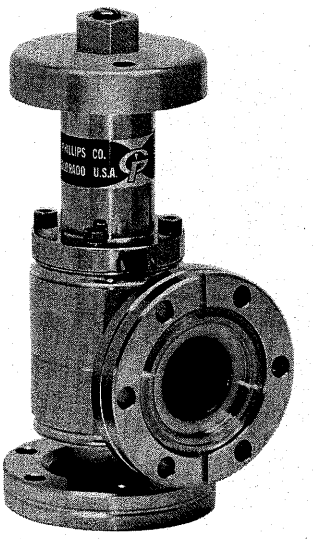
GRANVILLE-PHILLIPS



Installation and Operating Instructions 204018 101 For Series 204, 1 Inch Gold Seal Ultra-High Vacuum Valve

SAFETY HAZARDS

DO NOT use valve with positive internal pressure.

1. IMPORTANT PRECAUTIONS

The Gold Seal Ultra-High Vacuum Valve is a precision instrument manufactured under critical control to produce results which are orders of magnitude better than valves with organic seals. Successful use is dependent upon strict adherence to the procedures specified in these instructions. The metal-to-metal seal is particularly susceptible to damage by excessive temperatures, scratches, foreign particles, improper use, and careless bakeout procedures. However, properly cared for and used in accordance with the following suggestions, your valve will provide long and reliable service.

DO NOT remove the valve from its container until these instructions are understood.

DO NOT remove the port covers until the valve is mounted and ready to be connected to the vacuum system so contaminants will not enter the valve.

DO NOT support the valve by the valve ports only. Do not weld directly to the valve body, or tighten the mounting U-bolts excessively.

DO NOT apply more torque than necessary to produce a closing seal.

2. DESCRIPTION

2.1 COMPONENTS

The valve consists of a non-bakeable Driver Assembly and a bakeable Valve Body Assembly. The Driver Assembly controls valve conductance. The valve is held in the open position during bakeout by a Bakeout Pin. A stainless steel mounting bracket is available and permits mounting the valve in a variety of positions. Fig. 1 identifies and shows the proper location of all valve components. Fig. 3 shows mounting dimensions.

2.2 DESIGN AND CONSTRUCTION DETAILS

The valve seal is produced by compressing a very thin film of gold, plated on the precision knife edge of the Nosepiece, against a specially processed sealing surface in the Valve Body.

This unique seal depends on **strict cleanliness and proper closing torque** for its continued dependability. In routine tests, stock Series 204 Gold Seal Valves have been sealed mass spectrometer leak tight over 1000 consecutive times without evidence of seal deterioration.

The Nosepiece motion seal in the Valve Body Assembly is provided by the compact, welded, stainless steel Bellows which permits the Nosepiece of the Series 204 valve to be retracted approximately ¾ inch from the sealed position.

3. INSTALLATION

3.1 CLEANLINESS

Keep the entire valve as clean as possible at all times. Do not remove the port covers until the valve is ready for installation in the vacuum system. Always keep the components in clean polyethylene bags when not in use. Contamination such as dust, dirt, film, lint, oxide scale, glass chips, metal chips, and corrosive materials can permanently damage the valve. Every known case of failure of valves to seal properly has been caused by contamination of the valve seal or contamination of the Driver Assembly lubricant, causing insufficient sealing force. For this reason, pass only clean, dry gas through the valve and keep the Driver Assembly clean.

3.2 MOUNTING

3.2.1 General

The valves may be mounted rigidly in any position using a Granville-Phillips Mounting Bracket or similar mounting device as shown in Fig. 3. The valve should NOT be supported solely by its port connections wherever possible,

