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Research Report Project No: MP 1659
Generation 9 System – Cooling Rate

DATE	REV	DESCRIPTION OF CHANGE	INITIALS
05/03/04	6	INITIAL RELEASE	

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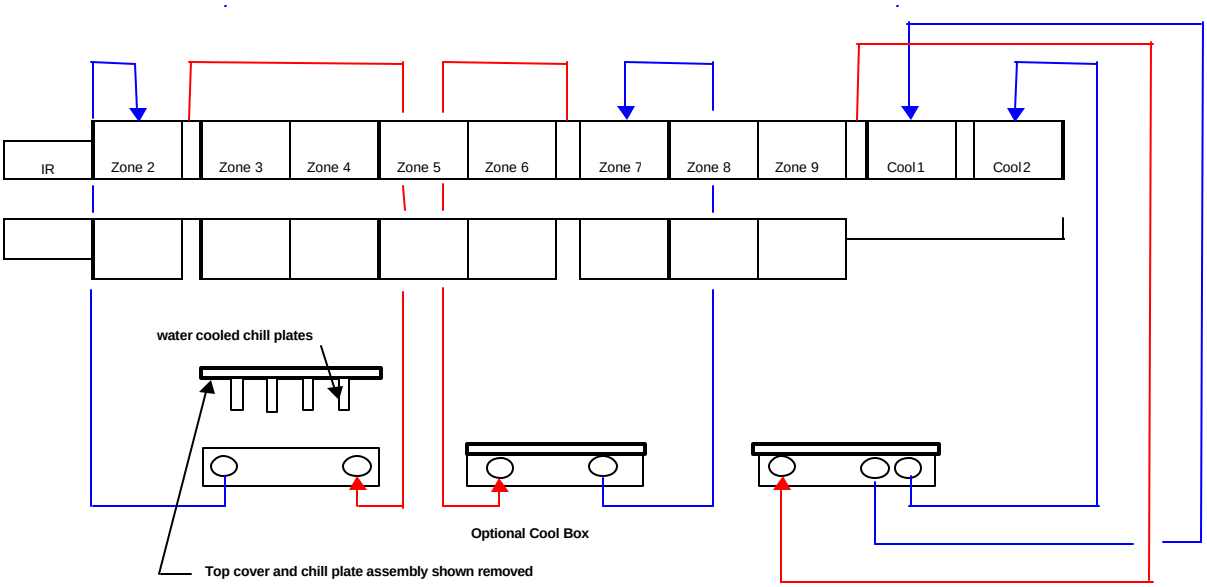
ABSTRACT: ***Testing was performed to determine the attainable cooling rates using the Gen 9 system with chilled water.***

INTRODUCTION / BACKGROUND: ***Some Solder Paste Manufacturers are now asking for cooling rates greater than 2 °C/Sec as it is believed the solder joint's grain structure can be enhanced by fast "freezing". This can be especially popular when processing Lead Free pastes. Existing Reflow Ovens can provide cooling rates of 2 °C/ sec or more without chilled water however, chilled water is needed when processing very large boards or when extremely fast cooling rates are desired.***

DESCRIPTION & PROCEDURE: ***The Gen 9 system is structured as follows:***

Fig. 1



The Gen 9 Cooling System takes flux laden exhaust gas from between the Reflow and Cooling sections of the oven and cools the gas. The cooled gas is then returned to the cooling zones for enhanced cooling rates.

A side benefit of this process is that the flux is precipitated in the Gen 9 box. In this way, the cooling area is kept much cleaner and maintenance is reduced. This phenomenon will be addressed in a separate paper.

