

PART 1 - GENERAL

1.1 REFERENCES

- .1 ASTM International (ASTM)
 - .1 ASTM B819-19, Standard Specification for Seamless Copper Tube for Medical Gas Systems.
- .2 Canadian Standards Association (CSA)
 - .1 CSA B51-19, Boiler, Pressure Vessel and Pressure Piping Code.

1.2 SUBMITTALS

- .1 Submit shop drawings/product data sheets for products specified in this Section except pipe and fittings. Clearly indicate appropriate Canadian Registration Number (CRN) assigned to each component, on component shop drawing/product data sheet.
- .2 Submit product data sheets for motors, and certified wiring diagrams for equipment requiring power, control and/or alarm wiring connections.
- .3 Submit, prior to work commencing on site, a detailed account of proposed pipe joint brazing procedures including pre- and post-nitrogen purging.
- .4 Submit written certification by equipment manufacturers/suppliers confirming equipment is properly installed, has been tested, and is in proper operating condition, all as specified in Part 3 of this Section.
- .5 Submit manufacturer's start-up reports as specified in Part 3 of this Section.
- .6 Submit 3 identified keys for cabinet/panel lockable doors prior to Substantial Performance of the Work.
- .7 Submit record as-built drawings in accordance with requirements specified in Section 22 05 00.

1.3 DESIGN PRESSURE AND TEMPERATURE REQUIREMENTS

- .1 System design pressures are as follows:
 - .1 Argon:
 - .1 maximum system pressure, 380 kPa.
 - .2 Nitrogen:
 - .1 maximum system pressure, 1400 kPa.
- .2 Design temperature for services will be ambient temperature.

1.4 QUALITY ASSURANCE

- .1 Products and work must comply in all respects with requirements of local governing authorities, and requirements of applicable codes and standards.
- .2 Provide registration, inspection, and/or approval for gas system work, as required, with local governing regulatory authority.

- .3 Laboratory gas systems work must be performed by journeyman plumber/pipefitter/steamfitter tradesmen completely familiar with requirements local codes and standards, and who are qualified and certified (with jurisdictional authority issued Certificate) for silver brazing with nitrogen backing without using flux in accordance with Clause 4.5 in Part 1 of CSA B51. Jurisdictional authority is the authority designated by the province of the work to perform oversight functions cited in Clause 4.5 in Part 1 of CSA B51.

PART 2 - PRODUCTS

2.1 GENERAL RE: PIPING SYSTEM MATERIALS AND COMPONENTS

- .1 Pipe, fittings, and piping system components are factory washed and degreased. Cap pipe. Package fittings and components.
- .2 Piping system components site connected with piping are complete with factory installed, washed, degreased and capped Type "K" hard copper piping stubs with joints silver brazed while component and piping is full of nitrogen.

2.2 PIPE, FITTINGS AND JOINTS

- .1 Aboveground
 - .1 Type "L" or type "K" (as specified in Part 3) hard temper copper tubing to ASTM B819, complete with wrought copper, brass or bronze fittings and silver brazed joints made with brazing alloy conforming to ANSI/AWS Standard A5.8 Classification BcuP-5.

2.3 PIPE ANCHORS

- .1 Welded structural black steel anchors of design, size, and type to securely anchor pipe at point shown.
- .2 Each anchor can withstand 150% axial thrust, and is designed and detailed by third party structural Professional Engineer.
- .3 Submit anchor design and fabrication shop drawings.

2.4 SHUT-OFF VALVES

- .1 Full flow bronze body ball type valves, 4140 kPa rated, ¼ turn on-off from a fully closed to a fully open position, in-line serviceable, blow-out proof, factory pressure tested, and complete with a chrome plated brass or stainless steel ball depending on valve size, a double Teflon seal, a Teflon seat, O-ring packing, lever handle capable of locking in open or closed position, and colour coded permanent identification labels.

