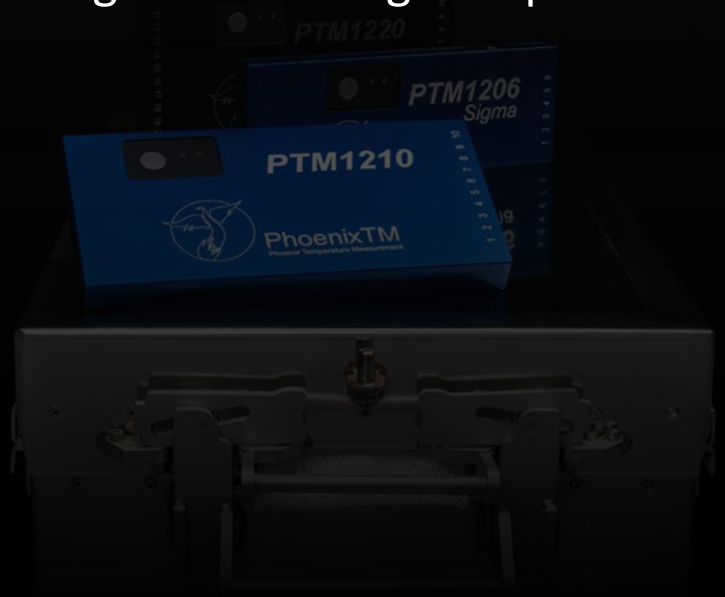
Temperature Monitoring in Aluminium Brazing Processes

Temperature monitoring in aluminium brazing processes is not an easy job. Neither for the engineer nor for the profiling system.

The atmosphere, flux, temperature on one hand and conformity to e. g. CQI-29 (TUS – Temperature Uniformity Survey and SAT – System Accuracy Tests and others) at the other are challenges which have to be taken in account.

In the following you will find some tips and tricks to achieve a conforming and meaningful report:



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Temperature Monitoring Systems

Components:

- Data Logger

  The measuring device

- Thermal Barrier

  The protector of the logger

- Thermocouples

  The temperature sensors

- Software

  The data analysing tool

Find out how these come together to the helpfull tool they are for your brazing process…

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Data Logger

The core of the system

Usually available in 6, 10 or 20 channel versions:

- see CQI-29 for minimum requirement of channels (mostly min. 7 measuring points needed).

Accuracy is important for CQI-29:

- should be ± 0,6°C or better (PTM1200 = ± 0,3°C).

Quality is essential:

- ideal sealed housing (IP60)
- standard batteries
- Well designed and implemented cold junction compensation

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Thermal Barrier

Thermal barriers consist of a very effective insulation, and in most cases a phase change heatsink, which helps to keep the temperature in the barrier on a certain level.
They are available in different sizes appropriate to the size, duration and temperature which suits to the furnace and process.

The top challenge for a Thermal barrier in a brazing furnace atmosphere is:

- **Flux and**
- **Moisture**

This attacks the cloth which covers the insulation and the insulation itself. The photo on the right shows the impact to the material.

Acid attacks the cloth protecting the insulation

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Temperature Monitoring Systems Components

Thermal Barrier

Solution!

Minimise the open surface insulation/cloth to protect it as much as possible.

Thermal barriers especially developed for these kind of processes solve the problem with nearly fully covered insulation in a stainless steel body. The only visible insulation material is inside the logger tray. This improves lifetime of the system essentially and reduces also airflow into the barrier and along this also the moisture problem.

At the right side the photo above shows our demo thermal barrier and was taken in 2010 when it was new. Below is the same barrier but more than 14 years later. The insulation is still in good shape, despite many profile runs, whilst on loan to different customers over Europe.

