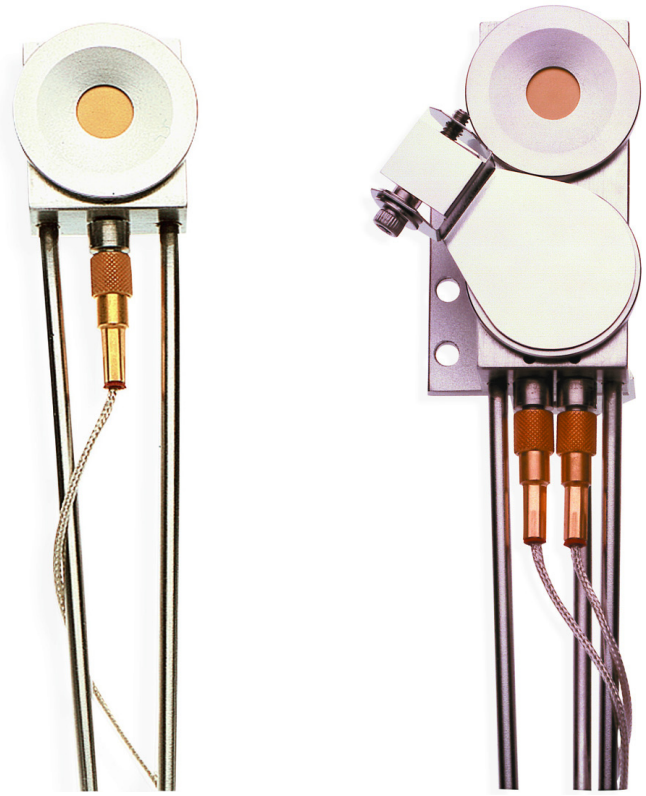
O P E R A T I N G M A N U A L



Front Load Single and Dual

Sensors

PN 074-156M

INFICON

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

Front Load Single and Dual Sensors

PN 074-156M

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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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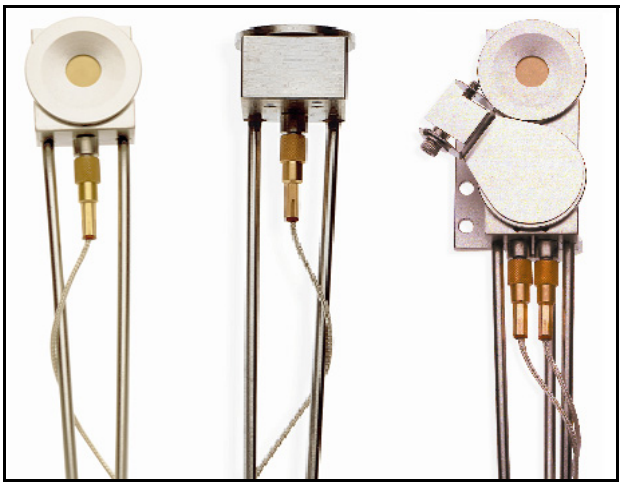
Chapter 1
Introduction

1.1 Introduction

INFICON Front Load sensors, see Figure 1-1, offer proven reliability and durability combined with excellent thermal stability. The Front Load design allows for easy insertion of the crystal holder in applications lacking sufficient room for side access. Because they are assembled mechanically rather than soldered, parts can conveniently be replaced in the field. Sensors can be ordered individually or in a sensor and feedthrough combination that can be either welded or assembled with compression fittings.

Figure 1-1 Front load sensors



The Front Load sensor comes in two styles: Single or Dual.

The Front Load Single sensor comes in two sensor configurations: Standard and Right Angle (Compact).

- Standard configuration - installed from the side or bottom of the chamber, with the cooling tubes aligned parallel to the crystal face.
- Right Angle configuration: installed through the top of the vacuum system, with the water cooling tubes aligned perpendicular to the crystal face.

For the Front Load Dual sensor, a Standard configuration (i.e., waterlines parallel to the crystal face) is available.

Optionally, sensors can be ordered with a pneumatically driven crystal shutter to protect the crystal during source warm up, or when the sensor is not used during deposition of an alternate material, or to extend crystal life when used with RateWatcher™.

NOTE: Crystal shutters are standard on dual sensors.

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1.2 Definition of Notes, Cautions and Warnings

Before using this manual, please take a moment to understand the 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 current topic.

HINT: Hints provide insight into product usage.

CAUTION

Failure to heed these messages could result in damage to the instrument.

WARNING

Failure to heed these messages could result in personal injury.

1.3 How to Contact Customer Support

If you need assistance with your sensor, please read this Operating Manual before contacting Customer Support. If you can not find the answer in this manual, consider the following scenarios:

- Sensor functions, but it does not work for your application — request Application Assistance.
- Sensor functions, but you need to know how to use it — request Technical Support.
- Sensor does not function (is broken) — request Repair Services.
- Parts are needed — request Order Services.

When contacting Customer Support, please have the following information readily available:

- The Lot Identification Code, located on the side surface of the sensor head.
- A description of the problem.
- An explanation of any attempts at corrective action.
- Exact wording of any error messages received.

To contact Customer Support, see Support on the www.inficon.com website.

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1.3.1 Returning Your Sensor to INFICON

Do not return any component of your sensor to INFICON without first speaking with a Customer Support Representative. You must obtain a Return Material Authorization (RMA) number from the Customer Support Representative.

If you deliver a package to INFICON without an RMA number, your package will be held and you will be contacted. This will result in delays in servicing your sensor.

Prior to being given an RMA number, you will be required to complete a Declaration Of Contamination (DOC) form. 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.

1.4 Unpacking and Inspection

1. If the Front Load sensor has not been removed from its packaging, do so now. The sensor and accessories are packaged in a single cardboard carton with a rigid foam insert. Carefully remove the packaged accessories before removing the sensor.
2. Carefully examine the sensor for damage that may have occurred during shipping. This is especially important if you notice obvious rough handling on the outside of the container. *Immediately report any damage to the carrier and to INFICON.*
3. Do not discard the packing materials until you have taken inventory and have successfully installed the sensor.
4. Take an inventory of your order by referring to your order invoice and the information contained in section 1.5.4 or section 1.6.4.
5. To install the Sensor, see Chapter 2, Sensor Installation.
6. For additional information or technical assistance, contact INFICO., (Refer to section 1.3 on page 1-2)

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1.5 Front Load Single Sensors (PN SL-XXXXX)

Figure 1-2 Standard sensor

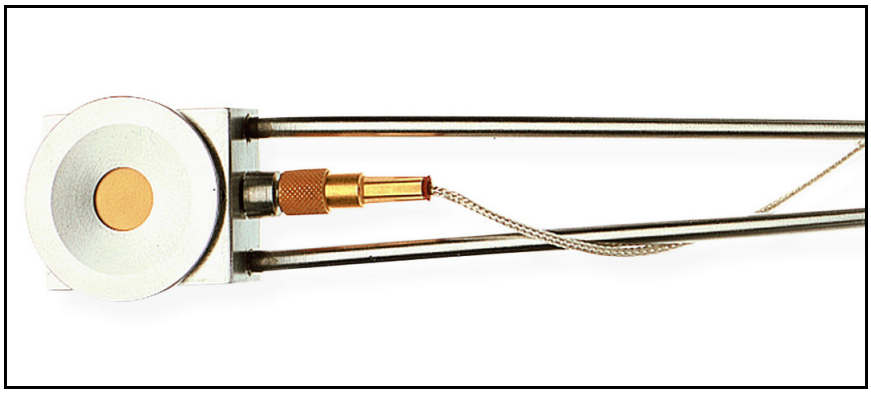
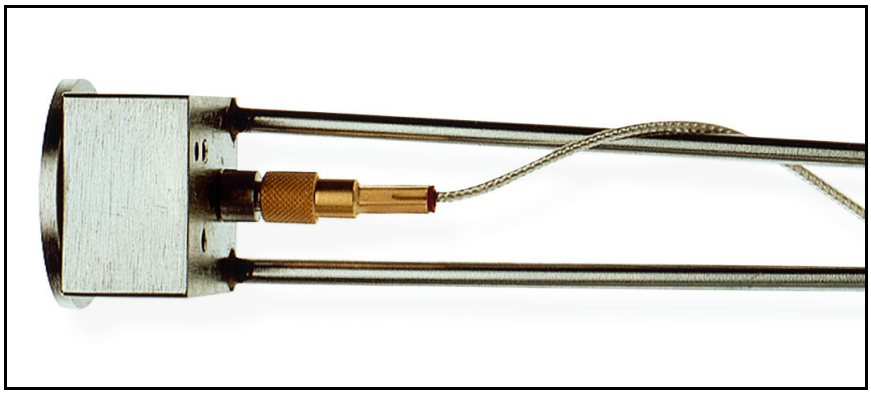


Figure 1-3 Right angle (compact) sensor



1.5.1 Specifications

Maximum bakeout temperature with no water: . . . . 130°C

Maximum operating isothermal environment temperature with minimum water flow:. . . . . 400°C

Size
(maximum envelope without shutter): . . . . . Standard Sensor
1.06 in. x 2.42 in. x 0.69 in. (27.00 mm x 61.47 mm x 17.53 mm)
See Figure 1-5 on page 1-9.
Right Angle Sensor
1.11 in. x 1.06 in. x 1.06 in. (28.19 mm x 26.92 mm x 26.92 mm)
See Figure 1-7 on page 1-11.

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Water tube and coax length:	Standard(E) 30 in. (762 mm) Includes 30.75 in. (781 mm) in-vac cable Extended(G) 48 in. (1219 mm) Includes 60 in. (1524 mm) in-vac cable; 1/8 in. (3.175 mm) O.D. seamless stainless steel
Crystal exchange:	Front loading; self-contained package for ease of exchange
Mounting:	Two #4-40 tapped holes on the back of the sensor body.

1.5.2 Installation Requirements

Feedthrough	Two pass water 3/16 in. (4.8 mm) OD tubing with Microdot® coax connector
Other	• Vacuum tight braze or weld joint or connectors for the water tubes (may be provided by INFICON if sensor/feedthrough combination is ordered or by customer) • XIU or Oscillator to match specific controller/monitor • SL-X1XXX only: Solenoid valve assembly for air PN 750-420-G1 (see section 3.1 on page 3-1)
Water Flow Rate	Minimum water flow 150-200 cc/min, 30°C maximum
Water Quality	Coolant should not contain chlorides as stress corrosion cracking may occur. Extremely dirty water may result in loss of cooling capacity.

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CAUTION

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

Air (SL-X1XXX only)	70 PSIG {85 PSIA} (5.9 bar) [586 kPa] (minimum) 80 PSIG {95 PSIA} (6.6 bar) [655 kPa] (maximum)

WARNING

Do not exceed 100 PSIG (115 PSIA) (7.9 bar) [790 kPa]. Connection to excessive pressure may result in personal injury or equipment damage.

1.5.3 Materials

Body and Holder	304 type stainless steel
Springs, Electrical Contacts	Au plated Be-Cu
Water tubes	S-304, 0.125 in. (3.175 mm) OD, 0.015 in. (0.381 mm) wall thickness
Microdot Connector	304 type stainless steel, Teflon® and glass insulated
Insulators	>99% Al_2O_3
Wire	Teflon insulated copper
Braze	Vacuum process high temperature Ni-Cr alloy
Crystal	0.550 in. (13.97 mm) diameter

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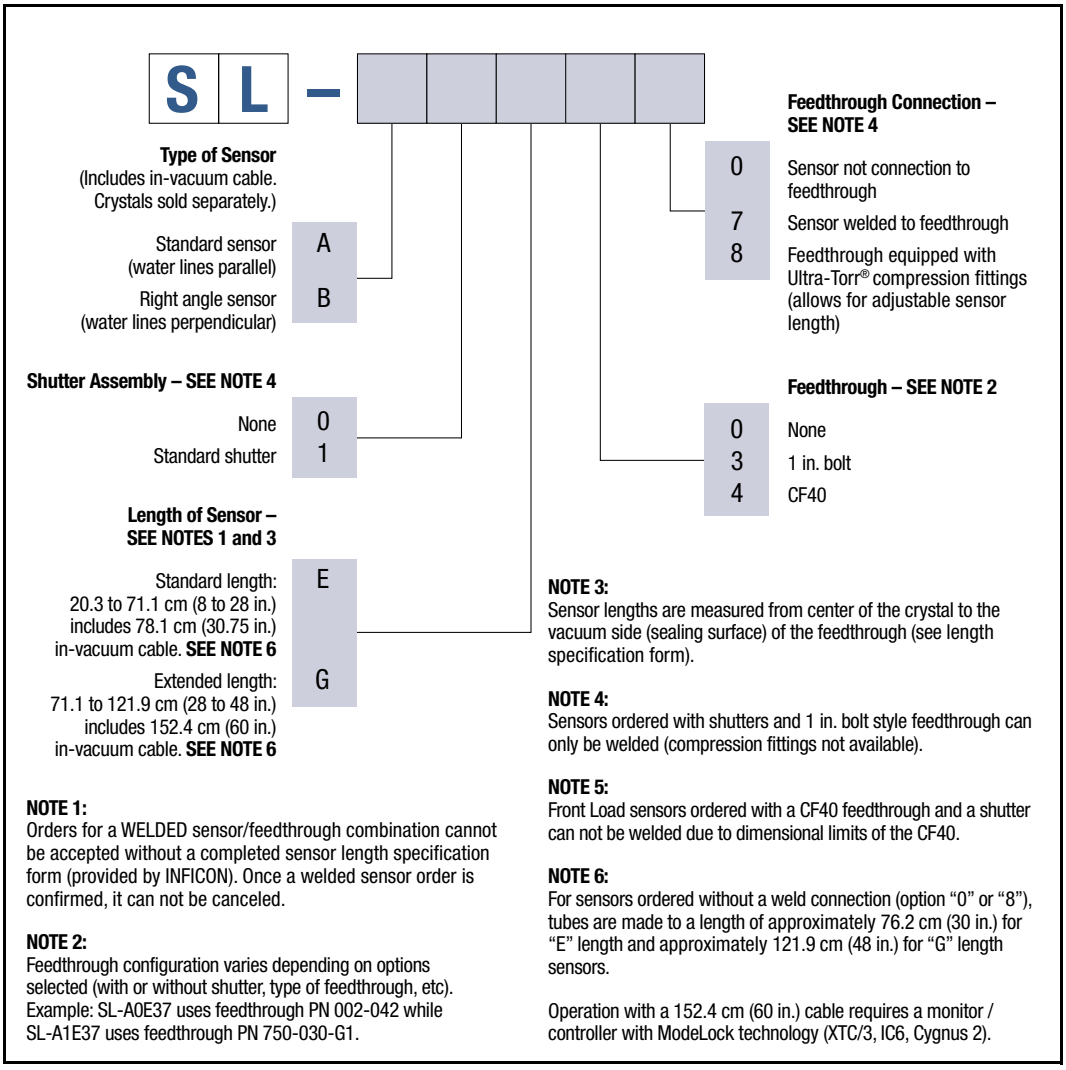
1.5.4 Parts and Options Overview (Single Sensor)

Front Load Single Sensor. . . . . **SL-XXXXX**—See Figure 1-4.

Figure 1-4 Front load single sensor configurations



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Crystal Snatcher. . . . . PN 008-007

In-vacuum Cable (30.75 in.). . . . . PN 007-044
30.75 in. (781 mm) long (standard length)

In-vacuum Cable (60 in.) . . . . . PN 321-039-G13
60 in. (1524 mm) long (extended length)

Molybdenum disulfide in Alcohol . . . . . PN 750-191-G1
(provided only with shuttered sensors)

Tube Bender Kit . . . . . PN 750-037-G1
(if non-welded sensor purchased)

1.5.5 List of Supplied Single Sensor Drawings

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

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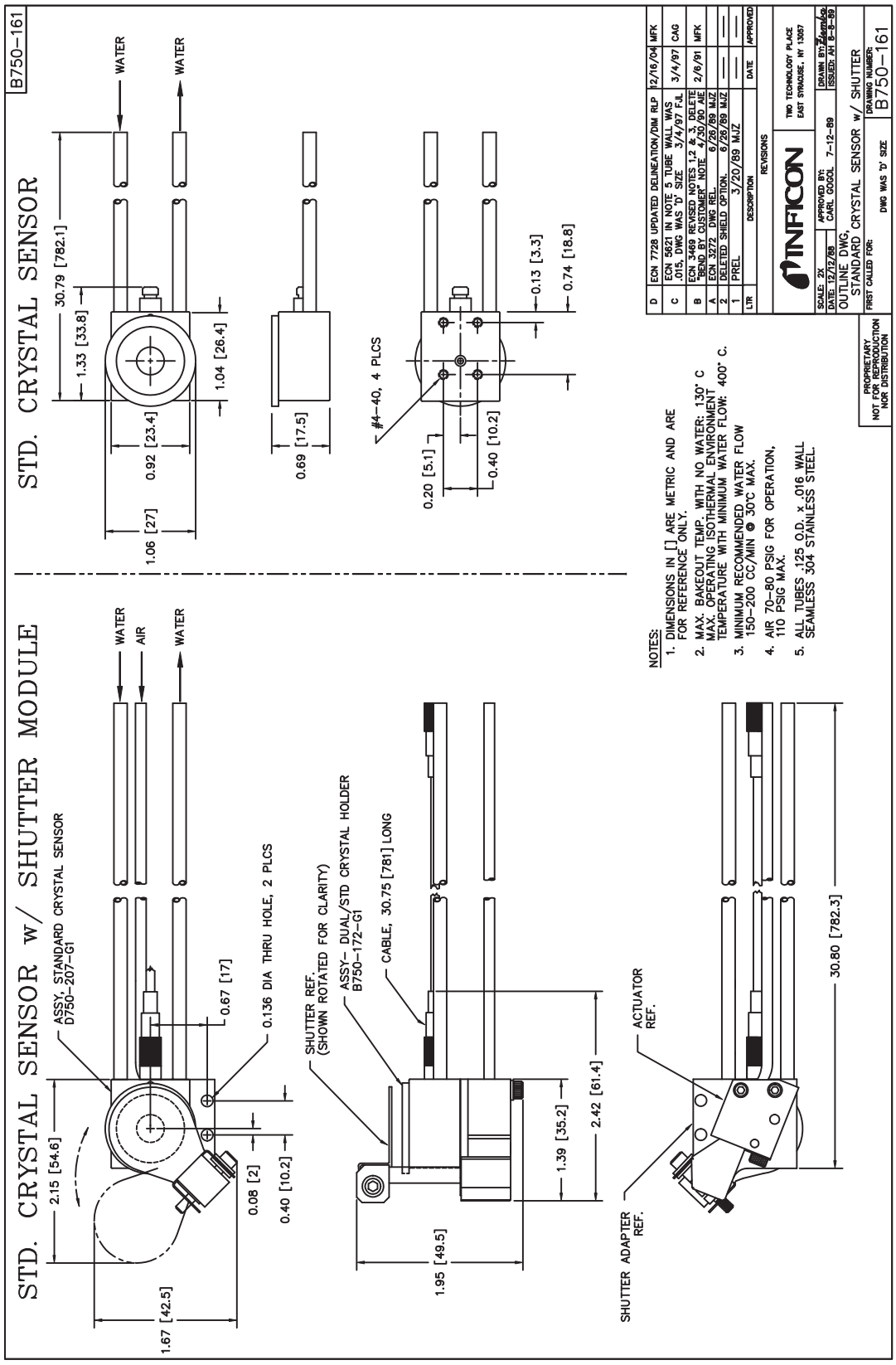