2.5 LOCAL EMERGENCY ALARM PANEL ASSEMBLIES

- .1 Wall mounting local emergency alarm panels assemblies incorporating an area alarm panel in one enclosure. Each assembly is to be complete with:
 - .1 Enamelled steel wall mounted box sized to suit components installed, complete with adjustable steel mounting brackets, an anodized aluminium frame.
 - .2 Modular, microprocessor-based, gas specific alarm units with large LED universal (psi, kPa, "Hg, Bar) pressure/vacuum displays, LED trend display, high and low alarms with dry contacts for connection to a master alarm panel, 90 dBA audible alarm with silence button and adjustable alarm reminder, alarm history recall, identified sensors with DISS connection located in back box, and remote monitoring hardware.

2.6 DUPLEX GAS MANIFOLDS

- .1 Factory assembled, pre-wired and tested, duplex, fully automatic, fail-safe design digital manifolds for cylinder arrangement as indicated on drawings, labelled for appropriate gas service and as follows:

SERVICE	MANUFACTURER & MODEL NO.	NO. OF CYLINDERS DELIVERY PRESSURE
argon		345 kPa
nitrogen		1210 kPa

Manifolds shall provide universal gas management system that can provide continuous supply of gas from either cryogenic liquid cylinders or high pressure gas cylinders, or any combination of both.

- .2 Changeover from primary supply to secondary supply is to be fully automatic and is not to require manual reset of manifold after cylinder replacement and gas flow and cylinder bank changeover is not to be affected by a power failure. Manifold is to utilize a single high-flow control solenoid valve and accomplish changeover by differential pressure.
- .3 Surface wall mounting, 120 volt, 1-phase, 60 Hz ~~barriered steel cabinet with hinged access door~~ **NEMA 13 cabinet** and wall mounting hardware, primed and painted and complete with:
 - .1 24 volt secondary control transformer and DIN rail-mounted user terminal connections.
 - .2 2 primary regulators, 2 pressure transmitters, 2 inlet check valves, 1 normally open brass solenoid valve, 4 union style ball type isolation valves, 2 main line pressure regulators, and 3 externally mounted ASME certified pressure relief valves with union connections.
 - .3 Plugged NPT port for a temporary gas supply connection.

- .4 Door mounted "Service Ready" LED, "Empty" LED's for each left and right cylinder banks, and LED digital displays of each cylinder bank pressure and main supply pressure.
- .4 Header bars consisting of rigid, silver brazed brass pipe and fittings, labelled for appropriate gas service and complete with wall mounting hardware and gas specific inlet connections with integral check valves.
- .5 600 mm long gas specific cylinder pigtailed complete with a Compressed Gas Association (CGA) nut and nipple inlet fitting with reverse flow outlet check valve, and CGA nut and nipple outlet fitting. Pigtail material is as follows:
 - .1 Argon: Semi-rigid copper (no lining).
 - .2 Nitrogen: Teflon lined stainless steel.

2.7 NITROGEN CONTROL PANELS

- .1 Flush wall mounting panel, factory tested and cleaned for nitrogen service, packaged for delivery, and complete with:
 - .1 1.6 mm thick extruded aluminium back box complete with plaster mounting flange, and inlet and outlet 9.5 mm diameter Type "K" copper tubing with brass fittings.
 - .2 2760 kPa rated flexible cross-over tubing complete with quick-connect fittings.
 - .3 Stainless steel front panel with black silk-screened labelling, and panel mounted components as follows:
 - .1 1750 kPa high flow self-relieving, adjustable, lockable pressure regulator.
 - .2 1/4 turn brass ball type inlet supply valve.
 - .3 50 mm diameter, 0 - 2100 kPa inlet and outlet pressure gauges.
 - .4 Cartridge style (Diameter-Index Safety System) DISS nitrogen outlet.

2.8 PRESSURE SWITCHES FOR ALARM SIGNALS

- .1 Factory assembled and set (to suit site requirements) switches as follows:
 - .1 each labelled for intended service.
 - .2 each suitable for pipeline pressure, laboratory gas involved, and alarm function.
 - .3 each complete with a ~~NEMA-4~~ NEMA 13 housing, tamper-proof external adjustment, a gas specific DISS inlet, a 50 mm diameter monitoring gauge, and instructions for field adjustment.

