Reuter-Stokes

Flame Tracker Dry 325

Operation and Maintenance Manual

Applicable to part numbers:

RS-FS-9010-03

RS-FS-9010-03-25X

RS-FS-9010-03-126

RS-FS-9010-03-173

FS-9010OM

Revision: L

June 2023

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Twinsburg, OH 44087

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IMPORTANT INFORMATION

You acknowledge and agree that you assume full responsibility for your use of the content and material in this manual. You acknowledge and agree that your use of the content and material in this manual is at your own risk. You acknowledge and agree that, to the fullest extent permitted by applicable law, Reuter-Stokes, Inc. will not be liable for any direct, indirect, punitive, exemplary, incidental, special, consequential or other damages arising out of or in any way related to the content and material in this manual, whether based on contract, tort, strict liability, or otherwise. This disclaimer applies, without limitation, to any damages or injury arising from any failure of performance, error, omission, your loss of profits, destruction, and any other tangible or intangible loss.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the design of this equipment may be impaired.

This instrument contains no operator serviceable parts and should be serviced by qualified personnel only.

WARNINGS AND CAUTIONS

Information and Safety Paragraphs

Note: These paragraphs provide information that provides a deeper understanding of the situation, but is not essential to the proper completion of the instructions.

WARNING: THESE PARAGRAPHS INDICATE A RISK OF POTENTIAL SERIOUS PERSONAL INJURY, UNLESS THESE INSTRUCTIONS ARE FOLLOWED CAREFULLY.

CAUTION: THESE PARAGRAPHS INDICATE A RISK OF POTENTIAL MINOR PERSONAL INJURY AND/OR SEVERE DAMAGE TO THE EQUIPMENT, UNLESS THESE INSTRUCTIONS ARE FOLLOWED CAREFULLY.

IMPORTANT: *THESE PARAGRAPHS PROVIDE INFORMATION THAT EMPHASIZES INSTRUCTIONS THAT ARE ESSENTIAL TO PROPER SETUP OF THE EQUIPMENT. FAILURE TO FOLLOW THESE INSTRUCTIONS CAREFULLY MAY CAUSE UNRELIABLE PERFORMANCE.*

General Safety Issues

The user must make sure to operate all auxiliary equipment in accordance with local codes, standards, regulations, or laws applicable to safety.

WARNING: DO NOT DISCONNECT THE SENSOR WHILE THE CIRCUIT IS ENERGIZED (LIVE), UNLESS THE AREA IS KNOWN TO BE NON-HAZARDOUS AND FREE OF EXPOSIVE GASES.

CAUTION: THE **FLAME TRACKER DRY** IS DESIGNED TO OPERATE AT EXTREME TEMPERATURES. DO NOT ATTEMPT TO WORK ON THE **FLAME TRACKER DRY** UNTIL IT HAS REACHED A SAFE HANDLING TEMPERATURE.

NOTE: IDENTIFIES INFORMATION THAT IS CRITICAL FOR SUCCESSFUL APPLICATION AND UNDERSTANDING OF THE PRODUCT.

AVERTISSMENT! RISQUE D'EXPLOSION. NE PAS BRANCHER NI DEBRANCHER SOUS TENSION.

OVERVIEW

The information contained in this document is applicable to all models of the Flame Tracker Dry 325 (FTD325) listed on the title page. There are small differences between these models as shown in Table 1.

Model	Gain	Nominal Cable Length
RS-FS-9010-03	Standard	30 feet
RS-FS-9010-03-25X	Increased(*)	30 feet
RS-FS-9010-03-126	Increased(*)	3.2 meters
RS-FS-9010-03-173	Increased(*)	4.4 meters

Table 1: Sensor Differences

(*) Gain is increased by roughly 2.5X for a given flame input signal until the output reaches between 11 and 12 mA, at which time the output is the same for all models.

GENERAL DESCRIPTION

The **Flame Tracker Dry** is an ultraviolet (UV) light sensitive detector used to measure the intensity of the flame in the combustion chambers of a gas turbine. Due to the use of a silicon carbide photodiode, the **Flame Tracker Dry** is very sensitive to the longer wavelength components of the UV light generated by the flame. These wavelengths penetrate the fog of fuel in the combustion can so the **Flame Tracker Dry** is significantly more sensitive to the flame than previous technologies, such as Geiger Mueller tubes. Being a UV sensitive device, the **Flame Tracker Dry** is not sensitive to the visible and infrared light generated by the hot combustion chamber walls so only the flame's light is detected.

The **Flame Tracker Dry** also separates the UV light sensitive photodiode in the *Hot End*, mounted on the combustion cans, from the temperature sensitive electronics in the *Cool End*, mounted below the turbine in a cool zone. This allows the **Flame Tracker Dry** to be operated indefinitely without the use of a cooling system. The single unit cannot be modified or disassembled. Any modifications will void the warranty and will cause an unsafe condition.

SPECIFICATIONS

Mechanical

Hot End Pipe Union:	300 series stainless steel
Hot and Cool End Housings:	300 series stainless steel
Hot End Mount:	3/4" NPT female, 2-1/4" union nut
Cool End Mount:	2-1/2" pipe clamp for 1-5/8" strut channel
Cool End to Interconnecting Cable:	MIL-C-38999 Series III size 15 (5 pin)
Sensor:	Silicon Carbide photodiode
Window:	Sapphire

Operating

Sensitivity:	>5 mA @ $1x10^{10}$ photons/in^2/sec. @ 310 nm
Output:	Operating: 4 - 20 mA dc, Max < 21 mA
Response time	<175 milliseconds
Power Requirements:	
Cool End:	12 - 30 vdc @ > 100 mA
Interconnecting Cable:	Max voltage 300 Vrms
Cool end temperature (ambient):	-60°F to 284°F (-51°C to 140°C) operating -60°F to 302°F (-51°C to 150°C) short duration with 150°C shutdown
Hot end temperature (ambient)	-60°F to 617°F (-51°C to 325°C) operating
Relative Humidity	100%
Process Pressure	400 psig (2.8 Mpa)

Table 2: Sensor Specifications

INTERCONNECTING CABLE

The recommended cable to attach the flame sensor to the junction box is the RS-E2-O285PXXX or 362A1053PXX. A right-angle cable version is shown in Figure 1. Dimensions shown are in inches (mm) and are reference only.

