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107428-P1
Rev L, 8/06

MKS Type 248A/B/C
Control Valve

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Safety Procedures and Precautions

The following general safety precautions must be observed during all phases of operation of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of intended use of the instrument and may impair the protection provided by the equipment. MKS Instruments, Inc. assumes no liability for the customer's failure to comply with these requirements.

Warning 

Before performing mass flow controller valve adjustments, you MUST purge your process equipment and the MFC with an inert gas, such as argon or nitrogen, and isolate the MFC from toxic and hazardous gases. Use an inert surrogate gas while adjusting the valve preload as a safeguard against inadvertent exposure to any toxic or hazardous gas. A release of hazardous or toxic gas could cause serious injury. If necessary, remove the MFC from the process equipment to adjust the valve.

Questions concerning the safe handling of toxic or hazardous gases may be answered by consulting your corporate policy, a government agency such as OSHA or NIOSH, or experts familiar with your process gas.

MKS assumes no liability for safe handling of toxic or hazardous gases.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT

Do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to an MKS Calibration and Service Center for service and repair to ensure that all safety features are maintained.

SERVICE BY QUALIFIED PERSONNEL ONLY

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified service personnel only.

USE CAUTION WHEN OPERATING WITH HAZARDOUS MATERIALS

If hazardous materials are used, users must take responsibility to observe the proper safety precautions, completely purge the instrument when necessary, and ensure that the material used is compatible with sealing materials.

PURGE THE INSTRUMENT

After installing the unit, or before its removal from a system, be sure to purge the unit completely with a clean dry gas to eliminate all traces of the previously used flow material.

USE PROPER PROCEDURES WHEN PURGING

This instrument must be purged under a ventilation hood, and gloves must be worn to protect personnel.

DO NOT OPERATE IN EXPLOSIVE ATMOSPHERES

To avoid explosion, do not operate this product in an explosive atmosphere unless it has been specifically certified for such operation.

USE PROPER FITTINGS AND TIGHTENING PROCEDURES

All instrument fittings must be consistent with instrument specifications, and compatible with the intended use of the instrument. Assemble and tighten fittings according to manufacturer's directions.

CHECK FOR LEAK-TIGHT FITTINGS

Before proceeding to instrument setup, carefully check all plumbing connections to the instrument to ensure leak-tight installation.

OPERATE AT SAFE INLET PRESSURES

This unit should never be operated at pressures higher than the rated maximum pressure (refer to the product specifications for the maximum allowable pressure).

INSTALL A SUITABLE BURST DISC

When operating from a pressurized gas source, a suitable burst disc should be installed in the vacuum system to prevent system explosion should the system pressure rise.

KEEP THE UNIT FREE OF CONTAMINANTS

Do not allow contaminants of any kind to enter the unit before or during use. Contamination such as dust, dirt, lint, glass chips, and metal chips may permanently damage the unit.

Definitions of WARNING, CAUTION, and NOTE messages used throughout the manual.

Warning 

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, condition, or the like, which, if not correctly performed or adhered to, could result in injury to personnel.

Caution 

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of all or part of the product.

Note 

The NOTE sign denotes important information. It calls attention to a procedure, practice, condition, or the like, which is essential to highlight.

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Chapter One: General Information

Introduction

The MKS Type 248 Control Valve is a modified solenoid valve that, when supplied with a controlling current, is able to modulate the flow of gas. When used with a MKS controller and appropriate flow sensor, the 248 valve modulates gas flow such that pressure or flow is maintained accurately and with precision. The valve seat connected to the armature is lifted away from the adjustable orifice as increasing current is applied to the solenoid. Two spiral springs center the armature within the valve body and oppose the magnetic lifting force. These springs minimize friction and hysteresis which are the major causes of poor control performance.

An important feature of the 248 valve is its orifice which may be adjusted or replaced without special tools. Adjustment may be required to eliminate leakage across the valve resulting from normal operational wear. Replacement is required when wear has become excessive or when it becomes desirable to change the flow range of the valve.

