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# RSH-600<sup>TM</sup>

## Rotary Sensor Head

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PN 153800-K

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## Chapter 4

### Outline Drawings

# Chapter 1

## Introduction

### 1.1 Introduction

RSH-600 rotary sensor, see [Figure 1-1](#), is designed for the most demanding processes employing very thick films and several different materials. Switching the crystal without venting the system makes it possible to run automatically with continuous deposition. The fixed position of the crystal being measured also makes it unnecessary to change the tooling factor.

RSH-600 can be used to deposit a different material on each of six crystals providing greater measurement accuracy. Upon completion of deposition of one material, the deposition controller may be programmed to switch crystals for the next material. It may also be actuated manually.

The RSH-600 sensor holds six crystals in a thermally shielded, water cooled housing, ensuring excellent crystal performance in temperature environments up to 300°C. Crystals are housed in an easily removable Teflon® and stainless steel crystal holder.

Crystal position is incremented by applying a one second pulse to a 110/115 V (ac) or 24 V (dc) pneumatic valve. A 7-pin connector provides an indication of the number of the active crystal. This may be used to interface with a thin film controller for automatic crystal switching operation. Refer to your controller operating manual for programming instructions.

*Figure 1-1 RSH-600 and sensor head options*



## 1.2 Safety

### 1.2.1 Definition of Notes, Cautions and Warnings

When using this manual, please pay attention to the Notes, Cautions, and Warnings found throughout. For the purposes of this manual they are defined as follows:

**NOTE:** Pertinent information that is useful in achieving maximum efficiency when followed.



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#### **CAUTION**

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

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#### **WARNING**

**Failure to heed these messages could result in personal injury.**

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## 1.3 How to Contact INFICON

Worldwide customer support information is available under Support at [www.inficon.com](http://www.inficon.com) where you can contact:

- ♦ a Technical Support Engineer with questions regarding applications.
- ♦ a Service Engineer with questions regarding troubleshooting, diagnosing or repairing a defective sensor.
- ♦ Sales and Customer Service, to find the INFICON Sales office nearest to you.
- ♦ Repair Service, to find the INFICON Service Center nearest to you.

If you are experiencing a problem with your sensor, please have the following information readily available:

- ♦ the serial number of your sensor,
- ♦ a description of your problem,
- ♦ an explanation of any corrective action that you may have already attempted,
- ♦ and the exact wording of any error messages that you may have received.

### 1.3.1 Returning Your Instrument

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 instrument.

Prior to being given an RMA number, you may be required to complete a Declaration Of Contamination (DOC) form if your sensor has been exposed to process materials. 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

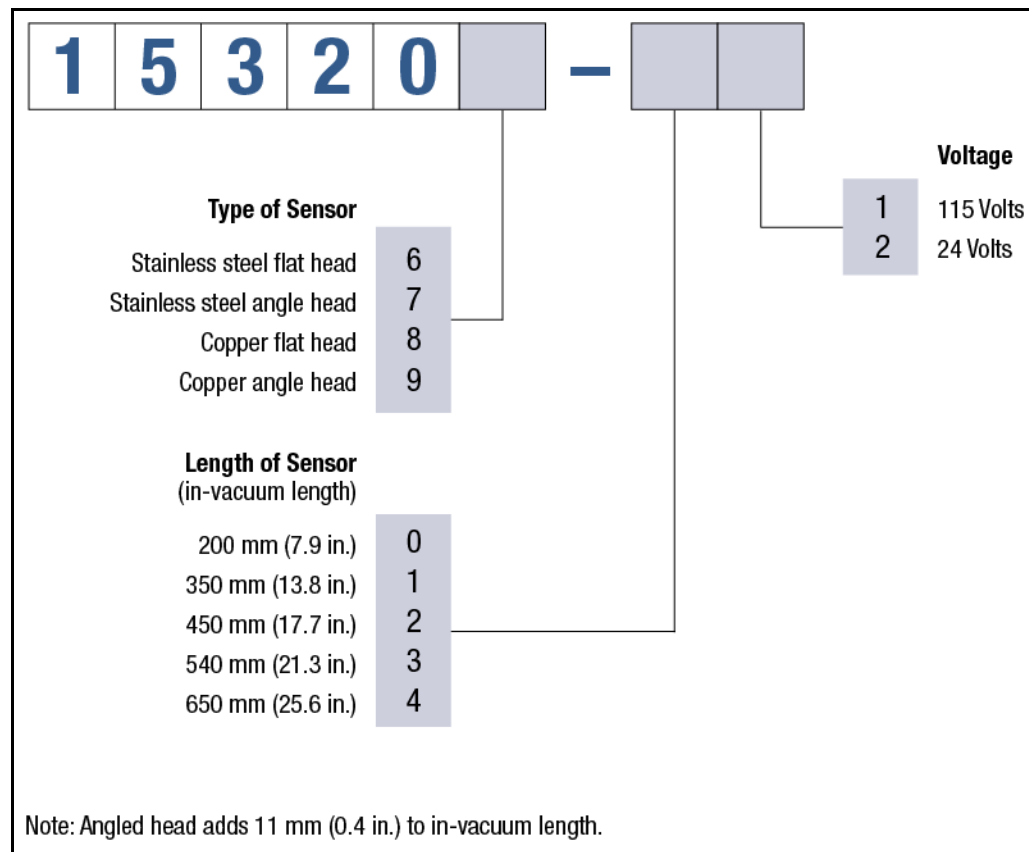
- 1 If the RSH-600 rotary sensor has not been removed from its shipping container, do so now.
- 2 Carefully examine the RSH-600 sensor for damage that may have occurred during shipping. This is especially important if there is obvious rough handling on the outside of the container. *Immediately report any damage to the carrier and to INFICON.*
- 3 Do not discard the packing materials until you have taken inventory and have at least performed a functional verification (see [section 2.2.](#))
- 4 Take an inventory of your order by referring to your order invoice and verifying that the items listed in [section 1.4.1](#) were received.

### 1.4.1 Base Configuration

RSH-600 Rotary Sensor Head . . . . . 15320X-XX

Consult [Figure 1-2](#) below for possible configurations.

