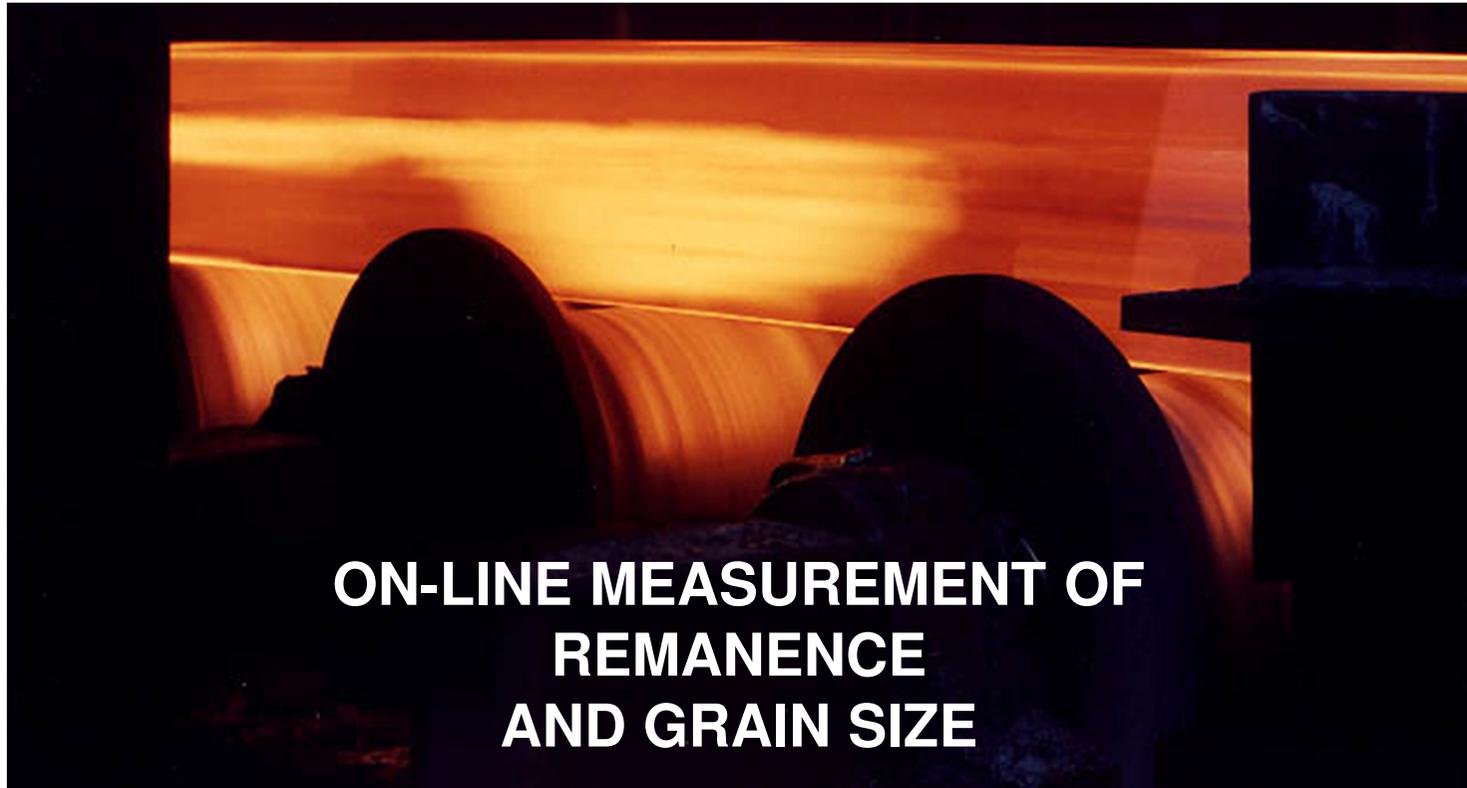


Measuring systems for cold rolling mills



**On-line annealing control improves efficiency
of continuous annealing lines**

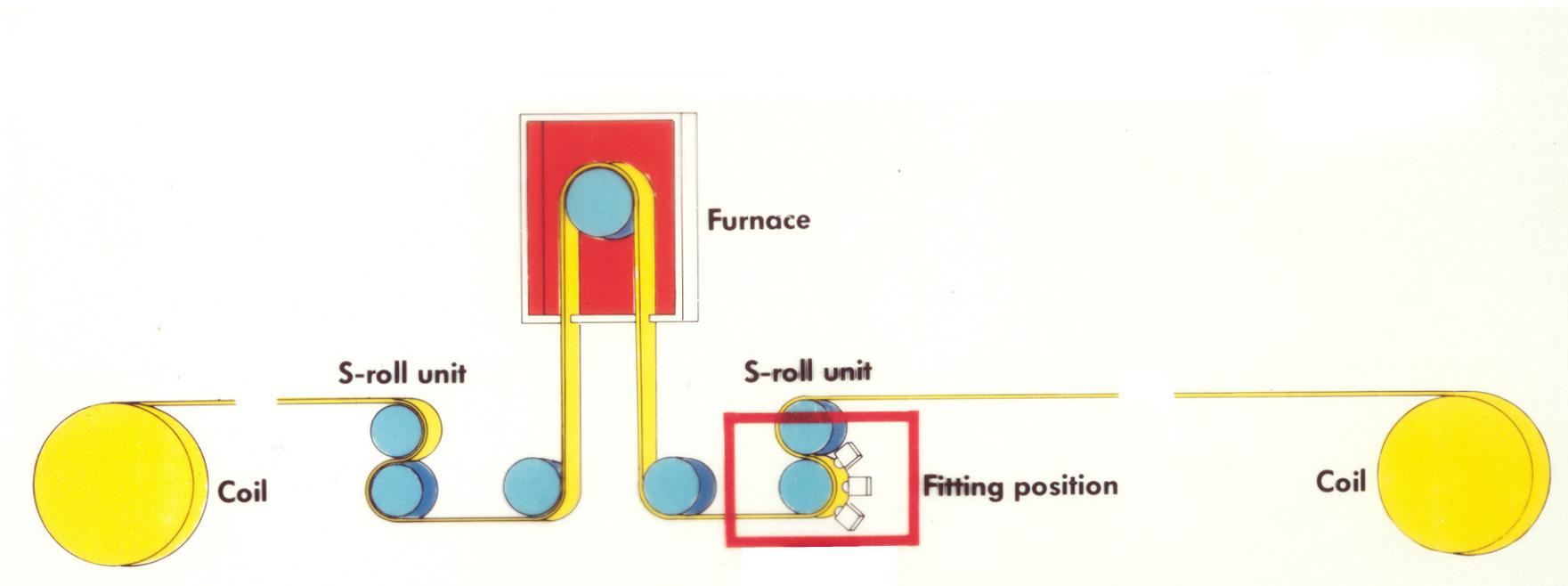


