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AMETEK®

PROCESS & ANALYTICAL INSTRUMENTS

CLEAR VISION SOUND STRATEGIES SOLID PERFORMANCE

Industrial Thermal Imaging for Process Applications

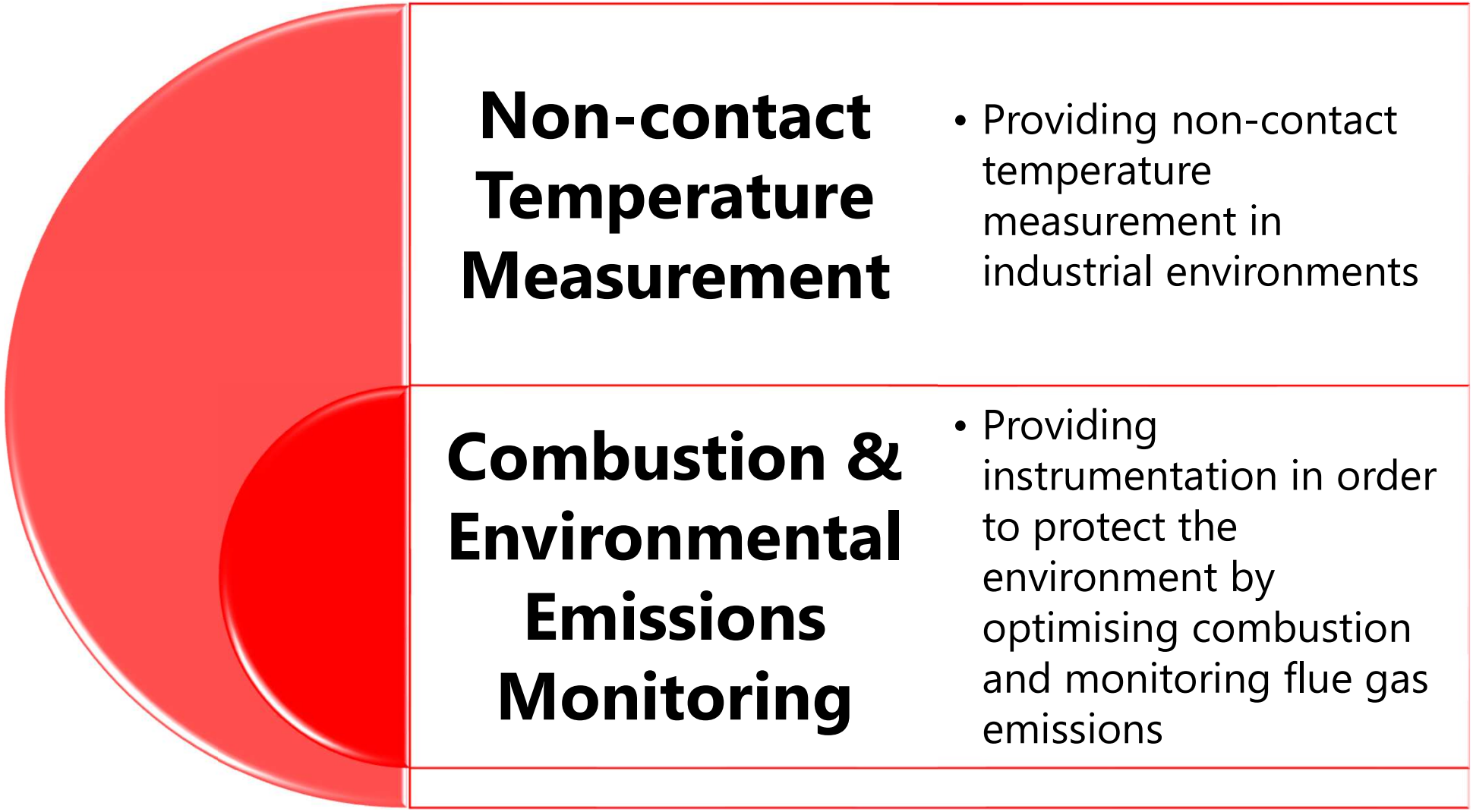
Nitin Gupta

27th Oct, 2023

COMPANY HISTORY

- **Established 1947 in Sheffield by Tom Land**
- **Industry Firsts**
  - Commercial infrared thermometer using silicon photodiode
  - Portable single lens reflex infrared thermometer
  - ISO9000 certified infrared thermometer manufacturer
  - Production in-flight infrared thermometer
  - Utility gas turbine infrared thermometer
- **2006 Acquired by AMETEK, Inc**
  - Transformed from traditional, family run business into modern, global enterprise

PRODUCT FAMILIES



Bangalore Service Center

Lab calibration services:

- Range from 0 to 1600 C
  - with NABL Approved
- Standard 3 point calibration
  - or as customer specified
- Repair and recalibration
  -LAND IR Products
- Non Land Pyrometers
  - Calibraiton and Certification

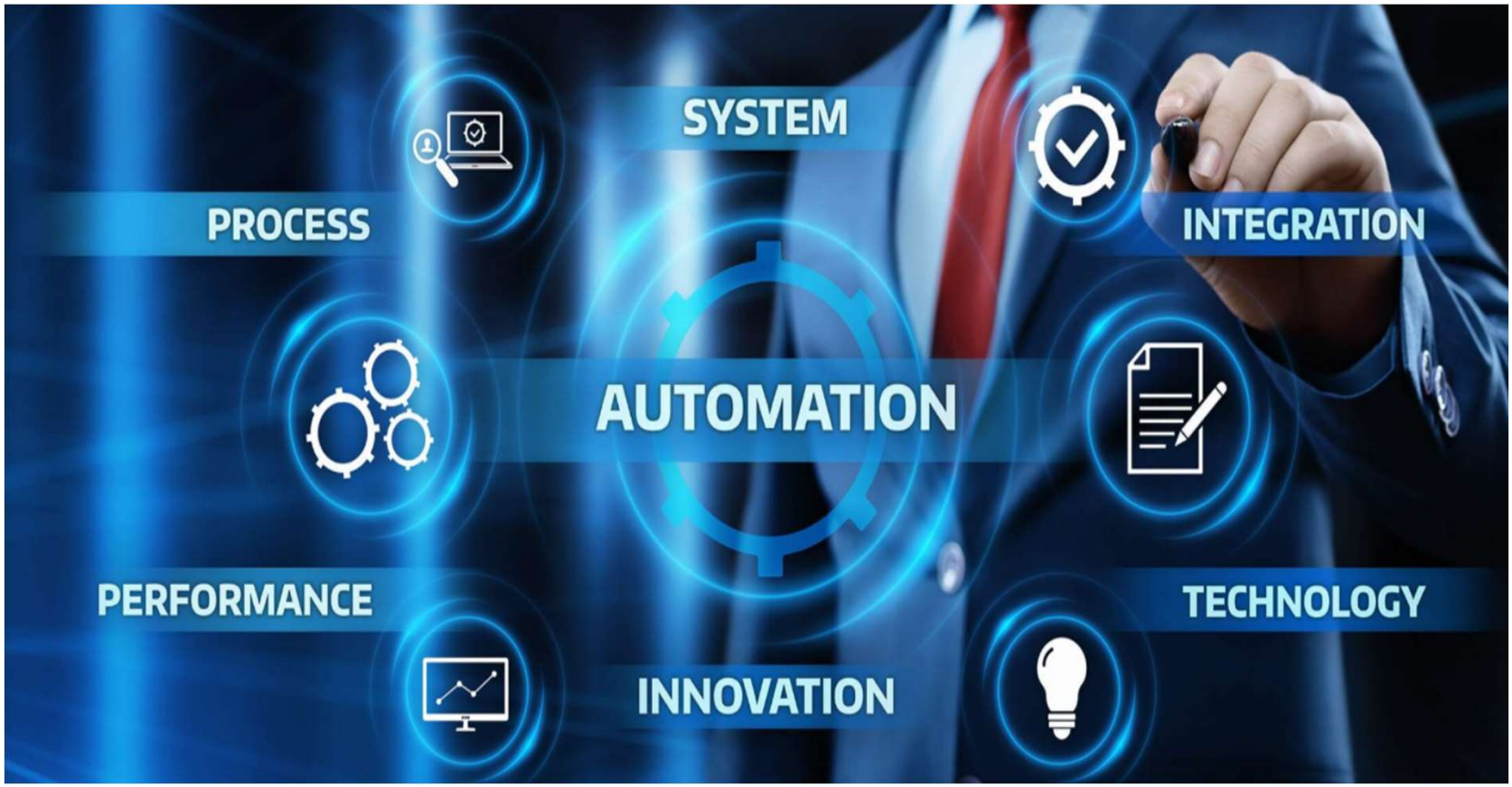
On-site Calibration Services:

- Calibration Range from 0 to 1200 DegC with NABL Approved
- Standard 3 point calibration or as customer specified

On-site Services:

- Field Services (Installation & Commissioning and Training support IR)
- Site Trails – Demonstrations & Technical supports

Our Partner
Axis Solutions Pvt. Ltd - Ahmedabad



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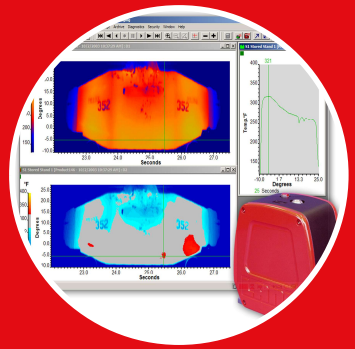
NON-CONTACT TEMPERATURE MEASUREMENT

