

Approved: 2022-08-16

Part 1 General

1.1 REFERENCE STANDARDS

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations
- .2 Province of British Columbia
 - .1 Workers Compensation Act, RSBC 1996 - Updated 2012.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01.
- .2 Submit site-specific Health and Safety Plan: Within 7 days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:
 - .1 Results of site specific safety hazard assessment.
 - .2 Results of safety and health risk or hazard analysis for site tasks and operation found in work plan.
- .3 Submit 2 copies of Contractor's authorized representative's work site health and safety inspection reports weekly to Departmental Representative.
- .4 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.
- .5 Submit copies of incident and accident reports.
- .6 Submit WHMIS Safety Data Sheets (SDS).
- .7 Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 7 days after receipt of plan. Revise plan as appropriate and resubmit plan to Departmental Representative within 7 days after receipt of comments from Departmental Representative.
- .8 Departmental Representative's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.
- .9 Medical Surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to Departmental Representative.

1.3 FILING OF NOTICE

- .1 File Notice of Project with Provincial authorities prior to beginning of Work.
- .2 Contractor shall be responsible and assume the Principal Contractor role for each work zone location and not the entire complex. Contractor shall provide a written acknowledgement of this responsibility with 3 weeks of contract award. Contractor to submit written acknowledgement to CSST along with Ouverture de Chantier Notice.
- .3 Work zone locations include:

.1 Mechanical Room.

.4 Contractor shall agree to install proper site separation and identification in order to maintain time and space at all times throughout life of project.

1.4 SAFETY ASSESSMENT

.1 Perform site specific safety hazard assessment related to project.

1.5 MEETINGS

.1 Schedule and administer Health and Safety meeting with Departmental Representative prior to commencement of Work.

1.6 PROJECT/SITE CONDITIONS

.1 Work at site will involve contact with:

.1 Propane fired equipment.

.2 Hydronic heating piping.

1.7 GENERAL REQUIREMENTS

.1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.

.2 Departmental Representative may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

1.8 RESPONSIBILITY

.1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.

.2 Contractor will be responsible and assume the role Constructor as described in the Ontario Occupational Health and Safety Act and Regulations for Construction Projects.

.3 Contractor shall be the Principal Contractor as described in the Quebec Act Respecting Health and Safety code for the Construction for only their scope and areas of work as defined and described this project specification.

.4 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.9 COMPLIANCE REQUIREMENTS

.1 Comply with Workers Compensation Act, B.C. Reg.

.2 Comply with R.S.Q., c. S-2.1, an Act respecting Health and Safety, and c. S-2.1, r.4 Safety Code for the Construction Industry.

.3 Comply with Occupational Health and Safety Regulations, 1996.

.4 Comply with Occupational Health and Safety Act, General Safety Regulations, O.I.C.

- .5 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations.

1.10 UNFORSEEN HAZARDS

- .1 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of Province having jurisdiction and advise Departmental Representative verbally and in writing.
- .2 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, advise Safety Officer and follow procedures in accordance with Acts and Regulations of Province having jurisdiction and advise Departmental Representative verbally and in writing.

1.11 HEALTH AND SAFETY CO-ORDINATOR

- .1 Employ and assign to Work, competent and authorized representative as Health and Safety Co-ordinator. Health and Safety Co-ordinator must:
 - .1 Have site-related working experience specific to activities associated with boiler work.
 - .2 Have working knowledge of occupational safety and health regulations.
 - .3 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.
 - .4 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.
 - .5 Be on site during execution of Work and report directly to and be under direction of the site supervisor.

1.12 POSTING OF DOCUMENTS

- .1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Province having jurisdiction, and in consultation with Departmental Representative.

1.13 CORRECTION OF NON-COMPLIANCE

- .1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Departmental Representative.
- .2 Provide Departmental Representative with written report of action taken to correct non-compliance of health and safety issues identified.
- .3 Departmental Representative may stop Work if non-compliance of health and safety regulations is not corrected.

1.14 WORK STOPPAGE

- .1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

Approved: 2022-08-16

Part 1 General

1.1 DEFINITIONS

- .1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humans; or degrade environment aesthetically, culturally and/or historically.
- .2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction.

1.2 REFERENCE STANDARDS

- .1 Canadian Society of Landscape Architects (CSLA)/Canadian Nursery Landscape Association (CNLA)
 - .1 Canadian Landscape Standard 2016, First Edition
 - .2 Canadian Nursery Stock Standard 2017, Ninth Edition
- .2 United States Environmental Protection Agency (EPA), Office of Water
 - .1 EPA-833-R-06-004, Developing Your Stormwater Pollution Prevention Plan: A Guide for Construction Sites

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for mechanical equipment and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit WHMIS Safety Data Sheets (SDS)
- .2 Submit Environmental Protection Plan (EPP) for review and approval by Departmental Representative before delivering materials to site or commencing construction activities.
- .3 EPP shall include comprehensive overview of known or potential environmental issues to be addressed on site during construction.
- .4 Address topics at level of detail commensurate with environmental issue and required construction tasks.
- .5 Include in Environmental Protection Plan (EPP):
 - .1 Names of persons responsible for ensuring adherence to EPP.
 - .2 Names and qualifications of persons responsible for manifesting hazardous waste to be removed from site.
 - .3 Names and qualifications of persons responsible for training site personnel.
 - .4 Descriptions of environmental protection personnel training program.
 - .5 Submit a Site Work Plan (SWP) showing work areas for proposed activities in each portion of area and identifying areas of limited use or non-use.

- .1 SWP to include measures for marking limits of use areas and methods for protection of features to be preserved within authorized work areas.
- .6 Submit a Solid Waste Disposal Plan (SWDP) for non-hazardous solid wastes identifying methods and locations for solid waste disposal including clearing debris.
- .7 Submit a site-specific Contaminant Prevention Plan (CPP) identifying the proper procedures and actions to be implemented to prevent potentially or expected hazardous substances due to the presence of any hazardous substances within the project site. The intent of the CPP is to:
 - .1 Prevent introduction of designated substances (DS) into air, water, or ground;
 - .2 Detail provisions for storage and handling of these materials in compliance with Federal, Provincial, and Municipal laws.
- .8 Submit a Wastewater Management Plan (WMP) identifying methods and procedures for management of discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines.

1.4 FIRES

- .1 Fires and burning of rubbish on site is not permitted.

1.5 NOTIFICATION

- .1 Departmental Representative will notify Contractor in writing of observed noncompliance with Federal, Provincial environmental laws and regulations or Municipal environmental bylaws, permits, and other elements of site-specific plans, such as EPP, SCP, CPP, and WMP as applicable.
- .2 Contractor after receipt of such notice, shall inform Departmental Representative of proposed corrective action and take such action to obtain the approval of Departmental Representative.
 - .1 Take action only after receipt of written approval by Departmental Representative.
- .3 Departmental Representative will issue stop order of work until satisfactory corrective action has been taken.
- .4 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 CLEANING

- .1 Leave Work area clean at end of each day.
- .2 Bury rubbish and waste materials on site is nor permitted unless approved in writing by Departmental Representative.
- .3 Ensure public waterways, storm and sanitary sewers remain free of waste and volatile materials disposal.
- .4 Proceed with final cleaning upon completion and removal of surplus materials, rubbish, tools and equipment.
- .5 Waste Management: separate waste materials for recycling.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

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Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for all mechanical equipment included on equipment schedules and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in British Columbia, Canada.
 - .2 Indicate on drawings:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
 - .3 Shop drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Points of operation on performance curves.
 - .3 Manufacturer to certify current model production.
 - .4 Certification of compliance to applicable codes.
 - .4 In addition to transmittal letter referred to in Section 01: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.
- .4 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75 % of construction wastes were recycled or salvaged.
 - .2 Building Energy for monitoring end-uses as follows:
 - .1 Boiler efficiencies.

1.2 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01.
- .2 Operation and Maintenance Data: submit operation and maintenance data for heating boilers and pumps for incorporation into manual.
 - .1 Operation and maintenance manual approved by, and final copies deposited with Departmental Representative before final inspection.
 - .2 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.
- .3 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.
- .4 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.
- .5 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 directed by Departmental Representative.
- .6 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .7 Site records:
 - .1 Consultant 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.
- .8 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 12 mm 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.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

1.3 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01.
- .2 Furnish spare parts as follows:
 - .1 One set of packing for each pump.
 - .2 One casing joint gasket for each size pump.
 - .3 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .3 Provide one set of special tools required to service equipment as recommended by manufacturers.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect boilers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse of packaging materials, as specified in Construction Waste Management Plan in accordance with Section 01.

Part 2 Execution

2.1 SYSTEM CLEANING

- .1 Clean interior and exterior of all systems including strainers.

2.2 FIELD QUALITY CONTROL

- .1 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 - ACTION AND INFORMATIONAL 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.

2.3 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 Boilers.
 - .2 Pumps.
- .3 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.
- .4 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .5 Instruction duration time requirements as specified in appropriate sections.
- .6 Departmental Representative will record these demonstrations on video tape for future reference.

2.4 CLEANING

- .1 Progress Cleaning:
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

2.5 PROTECTION

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

END OF SECTION

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Part 1 General

1.1 SUMMARY

- .1 This Section includes requirements for selective demolition and removal of heating, ventilation and air conditioning systems, controls and automated automation components, and related mechanical components and incidentals required to complete work described in this Section.

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA S350 M1980, Code of Practice for Safety in Demolition of Structures.

1.3 DEFINITIONS

- .1 Demolish: Detach items from existing construction and legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.
- .2 Remove: Planned deconstruction and disassembly of electrical items from existing construction including removal of conduit, junction boxes, cabling and wiring from electrical component to panel taking care not to damage adjacent assemblies designated to remain; legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.
- .3 Remove and Salvage: Detach items from existing construction and deliver them to Departmental Representative ready for reuse.
- .4 Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- .5 Existing to Remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed and salvaged, or removed and reinstalled.
- .6 Hazardous Substances: Dangerous substances, dangerous goods, hazardous commodities and hazardous products may include asbestos, mercury and lead, PCB's, poisons, corrosive agents, flammable substances, radioactive substances, or other material that can endanger human health or wellbeing or environment if handled improperly as defined by the Federal Hazardous Products Act (RSC 1985) including latest amendments.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Action Submittals: Provide the following in accordance with Section 01 before starting work of this Section:
 - .1 Construction Waste Management Plan (CWM Plan): Submit plan addressing opportunities for reduction, reuse, or recycling of materials prepared in accordance with Section 01 Waste Management and Disposal.
 - .2 Landfill Records: Indicate receipt and acceptance of selective demolition waste.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate work of this Section to avoid interference with work by other Sections.

