O P E R A T I N G M A N U A L

Sputtering
Sensor

PN 074-157M

INFICON

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Sputtering Sensor

PN 074-157M

INFICON Instruments for Intelligent Control®

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NOTE: These instructions do not provide for every contingency that may arise in connection with the installation, operation or maintenance of this equipment. Should you require further assistance, please contact INFICON.

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Chapter 1
Introduction

1.1 Introduction

The Sputtering Sensor is ideal for sputtering applications where the plasma is not well constrained (e.g., radio frequency (RF) sputtering systems).

RF sputtering systems result in a flux of high-energy electrons which impinge on the sensor head and can cause significant temperature related thickness errors if the temperature change of the crystal during deposition is significant.

The Sputtering Sensor protects against RF temperature changes by deflecting excess electrons away from the crystal and the sensor head.

Figure 1-1 Sputtering Sensor (PN 750-618-G1)

1.2 Definition of Notes, Hints, Cautions, and Warnings

Before using this manual, please take a moment to understand the Notes, Hints, Cautions, and Warnings used throughout. They provide pertinent information that is useful in achieving maximum instrument efficiency while ensuring personal safety.

NOTE: Notes provide additional information about the Sputtering Sensor.

HINT: Hints provide insight into Sputtering Sensor usage.

CAUTION

Failure to obey these messages could result in damage to the Sputtering Sensor.

WARNING

Failure to obey these messages could result in personal injury.

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1.3 How to Contact INFICON

Worldwide customer support information is available on www.inficon.com under **Support >> Support Worldwide**:

- Sales and Customer Service
- Technical Support
- Repair Service

When communicating with INFICON about a Sputtering Sensor, please have the following information readily available:

- The Sales Order or Purchase Order number of the Sputtering Sensor purchase.
- A description of the problem.
- The exact wording of any instrument error messages that may have been received.
- An explanation of any corrective action that may have already been attempted.

1.3.1 Returning Sputtering Sensor to INFICON

Do not return any sensor component to INFICON without first speaking with a Customer Support Representative and obtaining a Return Material Authorization (RMA) number. Sputtering Sensors will not be serviced without an RMA number.

Packages delivered to INFICON without an RMA number will be held until the customer is contacted. This will result in delays in servicing the Sputtering Sensor.

Prior to being given an RMA number, a completed Declaration Of Contamination (DoC) form may be required. DoC forms must be approved by INFICON before an RMA number is issued. INFICON may require that the sensor be sent to a designated decontamination facility, not to the factory.

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1.4 Unpacking and Inspection

1 Carefully open the cardboard box and then remove from the packaging material the plastic box containing the Sputtering Sensor and accessories.

1a Break the seals on both sides of the plastic box and lift the hinged cover to open the box. Remove the Thin Film Manuals CD, Crystal Snatcher, Crystals, and Sputtering Sensor from the box.

2 Examine the Sputtering Sensor and accessories for damage that may have occurred during shipping. It is especially important to note obvious rough handling on the outside of the cardboard box. *Immediately report any damage to the carrier and to INFICON.*

NOTE: Do not discard the packaging material until an inventory has been taken and installation is successful.

3 Take inventory. Refer to the invoice and the information contained in section 1.4.1.

4 Install the Sputtering Sensor as instructed by Chapter 2, Sensor Installation.

5 For additional information or technical assistance, contact INFICON. (Refer to section 1.3 on page 1-2.)

1.4.1 Parts and Options Overview

Sputtering Sensor	PN 750-618-G1 (Refer to Figure 1-1.)
Thin Film Manuals CD	PN 074-5000-G1
Crystal Snatcher	PN 008-007
6 MHz Silver Crystals	PN 008-009-G10
Optional Sputtering Shutter Module	PN 750-005-G1
Molybdenum Disulfide in Alcohol	PN 750-191-G1 (provided only with shutter module)

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1.5 Specifications

Maximum bakeout temperature with no water	105°C (225°F)
Sensor head size (maximum envelope)	3.45 x 3.45 x 1.75 cm (1.36 x 1.36 x 0.69 in.)
Water tube and in-vacuum cable length	Standard 76.2 cm (30 in.) Includes 78.1 cm (30.75 in.) in-vacuum cable.
Crystal exchange	Rear-loading
Mounting	User supplied
Crystal size	14 mm (0.550 in.) diameter

1.5.1 Materials

Body and Holder	Au plated Be-Cu
Springs, Electrical Contacts	Au plated Be-Cu
Water tubes	Au plated Be-Cu, 0.32 cm (0.125 in.) OD
Connector	304 stainless steel
Insulators	99% Al_2O_3
Wire	Teflon® insulated copper
Solder	Cadmium-free silver-tin alloy
Crystal	14 mm (0.550 in.) diameter
Magnet	ALNICO 5 Alloy

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1.5.2 Installation Requirements

Feedthrough	Without Shutter Two pass water 4.8 mm (3/16 in.) OD tubing with Microdot® coax connector. (See section 1.5.3 on page 1-6.) With Shutter Three pass tubes (two water and one air) 4.8 mm (3/16 in.) OD tubing with Microdot coax connector. (See section 1.5.3 on page 1-6.) Vacuum tight braze or weld joint or connectors for the water tubes.
Other	XIU or oscillator to match specific controller/monitor. The cable length from the crystal to the oscillator should not exceed 101.6 cm (40 in.) unless a ModeLock instrument is used. Refer to the controller/monitor operating manual for cable length limitations. Shutter module only: Solenoid Valve for air, PN 750-420-G1. (See section 3.3 on page 3-4.)
Water Flow Rate	Minimum water flow 750 cm^3/min (0.2 gpm), 30°C (86°F) maximum.
Water Quality	Coolant should not contain chlorides as stress corrosion cracking may occur. Extremely dirty water may result in loss of cooling capacity.

CAUTION

Do not allow water tubes to freeze. This may happen if the tubes pass through a cryogenic shroud and the flow of fluid is interrupted.

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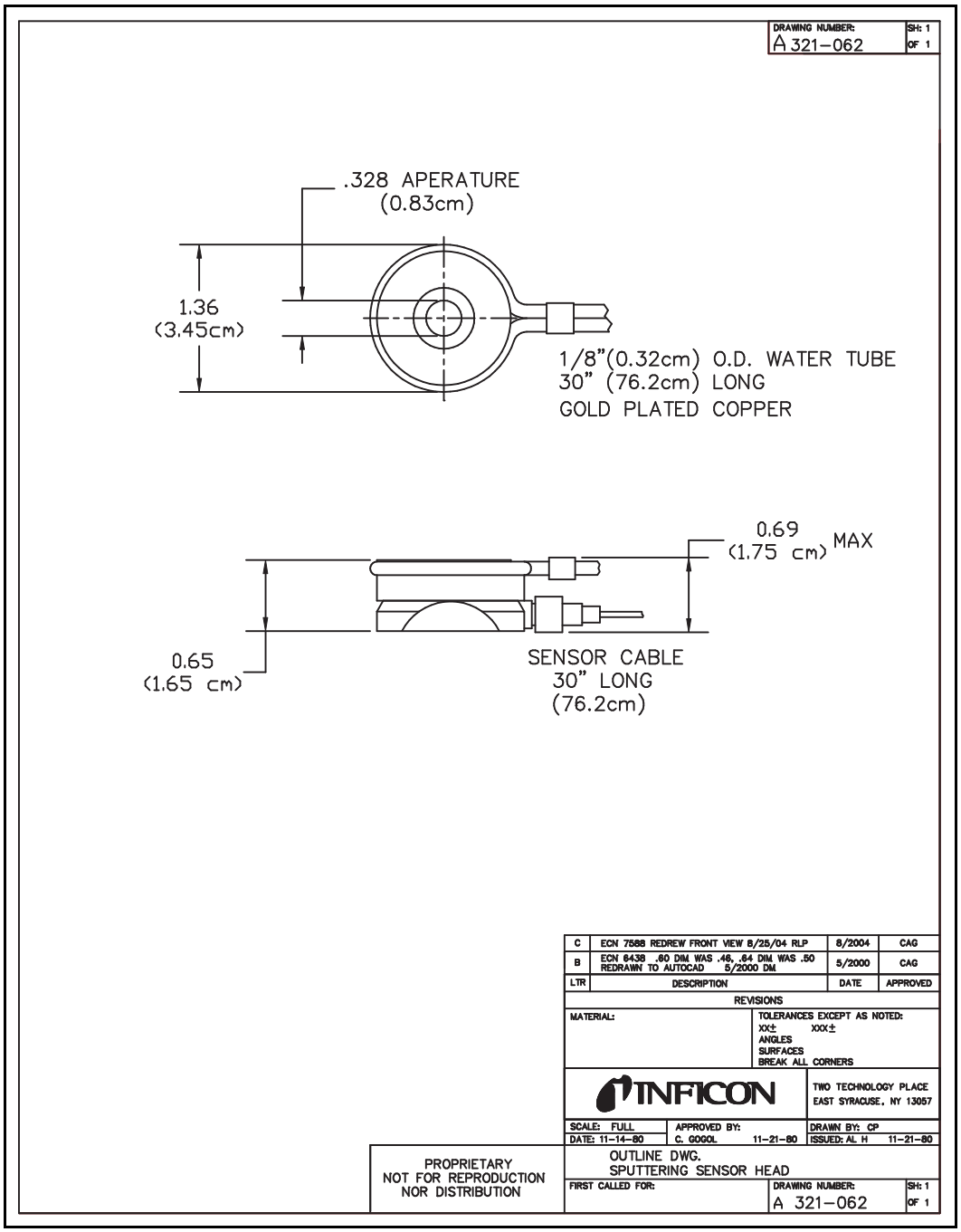
1.5.3 Sputtering Sensor Drawings

The following Sputtering Sensor outline drawings provide dimensions and other relevant data necessary for planning equipment configurations.

Figure 1-2 Sputtering Sensor Outline



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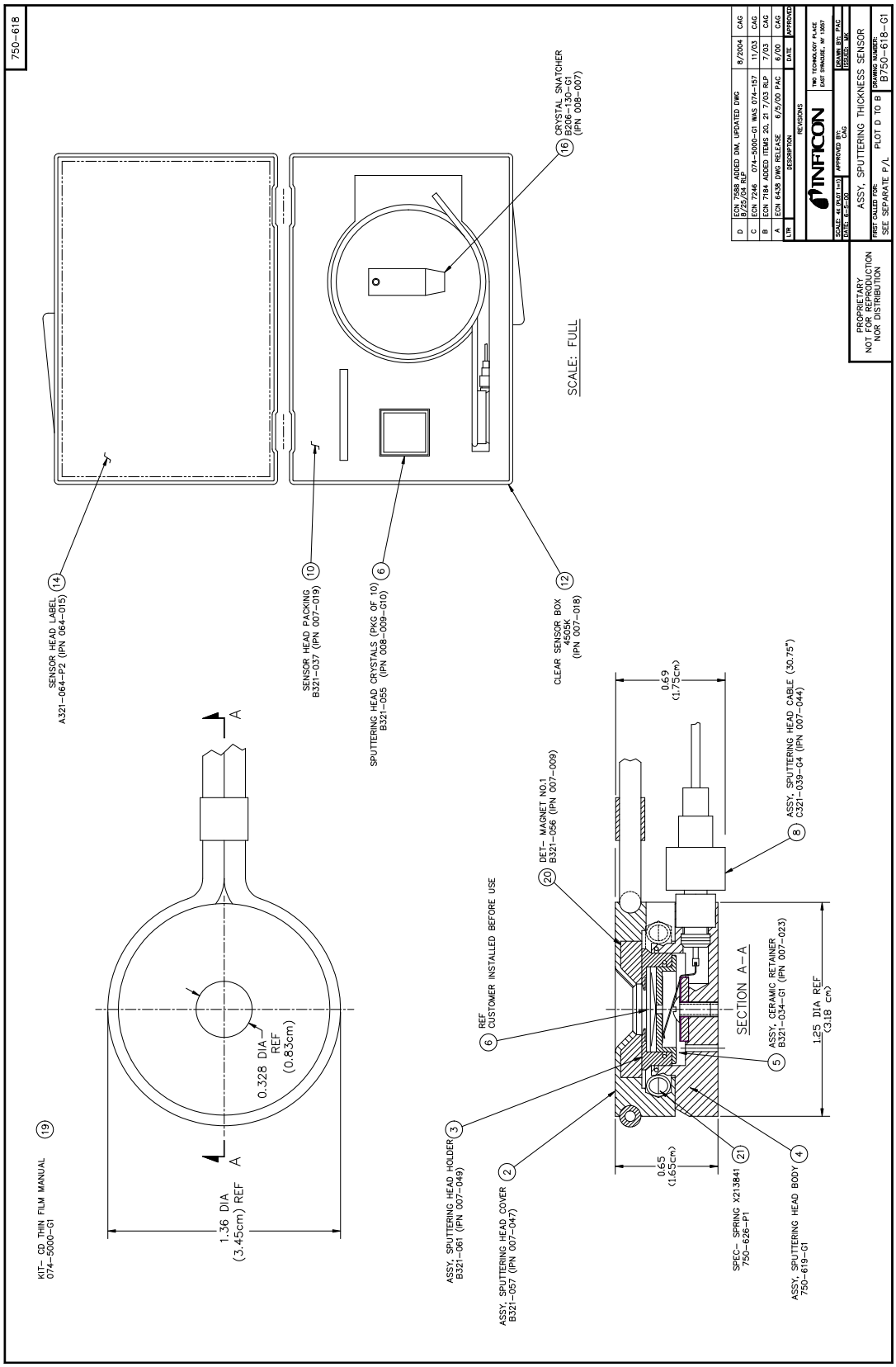

Figure 1-3 Sputtering Sensor assembly

1.5.4 Sputtering Shutter Module Specifications

Figure 1-4 Sputtering shutter module with Sputtering Sensor

Temperature	105°C (221°F)
Materials	300-series stainless steel
Pressure	Minimum: 90 psi (gauge) {105 psi (absolute)} (7.2 bar (absolute)) [724 kPa (absolute)] to maximum: 95 psi (gauge) {110 psi (absolute)} (7.6 bar (absolute)) [758 kPa (absolute)]
Shutter	Pneumatically operated
Braze	Vacuum process high temperature Ni-Cr Alloy

1.5.5 Sputtering Sensor Shutter Module Drawings

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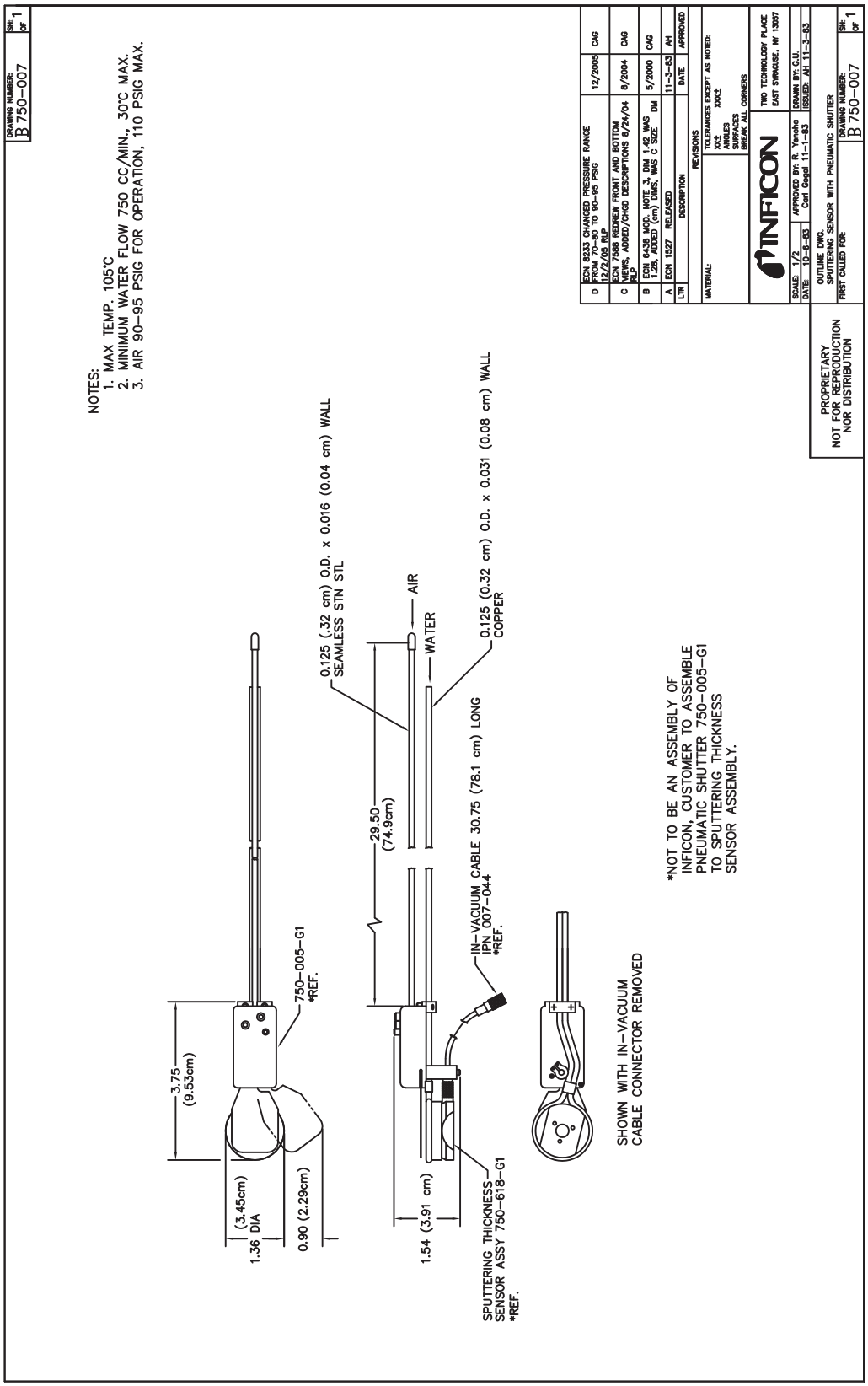