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Thermocouples

Two types of probes are suitable for CQI-29 measurements:

- Fibre insulated thermocouples
  In CQI-29 classified as Expendable Base Metal

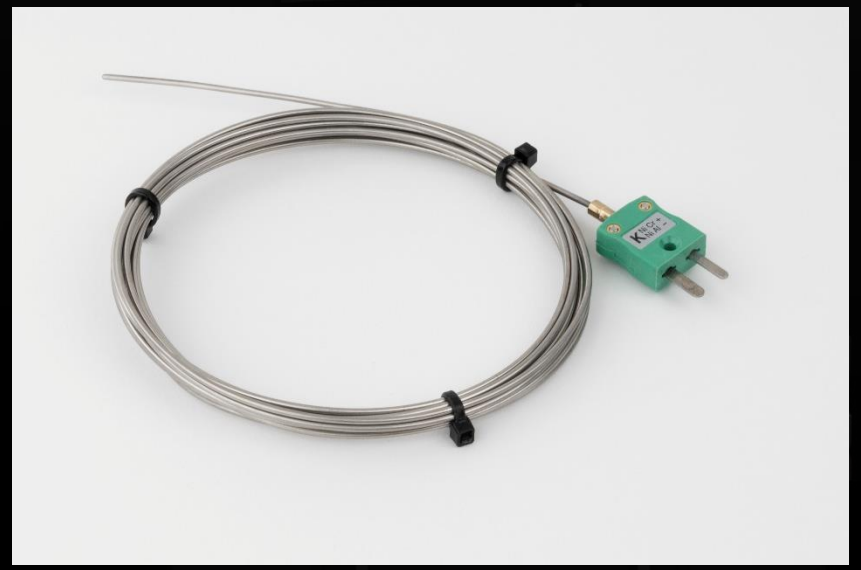
  - max. 15 uses allowed!

  The fibre insulation suffers from flux and heat and gets brittle quite quick.

- Mineral insulated thermocouples with stainless steel sheath
  In CQI-29 classified as Non-expendable Metal

  - max 180 uses allowed!

The sheath protects the insulation and thermocouple wire from the furnace atmosphere and so increases lifetime significant.



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Thermocouples

Placement according to CQI-29

The placement should be, of course, at the relevant and critical points of the product.

In CQI-29 there are two definitions of thermocouple placement methods:

1. Batch and semi-contiuous furnaces: Volume Method
   TC‘s are placed in each corner of the heat zone and one in the middle.
2. Continuous furnaces: Plane Method
   TC‘s are mounted on a rack to travel through the furnace.

The number of thermocouples used depends on the size of the furnace. Details in CQI-29.

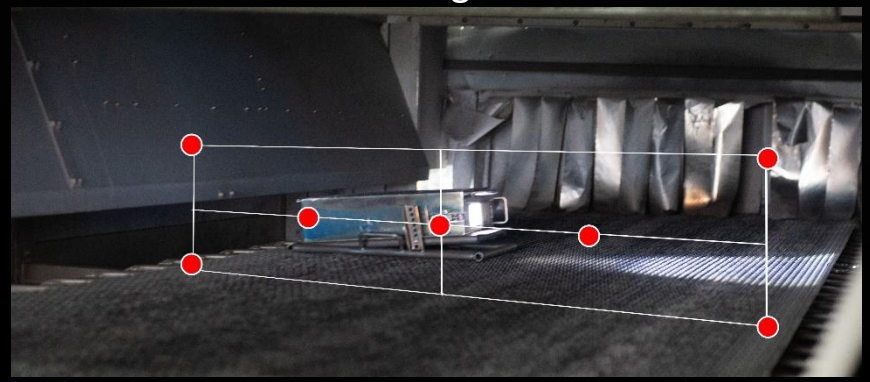

Table P3.4.1 – TUS Test Thermocouple

Workspace Volume	< 0.1 m³ (3ft³)	0.1 to 8.5m³ (3ft³ to 300ft³)
Number of Thermocouples	5	9

(VOLUMETRIC METHOD)

Note 1. For furnace volumes greater than 8.5 m³ (300ft³), add at a minimum one thermocouple for each additional 3 m³ (105 ft³) up to 85 m³ (3000ft³). For furnace volumes greater than 85 m³ (3000ft³) add at a minimum two additional TUS test thermocouples for each 14 m³ (500ft³). For example, for a 113.2 m³ (4000 ft³) furnace, 39 TUS test thermocouples shall be used at a minimum.

