PGH INFRASTRUCTURE PROJECT
FELICIDAD SY
MULTI-SPECIALTY BUILDING

Taft Ave., Ermita, Manila

Technical Specifications
for
Medical Gas

Prepared by: **MEINHARDT PHILIPPINES, INC.**
25/F Chatham House
116 Valero corner V.A. Rufino Streets
Salcedo Village, Makati City
1227 Philippines

October 2021

MARK JOHN C. TE
Professional Mechanical Engineer

Reg. No. : 5421
PTR No. : 7364776
Date Issued : 05 January 2021
Issued at : Pasay City
TIN No : 231-522-777

For Tender

OCT 27 2021

MEINHARDT

ARCHION ARCHITECTS
GF PIECO BUILDING
2242 DON CHINO ROCES AVENUE,
MAKATI CITY, PHILIPPINES
TEL NO.: (632) 817-1115
EMAIL: archion@archionarchitects.com

PHILIPPINE GENERAL HOSPITAL
Infrastructure Project
FELICIDAD SY MULTI-SPECAILTY BULDING
ERMITA, MANILA CITY

RECOMMENDING APPROVAL:

Arch. Rosalie G. Flores-Bernardo
Chief CPDMO
UP-Manila

Engr. Merlin Deblois-Herrera
Chief of OETS
PGH

Michael L. Tee, MD, MH Ped, MBA.
Vice-Chancellor for Planning & Development
UP-Manila

Apolinario Ericson B. Berberabe, M.D.
Coordinator for Infrastructure and
Special Projects
PGH

Arlene A. Samaniego, M.D.
Vice Chancellor for Administration
UP-Manila

Maria Teresa Julieta U. Benedicto, MD
Deputy Director for Administration
PGH

CARMENCITA D. PADILLA, MD, MAHPS
Chancellor
UP-Manila

GERARDO D. LEGASPI, M.D.
DIRECTOR
PGH

SECTION 15213
MEDICAL GAS PIPING

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. This Section includes piping and related specialties for the following medical gas systems:

1. Oxygen piping, designated "oxygen."
2. Medical compressed-air piping, designated "medical air."
3. Nitrous-oxide piping, designated "nitrous oxide."
4. Medical-surgical vacuum piping, designated "medical vacuum."
5. Waste anesthetic gas disposal piping, designated "evacuation."

B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 RELATED WORK

A. Section 03300 - Cast - in - Place Concrete

B. Section 15010 - Mechanical General Provisions.

C. Section 15050 - Basic Mechanical Materials and Methods.

D. Section 15060 - Hangers and Supports

E. Section 15122 - Meters and Gauges

E. Section 15200 - Noise and Vibration Control and Seismic Requirements

1.3 APPLICABLE PUBLICATIONS

A. American Society of Mechanical Engineers (ASME) :

B16.21 - Non- Metallic Flat Gaskets for Pipe Flanges
B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
B16.24 - Cast Copper Alloy Pipe Flanges and Flanged Fittings

ASME Boiler and Pressure Vessel Code; Section VIII Pressure Vessels

B. American Society for Testing and Materials (ASTM) :

B 88 - Seamless Copper Water Tube.
B 819 - Seamless Copper Tube for Medical Gas Systems
E 699 - Criteria for Evaluation of Agencies involved in Testing, Quality Assurance and Evaluating Building Components according with Test Methods Promulgated in Building ASTM Committee E6.

C. American Welding Society (AWS):

AWS A5.8 - Filler Metals for Brazing and Braze Welding.

D. Manufacturers Standardization Society of the Valve and Fitting Industry:

MSS SP 71	-	Gray Iron Swing Check Valves, Flanges and Threaded Ends.
MSS SP 72	-	Ball Valves with Flanged or Butt - Welding Ends for General Service
MSS SP 110	-	Ball Valves Threaded, Socket - Welding, Solder Joint, Grooved and Flared Ends

E. National Manufacturers Electrical Association (NEMA):

NEMA WD I	-	General Color Regulation

F. National Fire Protection Association (NFPA):

NFPA 50	-	Standard for Bulk Oxygen Systems at Consumer Sites
NFPA 70	-	National Electric Code
NFPA 99	-	Health Care Facilities
NFPA 99C	-	Gas and Vacuum Systems

G. Occupational Safety and Health Administration (OSHA):

Reg. 1910.7	-	Definition and Requirements for a Nationally Recognized Testing Laboratory

H. Underwriters Laboratories, Inc. (UL):

UL 498	-	Attachment Plugs and Receptacles
UL 544	-	Medical and Dental Equipment

1.4 SUBMITTALS

A. Product Data: For the following:

1. Special-purpose valves.
2. Medical gas specialties.
3. Medical gas alarm system components.
4. Cylinder wall racks and storage racks.
5. Medical gas storage tanks.

B. Wiring diagrams for medical gas alarm systems and tanks. Differentiate between manufacturer-installed and field-installed wiring.

C. Coordination Drawings: For medical gas systems, including relationship to other services that serve same work areas.

D. Product Certificates: Signed by manufacturer certifying that copper tubing complies with NFPA 99, Paragraph 4-3.1.2.2, "Gas Piping Systems (General)."

E. Certificates of Shop Inspection and Data Report: As required by ASME Boiler and Pressure Vessel Code.

F. Inspection and test reports specified in "Field Quality Control" Article in Part 3 of this Section.

G. Certificates of inspections and tests from an independent testing agency specified in "Field Quality Control" Article in Part 3 of this Section.

H. Maintenance Data: For specialties to include in the maintenance manuals specified in Division 1.

1.5 QUALITY ASSURANCE

A. Testing Agency Services: Owner will provide independent testing agency services under separate contract to inspect, test, and certify medical gas piping and components, except for inspections and tests specified in "Field Quality Control" Article in Part 3 of this Section.

B. Testing Agency Qualifications: Demonstrate to Engineer's satisfaction, based on Engineer's evaluation of criteria conforming to ASTM E 699 that the independent testing agency has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.