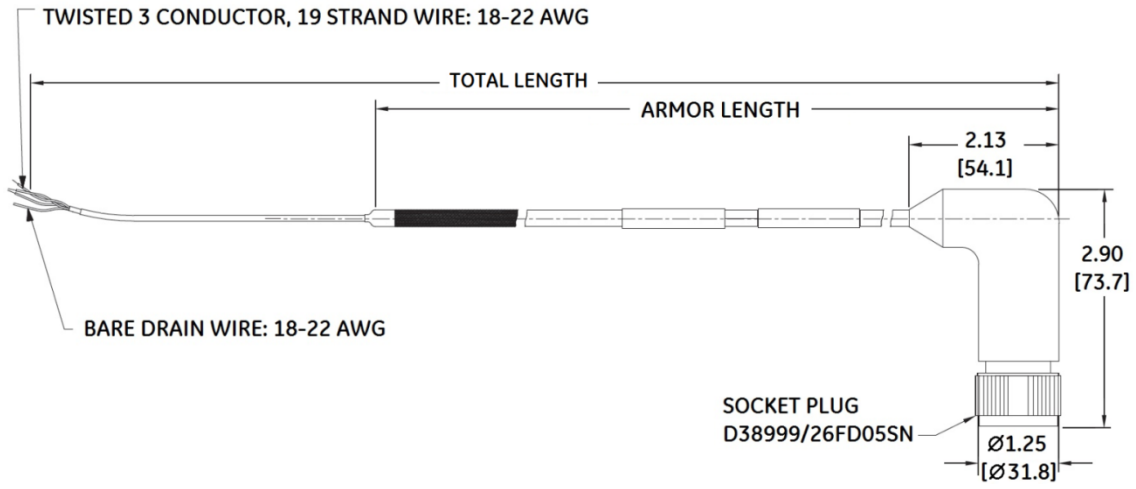


Figure 1: 4-20 mA Interconnect Cable

Connector : MIL-DTL-38999 series III, shell size 15, 5 #16 pins

Voltage (max) : 300 VRMS

Temperature (max) : 482°F (250°C)

Dimensions in inches [millimeters]

Dimensions are for reference only

The available cable part numbers are listed in Table .

Interconnecting Cable Part Number	Total Length ft [m]	Armor Length in [cm]	Connector Type
RS-E2-0285P001	60-62 [18.3-18.9]	36 [14.2]	Right Angle
RS-E2-0285P003	60-62 [18.3-18.9]	75 [190.5]	Right Angle
RS-E2-0285P004	120-123 [36.6-37.2]	36 [14.2]	Right Angle
RS-E2-0285P021	15-17 [11.9-12.50]	36 [14.2]	Right Angle
RS-E2-0285P011	60-62 [18.3-18.9]	36 [14.2]	Straight
RS-E2-0285P012	120-122 [36.6-37.2]	36 [14.2]	Straight
RS-E2-0285P013	60-62 [18.3-18.9]	96 [243.84]	Straight
RS-E2-0285P010	60-62 [18.3-18.9]	120 [304.8]	Straight

Table 3: Available 4-20 mA Cables

MECHANICAL DIMENSIONS

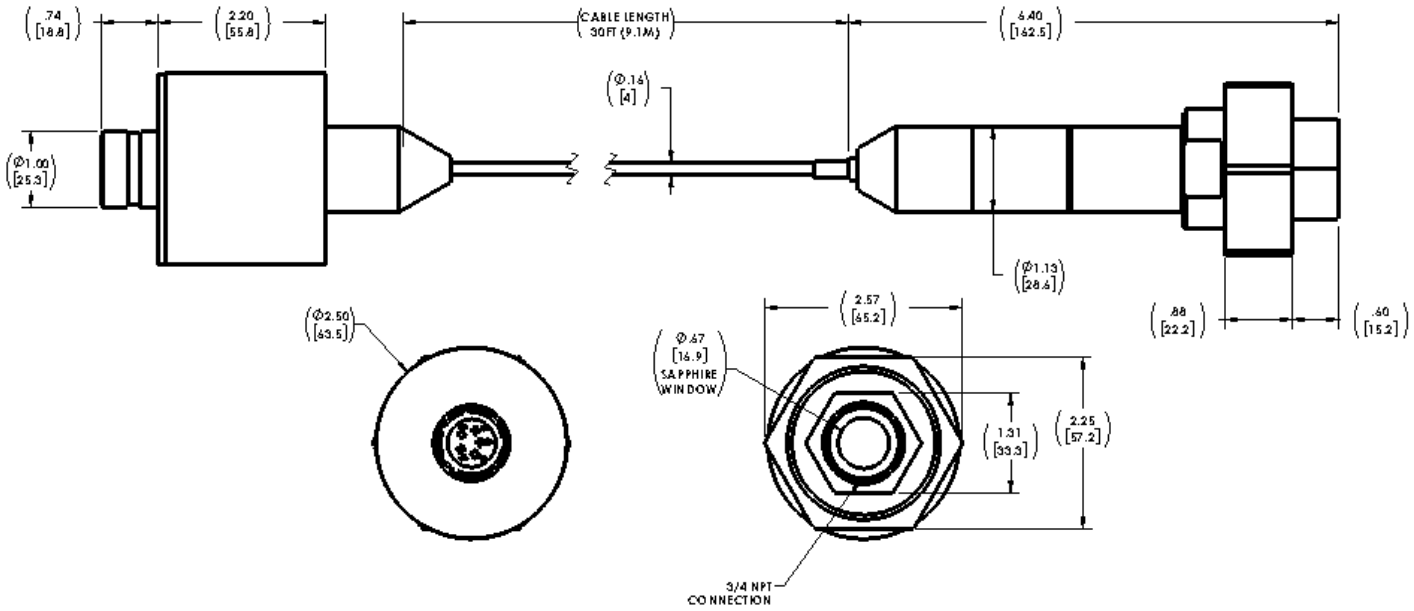


Figure 2: Mechanical Dimensions

Dimensions in inches [millimeters]

Dimensions are for reference only

CONNECTOR PINOUT

The pinout for the connector is shown in Table .

Pin	Signal	Wire Color for RS-E2-0285PXXX cable
A	-	Black
B	+	White
C	Ground	Green
D	Not used	n/a
E	Not used	n/a

Table 4: Connector Pinout

SENSOR

Error! Reference source not found. is a block diagram of the **Flame Tracker Dry**. Inside the *Hot End* a ssembly a lens focuses UV light from the combustion reaction onto a silicon carbide photodiode, which converts it into an electrical current in proportion to the intensity of the UV light. The photodiode is connected, via the *sensor cable*, to an amplifier in the *Cool End* assembly. The amplifier has a high initial gain, which automatically shifts to a lower gain in order to accommodate a wide range of input light levels without saturating. The sensor regulates the supply current in proportion to the intensity of the UV light. Both power and signal are transmitted on the same two wires on the output of the *Cool End.* The sensor can be powered from a DC voltage between 12 and 30 volts.