Figure 1-2 RSH-600 configurations



Crystals (2 boxes, 10 total). . . . . 103200-2

Technical Manual . . . . . 153800 on 074-5000-G1 CD



## 1.5 Specifications

Number of Crystals . . . . .	6
Crystal Size . . . . .	14 mm (0.550 in.) diameter
Installation Aperture . . . . .	5.08 cm (2.0 in.) diameter
Overall Length	
RSH-600 w/flat head . . . . .	208 mm (8.19 in.) plus in-vac length
RSH-600 w/angled head . . . . .	219 mm (8.62 in.) plus in-vac length
Adjustable in Vacuum Length . . . . .	200 mm (7.9 in.) (standard)
	350 mm (13.8 in.)
	450 mm (17.7 in.)
	540 mm (21.3 in.)
	650 mm (25.6 in.)
Power Requirement . . . . .	115 V (ac) @ 50 mA or 24 V (dc) @ 20 mA
Crystal Switching Method . . . . .	Air Actuated @ 55 PSI (4 kg/cm <sup>2</sup> ) regulated
Cooling Method . . . . .	Water-cooled @ 5 L/m at 2 kg/cm <sup>2</sup> (28 PSI)
Air and Water Connections . . . . .	(3) 1/4 in. quick connects
Operating Temperature . . . . .	300°C max with water cooling and Standard Head Cover
	400°C max with water cooling and Copper Head Cover
Weight (standard length) . . . . .	RSH-600 - Flat - 3.8 kg (8.5 lb.)
	RSH-600 - Angled - 4.5 kg (9.9 lb.)

## 1.6 Replacement Parts and Accessories

Flat Copper Head Cover . . . . .	153731
Angled Copper Head Cover . . . . .	153731-2
Flat Stainless Steel Head Cover (See <a href="#">Figure 1-3</a> ) . . . . .	153708
Angled Stainless Steel Head Cover (See <a href="#">Figure 1-4</a> ) . . . . .	153713
Flat Crystal Retainer Assembly (See <a href="#">Figure 1-3</a> ) . . . . .	153204
Angled Crystal Retainer Assembly (See <a href="#">Figure 1-4</a> ) . . . . .	153204-2
Flat Crystal Holder (See <a href="#">Figure 1-3</a> ) . . . . .	153710
Angled Crystal Holder (See <a href="#">Figure 1-4</a> ) . . . . .	153716
Flat Spring Retainer Assembly (See <a href="#">Figure 1-3</a> ) . . . . .	153706
Angled Spring Retainer Assembly (See <a href="#">Figure 1-4</a> ) . . . . .	153714
Flat Spring Retainer Contact Kit (See <a href="#">Figure 1-3</a> ) . . . . .	153724
Spring Contact (See <a href="#">Figure 1-3</a> and <a href="#">Figure 1-4</a> ) . . . . .	153726
Flat Retainer Screw (See <a href="#">Figure 1-3</a> ) . . . . .	153709
Angled Retainer Screw (See <a href="#">Figure 1-4</a> ) . . . . .	153715
Angled Retainer Spacer (See <a href="#">Figure 1-4</a> ) . . . . .	153717
M3x6 Screw for Flat Crystal Retainer Assembly (See <a href="#">Figure 1-3</a> ) . . . . .	144-101
M3x12 Screw for Angled Crystal Retainer Assembly (See <a href="#">Figure 1-4</a> ) . . . . .	144-224
Solenoid Valve Assembly, 24 V (See <a href="#">Figure 4-1</a> ) . . . . .	153707
Crystal Position Male Connector (See <a href="#">Figure 4-1</a> ) . . . . .	889128
Adjustable Flange (See <a href="#">Figure 4-1</a> and <a href="#">Figure 4-2</a> ) . . . . .	153202
O-ring for Adjustable Flange (see <a href="#">Figure 4-1</a> ) . . . . .	803188

