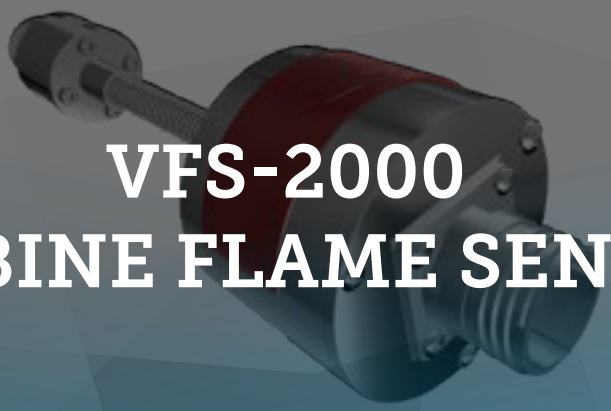
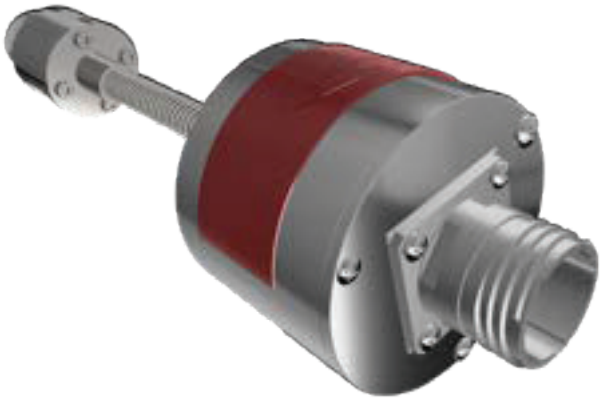
HMA INSTRUMENTATION



# VFS-2000
# TURBINE FLAME SENSOR

## OPERATING INSTRUCTIONS
## PLEASE READ CAREFULLY

# VFS-2000
# Turbine Flame Sensor



## DESCRIPTION

This document describes the Fireye Turbine Flame This document describes the Fireye Turbine Flame Sensor for turbine flame monitoring applications, its installation and setup. The Turbine Flame Sensor responds to Ultraviolet optical energy from the flame (200-400 nanometers) and has a loop powered 4-20mA output representing flame brightness from a very low level. It is not sensitive to visible and IR emissions from hot walls. The Fireye design basis is a total separation of the optical sensing device from the turbine without the need for expensive water or pressurized air cooling systems.

## APPLICATION

The Fireye Turbine Sensor is designed to sense flame in extreme high pressure and hot environments such as those found on turbine generators in power generation facilities. Similar challenging environments can be found near steam boilers, waste incinerators, down-fired reformer furnaces, ground flares, rotary kiln systems, ovens and dryers in power generation facilities, oil refineries, petrochemical, ammonia plants, paper and pulp industries.

## OPERATION

At the hot end is a sapphire glass window to protect the lens and fiber optic bundle from extreme pressure and temperature.

The fiber optic bundle transmits the UV light to the electronic assembly on the cool end, which amplifies the signal and converts it to a 4-20mA output. The sensor is a loop powered 4-20mA device. The sensor monitoring electronics needs to provide a voltage between 18 and 30 VDC and the sensor will vary the current between 4 and 20mA depending upon the turbine optical signal. Nominal voltage is 24 VDC. With no optical signal from the flame output will be 4mA as a minimum. Because of variation in fuel, sighting, turbine styles, etc. the output level for a FLAME ON is a site decision.

Fireye recommends that at least 5 mA be used as a threshold level to detect FLAME ON. The cable has multiple conductors and uses white for +24 VDC and black for the return of the 4-20mA signal.

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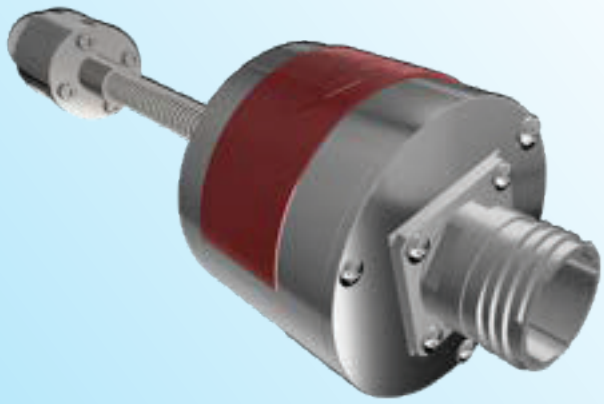
# Contents





# VFS-2000
# Turbine Flame Sensor

## WARNING

**The equipment described in this manual is capable of causing property damage, severe injury, or death. It is the responsibility of the owner or operator to ensure that the equipment described is installed, operated and commissioned in compliance with the manufacturer's instructions and all applicable codes and regulations.**

When this equipment is fitted to an appliance, due regard must also be given to the requirements of that appliance.

Before attempting to install, commission, or operate this equipment, all relevant sections of this document must be read and fully understood. If in doubt about any requirements consult your supplier.

Installation, commissioning or adjustment of this product MUST be carried out by suitably trained engineers or personnel qualified by training and experience.

