

226000-H: MEDICAL GAS SYSTEMS (15480-H)

Related Sections

Basis Guideline: N/A

[260510-H](#) – Electrical General Requirements

For an explanation of the use of these guidelines, see [“Design Guidelines for UMHHC Facilities”](#)

Included as part of this UMHHC guideline section are the details described within the following UM Master Specification sections:

[MS226313](#) - Medical Gas Certification

UMH Standard Details:

[D226000H-1](#) “EVAC Outlet Diagram”

[D226000H-2](#) “Standard Medical Gas Zone Valve Sign”

General

The most commonly used gases (noted w/ UMHHC abbreviations) are:

- Carbon Dioxide (CO₂)
- Dental Air (DA)
- Dental Vacuum (DVAC)
- Laboratory Compressed Air (LCA)
- Laboratory Vacuum (LVAC)
- Medical Air (MA)
- Medical Vacuum (MVAC)
- Nitrogen (N)
- Nitrous Oxide (N₂O)
- Oxygen (OX)
- Waste Anesthetic Gas Disposal/ Evacuation (WAGD/ EVAC)

Note: For purposes of differentiation, UMH uses the terms EVAC to refer to a dedicated, ducted suction system and WAGD to refer to hard-piped vacuum inter-connected with the MVAC system. The University Hospital facility is the only UMH facility that utilizes an EVAC system. Given the age and capacity limitations of the EVAC system, the A/E shall make every effort to convert existing EVAC outlets into WAGD outlets interconnected with the MVAC system. Prior to doing so, the AE shall confirm that MVAC capacity exists, both in the front-end vacuum pumps as well as the MVAC piping system.

Where applicable, in separate, adjacent facilities with dedicated medical gas systems, the A/E shall provide valved cross-connected medical gas piping between facilities to provide a means of redundancy.

Piping

Nitrogen, Nitrous Oxide, Oxygen, Dental Air, Laboratory Compressed Air, Laboratory Vacuum, Medical Air, Medical Vacuum, Dental Vacuum and Waste Anesthetic Gas Disposal Piping

All materials, installation and testing shall conform to NFPA 99C. It is worth highlighting the following NFPA 99C/ UMHHC requirements:

- Minimum medical vacuum and dental vacuum piping into each room shall be 1” with a minimum 3/4” branch to the respective outlet.
- Plugged tee fittings shall be installed in all changes of directions (elbows are not allowed) in dental vacuum and laboratory vacuum piping.
- Medical vacuum is a dry system and should not utilize plugged tee fittings due to the increased possibility of leaks. The exception to this is on medical vacuum systems where a plugged tee fitting shall be used for the first change in direction off of the medical vacuum outlet, located in an accessible area. The remainder of the system shall NOT use plugged tees.
- Piping shall be hard-drawn, seamless, ASTM B819 copper tube, type L, marked OXY or MED.
- All installers of medical gas and vacuum systems shall be ANSI 6010 certificated.

All medical gas system piping shall be purged with nitrogen during brazing and shall be purged in accordance with NFPA-99C before returning to use.

Valves

All medical gas service/ isolation valves shall be full port with dual gauge ports to allow temporary backfeeding of medical gases.

Wall Outlets

Wall outlets and devices shall match existing.

When multiple outlets are installed, there must be sufficient spacing between outlets to permit the simultaneous use of adjacent outlets with any of the various types of equipment that may be required.

All medical vacuum outlets shall have an equipment vacuum slide bracket (VSL) adjacent to each medical vacuum outlet on a one-for-one basis in all installations.

All EVAC outlets connected to the dedicated, ducted EVAC suction system in UH shall utilize a field-modified Chemtron outlet; see D15480H-1 "EVAC Outlet Diagram" standard detail.

In Operating Rooms utilizing a boom delivery system for medical gases, provide the following on the wall at the head end of the table:

- (2) MVAC
- (1) OX
- (1) MA

Medical Air Compressors

Medical air compressor designs shall incorporate the following:

- Medical air packages shall be redundant, modular and multiplex, consisting of multiple medical air compressors and a single stainless steel vertical tank sized to efficiently meet the load profile of the facility being served.
- All compressors, associated specialties (filters, valves, etc.), receivers, controllers and sequencers shall be packaged by a single manufacturer specializing in medical air systems, in full conformance with NFPA 99. Packages shall utilize single point service connections (inlet, discharge, electrical).
- Air compressors shall be air cooled and oil-free designed for a 115°F ambient operating temperature.
- Provide with redundant medical air dryers, compliant with NFPA 99.
- Package controls shall utilize a programmable controller (PLC) incorporating automatic compressor alteration (first on- first off) with cascading controls, so that only those compressors necessary to meet demand are enabled.
- Controllers shall function to automatically restart upon an interruption of power.
- Redundancy shall be provided for all vital control components (transformers/ relays, etc.) so that a single component failure does not interrupt operation. Failure of non-vital components (i.e. sequencer PLC) shall fail in a safe mode so that operation is uninterrupted. Failure of any component shall generate an alarm condition locally, remotely at the (2) master medical gas alarm panels in Systems Monitoring & Maintenance and also at the Building Management System (BMS).
- All compressor/ controller safeties and redundant features (i.e. high temp safety, redundant transformer, etc.) shall be provided with a visual confirmation of any fault thru an interface screen on the control panel.

Mechanical HVAC equipment shall be provided to offset the heat dissipation of the medical air system; sized so that a single failure of the HVAC system does not leave the medical air system without proper cooling. Equipment shall be powered from the emergency power system.

Room temperature (with high temperature alarm) and a general alarm of the medical air system and air dryer shall be connected to the building management system (BMS).

