an engineer can monitor and adjust furnace and curing oven temperatures. For automatic adjustments, sensors are connected directly to the control room. An ES100 is positioned after the curing oven to monitor drying uniformity and identify potentially dangerous glass slugs across the entire width of the product.

With infrared sensors in place along the forehearth, conveyor belt and curing oven, the production line moves along more efficiently and high quality is maintained.

Other Processes

Other processes that can benefit from Raytek infrared sensors include automotive windshield production, where the reheating and forming sections can be monitored and controlled by MP50 linescanners or Thermalert sensors (see Figure 5).

In the production of laminated safety glass, which is used in both vehicles and buildings, GS100/GS110 systems are positioned to ensure that temperatures are at the proper levels for laminate adhesion.

Any glass-related industry where heat is a factor in quality production can use Raytek noncontact infrared sensors for monitoring and controlling the process.

Raytek Products for the Glass Industry

Raytek manufactures a wide range of infrared products for the glass industry. All sensors are easily customized to fit your application.

Thermalert Series–a full line of compact and miniature sensing heads in two-piece (sensor and monitor) and integrated configurations as well as smart 2-wire noncontact infrared temperature sensors with remote online addressability. Measure temperatures of hot, moving, or inaccessible materials safely, accurately and with repeatability you can count on.

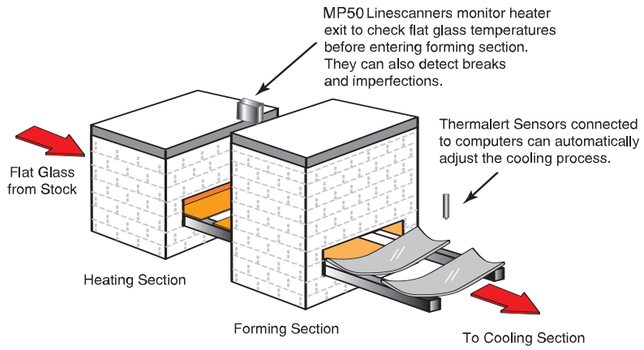


Figure 5: Windshield Production

Marathon Series–combining superior performance with state-of-the-art digital technology, the Marathon Series is a family of infrared pyrometers designed for harsh operating environments. These integrated sensors offer advanced electro-optics, video monitoring and image capture capability, a variable focus option and a built-in user interface in a rugged, compact housing.

MP50 Linescanner–the cost-effective way to measure edge-to-edge temperatures for control of product uniformity. Provides data for up to 256 points per scan, 48 scans per second, in a 90° field-of-view. And with DataTemp DP Windows software for the linescanner, remote temperature monitoring, remote scanner configuration and data analysis is at your fingertips. View real-time and saved thermal images, and correct process irregularities before they become problems. Based on the MP50 unit we provide the following special application solutions.

GS100–thermal imaging and analysis for defect detection and quality improvement in glass annealing/tempering and glass bending processes.

GS110–based on the GS110; this system has added sensors and temperature correction for low emissivity glass.

ES100–automated inspection system for detecting, measuring, and classifying defects occurring in sheet extrusion, cast film and other continuous web processes.

3i Series–portable infrared thermometers practically made-to-order for your special applications. The scope and scope-with-laser models are ideal for applications requiring long range temperature measurement, or for use in bright light.

Raytek Know-how and Service

With over 40 years experience, Raytek knows infrared temperature measurement. Our application specialists are located around the world to help answer your technical questions. In addition, maintenance, training, calibration and other customized services are available to ensure that you receive the maximum benefits from your Raytek infrared, noncontact thermometer. For more information on Raytek infrared temperature measurement solutions, contact us today.

www.raytek.com

Worldwide Headquarters
Raytek Corporation
Santa Cruz, CA 95060-5731, USA
Tel: 1 831 458 1110
Fax: 1 831 458 1239
solutions@raytek.com

China Headquarters
Raytek China Company
Beijing, China
info@raytek.com.cn

European Headquarters
Raytek GmbH
Berlin, Germany
Tel: 49 30 4 78 00 80
Fax: 49 30 4 71 02 51
raytek@raytek.de

