

Element D Services

Plumbing

D2060 Medical Vacuum and Gas Systems

PART 1 - GENERAL

1.01 OVERVIEW

- A. This section addresses medical vacuum, waste anesthetic gas disposal, compressed air, oxygen, nitrous oxide, nitrogen and carbon dioxide systems.

PART 2 - DESIGN CRITERIA

2.01 GENERAL

- A. Medical vacuum and gas systems shall be designed in accordance with current editions of AIA Guidelines for Design and Construction of Hospitals and Healthcare Facilities, NFPA 55, NFPA 99 and Compressed Gas Association Standards.
- B. Obtain all necessary information that is required from the Owner when determining system design and types of services.
- C. A proposed system design in either diagrammatic or narrative form shall be submitted to the designated Owner's representative during the schematic phase of the Project.
- D. Review the location, quantity and type of medical gas outlets, inlets and alarm panels with Owner's user groups during the design development phase of the Project.
- E. Medical vacuum and gas systems serving patients shall be independent of all other vacuum and gas systems serving laboratory, research and/or animal areas.
- F. Medical compressed air systems serving patients shall not be used to serve non-respiratory equipment, such as sterilizers, pneumatic doors, operating room service columns, etc.
- G. Design medical gas and vacuum systems to deliver the following nominal pressures at the points of use: All pressure systems, except nitrogen shall be 50 to 55 psig at maximum flow; Nitrogen shall be 160 to 185 psig at maximum flow; Vacuum shall be 15 to 19 inches Hg at most distant inlets.
- H. Coordinate the requirement for the use of ventilators with the Owner's user groups. Design the oxygen and medical air systems to accommodate required flow demands.
- I. Include waste anesthetic gas disposal (WAGD) terminal inlets and piping in appropriate projects. The source for WAGD inlets shall connect to the medical vacuum system piping above the ceiling and downstream of the zone valve box serving the individual room where the inlets are to be located.
- J. Provide at least one nitrogen control panel (NCP) within rooms containing nitrogen station outlets. Coordinate with Owner's users to determine quantity and location.

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- K. Locate station inlets and outlets at an appropriate height to prevent physical damage to attached equipment and accessories. Station inlets and outlets located above countertops shall be provided with sufficient space to allow usage and attachment of equipment without interferences by countertop, backsplash or overhead cabinets. All other station inlets and outlets having centerline located less than 60 inches above finished floor shall be protected by guardrails, recessing into walls or by other means approved by Owner.
- L. Provide sufficient spacing between station inlets and outlets to allow simultaneous use with vacuum collection bottles, regulators, adaptors or any other equipment attached. Provide slide retainer bracket for collection bottle attachment adjacent to each vacuum station inlet.
- M. Ensure that all medical vacuum and gas source equipment and alarm systems are provided with both normal and emergency electrical power supply.

2.02 CENTRAL SUPPLY SYSTEMS

- A. Locate medical air compressors and vacuum pumps in a dedicated mechanical room in accordance with NFPA 99. Mechanical room shall provide a clean, relatively cool environment (i.e., not to exceed 100 degrees F ambient temperature). Equipment shall be located with adequate access space for regular monitoring and servicing. Provide floor drain adjacent to equipment pads. Floor drains serving vacuum pumps shall be provided with smooth, acid resistant interior coating. Provide a hose bib within mechanical room.
- B. Locate the medical air compressor system intake outdoors above roof level, at least 25 feet (may require more depending upon prevailing wind direction and velocity) from all exhausts, vents, vacuum system discharges or any anticipated source of odor or particulate matter. Air that is filtered for breathable ventilation system use may be considered an acceptable source of intake air when approved by Owner's. Combined air intakes must be sized for no restriction while flowing the maximum intake possible, and shall be provided with an isolation valve at the header for each compressor served. Intake piping for air compressors shall be sized using the total SCFM for the system (both lead and lag pumps) and the total developed length of run. Coordinate with air compressor system technical representative and verify that proposed sizing of intake piping complies with manufacturer's recommendations.
- C. Terminate medical vacuum exhaust discharge outdoors above roof level, at least 25 feet horizontally (may be more depending upon prevailing wind direction and velocity) from all air intakes, doors, windows, louvers or any other building openings. Combine exhaust from each medical vacuum pump into one discharge pipe, sized for no restriction while flowing maximum discharge possible, and shall be provide with an isolation valve at the header for each pump served. Exhaust piping for vacuum pumps shall be sized using the total SCFM for the system (both lead and lag pumps) and the total developed length of run. Exhaust piping shall be sized and arranged to prevent moisture and back-pressure from entering pump. Provide valved drip-leg at base of exhaust stacks. Coordinate with vacuum pump system technical representative and verify that proposed sizing of exhaust piping complies with manufacturer's recommendations.
- D. Medical air compressors and vacuum pumps shall be multiplexed with receiver tanks and sized such that 100 percent of the design load is carried with the largest single unit out of

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service. Increase the calculated (SCFM) load by 25 percent to accommodate future system expansion.