1.6 QUALITY ASSURANCE

- .1 Regulatory Requirements: Perform work of this Section in accordance with the following
 - .1 Provincial/Territorial Workers' Compensation Boards/Commissions
- .2 Provincial Occupational Health and Safety Standards and Programs

1.7 SITE CONDITIONS

- .1 Existing Conditions: Condition of materials identified as being salvaged or demolished are based on their observed condition at time of site examination before tendering.
- .2 Existing Hazardous Substances: Departmental Representative has performed a hazardous substances assessment and identified materials requiring abatement as follows:
 - .1 Existing Hazardous Substances: Departmental Representative has performed a hazardous substances assessment and identified materials requiring abatement as follows:
 - .1 Cement Asbestos Board – Suspected on the bottom side of ceiling joists in the boiler room.
 - .2 Asbestos Insulating Cement – Located on hot/cold water heating/domestic pipe fittings both exposed and concealed above T-bar and drywall ceilings throughout the building.
 - .3 Asbestos Drywall Filler – Located on all finished drywall applications throughout the building.
 - .2 Hazardous substances will be removed by the Contractor as a part of the Contract before starting Work in accordance with work results described in Related Requirements listed above.

1.8 SALVAGE AND DEBRIS MATERIALS

- .1 Demolished items become Contractor 's property and will be removed from Project site; except for items indicated as being reused, salvaged, or otherwise indicated to remain Departmental Representative 's property.

Part 2 Products

2.1 MATERIAL

- .1 HVAC Repair Materials: Use only new materials required for completion or repair matching materials damaged during performance of work of this Section; new materials are required to meet assembly or system characteristics as existing systems indicated to remain and carry CSA approval labels required by the Authority Having Jurisdiction.

- .2 Fire stopping Repair Materials: Use fire stopping materials compatible with existing fire stopping systems where removal or demolition work affects rated assemblies, restore to match existing fire rated performance.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Existing Conditions: Visit site, thoroughly examine and become familiar with conditions that may affect the work of this Section before tendering the Bid; Departmental Representative will not consider claims for extras for work or materials necessary for proper execution and completion of the contract that could have been determined by a site visit.

3.2 PREPARATION

- .1 Protection of Existing Systems to Remain: Protect systems and components indicated to remain in place during selective demolition operations and as follows:
 - .1 Prevent movement and install bracing to prevent settlement or damage of adjacent services and parts of existing buildings scheduled to remain.
 - .2 Notify Departmental Representative and cease operations where safety of buildings being demolished, adjacent structures or services appears to be endangered and await additional instructions before resuming demolition work specified in this Section.
 - .3 Prevent debris from blocking drainage inlets.
 - .4 Protect mechanical systems that must remain in operation.
- .2 Protection of Building Occupants: Sequence demolition work so that interference with the use of the building by the Departmental Representative and users is minimized and as follows:
 - .1 Prevent debris from endangering the safe access to and egress from occupied buildings.
 - .2 Notify Departmental Representative and cease operations where safety of occupants appears to be endangered and await additional instructions before resuming demolition work specified in this Section.

3.3 EXECUTION

- .1 Demolition: Coordinate requirements of this Section and as follows:
 - .1 Disconnect and cap gas supply and electrical services in accordance with requirements of local Authority Having Jurisdiction.
 - .2 Do not disrupt active or energized utilities without approval of the Departmental Representative.
 - .3 Erect and maintain dust proof and weather tight partitions to prevent the spread of dust and fumes to occupied building areas; remove partitions when complete.
 - .4 At end of each day's work, leave worksite in safe condition.
 - .5 Perform demolition work in a neat and workmanlike manner:

- .1 Remove any tools or equipment after completion of work and leave site clean and ready for subsequent renovation work.
- .2 Repair and restore damages caused as a result of work of this Section to match existing materials and finishes.

3.4 CLOSEOUT ACTIVITIES

- .1 Demolition Waste Disposal: Arrange for legal disposal and remove demolished materials to accredited provincial landfill site or alternative disposal site (recycle centre)

END OF SECTION

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Part 1 General

1.1 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B40.100, Pressure Gauges and Gauge Attachments.
 - .2 ASME B40.200, Thermometers, Direct Reading and Remote Reading.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-14.4-M8, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.
 - .2 CAN/CGSB-14.5-M88, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.
- .3 Efficiency Valuation Organization (EVO)
 - .1 International Performance Measurement and Verification Protocol (IPMVP)
 - .1 IPMVP Current Version.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for thermometers and pressure gauges and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in British Columbia, Canada.
- .4 Certificates:
 - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Test and Evaluation Reports:
 - .1 Submit certified test reports for thermometers and pressure gauges from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
- .6 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

- .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 50% of construction wastes were recycled or salvaged.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store thermometers and pressure gauges indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect thermometers and pressure gauges from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return of packaging materials as specified in Waste Reduction Workplan in accordance with Section 01

Part 2 Products

2.1 GENERAL

- .1 Design point to be at mid-point of scale or range.

2.2 DIRECT READING THERMOMETERS

- .1 Industrial, variable angle type, mercury-free liquid filled, 125 mm scale length: to CAN/CGSB-14.4.
 - .1 Resistance to shock and vibration.

2.3 REMOTE READING THERMOMETERS

- .1 100 mm diameter mercury-free activated dial type: to CAN/CGSB-14.5, accuracy within one scale division, brass movement, stainless steel capillary, stainless steel spiral armour, stainless steel bulb and polished brass case for wall mounting.

2.4 THERMOMETER WELLS

- .1 Copper pipe: copper or bronze.
- .2 Steel pipe: brass.

2.5 PRESSURE GAUGES

- .1 112 mm, dial type: to ASME B40.100, Grade 2A, phosphor bronze bourdon tube having 0.5% accuracy full scale unless otherwise specified.

- .2 Provide:
 - .1 Gasketed pressure relief back with solid front.
 - .2 Bronze stop cock.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 GENERAL

- .1 Install thermometers and gauges so they can be easily read from floor or platform.
 - .1 If this cannot be accomplished, install remote reading units.
- .2 Install between equipment and first fitting or valve.

3.3 THERMOMETERS

- .1 Install in wells on piping. Include heat conductive material inside well.
- .2 Install in locations [as indicated] and on inlet and outlet of:
 - .1 Water boilers.
- .3 Install wells as indicated only for balancing purposes.
- .4 Use extensions where thermometers are installed through insulation.

3.4 PRESSURE GAUGES

- .1 Install in locations as follows:
 - .1 Suction and discharge of pumps.
 - .2 Outlet of boilers.
- .2 Install gauge cocks for balancing purposes, elsewhere as indicated.
- .3 Use extensions where pressure gauges are installed through insulation.

3.5 NAMEPLATES

- .1 Install engraved lamicoid nameplates in accordance with Section 23 05 53 - Identification For HVAC Piping and Equipment, identifying medium.

3.6 CLEANING

- .1 Progress Cleaning:
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
- .3 Waste Management: separate waste materials for recycling.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.7 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by thermometer and gauge installation.

END OF SECTION

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Part 1 General

1.1 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
 - .1 ANSI/ASME B1.20.1, Pipe Threads, General Purpose (Inch).
 - .2 ANSI/ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
- .2 ASTM International (ASTM)
 - .1 ASTM A276, Standard Specification for Stainless Steel Bars and Shapes.
 - .2 ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .3 ASTM B283, Standard Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).
 - .4 ASTM B505/B505M, Standard Specification for Copper-Base Alloy Continuous Castings.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
 - .1 MSS-SP-25, Standard Marking System for Valves, Fittings, Flanges and Unions.
 - .2 MSS-SP-80, Bronze Gate Globe, Angle and Check Valves.
 - .3 MSS-SP-110, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in British Columbia of Canada.
 - .2 Submit data for valves specified in this Section.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials/Spare Parts:
 - .1 Furnish following spare parts:

- .1 Stem packing: one for every 10 valves, each size. Minimum 1.
- .2 Valve handles: 2 of each size.
- .3 Gaskets for flanges: one for every 10 flanged joints.
- .2 Tools:
 - .1 Furnish special tools for maintenance of systems and equipment.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return of packaging materials in accordance with Section 01.

Part 2 Products

2.1 MATERIALS

- .1 Valves:
 - .1 Except for specialty valves, to be single manufacturer.
 - .2 Products to have CRN registration numbers.
- .2 End Connections:
 - .1 Connection into adjacent piping/tubing:
 - .1 Steel pipe systems: screwed ends to ANSI/ASME B1.20.1.
 - .2 Copper tube systems: solder ends to ANSI/ASME B16.18.
- .3 Lockshield Keys:
 - .1 Where lockshield valves are specified, provide 5 keys of each size: malleable iron cadmium plated.
- .4 Gate Valves:
 - .1 Requirements common to gate valves, unless specified otherwise:
 - .1 Standard specification: MSS SP-80.
 - .2 Bonnet: union with hexagonal shoulders.
 - .3 Connections: screwed with hexagonal shoulders.
 - .4 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.
 - .5 Packing: non-asbestos.
 - .6 Handwheel: non-ferrous.
 - .7 Handwheel Nut: bronze to ASTM B62.
 - .2 NPS 2 and under, non-rising stem, solid wedge disc, Class 125
 - .1 Body: with long disc guides, screwed bonnet with stem retaining nut.

- .2 Operator: Handwheel.
 - .3 NPS 2 and under, non-rising stem, solid wedge disc, Class 150:
 - .1 Body: with long disc guides, screwed bonnet with stem retaining nut.
 - .2 Operator: handwheel.
 - .4 NPS 2 and under, rising stem, split wedge disc, Class 125:
 - .1 Body: with long disc guides, screwed bonnet.
 - .2 Disc: split wedge, bronze to ASTM B283, loosely secured to stem.
 - .3 Operator: lockshield.
 - .5 NPS 2 and under, rising stem, solid wedge disc, Class 125:
 - .1 Body: with long disc guides, screwed bonnet.
 - .2 Operator: handwheel.
 - .6 NPS 2 and under, rising stem, solid wedge disc, Class 150:
 - .1 Body: with long disc guides, union bonnet.
 - .2 Operator: handwheel.
- .5 Globe Valves:
- .1 Requirements common to globe valves, unless specified otherwise:
 - .1 Standard specification: MSS SP-80.
 - .2 Bonnet: union with hexagonal shoulders.
 - .3 Connections: screwed with hexagonal shoulders.
 - .4 Pressure testing: to MSS SP-80. Tests to be hydrostatic.
 - .5 Stuffing box: threaded to bonnet with gland follower, packing nut, high grade non-asbestos packing.
 - .6 Handwheel: non-ferrous.
 - .7 Handwheel Nut: bronze to ASTM B62.
 - .2 NPS 2 and under, composition disc, Class 125:
 - .1 Body and bonnet: screwed bonnet.
 - .2 Disc and seat: renewable rotating PTFE disc composition to suit service conditions, regrindable bronze seat, loosely secured to bronze stem to ASTM B505.
 - .3 Operator: handwheel.
 - .3 NPS 2 and under, composition disc, Class 150:
 - .1 Body and bonnet: union bonnet.
 - .2 Disc and seat: renewable rotating PTFE disc in easily removable disc holder, regrindable bronze seat, loosely secured to bronze stem to ASTM B505.
 - .3 Operator: handwheel.
 - .4 NPS 2 and under, plug disc, Class 150, screwed ends:
 - .1 Body and bonnet: union bonnet.
 - .2 Disc and seat ring: tapered plug type with disc stem ring of AISI S420 stainless steel to ASTM A276, loosely secured to stem.
 - .3 Operator: handwheel.