Figure 1-5 Sputtering Sensor with pneumatic shutter

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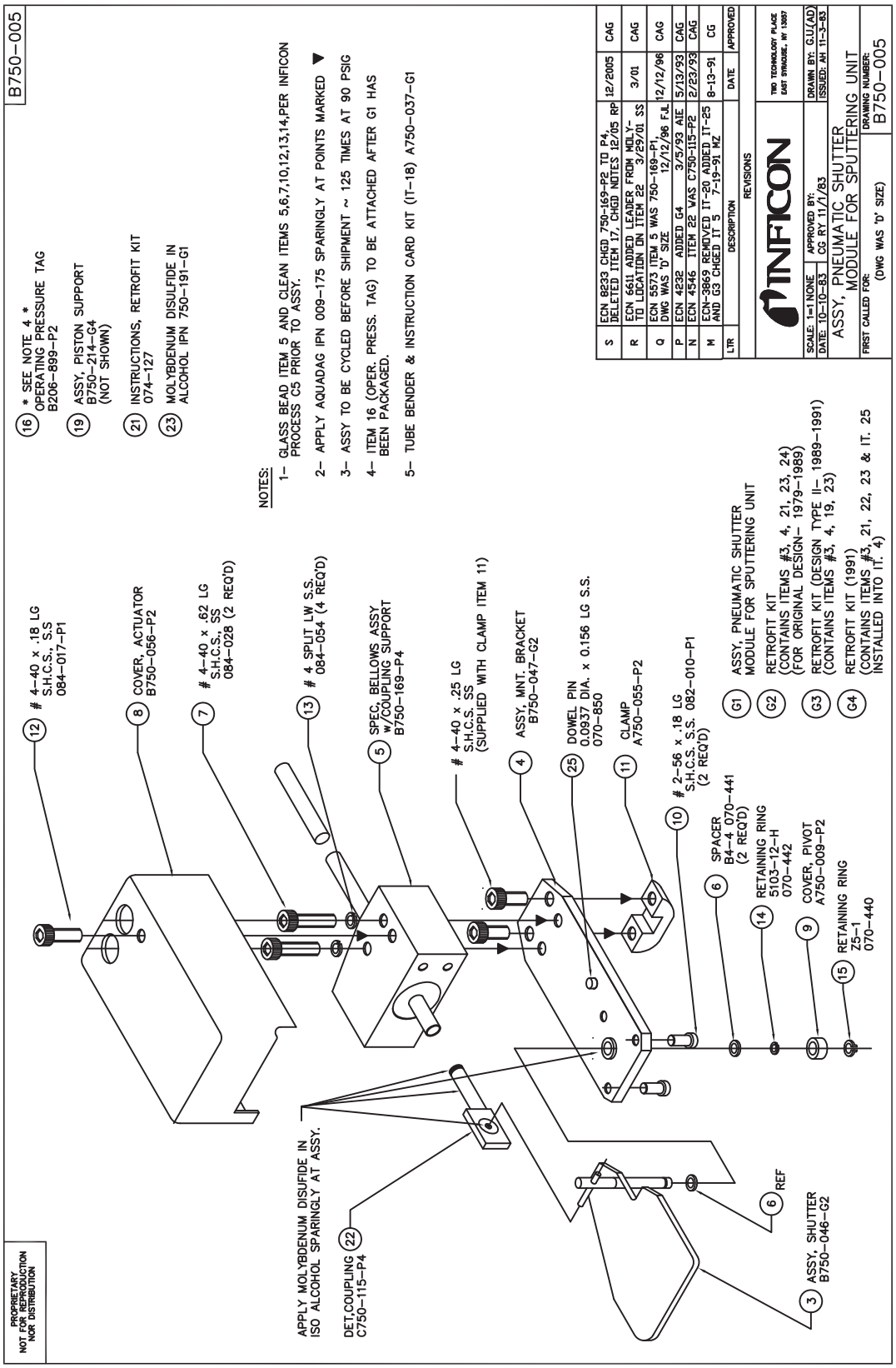

Figure 1-6 Pneumatic shutter assembly

1.5.6 Feedthrough Drawings

The following Feedthrough Outline Drawings provide dimensions and other pertinent data necessary for planning equipment configurations.

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Figure 1-7 2.54 cm (1 in.) bolt feedthrough with two tubes, one coax (PN 002-042)

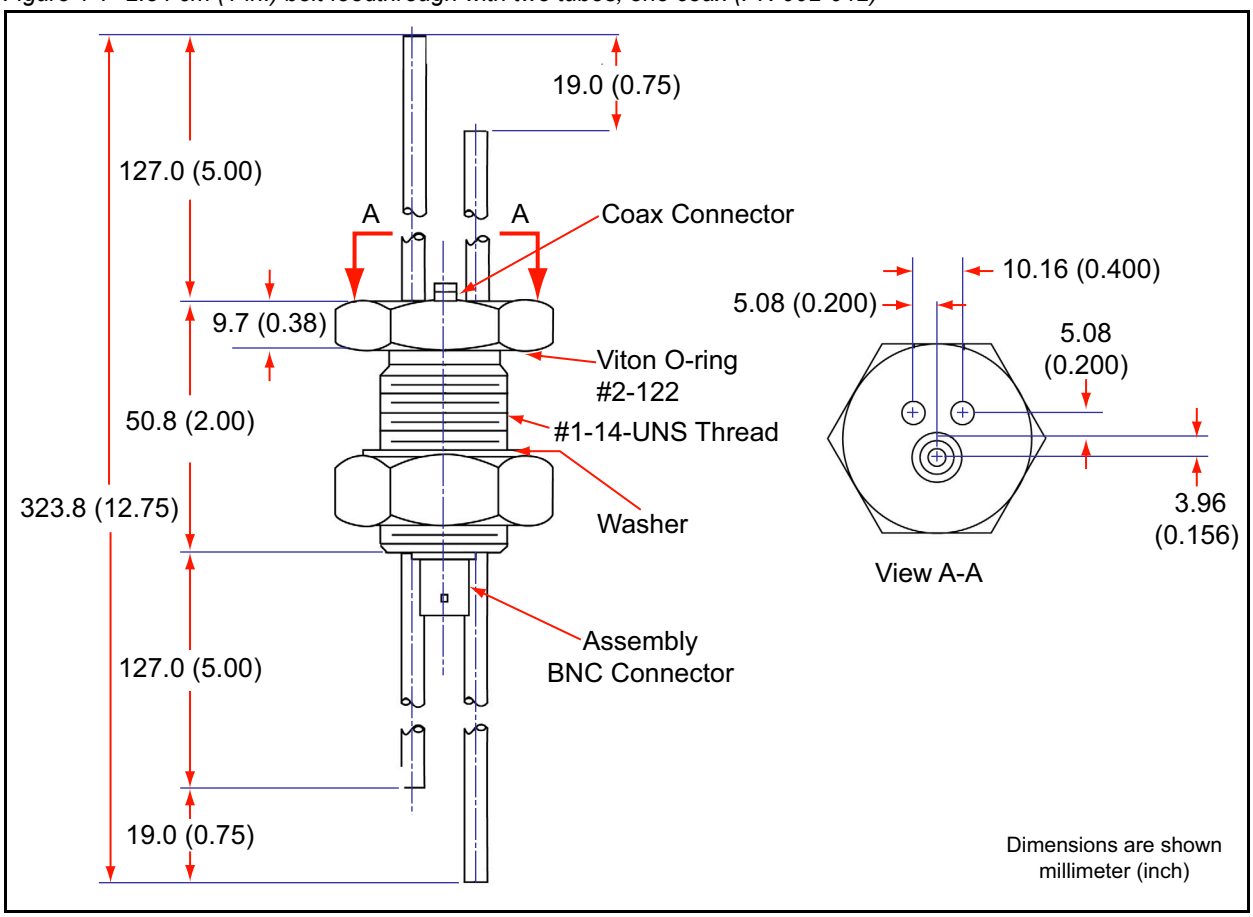

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Figure 1-8 2.54 cm (1 in.) bolt feedthrough with three tubes, one coax (PN 750-030-G1)

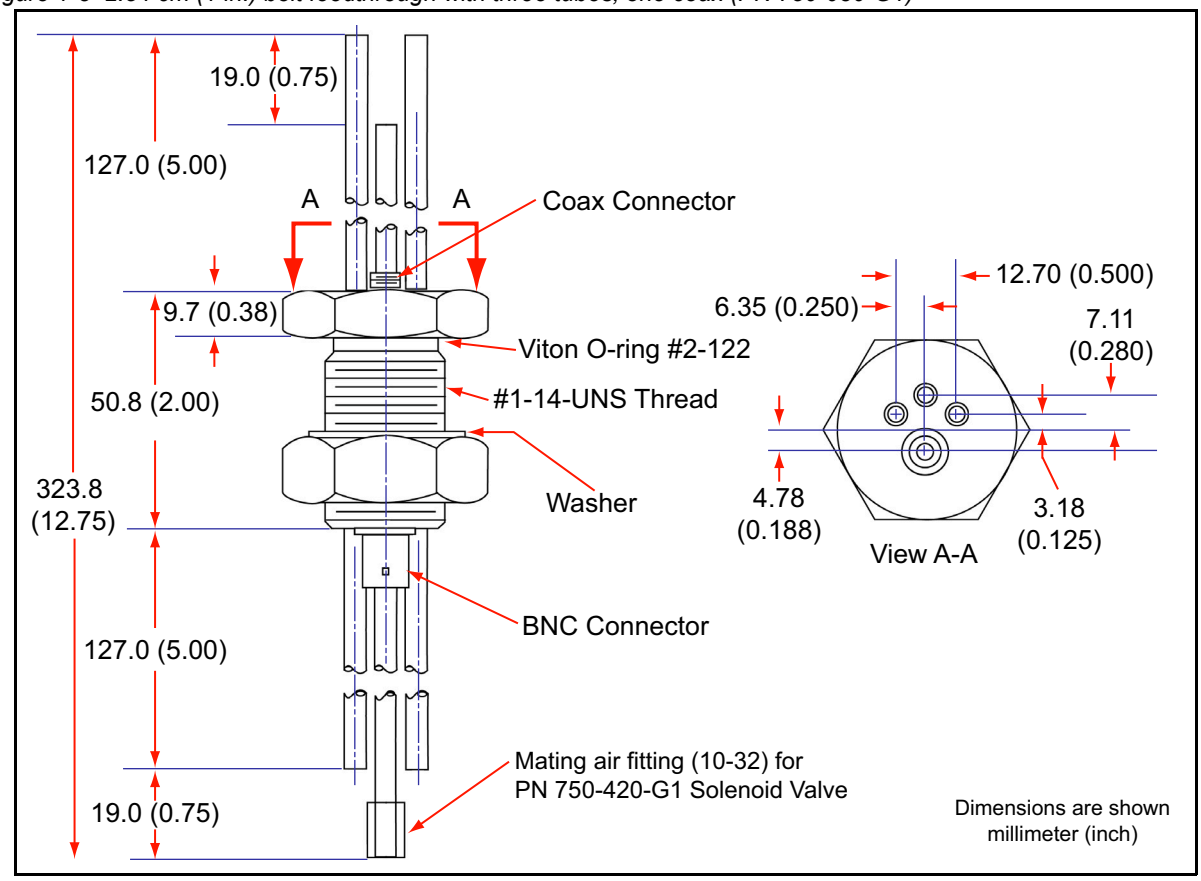

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Figure 1-9 2.54 cm (1 in.) bolt feedthrough with two tubes, one coax, with Ultra-Torr (PN 750-624-G1)

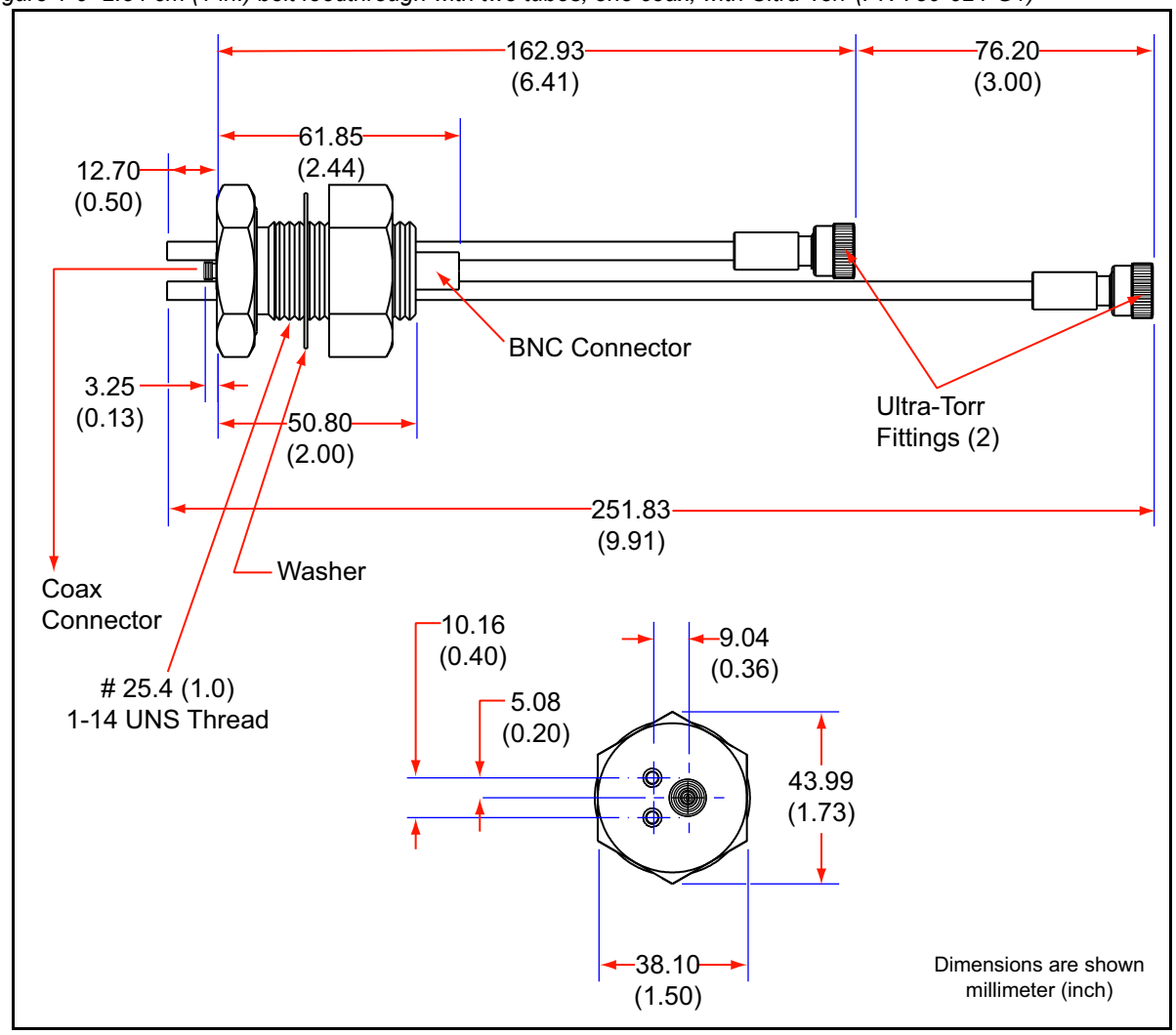

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Figure 1-10 CF40 (2-3/4 in. ConFlat) feedthrough with two tubes, one coax (PN 002-043)

