PART I - GENERAL

1.01 CONDITIONS OF THE CONTRACT

A. The Conditions of the Contract (General, Supplementary, and other Conditions) and the General Requirements (Sections of Division 1) are hereby made a part of this Section.

B. Division-15 Basic Mechanical Materials and Methods sections apply to work of this section.

1.02 WORK INCLUDED

A. Extent of medical gas systems is indicated on Drawings and by requirements of this section.

1.03 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of medical gas systems and products, of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with piping systems work similar to that required for project.

1. The Contractor must provide documentation to prove recent extensive experience in the piping of medical gas systems in hospital and medical facilities and current medical gas/vacuum brazing and installers certificate. The Contractor must certify in writing that all craftsperson's who will be assigned to the job will be experienced and qualified in the installation of medical gas systems. Craftsperson so designated will be listed by name, and only persons so listed will be permitted to work on the job.

2. Installer shall be certified yearly by the National Inspection Testing Certification (N.I.T.C.), or agency having equal standards to N.I.T.C.

3. Show current brazing and installation certifications upon request.

4. Certification shall be copied and provided to University's Representative to be kept on file by University's Plant Operations and Maintenance Plumbing Supervisor for duration of the job.

C. Codes and Standards:


1.04 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for medical gas piping systems materials and products.
B. Record Drawings: At project closeout, submit Record Drawings of installed systems piping and piping products, in accordance with requirements of Division 1.

C. Maintenance Data: Submit maintenance data and parts lists for medical gas piping systems materials and products. Include this data, product data, Shop Drawings, and Record Drawings in maintenance manual in accordance with requirements of Division 1.

1.05 JOB CONDITIONS

A. Cooperation with Other Trades: Coordinate the work of this section with that of other sections to ensure that the work will be carried out in an orderly fashion. It shall be this Contractor's responsibility to check the contract documents for possible conflicts between his work and that of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers, and structural and architectural features.

PART II - PRODUCTS

2.01 MATERIALS

A. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Provide materials and products complying with NFPA 99.

2.02 BASIC PIPES AND PIPE FITTINGS

A. Provide pipes and pipe fittings complying with Division-15 Mechanical Materials and Methods section "Pipes and Pipe Fittings," and NFPA 99 for the following systems:

1. Oxygen
2. Vacuum
3. Nitrous Oxide
4. Medical Compressed Air Piping

B. Medical gas copper piping shall be hard-drawn seamless medical gas tube, type K or L (ASTM B819), and bear one of the following markings: OXY, MED, OXY/MED, ACR/OXY, or ACR/MED. Mains and branches in piping systems shall be not less that ¾” nominal size. Runouts to area alarm panels shall be permitted to be ⅜” nominal size. All medical gas-medical vacuum pipes and fittings to be ACR cleaned and bagged when received at project site. All medical gas-medical vacuum pipes to be factory capped (sealed) when received at project site. These materials shall be protected from adverse weather and site conditions at all times.

C. All medical oxygen and medical nitrous oxide pipe shall be protected in galvanized EMT schedule 40 conduit sleeves when installed in walls. Top and bottom of sleeves shall be notched allowing sleeves to extend beyond heel of pipe elbows. Install Trisolator bushings at top and bottom of piping, or completely tape wrap piping, within conduit to provide separation between pipe and conduit.
2.03 BASIC PIPING SPECIALTIES

A. Provide piping specialties complying with Division – 15 Basic Mechanical Materials and Methods section, in accordance with the following listing:

1. Pipe escutcheons
2. Fire barrier penetration seals
3. Pipe sleeves

2.04 MEDICAL GASES AND VACUUM SYSTEM ACCESSORIES

A. Shut-Off Valves: Nellcor Puritan Bennett, Medase, Amico, or equal dual port, ball type, 600 lb. rating, solder type connection suitable for brazing. Valves shall have Teflon ball seats and stem seals. Valve levers shall have system service labeled on handle and tags provided identifying area served. Provide brass flanges for pipe connections to valves as required.

1. For oxygen, nitrous oxide, and medical air, valves shall be cleaned, dehydrated, and sealed.
2. All shutoff valves to be located outside of patient rooms and critical rooms.

B. Zone Valves: Nellcor Puritan Bennett 1403, pipe size as shown. Install at 5'-0" above finished floor to centerline.

C. Valve Boxes: Nellcor Puritan Bennett 1403, flush type, constructed of 18 Gauge steel with a white enamel finish, and anodized aluminum trim. Box shall be of size required to house system zone valves as indicated on the plans. Valve box shall have zone valve support brackets. Each zone valve box shall have a pull-ring type, frangible, clear plastic cover. Install at 5'-0" above finished floor to centerline of assembly. The shut-off boxes shall have a wall sign stating the area affected by the valves.