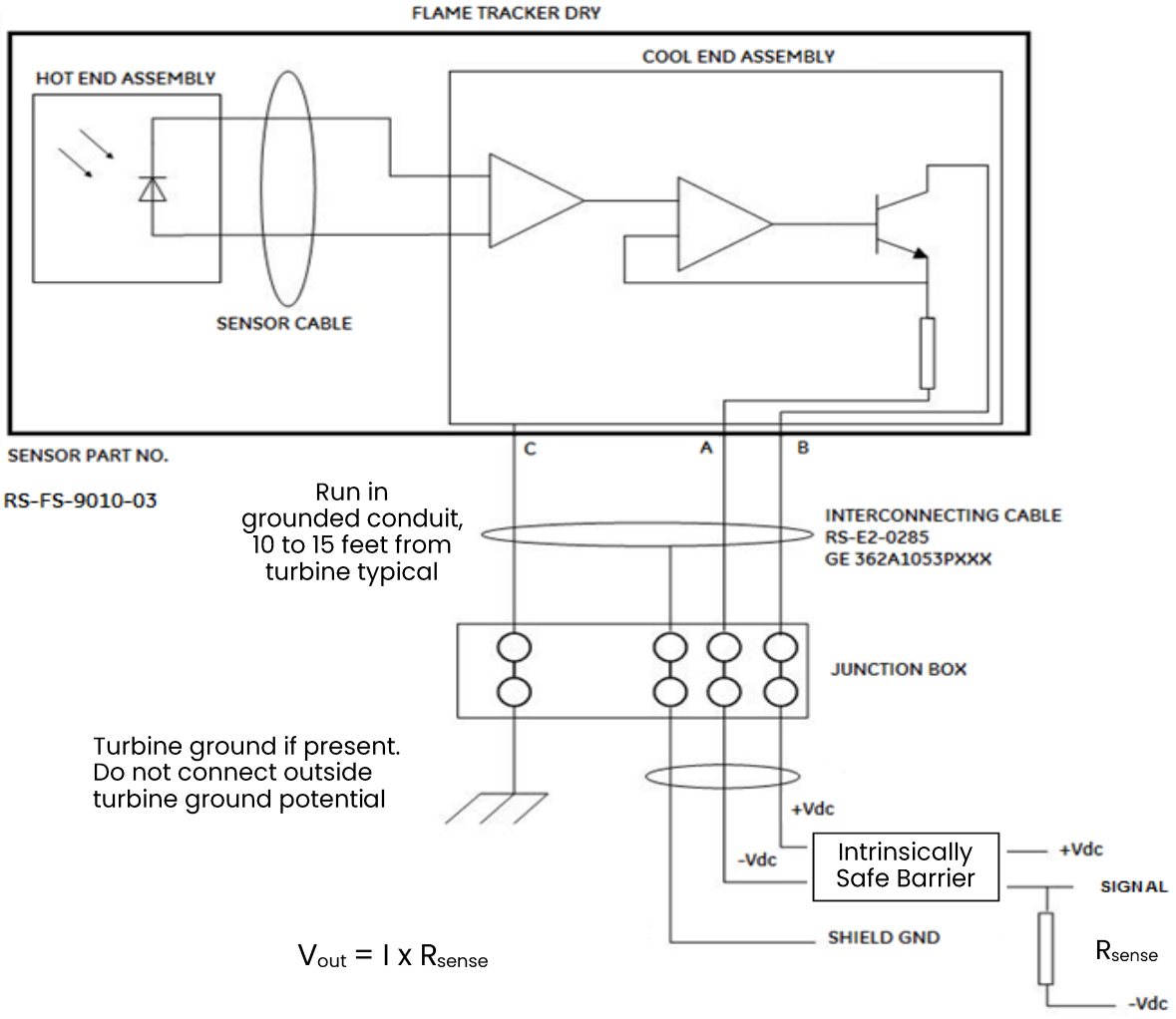


Figure 3: RS-FS-9010-03-XXX SiC Block Diagram

INSTALLATION

AVERTISSMENT! risque d'explosion. Ne pas brancher ni debrancher sous tension.

NOTE: DO NOT INSTALL A FLAME SENSOR THAT HAS A CRACKED WINDOW, DAMAGED THREADS, OR ONE THAT HAS BEEN DISASSEMBLED.

NOTE: MAINTAIN A MINIMUM BEND RADIUS OF 6 INCHES FOR ALL BENDS OF THE MI CABLE.

NOTE: STORE SENSORS IN SHIPPING CONTAINER PROVIDED. KEEP IN PLASTIC BAG WITH DESICCANT, THE DUST CAP IS TO REMAIN INSTALLED ON THE COOL END CONNECTOR UNTIL TIME OF INSTALLATION.

ROUTING THE SENSOR CABLE

The Hot End of the **Flame Tracker Dry** is mounted onto the sight tubes of the combustion cans. The *sensor cable* is mounted along the strut channel around the turbine. The Cool End is mounted in a location where ambient temperature will not exceed the value shown in the specifications above. See Figure 4 for an example installation on a Frame 7F turbine.