C. Listing and Labeling: Provide electrically operated specialties specified in this Section that are listed and labeled.

1. Terms "Listed" and "Labeled": As defined in National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

D. Comply with NFPA 50.

E. Comply with NFPA 70.

F. Comply with NFPA 99.

G. Comply with NFPA 99C.

H. Comply with UL 498.

I. Comply with UL 544.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Meet Section 15010.

B. Deliver and store large medical gas specialties on factory-installed shipping skids, small specialties in factory-fabricated fiberboard containers, and piping with sealing plugs in ends or with other end protection.

1. Store precleaned and sealed medical gas pipe, fittings, valves, and specialties with sealing plugs and sealing packaging intact.
2. Label medical gas pipe, fittings, valves, and specialties that have not been precleaned, or that have been precleaned but have seal or packaging that is not intact, with temporary labels indicating that cleaning is required before installation.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents. Deliver to Owner.

1. Service Outlets: Include box, valve block, valve body, O-ring, and cover plate. Furnish quantity not less than 10 percent of amount of each installed.
2. Service-Outlet Valve Bodies: Furnish quantity not less than 10 percent of amount of each installed.
3. Service-Outlet, Valve-Body O-Ring Seals: Furnish quantity not less than 50 percent of amount of each installed.

4. Vacuum Bottle Brackets: Furnish quantity not less than 10 percent of amount of each installed.
5. Nitrogen Control Panels: Furnish quantity not less than 10 percent of amount of each installed.
6. Service Hose Assemblies: Furnish quantity not less than 10 percentof amount of each installed.
7. Shutoff Valves: Furnish quantity not less than 10 percent of amount ofeach type and size zone valve installed.
8. Valve Seat, Packing, and Seals: Furnish quantity not less than 10 percent of amount of each type and size installed.
9. Pressure and Vacuum Switches: Furnish quantity not less than 10 percent of amount of each type installed.

PART 2 – PRODUCTS

2.1 PIPE AND TUBES

A. Precleaned, Hard Copper Tube: ASTM B 819, Type K or Type L, seamless, drawn temper, factory cleaned, purged, and sealed for medical gas service. Include marking or labeling "CLEANED FOR MEDICAL GAS SERVICE," "CLEAN FOR OXYGEN SERVICE," "NITROGENIZED."

2.2 PIPE AND TUBE FITTINGS

A. Wrought-Copper Fittings: ASME B16.22, solder-joint, pressure type. Fittings may be factory cleaned, purged, and sealed for medical gas service according to ASTM B 819 or field cleaned, purged, and sealed as specified in "Preparation" Article in Part 3. Include marking or labeling "CLEANED FOR MEDICAL GAS SERVICE," "CLEAN FOR OXYGEN SERVICE," "NITROGENIZED."

B. Bronze-Tube Flanges: ASME B16.24, Class 300.

C. Flexible Connectors: Bronze or stainless-steel flexible pipe connectors as specified in Section 15200.

2.3 JOINING MATERIALS

A. Refer to Section 15050 for joining materials not in this Section.

B. Brazing Filler Metals: AWS A5.8, BCuP (copper-phosphorus) series alloys. Flux is prohibited, except when used with bronze fittings.

C. Threaded-Joint Tape: PTFE plastic.

D. Gasket Material: ASME B16.21, nonmetallic, flat, asbestos free, and suitable for oxygen use.

2.4 VALVES AND VALVE BOXES

A. Ball Valves, 3-Inch NPS (DN80) and Smaller: MSS SP-110, bronze-body, full-port valve rated for 300-psig (2070-kPa) working pressure, with chrome-plated brass ball, PTFE or TFE seals, blowout-proof stem, threaded or braze-joint ends, and locking-type handle designed for quarter turn between open and closed positions.

1. Include union-type body with bolted swing-away center section.
2. Include factory-cleaned, factory-sealed for oxygen use, and factory-installed, ASTM B 88, Type K or L (ASTM B 88M, Type A or B), copper-tube

extensions with pressure gage installed downstream from valve in pressure systems and upstream from valve in vacuum systems.

B. Ball Valves, 4-Inch NPS (DN100) and Larger: MSS SP-72, bronze- or iron-alloy body, full-port valve rated for 300-psig (2070-kPa) working pressure, with chrome-plated brass ball valve, PTFE or TFE seals, blowout-proof stem, flanged ends, and locking-type handle designed for quarter turn between open and closed positions.

C. Check Valves, 3-Inch NPS (DN80) and Smaller: Bronze-body, straight-through pattern, spring-loaded ball check valve, designed for 300-psig (2070-kPa) minimum working pressure.

D. Check Valves, 4-Inch NPS (DN100) and Larger: MSS SP-71, Class 250, iron-body, bronze-trim, swing check valve, with flanged ends.

E. Safety Valves: Bronze body with settings to match system requirements.

1. Pressure Safety Valves: ASME construction.
2. Vacuum Relief Valves: Equipment manufacturer's option.

F. Pressure Regulators: Brass or bronze body and trim; spring-loaded, diaphragm-operated, relieving type; manual pressure-setting adjustment; rated for 250-psig (1725-kPa) minimum inlet pressure; and capable of controlling delivered air pressure within 0.5 psig for each 10-psig (5.0 kPa for each 100-kPa) inlet pressure.

G. Automatic Drain Valves: Corrosion-resistant metal body and internal parts, 200-psig (1380-kPa) minimum working-pressure rating, capable of automatic discharge of collected condensate.

H. Zone Valve Boxes: Minimum 0.048-inch- (1.2-mm-) thick steel, valve boxes for recessed mounting, with holes for medical gas piping and anchors. Include for single- or multiple-valve (with pressure gage) installation and in sizes to permit manual operation of valves.

1. Interior Finish: Factory-applied white enamel.
2. Cover Plate: Satin-chrome finish, minimum 0.048-inch- (1.2-mm-) thick steel with frangible or removable windows.
3. Valve-Box Windows: Clear or tinted transparent plastic with labeling, including space for rooms served, according to NFPA 99.

