INDUSTRIAL HEATING

NONCONTACT TEMPERATURE MEASUREMENT

Batch Heating
Continuous Heating
Induction/Resistance & Flame Heating
Heat Processing For Wire Products
Vacuum Chambers
Rotary Kilns

Williamson

Innovators in Noncontact Temperature Measurement

INNOVATORS IN NONCONTACT TEMPERATURE

Innovative Solutions for Traditional and New Heat Processing Applications

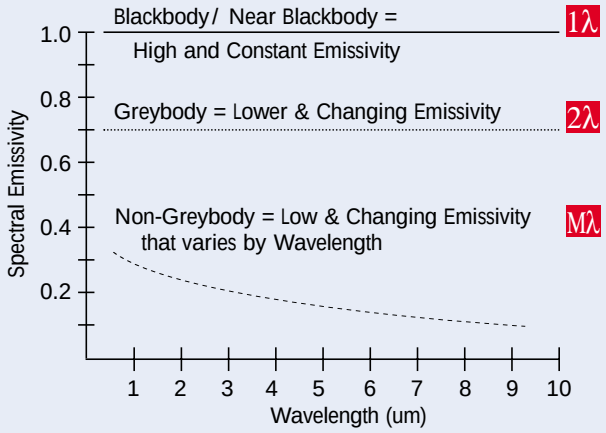
Williamson is dedicated to providing unique and creative solutions for Industrial Heat Processing applications. We offer a comprehensive line of industrial temperature sensors, as well as several innovative technologies for applications considered difficult to measure. Some significant sensor features include a patented single-wavelength **Auto Null Design**, a high-performance **Dual-Wavelength Design**, a patented **Multi-Wavelength Design**, and a variety of flexible **Fiber Optic Systems**. Combining these unique capabilities with our extensive heat processing application experience, Williamson can provide superior performance for both traditional and difficult to measure applications.

Greater Accuracy, Repeatability & Reliability for Temperature Measurement & Control

Williamson's noncontact temperature sensors measure the amount of infrared energy emitted from an object's surface and convert that signal into a temperature value. While many factors effect the measurement accuracy, an important consideration is the selection of the sensor design that most effectively compensates for the emissivity characteristics of the measured surface.

Emissivity is a technical term used to quantify the amount of energy emitted from a surface relative to its theoretical maximum for a given temperature. In general, most materials and applications exhibit a high and constant emissivity that reflects "near blackbody" conditions. For these applications, a single-wavelength sensor is recommended. However, for most metal applications where the surface emissivity is lower and can vary, the dual- and multi-wavelength sensors are recommended.

With a complete selection of single-, dual-, and multi-wavelength sensors, Williamson can provide the system that best meets the required level of accuracy, repeatability, and reliability for each application. The table below highlights Williamson's unique capabilities to effectively compensate for emissivity and to out perform all others, particularly when measuring ferrous and nonferrous metals.



Surface Emissivity Characteristics

Temperature Application	Recommended Sensor Design & Models	Unique Capability
Most Ferrous Metal Applications Which Exhibit Greybody Conditions	**Below 500˚F (250˚C)** 1λ Single Wavelength TempMatic 4200 Series FiberView 5200 Series	These sensors provide greater accuracy and repeatability for low emissivity applications at temperatures as low as 125˚F (50˚C). With infrared filtering in the 2 micron range, errors due to changes in emissivity are minimized or eliminated. While the **Patented Auto Null Design** eliminates noise and calibration drift often associated with this type of sensor.
	Above 300˚F (150˚C) 2λ Dual Wavelength TempMatic 8000 Series FiberView 9000 Series	These **High-Performance Dual-Wavelength Sensors** provide greater accuracy and repeatability on metal applications with emissivity variance and temperatures over 300˚F (150˚C). With an exceptionally high signal dilution factor, these sensors outperform all other ratio sensors.
Most Nonferrous Metal Applications Which Exhibit Non-Greybody Conditions	**Above 400˚F (200˚C)** Mλ Multi Wavelength TempMatic 12200 Series FiberView 12200 Series	With a Patented **Multi-Wavelength Design**, these sensors provide accurate and repeatable measurements of nonferrous metals such as aluminum, copper, brass, and zinc. This capability is a Williamson exclusive that combines multi-wavelength hardware with a blending algorithm specifically developed for these difficult materials.

