs, provide additional strength until there is a minimum of 200 lbs safety allowance in the strength of each support.
 - 3. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
 - 4. Support parallel runs of horizontal raceways together on trapeze-type hangers.
 - 5. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4-inch-diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.
 - 6. Space supports for raceways in accordance with Table I of this section. Space supports for raceway types not covered by the above in accordance with NEC.
 - 7. Support exposed and concealed raceway within 1 foot of an unsupported box and access fittings. In horizontal runs, support at the box and access fittings

SECTION 16190
SUPPORTING DEVICES

- may be omitted where box or access fittings are independently supported and raceway terminals are not made with chase nipples or threadless box connectors.
8. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminals.
- D. Vertical Conductor Supports: Install simultaneously with installation of conductors.
 - E. Miscellaneous Supports: Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.
 - F. In open overhead spaces, cast boxes threaded to raceways need not be supported separately except where used for fixture support; support sheet metal boxes directly from the building structure or by bar hangers. Where bar hangers are used, attach the bar to raceways on opposite sides of the box and support the raceway with an approved type of fastener not more than 24 inches from the box.
 - G. Sleeves: Install in concrete slabs and walls and all other fire-rated floors and walls for raceways and cable installations. For sleeves through fire rated-wall or floor construction, apply UL- listed firestopping sealant in gaps between sleeves and enclosed conduits and cables in accordance with requirements specified elsewhere.
 - H. Conduit Seals: Install seals for conduit penetrations of slabs on grade and exterior walls below grade and where indicated. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal.
 - I. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable trays, busways, cabinets, panelboards, transformers, boxes, disconnect switches, and control components in accordance with the following:
 1. Fasten by means of wood screws or screw-type nails on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.
 2. Holes cut to depth of more than 1-1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.
 3. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration- and shock- resistant fasteners for attachments to concrete slabs.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 16190
SUPPORTING DEVICES

- J. TESTS: Test pull-out resistance of one of each type, size, and anchorage material for the following fastener types:
1. Expansion anchors.
 2. Toggle bolts.
- K. Provide all jacks, jigs, fixtures, and calibrated indicating scales required for reliable testing. Obtain the structural Engineer's approval before transmitting loads to the structure. Test to 90 percent of rated proof load for fastener. If fastening fails test, revise all similar fastener installations and retest until satisfactory results are achieved.
- L. Conduit seals at walk-in cooler& freezer location: Install seals for conduit penetrations into cooler or freezer equipment where conduit enters the repsective conditional areas, and at slab locations.

3.2 TABLE I: SPACING FOR RACEWAY SUPPORTS

HORIZONTAL RUNS

<u>Raceway Size (Inches)</u>	<u>No. of Conductors in Run</u>	<u>Location</u>	<u>RMC & IMC (1)</u>	<u>EMT (1)</u>
1/2,3/4	1 or 2	Flat ceiling or wall.	5	5
1/2,3/4	1 or 2	Where it is difficult to provide supports except at intervals fixed by the building construction.	7	7
1/2,3/4	3 or more	Any location.	7	7
1/2-1	3 or more	Any location.		
1 & larger	1 or 2	Flat ceiling or wall.	6	6
1 & larger	1 or 2	Where it is difficult to provide supports except at intervals fixed by the building construction.	10	10
1 & larger	3 or more	Any location.	10	10
Any	Concealed.	10	10

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 16190
SUPPORTING DEVICES

VERTICAL RUNS

<u>Raceway Size (Inches)</u>	<u>No. of Conductors in Run</u>	<u>Location</u>	<u>RMC & IMC (1,2)</u>	<u>EMT (1)</u>
1/2,3/4	Exposed.	7	7
1,1-1/4	Exposed.	8	8
1-1/2 and larger	Exposed.	10	10
Up to 2	Shaftway.	14	10
2-1/2	Shaftway.	16	10
3 & larger	Shaftway.	20	10
Any	Concealed.	10	10

NOTES:

(1) Maximum spacing of supports (feet).

(2) Maximum spacings for IMC above apply to straight runs only. Otherwise the maximums for EMT apply.