Single Point Solutions

- Spot Thermometers
  - Portables
  - Fixed
  - Application solutions



Process Imaging Solutions

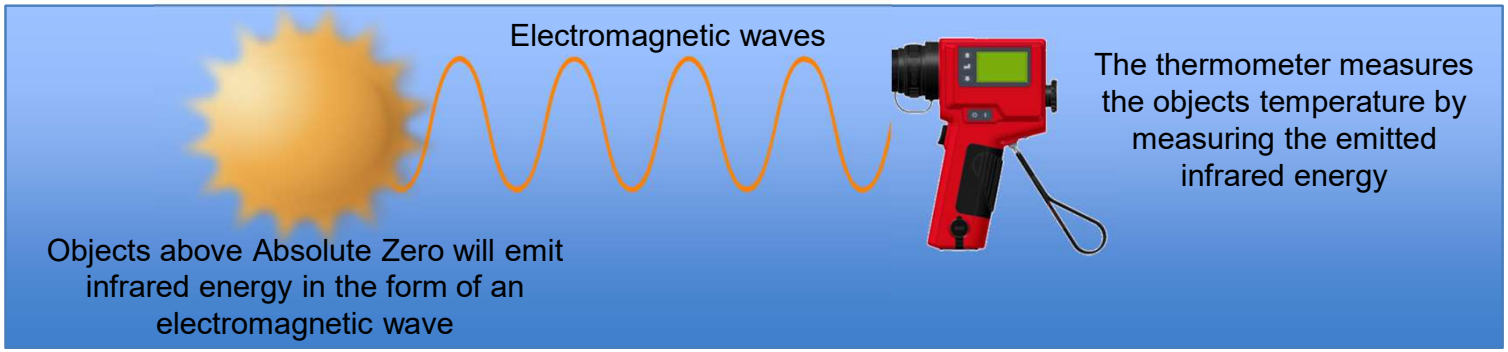
- Process Imaging
  - Line Scanning
  - Fixed Thermal Imaging
  - Application solutions

Brush up – IR Technology

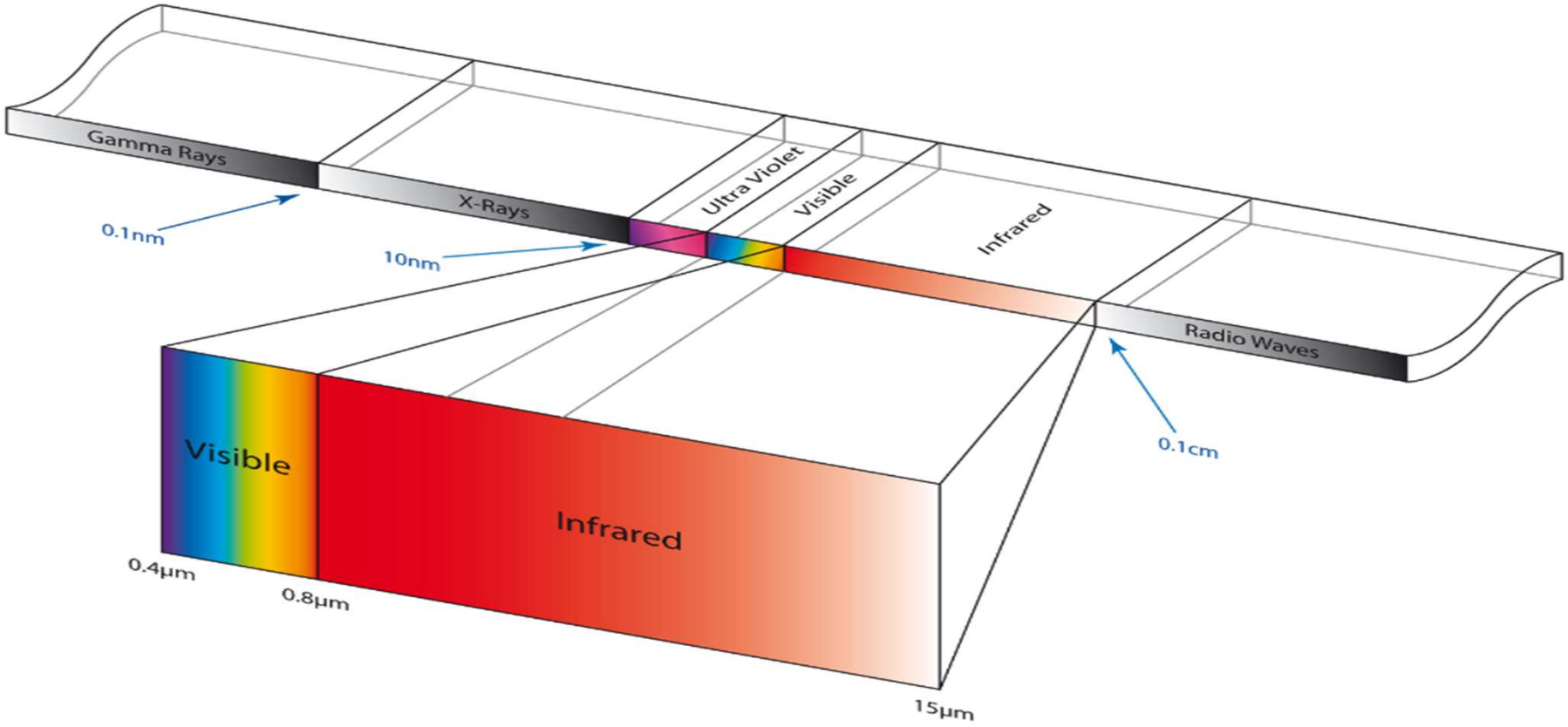
A wide variety of sensors are available for temperature measurement. These can broadly split into two areas:

- **Contact Measurement**
- **Non - Contact Measurement**
  - Radiation Thermometer

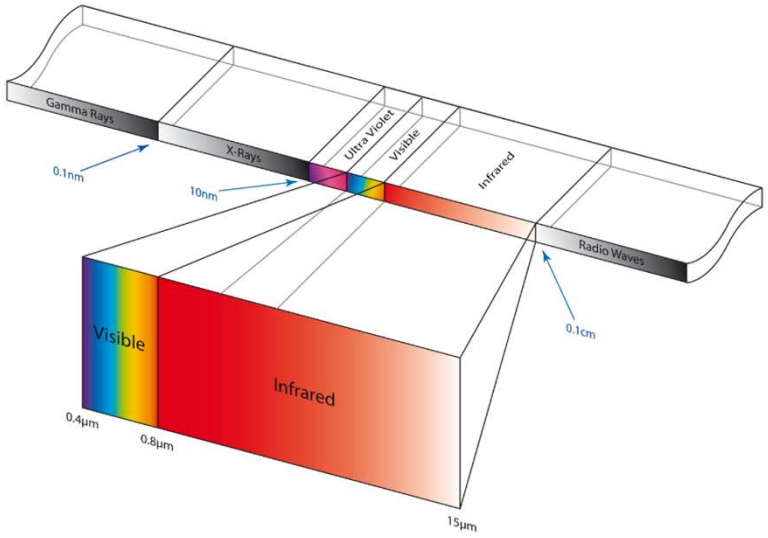
    Measures radiated energy from an object by focusing this radiated energy through an optical system onto a detector



Brush up – IR Technology



Brush up – IR Technology

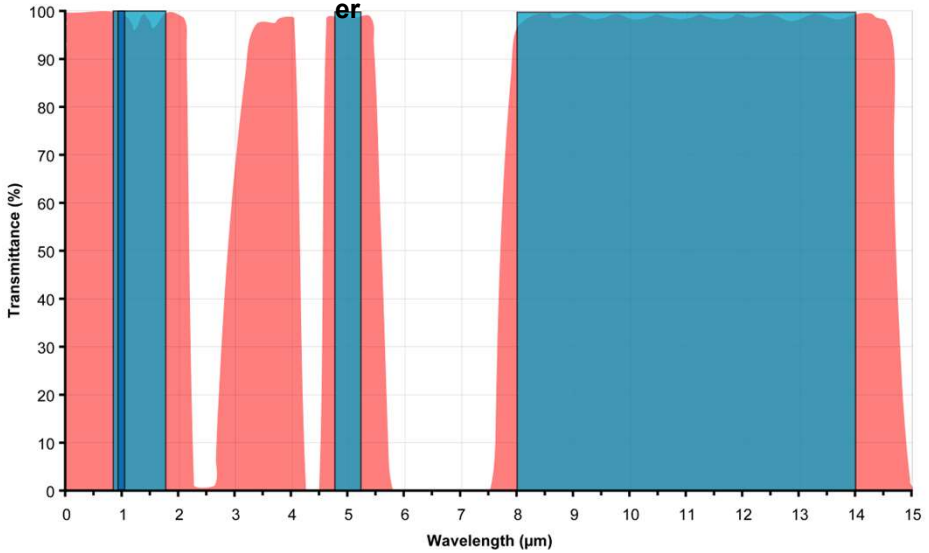


0.9 – 1.8 µm Thermometer

4.8 – 5.2 µm Thermometer

1.0 µm Thermometer

5 µm Thermometer



The regions that allow transmission are known as atmospheric windows

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Tube Wall Temperatures Reformers & Crackers