2.5 MEDICAL GAS PIPING SPECIALTIES

A. General: Provide the following medical gas piping specialties by same manufacturer:

B. Emergency Oxygen Connection: Low-pressure gaseous-oxygen inlet assembly, consisting of weatherproof enclosure with hinged locking cover, suitable for recessed mounting, with factory-installed 1- or 1-1/4-inch NPS (DN25 or DN32) plugged inlet, pressure gage, and minimum 1-inch NPS (DN25) ball valve, for connection to oxygen system. Include brass-body safety valve, set at 75 or 80 psig (520 or 550 kPa), which may be installed in enclosure or be separate for installation in oxygen piping system. Label enclosure cover "Emergency Low-Pressure Gaseous Oxygen Inlet."

C. Medical Gas Manifolds: Comply with NFPA 99, with the following features and design requirements:

1. Central Control Panel Unit: Weatherproof cabinet, supply and delivery pressure gages, electrical alarm system connections and transformer, indicator lights or devices, manifold connection, pressure changeover switch, line-pressure regulator, shutoff valves, and safety valve.

2. Manifold and Headers: Duplex, nonferrous metal header for number of cylinders indicated, divided into 2 equal banks. Units include design for 2000-psig (13.8-MPa) minimum inlet pressure, except nitrous-oxide manifolds may be designed for 800 psig (5500 kPa). Include cylinder bank headers with inlet (pigtail) connections complying with CGA V-1, individual inlet check valves, shutoff valve, pressure regulator, check valve, and pressure gage.
3. Operation: Automatic, pressure-switch-activated changeover from one cylinder bank to other cylinder bank when first bank becomes exhausted, without line-pressure fluctuation or resetting of regulators, and without supply interruption by shutoff of either cylinder bank header.
4. Mounting: Wall mounting, complete with mounting brackets for manifold control cabinet and headers.
5. Label manifold control unit with permanent label identifying medical gas type and system operating pressure.
6. Nitrous-Oxide Manifolds: 16 (8 x 8) cylinder, 2000 cu. ft./h (15.7 L/s) at 55-psig (380-kPa) line pressure with electric heater or orifice design that will prevent freezing during high demand.
7. Oxygen Manifolds: (8 x 8) cylinder, 2500 cu. ft./h (19.7 L/s) at 55-psig (380-kPa) line pressure.
8. Medical Air Manifolds: 8 (4 x4) cylinder, 2500 cu. ft./h (19.7 L/s) at 55-psig (380-kPa) line pressure.

The manifold shall be designed so that when the switchover from the primary service to the reserve supply occurs, there will be no drop or fluctuation in the line pressure. The control cabinet shall have a visual signal to indicate switchover from the primary service to the reserve supply.

D. Service Outlets: Gas specific for services listed with roughing-in and finishing assemblies. Include the following:

1. Roughing-in Assembly: Include the following:

    a. Steel outlet box or mounting plate.
    b. Brass-body outlet block with secondary check valve that will prevent gas flow when primary valve is removed.
    c. Double seals that will prevent gas leakage.
    d. ASTM B 88, Type K, 3/8-inch NPS (ASTM B 88M, Type A, DN10) copper inlet or outlet tube brazed to valve with gas-service marking and tube-end dust cap.

2. Finishing Assembly: Include the following:

    a. Brass housing with primary check valve.
    b. Double seals that will prevent gas leakage.
    c. Cover plate with gas-service label.

3. Quick-Connect Coupling: Indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment, and with positive-locking ring that retains equipment stem in valve during use.
4. DISS-Type Coupling: CGA V-5, DISS-threaded indexing to prevent interchange between services; constructed to permit one-handed connection and removal of equipment.

    a. Oxygen Outlets: CGA V-5, DISS No. 1240.
    b. Medical Air Outlets: CGA V-5, DISS No. 1160.
    c. Medical Vacuum Inlets: CGA V-5, DISS No. 1220.
    d. Nitrous-Oxide Outlets: CGA V-5, DISS No. 1040.
    e. Evacuation Inlets: CGA V-5, DISS No. 2220.

5. Wall Outlet Cover Plates: One-piece metal, with chrome-plated finish and permanent, color-coded, medical gas identifying label matching corresponding outlets.
6. Vacuum Bottle-Slide Brackets: Bottle-slide and mounting assembly matching pattern of vacuum outlet. Include one slide bracket for each wall-mounted vacuum inlet, except where no slide bracket requirement is indicated.

E. Power Outlets: UL 498, Hospital Grade, 125-V receptacles; color selected by Architect. Include the following configurations complying with NEMA WD 1:

1. L5-20R, locking type, 20 A, single or duplex.
2. L5-20R, isolated ground, locking type, 20 A, single or duplex.
3. Explosion proof, 20 A, 2 pole, 3 wire, single, flush mounting; suitable for Class I, Group C hazardous location; interchangeable with receptacles used in nonhazardous areas.
4. 5-20R, straight-blade type, 20 A, duplex.
5. 5-20R, isolated ground, straight-blade type, 20 A, duplex.

F. Electrical Accessory Outlets: Provide the following configured receptacles in color selected by Architect:

1. Patient-Equipment, Ground Jack: Single pole, 30 A.
2. Patient Monitoring: Single, 5 pin.
3. Patient Monitoring: Single, 37 pin.

G. Outlet Cover Plates: One-piece metal, with chrome-plated finish and permanent identifying label.

H. Service Hose Assemblies: Color coded, conductive, neoprene, 1/4- or 5/16-inch (6.4- or 7.9-mm) ID, of lengths indicated, and with indexed or DISS-type end-connection fittings suitable for medical gas service indicated.

I. Pressure Control Panels: Steel box and steel support brackets for recessed roughing-in. Include stainless-steel or anodized-aluminum cover plate with printed operating instructions. Include control panels with manifold assembly consisting of inlet supply valve, inlet supply pressure gage, line-pressure control regulator, outlet supply pressure gage, DISS service outlet, and piping outlet for remote service outlet.