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On-line measurement in a continuous annealing line

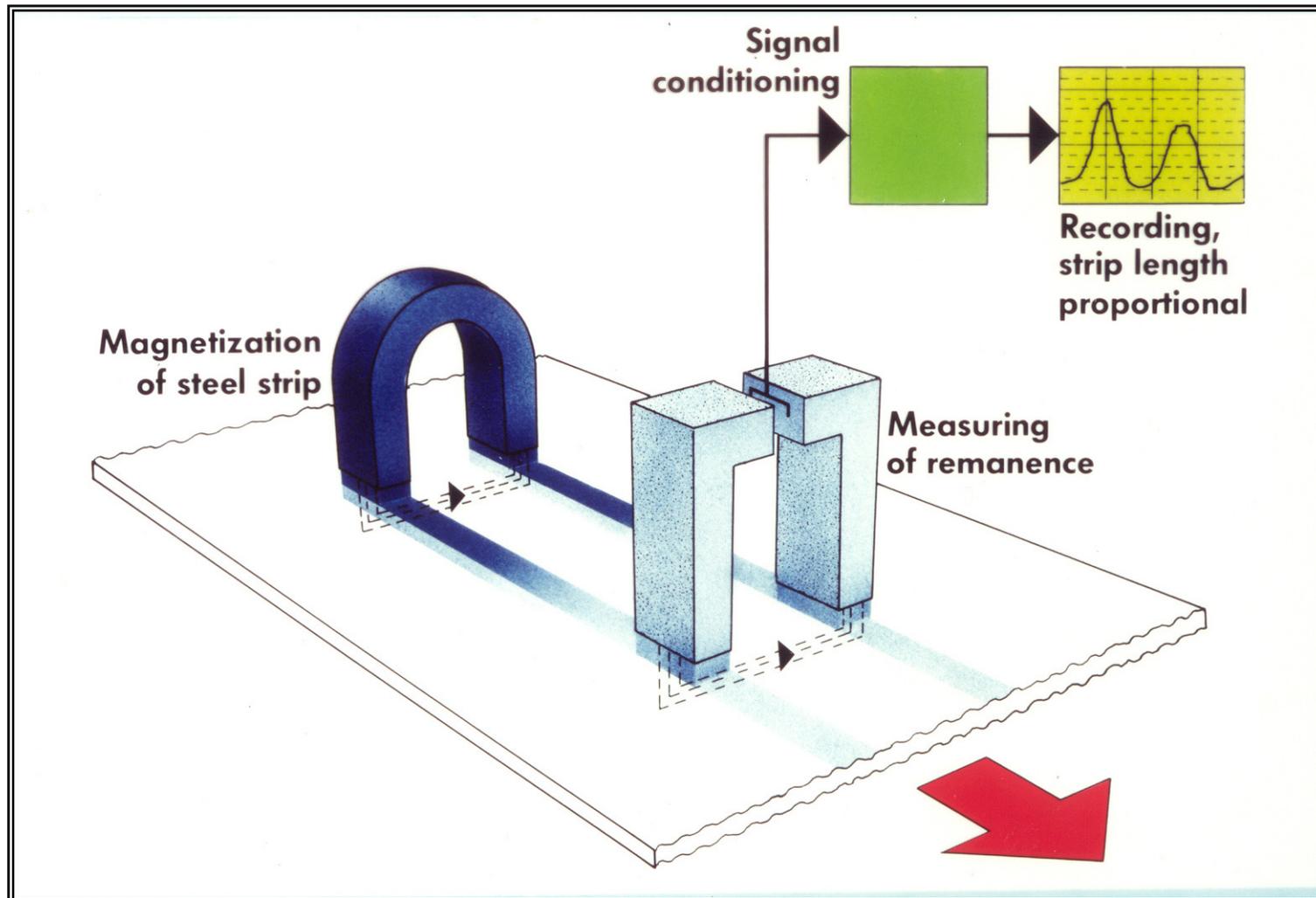


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Principle of remanence measurement

