



BURNERS

FLARES

THERMAL OXIDIZERS

VAPOR CONTROL

RENTALS

AFTERMARKET



ZEECO

ProFlame™ and ProFlame+™ Integrated Flame Scanners

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What Are Flame Scanners?



- Provides a safety input to a Burner Management System (BMS)
- Helps prevent boiler explosions by meeting approval agencies' various testing requirements
- Designed to **detect** target flames and **discriminate** background flames



Where Are Flame Scanners Applied?

Power Plants

- Duct Burners
- Steam Boilers
- Air Heaters
- CFB



Petro-Chemical / Refineries

- Incinerators
 - SRU's
- Heaters
- Power Boilers





Where Are Flame Scanners Applied?

Pulp & Paper

- Dryers
- Power Boilers
- Black Liquor Recovery



Other Industrial Plants

- Wood/Laminate Flooring
- Steel Industries
- Cement Plants
- Wastewater Treatment
- Food Processing
- Education
 - Universities



Flame Scanner Approval Agencies

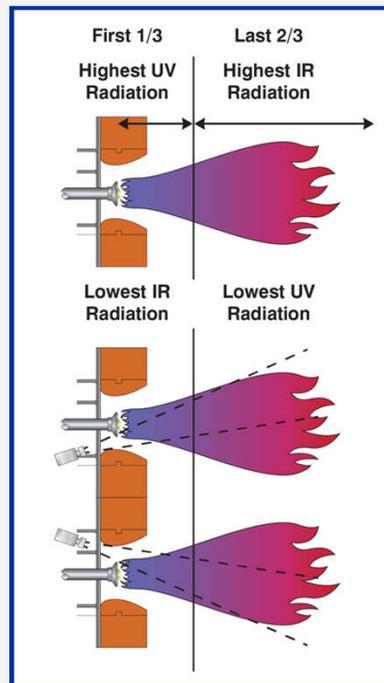


- CE (EN298 and EN230)
 - TÜV
 - ATEX and IECEX
- GOST-R (Russia)
- Marine - Lloyds Register
- InMetro (Brazil)
- North American
 - UL
 - CSA and cUL
 - FM

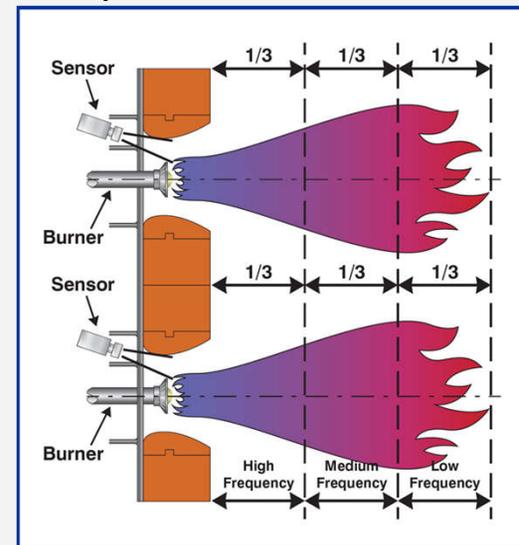
Basic Flame Characteristics (regardless of fuel)



