

## 18890 Series Thin-Film Rayotube Temperature Detectors and Assemblies

23-75-03-04

1/97

Page 1 of 4

## Specification

### Overview

For continuous temperature measurement in many industrial applications-and quite frequently, in applications where other methods prove impractical- the Honeywell Rayotube temperature detector provides a sensitive, stable and high responsive sensing element.

Since this detector responds to radiated heat energy, it can measure the temperature of either stationary or moving surfaces...or, sighting into a closed-end "target tube," it can measure the temperature of a furnace atmosphere or other medium. And the element housing is sealed - hermetically sealed, at viewing lens, window and thermopile leadwires... wherever vapor, fumes or dust might enter to contaminate the thermopile and cause calibration drift.

Rayotube temperature detectors can be used with a variety of Honeywell instruments for measurement and control. Although the detectors are available in a number of models and assemblies for both general and special requirements - varying in such characteristics as speed of response and size of the target area required - the 18890 Series described herein meet the needs of most applications.

### Features

- Non-contact continuous temperature measurement of hot surfaces, from 200 F to 5000 F
- Direct-sighting for surface measurements of stationary or moving targets; or

- Sighting into closed-end target tube for measurement of furnace atmosphere or other media
- Excellent reproducibility of measurement-ideal for control applications
- Thin-film thermopile for fast response; time constant of 0.015 second
- Small target-area requirement-permits using small diameter sighting or target tube
- Rugged construction for severe industrial environments
- Usable at 32 to 212 F ambient without forced cooling
- Standard mountings permit optional forced air or water cooling at high ambients, air purging of tubes
- Easy to install, easy to service; only occasional cleaning required
- Low initial cost
- Ordering of complete assemblies simplified by Model Selection Guide

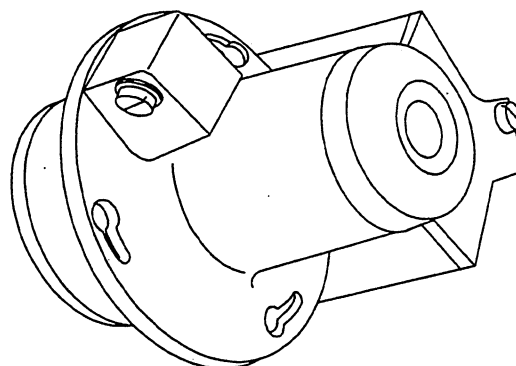
### Description

Utilizing a single-mirror optical system, the 18890 Series Rayotube detector focuses heat, radiated from the source whose temperature is being measured,

upon a blackened disk. Attached to the disk are the measuring junctions of a thin-film thermopile. Temperature of the disk rises until the rate of heat loss from the disk equals the rate of energy absorption from the source. Since the reference junctions of the thermopile are at the temperature of the housing, the junctions produce a millivoltage output which, at the measuring instrument, is indicated in terms of the temperature of the source.

**Calibration** - The temperature calibration curve of the Rayotube is non-linear, and - unless a linearizing device is used - provides greater temperature sensitivity (i.e., more millivoltage output per degree change) at the high end of a selected range than at the low end. This is largely because the radiation intensity is approximately proportional to the fourth power of the absolute temperature of the source. Calibration curves for the 18890 Series, in tabular form for all standard ranges, are included in Direction book 277122.

**Ambient Temperature Compensation** - To maintain reproducibility of measurement, the millivoltage signal from the detector



for a given source temperature must be constant over a wide range of ambient temperatures.

If no compensation were provided, the millivoltage output would decrease slightly with increasing ambient temperature. An integral sensistor is employed to maintain a constant signal output despite varying housing temperature, over a range of 32 to 212 F. (An air- or water-cooled mounting jacket can be provided for the detector where ambient temperatures exceed 212 F.)

Since no external reference-junction compensation is required, no special extension leadwires are necessary to connect the Rayotube detector to the measuring instrument. Suitably insulated copper wires are adequate.

**Emittance Compensation** - Each Rayotube has engraved on its nameplate the value of EMF which it produces when sighted on a source under blackbody conditions at the highest temperature of its range, as compared to an N.I.S.T.-calibrated standard.