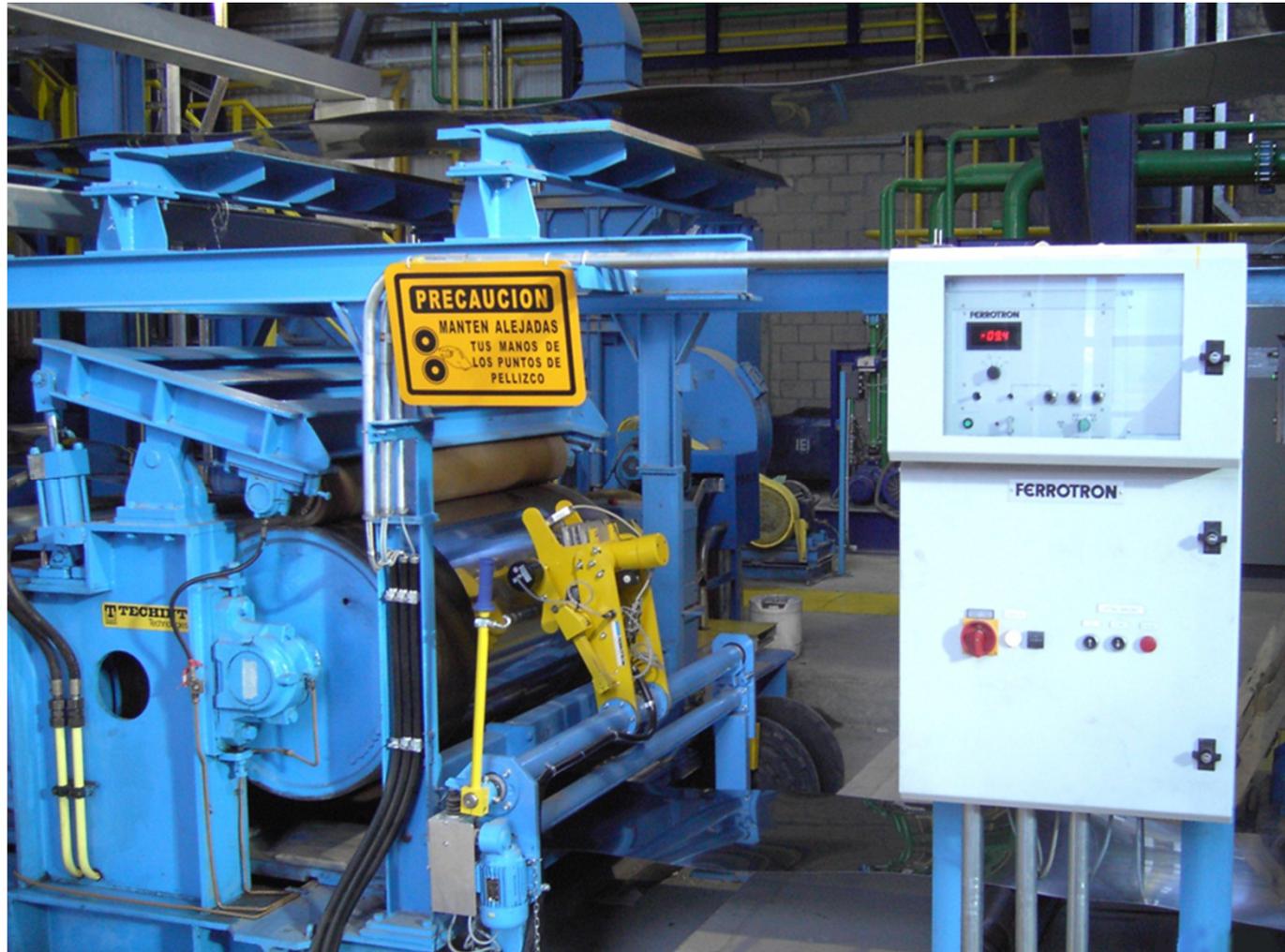


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Installation of a remanence system



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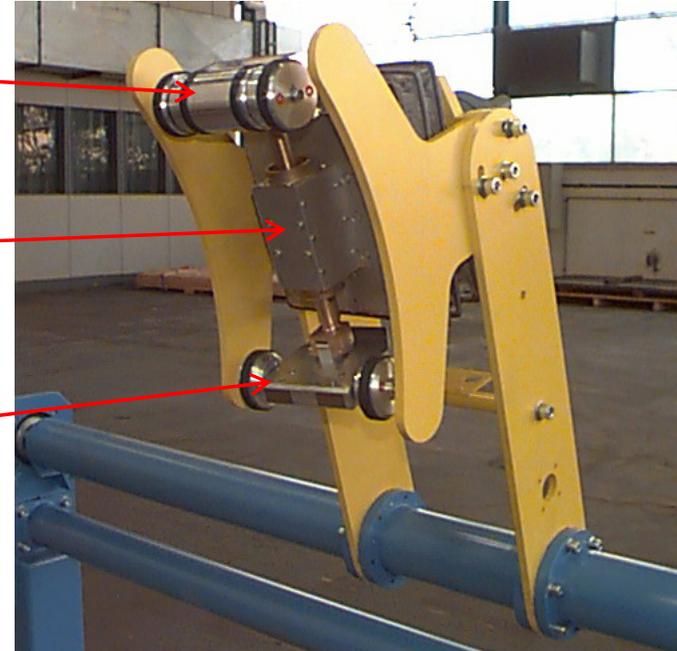
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Remanence head