UV/IR Concentrations



Flame Flicker Frequencies



Types of Flame Scanners



➤ Direct Contact Sensors

- Flame Rod – typically used on small heat input gas burners or gas pilots

➤ Optical Sensors

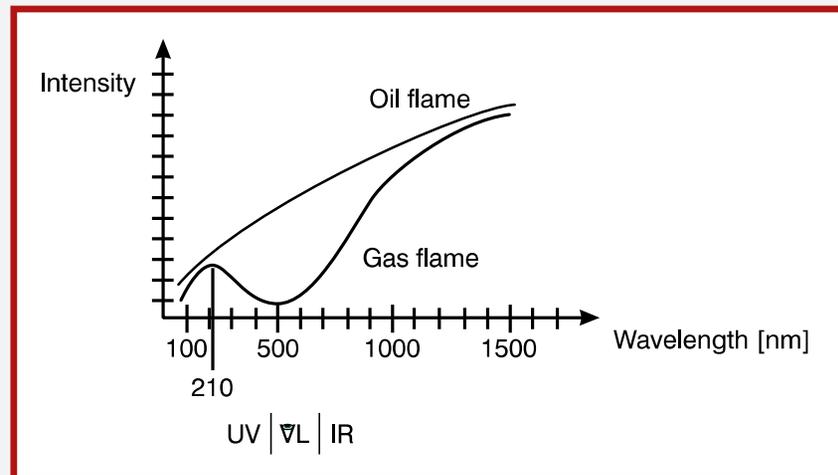
- Ultraviolet Radiation – typically used on gas flames and light oil flames
- Infrared Radiation – typically used on oil and coal flames
- Visible Light Radiation – typically used on residential heaters

Optical Flame Sensor Types



- Ultra-Violet (UV) Sensors
 - Quartz UV Tube
 - Solid State

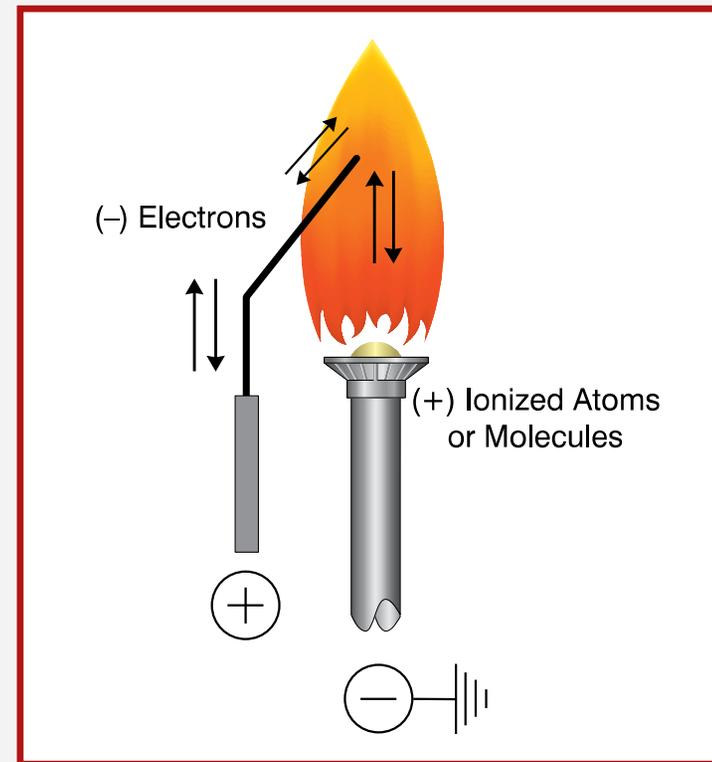
- Infra-red (IR) Sensors
 - Solid State



Flame Rod (aka Flame Ionization or Flame Rectification)



- The Flame Rod is an electrode
- Voltage is applied to the rod tip
- Combustion generates ions (+/-)
- Since the flame is conductive, current can flow between rod tip and ground. No flame, no current
- (-) Ions (electrons) collect on rod
- (+) Ions (protons) collect on ground



Flame Rod Summary



➤ Flame-On Signal

- Applied AC voltage during flame-on, results in rectified DC current
- 4:1 ground to rod ratio results in positive current flow

