

## **ORIENTATION NOTES ON RECOMMENDED MEDICAL GAS PIPING INSTALLATION PROCEDURES FOR INSTALLERS - NFPA 99 2002 Edition**

The Standard referred to is NFPA 99 Health Care Facilities.

All personnel installing the medical gas system on this project must be familiar with the above Standard and relevant section of the Specification.

A copy of the orientation notes will be left with the installer for reference.

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### **1. Installation of Piping.**

Piping must be free of all contamination and especially any oil or other oxidizable material. Confirm this by visually inspecting the inside of all pipes before they are hung. Look for plastic caps that may have been pushed inside the pipe. Do not assume that "Factory degreased" pipe has been properly degreased. Check it for yourself by running swabs of lint free tissue through approximately 10% of the pipes as soon as they are delivered to the site. The sooner this is performed, the more time you will have to make any corrections that may be necessary. Ensure that pipes are tightly capped at all times and that valves roughed in valve boxes and roughed in alarm panels are also kept capped.

Piping must be labelled on a daily basis. The easiest way to do this is to attach a label to the centre of each length of pipe before it is hung. Labelling should appear on the pipe at intervals of not more than 20', before and after barriers, behind access doors and at inlets and outlets. There should be labels at least once in each room and each storey traversed by the pipeline.

Area alarm sensing tube connections and pressure switches should always be connected to the top of the pipeline. Moisture in the pipeline will damage these components.

### **2. Cleaning and Degreasing.**

All tubing, valves and fittings (except piping that has been supplied and proved as medically degreased) shall be thoroughly cleaned of grease, oil or other combustible material by washing in a *hot* solution of Trisodium Phosphate mixed in the proportion of 1 lb to 3 gallons of hot water 140 deg F. (TSP - normal degreaser solution available at most hardware and supply stores). The equipment must then be rinsed with *hot* water and allowed to dry in a well aired and dust free area. Hot Nitrogen is a useful drying agent. All cutting tools that come in contact with the pipe must also be degreased. These tools should not be used on anything other than Medical Gas piping unless they are re-cleaned each time. After degreasing, piping must be tightly capped and fittings and other equipment sealed in plastic bags until they are about to be used. **NEVER** use an organic solvent such as carbon tetrachloride to degrease any components in a Medical Gas System.

### **3. Nitrogen Purge.**

During the brazing of pipe connections the interior of the pipe shall be purged continuously with Nitrogen. Use a flow meter with the regulator. Allow the purge to run for sufficient time to expel all the oxygen before brazing the first joint. Suggested flow rates are 10 cfh (cubic feet per hour) for ½" & ¾" pipes, 15 cfh for larger pipes. (Divide these flow rates by 2 to get l/m - litres per minute.) Confirm that these are adequate by performing some sample joints on a work-bench with varying flow rates. Cut open the sample joints and examine them. There should be no oxidation on the inside of the joint. A flow meter can save a lot of money by preventing unnecessarily high flow rates of Nitrogen. The Nitrogen purge must be directed past the point of brazing. Do not turn off the nitrogen purge until joints have cooled. A small hole in a plastic cap on the end of the line being purged will prevent a pressure build up inside the line and allows you to check for a flow with your hand. Alternatively, a balloon with the same size hole will inflate to give a visual indication that the purge is still running. If you are working on a branch line, be sure that you redirect the flow down the branch line and block the flow in the mainline downstream of the branch takeoff. For maximum efficiency prepare as many joints as possible in a progressive manner so that a minimum number of purges have to be set up. It is preferable to work on only one system at a time.

*If more than one Medical Gas System is being brazed at one time, never manifold the piping together to facilitate common purges. The manifolding of systems is seen as a potential for cross-connection.*

### **4. Silver Brazing.**

The Standard requires that for copper-to-copper joints on pressure gas, a fluxless silver brazing alloy be used, such as "Sil-fos" or "Silflo". The alloy must conform to AWS Classification BCuP-5 (15% silver, copper/phosphorous rods-see AWS Standard A5.8). For brazing dissimilar metals a flux is required and it should conform to the specifications of AWS brazing flux 3A. Improper fluxing will contribute particulate - therefore avoid excessive use of flux. Wash the outside of the tube and fittings with hot water after brazing to remove residual flux.

