# Medical Maintenance

## 5.1.14 NFPA 99 2012 Edition for ASSE 6040 Maintenance Personnel

Presented By:

Rickey Rutherford
Carolinas HealthCare System

&

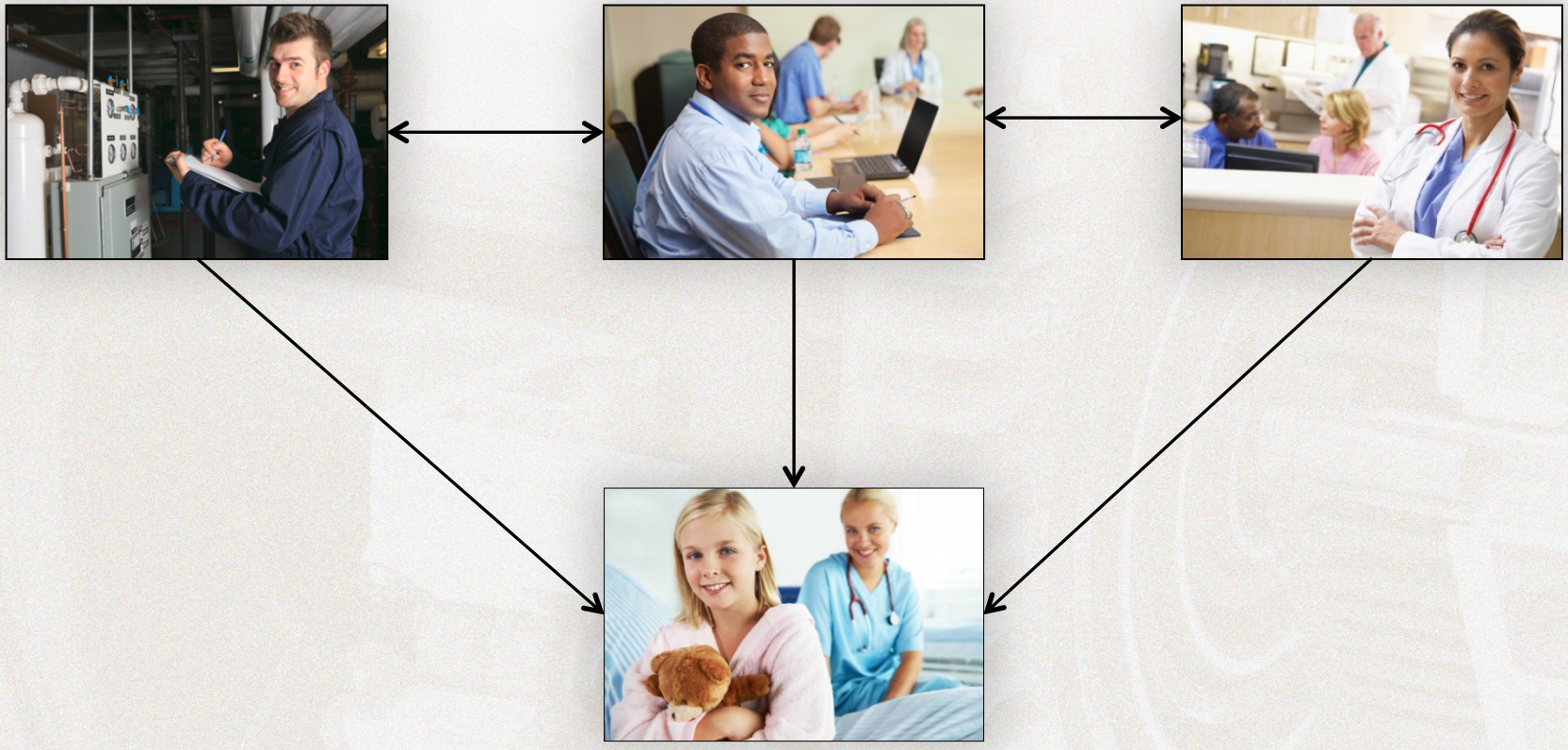
Scott Jussel
Medical Air Systems, Inc.

Medical Gas Professional
Healthcare Organization, Inc.