Warning 

Before performing mass flow controller valve adjustments, you MUST purge your process equipment and the MFC with an inert gas, such as argon or nitrogen, and isolate the MFC from toxic and hazardous gases. Use an inert surrogate gas while adjusting the valve preload as a safeguard against inadvertent exposure to any toxic or hazardous gas. A release of hazardous or toxic gas could cause serious injury. If necessary, remove the MFC from the process equipment to adjust the valve.

Questions concerning the safe handling of toxic or hazardous gases may be answered by consulting your corporate policy, a government agency such as OSHA or NIOSH, or experts familiar with your process gas.

MKS assumes no liability for safe handling of toxic or hazardous gases.

How This Manual is Organized

This manual is designed to provide instructions on how to set up, install, and operate a Type 249 unit.

Before installing your Type 248 unit in a system and/or operating it, carefully read and familiarize yourself with all precautionary notes in the *Safety Messages and Procedures* section at the front of this manual. In addition, observe and obey all WARNING and CAUTION notes provided throughout the manual.

Chapter One, *General Information*, (this chapter) introduces the product and describes the organization of the manual.

Chapter Two, *Installation*, explains the environmental requirements and describes how to mount the instrument in your system.

Chapter Three, *Operation*, describes how to use the instrument and explains all the functions and features.

Chapter Four, *Maintenance*, lists the maintenance required to keep the instrument in good working condition.

Chapter Five, *Repair*, lists the requirements for returning the instrument to MKS should any repair be needed.

Appendix A, *Product Specifications*, lists the specifications of the instrument.

Appendix B, *Model Code Explanation*, describes the instrument's ordering code.

Customer Support

Standard maintenance and repair services are available at all of our regional MKS Calibration and Service Centers, listed on the back cover. In addition, MKS accepts the instruments of other manufacturers for recalibration using the Primary and Transfer Standard calibration equipment located at all of our regional service centers. Should any difficulties arise in the use of your Type 248 instrument, or to obtain information about companion products MKS offers, contact any authorized MKS Calibration and Service Center. If it is necessary to return the instrument to MKS, please obtain an RMA Number (Return Material Authorization Number) from the MKS Calibration and Service Center before shipping. The RMA Number expedites handling and ensures proper servicing of your instrument.

Please refer to the inside of the back cover of this manual for a list of MKS Calibration and Service Centers.

Warning  **All returns to MKS Instruments must be free of harmful, corrosive, radioactive, or toxic materials.**

Chapter Two: Installation

How To Unpack the Type 248 Unit

MKS has carefully packed the Type 248 unit so that it will reach you in perfect operating order. Upon receiving the unit, however, you should check for defects, cracks, broken connectors, etc., to be certain that damage has not occurred during shipment.

Note  Do *not* discard any packing materials until you have completed your inspection and are sure the unit arrived safely.

If you find any damage, notify your carrier and MKS immediately. If it is necessary to return the unit to MKS, obtain an RMA Number (Return Material Authorization Number) from the MKS Service Center before shipping. Please refer to the inside of the back cover of this manual for a list of MKS Calibration and Service Centers.

Unpacking Checklist

Standard Equipment:

- Type 248 Unit
- Type 248 Instruction Manual (this book)

Optional Equipment:

- Electrical Connector Accessories Kit - 248A-K1
- Interface cables:

CB251-2-10	Connects the 248 valve to a Type 250D-E or 1250 controller
CB251-1-10	Connects the 248 valve to a Type 250A-C, or 260 controller

Note 

1. Overall metal, braided shielded cables are required to meet CE Mark specifications.
2. To order a metal braided, shielded cable, add an “S” after the cable type designation. For example, to order a standard cable to connect the 248 valve to a 250D-E controller, use part number CB251-2-10; for a metal, braided, shielded cable use part number CB251S-2-10

Interface Cables

As of January 1, 1996, all products shipped to the European Community must comply with the EMC Directive 89/336/EEC, which covers radio frequency emissions and immunity tests. MKS products that meet these requirements are identified by application of the CE Mark.