Too much heat, or an insufficient purge, or a combination of the two will result in the formation of copper oxide particulate inside the pipe. All synthetic and rubber components, which could be damaged by the heat of silver brazing, should be wrapped in a wet rag or removed (e.g.: ball valve seals and outlet face plates). Ball valve interiors should be temporarily replaced with a short pipe stub of appropriate length to allow the nitrogen purge to flow through. If removing the inside non-metal components, be careful of memory fit Teflon sealing rings, which may not re-seal. When brazing outlet stubs, the nitrogen purge should be connected to each outlet individually, and allowed to flow back into the pipeline. This helps prevent overheating outlet internal components. Care should always be exercised to prevent the flow of excess brazing material into the pipe, but particularly so on small diameter lines such as the 3/8" pipe stub on the wall outlets.

Soft solder or 50/50 solder must **NEVER** be used on a Medical Gas System including vacuum, not even caps, temporary connections, relief valve vents or *any* component including the Nitrogen purge apparatus.

After the lines are installed but before the wall outlets (or pre-piped headwall units if they are being used) are installed, blow the pipes free of any particulate that may be in them. The testing agency may be drawing particulate filter samples as the work proceeds to ensure that proper purge and brazing techniques are being used. In addition, random joints may be removed and cut out for internal inspection. Particulate can impair the function of outlet valves (causing substantial leaks), zone valves and secondary equipment such as flow meters, respirators and anaesthetic machines. When new and existing systems are to be tied together, it is advisable to have particulate filter tests performed on each section before the tie-in.

If headwalls or ceiling columns are being installed, it is advisable to pipe up to the rough-in plate, and complete pressure testing up to these points. Document these tests in conjunction with the hospital, construction management, or general contractor. Once filter testing is completed on all of your installations, the testing agency will advise the installer to complete the tie-in to the headwalls, and put finish plates on any ceiling columns. This is done because of the problems, which have been experienced with headwall and ceiling columns in being the source for both system leaks and particulate contamination.

#### **5. Pressure Testing.**

Some specifications require that all areas be pressure tested upon completion. Where pre-piped headwall units are to be installed, two pressure tests will be required - one before the drywalling is started and the other after the headwall unit is installed. The first test is required so that any leaks can be found before the drywalling is started. The second test is required because the headwall unit cannot be installed until after the drywall is complete. After the first test the lines should remain under pressure with a gauge attached and the pressure in the system shall be logged on a daily basis. Eventually each area must be leak tested at 150 psi for all systems, except nitrogen, which is tested at 300 psi. A final 24-hour pressure test must be applied with all components connected, including alarm sensors and finish outlets. Test pressure for this test is 60 psi for all gases and vacuum, except nitrogen, which is 200 psi. No pressure fluctuation is allowed within the 24 hours except that which is caused by temperature fluctuations. These final tests must be documented and witnessed. A pressure switch tee or a valve box with a pressure gauge tapping provides convenient places to install test gauges. The cylinder and regulator used to fill the system for the pressure tests must be physically disconnected from the system before the start of the test. The line pressure may be reduced after the test to about 50 psi and an area alarm, if there is one in that area, could be used to automatically monitor that system for sudden pressure drop. Pressurization of the lines after testing provides a twofold protection: one is that contamination from the ambient air is kept out of the system and the second is that the installer is warned immediately if any other trade, inadvertently or otherwise, punctures the system. Do not pressurize components that are not rated for the various test pressures such as vacuum gauges and switches, alarm panels, etc. Manifolds and pump packages are not normally included in 24-hour pressure tests.