- E. In designing a medical air system where ventilators are expected to be utilized, add the ventilator requirement of 200 L/min (7 SCFM) for each ventilator in use to the compressor sizing.
- F. Design air dryers, filters and pressure regulators for the medical air system in duplex, each sized for 100 percent of the load using duplex twin tower desiccant dryers. Include continuous line dewpoint and carbon monoxide monitoring with sample connections on the discharge piping downstream of the filters and regulators. Locate monitors at, or integral with, the control panel.
- G. Provide sufficiently sized, properly ventilated and constructed room for medical gas cylinder storage and manifold systems in accordance with NFPA 99. Coordinate with the designated Owner's representative to determine space required for storage of additional non-manifolded cylinders. Gas cylinder storage rooms shall be located at ground level with at least one exterior wall and be provided with a minimum 42 inch door opening to the outside.
- H. Bulk liquid oxygen supply systems shall be designed and located in accordance with NFPA 55 and closely coordinated with the Owner and designated oxygen supplier. Provide emergency oxygen inlet on exterior wall of building served. Insure that location of inlet allows truck access and that concrete pavement is provided where truck will park during transfer of oxygen.

2.03 ALARM SYSTEMS

- A. To ensure continuous responsible observation, provide two master system alarms, in separate warning locations, for all medical vacuum and gas source equipment systems. Coordinate both master alarm panel locations with the user facility and the other design services. When deciding upon alarm locations, consider emergency power circuits, engineering control center data relay interface locations, and the facility's established procedures for monitoring alarm signals.
- B. The primary warning location shall be supervised by engineering personnel, and is required to be located at one of the following (in order of priority): Boiler plant control office, engineering control center, or in the office or principal working area of the individual responsible for the maintenance of the medical vacuum and gas systems. The secondary warning location shall be located to assure 24-hour constant surveillance. Suitable secondary warning locations may include monitoring services, fire command station, telephone switchboard (PBX), security office or other continuously staffed location.
- C. Building management systems must not be exclusively relied upon to monitor medical vacuum and gas alarms.
- D. Provide local area alarms for all branches serving medical vacuum and gas station outlets and inlets. Locate area alarms at nurse stations visible and accessible to staff for monitoring. All alarm sensor locations shall be in conformance with NFPA 99.

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2.04 PIPING SYSTEMS

- A. Design pressure piping systems, except nitrogen, not to exceed 35 kPa (5 psi) loss from source to point of use. Design nitrogen piping systems not to exceed 138 kPa (20 psi) loss from source to point of use. Design vacuum piping systems not to exceed 10 kPa (3 inches Hg) from source to point of use.
- B. Include ventilator demand in sizing calculations for oxygen and compressed air piping. Ventilator usage shall be based upon 200 L/min (7 SCFM) for each ventilator from the outlet back to the source.
- C. Design medical gas and vacuum piping systems based upon the following minimum flow rates for any pipe section: Oxygen – 200 L/min (7 SCFM); Medical Air – 200 L/min (7 SCFM); Vacuum – 85 L/min (3 SCFM); Nitrous Oxide – 28 L/min (1 SCFM); Carbon Dioxide – 28 L/min (1 SCFM); Nitrogen – 425 L/min (15 SCFM).
- D. Include a 25 percent calculated (SCFM) load for sizing distribution mains to accommodate future system expansion.
- E. Distribution piping shall be designed in accordance with the following minimum size parameters to allow for future expansion and minimize service interruptions during renovations:
 - 1. Pressure Gases
 - a. Branch lines and drops to individual outlets for the pressure gases shall be a minimum of $\frac{1}{2}$ inch.
 - b. Branch lines serving more than one room or zone valve shall be a minimum of $\frac{3}{4}$ inch.
 - c. Main lines and risers shall be no less than 1 inch.
 - 2. Vacuum
 - a. Branch lines and drops to individual vacuum inlets shall be a minimum of $\frac{3}{4}$ inch.
 - b. Branch lines serving more than one room or zone valve shall be a minimum of 1 inch.
 - c. Main lines and risers shall be no less than 1½ inches.
 - 3. Zone valves and associated piping within walls shall not be smaller than $\frac{3}{4}$ inch, except for zones valves and piping serving an individual room.
- F. Place a source shut-off valve for each medical vacuum and gas system at the immediate outlet (or inlet, in the case of vacuum) of the source of supply, so that the entire supply source, including all accessory equipment, can be isolated from the entire pipeline system. Provide each main line supply line with a shut-off valve. Locate valve accessible by authorized personnel only and locate downstream of the source valve and outside of the

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source room, enclosure, or where the main valve enters the building. Provide medical vacuum and gas

services with line pressure and vacuum gauges at the source (and immediately inside the building, where source is remote from building).