Figure 1-5 750-161 Standard crystal sensor with shutter

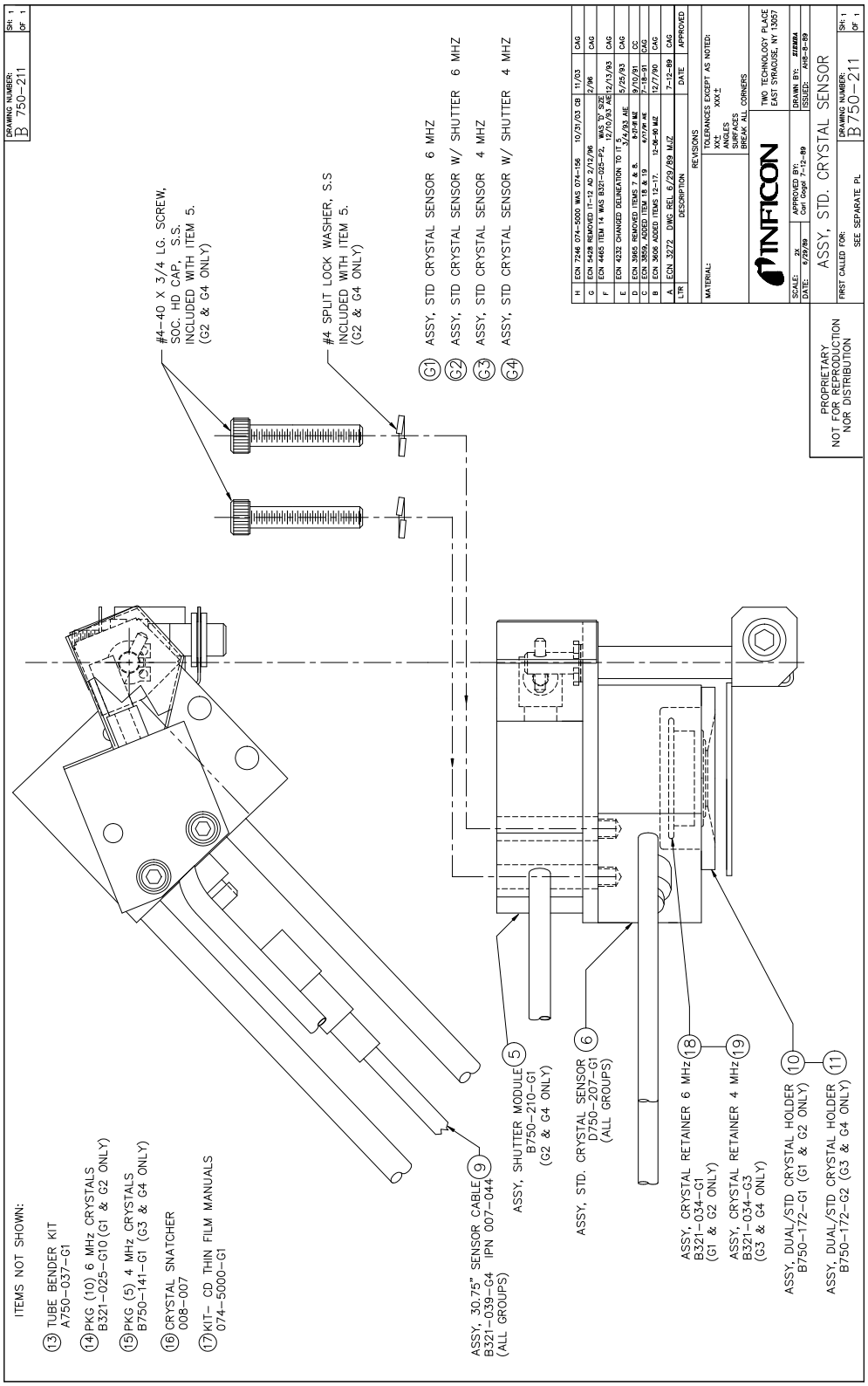

Figure 1-6 750-211 Standard crystal sensor

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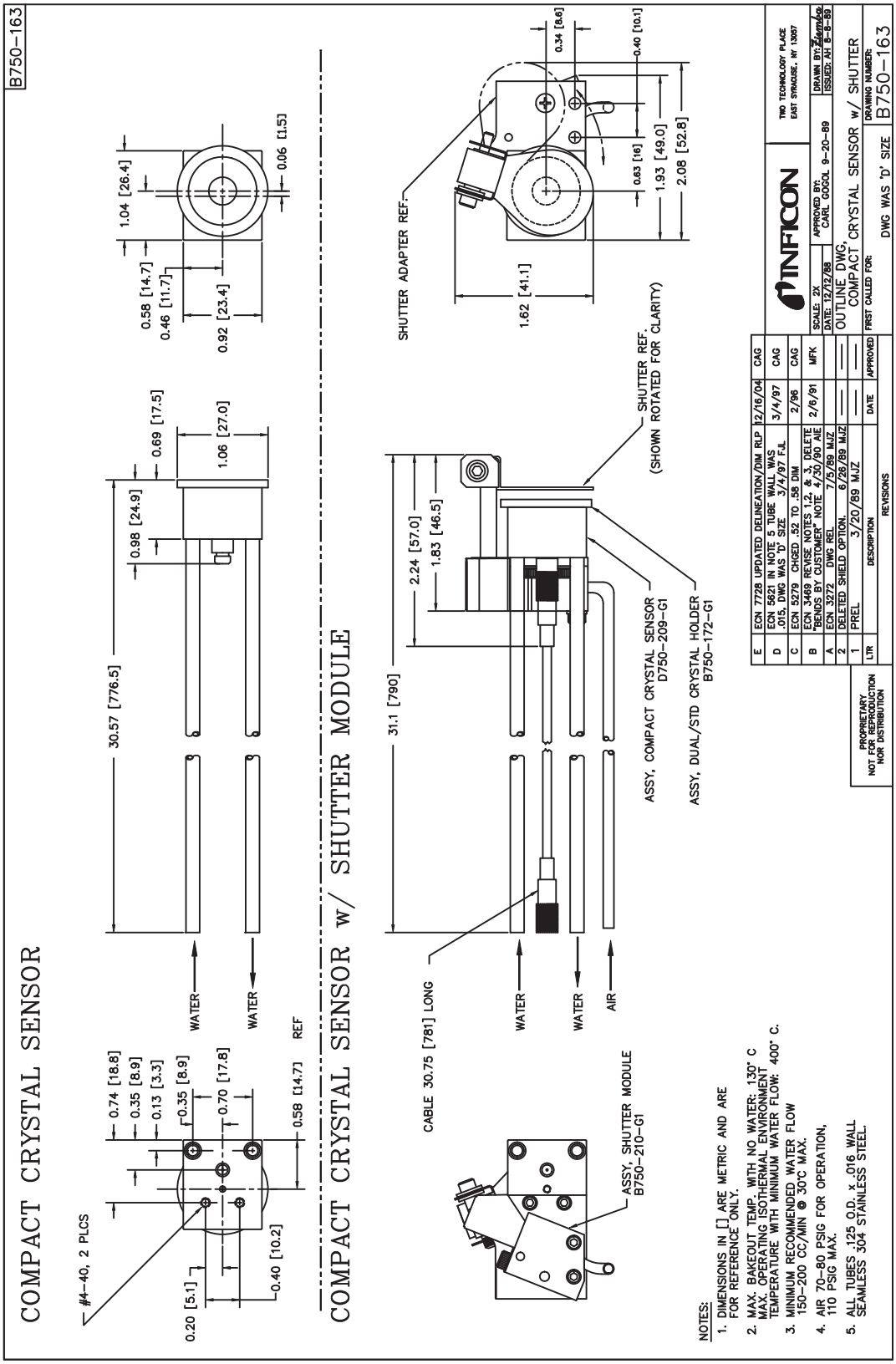


Figure 1-7 750-163 Right angle crystal sensor with shutter

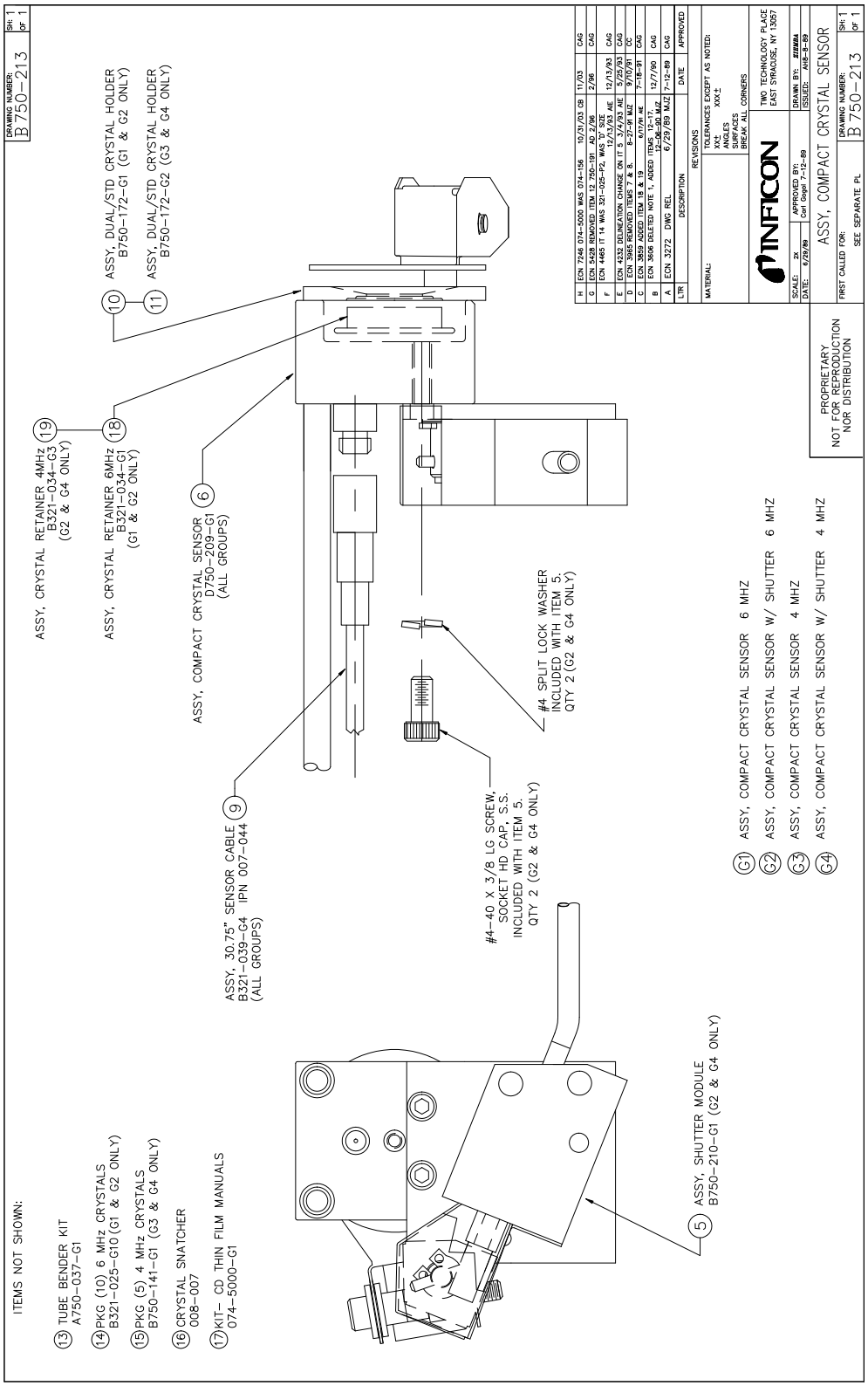
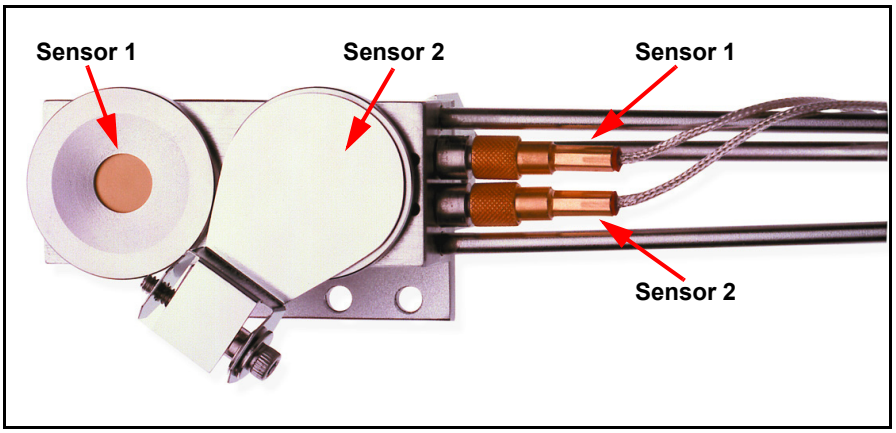


Figure 1-8 750-213 Right angle crystal sensor

1.6 Front Load Dual (Switchable) Crystal Sensor (PN DL-AXXX)

Figure 1-9 Dual (switchable) crystal sensor



1.6.1 Specifications

Maximum bakeout temperature with no water . . . . . 130°C

Maximum operating isothermal environment temperature with minimum water flow . . . . . 400°C

Size (maximum envelope) . . . . . 1.54 in. x 3.23 in. x 1.95 in. (39.12 mm x 82.04 mm x 49.54 mm)

Water tube and coax length . . . . . Standard(E) 30 in. (762 mm); Includes 30.75 in. (781 mm) in-vac cable. See Figure 1-11 on page 1-18. Extended(G) 48 in. (1219 mm); Includes 60 in. (1524 mm) in-vac cable. 1/8 in. (3.175 mm) OD seamless stainless steel

Crystal exchange . . . . . Front-loading, self-contained package for ease of exchange. Shutter flips up to ease access to the holders.

Mounting. . . . . Two #4-40 tapped holes on the back of the sensor body

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1.6.2 Installation Requirements

Feedthrough . . . . One 2-3/4 in. (69.85 mm) Conflat or 1 in. (25.4 mm) bolt with two Microdot connectors and with three fluid lines (two water, one air). See Chapter 5 for details.

Other . . . . . • Vacuum tight braze or weld joint or connectors for the water tubes (may be provided by INFICON if sensor/feedthrough combination is ordered or by customer)

- Solenoid valve assembly for air—PN 750-420-G1 (see section 3.1 on page 3-1).
- Two XIUs or oscillators designed to interface with the deposition controller or one XIU or oscillator and one CrystalTwo switch (not compatible with all controllers/monitors).
- For automatic operation, the deposition controller must be designed for the implementation of this feature.

Water Flow Rate. . . . Minimum water flow 150-200 cc/min, 30°C 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 fluid's flow is interrupted.

Air: . . . . . 70 PSIG {85 PISIA} (5.9 bar) [586 kPa] (minimum)
80 PSIG {95 PSIA} (6.6 bar) [655 kPa] (maximum)

WARNING

Do not exceed 115 PSIG (100 PSIG) (7.9 bar) [790 kPa]. Connection to excessive pressure may result in personal injury or equipment damage.

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1.6.3 Materials

Body and Holder	304 Type stainless steel
Springs	Au plated Be-Cu
Water tubes	S-304, 0.125 in. (3.175 mm) OD x 0.015 in. (0.381 mm) wall thickness seamless stainless steel tubing
Connector (Microdot)	Silver coated copper, Teflon and glass insulated
Insulators	>99% Al_2O_3
Wire	Teflon insulated copper
Other mechanical parts	304 or 18-8 stainless steel
Braze	Vacuum process high temperature Ni-Cr alloy
Crystal	0.550 in. (13.97 mm) diameter

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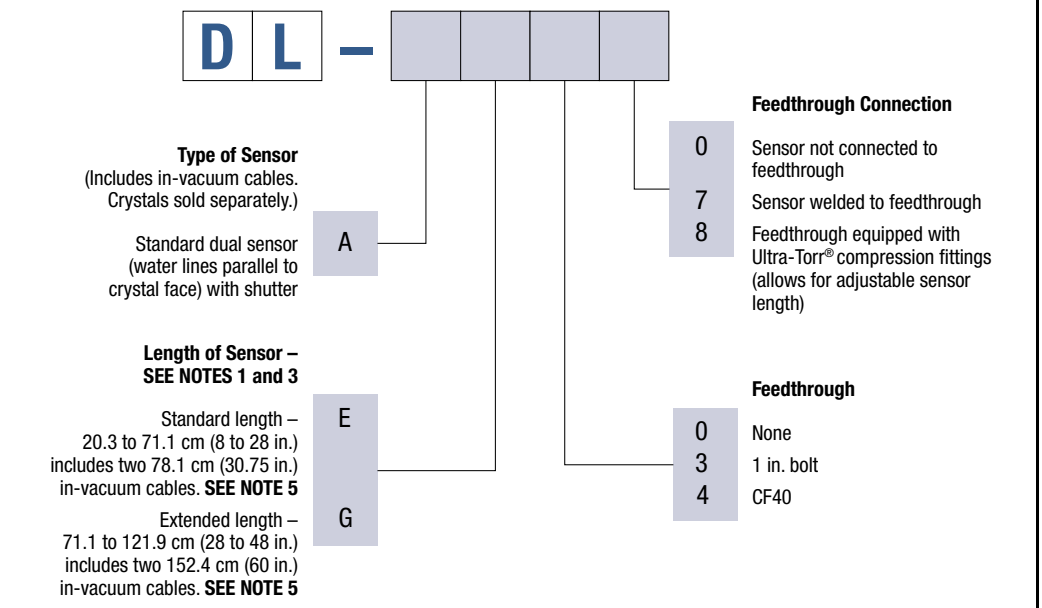
1.6.4 Parts and Options Overview (Dual Sensor)

Front Load Dual Sensor . . . . . DL-AXXX See Figure 1-10 for part number configuration.

Figure 1-10 Front load dual sensor configurations



NOTE 1:
Orders for a WELDED sensor/feedthrough combination cannot be accepted without a completed sensor length specification form (provided by INFICON). Once a welded sensor order is confirmed, it can not be canceled.

NOTE 2:
Feedthrough configuration varies depending on options selected (type of feedthrough and connection). Example: SL-A0E37 uses feedthrough PN 002-042 while SL-A1E37 uses feedthrough PN 750-030-G1.

NOTE 3:
Sensor lengths are measured from center of the crystal closest to the end of the sensor to the vacuum side (sealing surface) of the feedthrough (see length specification form).

NOTE 4:
Front Load Dual sensors ordered with a CF40 feedthrough cannot be welded due to dimensional limits of the CF40.

NOTE 5:
For sensors ordered without a weld connection (option "0" or "8"), tubes are made to a length of approximately 76.2 cm (30 in.) for "E" length and approximately 121.9 cm (48 in.) for "G" length sensors.