Cover Photo Courtesy of Inductoheat

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Unequaled Performance For Difficult Applications

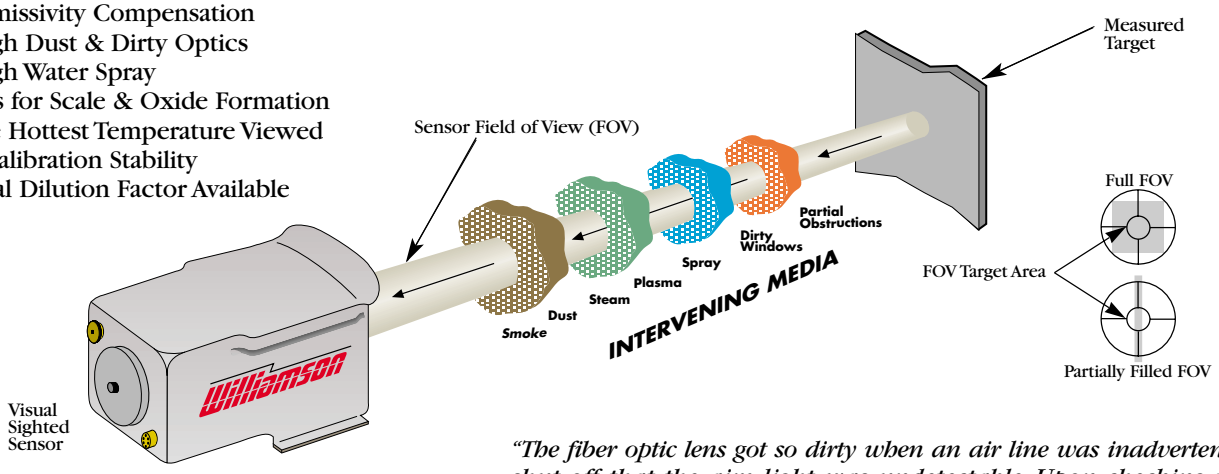
Williamson's 8000 and 9000 Series dual-wavelength sensors offer unique capabilities to meet the challenges of demanding heat processing applications. With the unique single detector design, these sensors offer a higher signal dilution factor that enables them to outperform all other ratio sensors. Specifically, this feature enables the Williamson sensors to operate properly when the target energy signal is diluted over 99%. Some typical heat treating application issues that dilute a target energy signal are a low surface emissivity, dirty optics, scale, water spray, small targets or any combination of these conditions.

MAXIMUM SIGNAL DILUTION FACTOR VALUES

	Ratio Sensor	Typical Ratio
Williamson Sensors	8100/9100 8200/9200 8300	1500:1 500:1 100:1
Competitive Sensors	Two Color Design	25:1

Dual-Wavelength Features

- Automatic Emissivity Compensation
- Views through Dust & Dirty Optics
- Views through Water Spray
- Compensates for Scale & Oxide Formation
- Measures the Hottest Temperature Viewed
- Long-Term Calibration Stability
- Highest Signal Dilution Factor Available