Figure 1-3 Rotary sensor head - flat

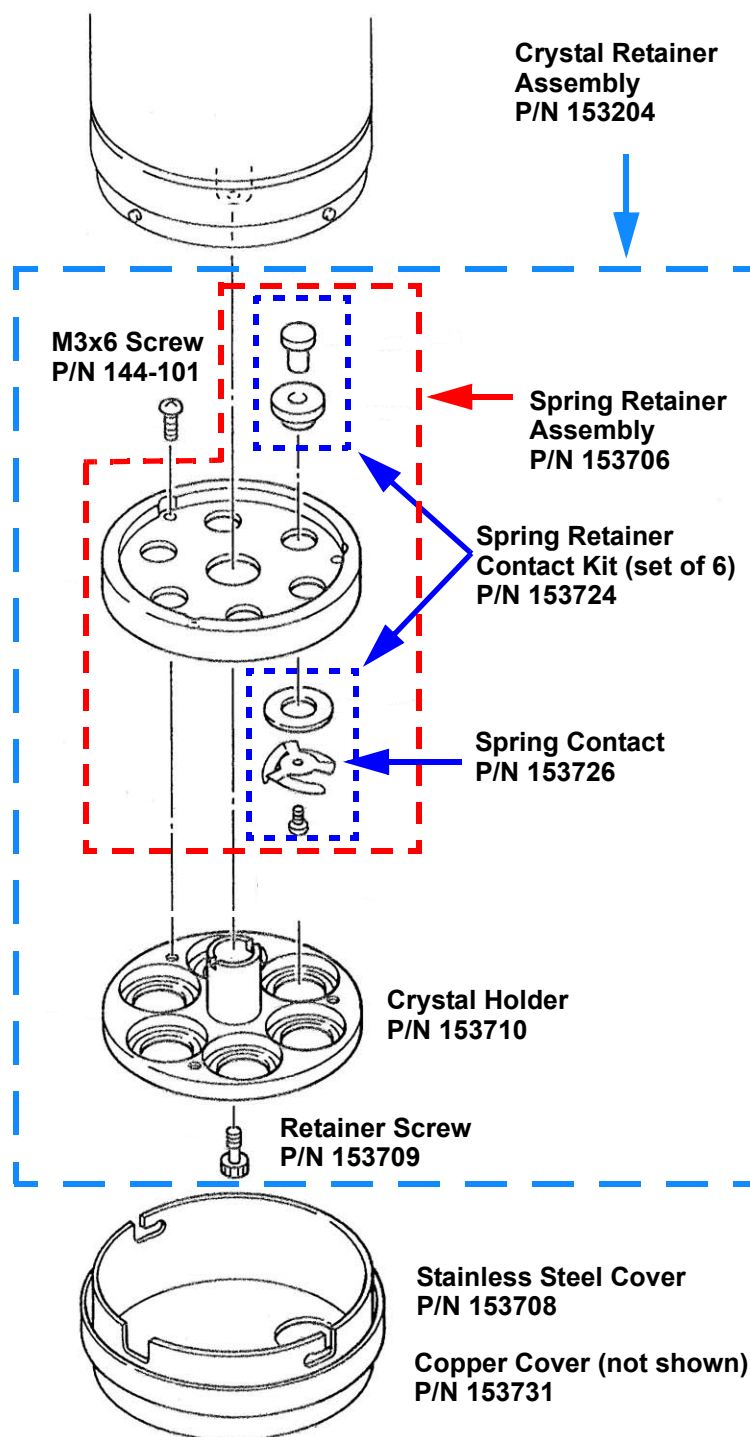
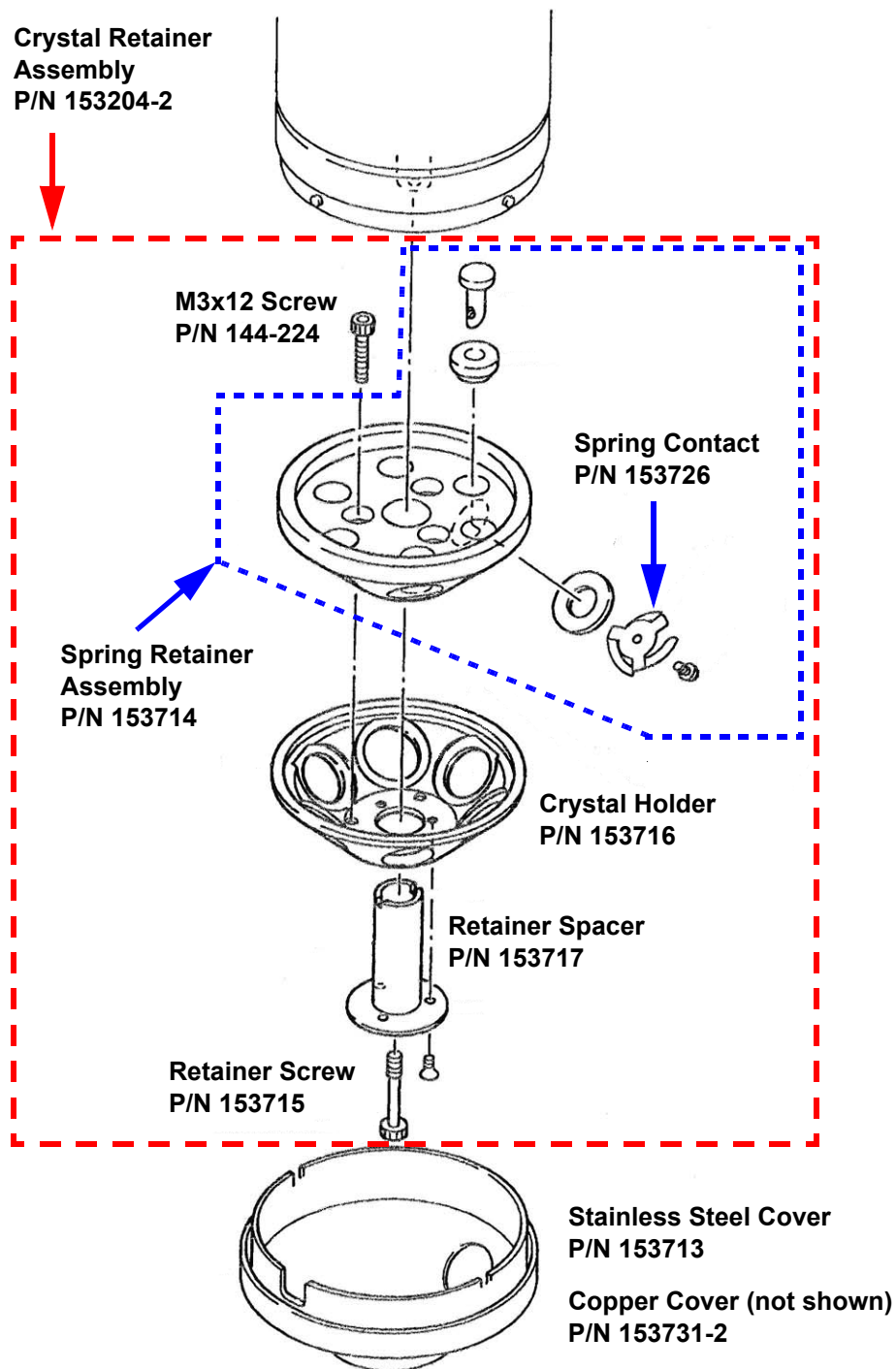


Figure 1-4 Rotary sensor head - angled



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## Chapter 2

### Installation

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#### CAUTION

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**During installation, special care must be taken to protect the barrel surface from being damaged. Scratches or gouges may prevent RSH-600 from forming a good vacuum seal to the O-ring.**

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Successful operation of any crystal sensor depends on proper placement, compatibility of its construction with its operating environment, and connection to proper utilities.