Operation with 152.4 cm (60 in.) in-vacuum cables requires a monitor / controller with ModeLock technology (XTC/3, IC6, Cygnus 2)

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Crystal Snatcher. . . . . PN 008-007

In-vacuum Cable (30.75 in.). . . . . PN 007-044
30.75 in. (781 mm) long (standard length)

In-vacuum Cable (60 in.) . . . . . PN 321-039-G13
60 in. (1524 mm) long (extended length)

Molybdenum disulfide in Alcohol . . . . . PN 750-191-G1

Tube Bender Kit . . . . . PN 750-037-G1
(if non-welded sensor purchased)

1.6.5 List of Supplied Dual Sensor Drawings

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

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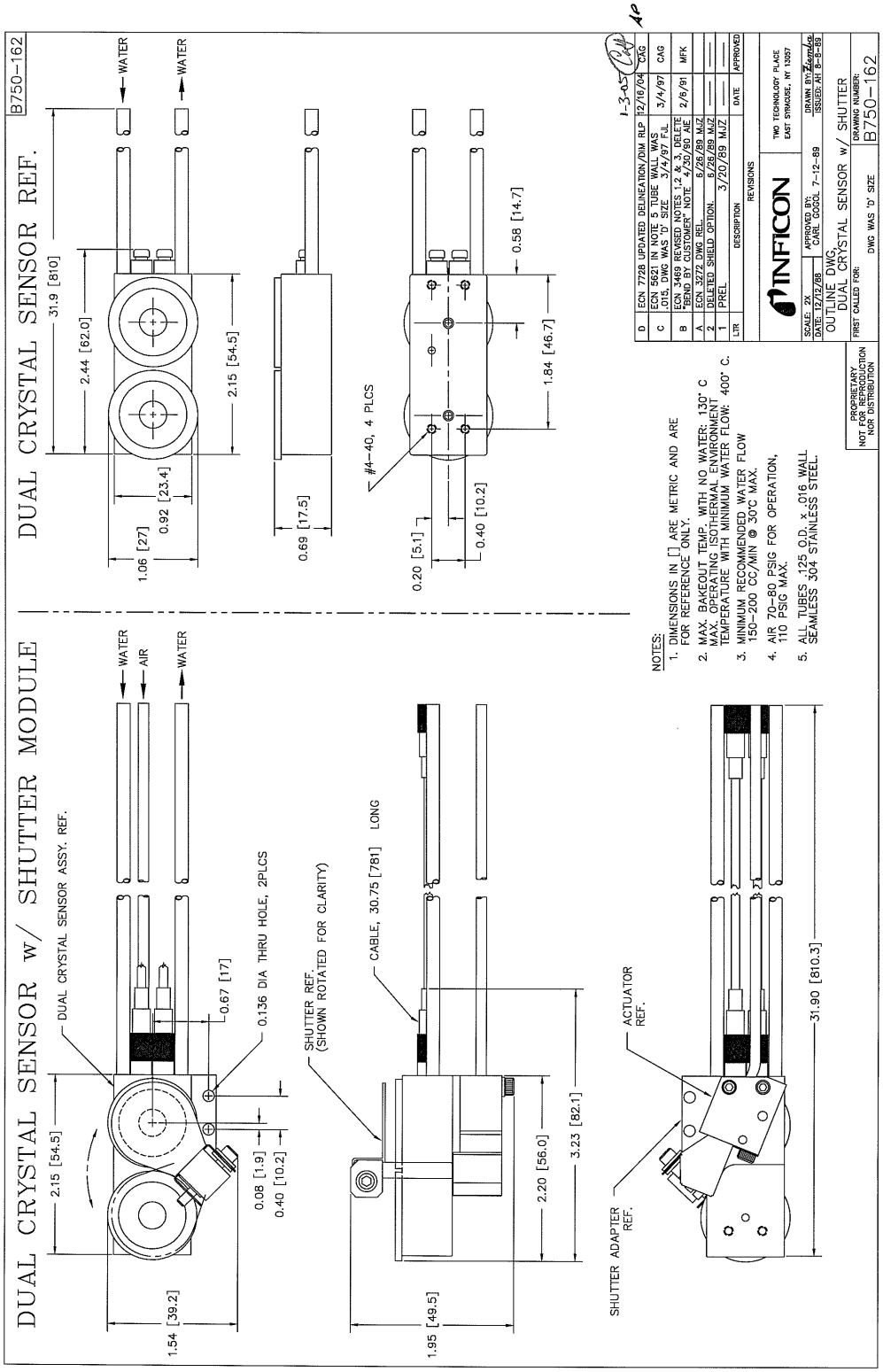


Figure 1-11 750-162 Dual crystal sensor with shutter

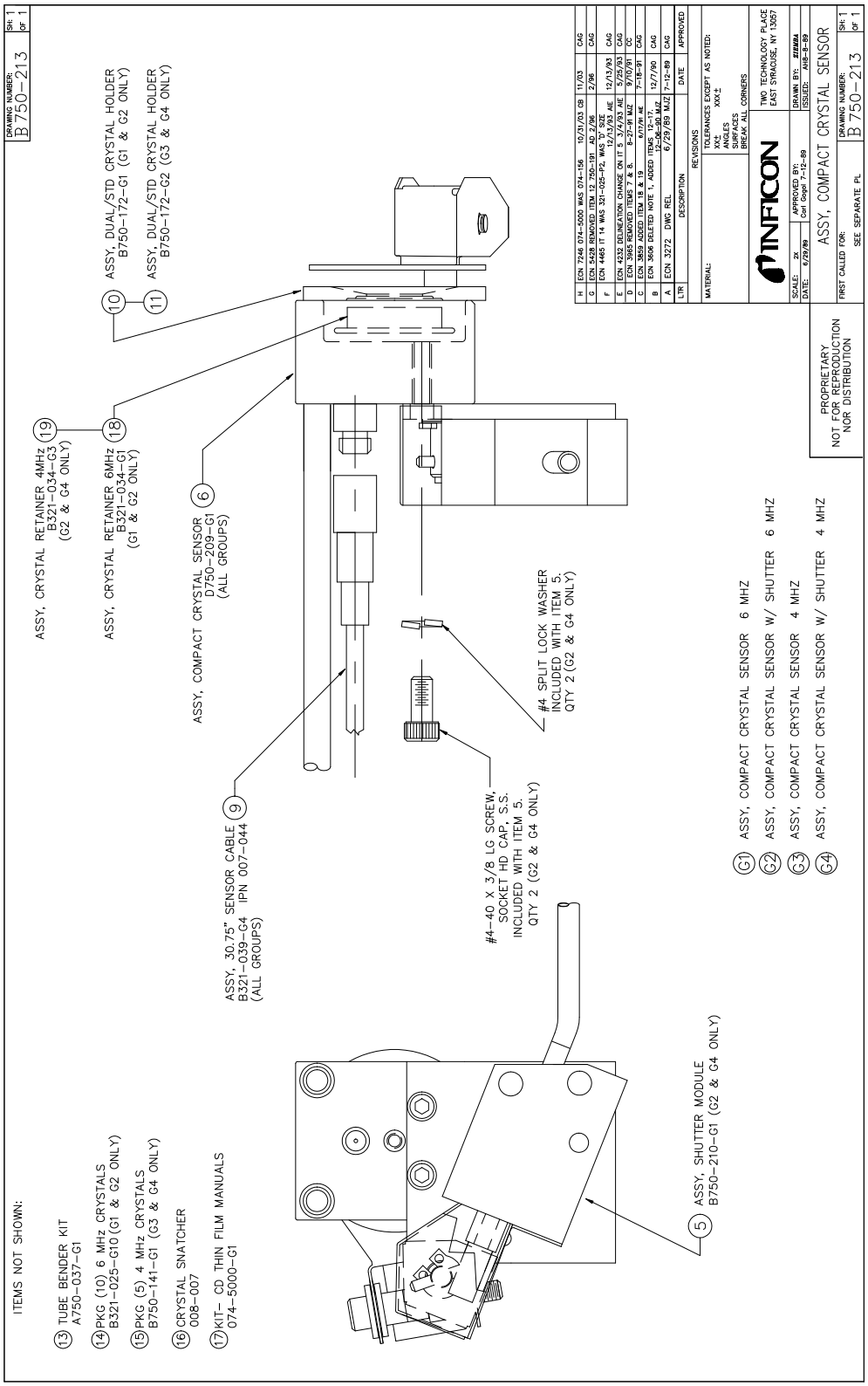
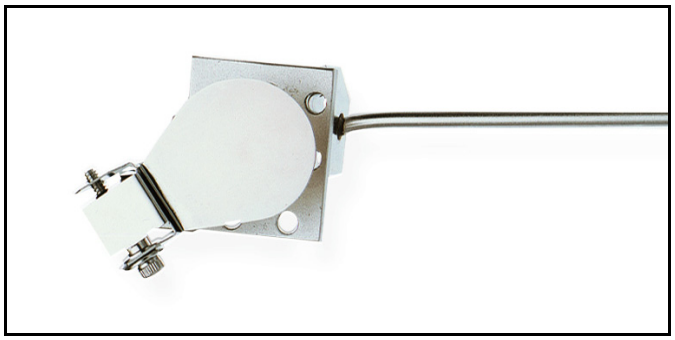


Figure 1-12 750-212 Assembly, dual crystal sensor

1.7 Specifications for the Shutter Module (PN 750-210-G1)

Figure 1-13 Shutter assembly module



Temperature . . . . 130°C (400°C if properly attached to water cooled sensor)

Air Tube . . . . . S-304, 0.125 in. (3.175 mm) OD x 0.015 in. (0.381 mm) wall thickness seamless stainless steel

Materials. . . . . 300 series stainless steel

Pressure . . . . . 70 PSIG {85PSIA} (5.9 bar) [586 kPa] (minimum)
80 PSIG {95 PSIA} (6.6 bar) [655 kPa] (maximum)
very low volume

WARNING

Do not exceed 110 PSIG (115 PSIA) (7.9 bar) [790 kPa]. Connection to excessive pressure may result in personal injury or equipment damage.

Shutter . . . . . Pneumatically operated. Shutter swings out of way for easy crystal exchange.

Braze . . . . . Vacuum process high temperature (Ni-Cr alloy)

1.8 List of Supplied Shutter Module Drawings

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

Figure 1-14. . . . . Shutter Module Assembly (PN 750-210)

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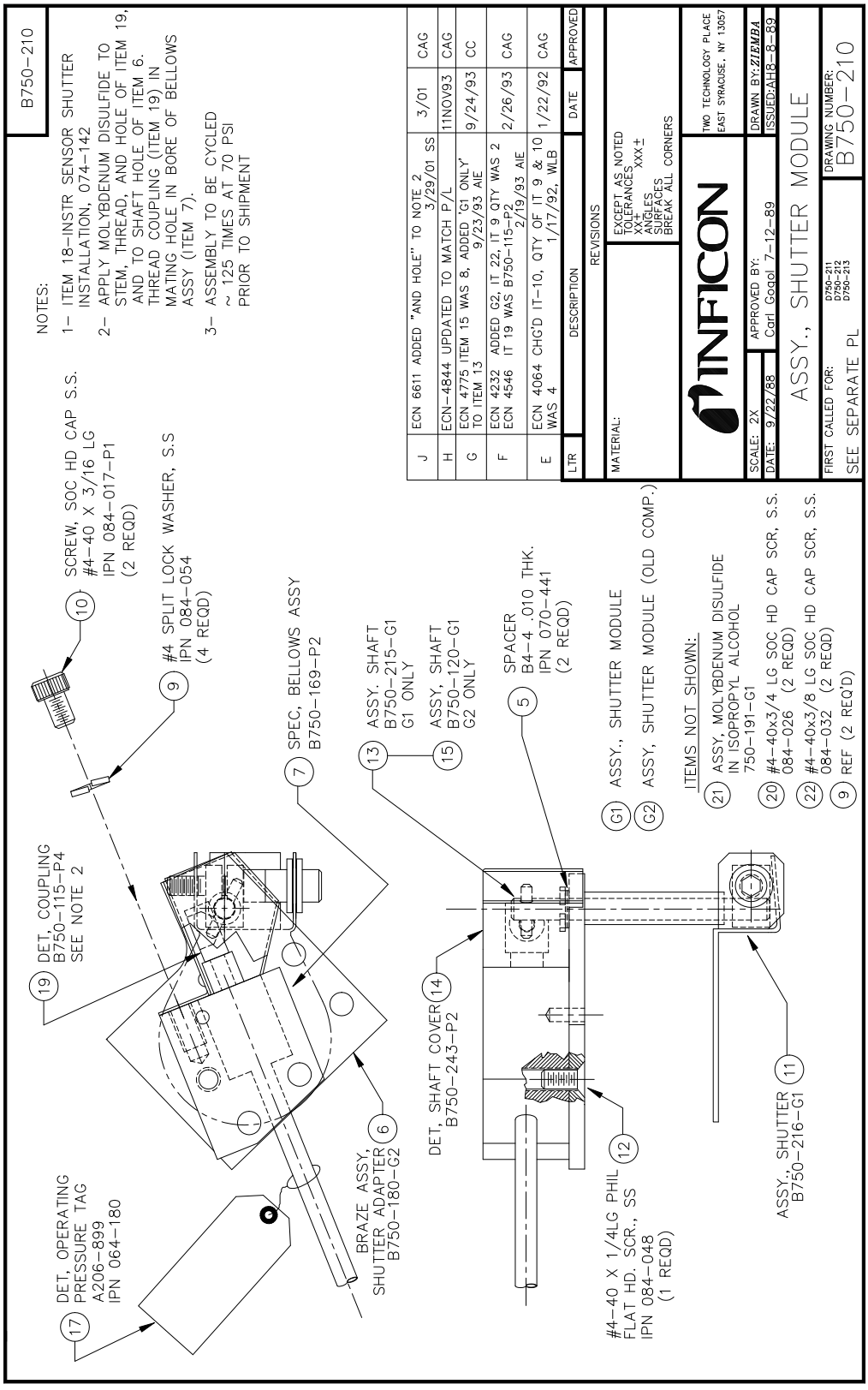

Figure 1-14 750-210 Assembly, shutter module

1.9 Replacement Parts and Accessories

1.9.1 Front Load Sensor

Body Assembly Tube length

Standard 30 in. (76 cm) . . . . . PN 750-207-G1

Standard 48 in. (122 cm) . . . . . PN 750-207-G2

Body Assembly Tube length

Compact 30 in. (76 cm) . . . . . PN 750-209-G1

Compact 48 in. (122 cm) . . . . . PN 750-208-G2

Body Assembly Tube length

Dual 30 in. (76 cm). . . . . PN 750-209-G1

Dual 48 in. (76 cm). . . . . PN 750-209-G2

Ceramic Retainer . . . . . PN 007-023

Crystal Holder. . . . . PN 750-172-G1

Finger Spring contact strip . . . . . PN 750-171-P1

Shutter . . . . . PN 750-216-G1

Crystal Snatcher. . . . . PN 008-007

Material Director. . . . . PN 750-201-G1

NOTE: The material director assembly is used for co-deposition processing. It replaces the crystal holder with a collimating tube to minimize cross talk deposition. The material director cannot be used with sensors while using the pneumatic shutter feature.

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1.9.2 In-Vacuum Cable

In-vacuum Cable, 6 in. (15.2 cm) long . . . . . PN 321-039-G12

In-vacuum Cable, 24 in. (61.0 cm) long . . . . . PN 321-039-G11

In-vacuum Cable, 30.75 in. (78.1 cm) long . . . . . PN 007-044

In-vacuum Cable, 12 in. (30.5 cm) long . . . . . PN 007-252

In-vacuum Cable, 36 in. (91.4 cm) long . . . . . PN 007-059

In-vacuum Cable, 48 in. (121.9 cm) long . . . . . PN 007-061

In-vacuum Cable, 60 in. (152.4 cm) long . . . . . PN 321-039-G13

In-vacuum Cable, 72 in. (182.9 cm) long . . . . . PN 321-039-G14

In-vacuum Cable, 137.8 in. (3.5 m) long . . . . . PN 321-039-G15

In-vacuum Cable, 157.5 in. (4 m) long . . . . . PN 321-039-G16

NOTE: The cable length from the sensor to the feedthrough distance should not exceed 40 in. (101.6 mm) unless a ModeLock instrument is used. Refer to the controller/monitor operating manual for its cable length limitations.

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Chapter 2
Sensor Installation

2.1 Introduction

Sensor type is determined by the type of process to be performed, the type of material to be evaporated, and the physical characteristics of the process chamber.

CAUTION

The sensor head, water tube, cable, etc., should be clean and free of grease when installed in the vacuum chamber. Clean nylon gloves should be worn while handling.

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

2.2 Pre-installation Sensor Check

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

2.2.1 Applies to Sensor Installation with a XTC/3, IC6 or Cygnus 2 Deposition Controller

1. Connect the in-vacuum sensor head cable to the feedthrough or a coax adapter (Microdot/BNC).
2. Connect one end of the 6 in. (152.4 mm) BNC cable (PN 755-257-G6) to the BNC connector on the feedthrough.
3. Connect the other end of the 6 in. (152.4 mm) 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-GXX) 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 4.3 on page 4-7.
7. Connect power to the controller and set the power switch to ON. Set density at 1.00 g/cm^3, and zero thickness. The display should indicate 0 or +/-.001 kÅ. Crystal life should read from 0 to 5%.
8. Breathe heavily on the crystal. A thickness indication of 1.000 to 2.000 kÅ should appear on the display. When the moisture evaporates, the thickness indication should return to approximately zero.

If the above conditions are observed, the sensor is in proper working order and may be installed.

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2.2.2 Applies to Sensor Installation with a SQM-160, SQC-310, SQM-242, or IQM-233 Deposition Controller/Monitor

1. Connect the in-vacuum sensor head cable to the feedthrough or a coax adapter (Microdot/BNC).
2. Connect one end of the 6 in. (152.4 mm) BNC cable (PN 782-902-011) to the BNC connector on the feedthrough.
3. Connect the other end of the 6 in. (152.4 mm) BNC cable to the connector of the oscillator (PN 782-900-010) labeled "feedthrough."
4. Connect one end of the oscillator cable (PN 782-902-012-XX) to the mating connector of the oscillator labeled "instrument."
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 4.3 on page 4-7.
7. Connect power to the controller and set the power switch to ON. For the SQM-242 or IQM-233 card, launch the appropriate software. Set density at 1.00 g/cm^3, and zero thickness. The display should indicate 0 or ±001 kÅ. Crystal life should read from 95% to 100%.
8. Breathe heavily on the crystal. A thickness indication of 1.000 to 2.000 kÅ should appear on the display. When the moisture evaporates, the thickness indication should return to approximately zero.

If the above conditions are observed, the sensor is in proper working order and may be installed.

