

# Thermoforming Temperature Control

## using the PyroMini infrared temperature sensor

In vacuum forming and thermoforming processes, an extruded plastic sheet is heated to make it pliable, before being moulded into shape by a vacuum or high pressure. Plastic bath tubs, car trim panels and plastic pallets, among many other products, are all manufactured by thermoforming. The process depends critically upon temperature.

Leading manufacturers of thermoforming machinery have been using Calnex pyrometers to control heaters and cooling fans in thermoforming for more than ten years, with the following benefits:

- Minimising the preheat time and cooling time allows an increase in the production rate
- Reduction in cost and energy used to heat the plastic
- Alarm signals can be provided to warn of critical temperatures
- Increase in product quality and consistency

### HEATING

Forming temperatures typically range from 120°C to 370°C, and the optimum temperature depends on the type of plastic. Some plastics may be formed at any temperature within a relatively wide band, whereas others require much more critical temperature measurement. For example, polypropylene is best formed just below its melting point, a very narrow temperature window that depends on its molecular structure and crystallinity. Precise temperature control is required, and the high performance of the PyroMini infrared temperature sensor makes it ideal for the task.

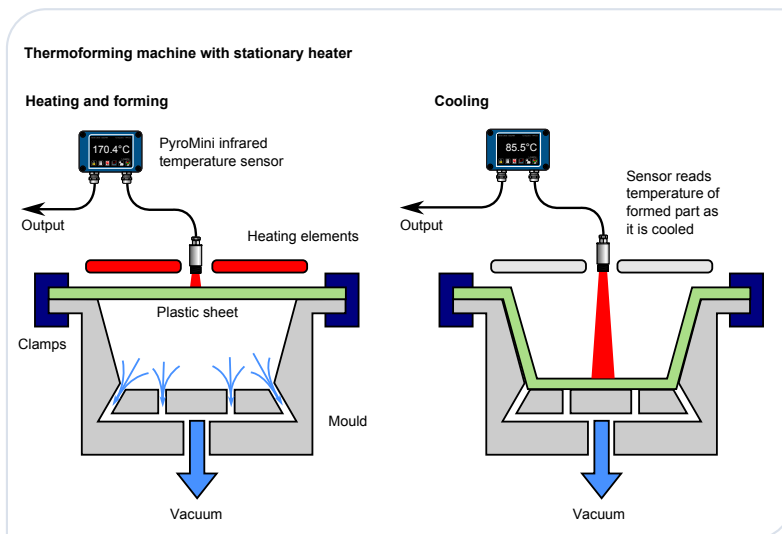
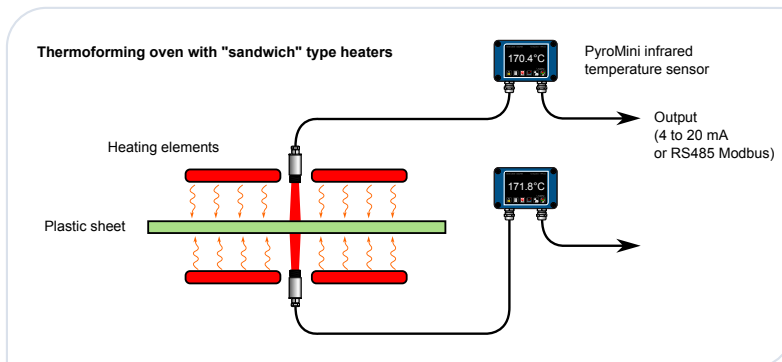
The plastic sheet is heated by banks of infrared heaters above the sheet. In some thermoforming ovens, especially for thicker sheets, the sheet is heated with "sandwich" type heaters, both above and below it. Radiant heating element types such as quartz, halogen and ceramic are frequently being installed to replace older radiant tubes in thermoforming ovens.

One sensor is used to measure the temperature of each heating zone, so an even temperature profile is ensured throughout the whole sheet. For good temperature uniformity, at least ten points should be measured: all four corners and the centre of the sheet, on both the top and bottom surfaces.



PyroMini with optional touch screen interface

The sensing head is positioned between the heating elements so it has an unobstructed view of the plastic surface. High ambient temperatures mean that PyroMini -JA (for ambient temperatures up to 120°C) and -HA (for ambient temperatures up to 180°C) models are most suitable. There is no need to cool the sensing head, which helps cut down on energy usage and cost.



### COOLING

In many cases, the production rate is limited by how quickly the formed part can be cooled before being removed from the mould. Another PyroMini sensor monitors the surface temperature of the formed part as it is cooled by fans and by the cooling system in the mould itself. The PyroMini has an instantaneous 240 ms response time, so the operator or automatic control system can see straight away when the part is cool enough, switch off the cooling fans and mould cooling system, and clear the mould for the next part as quickly as possible.

The optional touch screen display provides a large, bright indication of the PyroMini sensor's measured temperature, two alarm relay outputs, and data logging to a built-in MicroSD Card slot. The sensor is fully configurable via the intuitive interface.

For connection to existing instrumentation such as PLCs or temperature controllers, two output types are available: a linear 4 to 20 mA output for measured temperature, or full RS485 Modbus communications.

Calnex can also provide systems ranging from a single sensor with a PID controller, to a digital network of tens or even hundreds of sensors, providing display, control, alarm, analogue output and data acquisition functions.

### APPLICATION TIPS

Sheet thicknesses from approximately 1 to 2 mm upwards, in medium to heavy gauge thermoforming applications, are easy to measure with infrared temperature sensors because they are opaque to infrared radiation, and the sensor cannot "see" through them.

Thin gauge plastics, below a millimetre in thickness, may be partially transmissive to infrared radiation and therefore more difficult to measure.

For more information on choosing a suitable system for your application, please contact Calnex.

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