#### CAUTION

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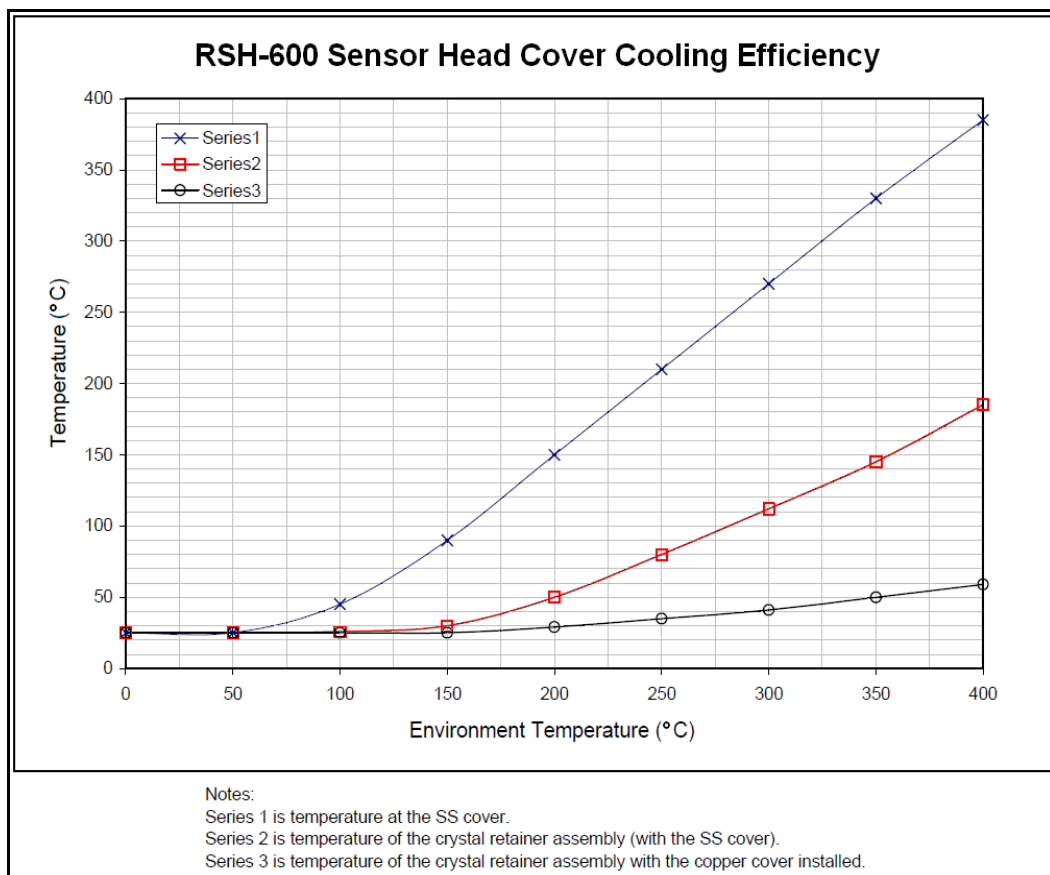
**RSH-600 must be clean and grease free when installed in the vacuum chamber. The sensor must be handled while wearing clean nylon gloves. If parts do become contaminated, clean them thoroughly using a suitable solvent to avoid outgassing and excessive peeling of deposition material from the sensor's surfaces.**

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## 2.1 Configurations

RSH-600 can be configured with a flat head or a 45° angled head. This allows for mounting in various locations within your vacuum chamber. Standard head covers are made of stainless steel. Copper head covers are available for applications where temperature is a concern (see [Figure 2-1](#)). All versions of RSH-600 are fixed to their specified lengths, but may be adapted to be adjustable in length using the optional adjustable mounting flange (see [section 1.6](#) for optional accessory information).

Figure 2-1 RSH-600 sensor head cooling efficiency

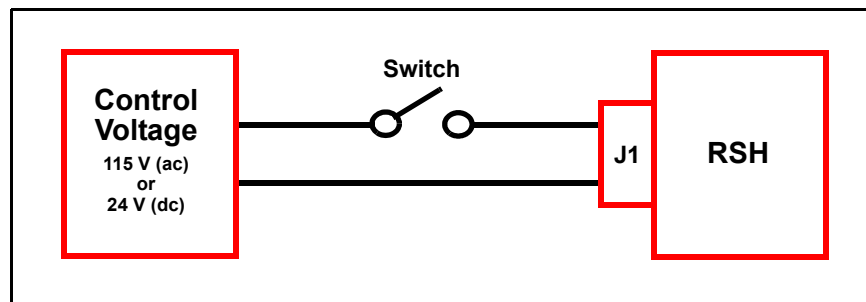


## 2.2 Functional Verification

RSH-600 is equipped to operate on a 115 V (ac), 60 Hz line or a 24 V (dc) supply depending on the model number. You can verify the required voltage on the body of the pneumatic valve mounted on the side of RSH-600. RSH-600 may be bench checked using the following procedure:

- 1 Connect air pressure (55 PSI) via 1/4 in. plastic tubing to the air inlet fitting at the base of the solenoid valve marked P.
- 2 Connect RSH-600 as shown in [Figure 2-2](#) or any convenient method of applying and removing the control voltage. RSH-600 will advance when the voltage is applied and latch into position when it is removed. The electrical pulse duration should be at least one second.

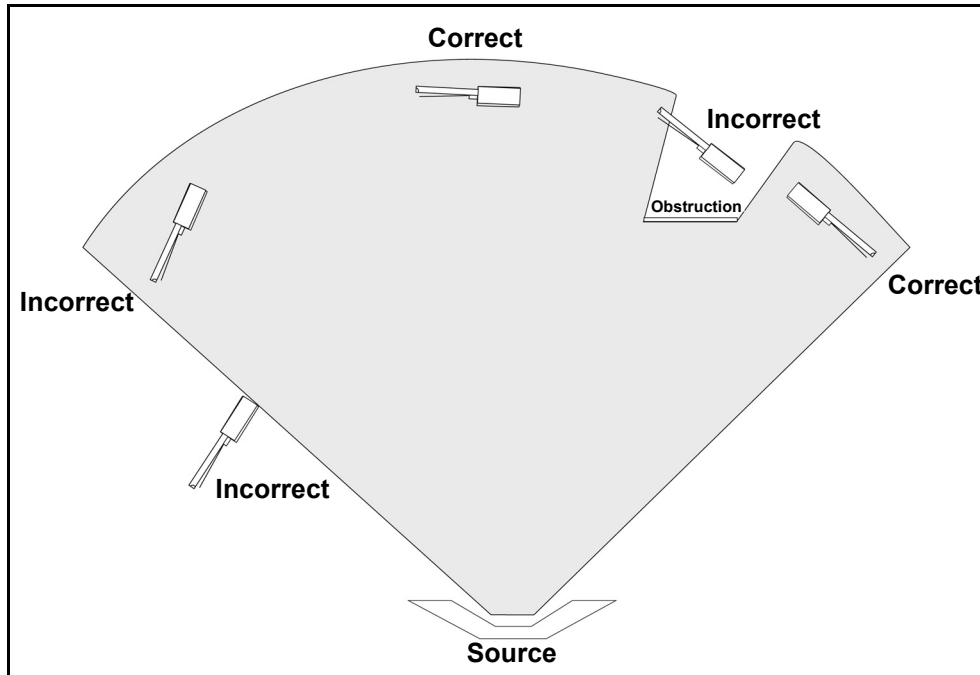
Figure 2-2 Electrical connection



## 2.3 Crystal Sensor Installation

Install the sensor as far as possible from the evaporation source (a minimum of 30.5 cm (12 in.) while still being in a position to accumulate thickness at a rate proportional to accumulation on the substrate. [Figure 2-3](#) shows proper and improper methods of installing sensors.