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2.2.3 Applies to Sensor Installation with a Q-pod™ Deposition Monitor

1. Connect the in-vacuum sensor head cable to the feedthrough or a coax adapter (Microdot/BNC)
2. Connect one end of the 6 in. (152.4 mm) BNC cable (PN 782-902-011) to the BNC connector on the feedthrough.
3. Connect the other end of the 6 in. (152.4 mm) BNC cable to the connector of the Q-pod.
4. Connect one end of the USB cable (PN 068-0472) to the mating connector of the Q-pod.
5. Connect the other end of the USB cable to a USB port on the computer being used to operate the Q-pod.
6. Install the crystal as instructed by section 4.3 on page 4-7.
7. Launch the Q-pod monitor software. Set density at 1.00 g/cm^3, and zero thickness. The display indicate 0 or ±.001 kÅ. Crystal life should read from 95% to 100%. The green LED on the Q-pod should be illuminated.
8. Breathe heavily on the crystal. A thickness indication of 1.000 to 2.000 kÅ should appear on the display. When the moisture evaporates, the thickness indication should return to approximately zero.

If the above conditions are observed, the sensor is in proper working order and may be installed.

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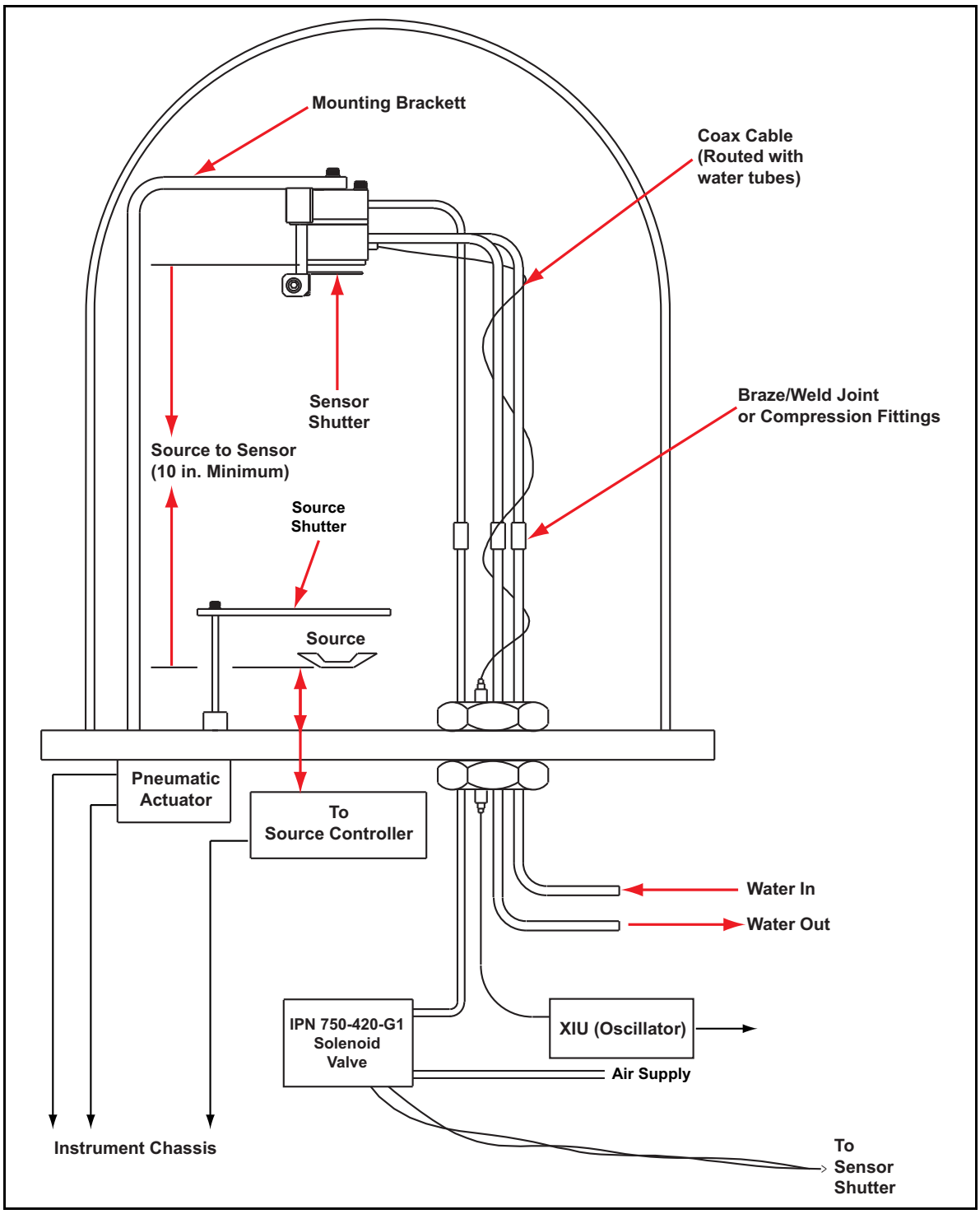
2.3 General Guidelines

Figure 2-1 shows the typical installation of an INFICON water-cooled crystal sensor in the vacuum process chamber. Use the illustration and the following guidelines to install your sensors for optimum performance and convenience.

Figure 2-1 Typical installation



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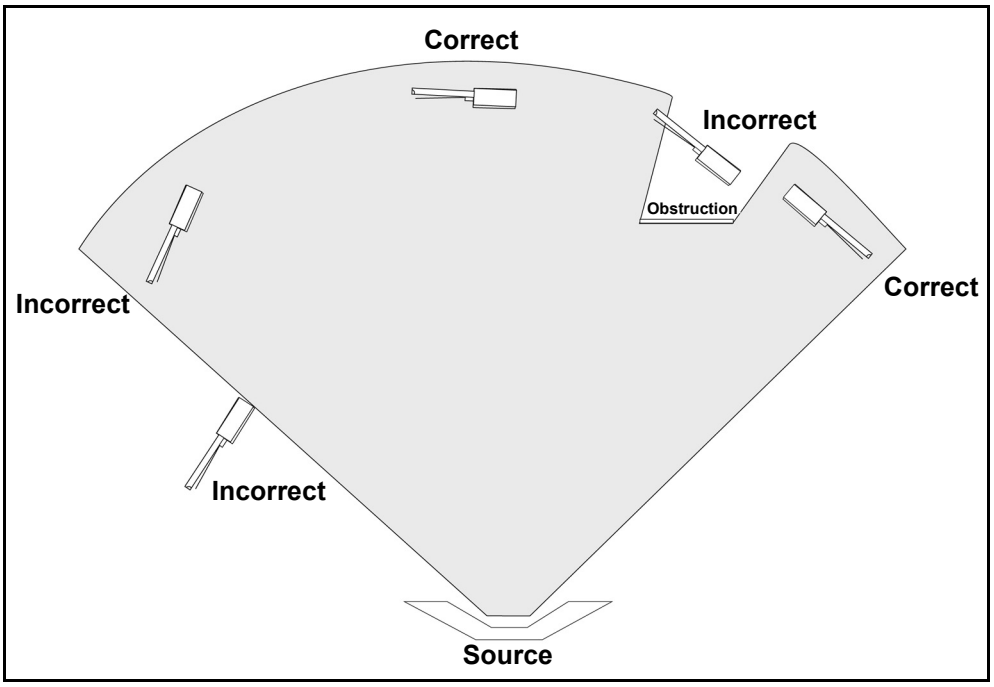
2.3.1 Crystal Sensor Installation

Install the sensor as far as possible from the evaporation source (a minimum of 12 in. or 305 mm) while still being in a position to accumulate thickness at a rate proportional to accumulation on the substrate. Figure 2-2 shows proper and improper methods of installing sensors.

NOTE: For best process reproducibility, rigidly support the sensor so that it cannot move during maintenance and crystal replacement.

Figure 2-2 Sensor installation guidelines



To guard against spattering, use a source shutter to shield the sensor during initial soak periods. If the crystal is hit with a minute particle of molten material, it may be damaged and stop oscillating. Even in cases when it does not completely stop oscillating, it may immediately become unstable or shortly after deposition begins instability may occur.

Plan the installation to ensure that there are no obstructions blocking a direct path between the sensor and the source.

Install sensors in such a manner that the center axis of the crystal is aimed directly at the source to be monitored. Verify that the angle of the sensor location (with reference to the source) is well within the evaporant stream. If the sensor is not square to the source, the coating on the crystal will be tapered and short crystal life can result.

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NOTE: In many cases installing multiple sensors to monitor one source can improve thickness accuracy for the product. The rules for multiple sensors are the same as for a single sensor installation, and the locations chosen should be as defined above. Consult your controller's manual for more information regarding the availability of this feature.

A technical description may be found in the 39th Annual Conference Proceedings, Society of Vacuum Coaters, *Reducing Process Variation Through Multiple Point Crystal Sensor Monitoring*, J. Kushneir, C. Gogol, J. Blaise, pp19-23, ISSN 0737-5921 (1996).

NOTE: If the purchased sensor is a complete sensor/feedthrough combination and no modifications are required, start with step 9.

1 Assemble the sensor mounting bracket (provided by customer) on the process system.

2 Temporarily position and attach the sensor head as outlined in the general guidelines above.

3 Temporarily install the feedthrough.

4 Form, measure, and mark the sensor tubes.

NOTE: Use the Tube Bender Kit, PN 750-037-G1, provided with all non-welded sensors to form the tubes.

CAUTION

Do not form the sensor tubes with a bend radius less than 0.3125 in. (8 mm). Do not use the sensor body as a leverage point; doing so stresses the tube's braze joints and may result in their failure.

5 Build the Sensor/Feedthrough Assembly.

6 Remove the sensor and the feedthrough.

7 Cut the water cooling tubes and air tubes to the proper length. Verify that they are clear of metal particles by forcing compressed air through the tubing.

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

8a Vacuum rated connectors, 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 water-cooling tubes prior to connection to the feedthrough. Make connections as follows:

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CAUTION

To prevent damage to the feedthrough or sensor during brazing, ensure that at least one inch of water tube is left between the sensor and the flame.

8b Clean the water tube and adapter surfaces with solvent, if necessary.

8c Apply brazing flux to surfaces being joined.

8d 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 water tube.

8e Verify that each joint is not blocked by blowing compressed air through the cooling tubes.

8f Thoroughly clean the braze joint and helium leak test before installing the sensor and feedthrough into the process chamber.

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

10 Shield the coaxial cable from heat radiating from the evaporant source of the substrate heater. You can do this very simply, if your process allows, by wrapping aluminum foil around the cable and water tubes.

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

12 Apply water pressure and verify the water connections.

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 that the thickness indication on the instrument accurately represents the thickness on the substrates.

Refer to the instrument operating manual for calibration procedures.

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2.4 Installing the Standard and Right Angle Sensors

Standard and Right Angle sensors may be installed in any appropriate location within the vacuum system. Two tapped holes are provided on the back of each sensor body for attaching to the system.

The standard cable length from the sensor to the feedthrough is:

- 30.75 in. (761 mm) for SL-XXEXX and DL-XEXX models
- 60 in. (1524 mm) for SL-XXGXX and DL-XGXX models.

The cable length from the sensor to the feedthrough distance should not exceed 40 in. (1016 mm) unless a ModeLock instrument is used. Refer to the controller/monitor operating manual for cable length limitations.

2.5 Sensor Shutter Function Check

Temporarily connect an air supply (70 PSIG {85 PSIA} - 80 PSIG {95 PSIA} (5.9 bar - 6.6 bar) [586-655 kPa]) to the actuator air tube and test operation (10-15 cycles).

When actuated, shutter movement should be smooth, rapid, and complete, and should retract completely from the crystal opening. When deactivated, the shutter should completely cover the crystal opening. Repositioning of the shutter may be required to achieve optimum on/off positioning.

If operation is impaired, lubricate the moving parts in the area shown on drawing PN 750-210 (Figure 1-14 on page 1-21) with molybdenum disulfide or equivalent.

NOTE: A Solenoid Valve (PN 750-420-G1) is required with any new shutter installation. See Chapter 3 for more information on the Solenoid Valve and its installation.

WARNING

Do not exceed 100 PSIG (115 PSIA) (7.9 bar) [790 kPa]. Connection to excessive pressure may result in personal injury or equipment damage.

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2.6 Installing Sensor Shutters on Existing Equipment

Installation of sensor shutters on existing equipment requires a Shutter Module Assembly (PN 750-210-G1, refer to section 1.7 on page 1-20).
The Shutter Module Assembly may be installed on either the standard crystal sensor (SL-A0XXX) or the right angle crystal sensor (SL-B0XXX).

2.6.1 Installation of Shutter Module on Standard Crystal Sensor (PN SL-A0XXX)

Reference INFICON drawings PN 750-211 (Figure 1-6 on page 1-10) and PN 750-210 (Figure 1-14 on page 1-21).

1. Remove the shutter assembly to provide easier pneumatic shutter installation.
2. Rotate the shutter module until the holes through the actuator assembly of the shutter module coincide with the #4-40 tapped holes in the rear side of the standard crystal sensor assembly.
3. Secure the shutter module to the standard crystal sensor assembly utilizing the #4-40 x 3/4 in. hardware provided with the shutter module.
4. Hold the sensor with the crystal opening facing upward. Mount the shutter assembly onto the shaft assembly. Do not tighten the shutter assembly.
5. Position the shutter assembly so that it is directly over the center of the crystal opening. Tighten the shutter assembly cap screw. Make certain that the shutter assembly, when activated, does not block deposition of the evaporant stream onto any portion of the crystal.

2.6.2 Installation of Shutter Module on a Right Angle Crystal Sensor (PN SL-B0XXX)

Reference INFICON drawings PN 750-210 (Figure 1-14 on page 1-21) and PN 750-213 (Figure 1-8 on page 1-12).

1. Remove the shutter assembly to provide easier module installation.
2. Position the holes of the braze assembly shutter adapter over the #4-40 tapped holes in the rear of the compact crystal sensor.
3. Secure the shutter module with the #4-40 x 3/8 in. stainless steel hardware provided with the shutter module.
4. Hold the sensor with the crystal opening facing upward. Mount the shutter assembly onto the shaft assembly. Do not tighten the shutter assembly.
5. Position the shutter assembly so that it is directly over the center of the crystal opening. Tighten the shutter assembly cap screw. Make certain that the shutter assembly, when activated, does not block deposition of the evaporant stream onto any portion of the crystal.

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Chapter 3
Installation of the Solenoid Valve Assembly

3.1 Introduction

The solenoid valve assembly (PN 750-420-G1) and the feedthrough should be installed at the same time. The same solenoid valve is used for both the 1 in. (25.4 mm) and the 2-3/4 in. (69.85 mm) feedthroughs.

- For an Installation with 1 Inch Bolts, see section 3.2 on page 3-1.
- For an Installation with 2-3/4 Inch Feedthrough, see section 3.3 on page 3-2.

  If the solenoid valve assembly is to be used with the 2-3/4 in. (69.85 mm) feedthrough, modify the valve bracket as follows. (See Figure 3-2 on page 3-4.)

  1. Align the score line on the valve assembly 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. Use a file to smooth any rough edges which occur along the break.

3.2 Installation with 1 Inch Bolts

When installing the solenoid valve assembly with a dual sensor, a 1 in. (25.4 mm) bolt equipped with three fluid lines (two water, one air) and two coaxial feedthroughs (PN 750-707-G1, see Figure 5-3 on page 5-4) is required.

All other shuttered sensors using 1 in. (25.4 mm) feedthroughs require only a single coaxial feedthrough (PN 750-030-G1, see Figure 5-2 on page 5-3).

Most INFICON 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) 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 place on the bolt.
2. Insert the 1 in. (25.4 mm) bolt such that the hexagonal shaped end of the bolt is on the vacuum side of the chamber.
3. Add the Bracket.
4. Add the Washer.

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5 Add the Nut.

6 Tighten the feedthrough nut.

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 1/8 in. (3.175 mm) air tube from the "A" port of the solenoid valve to the quick disconnect fitting installed in step 7.

9 Attach the "P" port of the solenoid valve to a source of air between 70 PSIG {85 PSIA} (5.9 bar) [586 kPa]—80 PSIG {95 PSOA} (6.6 bar) [655 kPa].

WARNING

Do not exceed 110 PSIG (115 PSIA) (PN 7.9 bar) [790 kPa]. Connection to excessive pressure may result in personal injury or equipment damage.

3.3 Installation with 2-3/4 Inch Feedthrough

When installing the solenoid valve assembly with a dual sensor, a 2-3/4 in. (69.85 mm) feedthrough equipped with two coaxial feedthroughs (PN 002-080, see Figure 5-7 on page 5-8) is required.

All other shuttered sensors using 2-3/4 in. (69.85 mm) feedthroughs require only a single coaxial feedthrough (PN 750-685-G1, see Figure 5-6 on page 5-7 or PN 750-685-G2, Figure 5-9 on page 5-10).

INFICON 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) to the feedthrough air line.

Follow the steps below:

1 Install the Feedthrough.

2 Add the valve bracket (modified) to the desired location using two of the flange's 1/4 in. (6.35 mm) clamp bolts.

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 1/8 in. (3.175 mm) air tube from the "A" port of the solenoid valve to the quick disconnect fitting installed in step 4.

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6 Attach the "P" port of the solenoid valve to a source of air between 70 PSIG {85 PSIA} (5.9 bar) [586 kPa]—80 PSIG {95 PSIA} (6.6 bar) [790 kPa].

WARNING

Do not exceed 110 PSIG (115 PSIA) (7.9 bar) [790 kPa]. Connection to excessive pressure may result in personal injury or equipment damage.

CAUTION

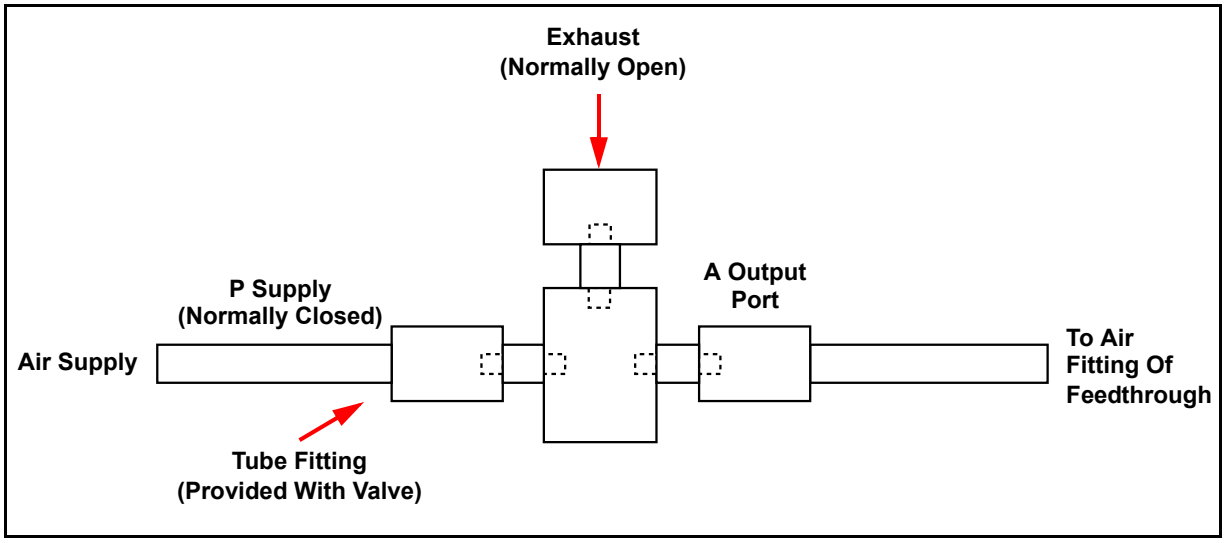
Maximum temperature for the solenoid valve assembly is 105 °C for bakeout and operation.

