Annealing Line Application Overview

Temperature Control on Annealing Lines

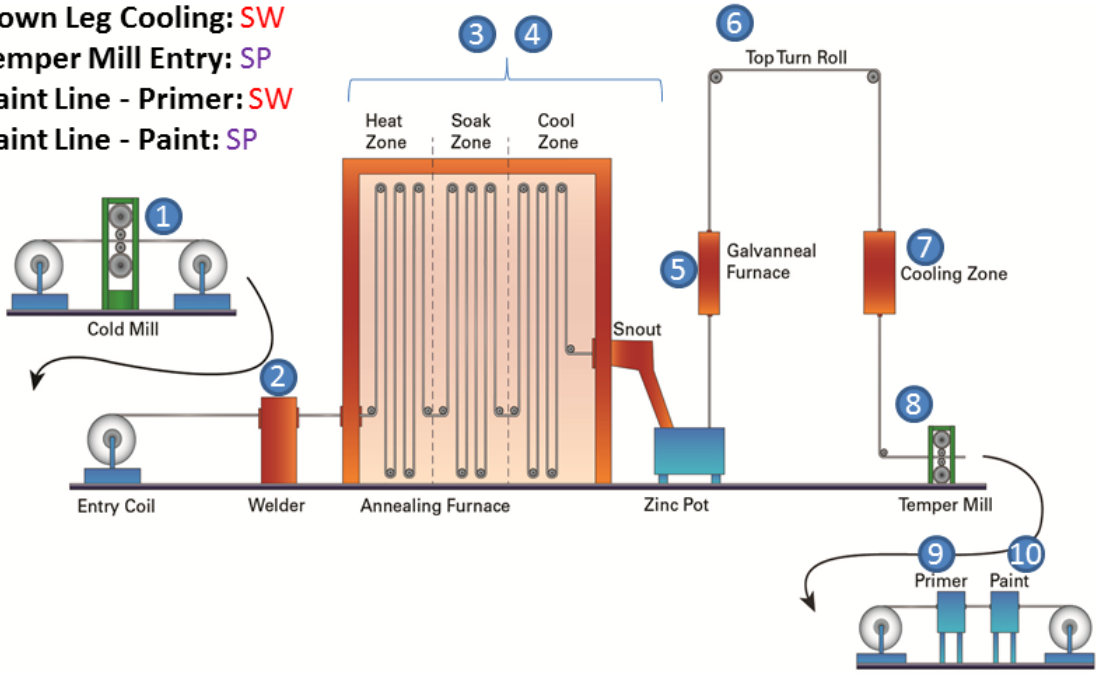
Steel consumers and competitive market conditions are driving steel mills to produce higher quality products more cost effectively. In order to meet these demands, steel mills must implement better controls to manage the temperature and surface character of the steel strip during the annealing process.

In the annealing process, a controlled time-temperature relationship is important to obtain the desired mechanical properties of the steel strip. Temperature variations can result in unacceptable mechanical properties, while side-to-side or top-to-bottom temperature gradients cause product inconsistencies. Non-uniform strip temperatures also adversely impact quality requirements downstream.

Williamson Wavelength Technologies

With 6 unique Wavelength technologies, Williamson can make accurate temperature measurements at every point along the annealing line – compensating for common problems like 1) Low and Variable Emissivity 2) Temperature gradients 3) Steam 4) Hot Wall reflections

1. **Cold Mill:** SW
2. **Welder:** DWF
3. **Annealing Furnace Wedge:** SW or DW
4. **Annealing Furnace Direct View:** MW
5. **Galvanneal Furnace:** MW
6. **Top Turn Roll:** MW or SW
7. **Down Leg Cooling:** SW
8. **Temper Mill Entry:** SP
9. **Paint Line - Primer:** SW
10. **Paint Line - Paint:** SP



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Cold Rolling Mill

Application Overview

Overheating steel as it is rolled affects the mechanical and dimensional properties of the steel and causes surface blemishes. Pyrometers are used to make sure the steel does not get too hot.

Williamson Wavelength Advantage

This can be a difficult measurement due to oil and steam, low emissivity surface and low temperatures. With thoughtful wavelength selection, the Williamson model SW-2A views clearly through oil and steam interferences and minimizes error due to emissivity variation.

Pyrometer Benefits

- Assure Desired Mechanical Properties
- Prevent Surface Blemishes
- Improve Dimensional Variation

Wavelength Technology

- Short-Wavelength (SW) Technology provides +/- 2 to 3°C accuracy
- Williamson's SW-2A wavelength views clearly through steam and tolerates oil films without interference.