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Current Practice

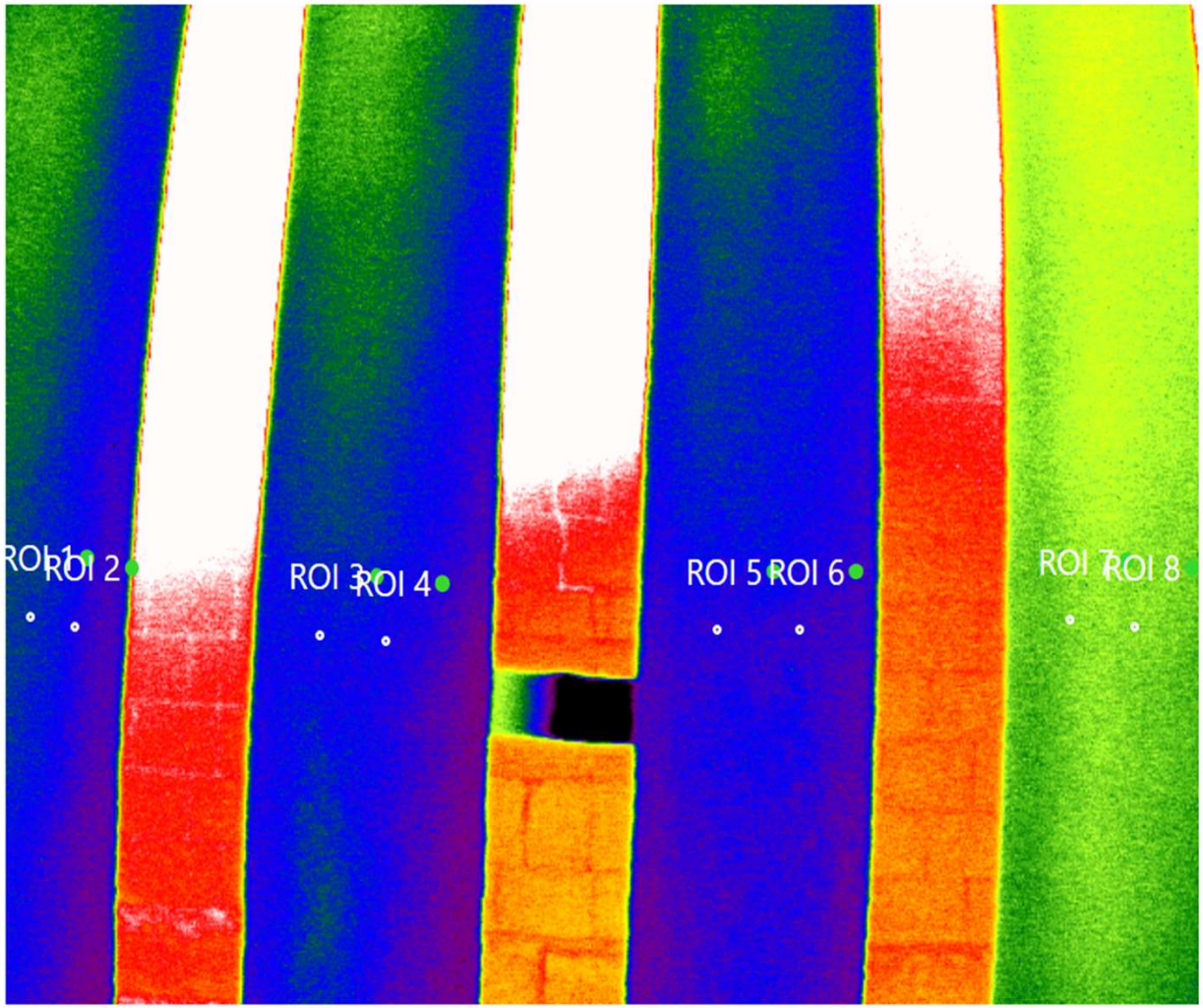
- Tube Thermocouple
- Handheld pyrometers with Limited Schedule is most common method.
- Temperature Measurement of outlet Gases.
- Periodic Thermography
- Experienced Eyes

The Challenges

- **Welded Tube Thermocouple** often slow in response and detached from tubes.
- **Periodic Measurement** – Frequency and Reliability of measurement.
- **Spot Temperature Measurement** is only spot reading and the operator might not always find the hottest area of the tube which can lead to overheating.
- **Outlet Temperature** by the time outlet temperatures rise above alarm limit, the TWT is already above normal temperature.
- **Outlet temperature measurement** does not indicate which tube / part of it is heating.

The Challenges

Simulator Live Image



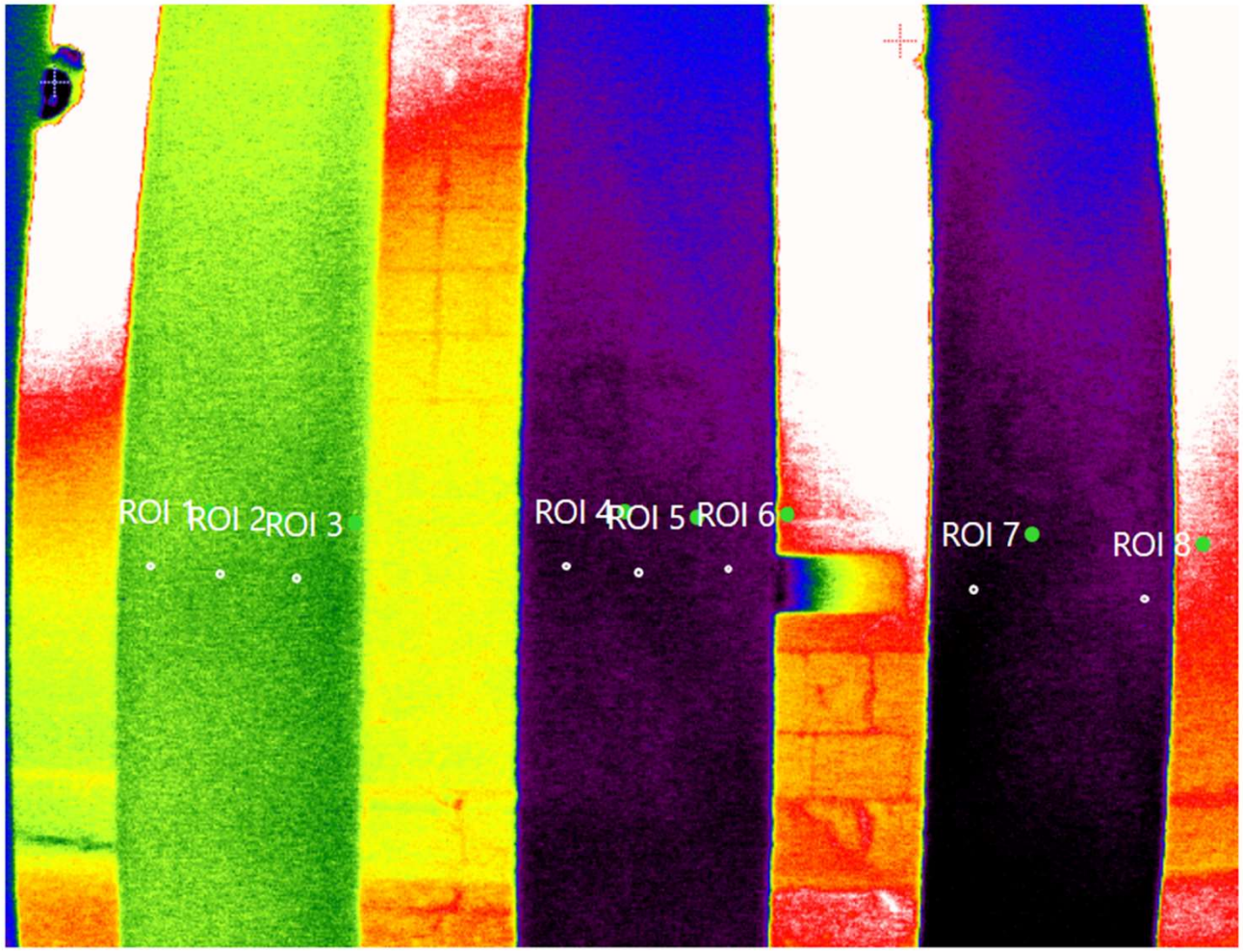
Analysis

Data	Temperatures in °C			⚠	ε	✳	% ROI
	Max	Mean	Min				
Frame	1114.1	876	686.5	●	1.00	-	-
ROI 1	841.9	841.9	841.9	●	-	-	-
ROI 2	833.7	833.7	833.7	●	-	-	-
ROI 3	834.7	834.7	834.7	●	-	-	-
ROI 4	829.9	829.9	829.9	●	-	-	-
ROI 5	828.7	828.7	828.7	●	-	-	-
ROI 6	823.3	823.3	823.3	●	-	-	-
ROI 7	863.7	863.7	863.7	●	-	-	-
ROI 8	865.1	865.1	865.1	●	-	-	-

The Challenges

Image Player

Browse Recordings



Analysis

Data	Temperatures in °C			⚠	ε		% ROI
	Max	Mean	Min				
Frame	1206.5	860	707.9	●	1.00	-	-
ROI 1	861.1	861.1	861.1	●	-	-	-
ROI 2	848.7	848.7	848.7	●	-	-	-
ROI 3	847.9	847.9	847.9	●	-	-	-
ROI 4	804.7	804.7	804.7	●	-	-	-
ROI 5	806.5	806.5	806.5	●	-	-	-
ROI 6	809.5	809.5	809.5	●	-	-	-
ROI 7	796.1	796.1	796.1	●	-	-	-
ROI 8	815.7	815.7	815.7	●	-	-	-

The Challenges

The Temperature effects

- The TWT is very critical for the life of Tubes and plant efficiency.

- Cost of not properly managing TWT can be extremely high.
  - Cost of Tubes
  - Catalyst
  - Labour
  - Production losses.

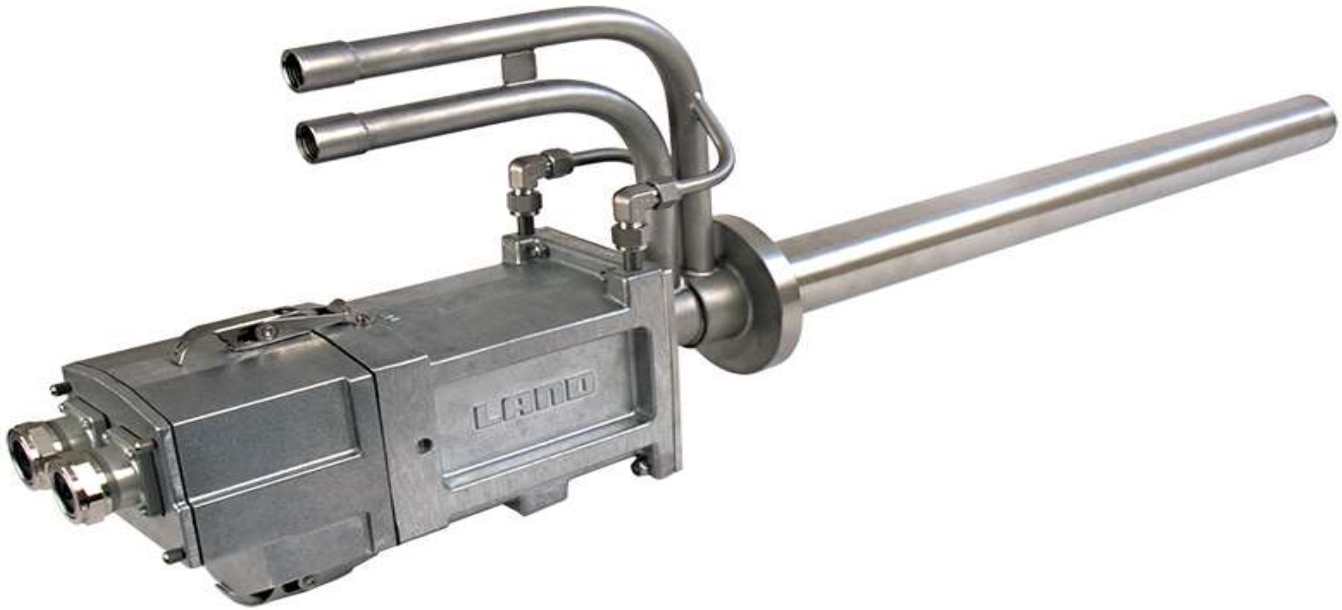
- As a rule of thumb operating at **20C** above design temperature will reduce the life by half.

