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                    PIA II Protocol

Production Data
Order No.:              735688
Date:                   24.12.2007
Time:                   6:00 pm
Foil Type:              6.35µ x 1630mm
Coil No.:               4-3523
Comment:                xyz

Class Limits[µm]        Count    % of total

    <  10:              13        36.1
 10 -  20:              17        47.2
 20 -  30:               4        11.1
 30 -  50:               2         5.6
 50 -  70:               0         0.0
 70 - 100:               0         0.0
100 - 150:               0         0.0
150 - 200:               0         0.0
200 - 250:               0         0.0
250 - 300:               0         0.0
    > 300:               0         0.0

Summary
No. of Pinholes:        36
No. of Outsize:          0
Sensity [per m²]:       3600

⇨  Sample within Specification
```

Typical Example of Printer Protocol

PIA - Benefits

- “Electronic Light Table”
- Objective Measurements of Pin Holes down to 5µm Diam.
- Objective Counting of Pin Holes in Foil Samples
- Supports Statistical Process Control
- Generates Statistical Data Base of Foil Quality

PIA - References

PIA is in operation for many years in several major foil rolling and converter plants, worldwide.

Related Products

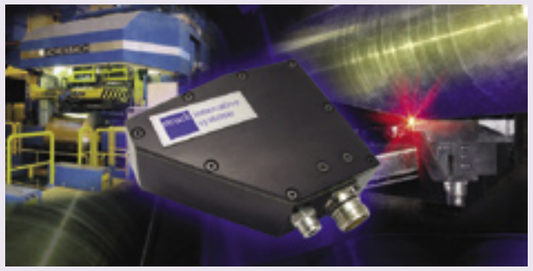
RSIS Roll Surface Inspection System

ROLL SURFACE INSPECTION IN ROLL GRINDER MACHINES

Features

- 100% Optical Surface Scanner for Ground Rolls
- Installation in Roll Grinder Machines
- Detection / Classification of Surface Patterns & Scratches (Chatter, Feedlines, Shadows, Twists, Diagonals…)
- Chatter Frequency Analysis
- 2D Surface Pattern Imaging, Grading
- Integrated into Grinder Operation

RMD Roll Mark Detector System



ONLINE SURFACE INSPECTION IN FOIL ROLLING MILLS

Features

- Optical Surface inspection
- System Installation in Foil Mills
- Detects & Classifies Periodical Work Roll Marks & Holes
- Surface Defect Size < 200µm
- Up to 2000m/min Rolling Speed
- Up to 2200mm Foil Width
- Adaptable to Various Foil Mill Makes & Models
- Permits Immediate Operator Reaction to Prevent Reject Coils

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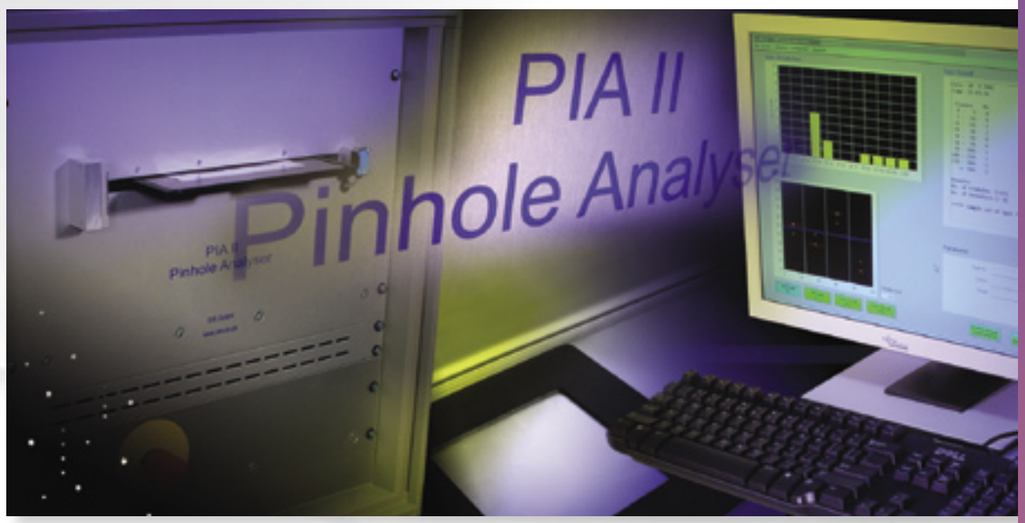
ALUMINIUM FOIL INSPECTION

PIA Pin Hole Analyzer



FEATURES

- Analyzes Aluminium Foil Samples
- Measures and Classifies Pin Hole Occurrence within a Surface Area of 100 x 100mm
- Statistical Product Quality Monitoring in Rolling and Converter Plants
- Supports Operators Visual Light Table Inspection by Objective Measurements of Pin Hole Counts, Diameter Distribution Down to 5µm

PIA - Objectives

The special barrier properties of aluminium foil are widely made use of, particularly for the durable packaging of sensitive products such as pharmaceuticals, cheeses, fatty goods, juices, etc. The barrier quality is determined essentially by the porosity of the foil, e.g. number of pin holes per m².