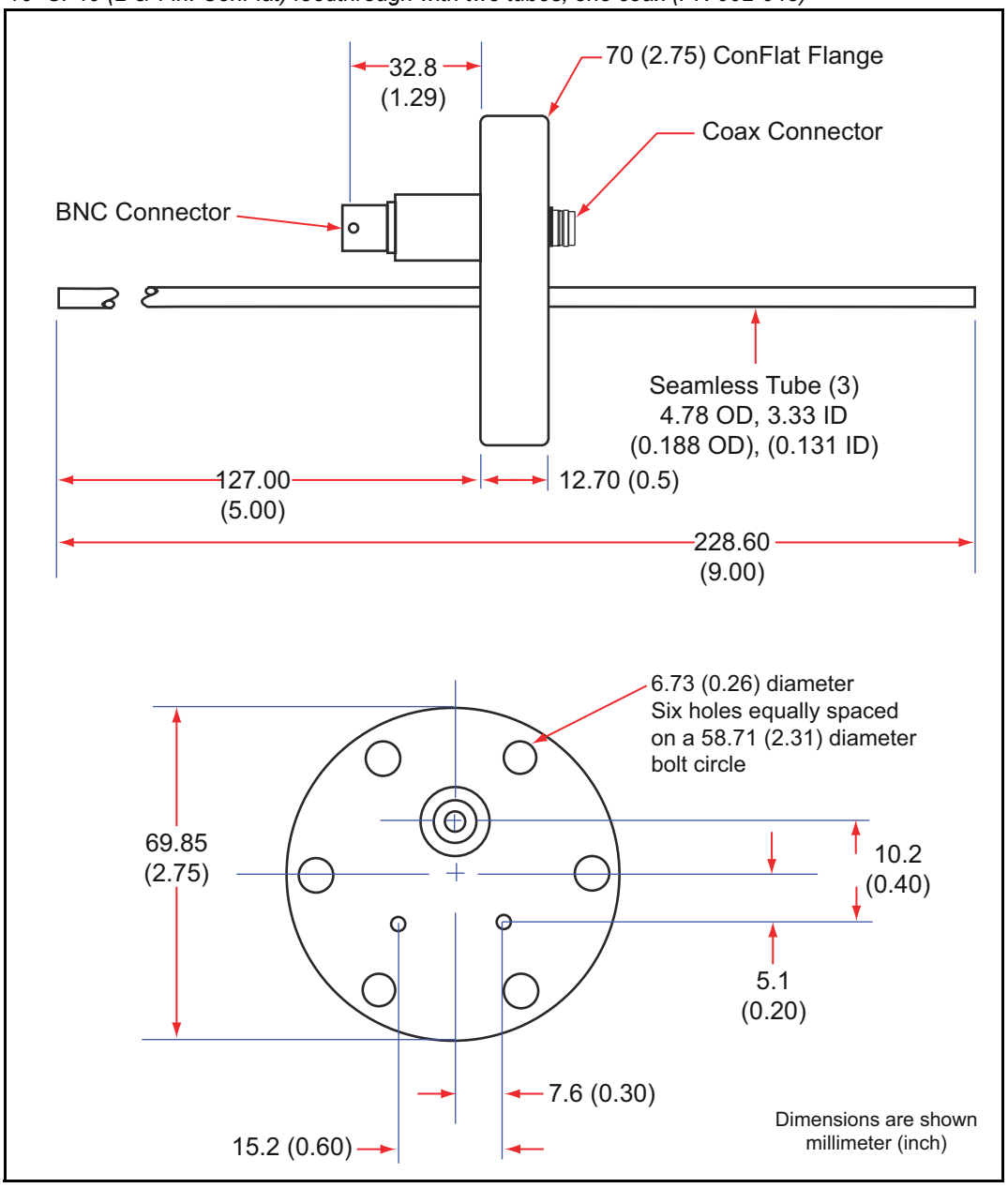

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Figure 1-11 CF40 (2-3/4 in. ConFlat) feedthrough with three tubes, one coax (PN 750-685-G1)

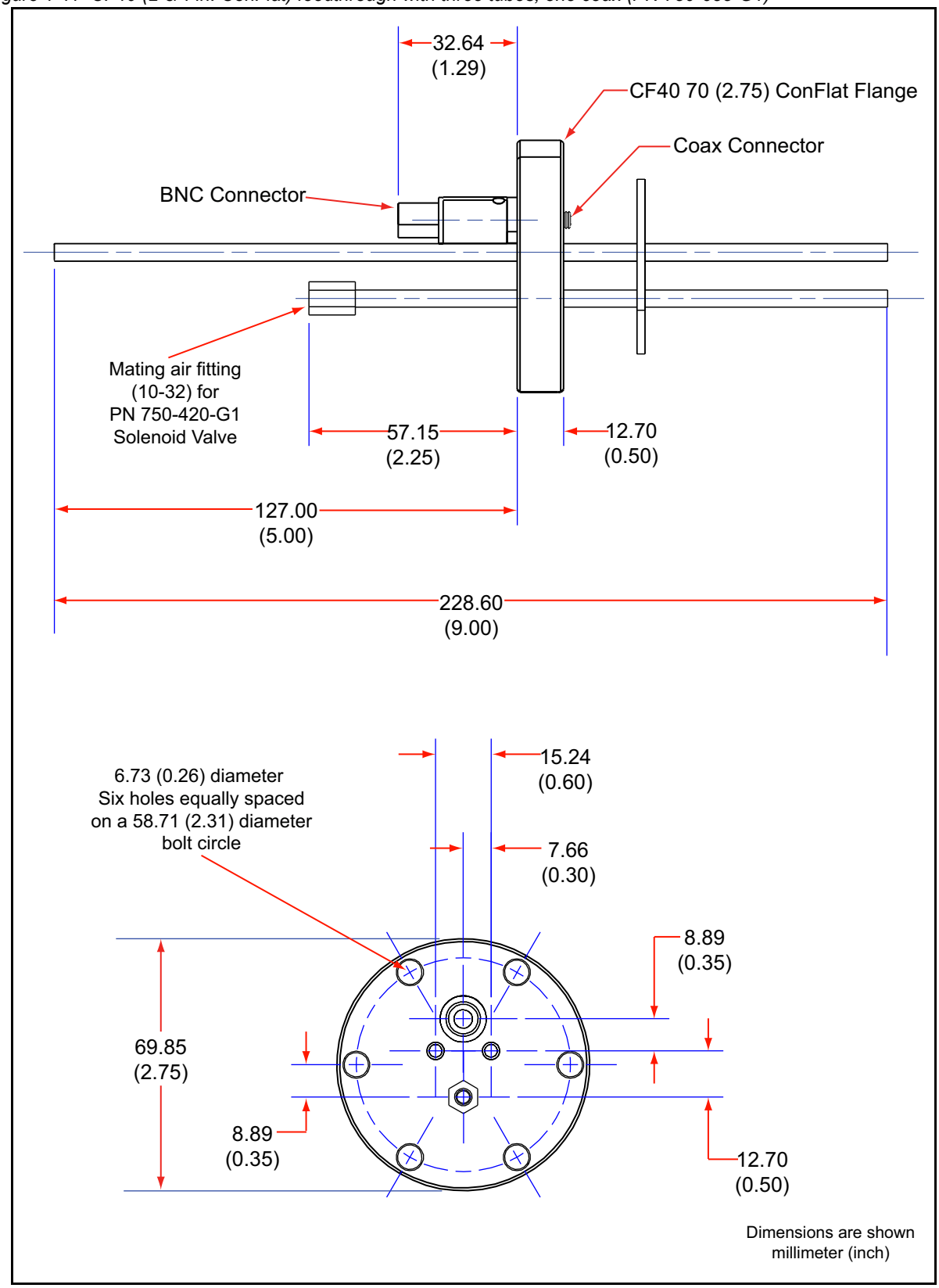

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Figure 1-12 CF40 (2-3/4 in. ConFlat) feedthrough with two tubes, one coax, with Ultra-Torr (PN 206-878-G2)

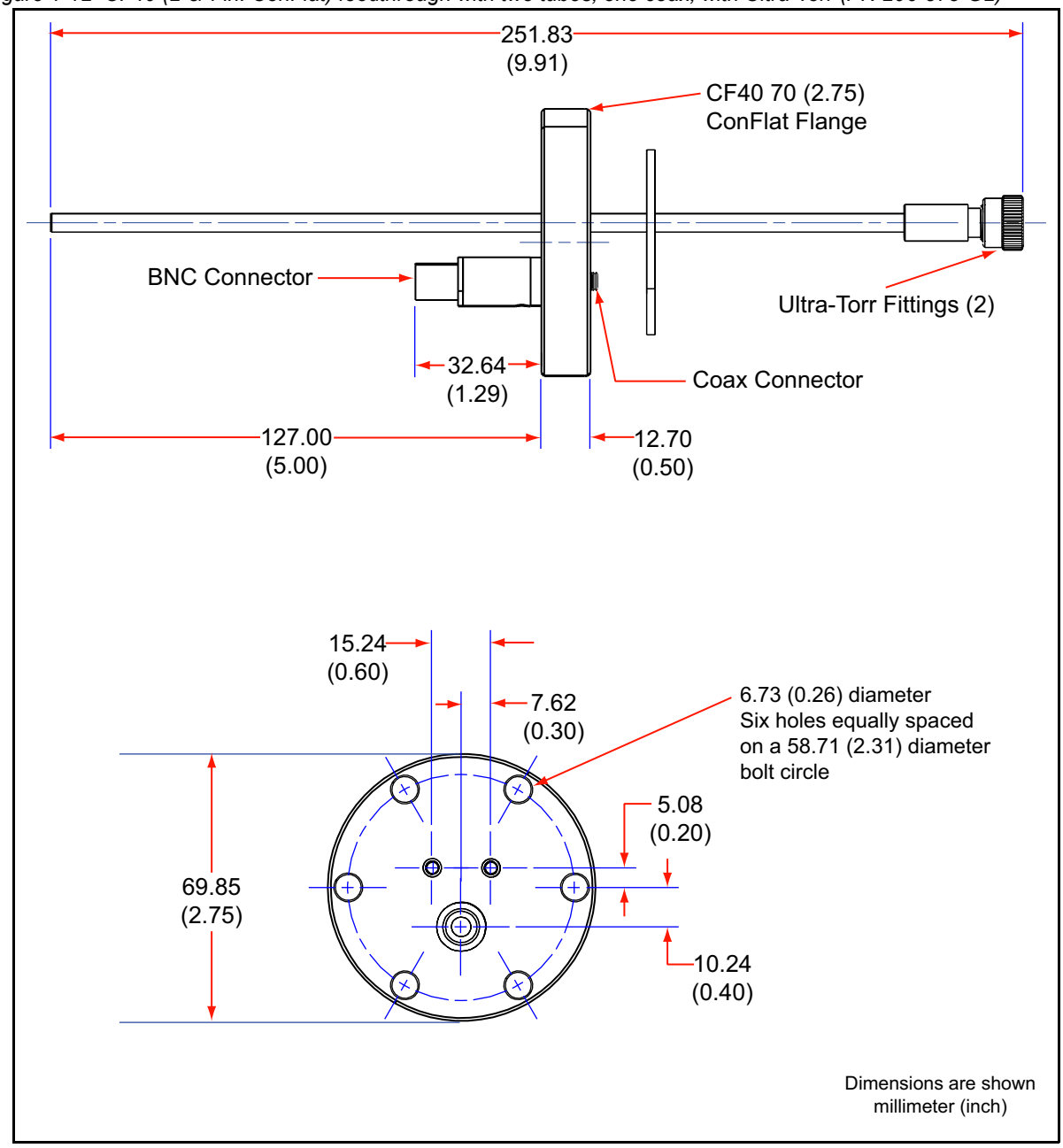

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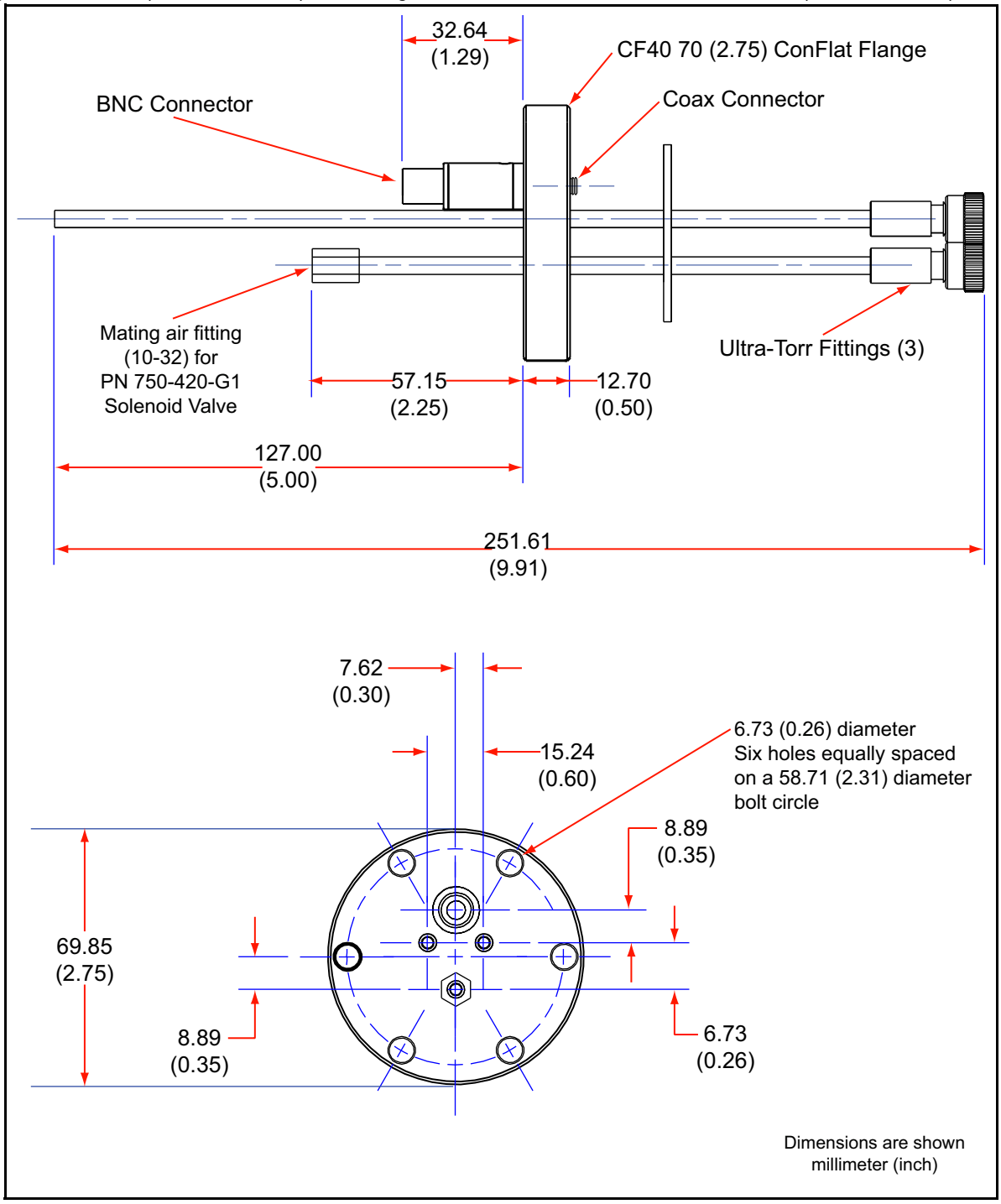
Figure 1-13 CF40 (2-3/4 in. ConFlat) feedthrough with three tubes, one coax, with Ultra-Torr (PN 750-685-G2)



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Chapter 2
Sensor Installation

2.1 Sensor Pre-installation Check

Prior to installing the Sputtering Sensor in the sputtering system, make certain that it is in proper working condition by following the appropriate procedure.

