

Infra-Red monitoring of Glass Futures furnace heat-up from Ambient air to operating oxy-fuel 2025 Glass Problems Conference

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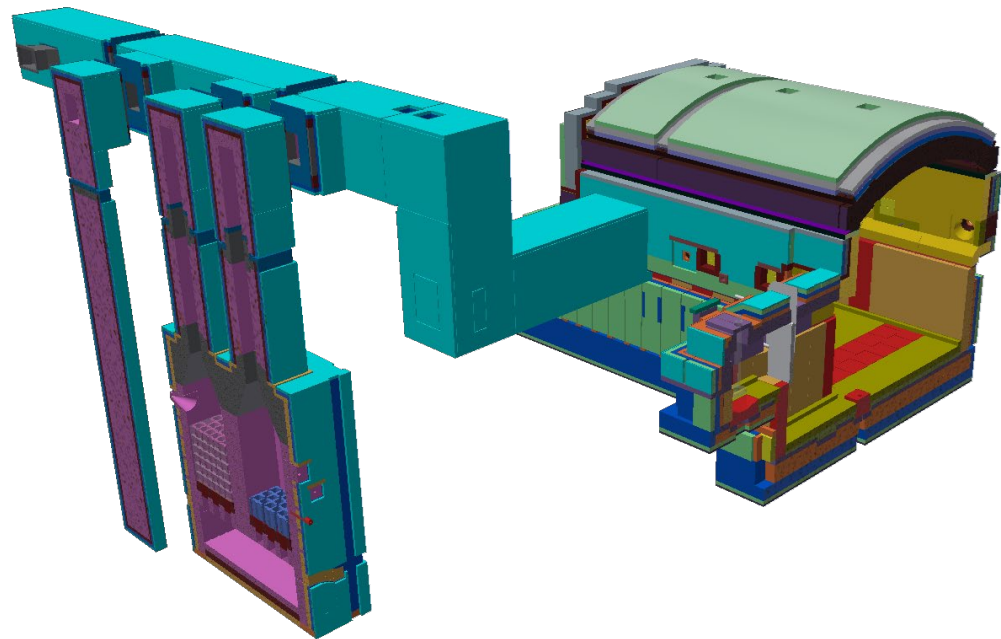
Ernesto Cattaneo - Stara Glass S.p.A.



GFL furnace design

Main data

- Melting area: 20 m²
- Nominal pull: 30 tpd
- Oxy combustion with different types of fuel, including natural gas, hydrogen and other sustainable fuels.
- Glass type: hollow AND flat!
- Test sections: one pocket in the tank for glass-contact refractory testing + room in the waste gas duct for checkers testing.
- Very big waste gas duct for a multi-purpose utilization of fumes.



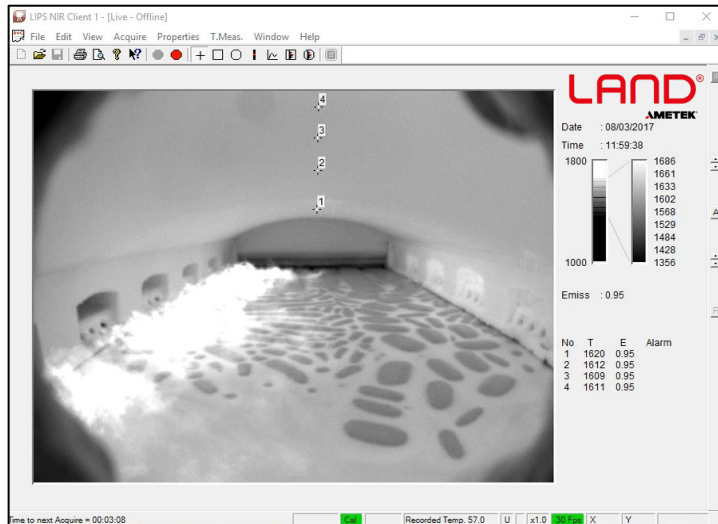
Infra-Red monitoring of Glass Futures furnace heat-up from Ambient air to operating oxy-fuel

Ben Simpson – LAND + Neil Simpson – Simpson Combustion and Energy



Background Glass Problems Conference Papers

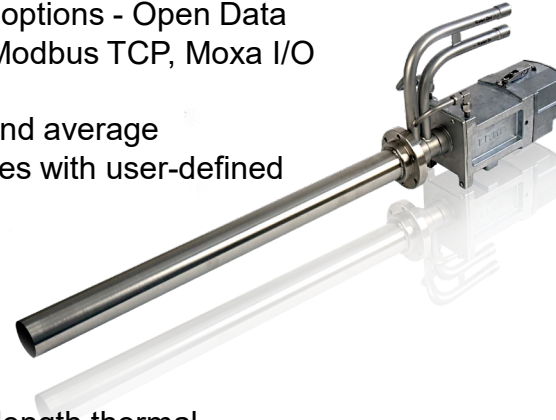
- 2017 – Cross Fired Furnace Optimisation for Record Pull
- 2018 – End Fired Furnace NOx Emission Reduction
- 2019 – Survey Tool and Glass Temp -Not Just a Pretty Picture
- 2020 - Supporting Hot and Cold Furnace repairs
- 2021 – In-Furnace Thermal Imaging Survey of a Float Furnace for Combustion Optimisation
- 2023 - Improved Process Optimisation as logical start on the Decarbonisation Journey
- 2024 - **Infrared does not lie! We have just never seen it before in base of regenerators**



EQUIPMENT USED:

NIR-b-2K GLASS - Near Infrared Borescope Glass Solution

- 1968x1476 resolution gives nearly 3 million pixels data points
- Wide 95° x 71° field of view
- Interfacing options - Open Data Interface, Modbus TCP, Moxa I/O unit
- Max, min and average temperatures with user-defined emissivity.



MWIR-640

- Mid-wavelength thermal imager
- Advanced spectral filtering
- 300 to 1800 °C
- 572 to 3271 °F
- Multiple I/O options

ImagePro -Advanced Image Processing and Controlling Software

Cyclops C100L

- Portable Infrared Thermometer
- Industry Standard
- Verify spot temperatures
- 550 to 3000°C
- 1022 to 5432°F



LWIR-640

- Long-wavelength thermal imager
- High temperature measurements accuracy and repeatability
- -20 to 1500 °C
- -4 to 2732 °F
- Multiple I/O options



Location of 2 Spie Heat- Up burners LWIR at Charging End MWIR/2K in Bridge Wall



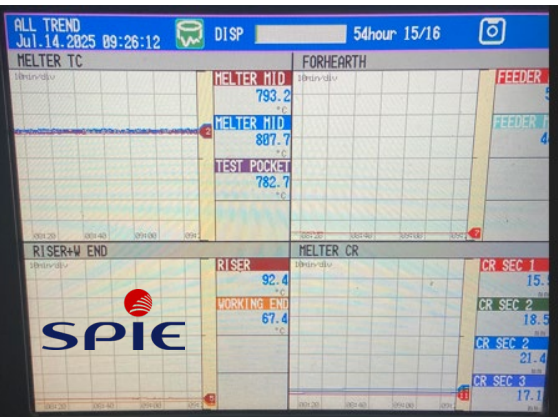
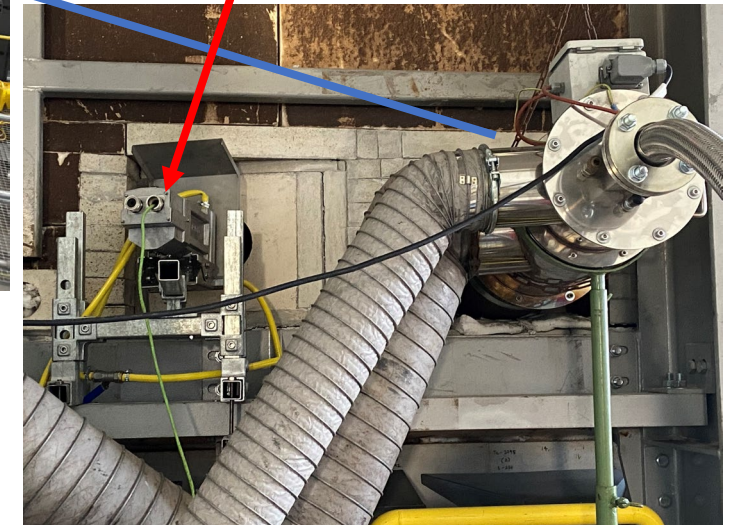
MWIR or 2K



<https://www.spie-excelcius.com/on-site-service/glass-industry-services/glass-furnace-heat-up-expansion-control/>



SPIE



CONFIDENTIAL Simpson C&E, Land, Glass Futures, Spie & Stara

Glass Futures Heat-Up Day 1 Initial Recording 62*0.5Degree Isotherms

AMETEK Land IMAGEPro (Administrator)

Configuration Data Views Help

Image Player

Analysis

Data	Temperatures in °C			▲	ε	✂	% ROI
	Max	Mean	Min				
Frame	67.1	49.7	36.2	●	1.00	-	-

ROI Editor

Palette

68

37

12:52:31 12:52:40

169 Frame

Camera1 (LWIR 640) 29.6°C ε: 1.00 FPS: 0.10

CONFIDENTIAL Simpson C&E, Land, Glass Futures, Spie & Stara

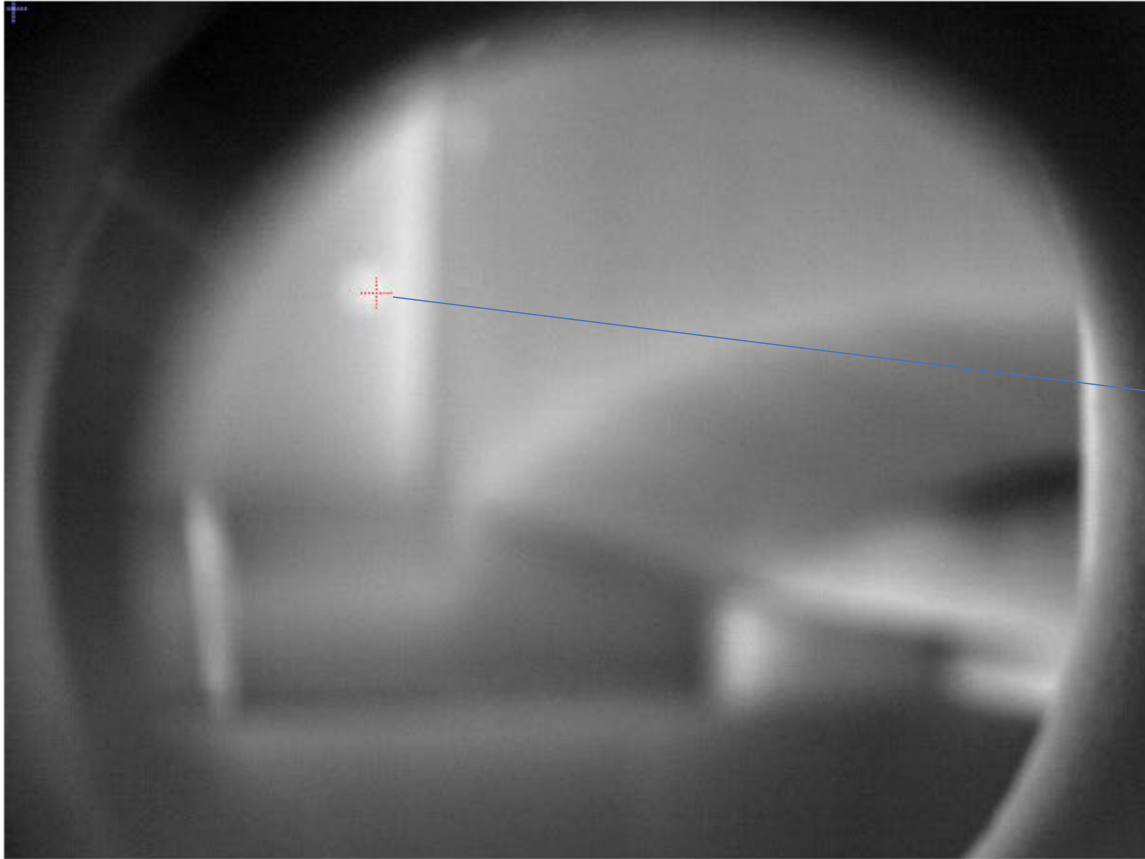
B&W 31Degree Delta Is this the “glue”?

AMETEK Land IMAGEPro (Administrator)

Configuration Data Views Help

Image Player

Browse Recordings



Analysis

Data	Temperatures in °C				ε		% ROI
	Max	Mean	Min				
Frame	67.1	49.7	36.2	●	1.00	-	-

ROI Editor

Palette

68

37

12:52:31 12:52:40

169 Frame

Camera1 (LWIR 640) 29.6°C ε: 1.00 FPS: 0.10

CONFIDENTIAL Simpson C&E, Land, Glass Futures, Spie & Stara

X: Y: T:

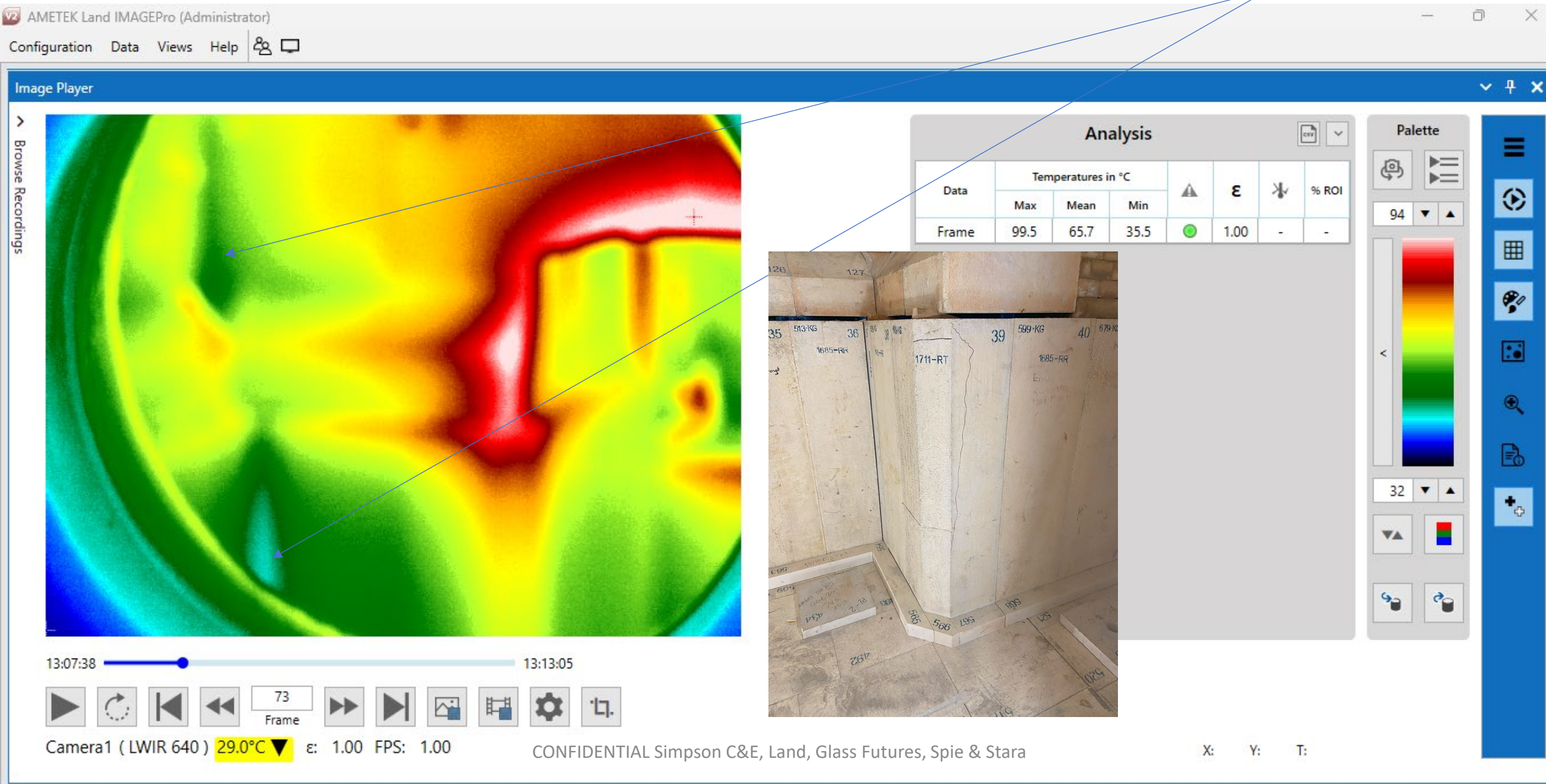
270 273

STEVE SHELLOCK
FIVES SPAIN
PARRY HALL

48 149 150

Anne M...
CHART 7.5.25

Using as a Transportable 62*1Degree Isotherm (Cold joints)



