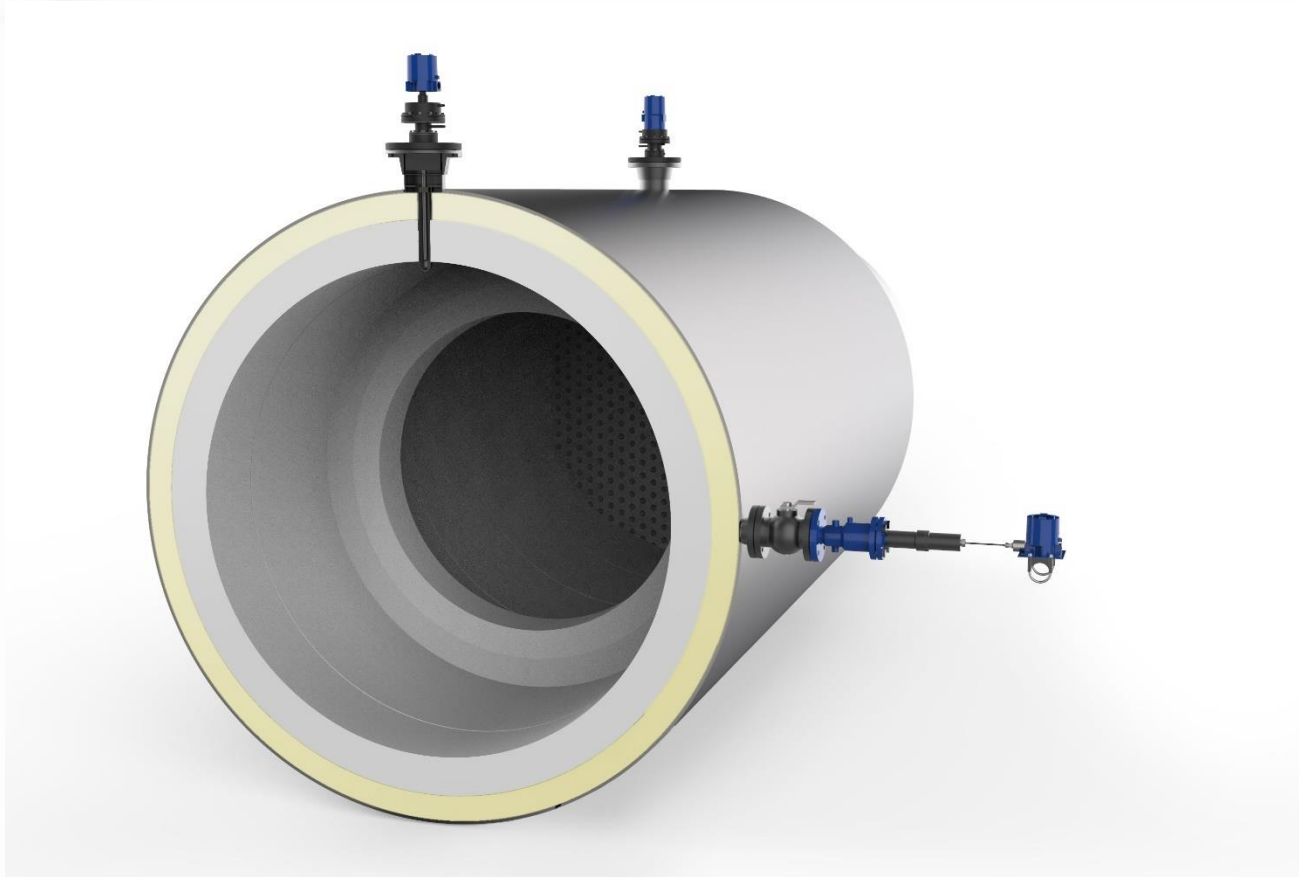


Temperature Measurement Considerations for the Claus Thermal Reactor



Delta Controls
CORPORATION

Temperature Measurement Methods



SRU Thermocouples



**Engineered
Reliability**

Thermocouple Basics

- Type R
 - Platinum + Platinum with 13% Rhodium
 - 32 °F — 3214 °F (0 °C — 1768 °C)
- Type B
 - Platinum with 6% Rhodium + Platinum with 30% Rhodium
 - 600 °F — 3300 °F (315 °C — 1820 °C)

Thermocouple SRU Challenges

- Process
 - High temperature
 - Corrosive gases
 - Thermal shock
 - Hotspots
 - Shifting refractory contact
- Installation
 - Refractory drilling / nozzle borehole
 - Improper dry-out
 - Startup and shutdown
- Nozzle
 - Location
 - Process Connection
 - Orientation