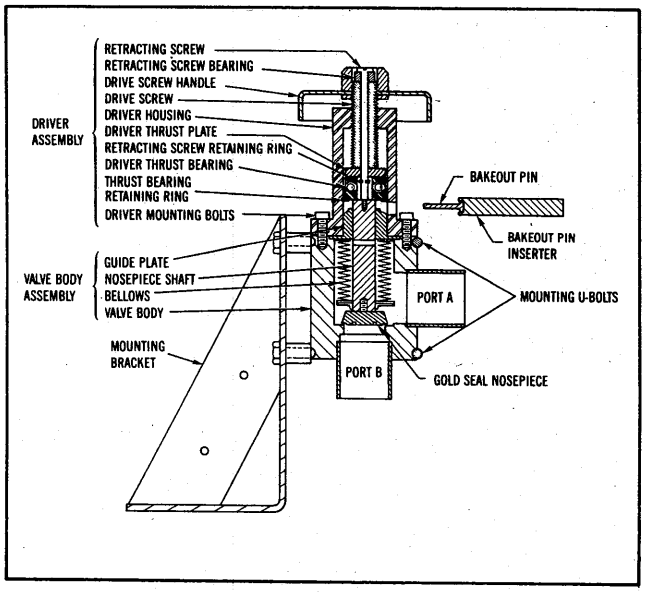


Figure 1. Sectional View of Series 204, 1 Inch Gold Seal Valve

and welds should not be made to the Valve Body in any instance. Do not tighten the Mounting U-bolts excessively or the valve may be deformed and ruined.

Arrange the valve with other system components so that they will be in good alignment when the connections are made. When installing, be sure to leave adequate clearance for removal of the Driver Assembly and installation of the Bakeout Pin for bakeout.

3.2.2 Flange Connections

Granville-Phillips' rotatable CuSeal* Flanges are provided on all flanged valves as standard equipment. CuSeal* is Granville-Phillips' name for UHV flanges manufactured under license from Varian Associates, Inc. which are compatible with ConFlat** Flanges. CuSeal* Flanges will also mate with most other types of copper gasketed flanges supplied by major manufacturers.

A new, clean OFHC copper gasket must be inserted between each pair of mating flanges during installation. Take care not to mar the gasket surfaces. Lubricate the flange bolt threads and heads with a high temperature thread lubricant such as Jet Lube SS30 (manufactured by Jet Lube Inc., 3093 N. California St., Burbank, California) for increased bolt efficiency for making the flange seal and for prevention of galling upon bolt removal. Insert the flange bolts and tighten them evenly until the surfaces of both flanges are in contact. Use only Type 18-8 Stainless Steel bolts for connecting the flanges. Other bolt materials have different co-efficients of expansion than the flanges and may not maintain a good seal during temperature cycling. Refer to data sheet 214 646 for part numbers of bolt, nut, and washer sets.

Properly installed flange connections will remain leak free though many ultra-high vacuum bakeouts to 450°C, if not subjected to extreme mechanical stresses.

3.2.3 Welding Connections

Welding connections are 1.00 inch o.d. x 0.035 inch wall on the Series 204 valve. Port connections are Type 304 Stainless Steel which welds readily to other Series 300 Stainless Steel except for the free machining grades. It is important that an inert atmosphere inside the valve be maintained in all welding operations to prevent the formation of an oxide scale which might enter the valve and cause failure of the valve seal.

3.2.4 Glass Connections

Welding Kovar-glass connections directly to valve ports is not recommended on these valves since Nosepiece removal through this type connection is not practical. It is suggested that connections to glass systems be made through a flanged glass seal offered by various manufacturers. The glass seal should be flanged to mate with the Series 204 flanged valve.

Flanged glass seals with metal bellows are desirable in reducing the stresses commonly encountered in glass or glass-metal systems. To prevent the collapse of large metal bellows due to atmospheric pressure and the resultant damage to system components from stresses, it is recommended that the non-collapsing bellows style be used in systems where bellows collapsing could be a problem.

* Trade Mark of Granville Phillips Company

**Trade Mark of Varian Associates, Inc.

4. VALVE OPERATION (See Fig. 1)

4.1 OPENING VALVE

The Driver Assembly contains the fine pitch Drive Screw which turns in the Driver Housing. The Drive Screw is fitted with a ¾ inch hex head nut to permit unsealing with a wrench and is also fitted with the Drive Screw Handle for rapid opening by hand.

Open the valve by rotating the drive Screw Handle counterclockwise as viewed from the handle end. This may require up to 14 ft.lbs. initially, depending upon the torque previously used to seal the valve. The valve is fully opened after approximately 29 full turns of the Drive Screw Handle. A built-in stop prevents opening the valve too far. Do not force the Drive Screw against the stop.