Figure 2-3 Sensor installation guidelines



To guard against spattering, use a source shutter to shield the sensor during the initial soak periods. If the crystal is hit with even 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.



## 2.4 Mounting

The RSH-600 smooth sealing surface mounts to an O-ring sealed nipple (not included). The optional adjustable flange allows the in-vacuum length to be adjustable up to the RSH-600 original length. A flat head cover is typically used for centered top mount applications while the angled heads may be used for either off-center top mount or side mount applications. The customer must supply specifications regarding mounting holes, exterior diameter of flange, and the system mating flange.

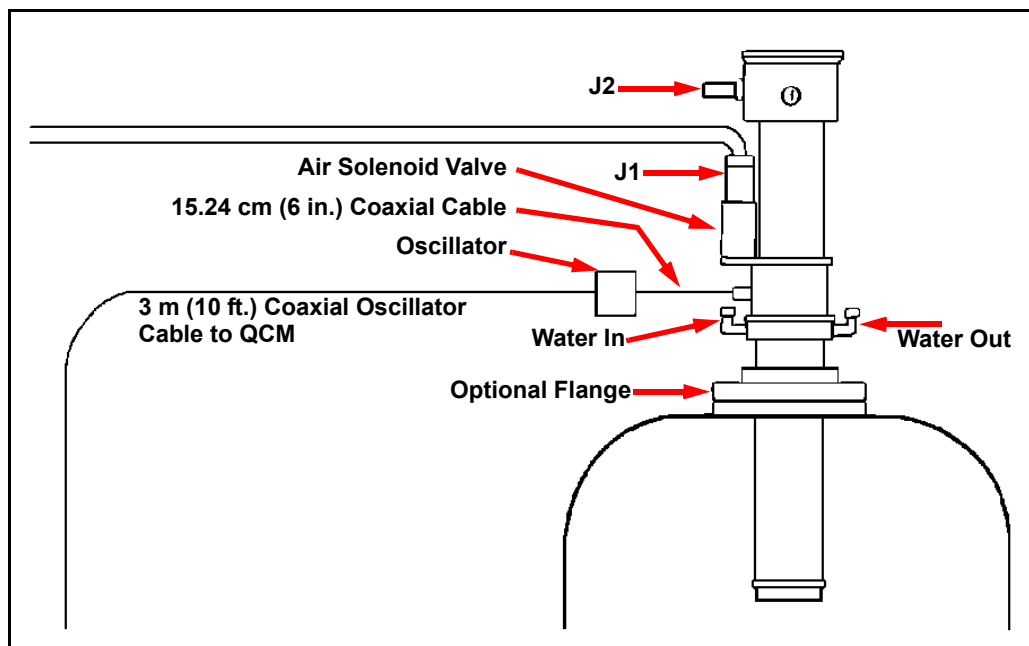
**NOTE:** The head cover must be removed from RSH-600 prior to installation.

To remove the standard stainless steel head cover: Loosen the retainer ring nut. Push the head cover inward while turning it counterclockwise until it stops (1/16 of a turn). Pull the head cover outward.

To remove the optional copper head cover: Loosen the Allen head screws that clamp the head to RSH-600 then gently pull the head off of the RSH-600 barrel.

The vacuum system has to be equipped with a 5.08 cm (2.0 in.) diameter aperture port. This port must have an O-ring to provide vacuum seal to the fixed flange on RSH-600. If the head cover has been removed, simply slide RSH-600 through the 5.08 cm (2.0 in.) port. Secure RSH-600 to the port using four 1/4-24 bolts minimum. Reinstall the head cover. See [Figure 2-4](#).

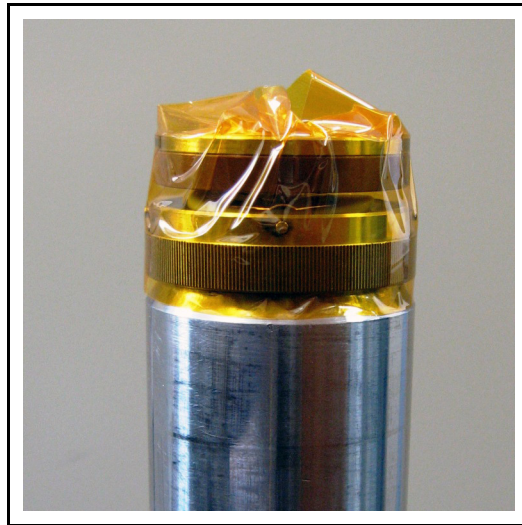
Figure 2-4 Typical mounting configuration