The manufacturer of this equipment accepts no liability for any consequences resulting from inappropriate, negligent or incorrect installation, commissioning or adjustment of operating parameters of the equipment. There are no user serviceable parts.

Before attempting any work on this equipment or any equipment controlled by or connected to this equipment, all related electrical supplies MUST be isolated. Safety interlocks MUST NOT be removed or overridden. Any faults once detected must be corrected before the control is operated.

**DO NOT** disconnect the sensor while the circuit is energized (live), unless the area is known to be non-hazardous and free of explosive gases. These paragraphs indicate a risk of potential serious personal injury, unless these instructions are followed carefully.

Failure to properly install or operate the equipment in this manual could result in significant property damage, severe injury, or death. It is the responsibility of the owner or user to ensure that the equipment described is installed and operated in compliance with this manual and other system component manuals, as well with all applicable national and local codes.

The flame sensor seals high pressures within the turbine. The union nut must be tightened to the specified torque. Insufficient torque could result in combustion gases being released into the turbine compartment. The window holds pressure. The union is only for mechanical attachment. The Turbine Sensor and its accessories are designed to operate at extreme temperatures. Do not attempt to work on this device until it has reached a safe handling temperature. The fiber optic cable cannot be bent to a radius less than 6 inches or 15 cm. Do not install a flame sensor that has a cracked window, damaged threads, or one that has been disassembled. Explosion hazard. Do not connect or disconnect when energized.

# VFS-2000
# Turbine Flame Sensor

## DIMENSIONS

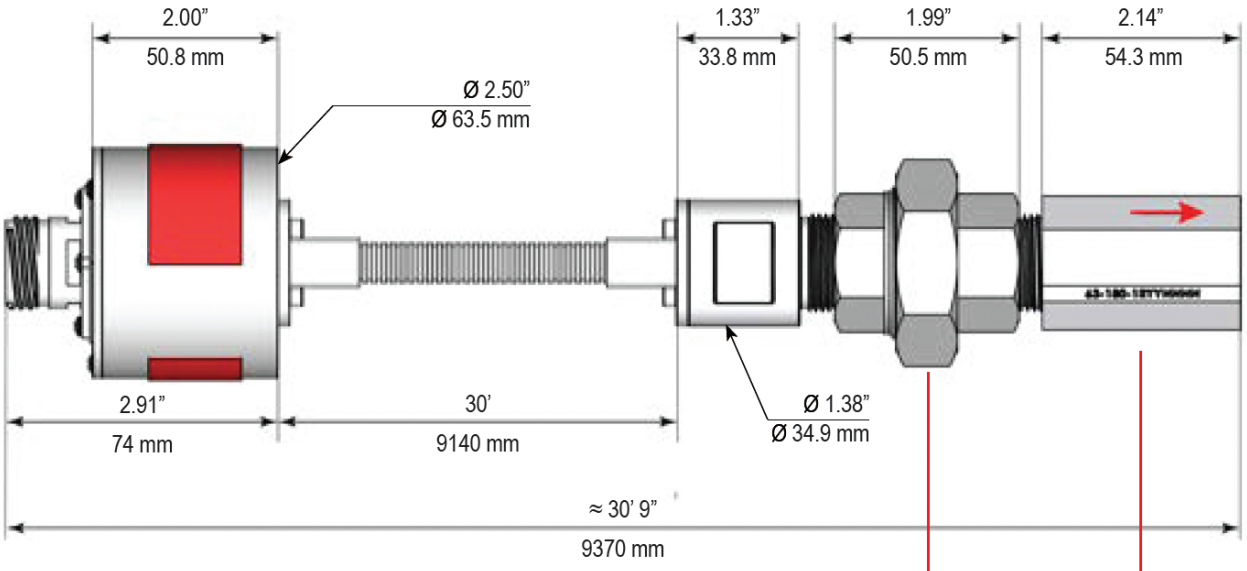
**VFS-2000-Kxx : Turbine flame sensor kit includes**

- Turbine flame sensor head & amp - Electronics assembly
- High pressure, high temperature window
- Stainless steel high temperature union
- UV Enhanced quartz fiber optic (fully sheathed) assembly, hot & cold end connections