France
info@raytek.france

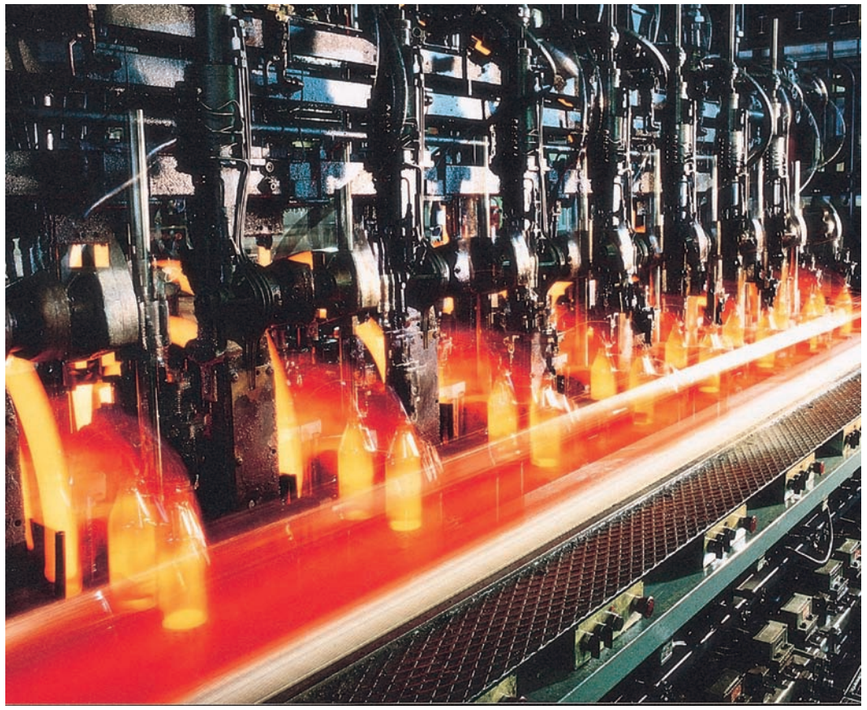
United Kingdom
ukinfo@raytek.com

Raytek
A Fluke Company

GLASS INDUSTRY SOLUTIONS

Glass Industry

Processing and Manufacturing



Noncontact Temperature Measurement Solutions

Major Applications

- Melt Furnace
- Flat Glass
- Automobile Windows
- Bottles, Container & Specialty Glass
- Molds & Plungers
- Lamps, Bulbs & Tubes
- Glass Fiber
- Safety Glass

Raytek noncontact infrared thermometers are designed for use in glass industries where monitoring and controlling temperature is critical to productivity and product quality.

Raytek infrared thermometers (or sensors) provide fast, accurate, noncontact temperature measurement. Realtime monitoring enables primary and secondary glass manufacturers to achieve the following benefits:

- Improved process control
- Increased product uniformity
- Higher product quality
- Less production downtime
- Increased throughput

Raytek infrared sensors are used with furnaces, bulk glass, melter, regenerator, refiner, forehearth, gob, molds, float lines, and annealing lehrs, as well as at the cooling and coating areas.

Efficient temperature measurement shows all aspects of the heating or cooling processes, such as whether a regenerator is too cool or too hot, or whether the tin bath and lehr zones are at their correct temperatures. Careful monitoring, from the molten state through the cooling process, ensures that the glass retains the desired properties as it travels through the manufacturing process.

Raytek infrared sensors take temperature measurement one step further. A wide range of optics, including the remote-controlled, motorized, variable focus in the Marathon MM, covers an enormeous variety of applications. The sensor can be aligned with the target by using the integrated through-the-lens sighting, plus either laser or video sighting for correct target location. Simultaneous analog and/or digital output allows temperature data to be integrated into a closed loop control system for remote temperature monitoring and analysis.

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Melt Furnace

Melters can be either cross-fired (as shown in Figure 1) or end-fired. Regenerators improve fuel efficiency by heating incoming air and alternating the firing direction. The temperature of the brick packing in the regenerator columns increases as the heated air from the furnace escapes. When this packing reaches the appropriate temperature, the cycle is reversed and these columns are then used to heat air entering the furnace.

To insure maximum operating efficiency, Raytek sensors are mounted at the top and bottom of each regenerator to trigger the air flow and firing direction at the optimum time.

Using Raytek sensors to monitor the packing and refractory material for deterioration is crucial in planning the maintenance and rebuilding schedules, and eliminating emergency situations which could cause a costly, unscheduled shut down. The temperatures at the port arch and the bridgewall are measured to maximize the useful life of the refractory material. The precise aiming capability of Raytek sensors allows measurement of individual target bricks and avoidance of the furnace flame.