Abbreviations: EMT Electrical metallic tubing.
 IMC Intermediate metallic conduit.
 RMC Rigid metallic conduit.

END OF SECTION 16190

Chiller Replacement at
Bethel Middle School
Bethel, CT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Requirements specified in other Division 16 Sections apply to this section.

1.2 SUMMARY

- A. This Section includes identification of electrical materials, equipment, and installations. It includes requirements for electrical identification components including but not limited to the following:
 - 1. Identification labeling for switchboards, panelboards, devices, raceways, cables, and conductors.
 - 2. Operational instruction signs.
 - 3. Warning and caution signs.
 - 4. Equipment labels and signs.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 16 Section "Wires and Cables" for requirements for color coding of conductors for phase identification.
- C. Refer to other Division 16 sections for additional specific electrical identification associated with specific items.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product Data for each type of product specified.
- C. Schedule of identification nomenclature to be used for identification signs and labels.
- D. Samples of each color, lettering style, and other graphic representation required for identification materials; samples of labels and signs.

1.4 QUALITY ASSURANCE

- A. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."
- B. ANSI Compliance: Comply with requirements of ANSI Standard A13.1, "Scheme for the Identification of Piping Systems," with regard to type and size of lettering for raceway and cable labels.

Chiller Replacement at
Bethel Middle School
Bethel, CT

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
1. American Labelmark Co.
 2. Ideal Industries, Inc.
 3. LEM Products, Inc.
 4. Markal Corp.
 5. National Band and Tag Co.
 6. Panduit Corp.
 7. Seton Name Plate Co.

2.2 ELECTRICAL IDENTIFICATION PRODUCTS

- A. Adhesive Marking Labels for Raceway and Cable: Pre-printed, flexible, self-adhesive labels with legend indicating voltage and service (Emergency, Lighting, Power, Light, Air Conditioning, Communications, Control, Fire, etc.).
- B. Label Size: as follows:
1. Raceways 1-Inch and Smaller: 1-1/8 inches high by 4 inches long.
 2. Raceways Larger than 1-Inch: 1-1/8 inches high by 8 inches long.
- C. Color: Black legend on orange background.
- D. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape not less than 3 mils thick by 1 inch to 2 inches in width.
- E. Pretensioned Flexible Wraparound Colored Plastic Sleeves for Raceway and Cable Identification: Flexible acrylic bands sized to suit the raceway diameter and arranged to stay in place by pre-tensioned gripping action when coiled around the raceway or cable.
- F. Wire/Cable Designation Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound, cable/conductor markers with preprinted numbers and letter.
- G. Plasticized Card Stock Tags: Vinyl cloth with preprinted and field-printed legends to suit the application. Orange background, except as otherwise indicated, with Eyelet for fastener.
- H. Engraved, Plastic-Laminated Labels, Signs, and Instruction Plates: Engraving stock melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 square inches,

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 16195
ELECTRICAL IDENTIFICATION

or 8 inches in length; 1/8-inch thick for larger sizes. Engraved legend in white letters on black face and punched for mechanical fasteners.

- I. Baked-Enamel Warning and Caution Signs for Interior Use: Preprinted aluminum signs, punched for fasteners, with colors, legend, and size appropriate to the location.
- J. Exterior Metal-Backed Butyrate Warning and Caution Signs: Weather-resistant, nonfading, preprinted cellulose acetate butyrate signs with 20-gage, galvanized steel backing, with colors, legend, and size appropriate to the location. Provide 1/4-inch grommets in corners for mounting.
- K. Fasteners for Plastic-Laminated and Metal Signs: Self-tapping stainless steel screws or number 10/32 stainless steel machine screws with nuts and flat and lock washers.
- L. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18-inch minimum width, 50-lb minimum tensile strength, and suitable for a temperature range from minus 50 deg F to 350 deg F. Provide ties in specified colors when used for color coding.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as approved in submittals and as required by code.
- B. Install identification devices in accordance with manufacturer's written instructions and requirements of NEC.
- C. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.
- D. Conduit Identification:
 - 1. The following areas shall be identified:
 - a. On wall surfaces directly external to conduits run concealed within wall.
 - b. On all accessible surfaces of concrete envelope around conduits in vertical shafts, exposed at ceilings or concealed above suspended ceilings.
 - 2. Apply identification to areas as follows:
 - a. Clean surface of dust, loose material, and oily films before painting.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 16195
ELECTRICAL IDENTIFICATION