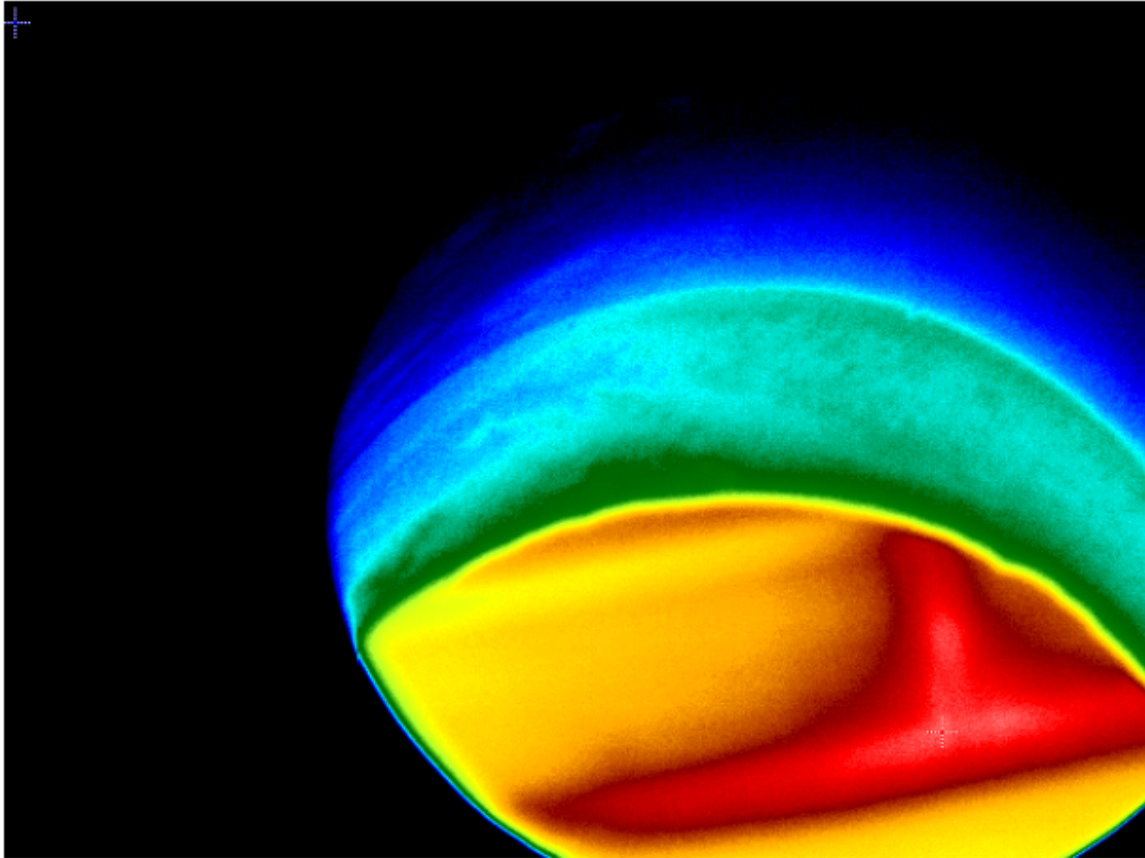
View of Crown Joint Suggests that the gases are exhausting through the joints

AMETEK Land IMAGEPro (Administrator)

ConfigurationDataViewsHelp

Image Player

Browse Recordings



15:34:35

15:39:08

370

Frame

Camera1 (LWIR 640)

31.8°C

ε: 1.00

FPS: 3.00

CONFIDENTIAL Simpson C&E, Land, Glass Futures, Spie & Stara

X: Y: T:

Analysis

Data	Temperatures in °C				ε		% ROI
	Max	Mean	Min				
Frame	124	73.5	43.8		1.00	-	-

Palette

127

65

291

292

293

276

275

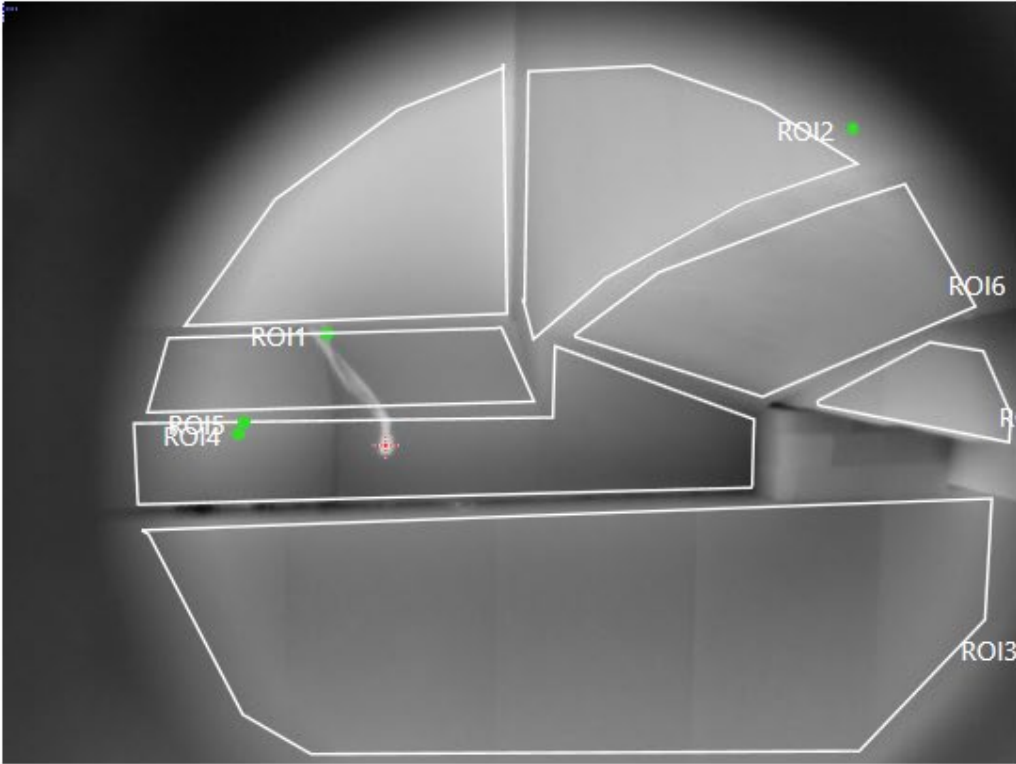
Day 2 – Camera Focussed

AMETEK Land IMAGEPro (Administrator)

Configuration Data Views Help

Image Player

Browse Recordings



ROI1, ROI2, ROI3, ROI4, ROI5, ROI6, ROI11, ROI12, ROI15

Analysis

Data	Temperatures in °C			⚠	ε	✂	% ROI
	Max	Mean	Min				
Frame	102.8	76.7	50	●	1.00	-	-
ROI1	100.2	94.2	82.1	●	-	-	-
ROI2	97	93.2	83.7	●	-	-	-
ROI3	84.4	78.5	71.5	●	-	-	-
ROI4	102.8	74.7	61.5	●	-	-	-
ROI5	92.1	82	73.5	●	-	-	-
ROI6	93.4	85.7	75.2	●	-	-	-
ROI7	93.9	87.2	75.2	●	-	-	-

ROI Editor

ROI Editor tools: selection, deletion, point, line, rectangle, ellipse, polygon, freeform, and ROI management.

Palette

Color palette and histogram.

File Details

Camera Type: LWIR 640
File Name: 2025-06-26-08-32-56_Camera1.erfx
Date: 26/06/2025
Time: 08:32 (GMT+00:00)

8:32:56 8:47:56

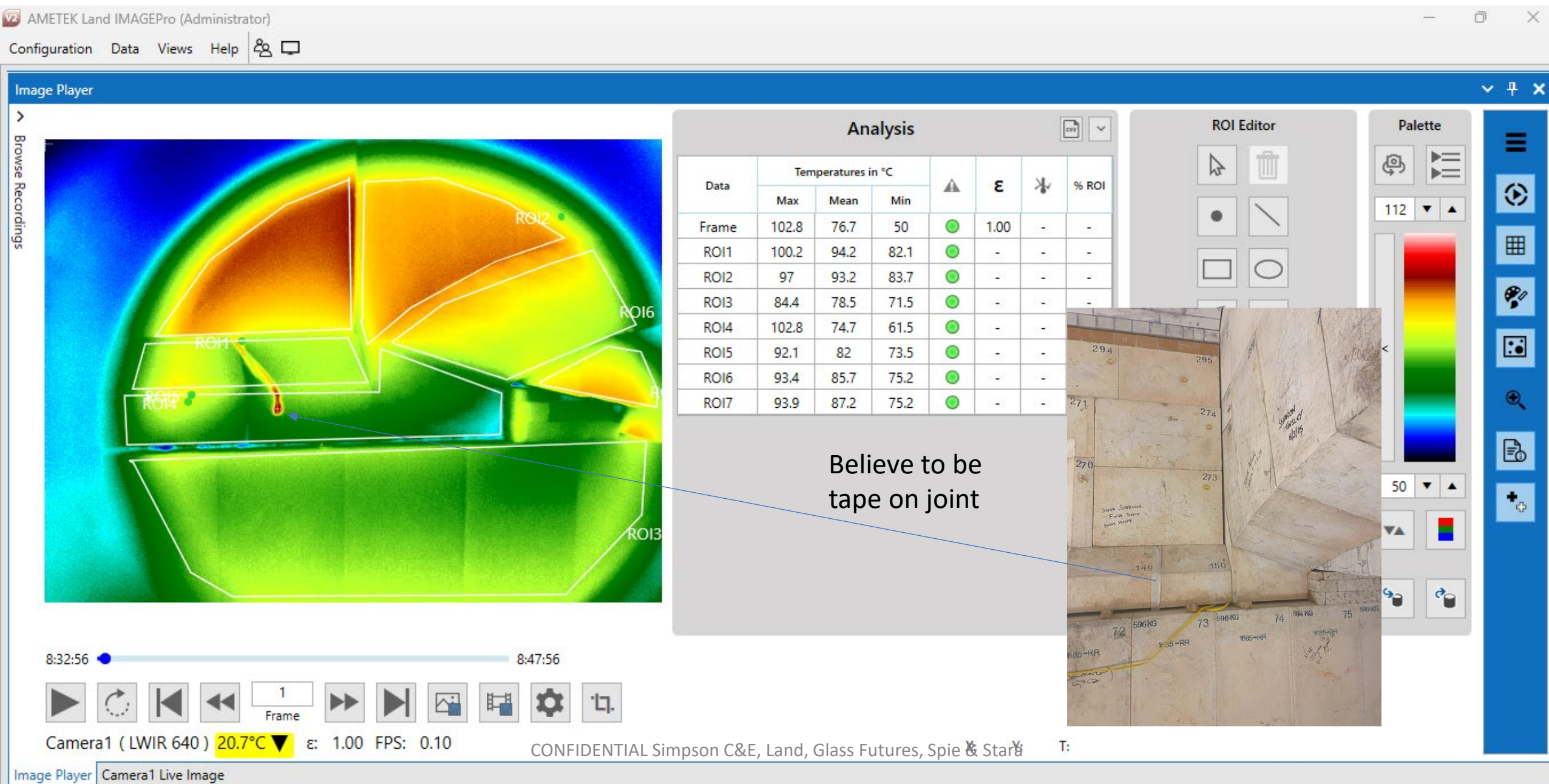
1 Frame

Camera1 (LWIR 640) 20.7°C ▼ ε: 1.00 FPS: 0.10

CONFIDENTIAL Simpson C&E, Land, Glass Futures, Spie & Staß T:

Image Player Camera1 Live Image

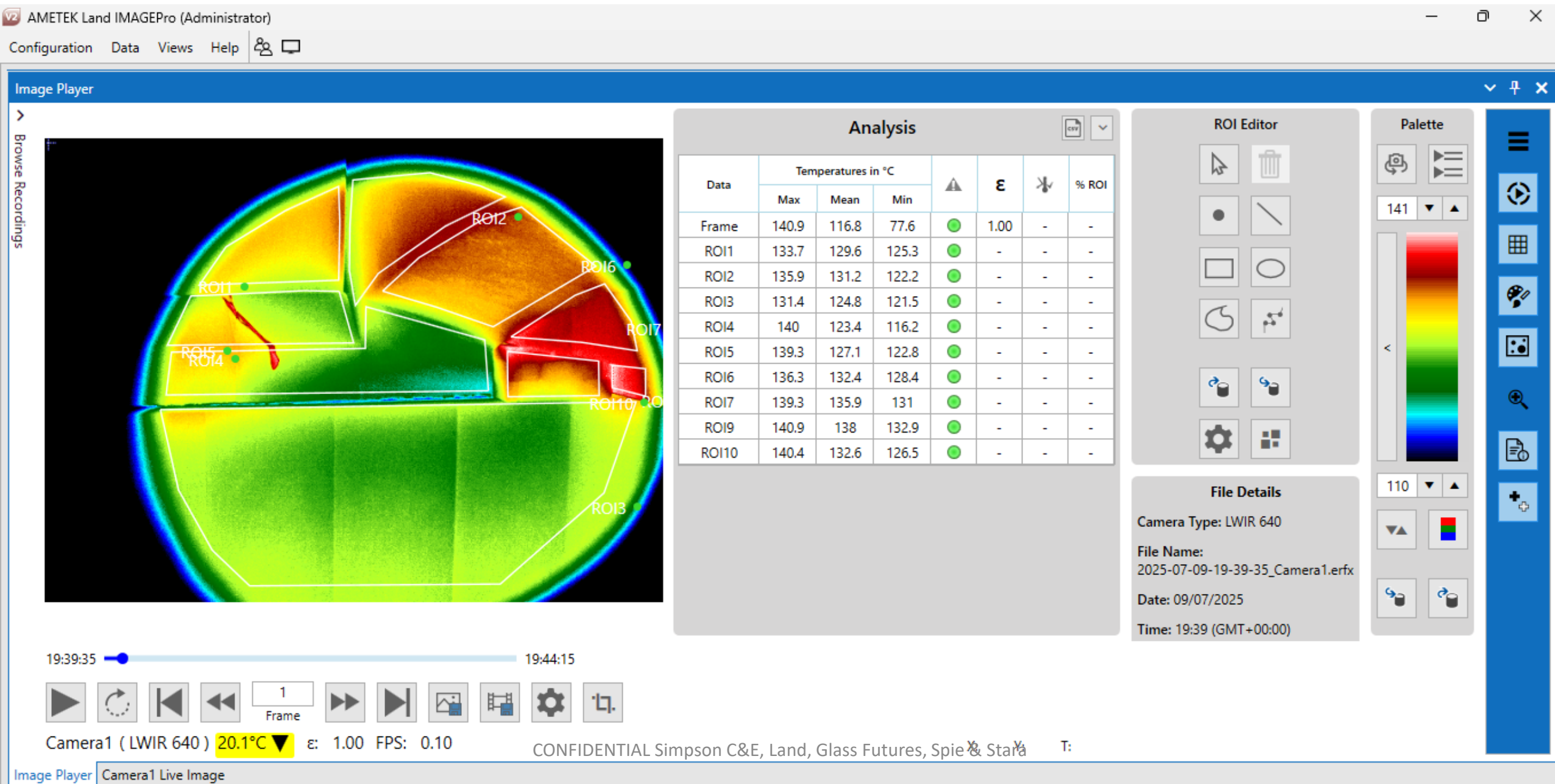
Day 2 am Initial Frame



Force Majeur - Extended Dry Out due to utilities

- The Glass Futures furnace was a new building but built on a brown field site – site of UG Peasley bottle works.
- All utilities were new and there was a cooling water problem which due to the electrode holders meant that the furnace heat up was put on hold providing an extended dry out.
- On 9th July (Day 15) the heat up continued at 14.00.
- LWIR Recordings recommenced at 19.39
- At 10am and 10pm each day a snapshot and analysis was made.
- The full paper will show each analysis but only daily in the conference copy

Day 15 – First Frame 110-141



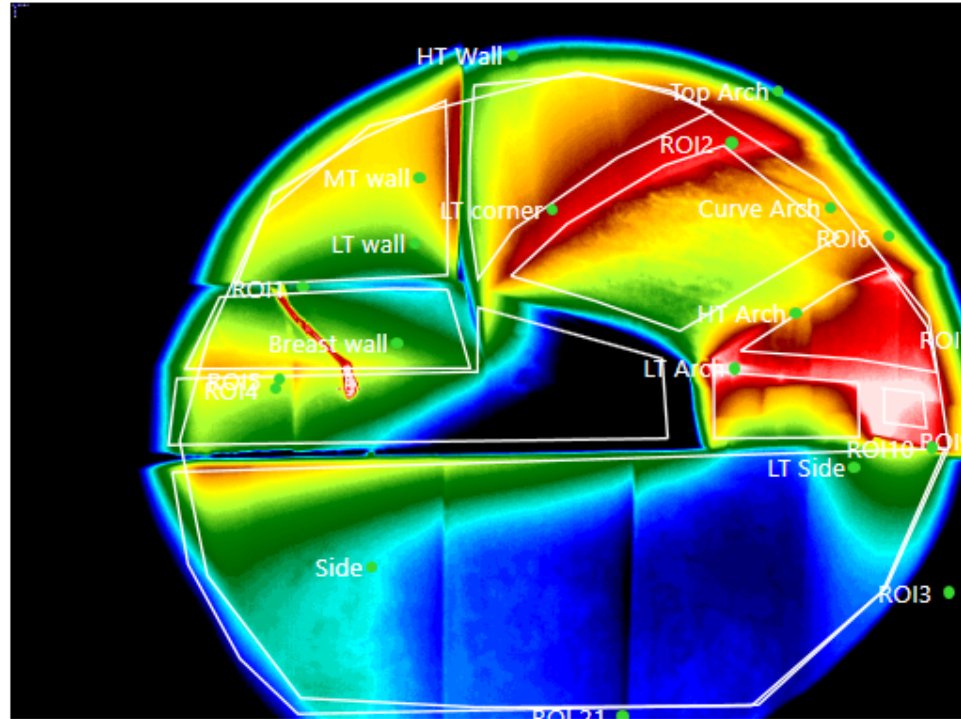
Day 17 10am 220-251 (+45) Frame Max +48.5

AMETEK Land IMAGEPro (Administrator)

8am slight movement in crown witnessed

Configuration Data Views Help

Image Player



Analysis

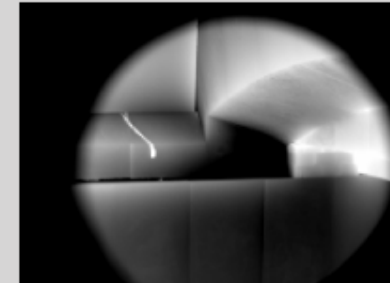
Data	Temperatures in °C				E		% ROI
	Max	Mean	Min				
Frame	261.7	220	162.3	●	1.00	-	-
ROI1	244.5	236.8	227.3	●	-	-	-
ROI2	246.3	240.5	232.8	●	-	-	-
ROI3	243.8	225.8	219.9	●	-	-	-
ROI4	261.7	225.6	205.5	●	-	-	-
ROI5	252.2	234	225.7	●	-	-	-
ROI6	248.9	239.5	230.3	●	-	-	-
ROI7	251.5	246.4	239.8	●	-	-	-
ROI9	253.7	251	249.2	●	-	-	-
ROI10	251.3	241.2	232.4	●	-	-	-
LT corner	228.9	228.9	228.9	●	-	-	-
Top Arch	246.8	246.8	246.8	●	-	-	-
Curve Arch	237.7	237.7	237.7	●	-	-	-
LT Arch	210.2	210.2	210.2	●	-	-	-
HT Arch	249.1	249.1	249.1	●	-	-	-
LT Side	222.3	222.3	222.3	●	-	-	-

Zoom

100 %



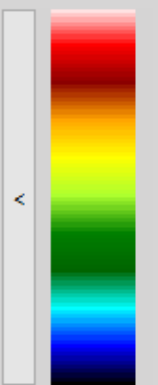
Reset



Palette



251



220



File Details

Camera Type: LWIR 640

File Name:
2025-07-11-09-39-00_Camera1.erfx

Date: 11/07/2025

Time: 09:39 (GMT+00:00)

Size: 709 MB

Duration: 3 hours 21 minutes 50 seconds

10:00:01 13:00:50



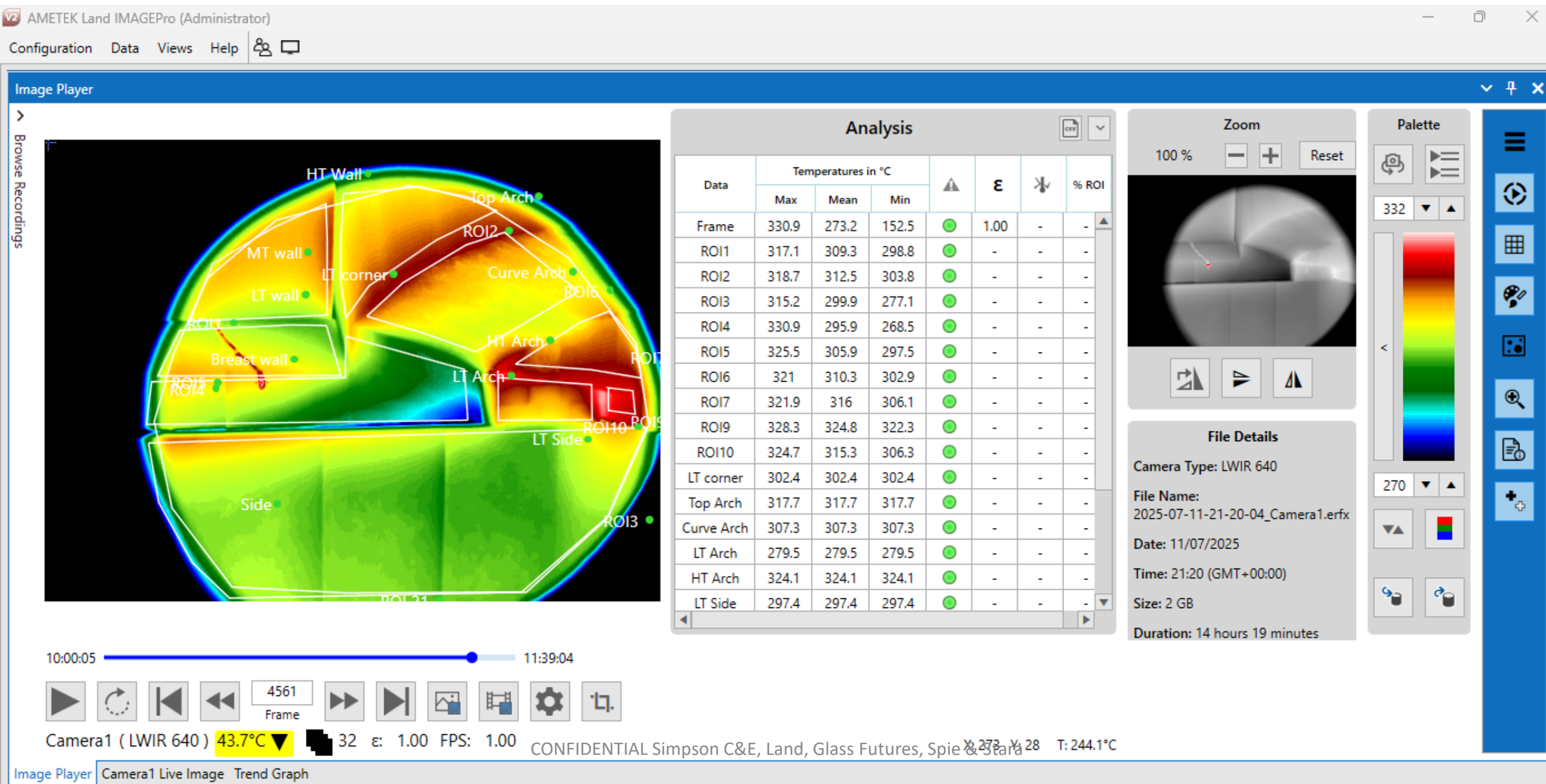
Camera1 (LWIR 640) 38.1°C 32 E: 1.00 FPS: 1.00

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Image Player

Camera1 Live Image Trend Graph

Day 18 10am 270-332 (+15+46) Frame Max +38.5



Day 18 Upset

- Spie Excelsius
 - AM Both burners 3000Nm³/hr Air (32% upstream 33% downstream)
 - 11am adjusting doghouse arch
 - 4pm Seeing some instability on temperatures
 - Evening Identified that two thermocouples had moved and so impacting the measurement
 - See fluctuations on MWIR

Day 19 10am 400-524(+100+62) Frame Max>500 (521)

AMETEK Land IMAGEPro (Administrator)

ConfigurationDataViewsHelp

Image Player

HT Wall

Top Arch

MT wall

LT wall

Breast wall

Side

LT corner

Curve Arch

HT Arch

LT Arch

LT Side

ROI1

ROI2

ROI3

ROI4

ROI5

ROI6

ROI7

ROI8

ROI9

ROI10

ROI11

ROI12

ROI13

ROI14

ROI15

ROI16

ROI17

ROI18

ROI19

ROI20

ROI21

ROI22

ROI23

ROI24

ROI25

Analysis

Data	Temperatures in °C				ε		% ROI
	Max	Mean	Min				
Frame	>500	421.1	224.8		1.00	-	-
ROI1	484.1	474	461.2		-	-	-
ROI2	488.3	474.4	463.1		-	-	-
ROI3	498.9	463.5	430.5		-	-	-
ROI4	492.6	472.2	442.4		-	-	-
ROI5	493	478.8	465.1		-	-	-
ROI6	493.6	475.6	465.9		-	-	-
ROI7	>500	496.8	474.2		-	-	-
ROI9	>500	>500	>500		-	-	-
ROI10	>500	>500	491.2		-	-	-
LT corner	469.5	469.5	469.5		-	-	-
Top Arch	476.7	476.7	476.7		-	-	-
Curve Arch	470.2	470.2	470.2		-	-	-
LT Arch	458.2	458.2	458.2		-	-	-
HT Arch	>500	>500	>500		-	-	-
LT Side	466.7	466.7	466.7		-	-	-

Zoom

100 %

Reset

524

400

File Details

Camera Type: LWIR 640

File Name: 2025-07-13-08-29-47_Camera1.erfx

Date: 13/07/2025

Time: 08:29 (GMT+00:00)

Size: 976 MB

Duration: 4 hours 37 minutes 50 seconds

10:00:08

13:07:37

543

Frame

Camera1 (LWIR 640) 47.9°C

32

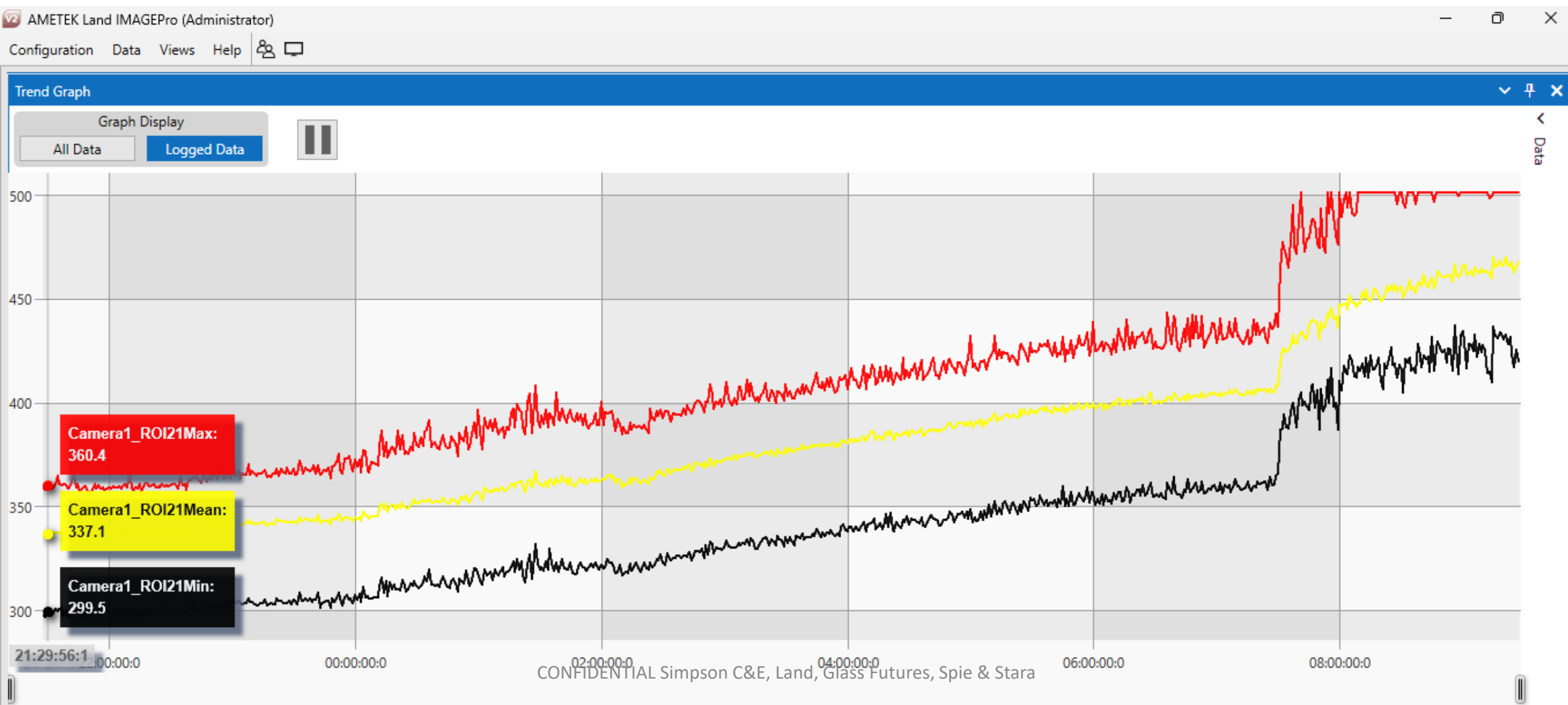
ε: 1.00

FPS: 10.00

X: 528 Y: 29 T: 294.8°C

CONFIDENTIAL Simpson C&E, Land, Glass Futures, Spie & Stara

Day 19 TrendBurner adjustments were made at around 14.00 as seen in the change in peak “flame” temperature.