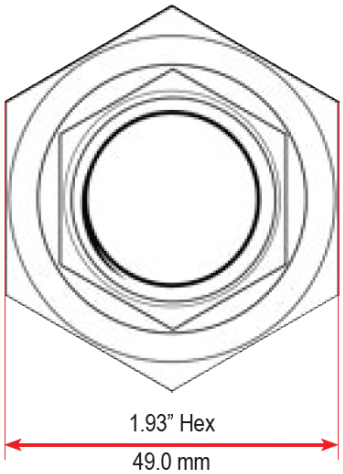
**Fiber optic length :**

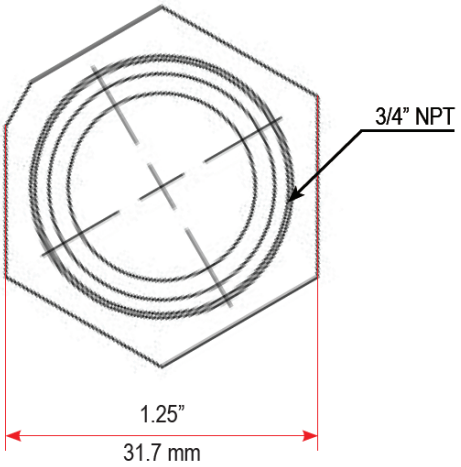
**VFS-2000-K15 : 15 feet or 4.6 meter**

**VFS-2000-K30 : 30 feet or 9.1 meter**




STAINLESS STEEL, HIGH TEMPERATURE UNION




HIGH PRESSURE, HIGH TEMPERATURE WINDOW

# VFS-2000
# Turbine Flame Sensor

## THE COOL END....


## THE HOT END....


## HAZARDOUS AREA REQUIREMENTS:

The plastic "Loc Fast" retainers (supplied) must be installed over the electrical connector.

High temperature electrical cable & backshell with exterior cable braid

## DET-TRONICS PORTABLE TURBINE SENSOR UV TEST LAMP

Specifically designed, intrinsically safe and portable, battery operated source of ultraviolet radiation, emitting a wide band of UV radiation corresponding to the response of the turbine sensor.

DET-TRONICS

# VFS-2000
# Turbine Flame Sensor

## SPECIFICATIONS

| VFS-2000-Kxx | |
|---|---|
| **Service** | FLAME SENSOR |
| **Manufacturer** | Fireye Inc |
| **Hazardous area classification** | Class I, Div 2 - Groups A,B,C & D, (North America). Ex II 3G Ex ec IIC T3 Gc (ATEX/IECEx) |
| **Housing material** | Stainless Steel 18-8 (304) |
| **Mounting connection** | 3/4" male NPT |
| **Min. operating temperature** | 32°F/0°C |
| **Min. operating temperature tested** | -40°F/-40°C |
| **Max. operating temperature hot end** | 618°F/325°C |
| **Max. operating temperature cool end** | 284°F/140°C |
| **Humidity** | 100% |
| **Vibration** | Per IEC 60068-2-64, Stationary Installation, Category 3 |
| **Detection principle** | Ultraviolet solid state sensor |
| **Sensor** | Silicon Carbide Diode |
| **Sensitivity** | 1nW/cm$^2$@310nm |
| **Output** | 4-20mA DC, current loop |
| **Flame Present Detection Time** | 175ms (typical < 75ms) |
| **Flame Failure Detection Time** | 175ms (typical < 75ms) |
| **Power supply** | 18-30 VDC |
| **Reverse polarity protected** | YES |
| **Electrical connection** | 5-pin male MIL-DTL-38999 shell, size 15 series III hermetic, scoop proof |
| **SIL Rating** | SIL 3 |
| **SIL Certificate** | EN61508 |
| **UL Certificate** | UL 353, 5th Ed., Issue Date: 1994-09-23, Revision Date: 2011-11-08 |
| **CSA Certificate** | C22.2 NO. 24-15, 9th Ed. Issue Date: 2015-01-01 |
| **CE Certificate** | EUROPEAN COMMUNITY COUNCIL DIRECTIVE 2014/30/EU |
| **Emissions** | FCC Part 15, Subpart B, Class A (30MHz to 1GHz) |
| **Expected lifecycle** | 36,000 hours |
| **Warranty standard** | 18 Months |

# VFS-2000
# Turbine Flame Sensor

## SPECIFICATIONS

| 63-180 | |
|---|---|
| **Service** | WINDOW |
| **Housing material** | Stainless Steel 316 |
| **Window** | Sapphire glass |
| **Mounting connection** | 3/4" female NPT |
| **High pressure window, differential pressure** | 27ATM/400PSI/27.5 bar |
| **High pressure window, differential temperature** | 849°F/454°C |

| 35-410 | |
|---|---|
| **Service** | UNION COUPLING |
| **Housing material** | Stainless Steel 316 |
| **Mounting connection** | 3/4" female NPT thread on both sides |

| | 59-606-40 | 59-606-60 | 59-606-80 | 59-606-100 |
|---|---|---|---|---|
| **Service** | CABLE & CONNECTOR | | | |
| **Manufacturer** | Fireye Inc | | | |
| **Shield** | YES | | | |
| **Voltage** | 18-30 VDC | | | |
| **Temperature range** | -40°F/-40°C - 284°F/140°C | | | |
| **Cable length** | 40 feet / 12.1 meter | 60 feet / 18.1 meter | 80 feet / 24.3 meter | 100 feet / 30.4 meter |

| | 59-606-40 | 59-606-60 | 59-606-80 | 59-606-100 |
|---|---|---|---|---|
| **Service** | CABLE & CONNECTOR | | | |
| **Manufacturer** | Fireye Inc | | | |
| **Shield** | ARMORED | | | |
| **Certification** | ATEX/IECeX | | | |
| **Voltage** | 18-30 VDC | | | |
| **Temperature range** | -40°F/-40°C - 284°F/140°C | | | |
| **Cable length** | 40 feet / 12.1 meter | 60 feet / 18.1 meter | 80 feet / 24.3 meter | 100 feet / 30.4 meter |