Source of power shall be provided from the equipment branch of the emergency power system. Each packaged medical air compressor system shall be fed from (2) distinct emergency power distribution sources, each fed from its own automatic transfer switch. These two feeds shall serve a local automatic transfer switch installed at the load, whereby each power source is capable of supporting the entire medical air compressor system. Coordinate with UMHHC electrical engineer. See UMH Design Guideline 260510-H "Electrical General Requirements".

Medical Vacuum / WAGD Pumps

Medical vacuum pump designs shall incorporate the following:

- Pump packages shall be redundant, modular and multiplex, consisting of multiple vacuum pumps and a single receiver tank, sized to efficiently meet the load profile of the facility being served.
- All pumps, associated pump specialties (filters, valves, etc.), receivers, pump controllers and sequencers shall be packaged by a single manufacturer specializing in medical vacuum systems, in full conformance with NFPA 99. Pump packages shall utilize single point service connections (inlet, discharge, electrical).
- In general, UMH prefers separate MVAC and WAGD systems. If separate systems are not provided, combined MVAC/ WAGD systems shall be designed to limit oxygen concentrations below the NFPA 99 2012 threshold of 23.6%, so as to allow the use of oil-flooded pumps. Dry, oil-free claw systems have proven to be unreliable, carry high maintenance costs, are inefficient and should not be used.
- Large vacuum pump designs serving MVAC and/ or combined MVAC/ WAGD vacuum systems (<23.6% O2 concentration) shall be air-cooled, utilizing oil-flooded screw pumps or oil-flooded rotary vane pumps. AE shall discuss selection basis with UMH FPD.
- All oil based pumps shall utilize primary and secondary oil separators on the exhaust discharge.
- Pump package controls shall utilize a programmable controller (PLC) incorporating automatic pump alteration (first on- first off) with cascading controls, so that only those pumps necessary to meet demand are enabled.
- Pump controllers shall function to automatically restart upon an interruption of power.
- Redundancy shall be provided for all vital control components (transformers/ relays, etc.) so that a single component failure does not interrupt operation. Failure of non-vital components (i.e. sequencer PLC) shall fail in a safe mode so that operation is uninterrupted. Failure of any component shall generate an alarm condition locally, remotely at the (2) master medical gas alarm panels in Systems Monitoring & Maintenance and also at the Building Management System (BMS).
- All pump/ controller safeties and redundant features (i.e. high temp safety, redundant transformer, etc.) shall be provided with a visual confirmation of any fault thru an interface screen on the control panel.

Mechanical HVAC equipment shall be provided to offset the heat dissipation of the medical vacuum system; sized so that a single failure of the HVAC system does not leave the medical vacuum system without proper cooling. Equipment shall be powered from the emergency power system.

Room temperature (with high temperature alarm) and a general alarm of the medical vacuum system shall be connected to the building management system (BMS).

Source of power shall be provided from the equipment branch of the emergency power system. Each packaged medical vacuum system shall be fed from (2) distinct emergency power distribution sources, each fed from its own automatic transfer switch. These two feeds shall serve a local automatic transfer switch installed at the load, whereby each power source is capable of supporting the entire medical vacuum system. Coordinate with UMHHC electrical engineer. See UMH Design Guideline 260513-H "Electrical General Requirements".

Medical Gas Local Alarm Panels

Local alarm panels shall be installed in locations required by NFPA 99C.

Alarm sensors shall be piped to monitor gas pressure on the patient side of the medical gas zone valves, regardless if the outlet location is in a room intended for anesthetizing gas delivery or not. The exception to this are local alarm panels serving a suite of multiple OR/ Procedure Rooms (Infection Control Type 1 & Type 2 Rooms- See SBA-K-H) with restricted access, which are allowed to be monitored via a common pressure switch/ transducer located on the non-patient side of the zone valve.

All alarm/ gauge connection points shall utilize a gas-specific demand check fitting, as required by NFPA 99C.

As required by NFPA99, all level 1 wiring systems from switches or sensors shall be supervised or protected per NFPA 70- Article 517.

Source of power shall be provided from the critical equipment branch of the emergency power system.

Medical Gas Master Alarm Panels

New master alarm panels shall be located in UH Systems Monitoring Room and the Building Maintenance Office.

All level 1 wiring systems from switches or sensors shall be supervised or protected per NFPA 70.

Source of power shall be provided from the critical equipment branch of the emergency power system.

Medical Gas Zone Valves

Zone valves shall be located in the same clinical area as the rooms served by the respective zone valve. The path of travel from furthest medical gas outlet to zone valve shall NOT require staff to travel between clinical areas or past other zone valves serving other rooms.

All zone valves shall be full port design. Where zone valve serves multiple rooms, provide a gauge port downstream of the valve with a means to connect in temporary gas tanks in order to backfeed the system. UMH prefers a zone valve box with a factory piped pressure switch/ transducer located within the zone valve box enclosure.

The zone valve box serving dedicated patient care rooms shall be located next to the patient door on the same side of the corridor.

The A/E shall include standard detail D226000H-2 "Standard Medical Gas Zone Valve Sign" on all projects that modify or add a medical gas zone valve. Edit detail to be job specific. Provide unique detail for all medical gas one valves on the project.

Testing and Certification

Medical gas systems shall be tested and certified by an independent certification company in contract directly with UM, in accordance with NFPA 99C. Certifiers to be ASSE 6030 qualified and shall be supervised by an ASSE 6020 certified inspector. Testing and certification shall affirm proper operation under normal and emergency power, after brief power interruptions and during generator tests. Final certification reports shall be free and clear of any/ all deficiencies. Any deficiencies shall be corrected and re-certified.