Thermocouple SRU Solutions

- Flush Gas System
- Ceramic Components

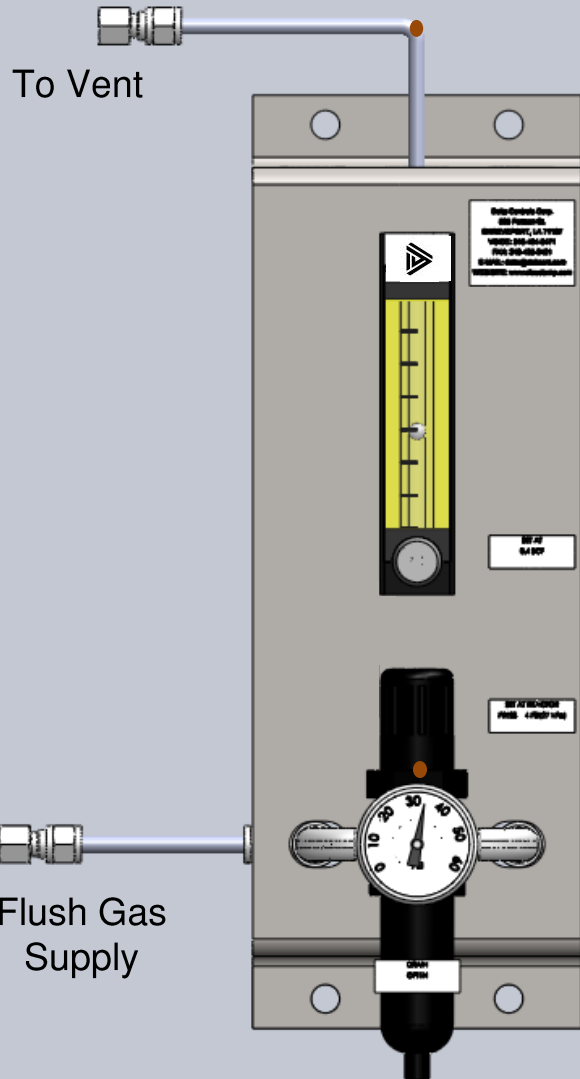


Model HFS

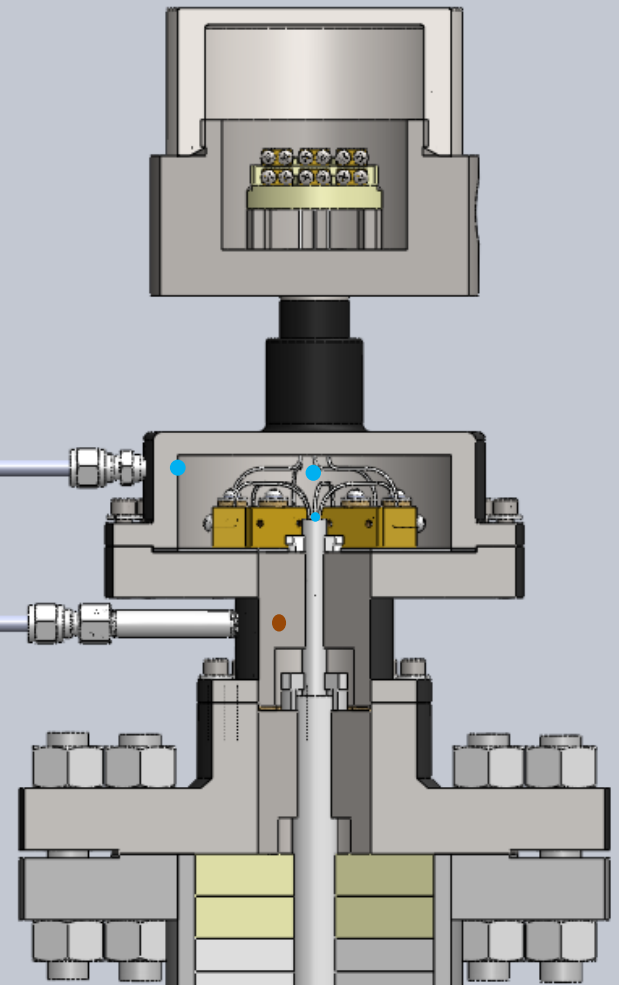


Model HRW

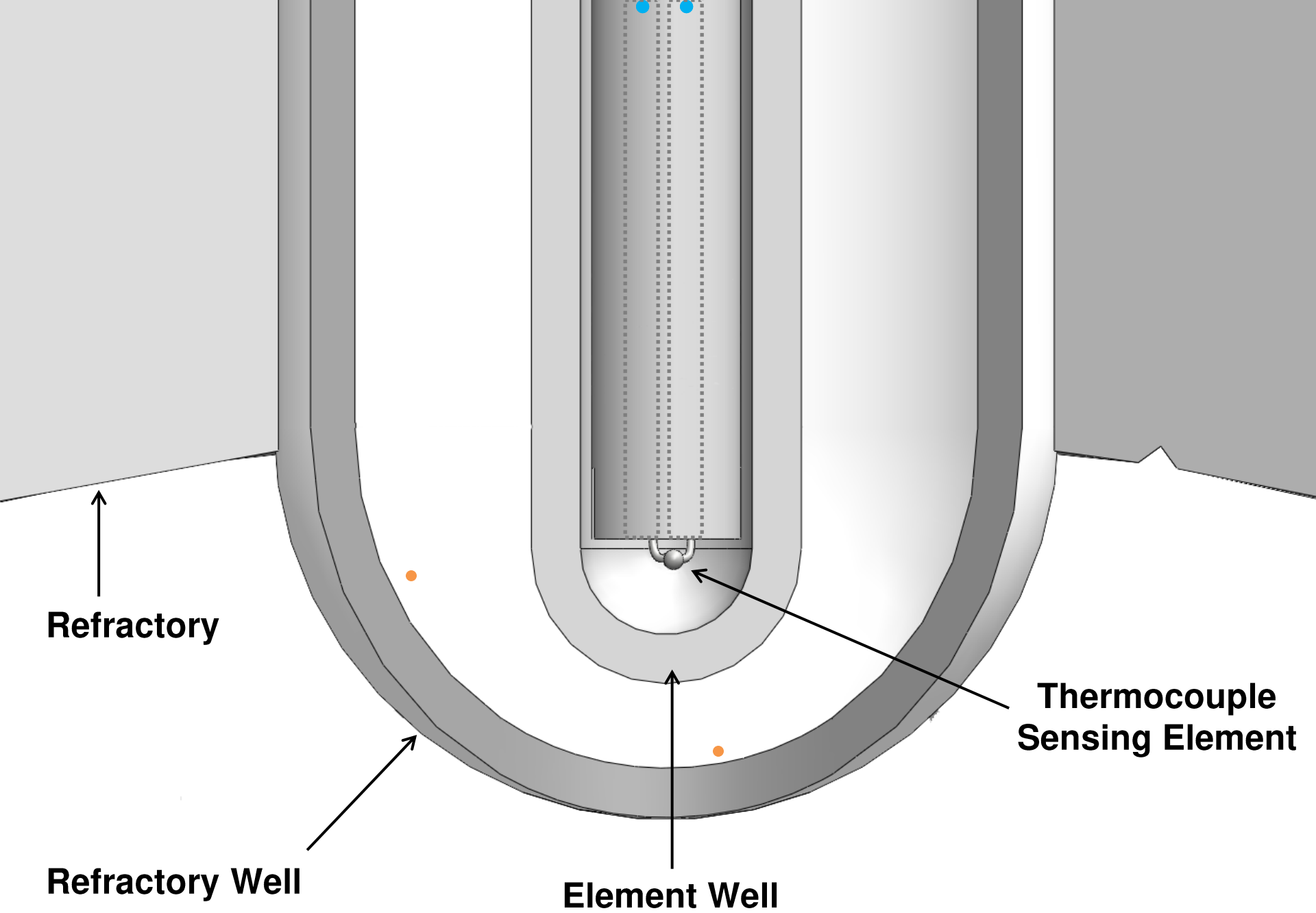
Flush Gas Control Station
Model HFS



Thermocouple | Model HTX

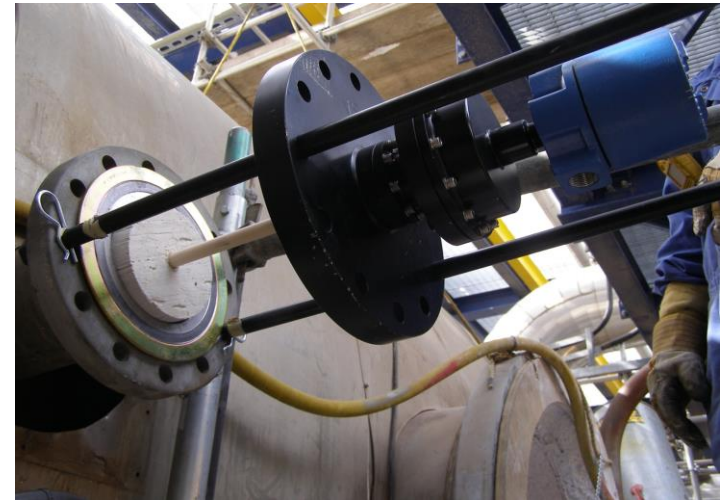


Claus Reactor



Thermocouple SRU Solutions

- Installation
 - Flush Gas Station
 - Nozzle Packing
 - Refractory Drilling
- Nozzle Recommendations
- Retrofitting
 - Compact Thermocouple
 - Horizontal and Nonvertical Orientations