# VFS-2000
# Turbine Flame Sensor

## PART NUMBERS

| REFERENCE | |
|---|---|
| **VFS-2000-K15** | Turbine flame sensor with fiber optic length 15 feet / 4.6 meter, Incl. high pressure, high temperature window & union |
| **VFS-2000-K30** | Turbine flame sensor with fiber optic length 30 feet / 9.1 meter, Incl. high pressure, high temperature window & union |
| **59-606-40** | High temperature electrical cable & prefabricated molded connector 40 feet / 12.1 meter |
| **59-606-60** | High temperature electrical cable & prefabricated molded connector 60 feet / 18.1 meter |
| **59-606-80** | High temperature electrical cable & prefabricated molded connector 80 feet / 24.3 meter |
| **59-606-100** | High temperature electrical cable & prefabricated molded connector 100 feet / 30.4 meter |
| **59-621-40** | High temperature electrical cable & backshell with exterior cable braid. 40 feet / 12.1 meter, EU |
| **59-621-60** | High temperature electrical cable & backshell with exterior cable braid. 60 feet / 18.1 meter, EU |
| **59-621-80** | High temperature electrical cable & backshell with exterior cable braid. 80 feet / 24.3 meter, EU |
| **59-621-100** | High temperature electrical cable & backshell with exterior cable braid. 100 feet / 30.4 meter, EU |

## PACKING

| | | |
|---|---|---|
| **Weight** | 7 lbs | 3.18 kg |
| **Length** | 34.25" | 870 mm |
| **Width** | 34.25" | 870 mm |
| **Height** | 3.75" | 95 mm |

# VFS-2000
# Turbine Flame Sensor

## MECHANICAL INSTALLATION

**There are four components to the sensor installation:**

- Turbine Flame Sensor with integral optical fiber (Ref. NED-GEAC-2000)
- High pressure, high temperature window
- Stainless steel 3/4 inch high temperature union
- High temperature electrical cable

## INSTALLATION

First step: Check all items for possible damage and/or discrepancies.
Do not install a flame sensor that has a cracked window, damaged threads, or one that has been disassembled.

Inspect the turbine sensor connection. Make sure the thread is clean and undamaged.

With respect to temperature, apply a small amount of high temperature lubricant to all threads before assembling. The use of hydrocarbon-based lubricant is not allowed.

Before installing the HIGH PRESSURE WINDOW, make sure both sides of the window are clean and if necessary clean with isopropanol cotton swab. Make sure window is clean and completely dry before installing.

The high temperature window, rated to 350°C (700°F) and 27ATM/400 PSI (27.5 bar) has a 3/4 inch NPT thread on both sides and is marked to show the orientation to be installed on the turbine. Install the window on the turbine view port, hand-tight. Tighten with a 11/4 inch wrench or approximately 2.5 turns. STOP tightening when 125 ft-lbs of torque is reached.

Separate the UNION and tighten one side to the HIGH PRESSURE WINDOW. Tighten with a 11/4 inch inch wrench for approximately 2.5 turns and STOP tightening when 125 ft-lbs of torque is reached.

Install the other side of the UNION to the LENS HOUSING. Tighten with a 11/4 inch wrench, securing the LENS HOUSING with a 11/16 inch wrench for approximately 2.5 turns and STOP tightening when 125 ft-lbs of torque is reached.

