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infrared
temperature
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APPLICATION Metal sheets

Temperature measurement of bright
metal sheets at low temperatures



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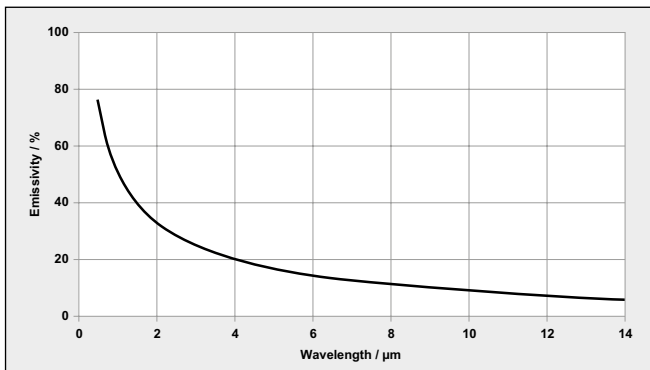


Non-contact temperature measurement of metal sheets



The measurement of metal sheets at low temperatures is still a challenging measuring task in the field of non-contact measurements due to the very low thermal radiation and the special radiation properties of metals.

For physical reasons only long-wave pyrometers with a spectral sensitivity of 8 - 14 μm can be used for measurements starting at room temperature. However, the emissivity of metals, i.e. the ability to emit thermal radiation, significantly decreases with a longer wavelength, which, in turn, increases the reflectivity of bright metals. Longwave instruments therefore capture mainly the reflecting radiation of the measuring environment and only to a lesser extent the sheet temperature itself. In addition, these devices are very sensitive to any pollution of their lenses. It is therefore recommended to use shortwave devices with a wavelength of approximately 2.4 μm for target temperatures starting at 75 $^{\circ}\text{C}$.



Emissivity of metals in relation to the wavelength

At the range beginning near a target temperature of 150 $^{\circ}\text{C}$ short-wave pyrometers are very sensitive to interfering radiation caused by artificial light or sunlight. The pyrometer detects both the infrared radiation of the measuring object and the amount of radiation of light reflected on the surface. The displayed value therefore is too high. The magnitude of the measuring error depends on the emissivity and the temperature of the metal sheets. To obtain a reliable measurement of the sheets at temperatures below 150 $^{\circ}\text{C}$ it is imperative to take measures to shadow the external radiation of daylight.

Multiple reflections in the coil gap

The emissivity of the galvanized sheet is < 20. Hence, 80 % of the heat radiation from the measuring environment is reflected from the surface and is detected by the pyrometer. In a coil gap the radiation of the sheet metal is reflected by the bright guide roller. This radiation is then again reflected by the sheet metal. The result is a multiple reflection attributable to the geometric arrangement in the coil gap. This leads to an artificial increase of emissivity (black body principle).

There are good conditions in the coil gap to measure the sheet temperature, as the improved radiation properties provide sufficiently



Measurement in the coil gap

strong thermal radiation. This also eliminates the influence of reflecting Interfering radiation.

Solution

Choosing the right pyrometer depends on the minimum sheet temperature at the respective measuring point. When you want to capture also temperatures below 75 $^{\circ}\text{C}$ you need a longwave pyrometer with a wavelength of 8 - 14 μm . In other cases, it is preferable to use the shortwave device (wavelength 1.8 - 2.4 μm) as it receives more radiant energy and is less sensitive to pollution. For temperatures up to approximately 150 $^{\circ}\text{C}$ shadowing measures are necessary to protect against extraneous light.

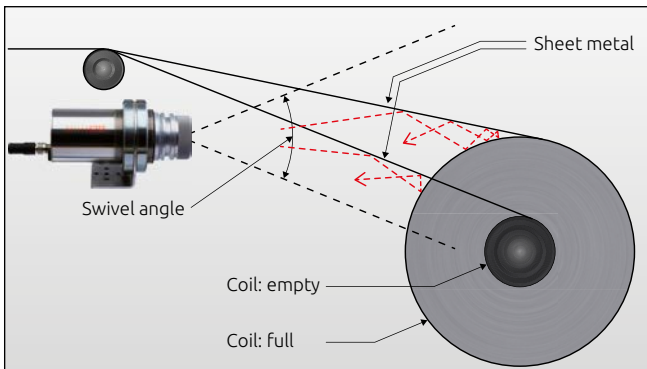
For measurements in the gap of a return roller, a pyrometer with high optical resolution is advantageous to measure from a safe distance into the coil gap. With varying positions of the gap - e.g. the position of the coil gap shifts with increasing coil diameters - an oscillating mirror is mounted in front of the pyrometer, which deflects the measuring spot periodically.



