

PART 1      GENERAL1.1      RELATED SECTIONS

- .1      Section 09 91 23 - Painting.
- .2      Division 21 - Fire Suppression.
- .3      Division 22 - Plumbing.
- .4      Division 23 - Heating, Ventilating and Air-Conditioning (HVAC).

1.2      GENERAL

- .1      Apply Section 21 05 01 to the Work of all Sections of Divisions 21, 22, 23.

1.3      REFERENCES

- .1      Canadian Standards Association (CSA International)
  - .1      CSA B149.1-10, Natural Gas and Propane Installation Code, Includes Update No. 1 (2010).

1.4      DESIGN DOCUMENTS

- .1      The design drawings are partly diagrammatic, intended to convey the scope of work and indicate the general arrangement of systems. Off-sets in piping and ductwork may not be indicated in all cases.
- .2      The drawings are not intended to show Structural details or Architectural features. Refer to Architectural and Structural drawings for these details and for accurate dimensions.
- .3      Do not determine locations of equipment and materials by measurement from the drawings.
- .4      Verify that there will be no obstructions or interferences caused by the Work of other Divisions or existing systems in advance of commencing Work.
- .5      All Sections to coordinate their Work with the Work of other Sections and other Divisions. This applies particularly to service shafts and ceiling spaces.

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**1.5 OMISSIONS AND DISCREPANCIES**

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- .1 The drawings and specifications are intended to describe complete working systems including all necessary labour and materials.

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**1.6 SUBMITTALS**

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- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings; submit drawings as indicated.
  - .1 Review, stamp and sign shop drawings prior to issuance to the Departmental Representatives, and to make notations with respect to the following aspects and any other deviations from Technical Documents:
    - .1 Deviation from specified duties.
    - .2 Deviation from specified electrical requirements.
    - .3 Changes in dimensions from equipment indicated or specified, including confirmation that the equipment will or will not fit into space allotted.
  - .2 Each shop drawing shall clearly indicate:
    - .1 Name of Project.
    - .2 Name of Contractor.
    - .3 Name of Departmental Representative.
    - .4 Name of Component.
    - .5 Name of Service or System.
- .3 Shop drawings to show:
  - .1 Mounting arrangements.
  - .2 Operating and maintenance clearances.
  - .3 Overall dimensions, roughing in dimensions, and clearance dimensions, as applicable.
  - .4 Certified performance data, gauge of materials, type of finish and other pertinent data.
- .4 Shop drawings and product data accompanied by:
  - .1 Detailed drawings of bases, supports, and anchor bolts.
  - .2 Acoustical sound power data, where applicable.
  - .3 Points of operation on performance curves.
  - .4 Manufacturer to certify current model production.
  - .5 Certification of compliance to applicable codes.
- .5 Review of shop drawings indicates only that the quality, performance and general design of the equipment is acceptable. Verification of dimensions and quantities, locations of connections to equipment, etc., shall be the full responsibility of this Division.
- .6 Obtain review of shop drawings prior to ordering materials or commencing related Work.

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- .7 Submit shop drawings for the equipment specified, including applicable wiring diagrams and descriptive sequence of operation for each control system where applicable.
  - .8 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.
  - .9 Closeout Submittals:
    - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
    - .2 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
    - .3 Operation data to include:
      - .1 Control schematics for systems including environmental controls.
      - .2 Description of systems and their controls.
      - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
      - .4 Operation instruction for systems and component.
      - .5 Description of actions to be taken in event of equipment failure.
      - .6 Valves schedule and flow diagram.
      - .7 Colour coding chart.
    - .4 Maintenance data to include:
      - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
      - .2 Data to include schedules of tasks, frequency, tools required and task time.
    - .5 Performance data to include:
      - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
      - .2 Equipment performance verification test results.
      - .3 Special performance data as specified.
      - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
    - .6 Approvals:
      - .1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.
      - .2 Make changes as required and re-submit as approved by Departmental Representative, and submit four revised and approved copies of the O&M manuals, in both official languages.
    - .7 Additional data:
      - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
    - .8 Site records:
      - .1 Departmental Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.