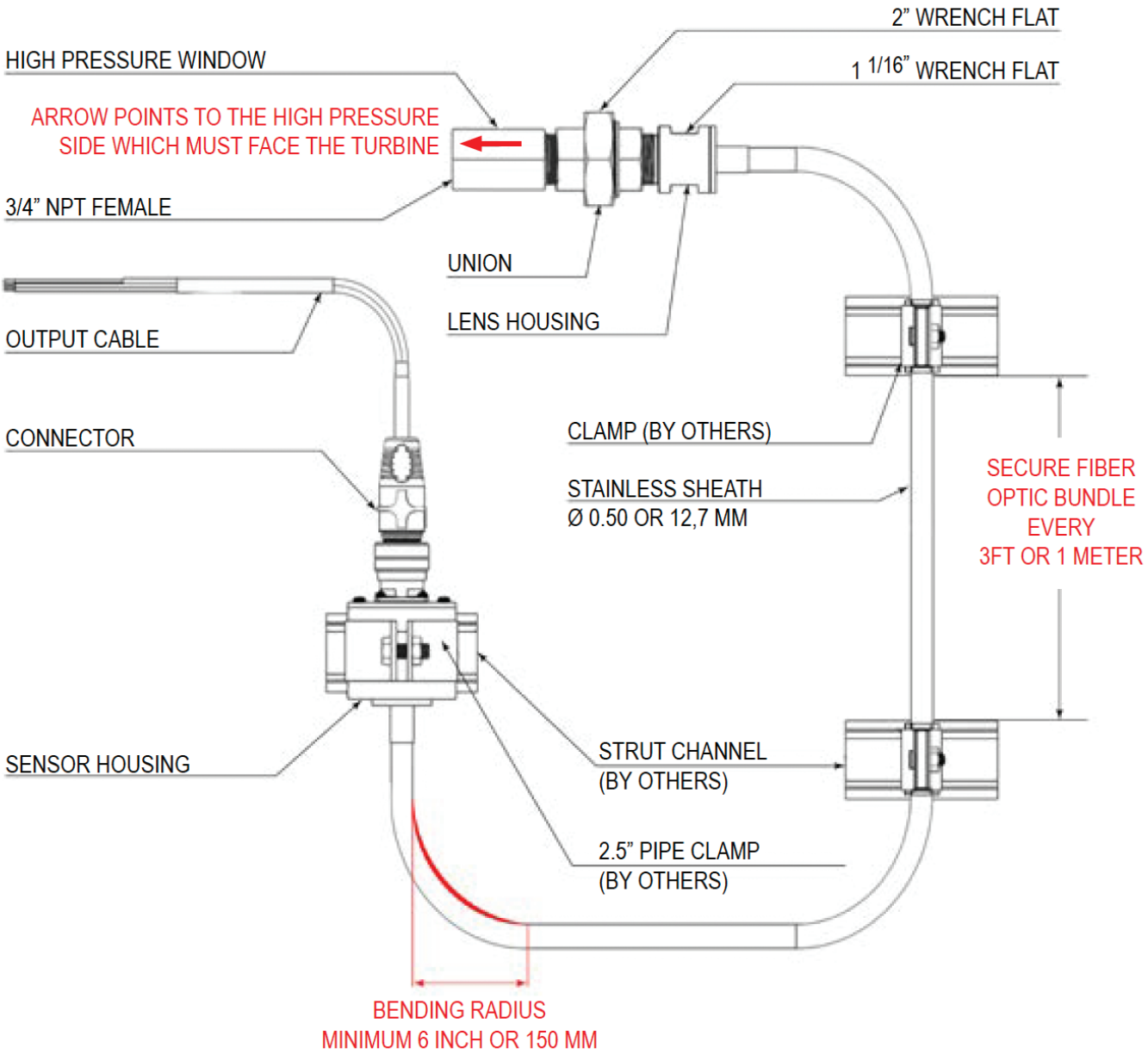
Mate the two union halves together. This will connect the LENS HOUSING with its integral fiber optic cable to the HIGH PRESSURE WINDOW. Tighten with a 2 inch wrench and a 11/4 inch inch wrench. DO NOT exceed 125 ft-lbs of torque. The union eliminates the need to rotate the fiber optic for installation.

The FIBER OPTIC BUNDLE should not be routed with any radius less than 6 inches (15 cm). Fireye recommends P-clamps or similar be installed every 3 feet (1 meter) to support the fiber optic bundle and avoid damage caused by vibration.

CHECK

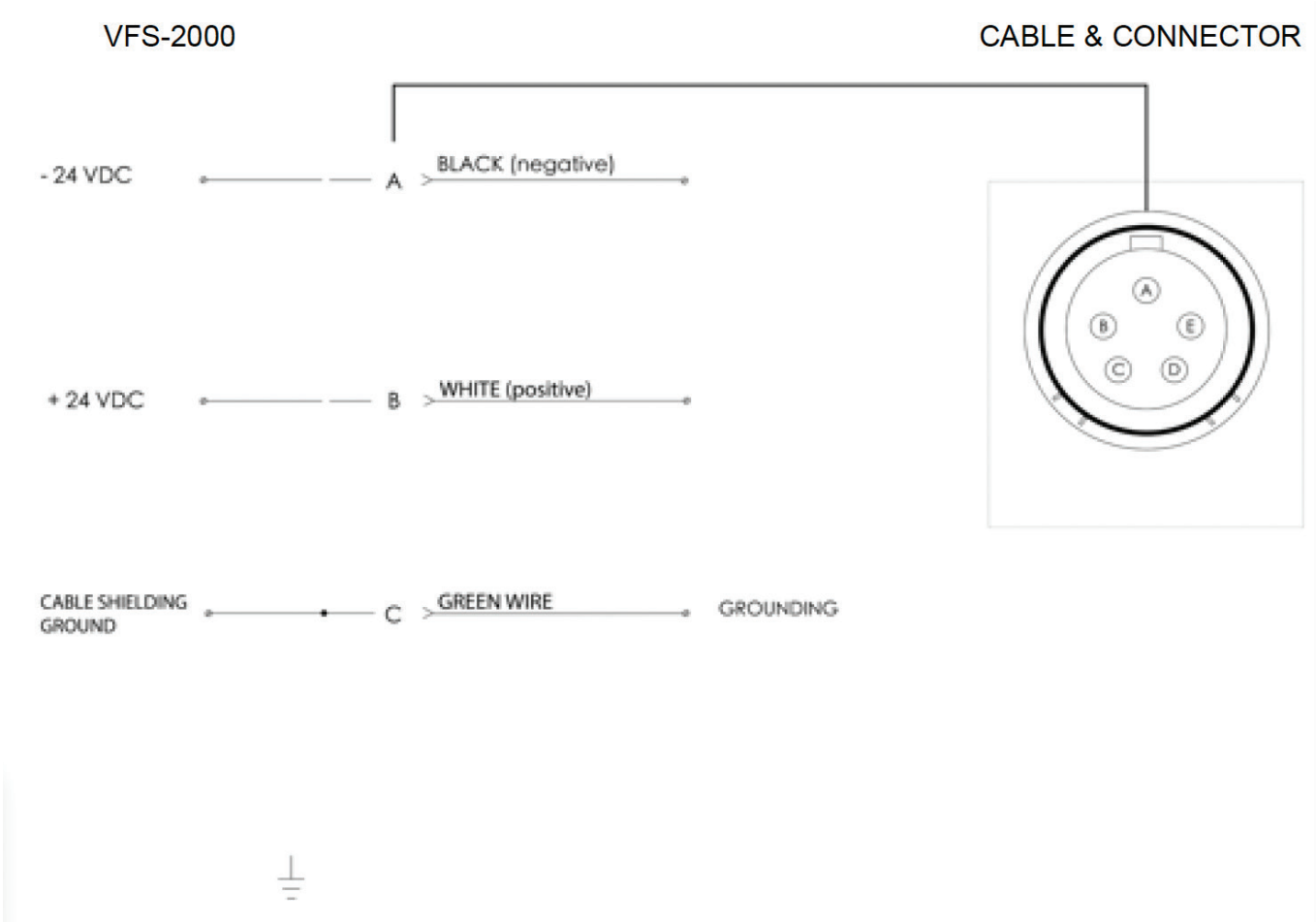
The SENSOR HOUSING temperature limit is 284°F/140°C. It is sealed against dust and fluids exposure & designed to be mounted with a 2.5 inch pipe clamp (not supplied).