Magnetizing roller

Lifting magnet

Measuring roller

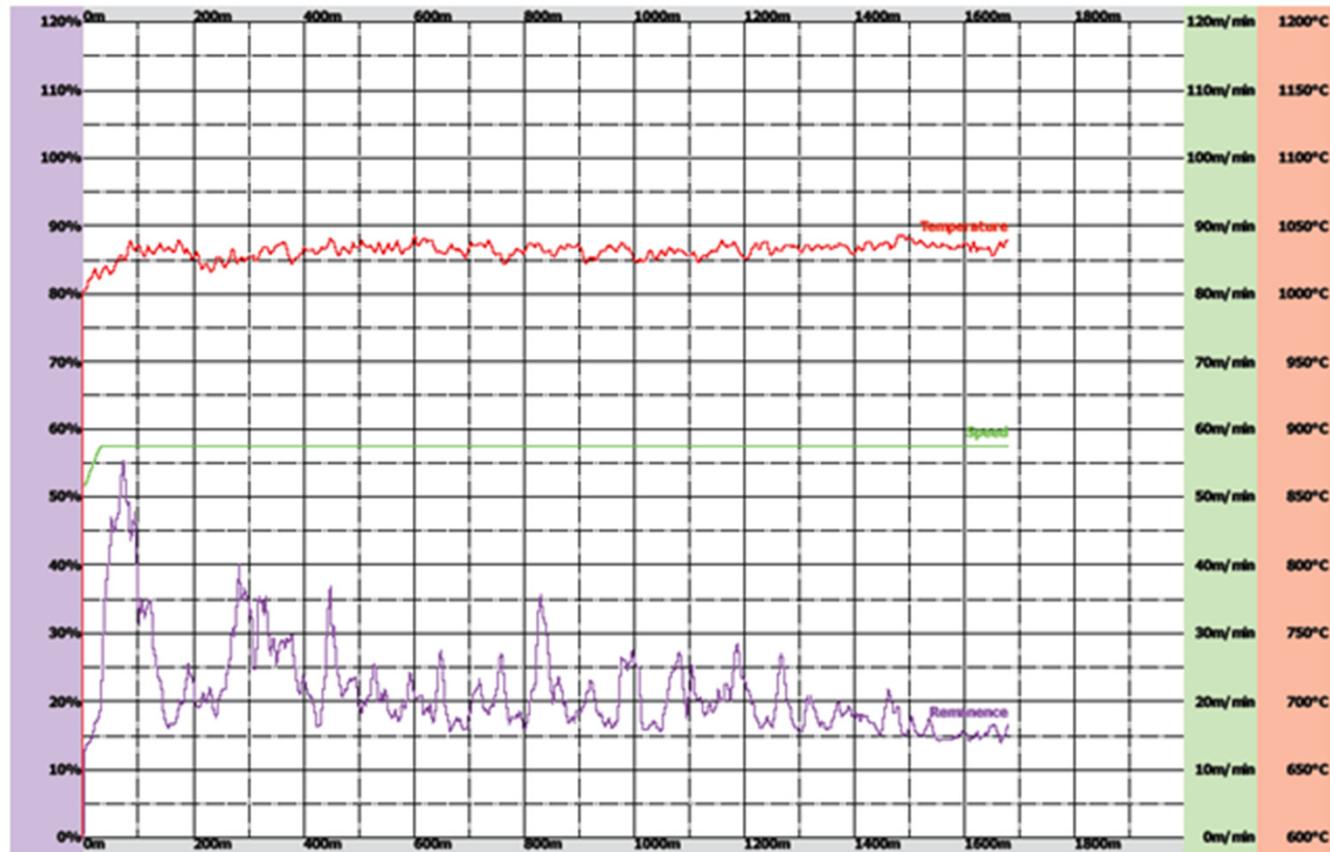


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Remanence record: badly annealed

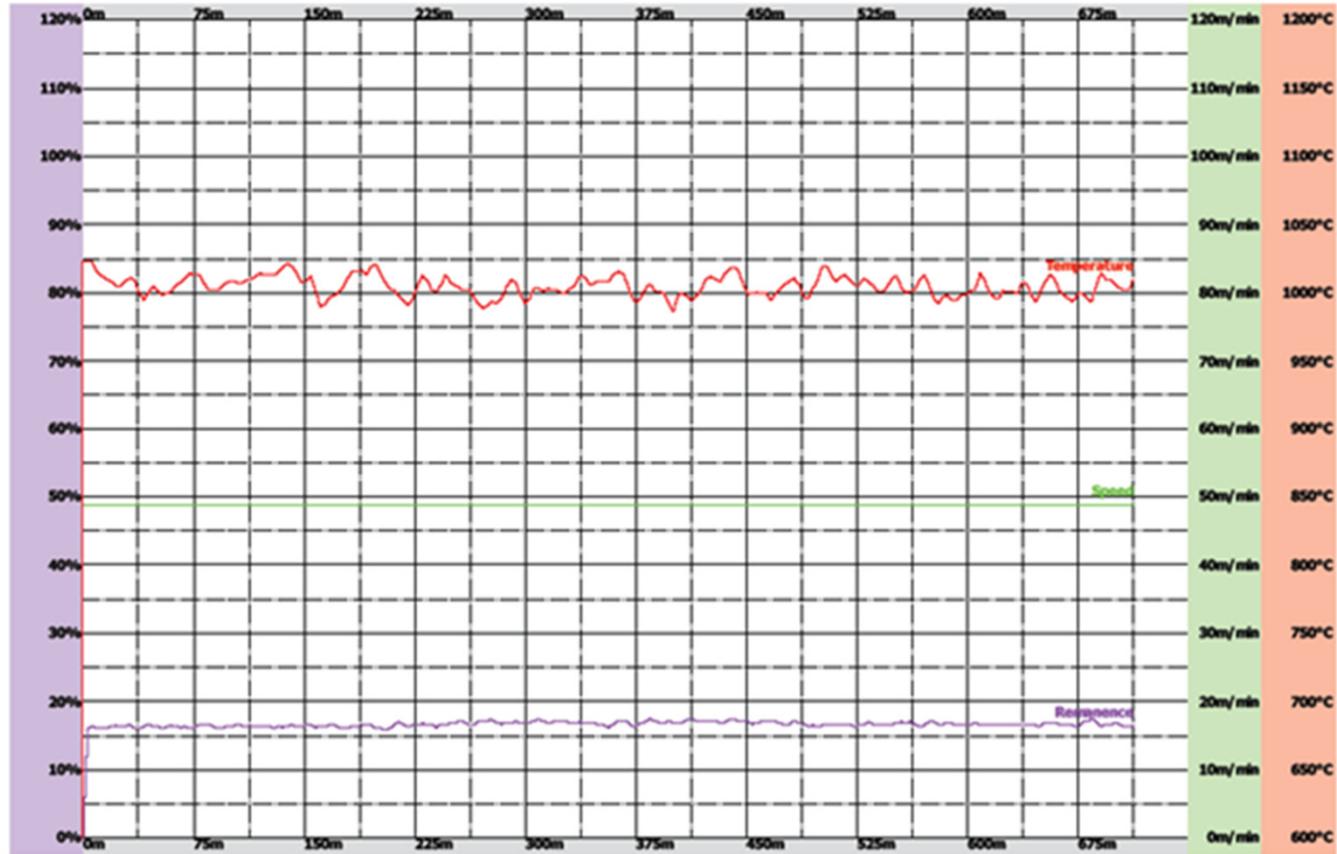


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Remanence record: well annealed