- Under temperature heavily affects the plant efficiency and cost of operation.

Deg C	Mean Tube Life
860	10 Years
880	5 Years
900	2.5 Years
925	11 Months
950	4.5 months
975	2 months
1000	4 weeks
1050	5.5 days
1100	1 day

Fig1.

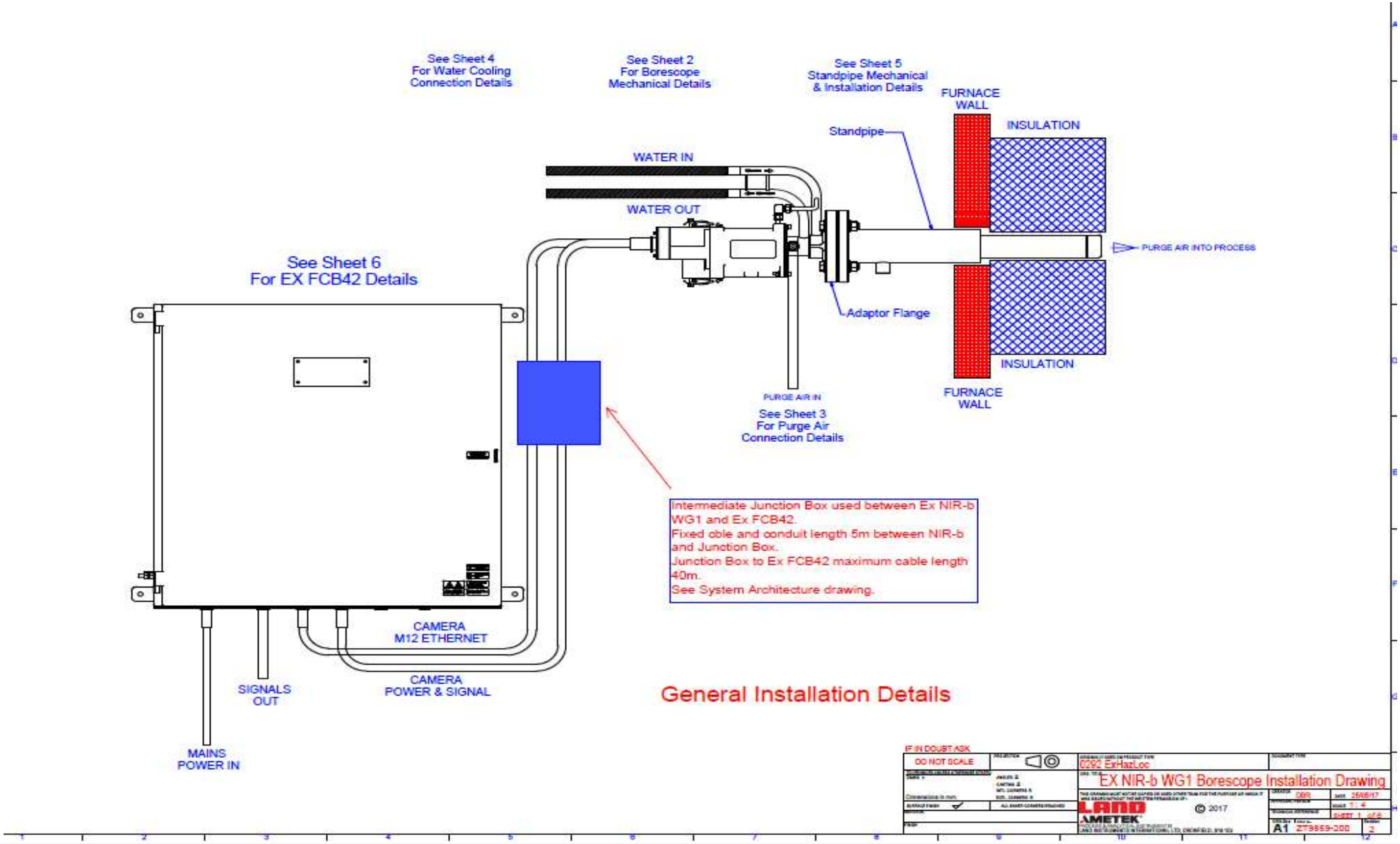
Our Solution



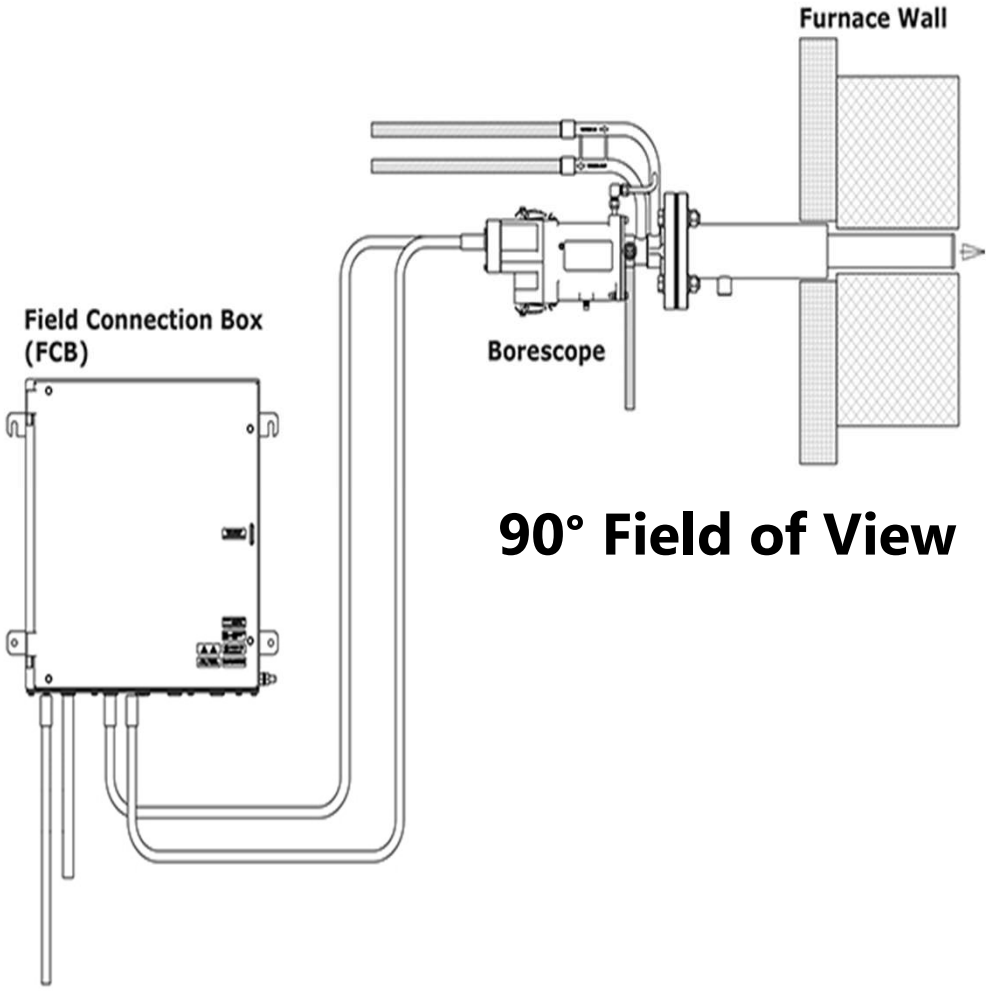
NIR-B 3XR

Near Infrared Borescopic Thermal Imaging Camera

General Installation Arrangement



Our Solution



90° Field of View

Measurement Range:	600 to 1800 °C / 1112 to 3272 °F
Spectral Response:	0.85 to 1.05 µm
Frame Rate:	7.5 fps (100M Ethernet)
Image Pixels:	640 x 480
Accuracy:	1.0 % Celsius
Sealing:	IP 65 (when connections mated/fitted with caps)
Repeatability:	1 °C
Data Out:	Digital data over 100M Ethernet (M12, 8 pin)
Software:	Complete Land Image Processing Software (LIPS) package for Windows
Standard Accessories:	Field Connection Box (ExHazloc) and cables (10 m, 25 m or 50 m), software, water cooled/purged mounting and tube
Field of View (Horizontal):	90°
Focus Range:	1000 mm to infinity
Probe Length:	305, 609 or 914 mm (12", 24" or 36")
Probe Diameter:	57 mm (2.24 in.) max.
Mountings:	Choice of 3" ANSI 150 RF Flange & Gasket or PN16 DN80 Flange & Gasket with a 12" standpipe
Dimensions:	254 x 560 x 717 mm (or 1021 mm or 1326 mm) 10" x 22" x 32" (or 44" or 56")
Power Rating:	21.6 - 26.4 V dc, 0.6 A
Weight:	< 25 kg (for 609 mm / 24" version)
Hazardous Area Certification: *EX Borescopes*	EX NIR-B WG1: Ex nA IIC T4 Gc Tamb=-20 °C to +55 °C (ATEX certificate: CML 15ATEX4086X / IECEx certificate: IECEx CML 15.0042X) EX NIR-B WG2: Class I, Division 2, Groups A, B, C, D; T4 Tamb=-20 °C to +60 °C (CSA certificate for US and Canada: 70080206)
Field Connection Boxes	EX FCB 31: Ex nA nC [op-is Ga] IIC T4 Gc Tamb=-25 °C to +54 °C (ATEX certificate: CML 15ATEX4085X) EX FCB 32: Class I, Division 2, Groups A, B, C, D; T4 Tamb=-25 °C to +50 °C (CSA certificate for US and Canada: 70052791)