- b. Prime surfaces: For galvanized metal, use single-component acrylic vehicle coating formulated for galvanized surfaces. For concrete masonry units, use heavy-duty acrylic resin block filler. For concrete surfaces, use clear alkali-resistant alkyd binder-type sealer.
 - c. Apply one intermediate and one finish coat of orange silicone alkyd enamel.
 - d. Apply primer and finish materials in accordance with manufacturer's instructions.
- E. Identify Raceways of Certain Systems with Color Banding: Band exposed or accessible raceways of the following systems for identification. Bands shall be pretensioned, snap-around colored plastic sleeves, colored adhesive marking tape, or a combination of the two. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side. Install bands at changes in direction, at penetrations of walls and floors, and at 40-foot maximum intervals in straight runs. Apply the following colors:
- 1. Fire Alarm System: Red
 - 2. Fire Suppression Supervisory and Control System: Red
 - 3. Mechanical and Electrical Supervisory System: Green and Blue
 - 4. Telephone System: Green and Yellow
- F. Identify Junction, Pull, and Connection Boxes: Code-required caution sign for boxes shall be pressure-sensitive, self-adhesive label indicating system voltage in black, preprinted on orange background. Install on outside of box cover. Also label box covers with identity of contained circuits. Use pressure-sensitive plastic labels at exposed locations and similar labels or plasticized card stock tags at concealed boxes.
- G. Conductor Color Coding: Provide color coding for secondary service, feeder, and branch circuit conductors throughout the project secondary electrical system as follows:

<u>208Y/120 Volts</u>	<u>Phase</u>	<u>480Y/277 Volts</u>
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray
Green	Ground	Green w/yellow strip

- H. Use conductors with color factory-applied the entire length of the conductors except as follows:
- 1. The following field-applied color-coding methods may be used in lieu of factory-coded wire for sizes larger than No. 10 AWG.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 16195
ELECTRICAL IDENTIFICATION

- a. Apply colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply the last two laps of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors as specified. Do not obliterate cable identification markings by taping. Tape locations may be adjusted slightly to prevent such obliteration.
 - b. In lieu of pressure-sensitive tape, colored cable ties may be used for color identification. Apply three ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and spaced 3 inches apart. Apply with a special tool or pliers, tighten for snug fit, and cut off excess length.
- I. Tag or label conductors as follows:
1. Future Connections: Conductors indicated to be for future connection or connection under another contract with identification indicating source and circuit numbers.
 2. Multiple Circuits: Where multiple branch circuits or control wiring or signal conductors are present in the same box or enclosure (except for three-circuit, four-wire home runs), label each conductor or cable. Provide legend indicating source, voltage, circuit number, and phase for branch circuit wiring. Phase and voltage of branch circuit wiring may be indicated by means of coded color of conductor insulation. For control and signal wiring, use color coding or wire marking tape at terminations and at intermediate locations where conductors appear in wiring boxes, troughs, and control cabinets. Use consistent letter/number conductor designations throughout on wire marking tapes.
 3. Match identification markings with designations used in panelboards shop drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installations.
- J. Apply warning, caution, and instruction signs and stencils as follows:
1. Install warning, caution, or instruction signs where required by NEC, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.
- K. Install equipment identification as follows:
1. Apply equipment identification labels of engraved plastic-laminate on each major unit of electrical equipment in building, including central or master unit of each electrical system. This includes alarm systems, unless unit is specified with its own self-explanatory identification. Except as otherwise indicated, provide single line of text, with 1/2-inch-high lettering on 1-1/2-inch-high label (2-inch-high where two lines are required), white lettering in black field. Text

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 16195
ELECTRICAL IDENTIFICATION

shall match terminology and numbering of the Contract Documents and shop drawings. Apply labels for each unit of the following categories of electrical equipment.