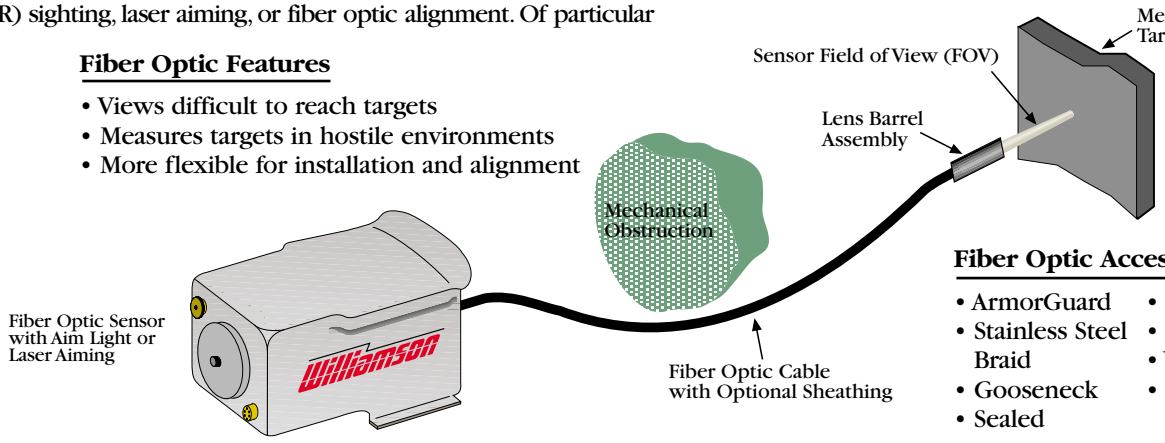
"The fiber optic lens got so dirty when an air line was inadvertently shut off that the aim light was undetectable. Upon checking the calibration with the dirty lens, I was amazed to find the reading still within 5 °F of the blackbody source." (John Olmsted—Stelco Steel)

More Durable Sensors, Easier Installation, and Less Maintenance

Through the use of innovative infrared technology, robust sensor design, and creative mounting and installation techniques, Williamson has made it simpler and easier to install and maintain its sensors. Each sensor is available in a system configuration with a remote display or as a stand alone sensor with a 4-20mA output. In addition, each sensor is available with either visual (SLR) sighting, laser aiming, or fiber optic alignment. Of particular interest, the fiber optic design of the FiberView Series provides greater durability and flexibility for sensor installations. These fiber optic sensors are used for measurements within confined spaces or severe environments, and they include a wide selection of fiber optic accessories to customize each system.

Fiber Optic Features

- Views difficult to reach targets
- Measures targets in hostile environments
- More flexible for installation and alignment



Fiber Optic Accessories

- ArmorGuard
- Stainless Steel Braid
- Gooseneck
- Sealed
- Monofilament
- Bifurcated Cables
- Vacuum Bushings
- Light Pipes

Improving Quality and Productivity Through

Heat Processing Temperature Applications

There are a wide range of industrial heat processing applications that can benefit from real time, noncontact temperature measurement and control. These applications vary by:

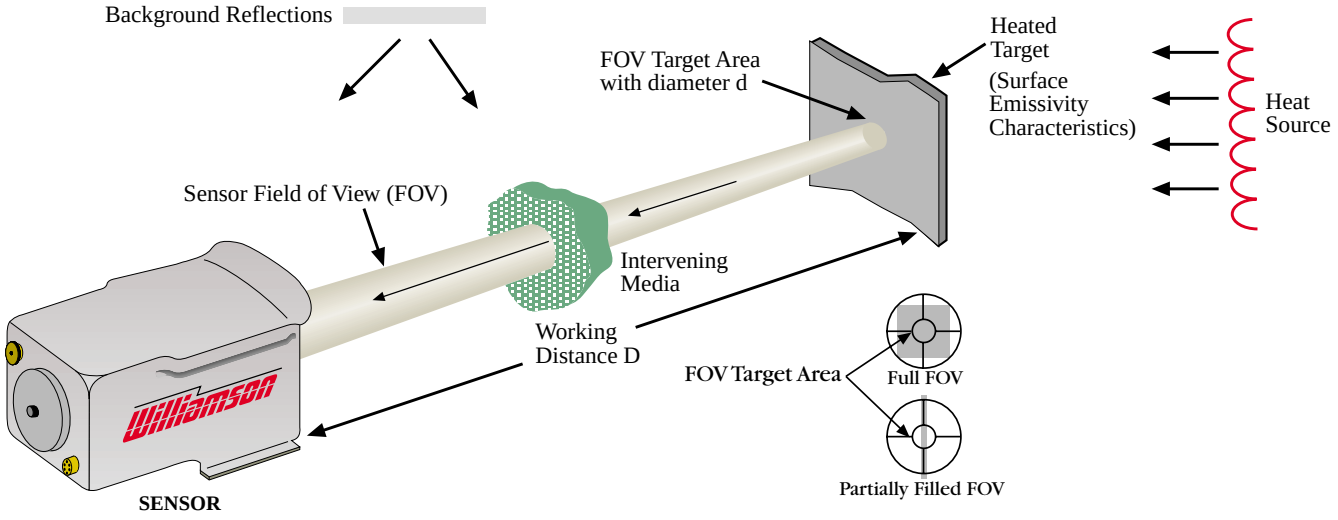
- **The heated material:** ferrous and nonferrous metals, glass, graphite, ceramics, paper, plastics, or aggregate
- **The heat source:** furnaces, ovens, kilns, infrared heaters, induction/resistance systems, flames, plasma, or lasers
- **The heating process:** batch, continuous, reheating, tempering, hardening, coating, laminating, soldering, welding, bonding, annealing, vacuum chamber, or brazing.