The 248A valve meets CE Mark requirements, per EMC Directive 89/336/EEC. To ensure compliance when installed, an overall metal braided shielded cable, grounded at both ends, is required during use.

Generic Shielded Cable Description

MKS offers a full line of cables for all MKS equipment. Should you choose to manufacture your own cables, follow the guidelines listed below:

1. The cable must have a *braided* shield, covering all wires. Neither aluminum foil nor spiral shielding will be as effective; using either may nullify regulatory compliance.

2. The connectors must have a metal case which has direct contact to the cable's shield on the whole circumference of the cable. The inductance of a flying lead or wire from the shield to the connector will seriously degrade the shield's effectiveness. The shield should be grounded to the connector before its internal wires exit.

3. With very few exceptions, the connector(s) must make good contact to the device's case (ground). "Good contact" is about 0.01 ohms; and the ground should surround all wires. Contact to ground at just one point may not suffice.

4. For shielded cables with flying leads at one or both ends; it is important at each such end, to ground the shield *before* the wires exit. Make this ground with absolute minimum length. Refer to Figures 1 and 2, page 9. (A ¼ inch piece of #22 wire may be undesirably long since it has approximately 5 nH of inductance, equivalent to 31 ohms at 1000 MHz). After picking up the braid's ground, keep wires and braid flat against the case. With very few exceptions, grounded metal covers are not required over terminal strips. If one is required, it will be stated in the Declaration of Conformity or in the instruction manual.

5. In selecting the appropriate type and wire size for cables, consider:
   A. The voltage ratings;
   B. The cumulative I^2R heating of all the conductors (keep them safely cool);
   C. The IR drop of the conductors, so that adequate power or signal voltage gets to the device;
   D. The capacitance and inductance of cables which are handling fast signals, (such as data lines or stepper motor drive cables); and
   E. That some cables may need internal shielding from specific wires to others; please see the instruction manual for details regarding this matter.

Example 1: Preferred Method To Connect Cable
(shown on a transducer)

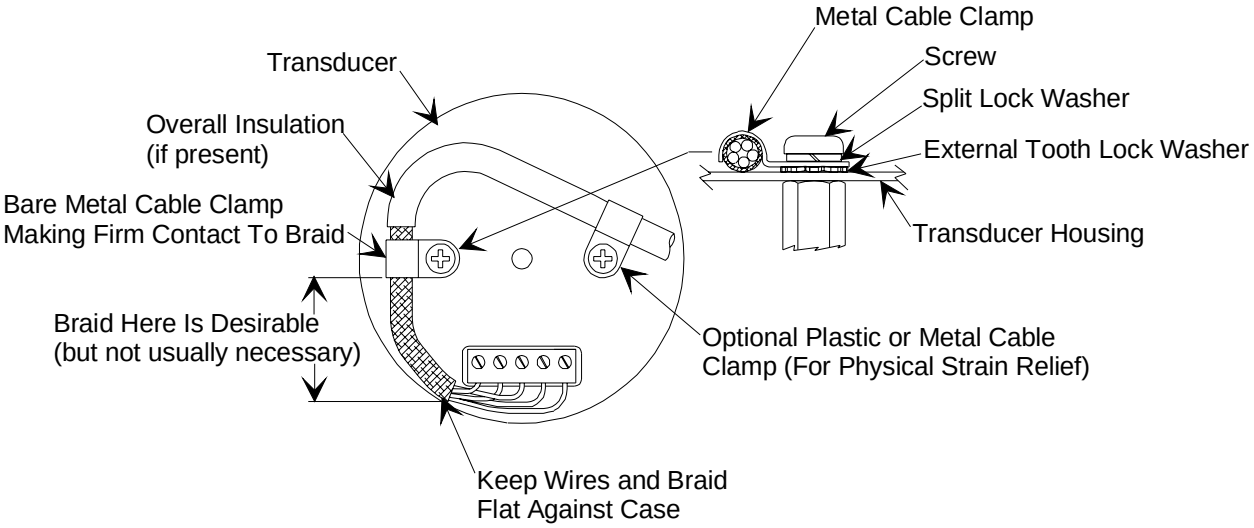


Figure 1: Preferred Method To Connect a Shielded Cable

Example 2: Alternate Method To Connect Cable
(shown on a transducer)