D. Local Alarm Panels: Nellcor Puritan Bennett 6-1292 or Amico, with power supply module, digital module, sensor module, and computer interface relay module to communicate with universities building management system. Connect to medical gas lines as required on downstream side of zone control valve. Install at 5'-0" above finished floor to centerline. Arrange audible alarms for automatic resetting.

1. Alarm panels shall be Nellcor Puritan Bennett or Amico, recessed stations located where directed. Provide gauges, red and green LED's and annunciators to indicate high line pressure, low line pressure, and test.

E. Vacuum, Scavenger, and Medical Gas Wall Outlets:

1. Nellcor Puritan Bennett, flush-type medical service outlets. Outlets shall be Quick-Connect Series B. Outlets shall have a rough-in box designated for wall construction at the location indicated on the Drawings. Multiple outlets of different services shall be ganged. Install at height indicated on architectural drawings.

   a. Coverplates shall have outlet service identification in raised letters.

   b. Provide slide and all required accessories for vacuum system support.
F. Medical Gas Ceiling Outlets:

1. Nellcor Puritan Bennett, Flush-Type medical service outlets. Outlets shall be DISS (Diameter-Index Safety System) and shall have a rough in box designated for ceiling construction at the location indicated on the drawings. Multiple outlets of different services shall be ganged.

2. Cover plates shall have outlet service identification in raised letters.

G. Available Manufacturers: Subject to compliance with requirements, manufacturers offering medical gas system accessories which may be incorporated in the work include the following:

1. Nellcor Puritan Bennett, to match existing.

PART III - EXECUTION

3.01 INSTALLATION AND CONNECTION OF SERVICES

A. Furnish, install, and test complete piping systems, including pipe, fittings, valves, outlets, alarm systems, and central supply manifold, all as indicated in the plans and specifications. The systems shall be complete in every respect and ready to be put into operation. Materials used shall be new and of the best grade and quality obtainable, and the workmanship shall be first class in every respect. The recommendations of the National Fire Protection Association (NFPA) as set forth in Pamphlet No. 99 as they may apply to this installation; and all University's requirements shall be strictly adhered to.

B. All pipe and fittings shall be cleaned and bagged for “medical gas service” by the manufacturer (contractor to verify that such process has been done and submit written certification of compliance with process). Any piping systems that have been contaminated and require cleaning on the job site shall be thoroughly cleansed of oil, grease, or other combustible materials by washing in a hot solution of sodium carbonate or trisodium phosphate mixed in the proportions of one pound to three gallons of water. The use of organic solvents, for example, carbon tetrachloride, is prohibited.

C. Scrubbing and continuous agitation of the parts shall be employed where necessary to remove all deposits and to ensure complete cleansing. After washing, all materials shall be rinsed thoroughly with clean, hot water. Pipe and fittings shall be temporarily bagged, capped, or plugged to prevent recontamination before final assembly.

D. After cleansing, great care must be exercised in the storage and handling of all materials and in the condition of tools used in cutting to prevent oil or grease being introduced into the tubing. Where such contamination is known to have occurred, the materials affected must be rewashed and rinsed.

3.02 PIPE JOINTS AND CONNECTIONS

A. All joints in the pipe and tubing, except those at equipment requiring screwed connections, shall be made with wrought copper fittings – med gas grade.

B. Suitable adapters shall be employed for the installation of equipment provided with threaded connections. All brazed connections shall be made with the type of brazing, alloy, and flux specified in this section.
C. Purge piping of air with oil-free medical grade NF nitrogen during brazing operations. Maintain a constant flow rate of nitrogen through piping. Use a regulator/flowmeter to ensure even gas flow during brazing operations.

1. Stub a 2' length of ½" diameter pipe to fitting during brazing to ensure adequate concentration of nitrogen gas in heated area.

D. Screwed Connections: A thin paste of litharge and glycerin shall be applied to the external threads only. Leave first thread clean. Use of excess glycerin shall be avoided.

E. Bends: All changes in direction shall be made by wrought copper fittings.

F. After erection of pipe and tubing, but prior to the installation of the service outlet valves, the system shall be blown clear of free moisture and foreign matter by means of cylinder water-pumped nitrogen.