These heating operations are typically performed to change the shape, microstructural characteristics or mechanical and physical properties of a material. The process is either controlled based on time, power, and other factors, or by temperature measurement with contact thermocouples or noncontact temperature sensors.

For the most accurate and repeatable results, noncontact temperature sensors are recommended for direct measurement and control. When it is difficult to produce a repeatable temperature from part to part, closed-loop temperature control is critical to achieve consistent quality results. For a heating process with repeatable results, the sensors are used as a setup tool for new jobs and for quality assurance to document process temperatures. Specific quality and process benefits include:

- Improved consistency of product quality with instantaneous feedback of operating parameters
- Increased process productivity and repeatability through optimal process monitoring and control
- Cost savings through reduced scrap and improved energy and operating efficiency
- Minimized down time through increased equipment life.

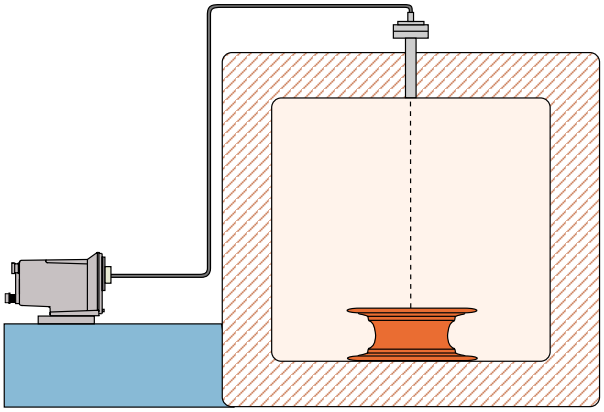
Sensor Selection Guidelines



Despite the wide range of industrial heat processing applications, the sensor selection process is simplified by focusing on a few standard application requirements and sensor features.

APPLICATION REQUIREMENTS	**Process Characteristics** • target material & emissivity • type of heat source • process temperature range • required measurement accuracy • intervening media • process response time	**Alignment** • type of access/view of target • size of the measured target • small, moving, or obstructed target • sensor distance from target • importance of alignment verification	**Installation & Maintenance** • surviving hostile ambient conditions • eliminating background reflections • eliminating effects of EMI • access to the sensor for maintenance
SENSOR FEATURES	**Model** • single, dual, or multi wavelength • temperature range • wavelength/spectral response • display, alarm, and control options	**Field of View** • sighting: line of sight, visual aiming, or fiber optic • FOV: spot size @ working distance • alignment verification: visual aiming, laser aiming, aim light, or viewing tube	**Accessories** • protective accessories: air purge and water cooling • installation accessories: mounting brackets and flanges

BATCH HEATING



1λ Furnace Measurements

"For several applications, the Williamson sensors have successfully compensated for emissivity and background interferences where other brands have failed."
(Jack Stewart—Thermation, Inc.)