- .5 Angle valve, NPS 2 and under, composition disc, Class 150:
 - .1 Body and bonnet: union bonnet.
 - .2 Disc and seat: renewable rotating PTFE disc in slip-on easily removable disc holder having integral guides, regrindable bronze seat, loosely secured to stem.
 - .3 Operator: handwheel.
- .6 Check Valves:
 - .1 Requirements common to check valves, unless specified otherwise:
 - .1 Standard specification: MSS SP-80.
 - .2 Connections: screwed with hexagonal shoulders.
 - .2 NPS 2 and under, swing type, bronze disc, Class 125:
 - .1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
 - .2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.
 - .3 NPS 2 and under, swing type, bronze disc:
 - .1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
 - .2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.
 - .4 NPS 2 and under, swing type, composition disc, Class 200:
 - .1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
 - .2 Disc: renewable rotating disc of number 6 composition to suit service conditions, bronze two-piece hinge disc construction.
 - .5 NPS 2 and under, horizontal lift type, composition disc, Class 150:
 - .1 Body: with integral seat, union bonnet ring with hex shoulders, cap.
 - .2 Disc: renewable PTFE no. 6 composition rotating disc in disc holder having guides top and bottom, of bronze to ASTM B62.
 - .6 NPS 2 and under, vertical lift type, bronze disc, Class 125:
 - .1 Disc: rotating disc having guides top and bottom, disc guides, retaining rings.
- .7 Silent Check Valves:
 - .1 NPS 2 and under:
 - .1 Body: cast high tensile bronze to ASTM B62 with integral seat.
 - .2 Pressure rating: Class 125.
 - .3 Connections: screwed ends to ANSI B1.20.1 and with hex. shoulders.
 - .4 Disc and seat: renewable rotating disc.
 - .5 Stainless steel spring, heavy duty.
 - .6 Seat: regrindable.
- .8 Ball Valves:

- .1 NPS 2 and under:
 - .1 Body and cap: cast high tensile bronze to ASTM B62.
 - .2 Pressure rating: Class125.
 - .3 Connections: screwed ends to ANSI B1.20.1 and with hexagonal shoulders.
 - .4 Stem: tamperproof ball drive.
 - .5 Stem packing nut: external to body.
 - .6 Ball and seat: replaceable hard chrome solid ball and Teflon seats.
 - .7 Stem seal: TFE with external packing nut.
 - .8 Operator: removable lever handle.
- .9 Butterfly Valves:
 - .1 NPS 2 1/2 through NPS 6, 2068 kPa with grooved ends.
 - .1 Body: cast bronze, with copper-tube dimensioned grooved ends.
 - .2 Disc: elastomer coated ductile iron with integrally cast stem.
 - .3 Operator: lever.

Part 3 Execution

3.1 INSTALLATION

- .1 Install rising stem valves in upright position with stem above horizontal.
- .2 Remove internal parts before soldering.
- .3 Install valves with unions at each piece of equipment arranged to allow servicing, maintenance, and equipment removal.

3.2 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for recycling in accordance with Section 01.

END OF SECTION

Approved: 2022-07-05

Part 1 General

1.1 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
 - .1 ASME B1.20.1-, Pipe Threads, General Purpose (Inch).
 - .2 ASME B16.1-05, Grey Iron Pipe Flanges and Flanged Fittings: Classes 25,125 and 250.
 - .3 ANSI/ASME B16.5-03, Pipe Flanges and Flanged Fittings: NPS ½ through 24.
 - .4 ANSI/ASME B16.11-05, Forged Fittings, Socket-Welding and Threaded.
 - .5 ANSI/ASME B16.25-07, Buttwelding Ends.
 - .6 ANSI/ASME B16.34-04, Valves - Flanged, Threaded and Welding Ends.
- .2 American Petroleum Institute (API)
 - .1 API Std. 609-04, Butterfly Valves: Double Flanged, Lug- and Wafer-Type.
- .3 ASTM International (ASTM).
 - .1 ASTM A126-04), Standard Specification for Grey Iron Castings for Valves, Flanges, and Pipe Fittings.
 - .2 ASTM A536-84, Standard Specification for Ductile Iron Castings.
 - .3 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .4 ASTM B209M-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate Metric.
- .4 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
 - .1 MSS SP-67-02a, Butterfly Valves.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheets for valves and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit data for valves specified in this section.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in British Columbia, Canada.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit maintenance data for incorporation into manual specified in Section 01.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return of packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials/Spare Parts:
- .2 Furnish following spare parts:
 - .1 Valve seats: one for every 10 valves each size, minimum 1.
 - .2 Discs: one for every 10 valves, each size, minimum 1.
 - .3 Stem packing: one for every 10 valves, each size, minimum 1.
 - .4 Valve handles: 2 of each size.
 - .5 Gaskets for flanges: one for every 10 flanged joints.
- .3 Tools:
 - .1 Furnish special tools for maintenance of systems and equipment.

Part 2 Products

2.1 BUTTERFLY VALVES - RESILIENT SEAT - 200 PSI

- .1 Except to specialty valves, to be of single manufacturer.
- .2 To be suitable for dead-end service.
- .3 CRN registration number required for products.
- .4 Sizes:
 - .1 Lug type: NPS 2 to 30.
 - .2 Grooved end type: NPS 2 to 12.
- .5 Pressure rating for tight shut-off at temperatures up to maximum for seat material.
 - .1 NPS 2 - 12:200 psig.
- .6 Minimum seat temperature ratings to 135 degrees C.
- .7 Application: on-off operation.
- .8 Full lug body (threaded).
- .9 Operators:
 - .1 NPS 2 - 6: handles capable of locking in any of ten (10) positions - 0 degrees to 90 degrees. Handle and release trigger - ductile iron. Return spring and hinge pin:

carbon steel. Latch plate and mounting hardware: cadmium plated carbon steel.
Standard coating: black laquer.

- .10 Designed to comply with MSS SP-67 and API 609.
- .11 Compatible with ANSI Class 125/Class 150 flanges.
- .12 Construction:
 - .1 Body ductile iron
 - .2 Disc: plated ductile iron
 - .3 Seat: EPT
 - .4 Shaft: 316stainless steel.
 - .5 Taper pin: 316 SS
 - .6 Key: carbon steel.
 - .7 O-Ring:Fluoroelastomer.
 - .8 Bushings: Teflon.

Part 3 Execution

3.1 PREPARATION

- .1 Valve and mating flange preparation.
 - .1 Inspect adjacent pipeline, remove rust, scale, welding slag, other foreign material.
 - .2 Ensure that valve seats and pipe flange faces are free of dirt or surface irregularities which may disrupt flange seating and cause external leakage.
 - .3 Install butterfly valves with disc in almost closed position.
 - .4 Inspect valve disc seating surfaces and waterway and eliminate dirt or foreign material.

3.2 INSTALLATION OF VALVES

- .1 Install in accordance with manufacturer's instructions.
- .2 Do not use gaskets between pipe flanges and valves unless instructed otherwise by valve manufacturer.
- .3 Verify suitability of valve for application by inspection of identification tag.
- .4 Mount actuator on to valve prior to installation.
- .5 Handle valve with care so as to prevent damage to disc and seat faces.
- .6 Valves in horizontal pipe lines should be installed with stem in horizontal position to minimize liner and seal wear.
- .7 Ensure that valves are centered between bolts before bolts are tightened and then opened and closed to ensure unobstructed disc movement. If interference occurs due, for example to pipe wall thickness, taper bore adjacent piping to remove interference.

3.3 CLEANING

- .1 Clean installed products in accordance to manufacturer's recommendation.
- .2 Waste Management: separate waste materials for recycling in accordance with Section 01.

END OF SECTION

Approved: 2022-07-05

Part 1 General

1.1 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B31.1-07, Power Piping.
- .2 ASTM International (ASTM)
 - .1 ASTM A125, Standard Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A307 07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A563-07a, Standard Specification for Carbon and Alloy Steel Nuts.
- .3 Factory Mutual (FM)
- .4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 MSS SP58, Pipe Hangers and Supports - Materials, Design and Manufacture.
 - .2 MSS SP69, Pipe Hangers and Supports - Selection and Application.
 - .3 MSS SP89, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .5 National Research Council Canada (NRC)
 - .1 National Plumbing Code of Canada 2015 (NPC).
- .6 Underwriter's Laboratories of Canada (ULC)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in British Columbia of Canada.
 - .2 Submit shop drawings for:
 - .1 Bases, hangers and supports.
 - .2 Connections to equipment and structure.
- .4 Certificates:
 - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Manufacturers' Instructions:

- .1 Provide manufacturer's installation instructions.
 - .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 01.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return of packaging materials in accordance with Section 01.

Part 2 Products

2.1 SYSTEM DESCRIPTION

- .1 Design Requirements:
 - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
 - .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58.
 - .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
 - .4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
 - .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.

2.2 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with MSS SP58. ANSI B31.1
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.3 PIPE HANGERS

- .1 Finishes:
 - .1 Pipe hangers and supports: galvanized after manufacture.
 - .2 Use hot dipped galvanizing process.

- .3 Ensure steel hangers in contact with copper piping are epoxy coated.
- .2 Upper attachment structural: suspension from lower flange of I-Beam:
 - .1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut carbon steel retaining clip.
 - .1 Rod: 9 mm UL listed
 - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed.
- .3 Upper attachment structural: suspension from upper flange of I-Beam:
 - .1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed.
 - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed.
- .4 Upper attachment to concrete:
 - .1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
 - .2 Concrete inserts: wedge shaped body with knockout protector plate UL listed to MSS SP69.
- .5 Hanger rods: threaded rod material to MSS SP58:
 - .1 Ensure that hanger rods are subject to tensile loading only.
 - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
- .6 Pipe attachments: material to MSS SP58:
 - .1 Attachments for steel piping: carbon steel galvanized.
 - .2 Attachments for copper piping: copper plated black steel.
 - .3 Use insulation shields for hot pipework.
 - .4 Oversize pipe hangers and supports.
- .7 Adjustable clevis: material to MSS SP69 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
 - .1 Ensure "U" has hole in bottom for rivetting to insulation shields.
- .8 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.
- .9 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.
 - .1 Finishes for steel pipework: galvanized.
 - .2 Finishes for copper, glass, brass or aluminum pipework: epoxy coated.