- a. Panelboards, electrical cabinets, and enclosures.
 - b. Access doors and panels for concealed electrical items.
 - c. Motor starters.
 - d. Contactors.
 - e. Control devices.
 - f. Transformers.
- L. Apply designation labels of engraved plastic laminate for disconnect switches, breakers, pushbuttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and alarm/signal components, where labeling is specified elsewhere. For panelboards, provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker.
- M. Install labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

END OF SECTION 16195

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes solid grounding of electrical systems and equipment. It includes basic requirements for grounding for protection of life, equipment, circuits, and systems. Grounding requirements specified in this Section may be supplemented in other sections of these Specifications.
- B. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 16 Section "Wires and Cables."

1.2 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for ground rods, connectors and connection materials, and grounding fittings.
- C. Field-testing organization certificate, signed by the Contractor, certifying that the organization performing field tests complies with the requirements specified in Quality Assurance below.
- D. Report of field tests and observations certified by the testing organization.

1.3 QUALITY ASSURANCE

- A. Listing and Labeling: Provide products specified in this Section that are listed and labeled. The terms "listed" and "labeled" shall be defined as they are in the National Electrical Code, Article 100.
 - 1. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- B. Field-Testing Organization Qualifications: To qualify for acceptance, the independent testing organization must demonstrate, based on evaluation of organization-submitted criteria conforming to ASTM E 699, that it has the experience and capability to conduct satisfactorily the testing indicated.
- C. Electrical Component Standard: Components and installation shall comply with NFPA 70, "National Electrical Code" (NEC).
- D. UL Standard: Comply with UL 467, "Grounding and Bonding Equipment."

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
1. Anixter Bros., Inc.
 2. Erico Products, Inc.
 3. GB Electrical, Inc.
 4. Ideal Industries, Inc.
 5. O-Z/Gedney Co.
 6. Raco, Inc.
 7. Thomas & Betts Corp.
 8. W.H. Salisbury & Co.
 9. Utilco Co.

2.2 GROUNDING AND BONDING PRODUCTS

- A. Products: Of types indicated and of sizes and ratings to comply with NEC. Where types, sizes, ratings, and quantities indicated are in excess of NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.
- B. Conductor Materials: Copper.

2.3 WIRE AND CABLE CONDUCTORS

- A. General: Comply with Division 16 Section "Wires and Cables." Conform to NEC Table 8, except as otherwise indicated, for conductor properties, including stranding.
- B. Equipment Grounding Conductor: Green insulated.
- C. Grounding Electrode Conductor: Stranded cable.
- D. Bare Copper Conductors: Conform to the following:
1. Assembly of Stranded Conductors: ASTM B-8.

2.4 MISCELLANEOUS CONDUCTORS

- A. Ground Bus: Bare annealed copper bars of rectangular cross section.
- B. Braided Bonding Jumpers: Copper tape, braided No. 30 gage bare copper wire, terminated with copper ferrules.
- C. Bonding Strap Conductor/Connectors: Soft copper, 0.05 inch thick and 2 inches wide, except as indicated.

2.5 CONNECTOR PRODUCTS

- A. General: Listed and labeled as grounding connectors for the materials used.
- B. Pressure Connectors: High-conductivity-plated units.
- C. Bolted Clamps: Heavy-duty units listed for the application.
- D. Exothermic Welded Connections: Provided in kit form and selected for the specific types, sizes, and combinations of conductors and other items to be connected.
- E. Aluminum-To-Copper Connections: Bimetallic type, conforming to UL 96, "Lighting Protection Components," or UL 467.

PART 3 EXECUTION

3.1 APPLICATIONS

- A. Equipment Grounding Conductor Application: Comply with NEC Article 250 for sizes and quantities of equipment grounding conductors, except where larger sizes or more conductors are indicated.
 - 1. Install separate insulated equipment grounding conductors with circuit conductors for the following in addition to those locations where required by Code:
 - a. Lighting circuits.
 - b. Feeders and branch circuits.
 - c. Receptacle Circuits.
 - d. Single-phase motor or appliance circuits.
 - e. Three-phase motor or appliance branch circuits.

