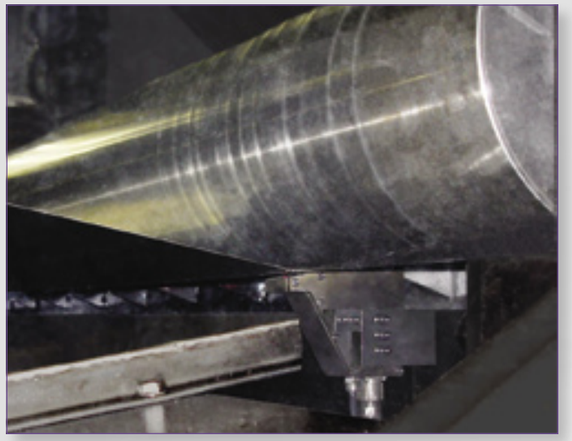


RMD Application: Sensor during Scanning

RMD - References

At present (March 2008) more than 20 systems are successfully commissioned in several major rolling plants world wide.
Repeated orders from most of the plants prove that RMD archieves a fast ROI and that productivity as well as process efficiency is considerably being increased.

RMD - Benefits

The main benefit of the system is that it allows an immediate reaction to really avoid defects rather than just counting and recording them at the end of a coil.
The benefits of the RMD system certainly depend on individual plant parameters and quality strategies. The occurence of critical roll marks spoils considerable amount of thin & heavy gauge foil per month in a typical universal, intermediate or finishing foil mill. Hence, the RMD capital investment cost can be "returned" within few months.

- Enables immediate Reaction to Stop Rolling
- Increases Foil Mill Efficiency
- Minimizes Scrap and on Hold Production
- Supports Automated Quality Control
- Helps Mill Operators and Process Engineers
- Improves overall Quality in Foil Rolling Process

Customers comment on RMD, who has 3 systems installed:

"The Rollmark detector is one of the great events of last 10 years in rolling technology! "……..

Related Products

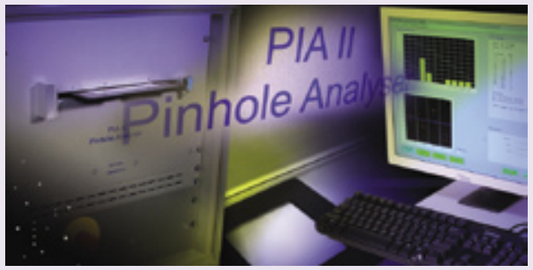
RSIS Roll Surface Inspection System

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

PIA Pin Hole Analyzer



ALUMINIUM FOIL INSPECTION

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 Measurement of Pin Hole Counts, Diameter Distribution down to 5µm

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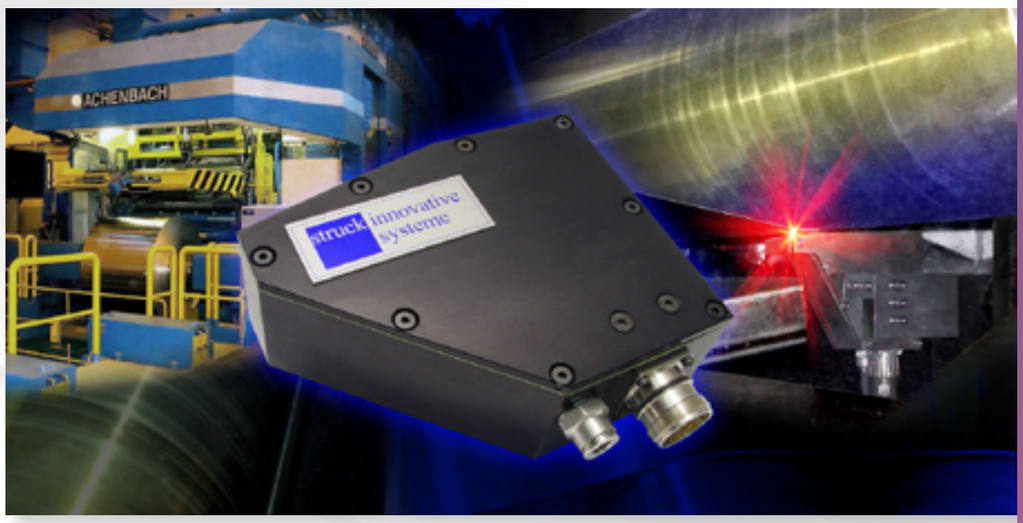
ONLINE SURFACE INSPECTION IN FOIL ROLLING MILLS