2.4 INSULATION PROTECTION SHIELDS

- .1 Insulated cold piping:

- .1 64 kg/m³ density insulation plus insulation protection shield to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span.
- .2 Insulated hot piping:
 - .1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP69.

2.5 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

- .1 Provide templates to ensure accurate location of anchor bolts.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Install in accordance with:
 - .1 Manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
 - .1 Install on piping systems at pumps, boilers, and as indicated.
- .3 Clamps on riser piping:
 - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
 - .2 Bolt-tightening torques to industry standards.
 - .3 Steel pipes: install below coupling or shear lugs welded to pipe.
 - .4 Cast iron pipes: install below joint.
- .4 Clevis plates:
 - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
- .6 Use approved constant support type hangers where:
 - .1 Vertical movement of pipework is 13 mm or more,
 - .2 Transfer of load to adjacent hangers or connected equipment is not permitted.
- .7 Use variable support spring hangers where:
 - .1 Transfer of load to adjacent piping or to connected equipment is not critical.
 - .2 Variation in supporting effect does not exceed 25 % of total load.

3.3 HANGER SPACING

- .1 Gas and piping: up to NPS 1/2: every 1.8 m.
- .2 Copper piping: up to NPS 1/2: every 1.5 m.
- .3 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.
- .4 Within 300 mm of each elbow.

Maximum Pipe Size: NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.4 m	1.8 m
1-1/2	3.0 m	2.4 m
2	3.0 m	2.4 m
2-1/2	3.7 m	3.0 m
3	3.7 m	3.0 m
3-1/2	3.7 m	3.3 m
4	3.7 m	3.6 m
5	4.3 m	
6	4.3 m	
8	4.3 m	
10	4.9 m	
12	4.9 m	

- .5 Pipework greater than NPS 12: to MSS SP69.

3.4 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.5 HORIZONTAL MOVEMENT

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.
- .2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.6 FINAL ADJUSTMENT

- .1 Adjust hangers and supports:
 - .1 Ensure that rod is vertical under operating conditions.
 - .2 Equalize loads.
- .2 Adjustable clevis:
 - .1 Tighten hanger load nut securely to ensure proper hanger performance.
 - .2 Tighten upper nut after adjustment.

- .3 C-clamps:
 - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps:
 - .1 Hammer jaw firmly against underside of beam.

3.7 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for recycling in accordance with Section 01.

END OF SECTION

Approved: 2022-07-05

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and requirements for the identification of piping systems, duct work, valves and controllers, including the installation and location of identification systems.
 - .2 Sustainable requirements for construction and verification.

1.2 REFERENCE STANDARDS

- .1 Canadian Gas Association (CGA)
 - .1 CSA/CGA B149.1-05, Natural Gas and Propane Installation Code.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.
 - .2 CAN/CGSB-24.3-92, Identification of Piping Systems.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
- .2 Submittals: in accordance with Section 01.
- .3 Product data to include paint colour chips, other products specified in this section.
- .4 Samples:
 - .1 Submit samples in accordance with Section 01.
 - .2 Samples to include nameplates, labels, tags, lists of proposed legends.

1.4 QUALITY ASSURANCE

- .1 Quality assurance submittals: submit following in accordance with Section 01.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Provincial Regulations.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:

- .1 Dispose of unused paint material at official hazardous material collections site approved by Departmental Representative.
- .2 Do not dispose of unused paint material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

Part 2 Products

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers raised or recessed.
- .3 Information to include, as appropriate:
 - .1 Equipment: manufacturer's name, model, size, serial number, capacity.
 - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

- .1 Colours:
 - .1 Hazardous: red letters, white background.
 - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction:
 - .1 3 mm thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes:
 - .1 Conform to following table:

Size # mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

- .2 Use maximum of 25 letters/numbers per line.
- .4 Locations:
 - .1 Equipment in Mechanical Rooms: use size # 9.
- .5 Identification for PSPC Preventive Maintenance Support System (PMSS):
 - .1 Use arrangement of Main identifier, Source identifier, Destination identifier.

- .2 Equipment in Mechanical Room:
 - .1 Main identifier: size #9.
 - .2 Source and Destination identifiers: size #6.
 - .3 Terminal cabinets, control panels: size #5.
- .3 Equipment elsewhere: sizes as appropriate.

2.3 EXISTING IDENTIFICATION SYSTEMS

- .1 Apply existing identification system to new work.
- .2 Where existing identification system does not cover for new work, use identification system specified this section.
- .3 Before starting work, obtain written approval of identification system from Departmental Representative.

2.4 PIPING SYSTEMS GOVERNED BY CODES

- .1 Identification:
 - .1 Propane gas: to CSA/CGA B149.1.

2.5 IDENTIFICATION OF PIPING SYSTEMS

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.
- .2 Pictograms:
 - .1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.
- .3 Legend:
 - .1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.
- .4 Arrows showing direction of flow:
 - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
 - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
 - .3 Use double-headed arrows where flow is reversible.
- .5 Extent of background colour marking:
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Materials for background colour marking, legend, arrows:
 - .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
 - .2 Other pipes: pressure sensitive [plastic-coated cloth] [vinyl] with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of

100% RH and continuous operating temperature of 150 degrees C and
intermittent temperature of 200 degrees C.

.7 Colours and Legends:

.1 Where not listed, obtain direction from [DCC Representative] [Departmental Representative] [Consultant].

.2 Colours for legends, arrows: to following table:

Background colour:	Legend, arrows:
Yellow	BLACK
Green	WHITE
Red	WHITE

.3 Background colour marking and legends for piping systems:

Contents	Background colour marking	Legend
** Add design temperature		
++ Add design temperature and pressure		
Treated water	Green	TREATED WATER
Hot water heating supply	Yellow	HEATING SUPPLY
Hot water heating return	Yellow	HEATING RETURN
Boiler feed water	Yellow	BLR. FEED WTR
Propane	to Codes	

2.6 IDENTIFICATION DUCTWORK SYSTEMS

- .1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.
- .2 Colours: back, or co-ordinated with base colour to ensure strong contrast.

2.7 VALVES, CONTROLLERS

- .1 Brass tags with 12 mm stamped identification data filled with black paint.
- .2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.8 CONTROLS COMPONENTS IDENTIFICATION

- .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.
- .2 Inscriptions to include function and (where appropriate) fail-safe position.

2.9 LANGUAGE

- .1 Identification in English.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide CSA registration plates as required by respective agency.
- .3 Identify systems, equipment to conform to PWGSC PMSS.

3.3 NAMEPLATES

- .1 Locations:
 - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Standoffs:
 - .1 Provide for nameplates on hot and/or insulated surfaces.
- .3 Protection:
 - .1 Do not paint, insulate or cover.

3.4 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification easily and accurately readable from usual operating areas and from access points.

- .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.5 VALVES, CONTROLLERS

- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.
- .2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Departmental Representative. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively.

3.6 CLEANING

- .1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Approved: 2022-07-05

Part 1 General

1.1 SUMMARY

- .1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.
- .2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.2 QUALIFICATIONS OF TAB PERSONNEL

- .1 Submit names of personnel to perform TAB to Departmental Representative within 90 days of award of contract.
- .2 Provide documentation confirming qualifications, successful experience.
- .3 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:
 - .1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1-2002.
 - .2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-1998.
 - .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing-2002.
- .4 Recommendations and suggested practices contained in the TAB Standard: mandatory.
- .5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.
- .6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.
- .7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
- .8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.
 - .1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.
 - .2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.3 PURPOSE OF TAB

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads
- .2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.
- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.4 EXCEPTIONS

- .1 TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction.

1.5 CO-ORDINATION

- .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.
- .2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.6 PRE-TAB REVIEW

- .1 Review Contract Documents before project construction is started confirm in writing to Departmental Representative adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report to Departmental Representative in writing proposed procedures which vary from standard.
- .3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.7 START-UP

- .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
- .2 Follow special start-up procedures specified elsewhere in Division 23.

1.8 OPERATION OF SYSTEMS DURING TAB

- .1 Operate systems for length of time required for TAB and as required by Departmental Representative for verification of TAB reports.

1.9 START OF TAB

- .1 Notify Departmental Representative 7 days prior to start of TAB.
- .2 Provisions for TAB installed and operational.

- .3 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
 - .1 Proper thermal overload protection in place for electrical equipment.
 - .2 Liquid systems:
 - .1 Flushed, filled, vented.
 - .2 Correct pump rotation.
 - .3 Strainers in place, baskets clean.
 - .4 Isolating and balancing valves installed, open.
 - .5 Calibrated balancing valves installed, at factory settings.
 - .6 Chemical treatment systems complete, operational.

1.10 APPLICATION TOLERANCES

- .1 Do TAB to following tolerances of design values:
 - .1 Hydronic systems: plus or minus 10%.

1.11 ACCURACY TOLERANCES

- .1 Measured values accurate to within plus or minus 2 % of actual values.

1.12 INSTRUMENTS

- .1 Prior to TAB, submit to Departmental Representative list of instruments used together with serial numbers.
- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .3 Calibrate within 3 months of TAB. Provide certificate of calibration to Departmental Representative.

1.13 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit, prior to commencement of TAB:
- .2 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.14 PRELIMINARY TAB REPORT

- .1 Submit for checking and approval of Departmental Representative, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
 - .1 Details of instruments used.
 - .2 Details of TAB procedures employed.
 - .3 Calculations procedures.
 - .4 Summaries.

1.15 TAB REPORT

- .1 Format in accordance with NEBB standard.

- .2 TAB report to show results in SI units and to include:
 - .1 Project record drawings.
 - .2 System schematics.
- .3 Submit 2 copies of TAB Report to Departmental Representative for verification and approval, in English in D-ring binders, complete with index tabs.

1.16 VERIFICATION

- .1 Reported results subject to verification by Departmental Representative.
- .2 Provide personnel and instrumentation to verify up to 30 % of reported results.
- .3 Number and location of verified results as directed by Departmental Representative.
- .4 Pay costs to repeat TAB as required to satisfaction of Departmental Representative.

1.17 SETTINGS

- .1 After TAB is completed to satisfaction of Departmental Representative, lock devices in set positions, ensure sensors are at required settings.
- .2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

1.18 COMPLETION OF TAB

- .1 TAB considered complete when final TAB Report received and approved by Departmental Representative.