2.9 ALARM PANEL

- .1 Modular, field expandable, 115 volt, solid state, electronic, microprocessor-based flush wall mounting audio-visual alarm panel designed for constant monitoring of piping system pressure or

vacuum as applicable, and initiation of an alarm function on any open circuit only. Panel is to be complete with:

- .1 Minimum 1.0 mm thick steel back box sized to suit gas service modules required and equipped with adjustable mounting brackets to accommodate different wall thicknesses, a 115 volt power connection terminal block, fused 24 volt secondary transformer, a motherboard for plug-in connection of modules, and matte finish extruded aluminium or equal trim.
- .2 Power module with green power on LED, and adjustable (2 to 30 minutes) alarm repeater.
- .3 Microprocessor-based, field adjustable modules, each capable of handling 10 functions, capable of field upgrading to interface with a building automation system or slave alarm, and supplied in quantities to connect alarms as follows:
 - .1 Argon:
 - .1 High Line Pressure.
 - .2 Reserve Manifold in Use.
 - .3 Low Line Pressure.
 - .2 Nitrogen:
 - .1 High Line Pressure.
 - .2 Reserve Manifold in Use.
 - .3 Low Line Pressure.
- .4 Red alarm LED's which flash and an audible alarm buzzer in excess of 90 dB which sounds when an alarm condition occurs, and an "ALARM MUTE" pushbutton to silence audible alarm, however, panel will remain in alarm state until problem is rectified.
- .5 "TEST" pushbutton to test all panel functions.
- .6 Dry contacts for remote monitoring of high and low alarms.
- .7 Building automation system signal interface panel.

PART 3 - EXECUTION

3.1 GENERAL RE: PIPING INSTALLATION

- .1 Perform pipe joint brazing work and brazing procedures in accordance with.
- .2 Departmental Representative reserves right to cut-out and examine piping joints during course of work or after work is complete, and if interior of cut-out sample and/or fittings are found to be contaminated with oxidation or any other material, piping will be considered unacceptable and must be cleaned or replaced.
- .3 Where low pressure connecting assemblies are used in retractable gas columns, articulating arms, or any other dispensing assembly, DISS body or terminal unit which is used to connect it to copper pipeline must be brazed to piping system.
- .4 Refer to drawing plans and elevations for exact locations of terminal units, zone valve boxes, alarm panels, and other such items.

3.2 INSTALLATION OF LABORATORY GAS SYSTEM PIPING

- .1 Provide required gas system piping. Unless otherwise shown or specified, and piping for services is to be minimum 12 mm diameter.
- .2 Piping aboveground, unless otherwise specified, is to be Type "L" hard copper.
- .3 Provide threaded piping unions at piping connections to source equipment. Do not silver braze unions. Braze a male NPT adaptor on end of pipe, wrap Teflon tape onto adaptor (2 threads back), and screw union as tight as possible by hand, then with proper wrenches for final tightening. Do not over tighten.
- .4 Perform pipe brazing operations.
- .5 Ensure tools used during erection of piping systems are kept clean and free from oil and grease.
- .6 Support piping by means of support materials and anchors of type to suit intended applications.
- .7 Prepare a separate set of as-built white prints on a daily basis. Identify piping system work, including valves, concealed and exposed. Submit record as-built drawings in accordance with requirements in Section 22 05 00.
- .8 Provide DISS identified riser outlet piping connections in ceiling and/or wall spaces for connection to terminal outlets integral with manufactured equipment. Terminal units will be pre-piped by equipment manufacturer to an accessible location. Carefully rough-in piping and coordinate equipment connections, particularly for flush mounted and/or ceiling mounted equipment.
- .9 Provide identified piping connections to ceiling columns and/or headwalls, and/or other locations as indicated.
- .10 Provide a full size branch tee with shut-off valve for each gas source downstream of main isolation valve.

3.3 INSTALLATION OF VALVES

- .1 Provide shut-off/isolation valves where shown or required by local governing codes or standards. Shut-off valves, unless otherwise specified, are to be ball type.
- .2 Provide check valves where shown or required by local governing codes or standards.
- .3 Locate valves in positions for easy access and operation.

3.4 INSTALLATION OF AREA ALARM BOXES

- .1 Provide area alarm assemblies. Provide a service isolation valve in piping immediately upstream of each zone valve and on same floor.
- .2 Accurately install boxes with reference to wall finish, and confirm exact locations prior to roughing-in.