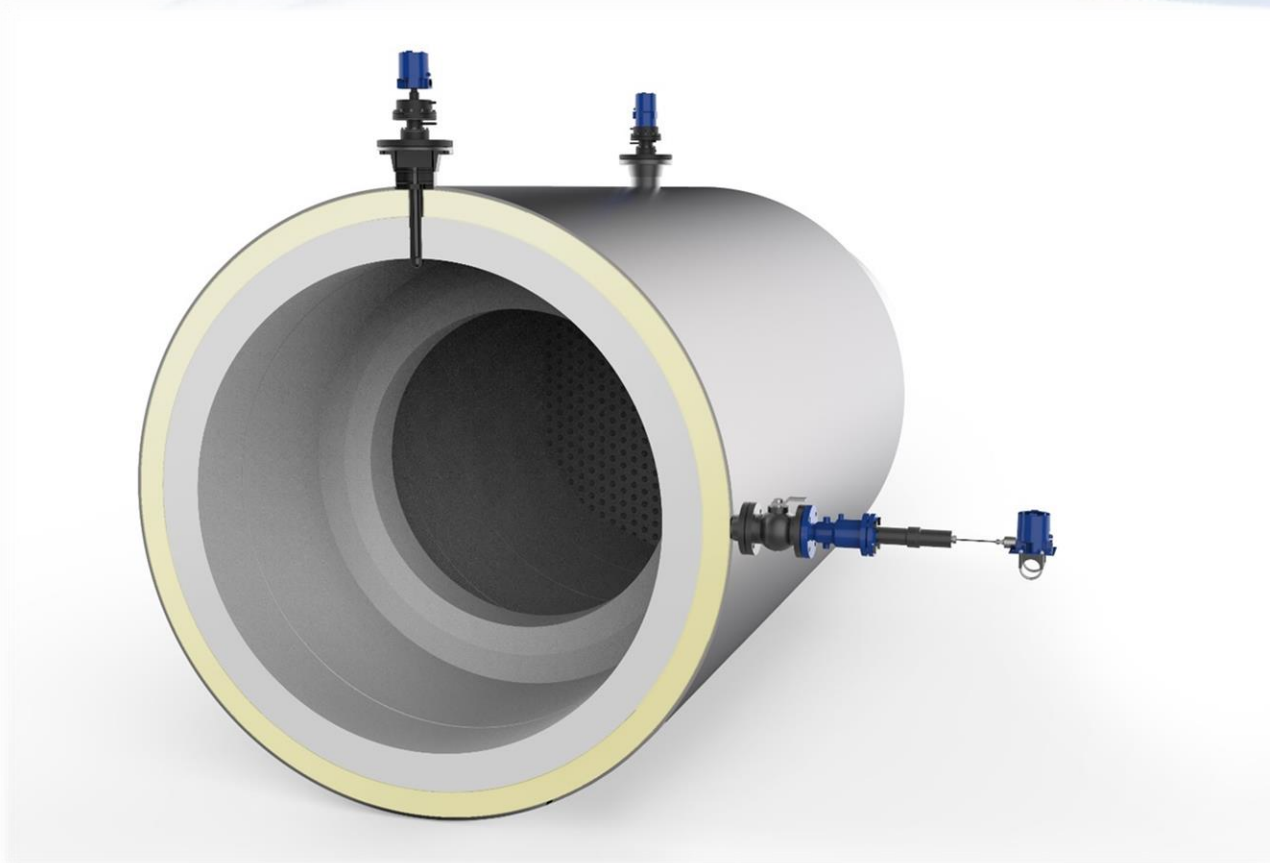


Model HTX installed with mounting bars (Model HMB)

Thermocouple Advantages & Limitations

- Advantages
 - Accuracy
 - Simplicity
 - Unaffected by Process Stream
- Limitations
 - Serviceability
 - Contact Measurement
 - Response Time