1. Minimum Working Pressure: 180 psig (1240 kPa).
2. Line-Pressure Control Regulator: Self-relieving, diaphragm type, and with precision manual adjustment.
3. Pressure Gages: 0- to 300-psig (0- to 2070-kPa) range.
4. Provide temporary dust shield and U-tube for testing for use before final assembly.
   Outlets should be DISS type. Specify quick-connect type only if required.
5. Air Control Panels: Label cover plate "Air Pressure Control." Include CGA V-5, DISS No. 1160 air service outlet.

J. Ceiling-Mounted Service Units: Provide service outlets (inlets) without cover plates and vacuum slides as specified in "Service Outlets" Paragraph; electric outlets as specified in "Power Outlets" Paragraph; and service labels color coded as indicated.

1. Ceiling-Mounting Plate: Include manufacturer's standard plate or field-fabricated plate or roughing-in assembly conforming to manufacturer's written instructions.
2. Exposed Surfaces: Minimum 0.0375-inch- (0.95-mm-) thick stainless steel with NAAMM AMP 503, No. 4 directional polish.
3. Servicing: Include access panels or means of removing shroud.
4. Blank cover plates for cutouts not having services.

5. ASTM B 88, Type K, 3/8-inch NPS (ASTM B 88M, Type A, DN10) copper-tube extensions for connection to medical gas systems.
6. Service Outlets: Types and number indicated.
7. Dust Covers: For service outlets.
8. DISS Service Outlets: CGA V-5, DISS-threaded indexing to prevent interchange between services; constructed to permit one-handed connection and removal of equipment; and with positive locking that retains equipment stem in valve during use.

    a. Oxygen Outlets: CGA V-5, DISS No. 1240.
    b. Medical Air Outlets: CGA V-5, DISS No. 1160.
    c. Medical Vacuum Inlets: CGA V-5, DISS No. 1220.
    d. Nitrous-Oxide Outlets: CGA V-5, DISS No. 1040.
    e. Evacuation Inlets: CGA V-5, DISS No. 2220.

9. Rigid Ceiling Service Columns: Rectangular or square, fixed column section, 44 inches (1120 mm) long, and with 2 double IV hooks. Include 0.078-inch-(2.0-mm-) thick, stainless-steel bottom plate having 2 oxygen, 2 vacuum, 1 medical air, 1 nitrous oxide, 1 nitrogen, and 1 evacuation quick-connect, except DISS for nitrogen, service outlets. Include two L5-20R, locking-type, 20-A, single, power receptacles and 2 patient-equipment, ground-jack, single-pole, 30-A receptacles.

10. Retractable Ceiling Service Columns: Manually adjustable using release and lock handles, capable of locking column in all positions from fully retracted to fully extended; 15-inch- (380-mm-) long rectangular or square, counterbalanced, telescoping section, with 2 double IV hooks; and 36-inch-(915-mm-) long fixed column section. Include 0.078-inch- (2.0-mm-) thick, stainless-steel bottom plate with 2 oxygen, 2 vacuum, 1 medical air, 1 nitrous oxide, and 1 evacuation quick-connect, service outlets. Include two L5-20R, locking-type, 20-A, single, power receptacles and 2 patient-equipment, ground-jack, single-pole, 30-A receptacles.

11. Hose-Reel Ceiling Service-Outlet Assemblies: Individual, concealed, hose-reel units, with stainless-steel faceplates, steel mounting boxes, factory- or field-fabricated mounting brackets, and color-coded service hoses with adjustable stops. Include DISS-type medical gas inlets for services indicated, and 72 inches (1830 mm) of conductive neoprene 1/4- or 5/16-inch- (6.4- or 7.9-mm-) ID medical gas hose, rated for 200-psig (1380-kPa) minimum working pressure and with end-connection fittings as indicated.

12. Provide the following type and quantity of hose services:

    a. Oxygen: One quick-connect outlet.
    b. Medical Vacuum: One quick-connect inlet.
    c. Nitrous Oxide: One quick-connect outlet.
    d. Evacuation: One quick-connect inlet.
    e. Power Receptacle: One L5-20R, single, locking type, 20 A.

2.6 MEDICAL GAS ALARM SYSTEMS

A. Description: Compatible alarm panels, remote sensing devices, and other related components where indicated and where required by NFPA 99. Power wiring is specified in Division 16 Sections.

B. Components: Designed for continuous service and to operate on power supplied from 220-V, ac power source to alarm panels and with connections for 24- or 12-V, ac low-voltage wiring to remote sensing devices. Include step-down transformers ifrequired.

C. Dew-Point Monitors: Continuous line monitoring, having panel with gage or digital display, pipeline sensing element, electrical connections for alarm system, factory- or field-installed valved bypass, and visual and cancelable audio signal for dryer site and master alarm panels. Operate alarm when pressure dew point rises above 39 deg F (3.9 deg C) at 55 psig (380 kPa).

1. Operation: Hygrometer moisture analyzer with sensor probe.

D. Pressure and Vacuum Switches or Pressure Transducer Sensors: Continuous line monitoring with electrical connections for alarm system.

1. Low-Pressure Switches: 0- to 100-psig (0- to 690-kPa) operating range.
2. High-Pressure Switches: Up to 250-psig (1725-kPa) operating range.
3. Vacuum Switches: 0- to 30-in. Hg (0- to 101-kPa vacuum) range.

E. Carbon-Monoxide Monitors: Panel with gage or digital display, pipeline sensing element, electrical connections for alarm system, and factory- or field-installed valved bypass. Operate alarm when carbon-monoxide level rises above 10 ppm.

F. Alarm Panels: Factory wired with audible and color-coded visible signals to indicate specified functions.

1. Mounting: Exposed, surface-mounting installation.
2. Enclosures: Fabricated from minimum 0.047-inch- (1.2-mm-) thick steel or minimum 0.05-inch- (1.27-mm-) thick aluminum, and with knockouts for electrical and piping connections.