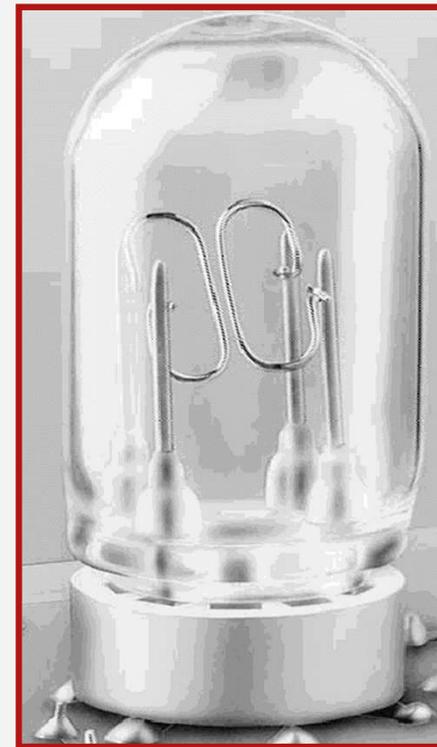
➤ No Flame Signal

- Fouled rod or ground surface prevents current flow
- Flame rod too far from ground surface
- No flame equals no current flow (open circuit)
- Rod tip touching ground or damaged ceramic insulator is a short circuit

Quartz UV Tube



- Response range
 - Typically 190nm to 280nm
- UV Tube Exciters
 - UV as byproduct of combustion
 - UV from Sun
 - X-Rays and Gamma Rays
- UV Tube Blockers
 - Water vapor (FGR or atomizing steam)
 - Unburned fuel
 - Some process gases (H_2S , NH_3 due to H_2O byproduct of the combustion process)
 - Glass windows or glass sealing unions



UV Tube Failure Modes



- Fails Safe: The tube ceases to fire, or fires intermittently
 - Caused by age and a total loss of UV sensitive backfilled gas
 - Results in no operation, or nuisance shutdowns

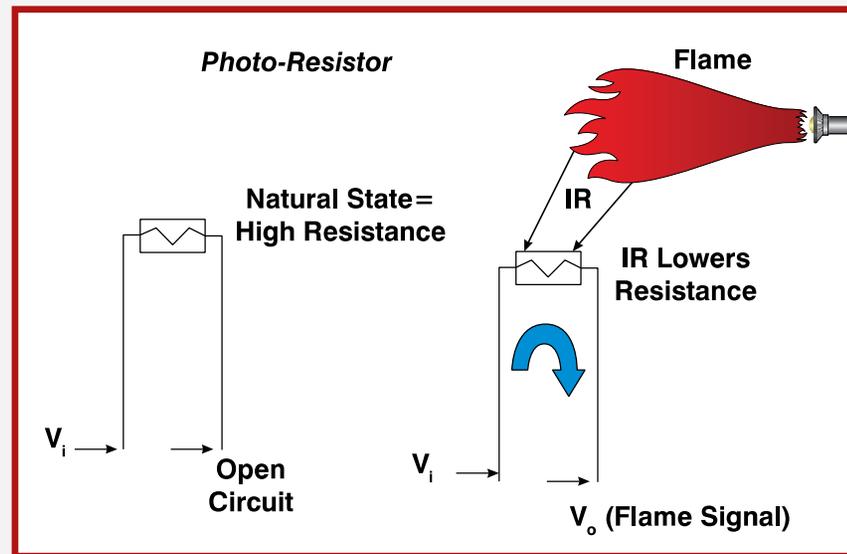
- Fails Unsafe: The tube continues to generate pulses after the ultraviolet source is removed or is sensitive to visible light
 - Contaminated electrode causes increase in de-ionization time.
 - Results in constant Flame-ON indication

- Electro-mechanical self-check is employed to ensure safe operation
 - Electro-mechanical shutter periodically blocks the UV striking the UV tube electrodes
 - The flame amplifier expects the output to go to zero when the shutter closes
 - If the output does not go to zero, the logic will de-energize the flame relay, shutting down the burner