The conductance of the Series 204 valve may be varied smoothly and easily from about 10 liters/second to less than 10^{-13} liter/second.

4.2 Closing Valve

Close the valve by rotating the Drive Screw Handle clockwise with the fingers until it bottoms. Apply minimum torque to the ¾ inch hex head nut of the Drive Screw to obtain the desired seal. A torque wrench must be used for reproducible torques and optimum life. See Table I for typical sealing torques.

4.3 Closing Torques

A mass spectrometer leak tight seal was obtained at the time your valve was shipped from the factory by torquing the valve to the value written on the yellow inspection tag attached to your valve. Use this torque as a guide in adjusting your valve.

Table I shows the sealing torque required for typical valves for the two conditions stated. Thus, for example, once it has been determined that a particular Series 204 valve requires 7 and 11 ft.lbs., respectively, for the two conditions shown in Table I, this valve will continue to require these two values of torque except for improper valve care.

Closing torques will normally increase slightly with extended use. Torques higher than necessary will greatly shorten the life of the valve seal. If the valve will not seal at normal closing torques, the Drive Screw or Driver Thrust Bearing may be dirty or not well lubricated. This is the most common cause of failure of a valve to seal and can easily be remedied by cleaning and relubricating the Driver Assembly. Refer to Cleaning and Lubricating instructions in Paragraph 6.1.

5. BAKEOUT PROCEDURES

5.1 PREPARATION FOR BAKEOUT

The Driver Assembly must be removed for high temperature bakeout during which time the valve is held in the open position by the Bakeout Pin. To prepare the valve for bakeout refer to Fig. 1 and proceed as follows:

5.1.1 Turn the Drive Screw Handle counterclockwise to the completely open position so that the hole in the side of the Driver Housing is visually in line with the hole in the Nosepiece Shaft.

5.1.2 Insert the Bakeout Pin through the hole in the Nosepiece Shaft using the Bakeout Pin Inserter.

5.1.3 Turn the Drive Screw Handle clockwise and gently advance the Nosepiece Shaft until the Bakeout Pin is held firmly in place. Do not turn the Drive Screw Handle too much as the Bakeout Pin will be bent.

5.1.4 Unscrew and remove the Bakeout Pin Inserter.

VALVE CONDITION	SERIES 204 1 INCH VALVE
Valve Seal exposed to atmosphere since last bakeout open.	5-8 ft.lbs.
Valve Seal retained at low pressure since last bakeout open.	10-14 ft.lbs.

Table I. Approximate Sealing Torques for a Typical Range of Gold Seal Valves

CAUTION

Never remove the Retracting Screw unless the Bakeout Pin is securely in place. To do so will allow the Nosepiece to fall against the valve seat and destroy the knife edge seal.

5.1.5 Loosen the Retracting Screw completely to disengage the Driver Assembly from the Nosepiece Shaft.

5.1.6 Remove the four Driver Mounting Screws attaching the Driver Assembly to the Valve Body.

5.1.7 Lift off the Driver Assembly and immediately place it in a clean, new polyethylene bag to keep the driver mechanism free of dirt and other contaminants. **This precaution is extremely important.**

5.1.8 The valve is now fully open and ready for bakeout.

5.2 BAKEOUT

The valve should be baked at temperatures above 250°C only in the open position with the Driver Assembly removed. When open with the Driver Assembly removed, bakeout temperatures up to 450°C may be safely used if low pressures are maintained to minimize oxidation of the interior stainless steel surfaces.

The valve may be baked with the Driver Assembly attached and in the closed position at temperatures not exceeding 250°C. Both sides of the valve seal must be protected by low pressure or an inert atmosphere during these bakeout procedures.

When baking the valve in the open position at temperatures between 150°C and 250°C, the Driver Assembly should be removed to extend the driver lubricant life.

Temperatures should be raised slowly since large quantities of gas may be evolved during the initial stages of bakeout. Do not bake longer than necessary. Excessive baking will shorten the useful life of the valve. However, valves of this design have been baked at 450°C in non-corrosive atmospheres for several hundred hours without sign of seal deterioration.

