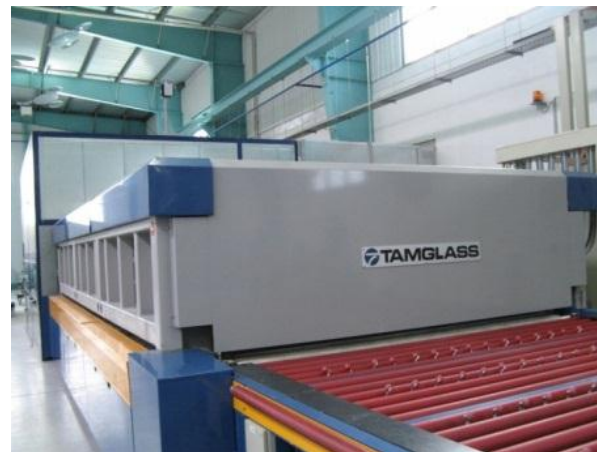


New System for Profiling the Glass Tempering Process

An introduction to two new low-height thermal profiling systems designed for use in the flat glass industry



Courtesy of FGT Polska.

Rob Hornsblow
Product Manager Datapaq

Glass Tempering



The Problem

The glass tempering process is conducted in very height restricted, oscillating roller furnaces. It has not been possible, up until this point, to measure the temperature profile experienced by the glass.

The Need

As the use of low-e glass has increased, so the need to monitor the tempering process has increased. This is because it requires changes to the furnace settings to be able to correctly temper low-e glass.



The Solution

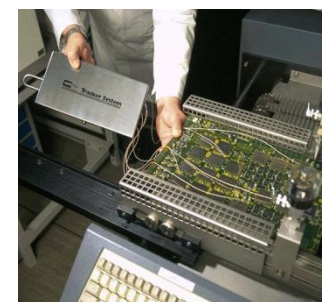
Datapaq was asked to design a temperature profiling system that can for the first time reveal the exact profile the glass is experiencing.

Strength through Experience

Datapaq has been developing and marketing solutions for in-process temperature profiling in high temperature industrial furnaces for more than 25 years.

We have had to use all that experience, combine it with detail computer modeling and some of the latest metal jointing and coating technologies to produce solutions that work in a small enough height to pass through the furnace.

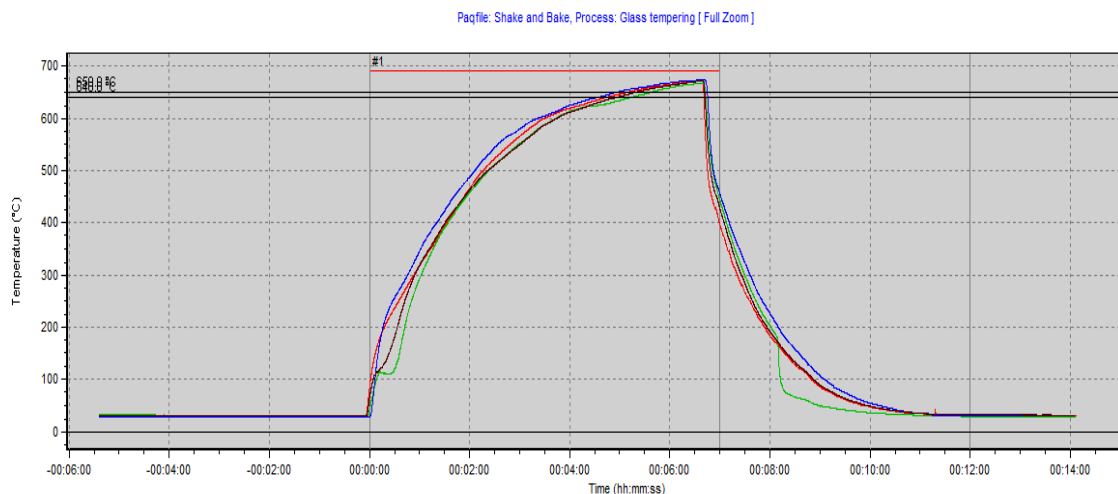
The new thermal barriers are only 29mm high and yet will provide sufficient protection to enable the system to be used in tempering processes of up to 10 minutes at 690°C.