Solid State Scanners



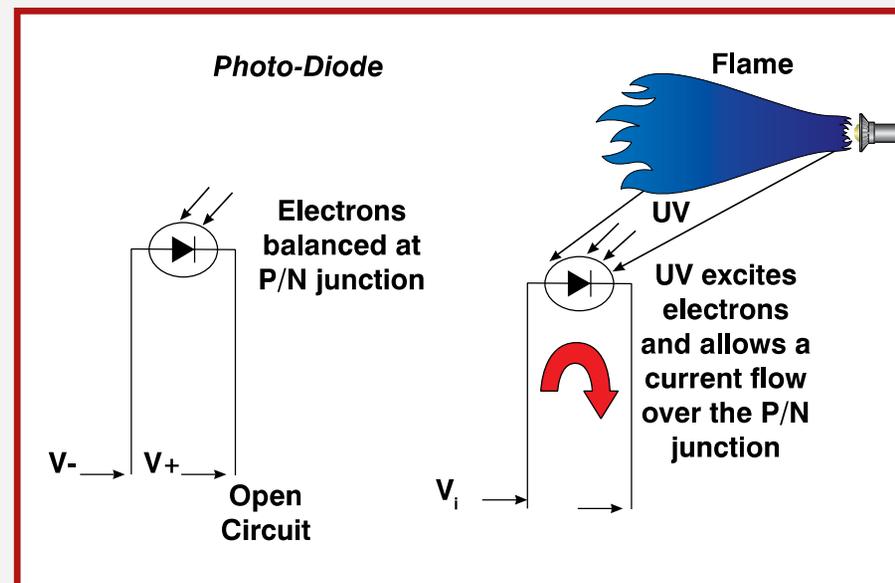
- IR Scanners typically use a Lead Sulfide (PbS) Photo-resistor. The PbS decreases resistance, in the presence of IR radiation



Solid State Scanners



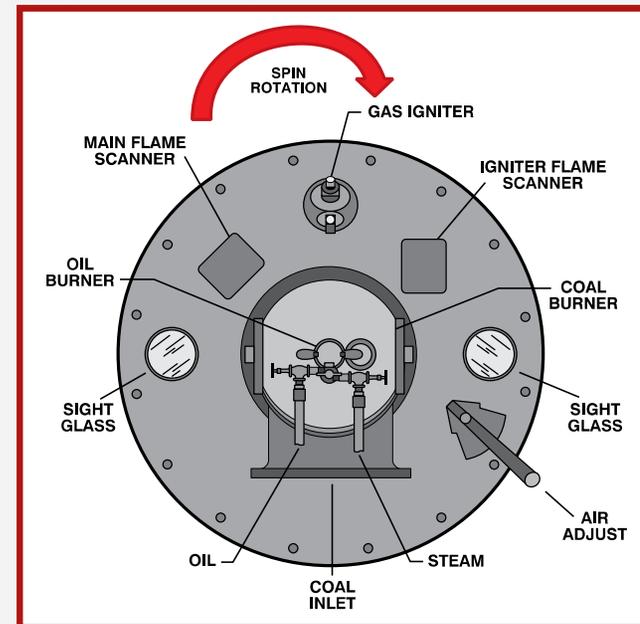
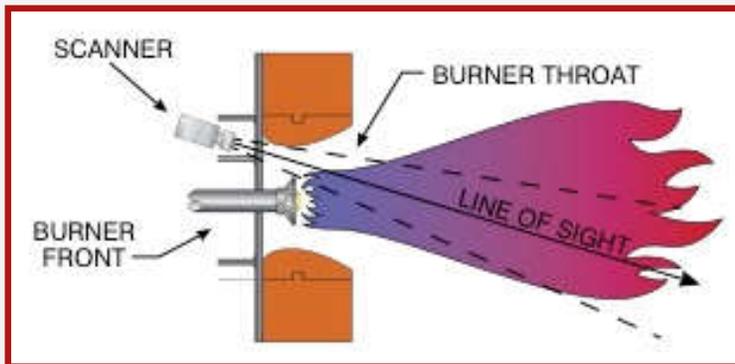
- UV solid state is usually Silicon (Si) based photodiode. As the UV strikes the P/N junction, electrons mix so current can flow



Optical Scanner Checks



- Spin rotation of burner
- Line of sight to flame
- Physical obstructions to viewing the flame (pipes, diffuser, bent sight tube, rust, dust, clinkers, risers, etc)