3.4 Electrical and Pneumatic Connections

3.4.1 Electrical

To complete installation of the assembly, make electrical connections where indicated in Figure 3-3 on page 3-5 to either 24 V(ac) or V(dc). Current required is approximately 70 mA.

Figure 3-1 Miniature pneumatic solenoid tube connections



3.5 List of Supplied Solenoid Valve Drawings

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

PN 074-156M

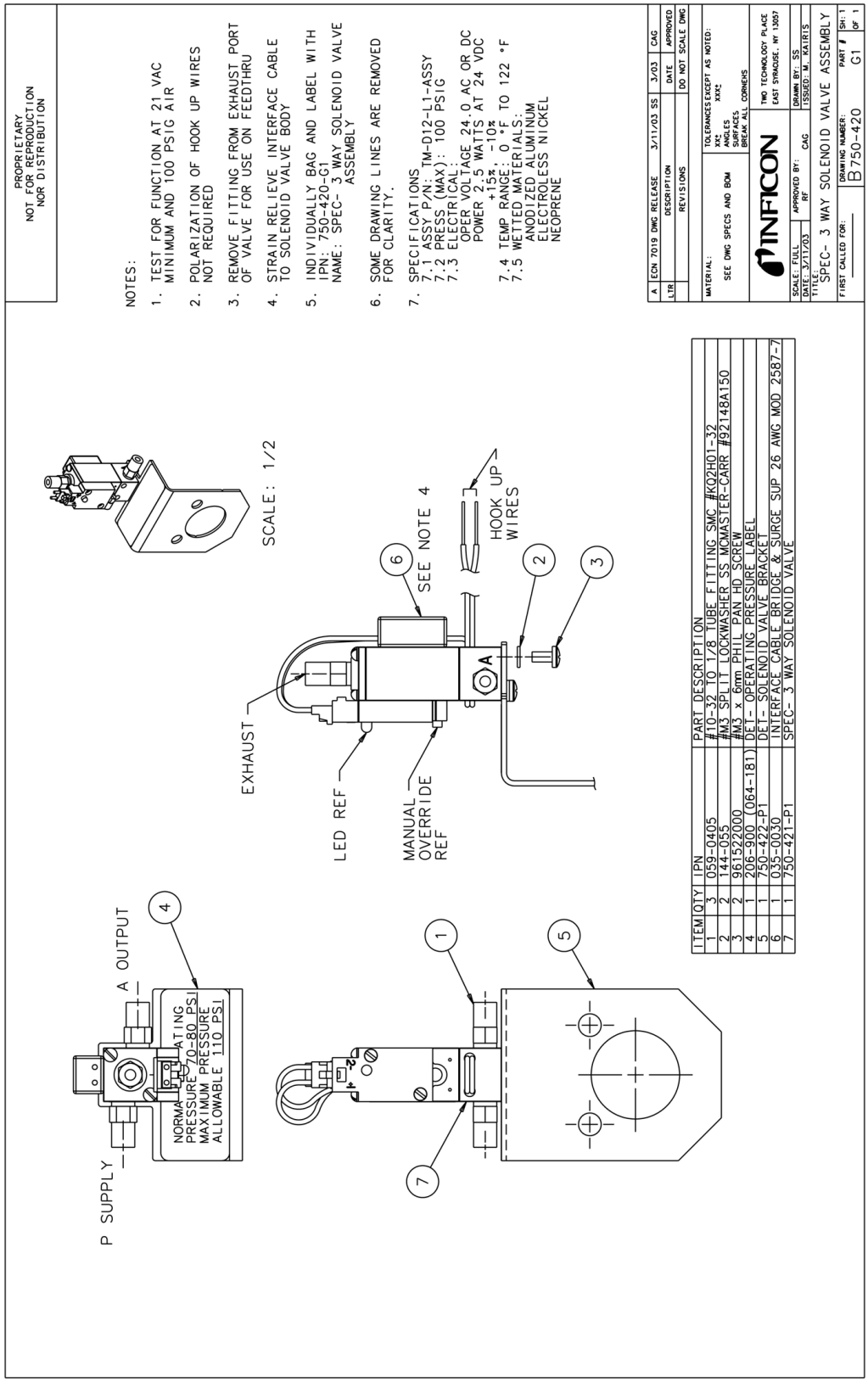


Figure 3-2 Solenoid valve assembly

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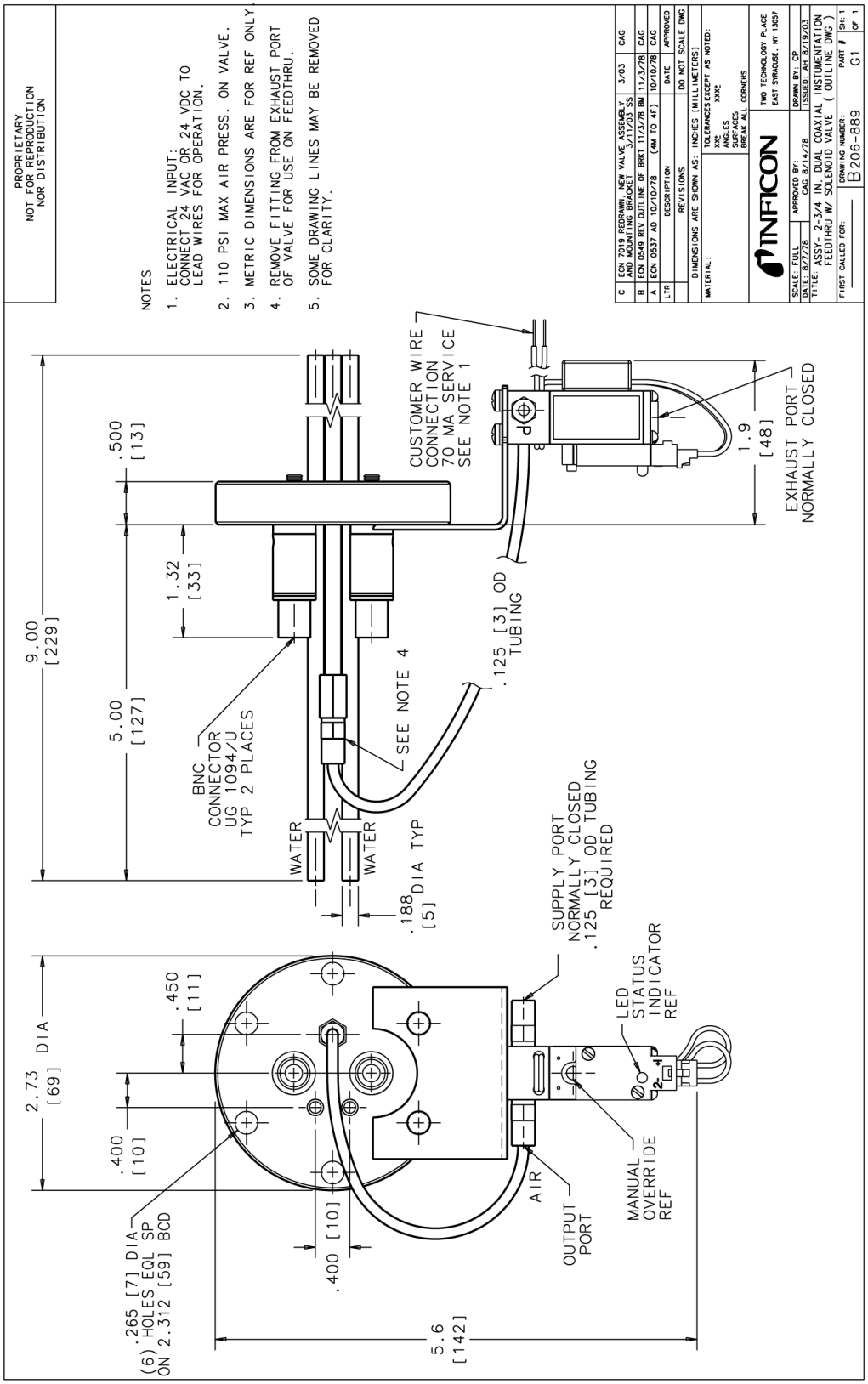

Figure 3-3 2-3/4 in. Dual coaxial feedthrough and valve assembly

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Chapter 4
Troubleshooting and Maintenance

4.1 Troubleshooting Guide

If the Front Load Sensor fails to function, or appears to have diminished performance, the following Symptom/Cause/Remedy charts may be helpful.

4.1.1 Troubleshooting

A useful tool for diagnosing sensor head problems is the DMM (Digital MultiMeter). Disconnect the short oscillator cable from the feedthrough and measure the resistance from the center pin to ground. If the reading is less than 10 MΩ the source of the leakage should be found and corrected. Likewise, with the vacuum system open, check for center conductor continuity, a reading of more than 1Ω from the feedthrough to the transducer contact indicates a problem. Cleaning contacts or replacing the in-vacuum cable may be required. The measured resistance may be slighty higher for the longer cable lengths.

Another useful diagnostic is to continuity-test the sensor head without a crystal. Install the ceramic retainer into the crystal holder without a crystal and place into the sensor body. The DMM should measure 1Ω or less from the center pin of the feedthrough to ground. Replacing the in-vacuum cable or reforming the leaf springs may be required.

A useful tool for rapidly evaluating the cause of a persistent "Crystal Fail" is the optional Crystal Sensor Emulator (PN 760-601-G2). It is designed to rapidly replace various sensor components to validate proper operation and thereby eliminate them as being possibly defective. Similar to the test crystal, which is included with each non-modelock oscillator package, this tool utilizes a packaged crystal at 5.5 MHz and has connectors that allow the direct connection of either BNC or Microdot RF cables, or it may be directly plugged into the Front Load type sensors (removal of the shutter may be required in a Front Load Dual sensor). The use of the Crystal Sensor Emulator may identify problems not readily diagnosed with a DMM. See Chapter 6 for more information on the Crystal Sensor Emulator.

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Table 4-1 Symptom - cause - remedy chart

SYMPTOM	CAUSE	REMEDY
Large jumps of thickness reading during deposition.	Mode hopping due to damaged crystal.	Replace the crystal.
	Crystal is near the end of its life.	Replace the crystal.
	Scratches or foreign particles on the crystal holder seating surface.	Clean or polish the crystal seating surface on the crystal holder. See section 4.5 on page 4-10.
	Uneven coating.	Square sensor to source. See section 2.3.1 on page 2-5.
	Particles	Remove source of particles.

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Table 4-1 Symptom - cause - remedy chart (continued)

SYMPTOM	CAUSE	REMEDY
Crystal ceases to oscillate during deposition before it reaches its “normal” life	Crystal is being hit by small droplets of molten material from the evaporation source.	Use a shutter to shield the sensor during initial period of evaporation; move the sensor further away.
	Damaged crystal.	Replace the crystal.
	Built-up material on edge of crystal holder is touching the crystal.	The crystal cover cannot have a build up of deposition material. This material may create an unreliable connection to the crystal. Removal of the deposition material is a maintenance necessity. Do not allow seat to get roughened by the removal process.
	Material on crystal holder is partially masking the full crystal area.	Clean the crystal holder.
NOTE: Crystal life is highly dependent on process conditions of rate, power radiated from source, location, material, and residual gas composition.		
Crystal does not oscillate or oscillates intermittently (both in vacuum and in air).	Damaged crystal.	Replace the crystal.
	Existence of electrical short or poor electrical contacts.	Check for electrical continuity and short in sensor cable, connector, contact springs, and the connecting wire inside the sensor; check for electrical continuity in feedthroughs.
NOTE: Check the Leaf Spring contact shape as part of a routine maintenance inspection. Flattened or deformed Leaf Spring contacts in the sensor body or ceramic retainer are common causes of “crystal problems".		
Crystal oscillates in vacuum but stops oscillation after open to air.	Crystal was 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 opening it to air; flow hot water through the sensor when the chamber is open.

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Table 4-1 Symptom - cause - remedy chart (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 not properly seated.	Check and clean the crystal seating surface of the crystal holder. See illustration on page 4-2.
	Excessive heat input to the crystal.	If heat is due to radiation from the evaporation source, move sensor further away from source and use sputtering crystals for better thermal stability; if the source of crystal heating is due to a secondary electron beam, change regular sensor to a sputtering sensor.
	No cooling water.	Check cooling water flow rate.
	Heat induced from electron flux.	Use sputtering head for non-magnetron sputtering.
Poor thickness reproducibility.	Erratic source emission characteristics	Move sensor to a different location; check the evaporation source for proper operating conditions; insure relatively constant pool height and avoid tunneling into the melt.
		Use multiple sensor option if available on controller.
	Material does not adhere to the crystal.	Check the cleanliness of the crystal's surface; evaporate an intermediate layer of proper material on the crystal to improve adhesion. Use silver or gold coated crystals, as appropriate.

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4.2 General Precautions

4.2.1 Handle the Crystal with Care

The crystal surfaces are easily contaminated; handle the crystals only by their edges, and always use nylon lab gloves and clean plastic tweezers. 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.

4.2.2 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 would not result in a noticeable reduction of total flow.

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 evaporant source and from substrate heaters.

4.2.3 Use the Optimum Crystal Type

Silver crystals are recommended for sputtering applications.

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 your specific evaporant application.

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4.2.4 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.

4.2.5 Care of the Ceramic Retainer

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.**

Always use clean nylon lab gloves and plastic tweezers for handling the crystal, as this can deter contamination. Contamination may lead to poor adhesion of deposited material to the electrode.

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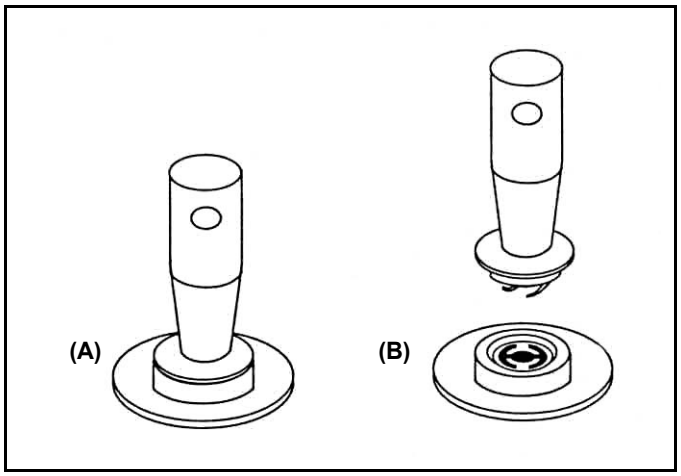
4.3 Crystal Replacement Instructions

Follow the steps below to replace the crystals (refer to Figure 4-4 on page 4-10).

NOTE: Review section 4.2, General Precautions, on page 4-5.

1. Using clean nylon gloves, grip the crystal holder with your fingers and pull it straight out of the sensor body.
2. 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



3. Invert the crystal holder and the crystal will drop out.
4. Prior to installing the new crystal, review section 4.2.1, Handle the Crystal with Care, on page 4-5.
5. Grasp the edge of the new crystal with a clean pair of plastic 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.
6. Replace the ceramic retainer. Initially orient it at an angle to displace the spring wire segments in the crystal holder.
7. 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.
8. Reinstall the holder in the sensor body; push the holder straight in making certain that it is completely seated in the sensor body.

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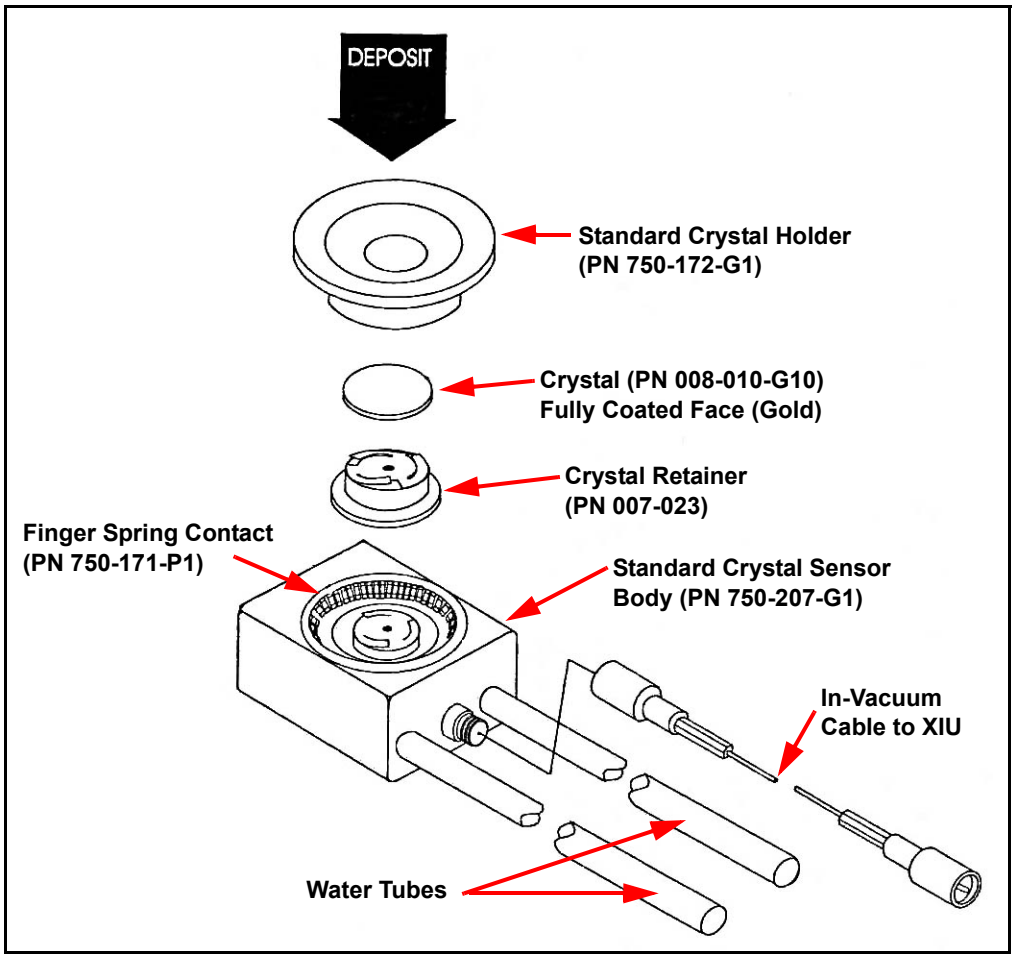
Figure 4-2 Standard crystal sensor (exploded)



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.

4.4 Retainer Spring Adjustment Instructions

Occasionally, you may become dissatisfied with the way the ceramic retainer is secured in the crystal holder.

To alter the retainer retention force, use the following procedure.