# VFS-2000
# Turbine Flame Sensor



# VFS-2000
# Turbine Flame Sensor

## WIRING DIAGRAM




## ELECTRICAL INSTALLATION

Before attempting any work on this equipment or any equipment controlled by or connected to this equipment, all related electrical supplies MUST be isolated.

Mount the OUTPUT CABLE along the strut channel around the turbine with sufficient length to handle the connector. The electrical cable must be routed in conduit and the conduit must be grounded.

Do not use excessive torque when mating as connector damage may result.

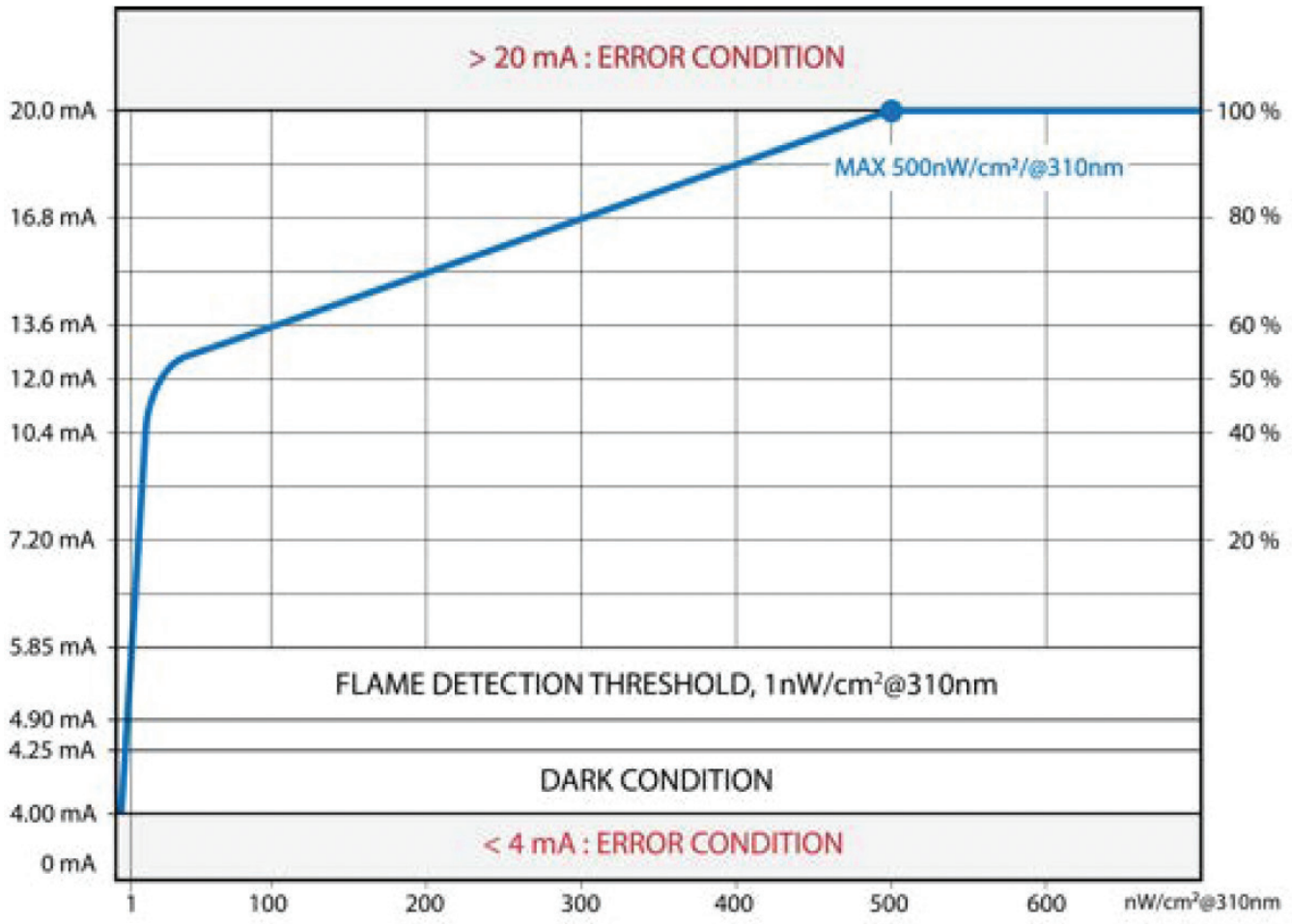
With power off, wire the cable to the junction box.