Medical Maintenance - 5.1.14 NFPA 99 2012 Edition for ASSE 6040 Maintenance Personnel

Medical Gas Professional
Healthcare Organization, Inc.

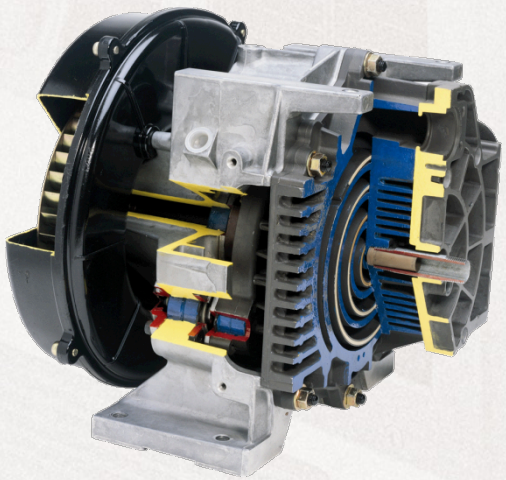
The intent is to keep all maintenance personnel properly trained and informed in order to improve the overall wellbeing and efficiency with which a healthcare facility as well as its' staff functions,



ultimately for the benefit of their patients.

## 5.1.14.2.1 * General (Maintenance)

Health care facilities with installed medical gas, vacuum, WAGD, or medical support gas systems, or combinations thereof, shall develop and document periodic maintenance programs for these systems and their subcomponents as appropriate to the equipment installed.



## 5.1.14.2.2.1 – Maintenance Programs: Inventories

Inventories of medical gas, vacuum, WAGD, and medical support gas systems shall include at least all source subsystems, control valves, alarms, manufactured assemblies containing patient gases, and outlets.

Ex: This evaluation consists of the follow medical gas system equipment quantities:

| Gases | Valves | Alarms | Outlets | Sources |
|---|---|---|---|---|
| O2 | 33 | 20 | 361 | 1 |
| MA | 20 | 15 | 77 | 1 |
| VAC | 33 | 20 | 402 | 2 |
| N2O | 7 | 2 | 14 | 1 |
| N2 | 7 | 2 | 14 | 1 |
| CO2 | 7 | 2 | 7 | 1 |
| WAGD | 7 | 2 | 7 | 1 |
| IA | 2 | 0 | 2 | 1 |

## 5.1.14.2.2.2 – Maintenance Programs: Inspection Schedules

Scheduled inspections for equipment and procedures shall be established through the risk assessment of the facility and developed with consideration of the original equipment manufacturer recommendations and other recommendations as required by the authority having jurisdiction.


**Ex: Vacuum Pump Inspection Schedule**

- Annually
- Semi-Annually
- Quarterly
- Bi-Monthly
- Monthly
- Daily
- Based on hourly run time

## 5.1.14.2.2.3 – Maintenance Programs: Inspection Procedures

The facility shall be permitted to use any inspection procedure(s) or testing methods established through its own risk assessment.


**Ex: Vacuum Pump Inspection**

- Document Inlet Performance Criteria (Flow, Labeling, Latch, Leaks, etc.)
- Document Area Alarm Settings
- Document Master Alarm Settings
- Etc.

## 5.1.14.2.2.4 – Maintenance Programs: Maintenance Schedules

Scheduled maintenance for equipment and procedures shall be established through the risk assessment of the facility and developed with consideration of the original equipment manufacturer recommendations and other recommendations as required by the authority having jurisdiction.


**Ex: Vacuum Pump Maintenance**

- Check Hours
- Check Amps
- Check Volts
- Check Vane Wear/Oil
- Check Filters
- Check Lead/Lag Settings
- Etc.