Our Solution – NIR-B Portable

1: AIR SUPPLY & FILTER
Connection of plant instrument air supply

2: EASY TO HANDLE
Integrated handle enables easy carrying of the system

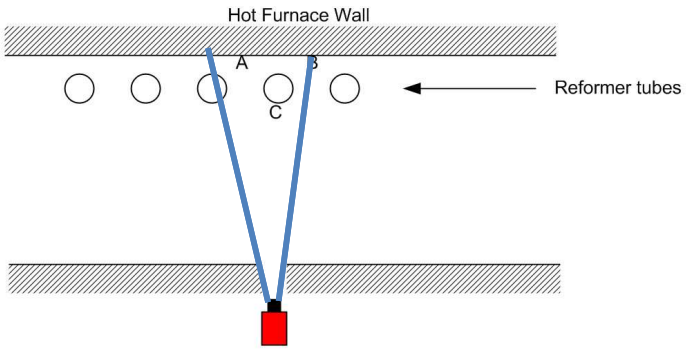
3: PORTABLE BASE UNIT
Contains one 3700 mAh battery for instrument power. A spare battery is included with the system

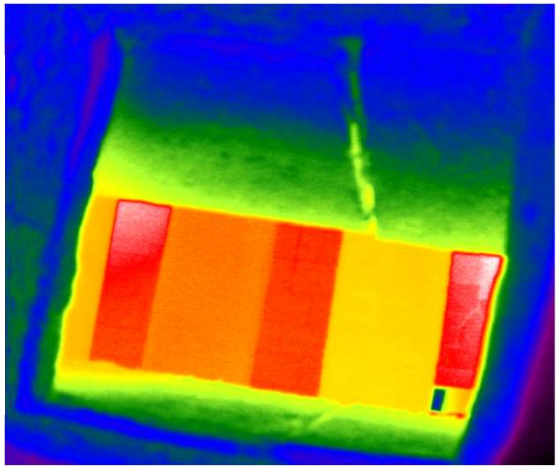
4: HEAT PROTECTION SHIELD
Protects the operator from heat radiation and hot furnace air

5: TABLET
Portable Windows® tablet provides full IMAGEPro thermal imaging software functionality for data analysis and capture

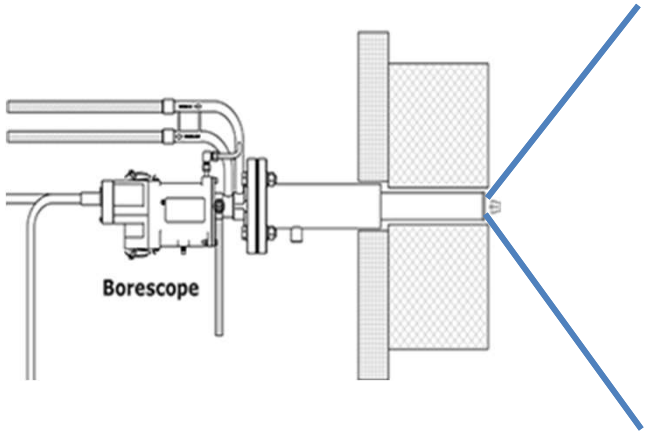
Borescope Field of view

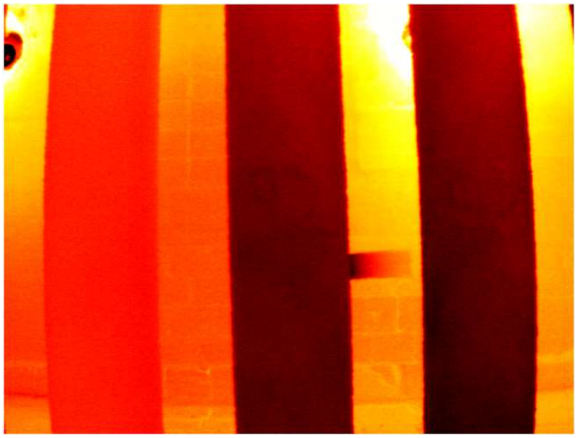
Standard Non-intrusive Thermal Imager camera





Borescope Type Thermal Imager camera

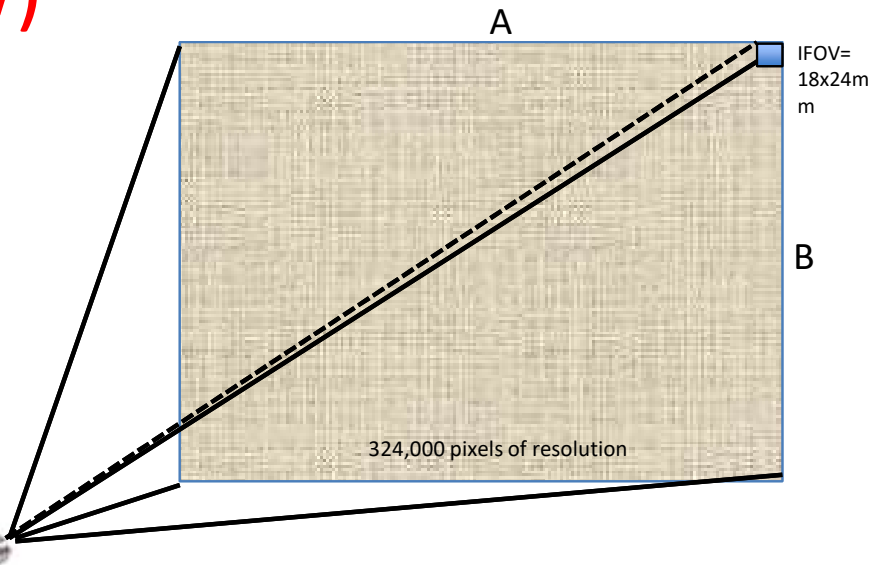




NIR-b (Field of View)

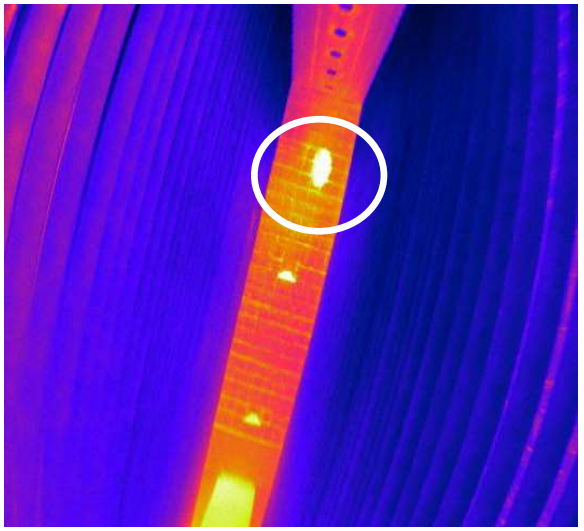
NIR-b is available in two versions

- 90 x 67° and 44 x 34°
- Expansive width/height ratio
- Excellent resolution
  - Ex: @ 10 m, IFOV = 24mm

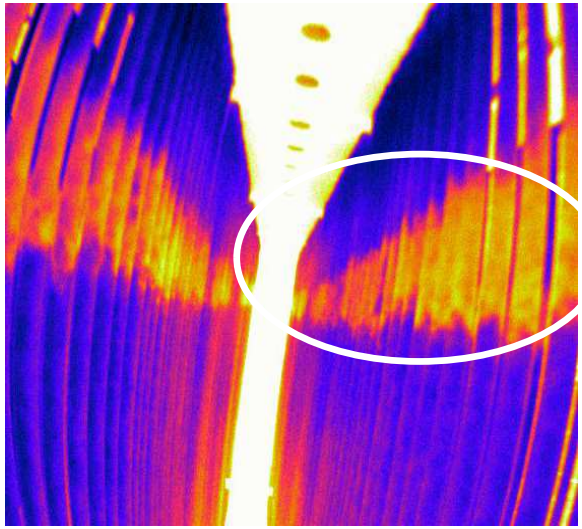


90x67°	A (m)	B (m)	IFOV (mm)
0.3m	0.60	0.45	0.72
0.5m	1.00	0.75	1.20
1.0m	2.00	1.50	2.40
5.0m	10.00	7.50	12.00
10.0m	20.00	15.00	24.00