2.1.1 Sensor Check with XTC/3, IC6, or Cygnus 2 Deposition Controller

1. Connect the in-vacuum cable from the sensor head to the feedthrough or a coax adapter (Microdot/BNC).
2. Connect one end of the 15.2 cm (6 in.) BNC cable (PN 755-257-G6) to the BNC connector on the feedthrough.
3. Connect the other end of the 15.2 cm (6 in.) BNC cable to the connector of the ModeLock oscillator (XIU) (PN 781-600-GX).
4. Connect one end of the XIU cable (PN 600-1261-PXX) to the mating connector of the XIU.
5. Connect the other end of the XIU cable to a sensor channel at the rear of the controller.
6. Install the crystal as instructed by section 4.2 on page 4-2.
7. Connect power to the controller.
8. Set the power switch to ON.
9. Set density at 1.00 g/cm^3.
10. Zero the thickness. The display should indicate 0 or ± 0.001 kÅ. Crystal life should read from 0 to 5%.
11. Breathe heavily on the crystal. A thickness indication of 1.000 to 2.000 kÅ should display. When the moisture evaporates, the thickness indication should return to approximately zero. If these conditions are observed, the sensor is in proper working order and may be installed. (See section 2.3 on page 2-8.)

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2.1.2 Sensor Check with STM-2XM, SQM-160, SQC-310, or IQM-233 Deposition Controller/Monitor

1. Connect the in-vacuum cable from the sensor head to the feedthrough or a coax adapter (Microdot/BNC).
2. Connect one end of the 15.2 cm (6 in.) BNC cable (PN 782-902-011) to the BNC connector on the feedthrough.
3. Connect the other end of the 15.2 cm (6 in.) BNC cable to the connector of the oscillator (PN 783-500-013) labeled Sensor.
4. Connect one end of the oscillator cable (PN 782-902-012-XX) to the mating connector of the oscillator labeled Control Unit.
5. Connect the other end of the oscillator cable to a sensor connector at the rear of the controller/monitor.
6. Install the crystal as instructed by section 4.2 on page 4-2.
7. Connect power to the controller or monitor.
8. Set the power switch to ON.
9. For the IQM-233 card, launch the appropriate software.
10. Set density at 1.00 g/cm^3.
11. Zero the thickness. The display should indicate 0 or ± 0.001 kÅ. Crystal life should read from 95 to 100%.
12. Breathe heavily on the crystal. A thickness indication of 1.000 to 2.000 kÅ should display. When the moisture evaporates, the thickness indication should return to approximately zero. If these conditions are observed, the sensor is in proper working order and may be installed. (See section 2.3 on page 2-8.)

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2.1.3 Sensor Check with STM-2 Deposition Monitor

1. Connect the in-vacuum cable from the sensor head to the feedthrough or a coax adapter (Microdot/BNC).
2. Connect one end of the 15.2 cm (6 in.) BNC cable (PN 782-902-011) to the BNC connector on the feedthrough.
3. Connect the other end of the 15.2 cm (6 in.) BNC cable to the connector of STM-2.
4. Connect one end of the USB cable (PN 068-0472) to the mating connector of STM-2.
5. Connect the other end of the USB cable to a USB port on the computer being used to operate STM-2.
6. Install the crystal as instructed by section 4.2 on page 4-2.
7. Launch the appropriate monitor software.
8. Set density at 1.00 g/cm^3.
9. Zero the thickness. The display will indicate 0 or ± 0.001 kÅ. Crystal life should read from 95 to 100%. The green indicator on STM-2 should be illuminated.
10. Breathe heavily on the crystal. A thickness indication of 1.000 to 2.000 kÅ should display. When the moisture evaporates, the thickness indication should return to approximately zero. If these conditions are observed, the sensor is in proper working order and may be installed. (See section 2.3 on page 2-8.)

2.2 Sensor Installation Guidelines

Figure 2-1 on page 2-5 shows typical installations of Sputtering Sensors. Use this illustration and the following guidelines to install the Sputtering Sensor for optimum performance and convenience.

- Install the sensor in a position well within the stream of material sputtered from the target to accumulate thickness at a rate proportional to accumulation on the substrate.
- Ensure that the thickness indication from the sensor represents the thickness on the substrates by determining the tooling. Refer to the monitor or controller operating manual for calibration procedures.
- Plan the installation to ensure that there are no obstructions blocking a direct path between the sensor and the target.
- The Sputtering Sensor can be supported by the sensor water tubes, however, for best process reproducibility, support the sensor so that it cannot move during maintenance and crystal replacement.

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- The sensor must be installed such that the face of the crystal is perpendicular to the stream of material sputtered from the target. Install the sensor in a location without obstructions between material stream and sensor and in a location where the sensor will not obstruct the flow of material to the substrate.

Two effects may arise if the crystal face is not perpendicular to the stream of material sputtered from the target, and the combination of these effects will have a negative effect on crystal life and increase the probability of mode hops:

- The deposit will not be even across the crystal surface, causing the thickness of the deposit to become wedge shaped. This wedge shape in the deposited film tends to reduce the activity of the crystal at its primary resonance.
- The area of the deposit shifts from the center of the crystal. This is due to the shadowing effect of the crystal aperture. If the crystal is not perpendicular to the stream of material sputtered from the target, the strength of spurious (non-thickness shear) modes of vibration are enhanced. If the activity of these spurious modes of oscillation become strong enough, they cause short-term perturbation of the fundamental frequency. If they get very strong, the oscillator can lock onto the spurious mode of oscillation, causing a mode hop, unless a ModeLock instrument is used.

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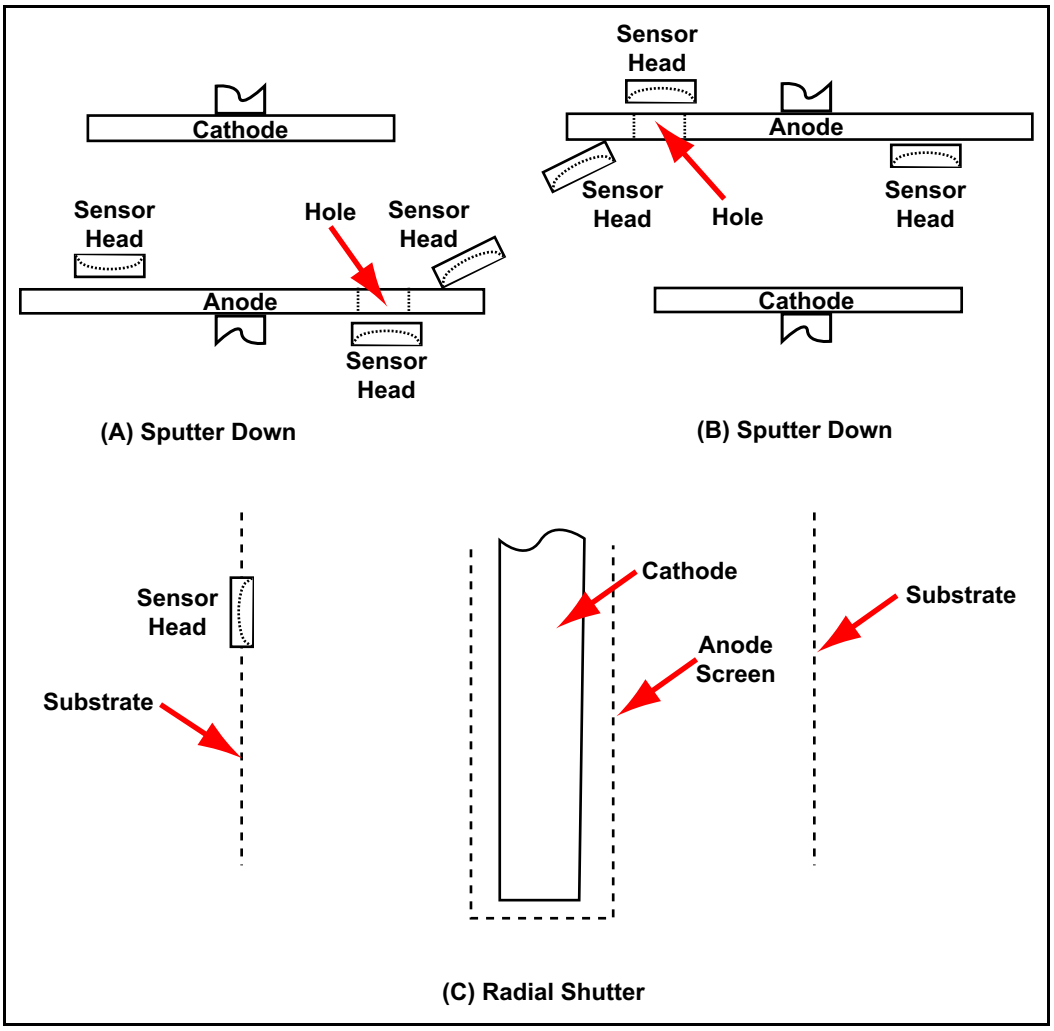
Figure 2-1 Suggested Sputtering Sensor locations



- The sensor must not disrupt electrical fields or otherwise disturb the normal material deposition pattern.
- Because the sputtering process is very noisy electrically, ground the monitor or controller, as well as the sensor, to the base plate or housing of the sputtering chamber. Refer to the monitor or controller operating manual for detailed grounding information.

  HINT: Use a wide ground strap to obtain low impedance at radio frequencies. Normal diameter wires have relatively high impedance at radio frequencies.
- The Sputtering Sensor can be installed in any position.
- Avoid exposing the sensor in-vacuum cable to the plasma by wrapping the cable around the water-cooling tubes and covering with aluminum foil.

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- Use water-cooling during the sputtering process. 750 cm^3/min (0.2 gpm) at 30°C (86°F) (maximum temperature) water flow is sufficient for most applications.

  HINT: Always check the water flow before starting the plasma.

- In sputtering systems which use a substrate shutter, the Sputtering Sensor should be mounted in a location where it is always exposed to plasma. If it is not, and the shutter is covering the sensor, there will be a small thickness jump when the shutter is opened, caused by thermal stress in the crystal.

- The sensor front cover assembly contains a permanent magnet that can deflect electronic flux away from the sensor to minimize unwanted heating of the crystal. (See section 2.2.1.) If the sensor is installed in a sputtering system which employs external magnetic fields, make sure the magnetic field direction of the sensor is not opposing the external magnetic field. (See Figure 2-3.)

2.2.1 Sensor Magnet Adjustment

Figure 2-2 Sensor magnet and field configuration

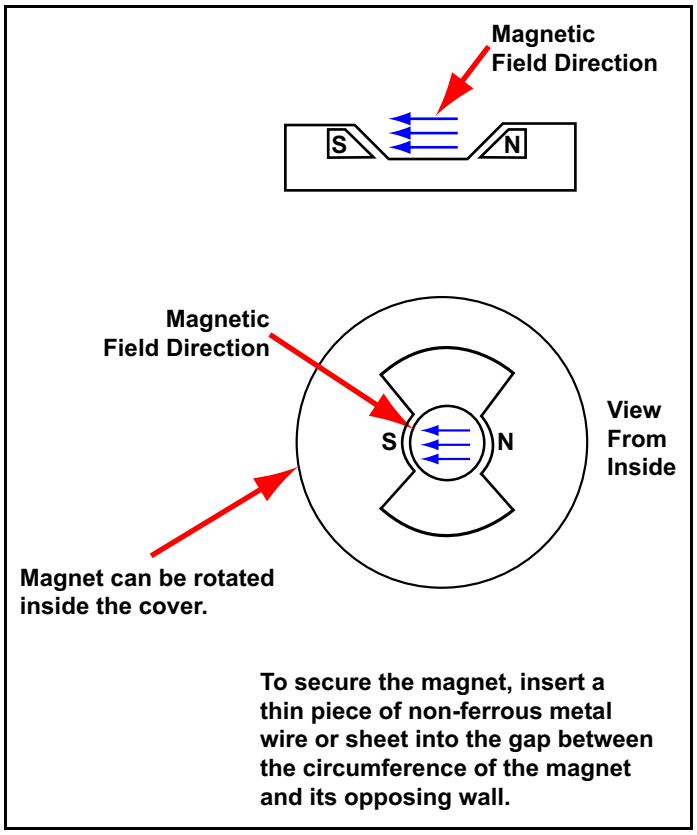

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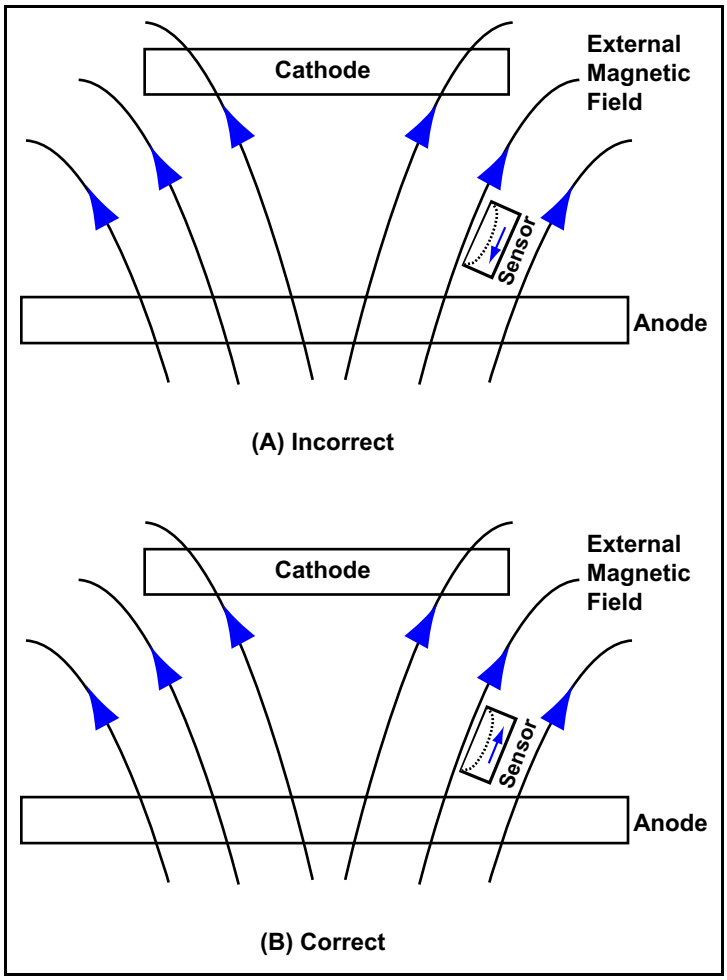
Figure 2-3 Orientation of sensor magnetic field in a sputtering system employing an external magnetic field



The cancellation of magnetic fields near the sensing crystal may cause undesirable crystal heating. Use a small magnet to determine the field direction and rotate the magnet in the sensor to a desirable position. The sensor magnet can be held in position by inserting a small piece of thin non-magnetic wire or sheet into the gap between the circumference of the magnet and the opposing wall. The magnetic field of the sensor is localized and will not affect the external magnetic field.

- The sensor is always at ground potential and cannot be made floating. In sputtering systems where the substrate holder (anode) is biased, the sensor should be located where it is electrically isolated from the substrate holder and where it does not affect the electric field near substrates.

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2.3 Sensor Installation Procedure

CAUTION

The sensor head, water tubes, cable, etc., should be clean and free of grease when installed in the vacuum chamber. Clean nylon or talc-free gloves should be worn while handling any sensor components.

If parts do become contaminated, clean them thoroughly using a suitable solvent to avoid outgassing.

NOTE: If the optional Sputtering Shutter Module will be used with the Sputtering Sensor, install the shutter module before proceeding with the sensor installation procedure. (See Chapter 3.)

1. Assemble a sensor mounting bracket (user supplied) on the process system.

   NOTE: A mounting bracket is recommended to prevent movement of the sensor during crystal replacement or sensor maintenance.

2. Temporarily position and attach the Sputtering Sensor as outlined in the general guidelines. (Refer to section 2.2 on page 2-3.)
3. Temporarily install the feedthrough.
4. Form, measure, and mark the sensor tubes. (See section 2.3.1 on page 2-11.)

   NOTE: The Tube Bender Kit, PN 750-037-G1, is recommended for bending the tubes (not included).

CAUTION

Do not form the water tubes with a bend radius less than 8 mm (0.315 in.) from the inside of the bend or 9.5 mm (0.375 in.) from the center line of the tubes.

Do not use the sensor body as a leverage point when bending the tubes.

5. Build the sensor/feedthrough assembly.
6. Remove the sensor and the feedthrough.
7. Cut the sensor water tubes and air tubes (if applicable) to the proper length. Verify that the water tubes are clear of metal particles by blowing compressed air through the water tubing.