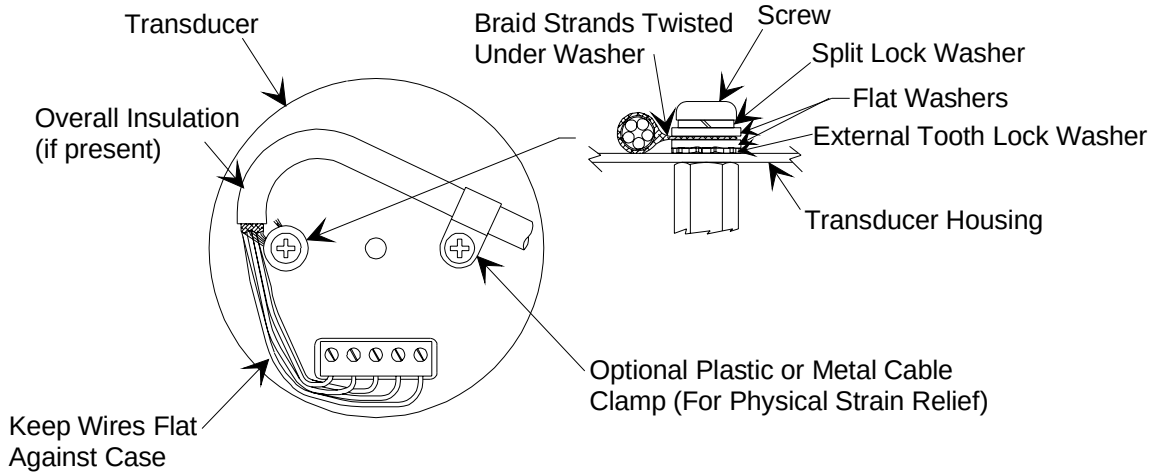


Figure 2: Alternate Method To Connect a Shielded Cable
(Use When Cable Clamp is Not Available)

Setup

Dimensions

Note All dimensions are listed in inches with millimeters referenced in parentheses.