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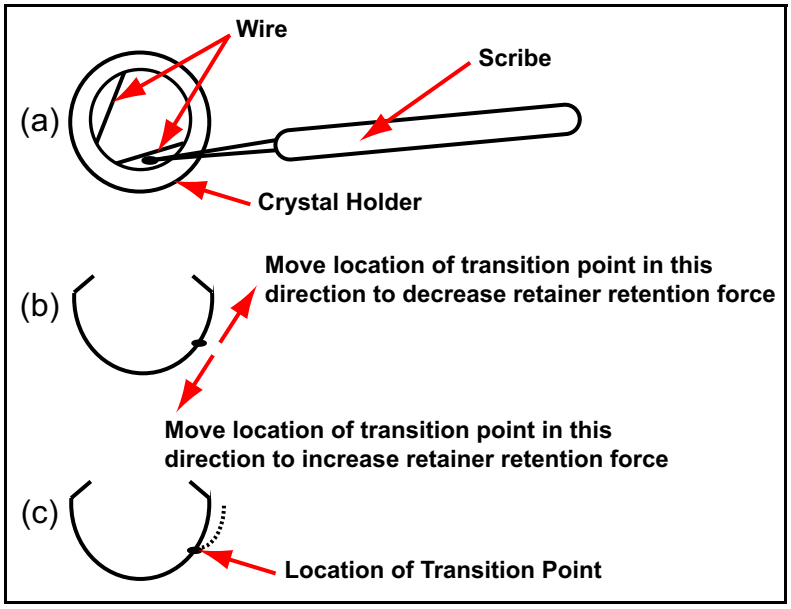
Tools required

- 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 cavity and one of the two wire segments that protrude into the crystal cavity (see Figure 4-3-a).

Figure 4-3 Location of the transition point



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

4.5 Maintenance

These maintenance requirements apply to the Front Load Single and Dual crystal sensors.

4.5.1 Crystal Holder Maintenance

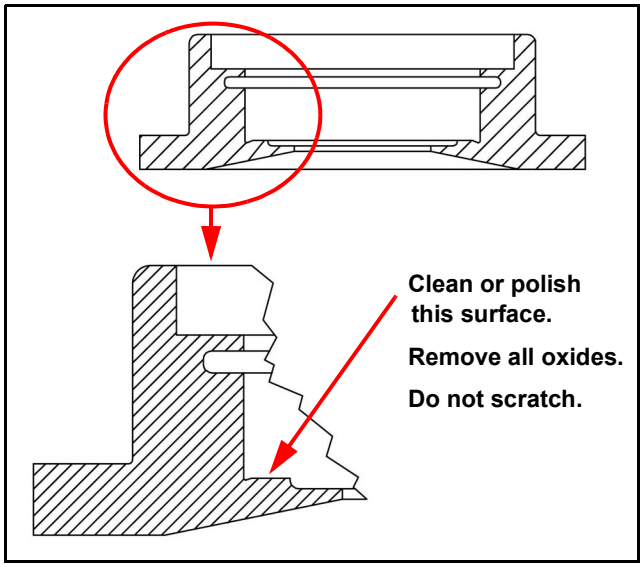
In dielectric coating applications, the surface where the crystal contacts the crystal holder may require periodic cleaning. Since most dielectrics are insulators, any buildup due to blow-by will eventually cause erratic, or poor, electrical contact between the crystal and the sensor body. This buildup will also cause a reduction in thermal transfer from the crystal to the sensor body. Dielectric buildup 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 Scotch-Brite™ cleaning pad.
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. See Figure 4-4 on page 4-10.

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

Figure 4-4 Crystal holder cleaning



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4.5.2 Crystal Sensor: Replacing the Finger Spring Contact

The finger spring contact strip (PN 750-171-P1) that retains the crystal holder assembly in the crystal sensor must be replaced:

- When finger spring contact strip begins to exhibit reduced holder retention.
- When the sensor has been subjected to an environment exceeding 130°C.
- After 4000 extractions. Subjecting the spring contact to 4000 holder extractions reduces the magnitude of the extraction force one pound. 4000 extractions represent the recommended life expectancy of the spring.

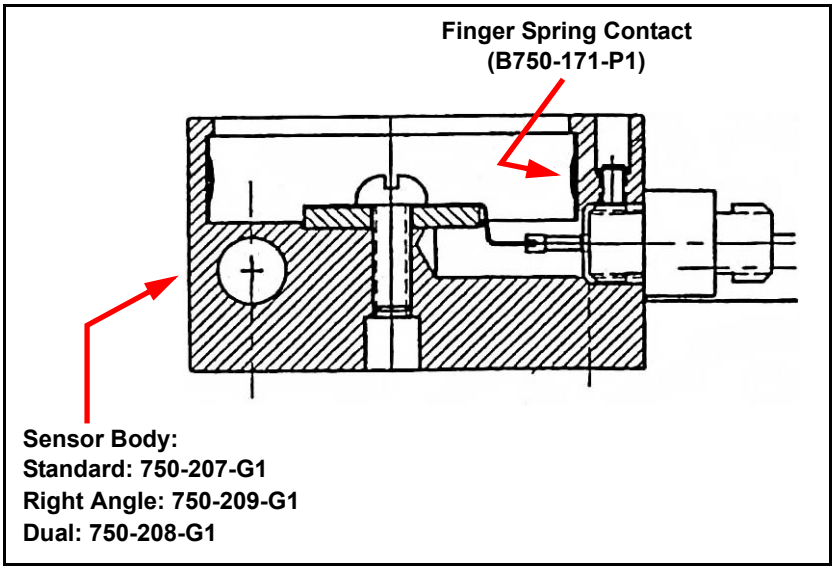
  NOTE: The actual number of extractions will vary based on process conditions.

Proceed as follows to replace the finger contact. (See Figure 4-2 and Figure 4-5.)

1. Extract the crystal holder. (See Figure 4-2).
2. Remove the finger spring contact with a pair of tweezers. (See Figure 4-5.)
3. Insert the new finger spring contact, allowing it to expand and conform to the inner diameter of the sensor assembly as shown in Figure 4-5 on page 4-11.

   NOTE: The finger springs are formed and heat treated to a diameter that is larger than the diameter of its groove to aid in assembly and retention.
4. Run your finger along the inner lip of the sensor assembly to verify that the spring contact is contained in the recess provided and that the spring has not overlapped onto itself. This will ensure that the spring contact will not be damaged during holder installation.
5. Insert the crystal holder.

Figure 4-5 Spring contact replacement



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4.5.3 Shutter Module Maintenance

The Shutter module should be dismantled and lubricated approximately every 2000 strokes at areas specified on INFICON drawing PN 750-210, shown in Figure 1-14 on page 1-21. Failure to lubricate may significantly reduce life of operation or cause assembly to become totally inoperative.

Sparingly use the molybdenum disulfied or use Fomblin™ E25 (perfluorinated polyether), if appropriate for your process.

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Chapter 5
Feedthroughs

5.1 List of Supplied Feedthrough Drawings

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

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Figure 5-1 1 in. bolt feedthrough with two tubes, one electrical (PN 002-042)

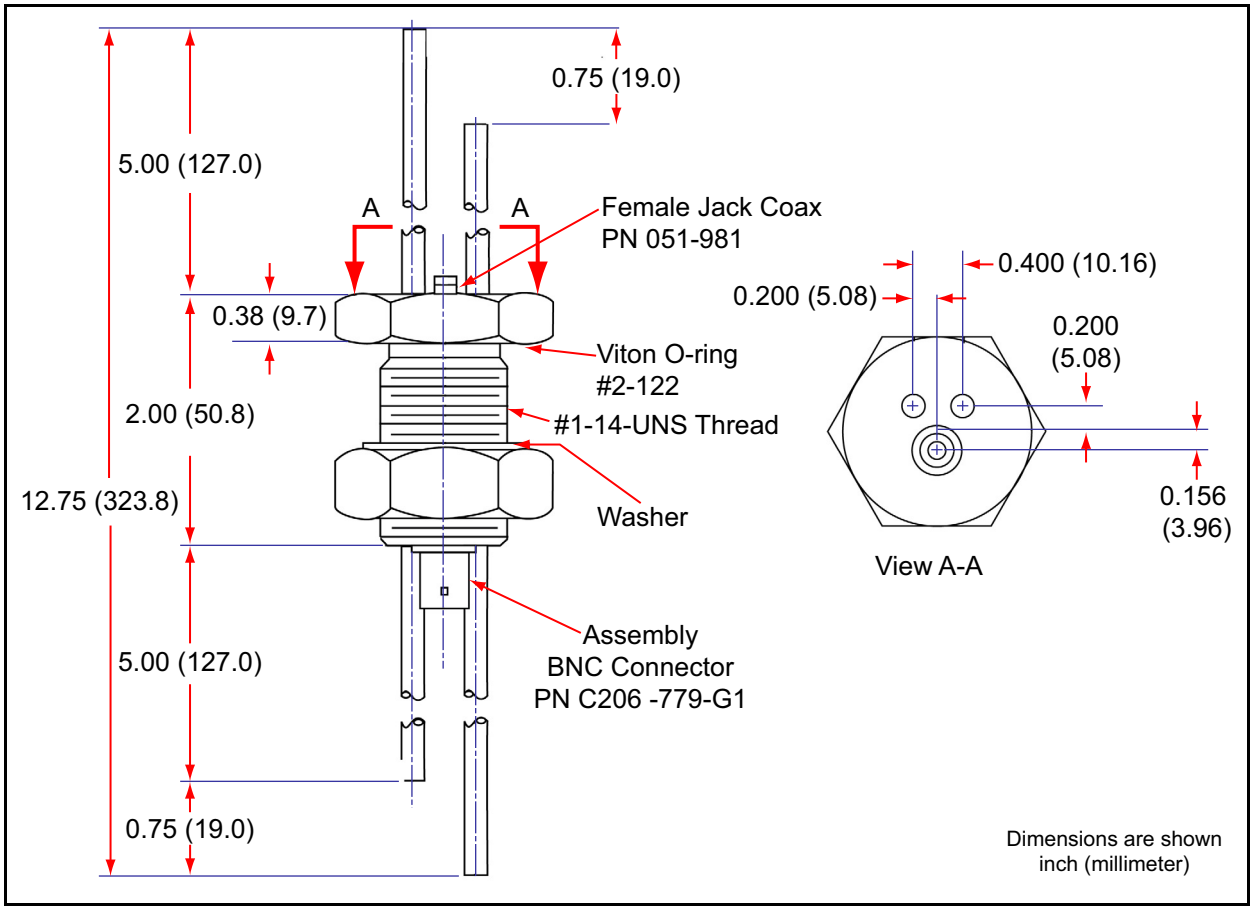

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Figure 5-2 1 in. bolt feedthrough with three tubes, one electrical (PN 750-030-G1)

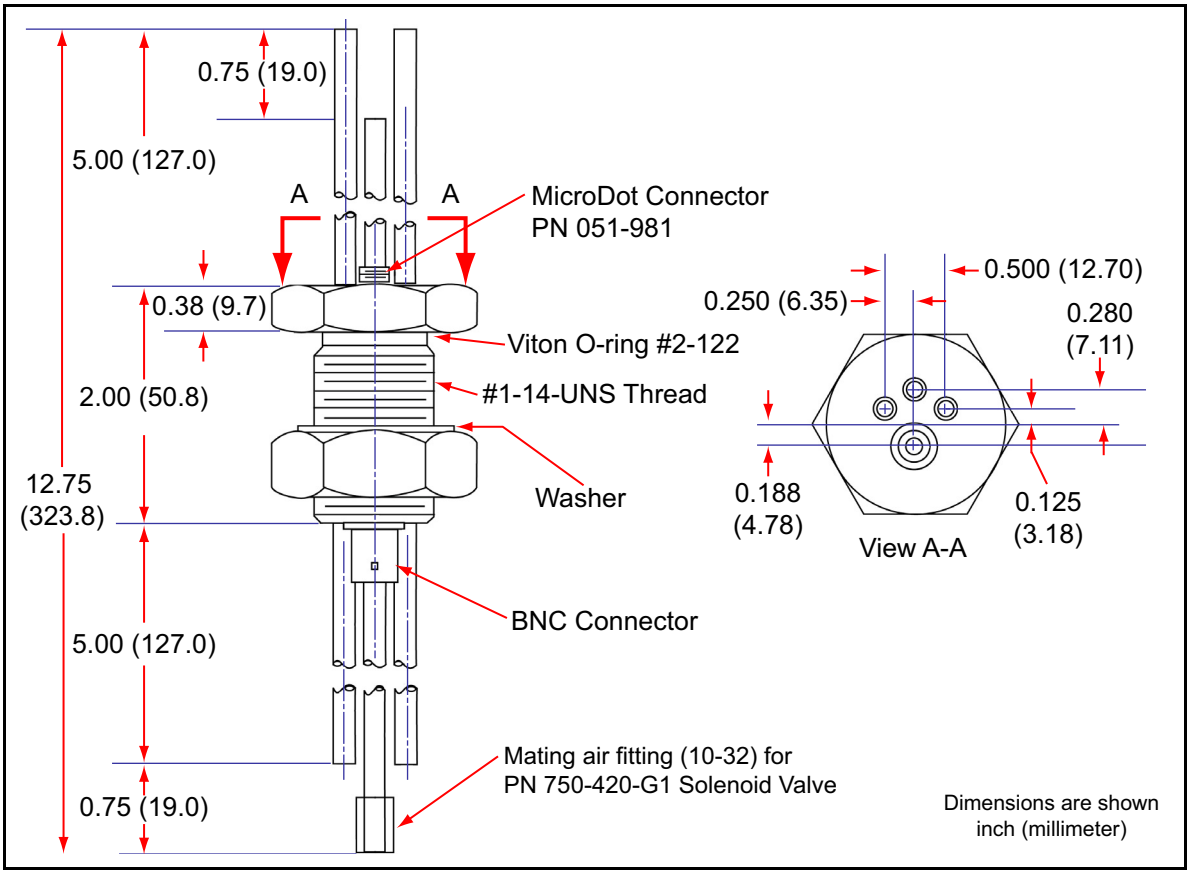

Figure 5-3 1 in. bolt feedthrough with three tubes, two electrical (PN 750-707-G1)

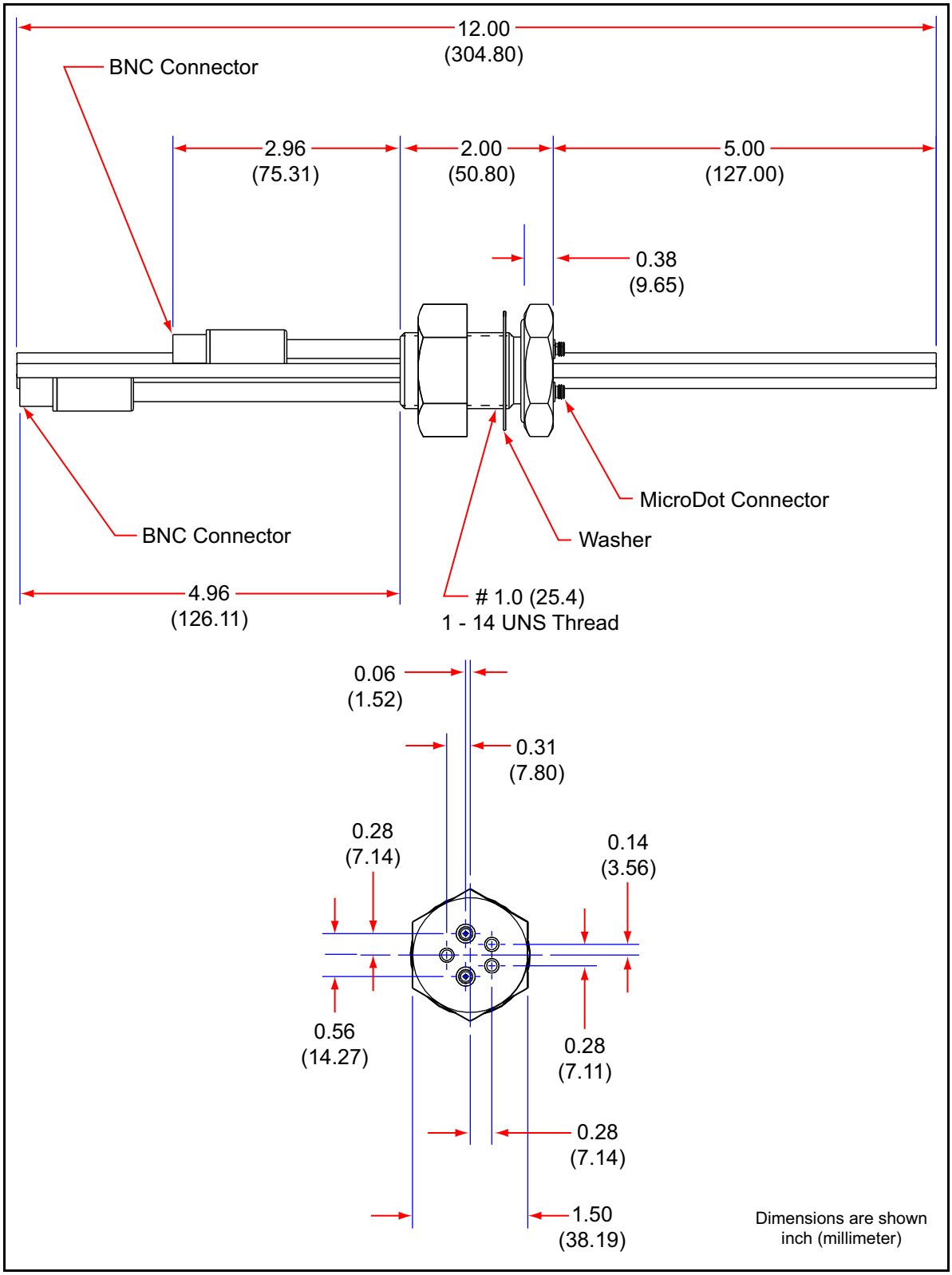

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Figure 5-4 1 in. bolt feedthrough with two tubes, one electrical, with Ultra-Torr (PN 750-624-G1)