- .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
- .3 Use different colour waterproof ink for each service.
- .4 Make available for reference purposes and inspection.
- .9 As-built drawings:
  - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
  - .2 Identify each drawing in lower right hand corner in letters at least 12mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
  - .3 Submit to Departmental Representative for approval and make corrections as directed.
  - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
  - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
  - .6 This set of drawings will form the Departmental Representative's records and must be accurate in terms of all services including locations for hidden or buried services, etc. Record drawings shall indicate depth (inverts) of all buried services and elevations to underside of all above floor services. Provide dimensions of all buried services to nearest column lines.
- .10 Submit copies of as-built drawings for inclusion in final TAB report.

#### 1.7 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

#### 1.8 MAINTENANCE

- .1 Furnish spare parts in accordance with Section 01 78 00 - Closeout Submittals as follows:
  - .1 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- .1 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

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### 1.10        MOCK-UP INSTALLATIONS

- .1        Provide complete mock-ups of equipment and systems when so specified in individual work sections. Include costs.
- .2        Co-ordinate installation of mock-ups at a time requested by the Departmental Representative.

### 1.11        INTERFERENCE DRAWINGS

- .1        The mechanical systems drawings are intended to indicate the general extent of the Work, arrangement of equipment, sizes of ducts and pipes, etc. It is the responsibility of the Contractor to coordinate the Work of the various Mechanical Sections and lay out the systems accordingly.
- .2        The Contractor shall provide interference drawings of congested locations where required by notes on the drawings, and where required in order to perform the Work efficiently.
- .3        Make allowances in the tender price for additional piping and ductwork off-sets to those indicated in order to achieve a properly coordinated installation.
- .4        Initiate the production of interference drawings immediately following the Award in order not to affect construction schedules.
- .5        Equipment dimensions shown on the Technical Documents are based upon a selected manufacturer's published data in each case. Ensure that alternative equipment, if selected, will fit within the allotted space with adequate room for access and servicing, and make any required adjustments to both duct and piping layouts.
- .6        Include these drawings in the Record Drawing submission.

### 1.12        COLOURS AND FINISHES

- .1        Where materials and equipment are available in optional colours and/or finishes, and if these options are not specified, consult the Departmental Representative to obtain selection.

## PART 2        PRODUCTS

### 2.1        MATERIALS

- .1        Materials and equipment to be new, unless otherwise indicated, and free from blemishes, oxidation, damage, etc. New materials and equipment to be of proven design and quality, and for which replacement parts are readily available. Use current models of equipment, for which published ratings are available.

- .2 Materials used for similar purposes and functions shall be the product of one manufacturer unless specified otherwise.
- .3 Ensure that all materials used are compatible with all adhesives, caulking, sealers, coatings, and any other materials that may make contact. No contact between any materials shall cause corrosion or otherwise attack and cause any deterioration.

## 2.2 ACCESSORIES

- .1 Provide accessory items or materials required such as equipment supports, fabricated bases, brackets, cleats, connectors, sealants, lubricants, cleaners, protection, etc., whether specified or not, so that the Work is complete and will perform as required.

## 2.3 ELECTRIC EQUIPMENT AND CONTROLS

- .1 All electrical Work shall conform to Division 26 requirements.
- .2 Power wiring for Divisions 21, 22, 23 equipment will be provided by Division 26. Disconnects will be provided by Division 26 except when part of packaged equipment, as indicated in mechanical equipment specifications and schedules.
- .3 All control wiring and conduits to be provided by Division 23 unless specified otherwise. Refer to Division 26 Specifications for quality of materials and workmanship.
- .4 Electrical equipment shall bear CSA labels.
- .5 Conform to requirements of Canadian Electrical Code, local, municipal and provincial authorities, and specified standards.
- .6 Mechanical equipment motors are to be provided by Divisions 21, 22, and 23. Coordinate power supply and overload requirements with Division 26.
- .7 Ensure that Electrical Contractor has provided for auxiliary contacts for the building controls systems. Refer to Controls Specifications.
- .8 All three-phase starters furnished as part of mechanical equipment to have hand-off-auto switches.
- .9 Provide loss-of-phase protection for all packaged equipment supplied with three-phase motors.
- .10 Furnish composite schematic wiring and interconnection diagrams for equipment, including description of performance and sequence of operation of mechanical systems. Submit to Departmental Representative for approval as part of shop drawing submission.