G. Special Features: In addition to manufacturer's standard features, include the following:

(Note: Panels below are usually installed in building engineer's office and also at telephone switchboard or in security office.)

1. Master Alarm Panels: Separate trouble alarm signals, pressure (vacuum) gages, and indicators for oxygen, medical air, medical vacuum, nitrous oxide, nitrogen, evacuation, carbon dioxide, and high-pressure air. Include signal alarms at master alarm panels when the following conditions exist:

   a. Bulk Oxygen (main supply): Liquid level is low, pressure downstream from main shutoff valve drops below 40 psig (275 kPa) or rises above 60 psig (415 kPa), changeover is made to reserve, reserve is in use, reserve level is low, and reserve pressure is low.
   b. Oxygen manifold (reserve): Pressure downstream from main shutoff valve drops below 40 psig (275 kPa) or rises above 60 psig (415 kPa), and changeover is made to alternate bank.
   c. Medical Air: Pressure drops below 40 psig (275 kPa) or rises above 60 psig (415 kPa), back-up air compressor is in operation, pressure drop across filter assembly increases more than 2 psig (13.8 kPa), dew point rises above 39 deg F (3.9 deg C) at 55 psig (380 kPa), carbon-monoxide level rises above 10 ppm, and high water level is reached in receiver for liquid-ring, medical air compressor systems.
   d. Medical Vacuum: Vacuum drops below 12 in. Hg (40 kPa) and back-up vacuum pump is in operation.
   e. Nitrous Oxide: Pressure drops below 40 psig (275 kPa) or rises above 60 psig (415 kPa), and changeover is made to alternate bank.
   f. Evacuation: Vacuum drops below 12 in. Hg (40 kPa).
   g. High-Pressure Air: Pressure drops below 160 psig (1100 kPa) or rises above 200 psig (1380 kPa).

(Note: Panels below are usually installed in nurse stations and corridors.)

2. Area Alarm Panels: Separate trouble alarm signals; pressure and vacuum gages; and indicators for oxygen, medical air, and medical vacuum.

(Note: Panels below are usually installed in surgical suites.)

3. Anesthetizing-Area Alarm Panels: Separate trouble alarm signals; pressure and vacuum gages; and indicators for oxygen, medical air, medical vacuum, nitrous oxide, nitrogen, evacuation, carbon dioxide, and high-pressure air.
4. Signal alarms at area alarm panels and at anesthetizing-area alarm panels when the following conditions exist:

   a. Oxygen: Pressure drops below 40 psig (275 kPa) or rises above 60 psig (415 kPa).
   b. Medical Air: Pressure drops below 40 psig (275 kPa) or rises above 60 psig (415 kPa).
   c. Medical Vacuum: Vacuum drops below 12 in. Hg (40 kPa).
   d. Nitrous Oxide: Pressure drops below 40 psig (275 kPa) or rises above 60 psig (415 kPa).
   e. Evacuation: Vacuum drops below 12 in. Hg (40 kPa).
   f. High-Pressure Air: Pressure drops below 160 psig (1100 kPa) or rises above 200 psig (1380 kPa).

H. Computer Interface Cabinet: Wall-mounting, welded-steel, control cabinet with gasketed door, mounting brackets, grounding device, and white-enamel finish. Include factory-installed signal circuit boards, power transformer, circuit breaker, wiring terminal board, and internal wiring capable of interfacing 20 alarm signals.

2.7 MEDICAL GAS STORAGE TANKS

A. Bulk Gas Systems: Bulk storage tank with connections for alarm system, continuous supply, and reserve supply that will operate only during emergencies, complying with NFPA 99.

B. Controls: Include actuating switch for alarm system connection and means for automatic actuating of reserve supply.

C. Bulk Gas Storage Tanks: Vertical mounting, double-wall construction with inner vessel fabricated according to ASME Boiler and Pressure Vessel Code, Section VIII, "Pressure Vessels," for unfired pressure vessels, and suitable for medical gas service. Include insulation and vacuum seal between walls. Fabricate outer shell from carbon steel with factory-applied manufacturer's standard protective paint finish suitable for exterior installation. Include the following features, specialties, and components:

1. Safety Valves: ASME construction with pressure setting to correspond to tank working pressure.
2. Relief Valves: ASME construction with pressure setting as required for component or system being protected.
3. Pressure Gages: For tank pressure and facility service line pressure.
4. Contents Gage: High- and low-level indicator with electric signal circuit connection.
5. Drain Valves: For piping, inner vessel, and outer shell.
6. Fill Assembly: Fill connection, piping, valves, relief devices, and controls.
7. Facility Service Assembly: Piping, valves, relief devices, vaporizer, shutoff valve, pressure regulator, line shutoff valve or check valve, and reserve supply connection for connection to building service piping.

8. Include permanent label showing medical gas type, storage tank capacity, tank pressure rating, vaporizer capacity, and operating instructions.
9. Capacity of Storage Tanks and Vaporizers: As indicated.
10. Liquid Oxygen Storage Tank: Nickel-steel or stainless-steel inner vessel with 250-psig (1725-kPa) minimum working pressure. Include electric, steam, or ambient vaporizer as indicated.

D. Oxygen Reserve Supply: Manifolded header for high-pressure cylinders, fabricated of copper-tube or brass pipe and fittings, and suitable for pressures up to 4000 psig (27.6 MPa). Header shall have inlet connections complying with CGA V-1, with individual inlet check valves, header shutoff valve, header pressure regulator, line shutoff valve or check valve, pressure gage, and inlet connections for number of cylinders indicated.

E. Nitrous-Oxide Supply: Manifolded header for high-pressure cylinders, fabricated of copper-tube or brass pipe and fittings, and suitable for pressures up to 4000 psig (27.6 MPa). Header shall have inlet connections complying with CGA V-1, with individual inlet check valves, header shutoff valve, header pressure regulator, line shutoff valve or check valve, pressure gage, and inlet connections for number of cylinders indicated. Include electric heater.

