

In order to use a quartz crystal in the coating chamber, a device had to be developed that could be electrically activated to vibrate the crystals in vacuum, allow only a portion of the crystal to be coated with evaporated material, and permit the crystal to be changed easily. Furthermore, the device would have to shield the crystal from the high temperatures inherent in the coating process. Thus, the "sensor head" was created.

In currently available sensor head designs, the crystal rests in the "crystal holder", a metal cap with a hole drilled through the center of the cap. The holder serves as one half of the electrical circuit that causes the crystal to vibrate. This hole allows the evaporating film to coat a circular region of approximately 0.3" diameter (7.6 mm) on the crystal face. The crystal is held in place in the holder by a spring. In some models, the spring is located around the inside of the holder and presses against the crystal edge. In other designs, a "ceramic retainer" with a gold-coated spring in the center presses against the outer back edge of the crystal.

In both designs, the crystal holder is inserted into the sensor head (a small metal block), where a second gold coated spring presses against the back of the crystal or retainer to complete the crystal electrical circuit. The head often contains another spring for holding the crystal holder in place and providing electrical contact between the holder and the head.

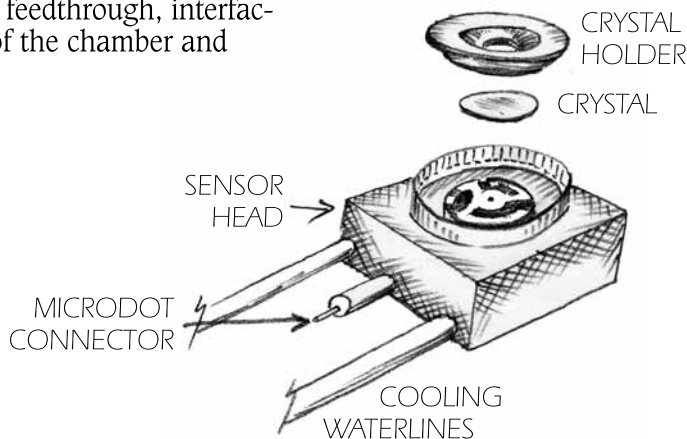
On the outside of the sensor head is a screw-on miniature connector, a "Microdot Connector". At this point, a thin microcoaxial (two wires in one body) cable connects the sensor head to the feedthrough, interfacing the inside of the chamber and

atmosphere. The feedthrough then connects in atmosphere to the oscillator and on to the thin film monitor.

The sensor head also has two small metal tubes, "water lines", extending from one end to provide water-cooling to the crystal. The water lines feed either an internal passageway drilled through the sensor head or simply connect to a tubing bend that rests in the back of the head. Both water lines connect to the feedthrough.

When new, a sensor head allows easy insertion of the crystal, snug mounting of the crystal holder, uninterrupted electrical connection to the feedthrough, and unimpeded water cooling. After repeated use, however, this system can break down and lead to erratic or failed crystal readings. Several of the most common modes of failure are:

- 1) The contact springs in the crystal holder or sensor head break or bend sufficiently, interrupting the electrical circuit;
- 2) The wires inside the sensor head connecting to the microcoaxial cable fitting break, interrupting the electrical circuit;
- 3) The microcoaxial cable connecting the sensor head to the feedthrough cracks or loosens, interrupting the electrical circuit; or
- 4) The water lines clog due to high mineral content of the water, causing the sensor head to overheat.



Crystal Sensor Head Design and Failure Modes

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