Temperature Measurement Methods



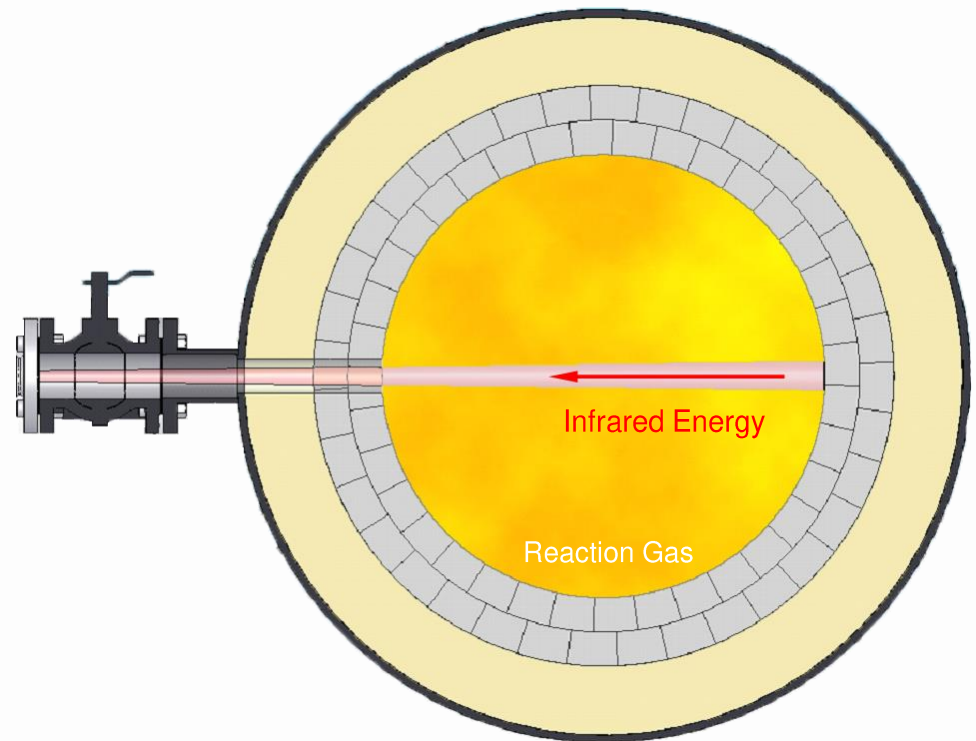
SRU Pyrometers



**Engineered
Reliability**

Pyrometer Basics

- Infrared Energy Intensity
- Inferential Measurement
- Temperature Output



Pyrometer SRU Challenges

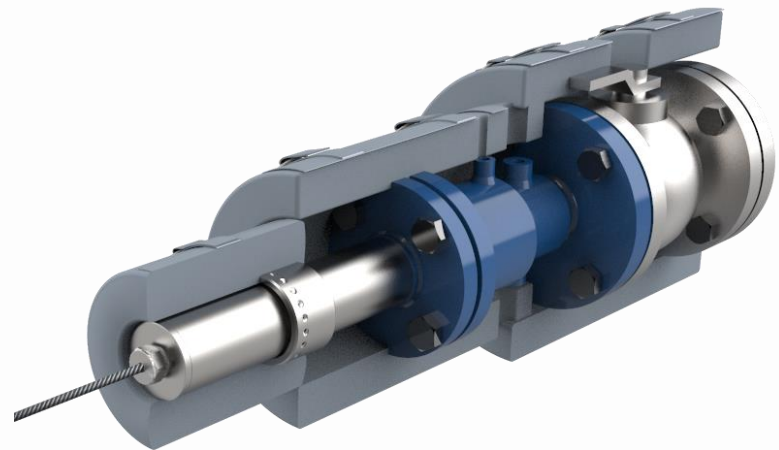
- Electronic Drift
- Sight Path Occlusion
- Misalignment
- Gas Composition Changes



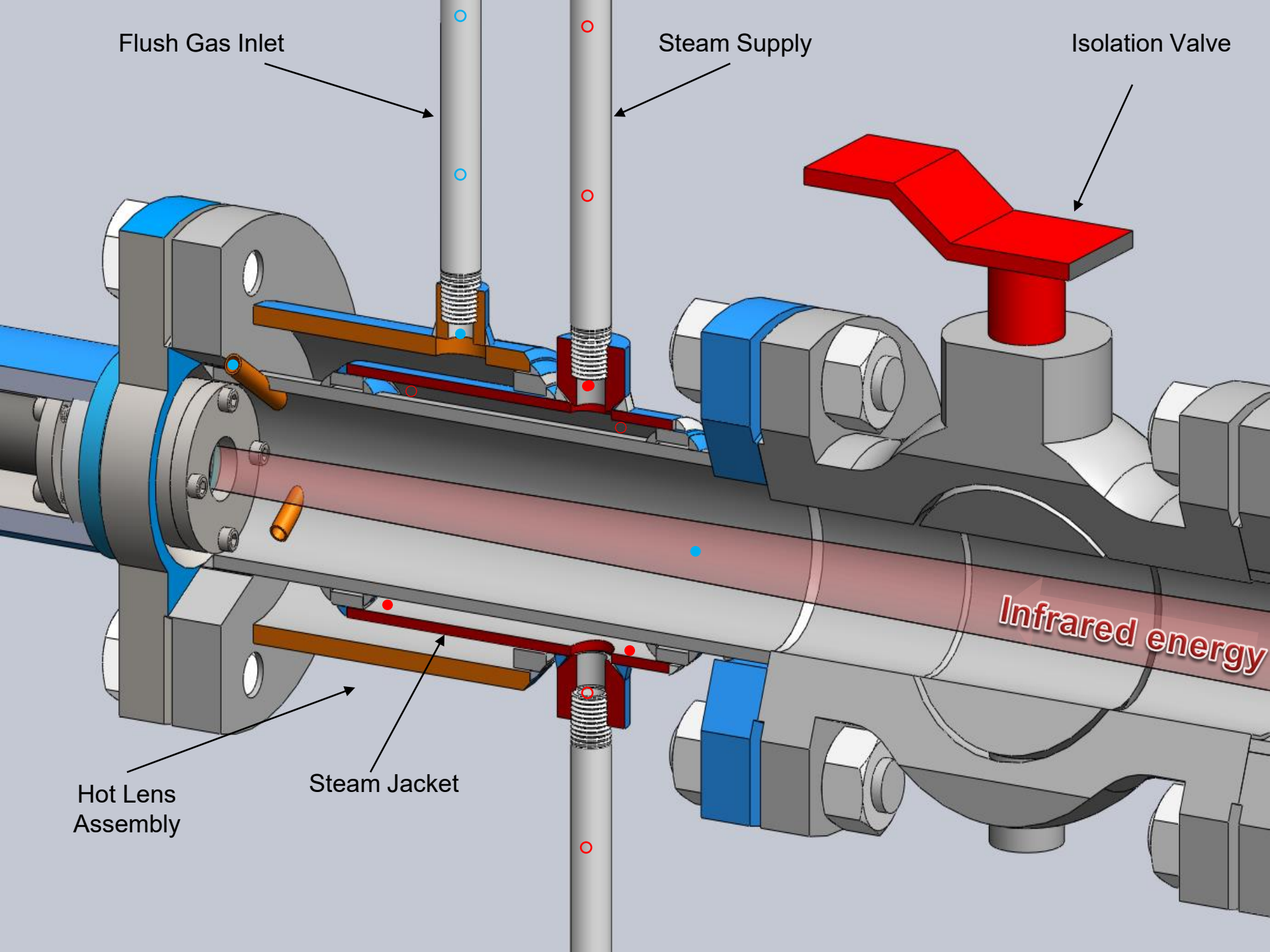
Material buildup in a sight port nozzle.