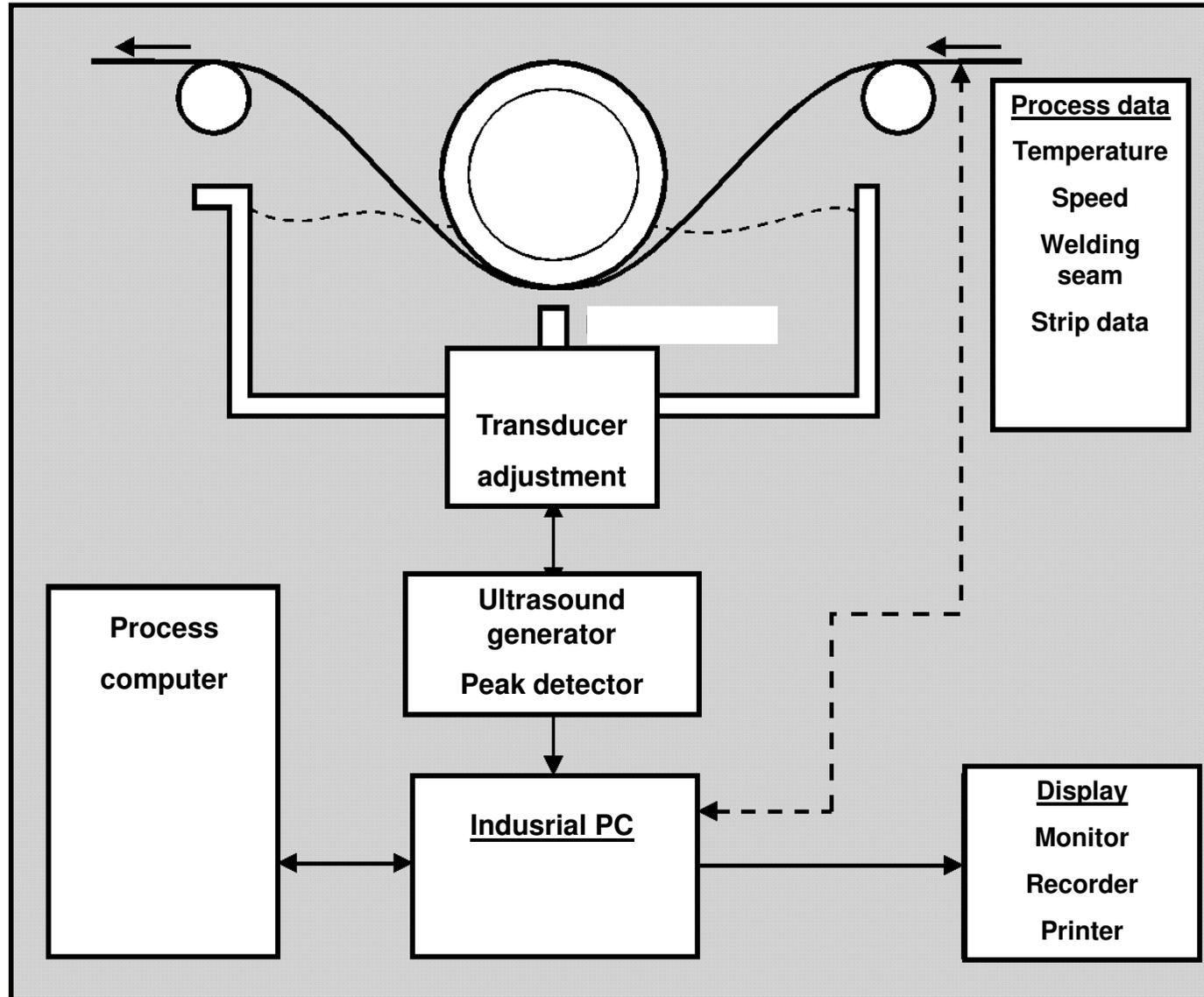


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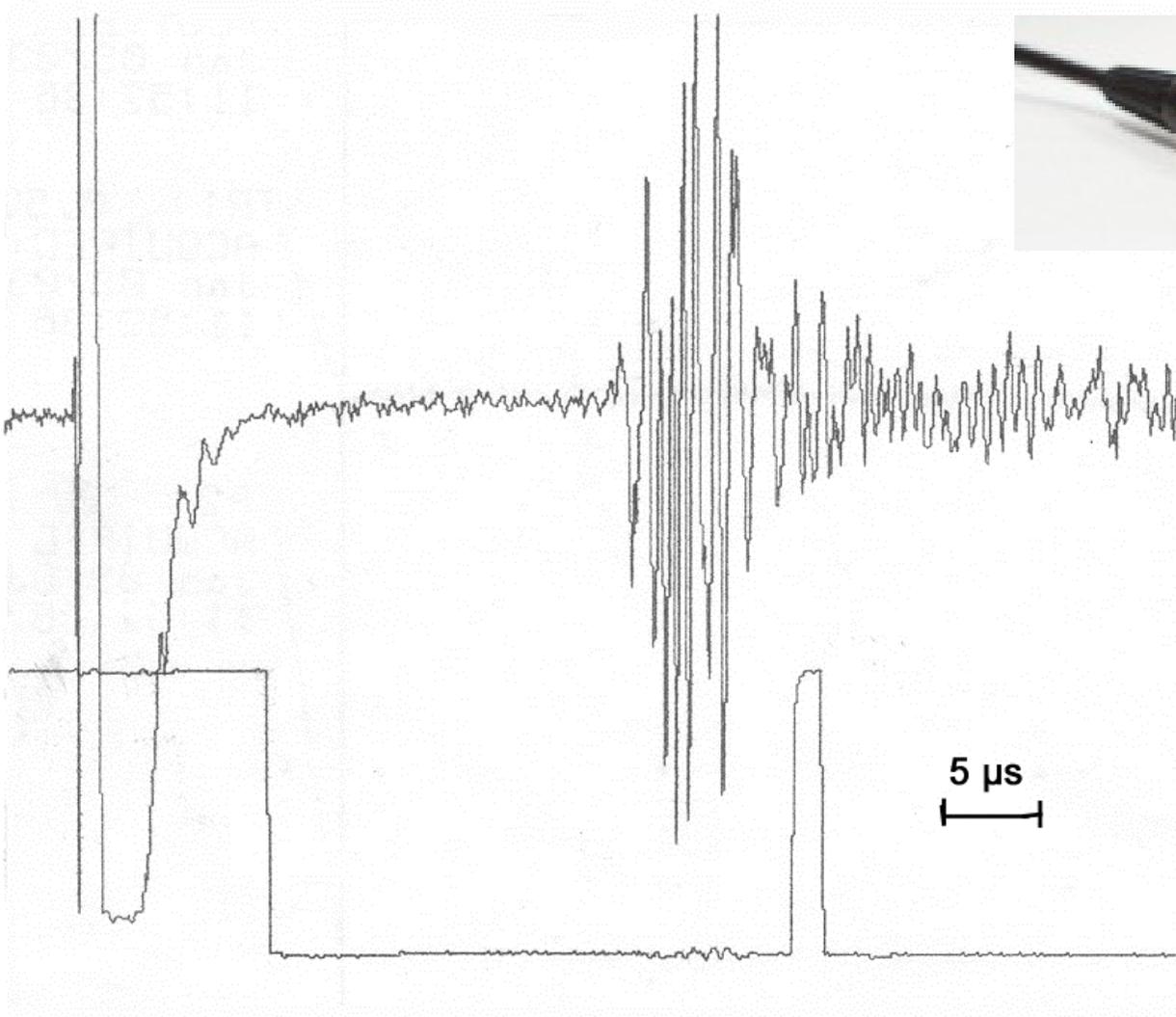


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Measuring principle of grain size



Typical ultrasound signal



Ultrasonic transducer



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Evaluation of grain size measurement