3.5 INSTALLATION OF DUPLEX GAS MANIFOLDS

- .1 Provide duplex gas manifold assemblies.

- .2 Surface wall mount control panel.
- .3 Rigidly secure each manifold in place and connect to control panel. Surface wall mount dual line pressure regulator and connect to control panel. Connect control panel outlet to system piping.
- .4 Pipe manifold relief valves to atmosphere using piping sized one size larger than outlet port of relief valve. Terminate vent piping in a "turned down" elbow arrangement with bronze insect screen permanently secured over pipe opening. Confirm exact termination points prior to roughing-in.

3.6 INSTALLATION OF NITROGEN CONTROL PANELS

- .1 Provide nitrogen control panels and flush wall mount. Confirm exact locations prior to roughing-in.
- .2 Connect with Type "K" copper inlet and outlet piping. Test operation and adjust as required.

3.7 INSTALLATION OF PRESSURE/VACUUM SWITCHES

- .1 Provide pressure or vacuum switches, as applicable, and all required connection hardware for medical gas pressure or vacuum alarms. Install in piping tees in accessible locations.
- .2 Adjust each switch in accordance with manufacturer's/supplier's instructions to suit site and system conditions.

3.8 INSTALLATION OF ALARM PANELS

- .1 Provide wall mounted gas pressure/vacuum alarm panels. Confirm exact panel locations prior to roughing-in.
- .2 Provide required hardware and connect each panel with required piping as applicable.
- .3 Carefully check panel pressure/vacuum readings and make any required adjustments.
- .4 When installation is complete, test each panel function, and make any adjustments and corrections necessary.

3.9 PIPING SYSTEM CLEANING AND LEAKAGE TESTING

- .1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction approval of Departmental Representative.
- .2 Disinfect piping with in accordance with local governing standards.
- .3 Refer to additional requirements in Section 22 05 00.

3.10 POWER AND CONTROL WIRING

- .1 Line voltage power wiring to equipment, unless otherwise specified, will be done as part of electrical work.
- .2 Control and alarm wiring, unless otherwise specified, is to be installed in conduit as part of medical gas system work in

accordance with electrical work wiring requirements, and manufacturer's/supplier's certified wiring schematics.

- .3 Generally, power wiring (provided as part of work of Division 26) and control and alarm wiring (provided as part of work of this Division and Division 25) is to be as follows:

EQUIPMENT	LINE VOLTAGE POWER WIRING	CONTROL AND/ OR ALARM WIRING
duplex manifolds	115 volt to cabinet	alarm wiring from cabinet to master alarm panel
local alarm panels	115 volt to panel	
combo zone valve and area alarm units	115 volt to panel	

3.11 EQUIPMENT START-UP AND CERTIFICATION

- .1 When installation of gas system equipment from source of supply up to but not including outlets is complete, and piping leakage testing is complete, arrange for equipment manufacturers/suppliers to visit site for length of time necessary to:
- .1 Check installation of equipment and recommend any adjustments required to be performed immediately.
 - .2 Start-up equipment, test operation, recommend any adjustments required to be performed immediately, check and verify safeties, operational sequences, controls and alarms to ensure they are operating properly, and ensure equipment performs as intended.
 - .3 Obtain letter(s) from system manufacturer(s)/supplier(s) certifying above requirements have been successfully completed, have letter(s) signed by system manufacturer(s)/supplier(s), and submit to Department Representative.

3.12 GAS SYSTEM CERTIFICATION

- .1 When equipment start-up and certification is complete, notify Department Representative that systems are ready for gas system certification.
- .2 Arrange for system installer to be part of certification team.
- .3 Perform gas system certification in accordance with requirements of local governing authorities and codes.

3.13 IDENTIFICATION AND LABELLING

- .1 Identify piping with labelling in accordance with local governing codes and standards.
- .2 Provide identification nameplate on equipment.

- .3 Review nomenclature, sizing, colours, and other identification requirements with Departmental Representative.
- .4 Refer to additional requirements specified in Section 23 05 00.

3.14 SYSTEM TRAINING

- .1 Include for 2 site training sessions for a minimum of 6 people for 8 hours per session. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

END OF SECTION