Pyrometer SRU Solutions | Sight Path Occlusion

- Heat Wetted Components
 - Steam Jacketed Lens Body
 - Insulate Nozzle, Valve, Lens Assembly
- Low Flow Lens Sweep



Model HIR with Insulation System



Flush Gas Inlet

Steam Supply

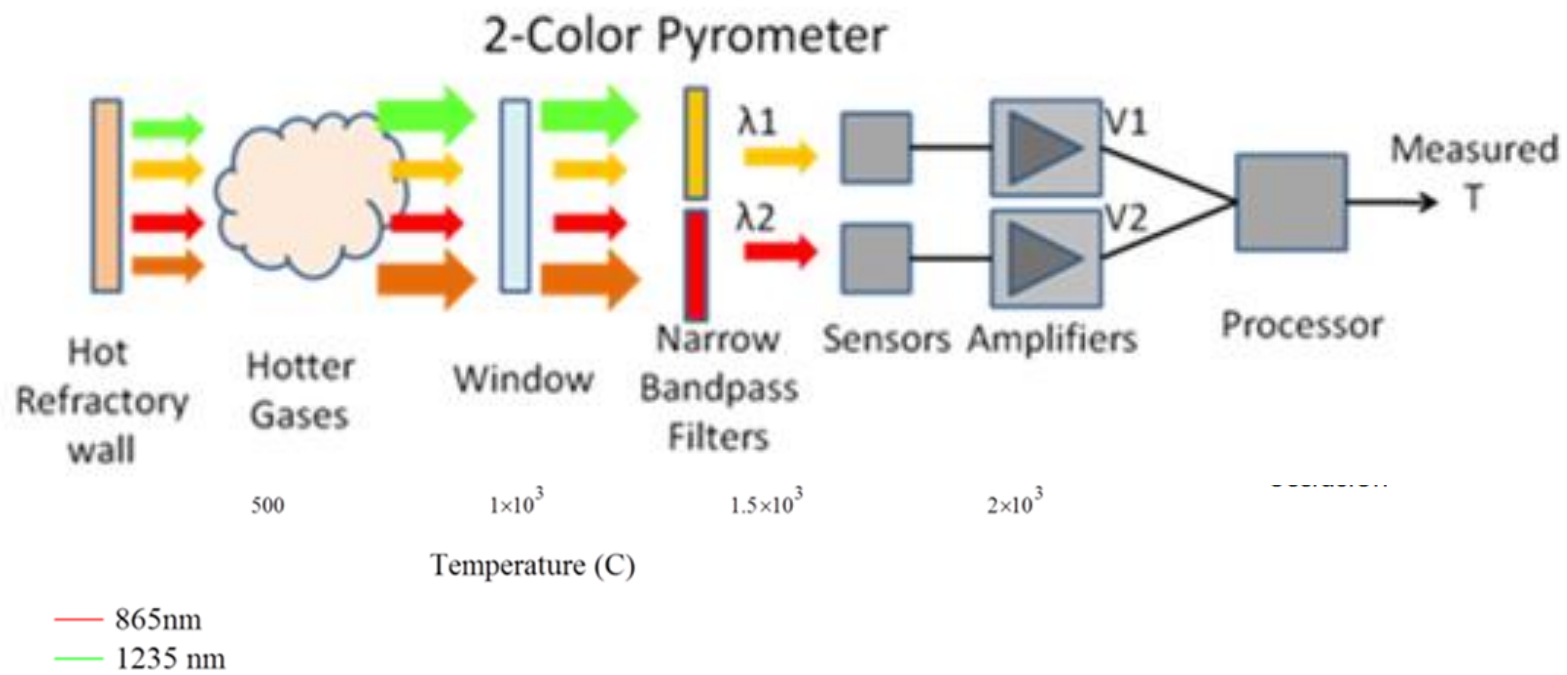
Isolation Valve

Infrared energy

Hot Lens
Assembly

Steam Jacket

Pyrometer SRU Solutions | Sight Path Occlusion



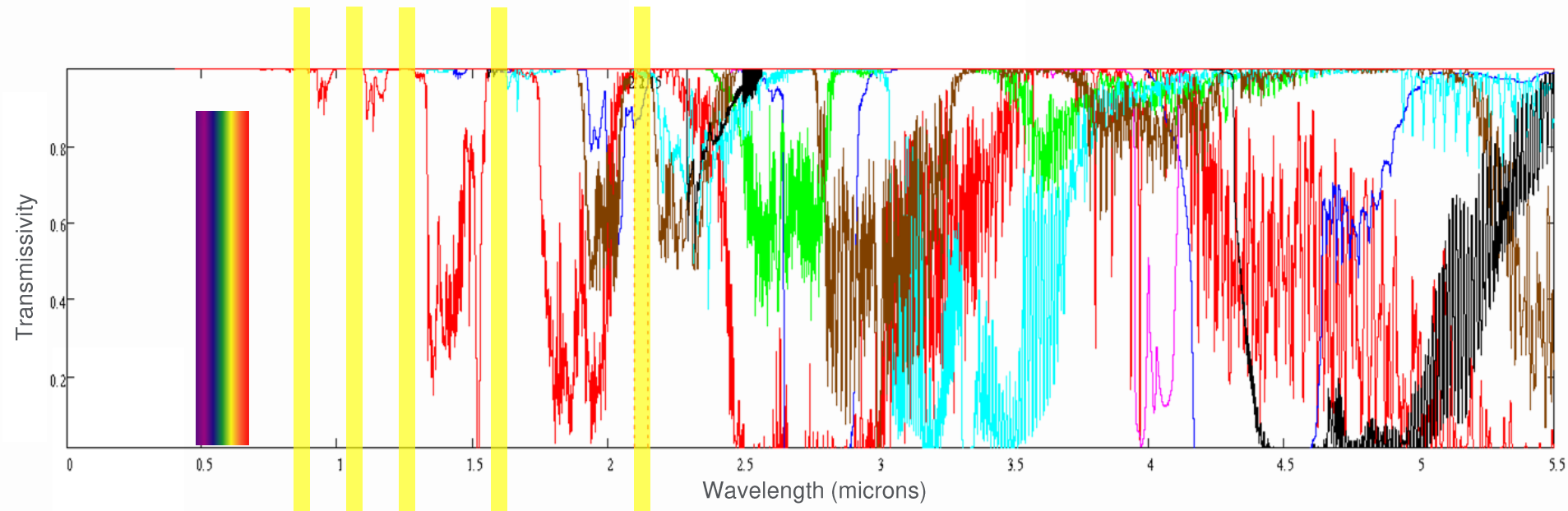
Pyrometer SRU Solutions

- Avoiding Measurement Problems
 - Measure Hot Face Temperature
 - Immune to changes in gas composition
- Calibration
- Startup refractory dryouts