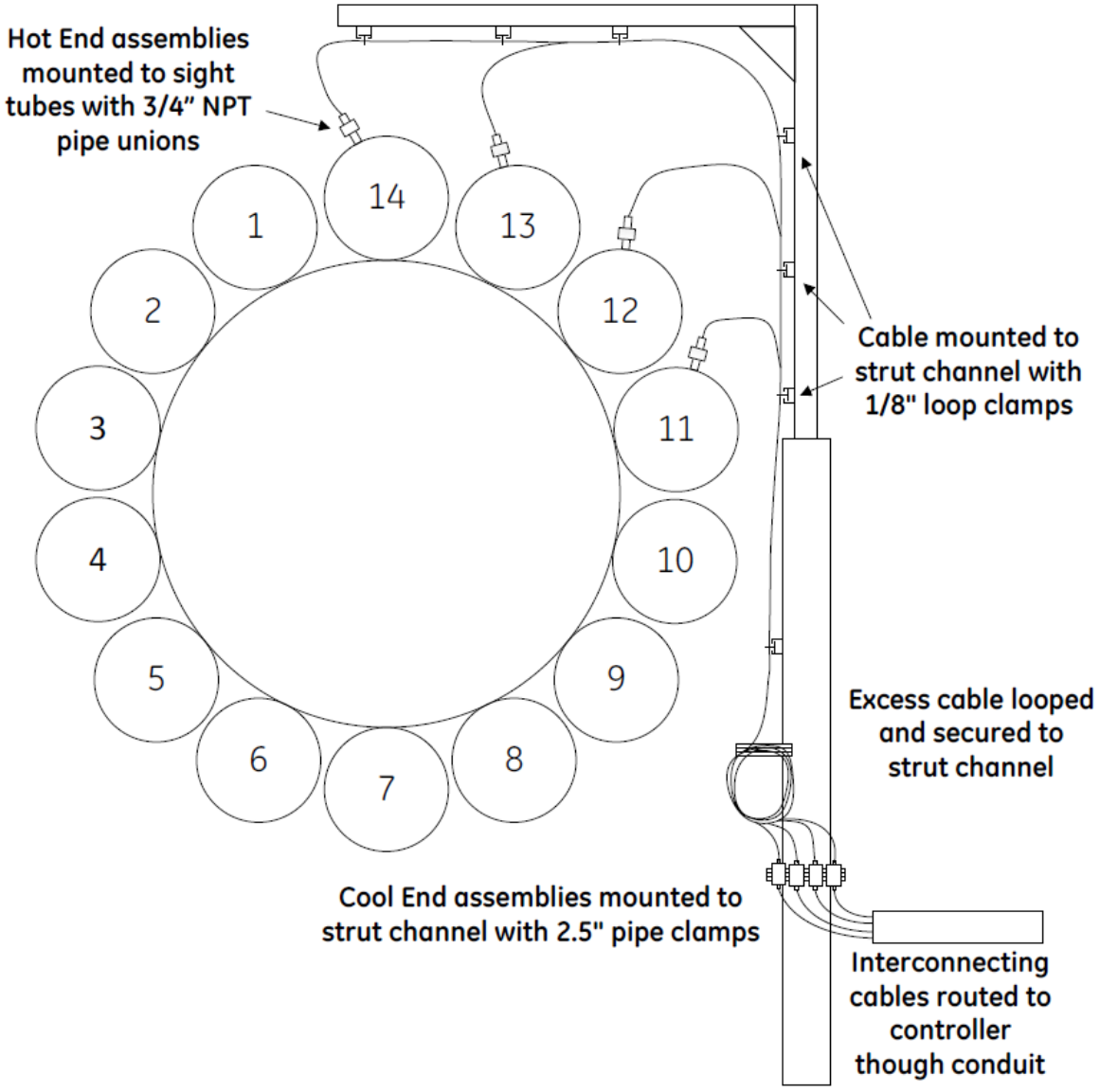


Figure 4: GE 7F Mounting Example

Note: Guide the Cool End down to the Cool End mounting location. Use care in handling the Cool End during the installation process to protect the electronics located inside the Cool End.

Example 7EA Turbine Detector and Cable Routing

Figure 5 shows one possible installation on a 7EA turbine. Before installing the cool ends, the user must ensure that maximum ambient temperatures for the cool ends do not exceed those listed in the Specifications.

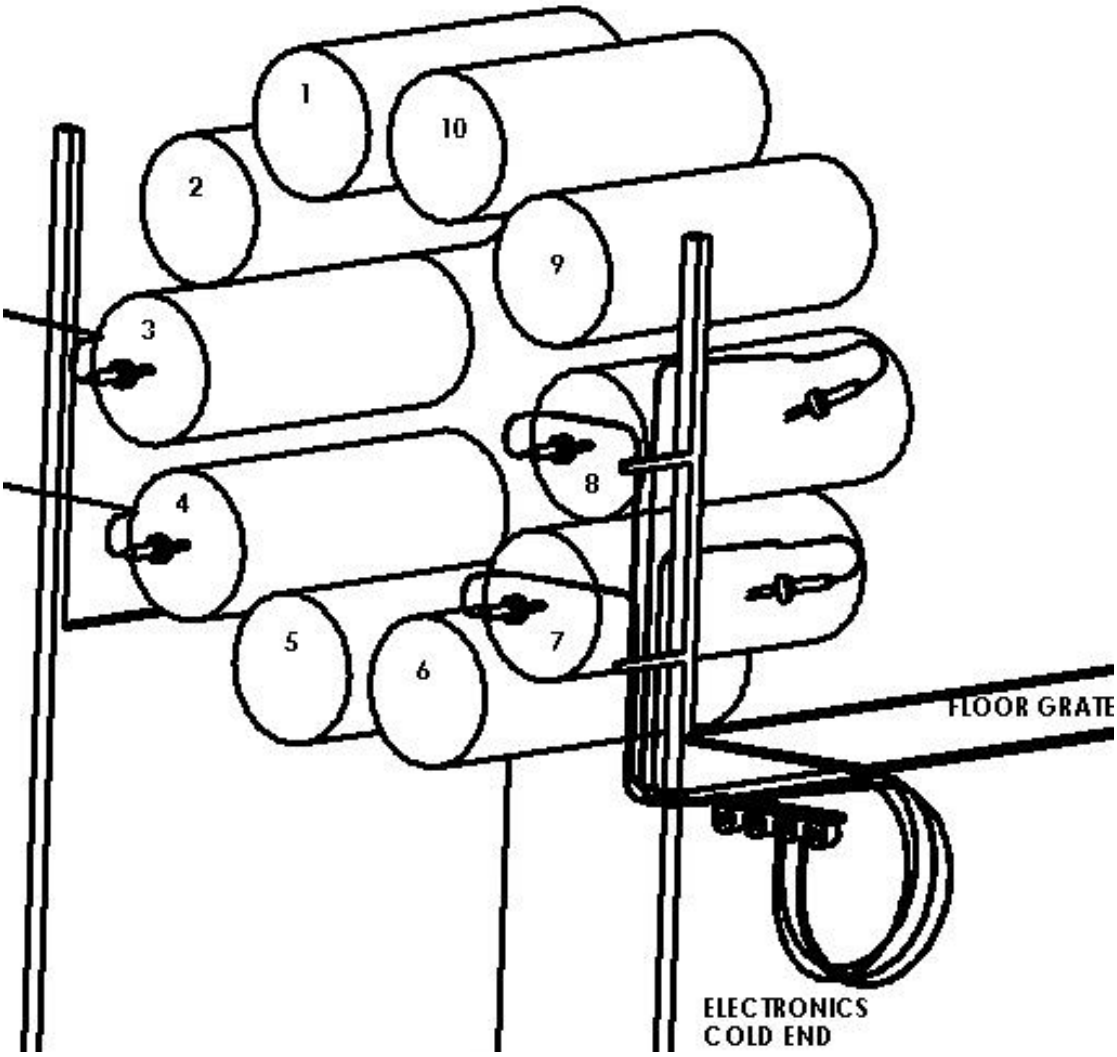
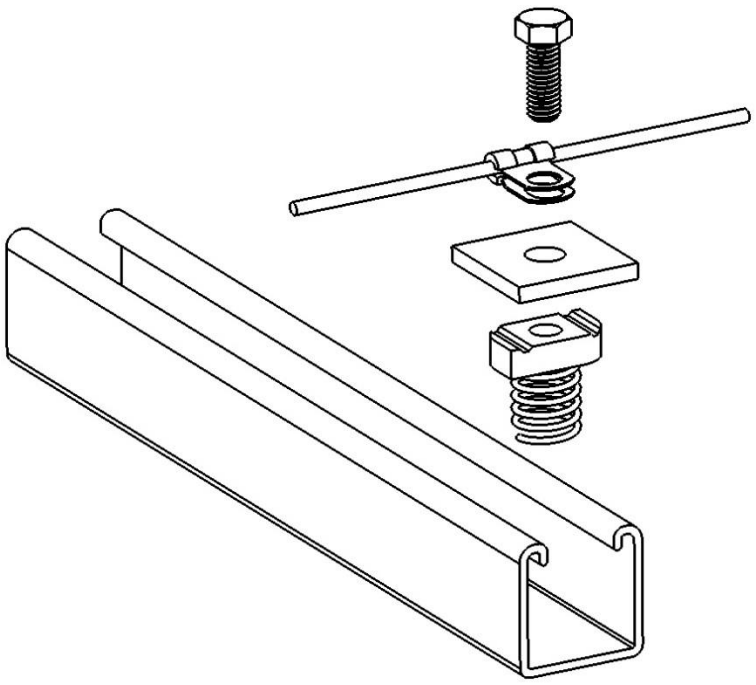