1.19 OTHER TAB REQUIREMENTS

- .1 General requirements applicable to work specified this paragraph:
 - .1 Qualifications of TAB personnel: as for liquid systems specified this section.
 - .2 Quality assurance: as for liquid systems specified this section.

1.20 POST-OCCUPANCY TAB

- .1 Participate in systems checks twice during Warranty Period - #1 approximately 3 months after acceptance and #2 within 1 month of termination of Warranty Period.

END OF SECTION

Approved: 2022-07-05

Part 1 General

1.1 HYDRONIC SYSTEMS - PERFORMANCE VERIFICATION (PV)

- .1 Perform hydronic systems performance verification after cleaning is completed and system is in full operation.
- .2 When systems are operational, perform following tests:
 - .1 Conduct full scale tests at maximum design flow rates, temperatures and pressures for continuous consecutive period of 48 hours to demonstrate compliance with design criteria.
 - .2 Verify performance of hydronic system circulating pumps as specified, recording system pressures, temperatures, fluctuations by simulating maximum design conditions and varying.
 - .1 Pump operation.
 - .2 Boiler operation.
 - .3 Pressure bypass open/closed.
 - .4 Control pressure failure.
 - .5 Maximum heating demand.
 - .6 Boiler failure.
 - .7 Outdoor reset. Re-check heat exchanger output supply temperature at 100% and 50% reset, maximum water temperature.

1.2 HYDRONIC SYSTEM CAPACITY TEST

- .1 Perform hydronic system capacity tests after:
 - .1 TAB has been completed
 - .2 Verification of operating, limit, safety controls.
 - .3 Verification of primary and secondary pump flow rates.
 - .4 Verification of accuracy of temperature and pressure sensors and gauges.
- .2 Calculate system capacity at test conditions.
- .3 Using manufacturer's published data and calculated capacity at test conditions, extrapolate system capacity at design conditions.
- .4 When capacity test is completed, return controls and equipment status to normal operating conditions.
- .5 Submit sample of system water to approved testing agency to determine if chemical treatment is correct. Include cost.
- .6 Heating system capacity test:
 - .1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:

- .1 Increasing OA flow rates through heating coils (in this case, monitor heating coil discharge temperatures to ensure that coils are not subjected to freezing conditions) or
- .2 Reducing space temperature by turning of heating system for sufficient period of time before starting testing.
- .2 Test procedures:
 - .1 Open fully heat exchanger, heating coil and radiation control valves.
 - .2 With boilers on full firing and hot water heating supply temperature stabilized, record flow rates and supply and return temperatures simultaneously.
 - .3 Conduct flue gas analysis test on boilers at full load and at low fire conditions.

1.3 REPORTS

- .1 In accordance with Section 01.

1.4 TRAINING

- .1 In accordance with Section 01.
 - .1 Include following:
 - .1 Hydronic Systems.

END OF SECTION

Approved: 2022-07-05

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Procedures and cleaning solutions for cleaning mechanical piping systems.

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM E202-00, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Safety Data Sheets (SDS).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01. Include product characteristics, performance criteria, and limitations.
- .2 Quality assurance submittals: submit following in accordance with Section 1.
 - .1 Instructions: submit manufacturer's installation instructions.
 - .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.

1.4 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Provincial Regulations.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01.
- .2 Waste Management and Disposal:
 - .1 Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01.

Part 2 Products

2.1 CLEANING SOLUTIONS

- .1 Tri-sodium phosphate: 0.40 kg per 100 L water in system.
- .2 Sodium carbonate: 0.40 kg per 100 L water in system.
- .3 Low-foaming detergent: 0.01 kg per 100 L water in system.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 CLEANING HYDRONIC SYSTEMS

- .1 Timing: systems operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.
- .2 Cleaning Agency:
 - .1 Retain qualified water treatment specialist to perform system cleaning.
- .3 Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering valves only after cleaning is certified as complete by water treatment specialist.
- .4 Cleaning procedures:
 - .1 Provide detailed report outlining proposed cleaning procedures at least 4 weeks prior to proposed starting date. Report to include:
 - .1 Cleaning procedures, flow rates, elapsed time.
 - .2 Chemicals and concentrations used.
 - .3 Inhibitors and concentrations.
 - .4 Specific requirements for completion of work.
 - .5 Special precautions for protecting piping system materials and components.
 - .6 Complete analysis of water used to ensure water will not damage systems or equipment.
- .5 Conditions at time of cleaning of systems:
 - .1 Systems: free from construction debris, dirt and other foreign material.
 - .2 Control valves: operational, fully open to ensure that terminal units can be cleaned properly.
 - .3 Strainers: clean prior to initial fill.
 - .4 Install temporary filters on pumps not equipped with permanent filters.
 - .5 Install pressure gauges on strainers to detect plugging.

- .6 Report on Completion of Cleaning:
 - .1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.
- .7 Hydronic Systems:
 - .1 Fill system with water, ensure air is vented from system.
 - .2 Fill expansion tanks 1/3 to 1/2 full, charge system with compressed air to at least 35 kPa (does not apply to diaphragm type expansion tanks).
 - .3 Use water metre to record volume of water in system to +/- 0.5%.
 - .4 Add chemicals under direct supervision of chemical treatment supplier.
 - .5 Closed loop systems: circulate system cleaner at 60 degrees C for at least 36 h. Drain as quickly as possible. Refill with water and inhibitors. Test concentrations and adjust to recommended levels.
 - .6 Flush velocity in system mains and branches to ensure removal of debris. System pumps may be used for circulating cleaning solution provided that velocities are adequate.
 - .7 Add chemical solution to system.
 - .8 Establish circulation, raise temperature slowly to [82 degrees C minimum] [maximum design]. Circulate for 12 h, ensuring flow in all circuits. Remove heat, continue to circulate until temperature is below 38 degrees C. Drain as quickly as possible. Refill with clean water. Circulate for 6 hours at design temperature. Drain and repeat procedures specified above. Flush through low point drains in system. Refill with clean water adding to sodium sulphite (test for residual sulphite).

3.3 START-UP OF HYDRONIC SYSTEMS

- .1 After cleaning is completed and system is filled:
 - .1 Establish circulation and expansion tank level, set pressure controls.
 - .2 Ensure air is removed.
 - .3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.
 - .4 Dismantle system pumps used for cleaning, inspect, replace worn parts, install new gaskets and new set of seals.
 - .5 Clean out strainers repeatedly until system is clean.
 - .6 Commission water treatment systems as specified in Section 23 25 00 - HVAC Water Treatment.
 - .7 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.
 - .8 Repeat with water at design temperature.
 - .9 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.
 - .10 Bring system up to design temperature and pressure slowly over a 48 hour period.

- .11 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .12 Adjust pipe supports, hangers, springs as necessary.
- .13 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.
- .14 Re-tighten bolts using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.
- .15 Check operation of drain valves.
- .16 Adjust valve stem packings as systems settle down.
- .17 Fully open balancing valves (except those that are factory-set).
- .18 Check operation of over-temperature protection devices on circulating pumps.
- .19 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

3.4 CLEANING

- .1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Approved: 2022-07-05

Part 1 General

1.1 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)/American Welding Society (AWS)
 - .1 ANSI/AWS A5.8/A5.8M-11, AMD1 Specification Filler Metals for Brazing and Braze Welding.
- .2 ASME
 - .1 ANSI/ASME B16.4-06, Gray-Iron Threaded Fittings Classes 125 and 250.
 - .2 ANSI/ASME B16.15-11, Cast Copper Alloy Threaded Fittings Classes 125 and 250.
 - .3 ANSI B16.18-12, Cast Copper Alloy, Solder Joint Pressure Fittings.
 - .4 ANSI/ASME B16.22-12, Wrought Copper and Copper-Alloy Solder Joint Pressure Fittings.
- .3 ASTM International (ASTM)
 - .1 ASTM B32-08, Standard Specification for Solder Metal.
 - .2 ASTM B61-08, Standard Specification for Steam or Valve Bronze Castings.
 - .3 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .4 ASTM B88M-05, Standard Specification for Seamless Copper Water Tube Metric.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Safety Data Sheets (SDS).
- .5 Manufacturers Standardization Society (MSS)
 - .1 MSS SP67-2011, Butterfly Valves.
 - .2 MSS SP70-2011, Cast Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS SP71-2011, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
 - .4 MSS SP80-2008, Bronze Gate, Globe, Angle and Check Valves.
 - .5 MSS SP85-2011, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for hydronic systems and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:

- .1 Submit drawings stamped and signed by professional engineer registered or licensed in British Columbia, Canada.
- .2 Indicate on manufacturers catalogue literature the following: valves.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 50% of construction wastes were recycled or salvaged.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01.
- .2 Operation and Maintenance Data: submit operation and maintenance data for hydronic systems for incorporation into manual.
- .3 Submit 2 copies of operation and maintenance manual.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Furnish following spare parts:
 - .1 Valve seats: one for every ten valves, each size. Minimum one.
 - .2 Discs: one for every ten valves, each size. Minimum one.
 - .3 Stem packing: one for every ten valves, each size. Minimum one.
 - .4 Valve handles: two of each size.
 - .5 Gaskets for flanges: one for every ten flanges.

1.5 QUALITY ASSURANCE

- .1 Regulatory Requirements: ensure Work is performed in compliance with applicable Provincial regulations.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect hydronic systems from damage.

- .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse of packaging materials as specified in Construction Waste Management Plan in accordance with Section 01.

Part 2 Products

2.1 TUBING

- .1 Type L hard drawn copper tubing: to ASTM B88M.

2.2 FITTINGS

- .1 Cast bronze threaded fittings: to ANSI/ASME B16.15.
- .2 Wrought copper and copper alloy solder joint pressure fittings: to ANSI/ASME B16.22.
- .3 Cast iron threaded fittings: to ANSI/ASME B16.4.
- .4 Cast copper alloy solder joint pressure fittings: to ANSI B16.18.

2.3 FLANGES

- .1 Brass or bronze: threaded.
- .2 Cast iron: threaded.
- .3 Orifice flanges: slip-on, raised face, 2100 kPa.

2.4 JOINTS

- .1 Solder, tin-antimony, 95:5: to ASTM B32.
- .2 Silver solder BCUP: to ANSI/AWS A5.8.
- .3 Brazing: as indicated.