Suggested Model

Traditional Configuration

- Pro SW-2A-30, 150-800°F / 65-425°C

Tolerates steam and oil, shield from reflected light

Pro Series

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Welder

Application Overview

The trailing edge of one coil is welded to the leading edge of the next to allow strip to be fed continuously through the coating or annealing line. A weld break stops production for an extended time. Therefore, assuring a quality weld is an important safeguard to assure high productivity. Current anomalies, pressure variance, impurities, misalignment and other weld inconsistencies all manifest themselves as a temperature variation. As a result, weld temperature is commonly used as a go / no-go indicator at the welder.

Williamson Wavelength Advantage

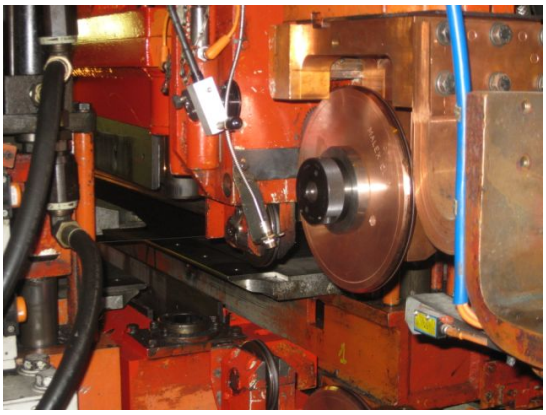
At the welder, consistent alignment to the small weld bead is the most important application attribute. Short-wavelength or two-color pyrometers must be configured to view a small spot and be precisely aligned to the critical hot spot. This makes it virtually impossible to achieve a consistent reading using these models as even the slightest change in alignment will change the reading. Dual-wavelength pyrometers are configured to measure the hottest temperature within a larger viewing area, making the dual-wavelength model virtually self-aligning and resulting in a highly reliable and repeatable measure of temperature.

Pyrometer Benefits

- Assurance of High Quality Weld
- Prevent Weld Breaks and Resultant Down Time
- Appropriate for In-Line Annealing

Wavelength Technology

- Dual-Wavelength Technology self-aligns to the hot weld seam



Suggested Model

Fiber Optic Configuration

- Pro DWF-12-15, 750-2500°F / 400-1375°C

Optical configuration should produce a spot size between 0.35-0.70in (9-18mm) in diameter.

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Continuous Annealing – Roller Wedge

Application Overview

Temperature of steel in the Continuous Annealing Line determines the customer desired mechanical properties, making temperature the most critical process parameter to monitor and control.

Williamson Wavelength Advantage

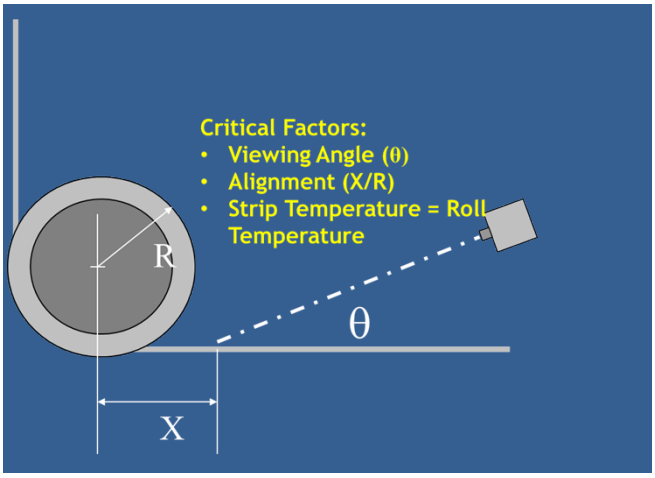
The roller wedge measurement is a popular technique for eliminating the influence of emissivity variation and background reflections. It is an appropriate technique whenever the strip and the roll are at the same temperature and when the pyrometer is properly positioned and aligned to the critical sweet spot. When the measurement conditions are invalid, then a false reading occurs. The Williamson dual-wavelength pyrometers self-align to the critical sweet spot and provide a measured emissivity value to indicate the validity of the measurement conditions.

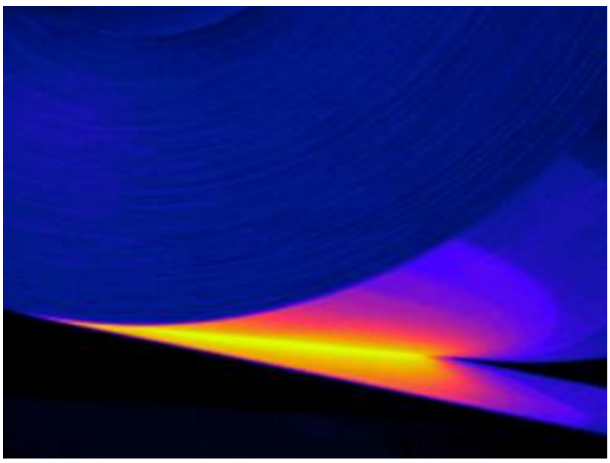
Pyrometer Benefits

- Accurate Temperature Values Assure Desired Mechanical Properties.
- Eliminates the Influence of Emissivity and Background Reflections

Wavelength Technology

- Dual-Wavelength technology self-aligns to the roller wedge sweet spot.
- Dual-Wavelength pyrometers include a real time measure of emissivity and infrared energy – confirming valid measurement conditions.