Note 2. Total offset/bias attributable to the centering of a TUS shall not exceed 3°C (5°F). This permissible offset/bias is separate from offset/bias assignable to the correction of a calibration error or an SAT error.

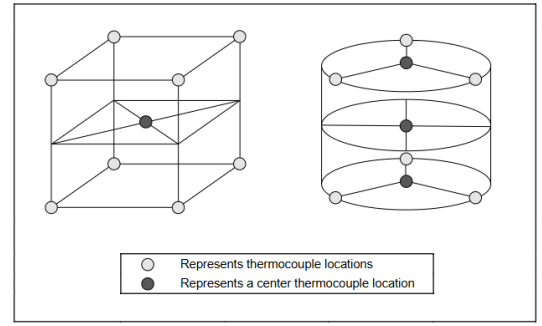

Figure P3.4.1 – Volumetric Method TUS Test Thermocouple Locations

Table P3.4.2 – Number and Location of the TUS Thermocouples (PLANE METHOD)

Qualified work zone width	Qualified work zone height ≤ 300 mm (1 ft.) see Note 1	Qualified work zone height > 300 mm (1 ft.) see Note 2
< 0.3 m (1 ft.)	2	4
0.3 m to 0.75 m (1 ft. – 2.5 ft.)	3	5
0.75 m to 1.5 m (2.5 ft. – 5 ft.)	3	7
1.5 m to 2.4 m (5 ft. – 8 ft.)	3	8
> 2.4 m (8 ft.)	Add one thermocouple for each 0.6 m (2 ft.) of additional width	8

Note 1: For qualified work zone widths greater than 0.3 m (1 ft.), two TUS thermocouple locations shall be within 50 mm (2 inches) of the work zone corners or edge and one TUS thermocouple location shall be at the center. Additional TUS thermocouples shall be uniformly distributed throughout a plane perpendicular to the conveyance direction.

Note 2: Four TUS thermocouple locations shall be within 50 mm (2 inches) of the work zone corners and the remainder shall be at the center and symmetrically distributed about the center of a plane perpendicular to the conveyance direction.

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Thermocouple - Fixing

There are several methods of fixing the thermocouples to the product.

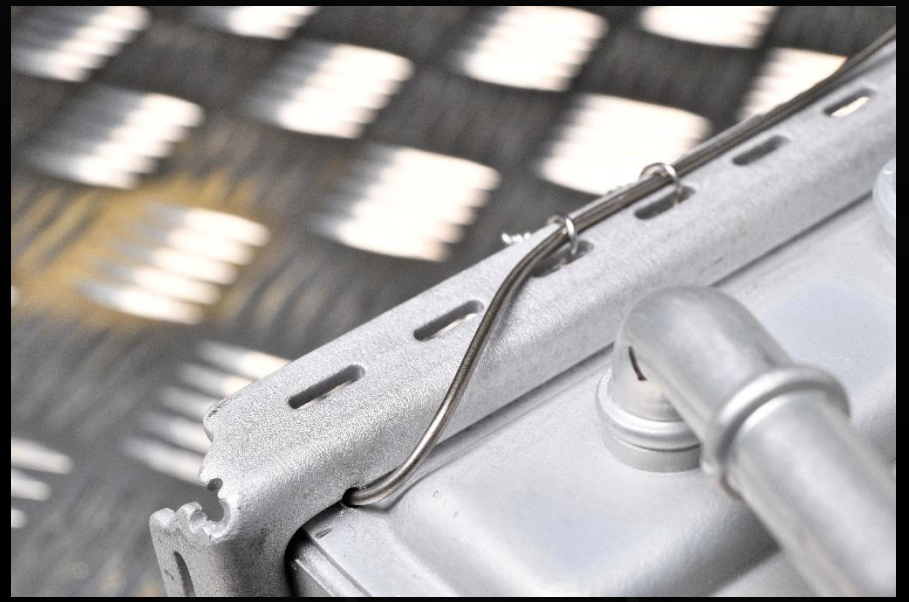
Attention has to be put to a good thermal contact and strain releave.

