



ADI 2105-E

Purges

INSTALLATION AND OPERATION INSTRUCTIONS

Before Installing or Operating, Read and Comply with These Instructions

Controls Corporation of America
1501 Harpers Road Virginia Beach, VA 23454
To Order Call 1-800-225-0473 or 757-422-8330 • Fax 757-422-3125
www.concoa.com

USER RESPONSIBILITY

This equipment will perform in conformity with the description contained in this manual and accompanying labels and/or inserts when installed, operated, maintained, and repaired in accordance with the instructions provided. This equipment must be checked periodically. Improperly working equipment should not be used. Parts that are broken, missing, worn, distorted or contaminated, should be replaced immediately. CONCOA recommends that a telephone or written request for service advice be made to CONCOA Customer Service (see contact information below).

This equipment or any of its parts should not be altered without prior written approval by CONCOA. The user of this equipment shall have the sole responsibility for any malfunction that results from improper use, faulty maintenance, damage, improper repair, or alteration by anyone other than CONCOA or a service facility designated by CONCOA.

CUSTOMER SERVICE

In the event of equipment failure, call CONCOA Customer Service. Please be prepared to provide the model number and serial number of the equipment involved in addition to some details regarding its application.

Address: 1501 Harpers Road, Virginia Beach, VA 23454

Phone: 1-800-225-0473

FAX: 1-757-422-3125

E-MAIL:

info@concoa.com



GENERAL SAFETY PRACTICES

Comply with precautions listed in C.G.A. Pamphlet P-1, Safe Handling of Compressed Gases in Containers.

Consult the cylinder distributor for the proper use of cylinders and for any restrictions on their use such as flow rate and temperature requirements.

Never use an open flame when leak testing.

When risking the release of toxic, corrosive, flammable, or oxidizing gas, such as during disconnection of a gas cylinder containing such gas, use appropriate measures such as breathing apparatus, eye protection, and protective clothing to ensure the safety of personnel.

Always open valves slowly when high-pressure gases are being used.

Always be sure that a cylinder contains the correct gas before connecting it to any regulator.

Always leak-test any manifold or distribution pipeline before using.

Always be sure that the gas in the system is the correct gas for the intended use.

For the United States, some applicable safety rules and precautions are listed below:

1. American National Standards Institute standard Z49.1, Safety in Welding and Cutting, American Welding Society, 2501 NW Seventh Street, Miami, Florida 33125
2. N.F.P.A. Standard 51, Oxygen-Fuel Gas systems for Welding and Cutting, N.F.P.A., 470 Atlantic Avenue, Boston, Massachusetts 02210
3. N.F.P.A. Standard 51B, Cutting and Welding Processes (same address as #2).
4. CONCOA publication ADE 872, Safety Precautions in Welding and Cutting.
5. Local Ordinances
6. O.S.H.A. Standard 29 CFR
7. C.G.A. Pamphlet C-4, American National Standard Method of Marking Portable Compressed Gas Containers to Identify the Material Contained.
8. C.G.A. Pamphlet G-4, Oxygen – Information on the properties, manufacture, transportation, storage, handling, and use of oxygen.
9. C.G.A. Pamphlet G-4.1, Equipment Cleaned for oxygen service.
10. C.G.A. Pamphlet G-4.4, Industrial Practices for Gaseous Oxygen Transmission and Distribution Piping Systems.
11. C.G.A. Pamphlet G-5, Hydrogen – Information on the properties, manufacture, transportation, storage, handling, and use of hydrogen.
12. C.G.A. Pamphlet G-6, Carbon Dioxide – Information on the properties, manufacture, transportation, storage, handling, and use of carbon dioxide.
13. C.G.A. Pamphlet G-6.1, Standard for Low Pressure Carbon Dioxide Systems at Consumer Sites.
14. C.G.A. Pamphlet P-1, Safe Handling of Compressed Gases in Containers.
15. C.G.A. Safety Bulletin SB-2, Oxygen Deficient Atmospheres.

C.G.A. pamphlets can be obtained from:

The Compressed Gas Association

1235 Jefferson Davis Highway, Arlington, VA 22202-3239

Phone: (703) 979-0900. Publications: (703) 979-4341. Fax: (703) 979-0134

PURGING

Purges allow users to connect a purge gas to their system. Purging has the following benefits:

1. To start with and maintain a high purity gas stream. Purging allows the user to remove unwanted gases and water vapor contamination from their system. This benefits processes such as pollution control calibration, doping modules, and chromatography.
2. To prevent dangerous gases (toxic, corrosive, flammable, oxidizing) from getting into a workplace area.
3. To prevent the mixing of reactive gases. Example: Air, moisture, and intense acid formers may mix after cylinder changes without purging. The resultant acids formed from the mixture may react with the system equipment. Reactions with the equipment may shorten the life of equipment components.
4. To avoid the waste of valuable system gases that might have originally been used for purging.