Temperature Application Highlights

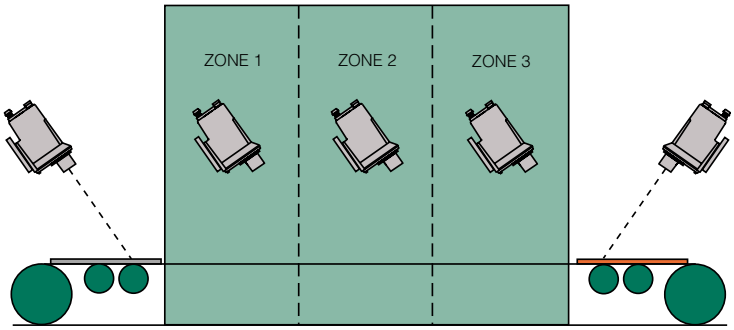
With a batch heating process, the product is heated to a setpoint temperature and held there for a period of time or removed immediately for further processing. To efficiently produce a quality product, it is important to accurately track the product temperature to the setpoint. When selecting a sensor, alignment and durability are important considerations depending on the product's positioning inside the furnace and the location of the sensor in the process.

Solution

Single-wavelength sensors are most often recommended for batch heating applications because the system geometry tends to reduce the sensitivity to emissivity variance at or near the process setpoint. Fiber optic sensors are often used to simplify the sensor installation and to eliminate requirements for water cooling the sensor in high ambient temperatures. When verification of sensor alignment is required, the visual sighted 4000 series, laser aiming, built-in aim light, or viewing tube options may be selected.

When heating with quartz lamps or exposed electric heating elements, single-wavelength sensors filtered at wavelengths longer than 4.8 microns are generally used to eliminate the interference of reflected energy.

CONTINUOUS HEATING



1λ In Zone Measurements
2λ Mλ Entrance and Exit Measurements

"By replacing our thermocouples with temperature sensors, we have obtained a more repeatable control process and eliminated significant maintenance requirements."
(Darrel Mendoza—Universal Alloys)

Temperature Application Highlights

With a continuous heating process, the product is heated as it passes along a conveyor, walking beam, or roller system. In this process, controlling product temperature uniformity is important because variations in the side-to-side temperatures as well as the thermal load can result in inconsistent product quality. For temperature process control, some systems use computer models or thermocouples, but for more accurate and repeatable results, infrared sensors are often used for direct in-zone control as well as furnace entrance and exit temperature measurements.

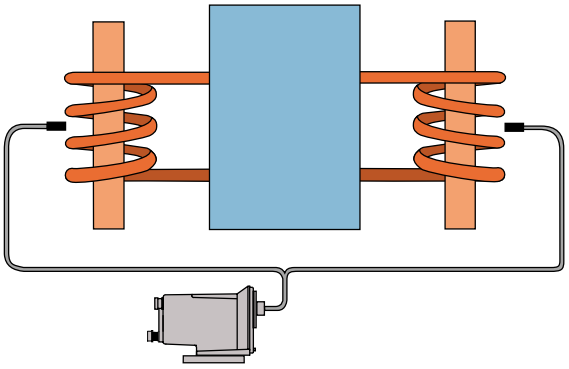
Solution

For metal applications, short-wavelength, single-wavelength sensors are used within the furnace to minimize sensitivity to emissivity variation, flames, and reflections from hot furnace walls. With furnace entrance and exit measurements, Williamson's high-performance dual-wavelength sensors are typically used to provide effective compensation for emissivity variance and the formation of scale and oxides. Fast response time and signal conditioning options are available for specific process control requirements.

When heating with quartz lamps or exposed electric heating elements, single-wavelength sensors filtered at wavelengths longer than 4.8 microns are generally used to eliminate the interference of reflected energy.