This is important, as a good thermal contact provides comparable data from each run.

If thermocouples don‘t have a proper fixing to the product the measurement can differ from one to another run.

The above photo shows a thermocouple pluged into the net and fixture at the frame.

In the picture below the thermocouple is fixed in a drilled hole in a thicker part of the radiator. It is also fixed at the frame to avoid movement.



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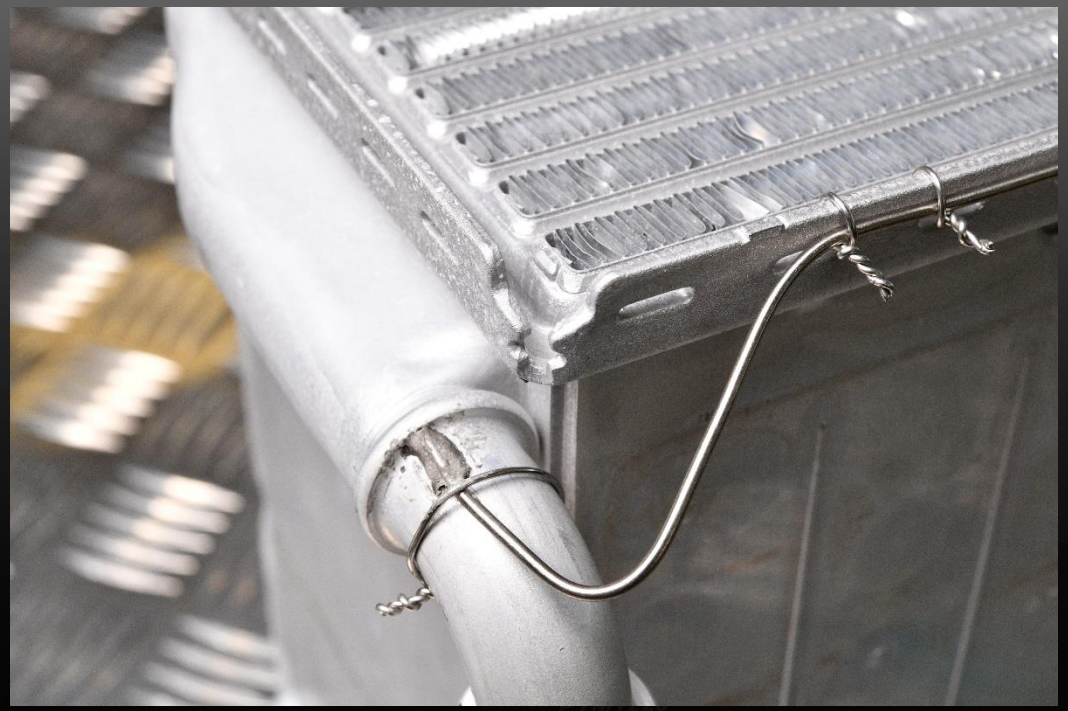
Thermocouple - Fixing

Another possible method, but not very common, is to fix the thermocouple with ceramic glue on the surface of the part.

Although this gives a good thermal contact and can provide temperature information at critical product parts.