5.3 AFTER BAKEOUT

After the valve has cooled, the Driver Assembly is replaced as follows:

5.3.1 Turn the Drive Screw Handle counterclockwise so that the Driver Assembly is in the full open position. Refer to Section 4, Valve Operation. If the Driver Assembly is attached to the Valve Body with the drive mechanism not fully retracted, the Bakeout pin will be sheared on the Guide Plate.

5.3.2 Carefully place the Driver Assembly on the Valve Body Assembly with the hole in the Driver Housing in line with the threaded end of the Bakeout Pin.

5.3.3 Install and tighten the four Driver Mounting Screws.

5.3.4 Gently turn the Drive Screw Handle clockwise until the Drive Screw and Driver Thrust Bearing bottom on the Nosepiece Shaft.

5.3.5 Engage the Nosepiece Shaft with the Retracting Screw and tighten the Retracting Screw securely, but do not use excessive force.

5.3.6 Engage the Bakeout Pin with the Bakeout Pin Inserter.

5.3.7 Gently turn the Drive Screw Handle counterclockwise until the Bakeout Pin is free, and remove the Bakeout Pin.

5.3.8 The valve is now reassembled in the open position and ready for use.

6. VALVE MAINTENANCE

6.1 CLEANING AND LUBRICATING THE DRIVER ASSEMBLY

6.1.1 Disassembly (See Fig. 1)

6.1.1.1 Remove the Driver Assembly as described in Paragraph 5.1, Preparation for Bakeout.

6.1.1.2 Remove the Thrust Bearing Retaining Ring and Driver Thrust Bearing from the Driver Housing.

6.1.1.3 Remove the Retracting Screw Retaining Ring from the Retracting Screw, and remove the Retracting Screw and Retracting Screw Bearing from the Drive Screw.

6.1.1.4 Remove the Driver Thrust Plate from the Driver Housing. The Driver Thrust Plate is a close fit in the Driver Housing and tends to cock in the Driver Housing so that it will not freely drop out. With the Driver Housing held upright, insert the Retracting Screw into the Driver Thrust Plate through the bottom of the Driver Housing and rapidly oscillate it sideways. The Driver Thrust Plate will then fall out of the Driver Housing.

6.1.1.5 Unscrew the Driver Screw from the Driver Housing.

6.1.1.6 The parts are now ready for cleaning and lubricating.

6.1.2 Cleaning

6.1.2.1 Vigorously scrub all threads with a brush while rinsing with 1,1,1 trichloroethane (Chlorothene NU).

6.1.2.2 Clean all parts except the Driver Housing (which bears a label) in an ultra-sonic degreaser. If one is not available, wash and scrub all parts with a non-oil base solvent until completely clean. Recommended solvents are trichloroethylene or 1,1,1 trichloroethane. Do not use oily base or other solvents which leave a residual film on the parts.

6.1.2.3 Air dry all parts in a dust free atmosphere. Do not dry the parts by rubbing with any type of absorbent material.

6.1.3 Lubricating

6.1.3.1 The recommended lubricant for these valves is molybdenum disulfide (Molykote®, G-n paste, Dow Corning Corp., Midland, Mich., 48640). DO NOT use light oils, greases, or other materials which may enter the Bellows in the Valve Body Assembly and cause damage during subsequent bakeouts. Graphite is completely unsuitable.

6.1.3.2 Do not overlubricate. Use amounts that will not clump when the parts are replaced in the Driver Housing. Lubricate the following parts with a thin coat of molybdenum disulfide:

Drive Screw
Driver Thrust Bearing
Driver Mounting Bolts

6.1.4 Reassembly (See Fig.1)

6.1.4.1. Install the Drive Screw through the top of the Driver Housing.

6.1.4.2 Install the Retracting Screw Bearing and the Retracting Screw in the top of the Drive Screw. Hold the Retracting Screw with a finger, turn the Driver Assembly upside down, install the Driver Thrust Plate and install the Retracting Screw Retaining Ring, making certain it is securely seated in its slot on the Retracting Screw.