Figure 5: Sample 7EA Installation

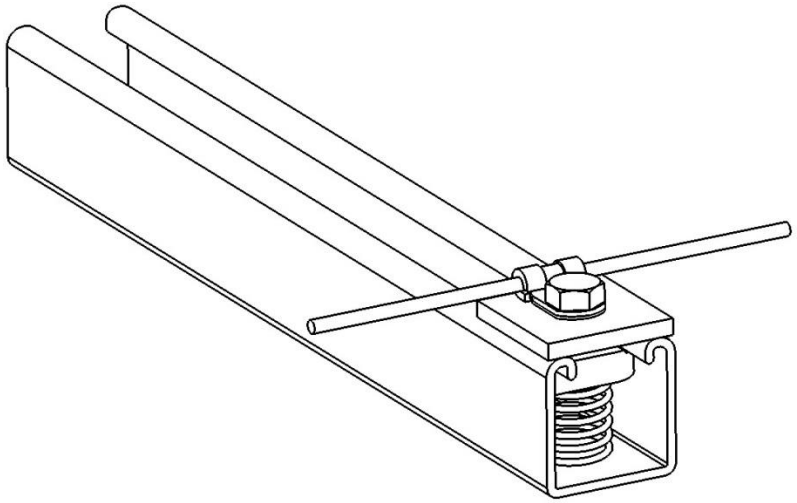
Mount the *sensor cable* to the strut channel using 1/8" cushioned loop clamps. A silicone cushion is recommended for its high temperature resistance. See the images below for the recommended cable mounting.

IMPORTANT: *The cable must be secured at least every 3ft. The minimum bend radius of the cable is 6 inches.*

1. Place the loop clamp on the *sensor cable* and position it over the opening in the strut channel.



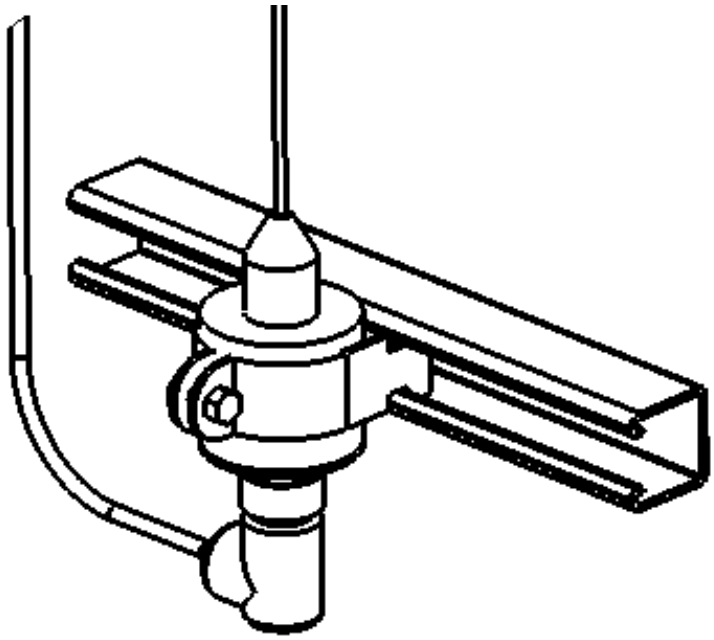
2. Place the mounting nut in the strut channel and secure the installation using a bolt.



At the *Cool End*, the extra cable should be looped and mounted to a nearby strut channel using any convenient means. A secure mounting is required to prevent the *sensor cable* from rubbing due to turbine vibration. An appropriately sized pipe clamp for the size of the loops is recommended.

COOL END INSTALLATION

The *Cool End* is to be mounted in a location where the ambient temperature does not exceed the maximum operating temperature listed in the Specifications section. In most cases, this is below the turbine on the pedestal or I-beam on F-Class gas turbines or under the foot grating on E-Class gas turbines. Mount the *Cool End* to the strut channel using a 2-1/2" pipe clamp.



1. Mount the *Cool End* on a 1-5/8" strut channel using 2-1/2" pipe clamp.

2. Attach the *interconnecting cable* to the large connector on the bottom of the cold end as shown above. Spin the coupling nut on the connectors until the blue line on the cable connector completely covers the red line on the housing connector. This indicate the connectors are fully engaged.

3. The *interconnecting cable* has a short, armored section after the connector. The rest of the *interconnecting cable* is not armored and must be routed through grounded conduit for protection. Ensure that only the armored cable section protrudes from the conduit. Reference *section 1.3* for armored cable specifications.

4. The strut channel used for mounting the Cold Ends (electronics) must also be grounded.

IMPORTANT: *Do not use excessive torque when mating these connections as connector damage may result. The connectors should be engaged by hand without the use of tools.*

Note: *Do not discard the protective caps covering the connectors as they will be reinstalled to prevent damage to the connectors during maintenance outages.*

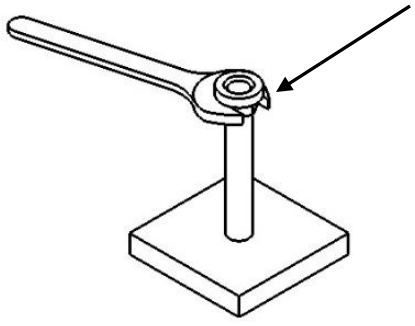
HOT END INSTALLATION

1. Before installing the Hot End onto the sight tube, perform a sensor functional check per the Sensor Checkout section. The flame sensor is installed to the sight tube using a pipe union. The pipe union consists of a 2-1/4" union nut, a female-end to be installed on the sight tube, and a male end that is integral to the flame sensor. To avoid damage to the sensor and the *sensor cable*, two wrenches must be used when installing the Hot End onto the sight tube. See the installation and removal steps below.

2. Apply a small amount of NEVER-SEEZ, PART NO NG-165 (BH PN 248A9779P001) to the external threads of union nut and the threads of the sight tube prior to installing the Hot End of the flame sensor. Be sure the NEVER-SEEZ applied to both parts is minimal and only applied below the 2nd thread. If NEVER-SEEZ is applied to the face of the sight tube or union nut, upon heating, it can fog the window of the flame sensor and reduce output.

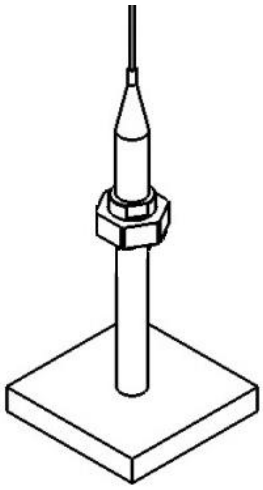
3. Inspect the window and clean with an isopropanol-soaked swab, if required.

4. Tighten female pipe union onto the sight tube hand tight (3-4 full turns). Tighten with a wrench approximately 2.5 additional turns.