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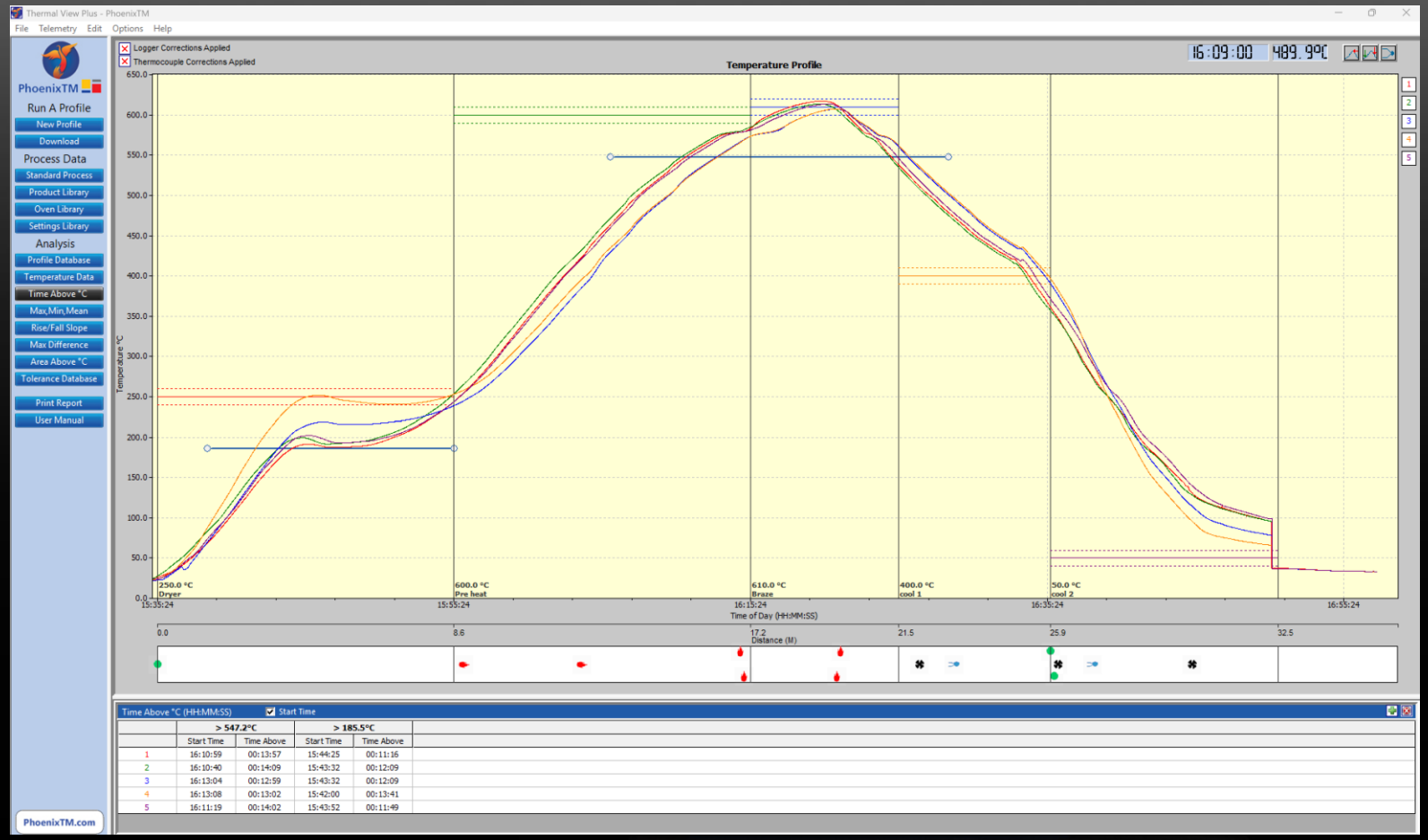
Analysis Software

Profiling Software SW15

The Standard

Ideal for:

- Furnace Setup
- Process Optimization
- Fault Finding
- Energy Savings
- CO_2 Economies