In practice, these "ideal" conditions are usually attained only when the Rayotube detector sights into a closed-end target tube. In nearly all direct sighting applications, the emittance of the target is less than 1 - varying with the material and surface condition of the target - and the millivoltage value is proportionately less.

**Speed of Response** - Rayotube response is expressed as the time constant: the time required for a Rayotube to attain 63.2% of the difference between initial and final millivoltage output, when suddenly exposed to a source of higher temperature.

For the 18890-Series, the time constant is only 0.015 second, making it highly responsive to temperature change, and well-suited to direct-sighting applications where source temperature varies rapidly, or

where temperature variations along a moving body - e.g., steel sheet or strip - must be measured.

**Target Area** - Size of target required for optimum Rayotube performance varies directly as the distance between the detector and the target. For the 18890-Series Rayotube detectors:

$$t = 0.018(D + 2.5")$$

where  $T$  is the minimum target diameter required and  $D$  is the distance from the detector window to the target in inches. The small target-diameter requirement of the 18890-Series permits the use of small diameter sighting or target tubes, with a saving in cost.

The narrow-angle sighting "cone" (only 0.26" in diameter at 12" from the window) also facilitates the use of the 18890 Series in specialized applications.

**Focus** - All 18890 Series Rayotube detectors are prefocused to one of six focal lengths, as specified in the Model Selection Guide. When ordering a direct-sighting assembly, focus is determined by the distance "D", from the Rayotube window to the target. When ordering a target-tube assembly, focus is determined by the tube length plus a length "M" (see Figure 2) which varies with the mounting assembly.

Values of "M" are:

For Suffix CD = 310 or 320: 2.25"  
For Suffix CD = 311, 312, 321, 322 or 220 : 4.0"  
For Suffix CD = 331 or 332 : 6.2"

**Temperature Range** - When a Rayotube detector is used with an instrument with a non-linear scale and chart, a range should be selected (see "Range Table") so that the temperatures normally measured or controlled fall in the upper one-third of the span (which covers approximately one-half of the scale and chart) for best resolution.

## Assemblies

For most applications, the complete Rayotube assembly comprises a Rayotube detector, a mounting assembly, mounting safety features (if required) and a sighting or target tube.

**Mounting Assembly** - The Mounting Assembly joins the Rayotube detector to the sighting or target tube and consists of a Cooling Jacket, one or two mounting flanges, and other accessory items as specified.

**Air/Water Cooling Jacket:** for use at the ambient temperatures for 32 to 212 F (0 to 100 C). This unit has an inlet and outlet for forced air or circulating water to cool it where ambients are above 212 F. Three quick release latches lock the Rayotube detector to the Jacket; the detector can be removed for window-cleaning, service or replacement without disturbing the Mounting.

**Air/Water Cooling Jacket with Air Purge (Nozzle):** Includes a nozzle for connection of purging air to clear a sighting tube where smoke, fumes, dust, etc. are extremely