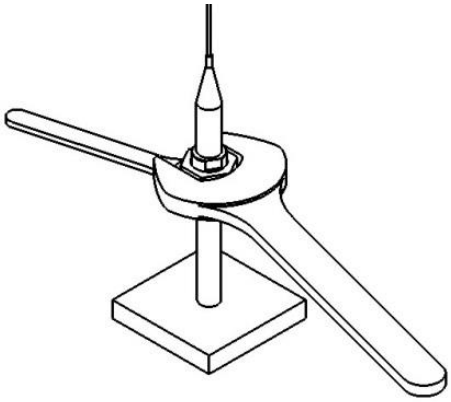


Remove NEVER-SEEZ from faces of the sight tube and f*emale pipe union* end

5. Tighten the *union nut* to the f*emale pipe union* end by hand.



6. Use a 1-5/16" wrench to hold the f*emale pipe union end*. Tighten the *union nut* 120 ft.-lbs. using a 2-1/4" wrench.



7. To temporarily remove the hot end from the sight tube, reverse the instructions in step 6. The female pipe union end may be left on the sight tube. Remove the MI cable from a sufficient number of strut channel clamps and coil up the section of the hot end that is over the turbine. Tie up the coiled hot end and place to the side during outage activities.

CAUTION: THE FLAME SENSOR SEALS HIGH PRESSURES WITHIN THE TURBINE. THE UNION NUT AND FEMALE PIPE UNION END MUST BE TIGHTENED TO THE SPECIFIED TORQUE. INSUFFICIENT TORQUE COULD RESULT IN COMBUSTION GASES BEING RELEASED INTO THE TURBINE COMPARTMENT.

DO NOT WRENCH ON THE SENSOR BODY. ONLY APPLY WRENCHES TO THE HEXAGONAL FEMALE PIPE UNION END AND UNION NUT. WRENCHING ON THE SENSOR BODY MAY CAUSE HOT END DISASSEMBLY AND DAMAGE AND CAN RESULT IN THE MALFUNCTION OF THE SENSOR.

NOTE: UNION NUT SELF-ALIGNS THE FLAME SENSOR BODY TO THE SITE TUBE. THE UNION NUT MUST BE TIGHTENED TO THE SPECIFIED TORQUE. INSUFFICIENT TORQUE COULD RESULT IN POOR FLAME SENSOR SENSITIVITY.

WIRING TO THE CONTROLLER

The sensors are connected to the turbine junction box with *interconnecting cable* RS-E2-0285PXXX or GE engineering approved equivalent. The RS-E2-0285PXXX consists of black, white and green wires twisted and shielded.

IMPORTANT: *All interconnecting cables must be in grounded conduit. The green wire must be connected to earth ground at the junction box. Do not connect the shields to each other or to earth ground at any location. The shields should be individually jumped through all junction boxes and connected to the proper ground terminal at the controller.*

The polarity of the *interconnecting cable* is as follows; white is positive and black is negative/signal return. Reverse polarity will not damage the sensor but will prevent it from operating. Signal cables from the junction box to the controller should be 18 gauge (1.02 mm) twisted shielded pair. The extension cable from the junction box to the controller is the customer's responsibility.

The **Flame Tracker Dry** is connected to the controller through an active intrinsically safe barrier. Do not use passive barriers since they will prevent the sensor from operating properly. The two recommended barriers are the STAHL 9001/51-280-110-141 and the MTL 7706+. They can be operated from any well-filtered DC supply from 20 volts to 30 volts. The nominal operating voltage is 24 VDC. The power supply should be capable of providing 100 milliamps and must be current limited. The sensor is protected against reverse polarity.

The power supply must be protected to prevent the supply voltage from exceeding 30 volts in normal use and more than 42 volts under transient conditions. The maximum value for the sense resistor plus the wire resistance is dependent on the supply voltage. At 24 volts this value is 560 ohms. Resistance values for other voltages can be determined from the chart in Figure 6.

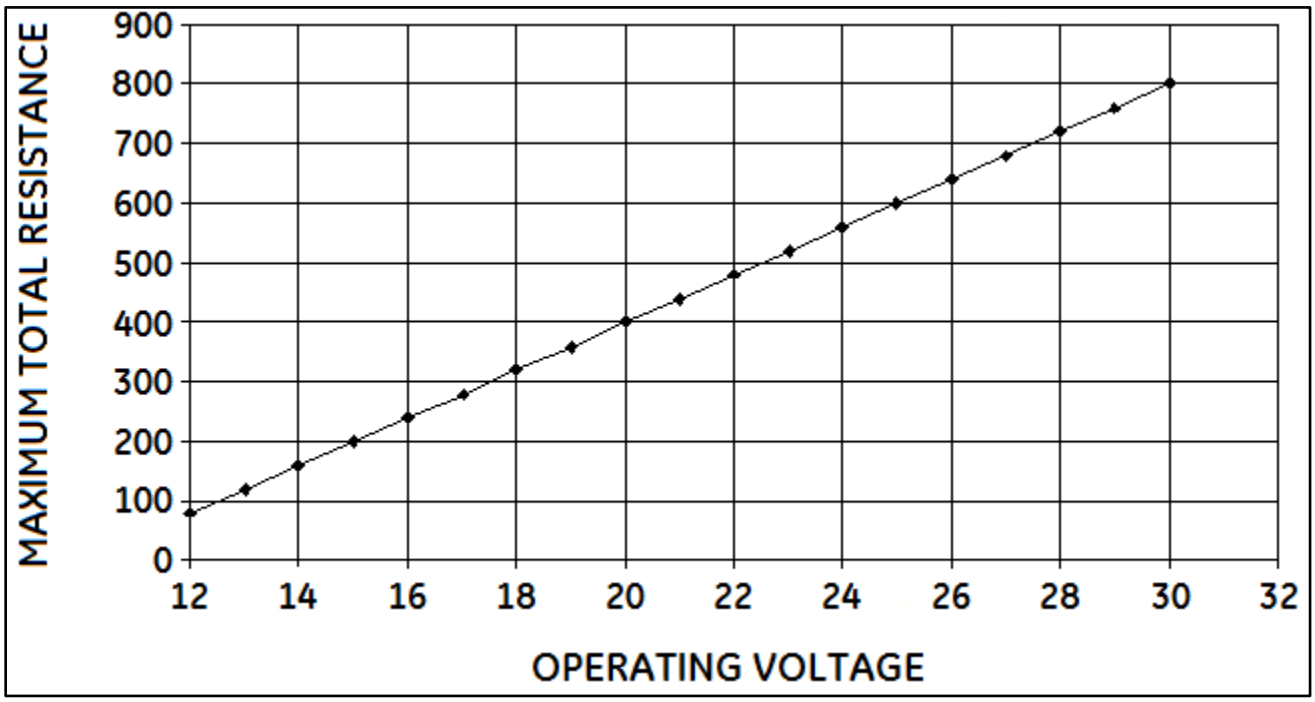


Figure 6: Maximum Resistance vs. Operating Voltage

Figure 3 shows the preferred wiring for the sensor with the R_{sense} of the controller in the return line of the sensor. This configuration can be used with controllers that have single ended inputs (one side of the input grounded) or differential inputs (neither side of the input grounded). For the interconnecting cable pinout see Table .