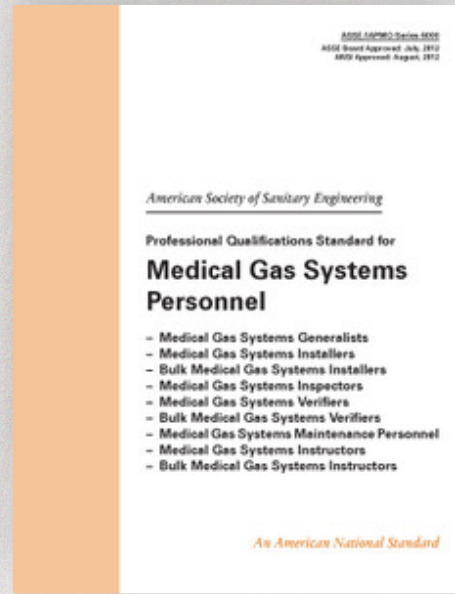
## 5.1.14.2.2.5 – Maintenance Programs: Qualifications

Persons maintaining these systems shall be qualified to perform these operations. Appropriate qualification shall be demonstrated by any of the following:

(1) Training and certification through the health care facility by which such persons are employed to work with specific equipment as installed in that facility

(2) Credentialing to the requirements of ASSE 6040, *Professional Qualification Standard for Medical Gas Maintenance Personnel*

(3) Credentialing to the requirements of ASSE 6030, *Professional Qualification Standard for Medical Gas Systems Verifiers*


American Society of Sanitary Engineering

Professional Qualifications Standard for

**Medical Gas Systems Personnel**

- Medical Gas Systems Generalists
- Medical Gas Systems Installers
- Bulk Medical Gas Systems Installers
- Medical Gas Systems Inspectors
- Medical Gas Systems Verifiers
- Bulk Medical Gas Systems Verifiers
- Medical Gas Systems Maintenance Personnel
- Medical Gas Systems Instructors
- Bulk Medical Gas Systems Instructors

An American National Standard

## 5.1.14.2.3 General (Inspection & Testing)

The elements in 5.1.14.2.2.2 through 5.1.15 shall be inspected or tested as part of the maintenance program as follows:

(1)*Medical air source, as follows:

- (a) Room temperature
- (b) Shaft seal condition
- (c) Filter condition
- (d) Presence of hydrocarbons
- (e) Room ventilation
- (f) Water quality, if so equipped
- (g) Intake location
- (h) Carbon monoxide monitor calibration
- (i) Air purity
- (j) Dew point

## 5.1.14.2.3 General (Inspection & Testing)

**A.5.1.14.2.3.1(1)** Additional inspections for medical air sources include the following:
(1) After-coolers (condition, operation of automatic drains)
(2) Operating pressures (cut-in, cut-out, and control pressures)
(3) Electrical operation
(4) Receiver elements (auto drain, manual drain, sight glass, pressure gauge)
(5) Pressure regulators (condition)
(6) Dryer (operation, outlet dew point, condition, housekeeping)
(7) Dew point calibration
(8) Housekeeping around compressors

## 5.1.14.2.3 General (Inspection & Testing)

The elements in 5.1.14.2.2.2 through 5.1.15 shall be inspected or tested as part of the maintenance program as follows:

(2)*Medical vacuum source — exhaust location

**A.5.1.14.2.3.1(2)** Additional inspections for medical vacuum sources and WAGD sources include the following:
(1) Operating vacuum (cut-in, cut-out, and control pressures)
(2) Electrical operation
(3) Receiver elements (manual drain, sight glass, vacuum gauge)
(4) Housekeeping around pump

(3) WAGD source — exhaust location

## 5.1.14.2.3 General (Inspection & Testing)

The elements in 5.1.14.2.2.2 through 5.1.15 shall be inspected or tested as part of the maintenance program as follows:

(4)*Instrument air source — filter condition

**A.5.1.14.2.3.1(4)** Additional inspections for instrument air sources include the following:
(1) After-coolers (condition, operation of drains)
(2) Operating pressures (cut in, cut out, and control pressures)
(3) Electrical operation
(4) Receiver elements (auto drain, manual drain, sight glass, pressure gauge)
(5) Pressure regulators (condition)
(6) Housekeeping around compressors

## 5.1.14.2.3 General (Inspection & Testing)

The elements in 5.1.14.2.2.2 through 5.1.15 shall be inspected or tested as part of the maintenance program as follows:

(5)*Manifold sources (including systems complying with 5.1.3.5.10, 5.1.3.5.11, 5.1.3.5.12, and 5.1.3.5.13), as follows:

(a) Ventilation

(b) Enclosure labeling

**A.5.1.14.2.3.1(5)** Additional inspections for manifold sources include the following:

(1) Cylinder leads (condition)

(2) Cascade (switching from one header to another)