$$D = C_1 + C_2 \cdot [f(d) \cdot U_p]^{2/3}$$

D = Grain size value [μm]

C_1, C_2 = Calibration constants

d = Strip thickness [mm]

U_p = Averaged peak voltage [V]

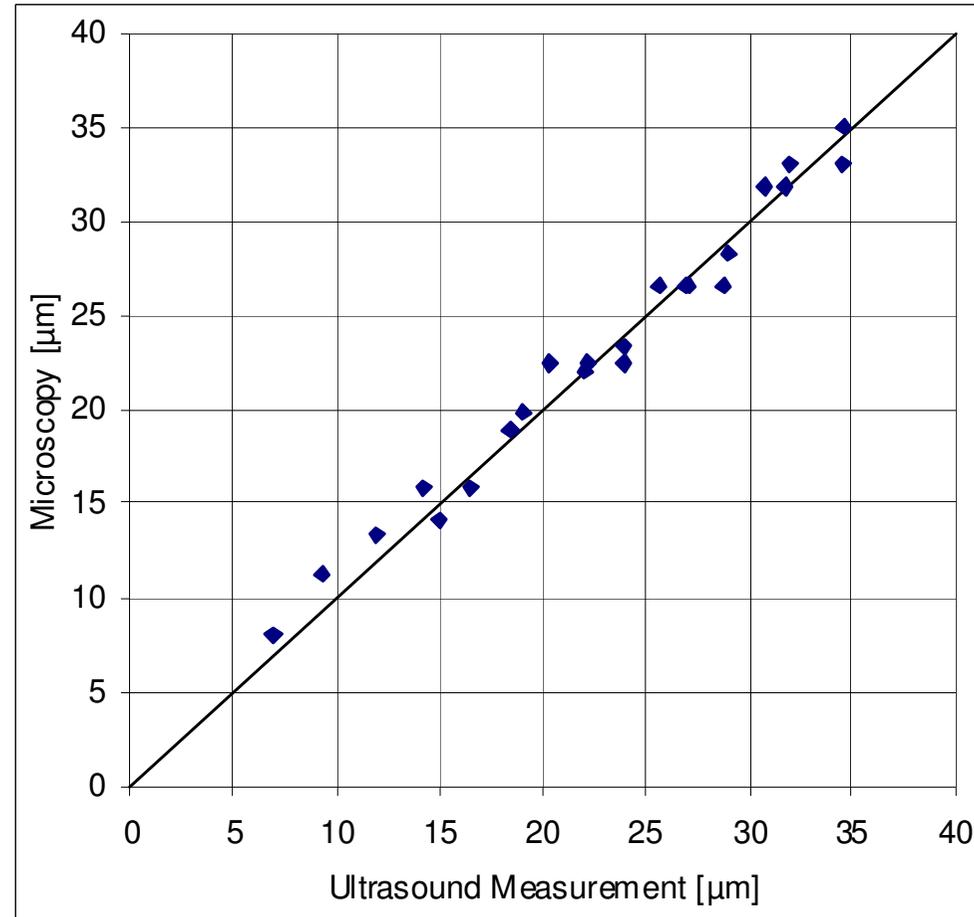


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Comparison of on-line grain size measurement with microscopy