- .11 Equipment provided with electric devices shall have all required CSA approvals to comply with Ontario Hydro requirements. Include for all special approvals of equipment not conforming to these requirements. Electrical equipment to be of weatherproof design and construction where installed outdoors.
- .12 Co-ordinate the electrical requirements for Divisions 21, 22, 23 equipment with the Division 26 Contractor.

## 2.4 BEARINGS

- .1 Provide type of bearings as specified for individual items of equipment.
- .2 Provide oil sumps with sight glass in accessible locations for oil-lubricated bearings.
- .3 Provide extended nipples for grease lubricated bearings, if not already accessible.

## PART 3 EXECUTION

### 3.1 GENERAL

- .1 Co-operate and co-ordinate Work prior to starting and during execution as required for satisfactory and expeditious completion of Work. Take field dimensions relative to this Work. Fabricate and erect Work to suit field dimensions and field conditions. Pay cost or extra Work caused by, and make up time lost as a result of, failure to provide necessary co operation and/or information.
- .2 Supply equipment measurements to other Sections to allow for necessary openings to be left in the structure.
- .3 Ducts and tubing which are to be concealed are to be installed neatly and as close as possible to building structure so that the necessary furring can be kept to a minimum.
- .4 Obtain approval of Departmental Representative prior to core drilling any structural members.
- .5 Provide all forms, templates, anchors, sleeves, inserts and accessories required to execute the Work and instruct as to location.
- .6 Provide unions and flanges to allow for maintenance and dismantling.
- .7 Allow adequate space for servicing, and dismantling and removal of equipment and components.
- .8 Provide drains for equipment as applicable, piped to sanitary drainage system.

- .9 Install equipment and system components parallel or perpendicular to building lines, unless indicated otherwise.
- .10 Maximize usable space.

### 3.2 DEMOLITIONS AND REMOVALS

- .1 Comply with all conditions specified under Sections 01 00 10 - General Instructions and 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Remove equipment and systems indicated on the drawings or specified in this document.
- .3 Co-ordinate with Division 1 for the provision of suitable recycling and refuse containers.
- .4 Remove and/or valve or cap all services to equipment being removed. Termination of services shall be made at their source or at their branch point off existing services being retained.
- .5 Cap all floor services flush with the finished floor with manufactured caps (i.e., clean-out caps) or below the elevation of the floor in such a manner that floor repairs will permanently conceal the abandoned service stubs. Record the location of abandoned services in accordance with Section 01 78 00 - Closeout Submittals.

### 3.3 EXCAVATION AND BACKFILL

- .1 Excavation required for the mechanical services will be performed by Division 1 with the co-operation of Divisions 21, 22, 23.

### 3.4 LOCATION OF EQUIPMENT

- .1 Locations of equipment, fixtures and outlets indicated on the mechanical drawings or specified are to be considered as approximate. Refer to Architectural plans for exact locations of plumbing fixtures, pipe chases, etc.
- .2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space, and in accordance with manufacturers' recommendations for safety, access and maintenance.
- .3 Where thermostats are located adjacent to light switches, align thermostat with light switch horizontally or vertically. Co-ordinate with Division 26. Thermostats to be mounted at 1200 mm above floor level unless noted otherwise.



- .4 Submit field drawings to indicate relative position of various services and equipment when requested by the Departmental Representative and/or when required to resolve a space restriction.
- .5 Coordinate the layouts of ductwork, diffusers, grilles, sprinkler heads, etc. with the ceiling and lighting layouts to ensure that Work of Divisions 21, 22, 23, and 26 Work will fit without relocation of lighting fixtures, etc.

### 3.5 CONCEALMENT

- .1 Conceal pipes, ducts and wiring in floor, wall and ceiling of finished areas except where otherwise indicated. Access doors required for servicing will be provided by Division 1. Coordinate with Division 1 for location of access doors.
- .2 All Work to be concealed shall be inspected, tested and insulated as applicable prior to closing in or covering.

### 3.6 CO-ORDINATION OF WORK

- .1 Provide a full-time on-site superintendent to oversee and coordinate Divisions 21, 22, and 23 Work.
- .2 The Work shall be laid out so that it does not conflict or interfere with the Work of other Division. Make any adjustments required to the Work of Divisions 21, 22, and 23 as a result of improper location or sequencing, at no additional cost to the Project.