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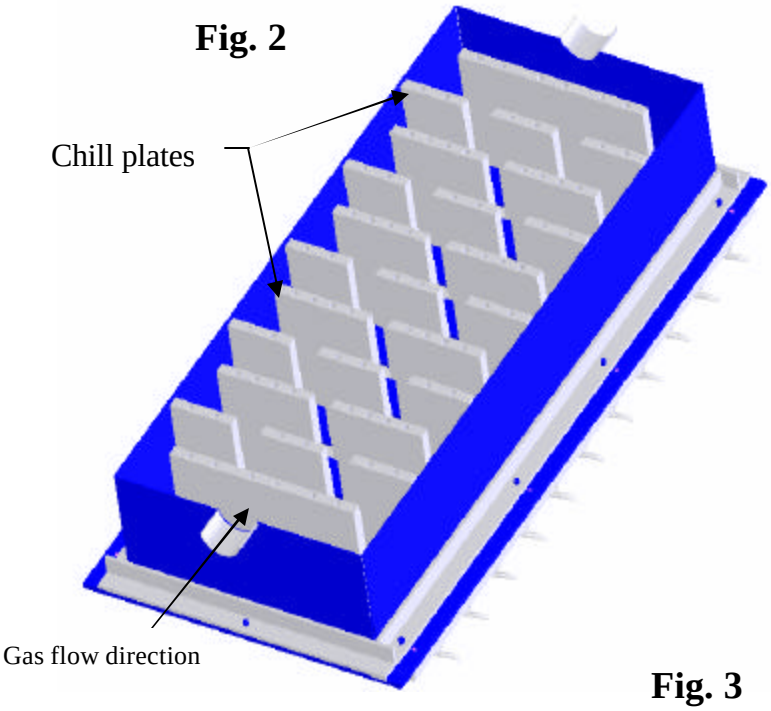
DESIGN AND OPERATIONAL PROPERTIES

Fig. 2

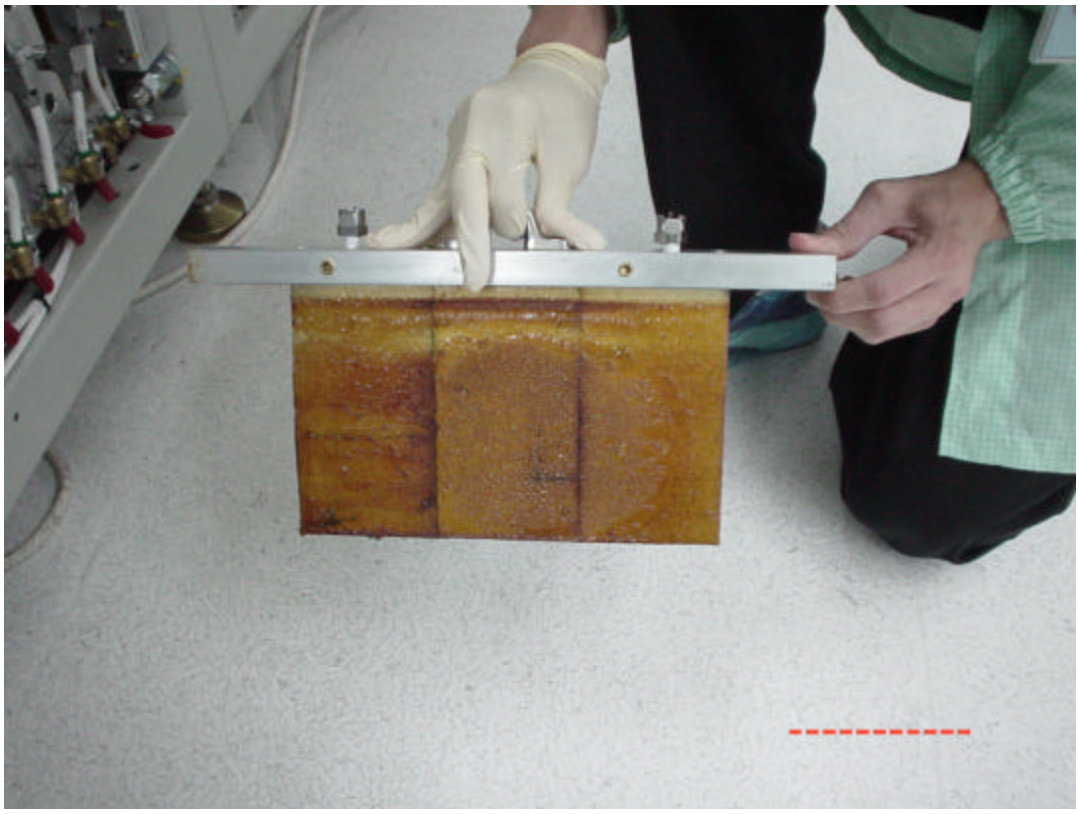


- **Replaces cooling air with cooling fluid**
- **Utilizes a labyrinth of chill plates with water running through them to cool the gas**
- **Condenses more flux due to lower operating temperature**
- **Mechanical Action in Labyrinth enhances separation**