## 2.5 Adjustable Flange Installation

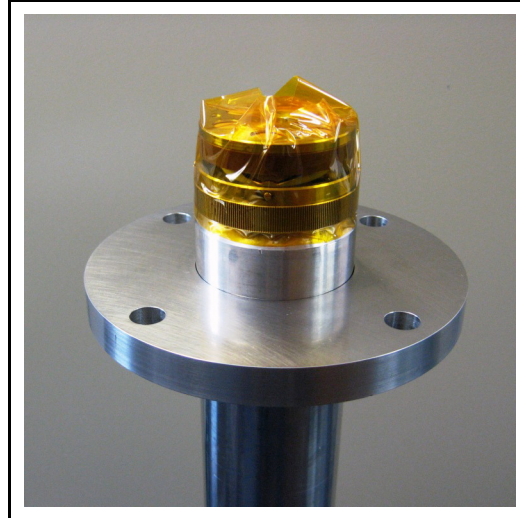
- 1 Apply a small amount of vacuum compatible grease to the entire surface of the O-ring that is included with the Adjustable Flange and then install the O-ring into the O-ring groove in the Adjustable Flange.
- 2 Loosen the Hex Socket Head screw on the Adjustable Flange.
- 3 Remove the cover from the RSH-600 sensor.
- 4 If the Crystal Holder contains any crystals, remove the holder and remove the crystals. Reinstall the Crystal Holder.
- 5 Cut a piece of Kapton<sup>®</sup> tape (or equivalent), 3.8 cm (1.5 in.) to 5.08 cm (2 in.) wide, to a length of approximately 16 cm (6.3 in.).
- 6 Position the Kapton tape with the bottom edge of the tape on the beveled surface just below the knurled ring. Not starting at any of the three bayonet pins, wrap the tape around the circumference of the sensor. Fold the excess tape over the top of the Crystal Holder. See [Figure 2-5](#).

Figure 2-5 Wrap kapton tape



- 7 Stand the RSH-600 sensor upright on a firm surface. Place the Adjustable Flange, with smooth side up, over the top of the sensor barrel. With the flange seating surface perpendicular to the sensor barrel, forcefully push the flange downward, sliding the flange onto the sensor barrel. See [Figure 2-6](#).

*Figure 2-6 Slide flange onto sensor barrel*



- 8 Slide the Adjustable Flange to the desired position on the sensor barrel and then secure the flange to the barrel by tightening the Hex Socket Head screw on the flange.
- 9 Remove the Kapton tape. Use a lint-free cloth dampened with Reagent grade Isopropyl Alcohol to clean the surfaces that were in contact with the tape.

## 2.6 Copper Head Installation

The optional copper head must be installed after RSH-600 has been mounted on the vacuum system. The copper head has two main pieces, the clamping ring and the head cover.

- 1 Loosen the Allen head screw on the clamping ring and on the clamp portion of the head cover.
- 2 Attach the clamping ring to the head cover.
- 3 Remove the crystal retainer to expose two gold springs. One spring makes contact with the backside of the retainer. The other spring makes contact with one of the individual crystal contacts.
- 4 Align the hole in the head cover so that the crystal, that this spring contacts, is exposed. Note the position of this spring and replace the crystal retainer.
- 5 Carefully slide the cover over the barrel of RSH-600 until it touches the crystal retainer, then rotate the cover so that the crystal, in contact with the spring, is centered in the hole in the cover.
- 6 Tighten the Allen screws on the clamping ring.

The clamping ring should be left attached to the head during crystal changing. Only the head cover should be removed so the alignment process will not have to be repeated unless the head is removed from the chamber.

If no flange was ordered and you are making your own adjustable flange, the factory can provide essential dimensions and O-rings.

## 2.7 Cooling System

The direction of the water flow is not important. Use 1/4 inch plastic tubing to connect one port to a water supply. The water flow rate should be 5 L/m (1.3 g/m) at 2 kg/cm<sup>2</sup> (28 PSI). Water temperature should be less than 30°C. Connect the other port to a drain or water recycle system.

## 2.8 Air Supply

Use 1/4 inch plastic tubing to connect the air inlet port to an air supply. Make sure the plastic tube is rated higher than 55 PSI. The air pressure should be regulated to 4 kg/cm<sup>2</sup> (55 PSI).

## 2.9 Crystal Position Feedback Connections

The Crystal Position Connector has seven pins. Pin numbers 1 through 6 correspond to the six crystals and pin number 7 is the common pin. A short between pin 7 and one of the pins 1 through 6 indicates the active crystal. For example, if pin 7 is shorted to pin 1, then crystal 1 is the active crystal.

Use this connector to interface with your controller for automatic crystal selection. Refer to your controller's operating manual for programming instruction.

Figure 2-7 Crystal position connector

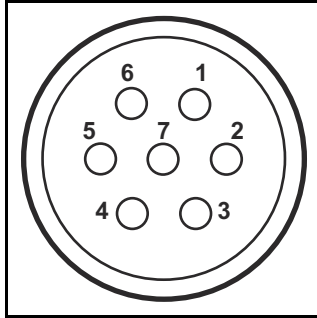
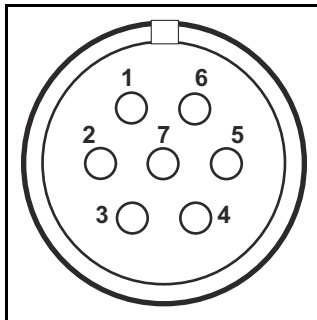
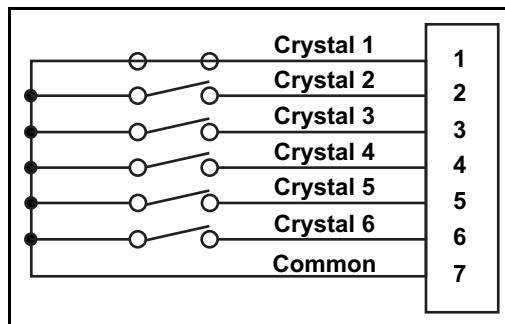


Figure 2-8 Mating connector (male) - crystal position connector



RSH-600 provides a switch closure through connector J2 that can be used to indicate which crystal is being used at a given time. Switch closure will be effected by crystal positions.

Figure 2-9 Crystal position feedback diagram



## **2.10 Protection from Evaporant**

Place aluminum foil over the RSH-600 head cover and barrel to protect them from evaporants.

## Chapter 3

# Troubleshooting and Maintenance

### 3.1 Troubleshooting

If RSH-600 fails to function, or appears to have diminished performance, the following Symptom/Cause/Remedy charts may be helpful.



#### **WARNING**

**There are no user serviceable components within the RSH-600 sensor.**

**Refer all maintenance to qualified INFICON personnel.**

A useful tool for diagnosing sensor head problems is the DMM (Digital Multi-Meter). 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 megohms the source of the leakage should be found and corrected.