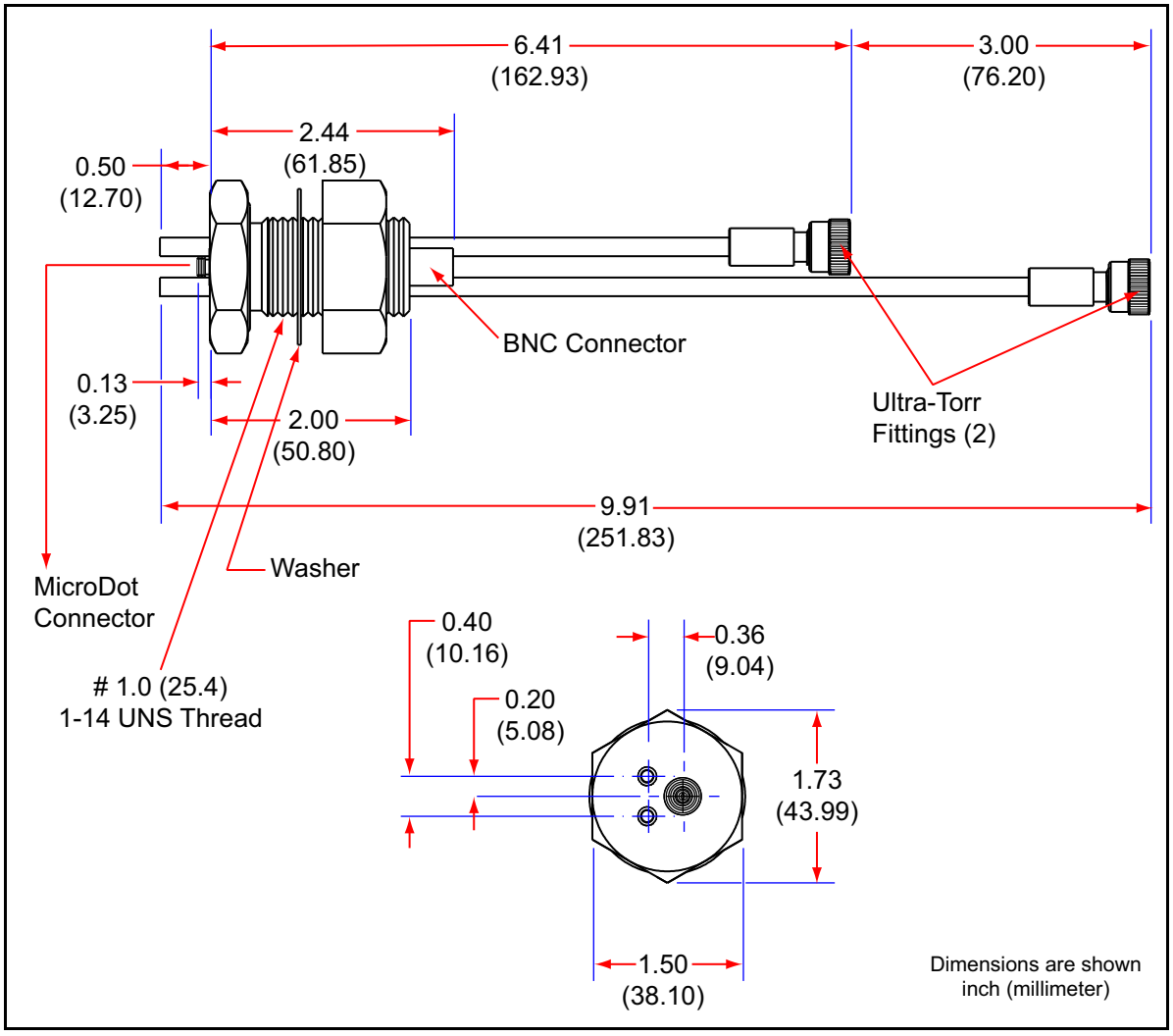

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Figure 5-5 2-3/4 in. Conflat feedthrough with two tubes, one electrical (PN 002-043)

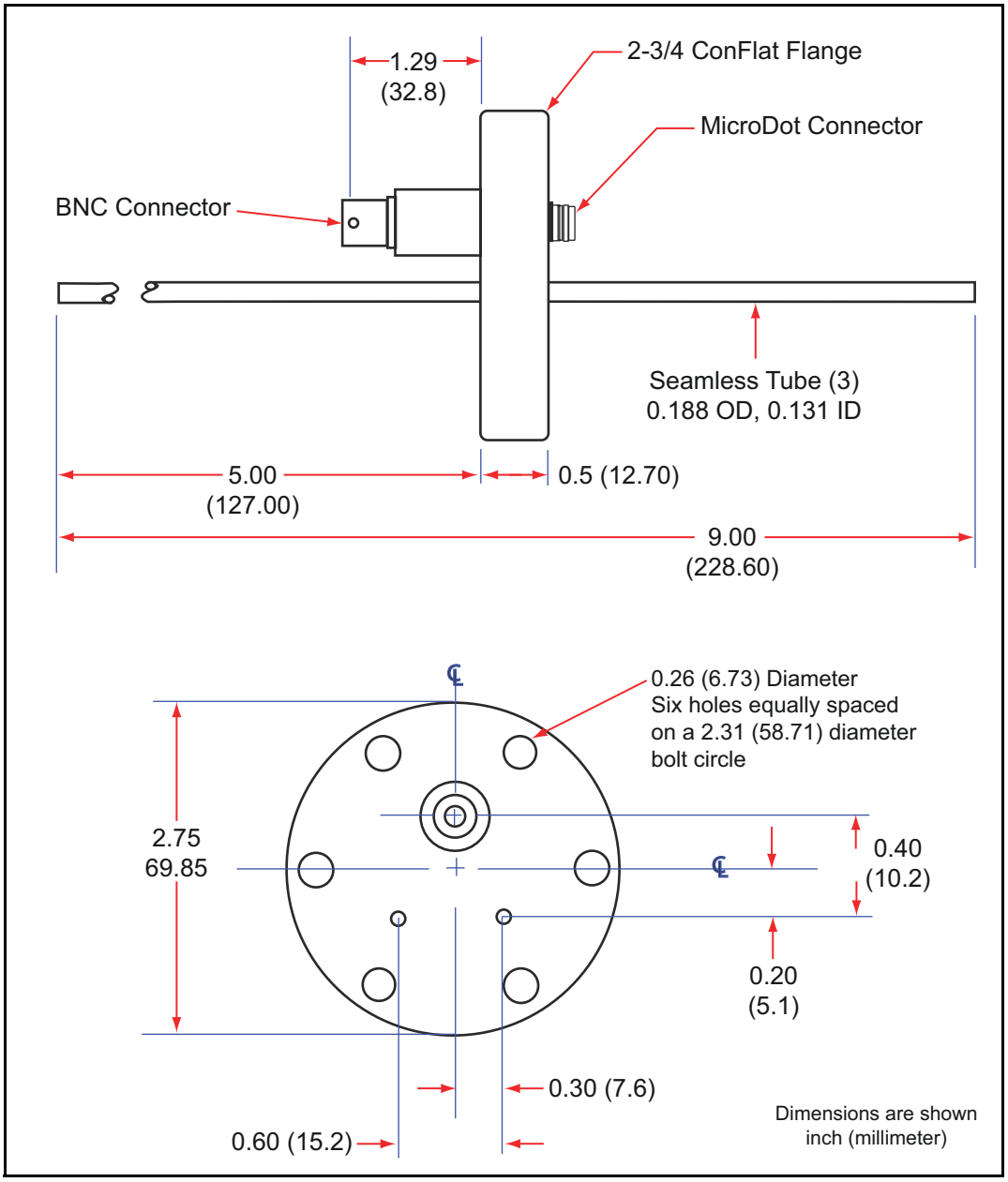

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Figure 5-6 2-3/4 in. Conflat feedthrough with three tubes, one electrical (PN 750-685-G1)

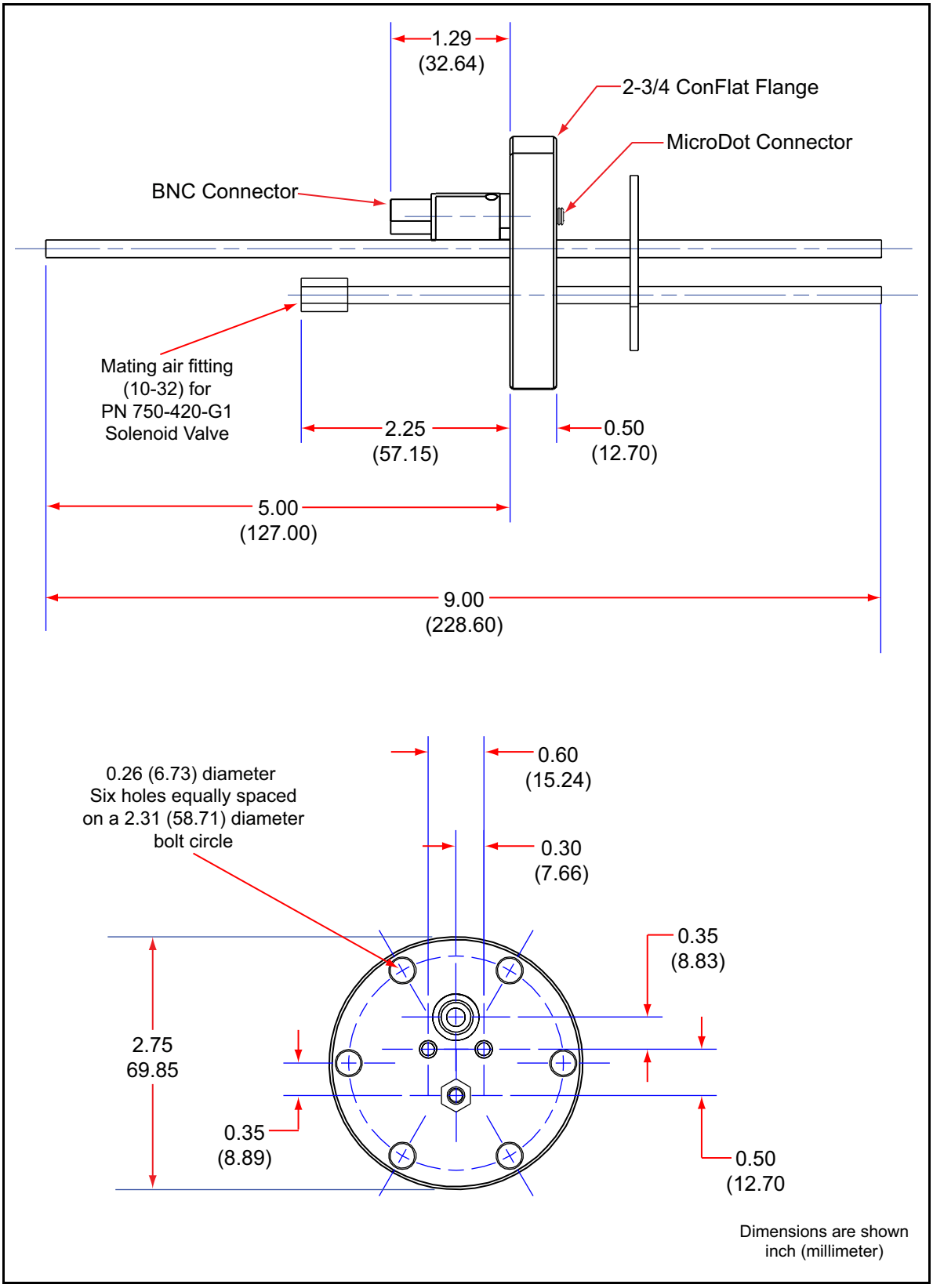

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Figure 5-7 2-3/4 in. Conflat feedthrough with three tubes, two electrical (PN 002-080)

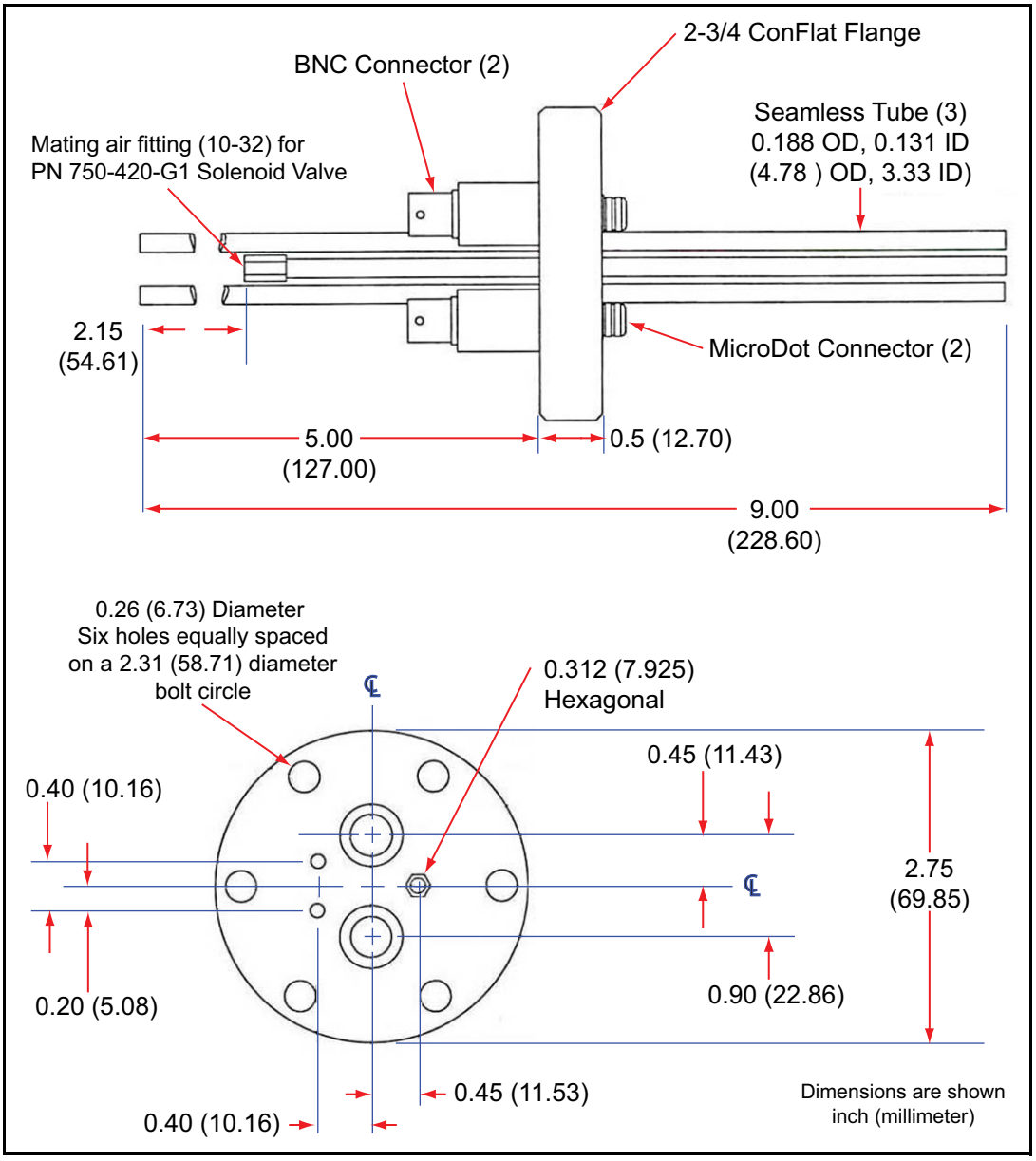

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Figure 5-8 2-3/4 in. Conflat with two tubes, one electrical, with Ultra-Torr (PN 206-878-G2)

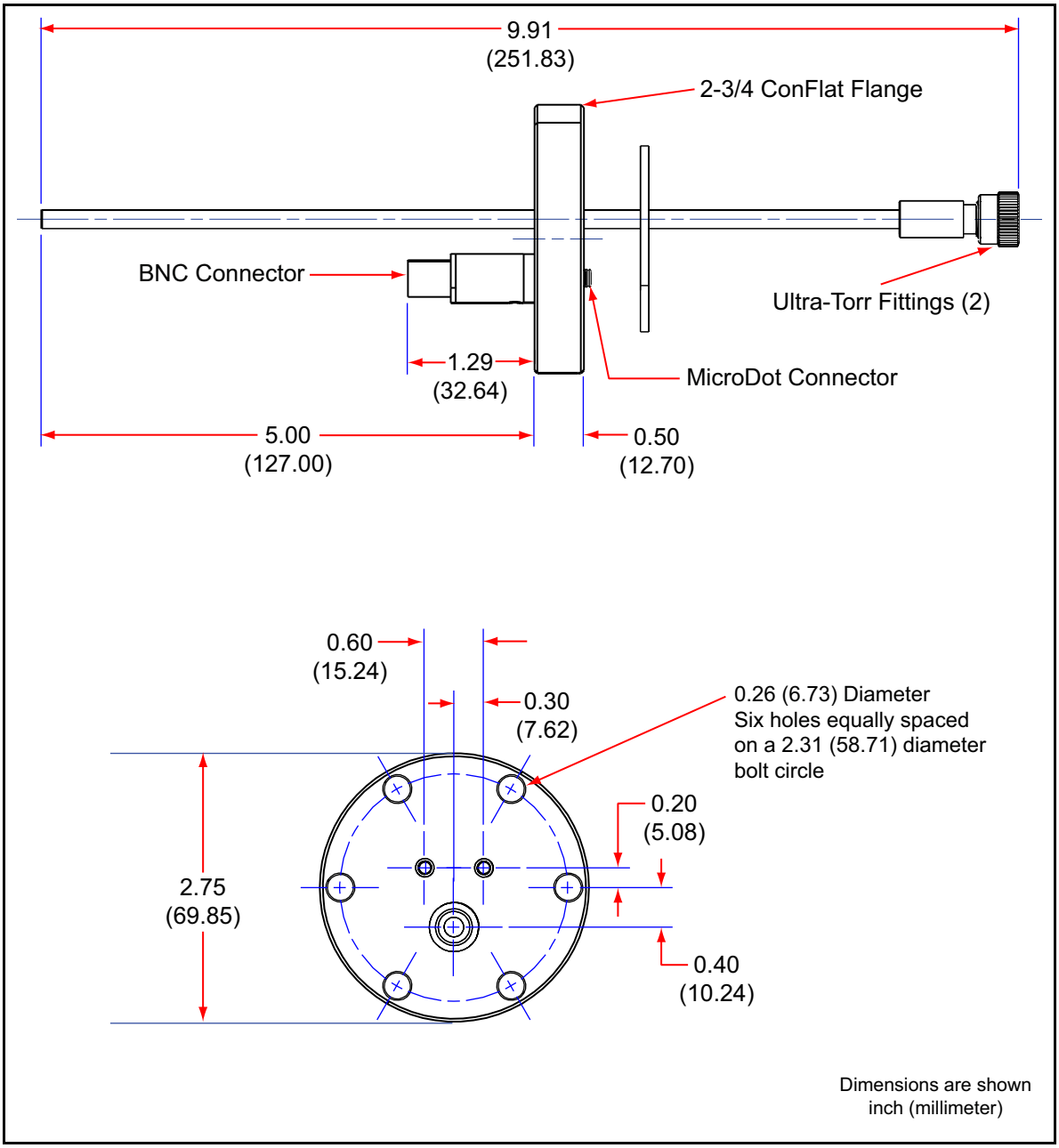

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Figure 5-9 2-3/4 in. Conflat with three tubes, one electrical, with Ultra-Torr (PN 750-685-G2)

