**The Application**

Furnaces are used in glass making plants to melt sand and recycled glass at high temperatures of more than 2000 degrees F. Liquid glass then flows through a forehearth to the bottle-making machine.

Each forehearth is equipped with heat-cool elements like gas burners and air flow coolers to control temperature profile along the forehearth in the direction of the glass flow.

See Figure 1 for schematic of furnace and control system.
Figure 1: After sand and recycled glass are melted in a furnace, the liquid glass flows through the forehearth. A control system is used to keep the temperature in the forehearth exactly at the setpoint.
**Operation**

It is critical to maintain temperature exactly at the setpoint, especially in the last forehearth zone where melted glass is injected to the bottle-making machine.

The other requirement is to be able to reach a new setpoint entered by the operators during job changes. The temperature setpoint depends on the product being manufactured, like type of bottles. Typically, the control system is required to maintain temperature at the setpoint plus or minus one degree F, and the job change (transition from one setpoint to a new one) should last no more than half hour.

**The Control System**

Split range heat-cool PID temperature control is currently used to maintain zone temperatures at their respective setpoints. Standard high-low value alarming and signal fault interlock algorithms are employed along with the PID controllers.

The PID controllers execute at 10–20 second scan rate, and are tuned with strong derivative action. MANTRA 47 embedded PID tuning technology was used along with PID loop tuning software INTUNE to obtain optimal PID tuning values.

OK/K.S.