- BLACK: -24 VDC (negative) A
- WHITE: +24 VDC (positive) B
- GREEN WIRE: Grounding C

CHECK

# VFS-2000
# Turbine Flame Sensor

## OUTPUT




| CONDITION | BRIGHTNESS | ANALOG OUTPUT |
|---|---|---|
| FLAME OFF | DARK | < 4.25mA |
| FLAME ON | 1nW/cm²@310nm | between 4.90mA & 5.85mA |
| Maximum flame | > 500nW/cm² | < 20mA |

- A current less than 4mA or greater than 20mA are considered error conditions.
- The response time is less than 175ms. (Typically < 75ms)

# VFS-2000
# Turbine Flame Sensor

## MAINTENANCE

No calendar/time-based preventive maintenance is required.

The feedback from the sensor however provides data that can be used for machine learning and to indicate the necessety for maintenance interaction. Monitoring the data will contribute in reducing reliability risks for operations.

**Following events may trigger a technical intervention:**

- A value below 4mA or above 20mA indicates an error condition.
- Check wiring, polarity and grounding
- A significant signal drop during operation may indicate the presence of condensation or dirt.

# VFS-2000
# Turbine Flame Sensor

## LAST MINUTE RISK ANALYSIS (LMRA)

**Following items serve as a guideline to complete the LMRA in place and do not overrule any local regulations.**

Inspect the turbine sensor connection. Make sure the thread is clean and undamaged.

With respect to temperature, apply a small amount of high temperature lubricant to all threads before assembling. The use of hydrocarbon-based lubricant is not allowed.

Before installing the HIGH PRESSURE WINDOW, make sure both sides of the window are clean and if necessary clean with isopropanol cotton swab. Make sure window is clean and completely dry before installing.

CHECK

**Danger of hot surface**
A hot surface can burn skin, either by contact or from radiated heat. The eyes are particularly sensitive to burning, especially from UV light radiation. Follow local Personal Protective Equipment (PPE) guidelines with fire-resistant garments and gloves, face masks and eye protection as a minimum.

**Danger of explosion**
for manipulating an electrical connector in a hazardous area, where there is potential for an explosive atmosphere special precautions apply. Please verify local regulations. Wearing a gasdetector as a minimum requirement.

**Risk of high pressure & high**
The turbine sensor is mounted on a high pressure, high temperature viewport. Ensure correct handling of the isolation valve prior to removing any of the turbine sensor components.

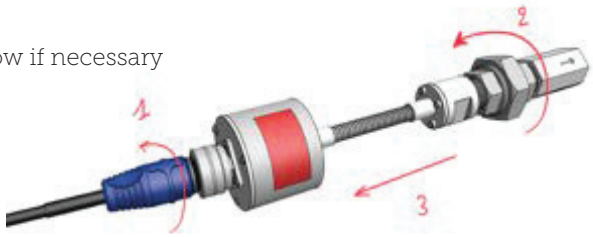
# VFS-2000
# Turbine Flame Sensor

## MAINTENANCE PROCEDURE

**STEP 1: REMOVE THE SENSOR**

- Disconnect the electrical connector to remove the power from the sensor. Caution: this may lead to an alarm in the control room. **HIGH TEMPERATURE, HIGH PRESSURE WARNING!**
- Open the 3-piece union coupling to disconnect the hot end from the turbine.
- Check all items for possible damages and/or discrepancies.
- Check the visibility of the flame by looking through the high pressure, high temperature window. **USE EYE PROTECTION!**
- Clean or replace the high pressure, high temperature window if necessary

CHECK




**STEP 2: IF NEEDED, CLEAN OR REPLACE HIGH TEMPERATURE, HIGH PRESSURE WINDOW**

**HIGH TEMPERATURE/HIGH PRESSURE WARNING!**

Close the block valve in front of the window completely.