2.8 IDENTIFICATION

A. Refer to Section 15050 for mechanical identification of piping, valves, gages, alarms, accessories, and labels for bulk storage tanks.

PART 3 – EXECUTION

3.1 PREPARATION

A. General: Where factory-precleaned and -capped piping is not available, or when precleaned piping must be recleaned because of exposure, perform the following procedures:

1. Clean medical gas pipe and pipe fittings, valves, gages, and other components of oil, grease, and other readily oxidizable materials as required for oxygen service, according to CGA G-4.1, "Cleaning Equipment for Oxygen Service."
2. Wash medical gas piping and components in hot, alkaline cleaner-water solution of sodium carbonate or trisodium phosphate in proportion of 1 lb (0.453 kg) of chemical to 3 gal. (11.3 L) of water.

    a. Scrub to ensure complete cleaning.
    b. Rinse with clean, hot water after washing to remove cleaning solution.

3.2 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit and not less than 4 inches (100 mm) high.

B. Refer to Section 03300 , for reinforcement, framing, and concrete materials for 4000-psig (27.6-MPa), 28-day compressive strength.

3.3 PIPING APPLICATIONS

A. General: Refer to Part 2 of this Section for the following materials:

1. Interior, Medical Gas Piping: Use precleaned, hard copper tube with wrought-copper fittings and brazed joints.
2. Exterior, Buried Medical Gas Piping: Use soft copper tube with wrought-copper fittings and brazed joints.
3. Underground, Protective Conduit: Use Schedule 80 PVC plastic pipe, Schedule 80 PVC plastic threaded pipe fittings, and threaded joints; or Schedule 80 PVC plastic socket-type pipe fittings, and solvent cement joints.

3.4 SERVICE ENTRANCES

A. Extend piping and connect to bulk storage tanks and exterior manifolds, of sizes and in locations indicated for service entrances to building.

B. Install sleeve and mechanical sleeve seal at penetrations through foundation wall for watertight installation.

3.5 PIPING INSTALLATION, GENERAL

A. Refer to Section 15050 ; for basic piping installation.

B. Install supports and anchors according to Section "Hangers and Supports."

1. Spacing between Hangers: As described in NFPA 99 and NFPA 99C.

C. Install emergency oxygen connection assembly with pressure relief valve and full-size discharge piping to outside, with check valve downstream from pressure relief valve, and with ball valve and check valve in supply main from bulk oxygen storage tank.

D. Valve Applications: Use ball valves specified in this Section for main shutoff and zone valve duties.

E. Install zone valves in valve box anchored to structure. Install valves at angle that prevents closure of cover when valve is in closed position. Single boxes may be used for multiple valves that serve same area or function.

F. Install thermometers and pressure gages according to Section 15122.

G. Install exterior, buried medical gas piping in protective conduit fabricated with PVC pipe and fittings. Do not extend conduit through foundation wall.

H. Purging: Purge medical gas piping using oil-free, dry nitrogen after installing piping but before connecting to service-outlet valves, alarms, and gages.

3.6 JOINT CONSTRUCTION

A. Refer to Section 15050 for basic piping joint construction.

3.7 SPECIALTIES INSTALLATION

A. Install specialties according to NFPA 99 and manufacturer's written instructions.

B. Install manifolds firmly anchored to substrate and with seismic controls as indicated.

C. Install ceiling-mounting service units firmly anchored to substrate according to manufacturer's written instructions. Provide structural steel, hanger rods, anchors, and fasteners, in addition to components furnished with specialties necessary to fabricate supports.

3.8 MEDICAL GAS ALARM SYSTEM INSTALLATION

A. General: Install alarm system components according to NFPA 99 and manufacturer's written instructions.

B. Install alarm panels in locations indicated.

3.9 BULK GAS STORAGE TANK INSTALLATION

A. Install gas storage tanks and reserve supply tanks on concrete bases. Set tanks and connect medical gas piping to tanks according to NFPA 50, NFPA 99, and manufacturers' written instructions.

B. Install gas storage tanks plumb and level, firmly anchored, in locations indicated, and maintain NFPA 50 and tank manufacturer's recommended clearances. Orient so controls and devices that need servicing are accessible.

C. Install gas storage tanks firmly anchored and with seismic controls as indicated.

3.10 CONNECTIONS

A. Install piping next to equipment to allow service and maintenance.

B. Connect medical gas piping to bulk storage tanks with unions. Install with ball valves and strainers where required.

C. Connect medical gas piping to equipment, gas manifolds, and accessories with unions. Install with ball valves and strainers.

1. Install flexible pipe connectors on air piping connections to air compressors, vacuum piping connections to vacuum units, and where indicated.
2. Install thermometers on air-compressor discharge piping, air receiver tanks, vacuum receiver tanks, and where indicated.
3. Install pressure gages on air-compressor discharge piping, air receiver tanks, vacuum receiver tanks, and where indicated.
4. Install pressure regulators downstream from air compressors, dryers, purification units, and filter assemblies.

D. Connect water piping to water-cooled units with union and reduced-pressure-zone-type backflow-preventer assembly having strainer, gate valves, and air-gap fitting for indirect waste. Connect cooler unit drains with union and ball valves, and discharge over closest floor drain.

1. Where water piping connections are of dissimilar metals, make connections with dielectric fittings or dielectric unions.

E. Install safety valves on bulk gas storage tanks.

F. Install medical gas piping and electrical connections to medical gas alarm system components.

G. Arrange for electric-power connections to specialties and devices that require power. Electric power, wiring, and disconnect switches are specified in Division 16 Sections.

3.11 LABELING AND IDENTIFICATION

A. Install labeling on valves, valve-box covers, and alarm panels according to requirements of NFPA 99.

B. Refer to Section 15050 for labeling and identification materials.

C. Captions and Color Coding: Use the following or similar medical gas captions and color coding for specialties, when specified and where required by NFPA 99:

1. Oxygen: White letters on green background.
2. Medical Air: Black or white letters on yellow background.
3. Medical Vacuum: Black letters on white background.
4. Nitrous Oxide: White letters on blue background.
5. Evacuation: Black letters on white background or white letters on purple background.