3.2 INSTALLATION

- A. General: Ground electrical systems and equipment in accordance with NEC requirements except where the Drawings or Specifications exceed NEC requirements.
- B. Braided-Type Bonding Jumpers: Install to connect ground clamps on water meter piping to bypass water meters electrically. Use elsewhere for flexible bonding and grounding connections.
- C. Route grounding conductors along the shortest and straightest paths possible without obstructing access or placing conductors where they may be subjected to strain, impact, or damage, except as indicated.
- D. Bond interior metal piping systems and metal air ducts to equipment ground conductors of pumps, fans, electric heaters, and air cleaners serving individual systems.

3.3 CONNECTIONS

- A. General: Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to assure high conductivity and make contact points closer in order of galvanic series.
 - 2. Make connections with clean bare metal at points of contact.
 - 3. Aluminum to steel connections shall be with stainless steel separators and mechanical clamps.
 - 4. Aluminum to galvanized steel connections shall be with tin-plated copper jumpers and mechanical clamps.
 - 5. Coat and seal connections involving dissimilar metals with inert material such as red lead paint to prevent future penetration of moisture to contact surfaces.

- B. Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure-type grounding lugs. Where metallic raceways terminate at metallic housings without mechanical and electrical connection to the housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground bus in the housing. Bond electrically noncontinuous conduits at both entrances and exits with grounding bushings and bare grounding conductors.

- C. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A and UL 486B.

- D. Compression-Type Connections: Use hydraulic compression tools to provide the correct circumferential pressure for compression connectors. Use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on the ground conductor.

- E. Moisture Protection: Where insulated ground conductors are connected to ground rods or ground buses, insulate the entire area of the connection and seal against moisture penetration of the insulation and cable.

3.4 FIELD QUALITY CONTROL

- A. Independent Testing Organization: Arrange and pay for the services of a qualified independent electrical testing organization to perform tests described below.

- B. Tests: Subject the completed grounding system to a megger test at each location where a maximum ground resistance level is specified, at service disconnect enclosure

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 16452
GROUNDING

ground terminal, and at ground test wells. Measure ground resistance without the soil being moistened by any means other than natural precipitation or natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by the 2-point method in accordance with Section 9.03 of IEEE 81, "Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System."

- C. Deficiencies: Where ground resistances exceed specified values, and if directed, modify the grounding system to reduce resistance values. Where measures are directed that exceed those indicated the provisions of the Contract, covering changes will apply.
- D. Report: Prepare test reports, certified by the testing organization, of the ground resistance at each test location. Include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

END OF SECTION 16452

Chiller Replacement at
Bethel Middle School
Bethel, CT

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes overcurrent protective devices (OCPDs) rated 600 V and below and switching devices commonly used with them.
- B. Panelboards: Application, installation, and other related requirements for overcurrent protective device installations in distribution equipment are specified in other Division 16 sections.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Cartridge Fuses:
 - a. Bussmann Div., Cooper Industries, Inc.
 - b. Gould Inc.
 - c. Littelfuse Inc.
 - 2. Fusible Switches:
 - a. Allen-Bradley Co.
 - b. Crouse-Hinds Distribution Equipment.
 - c. Eaton Corp.
 - d. General Electric Co.
 - e. Schneider Electric, Square D
 - 3. Molded-Case Circuit Breakers:
 - a. Eaton Corp.
 - b. General Electric Co.
 - c. Schneider Electric, Square D

2.2 OVERCURRENT PROTECTIVE DEVICES (OCPDs), GENERAL

- A. General: Provide OCPDs in indicated types, as integral components of panelboards and also as individually enclosed and mounted single units.
- B. General: Provide OCPDs in indicated types, as integral components of panelboards, switchboards, and motor control centers; and also as individually enclosed and mounted single units.
- C. Enclosures: NEMA 250 "Enclosures for Electrical Equipment (1,000 Volts Maximum)."