Thermal Barrier

- The ultra-low height thermal barriers can withstand temperatures up to 1150°C and can provide up to 10 minutes protection for the datalogger when used in a furnace operating at 690°C.
- The TB7528 and TB7729 make use of the very latest welding and coating technologies to ensure they perform without distorting in the extreme heat and will continue to perform for years to come.

Reveal for the first time what is happening inside the furnace



The Glass Tempering Process

The Challenges

The glass sheets to be tempered are passed through a combined furnace and air quench cooler. The aim is to heat the glass to its softening point (650°C) and then rapidly cool it. The cooling rate is calculated to create a temperature difference of 175°C between the core and outer surface of the glass. This imparts the required compressive strength to the glass and results in a fully tempered sheet.

The Problems

Failure to control the process correctly can result in some or all of the following:

- poor quality tempering – failure to meet the required specification
- excessive energy costs – reduced margins and profits
- reduced throughput – time wasted
- distortion of the glass- product rejected or sold at lower price
- glass breakage in the cooling quench – holding up production and increasing cost

Current Measurement Best Practice - Pyrometry

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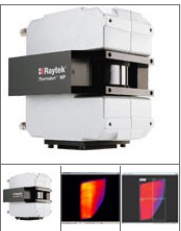
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Product Description

The GS150 Thermal Imaging System is an automated temperature measurement system for glass bending, forming, annealing, and tempering processes. The GS150 measures a line of up to 1024 points using a rotating mirror that scans a 90° field-of-view up to 150 times per second. The scanning of a glass part is initiated by the measured temperature, or an external "trigger" signal. As each heated glass part traverses the field-of-view, a two-dimensional thermal image or "thermogram" is formed.

The GS150 installs easily, just like a camera, and views the glass part from above, whenever it has a clear path. Connecting the pre-wired cables (included) to a PC and entering installation dimensions in the GS150 Software completes the installation process.

The newest addition to the GS150, the **GS150LE Thermal Imaging System for Low Emissivity (Low-E) Glass** with automatic emissivity correction, is designed to monitor one-side coated flat glass.

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The majority of furnaces are equipped with a non-contact temperature measuring system. This is located at the exit of the furnace and measures peak temperature at all points of the glass sheet.

This is excellent in providing a measure of process stability and heating uniformity.

Current Measurement Practice

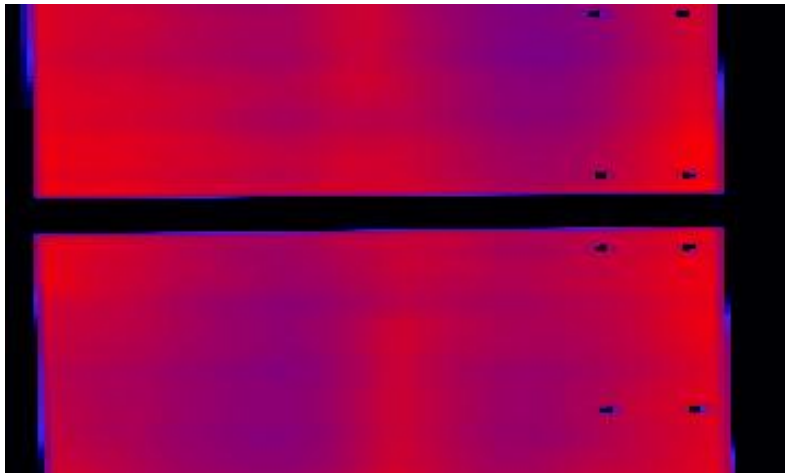
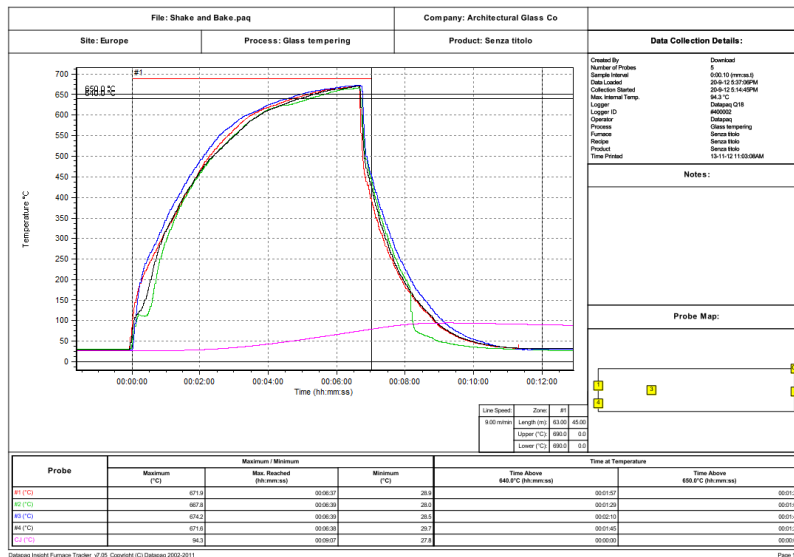