D. Label medical gas systems operating at other than standard pressure with system operating pressure.

E. Install continuous underground warning tape during backfilling of trench for underground medical gas piping.

F. Refer to Section "Earthwork" for warning tapes.

3.12 FIELD QUALITY CONTROL

A. Pressure Test: Subject each piping section of each system, except high-pressure air and nitrogen, to test pressure of from 150 to 200 psig (1035 to 1380 kPa) and high-pressure air and nitrogen systems to test pressure of 250 psig (1725 kPa) with oil-free, dry nitrogen before attaching system components, after installing station outlets with test caps (when supplied) in place, and before concealing piping system. Maintain test until joints are examined for leaks by means of soapy water.

B. Standing-Pressure Test: Install assembled system components after testing individual systems as specified above. Subject systems to 24-hour standing-pressure test at 20 percent above normal line pressure, but not less than 66 psig (455 kPa). Subject vacuum and evacuation systems to 12- to 18-in. Hg (40- to 61-kPa) minimum vacuum instead of pressure test.

C. Repair leaks, replace damaged components with new materials, and retest system until satisfactory results are obtained.

D. Inspect, test, and certify complete medical gas systems according to requirements of NFPA 99. Inspect, test, and certify each medical gas system, including each piping system, outlets and inlets, accessories, alarm panels and devices, safety devices, medical gas sources, and equipment.

1. Bulk Oxygen Systems: Comply with NFPA 50.

E. Provide oil-free, dry nitrogen; materials; equipment; and labor required for testing.

F. Provide medical gases required for testing systems.

G. Prepare written reports of tests results, including corrective action.

H. Certify that medical gas systems comply with requirements specified, that tests were properly performed, and that test results were satisfactory.

I. Inspect outlets and inlets, gages, alarms, and zone valves for proper labeling for gas service and function.

J. Inspect manifold supply systems for installation and operation as required by NFPA 99, Chapter 4.

K. Inspect bulk oxygen supply systems for installation and operation as required by NFPA 50.

L. Phase I Tests: Perform the following tests using oil-free, dry nitrogen after installing gas systems but before connecting new systems to existing gas sources:

1. Outlet and Inlet Cross-Connection Test: Pressurize one medical gas system to 50 psig (345 kPa), with other systems at atmospheric pressure, and access each outlet with appropriate adapter and test gage. Repeat procedure for each system.
2. Alarm System Test: Test for operation of functions specified in "Medical Gas Alarm Systems" Article within limits required.
3. Pressure Test: Test systems at operational pressure with system components installed. No leaks are allowed. Conduct tests by zone.
4. Particulate Sampling: Test positive-pressure terminal outlets, using 0.45-micron filter, for evidence of solid particulate contamination. Allowable limit is 2 mg/cu. m.
5. Moisture: Test positive-pressure terminal outlets for dew point to verify absence of moisture in piping. Dew point of gas dispensed from terminal outlets shall not exceed dew point of source test gas by more than 4 deg F (2.2 deg C).
6. System Purity: Test terminal outlets and gas source for contaminant levels as defined below. Excessive contaminant levels will require additional purging to outlets within specific zone until levels are within the following limits:

    a. Total Hydrocarbons as Methane: One ppm.
    b. Halogenated Hydrocarbons: 2 ppm.
    c. Carbon Monoxide: 2 ppm.

7. Air-Compressor Purity: Collect medical air-compressor air samples taken from downstream side of filters and air dryers. Test samples for contaminants and moisture within the following limits:

    a. Total Hydrocarbons as Methane: 25 ppm.
    b. Halogenated Hydrocarbons: 5 ppm.
    c. Carbon Monoxide: 10 ppm.
    d. Moisture, Dew Point: Plus 40 deg F (4.4 deg C) at dryer discharge.

M. Phase II Tests: After Phase I testing has been completed, test completed medical gas systems using applicable medical gas for each system. Completed systems have outlets and inlets, alarms, and gages installed; and gas supply systems are installed and ready for operation.

1. Final Purging: Introduce applicable medical gas for each system into respective piping systems. Purge installed outlet valves to remove nitrogen test gas present from Phase I testing. Test vacuum inlets for ability to flow.

2. Outflow Analysis: Analyze medical gas at positive-pressure outlets to confirm delivery of proper medical gas at proper concentration level. Minimum allowable concentration levels are defined by U.S. Pharmacopeia's USP-NF and the following CGA Commodity Specifications:

    a. CGA G-4.3, "Commodity Specification for Oxygen."
    b. CGA G-6.2, "Commodity Specification for Carbon Dioxide."
    c. CGA G-7.1, "Commodity Specification for Air."
    d. CGA G-8.2, "Commodity Specification for Nitrous Oxide."
    e. CGA G-10.1, "Commodity Specification for Nitrogen."

3. System Delivery Pressures: Test pressure piping systems to confirm supply sources are set to deliver gas at the following nominal pressure levels:

   a. All Systems, except Nitrogen and High-Pressure Air: 50 to 55 psig (345 to 380 kPa) at maximum flow.
   b. Nitrogen and High-Pressure Air: 180 psig (1240 kPa) minimum at maximum flow.

4. System Suction Levels: Test vacuum and evacuation piping systems to confirm that vacuum producers are set to maintain suction of not less than 12 in. Hg (40 kPa) at most distant inlets.

N. Testing Agency Certification: Certify that specified inspection, tests, and procedures have been performed and report results. Include the following:

1. Inspections performed.
2. Procedures, materials, and gases used.
3. Test methods used.
4. Results of tests.

3.13 COMMISSIONING

A. Startup Services: Engage a factory-authorized service representative to inspect alarm system installation and to provide startup service.

1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment discovered by service representative.

B. Perform the following final checks before startup:

1. Verify that specified tests of piping are complete.
2. Check safety valves for correct settings. Ensure settings are greater than air-compressor discharge pressure, but not greater than rating of system components.

