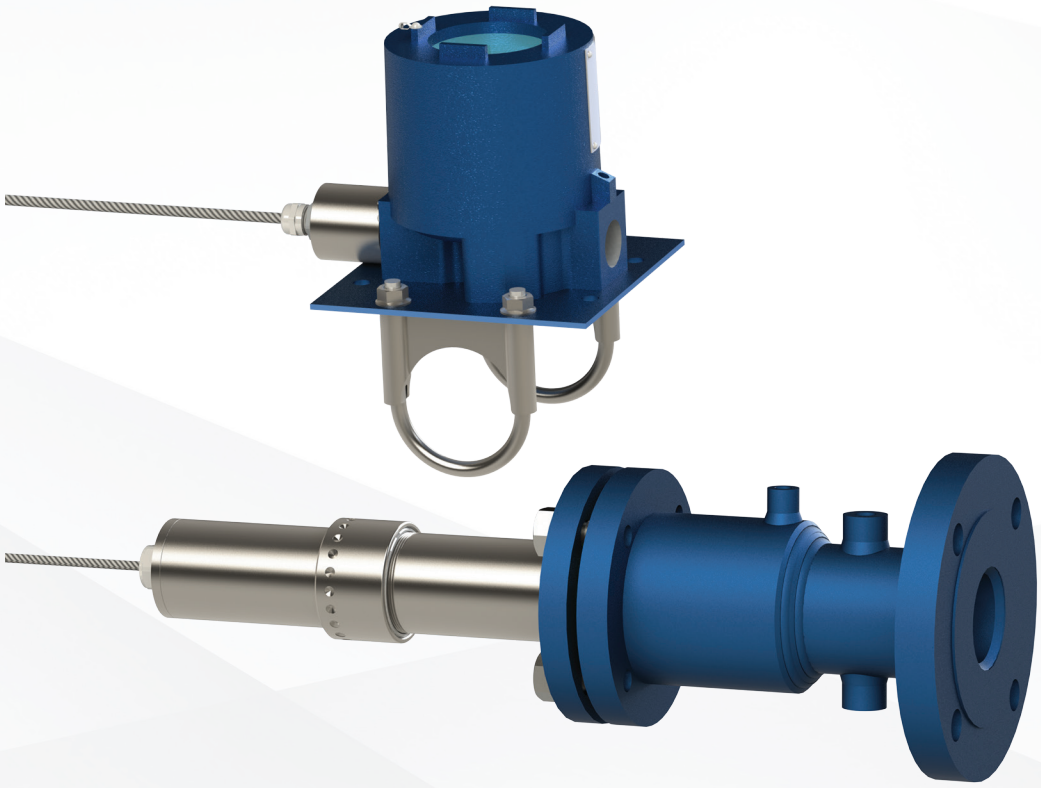

ENGLISH

Model HIR

INSTALLATION, OPERATION & MAINTENANCE MANUAL

00-HIR03 Rev R
Firmware 3.0N8
19 April 2024

Delta Controls
CORPORATION

Before installation and operation, please read this manual and take note of all safety instructions. Wear required personal protective equipment during installation, operation, and maintenance. Use this product only if it is in good condition. Delta Controls Corporation is not liable for damage caused by improper or non-designated use.

Delta Controls Corporation reserves the right to modify technical data without prior notice.

Engineered Reliability

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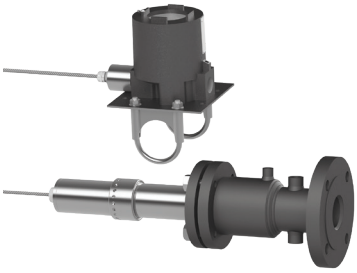
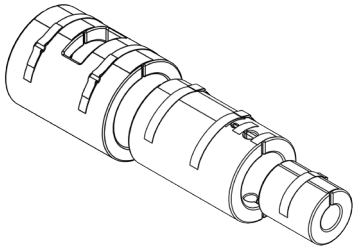
1. Components of the HIR Infrared Pyrometer System

The following listed components, referenced in this manual, are required for proper installation of the HIR. Failure to utilize these components will reduce the life of the HIR and cause possible failure.

HIR	HFI	
		
Infrared Pyrometer, Sulfur Processing Service	Flush Gas Station (usually shipped separately)	Thermal Insulation System 25-449, 25-450, and 25-451 (usually shipped separately)
Steam jacketed lens assembly, fiber optic assembly, and electronics housing with module	Includes flow meter with flow control valve, pressure regulator, filter, and pressure gauge on stainless steel panel with mounting hardware.	Includes three-section insulation system (quick connect cover, steam fixture cover, and isolation valve cover).