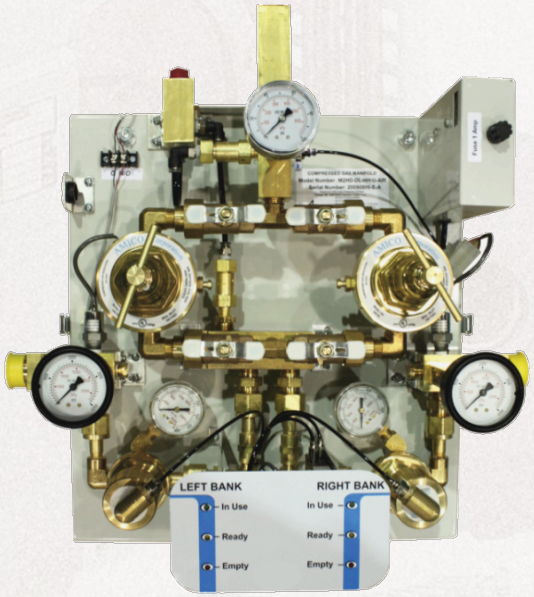
(3) Source valve (labeling)

(4) Relief valves (discharge location and condition)

(5) Leaks

(6) Security (door or gate locks and signage)

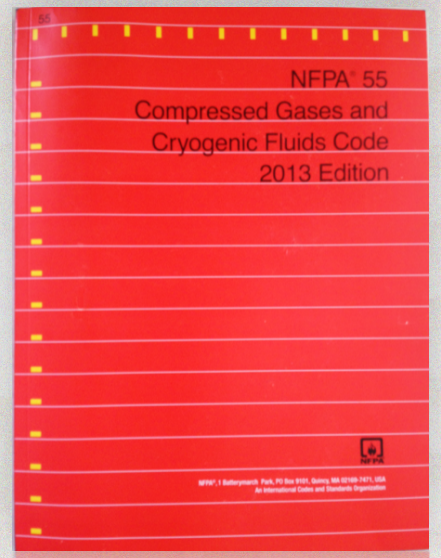
(7) Housekeeping around manifolds



## 5.1.14.2.3 General (Inspection & Testing)

The elements in 5.1.14.2.2.2 through 5.1.15 shall be inspected or tested as part of the maintenance program as follows:

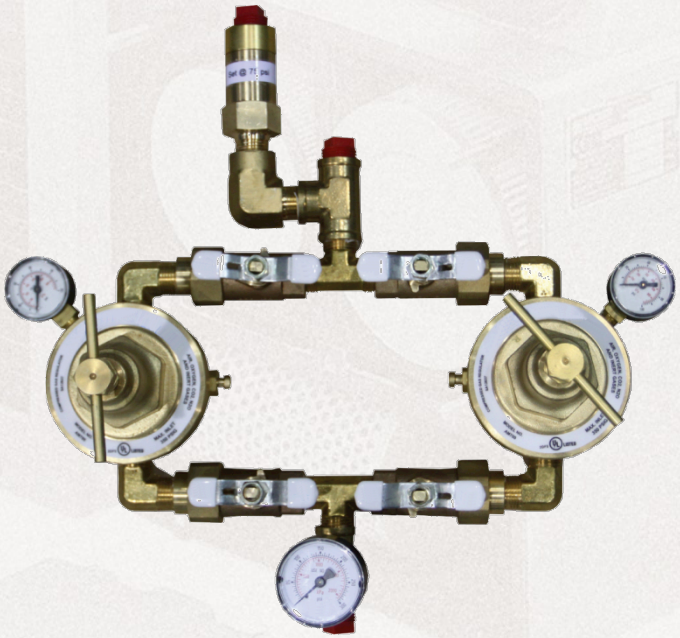
(6) Bulk cryogenic liquid source inspected in accordance with NFPA 55, *Compressed Gases and Cryogenic Fluids Code*



## 5.1.14.2.3 General (Inspection & Testing)

The elements in 5.1.14.2.2.2 through 5.1.15 shall be inspected or tested as part of the maintenance program as follows:

(7) Final line regulation for all positive pressure systems — delivery pressure



## 5.1.14.2.3 General (Inspection & Testing)

The elements in 5.1.14.2.2.2 through 5.1.15 shall be inspected or tested as part of the maintenance program as follows:

(8)*Valves — labeling

**A.5.1.14.2.3.1(8)** Additional inspections for zone valves include the following:
(1) Locations (relationship to terminals controlled)
(2) Leaks
(3) Labeling
(4) Housekeeping around alarm

## 5.1.14.2.3 General (Inspection & Testing)

The elements in 5.1.14.2.2.2 through 5.1.15 shall be inspected or tested as part of the maintenance program as follows:

(9)*Alarms and warning systems—lamp and audio operation

(10) Alarms and warning systems, as follows:
- (a) Master alarm signal operation
- (b) Area alarm signal operation
- (c) Local alarm signal operation

**A.5.1.14.2.3.1(9)** Additional inspections for alarms include the following:
(1) Dew point monitor (operation and calibration)
(2) Carbon monoxide monitor (operation and calibration)
(3) All local alarms on medical air, vacuum, WAGD, manifolds, medical support gas sources (verify presence of required alarms, perform electrical test, test lag alarm)
(4) Locations (visible to staff)
(5) Housekeeping around alarms

## 5.1.14.2.3 General (Inspection & Testing)

The elements in 5.1.14.2.2.2 through 5.1.15 shall be inspected or tested as part of the maintenance program as follows:

(11)*Station outlets/inlets, as follows:

- (a) Flow
- (b) Labeling
- (c) Latching/delatching
- (d) Leaks

**A.5.1.14.2.3.1(11)** An additional inspection for station outlets/inlets is a general condition (non-interchangeable indexing).

## 5.1.14.2.3.2 – Manufactured Assemblies Employing Flexible Connection(s) Between the User Terminal and the Piping System.

(A) Non-stationary booms and articulating assemblies, other than head walls utilizing flexible connectors, shall be tested for leaks, per manufacturer's recommendations, every 18 months or at a duration as determined by a risk assessment.

(B) The system pressure to non-stationary booms and articulating arms shall be maintained at operating pressure until each joint has been examined for leakage by effective means of leak detection that is safe for use with oxygen.

## 5.1.14.3 - Medical Gas & Vacuum Systems Information & Warning Signs

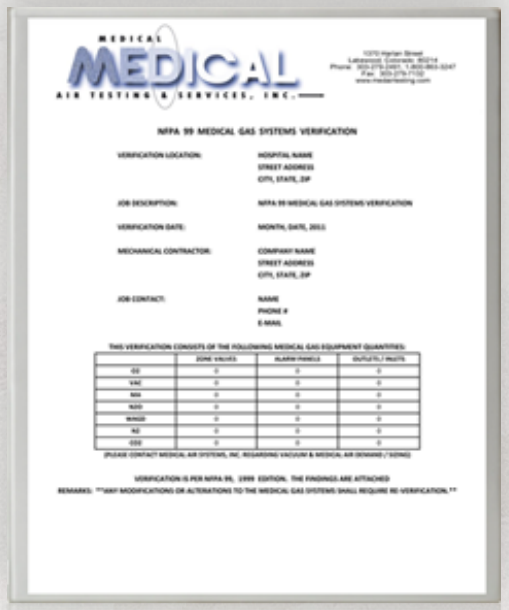
**5.1.14.3.1** The gas content of medical gas and vacuum piping systems shall be labeled in accordance with 5.1.11.1.

**5.1.14.3.2** Labels for shutoff valves shall be in accordance with 5.1.11.2 and updated when modifications are made changing the areas served.

## 5.1.14.4 – Maintenance & Record Keeping

**5.1.14.4.1** Permanent records of all tests required by 5.1.12.3.1 through 5.1.12.3.14 shall be maintained in the organization's files.

- **5.1.12.3.1 - System Verification**
  - 5.1.12.3.2 - Standing Pressure Test
  - 5.1.12.3.3 - Cross-Connection Test
  - 5.1.12.3.4 - Valve Test
  - 5.1.12.3.5 - Alarm Test
  - 5.1.12.3.6 - Piping Purge Test
  - 5.1.12.3.7 - Piping Particulate Test
  - 5.1.12.3.8 - Piping Purity Test
  - 5.1.12.3.9 - Final Tie-In Test
  - 5.1.12.3.10 - Operational Pressure Test
  - 5.1.12.3.11 - Medical Gas Concentration Test
  - 5.1.12.3.12 - Medical Air Purity Test (Compressors)
  - 5.1.12.3.13 - Labeling
  - 5.1.12.3.14 - Source Equipment Verification


MEDICAL
AIR TESTING & SERVICES, INC.