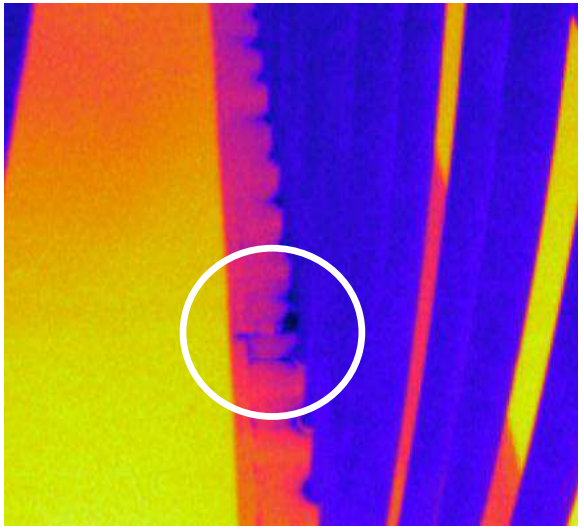
Hot spots



Flame impingement



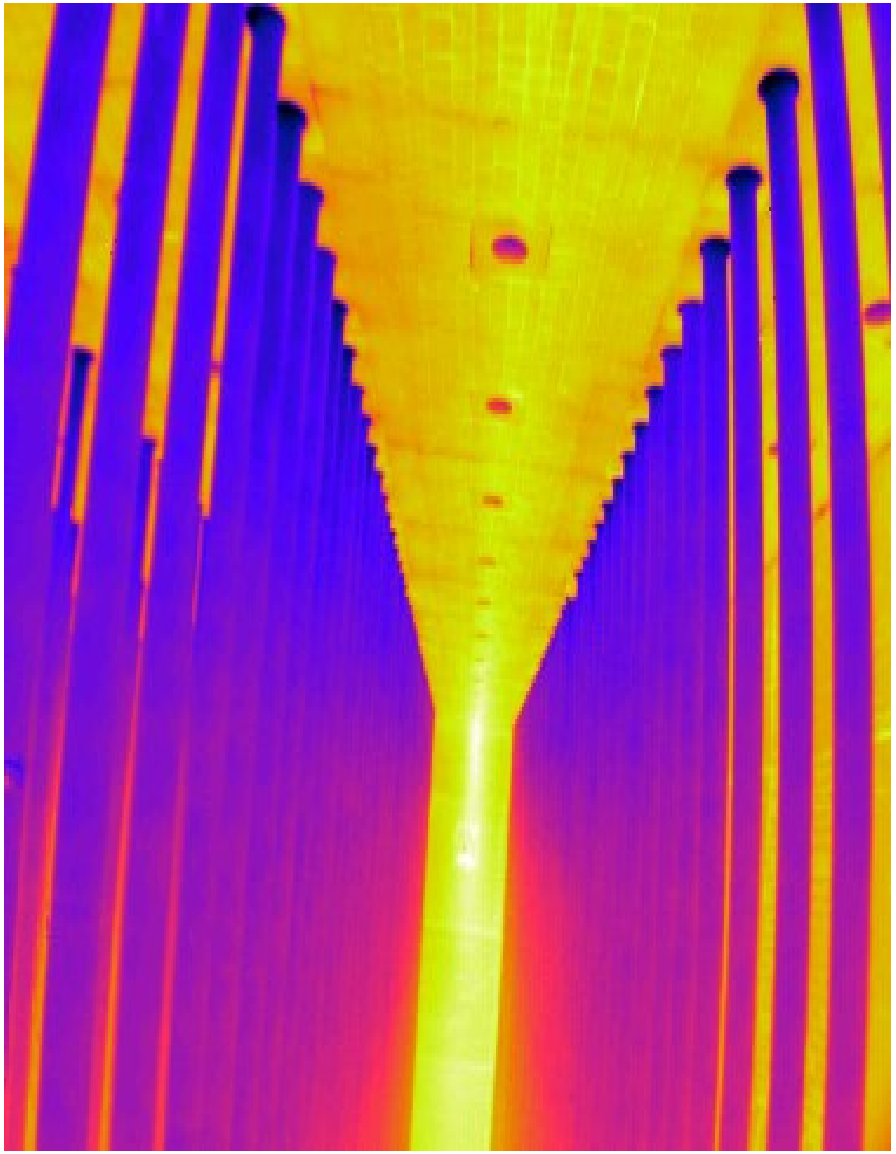
Hot bands



Refractory damage

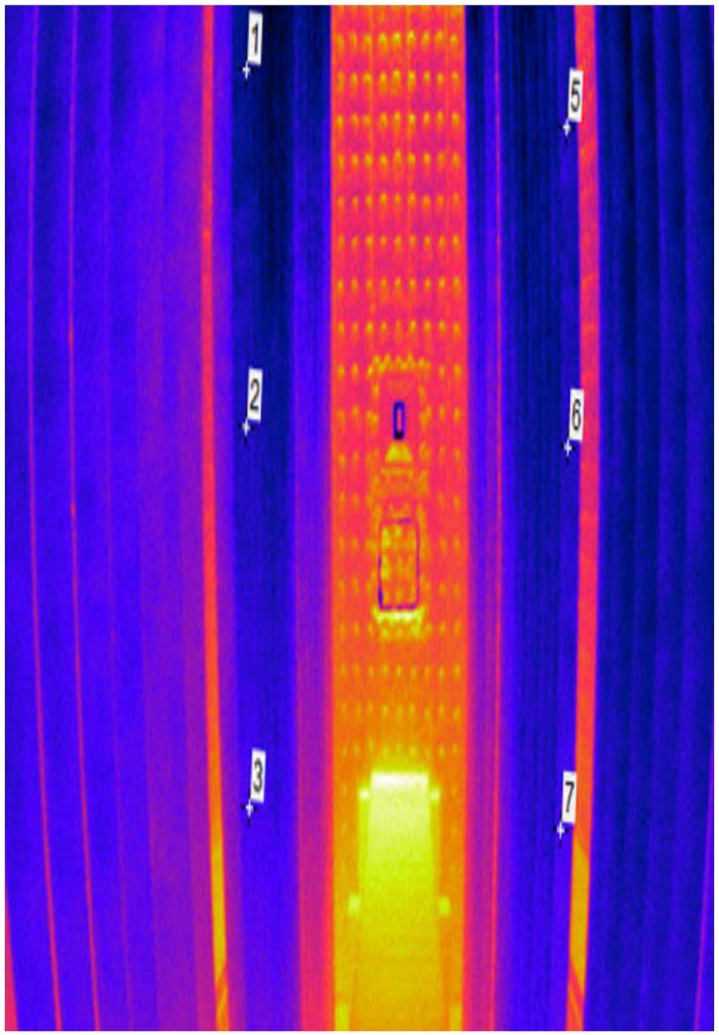
Our Solution

- Online Fixed Installation.
- Monitor TWT 24/7, early warning of increasing temperature
- Remote support in real time
- Build spreadsheets for weekly/monthly TWT average/min/max temps
- Monitor during startups and shutdowns
- Enhance operator safety