#### **6. Locating Leaks.**

If, after soap testing all the joints, a leak cannot be found, try to eliminate the most likely locations such as threaded joints, gauges, pressure switches, closed valves, etc.. It is better to test against capped open valves than closed valves. In our experience, leaks have been found in many unexpected places such as: valve bodies (cast brass); Bourdon tubes of pressure gauges; factory

joints on outlets; pipe seams; self contained alarm modules and others. Dividing a leaking system into smaller sections and testing each individually can save a great deal of time.

Always keep pressure on the system until the time for system tie-ins and certification. Usually, as the project progresses, various trades are required to make changes in pipe chases, ceilings, or replace drywall (and their associated screws). Common problems occur near the end of projects where screws, particularly drywall type, are driven into the copper tubing. This can create minute leaks, which are very hard to locate.

### **7. Cross-connection Testing.**

This test is performed by the medical gas installer and later by the testing agency. To determine that no cross-connection exists between piping systems used for different medical gases, the systems shall be tested as follows:

- a. The pressure in piping systems other than the system under investigation shall be reduced to atmospheric.
- b. Test the system with Nitrogen at a pressure of 50 psi.
- c. Test each individual station outlet of *every* piping system to determine that the test gas is being dispensed only from the outlet of the system under investigation. The actual pressure shall be measured with a gauge attached to the specific adaptor for that Medical Gas system. Cheater adaptors are not to be used. Screwdrivers or other damaging implements are not to be used.
- d. Purging: After completing the foregoing tests on each system, the test gas shall be disconnected and the system bled down to atmospheric pressure. The proper gas shall immediately be connected to each system. Following this, each system shall be purged a sufficient number of times to remove the test gas. Once purging is complete, leave the piping pressurized, awaiting analysis by the Medical Gas Testing Agency.

This last purging will remove any particulate that might have collected between the time it was previously purged and the connection of the wall outlets (and/or pre-piped headwall units). The final 24-hour pressure test could also be performed at this time.

***Never manifold two or more Medical Gas Systems together for any reason whatever, not even temporarily for pressure tests. It is extremely dangerous, and is not allowed by the standard.***

**8. General.**

The medical gas installation contractor should maintain a list of installers involved in the medical gas piping system installation and each of those installers should read these orientation notes, the relevant section of the specification and the Standard.

Where applicable, the medical gas installer should ensure that his pre-piped headwall unit supplier has complied to all the requirements of the Standard (such as labelling, Nitrogen purging, full size line for manifolding, degreased piping and fittings). Please note that the Standard allows the area alarm sensing lines to be run with pipe as small as 1/4", however that pipe must still be degreased, Nitrogen purged and brazed.

If you are required to make tie-ins to existing systems, ensure that all tie-ins do not permit contamination of existing systems. Permission will be required from the Hospital before any work can proceed on an existing system that is currently in use. Be very careful that you do not contaminate the existing system.

Main-line pressure or Vacuum switches are required to be installed using gas specific DISS valves so that the switch can be removed for service, testing or calibration without shut-down. If you need further assistance please call us.

**Note:** These Orientation instructions are the property of DOERKSEN MEDICAL GAS SYSTEMS LTD. These notes are intended as a supplement to NFPA 99 only and do not supersede the Standard. The guidelines presented are the result of many years experience in the Medical Gas Industry. DOERKSEN MEDICAL GAS SYSTEMS LTD. assumes no responsibility for action arising out of misinterpretation or misuse of the foregoing information. These notes are not intended to be a detailed installation manual. Your project may have special requirements beyond these notes - please check your specification carefully. No specification can overrule requirements of the Standard if the project is to be certified to the requirements of the Standard.