Image taken from a Raytek infrared linescanner shows two sheets with pre-drilled holes exiting the furnace.

- Non-contact scanner gives an image showing temperature at every point on the glass sheet. This is very useful for process control and stability checking.
- It takes an image of every sheet and these are automatically archived.
- Accuracy is at best $\pm 3^{\circ}\text{C}$ if the emissivity is correct.
- An emissivity change from 0.96 to 0.93 would create an 8°C error. This small change in emissivity can often be seen between two different sources of raw glass.

Benefits of Profiling with Datapaq

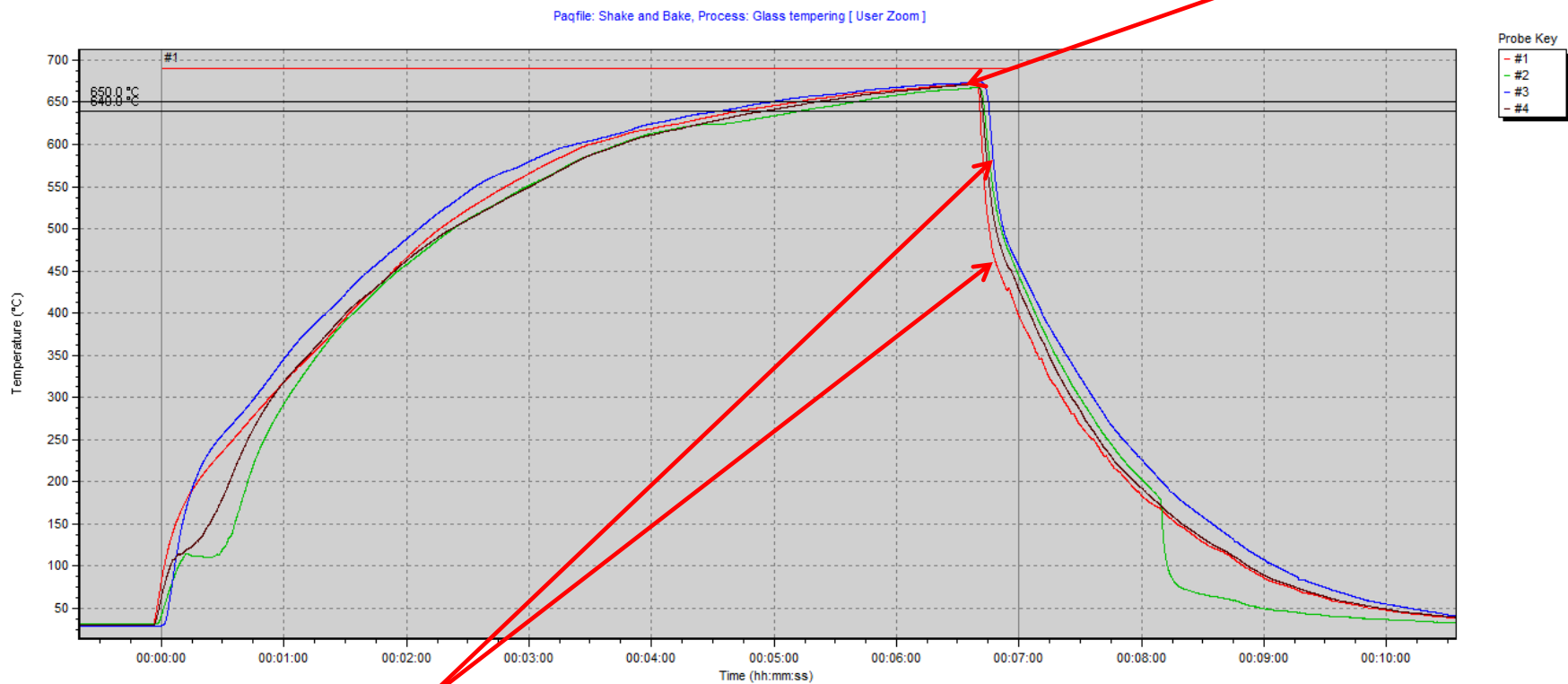


- Direct measurement of the glass surface temperature is accurate irrespective of emissivity values.
- A full profile of temperature ramp and up the critical quench cooling phase can be obtained.
- Can be used to set up the furnace for new glass types/thicknesses.

The Datapaq is best used as a complement to the scanner and is used to set the emissivity correctly. This enables the user to get the most benefit from both methods of measurement.

Typical Temperature Profiling

Area where glass was overheated
Peak temperature 670°C



Two stage cooling

Datapaq Glass Tempering System



TB7528 and TB7729



DQ1840

Essential elements of the Datapaq systems are:

- Q18 Datalogger; for use with up to 10 thermocouples accurate to $\pm 0.5^{\circ}\text{C}$ and equipped with a rechargeable battery.
- TB7528/TB7729; inconel cased, ceramic coated, low height thermal protection for the Q18 datalogger.
- Type K thermocouples with fast response open junction tips for attachment to the glass sheet being measured.
- Datapaq Insight Furnace Tracker Lite analysis software quickly transforms the data into meaningful information that can be used to optimize the process.

Thermal Barrier - Benefits



- TB7528 and TB7729 make use of an inconel outer case to ensure minimal expansion as heated - ensuring they will pass through with minimal clearance required.
- The fabrication is all conducted using laser welding technology ensuring no distortion - this maximizes product service life and guarantees the minimal height available can all be used.
- The outer surfaces are plasma sprayed with ceramic coating - thermal performance does not degrade with repeated use; as would happen with exposed metal.
- The ceramic coating also means there is no direct metal contact with the ceramic rollers in the furnace - very important as any roller damage would be seen as marks on the finished glass.

Thermal Barrier comparison

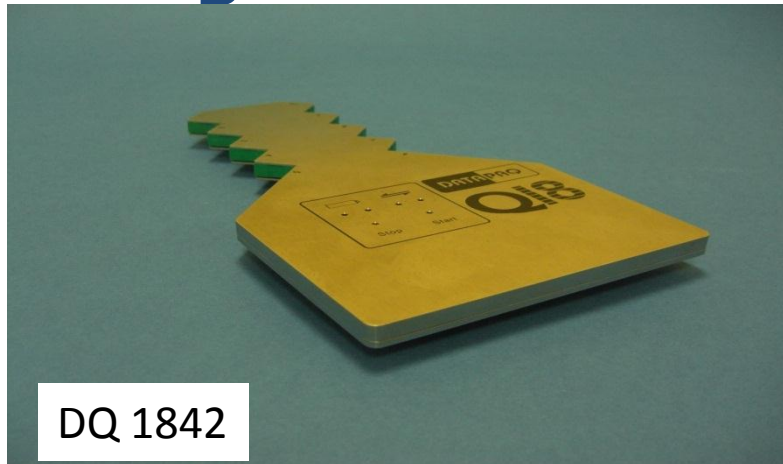
TB7528 4ch Thermal Barrier.

- Height 29mm (1.125")
- Width 220mm(8.66")
- Length 420mm(16.54")
- Weight 6kg (13.2lbs)