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8 Connect the water tubes and air tubes directly to the feedthrough, or use vacuum rated fittings.

- Vacuum rated fittings, such as Swagelok® VCR® or VCO®, are recommended for use between the sensor and the feedthrough to speed maintenance. If brazing adapters are to be used, attach them to the sensor tubes prior to connection to the feedthrough. Make connections as follows:

CAUTION

To prevent damage to the feedthrough or sensor during brazing, ensure that at least 2.54 cm (1 in.) of water tube remains between the sensor and the flame.

- Clean the sensor tubes and adapter surfaces with solvent, if necessary.
- Apply brazing flux to surfaces being joined.
- Braze the connections using a flame temperature appropriate for the brazing material being used.

CAUTION

Excessive application of brazing material, or excessive heat due to brazing, may result in blockage of the tubes.

- Verify that the water tubes are not blocked with braze material by blowing compressed air through the water tubes.
- Thoroughly clean the braze joints and helium leak test the braze joints before installing the sensor and feedthrough into the process chamber.

9 With all water tube and air tube connections installed, install the sensor and feedthrough assembly into the process system and secure all retaining hardware.

10 Shield the sensor in-vacuum cable from heat radiating from the plasma, if the process allows, by wrapping aluminum foil around the in-vacuum cable and sensor tubes.

11 Connect the external water tubes from the feedthrough to the water supply system and flow controller. Use detachable fittings (Swagelok or equivalent) for external water tube connections.

12 Apply water at the specified flow rate (refer to section 1.5.2, Installation Requirements, on page 1-5), and verify that the water connections are tight.

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13 If applicable, attach air connection to solenoid valve and adjust air pressure to be 90 psi (gauge) {105 psi (absolute)} (7.2 bar (absolute)) [724 kPa (absolute)] (minimum) to 95 psi (gauge) {110 psi (absolute)} (7.6 bar (absolute)) [758 kPa (absolute)] (maximum).

WARNING

Do not exceed 100 psi (gauge) {115 psi (absolute)} (7.9 bar (absolute)) [791 kPa (absolute)].

Connection to excessive pressure may result in personal injury or equipment damage.

NOTE: Because of geometric factors, variations in surface temperature, and differences in electrical potential, the crystal and substrates often do not receive the same amount of material. Calibration is required to make sure the thickness indication on the instrument accurately represents the thickness on the substrates. Refer to the monitor or controller operating manual for calibration procedures.

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2.3.1 Tube Bending

CAUTION

Read this entire section before attempting to bend the tubes. Incorrect tube bending that damages the tubes voids the warranty.

If it is necessary to bend the tubes to clear obstacles inside the chamber or to bring the Sputtering Sensor into a proper mounting location, observe the following precautions:

- Support the tubes where the bends will be placed to avoid a tube being collapsed or pinched.

  NOTE: The Tube Bender Kit, PN 750-037-G1, is recommended for bending the tubes (not included).

  - If the water tube is collapsed, water flow will be restricted. The sensor will not have sufficient cooling.
  - If the air tube is collapsed, air pressure will be restricted. The shutter will not operate correctly.

CAUTION

Do not form the sensor tubes with a bend radius less than 8 mm (0.315 in.) from the inside of the bend or 9.5 mm (0.375 in.) from the center line of the tubes.

Do not use the sensor body as a leverage point when bending the tubes.

NOTE: The 3.175 mm (1/8 in.) tubes are flexible enough to bend, but they are not designed for repeated bending. Plan bends wisely. Before the actual tube bending, verify the bend position again to avoid readjusting. If in doubt, contact INFICON support. (Refer to section 1.3, How to Contact INFICON, on page 1-2.)

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Chapter 3
Sputtering Sensor Module Installation

3.1 Shutter Module Installation Requirements

The Sputtering Shutter Module installation kit (PN 750-005-G1) mounts a pneumatic shutter module onto a Sputtering Sensor. The pneumatic shutter module is assembled and tested at the factory.

The parts shown in Table 3-1 are required.

Table 3-1 Parts required to install the pneumatic shutter module

Qty.	Description	IPN
1	Sputtering Shutter Module	750-005-G1 (Refer to section 1.5.4 on page 1-8.)
1	Sputtering Sensor Assembly	750-618-G1 (Refer to Chapter 1.)
NOTE: The following parts are listed as suggested equipment and may be ordered separately.		
1	Solenoid Valve Assembly	750-420-G1 (See section 3.3 on page 3-4.)
1	2.54 cm (1 in.) Bolt Feedthrough with Airline (or equivalent)	750-030-G1 (See Figure 1-8 on page 1-13.)
OR		
1	CF40 (2-3/4 in. ConFlat®) Feedthrough Copper Gasket with Airline	750-685-G1 (See Figure 1-11 on page 1-16.)

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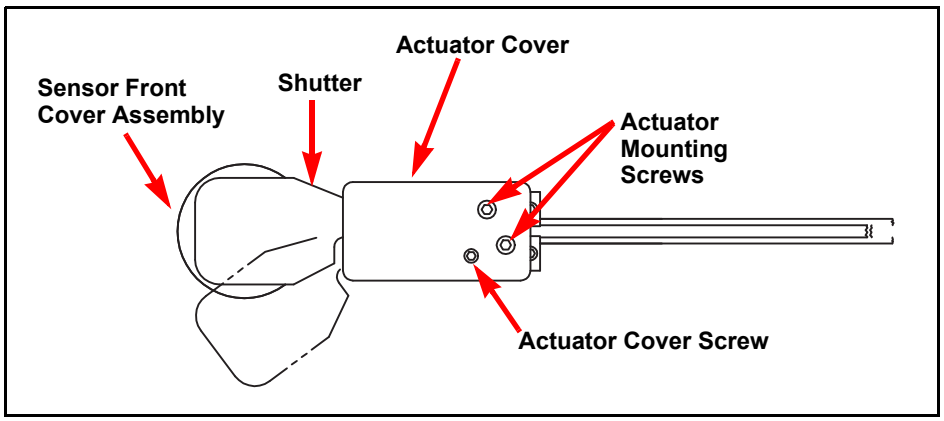
3.2 Shutter Module Installation Procedure

Before installation, review the figures to understand how the parts are assembled. The shutter assembly may be installed onto a new Sputtering Sensor or a used sensor in good condition.

1 Remove the actuator cover screw (4-40 x 3/16 in.) on the shutter assembly and remove the actuator cover. (See Figure 3-1.)

Figure 3-1 Top view



2 Remove the two water tube clamp screws (4-40 x 1/4) (not shown) and remove the clamp. (See Figure 3-2.)

3 Remove the sensor body assembly from the sensor front cover assembly and set it in a clean safe place. This is to protect the body assembly during the installation. (See Figure 3-2.)

Figure 3-2 Side view

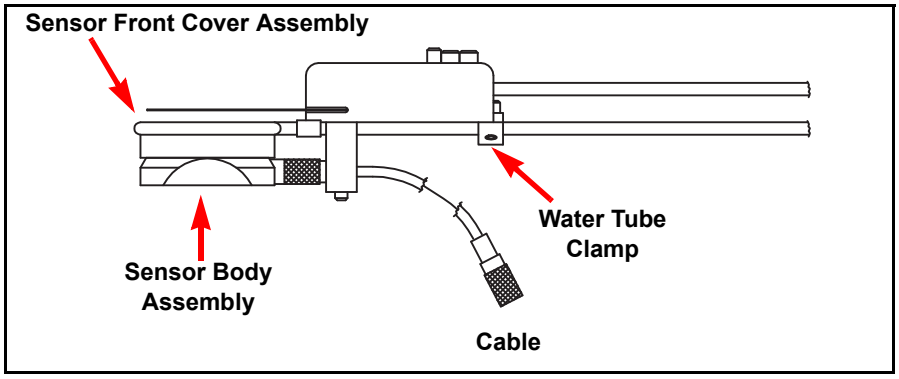


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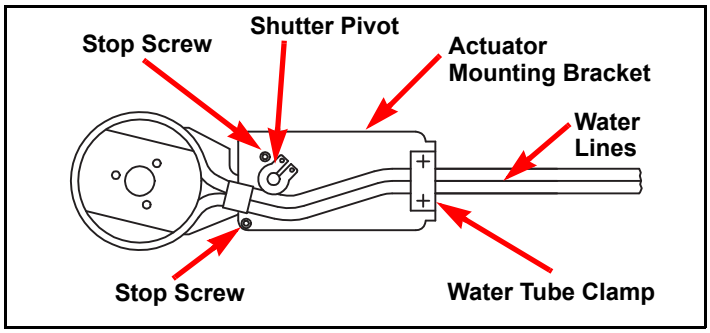
Figure 3-3 Bottom view



4. Place the sensor front cover assembly on the shutter module assembly as shown in Figure 3-3. The sensor water lines will fit between the shutter pivot and the stop screw. Carefully bend the water lines as shown.
5. Position the water line clamp on the shutter assembly and install the two mounting screws. Tighten the screws finger tight.
6. Position the sensor front cover assembly as shown in Figure 3-1. The shutter must cover the sensor. It may be necessary to align the sensor slightly to achieve the correct cover position.
7. The plane of the shutter and sensor front cover assembly should be parallel. (Refer to Figure 3-2.) It may be necessary to align the sensor slightly to achieve the correct position.
8. Tighten the two water tube clamp screws.
9. Manually rotate the shutter away from the sensor front cover assembly as shown in Figure 3-1 and then release it. The return operation must be smooth and unobstructed.
10. Install the actuator cover on the shutter actuator assembly and install the actuator cover screw (4-40 x 3/16). (Refer to Figure 3-1.)
11. Install the sensor body assembly into the sensor front cover assembly. The Sputtering Sensor with shutter module assembly will now appear as shown in Figure 3-2.

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3.2.1 Sensor Shutter Check

Temporarily connect an air supply to the actuator air tube. Use the manual override button on the solenoid valve (see Figure 3-5 on page 3-8 or Figure 3-6 on page 3-9), or other means, to activate and deactivate the pneumatic shutter several times.

NOTE: The air supply must be 90 psi (gauge) {105 psi (absolute)} (7.2 bar (absolute)) [724 kPa (absolute)] (minimum) to 95 psi (gauge) {110 psi (absolute)} (7.6 bar (absolute)) [758 kPa (absolute)] (maximum).

WARNING

Do not exceed 100 psi (gauge) {115 psi (absolute)} (7.9 bar (absolute)) [791 kPa (absolute)].

Connection to excessive pressure may result in personal injury or equipment damage.

When activated, shutter movement should be smooth, rapid, complete, and the shutter should completely expose the crystal opening. When deactivated, the shutter should completely cover the crystal opening.

NOTE: A solenoid valve assembly (PN 750-420-G1) is required for a shuttered sensor installation. See section 3.3 for solenoid valve and installation.

3.3 Solenoid Valve Assembly Installation Procedure

The solenoid valve assembly (PN 750-420-G1) and the feedthrough should be installed at the same time.

- For an 2.54 cm (1 in.) Bolt Feedthrough Installation, see section 3.3.1 on page 3-4.
- For an CF40 (2-3/4 in. ConFlat) Feedthrough Installation, see section 3.3.2 on page 3-5.

3.3.1 2.54 cm (1 in.) Bolt Feedthrough Installation

All shuttered sensors using 2.54 cm (1 in.) bolt feedthroughs require a single coaxial feedthrough, PN 750-030-G1. (Refer to Figure 1-8 on page 1-13.)

Most INFICON 2.54 cm (1 in.) bolt feedthroughs with air lines are equipped with a fitting adapter (PN 007-133). This adapter provides an easy way to attach a quick disconnect fitting (included with the PN 750-420-G1 solenoid valve assembly) to the feedthrough air line. The fitting adapter is available from INFICON for feedthroughs not equipped with this adapter.

Follow the steps below:

1. Ensure that the O-ring is in the groove on the bolt.
2. Insert the 2.54 cm (1 in.) bolt such that the hexagonal shaped end of the bolt is on the vacuum side of the chamber.
3. Add the solenoid valve bracket to the bolt threads.
4. Add the washer.
5. Add the feedthrough nut.
6. Tighten the feedthrough nut.

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7 Remove the quick disconnect air fitting from the exhaust port of the solenoid valve and thread it into the fitting adapter (PN 007-133) installed on the feedthrough air line.

8 Connect the 3.175 mm (1/8 in.) air tube from the **A** port of the solenoid valve to the quick disconnect fitting installed in step 7. (See section 3.3.3, Pneumatic Connections, on page 3-7.)

9 Attach the **P** port of the solenoid valve to a source of air. The air supply must be 90 psi (gauge) {105 psi (absolute)} (7.2 bar (absolute)) [724 kPa (absolute)] (minimum) to 95 psi (gauge) {110 psi (absolute)} (7.6 bar (absolute)) [758 kPa (absolute)] (maximum). (See section 3.3.3, Pneumatic Connections, on page 3-7.)

WARNING

Do not exceed 100 psi (gauge) {115 psi (absolute)} (7.9 bar (absolute)) [791 kPa (absolute)].

Connection to excessive pressure may result in personal injury or equipment damage.

CAUTION

Maximum temperature for the solenoid valve assembly is 105 °C for bakeout and operation.

10 Make electrical connections to the solenoid valve. (See section 3.3.4, Electrical Connections, on page 3-7.)

3.3.2 CF40 (2-3/4 in. ConFlat) Feedthrough Installation

If the solenoid valve assembly is to be used with the CF40 (2-3/4 in. ConFlat) feedthrough, modify the valve bracket as follows. (See Figure 3-5 on page 3-8.)

1 Align the score line on the solenoid valve bracket over the edge of a table or other square edge.

2 Using pliers, grasp the part of the bracket extending over the edge and push down. The assembly will break along the score line.

3 Use a file to smooth any rough edges which occur along the break.

All shuttered sensors using CF40 (2-3/4 in. ConFlat) feedthroughs require a single coaxial feedthrough, PN 750-685-G1 or PN 750-685-G2. (Refer to Figure 1-11 on page 1-16 or Figure 1-13 on page 1-18.)

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INFICON CF40 (2-3/4 in. ConFlat) feedthroughs with air lines are equipped with a fitting adapter (PN 007-133). This adapter provides an easy way to attach a quick disconnect fitting (included with the 750-420-G1 solenoid valve assembly) to the feedthrough air line.

Follow the steps below:

1 Install the Feedthrough.

2 Add the solenoid valve bracket (modified) to the desired location (shown in Figure 3-6 on page 3-9) using two of the 6.35 mm (1/4 in.) clamp bolts located on the flange.

3 Tighten the flange bolts.

4 Remove the quick disconnect air fitting from the exhaust port of the solenoid valve and thread it into the fitting adapter (PN 007-133) installed on the feedthrough air line.

5 Connect the 3.175 mm (1/8 in.) air tube from the **A** port of the solenoid valve to the quick disconnect fitting installed in step 4. (See section 3.3.3, Pneumatic Connections, on page 3-7.)

6 Attach the **P** port of the solenoid valve to a source of air. The air supply range is 90 psi (gauge) {105 psi (absolute)} (7.2 bar (absolute)) [724 kPa (absolute)] (minimum) to 95 psi (gauge) {110 psi (absolute)} (7.6 bar (absolute)) [758 kPa (absolute)] (maximum). (See section 3.3.3, Pneumatic Connections, on page 3-7.)

WARNING

Do not exceed 100 psi (gauge) {115 psi (absolute)} (7.9 bar (absolute)) [791 kPa (absolute)].

Connection to excessive pressure may result in personal injury or equipment damage.

CAUTION

Maximum temperature for the solenoid valve assembly is 105°C for bakeout and operation.