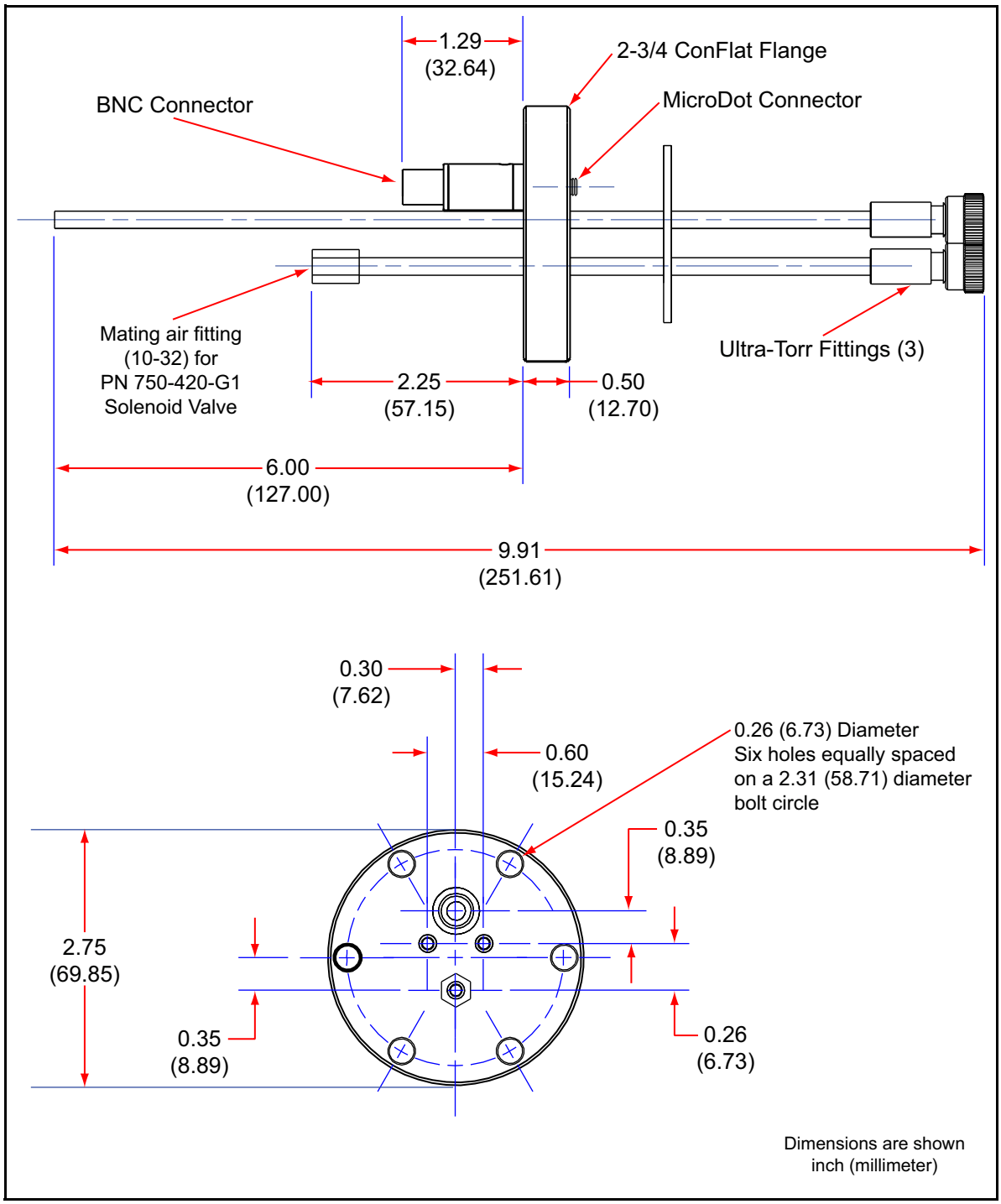

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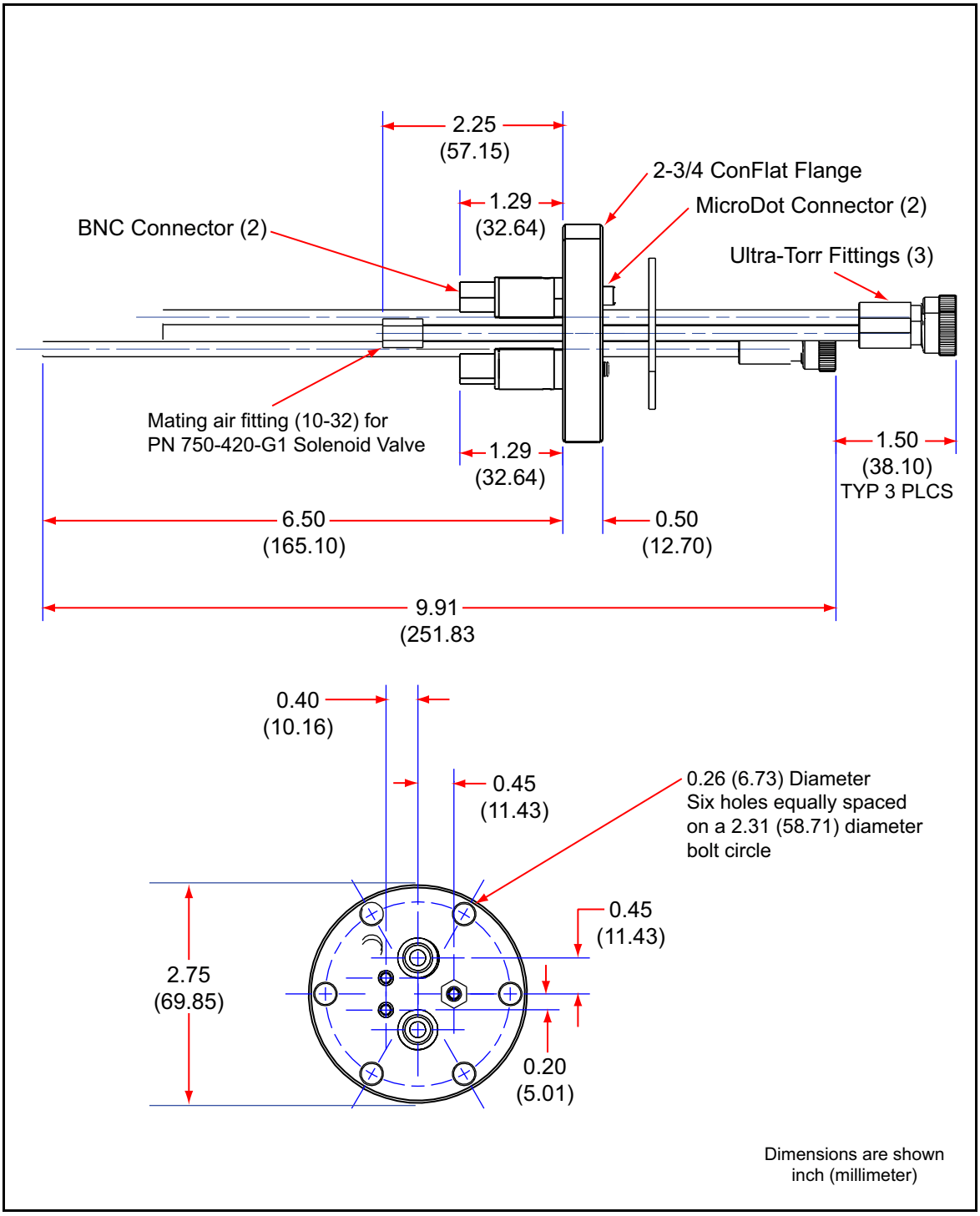
Figure 5-10 2-3/4 in. Conflat with three tubes, two electrical, with Ultra-Torr (PN 206-890-G2)



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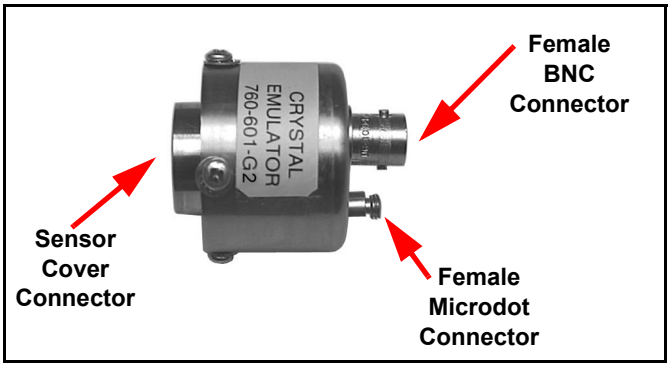
Chapter 6
Crystal Sensor Emulator

6.1 Introduction

NOTE: The Crystal Sensor Emulator is not compatible for use with an INFICON IC/4 Thin Film Deposition Controller.

The Crystal Sensor Emulator (PN 760-601-G2) option is used in conjunction with the thin film deposition controller to rapidly diagnose problems with the deposition controller's measurement system. See Figure 6-1.

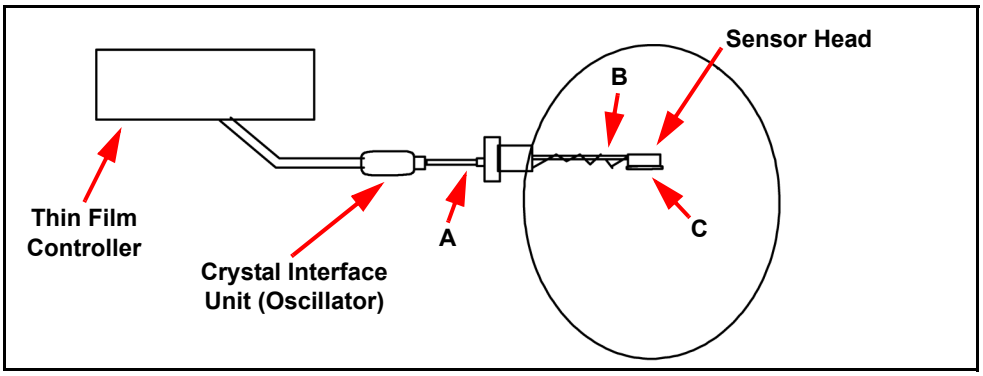
Figure 6-1 Crystal Sensor Emulator



The Crystal Sensor Emulator may be attached at various points in the measurement system, from the oscillator to the sensor head. It provides a known "good" monitor crystal with known "good" electrical connections.

Using the emulator and the controller in a systematic manner provides a fast means of isolating measurement system, cable, or sensor problems. See Figure 6-2.

Figure 6-2 Crystal Sensor Emulator attachment points



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CAUTION

This product is designed as a diagnostic tool, and is not intended for use in vacuum. Do not leave the Crystal Sensor Emulator installed in the vacuum system during processing.

6.2 Diagnostic Procedures

The following diagnostic procedures employ the Crystal Sensor Emulator to analyze a constant Crystal Fail message. The symptom is a Crystal Fail message that is displayed by the deposition controller even after the monitor crystal has been replaced with a new “good” monitor crystal.

NOTE: U**nable To Auto Z** will be displayed if the Crystal Sensor Emulator is attached to an IC/4 PLUS, IC/4 MPT, Cygnus, IC6 or Cygnus2, and you are attempting to use the Auto Z feature of these instruments. This is to be expected and is normal.

6.2.1 Measurement System Diagnostic Procedure

1. Refer to Figure 6-2 on page 6-1. Remove the BNC cable from the feedthrough at point A.
2. Connect the Crystal Sensor Emulator to the BNC cable at Point A.
   - If the XTAL Fail message disappears after approximately five seconds, the measurement system is working properly. Re-install the BNC cable to the feedthrough. Go to section 6.2.2.
   - If the XTAL Fail message remains, continue at step 3.
3. Disconnect the BNC cable from the Oscillator and from the Emulator.
4. Visually inspect the BNC cable to verify that the center pins are seated properly.
5. Use an Ohm meter to verify the electrical connections on the BNC cable.
   - There must be continuity between the center pins.
   - There must be isolation between the center pins and the connector shield.
   - There must be continuity between the connector shields.

   Replace the BNC cable if it is found to be defective, then repeat Step 2 of this procedure.
6. If the BNC cable is not defective, re-connect the BNC cable to the oscillator and to the Crystal Sensor Emulator. If the XTAL Fail message remains, contact INFICON.

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6.2.2 Feedthrough Or In-Vacuum Cable Diagnostic Procedure

1. Refer to Figure 6-2 on page 6-1. Remove the in-vacuum cable from the Sensor Head at point B.
2. Connect the Crystal Sensor Emulator to the in-vacuum cable.
   - If the XTAL Fail message disappears after approximately five seconds, the feedthrough and in-vacuum cable are working properly.

     Re-install the in-vacuum cable to the Sensor Head. Proceed to section 6.2.3 on page 6-4.
   - If the XTAL Fail message remains, continue at step 3.
3. Disconnect the in-vacuum cable from the feedthrough and the Emulator. Disconnect the BNC cable from the feedthrough.
4. Using an Ohm Meter, verify continuity from the BNC center pin on the feedthrough to the Microdot center pin on the feedthrough. A typical value would be less than 0.2 ohms.
5. Verify isolation of the center pin on the feedthrough from the electrical ground (feedthrough body). A typical value would be in excess of 10 mega ohms.

If the feedthrough is found to be defective, replace the feedthrough, re-attach the BNC and in-vacuum cables, and repeat this procedure, starting from Step 2. Otherwise, continue at step 6.

6. Verify continuity from center pin to center pin on the in-vacuum cable.
7. Verify that the center pin of the in-vacuum cable is isolated from the in-vacuum cable shield.

If the in-vacuum cable is found to be defective, replace the in-vacuum cable. Re-attach the BNC and in-vacuum cables, and repeat this procedure starting at step 2, otherwise continue at step 8.

8. Connect the in-vacuum cable to the feedthrough.
9. Verify continuity from the center pin on the BNC connector of the feedthrough to the center pin on the un-terminated end of the in-vacuum cable.
10. Verify isolation from the center pin to electrical ground (feedthrough body).

If the feedthrough/in-vacuum cable system is found to be defective, look for defective contacts at the feedthrough to in-vacuum cable connection. Repair or replace the feedthrough as necessary. Re-attach the BNC and in-vacuum cables and repeat this procedure starting at step 2. Otherwise, continue at step 11.

11. Connect the BNC cable to the feedthrough and disconnect it from the Crystal Interface Unit (or Oscillator).

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12 Verify continuity from the center pin of the Microdot connector on the feedthrough to the un-terminated end of the BNC cable.

13 Verify isolation from the center pin to electrical ground (feedthrough body).

If the feedthrough and BNC cable system are found to be defective, look for defective contacts at the feedthrough to BNC cable connection. Repair or replace the feedthrough as necessary, re-attach the BNC cable to the XIU and in-vacuum cable to the Crystal head, and repeat this procedure, starting at step 2.

6.2.3 Sensor Head Or Monitor Crystal Diagnostic Procedure

1 Remove the Crystal Cover from the Sensor Head.

2 Refer to Figure 6-1 on page 6-1. Connect the Crystal Sensor Emulator to the Sensor Head at point C.

- If the XTAL Fail message disappears after approximately 5 seconds, the Sensor Head is operating properly. Re-insert the Crystal Cover into the Sensor Head and go to section 6.2.4 on page 6-5.
- If the XTAL Fail message remains, continue at step 3.

3 Disconnect the in-vacuum cable from the Sensor Head and the feedthrough. Remove the Crystal Sensor Emulator from the Sensor Head.

4 Using an Ohm meter, verify the electrical connections on the Sensor Head.

- Verify there is continuity from the center pin contact on the Microdot connector on the Sensor Head to the finger spring contact in the Sensor Head.
- There must be electrical isolation between the center pin of the Microdot connector and the Sensor Head body.

If the Sensor Head is found to be defective, contact INFICON to have the Sensor Head repaired.

5 Connect the in-vacuum cable to the Sensor Head.

- Verify there is continuity from the finger spring contact in the Sensor Head to the center pin on the un-terminated end of the in-vacuum cable.
- Verify there is isolation between the finger spring contact and the in-vacuum cable shield.

If either the Sensor Head or the in-vacuum cable system is found to be defective, look for defective contacts at the in-vacuum cable to Sensor Head connection, repair or replace the Sensor Head as necessary. Re-attach the in-vacuum cable to the feedthrough and repeat this procedure, starting at step 2.

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6 Ensure that the leaf springs in the Sensor Head and those in the ceramic retainer are bent to the approximate angle of 60° and 45°, respectively. Refer to section 4.3 on page 4-7.

6.2.4 System Diagnostics Pass But Crystal Fail Message Remains

If the system is operating properly, yet **XTAL Fail** is displayed, perform the following tasks.

1 On the ceramic retainer verify that the center rivet is secure. Repair or replace the ceramic retainer as necessary.

2 Inspect the inside of the Crystal Cover for build-up of material. Clean or replace the Crystal Cover as necessary.

After verifying the Sensor Head contacts, the Sensor Head/in-vacuum cable connection, and the ceramic retainer contacts, re-assemble the system.

If the Crystal Fail message remains, replace the monitor crystal with a good monitor crystal. Verify that the monitor crystal works properly by inserting it into a known good measurement system.

If you continue to experience problems, contact INFICON.

6.3 % XTAL Life

The Crystal Sensor Emulator contains a quartz crystal having a fundamental frequency at 5.5 MHz. With the Crystal Sensor Emulator connected, the % XTAL Life display should read:

- approximately 45% for deposition controllers which allow a 1 MHz frequency shift (IC6000, XTC, XTC/2, XTC/C, XTM/2, and XTC/3).
- approximately 30% for deposition controllers which allow a 1.5 MHz frequency shift (IC/4 Plus, IC/4 MPT, IC/5, Cygnus, IC6 and Cygnus 2).

6.4 Sensor Cover Connection

The Crystal Sensor Emulator can be used to verify the measurement system for INFICON Thin Film Deposition Controllers and Monitors, including the IC6000, XTC, IC/4 Plus, IC/4 MPT, XTC/2, XTC/C, XTM/2, XTC/3, IC/5, Cygnus, IC6, Cygnus 2, SQM-160, SQC-310, SQM-242 and Q-pod.

The Crystal Sensor Emulator's Sensor Cover Connector is compatible with some sensor heads and is not compatible with others, as specified below:

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6.4.1 Compatible Sensor Heads

The Sensor Cover Connection will fit the sensor heads shown in Table 6-1.

Table 6-1 Compatible Sensor Heads

Sensor Head	Part Number
Front Load Single Sensor Head	SL-X0XXX

6.4.1.1 Incompatible Sensor Heads

The Sensor Heads for which the Crystal Sensor Emulator's Sensor Cover Connector will not fit are shown in Table 6-2.

Table 6-2 Incompatible Sensor Heads

Sensor Head	Part Number
Front Load UHV Bakeable Sensor Head	BK-AXX
Cool Drawer Single Sensor Head	CDS-XXXXX
Sputtering Sensor Head	750-618-G1
CrystalSix Sensor Head	750-446-G1
Cool Drawer Dual Sensor Head	CDD-XXXX
Crystal12 Sensor Head	XL12-XXXXXX
RSH-600 Sensor Head	15320X-XX
Front Load single Sensor Head - Shuttered	SL-X1XXX
Front Load Dual Sensor Head	DL-AXXX
NOTE: The Crystal Sensor Emulator’s Sensor Cover will not fit the crystal holder opening of the older style INFICON transducers that have the soldered finger springs.	
NOTE: The Sensor Cover Connection will fit SL-X1XXX and DL-AXXX if the Pneumatic Actuator Assembly is removed.	

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6.5 Emulator Specifications

Dimensions

1.58 in. x 1.58 in. x 1.79 in.
(40.13 mm x 40.13 mm x 45.47 mm)

Temperature Range

0 to 50^{o}C

Frequency

5.5 MHz +/- 30 ppm

Materials

304 Stainless Steel, Nylon, Teflon, brass.
Some internal components contain zinc, tin, and lead.

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