2. Theory of Operation

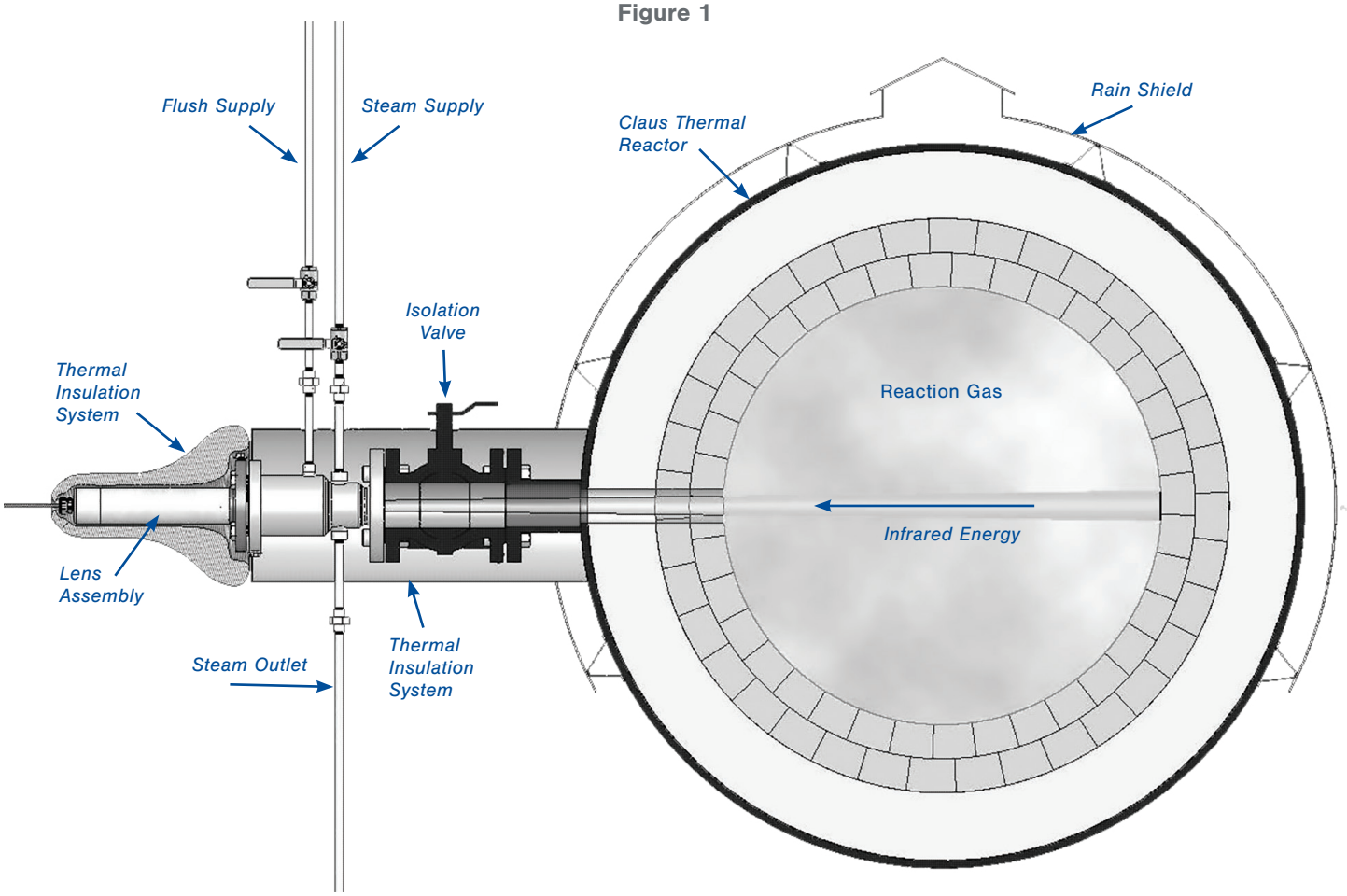
Model HIR uses infrared pyrometry to measure temperature. All materials radiate energy as a function of their absolute temperatures. Model HIR detects the amount and spectrum (wavelengths) of the infrared energy being emitted by the hot face of the refractory. The sensed energy is converted into a signal, which can be used to accurately display the refractory operating temperature.

2.1 Considerations when using Infrared Pyrometry in Claus Thermal Reactors

To effectively measure temperature, the instrument needs a clear, unobstructed view into the vessel. The infrared energy must pass through the reacting gases without being absorbed by them. The instrument must sense through those same gases without seeing them or sensing their high temperatures. This is accomplished by using optical bandpass filters. The selected sensing spectrums avoid errors due to absorption, reflection, etc.

A potential problem using infrared pyrometry in a Claus thermal reactor is that sulfur or other solids can accumulate on the lens or in the nozzle which blocks the infrared radiation, and requires expensive maintenance to clean the lens and optical path. Model HIR is designed to be nearly maintenance free. When properly installed and operated, it maintains the lens, sighting window, and nozzle at a sufficiently high temperature to avoid sulfur buildup and reduces frequency of periodic cleaning.

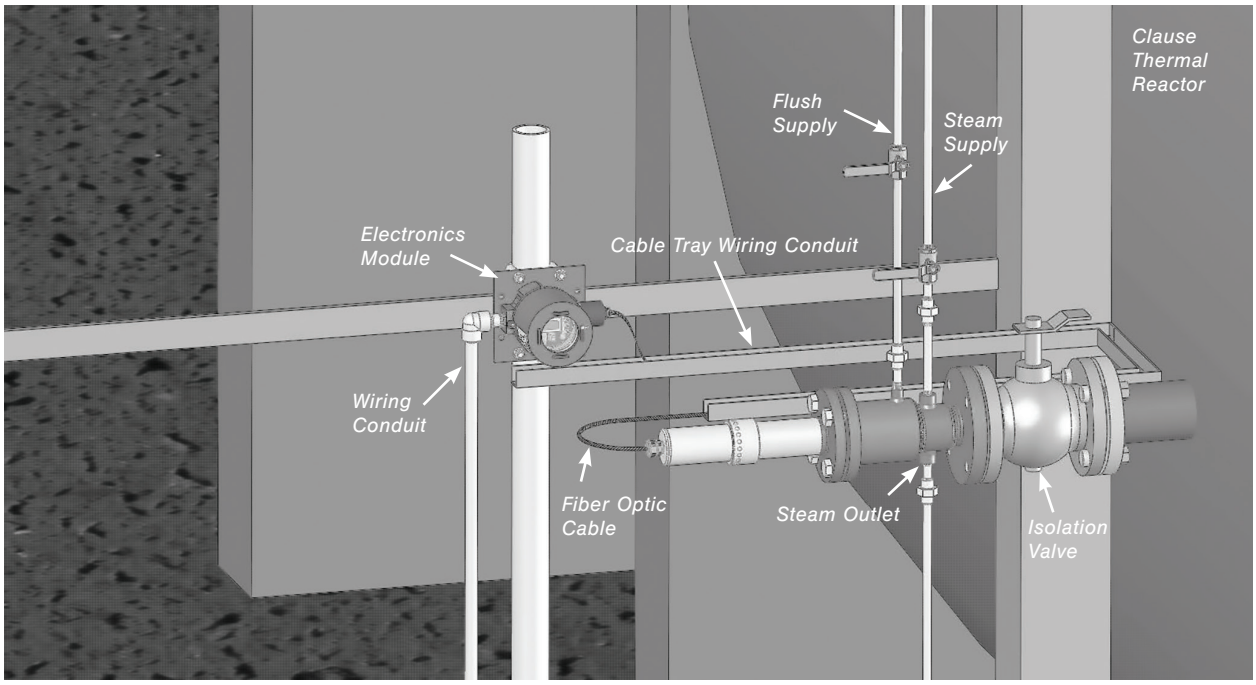
Figure 1



3. Installation

Figure 2 shows a typical installation. The HIR features a unique Steam Jacketed Lens Assembly that is mounted directly to the isolation valve, which is mounted on the vessel nozzle flange. The Steam Jacketed Lens Assembly is normally furnished in either a 2 inch or 3 inch flanged process connection size. Verify the size and type flange on the nozzle isolation valve matches the Steam Jacketed Lens Assembly mounting flange received. If the connections do not match, contact Delta Controls to secure a unit with the necessary nozzle connection size and type.