7 Make electrical connections to the solenoid valve. (See section 3.3.4, Electrical Connections, on page 3-7.)

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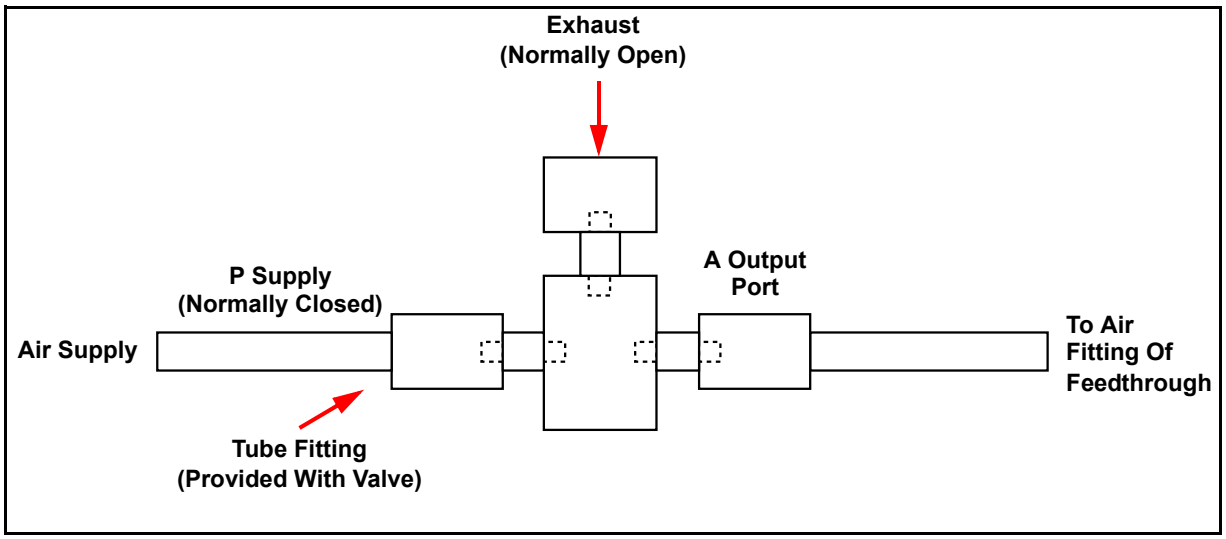
3.3.3 Pneumatic Connections

Figure 3-4 Pneumatic solenoid valve tube connections



3.3.4 Electrical Connections

To complete installation of the assembly, make electrical connections where indicated in Figure 3-6 on page 3-9 to either 24 V(ac) or V(dc). Current required is approximately 70 mA.

CAUTION

The maximum applied voltage must not exceed 26 V (ac) or 26 V (dc).

3.4 Solenoid Valve Assembly Drawings

The following Solenoid Valve Outline Drawings provide dimensions and other relevant data necessary for planning equipment configurations.

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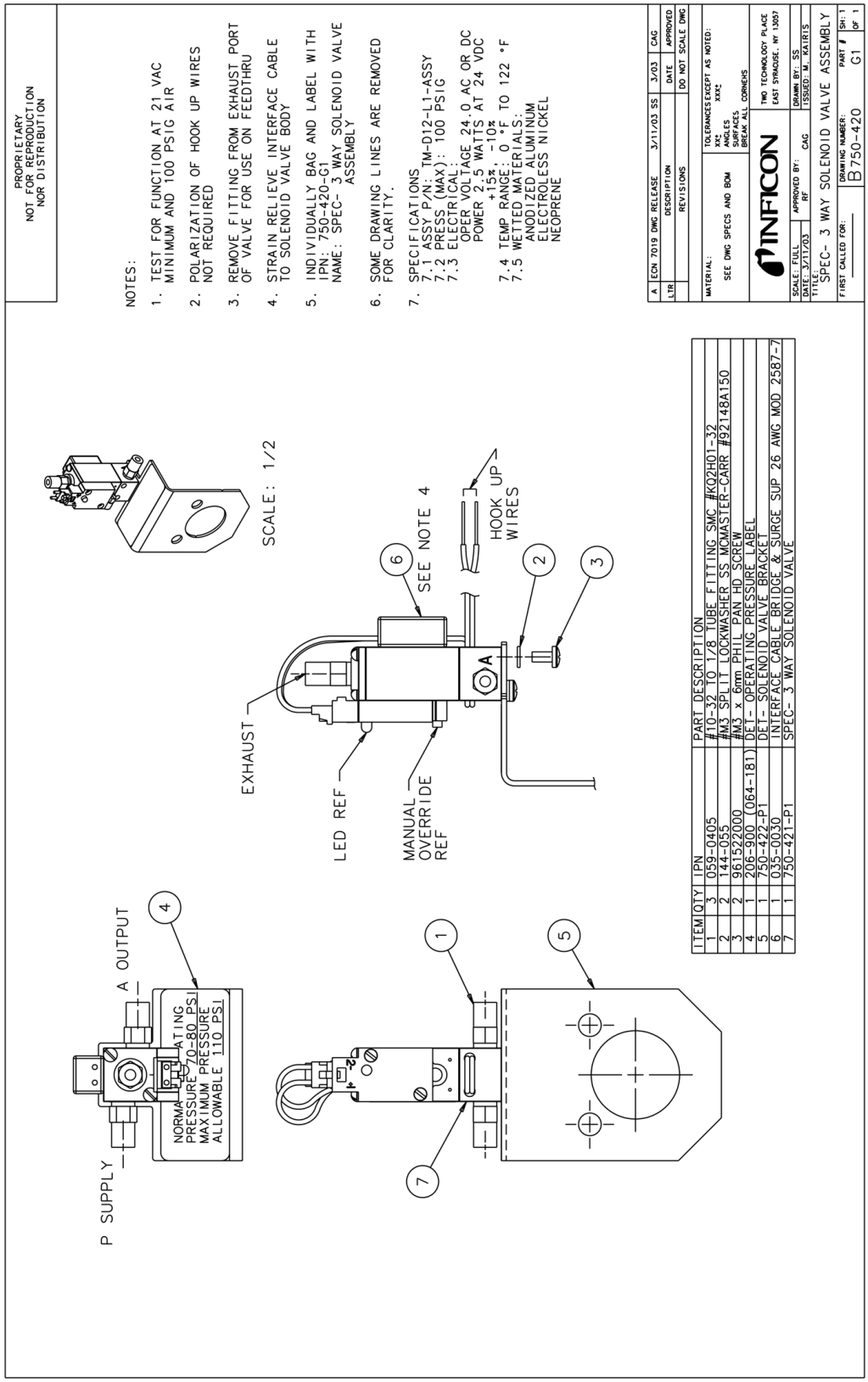

Figure 3-5 Solenoid valve Assembly

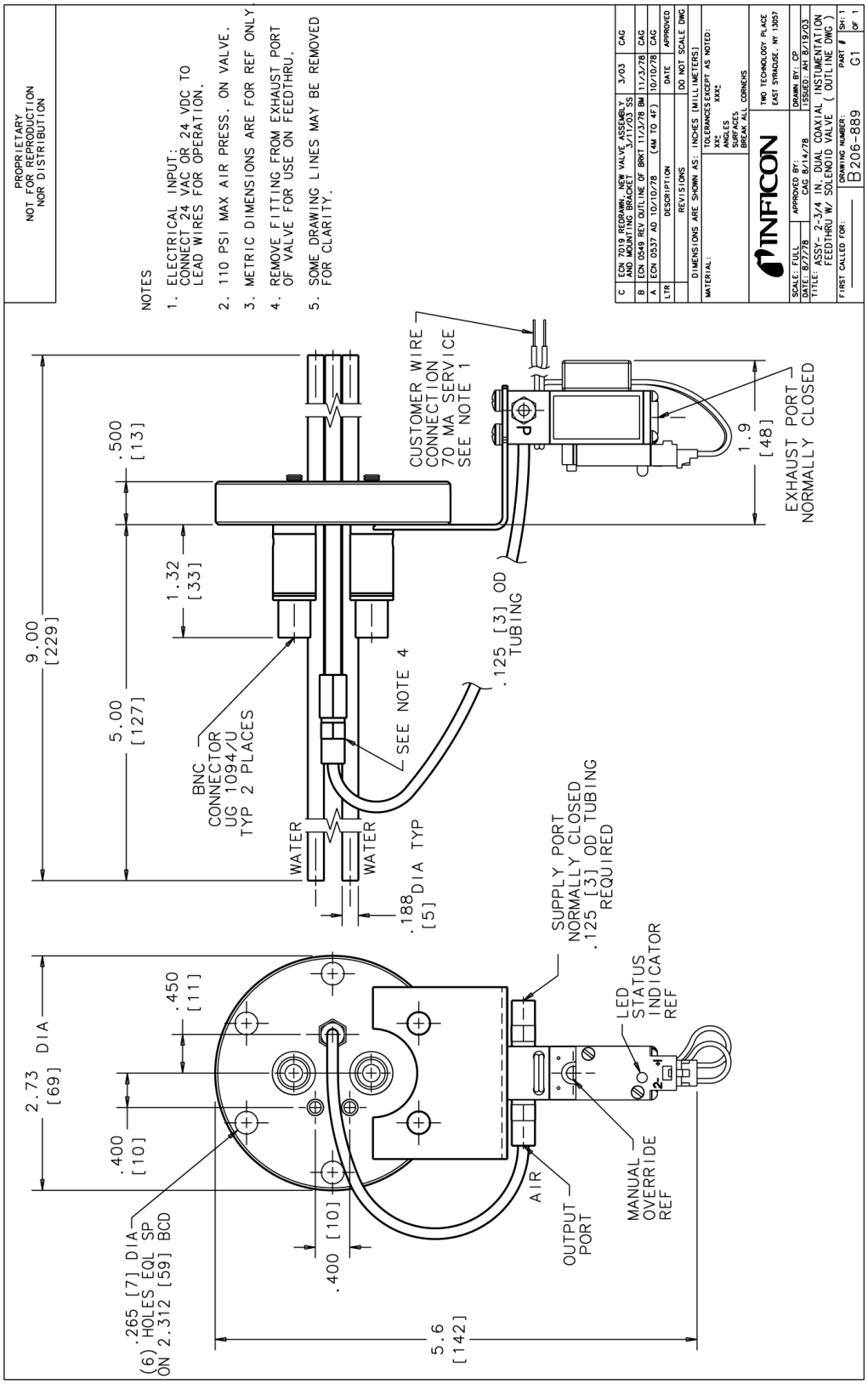

Figure 3-6 CF40 (2-3/4 in. ConFlat) dual coaxial feedthrough and solenoid valve outline

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Chapter 4
Maintenance and Spare Parts

4.1 General Precautions

CAUTION

Wear clean nylon or talc-free latex lab gloves when handling sensor components. If sensor components become contaminated, clean them thoroughly using a suitable solvent to avoid outgassing under vacuum.

4.1.1 Handle the Crystal with Care

The crystal surfaces are easily contaminated. Handle the crystals only by their edges. Always use clean nylon lab gloves when handling crystal holders and retainers. Use clean Teflon tweezers when handling crystals. If using a vacuum pencil to handle crystals, be sure the vacuum pencil tip is clean and not contaminated.

Contamination can lead to poor film adhesion. Poor film adhesion will result in high rate noise and premature crystal failure.

CAUTION

Do not use metal tweezers to handle crystals.
Metal tweezers may chip the edge of the crystal.

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4.1.2 Use the Optimum Crystal Type

Silver crystals are recommended for sputtering and other applications with sustained high heat loads.

Certain materials, especially dielectrics, may not adhere strongly to the crystal surface and may cause erratic readings. For many dielectrics, adhesion is improved by using alloy crystals.

Gold is preferred for other applications. Contact INFICON for crystal material electrode recommendations for a specific application. (Refer to section 1.3 on page 1-2.)

4.1.3 Maintain the Temperature of the Crystal

Periodically measure the water flow rate leaving the sensor to verify that the flow rate meets or exceeds the flow rate value specified on page 1-5.

Depending upon the condition of the cooling water used, the addition of an in-line water filtering cartridge system may be necessary to prevent flow obstructions.

Many system coaters use parallel water supplies that provide high water flow rates. With a parallel water supply, an obstruction or closed valve in the pipe that supplies water to the sensor head may not result in a noticeable reduction of total flow. Therefore, monitor the flow leaving the sensor.

The crystal requires sufficient water cooling to sustain proper operational and temperature stability. Ideally, a constant heat load is balanced by a constant flow of water at a constant temperature.

INFICON quartz crystals are designed to provide the best possible stability under normal operating conditions.

No crystal can completely eliminate the effects of varying heat loads. Sources of heat variation include radiated energy emanating from the plasma.

NOTE: Water cooling temperature near the dew point in the room should be avoided. Condensation can cause early crystal failures.

It is recommended that water cooling temperature be maintained at 5 to 10°C above the dew point in the room during a vent of the system. Water cooling temperature can be lowered to a temperature less than 30°C under vacuum.

4.1.4 Crystal Concerns when Opening the Chamber

Thick deposits of some materials, such as SiO, Si, and Ni will normally peel off the crystal when it is exposed to air due to changes in film stress caused by gas absorption. When peeling is observed, replace the crystal.

4.2 Crystal Replacement Instructions

Follow the steps below to replace the crystals.

NOTE: Review section 4.1, General Precautions, on page 4-1.

CAUTION

To preserve cleanliness and to maximize crystal performance, perform all work in a clean room environment.

1 Wearing clean nylon gloves, grip the body assembly and pull it straight out of the front cover assembly.

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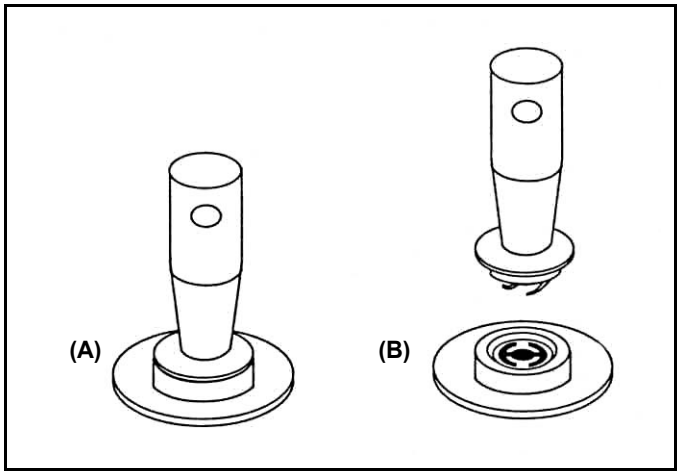
2 Wearing clean nylon gloves, grip the crystal holder and pull it straight out of the body assembly.

3 Insert the tapered end of the crystal snatcher (PN 008-007) into the ceramic retainer (see Figure 4-1 (**A**)), and apply a small amount of pressure. This locks the retainer to the snatcher and allows the retainer to be pulled straight out. (See Figure 4-1 (**B**).)

Figure 4-1 Using the crystal snatcher



4 Invert the crystal holder and the crystal will drop out.

5 Prior to installing the new crystal, review section 4.1.1, Handle the Crystal with Care, on page 4-1.

6 Grasp the edge of the new crystal with a clean pair of Teflon tweezers. Orient the crystal so the patterned electrode is facing up. Gently insert the edge of the crystal beneath one of the wire segments that protrude into the crystal cavity. Release the crystal.

7 Replace the ceramic retainer. Initially orient it at an angle to displace the spring wire segments in the crystal holder.

CAUTION

***Do not use excessive force* when handling the Ceramic Retainer Assembly since breakage may occur. Always use the crystal snatcher.**

***To prevent scratching* the crystal electrode, do not rotate the ceramic retainer after installation.**

8 Release the crystal snatcher with a slight side-to-side rocking motion. Using the backside of the crystal snatcher, push on the ceramic retainer to ensure it is completely seated.

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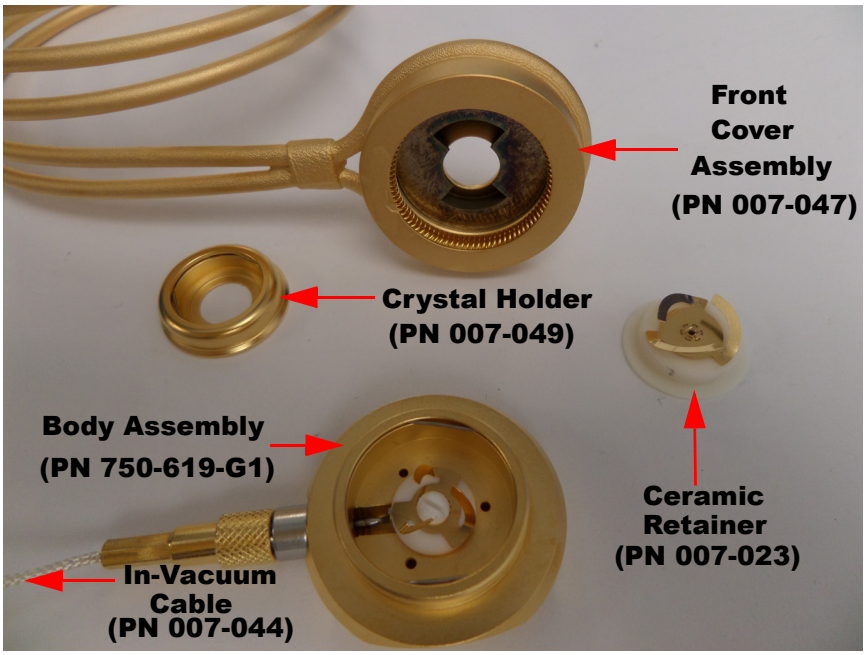
9 Reinstall the crystal holder in the body assembly; push the holder straight in making certain that it is completely seated in the body assembly.