NFPA 99 MEDICAL GAS SYSTEMS VERIFICATION

VERIFICATION LOCATION: HOSPITAL NAME / STREET ADDRESS / CITY, STATE, ZIP

JOB DESCRIPTION: NFPA 99 MEDICAL GAS SYSTEMS VERIFICATION

VERIFICATION DATE: MONTH, DATE, 2011

MECHANICAL CONTRACTOR: COMPANY NAME / STREET ADDRESS / CITY, STATE, ZIP

JOB CONTACT: NAME / PHONE # / E-MAIL

THIS VERIFICATION CONSISTS OF THE FOLLOWING MEDICAL GAS EQUIPMENT QUANTITIES:

| | ZONE VALVES | ALARM PANELS | OUTLETS / INLETS |
|---|---|---|---|
| O2 | 0 | 0 | 0 |
| VAC | 0 | 0 | 0 |
| MA | 0 | 0 | 0 |
| N2O | 0 | 0 | 0 |
| NANO | 0 | 0 | 0 |
| N2 | 0 | 0 | 0 |
| CO2 | 0 | 0 | 0 |

(PLEASE CONTACT MEDICAL AIR SYSTEMS, INC. REGARDING VACUUM & MEDICAL AIR DEMAND / SIZING)

VERIFICATION IS PER NFPA 99, 1999 EDITION. THE FINDINGS ARE ATTACHED

REMARKS: **ANY MODIFICATIONS OR ALTERATIONS TO THE MEDICAL GAS SYSTEMS SHALL REQUIRE RE-VERIFICATION.**

## 5.1.14.4 – Maintenance & Record Keeping

**5.1.14.4.2** The supplier of the bulk cryogenic liquid system shall, upon request, provide documentation of vaporizer(s) sizing criteria to the facility.

**5.1.14.4.3** An annual review of bulk system capacity shall be conducted to ensure the source system has sufficient capacity.

**5.1.14.4.4** Central supply systems for nonflammable medical gases shall conform to the following:
(1) They shall be inspected annually.
(2) They shall be maintained by a qualified rep of the equipment owner.
(3) A record of the annual inspection shall be available for review by the authority having jurisdiction.

**5.1.14.4.5** A periodic testing procedure for non-flammable medical gas and vacuum and related alarm systems shall be implemented.

## 5.1.14.4 – Maintenance & Record Keeping

**5.1.14.4.7** Procedures, as specified, shall be established for the following:

(1) Maintenance program for the medical air compressor supply system in accordance with the manufacturer's recommendations

(2) Facility testing and calibration procedure that ensures CO monitors are calibrated at least annually or more often if recommended by the manufacturer

(3) Maintenance program for both the medical–surgical vacuum piping system and the secondary equipment attached to medical–surgical vacuum station inlets to ensure the continued good performance of the entire medical–surgical vacuum system

(4) Maintenance program for the WAGD system to ensure performance

## 5.1.14.4 – Maintenance & Record Keeping

**5.1.14.4.8** Audible and visual alarm indicators shall meet the following requirements:

(1) They shall be periodically tested to determine that they are functioning properly.

(2) Records of the test shall be maintained until the next test is performed.