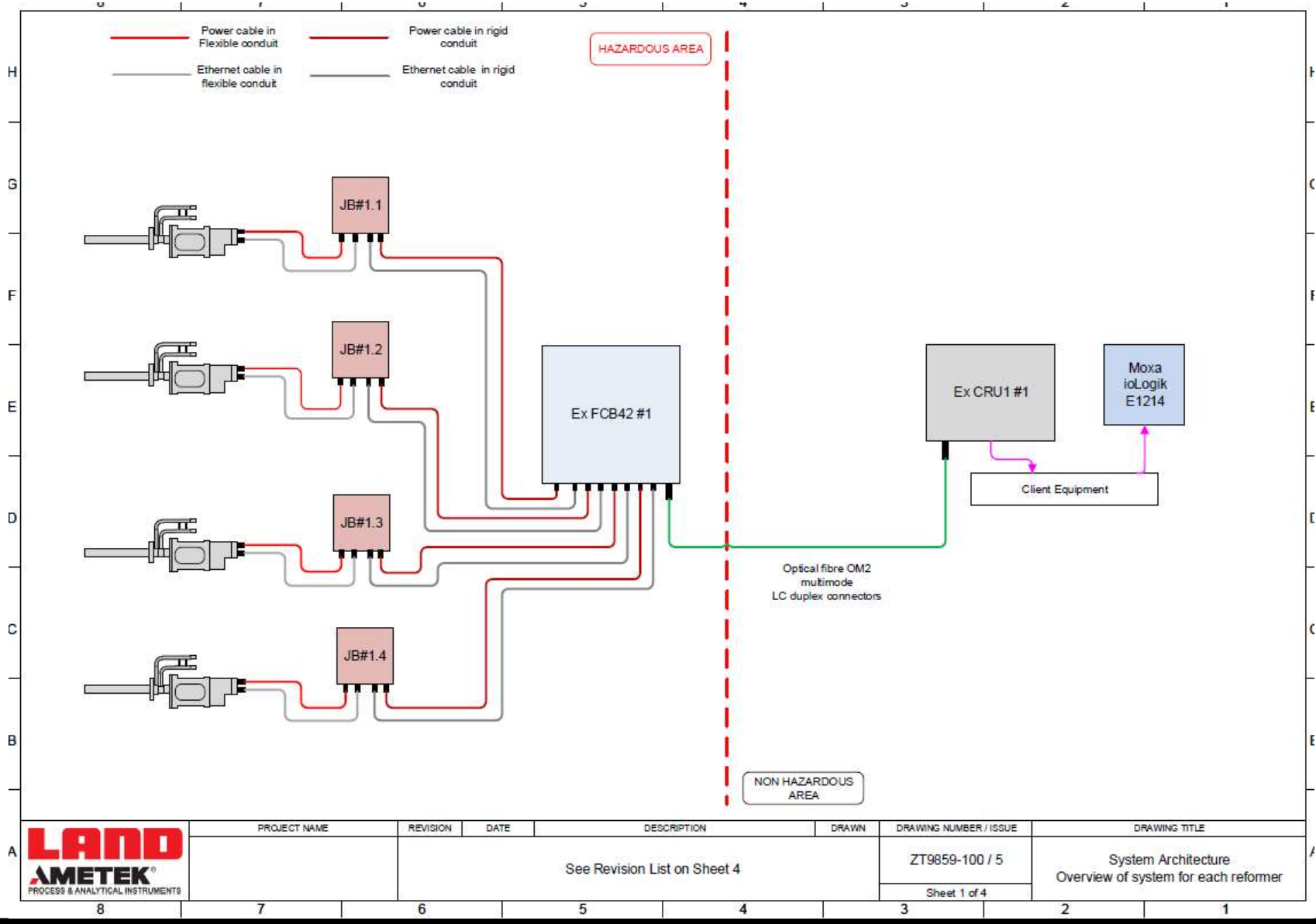


The Benefits

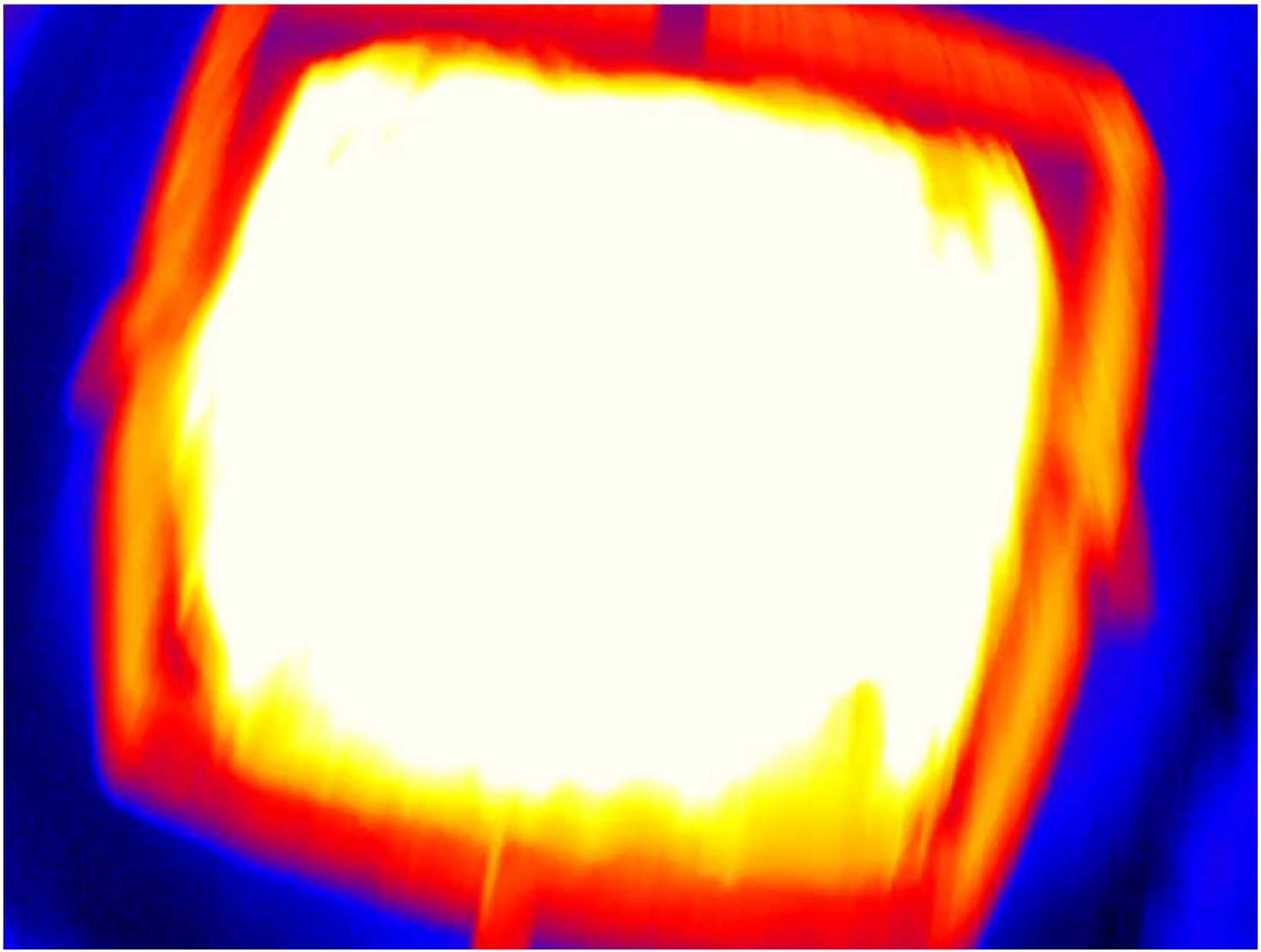
- Prevention to Tube failure due to over heating.
- Extend tube and catalyst life
- Safely increase temperature to increase production
- Improvement of firing balance and fuel Efficiency.
- Alarms first detection of HOT spot anywhere in the Tube.
- Cold spots, Flame impingement and Refractory temperature.



The System Architecture



Site Trials



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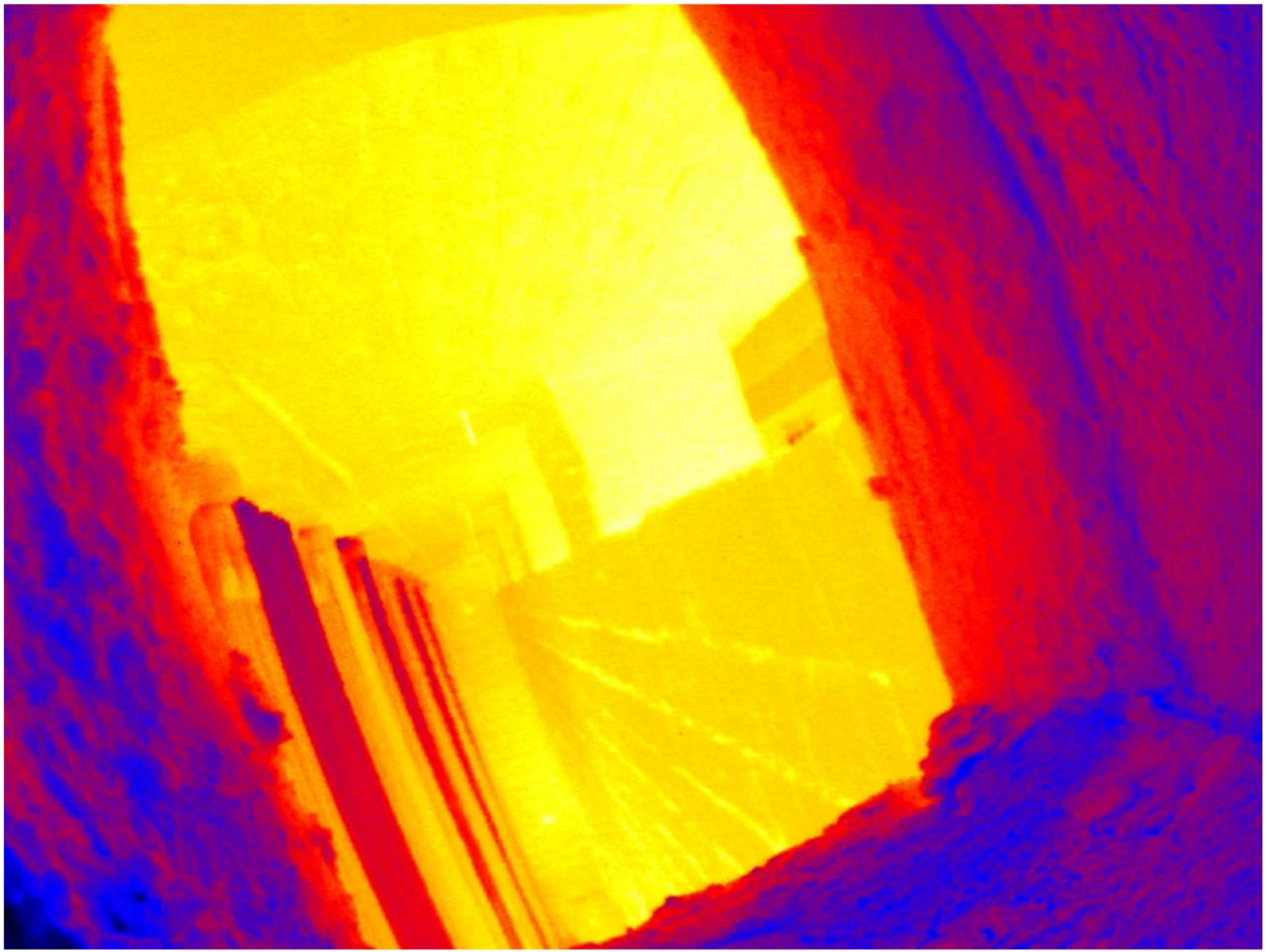

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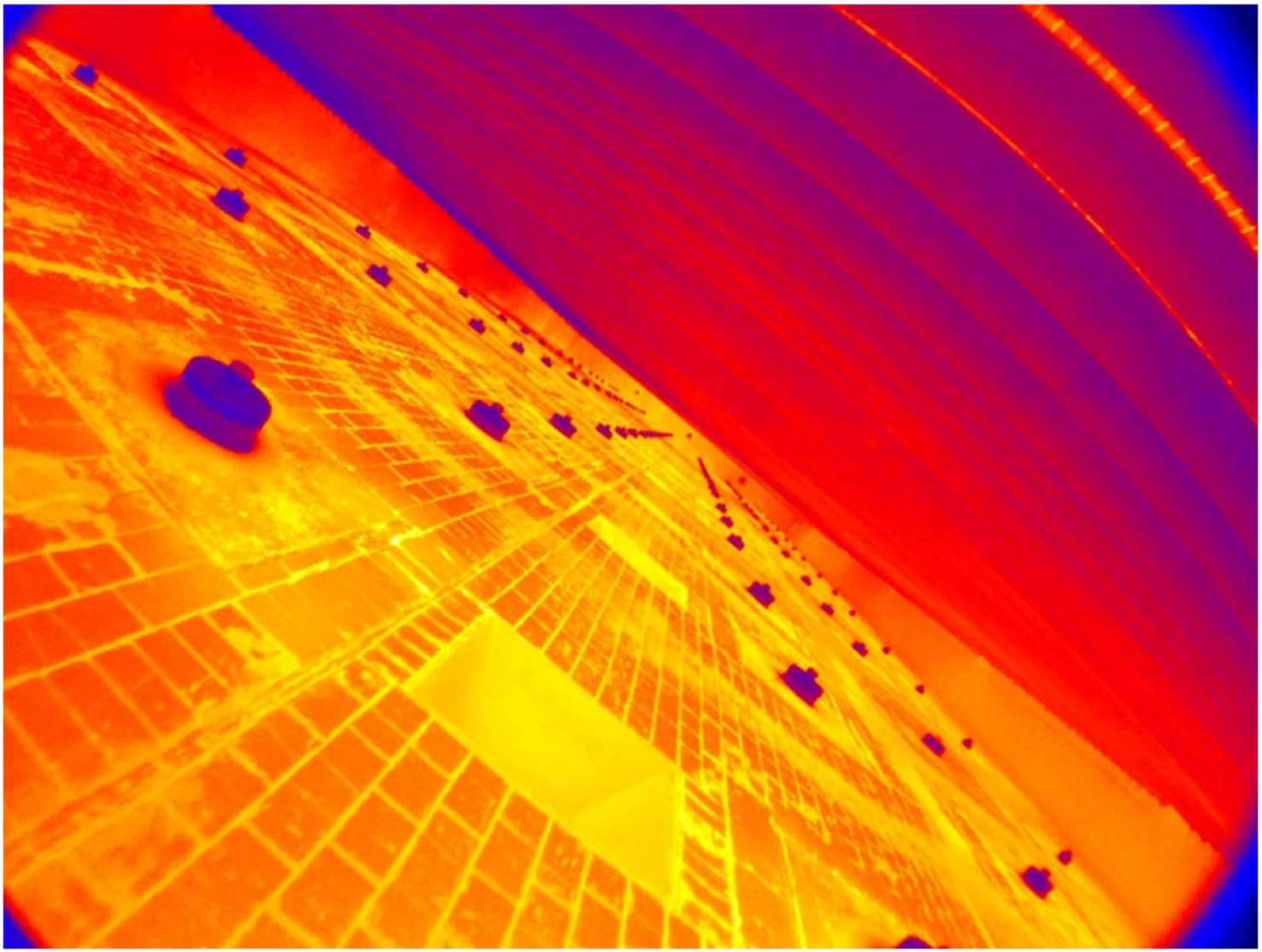
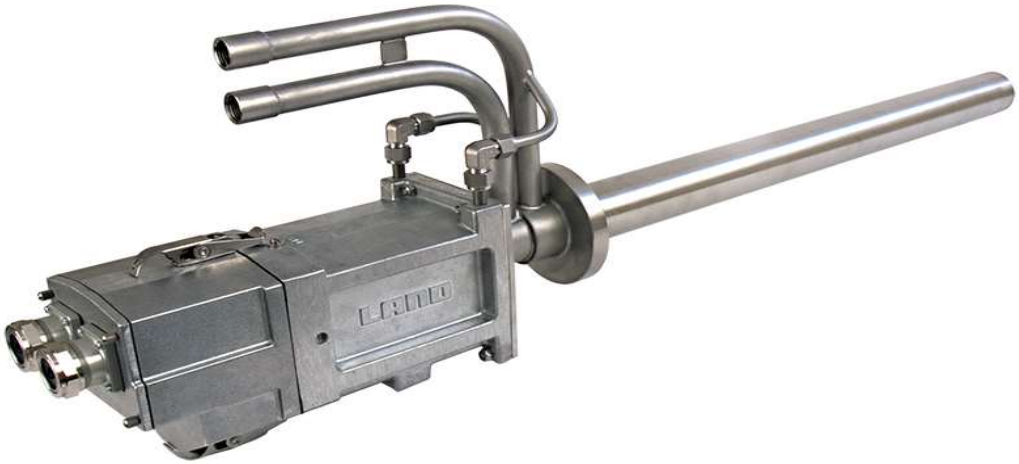


The Certification

- ATEX / IEC Ex and CSA Certified.