Figure 2 - Typical Installation (Thermal insulation not shown)



3.1 Mounting the Steam Jacketed Lens Assembly

While unit is not in service, verify operation of the isolation valve mounted on the vessel. Replace the valve if it appears to bind or if, there is any indication that it may leak. Close the valve [it will be opened after the reactor reaches a temperature over +572 °F (+300 °C)].

Bolt the HIR flange of the Steam Jacketed Lens Assembly to the valve flange with the 1/8" NPT flush port at the top.

3.1.1 Steam Supply

Long-term reliability of this instrument requires the use of steam to maintain the temperature of the window and nozzle above the melting point of sulfur. Failure to maintain a high enough temperature can allow sulfur to solidify and build up on the window and nozzle surfaces, blocking the light and causing inaccurate temperature readings.

In accordance with best practices, connect 50 psi to 100 psi (344 kPa to 689 kPa) steam supply to the 1/4 inch NPT inlet port. Connect the 1/4 inch NPT condensate outlet to a suitable steam trap. Insulating the steam lines is recommended, though not shown in Figure 1.

3.1.2 Lens Flush

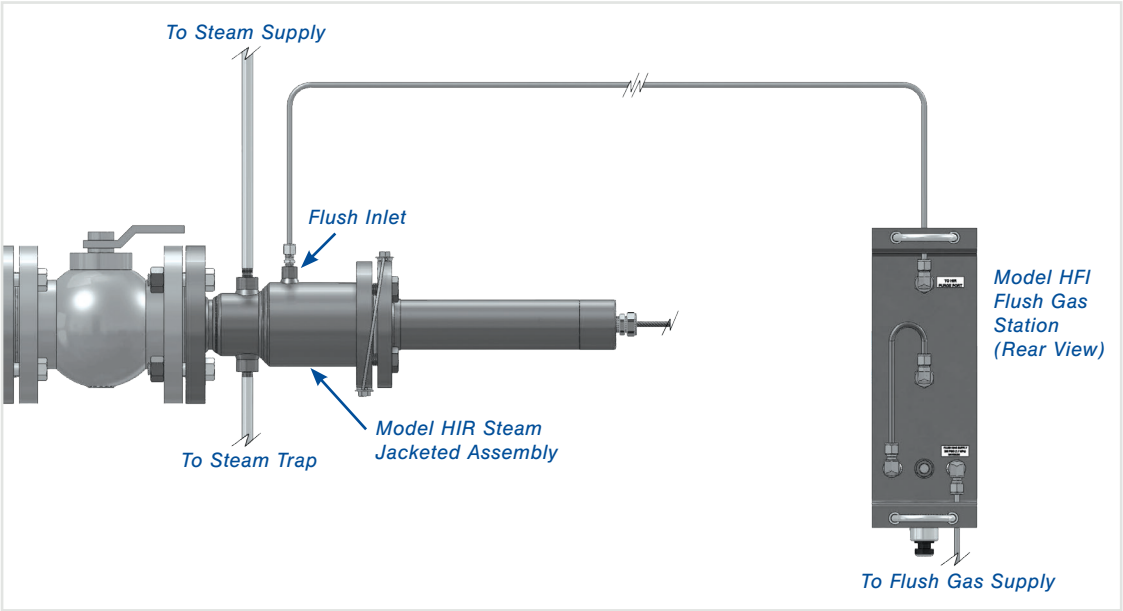
Model HIR requires a purge to the Steam Jacketed Lens Assembly. Ensure that the gas supply is clean, dry and oil free. Any moisture or hydrocarbons the purge media may cause the inside of the lens window to coat. Any coating will prevent some of the infrared energy from reaching the sensor, causing a low temperature reading to occur, and window cleaning to be required.

- Use a flow meter with a needle control valve suitable for a flow rate 4 L/m to 38 L/m.
- Connect the flush gas supply to the 1/8 inch NPT fitting on the top of the Steam Jacketed Assembly and set to 60 SCFH (28 L/m).
- Regulate the flush gas supply to 5 psig (0.34 bar) above reactor operating pressure.
- Delta Controls recommends using the Model HFI Flush Gas Station (Figure 3) as it provides a conveniently packaged assembly of the necessary purge supply components.

Connection of the Model HFI is shown in Figure 4.

Figure 3 - Model HFI Flush Gas Station

Figure 4 - Flush Connections

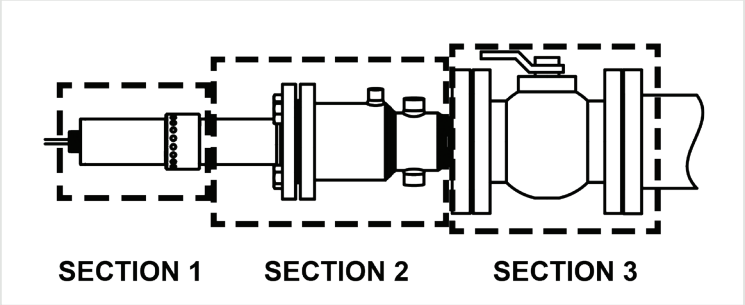


3.2 Thermal Insulation

To prevent sulfur from plugging the optical path, it is important that a temperature above +250 °F (+121 °C) be maintained on the nozzle, isolation valve, and Steam Jacketed Lens Assembly. In most cases, the heat from the reactor and steam body are not sufficient to keep the temperature of the valve and lens assembly above this temperature unless they are insulated. It is important, therefore, that insulation be installed around the nozzle, valve, and lens assembly, as shown in Figure 1, in accordance with the plant best practices. Adequacy of the insulation should be tested by verifying that the lens assembly flange and the isolation valve body are above +250 °F (+121 °C) under the most unfavorable conditions (wind, rain, snow, etc.)

The Delta Controls 3-section Thermal Insulation System is included with each Model HIR. The insulation system retains the heat produced by the steam jacket assembly. This system maintains the temperature above the sulfur freezing point and ensures sulfur cannot accumulate on the lens and reduce the amount of infrared energy received. Secure sections to the HIR using provided metal loop and hook and loop straps (shown below).

