

# 1. General Information

## Description

The model ST98 is a thermal mass flowmeter for air or gas measuring applications. The ST98 consists of a flow element, a flow transmitter, and an enclosure. An in-line flow element is used for smaller diameter pipe or tubing sizes and, for pipe sizes greater than 2-1/2 inches (40 mm bore), an insertion flow element is used. The flow element's process connections can be threaded or flanged.

The ST98 flow transmitter accepts AC or DC input power and the output signal can be set for either a standard range current or voltage. A display is optional. An RS-232C serial I/O port provides setup, monitoring and troubleshooting access using either *FCT*'s model FC88 Programmer or a PC-compatible computer.

The ST98 enclosures provide environmental protection for the flow transmitter. The flow transmitter can be integrally mounted with the flow element or remotely separated from it. Hazardous location local and remote enclosures are optional.

## Theory of Operation

The flow element of the model ST98 uses the thermal dispersion operating principle: A low-powered heater produces a temperature differential between two resistance temperature detectors (RTDs) by heating one of the RTDs. Mass flow rate changes cool the heated RTD and cause a proportional change in the temperature differential between the RTDs. The instrument's flow transmitter converts the RTD temperature differential into a scaled output signal and an optional indicated display value.

The signal from the unheated RTD is used to provide an indication of the air or gas temperature on the optional display.

## Insertion Sensing Element

The sensing element consists of two thermowells (hollow tubes) that when inserted into the flow process allows an unimpeded flow inside the process line. A heated RTD is inserted into the top thermowell. A reference RTD (with no heater) is inserted into the bottom thermowell. In order to correctly orient the sensing element a flow arrow has been etched onto a machined flat portion of the sensing element. See Figure 1-1 for a view of the sensing element.

The element is inserted into the process media through a hole drilled into the process line.

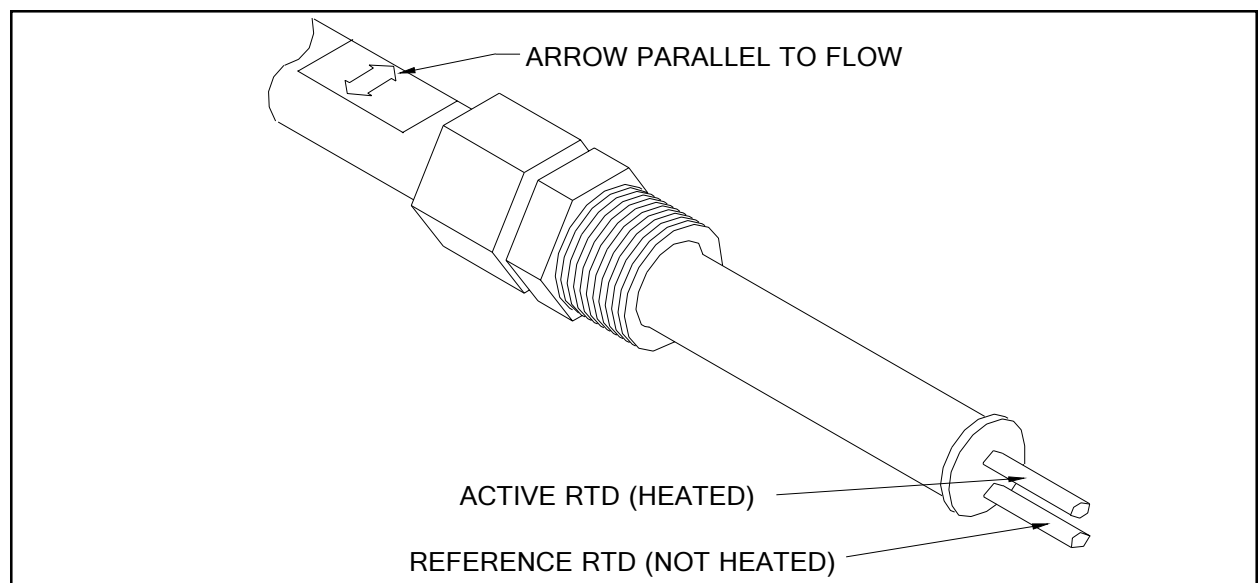


Figure 1-1 View of the Sensing Element

## In-Line Sensing Element (Flow Tee)

The in-line sensing element is made in the same way as the insertion type of flow element is. To correctly orient the in-line sensing element, a flow arrow has been etched onto one side of the sensing element.

The in-line flow element is inserted in the process line with the flow arrow pointing in the same direction of flow. See Figure 1-2 for a cutaway view of the in-line element.