Note: Be sure that your purge gas is compatible with your application and processes.

TYPES OF PURGES

CONCOA has three types of purges:

1. Deep Purge (used for positive displacement purging): The Deep Purge is the most effective and versatile purge. This unit has a snorkel design that forces purge gas into the process gas cylinder valve cavity. It is capable of purging the inlet side of a regulator without having to purge through the regulator and system. This method will use less purge gas.
2. Tee Purge (used for pressure cycle purging): This purge is more economical to purchase than the deep purge, and is the best choice for systems incompatible with positive displacement purging. It provides effective purging of cavities upstream and downstream of the regulator. This purge exhausts through the regulator and system outlet.
3. Straight Purge (used for pressure cycle purging): This purge functions like a Tee Purge, except that it is installed in an unused high pressure port on the regulator. This purge exhausts through the regulator and system outlet.

INSTALLATION

Please observe the previously mentioned safety precautions before actual installation. Use an open-end wrench, not a pipe wrench, when installing NPT connections. Be sure that all fittings are secure and leak tight. CONCOA uses PTFE tape on all of its NPT connections. PTFE must be used on NPT threads to ensure a gas tight seal. Avoid impinging on the gas stream. On stainless steel connections, PTFE tape also helps to prevent the connections from galling together when tightening or loosening. Follow the rules below when using PTFE tape:

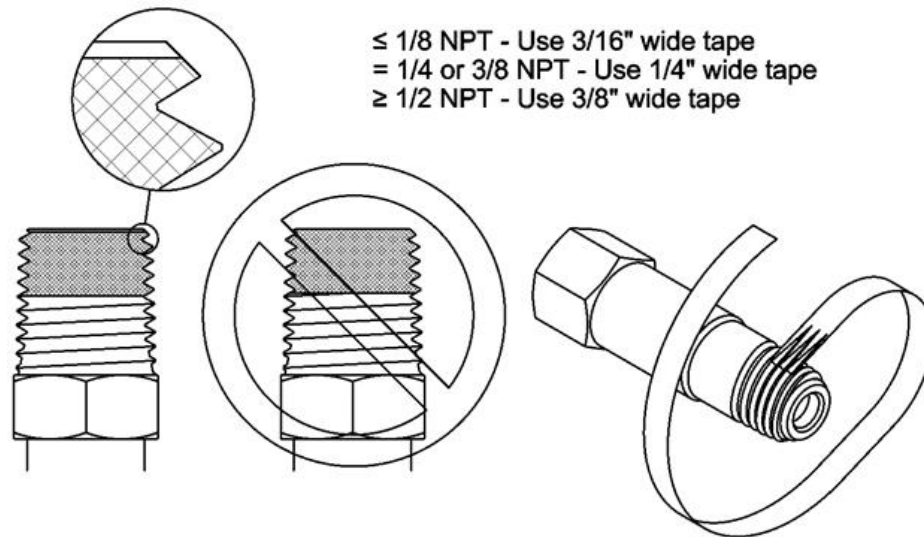


Figure 1. Tape Installation Procedures

Taping procedure:

Before applying PTFE tape, inspect the NPT threads, and, if necessary, clean the fitting to remove any dirt or thread sealant that remains on the threads. Start the PTFE tape on the first thread leaving a slight section of the chamfer exposed as shown in the figure above. Make sure the tape does not overlap the end of the fitting. As the tape is wrapped in the direction of the thread spiral, pull tightly on the end of the tape so that the tape conforms to the threads. Apply at least 2 but no more than 3 layers of tape to the threads. Cut off excess tape, and press the end firmly into the threads.

Installing Deep and Tee Purges

1. Deep Purge (see Fig. 2): If necessary, remove the regulator's process gas inlet fitting*, and carefully remove the temporary brass snorkel protector from the purge. Install the process gas inlet fitting into the purge's 1/4" NPT female inlet port with snorkel tube. Do not damage the snorkel tube when installing the connection. Note: Inlet glands with an integral check valve are not compatible with the snorkel tube. For these glands, remove the snorkel tube.

Tee Purge (see Fig. 3): If necessary, remove the regulator's process gas inlet fitting*. Install the process gas inlet fitting into the purge's 1/4" NPT female inlet port.

*Note: Process gas inlet glands without wrench flats on the gland stem should be removed with a 6 point hex socket to prevent damage to the seating surface of the gland. Otherwise, remove and install the gland using an open-end wrench. Do not use a pipe wrench.