Thermal Insulation System for use with Model HIR Pyrometer



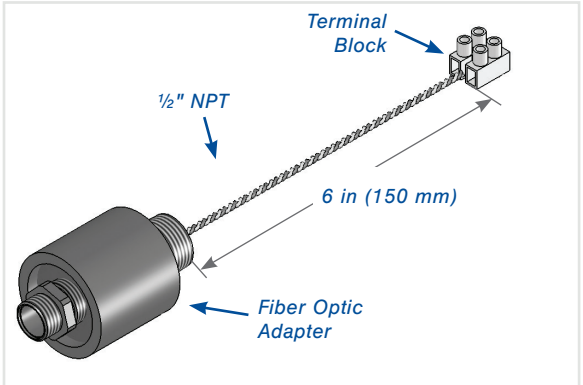
3.3 Installing the Electronics Housing

A mounting location must be provided nearby for the electronics module. Choose a location that is protected from the heat of the reactor, such that the maximum ambient temperature of the electronics is not exceeded. For convenience in performing optical alignment, the electronics display should be visible to an operator standing at the Steam Jacketed Lens Assembly.

3.3.1 Remote Sensor Mounting – Option RS

Under some circumstances, it is impractical to mount the electronics close to the lens body. Extending the fiber optic cable is not possible, due to losses that would occur in a longer fiber. However, it is possible to mount the electronics housing farther from the lens body by mounting the fiber optic adapter (Figure 5) at the end of the 10 feet (3 m) fiber optic cable, and extending the sensor wires back to the remotely mounted electronics housing, as shown in Figure 6.

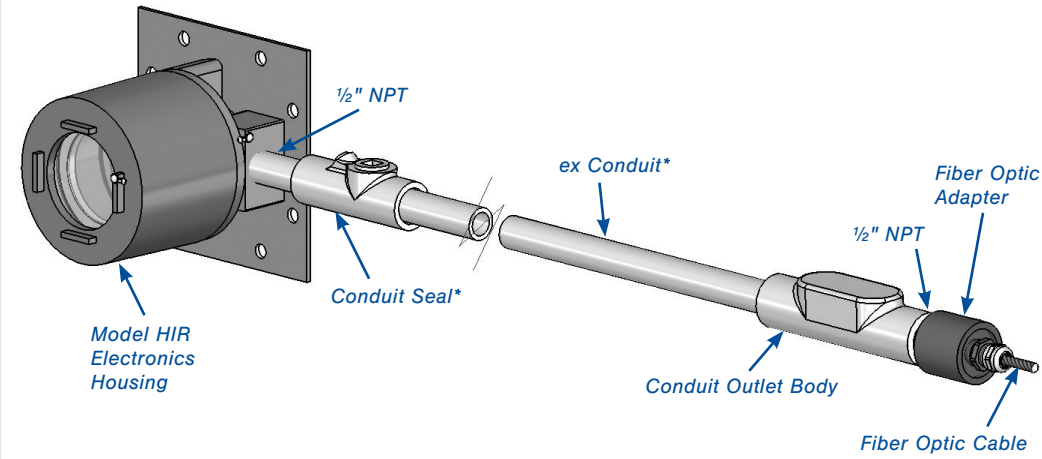
Figure 5 - Fiber Optic Adapter



The following considerations should be observed when remotely mounting the fiber optic adapter:

- The fiber optic adapter must be mounted in a location with an ambient temperature of 0 °F to +185 °F (-18 °C to +85 °C).
- The recommended maximum extension is 25 feet (7.6 m).
- Install 4-conductor insulated cable pair between fiber optic adapter and HIR electronics housing. The twisted pair MUST be run through metallic conduit. F-range models use two twisted pairs (4 wires total). Note that other models use a single twisted pair.
- Do not install other wires in the same conduit with the sensor wires.
- Conduit should be appropriate for the area classification. Seals should be installed near the electronics housing, in accordance with governing code.

Figure 6 - Typical Installation of Remote Fiber Optic Adapter



The loop wiring conduit connection on Model HIR is ¾ inch NPT. Unless 'RS' (remote sensor) option is specified, fiber optic adapter is normally factory installed in the ½ inch NPT opening in the housing.

Wire the electronics module in accordance with local governing code.

A green external earthing screw is located near the threaded conduit entry. An internal green earthing screw is also provided inside the housing. To connect to the internal earthing screw, you must first move the electronics module by removing the two screws securing the module. Replace the module and screws after connecting the earth ground conductor.

NOTE

If, for any reason, the fiber optic adapter must be unscrewed from the electronics housing, first make sure the fiber optic adapter sensor wires are disconnected from the electronics module terminals.

3.3.2 Flameproof Installation

When type ‘d’ flameproof protection is employed, wire the HIR as shown in Figure 7 or Figure 8. Use certified cable glands and conduit seals for all flameproof installations.

Figure 7 - Typical Wiring

(F-range shown; other ranges use a two-wire fiber optic adapter)

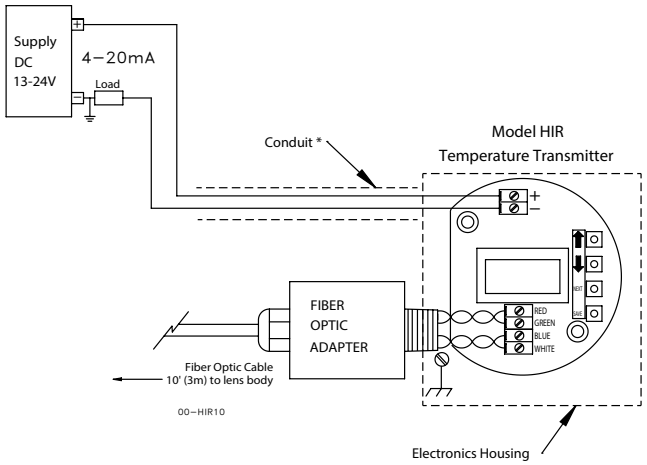
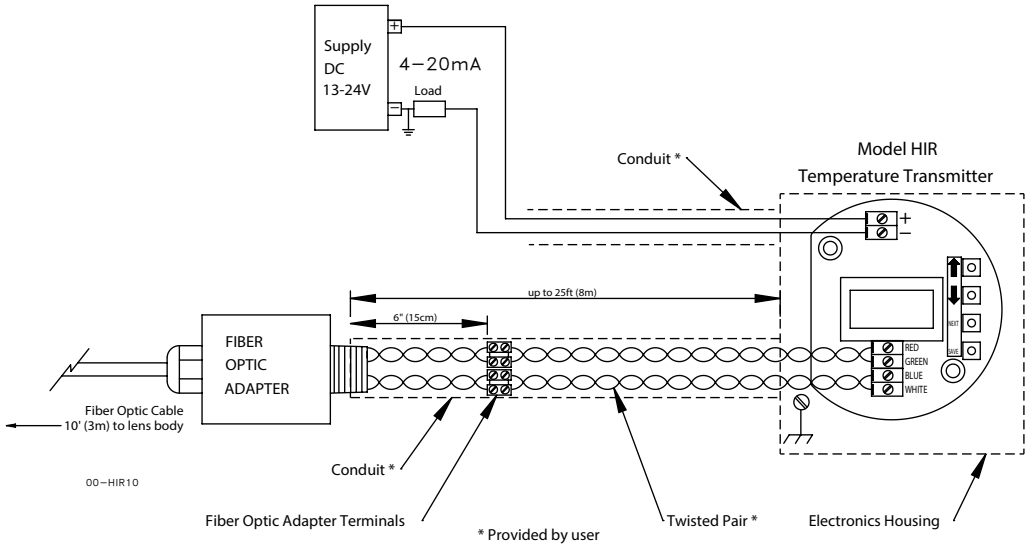