## 5.1.14.4 – Maintenance & Record Keeping

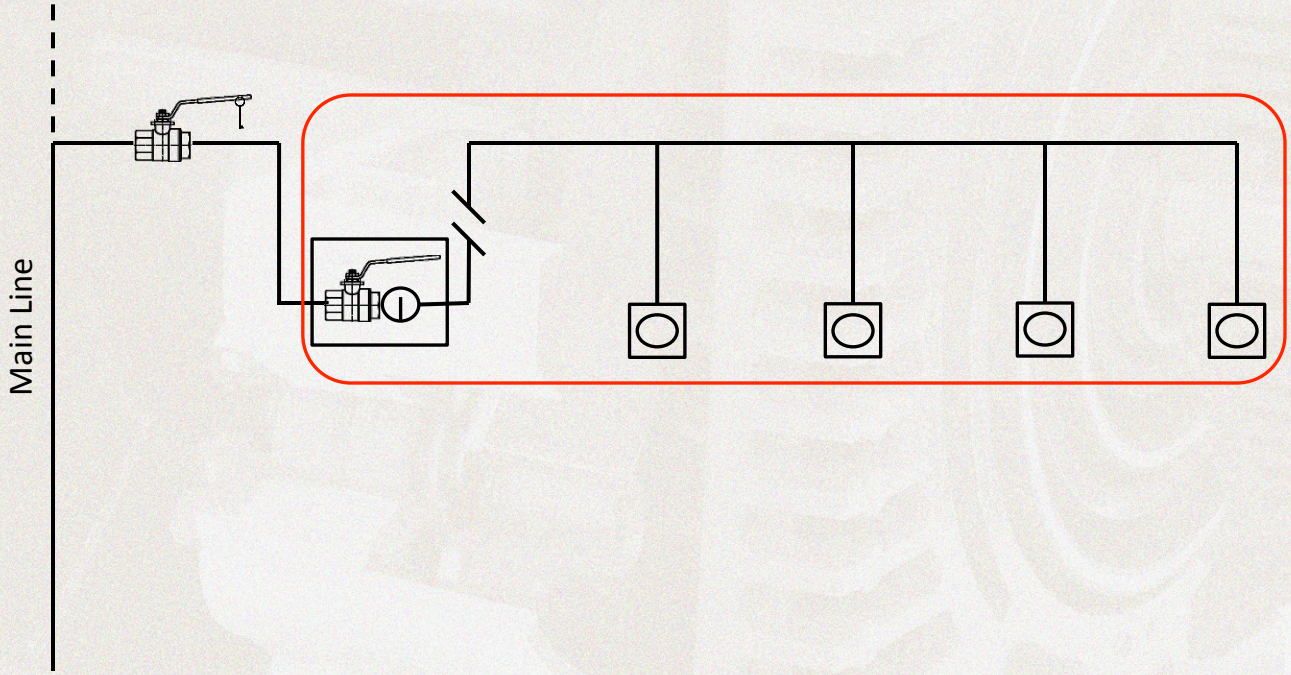
**5.1.14.4.9** Medical–surgical vacuum station inlet terminal performance, as required in 5.1.12.3.10.4, shall be tested as follows:

(1) On a regular preventive maintenance schedule as determined by the facility maintenance staff

(2) Based on flow of free air (Nl/min or SCFM) into a station inlet while simultaneously checking the vacuum level

## 5.1.14.4 – Maintenance & Record Keeping

**5.1.14.4.6** Whenever modifications are made that breach the pipeline, any necessary installer and verification test specified in 5.1.12 shall be conducted on the downstream portions of the medical gas piping system.



## 5.1.15* – Category 1 Maintenance / ANNEX A

Facilities shall have a routine maintenance program for their piped medical gas and vacuum systems.

**A.5.1.15** Medical gas and vacuum systems should be surveyed at least annually for the items that follow and deficient items corrected.

Survey of medical air and instrument air sources should include, but not be limited to, the following:

(1) Dew point monitor (operation and calibration)
(2) Carbon monoxide monitor (medical air only) (operation and calibration)
(3) After-coolers (condition, operation of drains)
(4) Operating pressures (cut-in, cut-out, and control pressures)
(5) All local alarms (verify presence of required alarms, perform electrical test, test lag alarm)
(6) Receiver elements (auto drain, manual drain, sight glass, pressure gauge)
(7) Filters (condition)
(8) Pressure regulators (condition, output pressure)
(9) Source valve (labeling)
(10) Intake (location and condition)
(11) Housekeeping around compressors

## ANNEX A

Survey of the medical vacuum and the WAGD source(s) should include, but not be limited to, the following:

(1) Operating vacuum (cut-in, cut-out, and control pressures)
(2) All local alarms (verify presence of required alarms, perform electrical test, test lag alarm)
(3) Receiver elements (manual drain, sight glass, vacuum gauge)
(4) Source valve (labeling)
(5) Exhaust (location and condition)
(6) Housekeeping around pump