- G. Provide each riser supplied from the main line with an in-line shut-off valve located at the base of the riser. Provide each branch supplied from a riser with an in-line shut-off valve adjacent to the riser. Provide additional service valves in each branch line at point of connections to mains, in branch lines serving more than one zone valve box, and at other locations to strategically subdivide areas for maintenance. Conceal in-line service and shut-off valves at secure locations (e.g. above ceiling with ceiling tag, or in a locked equipment room), and specify that these valves be locked open and identified in accordance with NFPA 99.
- H. Provide zone valves within recessed wall cabinets for all branch piping serving station outlets and inlets. Locate zone valves in corridor, visible and accessible to staff for operation of valves. All zone valve locations shall be in conformance with NFPA 99.
- I. Strategically locate minimum ¾ inch valved and capped connections for future system expansion of medical vacuum and gas piping distribution systems. Extend capped connections minimum 18 inches from valves. Coordinate size and locations of future connections with Owner's Patient Care Facilities and Building Operations Management during the Design Development phase of the Project.

2.05 RENOVATION PROJECTS

- A. Survey current installation and coordinate with Owner's Patient Care Facilities and Building Operations Management to verify type, location, size and capacities of existing piping and source equipment for determining adequate tie-in points.
- B. Survey current installation to ascertain the type of existing alarms, medical gas station outlets and medical vacuum terminal inlets. All new alarms shall match and be compatible with the existing installation. All new outlets and inlets shall match the existing terminal connections and not require the use of secondary adapters. In cases where existing alarms, station outlets or terminal inlets are no longer available, not U.L. approved, or are not NFPA 99 compliant, the A/E shall coordinate with Owner to determine types to be specified within Contract Documents.
- C. Review the proposed alarm, outlet and inlet types, and connection locations to existing piping and alarms with Owner's Patient Care Facilities and Building Operations Management during the design development phase of the Project.
- D. Provide a shut-off valve at the connection of new line to existing line.

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PART 3 - SPECIAL CONTRACT DOCUMENT REQUIREMENTS

3.01 GENERAL

- A. Develop plans, schematic diagrams, schedules and details indicating all information required to clearly illustrate the intent of system design.
- B. Floor plans shall include, but not be limited to location, sizes and identification of all: Piping from source equipment or existing piping connections to terminals; intake and exhaust piping from source equipment to termination through roof or connection to existing piping; master and local alarm panels; alarm sensors; pressure gauges; relief valves; relief valve discharge terminals; zone valve wall cabinets; nitrogen control cabinets; in-line shut-off and service valves; future valved connections; source equipment; inlets, outlets and slides.
- C. Schematic diagrams shall include, but not be limited to identification and sizes of all: piping from source equipment or existing piping connections to zone valve cabinets; all intake and exhaust piping from source equipment to termination through roof or connection to existing piping; local alarm panels; alarm sensors; pressure gauges; zone valve wall cabinets; nitrogen control cabinets; in-line shut-off and service valves; future valved connections; source equipment.
- D. Actual calculated usage flows (not including percentages added for future expansion) shall be noted on schematic diagrams at source valves, where service enters the building (when source is remote from building), base of risers, floor branch connections to risers, branch connections to mains and at zone valve cabinets. Indicate maximum flows allowed at each future valved connection.
- E. Identify location of each zone valve cabinet, area alarm panel, and source equipment on schematic diagrams with room name and number.
- F. Bottom of pipe elevations shall be noted for piping at locations where close coordination is required to prevent conflicts with other systems and/or building components.
- G. Graphically identify each riser on plans and schematic diagrams. Riser identification on schematic diagrams shall correspond to riser identification on plans. Graphically indicate floor levels and floor elevations on schematic diagrams.
- H. Details shall be provided for roof penetrations, floor and wall penetrations, and all other components that require installation explanation beyond the information included within plans and schematic diagrams.
- I. Include schedules clearly identifying: Location, capacity, size, manufacturer, model, electrical characteristics, options and other pertinent information for all vacuum pump systems, air compressor systems and cylinder manifolds; Locations, services monitored and annunciation descriptions for master alarm panels; Outlet and inlet combinations and mounting heights above finished floor; Zone valve cabinet combinations and mounting heights above finished floor.

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PART 4 - PRODUCTS

4.01 GENERAL

- A. Refer to Owner's Master Construction Specifications. These are available on the Owner's Design Guidelines website: <http://www2.mdanderson.org/depts/cpm/standards/specs.html>
- B. System design and piping specified for renovation of existing facilities shall be compatible with existing installation.

PART 5 - DOCUMENT REVISION HISTORY

Issue	Date	Revision Description	Reviser

END OF ELEMENT D2060