10 Reinstall the body assembly into the front cover assembly; push the body assembly straight in making certain that it is completely seated in the front cover assembly. (See Figure 4-2.)

Figure 4-2 Sputtering Sensor assembly



CAUTION

Never deposit material on a sensor unless the crystal holder and crystal are installed. Material improperly deposited on the exposed sensor body assembly will cause either complete failure to oscillate or lead to premature crystal failure. Removing the deposited material requires extensive rework and new components.

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4.3 Sensor Maintenance

4.3.1 Adjusting the Leaf Spring

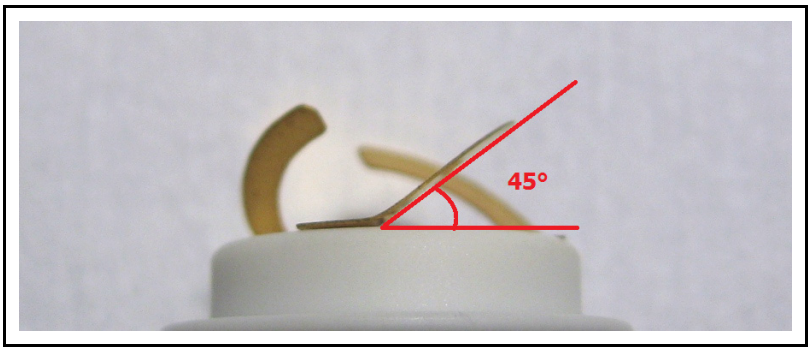
Sputtering Sensors have two leaf springs with three prongs each:

- a leaf spring inside the body assembly cavity that provides an electrical connection to the back of the ceramic retainer. This leaf spring is preformed and heat treated and should not require adjustment.
- a leaf spring on the ceramic retainer that provides an electrical connection to the crystal electrode.

Examine the prongs on the leaf spring positioned on the ceramic retainer. If they are significantly lower than shown by Figure 4-3, they should be adjusted to an angle of approximately 45 degrees.

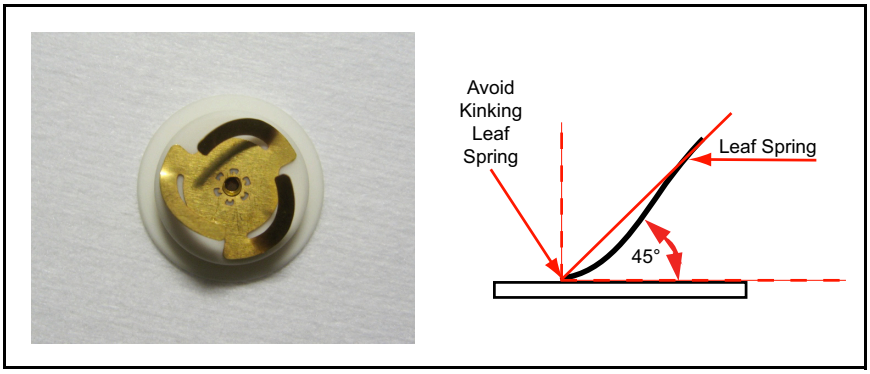
NOTE: A leaf spring adjusted to 45 degrees will flatten slightly after being inserted into and extracted from the crystal holder.

Figure 4-3 Ceramic retainer



To adjust the prongs on the leaf spring positioned on the ceramic retainer, touch the end of the prong with a gloved finger, or grip the prong with Teflon tweezers, and gently lift it upward. Be careful not to kink the prongs. An ideal bend has a smooth, sweeping shape as shown by Figure 4-4.

Figure 4-4 Leaf spring shape



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4.3.2 Cleaning the Crystal Holder

In dielectric coating applications, the crystal seating surface of the crystal holder may require periodic cleaning. Since most dielectrics are insulators, any material buildup on this surface from a sputtering process can cause a poor electrical contact between the crystal and the crystal holder. Material buildup will also cause a reduction in thermal transfer from the crystal to the water-cooled sensor. A poor electrical contact or poor thermal transfer will result in noisy operation and early crystal failure.

Cleaning may be accomplished by following three steps:

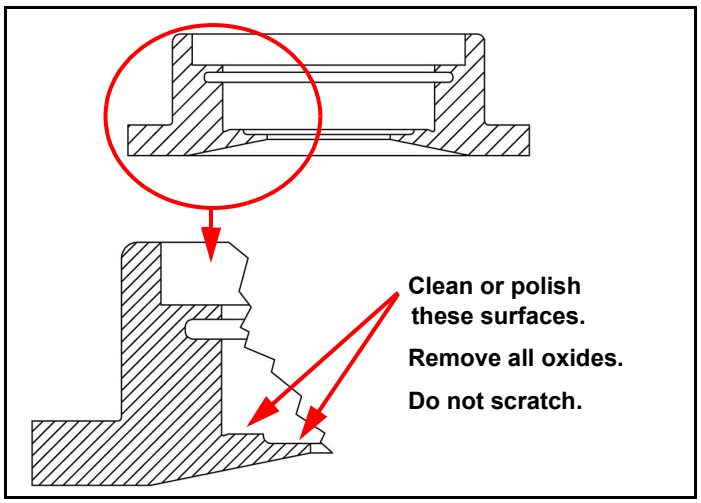
1. Gently buffing the crystal seating surface in the crystal holder with a white, #7445 Scotch-Brite™ cleaning pad. (See Figure 4-5.)
2. Washing the crystal seating surface in the crystal holder in an ultrasonic bath in soap solution.
3. Thorough rinsing of the crystal seating surface in the crystal holder with deionized water and drying, or by ultrasonic cleaning and deionized water rinsing only.

NOTE: The crystal holder seating surface is machined to a very fine finish (16 micro inches rms). This high quality finish is essential to provide good electrical and thermal contact with the crystal.

CAUTION

Applying excessive force during cleaning or using overly abrasive cleaning materials may damage this finish and reduce sensor performance.

Figure 4-5 Crystal holder cleaning



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4.3.3 Adjusting the Crystal Holder Retainer Spring

If the ceramic retainer is not being retained securely by the crystal holder, or if the ceramic retainer if difficult to insert, the retention force of the retainer spring in the crystal holder can be adjusted by the following procedure.

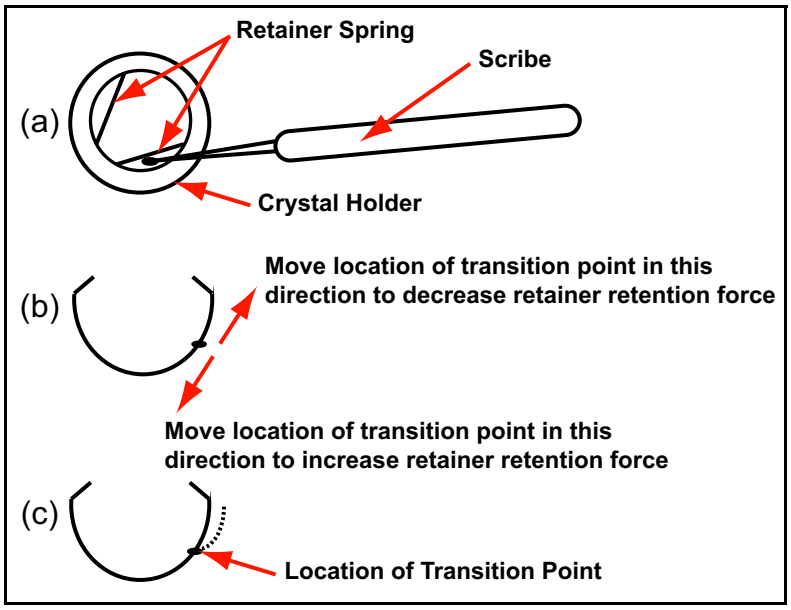
Tools required

- Scribe or other pointed tool
- Needle nose pliers (two required)

Procedure

1. Position the crystal holder with the crystal aperture oriented downward.
2. Insert the point of the scribe between the inside edge of the crystal holder and either side of the exposed retainer spring. (See Figure 4-6Figure 4-6 (**a**).)

Figure 4-6 Location of the transition point



3. Using the scribe, gently remove the retainer spring from its groove in the crystal holder.
4. Refer to Figure 4-6 (**b**) to determine the direction in which the 'transition point' must be relocated, to attain the desired retention forces. Moving this transition point approximately 1.59 mm (1/16 in.) is generally sufficient.
5. Grasp the retainer spring, with the pliers, just below the transition point. Use the second set of pliers to bend the retainer spring as illustrated by the dashed line in Figure 4-6 (**c**) to remove the existing transition point.
6. Use both pliers to form a new transition point according to Figure 4-6 (**b**), thus returning the retainer spring to a shape similar to the solid line delineation of Figure 4-6 (**c**).
7. Reinstall the retainer spring into the groove in the crystal holder.
8. Determine if the retention force is acceptable and that the wire does not impede crystal insertion. If needed, repeat the adjustment procedure.

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4.3.4 Lubricating the Shutter Module

The shutter module should be lubricated approximately every 2000 strokes. Failure to lubricate the shutter module may significantly reduce life of operation or cause assembly to become inoperative.

For lubrication, use molybdenum disulfide (PN 750-191-G1), provided with each shuttered sensor, or use Fomblin® E25 (perfluorinated polyether), if appropriate for the process.

4.4 Spare Parts and Accessories

Front Cover Assembly . . . . . PN 007-047

Body Assembly . . . . . PN 750-619-G1

Ceramic Retainer . . . . . PN 007-023

Crystal Holder. . . . . PN 007-049

Magnet . . . . . PN 007-009

Leaf Spring . . . . . PN 750-188-P3

Ceramic Insulator . . . . . PN 750-175-P1

Teflon Screw. . . . . PN 082-044

Crystal Snatcher. . . . . PN 008-007

Shutter Module . . . . . PN 750-005-G1

Tubing Adapter (#10-32) . . . . . PN 007-133

Crystal Sensor Emulator . . . . . PN 760-601-G2

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In-Vacuum Cable

15.2 cm (6 in.). . . . . PN 321-039-G12

25.4 cm (10 in.) . . . . . PN 783-500-023

30.5 cm (12 in.). . . . . PN 007-252

61.0 cm (24 in.). . . . . PN 321-039-G11

76.2 cm (30 in.) . . . . . PN 783-500-024

78.1 cm (30.75 in.) . . . . . PN 007-044

91.4 cm (36 in.). . . . . PN 007-059

121.9 cm (48 in.). . . . . PN 007-061

152.4 cm (60 in.). . . . . PN 321-039-G13

182.9 cm (72 in.). . . . . PN 321-039-G14

3.5 m (137.8 in.) . . . . . PN 321-039-G15

4 m (157.5 in.) . . . . . PN 321-039-G16

NOTE: The cable length from the crystal to the oscillator should not exceed 101.6 cm (40 in.) unless a ModeLock instrument is used. Refer to the monitor or controller operating manual for cable length limitations.

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Chapter 5
Troubleshooting

5.1 Troubleshooting Tools

If the Sputtering Sensor fails to function, or appears to have diminished performance, diagnose the sensor using one or more of the following:

- Symptom, Cause, Remedy Chart. (See section 5.1.1.)
- Diagnostic Tools. (See section 5.1.2 on page 5-4)
- Digital Multimeter. (See section 5.1.3 on page 5-5.)

5.1.1 Symptom, Cause, Remedy Chart

The Symptom, Cause, Remedy chart can help identify the causes of, and solutions to, sensor problems and related issues. (See Table 5-1.)

Table 5-1 Symptom, Cause, Remedy

SYMPTOM	CAUSE	REMEDY
Large jumps of thickness reading during deposition.	Mode hopping due to damaged or heavily damped crystal.	Replace the crystal.
	Crystal is near the end of its life.	
	Scratches or foreign particles on the crystal holder seating surface.	Clean or polish the crystal seating surface of the crystal holder. (Refer to section 4.3.2 on page 4-6.)
	Uneven coating.	Mount the sensor with the crystal face perpendicular to the stream of material sputtered from the target. (Refer to section 2.2 on page 2-3.)
	Particles on the crystal.	Remove source of particles and replace the crystal.

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Table 5-1 Symptom, Cause, Remedy (continued)

SYMPTOM	CAUSE	REMEDY
Crystal ceases to oscillate during deposition before it reaches its “normal” life.	Damaged crystal.	Replace the crystal.
	Deposition material on crystal holder opening is touching the crystal.	Remove material buildup from the crystal holder opening, being careful not to scratch the crystal seating surface. (Refer to section 4.3.2 on page 4-6.)
	Deposition material on crystal holder opening is partially masking the crystal.	
Short crystal life	Crystal life is highly dependent on process conditions of rate, location, material, and residual gas composition.	
Crystal does not oscillate or oscillates intermittently (both in vacuum and in air).	Damaged crystal.	Replace the crystal.
	Sensor or feedthrough has electrical short or open, or poor, electrical connections.	Check electrical continuity and isolation of sensor and feedthrough. (See section 5.1.3 on page 5-5.)
Crystal oscillates in vacuum but stops oscillation after open to air.	Crystal is near the end of its life; opening to air causes film oxidation, which increases film stress.	Replace the crystal.
	Excessive moisture accumulation on the crystal.	Turn off cooling water to sensor before venting vacuum chamber. Flow hot water through the sensor when the vacuum chamber is open.
Poor thickness reproducibility.	Erratic sputtering characteristics.	Check the sputtering system for proper operating conditions.
	Material does not adhere to the crystal.	Check the cleanliness of the crystal. Use gold or silver or alloy crystals, as appropriate. Sputter an intermediate layer of proper material on the crystal to improve adhesion.

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Table 5-1 Symptom, Cause, Remedy (continued)

SYMPTOM	CAUSE	REMEDY
Thermal instability: large changes in thickness reading during source warm-up (usually causes thickness reading to decrease) and after the termination of deposition (usually causes thickness reading to increase).	Crystal is not properly seated, causing poor thermal transfer from crystal to crystal holder.	Check and clean the crystal seating surface of the crystal holder. (Refer to section 4.3.2 on page 4-6.)
	Crystal not properly seated.	Check and clean the crystal seating surface of the crystal holder. (Refer to section 4.3.2 on page 4-6.)
	Excessive heat applied to the crystal.	If crystal heating is due to radiation from the plasma, move sensor farther away from target. Use Low Thermal Shock crystals (PN SPC-1157-G10) for better thermal stability. If crystal heating is due to electron flux, adjust the magnet to deflect electrons. (Refer to section 2.2.1 on page 2-6.)
	No cooling water.	Check cooling water flow rate.
	External magnetic field interferes with the sensor magnetic field.	Rotate the sensor magnet to a proper orientation with respect to the external magnetic field. (Refer to section 2.2.1 on page 2-6.)
	Sensor magnet defective (cracked or demagnetized)	Check sensor magnet field strength; if a gaussmeter is available, the maximum field at the center of the opening should give a reading of 700 gauss or greater.

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5.1.2 Diagnostic Tools

The following diagnostic tools can be used to determine if a crystal fail condition is due to the Sputtering Sensor or the instrument the sensor is used with:

- PN 782-902-023 oscillator with 5.5 MHz test crystal. (See section 5.1.2.1.)
- OSC-100 oscillator test function. (See section 5.1.2.2.)
- PN 760-601-G2 Crystal Sensor Emulator. (See section 5.1.2.3.)
- XIU test function. (See section 5.1.2.4.)

5.1.2.1 PN 782-902-023 Oscillator with 5.5 MHz Test Crystal

1. Disconnect the short BNC cable from the BNC connector on the Sputtering Sensor feedthrough.
2. Connect the 5.5 MHz test crystal (included with oscillator) to the short BNC cable connected to the oscillator.
   - If the crystal fail disappears within 5 seconds, the Sputtering Sensor is the cause of the crystal fail.
   - If the crystal fail is still present after 5 seconds, the controller or monitor, the oscillator, or a cable is the cause of the crystal fail. Refer to the monitor or controller operating manual.

5.1.2.2 OSC-100 Test Function

1. Disconnect the short BNC cable from the BNC connector on the Sputtering Sensor feedthrough.
2. Depress the test button on the OSC-100 oscillator.
   - If the crystal fail disappears within 5 seconds with the button depressed, the Sputtering Sensor or the short BNC cable is the cause of the crystal fail.
   - If the crystal fail is still present after 5 seconds with the button depressed, the controller or monitor, the oscillator, or a cable is the cause of the crystal fail. Refer to the monitor or controller operating manual.