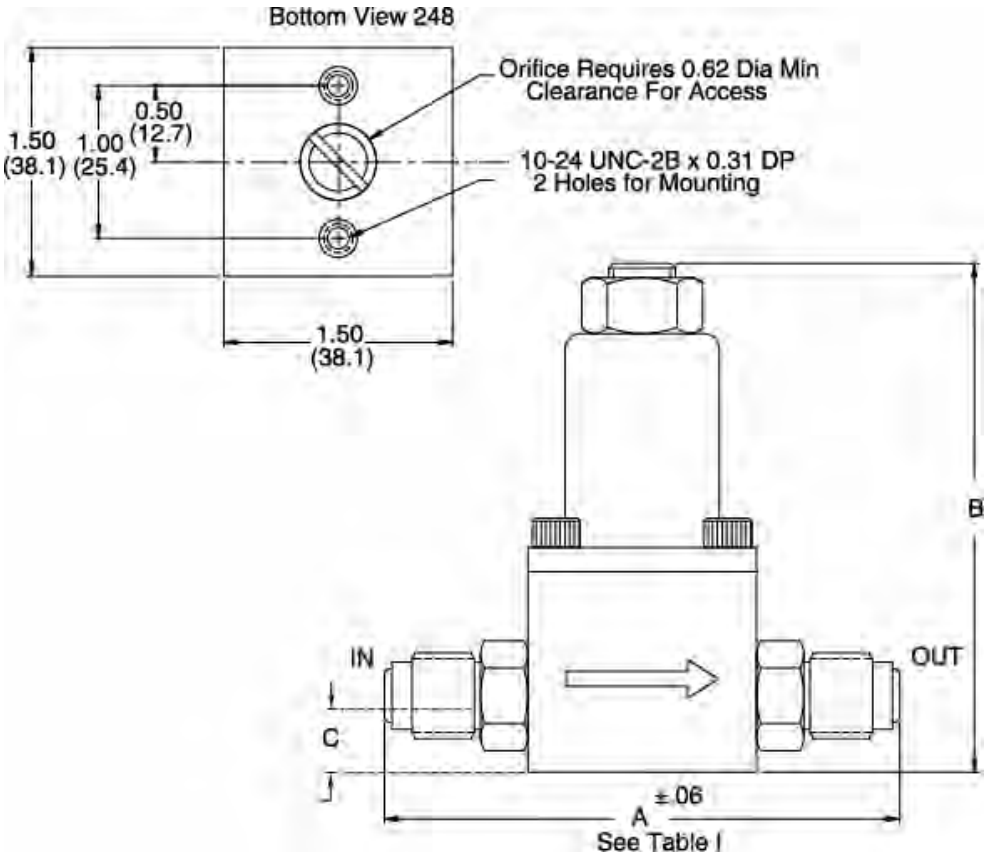


Table 1	A		B	
	(in.)	(mm)	(in.)	(mm)
4 VCR	3.37	85.6	3.38	85.9
4 VCO	3.05	77.5		
1/4" Swagelok	2.76	70.1		

Figure 3: Dimensions of a Type 248 Control Valve

Mounting Instructions

The valve may be installed in any position, although base vertically down is recommended. Although ¼" O.D. tubing connections are generally adequate to support the weight of the valve, two 10-24 mounting holes permit base mounting. A 0.62" minimum clearance hole in a mounting plate should be provided to allow the valve orifice to be adjusted or replaced without disconnecting the valve.

Tubing lengths should be kept short throughout the flow control loop and restrictions and bends eliminated wherever possible.

Always couple the 248 valve with the minimum practical length of straight ¼" tubing to the upstream flow sensor to achieve stable flow control.

Cables

To connect the 248 valve to a Type 250D-E or 1250 controller, use cable CB251-2-10.

To connect the 248 valve to a Type 250A-C, or 260 controller, use cable CB251-1-10.

Note 

1. Overall metal, braided shielded cables are required to meet CE Mark specifications.
2. To order a metal braided, shielded cable, add an "S" after the cable type designation. For example, to order a standard cable to connect the 248 valve to a 250D-E controller, use part number CB251-2-10; for a metal, braided, shielded cable use part number CB251S-2-10

The cable assembly is not considered part of the valve; it is furnished whenever a flow control system is ordered.

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Chapter Three: Operation

General Information

The 248 valve (≤10,000 sccm) may be operated with 150 psig maximum inlet pressure, however, the nominal flow rating is established at 1 atmosphere differential across the valve, increasing the inlet pressure up to the maximum allowed. This extends the maximum flow control range from approximately 3X (10K sccm range) to 250X (10 sccm range). Decreasing the outlet pressure increases the flow range until the choked flow condition is reached. Further lowering of outlet pressure for a fixed inlet pressure will not increase flow because a sonic restriction exists.

For 20,000 and 50,000 sccm 248 valves the maximum operating pressure drop is 15 psig to atmosphere.

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Chapter Four: Maintenance

General Information

Periodically check for wear on the cables and inspect the valve for visible signs of damage.

Orifice Adjustment and Replacement

All 248 valve seals are 100% leak checked at the factory prior to shipment. With no power applied, the valve should have no measurable leakage or flow when the valve is positioned vertically, base down, and 1 atmosphere differential pressure is applied.