3.14 DEMONSTRATION

A. Startup Services: Engage a factory-authorized service representative to demonstrate procedures for alarm system startup and shutdown, preventive maintenance and servicing, and troubleshooting. Review operating and maintenance information.

B. Provide written notice 7 days in advance of demonstration.

END OF SECTION

SECTION 15480
FIRESTOPPING SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Closures of openings in walls, floors, and roof decks against penetration of flame, heat, and smoke or gases in fire resistant rated construction.

B. Closure of openings in walls against penetration of gases or smoke in smoke partitions.

1.2 RELATED WORK

A. Section 01340 - Samples and Shop Drawings.

B. Section 15840 - Ductwork and Accessories: Fire and smoke damper assembles in ductwork.

C. Section 3 Part 9- Adhesives, Caulking, Sealants and Fasteners.

1.3 SUBMITTALS

A. Submit in accordance with Section 01340. All submittals shall be certified approved by the manufacturer's representative prior to submission to the Consultant.

B. Manufacturers literature, data, and installation instructions for types of firestopping and smoke stopping used.

C. List of FM, UL, or WH classification number of systems installed.

D. Certified laboratory test reports for ASTM E814 tests for systems not listed by FM, UL, or WH proposed for use.

1.4 DELIVERY AND STORAGE

A. Deliver materials in their original unopened containers with manufacturer's name and product identification.

B. Store in a location providing protection from damage and exposure to the elements.

1.5 GUARANTEE

Firestopping work subject to the terms of the Article GUARANTY of Section GENERAL CONDITIONS, except extend the guaranty period to five years.

1.6 QUALITY ASSURANCE

FM. UL, or WH or other approved laboratory tested products will be acceptable.

1.7 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM):

E84 - Surface Burning Characteristics of Building Materials
E814 - Fire Tests of Through-Penetration Fire Stops

C. Factory Mutual Engineering and Research Corporation (FM):

Annual Issue Approval Guide Building Materials

D. Underwriters Laboratories, Inc. (UL):

1479 - Fire Tests of Through - Penetration Firestops

Annual Issue Building Materials Directory
Annual Issue Fire Resistance Directory

E. Warnock Hersey (WH):

Annual Issue Certification Listings

PART 2 – PRODUCTS

2.1 FIRESTOP SYSTEMS

A. Use either factory built Firestop Devices or field erected through-Penetration Firestop Systems to form a specific building system maintaining required integrity of the fire barrier and stop the passage of gases of smoke.

B. Through-Penetration firestop systems and firestop devices tested in accordance with ASTM E814 or UL 1479 using the “F” or “T” rating to maintain the same rating and integrity as the fire barrier being sealed. “T” ratings are not required for penetrations smaller than or equal to 100 mm (4 in) nominal pipe or 0.01 m² (16 sq.in) in overall cross sectional area.

C. Products requiring heat activation to seal an opening by its intumescence shall exhibit a demonstrated ability to function as designed to maintain the fire barrier.

D. Firestop sealants used for firestopping or smoke sealing shall have following properties:

1. Contain no flammable or toxic solvents.
2. Have no dangerous or flammable outgassing during the drying or curing of products.
3. Water-resistant after drying or curing and unaffected by high humidity, condensation or transient water exposure.
4. When used in exposed areas, shall be capable of being sanded and finished with similar surface treatments as used on the surrounding wall or floor surface.

E. Firestopping system or devices used for penetrations by glass pipe, plastic pipe or conduits, unenclosed cables, or other non-metallic materials shall have following properties:

1. Classified for used with the particular type of penetrating material used.
2. Penetrations containing loose electrical cables, computer data cabl,es and communications cables protected using firestopping systems that allow unrestricted cable changes without damage to the seal.
3. Intumescent products which would expand to seal the opening and act as fire, smoke, toxic fumes, and, water sealant.

F. Maximum flame spread of 25 and smoke development of 50 when tested in accordance with ASTM E84.

G. FM, UL, or WH rated or tested by an approved laboratory in accordance with ASTM E814.

H. Materials to be asbestos free.

2.2 SMOKE STOPPING IN SMOKE PARTITIONS

A. Use silicone sealant in smoke partitions as specified in Section 3 Part 9.

B. Use mineral fiber filler and bond breaker behind sealant.

C. Sealants shall have a maximum flame spread of 25 and smoke developed of 50 when tested in accordance with E84.

D. When used in exposed areas capable of being sanded and finished with similar surface treatments as used on the surrounding wall or floor surface.

PART 3 – EXECUTION

3.1 EXAMINATION

Submit product data and installation instructions, as required by article, submittals, after an on site examination of areas to receive firestopping.

3.2 PREPARATION

A. Remove dirt, grease, oil, loose materials, or other substances that prevent adherence and bonding or application of the firestopping or smoke stopping materials.

B. Remove insulation on insulated pipe for a distance of 150 mm (six inches) on either side of the fire rated assembly prior to applying the firestopping materials unless the firestopping materials are tested and approved for use on insulated pipes.

3.3 INSTALLATION

A. Do not begin work until the specified material data and installation instructions of the proposed firestopping systems have been submitted and approved.

B. Install firestopping systems with smoke stopping in accordance with FM, UL, WH, or other approved system details and installation instructions.

C. Install smoke stopping seals in smoke partitions.

3.4 CLEAN-UP AND ACCEPTANCE OF WORK

A. As work on each floor is completed, remove materials, litter, and debris.

B. Do not move materials and equipment to the next-scheduled work area until completed work is inspected and accepted by the Resident Engineer.

C. Clean up spills of liquid type materials.

D. Contractor’s Installation of all firestopping materials and products shall be closely supervised by manufacturer’s representative.

E. Regular inspection shall be done by the manufacturer's representative to ascertain that the works are being done according to the design intent. A copy of the inspection report with all its findings and recommendations including the corrective works implemented shall be forwarded to the Consultant on regular basis.

END OF SECTION