Pyrometer SRU Solutions

Transmissivity of Gases in a Claus Furnace

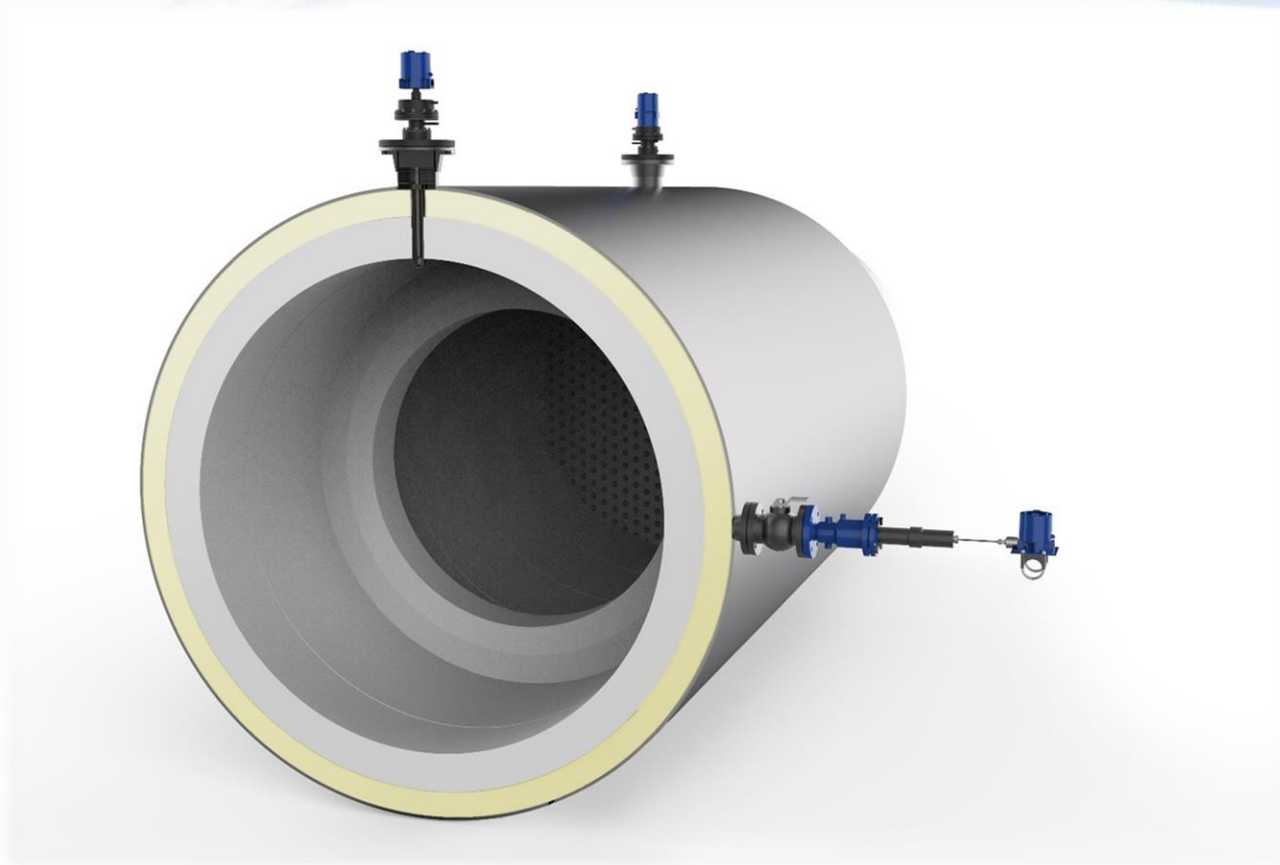


H ₂ O		CH ₄	
CO ₂		NH ₃	
H ₂ S		CO	
SO ₂		O ₂	

Pyrometer Advantages & Limitations

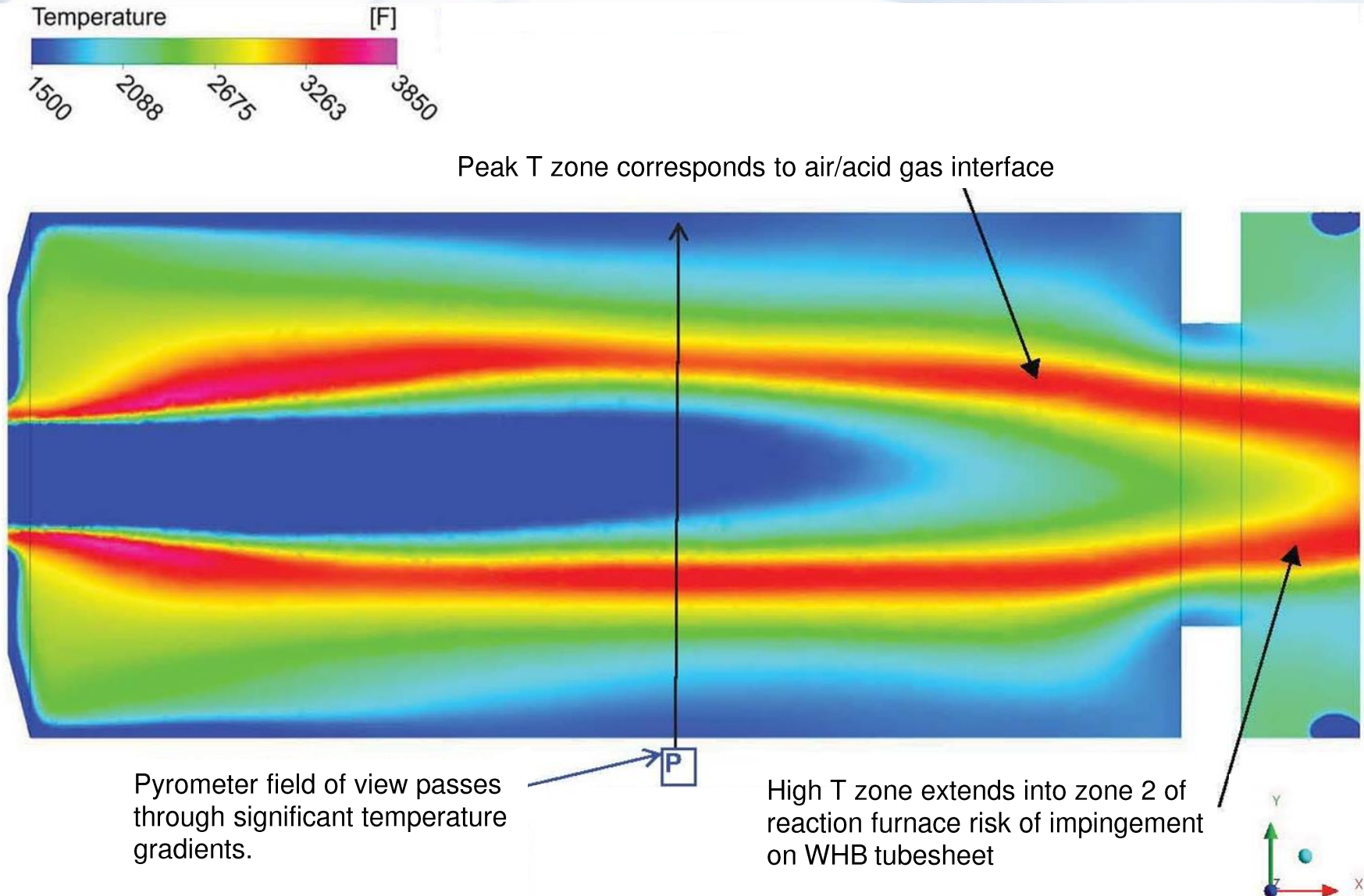
- Advantages
 - External Mounting
 - Non-contact Measurement
 - Immune to Temperature Spikes
 - Quick Response Time
- Limitations
 - Measurement Dependent on Sight Path
 - Calibration