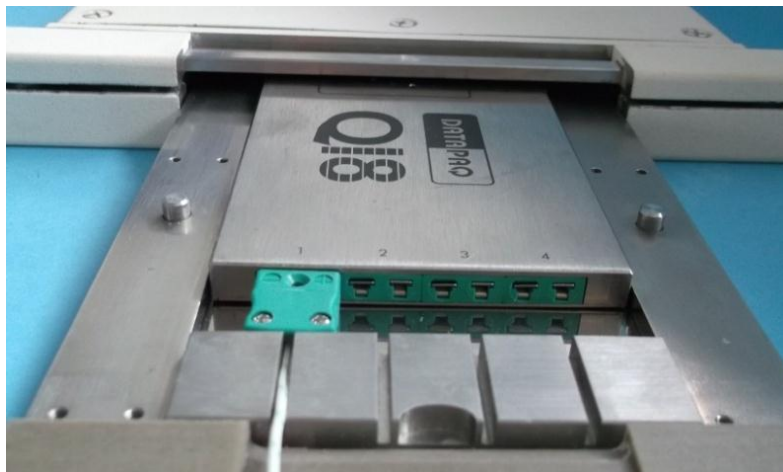
TB7729 10ch Thermal Barrier.

- Height 29mm (1.125")
- Width 256mm(10.08")
- Length 461mm(18.15")
- Weight 10kg (22.0lbs)

Glass Tempering System – Datalogger Design Features

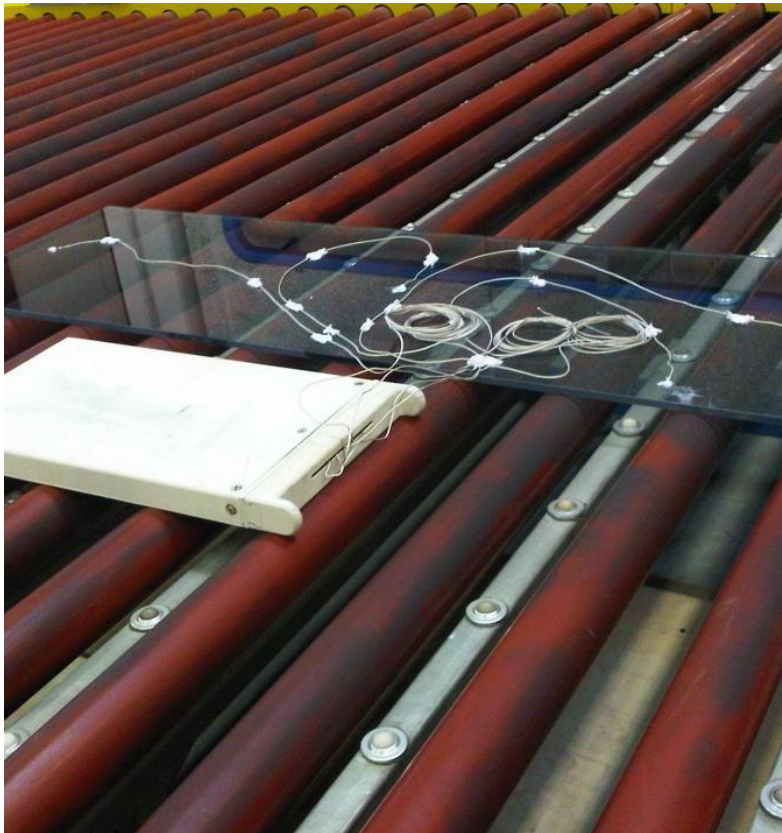


- The DQ1840/2 have their advanced electronics and the battery packed into a steel case only 9mm (0.35") high so freeing up space to maximize the thickness of the insulation.



- The LED indicators and buttons are recessed and so protected from damage while providing clear indication of the current status of the datalogger.

Recommended Thermocouple Attachment



The picture shows the Datapaq system prepared and waiting to enter the furnace.

- Recommended method is high temperature cement. There are many different products on the market.
- We have used MINco Foratfix Autostic FS adhesive in tests. This can be used up to 1000°C and is ready mixed and applied directly from a cartridge.

Datapaq Glass Tempering System

A complete solution enabling users, for the first time, to obtain a full temperature profile through the furnace and quench phases of the glass tempering process

Get the best of both methods - use the Datapaq to calibrate the IR Pyrometer, obtain accurate temperature measurements from every sheet.

Datapaq enables users to:

- Measure heat up and quench rates
- Locate cold spots in the furnace
- Reduce set up times especially for Low e and reflective coated glass.
- Optimize process settings
- Reduce rejects and breakages

Use of the Datapaq will help in ensuring maximum productivity and minimum reject rates.

The Datapaq Glass Tempering Systems

– a Unique Solution from the World's
Number One Thermal Profiling Provider