6.1.4.3 Install the Driver Thrust Bearing into the Driver Housing and install the Thrust Bearing Retaining Ring just above the Bakeout Pin hole in the Driver Housing as shown in Fig. 1.

6.1.4.4 Install the assembled Driver Assembly on the Valve Body as described in Paragraph 5.3, After Bakeout.

6.1.4.5 The valve is now completely reassembled and ready for use.

6.2 INSTALLING NEW GOLD SEAL NOSEPIECE (See Fig. 2)

6.2.1 General

Note that the Nosepiece is not removable through a Kovar-Pyrex seal. The replacement nosepiece kit, Part No. 204 014 for Series 204 valves contains a new Gold Seal Nosepiece and two pairs of tweezers. These tweezers are the only tools used in the replacement of the Nosepiece.

6.2.2 Removal of Valve from System

6.2.2.1 Open the valve (Paragraphs 4.1) and install the Bakeout Pin (Steps 5.1.1 and 5.1.2).

6.2.2.2 Tighten the Drive Screw Handle finger tight against the Bakeout Pin.

6.2.2.3 Disconnect both ports of the valve from the system and remove the valve.

6.2.2.4 Make certain all contamination is excluded from the valve during handling.

6.2.3 Removal of Gold Seal Nosepiece

6.2.3.1 Lay the valve on its side on a clean work top and so there is room to look and work through both valve ports.

6.2.3.2 Thoroughly degrease both pairs of tweezers.

6.2.3.3. Insert one pair of tweezers into Port B and engage the tweezer prongs into the two indentations in the face of the Nosepiece as shown in Step **A** of Fig. 2. Do not damage the Nosepiece knife edge.

6.2.3.4 Turn the tweezers counterclockwise and gently loosen the Nosepiece threads. Maintain pressure on the tweezers to securely hold the Nosepiece and continue to loosen the Nosepiece until it is free.

6.2.3.5 While holding the Nosepiece securely with the first pair of tweezers, carefully insert the second pair of tweezers through Port A and clamp them around the threaded portion at the rear of the nosepiece as shown in Step **B** of Fig. 2.

6.2.3.6 While firmly holding the threaded portion, release the first pair of tweezers from the indentations in the face of the Nosepiece, and remove them from Port B.

6.2.3.7 Look into Port A and position the Nosepiece so that its maximum diameter will coincide with the inside diameter of the tubulation, and remove the Nosepiece through Port A as shown in Step **C** of Fig. 2. Note that the maximum diameter of the Nosepiece must be extracted on a diameter of the tubulation so that the valve is not damaged.

6.2.4 Installation of Gold Seal Nosepiece

6.2.4.1 Make certain that both pairs of tweezers are clean, and degrease them if necessary.

6.2.4.2 Make certain that the valve is fully open and the Bakeout Pin is installed.

6.2.4.3 Lay the valve on its side on a clean work top and so there is room to look and work through both valve ports.

6.2.4.4 Carefully remove the new Gold Seal Nosepiece from its container. Using one pair of tweezers, firmly grasp the new Nosepiece by the threaded portion, with the tweezers perpendicular to the axis of the threads.

6.2.4.5 Line up the maximum diameter of the Nosepiece with the diameter of the Port A tubulation. Carefully insert the new Nosepiece into Port A as shown in Step **C** of Fig. 2,, and position the threaded portion in line with the threads in the Nosepiece Shaft.

6.2.4.6 Insert the second pair of tweezers through Port B and engage the tweezer prongs into the two indentations in the face of the Nosepiece as shown in Step **B** of Fig. 2.

6.2.4.7 Apply pressure to the tweezers to securely hold the Nosepiece by the two indentations, release the first pair of tweezers, and remove them from Port A.

6.2.4.8 Push the threaded portion of the Nosepiece into the threads of the Nosepiece Shaft as shown in Step **A** of Fig. 2. Turn the Nosepiece clockwise until the threads engage. Continue to rotate the Nosepiece with the tweezers until it is finger tight, and then remove the tweezers.