Should unacceptable leakage exist because of different operating conditions or normal wear, adjustment is achieved by turning the Orifice Assembly Adjustment Screw in the base clockwise. Refer to Figure 4, page 16, as needed.

Note 

- Turn the orifice 5° to 10° at a time, each time observing a change in leakage.
- Turn the orifice an additional 10° to 15° beyond the threshold of acceptable leakage. Excessive clockwise adjustment may reduce maximum flow control or impair control response.
- If leakage cannot be corrected by adjusting the Orifice Assembly, the problem is one of the following:
  1. Leaky seat - replace the Armature/Plug Assembly
  2. Leaky Orifice Assembly Seal - replace the seals or assembly
  3. Scored, pitted Body - inspect, replace as required
- ALWAYS disconnect the valve from its controller when adjusting for orifice leakage as valve bias misadjustment (refer to controller manual) may hold the valve partially open.

Caution 

NEVER screw the Orifice Assembly hard up to the Armature/Plug Assembly. Damage requiring replacement of either or both assemblies will result.

Orifice Adjustment and Replacement Chapter Four: Maintenance

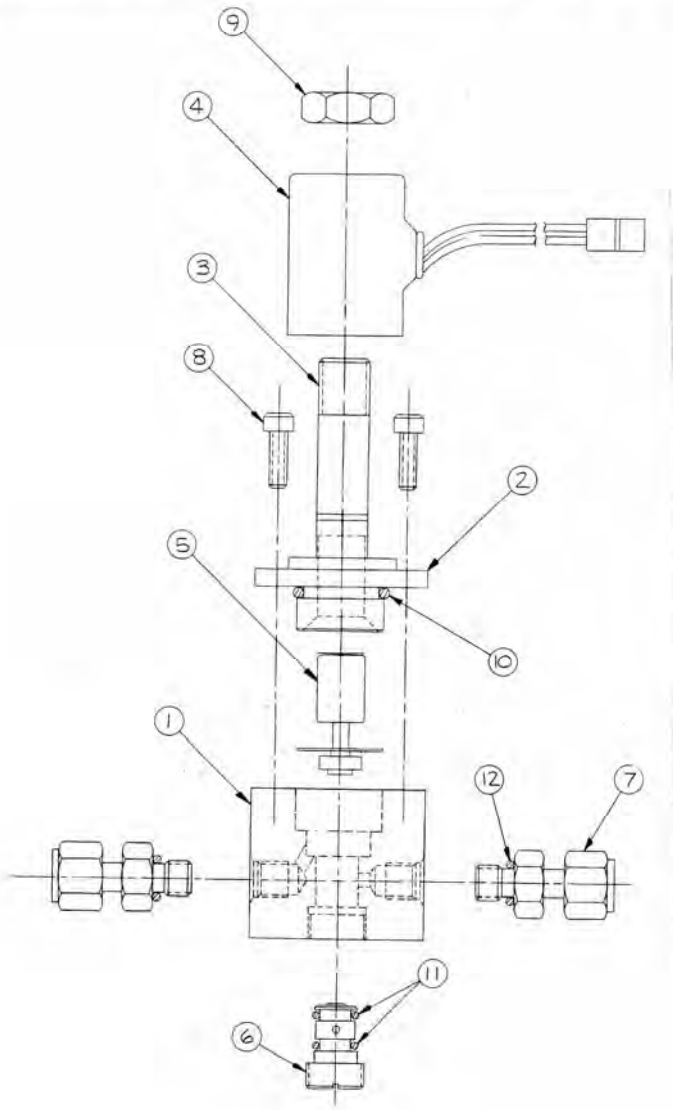


Figure 4: Typical Valve Assembly

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Note The drawing above is provided for reference purposes only. Disassembly of the valve will void its warranty. For maintenance, please contact MKS Instruments, Inc. and obtain an RMA (Return Materials Authorization). .