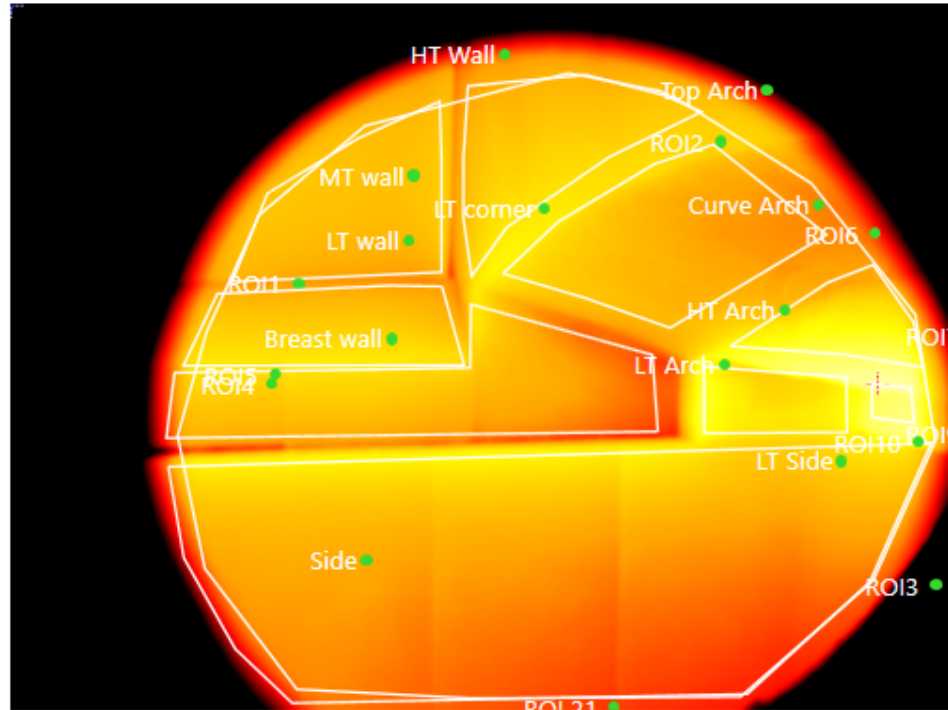
Day 19 10pm 500-624(+100) Frame Max 613.3 (Re-range 0-1000)

V2 AMETEK Land IMAGEPro (Administrator)

Configuration Data Views Help

Image Player

Browse Recordings



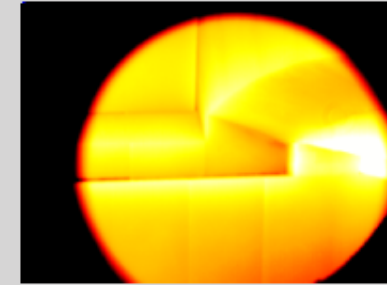
Analysis

Data	Temperatures in °C				E		% ROI
	Max	Mean	Min				
Frame	613.3	511.9	298.1	●	1.00	-	-
ROI1	576.4	570.3	560.1	●	-	-	-
ROI2	586.1	574.5	560.7	●	-	-	-
ROI3	591.2	561.4	523.2	●	-	-	-
ROI4	586.4	566.8	537.2	●	-	-	-
ROI5	587.1	575.7	561.1	●	-	-	-
ROI6	586.9	568.2	556.3	●	-	-	-
ROI7	607.4	587.7	561.3	●	-	-	-
ROI9	613.2	607.2	602.3	●	-	-	-
ROI10	609.4	586.8	576.7	●	-	-	-
LT corner	563.1	563.1	563.1	●	-	-	-
Top Arch	578.1	578.1	578.1	●	-	-	-
Curve Arch	562.1	562.1	562.1	●	-	-	-
LT Arch	548.6	548.6	548.6	●	-	-	-
HT Arch	584.3	584.3	584.3	●	-	-	-
LT Side	565.2	565.2	565.2	●	-	-	-

Zoom

100 %

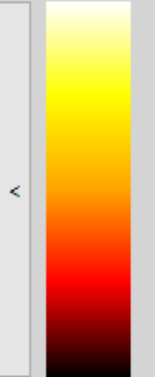
Reset



Palette



624



500



File Details

Camera Type: LWIR 640

File Name:

2025-07-13-20-43-28_Camera1.erfx

Date: 13/07/2025

Time: 20:43 (GMT+00:00)

Size: 2 GB

Duration: 11 hours 37 minutes 30 seconds

22:00:19 8:20:58



Camera1 (LWIR 640) 57.2°C 32 E: 1.00 FPS: 10.00

CONFIDENTIAL Simpson C&E, Land, Glass Futures, Spie & Starb

Day 19 10pm 500-624(+100) Frame Max 613.3 (Re-range 0-1000)

AMT Engineering (demo)

Configuration Data Views Help

Image Player

> Browse Recordings

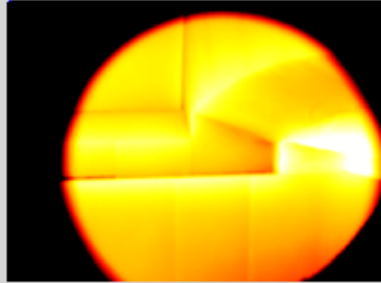


Analysis

Data	Temperatures in °C				ε		% ROI
	Max	Mean	Min				
Frame	613.3	511.9	298.1	●	1.00	-	-
ROI1	576.4	570.3	560.1	●	-	-	-
ROI2	586.1	574.5	560.7	●	-	-	-
ROI3	591.2	561.4	523.2	●	-	-	-
ROI4	586.4	566.8	537.2	●	-	-	-
ROI5	587.1	575.7	561.1	●	-	-	-
ROI6	586.9	568.2	556.3	●	-	-	-
ROI7	607.4	587.7	561.3	●	-	-	-
ROI9	613.2	607.2	602.3	●	-	-	-
ROI10	609.4	586.8	576.7	●	-	-	-
LT corner	563.1	563.1	563.1	●	-	-	-
Top Arch	578.1	578.1	578.1	●	-	-	-
Curve Arch	562.1	562.1	562.1	●	-	-	-
LT Arch	548.6	548.6	548.6	●	-	-	-
HT Arch	584.3	584.3	584.3	●	-	-	-
LT Side	565.2	565.2	565.2	●	-	-	-

Zoom

100 % - + Reset



File Details

Camera Type: LWIR 640

File Name: 2025-07-13-20-43-28_Camera1.erfx

Date: 13/07/2025

Time: 20:43 (GMT+00:00)

Size: 2 GB

Duration: 11 hours 37 minutes 30 seconds

Palette

624



500

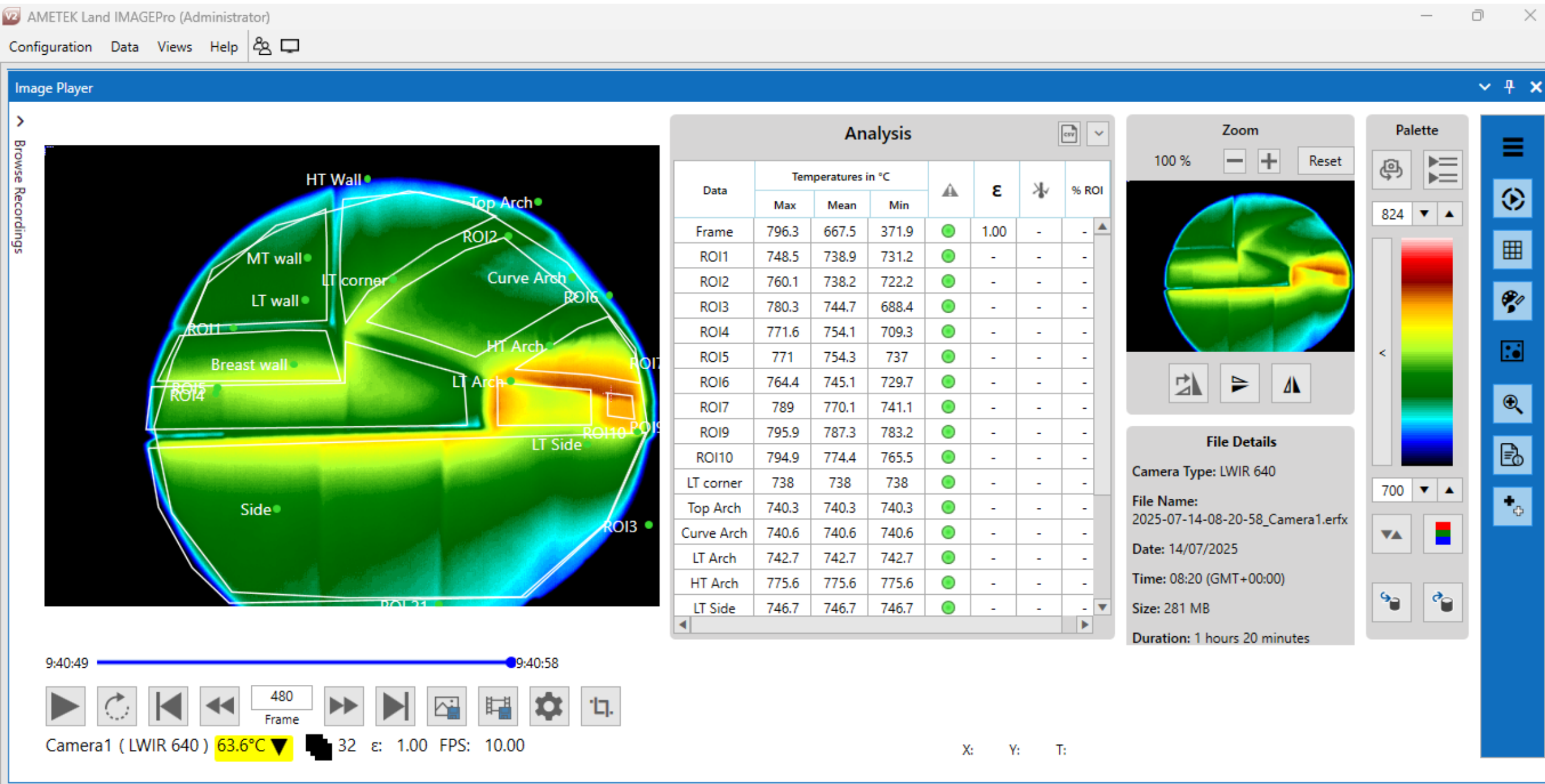
22:00:19 8:20:58

462 Frame

Camera1 (LWIR 640) 57.2°C 32 ε: 1.00 FPS: 10.00

CONFIDENTIAL Simpson C&E, Land, Glass Futures x Spie & Star

Day 20 10am 700-824(+200) Frame Max 796.3



14th July LWIR Removed

- Decision made to remove the LWIR on Day 20
- Did not want to exceed the high temp range overnight
- MWIR had been installed on Day 16 (below instrument min range)
- Day 18 MWIR two doghouse corner areas still below 300
- Day 19 MWIR all areas in range of instrument
- Potential to relocate for glass leak detection.

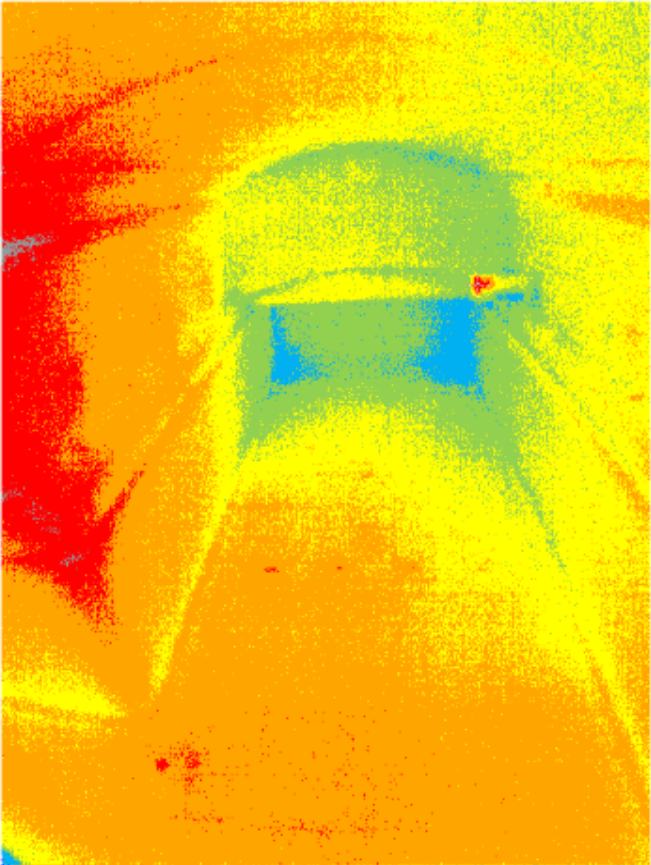
Day 16 First MWIR Images Below Inst Range200-250

AMETEK Land IMAGEPro (Administrator)

ConfigurationDataViewsHelp

Image Player

Browse Recordings



18:34:2619:25:54

▶↺⏮⏪

510


⏩⏭▶

Frame

Camera1 (MWIRb 640) 50.6°C ▼ 31°C OK 32 ε: 1.00 FPS: 1.00

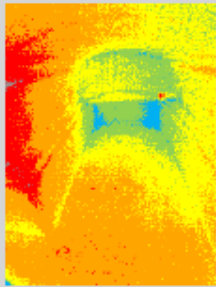
Analysis

Data	Temperatures in °C			▲	ε	⏴	% ROI
	Max	Mean	Min				
Frame	<300	<300	<300	●	1.00	-	-



Zoom

100 % - + Reset



270

File Details

Camera Type: MWIRb 640

File Name: 2025-07-10-18-25-56_Camera1.erfx

Date: 10/07/2025

Time: 18:25 (GMT+00:00)

Size: 2 GB

Duration: 59 minutes 58 seconds

Palette

300

180

240 - 250°C

230 - 240°C

220 - 230°C

210 - 220°C

200 - 210°C

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Day 18 10pm 300-393 (+28) Frame Max 391.5 (+27.9)

AMETEK Land IMAGEPro (Administrator)

ConfigurationDataViewsHelp

Image Player

Browse Recordings

Electrodes are hotter than the refractory blocks (also seen on and earlier MWIR heat-up.