NOT THIS



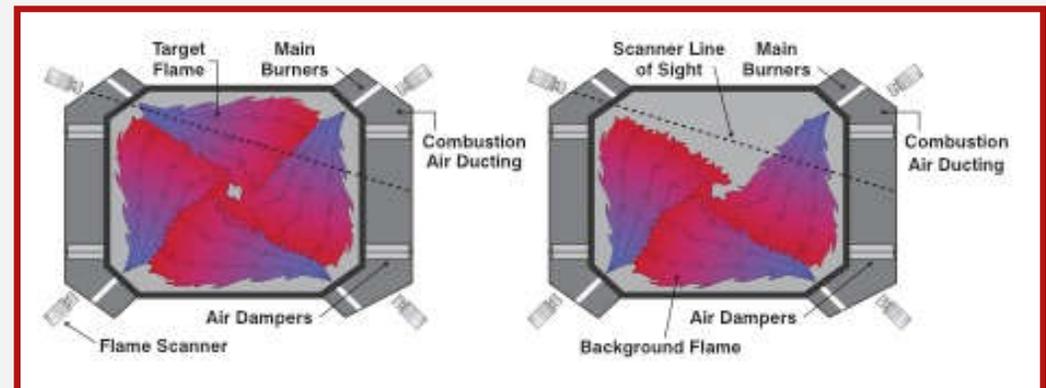
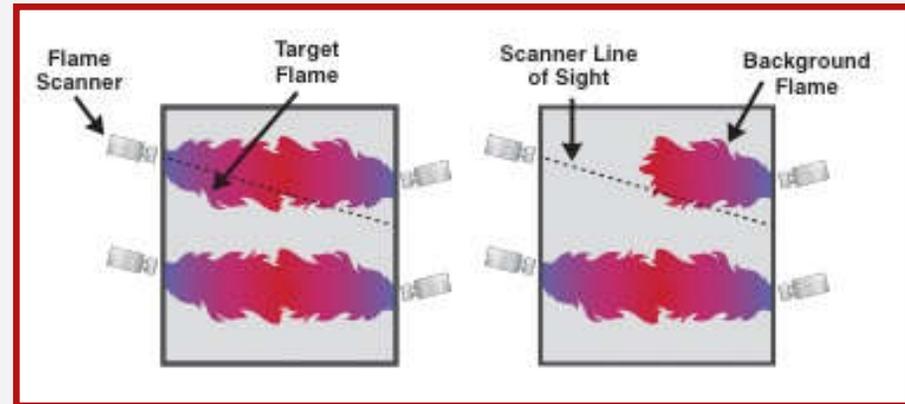
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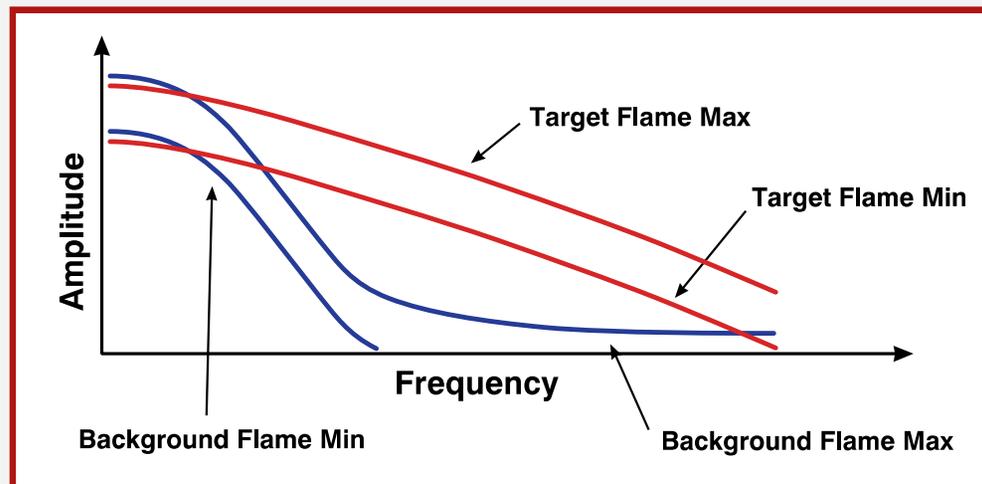
Flame Detection vs. Flame Discrimination