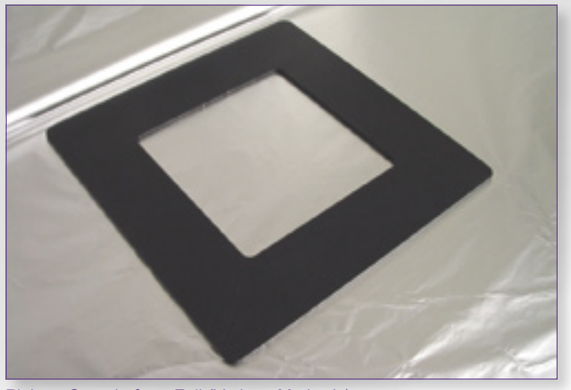
The current method of visual random sample inspection on light tables is often found to be insufficient to provide objective quality grading of the foil.

Quality control for foil is now efficiently supplemented by PIA, a foil sample analyzer unit.
The PIA instrument allows efficient and objective random sample control of thin gauge aluminium foil in accordance with EN 546-4 standard. PIA is used in rolling and converter plants.
It takes only a matter of a minute to analyze the foil area of 100cm² opto-electronically, and it yields an exact measurement of the number and diameter distribution of pin holes down to a minimum diameter of 5µm (optional 2µm).
PIA represents an ideal extension and improvement of present visual control methods using light tables.

PIA - System

The PIA system includes the following main elements:
1. 19" Cabinet with Scanner Unit and Sensor Electronics
2. Desk Top (or Tower) Personal Computer
3. Application Software

PIA Cabinet (PC external)

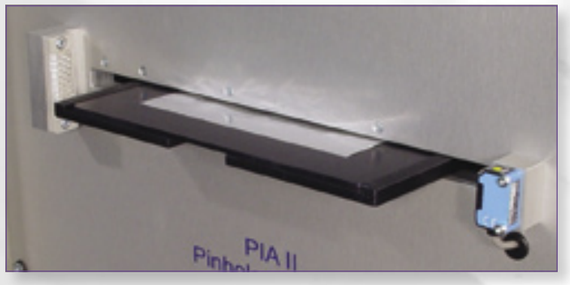


Pick up Sample from Foil (Various Methods)

Pin Holes in Foil

Typically the operator takes a foil sample directly from a coil or from the light table by means of a stiff or flexible support frame (different methods applicable). That frame together with the sample is inserted into the PIA device front panel port. After entering few related production data (coil identification, foil spec. etc.) the measurement is initiated. Within ca. 60s the optical sensor scans the sample "looking" for pin holes.

PIA classifies the detected pin holes into set diameter size ranges (e.g. 5 µm to 250µm in 5 classes).
In addition an entire list of pores is generated with individual sizes and positions.
Results are represented in various graphical or numerical modes like histograms, lists, maps etc.
If enabled, PIA prints a test protocol and stores data into a file archive for further statistical evaluation (Excel, Access etc.).



Foil Sample Inserted into Front

A stepper motor driven X/Y linear unit moves the frame with the attached sample sequentially in four rows of 100mm each and 25mm offset between light source and receiver.
The laser light source illuminates the sample with an intense, well focussed light line (size 25mm * 0.2mm) and a photo sensor module with 25mm aperture receives the light passing through the pin holes.

During scanning an analog-to-digital converter (ADC) digitizes the sensor output signals and transmits the data to the PC. Signal "energy" represents the amount of light passing through a hole, which is in first approximation proportional to the cross section of the hole.