2. Install the Deep Purge or Tee Purge into the regulator's 1/4" NPT female inlet port (marked HP or HI) as shown in Fig.2 and Fig. 3.
3. Deep Purge (see Fig. 2): The purge gas inlet is located on the bottom of the Deep Purge. It is a stainless steel 1/4" compression tube fitting. Using 1/4" tubing, connect the Deep Purge process gas inlet to a purge gas regulator (a brass 402 Series or stainless steel 422 Series regulator is recommended). The Deep Purge exhaust is located on the top of the Deep Purge. It is a stainless steel 1/4" compression tube fitting. Pipe the Deep Purge exhaust to a safe discharge area.

Tee Purge (see Fig. 3): The purge gas inlet is located on the top of the Tee Purge. It is a 1/4" NPT female port. Connect the Tee Purge to your purge gas regulator or flowmeter (customer must provide an appropriate fitting).

4. Using an inert gas, leak test all connections before use. Note that even inert gases can build up in a confined area and become hazardous if the oxygen in the air is reduced to less than 19%.

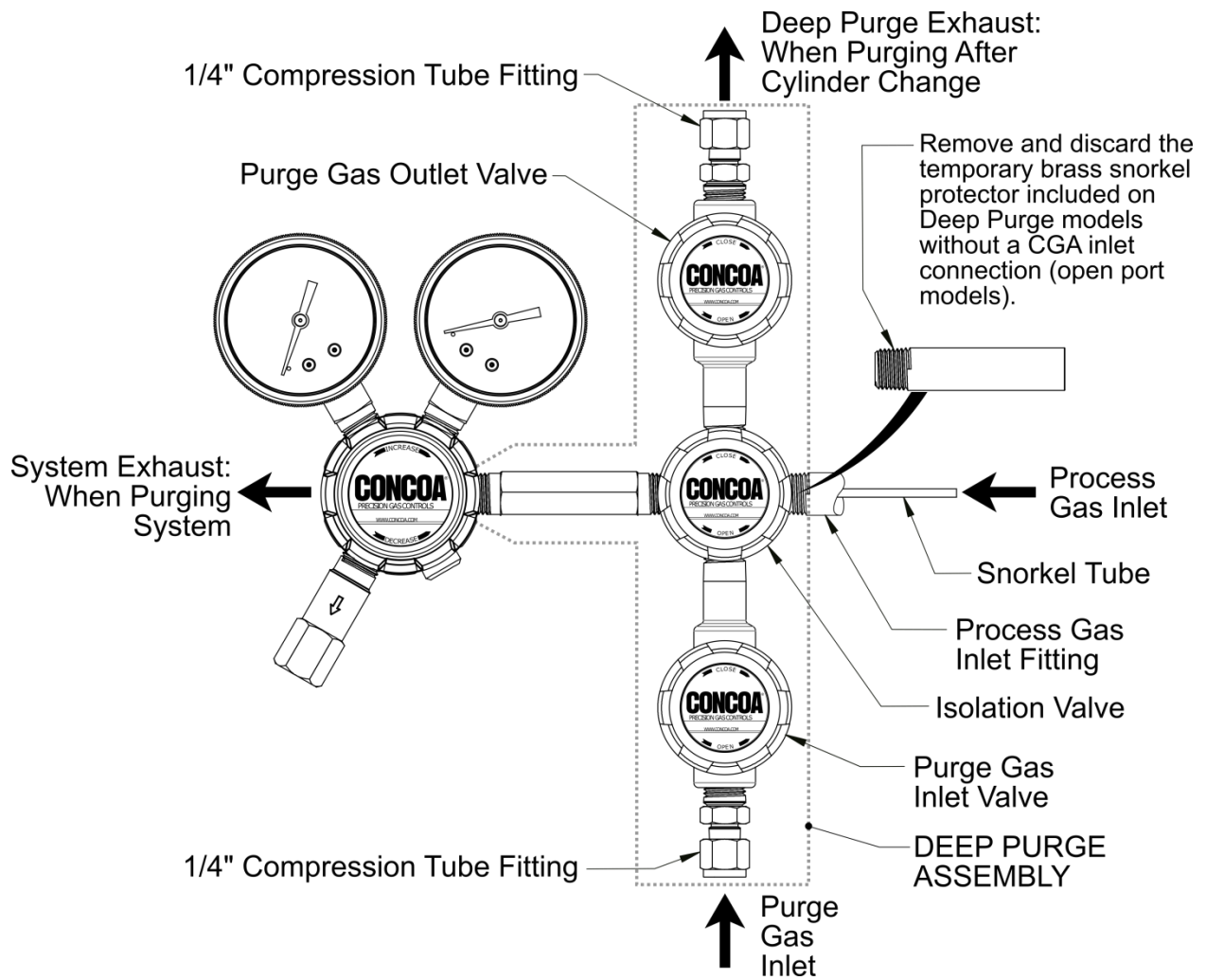


Figure 2. CONCOA Deep Purge

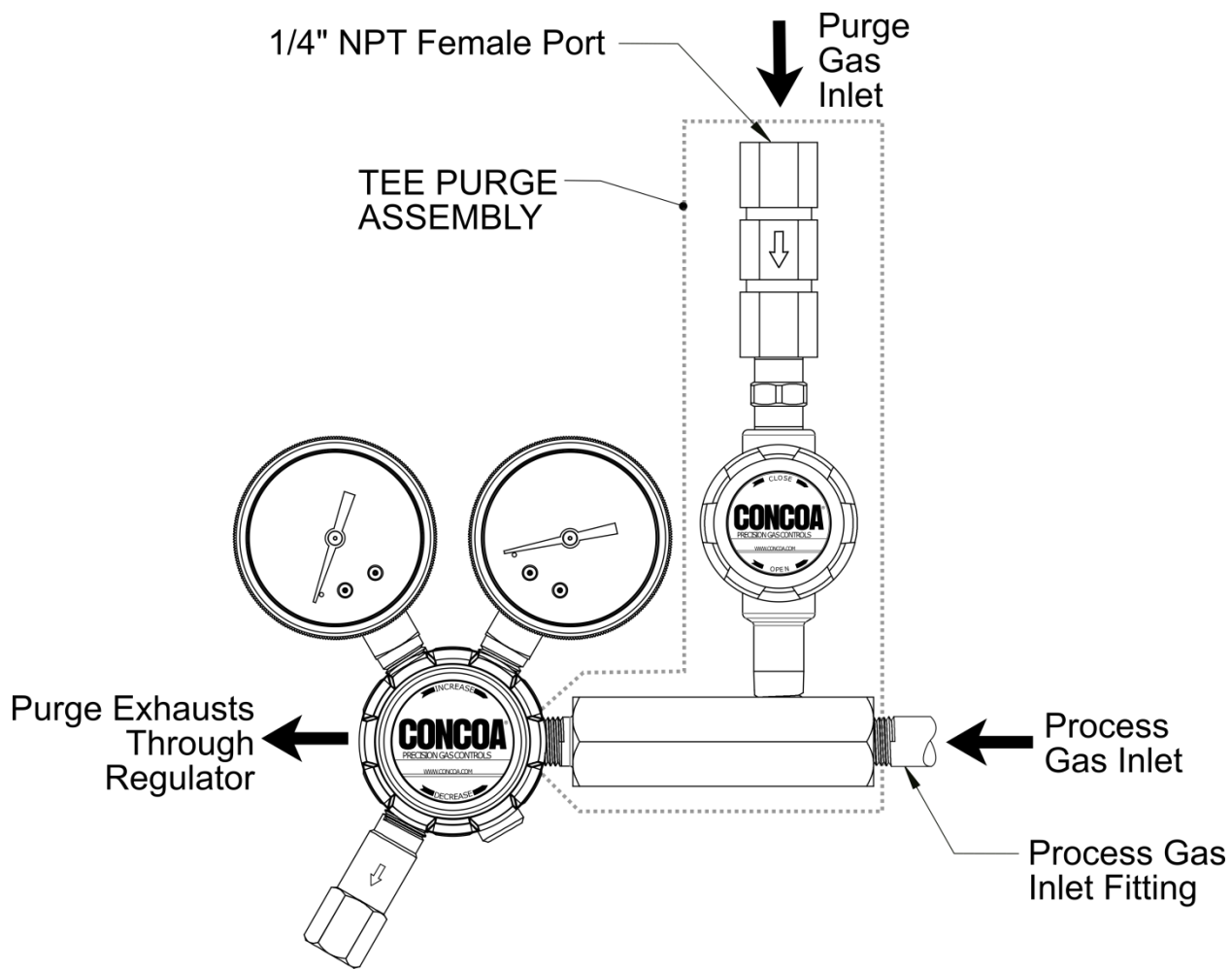


Figure 3. CONCOA Tee Purge

Installing Straight Purges

1. If necessary, remove the pipe plug from the regulator's auxiliary high pressure port (typically marked HP or HI). Install the straight purge into the open port as shown in Fig. 4.
2. The purge gas inlet is located at the end of the Straight Purge. It is a ¼" NPT female port. Connect the Straight Purge to a purge gas regulator (a brass 402 Series or stainless steel 422 Series regulator is recommended).
3. Using an inert gas, leak test all connections before use. Note that even inert gases can build up in a confined area and become hazardous if the oxygen in the air is reduced to less than 19%.