Analysis

Data	Temperatures in °C				E		% ROI
	Max	Mean	Min				
Frame	390.6	364.2	<300		1.00	-	-
Floor	383.3	365.7	346.2		-	-	-
Side L	374.7	362.4	344.5		-	-	-
Wall L	382.1	370.7	352.3		-	-	-
Skew L	388.7	376.1	361.2		-	-	-
Crown	386.2	373.3	358.5		-	-	-
Side R	370	360.4	349.4		-	-	-
Wall R	378	366.3	349.6		-	-	-
Skew R	386.1	376.8	358.3		-	-	-
DH Wall	368	359	304.1		-	-	-
DH Arch	361.3	349.4	300.5		-	-	-
DH Floor	367.7	350.7	316.5		-	-	-
DH Side L	357.8	346	328.3		-	-	-
DH End	350.7	342.2	323.9		-	-	-
DH Side R	358.6	349.9	337.9		-	-	-
LWIR T	369.8	362.6	354.7		-	-	-

Zoom

100 % - + Reset

File Details

Camera Type: MWIRb 640

File Name: 2025-07-12-21-07-45_Camera1.erfx

Date: 12/07/2025

Time: 21:07 (GMT+00:00)

Size: 2 GB

Duration: 11 hours 22 minutes

22:00:06 8:29:45

315

Frame

Camera1 (MWIRb 640) 60.0°C 34°C OK 32 E: 1.00 FPS: 10.00

CONFIDENTIAL Simpson C&E, Land, Glass Futures, Spie & Stara

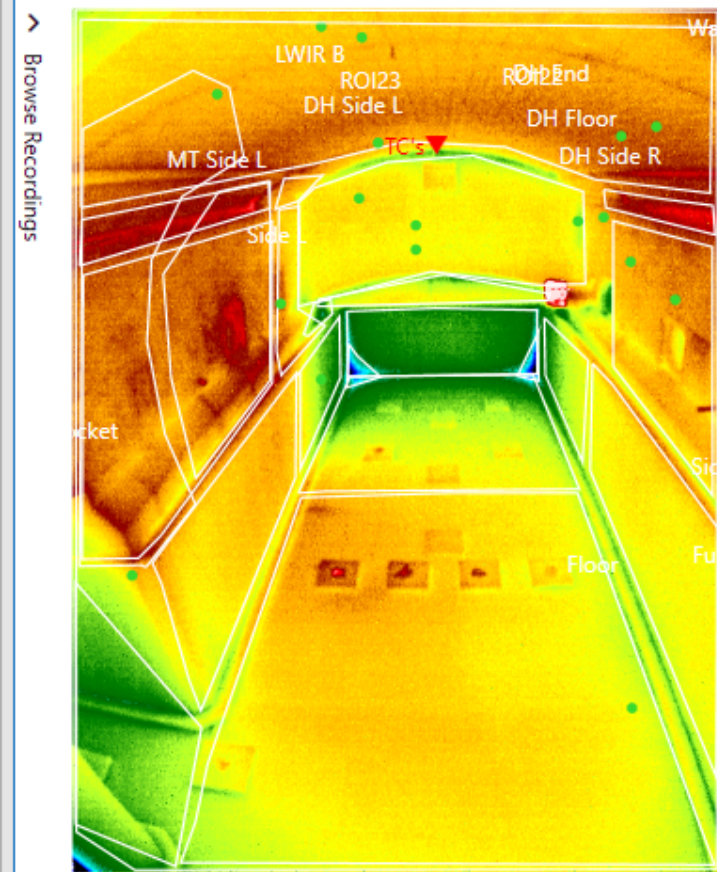
X: 531 Y: 223 T: 360.2°C

Day 19 10am 400-524 (+100) Frame Max 614

AMETEK Land IMAGEPro (Administrator)

Configuration Data Views Help

Image Player



10:00:04 20:54:03



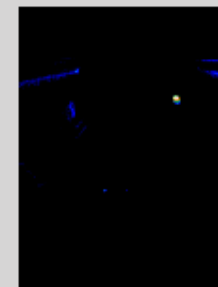
Camera1 (MWIRb 640) 58.5°C 33°C OK 32 ε: 1.00 FPS: 10.00

Analysis

Data	Temperatures in °C				ε		% ROI
	Max	Mean	Min				
Frame	614	478.5	<300	●	1.00	-	-
Floor	519	478.3	451.5	●	-	-	-
Side L	494.3	480.6	458.3	●	-	-	-
Wall L	511.9	491.3	466.8	●	-	-	-
Skew L	517.3	500.8	487.2	●	-	-	-
Crown	510.5	487.5	461.8	●	-	-	-
Side R	492	475.6	458.3	●	-	-	-
Wall R	502.3	486	466.1	●	-	-	-
Skew R	515.8	502.4	477.9	●	-	-	-
DH Wall	575.3	476.3	451.4	●	-	-	-
DH Arch	579.6	469.7	442.3	●	-	-	-
DH Floor	493.7	465.2	417.6	●	-	-	-
DH Side L	481.4	461.8	443	●	-	-	-
DH End	460.2	445.4	395.7	●	-	-	-
DH Side R	478.9	463.1	435.8	●	-	-	-
LWIR T	499.4	484.6	470.6	●	-	-	-

Zoom

100 % - + Reset



File Details

Camera Type: MWIRb 640

File Name:
2025-07-13-08-29-43_Camera1.erfx

Date: 13/07/2025

Time: 08:29 (GMT+00:00)

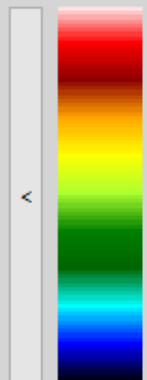
Size: 2 GB

Duration: 12 hours 24 minutes 20 seconds

Palette



524

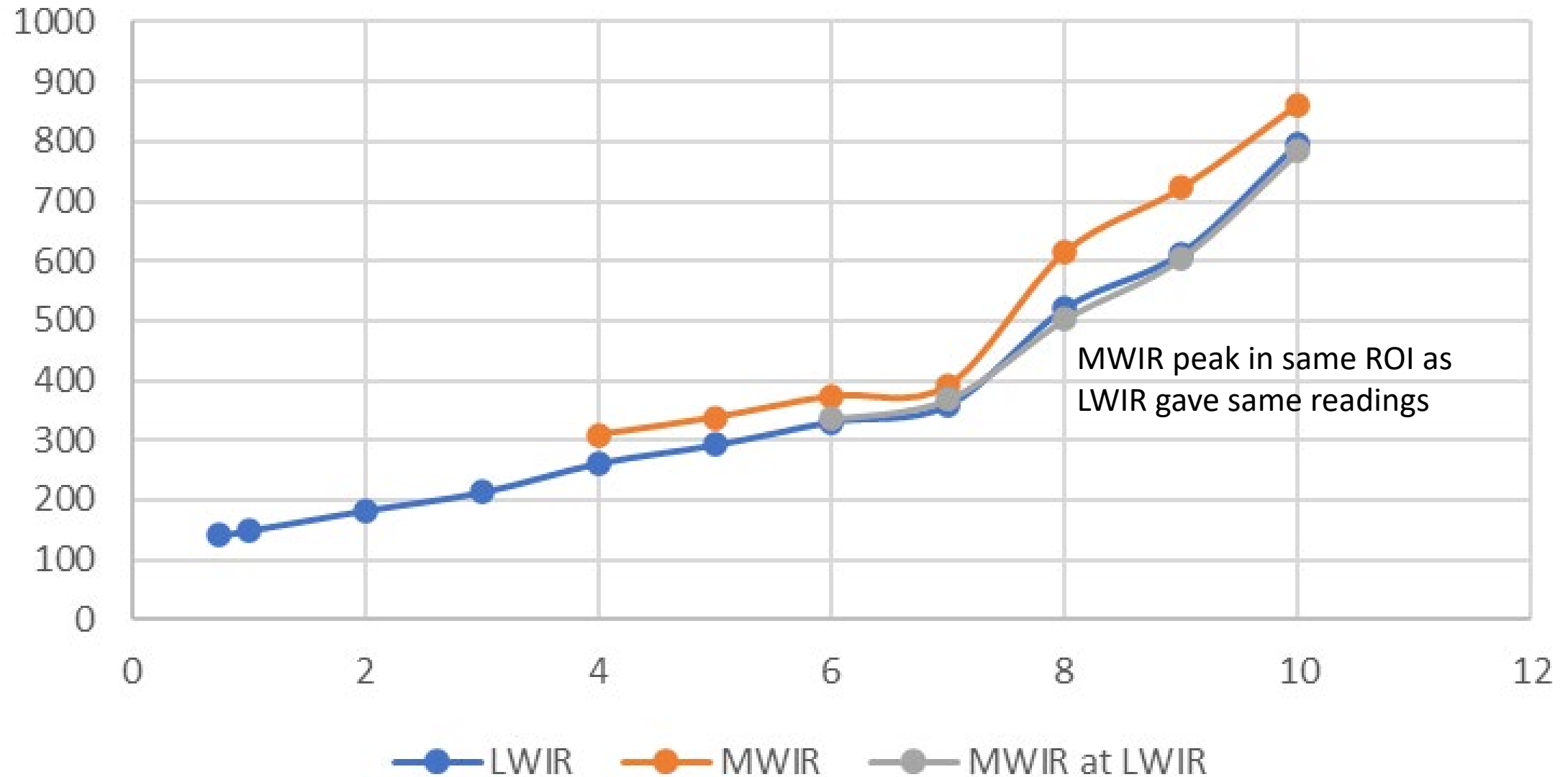


400

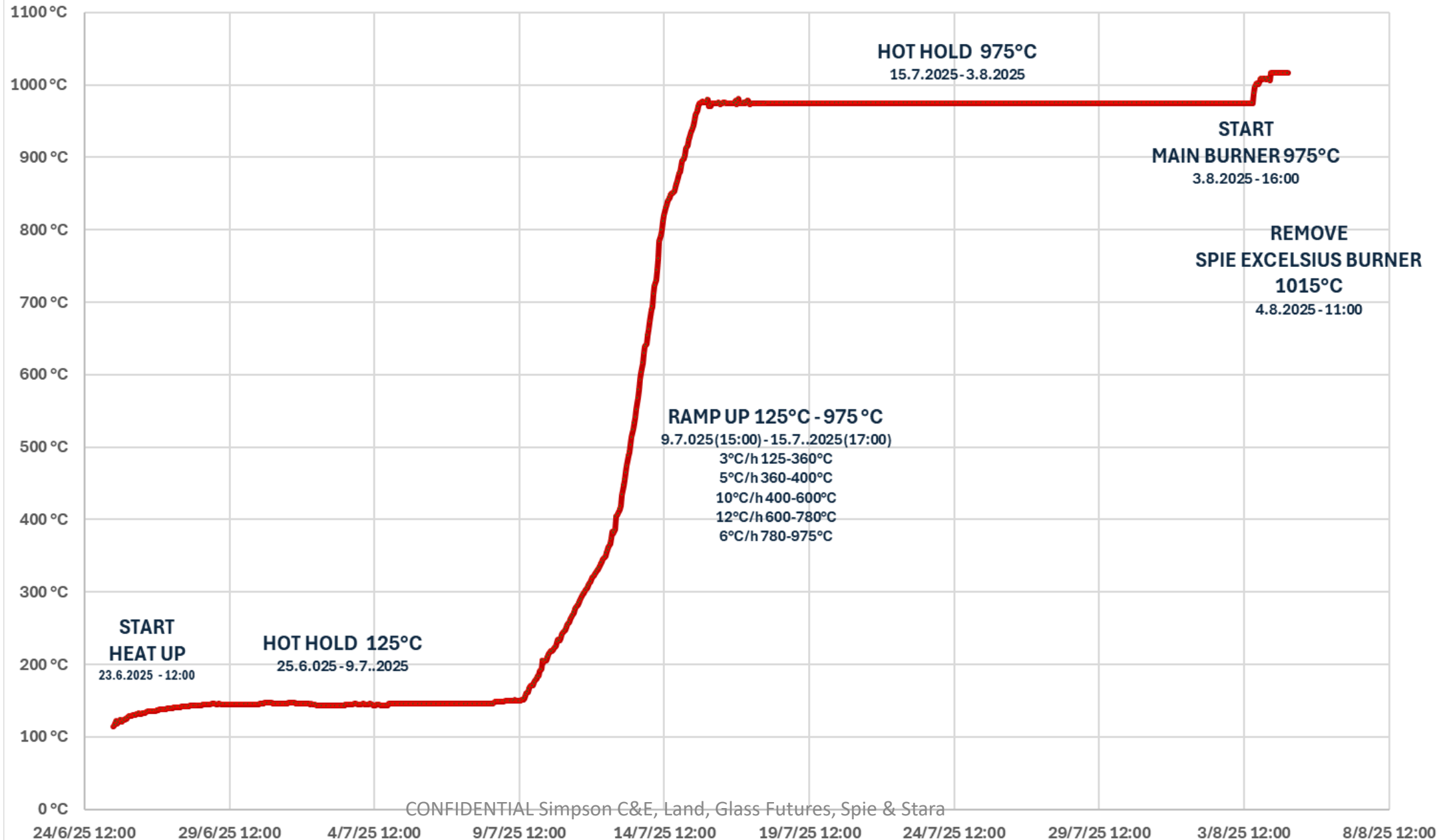


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Peak Temp v 12hr periods



116.23 GLASS FUTURES FURNACE HEAT UP CURVE / TC ME-CROWN (Center)



Observations and Lessons Learned Heat-Up

- Day 1 LWIR used in static and transportable mode
 - Identified hot spot on the blocks which was remains of a sticky label.
 - Perhaps opportunity to label blocks in future heat-up
 - Due to furnace pressure and exhaust issues the joints were initially hotter than the refractory face.
 - Suggest individual and discrete recordings for each location with cross-reference on timing.
- Day 2 LWIR re-focused and resolution of image improved significantly
 - Joint protection tape started to delaminate was still there day 19 at 260°
 - MWIR installed below range (300°C) of instrument but could identify thermal gradients using isotherms.
 - Suggest installing MWIR even earlier in future.
 - Electrodes are hotter than the refractory blocks (also seen on and earlier MWIR heat-up).
- Day 15 Onwards Avoid use of auto-range function but define temperature range to suit conditions
 - Upper joints such as skew were hot but cold at tuckstones.
 - MWIR peak temperature higher than LWIR due to wider field of view
 - MWIR peak in same ROI as LWIR gave same readings
 - LWIR required changing temperature range but a simple task in image pro
 - Two of the Spie Excelsius K-type thermocouples physically moved and change was identified in the MWIR.
 - 640 x 480 pixels = 300,000 optical temperature measurements on surfaces v multiple K-type gas temperature
- Never recommend a dissertation topic for a relative!