Figure 8 - Typical Wiring - Option RS (Remote Sensor)

(F-range shown; other ranges use a two-wire fiber optic adapter)



3.4 Connecting the Fiber Optic Cable

Use care in handling the fiber optic cable. Even though it is armored, sheathed, and sealed for durability, individual glass fibers within the cable can be damaged by mishandling. Avoid dropping, shocking, kinking, pulling, or sharply bending the cable.

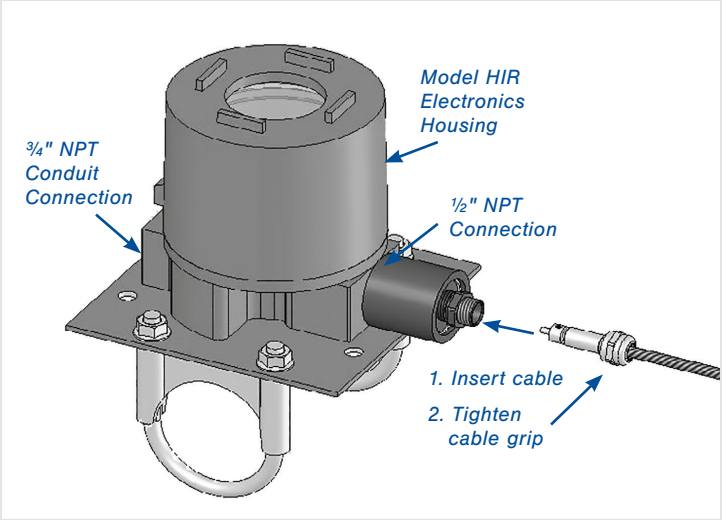
> **NOTE**
> When routing the fiber optic cable, it is important to observe the minimum bend radius specification of 3 inch (7.6 cm). Bending the fiber optic cable more sharply than specified radius can result in low temperature readings due to excessive infrared energy losses in the cable.

The fiber optic cable is connected to a sensor in the fiber optic adapter as shown in Figure 9.

A. Insert the cable into the fiber optic adapter. The cable must be inserted all the way to the bottom of the adapter hole for the cable grip to seat and to avoid calibration errors.

B. Tighten the cable grip to seal the cable against moisture.

Figure 9 - Inserting the Fiber Optic Cable

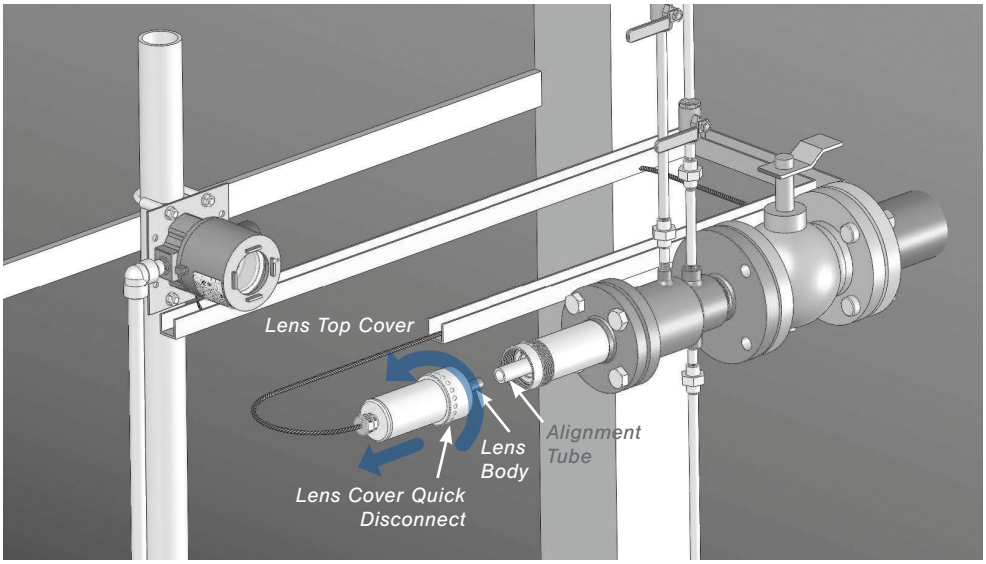


> **NOTE**
> Do not unscrew this ½ inch NPT connection without first disconnecting the sensor wires. Otherwise, damage to internal wiring could result.

3.5 Optical Alignment

The fiber optic lens is aligned at the factory to focus straight down the nozzle's bore. The alignment should be visually checked prior to using the instrument. This alignment check is only possible when there is light inside the reactor vessel, either with the vessel opened and lighted prior to operation, or from the light from the reaction after startup.

Figure 10



To view the optical path:

A. Unscrew lens cover quick disconnect and remove lens top cover as shown in Figure 10. Be careful not to allow the weight of the cover to damage the fiber optic cable.