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## INSTALLER FAX CHECKLIST

Project: \_\_\_\_\_ Date: \_\_\_\_\_

ITEM	OK?
1) All drywall and finishing work has been completed.	
2) The 60 psi, 24 hour, final pressure test has been verified to the satisfaction of Hospital and General Contractor.	
3) All pipe labels have been installed before and after all barriers, behind access panels, and at least every 20 feet. All labels should wrap <i>completely</i> around the pipe, with letters parallel to the pipe. Label colors should be as per Table 5.1.11 of NFPA 99 (the Standard).	
4) A cross connection test must be performed by the <i>installer</i> , simply by pressurizing one system at a time, and testing that all applicable outlets are pressurized.	
5) All alarms (master and local) must be wired to emergency power, connected, confirmed, and <i>powered up</i> , after all pressure testing is complete, and line pressures have been returned to normal. Circuit breaker number and location should be written on the face of each alarm panel.	
6) All ceiling isolation valves must be <i>tagged</i> as to area of control, and <i>sealed</i> in the open position. A plastic tie wrap is normally used for this purpose.	
7) All zone valves and alarm panels must be completely assembled, complete with door, and <i>identified</i> , as to the area of control. A list of room numbers, as will be used by the Hospital, or room names controlled by the valve or alarm must appear upon this identification.	
8) Each outlet must be <i>purged</i> "wide open" using the appropriate connector for at least 10 seconds to rid all purge gas.	
9) All outlets must be properly <i>secured</i> to the wall.	
10) With all alarms and finished outlets in place, each zone should be pressurized to normal line pressure or vacuum, then close the zone valve. If the alarm goes off, there is a leak to repair (sometimes a misplaced drywall screw).	
11) Medical air compressor packages, (if installed), must be <i>up and running</i> at a steady purge for at least 24 hours before testing to purge all manufacturing gases.	
12) Any gas manifold systems should be pressure tested by closing the bottles, and monitoring the pressure gauges for leaks over the period of 1 hour.	

To avoid costly delays in final medical gas systems testing, please check off the above items and fax this page to our office at (651) 351-5084. Please contact us at (866) 351-5077 with any question.

**DOERKSEN MEDICAL GAS SYSTEMS /U.S. LTD.**

**NON-FLAMMABLE MEDICAL GAS PIPING SYSTEM PRESSURE TEST - NFPA 99**

**DATE:**

**HOSPITAL:**

**AREA:**

**WITNESSED BY:**

**PRESENT AT TEST**

**START END**

(Signature)

(Name)

(Representing)

*ALL TESTS CONDUCTED IN ACCORDANCE WITH NFPA STANDARD 99 A final 24 hour pressure test must be applied with all components connected, including alarm sensors and finish outlets. Test pressure for this test is 60 psi(20% above normal pressure) for all gases and vacuum, except nitrogen, which is 200 psi(20% above normal pressure). No pressure fluctuation is allowed within the 24 hours except that which is caused by temperature fluctuations. Vacuum alarm sensors, gauges and sensitive equipment must be removed.*

**STANDING PRESSURE TEST: TEST GAS**

SERVICE:

START: DATE: \_\_\_\_\_ TIME: \_\_\_\_\_ PRESSURE: \_\_\_\_\_ TEMP:  
COMPLETION: DATE: \_\_\_\_\_ TIME: \_\_\_\_\_ PRESSURE: \_\_\_\_\_ TEMP:

SERVICE:

START: DATE: \_\_\_\_\_ TIME: \_\_\_\_\_ PRESSURE: \_\_\_\_\_ TEMP:  
COMPLETION: DATE: \_\_\_\_\_ TIME: \_\_\_\_\_ PRESSURE: \_\_\_\_\_ TEMP:

SERVICE:

START: DATE: \_\_\_\_\_ TIME: \_\_\_\_\_ PRESSURE: \_\_\_\_\_ TEMP:  
COMPLETION: DATE: \_\_\_\_\_ TIME: \_\_\_\_\_ PRESSURE: \_\_\_\_\_ TEMP:

SERVICE:

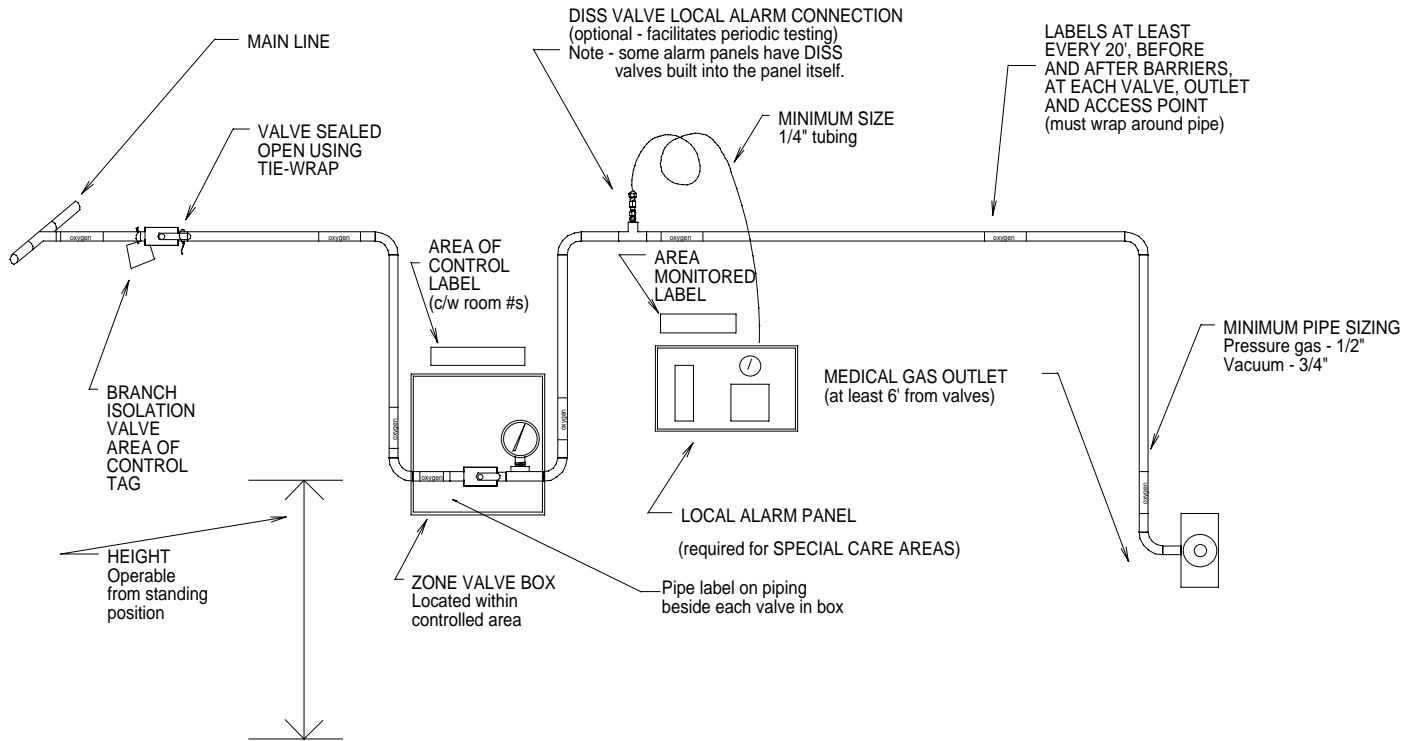
START: DATE: \_\_\_\_\_ TIME: \_\_\_\_\_ PRESSURE: \_\_\_\_\_ TEMP:  
COMPLETION: DATE: \_\_\_\_\_ TIME: \_\_\_\_\_ PRESSURE: \_\_\_\_\_ TEMP:

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## ZONAL INSTALLATION SCHEMATIC

The following schematic depicts requirements of the current Standard with respect to piping changes within a specific zone. Note that **all modified piping components** must be upgraded to current requirements.



### Zone valve location:

AREA	ZONE VALVE LOCATION
Patient ward (non-special care)	Within view of the main working area of the nursing station or control location responsible for all rooms controlled, preferably within the nurses station itself.
Special Care area (eg: ICU, Recovery)	Immediately outside the area, in a readily accessible location, not obstructed by the door.
Any room piped with Nitrous Oxide	Immediately outside each room.