For the measurement, a pyrometer with laser sighting is recommended to detect the swivelling range and the speed and to adjust it optimally.

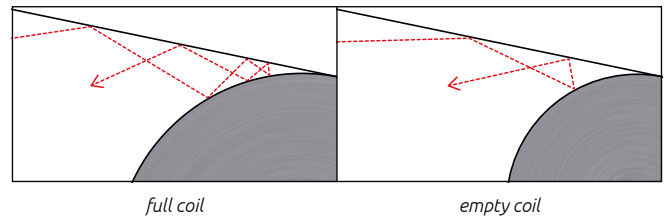
The pyrometer continuously scans the area of the minimum and maximum possible diameter. During an oscillating interval the measuring spot of the pyrometer also passes through the reeling gap and detects a signal peak at this position due to the good radiation properties.

This signal peak is detected by the peak picker which is integrated into the pyrometer. The measurement interval of the peak picker is selected according to the set swivel period. As a result, the varying signal becomes a continuous temperature value.



The correlations are as follows:

- The larger the coil, the narrower is the formed gap.
- The narrower the gap, the higher is the number of reflections.
- The higher the number of reflections, the higher is the artificial increase of the emissivity.
- The higher the emissivity, the higher is the temperature signal received by the pyrometer.



Consequently, a larger coil diameter can lead to higher temperatures of up to 3 K. If necessary, a control system can correct the measured value on the basis of the coil diameter.

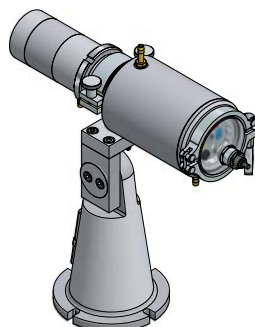
Measuring systems

Pyrometer	PA 10 AF 1/L	PA 28 AF 10/L
Sighting device	Laser spot light	
Measuring range	0 - 1000 °C	75 - 650 °C
Spectral range	8 - 14 µm	1.8 - 2.4 µm
Focal range	300 mm - ∞	
Distance ratio	50 : 1	48 : 1
Response time t_{98}	≤ 30 ms	≤ 200 ms (T > 75 °C) ≤ 50 ms (T > 100 °C) ≤ 15 ms (T > 125 °C) ≤ 2 ms (T > 200 °C)
Voltage supply	24 V DC +10% / -20%	
Analogue output	2 x 0(4) - 20 mA linear, scalable	
Switching output	2 x Open collector 24 V, ≤ 30 mA	
Admissible ambient temperature	0 - 65 °C	
Dimensions	Ø65 x 220 mm	
Housing material	Stainless steel	
Connection	M14 screw connection 8 poles	

Mounting assemblies

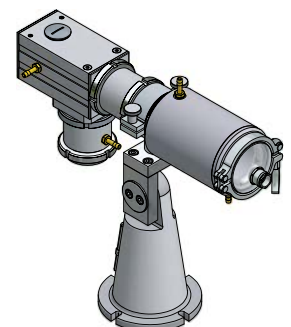
Mounting assembly PA 83-004, consisting of:

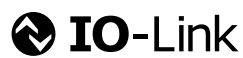
- Dust stop PZ 10/T
- Clamping collar PZ 20/L AF2
- Cooling jacket, closed PA 20/M AF1
- Pedestal mount PB 08/K AF2
- Axial air purge PZ 20/A
- Intermediate tube PZ 20/J



Mounting assembly PA 20-096, consisting of:

- Oscillating mirror PZ 20/X AF5
- Clamping collar PZ 20/L AF2
- Intermediate tube PZ 20/J
- Cooling jacket, closed PA 20/M AF1
- Pedestal mount PB 08/K AF2
- Mounting flange PZ 40/D
- Protective screen M62x0.75
- Axial air purge PZ 20/A





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