1λ Single Wavelength 2λ Dual Wavelength Mλ Multi Wavelength 2w Two Wire

INDUCTION, RESISTANCE & FLAME HEATING



2λ Measurements Greater than 300°F (150°C)
1λ Low Temperature Measurements

"The advanced technology employed by the Williamson sensors provides the confidence that control techniques developed in the lab will transfer smoothly to the production environment. The dual-wavelength systems have proven to be particularly robust under severe application conditions."
(Mike Wiezbowski—Chrysler Technology Center)

Temperature Application Highlights

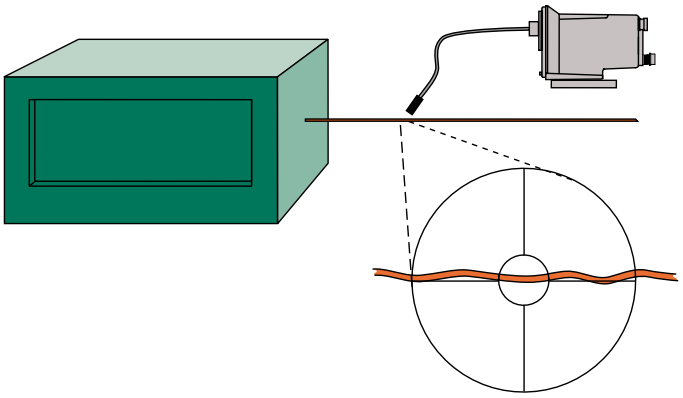
Induction, resistance, and flame heating systems are often used to accelerate heating rates for faster processing or to localize heating to a targeted area. With a rapid heating capability, precise temperature control is critical to achieve consistent quality results. Many systems are controlled based on time, power, and other factors, but when accuracy and repeatability are critical, infrared sensors are used for direct temperature measurement and control. When selecting a sensor, accuracy, response time, alignment, and durability are all important considerations. With flame applications, selection of the sensor wavelength is also critical.

Solution

Williamson's dual-wavelength sensors provide unequalled performance for induction, resistance, and flame heating applications. These high-performance sensors provide automatic alignment to the hottest temperature viewed as well as effective compensation for variations in emissivity, dirty optics, quench fluids, and surface oxidation or scale. Fiber optic sensors are often used for alignment with difficult to access targets, and a bifurcated fiber cable option can enable the measurement of two areas with one sensor.

For low temperature, low emissivity applications, Williamson offers innovative short-wavelength, single-wavelength sensors. The Auto Null design provides unequalled performance for these difficult applications.

HEAT PROCESSING FOR WIRE PRODUCTS



2λ Measurements Greater than 300°F (150°C)
1λ Low Temperature Measurements

"We evaluated several brands of infrared temperature sensors for our wire forming applications. The Williamson sensor was clearly the best performer and the only one able to measure the small wires"
(Howard Vormelker – General Electric Lighting)

Temperature Application Highlights

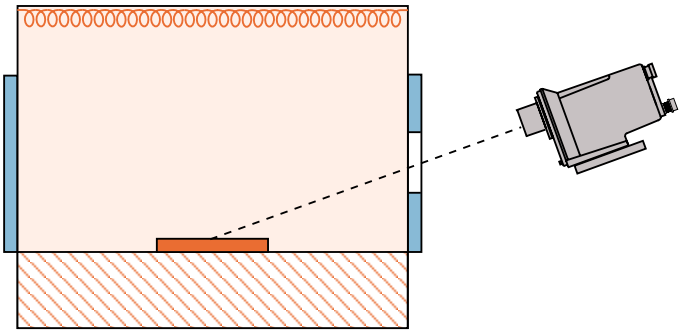
The typical thin wire process involves a small and moving metal target that is heated to obtain specific material properties. With each process, accurate temperature measurement and control is critical to efficiently produce a consistent quality wire product. The small diameter and motion of the target create unique challenges for any temperature control system, but with Williamson's innovative capabilities and the proper selection of the sensor optics, it is possible to obtain accurate and repeatable results on wires smaller than .001 in (.0254 mm).