The PIA software calculates the equivalent diameter and position of individual pinholes. Based on these measurements the PC proceeds with further processing (like size classification, travel map, etc.)
System configuration (size class limits etc.) is defined by software parameters stored in files.

Calibration

The determination of equivalent pinhole diameter using transmitted light measurement results in a "relative magnitude". Hence, the system needs to be calibrated before use. Calibration is done by means of three different precision pin hole targets with known diameters.
Typical targets diameter used are 5µm, 20µm and 200µm. By scanning these targets and analysing the signals a calibration function is fitted that is applied for further measurements.

Calibration targets are integrated into a specific calibration frame, which easily can be used for regular system checks and/or re-calibration.

Accuracy

Due to the component tolerances and based on the measurement method the system features some "special characteristics" that inherently influence the accuracy.

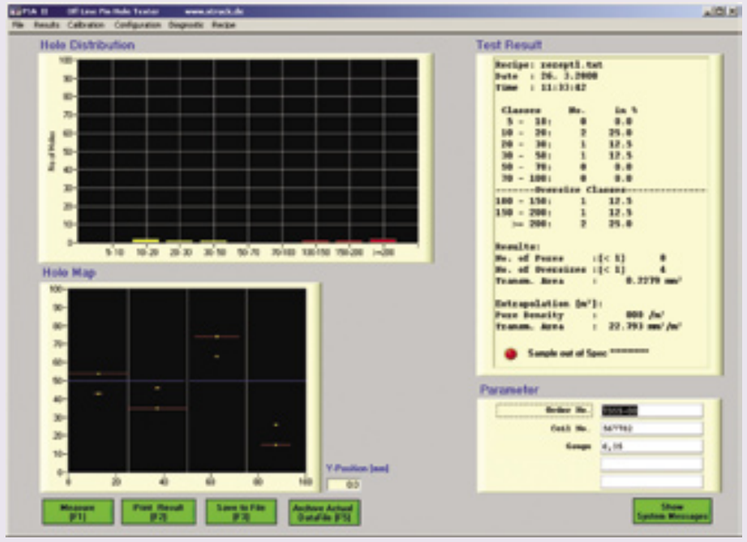
- Diameter Measurement Accuracy:
  That accuracy is mainly determined by the homogeneity of the laser light source and the sensor/optics elements.
  The diameter accuracy typically is better than 5% (CoV) over the size range and measurement area.

- Counting Accuracy:
  Since the foil sample is scanned using a 25mm wide line, a certain probability exists that two pinholes are exactly lined up (within 0.2mm) such that only one single signal is produced (instead of two). In that case instead of two holes of 50µm (as an example) one single hole of 70µm is counted. Of course that "merging probability" increases with higher pore density in the foil sample. The counting error is minimised by sharp focussing of the laser in order to improve "double hole" resolution.
  The counting accuracy at high pin hole density (equivalent >4000 per m²) typically is better than 10%.

Software Features

- The software implements a graphical user interface with a main menu and several sub-menus.
- The main menu is the principal operators interface.
  Measuring/printing/data storage functions can be executed either by "mouse click" software "buttons" or by function keys.

Sub-Menus (partly pass-word protected) are used e.g. for
- Data visualisation (travel map, diameter/position table)
- Diagnostic (signal analysis, stepper control, digital I/O)
- System configuration like diameter class presets
- Calibration.



Software Functions

- Input Production Data
- Start of Measurement
- Print Protocol, Save Data to File
- Display Histogram (Size Distribution)
- Display Pinhole Position Canvas (Local Distribution)
- Plot Sensor Signal ("Oscilloscope")
- List/Print Pinhole Data (individual size/position)
- Set-up System Configuration
- Run Calibration Procedure
- Diagnostic Functions

PIA Main Menue