2.3 CARTRIDGE FUSES

- A. General: NEMA Standard FU1, "Low-Voltage Cartridge Fuses." Unless indicated otherwise, provide nonrenewable cartridge fuses of indicated types, classes, and current ratings that have voltage ratings consistent with the circuits on which used.
- B. Class J Fuses: UL 198C, "High-Interrupting Capacity Fuses, Current-Limiting Type."
- C. Class L Fuses: UL 198C, "High-Interrupting Capacity Fuses, Current-Limiting Type."
- D. Class RK1 and RK5 Dual Element Time-Delay Fuses: UL 198E, "Class R Fuses."
- E. Class RK1 Fast-Acting Fuses: UL 198E, "Class R Fuses."

2.4 FUSIBLE SWITCHES

- A. General: UL 98 "Enclosed and Dead Front Switches" and NEMA KS 1 "Enclosed Switches," quick-make, quick-break heavy-duty units.
- B. Rating: Load-breaking capacity in excess of the normal horsepower rating for the switch.
- C. Withstand Capability: In excess of the let-through current permitted by its fuse when subject to faults up to 100,000 RMS symmetrical amperes.
- D. Operation: By means of external handle.
- E. Interlock: Prevents access to switch interior except when in "off" position.
- F. Fuse Clips: Rejection type.
- G. Padlocking Provisions: For 2 padlocks, whether open or closed.
- H. Enclosure for Independent Mounting: NEMA Type 1 enclosure except as otherwise indicated or required to suit environment where located.

2.5 MOLDED-CASE CIRCUIT BREAKERS

- A. General: UL 489, "Molded Case Circuit Breakers and Circuit Breaker Enclosures," and NEMA AB 1, "Molded Case Circuit Breakers."
- B. Construction: Bolt-in type, except breakers 225-ampere frame size and larger may be plug-in type if held in place by positive locking device requiring mechanical release for removal.

SECTION 16475
OVERCURRENT PROTECTIVE DEVICES

- C. Construction: Bolt-in type, except breakers in load-center-type panelboards and breakers 225-ampere frame size and larger may be plug-in type if held in place by positive locking device requiring mechanical release for removal.
- D. Characteristics: Indicated frame size, trip rating, number of poles, and a short-circuit interrupting capacity rating of 10,000 amperes symmetrical, unless a greater rating is indicated.
- E. Tripping Device: Quick-make, quick-break toggle mechanism with inverse-time delay and instantaneous overcurrent trip protection for each pole.
- F. Enclosure for Panelboard Mounting: Suitable for panel mounting in switchboard or panelboards where indicated.
- G. Enclosure for Independent Mounting: NEMA Type 1 enclosure, except as otherwise indicated or required to suit environment where located.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Independently Mounted OCPDs: Locate as indicated and install in accordance with manufacturer's written installation instructions.
- B. OCPDs in distribution equipment shall be factory installed.

3.2 IDENTIFICATION

- A. Identify components in accordance with Division 16 Section "Electrical Identification."

3.3 CONTROL WIRING INSTALLATION

- A. Install wiring between OCPDs and control/indication devices as specified in Division 16 Section "Wires and Cables" for hard wired connections.

3.4 CONNECTIONS

- A. Check connectors, terminals, bus joints, and mountings for tightness. Tighten field-connected connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A and UL 486B.

3.5 GROUNDING

- A. Provide equipment grounding connections for individually mounted OCPD units as indicated and as required by NEC. Tighten connectors to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounding.