### 3.7 WORKMANSHIP

- .1 Perform the Work in a neat and careful manner so that items are installed, and will remain, plumb, square and straight. Items not so installed will be rejected and redone at no extra cost to the project.
- .2 Ensure that products are properly related to form close joints and appropriately aligned junctions, edges and surfaces, and that elements are free of warp, twist or other irregularities.
- .3 Except where specified otherwise, use products in strict accordance with manufacturers' published or written instructions, specifications or recommendations regarding handling, storage, preparation, site conditions, ancillary products or accessories, methods of installation, protection and cleaning.
- .4 When required either by the specifications or manufacturers' instructions, have manufacturer or his accredited agent or the supplier supervise the Work.

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**3.8            INSTALLATION OF MECHANICAL EQUIPMENT**

- .1        Provide for equipment maintenance and disassembly by use of unions or flanges in appropriate places.
- .2        Provide access for lubricating equipment including permanently lubricated bearings.
- .3        Install base-mounted equipment on chamfered edge reinforced concrete housekeeping pads a minimum of 100 mm high and 100 mm larger all around than equipment dimensions. Housekeeping pads to be provided by others under the direction of Divisions 21, 22, and 23.
- .4        Install drain lines to floor drains.
- .5        Position equipment to allow for easy removal of components such as filters, tubes, coils, etc., according to manufacturers' recommendations.

**3.9            INSTALLATION OF ELECTRICAL EQUIPMENT**

- .1        Supply and install motors and local controls for all motor driven equipment.
- .2        Supply, install and wire electrical items shipped loose and required for controls systems such as thermostats, flow switches, valve motors, sensors, etc.

**3.10          USE OF MECHANICAL SYSTEMS DURING CONSTRUCTION**

- .1        Use of new and/or existing permanent heating and ventilating systems for supplying temporary heat is permitted only under the following conditions:
  - .1        Written permission has been obtained from the Departmental Representative.
  - .2        Entire system is complete, pressure tested, cleaned, flushed out.
  - .3        Building has been closed in, areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.
  - .4        There is no likelihood of damage from any cause.
  - .5        Supply ventilation systems are protected by 60% filters, which shall be inspected daily, changed every two weeks or more frequently as required.
  - .6        Return systems have approved filters over all openings, inlets, outlets.
  - .7        All systems will be:
    - .1        Operated as per manufacturer's recommendations or instructions.
    - .2        Operated by Contractor.
    - .3        Monitored continuously by Contractor.
  - .8        Regular preventive and all other manufacturers recommended maintenance routines are performed by Contractor at his own expense and under supervision of Departmental Representative.
  - .9        Before completion, entire system to be refurbished, cleaned internally and externally, restored to "as-new" condition to the satisfaction of the Departmental Representative, and filters in air systems replaced.

- .2 Filters referred to herein are over and above those specified elsewhere in this specification.
- .3 Exhaust systems are not included in any approvals for temporary heating and ventilation.

### 3.11 PAINTING

- .1 Appropriate Sections of Divisions 21, 22, and 23 shall touch up minor damage to finish on equipment to match standard factory applied baked enamel finish. Items suffering major damage to finish shall be replaced entirely if, in the opinion of the Departmental Representative, the damage is too extensive to be remedied by touch up.
- .2 Provide for all painting of equipment or materials as specified or required by regulations. Where painting is to be performed by Division 9, clean and leave surfaces ready for painting.
- .3 Apply two coats of corrosion resistant primer paint to supports, hangers and equipment fabricated from ferrous metals after cleaning dirt, oil and rust. Touch up galvanized members using zinc rich paint.

### 3.12 REPAIRS/RESTORATION

- .1 To Section 09 91 23 - Painting.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged extensively for priming and touch-up.

