

Aluminium Brazing – Improved System Design for Temperature Profilers

Dave Plester – Director PhoenixTM – January 2015



Temperature logging system enters furnace with the product

Brazing aluminium products such as radiators, condensers, evaporators, etc. for the auto industry is a mass production process where the raw material used to manufacture the product is thinly 'clad' with an alloy having a lower melting temperature than the 'parent' metal. This 'cladding' layer becomes the filler metal to join the parts. The brazing operation is generally carried out in a mesh belt furnace under a nitrogen atmosphere and is commonly known as 'CAB' - Controlled Atmosphere Brazing.

As the difference between the melting points of the two materials is small, accurate temperature measurement of the product throughout the furnace can be critical. Using a 'through furnace' temperature profiling system to measure product temperature is common practice within the industry, and the benefits are well established. There are

also some known disadvantages to using these types of systems and here we look at recent developments to overcome these problems.

The 'through furnace' profiling system measures temperature by connecting thermocouples at specific points on the product which feed temperature information back to the data logger. The logger is protected from the heat of the furnace by a 'hot box' or thermal barrier, allowing the system to travel through the furnace together with the product, storing valuable temperature data which is analyzed at the end of the process using specialized software.



Typical profile obtained using a 'through furnace' temperature data logging system

The main disadvantages to these systems are:

- The thermal barrier normally has a very limited life span as part of the insulation package is subject to acid attack from chemicals within the flux.
- Oxygen can leak from within the thermal barrier while it is in the furnace, potentially contaminating the nitrogen atmosphere.

Phoenix Temperature Measurement (PhoenixTM) has developed a thermal barrier designed to address both of these problems:

- Acid attack:** During the braze cycle, moisture in the air inside the 'hot box' or thermal barrier will combine with chemicals in the brazing flux to form hydrofluoric acid which attacks the high temperature cloth covering the microporous insulation. Once this cloth begins to break down, the unprotected insulation at the entrance to the 'hot box' wears away increasing the aperture where the thermocouples enter. This allows heat in, potentially damaging the data logger, and lets oxygen escape into the furnace atmosphere, which may affect braze quality.



Acid attacks the cloth protecting the insulation

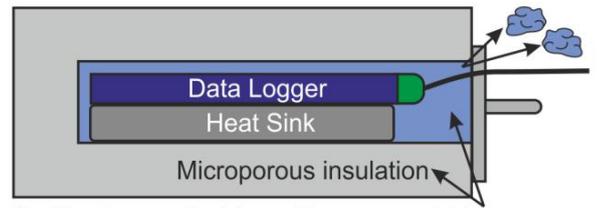


Thermal Barrier or 'Hot Box' designs: Typical 'clam shell' design left, 'Drawer' design right

The life of this type of thermal barrier is severely reduced leading to high maintenance costs. The Phoenix™ solution uses a robust 'drawer' design rather than the traditional 'clam shell' type.

This eliminates exposure of the high temperature cloth to the aggressive flux atmosphere, and significantly increases the life of the barrier. This new type of thermal barrier has been used in daily production since April 2011 at many leading automotive parts suppliers, with one major North American auto manufacturer reporting over two thousand uses without any wear problems.

B: Oxygen leakage: Whether the thermal barrier is a 'clam shell' or 'drawer' type it will contain air. As the system travels through the furnace the air begins to warm up and expands. As it expands it begins to leak out into the furnace atmosphere, which may be an issue to some users.



Air within microporous insulation, and in spaces around data logger, heats and expands during the process, escaping into furnace atmosphere. But evacuation under vacuum and purging with nitrogen ensures only nitrogen leaks from the thermal barrier

There are two areas within the thermal barrier where air will accumulate – within the microporous insulation, and in the spaces around the data logger and heat sink. A 'two stage' approach has been developed to remove this air.



The optional nitrogen purge nozzle at the rear of the thermal barrier allows the system to be completely purged of all air just prior to loading in the furnace

Firstly eliminating the air deep within the microporous insulation is achieved by heating the whole thermal barrier or 'hot box' in a high vacuum, then back filling with nitrogen. This operation is carried out prior to shipping the system to the customer.

Secondly, as an option for customers with sensitive processes, all remaining air in the spaces around the data logger can be purged with low pressure nitrogen just prior to placing the system in the customer's brazing furnace. The nozzle for the nitrogen purge has been designed to allow free flow of the gas through the barrier, but by use of strategically placed internal 'baffles', heat penetration is minimized during the brazing process.

Conclusion

Although using a profiling system to monitor the product temperature in a CAB furnace has always been considered high maintenance, it was judged that the value of the data obtained was worth the extra cost. However through careful system design a solution has been engineered that successfully overcomes these problems, saving maintenance costs and allowing the 'hot box' temperature profiling system to be used on a regular basis.

Dave Plester, Director
Phoenix Temperature Measurement
www.phoenixtm.com
sales@phoenixtm.com