# Temperature:
## Most Critical Factor For Glass manufacturing
### Tempsens white paper

Tempsens Instruments Pvt. Ltd.

We can't imagine the world with out glass, glass is very important part of today's daily life, and it has its uses from daily house hold up to industries. As the glass is taking bigger shape in today's race, industries that are manufacturing glass are becoming more conscious about the quality of their product, along with quality the reduction of manufacturing cost and increasing efficiency of production is also a big factor.

In this paper we will discus about the importance of accurate temperature measurement at different segments of glass manufacturing furnace.

## Important Location in a Glass Furnace to measure Temperature

### Furnace Regenerator Crown

The arc of the melting chamber where solid batch material is heated up to produce molten glass is called crown. Over heating of the crown may cause of early erosion of crown refractory and if the temperature is low it can affect the melting efficiency and increase the fuel consumption that is why to measure and control the correct temperature of the crown is very important.
The temperature of crown may be more than 1600 deg C, so thermocouple with dual protection HWT (Heavy Wall Thickness) ceramic sheets are recommended to increase the service life of the thermocouple.

### Furnace Bottom

Bottom Blocks are the costliest part of a melting tank. It become very much important to measure accurate temperature even difference of 2-3 deg can lead to more fuel consumption of the furnace. It is difficult for a thermocouple to withstand whole campaign life of a furnace, TEMPSENS thermocouple has achieved this goal in many projects. If the thermocouple to be used in glass with direct contact to molten glass Platinum thimbled thermocouple are used, or some furnace has hole or a pocket for thermocouple then thermocouple with re-crystallized alumina sheet are used.

### Fore Hearth

A glass fore hearth control system includes temperature sensing system and a control system. Temperature sensing system includes an arrangement of pre-positioned temperature sensors. Simplex and triplex (tri level) thermocouple consist of an assembly of a bottom, middle & top thermocouples for sensing the vertical temperature profile of the molten glass at a fixed location. The output signals from these temperature sensors are received by controllers of the control system which the provide control signals and regulate the operation of heat input devices and the cooling input devices. It very important that thermocouple output and controller's calibration must be accurate, reliable and repeatable.

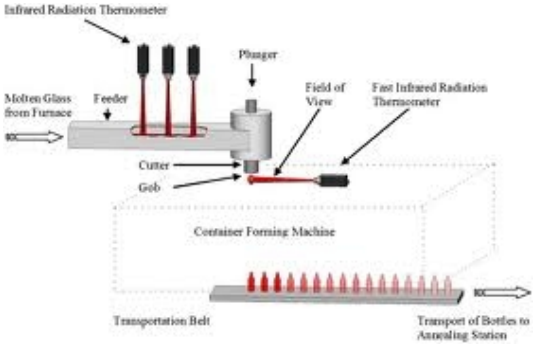
The **Trilevel thermocouples** designed to achieve thermal homogeneity of the glass existing from the fore-hearth for forming, as the homogeneity will help to get the proper distribution of gob in moulds.

### Non- Contact temperature sensing in glass industry

Pyrometers are use in various important locations like fore hearth, feeder, working end in glass furnace, pyrometers also enables measurement of surface temperature of glass during production process such as toughening of glass, test of thermal resistance of glassware,

monitoring the temperature strip drawn from the furnace, float glass production, bottle temperature, bulb shell and tube temperature. Pyrometers with fiber optic cable are used widely in fore hearth of a furnace, the sensor part and other electronic are connected through fiber optic cable, this allows to keep the electronic assembly away from the high temperature.

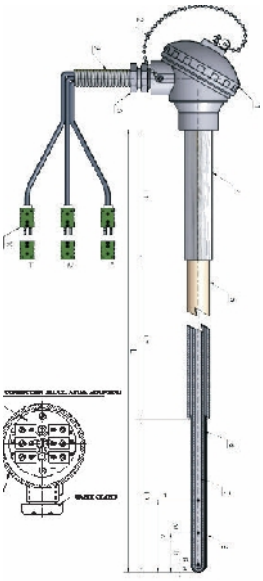
The core temperature measurement of the gob is important to ensure the desired container wall surrounding thickness. As there are lots of fumes in the during the process of gob manufacturing, two colors pyrometers are used to the temperature of the gob, they should have low response time which facilitates the measure measurement of fast heating process.




## Special Thermocouple to measure molten glass Temperature

As thermocouple measures the temperature when in contact to media whose temperature is to be measured and if this media is molten glass the situation is critical as temperature is more than 1400 deg C & molten glass can contaminate the material in direct contact with it.
To overcome this problem platinum thimble is used at the contact end of thermocouple to improve the life of the thermocouple.

So this enables to measure the instant temperature of the molten glass with thermocouple.



## Tri-level Thermocouple

There are special deigns for the thermocouple used in fore hearths of the furnace; the outer dia is reduced to increase response time and protected with platinum coating. The temperature at different level of molten glass are varying, the Tri-level thermocouple, the three thermocouple sensors mounted in a single assembly, resulting in a tri-level thermocouple and are used read the through out temperature profile of the molten glass, (bottom layer, middle layer, upper layer).