Solution

Williamson's dual-wavelength sensors provide unequalled performance for temperature measurement and control on wire applications. These high-performance sensors provide automatic alignment to the hottest temperature viewed as well as effective compensation for variations in emissivity, dirty optics, and surface scale. A relatively large sensor target area also allows the wire to wander in the process without leaving the sensor's field of view.

For low temperature, low emissivity applications, Williamson offers innovative short-wavelength, single-wavelength sensors with an Auto Null design that provides unequalled performance for these difficult applications. With these installations small spot optics or fiber optics are used to insure that the sensor's field of view is completely filled by the measured target.

VACUUM CHAMBERS



2λ Vacuum Chamber Measurements

"Williamson's flexibility to select the wavelengths for its dual-wavelength sensors enables us to measure substrate temperatures through a high energy plasma field."
(Roy Gat—Applied Science & Technology)

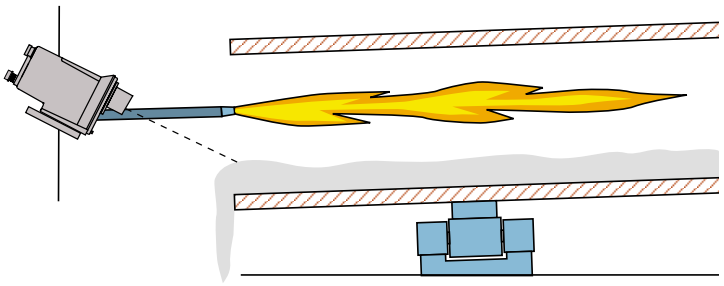
Temperature Application Highlights

There are many unique procedures with metal, ceramic, and semiconductor substrates that require the use of a vacuum chamber. Typically these procedures are used to change and enhance the characteristics of the material and can involve a variety of heating techniques ranging from lasers, various plasmas, and magnetic fields. Common examples of these procedures include Ion Nitriding for the hardening of metals, and Chemical Vapor Deposition for the coating of substrates. Due to the complexity of these procedures, temperature process control is often critical and requires careful selection of the proper temperature sensor.

Solution

Williamson's high-performance dual-wavelength sensors are frequently used to provide unequalled performance for accurate and repeatable temperature measurements on vacuum chamber applications. These unique sensors provide automatic alignment to the hottest temperature viewed as well as effective measurements when viewing through a dirty window or plasma or when measuring a surface with varying emissivity. Measurements can be made through a window or from within the chamber using a fiber optic vacuum bushing option.

ROTARY KILNS



2λ Measurement Through Dust and Smoke
1λ Measurement Through Flames

"The 8000 system on our lime kiln provides very accurate and stable temperature measurements in a very hostile operating environment."
(Jens Hammarstrom, Partek Nordkalk)

Temperature Application Highlights

Rotary Kilns are commonly used for heat processing of minerals and aggregates such as lime, cement, and iron ore. To achieve consistent quality results, it is important to maintain a uniform product temperature at the kiln entry, mid zone, and discharge. In most rotary kilns, the challenge with temperature process control is that the temperature sensor must view through flames or heavy smoke and dust. Consequently, when selecting a sensor, the design, wavelength, and alignment are all important considerations.

Solution

Williamson's high-performance dual-wavelength sensors offer unequalled performance for accurate and repeatable measurements on kiln applications. These sensors can operate properly when the target energy signal is diluted over 99% by such things as dust and smoke. To effectively measure targets through flames, the 1400 and 4400 Series are recommended. These single-wavelength sensors utilize a very narrow band 3.8 micron filter that provides unequalled performance with measurements through flames. Common process measurements include:

- Hot Clinker Detection — 1λ 2w
- Product Discharge Temperature — 2λ 1λ 2w
- Product Entry Temperature — 2λ
- Mid-Zone Temperature — 1λ
- Combustion Gas Temperature — 1λ 2λ
- Kiln Shell Hot Spot Detection — 1λ 2λ

1λ Single Wavelength 2λ Dual Wavelength Mλ Multi Wavelength 2w Two Wire

Commitment to Innovative Technology, Application Expertise and Quality Service

For over 50 years, Williamson has been in the business of improving process control and product quality through non-contact temperature measurement. Through a worldwide distribution network, we offer a comprehensive line of industrial temperature sensors as well as several innovative technologies for applications considered difficult to measure. With extensive application experience focusing on solving customer problems, we are committed to providing quality service and support that is essential for building long-term customer partnerships.