Suggested Models

Traditional Configuration

- Pro DW-12-10, 700-2100°F / 375-1150°C
- Pro DW-24-34, 500-1700°F / 260-925°C

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Continuous Annealing – Direct View

Application Overview

Temperature of steel in the Continuous Annealing Line determines the customer desired mechanical properties, making temperature the most critical process parameter to monitor and control.

Williamson Wavelength Advantage

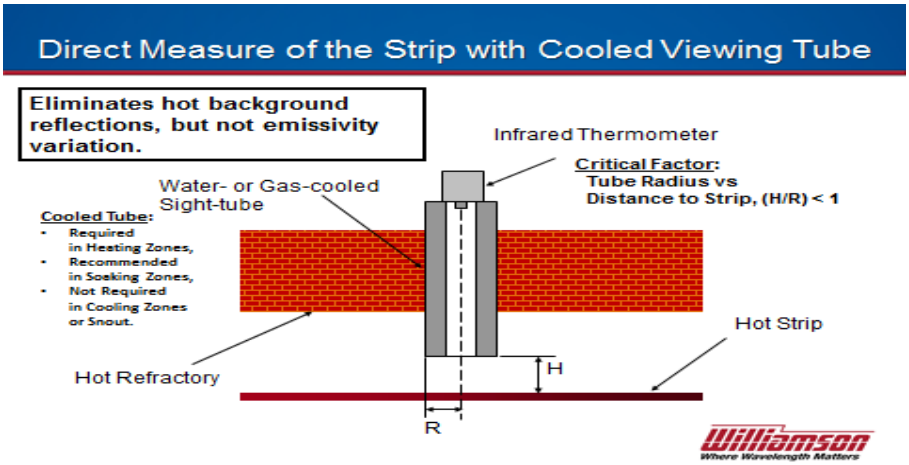
When a roller wedge measurement is impractical or inappropriate, then the direct view measurement technique is applied. For heating zones, a cooled viewing tube is required to eliminate hot background reflections. Cooled viewing tubes are not required for cooling zones. Because low-emissivity steel is a non-greybody material, a multi-wavelength pyrometer is needed to automatically compensate for the emissivity of the strip.

Pyrometer Benefits

- Accurate Measure of Temperature Assures Desired Mechanical Properties.
- Real-Time Measure of Emissivity allows for heating zone optimization through controlled oxidation.
- Real-Time measure of Emissivity provides validation of measurement conditions.

Wavelength Technology

- Multi-Wavelength Technology automatically corrects for non-greybody emissivity variation.
- Eliminates Errors due to emissivity variation and background interference.
- Twenty times less sensitive to warm wall reflections.
- Measures all steel alloys, including high-strength steels



Suggested Models

Traditional Configuration

- Pro MW-20-35, 575-1800°F / 300-980°C
- Pro MW-20-27, 400-1200°F / 200-650°C
- Pro MW-20-05, 300-900°F / 150-475°C

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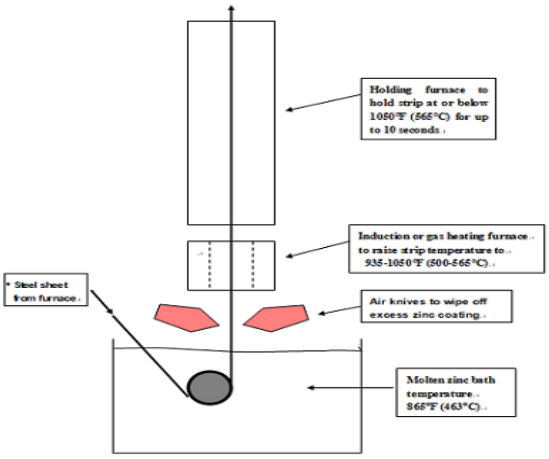
Galvanneal

Application Overview
Temperature control is critical to assure the desired coating, alloying and diffusion properties.

Williamson Wavelength Advantage
Traditional infrared pyrometers struggle with this application because the zinc-coated strip undergoes a dramatic emissivity variation, from about 0.1 to about 0.7, as it passes through the galvanneal process. The Williamson Multi-Wavelength pyrometer with application specific algorithms is designed specifically for this demanding application.