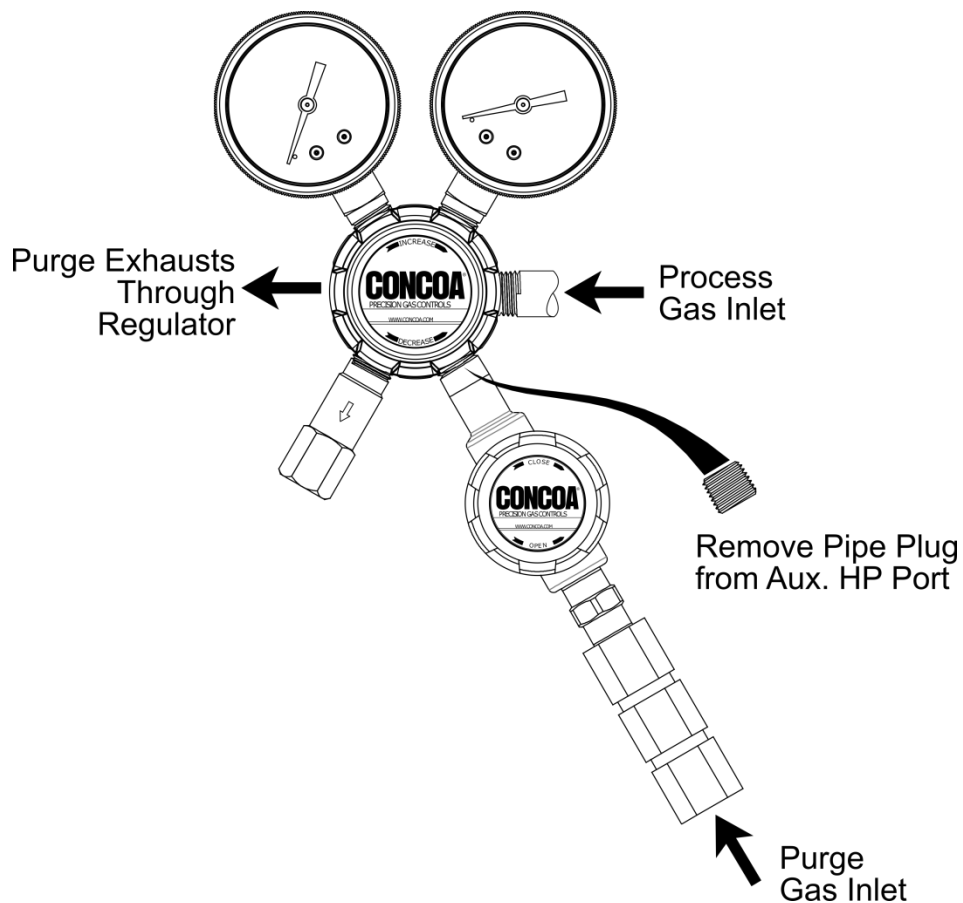


Figure 4. CONCOA Straight Purge

PURGE OPERATION

The following instructions cover methods commonly used with CONCOA specialty equipment, and they provide a general guideline of the methods and procedures to follow when venting and purging the gas in a simple system to a safe discharge area. Complex systems may require different procedures to remove the unwanted gas. Required procedures need to be evaluated on an individual basis. For higher purity systems and corrosive, toxic, flammable, or oxidizing gases, use a pure dry inert gas such as grade 4.5 to 5.0 nitrogen or grade 4.5 to 5.0 argon. Do not unnecessarily leave the system open to the atmosphere after purging. Doing so may result in the need for additional purging to remove atmospheric contamination.

POSITIVE DISPLACEMENT PURGING (Deep Purge only):

Positive displacement purging removes unwanted gases and contaminants from the system by physically pushing the gases out the purge exhaust. This method is suitable for systems with long runs of tubing, and little or no dead space. Purge gas flow should be slow to avoid mixing with the system gases to be removed. Positive displacement purging requires the Deep Purge.

Cylinder Change Positive Displacement Purging with the Deep Purge (see Fig. 2):

1. Ensure that the purge gas inlet valve is closed, and close the process gas supply cylinder valve.
2. Close the center isolation valve on the Deep Purge. This will shut off the process gas supply to the regulator.
3. Slowly open the purge gas outlet valve to vent trapped process gas on the high pressure side of the system to a safe discharge area.
4. Open the purge gas inlet valve, and allow the purge gas to flow for the calculated period of time (see Appendix 1) to reach the desired system purity.
5. Close the purge gas inlet valve, and allow the system to vent the remaining purge gas. Close the purge gas outlet valve after venting the purge gas.
6. Change the process gas cylinder.
7. Repeat steps 3-5 to remove the air trapped in the system after changing the cylinder.
8. If it is necessary to purge the purge gas, open the purge gas outlet valve, and then open the process gas cylinder valve a small amount. This will allow the process gas to push the purge gas from the system. Close the purge gas outlet valve when purging is complete.
9. After all purging has been accomplished, open the isolation valve on the Deep Purge.