Force Majeur 2

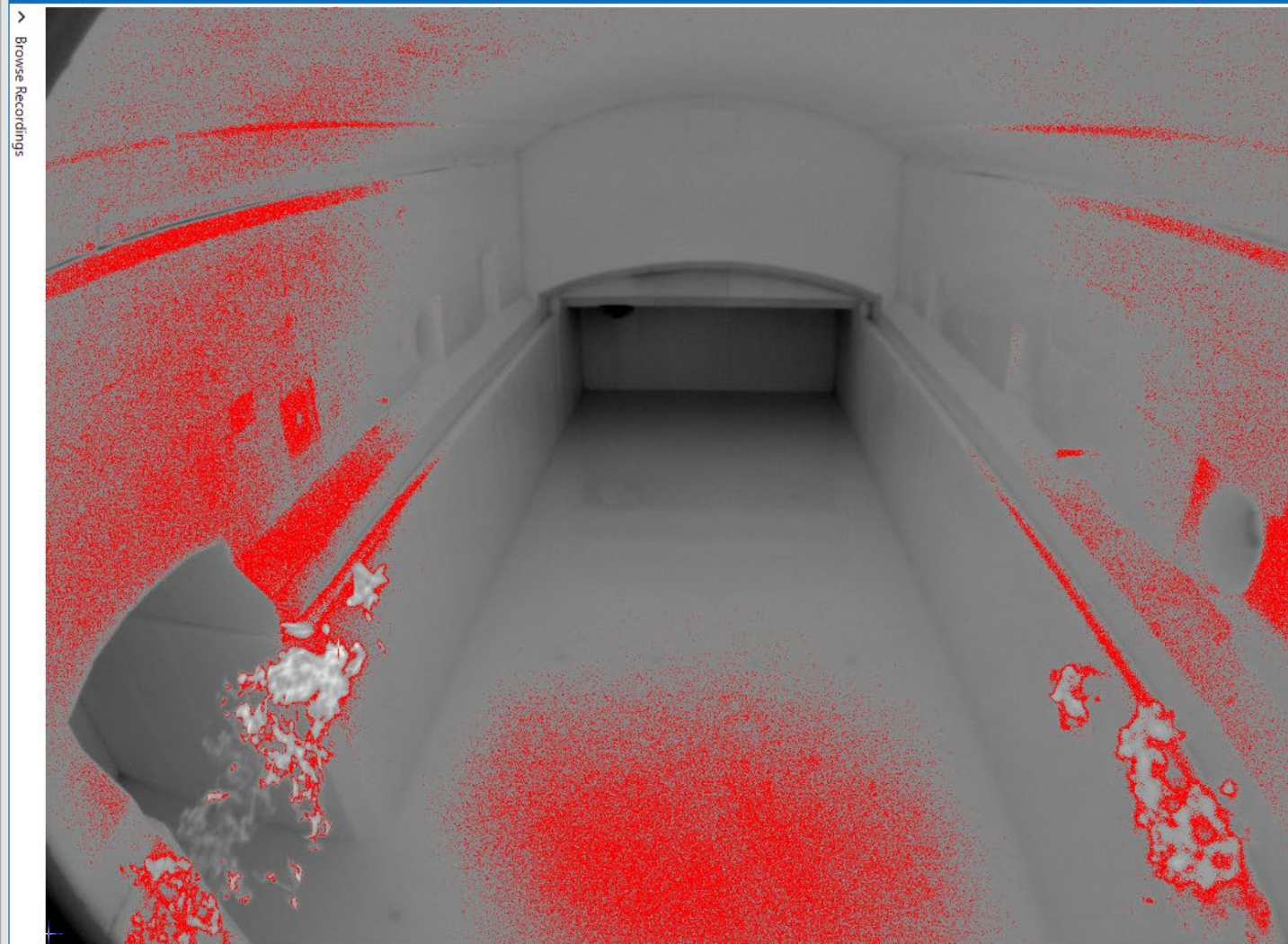
- During the furnace heat-up and pre-commissioning of the batch plant and oxy gas train there were several challenges identified.
- A 2nd hot hold was performed
- The MWIR camera was required on another site trial and so removed
- A transition to main oxy burners commenced early august
- The Spie Excelsius charger was run briefly with around 2”(50mm) filled to cover the electrodes.
- The permanent production NIR B was commissioned by Mark Briggs on Monday 11th August

Initial Image Monday Mono/B&W often gives clearest visible image 1370-1380

AMETEK Land IMAGEPro (Administrator)

Configuration Data Views Help

Image Player



Data	Temperatures in °C				ε		% ROI
	Max	Mean	Min				
Frame	1504.7	1353.6	1041.3	●	1.00	-	-
ROI1	1371.2	1371.2	1371.2	●	-	-	-
ROI2	1266.1	1266.1	1266.1	●	-	-	-
ROI13	1361.7	1361.7	1361.7	●	-	-	-

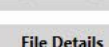
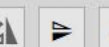
Pretty hot on top of soldier blocks and tuckstones. RHS hotter than LHS and so may be worth redistributing power (small adjustment). Alcove/Refractory test pocket may be pulling flame over.

ROI Editor



Zoom

100 % - + Reset



File Details

Camera Type: NIR 2K

File Name: GFL_2025-08-11-22-17-40_Camera1.erfx

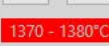
Date: 11/08/2025

Time: 22:17 (GMT+00:00)

Size: 332 MB

Duration: 1 minutes

Palette



22:17:41 22:18:40



Camera1 (NIR 2K) 50.0°C OK ε: 1.00 FPS: 1.00

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X: Y: T:

Sim Live Image Trend Graph Image Player Profile Line

+1360-1370

AMETEK Land IMAGEPro (Administrator)

ConfigurationDataViewsHelp

Image Player

Browse Recordings

22:17:4122:18:40

1

Frame

Camera1 (NIR 2K) 50.0°C OK ε: 1.00 FPS: 1.00

Sim Live ImageTrend GraphImage PlayerProfile Line

Analysis

Data	Temperatures in °C				ε		% ROI
	Max	Mean	Min				
Frame	1504.7	1353.6	1041.3		1.00	-	-
ROI1	1371.2	1371.2	1371.2		-	-	-
ROI2	1266.1	1266.1	1266.1		-	-	-
ROI13	1361.7	1361.7	1361.7		-	-	-

ROI Editor

Palette

1510

Zoom

100 %

Reset

File Details

Camera Type: NIR 2K

File Name: GFL_2025-08-11-22-17-40_Camera1.erfx

Date: 11/08/2025

Time: 22:17 (GMT+00:00)

Size: 332 MB

Duration: 1 minutes

1370 - 1380°C

1360 - 1370°C

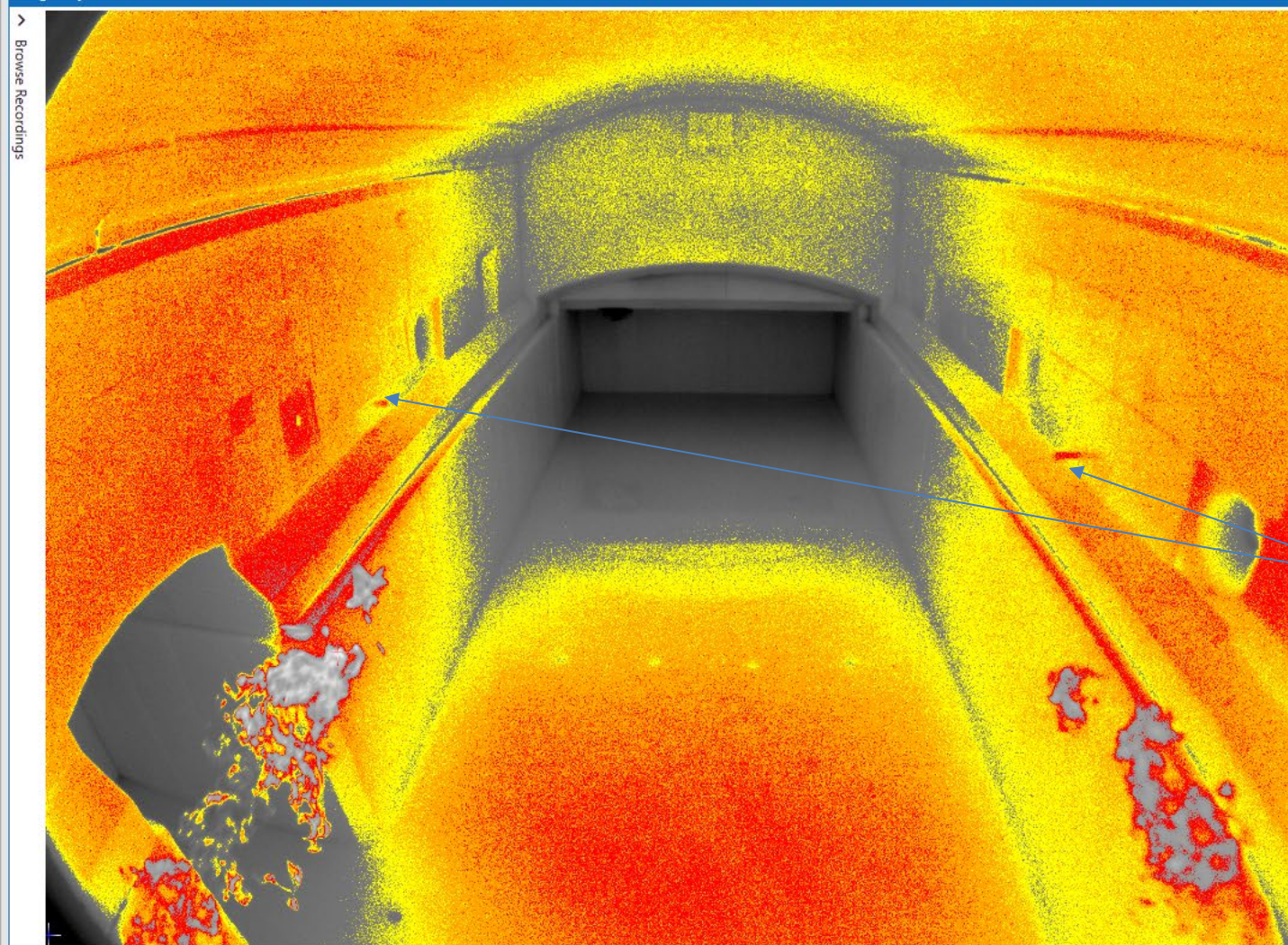
Exaggerates previous slide and starts to show open joints at skew and metal line. Refractory test pocket and Electrodes are cooler.

+1350-1360

AMETEK Land IMAGEPro (Administrator)

Configuration Data Views Help

Image Player



Analysis

Data	Temperatures in °C				ε		% ROI
	Max	Mean	Min				
Frame	1504.7	1353.6	1041.3	●	1.00	-	-
ROI1	1371.2	1371.2	1371.2	●	-	-	-
ROI2	1266.1	1266.1	1266.1	●	-	-	-
ROI13	1361.7	1361.7	1361.7	●	-	-	-

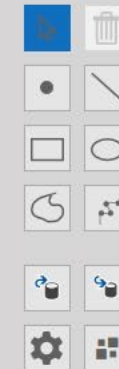
Ditto prior slides.

Suggest retracting the ceramic plugs

Charging end looks symmetrical.

Highlights cold/open joints

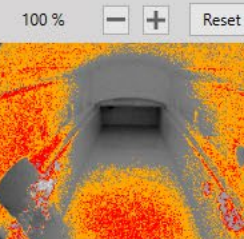
ROI Editor



Palette



Zoom



File Details

Camera Type: NIR 2K
File Name: GFL_2025-08-11-22-17-40_Camera1.erfx
Date: 11/08/2025
Time: 22:17 (GMT+00:00)
Size: 332 MB
Duration: 1 minutes

22:17:41 22:18:40



Camera1 (NIR 2K) 50.0°C OK ε: 1.00 FPS: 1.00

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X: Y: T:

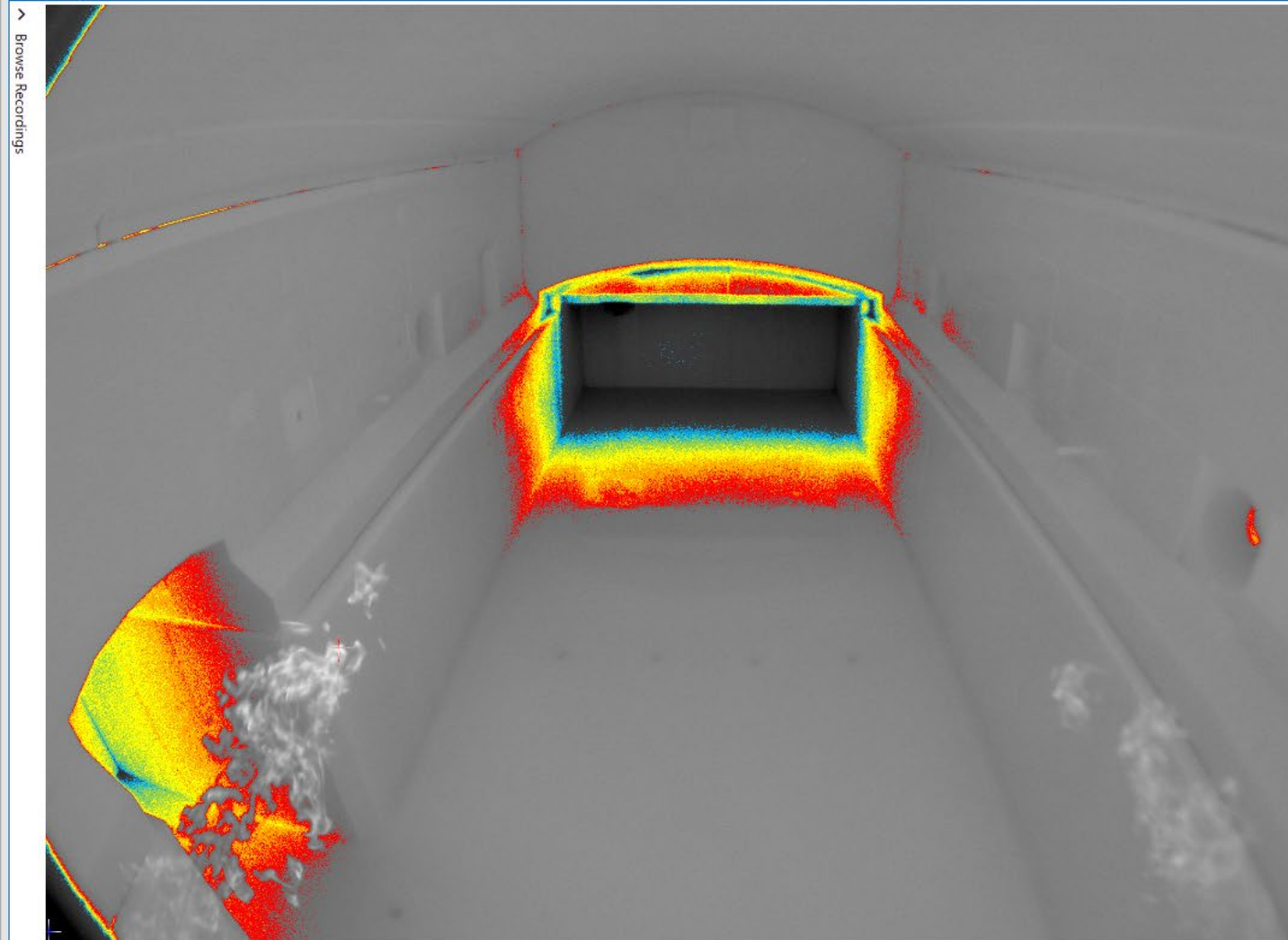
Sim Live Image Trend Graph Image Player Profile Line