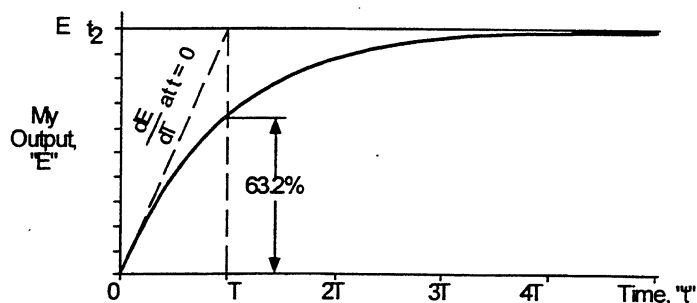


Figure 1

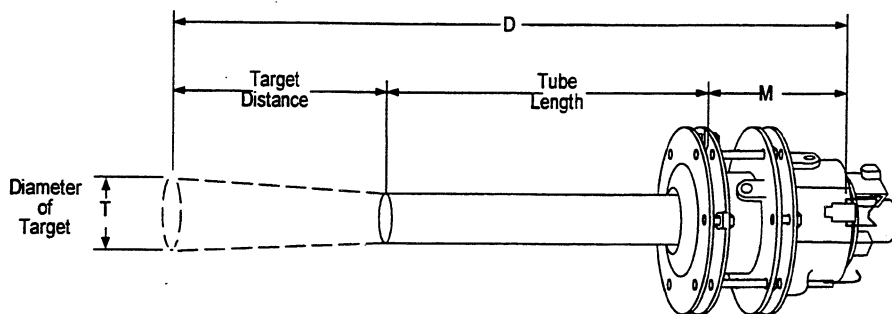


Figure 2

heavy; is occasionally used to prevent seepage of fumes into a target tube. Assembly permits combining water-cooling of the Jacket with air purging of the tube, or air-cooling of the Jacket with outlet air from the Jacket connected to the nozzle for purging. Quick release latches are provided.

**Air Cooling Jacket with Integral Air Purge:** Used to purge a sighting tube where conditions are not severe. Jacket has holes drilled in

base and cooling-air outlet plugged so cooling air exhausts down tube. Quick-release latches are provided

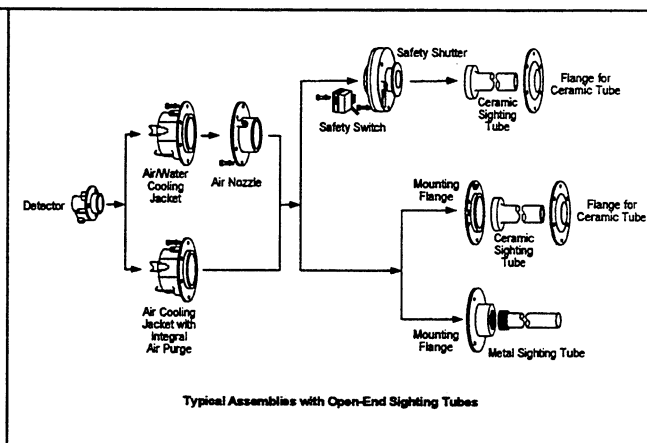
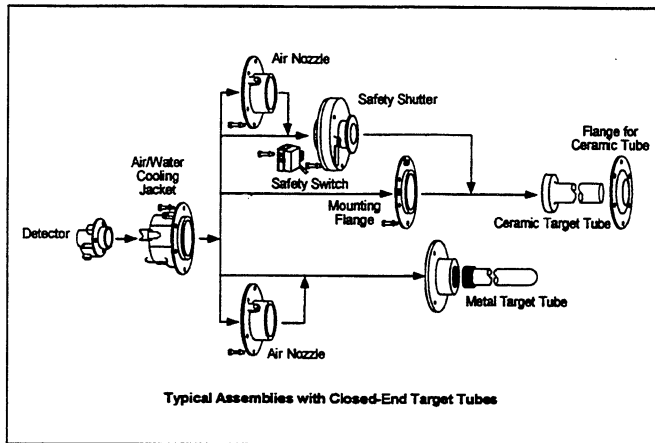
**Mounting Safety Features:** Where hot gas or flame might reach the window and damage the detector, either through an open-end sighting tube or a broken ceramic target tube, a Safety Shutter - actuated by a bimetallic trip at 212 F (100 C) - can provide temporary protection.

Since the action of the Safety Shutter cuts off the detector signal output, a Safety Switch, tripped by

the Shutter, must be specified in control applications to open the control circuit.

**Tubes:** Available standard tubes are described in a table in this sheet. Temperature limits and operating conditions will dictate a choice of material. An open-end tube should be long enough to provide a clear sighting path (with air purging, if required); a closed-end tube should extend far enough into the furnace atmosphere (or other medium) to provide a representative temperature source).