### 3.13 CLEANING

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

### 3.14 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - SUBMITTALS.

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- .2 Start-up reports:
    - .1 All major equipment such as boilers, chillers, packaged heating and cooling equipment, and others as described in the equipment specifications shall be started up by factory authorized personnel. A written report of each procedure is to be signed by the factory authorized personnel, and submitted to the Departmental Representative as part of the warranty documents package.
  - .3 Tests - General:
    - .1 Give at least two days notice in writing when tests will be conducted.
    - .2 Conduct tests in the presence of appropriate representatives and bear the costs of testing, and for re-testing where necessary.
    - .3 Conduct performance, leakage and grade tests as specified and as requested by inspection Authorities Having Jurisdiction, both during progress of Work and at its completion, to prove that equipment and systems meet quality of installation, quality of Work and operating characteristics as specified.
    - .4 Supply test equipment, apparatus, gauges meters, etc., together with skilled personnel as required to perform tests and record the results.
    - .5 Conduct tests before application of external insulation and before any portion of pipes or ducts are concealed.
    - .6 Do not subject expansion joints, flexible pipe connections, meters, control valves and fixtures to test pressures greater than stated working pressure of equipment. Isolate or remove equipment or device during tests when prescribed test pressure is greater than the working pressure of any piece of equipment or device.
    - .7 Should a section of pipe or duct fail under test, repair and retest the pipe or duct. Replace faulty fittings, pipe or duct sections. Where it is necessary to test portions of duct and piping systems before the system is complete, overlap successive test sections so that no joint or section of duct or pipe is missed in the testing.
    - .8 Thoroughly clean piping and ducts after completion of tests, in accordance with these Specifications. Clean strainers and filters after the cleanout period.
    - .9 Test and calibrate controls, PRVs, instrumentation and relief valves after the cleanout period. Adjust valves and dampers and balance systems in an approved manner so that job is left ready for continuous and efficient operation.
    - .10 Supply lubricating oils and packing as required for proper operation of equipment and systems until the Work has been accepted.
    - .11 Demonstrate upon completion of the Work and testing of same, that all tests and calibrations have been carried out satisfactorily. Repeat any tests if so required.
  - .4 Final inspection:
    - .1 When the Work required under these Divisions has been completed to the best of the Contractor's knowledge, inform the Departmental Representative in writing that the job is ready for final inspection.
    - .2 Do not submit this written request until:
      - .1 All deficiencies recorded during site review(s) have been corrected.
      - .2 All systems have been successfully balanced and tested, and are ready for operation.

- .3 Balancing reports have been submitted, reviewed, corrections made on site if required, and the reported has been accepted by the Departmental Representative.
- .4 Completed O&M Manuals have been delivered and accepted.
- .5 Equipment and system identification is complete, including valve tags, nameplates, etc., and valve charts and flow diagrams have been submitted and accepted.
- .6 Cleaning has been completed.
- .7 Spare parts have been delivered to the Departmental Representative as specified.
- .8 Record Drawings have been completed, delivered and accepted.
- .9 Instruction sessions have been delivered.
- .3 Upon receipt of a deficiency list proceed immediately with steps to correct the deficiencies and report to the Departmental Representative within fifteen (15) days as to the status of same.
- .4 Before final payment is made provide a written warranty covering all defects in equipment, materials and workmanship for a period of one year from the date of substantial completion.
- .5 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

### 3.15 WARRANTY

- .1 Furnish a written warranty for the satisfactory operation of all work and apparatus installed. At no cost to the Departmental Representative, replace immediately any part which may fail or prove defective within a period of twelve months after date of substantial completion (unless specified otherwise). Warranty does not apply to failure due to improper usage or ordinary wear and tear.
- .2 No certificate issued, payment made or partial use of the equipment by the Departmental Representative shall be construed as acceptance of defective Work or improper materials.
- .3 This general warranty shall not act as a waiver to any specified warranty for any other length of time.

### 3.16 DEMONSTRATION

- .1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

- .2 Trial usage to apply to following equipment and systems:
  - .1 HVAC equipment and systems.
  - .2 Plumbing equipment and systems.
  - .3 Fire Protection equipment and systems.
- .3 Contractor's trial usage:
  - .1 Obtain written permission from the Departmental Representative to use and test permanent equipment and systems prior to acceptance by Departmental Representative. Do not make application for permission to operate ventilation equipment until drywall-sanding operations are finished and the drywall dust has been removed.
  - .2 Departmental Representative trial usage of any mechanical device, machinery, apparatus, equipment or other Work supplied under these Divisions before final completion and written acceptance is not to be construed as evidence of acceptance.
- .4 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .5 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .6 Instruction duration time requirements as specified in appropriate sections.

### 3.17 PROTECTION OF MATERIALS

- .1 Protect openings in pipes, ducts and factory fabricated equipment stored or installed on site from damage and the entry of dust, grit, sand, water or any other foreign material. Protect threaded connections with temporary threaded caps.