2.5 VALVES

- .1 Connections:
 - .1 NPS 2 and smaller: ends for soldering.
 - .2 NPS 2 1/2 and larger: flanged ends.
- .2 Gate Valves: application: isolating equipment, control valves, pipelines:
 - .1 NPS 2 and under:
 - .1 Mechanical Rooms: Class 125, rising stem split wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.
- .3 Butterfly valves: application: isolating each cell or section of multiple component equipment (i.e. multi-section coils, multi-cell cooling towers):
 - .1 NPS 2 1/2 and over: lug type: as specified Section 23 05 17 - Pipe Welding.
- .4 Globe valves: application: throttling, flow control, emergency bypass:

- .1 NPS 2 and under:
 - .1 Mechanical Rooms: with PTFE disc, as specified Section 23 05 23.01 - Valves - Bronze.
- .5 Balancing, for TAB:
 - .1 Sizes: calibrated balancing valves, as specified.
 - .2 NPS 2 and under:
 - .1 Mechanical rooms: globe, with plug disc as specified Section 23 05 23.01 - Valves - Bronze.
- .6 Drain valves: gate, Class 125 23 05 23.01 - Valves - Bronze.
- .7 Swing check valves:
 - .1 NPS 2 and under:
 - .1 Class 125, swing, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 NPS 2 1/2 and over:
 - .1 Flanged ends: as specified Section 23 05 23.02 - Valves - Cast Iron.
- .8 Silent check valves:
 - .1 NPS 2 and under:
 - .1 As specified Section 23 05 23.01 - Valves - Bronze.
 - .2 NPS 2 1/2 and over:
 - .1 Flanged ends: as specified Section 23 05 23.02 - Valves - Cast Iron.
- .9 Ball valves:
 - .1 NPS 2 and under: as specified Section 23 05 23.01 - Valves - Bronze.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for hydronic systems installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.3 PIPING INSTALLATION

- .1 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.
- .2 Install concealed pipes close to building structure to keep furring space to minimum. Install to conserve headroom and space. Run exposed piping parallel to walls. Group piping where ever practical.
- .3 Slope piping in direction of drainage and for positive venting.
- .4 Use eccentric reducers at pipe size change installed to provide positive drainage or positive venting.
- .5 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.
- .6 Assemble piping using fittings manufactured to ANSI standards.

3.4 VALVE INSTALLATION

- .1 Install rising stem valves in upright position with stem above horizontal.
- .2 Install ball valves at branch take-offs and to isolate each piece of equipment, and as indicated.
- .3 Install globe valves for balancing and in by-pass around control valves as indicated.
- .4 Install silent check valves on discharge of pumps and as indicated.
- .5 Install swing check valves in horizontal lines on discharge of pumps and as indicated.

3.5 CIRCUIT BALANCING VALVES

- .1 Install flow measuring stations and flow balancing valves as indicated.
- .2 Remove handwheel after installation and TAB is complete.
- .3 Tape joints in prefabricated insulation on valves installed in chilled water mains.

3.6 FLUSHING AND CLEANING

- .1 Flush and clean in presence of Departmental Representative.
- .2 Flush after pressure test for a minimum of 4 hours.
- .3 Fill with solution of water and non-foaming, phosphate-free detergent 3% solution by weight. Circulate for minimum of 8 hours.
- .4 Refill system with clean water. Circulate for at least 4 hours. Clean out strainer screens/baskets regularly. Then drain.
- .5 Refill system with clean water. Circulate for at least 2 hours. Clean out strainer screens/baskets regularly. Then drain.

- .6 Drainage to include drain valves, dirt pockets, strainers, low points in system.
- .7 Re-install strainer screens/baskets only after obtaining Departmental Representative's approval.

3.7 FILLING OF SYSTEM

- .1 Refill system with clean water adding water treatment as specified.

3.8 FIELD QUALITY CONTROL

- .1 Testing:
 - .1 Test system in accordance with Section 23 05 00 - Common Work Results for HVAC.
- .2 Balancing:
 - .1 Balance water systems to within plus or minus 5 % of design output.
 - .2 Refer to Section 23 05 93 for applicable procedures.

3.9 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01.
 - .1 Leave Work area clean at end of each day.

END OF SECTION

Approved: 2022-07-05

Part 1 General

1.1 REFERENCE STANDARDS

- .1 ASME
 - .1 ASME Boiler and Pressure Vessel Code (BPVC), Section VII-2013.
- .2 ASTM International (ASTM)
 - .1 ASTM A47/A47M-99, Standard Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A278/A278M-01, Standard Specification for Grey Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (350 degrees C).
 - .3 ASTM A516/A516M-10, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.
 - .4 ASTM A536-84, Standard Specification for Ductile Iron Castings.
 - .5 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .3 CSA Group (CSA)
 - .1 CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for expansion tanks, air vents, separators, valves, and strainers and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in British Columbia, Canada.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01.
- .2 Operation and Maintenance Data: submit operation and maintenance data for hydronic specialties for incorporation into manual.
- .3 Submit 2 copies of operation and maintenance manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions.

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect hydronic specialties from damage.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return of packaging materials as specified in Construction Waste Management Plan in accordance with Section 01.

Part 2 Products

2.1 DIAPHRAGM TYPE EXPANSION TANK

- .1 Vertical pressurized diaphragm type expansion tank.
- .2 Capacity: as indicated on drawings.
- .3 Size: as indicated on drawings.
- .4 Diaphragm sealed in EPDM suitable for 115 degrees C operating temperature.
- .5 Working pressure: 860 kPa with ASME stamp and certification.
- .6 Air precharged to 84 kPa (initial fill pressure of system).
- .7 Base mount for vertical installation.
- .8 Supports: provide supports with hold down bolts and installation templates incorporating seismic restraint systems.
- .9 Renewable diaphragm.

2.2 AUTOMATIC AIR VENT

- .1 Standard float vent: brass body and NPS 1/8 connection and rated at 860 kPa working pressure.
- .2 Industrial float vent: cast iron body and NPS 1/2 connection and rated at 860 kPa working pressure.
- .3 Float: solid material suitable for 115 degrees C working temperature.

2.3 AIR SEPARATOR - IN-LINE

- .1 Working pressure: 860 kPa.
- .2 Size: as indicated.

2.4 COMBINATION LOW PRESSURE RELIEF AND REDUCING VALVE

- .1 Adjustable pressure setting: 206kPa relief, 55 to 172 kPa reducing.
- .2 Low inlet pressure check valve.

- .3 Removable strainer.

2.5 PIPE LINE STRAINER

- .1 NPS 1/2 to 2: bronze body to ASTM B62, screwed connections, Y pattern.
- .2 NPS 2 1/2 to 12: cast iron body to ASTM A278/A278M, Class 30 flanged connections.
- .3 Blowdown connection: NPS 1.
- .4 Screen: stainless steel with 1.19 mm perforations.
- .5 Working pressure: 860 kPa.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for hydronic specialties installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and data sheets.

3.3 GENERAL

- .1 Run drain lines and blow off connections to terminate above nearest drain.
- .2 Maintain adequate clearance to permit service and maintenance.
- .3 Should deviations beyond allowable clearances arise, request and follow Departmental Representative's directive.
- .4 Check shop drawings for conformance of tappings for ancillaries and for equipment operating weights.

3.4 STRAINERS

- .1 Install in horizontal or down flow lines.
- .2 Ensure clearance for removal of basket.
- .3 Install ahead of each pump.

3.5 AIR VENTS

- .1 Install at high points of systems.
- .2 Install gate valve on automatic air vent inlet. Run discharge to nearest drain.

3.6 EXPANSION TANKS

- .1 Adjust expansion tank pressure to suit design criteria.
- .2 Install lockshield type valve at inlet to tank.

3.7 PRESSURE SAFETY RELIEF VALVES

- .1 Run discharge pipe to terminate above nearest drain.

3.8 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Approved: 2022-07-05

Part 1 General

1.1 REFERENCE STANDARDS

- .1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE/IES Standard 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 CSA Group (CSA)
 - .1 CAN/CSA-B214-12, Installation Code for Hydronic Heating Systems.
- .3 Electrical Equipment Manufacturers Association of Canada (EEMAC)
- .4 National Electrical Manufacturers' Association (NEMA)
 - .1 NEMA MG 1-2011, Motors and Generators.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for pump, circulator, and equipment and include product characteristics, performance criteria, physical size, finish and limitations indicate point of operation, and final location in field assembly.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in British Columbia, Canada.
 - .2 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01.
- .2 Operation and Maintenance Data: submit operation and maintenance data for hydronic pumps for incorporation into manual.
- .3 Submit 2 copies of operation and maintenance manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:

- .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect hydronic pumps from damage.
- .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return of packaging materials as specified in Construction Waste Management Plan in accordance with Section 01.

Part 2 Products

2.1 EQUIPMENT

- .1 Size and select components to: CAN/CSA-B214.

2.2 VERTICAL IN-LINE CIRCULATORS

- .1 Volute: cast iron radially split, with tapped openings for venting, draining and gauge connections, with screwed or flanged suction and discharge connections.
- .2 Impeller: cast iron.
- .3 Shaft: stainless steel with bronze sleeve bearing, integral thrust collar.
- .4 Seal assembly: mechanical for service to 135 degrees C.
- .5 Coupling: rigid self-aligning.
- .6 Motor: to NEMA MG 1 resilient mounted, drip proof, sleeve bearing, 1750 r/min, HP as indicated on drawings.
- .7 Capacity: as indicated on drawings.
- .8 Design pressure: 1200 kPa.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for hydronic pump installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and data sheets.

3.3 INSTALLATION

- .1 Install hydronic pumps to: CAN/CSA-B214.
- .2 In line circulators: install as indicated by flow arrows.
 - .1 Support at inlet and outlet flanges or unions.
 - .2 Install with bearing lubrication points accessible.
- .3 Ensure that pump body does not support piping or equipment.
 - .1 Provide stanchions or hangers for this purpose.
 - .2 Refer to manufacturer's installation instructions for details.
- .4 Pipe drain tapping to floor drain.
- .5 Install volute venting pet cock in accessible location.
- .6 Check rotation prior to start-up.
- .7 Install pressure gauge test cocks.

3.4 START-UP

- .1 General:
 - .1 In accordance with manufacturer's recommendations.
- .2 Procedures:
 - .1 Before starting pump, check that cooling water system over-temperature and other protective devices are installed and operative.
 - .2 After starting pump, check for proper, safe operation.
 - .3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
 - .4 Check base for free-floating, no obstructions under base.
 - .5 Run-in pumps for 12 continuous hours minimum.
 - .6 Verify operation of over-temperature and other protective devices under low- and no-flow condition.
 - .7 Eliminate air from scroll casing.
 - .8 Adjust water flow rate through water-cooled bearings.
 - .9 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.
 - .10 Adjust alignment of piping and conduit to ensure true flexibility.
 - .11 Eliminate cavitation, flashing and air entrainment.
 - .12 Adjust pump shaft seals, stuffing boxes, glands.
 - .13 Measure pressure drop across strainer when clean and with flow rates as finally set.

- .14 Replace seals if pump used to degrease system or if pump used for temporary heat.
- .15 Verify lubricating oil levels.