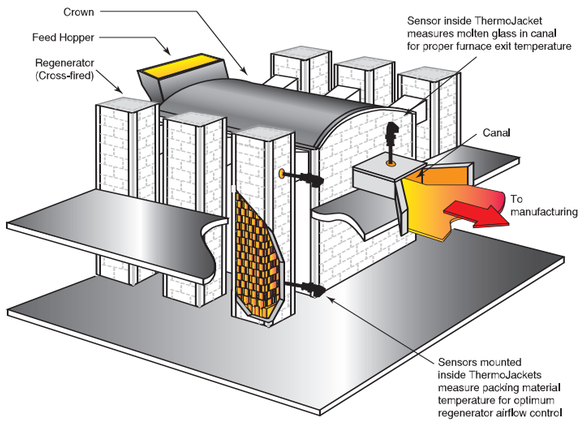

Figure 1: Melt Furnace

Flat Glass

Temperature monitoring is critical in each stage of flat glass production (Figure 2). Incorrect temperatures or rapid temperature changes cause uneven expansion and contraction, resulting in improper annealing. At the tin bath, sensors are mounted over each zone to insure correct glass temperature. The annealing lehr also has several temperature control zones. Sensors with air-cooled ThermoJacket housings are mounted at each zone to measure flat glass surface temperature and to monitor edge-to-edge temperature distribution. For this reason, ES100 systems are mounted between the tin bath and lehr, at specific zones in the lehr and at the exit, to scan across the width of the glass. Areas with surface imperfections, such as a crack, a bubble or a thinner or thicker section will cool differently than the surrounding glass and are visible as a realtime color image on the computer screen.

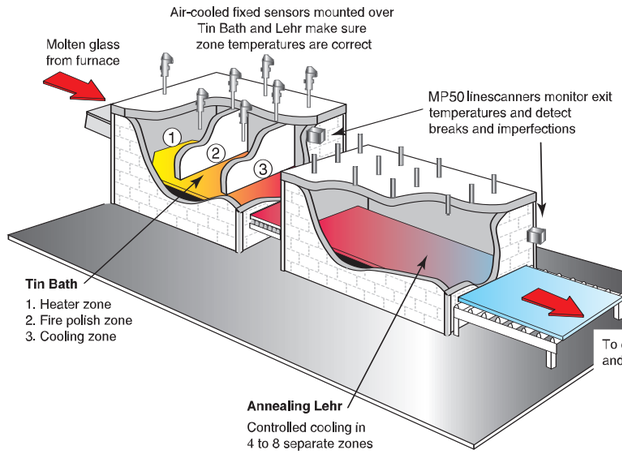

Figure 2: Flat Glass Production

Bottles and Containers

From the furnace, the molten glass flows into one or more forehearths (depending on the size of the operation), where the molten glass is kept at a uniform temperature. At the end of the fore-hearth, the gob is dropped into molds where initial forming is done by either a blowing process (compressed air) or pressing process using plungers and molds (Figure 3).

Maintaining the proper temperature in the forehearth is critical to insure that the molten glass is in the proper homogenous condition when it reaches the exit. When the gob is forced out of the opening, it must have the proper viscosity (a 1°C change causes a 1% change in viscosity).

Infrared fiber optic sensors are placed along the forehearth to monitor the molten glass temperature and control the forehearth zone temperatures.

The annealing lehr's temperature control zones must be properly monitored and controlled to keep product quality high. If the glass containers are too hot when they leave the lehr, they can mar at the next processing step or crack when they meet the cooler air outside the lehr. If they cool too fast inside the lehr, cracking or breaking can occur. Also, bottles and containers must be at the proper temperature if the glass receives a cold end surface treatment.

Sensors mounted over each of the annealing lehr's temperature zones can accurately monitor and control the cooling process and cold end surface treatment. This allows better quality control and fewer rejected pieces.

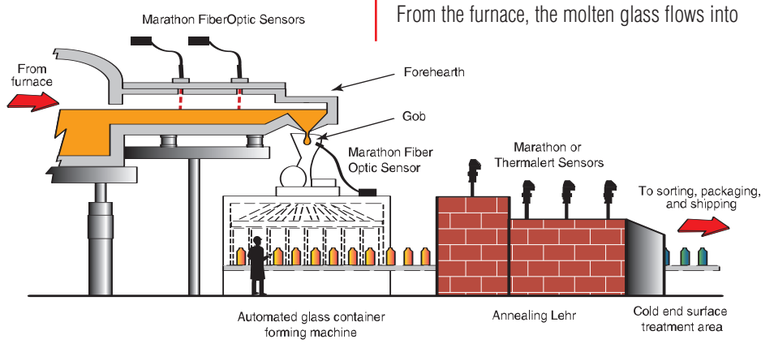

Figure 3: Container Glass Production

Glass Fiber

There are two main processes for making glass fiber: crown wool and white wool. The crown wool process is shown in Figure 4.