Temperature Instrumentation Location



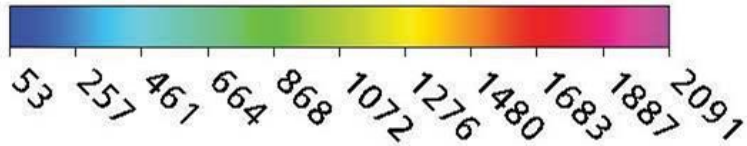
**Engineered
Reliability**

Temperature Instrumentation Location

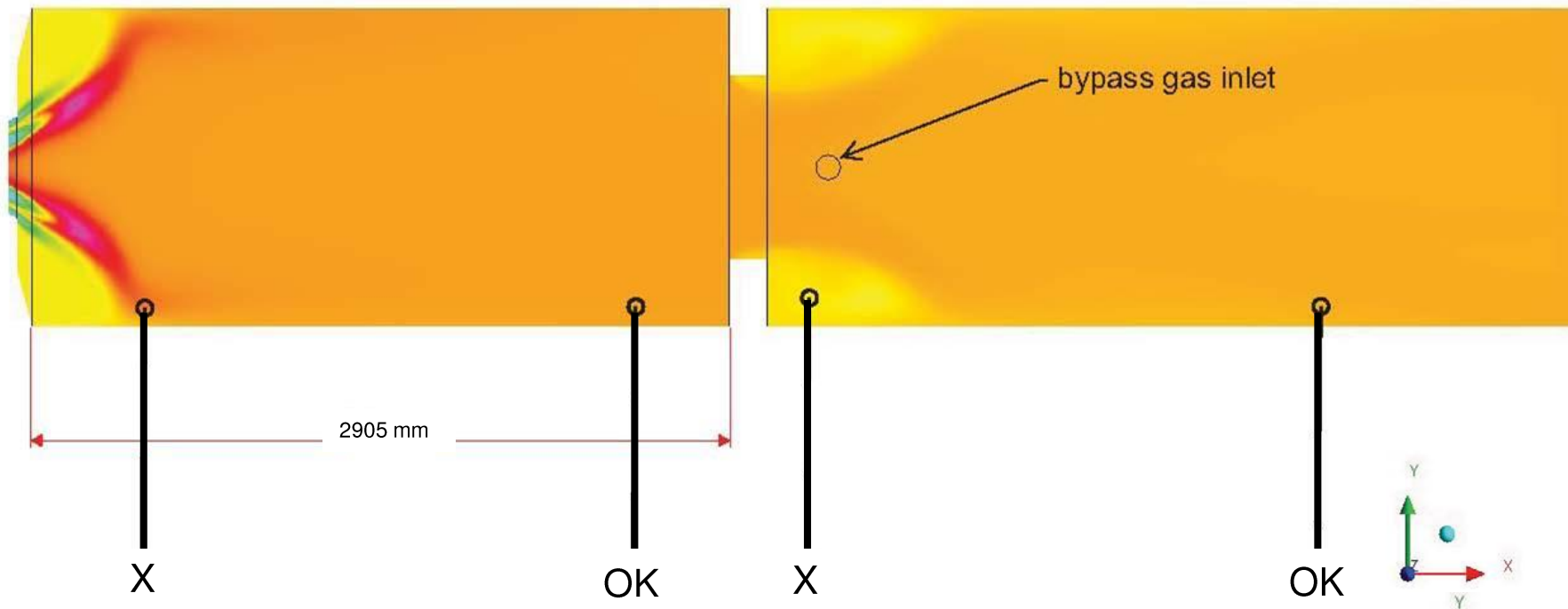


Temperature Instrumentation Location

Temperature
[C]