3.5 PERFORMANCE VERIFICATION (PV)

- .1 Verify that manufacturer's performance curves are accurate.
- .2 Ensure valves on pump suction and discharge provide tight shut-off.
- .3 Net Positive Suction Head (NPSH):
 - .1 Application: measure NPSH for pumps which operate on open systems and with water at elevated temperatures.
- .4 Multiple Pump Installations - Series and Parallel:
 - .1 Repeat PV procedures specified above for pump performance and pump BHP for combinations of pump operations.
- .5 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.
- .6 Commissioning Reports: in accordance with Section 01. Reports to include:
 - .1 Record of points of actual performance at maximum and minimum conditions and for single and parallel operation as finally set at completion of commissioning on pump curves.
 - .2 Use Report Forms specified in Section 01: Report Forms and Schematics.
 - .3 Pump performance curves (family of curves).

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Approved: 2022-06-17

Part 1 General

1.1 REFERENCE STANDARDS

- .1 American Boiler Manufacturers Association (ABMA)
- .2 ASME
 - .1 ASME Boiler and Pressure Vessel Code (BPVC), Section VII-[2013].
- .3 CSA Group (CSA)
 - .1 CAN1-3.1-77 (R2011), Industrial and Commercial Gas-Fired Package Boilers.
 - .2 CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code.
 - .3 CSA B149.1-10, Natural Gas and Propane Installation Code.
 - .4 ANSI Z21.13-10 /CSA 4.9-10, Gas-Fired Low-Pressure Steam and Hot Water Boilers.
- .4 Electrical and Electronic Manufacturers Association of Canada (EEMAC)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for heating boilers and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in British Columbia, Canada.
 - .2 Indicate on drawings:
 - .1 General arrangement showing terminal points, instrumentation test connections.
 - .2 Clearances for operation, maintenance, servicing, tube cleaning, tube replacement.
 - .3 Foundations with loadings, anchor bolt arrangements.
 - .4 Piping hook-ups.
 - .5 Equipment electrical drawings.
 - .6 Burners and controls.
 - .7 All miscellaneous equipment.
 - .8 Flame safety control system.
 - .9 Breeching and stack configuration.
 - .3 Engineering data to include:
 - .1 Boiler efficiency at 25%, 50%, 75%, 100%, of design capacity.
 - .2 Radiant heat loss at 100% design capacity.

- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01.
- .2 Operation and Maintenance Data: submit operation and maintenance data for heating boilers for incorporation into manual.

1.4 QUALITY ASSURANCE

- .1 Regulatory Requirements: work to be performed in compliance with applicable Provincial regulations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra materials:
 - .1 Submit maintenance materials in accordance with Section 01.
 - .1 Special tools for burners, access opening, handholes and Operation and Maintenance.
 - .2 Spare parts for 1 year of operation.
 - .3 Spare gaskets.
 - .4 Spare gauge glass inserts.
 - .5 Probes and sealants for electronic indication.
 - .6 Spare burner tips.
 - .7 Spare burner gun.
 - .8 Safety valve test gauge.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect boiler and equipment from damage.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse of packaging materials in accordance with Section 01.

Part 2 Products

2.1 GENERAL

- .1 Packaged boiler:
 - .1 Complete with burner and necessary accessories and controls.
 - .2 Factory tested at rated capacity to, and bearing seal or nameplate certifying compliance with, CSA B140.7, witnessed and certified by Departmental Representative.
 - .3 Ready for attachment to piping, electrical power, controls, flue gases exhaust.
 - .4 Designed and constructed to ASME Boiler and Pressure vessel Code.
 - .5 CRN (Canadian Registration Number), to CSA B51.
 - .6 Boiler/burner package to bear ULC label.
- .2 Start-up, instruction, on-site performance tests: 1 day per boiler.
- .3 Trial usage:
 - .1 Departmental Representative may use boilers for test purposes prior to acceptance and commencement of warranty period.
 - .2 Supply labour, materials and instruments required for tests.
- .4 Temporary use by contractor:
 - .1 Contractor may use boilers only after written approval from Departmental Representative.
 - .2 Monitor and record performance continuously. Keep log of maintenance activities carried out.
 - .3 Refurbish to as-new condition before final inspection and acceptance.

2.2 CAST IRON BOILERS (BUNKHOUSE)

- .1 Furnish and install 2 low pressure, wet base, cast iron sectional boilers with power burners that pressurize the firebox and operate under forced draft.
- .2 Assemble and install boiler-burner unit(s) in compliance with manufacturer's installation instructions. All work must be done in a neat and workman like manner.
- .3 Boiler-burner units filed assembled with burners capable of burning propane gas at 11" W.C. inlet pressure.
- .4 Boilers shall have AHRI gross output at 100% firing rate – 491 MBH per boiler.
- .5 Boilers shall be manufactured to conform to Section IV of the ASME Boiler and Pressure Vessel Code:
 - .1 Individual sections and section assemblies to be hydrostatically pressure tested at factory in accordance with ASME requirements.
 - .2 Individual sections shall bear the ASME symbol as well as the "MAWP WATER 80 PSI" and "MAWP STEAM 15 PSI" on the outside surface of each section.
 - .3 The boiler rating label shall read Maximum Allowable Working Pressure 80 PSI water.
- .6 Regulatory Requirements:

- .1 Boilers and controls to comply with applicable regulations.
 - .2 Provide U.L. labeled burners.
 - .3 Provide add option for local codes ie: MASS Code, BAR
- .7 Acceptable boiler/burner manufacturers include:
 - .1 Weil-McLain Model 80
 - .2 Burnham Hydronics Model V903A
 - .3 Smith Cast Iron Boilers Model 19HE-4
 - .4 All other manufacturers must comply with specifying engineer's requirements, including:
 - .5 Full intent of these specifications, and provide complete submittal including literature, wiring diagrams, fuel piping diagrams, and a list of similar installations.
 - .6 Submittal to be presented to specifying engineer at least seven working days for approval before bid opening. Substitutions are not permitted after contract is awarded.
 - .7 Burner(s) and Energy Management Control System(s) must be tested and approved for installation with specified boiler by boiler manufacturer.
- .8 Boiler construction
 - .1 Cast Iron sections
 - .2 Assembled with short, individual draw rods.
 - .3 Cast with sealing grooves for high temperature sealing rope to assure permanent gas-tight seal.
 - .4 Sealed watertight by elastomer sealing rings, not cast iron or steel nipples. Each port opening is machined to completely capture sealing ring between sections.
 - .5 Must be hydro-wall design to provide completely water-cooled combustion chamber.
 - .6 Provided with sufficient tapings to install required controls.
 - .7 Limited 10-year warranty against workmanship and defects to be in writing by manufacturer.
- .9 Boilers:
 - .1 Boilers to be designed with a rear flue outlet.
 - .2 Provided with cast-in air elimination to separate air from circulating water.
 - .3 Provided with expansion tank tapping to divert separated air to expansion tank.
 - .4 Constructed to provide balanced water flow through entire section assembly using single supply and return connections for water. No external headers are necessary for water. Steam requires an external header 24" minimum from the waterline to the bottom of the header.
 - .5 Designed with a low silhouette to provide maximum headroom.
 - .6 Furnished with insulated burner mounting plate having necessary holes and tapings to mount burner. High temperature sealing rope is used to provide permanent gas-tight seal between front section and plate.

- .7 Furnished with two observation ports (one in front and one in back) to allow visual inspection of the flame.
- .8 Provided with steel flue damper assembly with a built-in adjustable damper capable of being locked into place after adjustment.
- .9 Furnished with flanged aluminized steel flue collector hood bolted to top of section assembly.
- .10 High temperature sealing rope used to provide permanent gas-tight seal between hood and section assembly.
- .11 Furnished with heavy-duty ¼" steel cleanout plates to cover cleanout openings on the side of the boiler(s).
- .12 Port openings must be of captured seal design – a machined groove assures uniform compression of the sealing ring and protects the seal from contaminants. Elastomer sealing rings are to be used to provide permanent watertight seal between sections. Unlike cast iron or steel push nipples, the elasticity of the seals fills any gaps caused by misalignment or expansion and contraction.
- .13 Provided with flexible refractory blankets to be attached to back and floor of combustion chamber.
- .14 Shipped with insulated heavy gauge steel jacket(s) with durable powdered paint enamel finish. Jacket designed to be installed after connecting supply and return piping.
- .15 Jacket design will allow easy access to top and sides of boiler for maintenance and/or inspection without use of tools.
- .10 Boiler Trim:
 - .1 All electrical components to be of high quality and third (3rd) party recognized.
 - .2 Water boilers standard controls furnished:
 - .1 Combination low temperature limit (operating) and high temperature limit control.
 - .2 Low temperature limit set according to system design. High temperature limit set at least 20°F higher than the low limit (240°F is the maximum allowable water temperature).
 - .3 Combination pressure-temperature gauge with dial clearly marked and easy to read.
 - .4 ASME certified pressure relief valve, set to relieve at 30 PSIG. Side outlet discharge type; contractor to pipe outlet to floor drain or near floor, avoiding any area where freezing could occur.
 - .3 Low water cut-off for water boilers:
 - .1 Boilers to be furnished with U.L. labeled low water cut-off with ASME working pressure rating equal to or exceeding the maximum boiler working pressure as shown on the boiler's rating label. Install cut-off according to manufacturer's instructions.
 - .2 Do not use quick-connect fittings on boilers.
 - .3 Locate so burner shuts down if boiler water level falls below allowable safe waterline.
- .11 Burners:

- .1 Burner fuel supply system and burner installation to conform to burner manufacturer's installation instructions and applicable codes.
- .2 Burner motor characteristics: 120/60/1
- .3 Control characteristics 120/60/1.
- .4 Burner fuel – propane gas 11" W.C. minimum.
- .5 Code - standard boiler
- .6 Burners to have U.L. labels supplied by the burner manufacturer.
- .7 Burners designed to ensure high efficiency and good performance under forced draft conditions with 0.1" W.C. positive pressure at the flue collar.
- .8 Burners to be adjusted to provide 9.0 to 10.0% CO₂ for natural gas and/or 12% CO₂ (□ ¼%) with zero smoke for oil firing.
- .9 Burner operating mode: modulating
- .12 Control Panel:
 - .1 Panel options – power on/fuel on light is standard on all burners with panels.
 - .1 Call For Heat
 - .2 Ignition On
 - .3 Pilot Failure
 - .4 Low Water
 - .5 Flame Failure
 - .6 Silencing Switch
 - .7 Control Fuse and Holder
 - .8 Post Purge Timer
 - .9 Alarm Bell
- .1 Start-up and Service:
 - .1 The contractor shall obtain the services of a factory-authorized agent to provide burner light off and adjustment. The start-up agent shall provide a burner light-off report as written proof that the burner was adjusted to optimum performance.
 - .2 The authorized agent shall provide a one-year service warranty after start-up.