Fig. 3

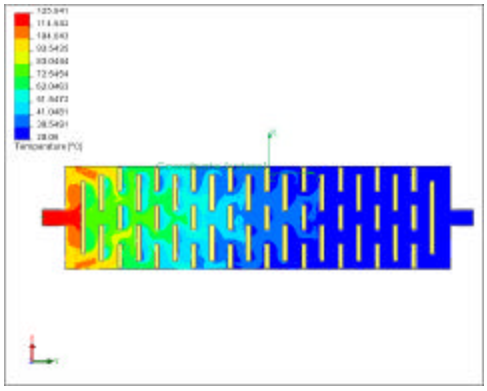
Photo showing vertical mounting of Gen 9 box hinged for access.

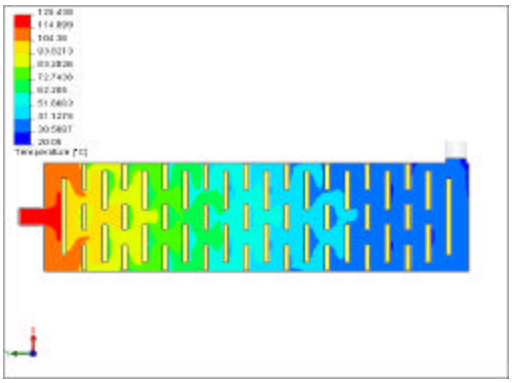
Fig. 4

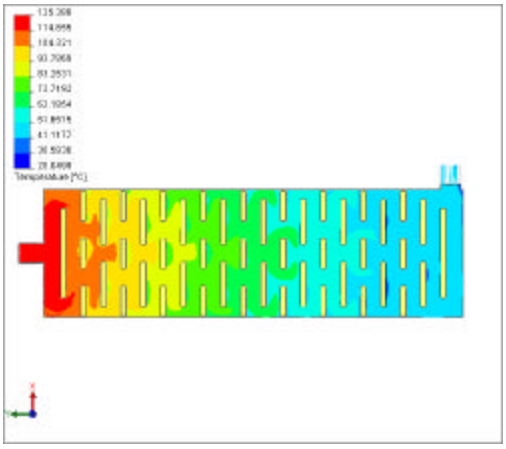


Quick release Chill Plate removed from Generation 9 Flux Box shows evidence of flux residues. The chilled water supply that runs through the chill plates provides a cold surface to force flux precipitation through a radical temperature drop and the mechanical action of the flux laden gas stream hitting the surface.

Fig. 5







Gas Modeling tests demonstrate gas flow characteristics / volumes and their effect on gas return temperatures to the oven tunnel.

Test is also valuable to determine flux separation tendencies on the individual chill plates in the Generation 9 flux box.

Fig. 6

Gas Modeling tests provide data to determine appropriate number of chill plates needed for good flux separation and suitable gas return temperatures to the oven tunnel.

For the Generation 9 "A" box the return is to a heated preheat zone. In this case, a smaller box (fewer chill plates) is appropriate for good flux separation and warmer gas return.