Forehearth zone temperatures are monitored and controlled by infrared fiber optic sensors. This allows the engineer to maintain the optimum molten glass temperatures (viscosity) as it enters the fiberizer (spinner). The spinner temperature is monitored by a fiber optic IR sensor or an ES100 system to maintain consistency of the fiber glass strands and to prevent the spinner holes from clogging. Clogged holes can cause glass "slugs" to enter the glass mat. Hot glass slugs can ignite the backing paper of insulation many days after production is complete.

At the curing oven, proper temperature control must be maintained or the binding agent will not cure properly. If paper and/or foil is glued to the glass fiber after curing, the fiber must be at the correct temperature for the material to properly adhere.

Sensors are mounted along the conveyor line to monitor temperatures before and after the curing oven. Based on temperature feedback,

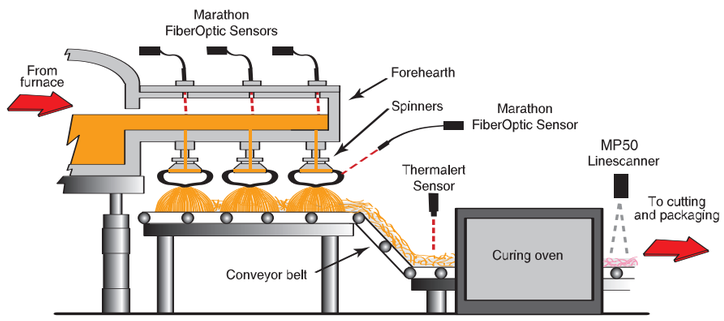

Figure 4: Glass Fiber Production (Crown Wool Process)

The Right Solution for Your Process

Raytek manufactures a wide range of infrared products for the glass manufacturing industries. These include noncontact infrared linescanners, smart sensors, and modular systems (sensors and monitor units), all easily customized to fit your glass manufacturing applications. All Raytek products are supported worldwide with on-site calibration, training, and support.

Process	Temperature Measurement Area	Raytek Solution (Product)		Key Features for Automation Sensors
		Automation	Portable	
Melt Furnace (see Figure 1)	Furnace/Regenerator Crown	FA1G	3i1M	Multidrop network, maximum accuracy, no water cooling
	Regenerator packing	FA1G	3i1M	
	Port arch/Bridgewall	MM1M	3i1M	Accurate sighting (Video, Laser, Through-the-lens)
Flat Glass: Float/Tin Bath & Annealing Lehr (see Figure 2)	Canal	FA1G	3i1M	Maximum accuracy
	Tin bath zones	TXG5	3iG5	2-wire installation, multidrop network
	Break detector	TXG5		2-wire installation, fast response
	Glass temperature	TXG5	3iG5	Sensor cooling alarm (TXG5)
	Glass temperature profile	ES100, TXLT		Ease of installation
	Lehr and Lehr exit	ES100, TXLT		Multidrop network (TXLT)
Container Glass (includes holloware, pressware, and TV panels) (see Figure 3)	Forehearth	FA1G	3i1M	Maximum accuracy, no water cooling
	Gob or stream	FA1G	3i1M	Maximum accuracy, fast response
	Plunger/Mold	FA1/FA2		Low temp., fast response, small spot size
	Annealing Lehr	MP50G5, TXG5		Multidrop network
	Coating Applications	GS100, TXG5		2-wire installation
Lamps/Bulbs	Flare machine	MR1S (leaded glass)		Small spot size, fast response
	Automount/Stem machine	MMG5		
	Press Sealing	MMG5		
	Tungsten/Molybdenum	MM2M, MR1S		
Glass Fiber	Forehearth	FA1G	3i1M	Maximum accuracy, fast response
	Spinners (Crown Wool)	ES100, FA1G	3i1M	
	Curing oven entry	TXLT		2-wire installation
	Curing oven exit	ES100, TXLT		Fast response, hot spot detection
Automobile Windows (Figure 5)	Heating	GS100		Rapide scan speed, small spot size
	Forming/Bending	TXG5		Fast response
Glass Tempering	Oven exit	GS100/GS110		Monitoring of uncoated/coated glass; Automatic emissivity correction

KONTAKTA OSS GÄRNA FÖR MER INFORMATION

Hugo Tillquist AB
Mejl: info@tillquist.com
Telefon: + 46 8 594 632 00