### 3.2 Troubleshooting the RSH-600

Table 3-1 General troubleshooting

SYMPTOM	CAUSE	REMEDY
Crystal fail signal on front panel of unit will not disappear.	Damaged crystal.	Replace crystal.
	Loss of electrical signal.	Check for electrical continuity at the BNC connector.
Unit will not advance when crystal switch key is pressed. Xtal switch error message displayed.	Loss of pneumatic supply or pressure is insufficient for proper operation.	Establish air supply and regulate to 55 PSI.
	Operation has been impaired as a result of peeling of the material accumulated on the face of the aperture plate.	Remove accumulated material.
Crystal not centered in aperture.	Improper alignment.	RSH-600 should realign automatically. Be sure the correct air pressure (55 PSI) is used. Contact INFICON if the issue persists.

Table 3-1 General troubleshooting (continued)

SYMPTOM	CAUSE	REMEDY
Large jumps of thickness reading during deposition.	Mode hopping.	Mode hopping is a by product of active oscillation with a heavily damped crystal. Temperature stabilization is key in diminishing this. Replace the crystal.
	Crystal near the end of its life.	Replace crystal.
	Scratches or foreign particles on the crystal holder seating surface.	Clean, polish the crystal seating surface of the crystal holder.
	Insufficient crystal cooling.	Check water flow and temperature.
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.	Move the sensor further away from the evaporant.
	Damaged crystal.	Replace crystal.
	Deposition material built-up on the edge of the crystal carousel aperture plate and touching the crystal, partially masking full crystal area.	Clean the crystal carousel aperture plate.
Crystal does not oscillate or oscillates intermittently (both in vacuum and in air.)	Defective or damaged crystal.	Replace crystal.
	Existence of electrical short or poor electrical contacts.	Check for electrical continuity and short in sensor cable, electrical connection assembly, feedthroughs, and crystals carousel.
	Insufficient crystal cooling.	Check water flow and temperature.
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 crystal.
	Excessive moisture accumulates on the crystal.	Turn off cooling water to sensor prior to venting, flow warm water through sensor while chamber is open.



Table 3-1 General troubleshooting (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.)	Inadequate cooling water/cooling water temperature too high.	Check cooling water flow rate, be certain that cooling water temperature is less than 30°C.
	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.
	Crystal not seated properly in holder.	Clean or polish the crystal seating surface on the crystal holder.
Poor thickness reproducibility.	Variable source flux distribution.	Move sensor to a more central location to reliably sample evaporant, ensure constant relative pool height of melt, avoid tunneling into the melt.
	Sweep, dither, or position where the electron beam strikes the melt has been changed since the last deposition.	Maintain consistent source distribution by maintaining consistent sweep frequencies, sweep amplitude and electron beam position settings.
	Material does not adhere to the crystal.	Make certain the crystal surface is clean; avoid touching crystal with fingers, make use of an intermediate adhesion layer.

### 3.3 *Maintain the Temperature of the Crystal*

Periodically, measure the water flow rate through the crystal sensor to verify that it meets or exceeds the value specified in [section 2.7 on page 2-8](#). 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 supply taps that provide high total flows. 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 best test is to directly 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 evaporant source and from substrate heaters.

### 3.4 *Use the Optimum Crystal Type*

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 crystals with alloy coated electrodes. Gold is preferred for other applications.

### 3.5 *Crystal Concerns when Opening the Chamber*

Thick deposits of some materials, such as SiO<sub>2</sub>, 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 material is observed, replace the crystal.

### 3.6 *Crystal Holder Maintenance*

In many applications, the surface where the crystal contacts the crystal holder may require periodic cleaning. Material buildup on this surface can cause erratic or poor electrical contact between the crystal and the sensor body. This buildup can also cause a reduction in thermal transfer from the crystal to the sensor body. Both of these can result in excessive rate noise or premature or intermittent crystal failure.

Cleaning may be accomplished by gently buffing the crystal holder to crystal seating surface with a white Scotch-Brite® pad followed by an ultrasonic bath in soap solution followed by thorough rinsing in deionized water and drying or by ultrasonic cleaning and 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. Applying excessive force during cleaning or using overly abrasive cleaning materials may damage this finish and reduce sensor performance.

### 3.7 Crystal Replacement

Always use clean nylon lab gloves and clean plastic tweezers when handling the crystal. Handle the crystals only by their edges. Anything that comes in contact with the crystal surfaces may leave contamination, which may 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.**