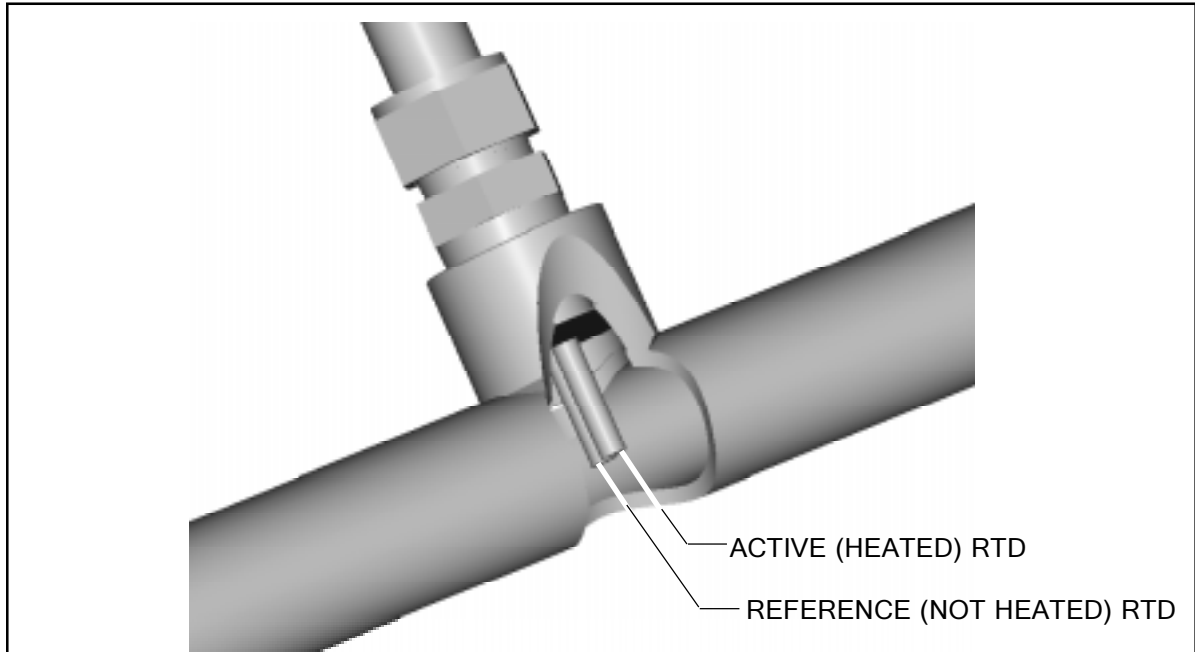


Figure 1-2. Cut-Away View Of The In-Line Flow Element Tube

## Transmitter Electronics

The transmitter electronics convert the sensing element's RTD temperature differential into a flow signal that is read on a display. The transmitter also produces an analog output flow signal suitable to interface with process controls. The output is a representation of the amount of flow or temperature present in the process. The flow output is transmitted on a source milliamp output and / or voltage output. Both the flow output and process temperature can be displayed on an optional LCD display.

There are 2 kinds of enclosures available for the electronics:

1. Standard:  
Polyester Coated Carbon Steel Rated NEMA/CSA Type 4X (equivalent to IP66) and Division 2 (Ex n), Rating is pending. (This is a 6 X 6 X 4 Inch Square Enclosure.) (152.4 X 152.4 X 101.6 mm)
2. Optional:  
Aluminum rated for Hazardous Location use Class I and II, Division 1 and 2, Group B, C, D, E, F, G (previously referred to as NEMA 7 and EEx d IIC) resists the effects of weather and corrosion. (This is a 4.8 X 9.31 Inch Cylindrical Enclosure.) (121.8 X 236.47 mm)

## Instrument Configuration

The instrument can be in integral arrangement (the electronics and the sensing element are combined in one enclosure), or the instrument can be in a remote arrangement (the electronics and sensing element are in separate enclosures).

In the case of a remote enclosure, the standard configuration of the sensing element (local) enclosure is an aluminum rated for Hazardous Location use Class I and II, Division 1 and 2, Group B, C, D, E, F, G (previously referred to as NEMA7) and EEx d IIC and resists the effect of weather and corrosion. The dimensions are 4.68 X 4.82 inches (119 X 122 mm) and is cylindrical in nature.

## Technical Specifications

- **Process Connection**
  - Insertion Configuration:  
Soft Seal or Metal Ferrule (Can be Stainless Steel or Hastelloy C):  
3/4 inch male NPT or Flanged
  - Inline Configuration:  
1.0 inch tubing, 1.0, 1.5 or 2.0 inch SCH 40 pipe,  
Female NPT, Male NPT, Butt Weld or Flanged.
- **Insertion U-Length**
  - Beginning as low as 1.0 inch (25.4 mm) to 21 inches (533 mm).
- **Sensing Element Material**
  - All wetted surfaces are 316 Stainless Steel, with all-welded construction. Hastelloy C-276 is optionally available.
- **Operating Temperature**
  - Control circuit:  
Ambient temperature configuration:  
0 to 140°F (-18 to 60°C).
  - Sensing element:  
Standard temperature configuration:  
-40 to 350°F (-40 to 177°C).
- **Operating Pressure**
  - 0 to 250 psig [0 to 17 bar(g)]. (Derated with Teflon ferrule.)
- **Flow Range**
  - Insertion:  
0.75 to 600 SFPS (0.006 to 0.23 NMPS)
  - Inline:  
0.0062 to 1850 SCFM (0.01 to 3140 Nm<sup>3</sup>/h)
- **Signal Output**
  - 4-20 mA, 700 ohms maximum load  
0-5, 1-5 and 0-10 Volts DC 100K ohms minimum load
- **Accuracy**
  - Flow accuracy:  
±1 % reading + 0.5% full scale
  - Temperature accuracy:  
±2°F (display only, flow rate must be greater than 1 SFPS).
- **Repeatability**
  - ±0.5% of reading.
- **Input Power**
  - A.C. Input: 100-240 VAC 50/60 Hz. 17 Watts  
Maximum 120 mA Maximum.
  - D.C. Input: 22-30 VDC 250 mA Maximum 7.5 Watts  
Maximum.
- **Pending Approvals**
  - FM, CSA, CENELEC, CE Marking  
(EMC Directive 89/336/EEC)

# Quick Start Menu (Abbreviated)

The following menu shows how to use the most frequently accessed functions of the instrument. For a complete menu and explanation see Chapter 3 - Operation.

Table 1-1. Quick Start Menu (Abbreviated Menu, See Chapter 3 For Full Details)