Type 248 Valve Components	
Valve Assembly ID Number (refer to Figure Error! Bookmark not defined.**, page** Error! Bookmark not defined.**)**	**Valve Component**
1	Body
2	Collar
3	Center Shaft
4	Coil Assembly
5	Armature/Plug Assembly (with O-rings, see #10)
6	Orifice Assembly (without O-rings)
7	¼" Swagelok® Fitting
8	Socket Head Screw (8-32 x 0.50)
9	Hex Nut ($^{7}/_{16}$ - 14)
10	O-Ring, Viton®, Size 2-016
11	O-Ring, Viton, Size 2-009
12	O-Ring, Viton, Size 3-902

Table 1: Type 248 Valve Components

Note 

Table 1 above is provided for reference purposes only. Disassembly of the valve will void its warranty. For maintenance, please contact MKS Instruments, Inc. and obtain an RMA (Return Materials Authorization.

Disassembly, Inspection, and Cleaning

Note 

The guide below is provided for reference purposes only. Disassembly of the valve will void its warranty. For maintenance, please contact MKS Instruments, Inc. and obtain an RMA (Return Materials Authorization.

Disassemble the 248 valve as follows with the valve held vertically, base down. Refer to Figure **Error! Bookmark not defined.**, page **Error! Bookmark not defined.**, as needed.

1. Carefully remove the hex nut coil cover; do not allow the cover to rotate relative to the Body.

2. Remove the cover and coil as an assembly.

   Note the position at removal. Replace the parts if the cover is damaged or the coil is an open circuit.

3. Remove the four 8-32 screws holding the Collar to the Body.

4. Remove the Collar and Center Shaft Assembly and carefully withdraw the Armature/Plug Assembly.

   Replace the Armature/Plug Assembly if either spring is broken or bent or if the valve seat appears marked or fails to seal during the orifice adjustment.

5. Remove and inspect the Orifice Assembly.

   Inspect for orifice plugging/damage, and replace as necessary. Ultrasonic cleaning with suitable non-reactive solvents is recommended. Store in a clean plastic bag.

6. Inspect the cavity of the 316 stainless steel Body and Center Shaft Assembly for damage and deposits.

   Clean or replace as required. Similarly inspect, clean, or replace all tubing, fittings, and seals.

Assembly

Reassemble the 248 valve as follows. Refer to Figure **Error! Bookmark not defined.**, page **Error! Bookmark not defined.**, as needed.

1. Screw the Orifice Assembly into the Body until it is just flush with the base.
2. Carefully install the tubing fittings with new O-rings.

   Tighten firmly, being careful not to pinch the O-rings.

Caution **Handle the Armature/Plug Assembly with care. Avoid touching the main spring and centering spring which have been factory adjusted. Do not attempt to loosen or remove the seat as this will destroy the assembly.**

3. Lower the Armature/Plug Assembly carefully into the Body, making sure the main spring fits freely on the shoulder of the Body.
4. Install a new O-ring (furnished with the replacement Armature/Plug Assembly) on the Center Shaft Assembly and install this assembly into the Body and onto the main spring.
5. Install the collar and the four 8-32 screws carefully as follows:
   a. Hand tighten the 4 screws evenly in a criss-cross pattern making sure the collar remains parallel to the top of the Body.
   b. Continue to maintain the collar parallel to the Body while gradually tightening the screws in a criss-cross pattern to a final torque of 16 in-lbs.

Caution **Failure to follow step 5 may damage the Armature/Plug Assembly or result in poor valve operation.**

7. Install the Coil and Cover Assembly in the original position.

   Install and tighten the $^{7}/_{16}$ - 14 hex nut to 60 in-lbs. to lock the cover from rotation.

Caution **Do not overtighten the hex nut as coil damage may occur.**

7. Adjust the Orifice as described in *Orifice Adjustment and Replacement,* page 15.

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Chapter Five: Repair

General Information

If the 248 valve instrument fails to operate properly upon receipt, check for shipping damage, and check the cables for proper continuity. Any damage should be reported to the carrier and MKS Instruments immediately. If it is necessary to return the unit to MKS, obtain an RMA number (Return Material Authorization Number) from a MKS Service Center before shipping. Please refer to the inside back cover of this manual for a list of MKS Calibration and Service Centers.