2.3 COIL TUBE HOT WATER BOILER (GARAGE)

- .1 Packaged, forced circulation, water tube, employing multiple coiled copper tubes, refractory combustion chamber, and forced draft combustion.
- .2 Heat exchanger:
 - .1 Each water-tube boiler shall contain an ASME Section IV heat exchanger with an "H" stamp designed for a maximum allowable working pressure of 160 PSIG and a maximum allowable temperature of 250°F.
 - .2 Each heat exchanger shall consist of vertical, ASME SB-359 CDA 122 copper finned-tubes (or approved equal) installed in an evenly spaced circular arrangement around a cylindrical burner. The heat transfer fins on the O.D. of the tubing must be extruded from the same base copper as the tubing itself. Mechanically attached or welded heat transfer fins are not acceptable.

- .3 The copper finned-tubes shall be rolled into the upper and lower tubesheets, and shall maintain a minimum wall thickness of at least 0.063”.
 - .4 Each heat exchanger shall consist of two removable ASME SA 278 Class 35 Cast Iron headers/manifolds (or approved equal) with O-ring gaskets. Boilers that consist of a primary and secondary heat exchanger are not acceptable.
 - .5 Each heat exchanger shall consist of two ASME SA516 Grade 70 Carbon Steel tubesheets (or approved equal) with machined grooves for O-ring gaskets and tapped holes for bolting the upper & lower Cast Iron headers/manifolds. In addition, the tubesheets shall feature tapped holes on the outer surface for bolting the combustion chamber jacket assembly.
 - .6 Each heat exchanger shall feature a machined groove on the lower tubesheet which acts as a channel to collect and drain condensate from inside the heat exchanger and shall be connected to a minimum 3/4” steel drain pipe. This groove also assists drainage during annual heat exchanger cleaning.
 - .7 Each heat exchanger must be hydrostatically tested by the manufacturer to a minimum of 1-1/2 times the maximum allowable working pressure for a minimum of 5 minutes. During this hydrostatic pressure test, the operator will inspect the pressure gauge and visually verify there are no water leaks.
 - .8 Each heat exchanger shall be assembled, tested and certified by the boiler manufacturer. Heat exchangers assembled and certified by a 3rd party are not acceptable.
 - .9 Each boiler is non-condensing and requires a minimum inlet (return) water temperature of 130°F to avoid excessive condensation within the heat exchanger. If the inlet (return) water temperature is expected to drop below 130°F, a temperature controlled 3-way valve shall be installed to blend the boiler’s outlet (supply) water with the inlet (return) water.
- .3 Main gas train:
- .1 Each boiler shall be equipped with an integral main gas valve train capable of burning either Natural Gas or Propane Gas as per drawings.
 - .2 The main gas valve train shall be factory assembled, piped, and wired and allow for operation at full rated boiler capacity from 4.0” W.C. up to the maximum inlet gas pressure of 14.0” W.C. The boiler shall operate reliably down to an inlet gas pressure of 3.5” W.C. although the boiler may not be able to achieve full rated capacity at this pressure.
 - .3 Each main gas valve train shall include at least the following: Forced draft with:
 - .1 One (1) upstream manual shutoff valve for field-connection.
 - .2 One (1) combination Air-Gas ratio control and safety shutoff valve with dual solenoids (in-series) that can be independently energized for leak testing and integrated into a single body design. The combination gas valve shall operate as a “Zero Governor” and control to a neutral gas pressure inside the gas valve.
 - .3 One (1) low gas pressure switch (manual reset).
 - .4 One (1) high gas pressure switch (manual reset).
 - .5 Two (2) gas pressure test ports.
 - .6 One (1) downstream manual shutoff valve.

- .4 If the supplied gas pressure exceeds 14" W.C., the contractor shall supply a suitable intermediate gas pressure regulator of the lock-up type to reduce the gas pressure to acceptable levels.
- .4 Power Burner:
 - .1 The boiler manufacturer shall furnish an integral power type fuel burner with each boiler configured for 208 – 240 VAC, Single Phase, 60 Hz. The complete power fuel burner assembly shall consist of a gas burner, combustion air blower, main gas valve train, and ignition system. The burner manufacturer shall fully coordinate the burner design with the boiler's heat exchanger and the boiler control system in order to provide the required capacities, efficiencies, and performance specified. Boilers shipped without a power burner and field-equipped with a 3rd party power burner are not acceptable.
 - .2 Each burner shall be installed vertically inside the combustion chamber with combustion gases flowing radially across the copper finned tube heat exchanger. The burner shall consist of a stainless steel flange and a perforated stainless steel cylinder with a stainless steel outer knit mesh.
 - .3 Each boiler shall be equipped with direct spark ignition. Main flame shall be monitored and controlled by a UV Scanner.
- .5 Boiler Safety and Trim Devices:
 - .1 The boiler manufacturer shall furnish and test the following safety and trim devices with each boiler:
 - .1 Safety relief valve shall be provided in compliance with the ASME code. Contractor is required to pipe the relief valve discharge piping to an acceptable drain.
 - .2 Water pressure/temperature gauge.
 - .3 Low Water / Flow cutoff.
 - .4 Manual reset high limit water temperature controller.
 - .5 Operating temperature control to control the sequential operation of the burner.
 - .6 High and Low Gas Pressure switches.
 - .7 UV Scanner type flame sensor.
 - .2 The boiler manufacturer shall provide a CSD-1 form identifying each safety and trim device.
 - .3 The boiler shall be capable of interfacing with the following external safety devices:
 - .1 Auxiliary Low Water Cutoff device.
 - .2 Combustion Air Damper End Limit Switch.
 - .3 Emergency Stop (E-Stop) switch.
 - .4 External Safety Device w/ contact closure.
- .6 Boiler Control System
 - .1 Each boiler shall be provided with all necessary controls, all necessary programming sequences, and all safety interlocks. Each boiler control system shall be properly interlocked with all safeties.

- .2 Each boiler shall be provided with a “Full Modulating” firing control system whereby the firing rate is infinitely proportional at any firing rate between low fire and high fire as determined by the pulse width modulation input control signal. Both fuel input and air input must be sequenced in unison to the appropriate firing rate without the use of mechanical linkage.
- .3 The boiler’s control system shall provide the minimum capabilities:
 - .1 7” color touchscreen display with one or more USB ports.
 - .2 Parameter uploads and downloads via external USB flash drive.
 - .3 Software updates via external USB flash drive.
 - .4 Capture screen shots from the control’s display by saving digital image files to external USB flash drive.
 - .5 Local Representative Screen can be programmed to provide contact information for the local boiler manufacturer’s representative.
 - .6 Programmable Relay Outputs for direct control of pumps, control valves, dampers and other auxiliary devices.
 - .7 Multiple boiler “cascade” network up to 24 boilers without any external control panel. The installation of external sequencing control panels is not acceptable.
 - .8 Auxiliary Boiler Relay for multiple boiler “cascade” systems which can be used to enable a 3rd party boiler platform in the event the “cascade” system is unable to satisfy the heating load.
 - .9 Programmable Boiler and System pump control for multiple boiler “cascade” systems installed in a Primary-Secondary piping arrangement.
 - .10 Programmable Control Valve logic for multiple boiler “cascade” systems installed in a Primary-Only piping arrangement.
 - .11 Intuitive “Setup Wizards” ask the user a series of questions and allow for step-by-step configuration of the boiler control.
 - .12 On-Screen error notifications with a comprehensive description of all alarm conditions and several troubleshooting steps.
 - .13 Automatic anti-condensing control to minimize the amount of operation in the condensing mode when inlet (return) temperature drops below 130°F.
 - .14 Automatic flue gas temperature and outlet (supply) temperature compensation to prevent over-firing of the boiler equipment.
 - .15 Automatic differential temperature compensation to prevent over-firing of the boiler equipment in a low flow condition.
 - .16 Automatically adjust the temperature set point and shutdown the boiler based on the outdoor air temperature conditions.
 - .17 Night Setback functionality via external point of closure (or BMS integration) for unique “Occupied” and “Unoccupied” temperature setpoint values.
 - .18 Maintain single temperature set point with a minimum outlet (supply) water temperature of 140°F up to a maximum outlet (supply) water temperature of 220°F.

- .19 On-Board DHW Priority capable of seamless transition between Comfort Heat (CH) and Domestic Hot Water (DHW) operation.
- .20 On-Board CH&DHW operation for simultaneous Comfort Heat (CH) and Domestic Hot Water (DHW) operation.
- .21 Alarm Relay Output to announce alarm conditions which require manual reset.
- .22 Programmable Low Fire Delay to prevent excessive short-cycling of the boiler equipment.
- .23 Local Manual Operation.
- .4 The boiler control system shall be capable of interfacing with the following external control devices:
 - .1 Building Management System (MODBUS®). NOTE: Optional Protocol Converter for communication via LONWORKS® and BACnet® must be available for purchase from the boiler manufacturer.
 - .2 Domestic Hot Water Break-on-Rise Aquastat (Normally Closed).
 - .3 Domestic Hot Water Tank Temperature Sensor (12kΩ).
 - .4 External Header Temperature Sensor (12kΩ).
 - .5 Outdoor Air Temperature Sensor (12kΩ).

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for heating boiler installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied [and after receipt of written approval to proceed from Departmental Representative.

3.2 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.3 INSTALLATION

- .1 Install in accordance with ASME Boiler and Pressure Vessels Code, regulations of Province having jurisdiction, except where specified otherwise, and manufacturers recommendations.
- .2 Make required piping connections to inlets and outlets recommended by boiler manufacturer.

- .3 Maintain clearances as indicated or if not indicated, as recommended by manufacturer for operation, servicing and maintenance without disruption of operation of any other equipment/system.
- .4 Pipe hot water relief valves full size to nearest drain.
- .5 LP gas installations - in accordance with CSA B149.1.

3.4 MOUNTINGS AND ACCESSORIES

- .1 Safety valves and relief valves:
 - .1 Run separate discharge from each valve.
 - .2 Terminate discharge pipe as indicated.
 - .3 Run drain pipe from each valve outlet and drip pan elbow to above nearest drain.

3.5 FIELD QUALITY CONTROL

- .1 Commissioning:
 - .1 Manufacturer to:
 - .1 Certify installation.
 - .2 Start up and commission installation.
 - .3 Carry out on-site performance verification tests.
 - .4 Demonstrate operation and maintenance.
 - .2 Provide Departmental Representative at least 24 hours notice prior to inspections, tests, and demonstrations. Submit written report of inspections and test results.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01.

END OF SECTION