Complete System Positive Displacement Purging with the Deep Purge (see Fig. 2):

For extended periods of shut down, it is recommended that the complete system be purged. A downstream vent valve must be installed so the system can be fully swept with the purge gas. Do not install the vent valve so that a dead volume is created when purging. Use the following procedure to perform a positive displacement purge on the entire system with the Deep Purge assembly:

1. Close the cylinder valve on the process gas supply cylinder.
2. Turn the adjusting knob on the regulator clockwise to open the regulator seat.
3. Keep the center isolation valve on the Deep Purge open.
4. Open the downstream vent valve, and vent the process gas to a safe location.
5. After venting the gas in the system, slowly open the purge gas inlet valve. Allow the purge gas to flow through the regulator and out the downstream vent valve for the calculated period of time to reach the desired level of purity. See Appendix 1 for calculating the purge time required.
6. Upon completion of the purge, close: a) the downstream vent valve; b) the Deep Purge isolation valve; and c) the purge gas inlet valve. Closing the valves in this order will maintain a positive pressure in the system, prevent back flow of air into the system, and maintain an inert atmosphere within the system.

PRESSURE CYCLE PURGING:

Pressure cycle purging is used on complex systems with dead end passages where a steady flow of gas cannot flush all areas of the system. This method of purging a regulator is best suited for a Straight Purge or a Tee Purge (a Deep Purge can be used, but the Deep Purge exhaust will serve no purpose). When a Tee Purge or a Straight Purge is used on a regulator, the cylinder connection to the regulator is a dead end passage that can only be purged by pressure cycle purging. A typical system designed for pressure cycle purging will include a block valve and a bleed valve downstream from the regulator.

1. Close the cylinder valve on the process gas cylinder.
2. Turn the adjusting knob on the regulator clockwise to open the regulator seat.
3. Close the downstream block valve and carefully open the bleed valve to vent process gas from the system to a safe discharge area.
4. Close the bleed valve, and open the purge gas valve on the Straight or Tee Purge. Allow gas pressure to equalize in the system. This may take 15 seconds or more.
5. Once the pressure has equalized, close the purge gas valve on the Straight or Tee Purge. Wait an additional 15 seconds to allow the gases in the system to completely mix.
6. Open the bleed valve to exhaust the gases from the system to a safe discharge area.
7. Repeat steps 3-5 as many times as needed to reach the desired gas purity. Use the formulas in Appendix 2 to calculate the number of purge cycles required.

Vacuum assisted exhaust purging may be done at the end of each purge cycle to improve the efficiency of the purge process.

If a cylinder change is made after purging, repeat steps 1-6 to remove atmospheric contamination that has entered the system. Additional purging with the process gas may be done if removal of the purge gas from the system is desired.

MAINTENANCE

At regular intervals, the purge assembly should be checked for leaks and proper function (see TROUBLESHOOTING). Any leaks in the system should be corrected immediately.

SERVICE

A unit that is not functioning properly should not be used. It is recommended that all servicing be done by a service facility authorized by CONCOA. Prior to returning equipment to CONCOA for warranty or non-warranty repair, contact the Customer Service Department (see CUSTOMER SERVICE).

If so advised, the unit should be sent to a service facility authorized by CONCOA, adequately packaged, in the original shipping container if possible, and shipped prepaid, with a statement of observed deficiency. The gas service that the equipment has been subjected to must be clearly identified. All equipment must be purged before shipment to protect the transporter and service personnel. The purging is especially important if the equipment has been in toxic, corrosive, flammable, oxidizing, or other hazardous gas service. Return trip transportation charges are to be paid by Buyer. In all cases other than where warranty is applicable, repairs will be made at current list price for the replacement part(s) plus a reasonable labor charge.

TROUBLE SHOOTING

Typical symptoms listed below indicate malfunctions needing repair. Replace immediately with a clean, repaired and tested, or new system.

<i>Symptom</i>	<i>Probable Cause</i>
Gas leakage from any pipe thread joint.	Loose fitting. Remove connection, clean it, reapply PTFE tape, and retighten.
Diaphragm valve fails to cut off gas flow when closed.	Damaged or faulty valve seat. Replace valve.
System makes a humming noise.	Capsule failure: Have the regulator repaired or replaced.

Step 5:

Determine a reasonable working flow rate for the purge gas, and divide it into the required volume (V_r) to obtain the purging time to achieve the desired purity. Be sure the units are the same.

T = Required Purging Time

F = Purge Gas Flow Rate

$$T = \frac{V_r}{F} = \underline{\hspace{4cm}} = \underline{\hspace{4cm}}$$

APPENDIX 2

With pressure cycle purging, dilution of the contaminant occurs approximately as the ratio of the purge exhaust pressure to the purge applied pressure. Units must be expressed in absolute pressure (PSIA) instead of gauge pressure (PSIG). The two examples below show the advantage of using a vacuum to assist purging. Please note the pressure throughout the system is the same.