B. Open isolation valve.

C. Sight down the Alignment Tube, through the process window and into reaction chamber.

The light from the reaction vessel should appear centered in the Alignment Tube. If it is not, the Alignment Tube should be aligned as follows:

A. Loosen three alignment clamp screws using a 9/64 inch hex wrench (Figure 11).

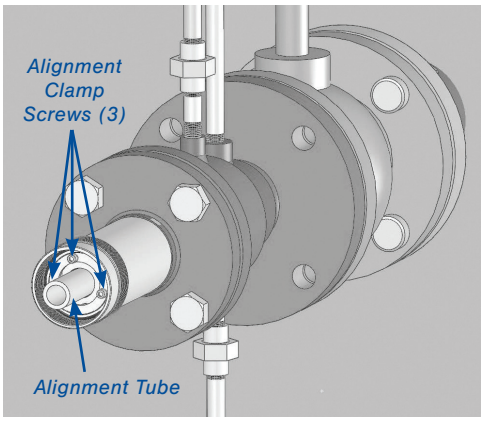
B. Manually adjust alignment tube until light is centered.

C. Tighten three alignment clamp screws.

D. Re-check alignment to make sure alignment tube did not move while tightening clamp screws.

E. Replace Lens Top Cover, making sure the Lens Body is inserted into the Alignment Tube, and tighten Lens Cover Quick Disconnect.

Figure 11



4. Operation

CAUTION

When used with type ‘d’ flameproof protection, do not open cover when circuits are energized nor when hazardous gasses might be present.

Model HIR user interface consists of an LCD display and 4 setup pushbuttons. The temperature characteristics of the display are such that you should only calibrate the unit when the ambient temperature is between 0 °F and +140 °F (-18 °C through +60 °C). Outside this temperature range, the transmitter will operate properly, but the display may be difficult to read.

Pushbuttons:

↑	Pressing the UP button causes the value displayed to be incremented. Holding the button down causes the value to continue upward at an ever-increasing rate.
↓	Pressing the DOWN button causes the value displayed to be decremented. Holding the button down causes the value to continue downward at an ever-increasing rate.
NEXT	Pressing this button shifts the display to the next setup parameter.
SAVE	Pressing the SAVE button saves all calibration values and setup parameters. The display will indicate “Saving...” to verify that the values are being saved.

4.1 Setup Parameters

IR Temp	This parameter displays the temperature as measured by the infrared sensor. When displaying this parameter, the signal strength is also displayed. (Refer to section 3.4 Preventative Maintenance: Signal Strength.)
LOOP mA	Loop current transmitted in milliamperes.
LOOP %	Loop current as a percentage where 0 % = 4 mA and 100 % = 20 mA.
Units	This parameter sets the units of measure for temperatures. Use the up or down arrows to toggle between degrees Fahrenheit and Celsius.
4mA =	Zero scale temperature, i.e., the temperature corresponding to 4.00 mA loop current.
20mA	Full scale temperature, i.e., the temperature corresponding to 20.00 mA loop current.
Lo Alarm	Low alarm setpoint – If the measured temperature falls below this setpoint, the Low Alarm bit will be set in the HART Device Status and an exclamation (!) will appear next to the displayed temperature.
Hi Alarm I	Hi alarm setpoint – If the measured temperature rises above this setpoint, the High Alarm bit wil be set in the HART Device Status and an exclamation (!) will appear next to the displayed temperature.
Sig Alarm	Signal level alarm setpoint – If optical occlusions cause the amount of light reaching the sensor to fall below this level the Signal Alarm bit will be set in the HART Device Status and “LOW!” will appear in the signal display field when displaying the IR TEMP parameter. Enter a number between 0 and 100 where 0 means light is completely blocked. 100 means no blockage. Typical values would be 50 to 70.

The parameters listed on the next page are normally used only during factory setup. However, they can be accessed by pressing and holding the NEXT button while simultaneously pressing the UP arrow button.

CAUTION

Accessing these parameters can result in at least momentary disruption of the transmitted 4-20 mA signal as described below under Zero Adj and Span Adj.

Version	Software/Hardware Revision number
Cal Temp	Calibration Temperature
LowCutoff	Temperature below which the unit will not read.
HART ADDR	When using HART in multidrop mode, this parameter sets the HART address on the bus.
LOOP CTL	0 = normal (current follows temperature); 1 = multidrop (loop set to 4.00 mA); 2 = manual. When set to 2 (manual), current can be set by changing the LOOP mA parameter above.

NOTE

LOOP CNTRL = 2 is used for testing purposes only and reverts to 0 on device reset or cycling power.

Zero Adj	When accessed, current loop immediately transmits 0 scale or 4 mA. Adjust parameter up or down until device measuring the output current indicates exactly 4.00 mA.

CAUTION

Accessing this parameter causes the temperature measurement to STOP transmitting and instead transmits Zero Scale. **Be sure that any equipment connected to this transmitter is prepared for the disruption in the temperature signal level before accessing this parameter.**

Span Adj	When accessed, instrument immediately transmits full scale or 20 mA. Adjust parameter up or down until the device measuring the output current indicates exactly 20.00 mA.

CAUTION

Accessing this parameter will cause the transmitter to transmit Full Scale Temperature. **Be sure that any equipment connected to this transmitter is prepared for the disruption in the temperature signal level before accessing this parameter.**

ALRM ACTN	Alarm Action – This controls how current loop responds to a detected diagnostic alarm. 0 = drive high (22.0 mA); 1 = drive low (3.6 mA); 2 = hold; 3 = ignore.

NOTE

This alarm action is based only on internal consistency checks that are used to detect hardware failures. If a diagnostic alarm is detected, check the wiring between the fiber optic adapter and the electronics module and/or consult the factory. The alarm action can be tested by disconnecting the red or green wire to the fiber optic adapter while the pyrometer is measuring a hot reactor or other incandescent light source.

DAMPING	The measurement time constant in seconds. Higher numbers provide more smoothing.
MemCmd	Factory Use Only

4.2 Initial Startup

A. Confirm the nozzle isolation valve is closed. This prevents any foreign matter from collecting on the viewport window during refractory dry out, curing, initial burner startup, and hydrocarbon firing.

B. Establish steam flow to the Steam Jacketed Assembly and ensure that the steam trap is functioning properly. This assures that condensation will not accumulate on the viewport.

C. After verifying that the Steam Jacketed Lens Assembly is up to temperature, open the nozzle isolation valve.

> **NOTE**
> It is important to keep the isolation valve closed until the reactor temperature is above +572 °F (+300 °C) in order to prevent sulfur from condensing and solidifying on the window.