SENSOR CHECKOUT

WARNING: Do not disconnect while the circuit is energized (live) unless the area is known to be non-hazardous.

CAUTION: The **Flame Tracker Dry** is designed to operate at extreme temperatures. Do not attempt to work on the **Flame Tracker Dry** until it has reached a safe handling temperature.

AVERTISSMENT! risque d'explosion. ne pas brancher ni debrancher sous tension.

Disconnect the sensors and unscrew the Hot Ends from the turbine, being careful to use two wrenches on the union nut to avoid spinning of the sensor. Plug the interconnecting cables back in to each of the Cool Ends. Apply power to the sensors. Check the current values at the controller for each of the sensors. The sensors are sensitive to light, and may have some reading, depending on the ambient light level.

Test each sensor by covering the window to see the "flame off" reading. The "flame off" reading should be 3.60 to 4.25 milliamps. Next, test the "flame on" reading with a flashlight with an incandescent bulb. With most flashlights the reading should be above 8.0 milliamps. An LED flashlight may not work for this application. UV Inspection flashlights with a UV wavelength between 245nm-365nm work best. Variations in flashlight type, strength, or battery voltage may cause variation in signal output. The flashlight test is intended as a field test for general functionality only and is not a controlled or quantitative test. If a sensor is outside these rough limits, see the Troubleshooting section.

Disconnect the *interconnecting cables* and make sure that the sapphire windows in the *Hot End* assemblies are clean. Make sure the sapphire window is clean; If it needs cleaning, do this according to the maintenance instructions in the Maintenance section. Reinstall the sensors according to the Hot End Installation section. After reinstallation, verify with the controller that all sensors still output between 3.60 and 4.25 milliamps under “flame off” conditions.

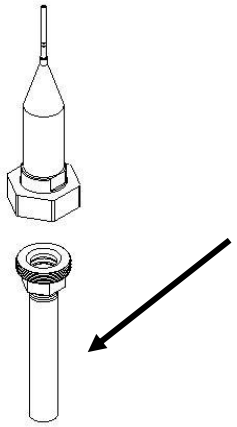
CONTROLLER SETUP

The Flame Sensor provides a minimum output as listed in the Specifications section when exposed to the minimum flame intensity specified. In most turbines, the set point for flame off should be set to 6.25%, which is equal to 5 milliamps. The set point for flame on should be 12.5%, which equals 6 milliamps. If the light intensity levels are too low for these settings, there may be other problems. Refer to the Troubleshooting section.

SENSOR REMOVAL

To remove the sensor reverse the installation process from Hot End Installation section.

WARNING! Do not wrench on the sensor body. Only apply wrenches to the hexagonal male pipe union and union nut. Wrenching on the sensor body may cause hot end disassembly and damage and can result in the malfunction of the sensor.



MAINTENANCE

WARNING: Do not disconnect while the circuit is energized (live) unless the area is known to be non-hazardous.

CAUTION: The Flame Tracker Dry is designed to operate at extreme temperatures. Do not attempt to work on the Flame Sensor or the cable until they have reached to a safe handling temperature.

AVERTISSMENT! risque d'explosion. ne pas brancher ni debrancher sous tension.

Do not remove the sensor by wrenching on the body. Always use the 2-1/4" union nut. Wrenching on the body may breach the seal. Breaching the seal of the sensor will cause loss of the inert fill gas and render the sensor unusable. Once the seal has been broken it cannot be resealed.

Do not attempt to disassemble the sensor. Sensor is not repairable. Once the seal has been broken it cannot be resealed.

The **Flame Tracker Dry** output will deteriorate as the sapphire window becomes dirty. It is recommended, when initially installed, that the signal level be recorded during normal operation. During subsequent operation, the signal level should be compared with the initial values. If a significant reduction in the signal level is noticed, it is recommended that the window be cleaned at the next opportunity (with the turbine shut down and cold). Clean the window with isopropyl alcohol or other residue free solvent compatible with sapphire, stainless steel and gold.

TROUBLESHOOTING

WARNING: Do not disconnect while the circuit is energized (live) unless the area is known to be non-hazardous.

CAUTION: The flame sensor operates at extreme temperatures. Do not attempt to work on the flame sensor until it has reached a safe handling temperature.

AVERTISSMENT! risque d'explosion. ne pas brancher ni debrancher sous tension.

Problem	Cause	Solution
No current flows	1. Reversed polarity 2. Open wire 3. No 12-30V supply	1. Change polarity at junction box, flame sensor module (if applicable – Mark V and below) 2. Check connections at junction box, flame sensor module (if applicable – Mark V and below) 3. Check voltage supply to ensure power is reaching sensor
Low sensitivity during checkout or operation	1. Dirty window 2. Grounded cable 3. Tube mount not torqued	1. Clean window with isopropyl alcohol 2. Check cables for grounds 3. Check torque, torque to specified values
Low flame intensity signal during operation	1. Misalignment of the sensor mount 2. Dirty window 3. Tube mount not torqued	1. Check the squareness of all flanges and pipes of the sensor mount. 2. Verify that the sensors have a clear view of the flame. 3. Ensure the sight tube is properly torqued to the combustion chamber. 4. Ensure that the pipe union end of the hot end in properly torqued.

Periodic low reading on secondaries of DLN1 turbines	1. Condensation on the sensor window that can occur under high humidity situations.	1. A shorter mount tube (PN# E1-0058P002), available from BHGE Reuter Stokes may improve this condition. Please contact Reuter Stokes for further information.
No flame indication	1. Cable connection open 2. Open wire 3. No-12-30V supply 4. Interconnecting cable has failed	1. Check connections at junction box, flame sensor module (if applicable – Mark V and below) 2. Check voltage supply to ensure power is reaching sensor 3. Check voltage supply to ensure power is reaching sensor