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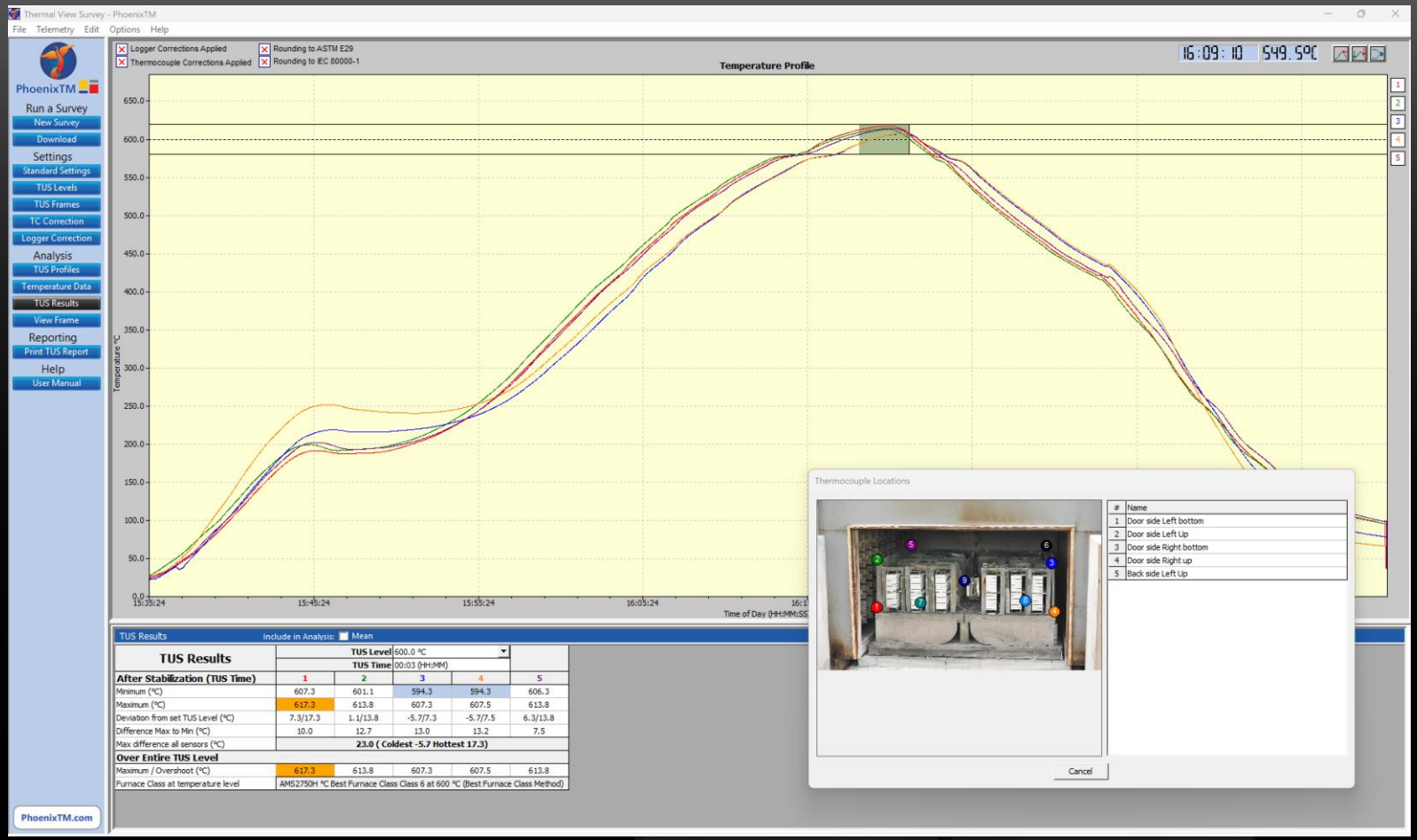
Analysis Software

Analysis Software Software SW25

For TUS Measurements

Ideal for:

- TUS Analysis
- All required calculations conforming to CQI-29
- Presets for processes for easy set up
- Data from multiple measurements are easy to compare.