- Remove the window.
- Check for possible damage and/or discrepancies.
- Replace in case of cracked window or damaged threads.
- Clean the window from both sides with an isopropanol cotton swab.
- Make sure window is clean and completely dry before re-installing.
- Install the window and tighten with a $1^{1/4}$ inch wrench for another 2.5 turns, approximately.
- Make sure the arrow points towards the turbine.

- Repeat the visibility check of the flame by looking through the high pressure, high temperature window. **USE EYE PROTECTION!**
- Repeat the cleaning procedure if necessary.

CHECK

# VFS-2000
# Turbine Flame Sensor

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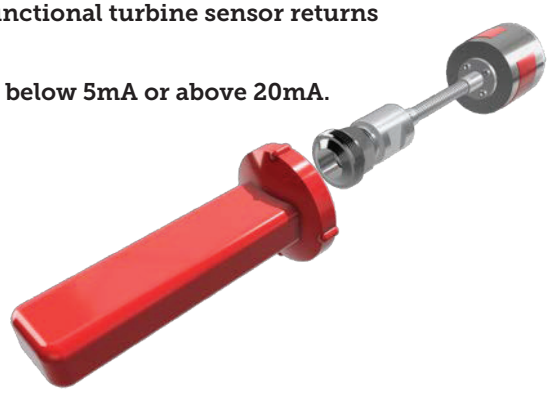
### STEP 3: TEST TURBINE SENSOR FUNCTIONALITY

- Place the turbine sensor in a comfortable position to prevent it from falling, within reach of the electrical connector
- Re-connect the electrical connector to power the turbine sensor.
- Be sure to wear proper **EYE PROTECTION.**
- Check all items for possible damages and/or discrepancies.
- Place the portable, Intrinsically safe UV test lamp in front of turbine sensor window as shown below to simulate a flame.
- **A good functional test lamp, close and in front of a good functional turbine sensor returns a signal between 5mA and 20mA.**
  **We recommend to replace the turbine sensor for any value below 5mA or above 20mA.**

CHECK



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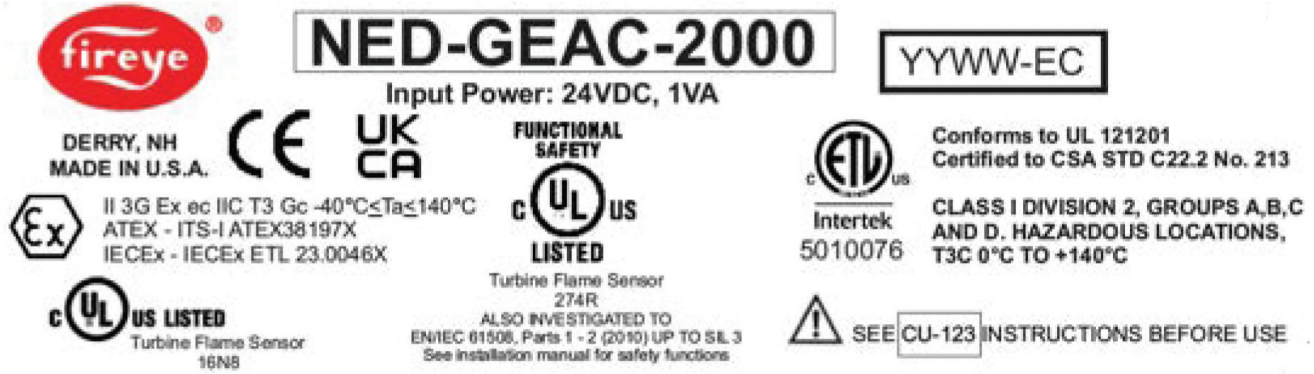


## CERTIFICATIONS

- SIL3 Certificate EN/IEC 61508
- UL Certificate UL 353, 5th Ed., Issue Date: 1994-09-23, Revision Date: 2011-11-08
- CSA Certificate C22.2 NO. 24-15, 9th Ed. Issue Date: 2015-01-01
- CE: EUROPEAN COMMUNITY COUNCIL DIRECTIVE 2014/30/EU
- UKCA
- ATEX: ITS-I ATEX38197X
- IECEx: IECEx ETL 23.0046X

## NOTICE

When Fireye products are combined with equipment manufactured by others and/or integrated into systems designed or manufactured by others, the Fireye warranty, as stated in its General Terms & Conditions of Sale, pertains only to the Fireye products and not to any other equipment or to the combined system or its overall performance.

## WARRANTIES, EXCLUSIVE REMEDIES, AND LIMITATION OF DAMAGES

Fireye guarantees for 24 months from the date of manufacture to replace, or at its option, to repair any product or part thereof which Fireye, in its sole discretion, deems to be defective in material or workmanship or which otherwise fails to conform to the description of the product on the face of its sales order. Fireye's obligations pursuant to this warranty do not extend to any products or parts thereof which Fireye determines to have been installed, operated, maintained, repaired, or altered improperly or otherwise than in conformity to Fireye's applicable instructions, or which have been subject to misuse, accident or neglect.

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