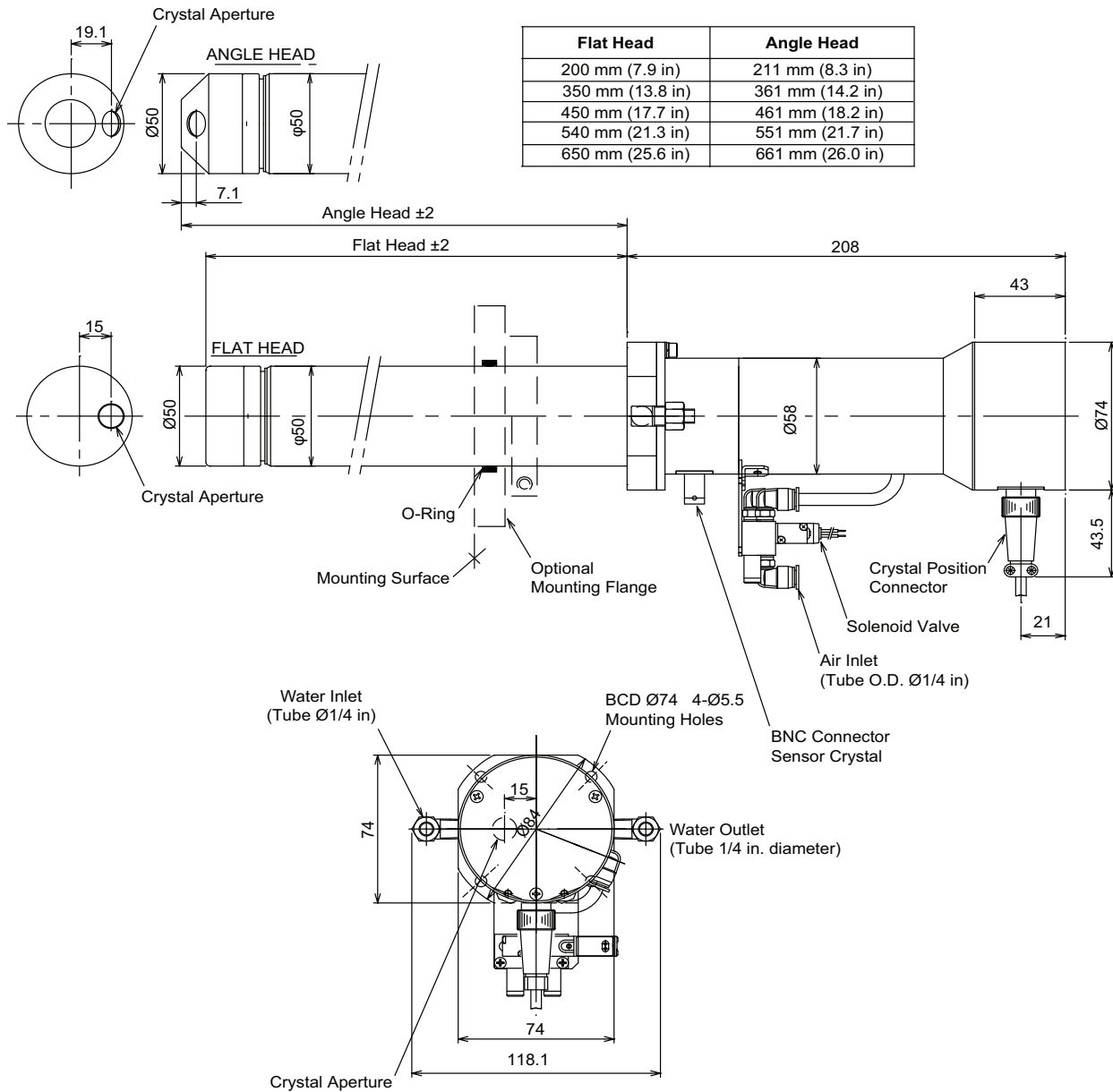
- 1 Remove aluminum foil (if installed).
- 2 Remove the stainless steel head cover.
  - 2a Loosen the retainer ring nut.
  - 2b Push the head cover inward while turning it counterclockwise until it stops (1/16 of a turn.)
  - 2c Pull the head cover outward and remove head cover from the head barrel.
- 3 Remove the copper head cover.
  - 3a Loosen the three Allen head screws that attach the head cover to the copper clamping ring. (Leave clamping ring attached.)
  - 3b Carefully slide the head off of the barrel of the RSH-600 sensor.
- 4 Loosen center screw of the head to release crystal retainer.
- 5 Remove the remaining three screws (on the backside of the retainer) to separate the head from the spring retainer.
- 6 Remove the used crystals and replace new ones into the crystal holder. Make sure to place the crystal so that the solid electrode is facing out of the head.
- 7 Put the spring retainer and crystal housing back together and tighten the three screws being careful not to deform the crystal springs or break the crystals.
- 8 Place the complete crystal retainer assembly back on the head barrel, observe and line it up with the indexed pin. Tighten the screw.
- 9 Replace the head cover.

**NOTE:** Crystal replacement time can be reduced by using a spare crystal holder.

## Chapter 4

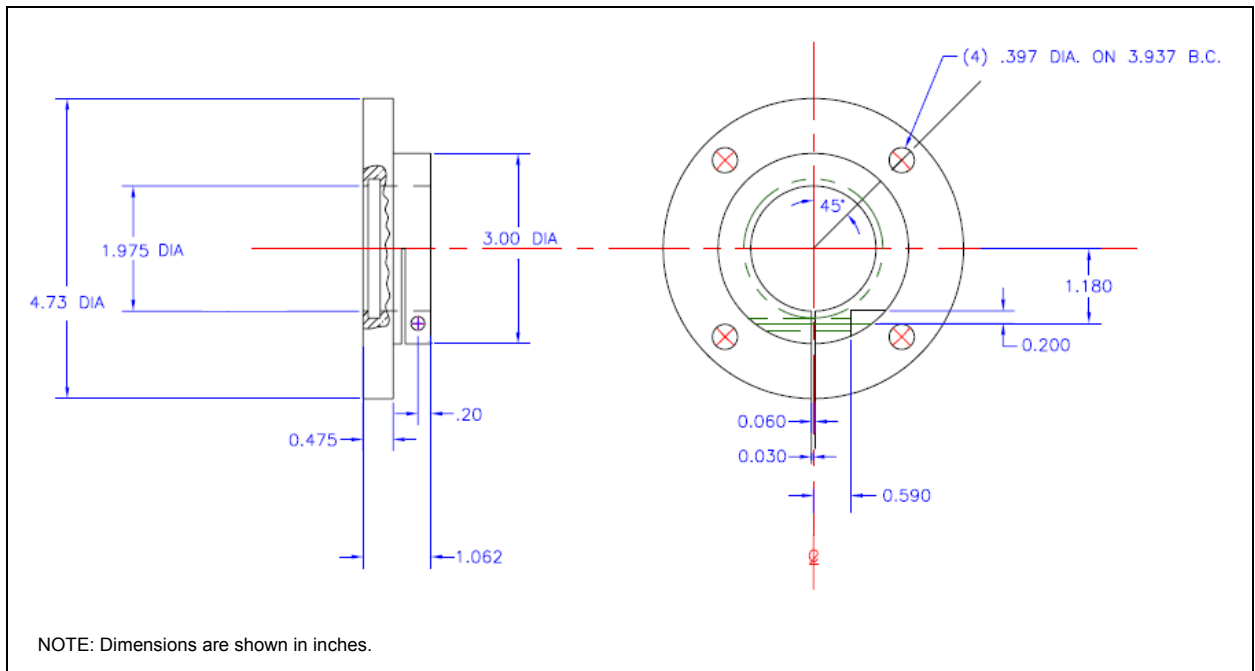
### Outline Drawings

Figure 4-1 Sensor head



NOTE: Dimensions are shown in mm except when noted otherwise.

Figure 4-2 Adjustable flange (dimensions in inches)





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