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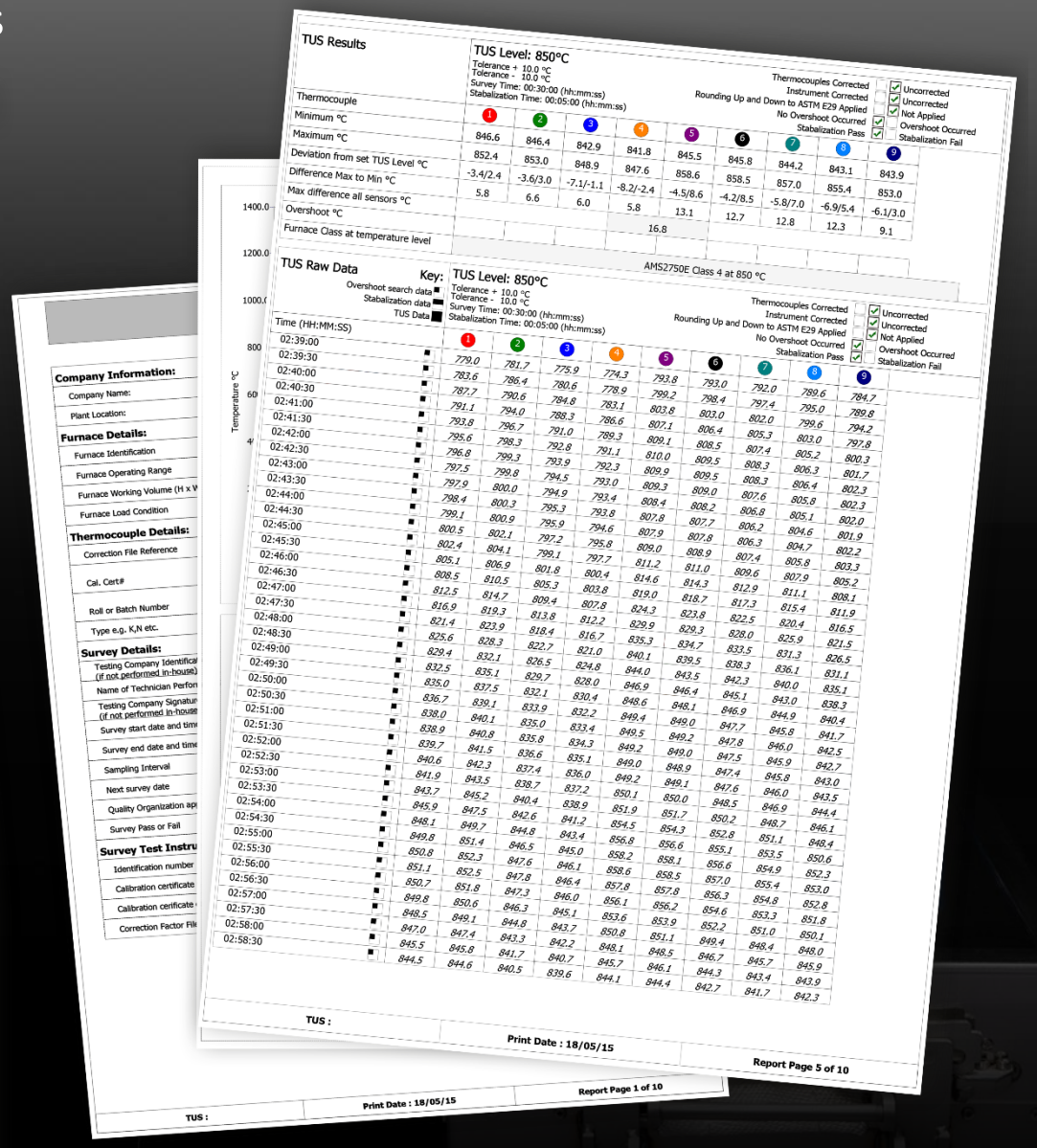
Temperature Monitoring Systems Components

Analysis Software

TUS Analysis Software Reporting

- Generate a TUS report with just a few clicks in minutes
- Most important: Auditors accept this report!
- All data is archived in a database
- Reports can be printed on paper or as a .pdf



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Questions?

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