Survey of the medical gas manifold source(s) should include, but not be limited to, the following:

(1) Number of cylinders (damaged connectors)
(2) Cylinder leads (condition)
(3) Cascade (switching from one header to another)
(4) All local alarms (verify presence of required alarms, perform electrical test, test all alarms)
(5) Source valve (labeling)
(6) Relief valves (discharge location and condition)
(7) Leaks
(8) Security (door or gate locks and signage)
(9) Ventilation (general operation, housekeeping)
(10) Housekeeping around manifolds

## ANNEX A

Survey of medical gas area alarms should include, but not be limited to, the following:
(1) Locations (visible to staff)
(2) Signals (audible and visual, use test function)
(3) Activation at low pressure
(4) Housekeeping around alarm

Survey of medical gas master alarms should include, but not be limited to, the following:
(1) Locations (visible to appropriate staff)
(2) Signals (audible and visual, use test function)
(3) Activation at low pressure
(4) Housekeeping around alarm

Survey of zone valves should include, but not be limited to, the following:
(1) Locations (relationship to terminals controlled)
(2) Leaks
(3) Labeling
(4) Housekeeping around alarm

## ANNEX A

Survey of medical gas outlet/inlets should include, but not be limited to, the following:
(1) Flow and function
(2) Latching/delatching
(3) Leaks
(4) General condition (non-interchangeable indexing)

The facility should retain a written or an electronic copy of all findings and any corrections performed.

**A.5.2.1** Section 5.1 covers requirements for Category 1 piped gas and vacuum systems; Section 5.2 covers Category 2 piped gas and vacuum systems; and Section 5.3 covers Category 3 piped gas and vacuum systems. Laboratory systems are no longer covered by Chapter 5 (2002 edition).

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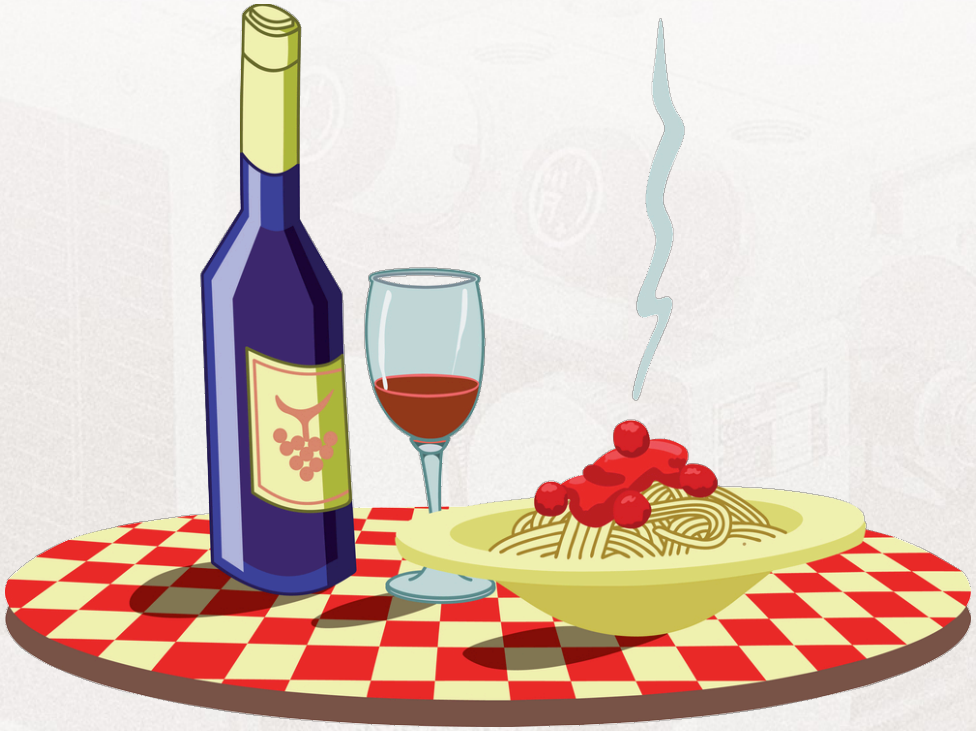

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