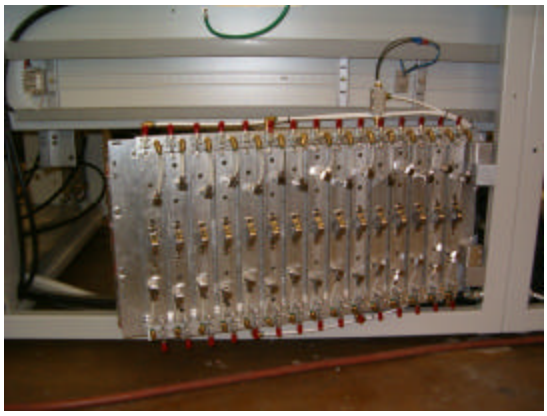
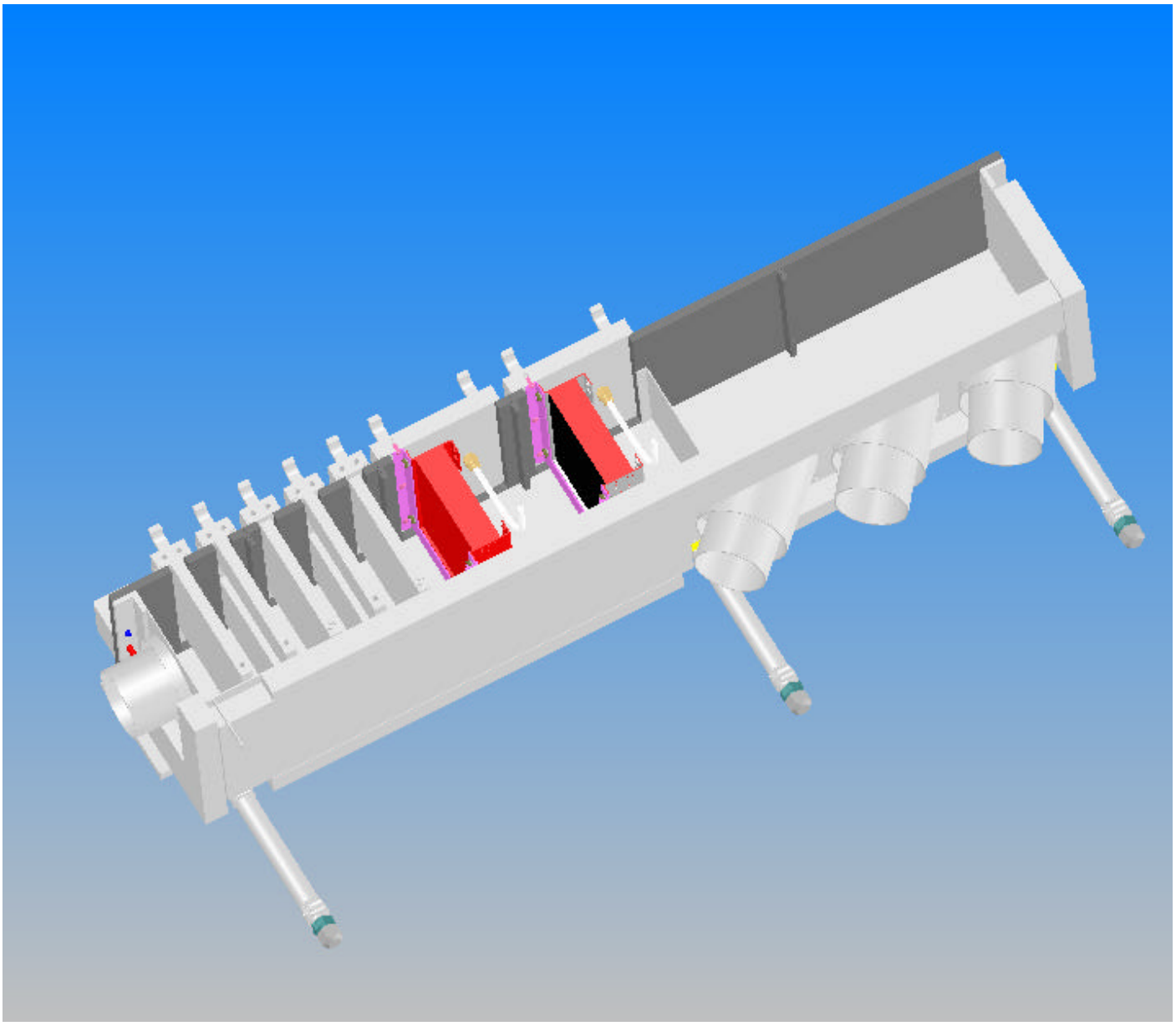
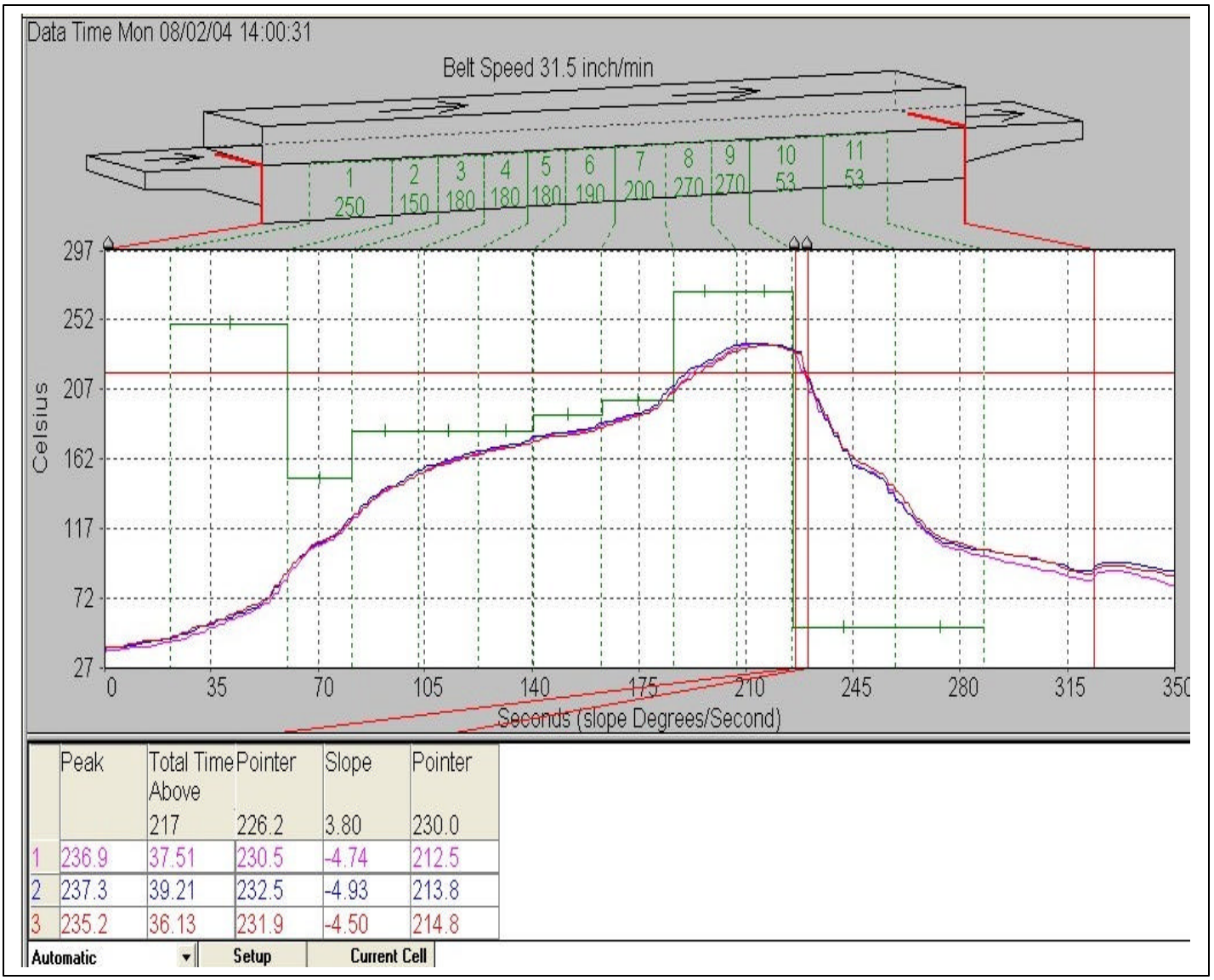


Fig. 7



Next Generation 9.2 Flux Separation box replaces down stream chill plates with more efficient heat exchangers for greater surface area and lower return gas temperatures into the cooling zones of the oven.

Fig. 8
Profile Results



	Peak	Total Time Above 217	Pointer 226.2	Slope 3.80	Pointer 230.0
1	236.9	37.51	230.5	-4.74	212.5
2	237.3	39.21	232.5	-4.93	213.8
3	235.2	36.13	231.9	-4.50	214.8

Automatic | Setup | Current Cell

CONCLUSIONS:

1) **The Gen 9 system was able to satisfy and exceed the requirements for increased cooling slope associated with the Lead Free process.**
2) **The Gen 9 box was quite effective at reducing the cooling gas temperature and it is believed that additional reductions in temperature can be achieved with some design enhancements.**
3) **The Gen 9 box is also capable of precipitating out a large amount of flux which in turn keeps the tunnel clean and the exhaust free from pollutants. A separate report will be conducted on the efficacy of the Gen 9 box for flux elimination and maintenance reduction.**