Chiller Replacement at
Bethel Middle School
Bethel, CT

3.6 FIELD QUALITY CONTROL

- A. Independent Testing Organization: Arrange and pay for the services of an independent electrical testing organization to perform tests and observations on OCPDs.
- B. Reports: Prepare written reports certified by testing organization on tests and observations. Report defective materials and workmanship and unsatisfactory test results. Include complete records of repairs and adjustments made.
- C. Labeling: Upon satisfactory completion of tests and related effort, apply a label to tested components indicating test results, date, and responsible organization and person.
- D. Schedule visual and mechanical inspections and electrical tests with at least one week's advance notification.
- E. Pretesting: Upon completing installation of the system, perform the following preparations for independent tests:
 - 1. Make insulation resistance tests of OCPD buses, components, and connecting supply, feeder, and control circuits.
 - 2. Make continuity tests of circuits.
 - 3. Provide set of Contract Documents to test personnel. Include full updating on final system configuration and parameters where they supplement or differ from those indicated in original Contract Documents.
 - 4. Provide manufacturer's instructions for installation and testing of OCPDs to test personnel.
- F. Visual and mechanical inspection: Include the following inspections and related work.
 - 1. Overcurrent-Protective-Device Ratings and Settings: Verify indicated ratings and settings to be appropriate for final system arrangement and parameters. Where discrepancies are found, test organization shall recommend final protective device ratings and settings. Use accepted revised ratings or settings to make the final system adjustments.
 - 2. Inspect for defects and physical damage, NRTL labeling, and nameplate compliance with current single line diagram.
 - 3. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.
 - 4. Check tightness of electrical connections of OCPDs with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
 - 5. Clean OCPDs using manufacturer's approved methods and materials.
 - 6. Verify installation of proper fuse types and ratings in fusible OCPDs.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 16475
OVERCURRENT PROTECTIVE DEVICES

- G. Electrical Tests: Include the following items performed in accordance with manufacturer's instructions:
1. Insulation resistance test of OCPD conducting parts. Insulation resistance less than 100 megohms is not acceptable.
 2. Contact resistance test or measurement of millivolt drop across contacts of drawout circuit breakers and fused power circuit devices at rated current. Compare contact resistance or millivolt drop values of adjacent poles and of similar breakers. Deviations of more than 50 percent are not acceptable.
 3. Insulation resistance test of fused power circuit devices and insulated-case and molded-case circuit breakers over 600-ampere frame size at 1000 V d.c. for one minute from pole to pole and from each pole to ground with breaker closed and across open contacts of each phase. Insulation resistance less than 100 megohms is not acceptable.
 4. Use primary current injection to check performance characteristics of trip units of molded-case breakers over 600-ampere frame size. Trip characteristics not falling within manufacturer's published time-current characteristic tolerance bands when adjusted to approved parameters are not acceptable. Perform the following tests:
 - a. Determine minimum pickup current acceptable per manufacturer's instructions.
 - b. Determine long-time delay at 300 percent pickup current.
 - c. Determine short-time-pickup current and corresponding delay time.
 - d. Determine ground-fault current pickup and corresponding delay time.
 - e. Determine instantaneous pickup current value.
 5. Make adjustments for final settings of adjustable-trip devices.
 6. Activate auxiliary protective devices such as ground fault or undervoltage relays, to verify operation of shunt-trip devices.
 7. Check operation of electrically operated OCPDs in accordance with manufacturer's instructions.
- H. Retest: Correct deficiencies identified by tests and observations and provide retesting of OCPDs by testing organization. Verify by the system tests that specified requirements are met.

3.7 CLEANING

- A. Upon completion of installation, inspect OCPDs. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

3.8 DEMONSTRATION

- A. Training: Arrange and pay for the services of factory-authorized service representatives to demonstrate OCPDs and train Owner's maintenance personnel.

Chiller Replacement at
Bethel Middle School
Bethel, CT

SECTION 16475
OVERCURRENT PROTECTIVE DEVICES

- B. Conduct a minimum of one half day of training in operation and maintenance as specified under "Instructions to Owner Employees" in the "Project Closeout" Section of these specifications. Include both classroom training and hands-on equipment operation and maintenance procedures.
- C. Schedule training with at least seven days' advance notification.

3.9 COMMISSIONING

- A. Infrared Scanning: After Substantial Completion, but not more than 2 months after Final Acceptance, perform an infrared scan of OCPDs including their line and load connections, fuses, and fuse clips. Also scan OCPD contact structures where accessible to a portable scanner. Include individual OCPDs and those installed in switchboards, panelboards, and motor control centers.
- B. Follow-up Infrared Scanning: Perform two additional follow-up infrared scans of the same devices: one four months after Substantial Completion, and one 11 months after Substantial Completion.
- C. Instrument: Use an infrared scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
- D. Record of Infrared Scanning: Prepare a certified report identifying all OCPDs checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and rescanning observations after remedial action.

END OF SECTION 16475

Chiller Replacement at
Bethel Middle School
Bethel, CT