ON-LINE MEASUREMENT OF REMANENCE AND GRAIN SIZE

On-line annealing control improves efficiency of continuous annealing lines
On-line measurement in a continuous annealing line
Principle of remanence measurement
Installation of a remanence system
Remanence head

- Magnetizing roller
- Lifting magnet
- Measuring roller
Remanence record: badly annealed
Remanence record: well annealed
Measuring principle of grain size

- Transducer adjustment
- Ultrasound generator
- Peak detector
- Industrial PC
- Display
  - Monitor
  - Recorder
  - Printer

- Process computer
- Process data
  - Temperature
  - Speed
  - Welding seam
  - Strip data
Typical ultrasound signal

Ultrasonic transducer
Evaluation of grain size measurement

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

- \( D \) = Grain size value [\( \mu m \)]
- \( C_1, C_2 \) = Calibration constants
- \( d \) = Strip thickness [mm]
- \( U_p \) = Averaged peak voltage [V]
Comparison of on-line grain size measurement with microscopy

![Graph showing comparison between ultrasound measurement and microscopy. The graph plots ultrasound measurement in μm on the x-axis and microscopy in μm on the y-axis. There is a trend line indicating a strong correlation between the two methods.](image-url)
Construction drawing

Process and strip data

Measuring unit

Bath

Transducer

Pulser-receiver

Peak detector

Step motor control

Process computer

Industrial PC

Monitor

Recorder

MinTEQ
Grain size measurement on site
Grain size record: badly annealed

On-line grain size recording
Grain size record: well annealed
Benefits of annealing control systems

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