G. After installing service outlet valves, each gas system shall be subjected to the test pressures required by NFPA 99 for "Initial Pressure Test". The test pressure shall be maintained until each joint has been thoroughly examined for leaks by means of soapsuds. (The soap solution should be mixed in the following proportions: One ounce of castile or palm soap, 8 ounces of water, and 4 ounces of glycerin. Dissolve the soap in the water, then add the glycerin and mix thoroughly.) Wipe joints clean after test.

H. All new sections of all piping systems shall be tested in accordance with NFPA Code requirements.

I. All leaks shall be properly repaired and the system retested.

J. Final Test: Provide 24-hour standing pressure test using the same test pressures and media required per NFPA 99 to check the completeness of prior joint pressure tests.

K. Particular care must be exercised to assure that all nitrogen is flushed out of the piping with gas to be used before placing each system in service.

L. A visual inspection of each brazed joint is required to make sure that the alloy has flowed completely in and around the joint and that hardened filler metal has not formed a temporary seal which holds test pressure. Remove all excess filler metal for clear visual inspection of brazed connections. All leaks shall be repaired and the section retested. During construction, the Contractor shall be required to cut out several brazed fittings for inspection. Fittings cut out for inspection shall be replaced by the Contractor at no additional cost. Poor workmanship in the brazing of the inspected fittings shall be cause for replacement of all brazed fittings in that system depending on the apparent scope of the problem.

M. Purging: After completion of each system, purge system of air at each outlet in progressive order from the central gas supply.

N. Final Connection:

1. Extend oxygen pipe to the connection point for shown on the drawings, and provide threaded capped connection for connection by oxygen vendor.

2. Extend vacuum piping medical compressed air piping, nitrous oxide piping, and nitrogen piping as indicated on Drawings, and make final connection to the equipment as directed by manufacturer.
O. Cross-Connection Test: The University shall arrange for all piping systems to be tested against cross-connection by a responsible third party testing agency to the requirements of NFPA 99 after all "installer Performance Tests required have been performed.

P. Final testing, purging, and analyzing shall be performed to the requirements of NFPA 99.

Q. Permanent Record of Tests: Prior to use of any medical gas piping system, the Contractor shall assure the responsible authority of the facility that all tests required by NFPA 99 have been successfully conducted and permanent records of the tests maintained. These records shall be turned over to the University upon completion of the job.

R. Identify gas content of pipeline by appropriate labeling with the name of the gas contained. Such labeling shall be by means of metal tags, stenciling, stamping, or with adhesive markers, in a manner that is not readily removable. Such labeling shall appear on the pipe every 10’ and in at least one place in each room.

3.03 ADJUSTMENTS AND TESTS

A. All testing of medical gas systems shall be commissioned in accordance with specification sections 01660 and 01400. This contractor shall be responsible for coordination with testing agency. The "Medical Gas Test Report" located at the end of this section shall be filled-out and submitted upon completion of all testing procedures.

B. Piping Leak Tests:

1. All medical gas piping systems shall be tested in accordance with NFPA 99 and the requirements of this section. Do not interconnect medical gas lines at any time. Test each system separately.

3.04 TRAINING

A. Provide a minimum of 4 hours of training and orientation of University's operating staff in proper care and operation of equipment, systems and controls.

3.05 CARE AND CLEANING

A. Repair or replace broken, damaged, or otherwise defective parts, materials, and work. Leave entire work in condition satisfactory to University Representative. At completion, carefully clean and adjust equipment, fixtures and trim that are installed as part of this work. Leave systems and equipment in satisfactory operating condition.
### Plant Operations and Maintenance

**Medical Gas Test Report**

QA Plumbing Inspector ______________________   Date _____/_____/_____

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Comments: ______________________________________________________

_____________________________________________________________

Testing Agency _______________________________ Contractor _______________________

Testers Name (s) ______________________________ IOR ___________________________

#### NFPA 99 Test Requirements

**3.06 Inspector-Contractor**

1. Pressure Test (initial) 4-5.1.2.1
2. Blowdown Test 4.5.1.2.2
3. Pressure Test 4-5.1.2.3
4. Piping Purge 4-5.1.2.4
5. Cross Connection Test 4-5.1.2.5

**3.08 Vacuum Testing**

A. Testing 4-10.1.2B
B. Inspection of vacuum Systems 4-10.1.2.1
C. Leakage Tests 4-10.1.2.2
D. Standing Press Test 4-10.1.2.3
E. Cross Connection 4-10.1.2.4
F. Vac Sys Alarm Test 4-10.1.2.6

END OF SECTION 15495