Warning  **All returns to MKS Instruments must be free of harmful, corrosive, radioactive, or toxic materials.**

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Appendix A: Product Specifications

Specifications

CE Mark Compliance[1] (248A Valve ***only)***	EMC Directive 89/336/EEC
Compatible MKS Controllers	Types 250, 1250, and 260
External Leak Integrity	< 1 x 10^{-9} scc/sec He
Material exposed to gas (process wetted) Metals Elastomer Seals Fluoroelastomer Seals	 316 stainless steel 440 C stainless steel Viton® (V) - standard Neoprene® (N) - optional Buna-N (B) - optional Kalrez® - optional
Maximum Closed Conducatance	1 x 10^{-5} scc/sec He for ≤10,000 sccm <1% F.S for >10,000 sccm
Maximum Inlet Pressure[2]	150 psig
Maximum Throughtput (1 atmosphere at inlet)	50 slm (maximum valve range configuration)
Minimum Controllable Flow Rate	0.2% F.S. < 100 sccm 0.1% F.S. > 100 sccm to 10,000 sccm 2% F.S. for >10,000 sccm
Pressure Connections Standard Optional	 ¼" tubing (Swagelok®) 4-VCR® (Swagelok) 4-VCO® (Swagelok)
Pressure Control Range	10^{-4} to 5000 Torr
Response Time	15 msec
Temperature Range	-10° to 60° C (14° to 140° F)
Type of Valve	Proportioning, electro-magnetically operated

Due to continuing research and development activities, these product specifications are subject to change without notice.

[1] Requires overall braided, shielded cables, properly grounded at both ends.

[2] For 20,000 and 50,000 sccm valves, maximum operating pressure drop is 15 psig to atmosphere.

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Appendix B: Model Code Explanation

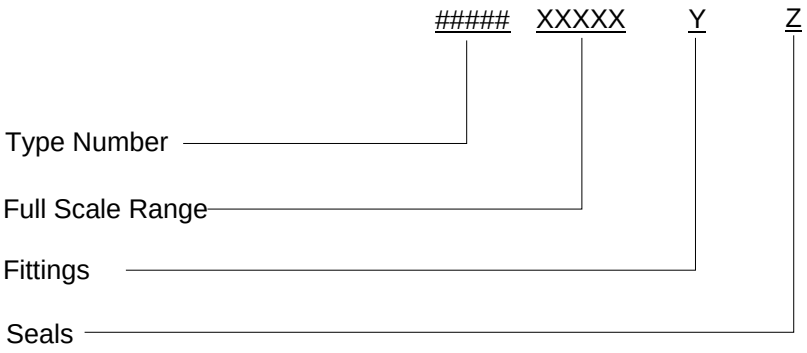
Model Code

The options of your valve are identified in the model code when you order the unit.

The model code is identified as follows:

- XXXXX Y Z

where:



Type Number (#####)

This designates the model number of the instrument: 0248A

Full Scale Range (XXXXX)

The full scale range is indicated by a five digit code.

Full Scale Range - sccm of Nitrogen	Ordering Code
10	00010
20	00020
50	00050
100	00100
200	00200
500	00500
1,000	01000
2,000	02000
5,000	05000
10,000	10000
20,000	20000
50,000	50000

Fittings (Y)

Three types of fittings are available, designated by a single letter code.

	Ordering Code
Swagelok ¼" tube, standard	S
Cajon 4-VCR male, optional	R
Cajon 4-VCO male, optional	G

Seals (Z)

Four types of seals are available, designated by a single letter code.

	Ordering Code
Viton, standard	V
Neoprene, optional	N
Buna-N, optional	B
Kalrez, optional	K

Note  For the High temperature coil option (up to 150 C), Consult Factory for model part number.

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