This commitment includes:

- listening and working with our customers to provide the best possible solution for each application
- developing customized solutions for unique requirements
- providing knowledgeable and timely support before, during and after each sale.

Please contact us for more information about our products and unique capabilities. We would be pleased to provide the requested information and to discuss your specific application.

WILLIAMSON SENSOR SELECTOR GUIDE

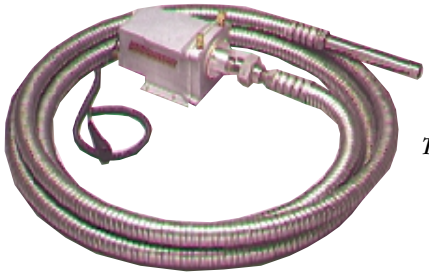
Single Wavelength 1λ

MODELS:

- 2w *TransTemp 1000 Series*
- 2w *FiberView 1100 Series*
- *TempMatic 4000 Series*
- *FiberView 5000 Series*

TEMPERATURE LIMITS:
-50 - 4500˚F
-45 - 2500˚C

Designed for use in many general purpose applications where surface emissivity is reasonably constant, Williamson's single-wavelength sensors offer broad temperature and infrared spectral response selections and a variety of optical options. Low temperature fiber optic sensors, small spot optics, and distant optics with visual or laser aiming are available to meet specific application requirements. The short wavelength 4200 and 5200 Series with the Auto Null Technology are excellent for low temperature, low emissivity applications. The Transtemp 1000 and FiberView 1100 Series also offer single-wavelength capabilities in a convenient and cost-effective two-wire transmitter configuration.



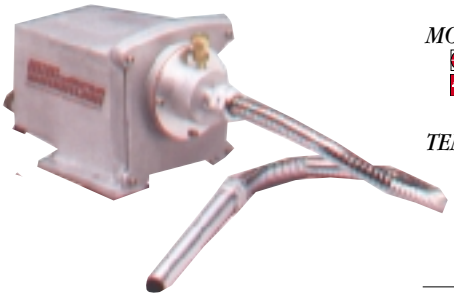
Dual Wavelength 2λ

MODELS:

- *TempMatic 8000 Series*
- *FiberView 9000 Series*

TEMPERATURE LIMITS:
300 - 4400˚F
150 - 2425˚C

These dual-wavelength sensors are designed for difficult to measure materials and hostile operating environments where single-wavelength sensors have limited effectiveness. Dual-wavelength sensors provide automatic compensation for low and varying emissivity of greybody surfaces as well as for interference from smoke, steam, heavy scale, dirty windows, water spray, or dust. These sensors also measure the hottest temperature in the Field of View and are effective for stream, flame, and wire measurements. The unique, single detector design offers an exceptionally high signal dilution factor and drift-free calibration stability for maximum performance with demanding applications.



Multi Wavelength Mλ

MODELS:

- *TempMatic 12200 Series*
- *FiberView 12200 Series*

TEMPERATURE LIMITS:
400 - 2000˚F
200 - 1100˚C

This patented, multi-wavelength sensor is designed specifically for measuring difficult surfaces like aluminum, copper, brass, and zinc, as well as galvannealed steel. The sensor uses multi-wavelength hardware and a unique blending algorithm that was developed based on the non-greybody surface characteristics of these materials. This innovative technology provides non-contact temperature measurement and control accuracy never before achieved with applications involving these non-ferrous metal materials.

2 Year Warranty on All Sensors

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