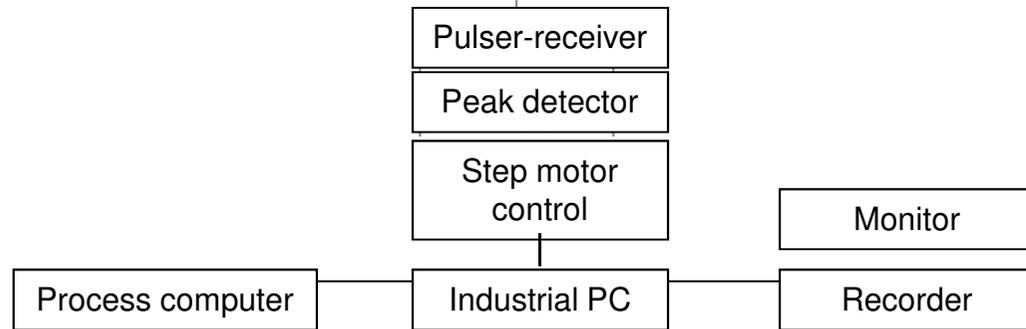
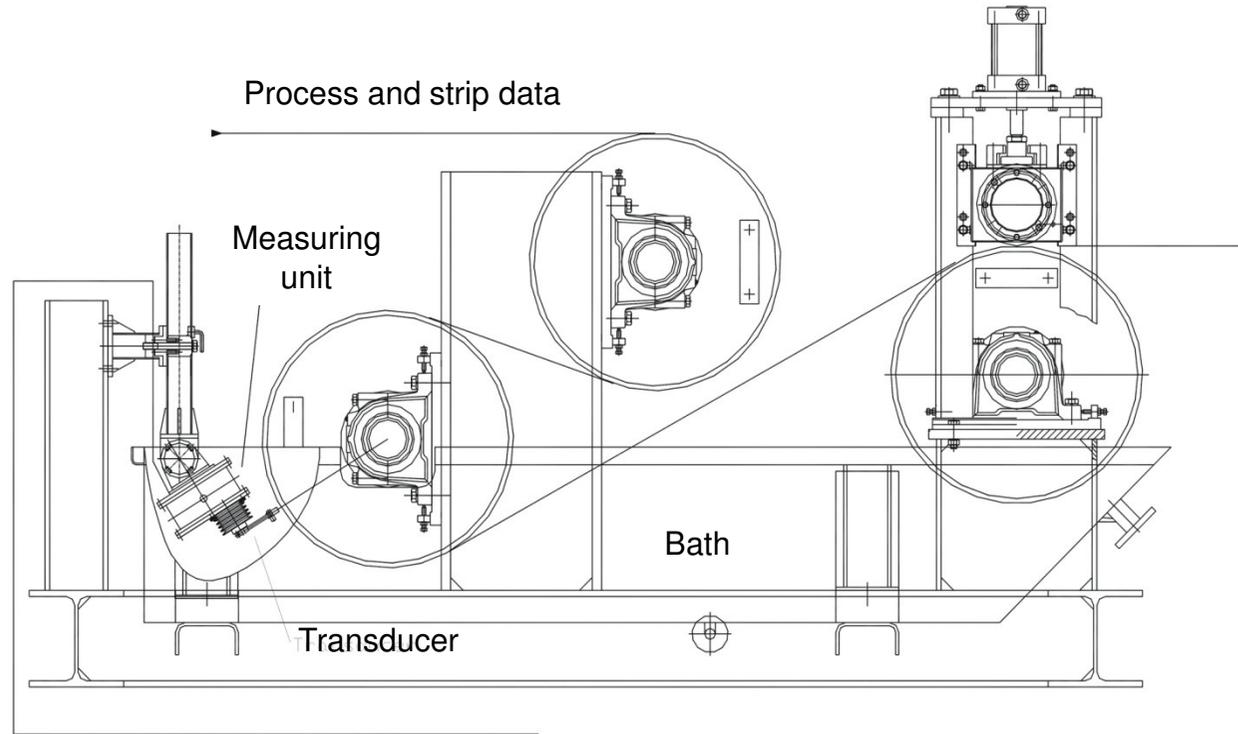