CAUTION

Do not overtighten the Gold Seal Nosepiece. Do not permit the tweezers to slip out of the two indentations and hit the knife edge seal on the face of the Nosepiece. A slight nick in this knife edge will completely destroy the sealing qualities of the valve.

6.2.4.9 The valve is now ready for installation in the vacuum system.

6.3 VALVE STORAGE

When the valve must be stored for any length of time, close the valve to finger tight torque to protect the seal from contamination. Stopper the ports with rubber or plastic plugs, or cover them with aluminum foil. Corks are not suitable because of their tendency to break and crumble. Do not use tape on open port ends. Place the valve in a clean, new polyethylene bag when it is removed and not in use.

7. VALVE CHARACTERISTICS

7.1 WELDS

To insure uniform weld smoothness and freedom from both real and virtual leaks, all vacuum joints are inert gas welded on an automatic welder in all cases and are welded on the vacuum side in every case where possible. Each joint is tested immediately after welding on a helium mass spectrometer leak detector capable of detecting a leakage conductance of less than 1×10^{-13} liter/second. No detectable leaks are permitted.

7.2 MATERIALS

Metals in contact with vacuum are specially processed Types 304 Stainless Steel, and pure gold. No organic or high vapor pressure materials are in the vacuum enclosure.

7.3 TEMPERATURE RANGE

The valve with Driver Assembly attached is designed to operate at temperatures to 250°C without damaging the valve seal or the Driver Assembly. With the Driver Assembly removed and the valve held in the open position by the Bakeout Pin, the valve is bakeable for prolonged periods to 450°C if low pressures are maintained. When closed and sealed, it may be baked repeatedly to 250°C. The valve is not designed to be baked out to higher temperatures for long periods in the closed position because the degree of diffusion welding depends on time and temperature, and at temperatures much above 250°C, rapid diffusion welding occurs.

7.4 CONDUCTANCE

These Series 204 valves have a fully opened conductance port to port of about 10 liters/second for air in the molecular flow region. When fully closed, the leakage conductance is less than 10^{-13} liter/second both before and after bakeout.