Material	Construction	Recommended Maximum Temperature	Description
Inconel	Open- or closed-end	2100 F	80% nickel, 15% chromium alloy. High mechanical strength, rugged; should be used in place of ceramic tube (conditions permitting) where work in furnace is withdrawn frequently or may strike tube. Should not be used in sulfur atmospheres or where producer gas is used as fuel.
Fyrestan	Open- or closed-end	2800 F. When mounted horizontally, 2500 and 2300 F, respectively, for unsupported lengths of 12 and 18 inches.	Refractory of mullite and glass, with high impermeability.
Hi-Purity Alumina	Open- or closed-end	3400 F, mounted vertically; mounted horizontally, must be supported at temperatures above 3000 F (even in 12" lengths)	High-temperature refractory, but with low thermal-shock resistance.



## Specifications

<b>Type</b>	Radiation-type temperature detector, comprising single-mirror optical system with image-viewing lens
<b>Element</b>	Thin-film thermopile
<b>Resistance</b>	Approximately 1500 ohms
<b>Time Constant</b>	0.015 second, for 63.2% of an instantaneous temperature change
<b>Range</b>	200 to 5000 F. For standard temperature spans, see Range Table
<b>Optional Output Adjustment</b>	To permit matching millivolt outputs of two or more detectors in dire-sighting applications when used with multipoint recorders, the external millivolt adjustment screw can be left unsealed.
<b>Housing</b>	Brass-alloy forging, nickel-plated and hermetically sealed, with three slotted holes for mounting
<b>Electrical Connections</b>	Two screw terminals on terminal block, accessible beneath cover, copper leadwire connections to measuring instrument.
<b>Dimensions</b>	3 1/2" OD by 3 27/32" long (89 x 98 mm)
<b>Operating Limits</b>	
<b>Ambient Temperature</b>	32 to 212 F (0 to 100 C), without forced-air or water cooling
<b>Pressure</b>	40 psig (275 kPa)
<b>Vibration</b>	1 g to 10 to 200 Hz
<b>Relative Humidity</b>	to 90% R.H. at 104 F (40 C)
<b>Performance Characteristics</b>	
<b>Spectral Response</b>	On ranges 0163 (200 - 1000 F) and 1019 (650-1400 F): 0.3 to 10.5 microns. On all other ranges: 0.3 to 4.5 microns.
<b>Output at High End of Range</b>	24 mV, for ranges to 2300 F (1260 C) or higher. For lower ranges, high-end output varies with range (see Range Table).
<b>Stability</b>	Within 1% of reading over 6000 hours at 130 F (55 C) ambient temperature.
<b>Calibration</b>	Each unit is calibrated at blackbody conditions; the tolerance and conformity to the temperature curve is 1% of reading over the entire range.
<b>Temperature Coefficient</b>	Output in a given temperature will not change by more than 1% for a 100 F (38 C) ambient temperature change.

Distributor :

### Industrial Automation and Control

#### Honeywell Inc.

*In the U.S.A.:* Honeywell Industrial Automation and Control, 16404 North Black Canyon HWY., Phoenix, AZ 85023, (800) 343-0228

*In Europe:* Honeywell S.A., 80084 Amiens Cedex 2, (33) 22.54.56.56

Honeywell Control System Ltd., Honeywell House, Bracknell, UK-RG 12 1 EB, (44) 1344 826000

*In Japan:* Yamatake-Honeywell Co. Ltd., Nagai Int'l Bldg., 2 - 12 - 19 Shibuya-Ku, Tokyo 150 Japan, 81-3-3486-2051

*In Asia:* Honeywell Asia Pacific Inc., Room 3213-3225, Sun Hung kai Centre, No. 30 Harbor Road, Wanchai, Hong Kong, (852) 829-8298

*In the Mediterranean:* Africa and Middle East Region, Honeywell SpA, Via Vittor Pisani 13, 20124 Milano, Italy (39-2) 67731

*Honeywell Pacific Division:* Honeywell Pty Ltd., 5 Thomas Holt Drive, North Ryde Sydney, NSW Australia 2113, (61-2) 353 7000

*In Canada:* The Honeywell Centre, 155 Gordon Baker Road, Ontario M2H 3N7, 1-800-461-0013

*In Latin America:* Honeywell Inc., 14505 Commerce Way, Suite 500, Miami Lakes, Florida 33016-1556, (305) 364-2300