5.1.2.3 PN 761-601-G2 Crystal Sensor Emulator

1. Disconnect the short BNC cable from the BNC connector on the Sputtering Sensor feedthrough.
2. Connect the Crystal Sensor Emulator to the short BNC cable connected to the XIU or oscillator.
   - If the crystal fail disappears within 5 seconds, the Sputtering Sensor is the cause of the crystal fail.
   - If the crystal fail is still present after 5 seconds, the controller or monitor, the oscillator or XIU, or a cable is the cause of the crystal fail. Refer to the monitor or controller operating manual.

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5.1.2.4 XIU Test Function

The XIU Test function is a feature of IC/5, Cygnus, IC6, Cygnus 2, and XTC/3 controllers. Refer to the controller operating manual for instructions on using the XIU test function.

5.1.3 Digital Multimeter

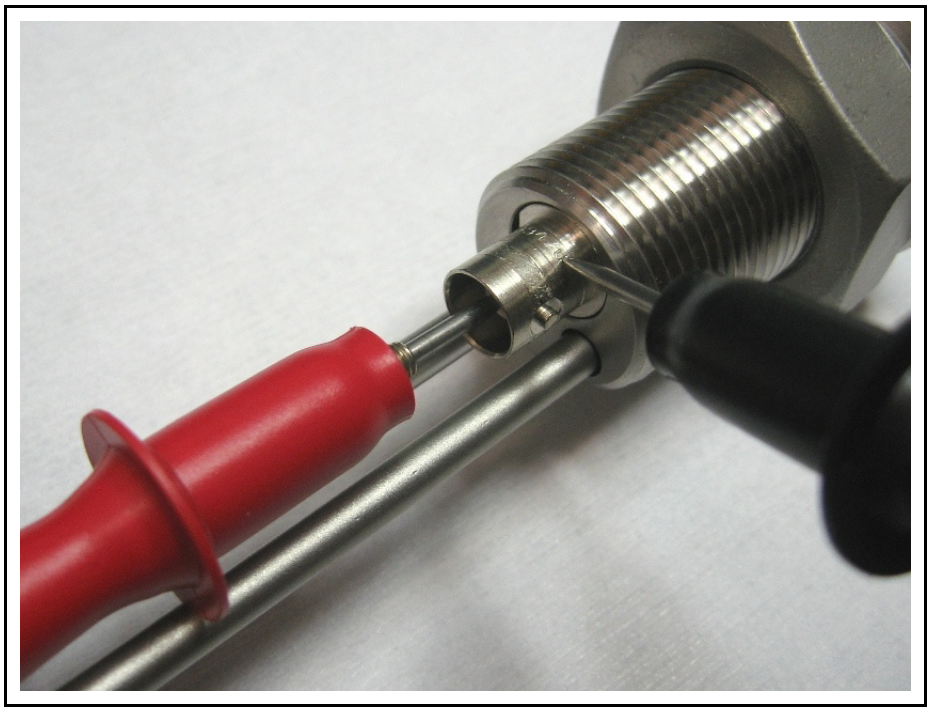
A useful tool for diagnosing sensor problems is the Digital Multimeter (DMM).

To isolate the cause of a sensor problem, perform electrical isolation and continuity checks, starting with the Electrical Isolation Check, section 5.1.3.1.

5.1.3.1 Electrical Isolation Check

1. Remove the crystal holder from the body assembly.
2. Disconnect the short BNC cable from the feedthrough.
3. Select the DMM ohmmeter function and high resistance (MΩ) scale.
4. At the feedthrough, measure resistance between center contact and shield of the BNC connector. (See Figure 5-1.)
   - If resistance is more than 10 MΩ, electrical isolation is good. Go to section 5.1.3.2, Electrical Continuity Check, on page 5-7.
   - If resistance is less than 10 MΩ, continue to step 5.

Figure 5-1 Resistance check



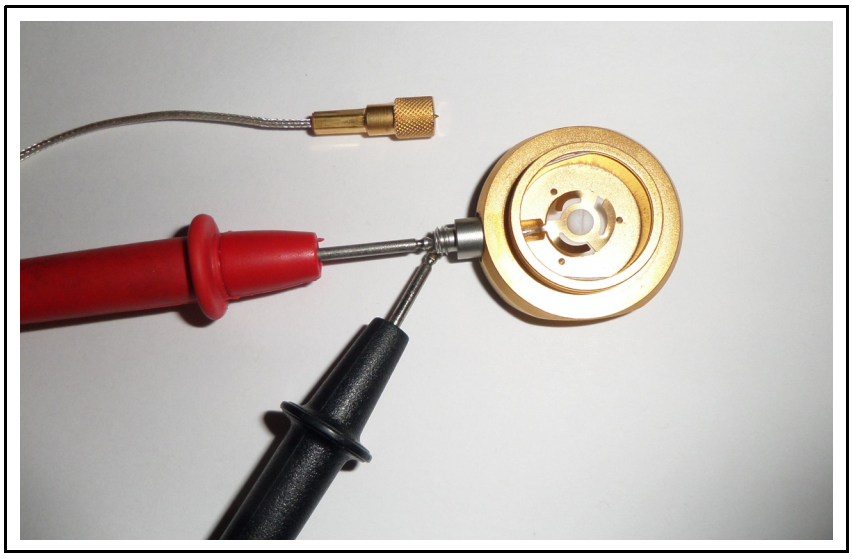
5. Disconnect the in-vacuum cable from the body assembly.

6 Measure resistance between center contact and shield of the BNC.

- If resistance is less than 10 MΩ, continue to step 7.
- If resistance is more than 10 MΩ, continue to step 6a.

6a Measure resistance between the center contact and threads of the coaxial connector on the body assembly (shown by Figure 5-2). If resistance across the coaxial connector is less than 10 MΩ, examine the body assembly and coaxial connector for the cause of the low resistance. Contact INFICON if cause of low resistance is not found. (Refer to section 1.3, How to Contact INFICON, on page 1-2.)

Figure 5-2 Body assembly isolation check



7 Disconnect the in-vacuum cable from the feedthrough.

8 Measure resistance between center contact and shield of the BNC.

- If resistance is less than 10 MΩ, continue to step 8a.
- If resistance is more than 10 MΩ, continue to step 9.

8a Examine the feedthrough for the cause of the low resistance. Contact INFICON if cause of low resistance is not found. (Refer to section 1.3, How to Contact INFICON, on page 1-2.)

9 Replace the in-vacuum cable.

10 Measure resistance between center contact and shield of the BNC.

- If resistance is more than 10 MΩ, electrical isolation is good. Go to section 5.1.3.2, Electrical Continuity Check, on page 5-7.
- If resistance is less than 10 MΩ, contact INFICON.

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5.1.3.2 Electrical Continuity Check

1 Select the DMM ohmmeter function and a low resistance scale.

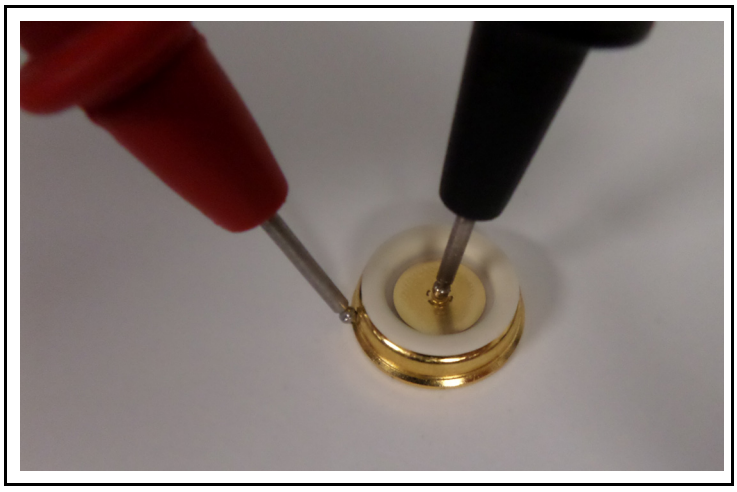
NOTE: The resistance specifications in the following steps do not take into account the resistance of the Digital Multimeter probes. Touch the probe tips together and note the resistance reading. Compensate for probe resistance by subtracting probe resistance from resistance measurements or by zeroing the ohmmeter while the probes are touching.

2 Remove the crystal (if installed) from the crystal holder and reinstall the ceramic retainer into the crystal holder.

3 Measure the resistance between the ceramic retainer and crystal holder. (See Figure 5-3.)

- If resistance is less than 0.3 Ω, continue to step 4.
- If resistance is more than 0.3 Ω, correct the cause of the high resistance before continuing to step 4. Check the following:
  - Cleanliness of the crystal seating surface inside the crystal holder. (Refer to section 4.3.2, Cleaning the Crystal Holder, on page 4-6.)
  - Angle of the leaf spring on the ceramic retainer. (Refer to section 4.3.1, Adjusting the Leaf Spring, on page 4-5.)
  - Verify that the leaf spring and circular plate on the ceramic retainer are tightly held together by the rivet.

Figure 5-3 Resistance between ceramic retainer and crystal holder

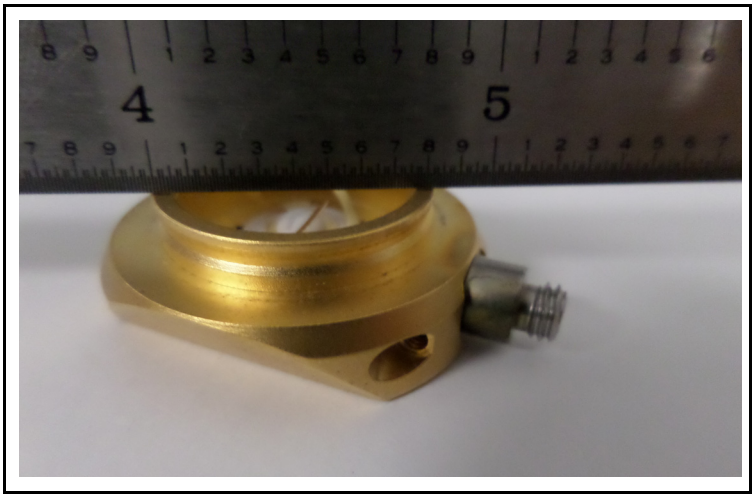


4 Install the crystal holder with ceramic retainer and without the crystal into the body assembly. Make sure the crystal holder is held securely in the body assembly.

5 At the feedthrough, measure resistance between center contact and shield of the BNC connector. (Refer to Figure 5-1.)

- If resistance is less than 1 Ω, electrical continuity is good.
- If resistance is more than 1 Ω, check the following before continuing to step 6:
  - Verify that in-vacuum cable connections to body assembly and feedthrough are tight. Do not overtighten.
  - Remove the crystal holder and examine the leaf spring inside the body assembly. The three prongs on the leaf spring should reach to approximately 1 mm (0.039 in.) from the top of the body assembly. To check prong height, place a straight edge across the body assembly. (See Figure 5-4.) If the prongs are not high enough, gently bend each prong upward using a gloved finger or plastic tweezers.

Figure 5-4 Leaf spring



6 Reinstall the crystal holder with ceramic retainer into the body assembly.

7 Measure resistance between center contact and shield of the BNC.

- If resistance is less than 1 Ω, electrical continuity is good.
- If resistance is more than 1 Ω, continue to step 8.

8 Disconnect the in-vacuum cable from the body assembly and remove the crystal holder.

9 Measure resistance between the center contact of the coaxial connector and leaf spring (see Figure 5-5) being careful to place the probe at the base of the leaf spring to prevent damage to the prongs of the leaf spring.

- If resistance is more than 0.3 Ω, continue to step 9a.
- If resistance is less than 0.3 Ω, continue to step 10.

9a Examine the solder connection between the leaf spring and coaxial connector. Contact INFICON if the cause of the high resistance is not found. (Refer to section 1.3, How to Contact INFICON, on page 1-2.)

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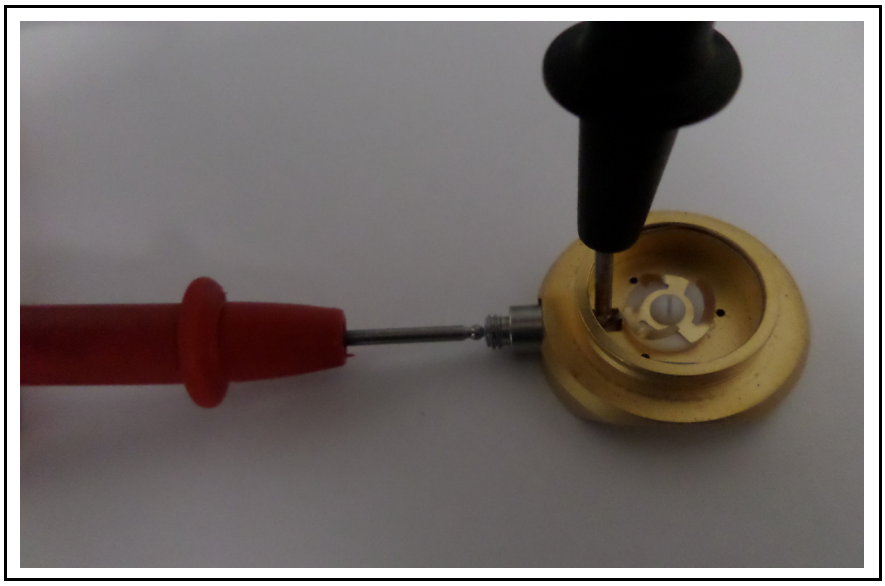
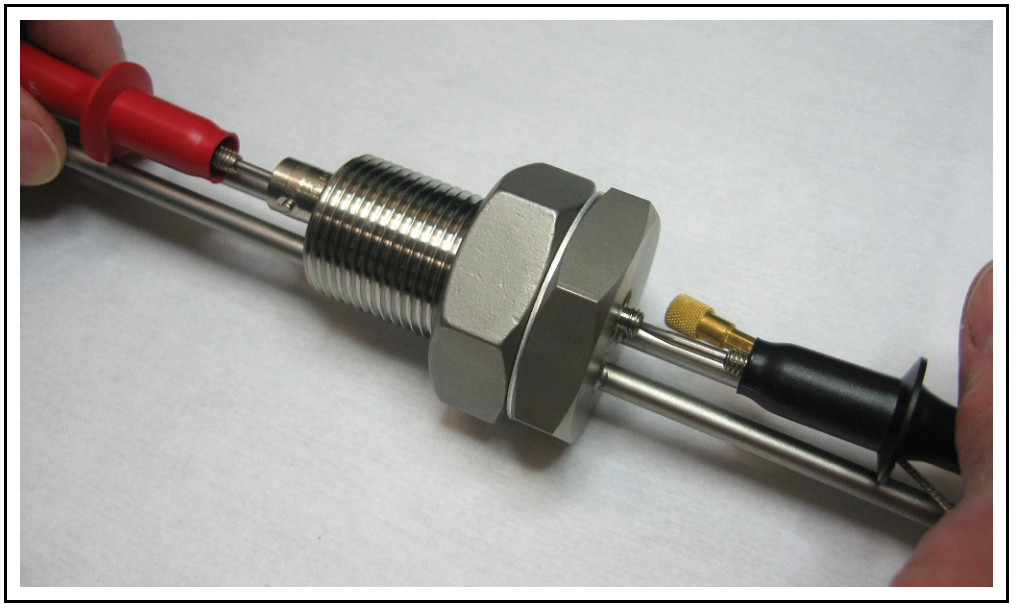
Figure 5-5 Body assembly continuity check



10 Disconnect the in-vacuum cable from the feedthrough.

11 At the feedthrough, measure resistance between the center contacts of the BNC and coaxial connectors. (See Figure 5-6.)

Figure 5-6 Feedthrough Resistance



- If resistance is more than 0.3 Ω, contact INFICON. (Refer to section 1.3, How to Contact INFICON, on page 1-2.)
- If resistance is less than 0.3 Ω, continue to step 12.

12 Replace the in-vacuum cable.

13 Reinstall the crystal holder with ceramic retainer and without the crystal into the body assembly.

14 Measure resistance between center contact and shield of BNC.

- If resistance is less than 1 Ω, electrical continuity is good.
- If resistance is more than 1 Ω, contact INFICON. (Refer to section 1.3, How to Contact INFICON, on page 1-2.)

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