Atmospheric Pressure = Patm = 14.7 PSI

PSIG = Gauge Pressure = Pressure Above Atmospheric Pressure

PSIA = PSIG + Patm

PSIG = PSIA - Patm

Example 1 (.25atm Vacuum Assist):

Purge Applied Pressure = 60 PSIG

Vacuum Assist = .25atm

$$\text{Dilution for Each Cycle} = \frac{\text{Exhaust Pressure}}{\text{Purge Applied Pressure}} = \frac{.25\text{atm (14.7 PSI/atm)}}{60 \text{ PSIG} + 14.7 \text{ PSI}} = \frac{3.675 \text{ PSIA}}{74.7 \text{ PSIA}} = .05$$

Example 2 (No Vacuum Assist):

Purge Applied Pressure = 60 PSIG

Vacuum Assist = 0

$$\text{Dilution for Each Cycle} = \frac{\text{Exhaust Pressure}}{\text{Purge Applied Pressure}} = \frac{1\text{atm (14.7 PSI/atm)}}{60 \text{ PSIG} + 14.7 \text{ PSI}} = \frac{14.7 \text{ PSIA}}{74.7 \text{ PSIA}} = .197$$

If starting with an initial concentration of 1,000,000 parts per million (undiluted process gas), the vacuum assist purge method in example 1 above would yield a concentration of $1,000,000 \times 0.05 = 50,000$ parts per million after one purge. Without using the vacuum assist (example 2 above), one purge would yield a concentration of $1,000,000 \times 0.197 = 197,000$ parts per million.

To calculate the number of cycles needed for purging, use the equation below:

N = Number of Cycles Required to Reach Cf

C₀ = Initial Concentration (parts per million)

C_f = Targeted Final Acceptable Concentration (parts per million)

P₁ = Purge Exhaust Pressure (PSIA)

P₂ = Purge Applied Pressure (PSIA)

$$N = \frac{\log_{10} C_f - \log_{10} C_0}{\log_{10} P_1 - \log_{10} P_2} = \frac{\log_{10} \text{---} - \log_{10} \text{---}}{\log_{10} \text{---} - \log_{10} \text{---}} = \text{---}$$

Example 1a (.25atm Vacuum Assist, see Example 1 above):

C₀ = 1,000,000 C_f = 50 P₁ = .25atm = 3.675 PSI P₂ = 60 PSIG = 74.7 PSIA

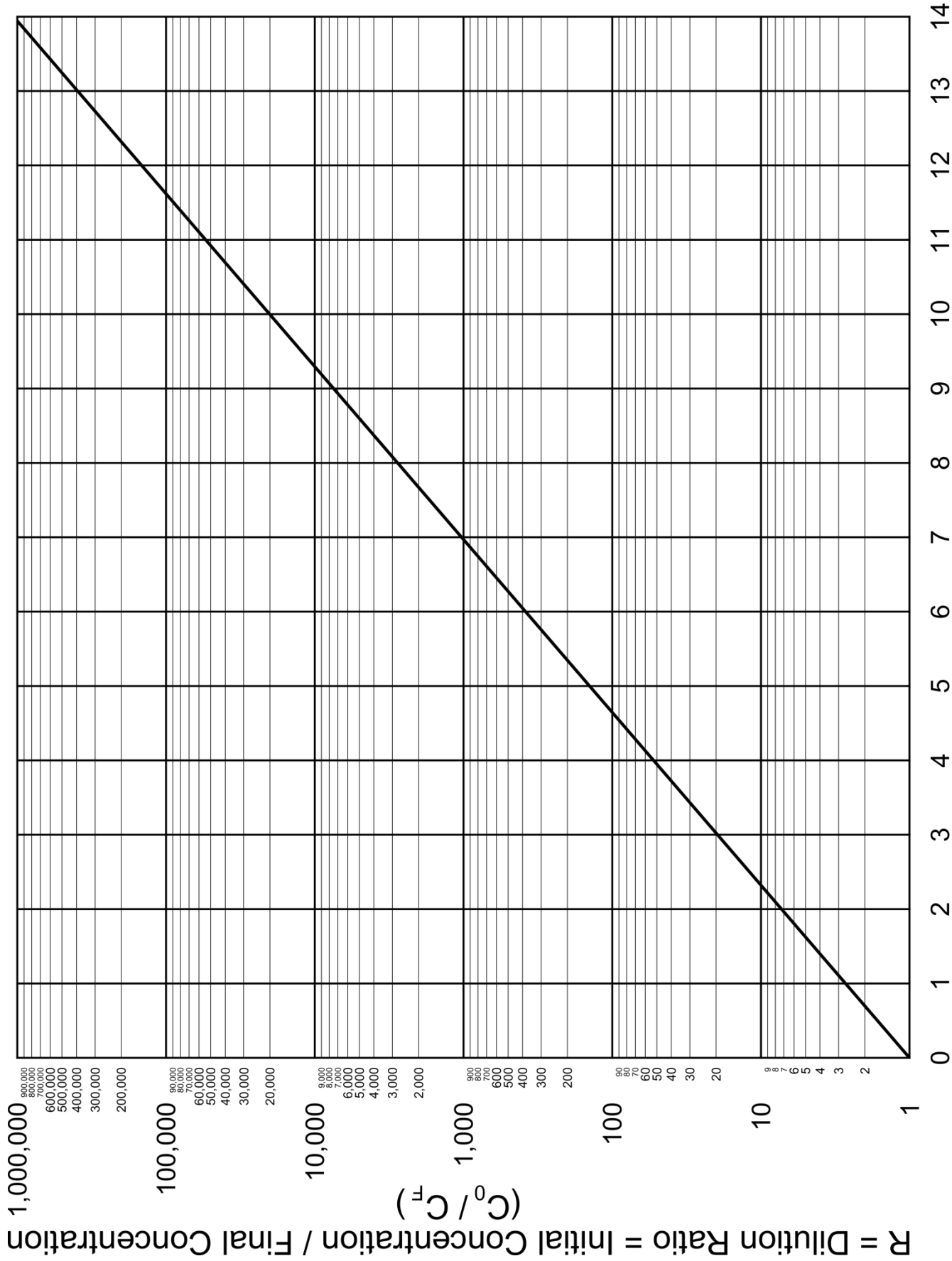
$$N = \frac{\log_{10} 50 - \log_{10} 1,000,000}{\log_{10} 3.675 - \log_{10} 74.7} = \frac{1.700 - 6}{.565 - 1.873} = \frac{-4.300}{-1.308} = 3.3 \rightarrow 4 \text{ Cycles Required}$$