- Flame detection is detecting the radiation from a target burner
- Flame discrimination is being able to tell the differentiate the target flame from the background flames



Existing Methods of Flame Discrimination

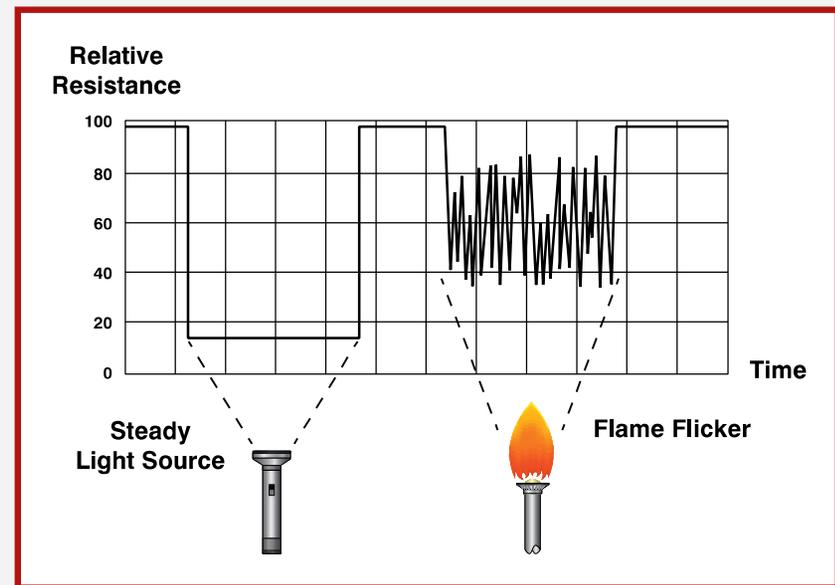
- Gain adjustment - The signal is sent through a buffer, which can be used to strengthen or weaken the response of the detector



Flicker Frequency

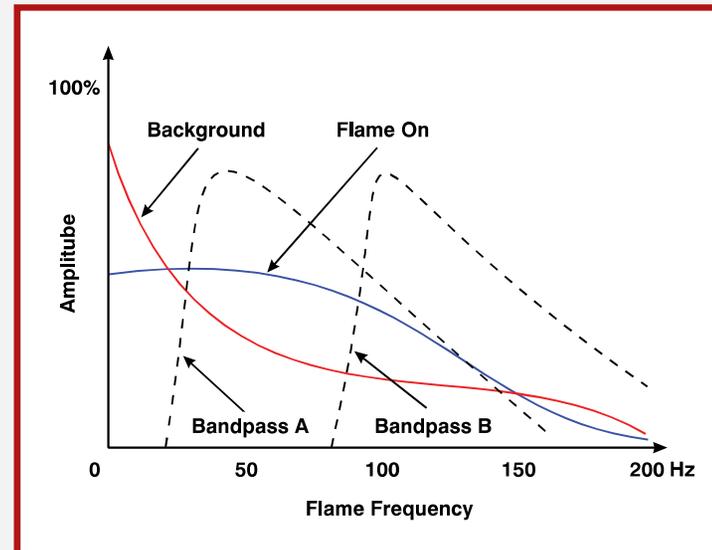
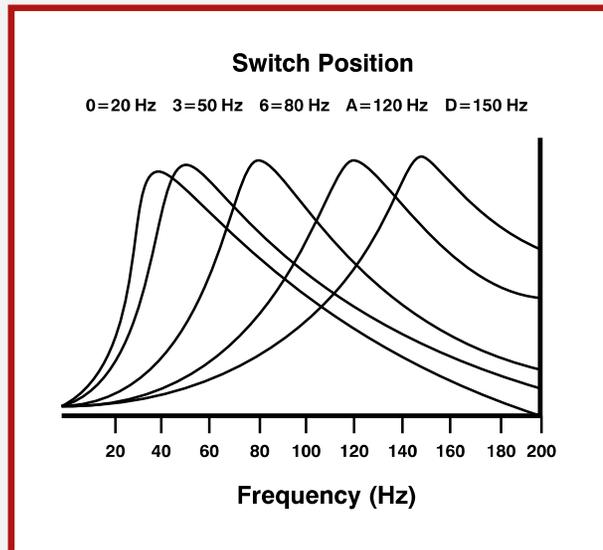