- Marking
  - Ex nA IIC T_4 Gc
  - Ta = -20° to +55° C

- Confirming to
  - IEC 60079-0:2011
    - Edition : 6
  - IEC 60079-15:2010
    - Edition : 4



Case Study – Air Liquide – Spain
Methane Reformer Furnace

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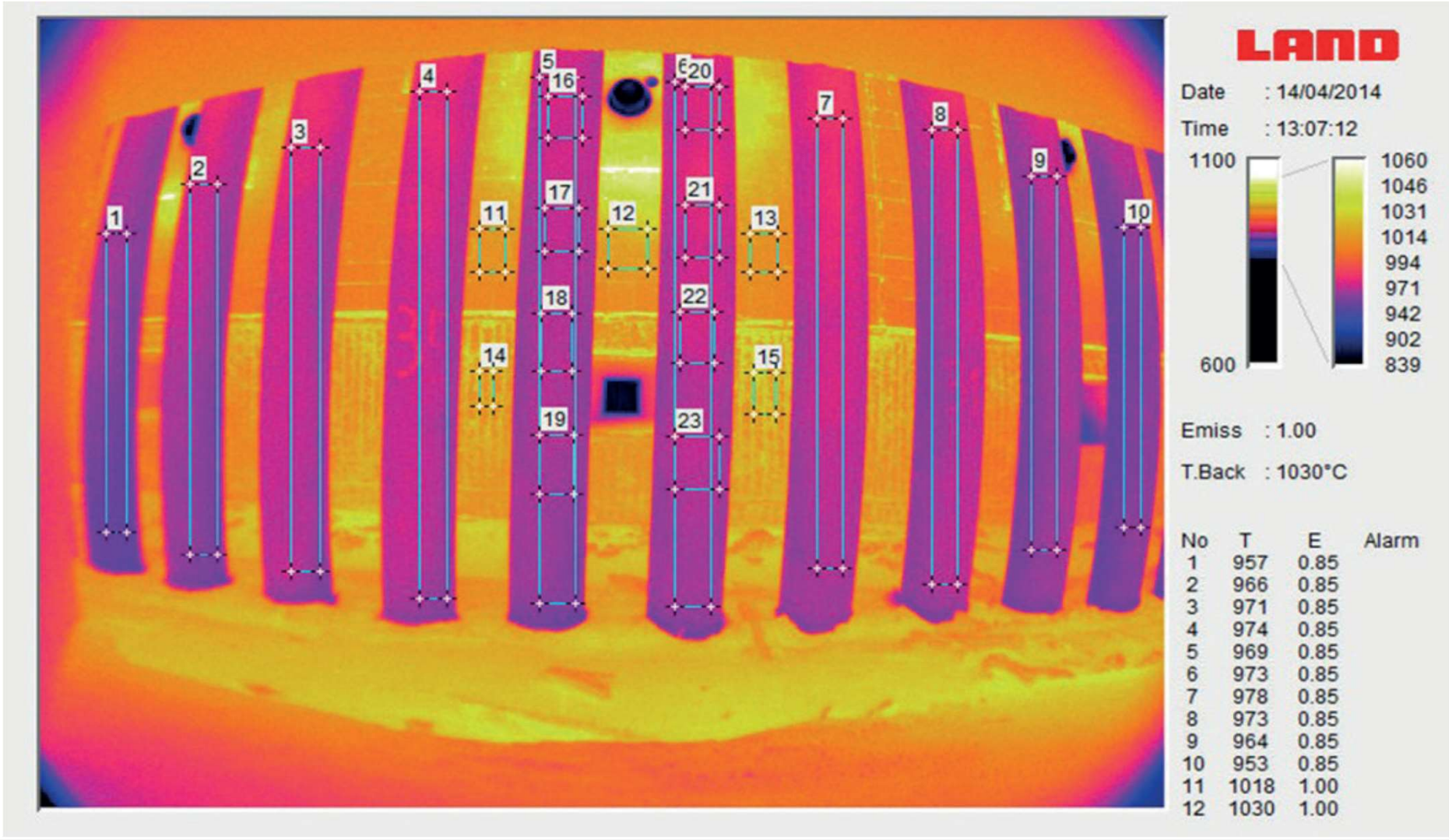
Methane Reformer Furnace



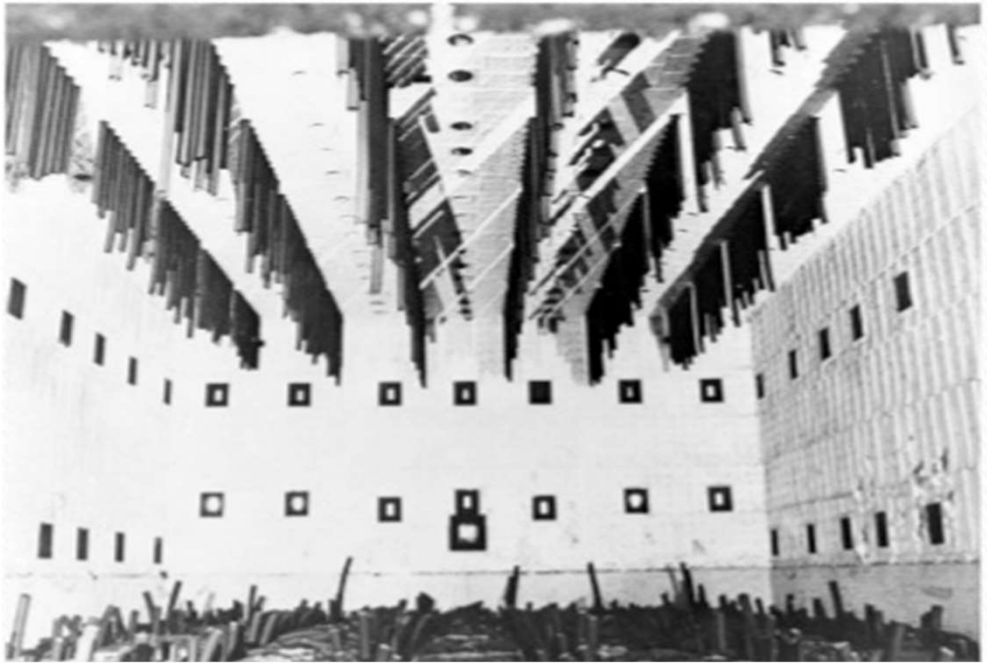
Case Study – Air Liquide – Spain
Methane Reformer Furnace

- Customer's Response

"Mr. Gonzalo Navarro, Production Manager says, THE IMPLEMENTATION OF THE THERMAL IMAGERS HAS ALLOWED US TO GAIN FURNACE KNOW-HOW. NOW, OUR TEAMS ARE ABLE TO MONITOR THE TEMPERATURE OF THE TUBES CONTINUOUSLY, THEY ARE ABLE TO MAKE MORE INFORMED AND CONFIDENT DECISIONS IMPLYING GREATER PLANT RELIABILITY."

- Continuous monitoring of the reformer TWT and process provides many advantages.
- It allows the plant to operate within an integrity operating window by doing this production can be increased in a safe manner.
- Equipment and personnel safety can be increased as 24/7 monitoring will give operators immediate notice thru preset alarms of any changing conditions of temperatures and process within the reformer.

There's no way to alleviate all issues with the reformer but by giving your operators better tools they will be able to make more informed and confident decisions when operating the reformer.



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Flare Stack Monitoring

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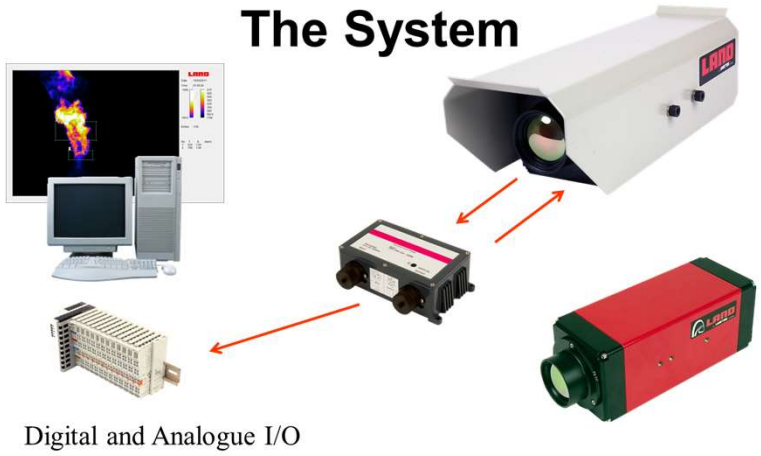
FLARE STACK MONITORING

- Plants need continuous monitoring of the flare and pilot light to avoid unignited flaring.
- Stack mounted sensors are often unreliable.
- Flare is often invisible to the naked eye.

- Thermal imaging can overcome this challenge and give a reliable status signal for the flare and pilot light.
- AMETEK LAND offer a hazardous area approved system with simple status signal for PLC / DCS integration.



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