Zone 1 and 2 Thermocouple / Pyrometer Location



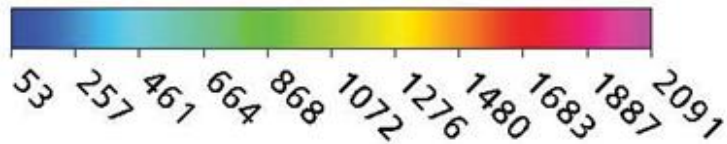
Temperature Measurement Location



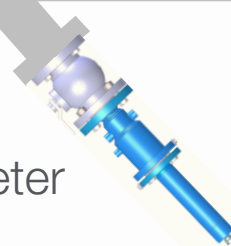
Thermocouple



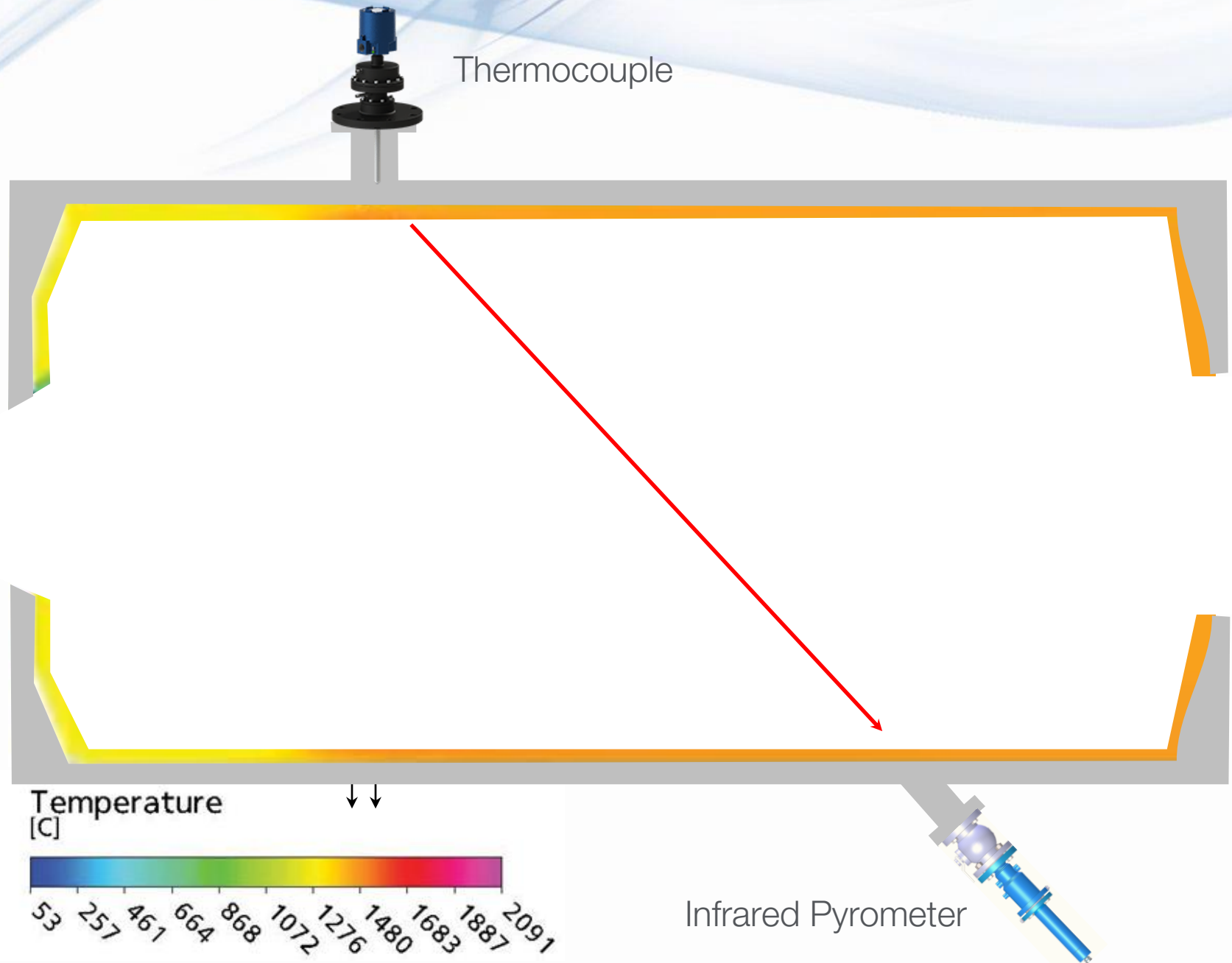
Temperature
[C]



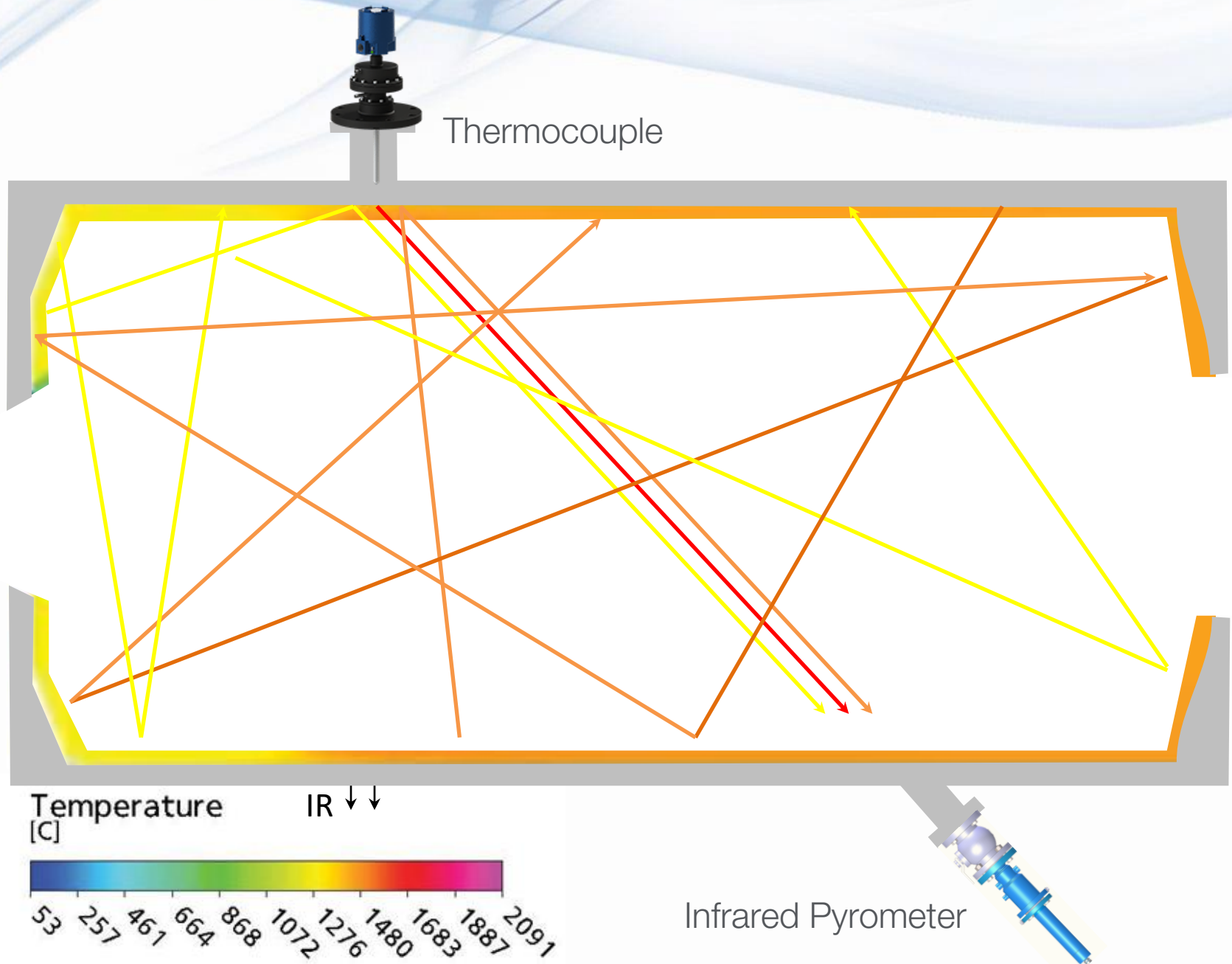
Infrared Pyrometer



Temperature Measurement Location



Temperature Measurement Location



Utilizing Both Technologies

- Leverages Advantages of Each Technology
 - Thermocouple
 - Robust
 - Accurate
 - Pyrometer
 - Quick Response Time
 - Non-contact Measurement



Utilizing Both Technologies

- Avoid Common-cause Failures
 - Thermocouple
 - Pyrometer





Engineered Reliability