- IR from flash light is steady frequency
- IR or UV from flame varies as a function of the combustion process
- Wavelength (IR or UV) is not flicker frequency
- Wavelengths react with the sensor to cause current flow
- Flicker frequency is used to help the scanner discriminate by applying a filter to the frequency of the flame



Existing Methods of Flame Discrimination

- Frequency adjustment - by changing the frequency used for scanning, the response curve at that frequency changes



Solid State Scanner Summary



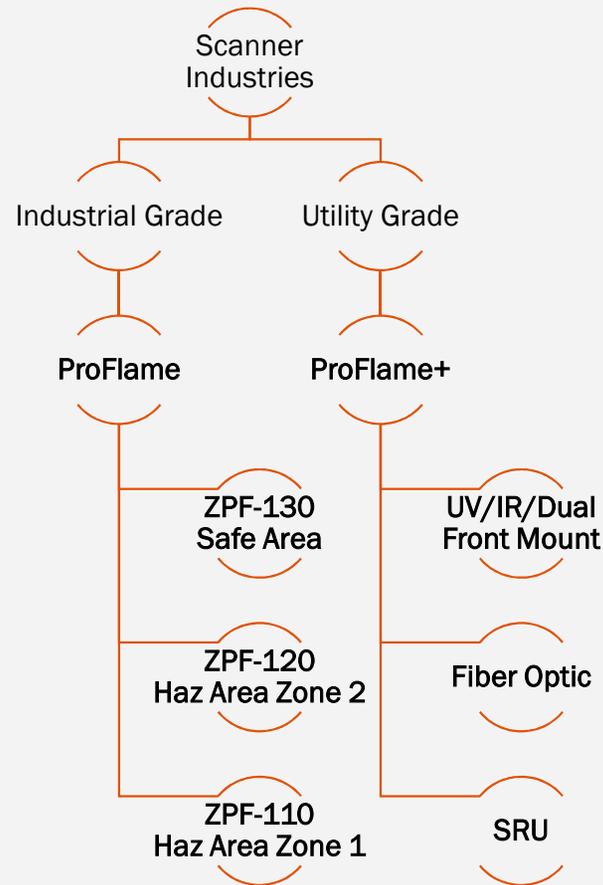
➤ Flame-On Signal

- Uses amplitude (flame intensity) as a component of flame detection
- Uses flame flicker frequencies as a component of flame discrimination
- Uses relay threshold to determine flame relay status based on amplitude and frequency components of flame signal

➤ No Flame Signal

- Scanner not properly sighted, or field of view is obstructed
- Low flicker flame or high flicker flame (flare, process burner, etc)
- Gain not properly set (too high, or too low)
- Relay threshold not properly set
- Scanner, scanner wiring or quick disconnect cable is defective

ProFlame Scanners





Application Issues and Contact Information

- Nuisance trips (burner mysteriously shuts down)?
- False flame pick up?
- Fuel switchover problems or FGR related trips?
- Costly obsolete equipment or X-Ray related issues?
- Flame Rod maintenance issues or over temperature issues?
- Ignition issues with High Voltage systems or existing HEI systems?

- Contact Combustion Electronics Group

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|--------------------------------|----|----------------------------|
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