D. Establish flush gas pressure and set flush flow meter needle control valve to 60 SCFH (28 L/m).

E. Apply power to the electronics module. “IR Temp” value will be displayed.

F. Press the NEXT button to display the “Units” parameter.

G. Press the UP or Down arrow buttons to toggle between Celsius or Fahrenheit and set as desired.

H. Press the NEXT button to display the “4mA=” parameter.

I. Press the UP or DOWN arrow buttons to set the temperature corresponding to 4.00 mA loop current.

J. Press the NEXT button to display the “20mA=” parameter.

K. Press the UP or DOWN arrow buttons to set the temperature corresponding to 20.00 mA loop current.

L. Press the SAVE button to save all changes. The display will briefly indicate “Saving...”

> **NOTE**
> If SAVE is not pressed, then changes just made will not be remembered after a power fail.

M. Press the NEXT button to display the current measured temperature.

4.3 Ratiometric Two-Wavelength Sensing

The HIR ‘F range’ transmitter measures the intensity of light at two different wavelengths to determine the temperature. This allows the measurement to be accurate even if there is a partial blockage of light due to material buildup (occlusion) on the window or in the nozzle. The measurement is based on the light’s color (wavelength), instead of the intensity, as is usually done with a single wavelength measurement. In addition to the temperature, the amount of occlusion can also be measured as a Signal Value number from 0 (completely blocked) and 100 (no blockage). The Signal Value appears on the LCD display in small numbers below the temperature. If the number falls below the Signal Alarm setpoint, then “LOW!” appears next to the displayed signal level, and HART Additional Device Status Byte 1, bit 2 is set.

Note that below +1472 °F (+800 °C), there is insufficient infrared light at both wavelengths to make a two-wavelength measurement. Therefore, temperatures between +662 °F and +1472 °F (+350 °C and +800 °C) are only measured with a single wavelength. In that case, the amount of blockage cannot be determined.

4.4 Transmissivity Measurement

Transmissivity measurement (Trans=X.XX) is located beneath the temperature measurement and should read between 0 and 1.00. This value indicates the amount of light reaching the sensor relative to an unobstructed sight path. A value of ≥ 0.95 is normal. Values below 0.95 may indicate the occurrence of sight path attenuation, possibly due to material build-up on window or inside the nozzle.

NOTE

HIR uses a two-wavelength ratiometric measurement above +1472 °F (+800 °C). Below +1472 °F HIR reverts to a single wavelength measurement. The two-wavelength measurement mode is accurate with transmissivities below 0.05. The single wavelength mode measurement is affected by sight path occlusions and will read incorrectly if any obstructions are present.

If the transmissivity is below 0.95:

A. Investigate cause of obstruction. Take corrective action (i.e., improve insulation, align sight tube) or schedule maintenance activities (i.e., clean window, clean the nozzle).

B. Calibrate HIR to Model HIP's temperature measurement.

5. Maintenance

5.1 Preventive Maintenance

Model HIR is designed to give years of trouble-free operation without the need for service. In most cases, to achieve this performance, the only requirement is that the optical path (nozzle, valve, window) temperature be maintained above the freezing point of sulfur, and that the window flush be maintained to keep the window free of particulates. Thus, a preventive maintenance schedule should include periodic inspections to verify that:

A. The steam supply is on, the steam trap is functioning, and steam is heating the lens body.

B. The lens flush flows at the recommended rate of 60 SCFH (28 L/m).

C. The thermal insulation as shown in Figure 1 is in place and in good condition.

5.2 Signal Strength Indication

Signal strength measurement (Signal=XXX.XX) is located beneath the temperature measurement when displaying the temperature parameter. This value should read between 0 and 100 and indicates the amount of light reaching the sensor relative to an unobstructed sight path. A value of ≥ 95 is normal. Values below 95 may indicate the occurrence of sight path attenuation, possibly due to material build-up on window or inside the nozzle.

The signal strength should be monitored periodically. If it drops significantly or if the optical path temperature or flush gas is suspected to be compromised, corrective action should be scheduled. This includes inspecting the optical sight path and performing any necessary sight glass or lens cleaning and/or nozzle cleanout. Refer to section 2.5 Optical Alignment for details.

5.3 Calibration

Calibration should be verified annually or any time an anomaly is suspected. Use the CLAUSTEMP® Model HIP Handheld Pyrometer for verification or calibration. See *www.claustemp.com* for more details.

To calibrate the HIR Pyrometer:

A. Ensure HIR has a clear sight path into the reactor.

B. Remove the fiber optic assembly and disconnect the lens.

C. Measure reactor temperature using Model HIP handheld pyrometer or other means.

D. Press and hold the NEXT button while simultaneously pressing the UP arrow button. Then release both buttons.

E. Press the NEXT button to display the CAL TEMP parameter.

F. Unlock the calibration feature by pressing and holding the NEXT button while simultaneously, pressing the DOWN arrow button. Then release both buttons.

G. Use the UP and Down arrow buttons to set the known reactor temperature.

H. Press the SAVE button. Calibration is complete.

6. Specifications

Range:	
"F" Range	
Dual Wavelength	+1472 °F to +3092 °F (+800 °C to +1700 °C)
Single Wavelength	+662 °F to +3092 °F (+350 °C to +1700 °C)
Accuracy:	0.5 % of reading or ±36 °F (±20 °C), whichever is greater
Repeatability:	0.1 % of full-scale span
Warm-Up Time:	60 sec
Display:	High Contrast LCD Display
Output Signal:	4-20 mADC, 2-wire loop-powered
Hazardous Location Rating:	II 2 G Ex d IIB+H2 T6 (When installed per section 2.3) IP65
Certifications:	CSA 18CA70131733 Sira 18ATEX1044X IECEx SIR 18 0012X
Fiber Optic Cable:	Flexible PTFE over SS armor 10 ft (3 m) standard length
Minimum Bend Radius	3 in (7.6 cm)
Hot Lens Mounting:	3" ANSI is standard on a flanged nozzle steam jacketed. Other types and sizes available
Ports:	
Steam Jacket in and out	50 psi to 100 psi (344 kPa to 689 kPa) for steam to heat the lens assembly
Nitrogen Flush	60 SCFH (28 L/m) typical
Housing Mounting:	Vertical surface or 2.4 in (61 mm) pipe stand with vertical or horizontal orientation
Housing Conduit Connection:	¾" NPT
Ambient Temperature Limits:	
Fiber Optics & Lens	-40 °F to +400 °F (-40 °C to +204 °C)
Fiber Optics Adapter	-4 °F to +185 °F (-20 °C to +85 °C)
Electronics	-4 °F to +158 °F (-20 °C to +70 °C)
Maximum Process Pressure:	150 psi (1034 kPa)

"X" behind the certification number indicates special conditions for safe use:
"Flamepath joints are not intended to be repaired."