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Construction drawing

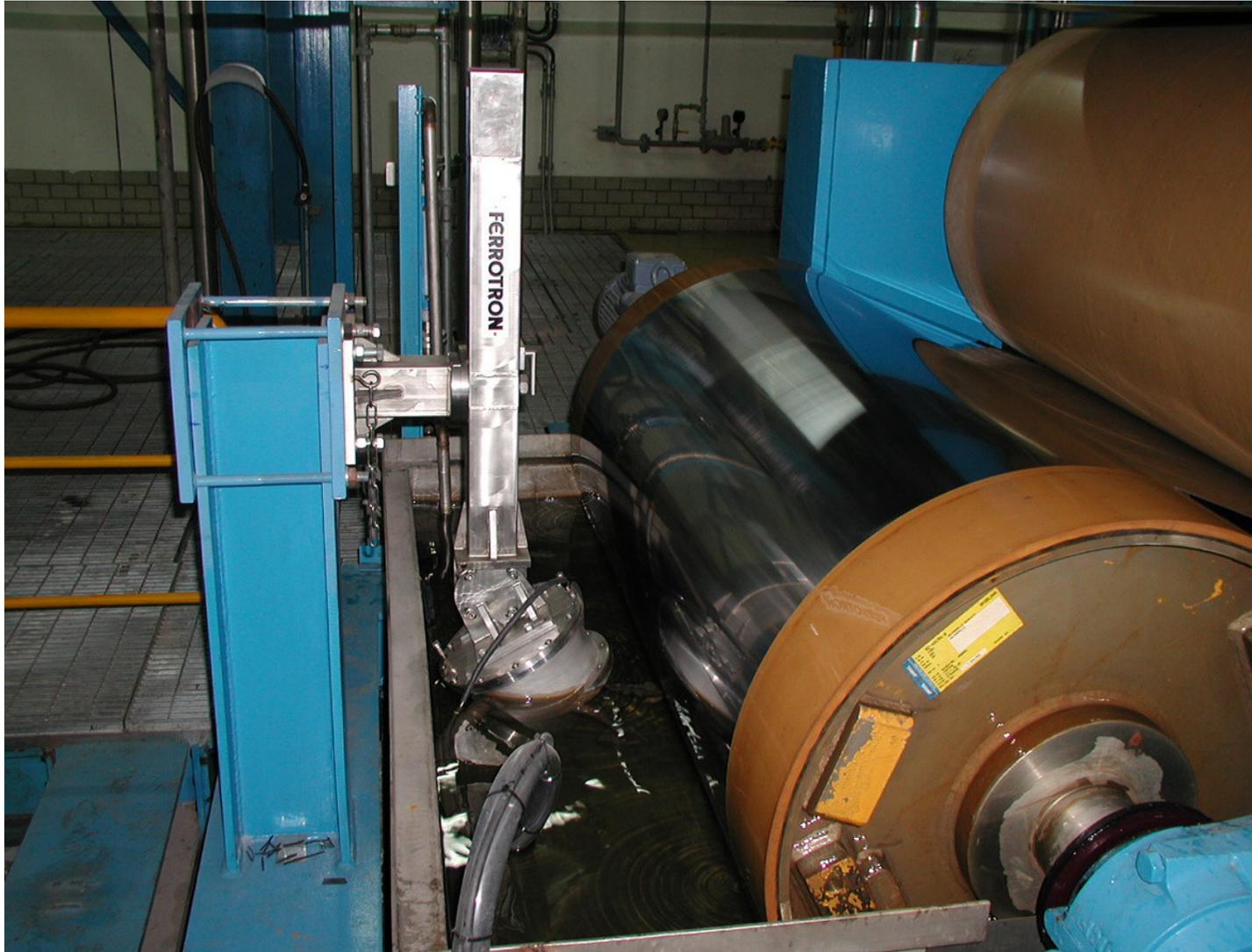


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Grain size measurement on site



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Grain size record: badly annealed



On-line grain size recording

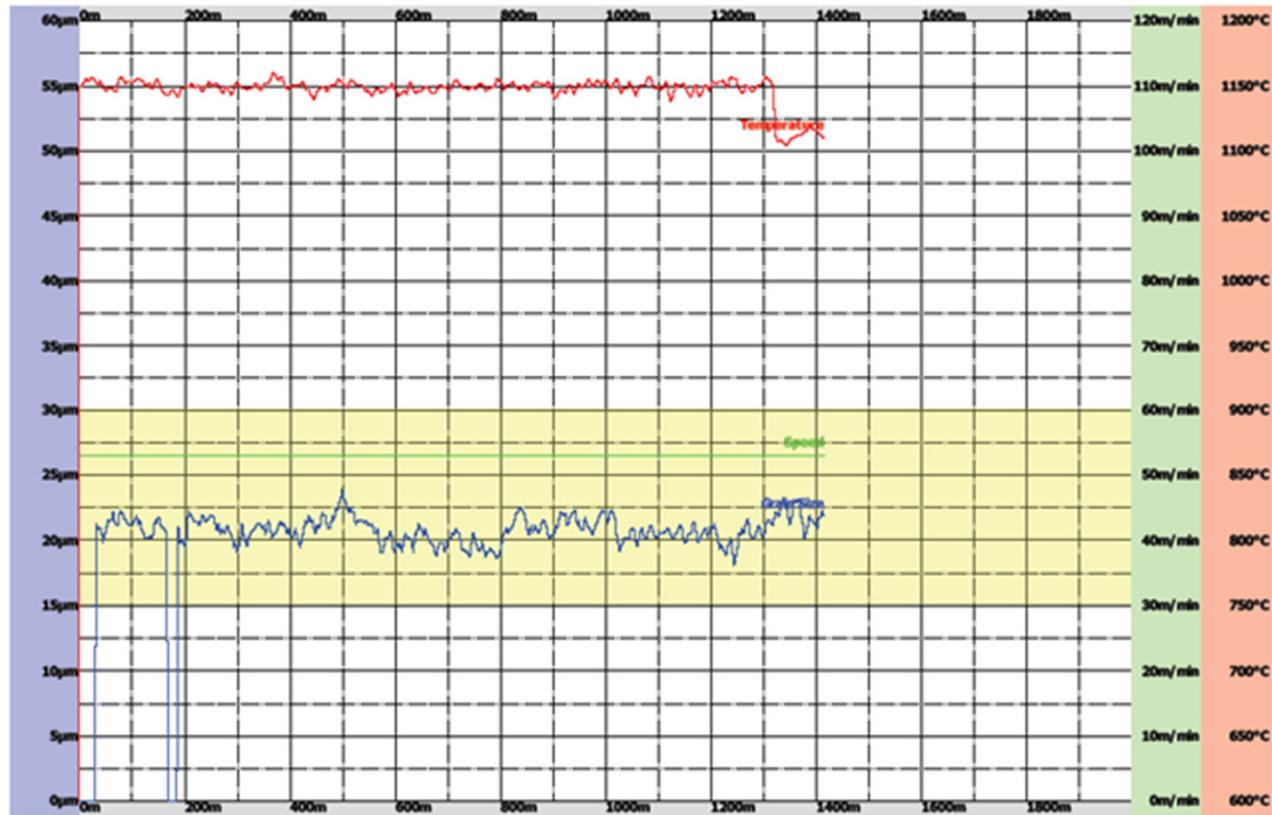


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Grain size record: well annealed



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Benefits of annealing control systems

- **Improved quality assurance**
- **Enhanced reliability of production**
- **Reduction of sampling costs**
- **Increased annealing line throughput**



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Short reference list

- **ThyssenKrupp Nirosta, Germany**
- **UGINE, France**
- **ThyssenKrupp AST, Italy**
- **Acerinox, Spain**
- **Columbus Stainless, South Africa**
- **Mexinox, Mexico**
- **SKS Shanghai, China**
- **Chia Far, Taiwan**