1280-1330 (5*10°isotherms)

AMETEK Land IMAGEPro (Administrator)

Configuration Data Views Help

Image Player



22:17:41 22:18:40



Camera1 (NIR 2K) 50.0°C OK e: 1.00 FPS: 1.00

Sim Live Image Trend Graph Image Player Profile Line

Analysis

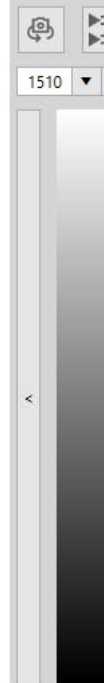
Data	Temperatures in °C				ε		% ROI
	Max	Mean	Min				
Frame	1504.7	1353.6	1041.3	●	1.00	-	-
ROI1	1371.2	1371.2	1371.2	●	-	-	-
ROI2	1266.1	1266.1	1266.1	●	-	-	-
ROI13	1361.7	1361.7	1361.7	●	-	-	-

50° is a big thermal gradient over a short distance

ROI Editor

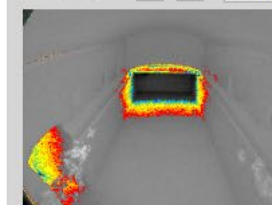


Palette



Zoom

100 % - + Reset



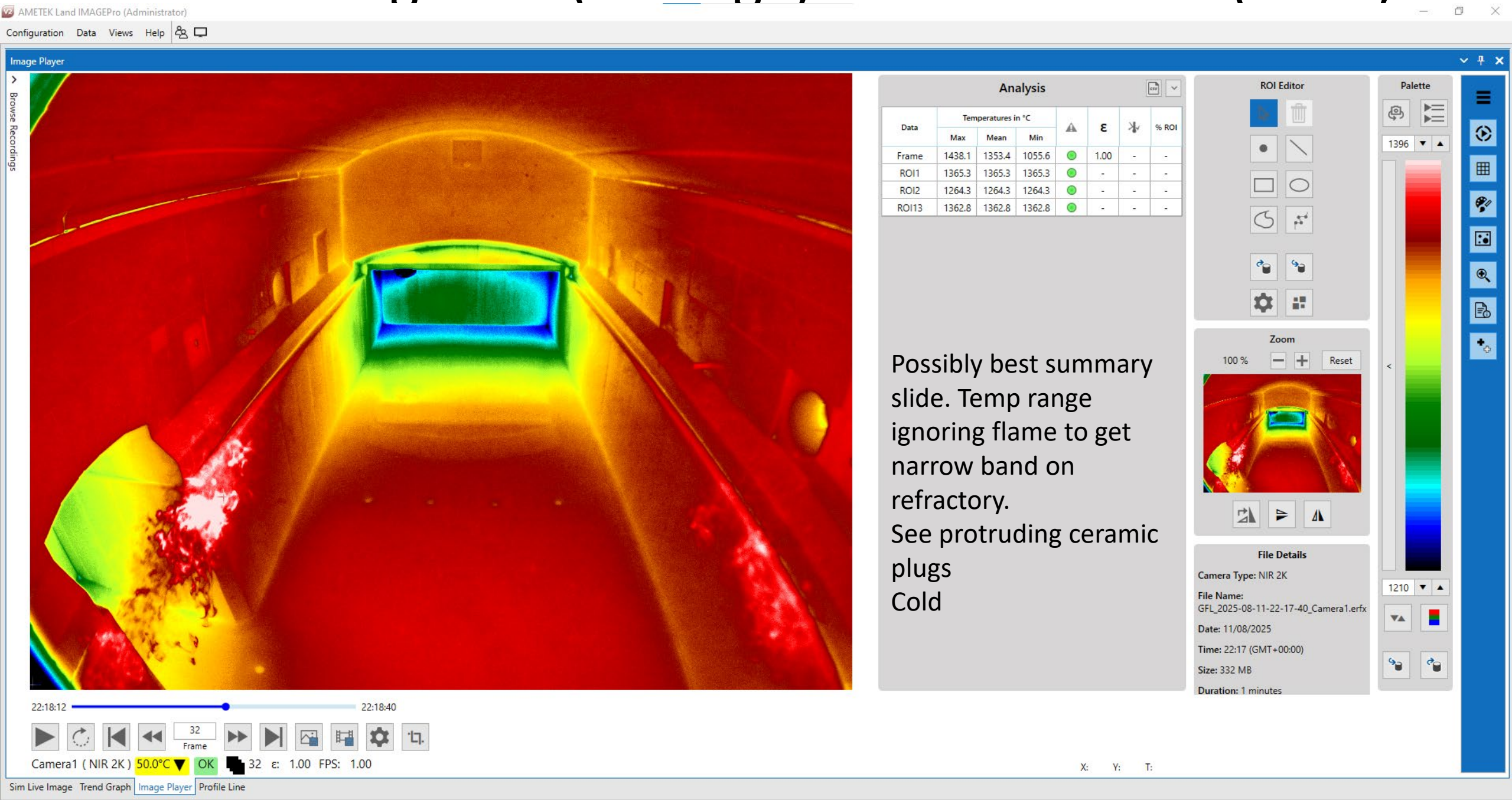
File Details

Camera Type: NIR 2K
File Name: GFL_2025-08-11-22-17-40_Camera1.erfx
Date: 11/08/2025
Time: 22:17 (GMT+00:00)
Size: 332 MB
Duration: 1 minutes



X: Y: T:

32 frames Integrated (Average) 1210-1396=186(62*3)



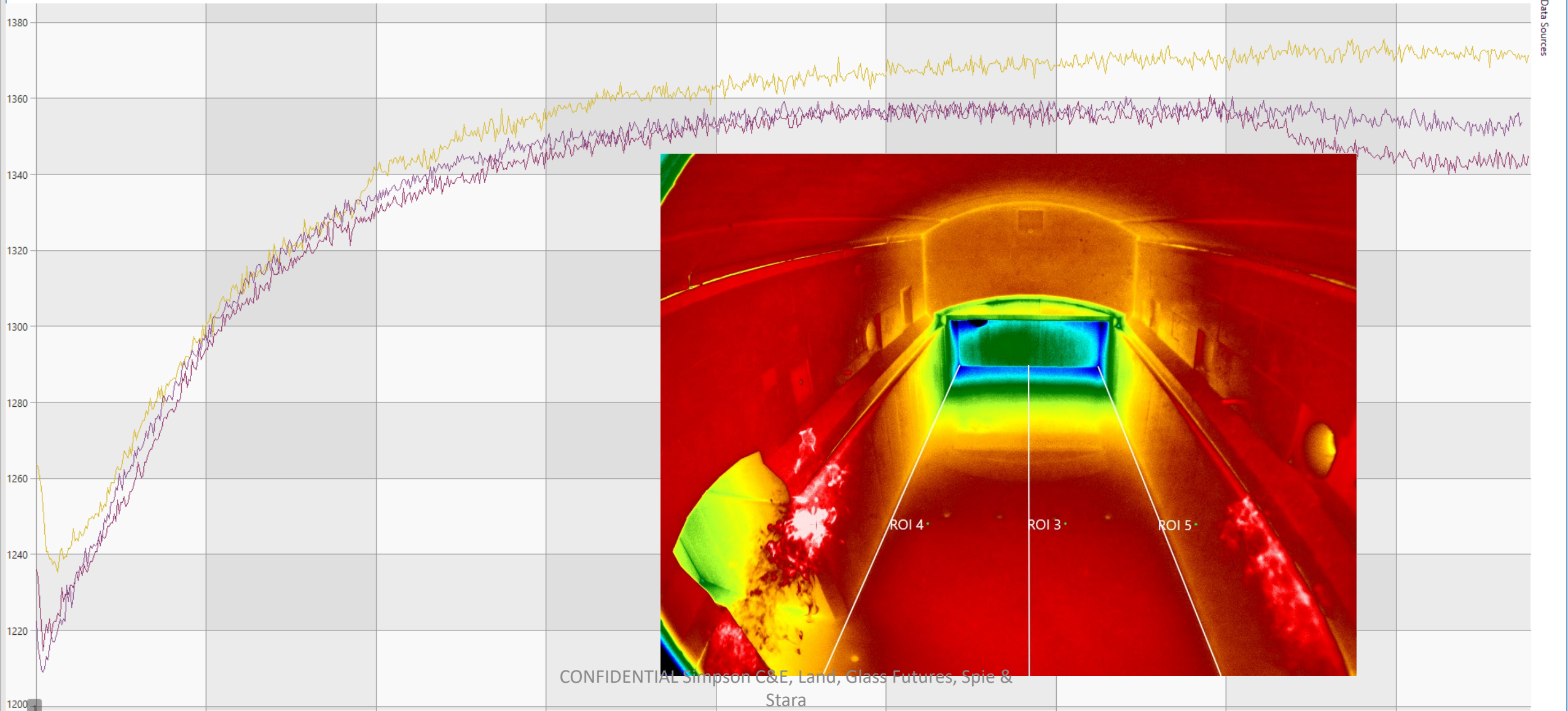
Adding side wall

AMETEK Land IMAGEPro (Administrator)

Configuration Data Views Help

Profile Line

Max: 1375°C Min: 1209°C



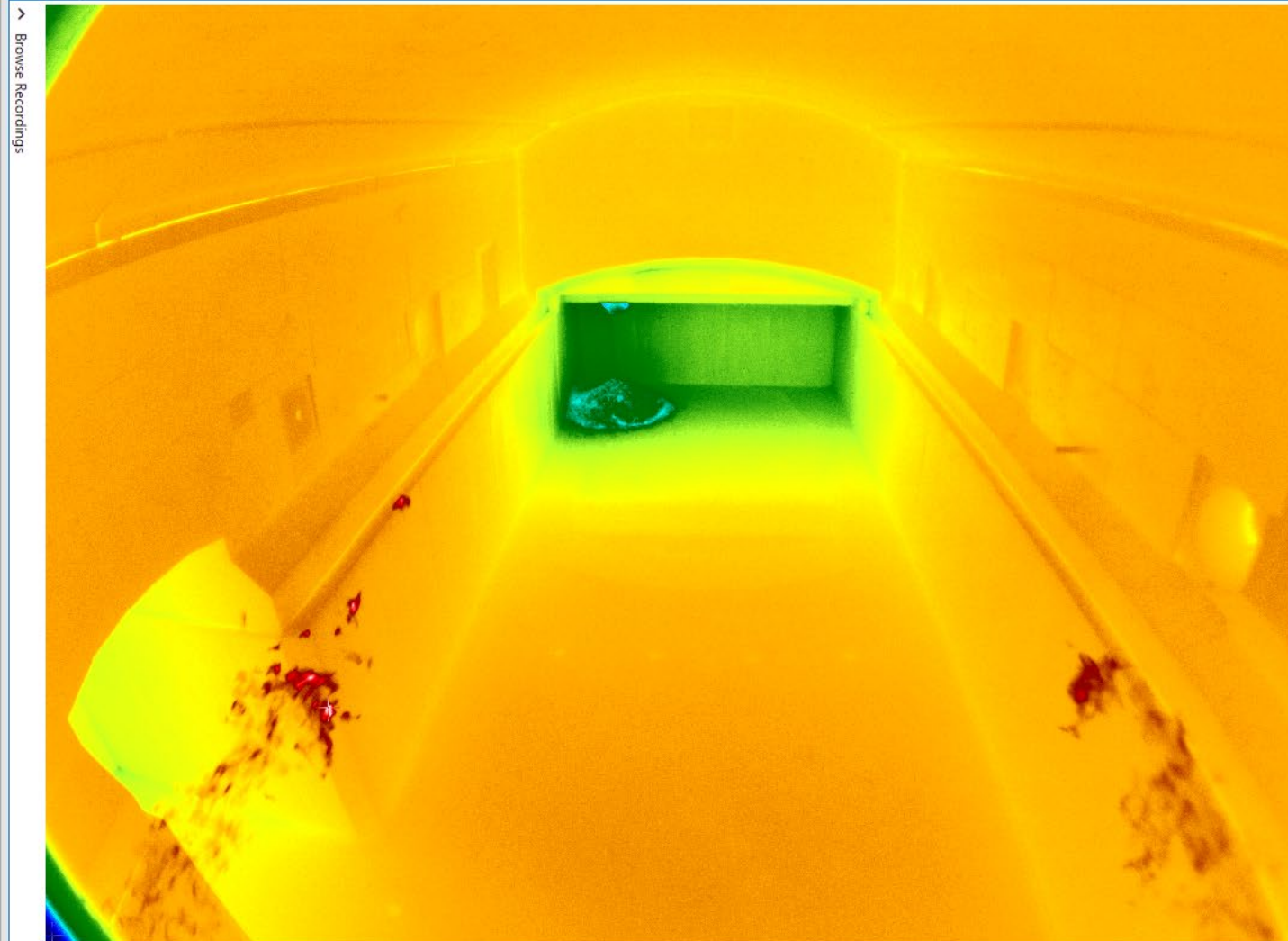
Tuesday Morning Fill in Progress 1st Image

Auto Span is OFF Lower Lower Range to ~Min

AMETEK Land IMAGEPro (Administrator)

Configuration Data Views Help

Image Player



Analysis

Data	Temperatures in °C				ε		% ROI
	Max	Mean	Min				
Frame	1540	1356	1046.3	●	1.00	-	-

ROI Editor

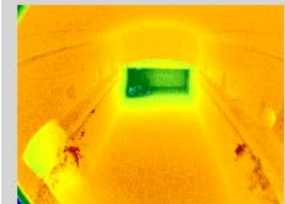


Palette



Zoom

100 % - + Reset



File Details

Camera Type: NIR 2K
File Name:
GFL_2025-08-12-09-32-40_Camera1.erfx
Date: 12/08/2025
Time: 09:32 (GMT+00:00)
Size: 332 MB
Duration: 1 minutes

9:32:41 9:33:40



Camera1 (NIR 2K) 49.0°C OK ε: 1.00 FPS: 1.00

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X: Y: T:

Sim Live Image Trend Graph Image Player Profile Line

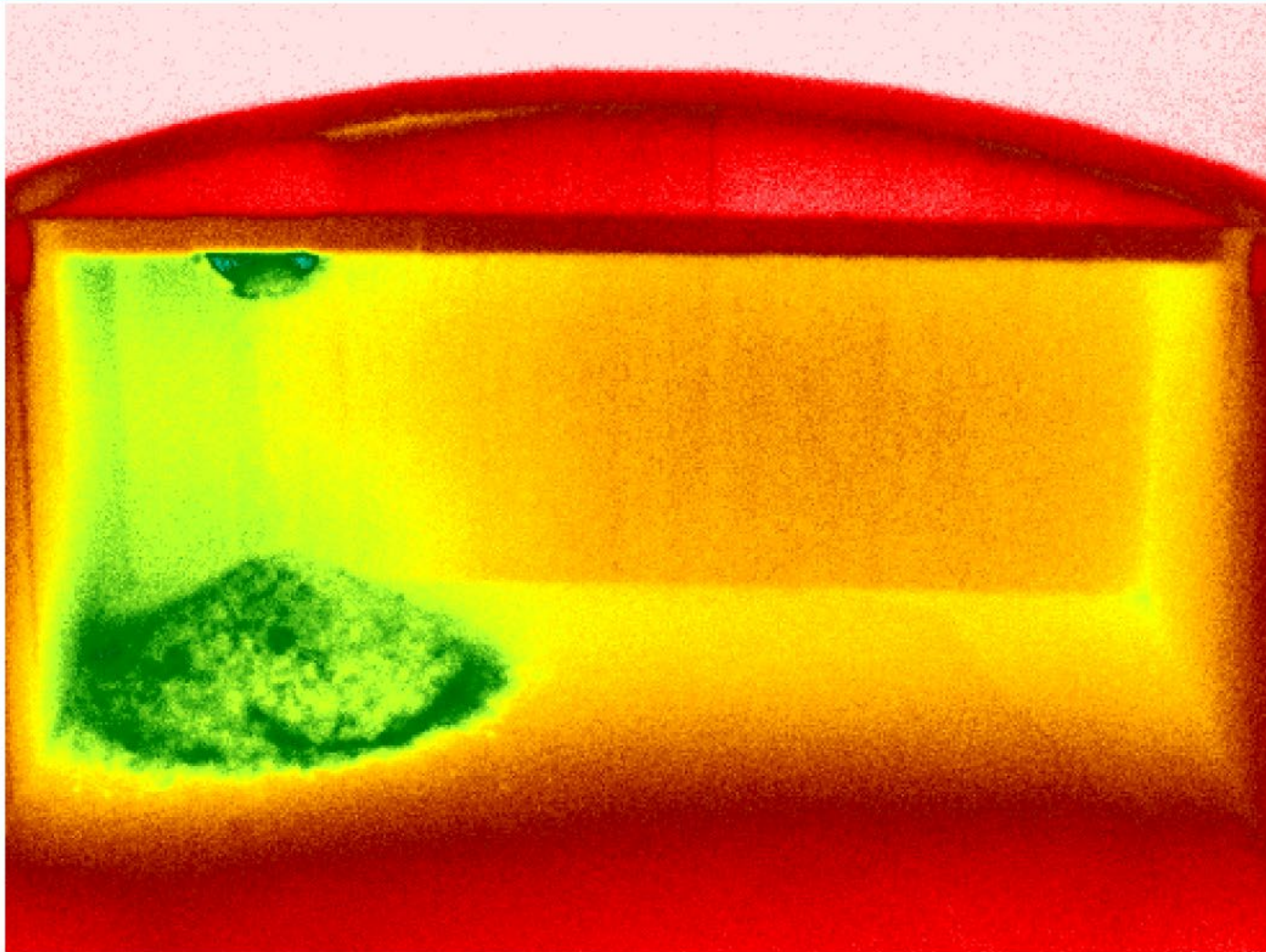
Zoom 400% and 62*5

AMETEK Land IMAGEPro (Administrator)

Configuration Data Views Help

Image Player

Browse Recordings



9:32:41 9:33:40



Camera1 (NIR 2K) 49.0°C OK ε: 1.00 FPS: 1.00

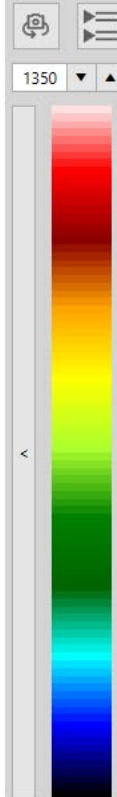
Analysis

Data	Temperatures in °C				ε		% ROI
	Max	Mean	Min				
Frame	1540	1356	1046.3		1.00	-	-

ROI Editor



Palette

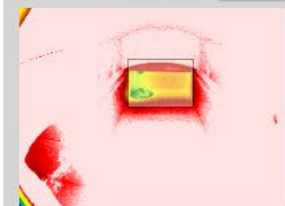


1040

1350

Zoom

400 %



File Details

Camera Type: NIR 2K

File Name:

GFL_2025-08-12-09-32-40_Camera1.erfx

Date: 12/08/2025

Time: 09:32 (GMT+00:00)

Size: 332 MB

Duration: 1 minutes

X: Y: T:

Sim Live Image Trend Graph Image Player Profile Line

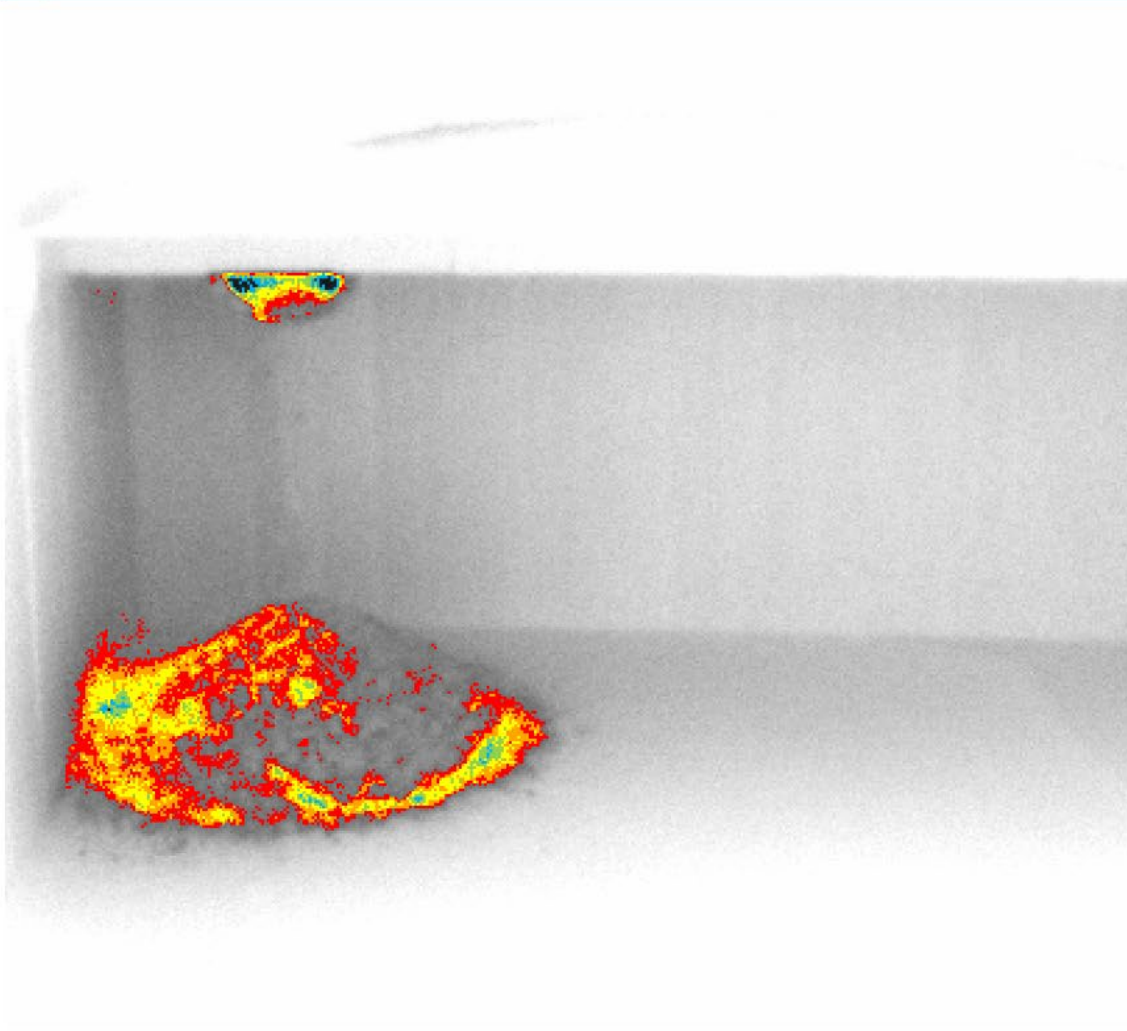
Can see small changes in 60 seconds

AMETEK Land IMAGEPro (Administrator)

Configuration Data Views Help

Image Player

Browse Recordings



9:32:41 9:33:40



Camera1 (NIR 2K) 49.0°C OK ϵ : 1.00 FPS: 1.00

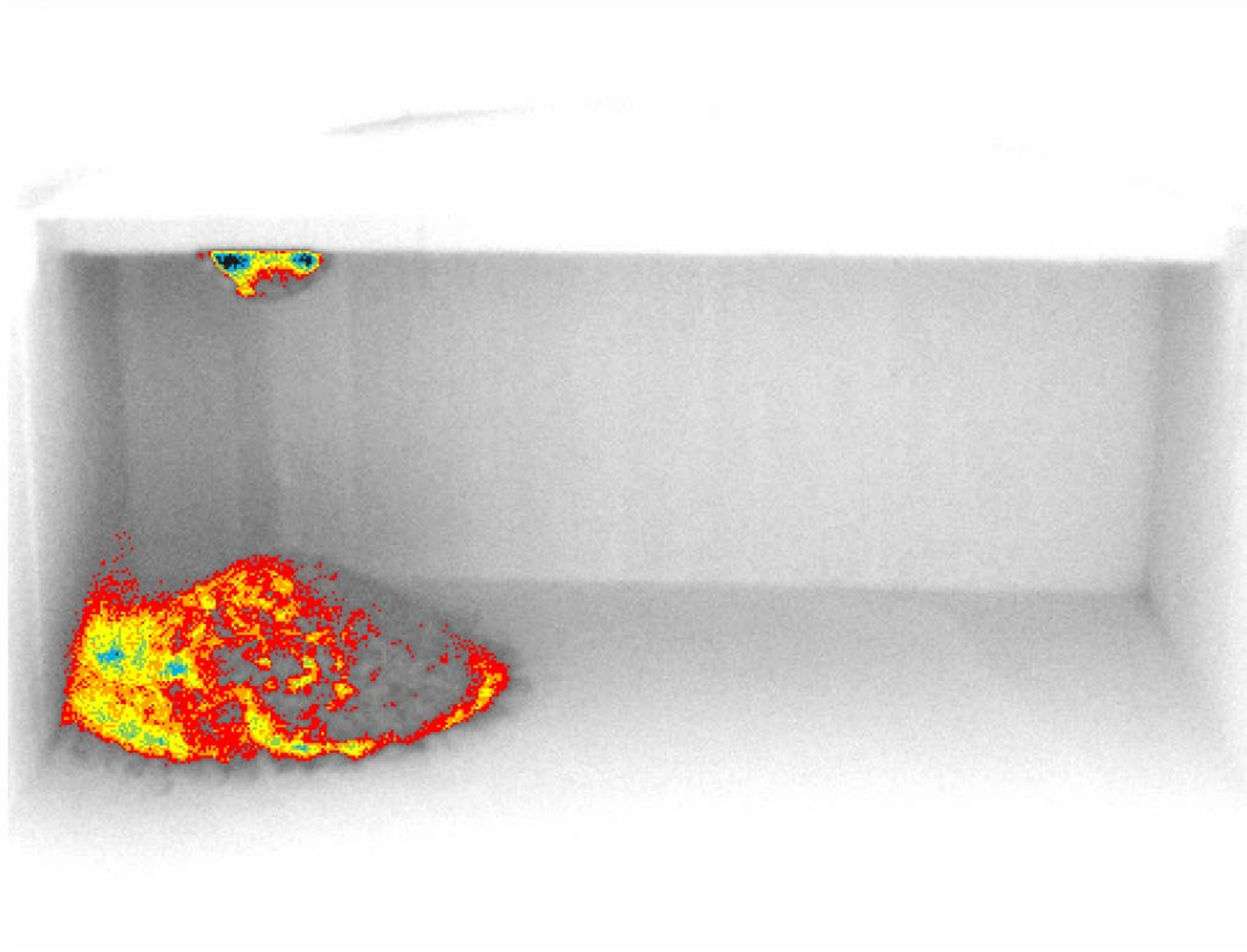
Sim Live Image Trend Graph Image Player Profile Line

AMETEK Land IMAGEPro (Administrator)

Configuration Data Views Help

Image Player

Browse Recordings



9:33:40 9:33:40



Camera1 (NIR 2K) 49.0°C OK ϵ : 1.00 FPS: 1.00

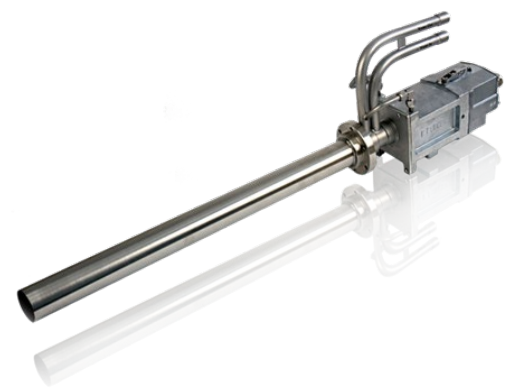
Sim Live Image Trend Graph Image Player Profile Line

Observations/Lessons Learned for Main firing & Fill

- Simplifies process having one piece of software for all instruments and all temperatures
- Due to extended hot hold the MWIR camera was removed for another site trial
- The MWIR has a replaceable lens and so may be an option in other sites for the fill
- The electrodes are now colder than the surrounding area.
- The two oxy burners are in the field of view of the NIR B 2k
- Per LWIR and MWIR it is good practice to avoid the auto temperature range but define narrower range below peak.
- Where practical use a 32fps integrator to get an average and better-defined isotherm
- The NIR B has been used on more than 10 occasions to support the furnace fill anecdotal feedback is that it saved a day on the glass to glass previously
- Write abstract for conferences after you have the data



Summary and Conclusions



- First published report from the Glass Futures 30MTPD Glass Furnace
- One Image Pro software package and 3 Infra-Red [IR] instruments were successfully used to support the Glass Futures Furnace heat-up
 - LWIR (Long Wave) 0-500°C and 100-1000°
 - MWIR (Medium Wave) 300 to 1200 °C (used)
 - NIR (Near) 2K 1000 - 1800 °C (used)
- Spie Thermocouples were used and will still have to be used! It's an enhancement not alternative!!
 - The cameras confirmed the impact of thermocouples physically moving
 - “The camera makes it dramatically obvious...” Spie Excelsius
- With Land commissioning support a new NIR B can be installed for the fill but requires a further 2nd visit
- For existing NIR B users there is the opportunity to exchange an MWIR for the cool-down and heat-up/fill on a cold repair and/or rebuild.
- The LWIR is limited to the peep-hole v CCTV location but has shown information not “seen” previously
- Ideally LWIR is used for heat-up when purchased for regenerator Optimisation and glass leak detection
- Difficult to quantify benefit since ever furnace and heat-up is slightly different. “Are you glad you had it installed?” OR “Wish you had it installed??” Bigger the furnace capacity and order book the faster the payback!



- <https://www.glass-futures.org/>



- <https://www.ametek-land.com/>
- Simpson Combustion & Energy Ltd
- neilsimpsonfs@btinternet.com



- <https://www.spie-excelcius.com/>



- <https://www.staraglass.com/en/>

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THANK-YOU!
ANY QUESTIONS?