Table 5: Troubleshooting

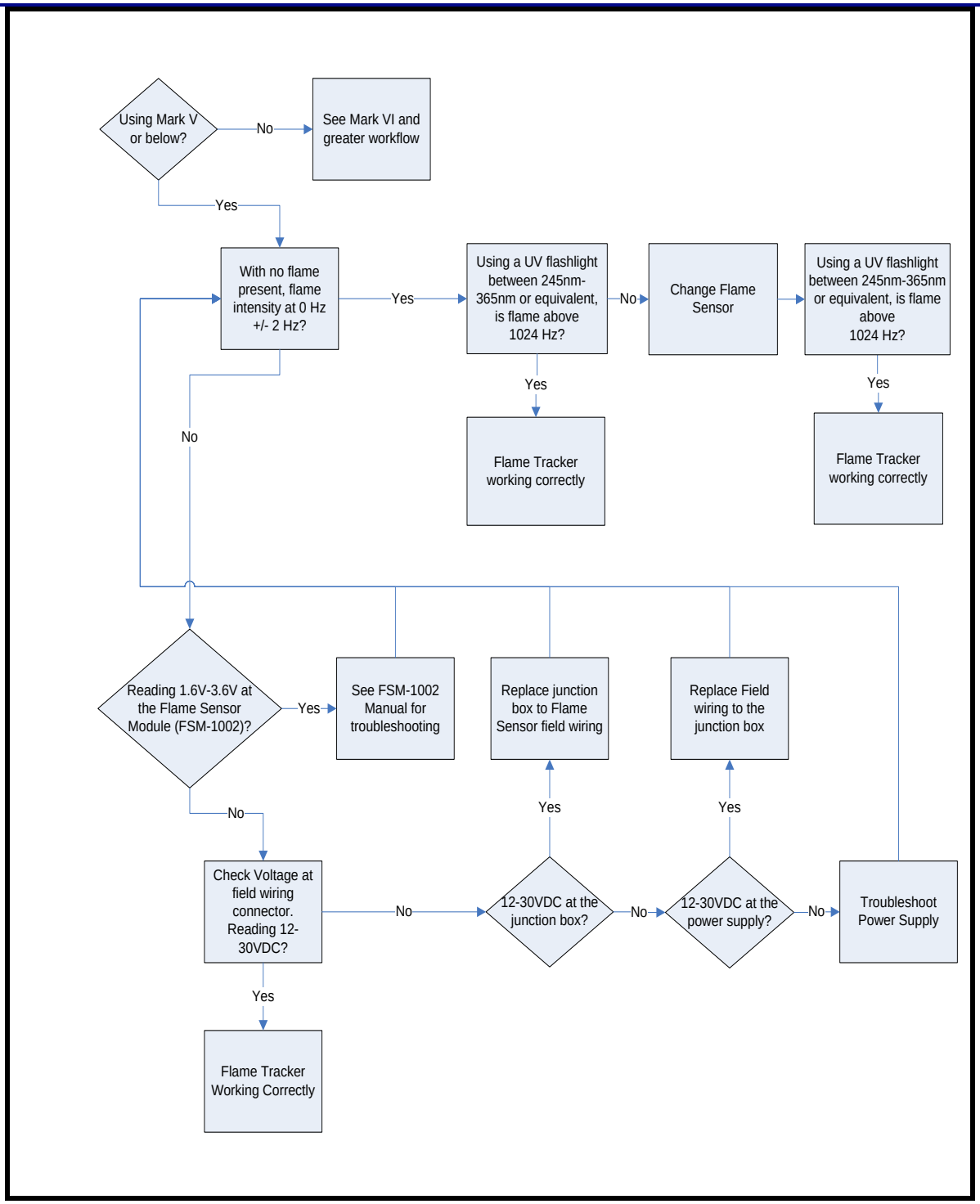


Figure 7: Mark V and Below Control System Troubleshooting Flow Diagram

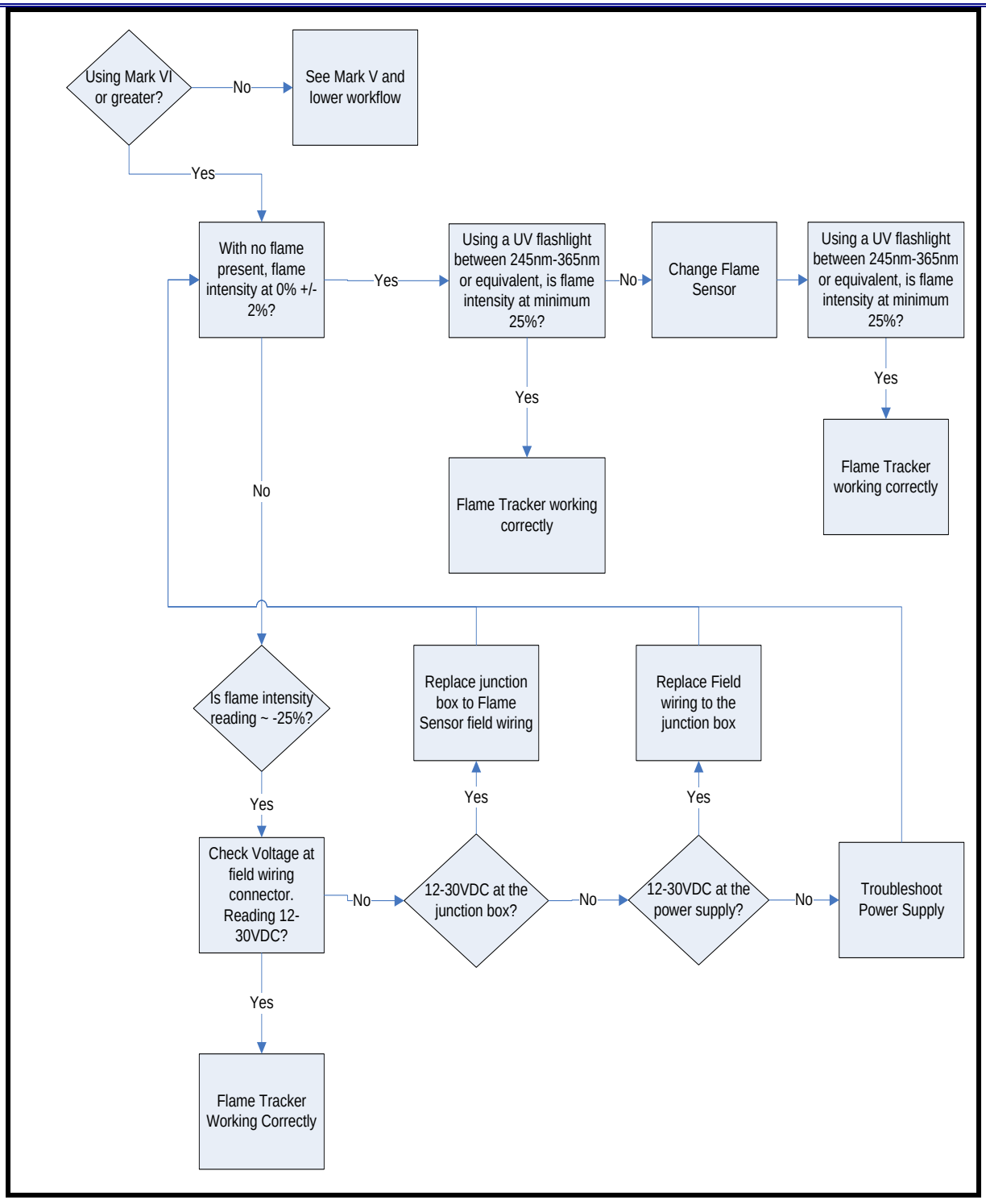


Figure 8: Mark VI and Greater Control System Troubleshooting Flow Diagram

CUSTOMER SUPPORT CENTERS

For Sales, Service and Technical Support:

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T: 330-425-3755

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