Model Numbering System

MODEL EXAMPLE	MODEL	-	SENSING RANGE	-	HOUSING RATING	-	CABLE LENGTH	-	PROCESS CONNECTION	-	OPTIONS
	HIR-A	-	F	-	7WR	-	10	-	2"150RS	-	AA

MODEL	DESCRIPTION
HIR-A	Infrared Pyrometer, Sulfur Processing Service

SENSING RANGE	DESCRIPTION	RANGE
F	2 color	+662 °F to +3092 °F (+350 °C to +1700 °C)

HOUSING RATING	DESCRIPTION
7B	Flameproof Ex db IIB + H2 T6 IP65

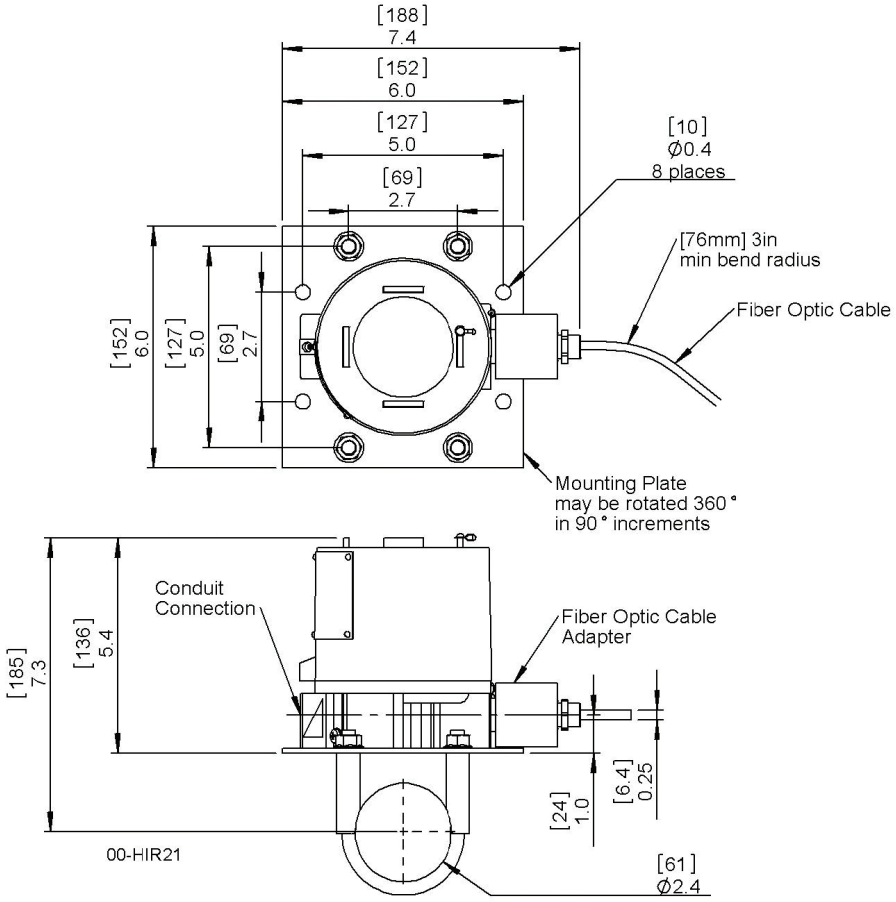
CABLE LENGTH	DESCRIPTION
10	10 ft fiber optic cable (3 m)

PROCESS CONNECTION	DESCRIPTION
2”150RS	2 in Class 150 raised face flange, Carbon steel
3”150RS	3 in Class 150 raised face flange, Carbon steel
2”300RS	2 in Class 300 raised face flange, Carbon steel
3”300RS	3 in Class 300 raised face flange, Carbon steel

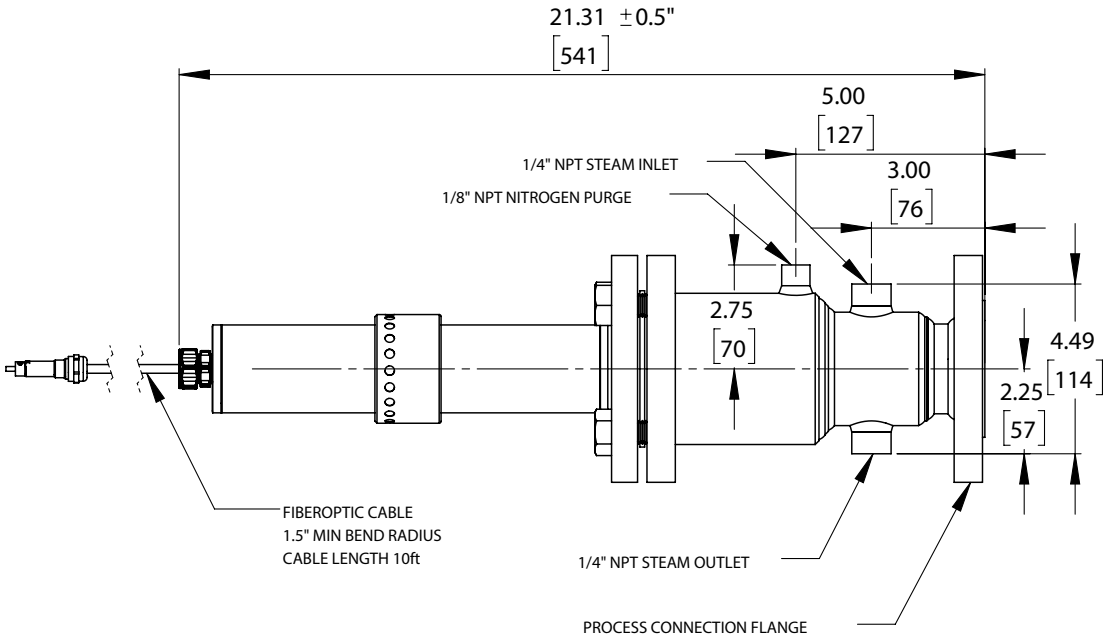
OPTIONS	DESCRIPTION
AA	None
RS	Remote Sensor
XPB	300 grade stainless steel housing

Model HIR Dimensional Drawings

Electronics Housing



Steam Jacketed Lens Assembly



Contact Us

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