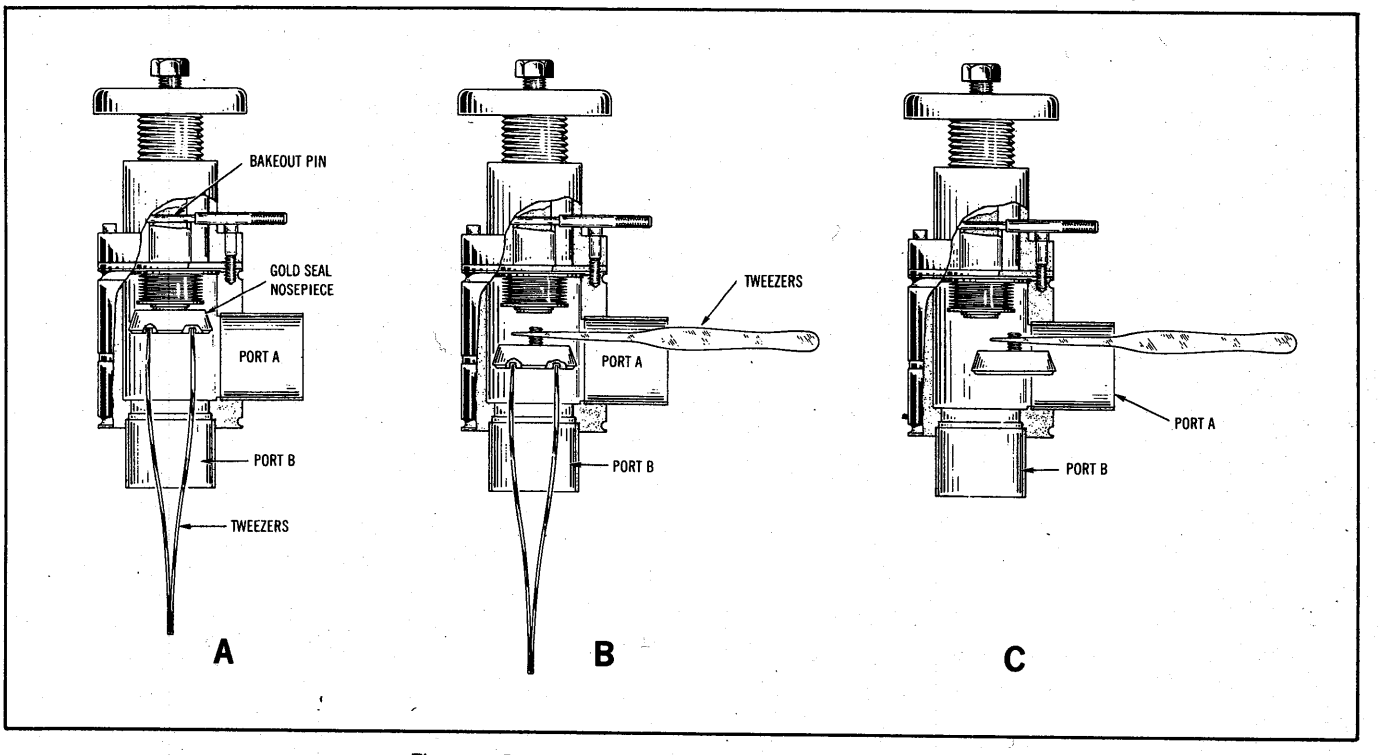


Figure 2. Removal and Installation of Gold Seal Nosepiece

SPECIFICATIONS

Materials

Seal . . . . . Pure gold and specially processed Type 304 Stainless Steel

All other interior surfaces . . . . . Specially processed Type 304 Stainless Steel

Physical Data

Bakeout temperature . . . . . 450°C, valve open, driver removed; 250°C valve open or closed, driver installed

Seal deformation vs. number of closures . . . . . Negligible

Increase in closing torque vs number of closures . . . . . Negligible

Nosepiece replacement . . . . . May be changed in the field with the Replacement Gold Seal Nosepiece Kit

Minimum Flow path, flange to flange, when fully open . . . . . 4.28 in

Maximum conductance for dry nitrogen at 25°C . . . . . 10 liters/sec.

Leakage conductance when fully closed . . . . . 10^{-13} liter/sec.

Nominal closing torque without bakeout . . . . . 5-8 ft.lbs.

Nominal closing torque after bakeout . . . . . 10-14 ft.lbs.

Standard connections . . . . . Type 304 Stainless Steel or CuSeal* flanges. Pyrex and Flex-Pryex connections welded to the valve ports are not recommended because their inside diameter is too small to permit replacement of the gold seal. If you need glass connections, we suggest they be made with a flanged glass seal.

* CuSeal flanges are manufactured to geometries licensed by Varian Associates, Inc. All CuSeal flanges are produced in-house by Granville-Phillips and conform to AVS Standard 3. 2-1965.

204 REPLACEMENT PARTS

Gold Seal Nosepiece Kit, Includes Tweezers	204014 401
Gold Seal Nosepiece Only	204008 401
Valve Body Assembly, Includes Gold Seal Nosepiece	204015 403
Valve Driver Assembly	204002 401
Retracting Screw	000065 102
Retracting Screw Bearing	000066 102
Drive Screw Handle	000059 102
Drive Screw	000043 201
Driver Housing	000042 203
Driver Thrust Plate	000045 202
Retracting Screw Retaining Ring	000068 100
Driver Thrust Bearing	005733 100
Thrust Bearing Retaining Ring	000067 100
Driver Mounting Bolts (4 Req'd)	000037 100
Mounting Bracket Assembly	006203 100
Bracket	000012 301
Bracket Spacer (2 Req'd)	000055 202
Mounting U-Bolt (2 Req'd)	000056 201
Bracket Nut (4 Req'd)	000081 100
Bakeout Pin	000054 202
Bakeout Pin Inserter	000053 201

