Element D Services

Plumbing

D2065 Laboratory Vacuum and Gas Systems

PART 1 - GENERAL

1.01 OVERVIEW

A. This section addresses laboratory vacuum, compressed air, gaseous nitrogen, and carbon dioxide systems within and to five feet beyond building perimeter.

PART 2 - DESIGN CRITERIA

2.01 GENERAL

A. Laboratory vacuum and gas systems shall be designed in accordance with requirements stated herein and the current editions of NFPA 99, NFPA 45 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 laboratory gas outlets, inlets and alarm panels with Owner's user groups during the design development phase of the Project.

E. Vacuum and gas systems serving laboratory, research and/or animal areas shall be independent of vacuum and gas systems serving patients.

F. Laboratory compressed air systems shall not be used to serve utility equipment, such as pneumatic doors, HVAC controls, etc.

G. Design lab gas and vacuum systems to deliver the following nominal pressures at the points of use: All pressure systems shall be 45 to 50 psig at maximum flow; Vacuum shall be 19 inches Hg at most distant inlets.

H. 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.

I. 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 recessed wall type vacuum station inlet.

J. Ensure that all laboratory 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 laboratory 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 laboratory air compressor system intake outdoors above roof level. Air intake may extend through exterior wall and terminate below roof level when approved by Owner's. Air compressor system intake terminals shall be located 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 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 laboratory vacuum exhaust discharge outdoors above roof level. Exhaust may extend through exterior wall and terminate below roof level when approved by Owner's. Laboratory vacuum exhaust shall terminate 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 laboratory 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. Laboratory 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 service. Increase the calculated (SCFM) load by 25 percent to accommodate future system expansion.

E. Design air dryers, filters and pressure regulators for the laboratory 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.

F. Provide sufficiently sized, properly ventilated and constructed room for laboratory 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. Localized gas cylinder storage rooms may be provided at other locations within the building when approved by Owner.

2.03 ALARM SYSTEMS

A. To ensure continuous responsible observation, provide two master system alarms, in separate warning locations, for all laboratory vacuum and gas source equipment systems. Coordinate both master system alarm annunciator locations with the user facility and the other design deciplines. 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): Main equipment plant control office, engineering control center, or in the office or principal working area of the individual responsible for the maintenance of the laboratory vacuum and gas systems. The secondary warning location shall be located to assure 24-hour constant surveillance. Suitable secondary warning locations may include building automation system (BAS) station, telephone switchboard (PBX), security office or other continuously staffed location.

C. Building management systems must not be exclusively relied upon to monitor laboratory vacuum and gas alarms.

D. Provide high/low line pressure/vacuum sensors at most remote points from source equipment in each system. Status of remote monitoring points shall be annunciated at both master system alarm locations.

2.04 PIPING SYSTEMS

A. Design pressure piping systems not to exceed 35 kPa (5 psi) loss from source to point of use. Design vacuum piping systems not to exceed 10 kPa (3 inches Hg) loss from source to point of use.

B. Design laboratory gas and vacuum piping systems based upon the following simultaneous usage tables: Note: Minimum flow rates for any pipe section shall be: Laboratory Air – 57 L/min (2 SCFM); Vacuum – 85 L/min (3 SCFM); Carbon Dioxide – 57 L/min (2 SCFM); Nitrogen – 142 L/min (5 SCFM).

Laboratory Compressed Air Outlet Simultaneous Use Factors
(1 SCFM per inlet)

Quantity of Inlets	Use Factor %	Minimum SCFM
1 - 2	100	2

3 - 12	80	5
13 - 38	60	10
39 - 115	40	25
116 - 316	30	50
317 - 700	20	95

Laboratory Vacuum Inlet Simultaneous Use Factors (1 SCFM per inlet)

Quantity of Inlets	Use Factor %	Minimum SCFM
1 - 4	100	3
6 - 12	80	5
13 - 33	60	10
34 - 80	50	21
81 - 150	40	40
151 - 315	35	61
316 - 565	30	111
566 – 1,000	25	171
1001 – 2,175	20	251
2,176 – 4,670	15	436
4,671 and Above	10	701

Laboratory Carbon Dioxide Outlet Simultaneous Use Factors (1 SCFM per inlet)

Quantity of Inlets	Use Factor %	Minimum SCFM
1 - 2	100	2
3 - 12	80	5
13 - 38	60	10
39 - 115	40	25
116 - 316	30	50
317 - 700	20	95

Laboratory Gaseous Nitrogen Outlet Simultaneous Use Factors
(1 SCFM per inlet)

Quantity of Inlets	Use Factor %	Minimum SCFM
1 - 5	100	5
6 - 12	80	7
13 - 38	60	10
39 - 115	40	25
116 - 316	30	50
317 - 700	20	95

C. Include a 25 percent calculated (SCFM) load for sizing distribution mains to accommodate future system expansion.

D. To allow for future expansion and renovations without replacing piping; branches and drops to individual outlets for the pressure gases shall be a minimum of ½ inch, sub-mains shall be a minimum of ¾ inches in size and main lines shall be no less than 1 inch. Branches and drops to individual vacuum inlets shall be a minimum of ¾ inches, sub-mains shall be a minimum of 1 inch in size and main lines shall be no less than 1½ inches. Zone valves and associated piping within walls shall not be smaller than ¾ inch except for zones valves and piping serving individual rooms.

E. Place a source shut-off valve for each laboratory 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 source room, enclosure, or where the main valve enters the building. Provide laboratory vacuum and gas services with line pressure and vacuum gauges at the source (and immediately inside the building, where source is remote from building).

F. 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, 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.

G. Provide zone valves for all branch piping serving individual laboratory rooms. Locate zone valves above ceiling in corridor immediately outside of room and accessible to staff for servicing and operation.

H. Strategically locate minimum ¾ inch valved and capped connections for future system expansion of laboratory vacuum and gas piping distribution systems. Extend capped connections minimum 18 inches from valves. Coordinate size and locations of future connections with Owner's Research and Education Facilities and Building Operations Management during the Design Development phase of the Project.

I. Design carbon dioxide distribution piping to allow metering of usage by various departments. Coordinate with Owner for quantity and location of meters.

2.05 RENOVATION PROJECTS

A. Survey current installation and coordinate with Owner's Research and Education 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, laboratory gas station outlets and laboratory 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 not NFPA 99 compliant 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 Research and Education engineering and building operations staff during the Design Development phase of the Project.

D. Install shut-off valve at the connection of new line to existing line.

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 terminal or connection to existing piping; alarm panels; alarm sensors; pressure gauges; relief valves; relief valve discharge terminals; zone valves; in-line shut-off and service valves; future valved connections; source equipment; inlets and outlets.

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 valves; all intake and exhaust piping from source equipment to terminals or connections to existing piping; alarm annunciators; alarm sensors; pressure gauges; zone valves; 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 valves. Indicate maximum flows allowed at each future valved connection.

E. Identify location of each zone valve, area alarm annunciator 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 annunciators; Outlet and inlet combinations and mounting heights above finished floor.

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
	01-01-07	Initial Adoption of Element	
Rev. 1	07-08-10	2.01 G. ; Changed vacuum level from 25 to 19 inches of mercury (Hg). 2.04 I. ; Added requirement for metering carbon dioxide usage.	DOS
Rev. 2	11-15-2012	2.04 F & H – Deleted requirement for purge connections downstream of line shut-off valves.	DOS
Rev. 3			
Rev. 4			
Rev. 5			

END OF ELEMENT D2065