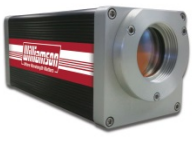
Pyrometer Benefits
- Assure desired product properties.
- Precision Feedback Temperature Control optimizes the process.
- Real-Time measure of Emissivity provides validation of measurement conditions.

Wavelength Technology
- Multi-Wavelength Technology automatically corrects for non-greybody emissivity variation.



Suggested Model
Traditional Configuration
- Pro MW-20-27, 400-1200°F / 200-650°C

Typically installed on the galvanneal furnace, using either a swivel bracket or a flange mount.



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Hot Dip Line – Top Turn Roll

Application Overview

The strip can be damaged (by pickup and surface marring) if it is hotter than about 650°F / 345°C as it crosses the top turn roll, and many plants are speed-limited by the temperature at this point.

Williamson Wavelength Advantage

Most coatings have an exceptionally low emissivity (0.08-0.12), but the emissivity of galvanneal is higher (0.7-0.8). Many infrared pyrometers are not able to tolerate this low and often variable emissivity condition, but Williamson Short-Wavelength and Multi-Wavelength models are ideal for this important measurement.

Pyrometer Benefits

- Prevent pickup and surface marring.
- Increase Line Speed
- Feed Real-Time Emissivity to downstream pyrometers (multi-wavelength model).

Wavelength Technology

- Short-Wavelength technology is 10 times less sensitive to emissivity variation compared to general purpose Long-Wavelength models.
- Multi-Wavelength technology automatically corrects for non-greybody emissivity variation and provides a real-time measure of emissivity.

Suggested Models

Best Configuration

- Pro MW-20-05, 300-900°F / 150-475°C

Alternative Configuration

- Pro SW-2A-30, 150-800°F / 65-425°C

SW sensor may be used successfully on lines that do not run galvanneal or that have the ability to feed a real-time emissivity value to the pyrometer

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Down Leg Cooling

Application Overview
Steel strip is cooled prior to delivery to the temper mill. Overcooling wastes energy and undercooling risks poor mechanical properties after the temper mill.

Williamson Wavelength Advantage
Steam is often present and the strip emissivity is low and variable. For this application it is also possible to receive an emissivity input from a Multi-Wavelength unit measuring at the top turn roll.

Pyrometer Benefits
- Conserve Energy
- Assure Desired Mechanical Properties

Wavelength Technology
- Short-Wavelength (SW) technology minimizes errors of low-emissivity strip.
- The SW-2A wavelength tolerates steam without interference.

Suggested Model
Traditional Configuration
- Pro SW-2A-30, 150-800°F / 65-425°C
Views through steam

Pro Series

Temper Mill Entry

Application Overview

Strip temperature is a key process parameter at the temper mill. If the strip is above about 120°F / 50°C, then the temper mill may not produce the desired mechanical properties.

Williamson Wavelength Advantage

Because the strip is highly reflective and at a near-ambient temperature, Long-Wavelength pyrometers are more influenced by the reflected background temperature than by the temperature of the strip. The shorter PG wavelength set significantly reduces this background reflection interference problem.

Pyrometer Benefits

- Assure Desired Mechanical Properties and Surface Hardness

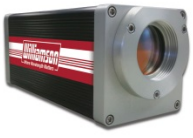
Wavelength Technology

- The Specialty-Wavelength model SP-PG eliminates excessive sensitivity to reflected background temperature.

Suggested Model

Traditional Configuration

- Pro SP-PG-13, 85-600°F / 30-315°C



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Paint Line

Application Overview

Various coatings, including dry lube, oil, clear acrylic, primer and a wide range of opaque coatings, are applied to steel strip in order to protect the metal and provide value-added benefits to consumers. Temperature control at the paint line is needed to ensure proper adhesion of the paint to the steel. Additionally, accurate temperature measurement assures consistent product color and curing speed.

Williamson Wavelength Advantage

Depending on the strip coating, the emissivity of the strip can vary dramatically, which complicates the strip temperature measurement. Due to the possibility of optical interference patterns, Two-Color, Dual-Wavelength and Multi-Wavelength technologies are not compatible with thin coatings. Instead, careful wavelength selection is used to optimize measurement accuracy.

Pyrometer Benefits

- Improved Process Quality
- Lower Energy Costs

Wavelength Technology

Uncoated and Primer-Coated Strip

- Short-Wavelength Technology minimizes measurement errors.
- Williamson's unique SW-2A wavelength views clearly through primer and transparent coatings.

Coated Strip

- Emissivity is highest and most stable using Specialty Wavelength Set PG

Suggested Models

Uncoated Strip and Primer-Coated Strip
- Pro SW-2A-30, 150-800°F / 65-425°C

Coated Strip
- Pro SP-PG-13, 85-600°F / 30-315°C

Chromate Passivation Drying Oven Exit
- Pro SW-29-08, 100-800°F / 40-425°C

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