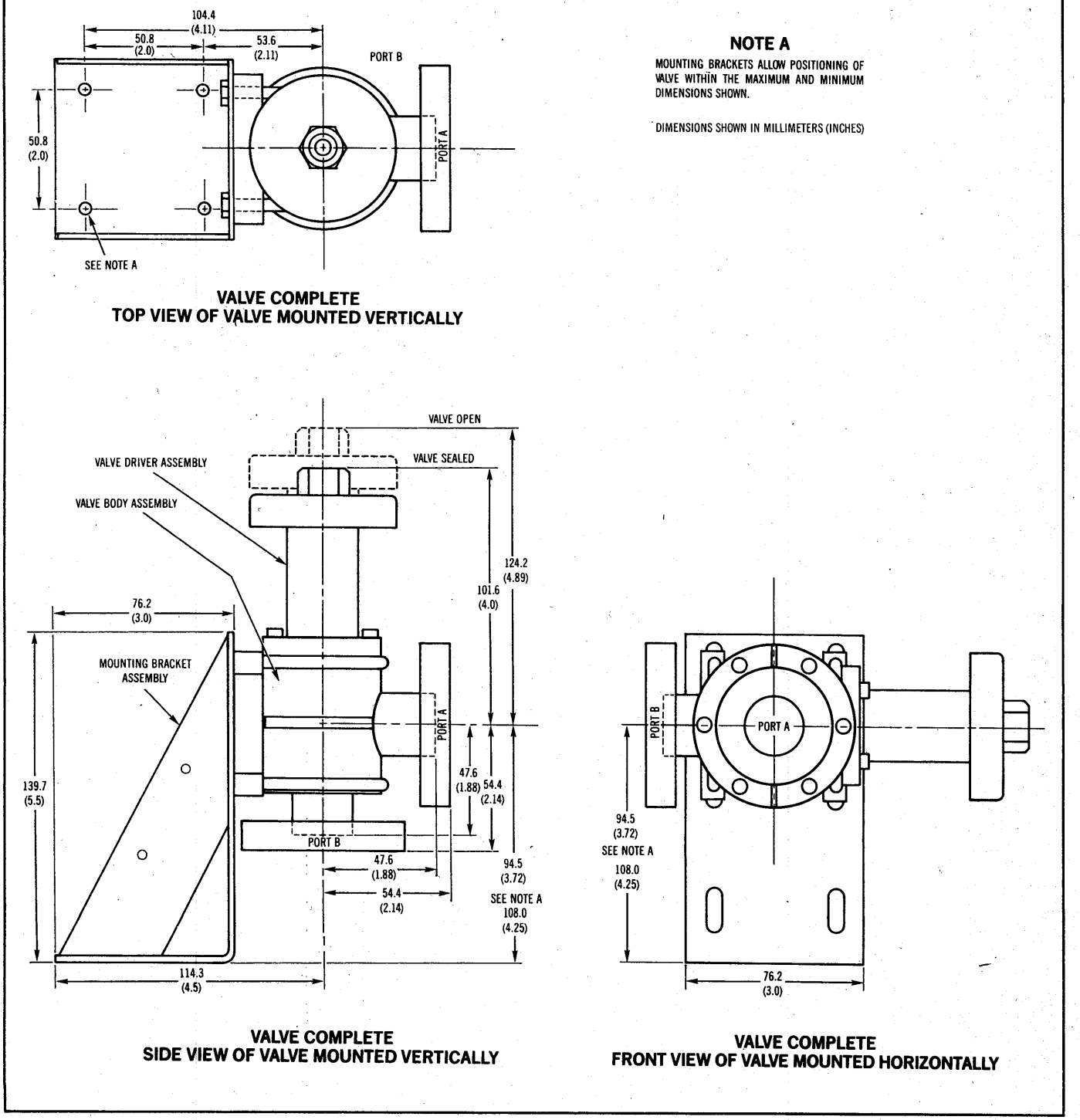


Figure 3. Mounting Dimensions for Series 204 Gold Seal Valves

CERTIFICATION

Granville-Phillips Company certifies that this product met its published specifications at the time of shipment from the factory.

LIMITED WARRANTY

This Granville-Phillips product is warranted against defects in materials and workmanship for one year from the date of shipment provided the installation and preventive maintenance procedures specified in this instruction manual have been followed. Granville-Phillips Company will, at its option, repair or replace or refund the selling price of an item which proves to be defective during the warranty period provided the item is returned to Granville-Phillips Company together with a written statement of the problem.