Example 2a (No Vacuum Assist, see Example 2 above):

C₀ = 1,000,000 C_f = 50 P₁ = 1atm = 14.7 PSI P₂ = 60 PSIG = 74.7 PSIA

$$N = \frac{\log_{10} 50 - \log_{10} 1,000,000}{\log_{10} 14.7 - \log_{10} 74.7} = \frac{1.700 - 6}{1.167 - 1.873} = \frac{-4.300}{-.706} = 6 \text{ Cycles Required}$$

When purging a system where multiple pressures may be present, it will be necessary to separate each pressure region into a separate system when calculating the number of purges required. When purging down to very low concentrations (less than 1.0 ppm), add at least 5 volumes to N for increased assurance.



X = Number of Vessel Volumes of Inert Purge Gas Required for Positive Displacement Purging

Warranty Information

This equipment is sold by CONTROLS CORPORATION OF AMERICA under the warranties set forth in the following paragraphs. Such warranties are extended only with respect to the purchase of this equipment directly from CONTROLS CORPORATION OF AMERICA or its Authorized Distributors as new merchandise and are extended to the first Buyer thereof other than for the purpose of resale.

For a period of one (1) year from the date of original delivery (90 days in corrosive service) to Buyer or to Buyer's order, this equipment is warranted to be free from functional defects in materials and workmanship and to conform to the description of this equipment contained in this manual and any accompanying labels and/or inserts, provided that the same is properly operated under conditions of normal use and that regular periodic maintenance and service is performed or replacements made in accordance with the instructions provided. The foregoing warranties shall not apply if the equipment has been repaired: other than by CONTROLS CORPORATION OF AMERICA or a designated service facility or in accordance with written instructions provided by CONTROLS CORPORATION OF AMERICA, or altered by anyone other than CONTROLS CORPORATION OF AMERICA, or if the equipment has been subject to abuse, misuse, negligence or accident.

CONTROLS CORPORATION OF AMERICA's sole and exclusive obligation and Buyer's sole and exclusive remedy under the above warranties is limited to repairing or replacing, free of charge, at CONTROLS CORPORATION OF AMERICA's option, the equipment or part, which is reported to its Authorized Distributor from whom purchased, and which if so advised, is returned with a statement of the observed deficiency, and proof of purchase of equipment or part not later than seven (7) days after the expiration date of the applicable warranty, to the nearest designated service facility during normal business hours, transportation charges prepaid, and which upon examination, is found not to comply with the above warranties. Return trip transportation charges for the equipment or part shall be paid by Buyer.

CONTROLS CORPORATION OF AMERICA SHALL NOT BE OTHERWISE LIABLE FOR ANY DAMAGES INCLUDING BUT NOT LIMITED TO: INCIDENTAL DAMAGES, CONSEQUENTIAL DAMAGES, OR SPECIAL DAMAGES, WHETHER SUCH DAMAGES RESULT FROM NEGLIGENCE, BREACH OF WARRANTY OR OTHERWISE.

THERE ARE NO EXPRESS OR IMPLIED WARRANTIES WHICH EXTEND BEYOND THE WARRANTIES HEREINABOVE SET FORTH. CONTROLS CORPORATION OF AMERICA MAKES NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE EQUIPMENT OR PARTS THEREOF.



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