RMD Roll Mark Detector System

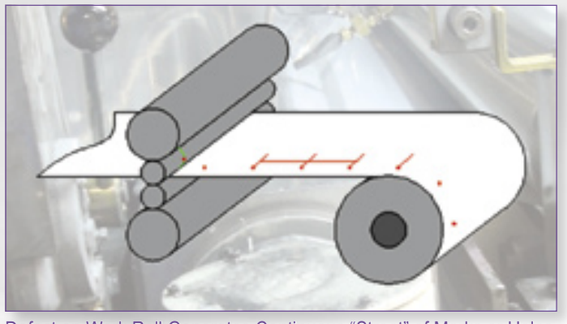


FEATURES

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

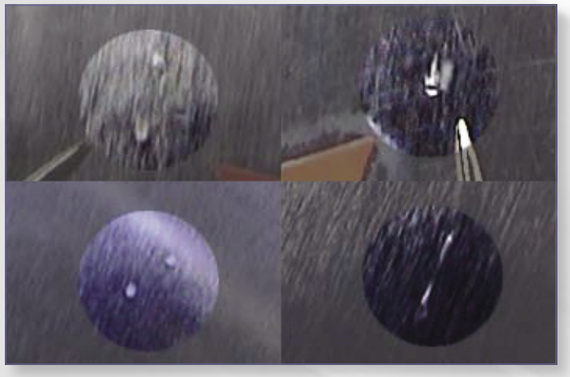
RMD - Objectives

In modern foil rolling mills automated control of strip gauge, shape and other product parameters is state-of-the art since many years. However, monitoring of the foil surface today is still based on human visual inspection. Samples are typically checked offline on a light table after a coil is produced.
The objective of the RMD Roll Mark Detector is to close this "gap" and to provide a new powerful ONLINE surface inspection scanner for operators and process engineers.
Roll marks are periodical surface defects on the strip. A slightly damaged work roll imprints repetitively roll marks into the surface continuously downstream the foil.
Using the RMD technology it is now possible to detect roll marks and roll holes at highest production speed during foil rolling, on the fly.
In case a critical surface problem shows up, the operator can immediately stop the mill, thus "saving" tons of reject material and hours of wasted production time.



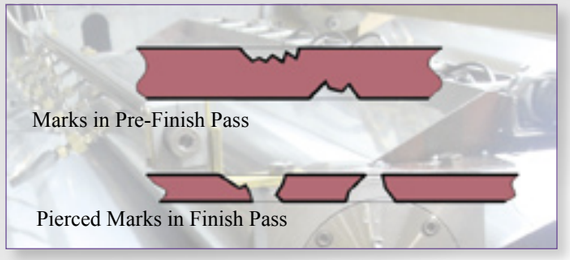
Defect on Work Roll Generates Continuous "Street" of Marks or Holes

A work roll damage occurs mainly when hard grains (e.g. oxide particles, metal, grit) infiltrate the rolling gap. The risk to affect the roll surface tends to be highest after a strip break or right after starting a new coil.
Especially in foil rolling these small, punctual roll marks are highly critical because in the pre-finish or finish passes they finally cause pin holes (pierced marks). Thus, an entire coil of several tons of thin gauge foil might be rejected after hours of rolling if it´s spoiled by a continuous pin hole "street" along the foil.
Pin holes above a certain size are unacceptable flaws in foils used as barrier in dairy, pharmaceutical or other packaging products.



Typical Roll Marks in Heavy and Thin Gauge Foil

Typically an indent of one roll is "copied" onto its counterpart which explains the characteristical double defect patterns, especially in thin gauge foil.



Critical Mark with Pit, Next Pass Generates a Pierced Mark (Pin Hole)

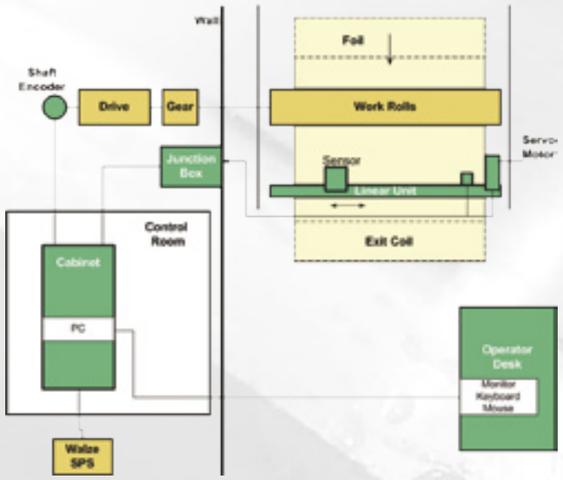
The challenges for this application are

- Very High Production Speed Range of the Rolling Process up to 2000m/min
- Harsh Mill Environmental Conditions (Temperature, Kerosene Vapour, Sporadically Fires, Strip Break etc)
- Tiny Size of the Defects to be Revealed (<0.2mm)
- Restricted Space Available in the Mill

RMD - System

The system consists of the following main components:

1. Rugged Sensor Head
2. Servo Motor Driven Linear Scanner System
3. Signal Conditioning Unit & Mill Interface
4. Data Acquisition Unit and Computer System



RMD System Structure

The operating principle is based on the fact that spoiled work rolls generate repetitive defects (streets of marks) on the foil. Without RMD installed these marks generally remain unnoticed until finishing of the coil. This repetitive "defect feature" is utilised in the RMD system to reduce system complexity. RMD covers only one small foil section at a time.
The sensor head scans across the foil step-by-step and explores the strip surface through an "inspection window" of 4mm width. A laser line illuminates the surface. The reflected, scattered light is monitored by a proprietary photo sensor arrangement. Analog signals are continuously digitized, analyzed and classified by sophisticated digital signal processing algorithms. Efficient analysis is especially important to distinguish the tiny "real" marks from oil and other surface contamination during rolling.
Surface anomalies are reported to a Computer (PC), which acts as the operator's console. The PC evaluates and displays cross web roll mark profile, size of roll marks (severity level), location of marks, work roll history etc.
Furthermore the PC provides coil reports, data archive onto disk and alarm PLC outputs.
The system is mounted in the exit section of a foil mill close to the shape control roll or the tucking roll.

Typical RMD Sensor Head Implementation

Typically the available space in the exit section of foil mills is limited; thus the size of the RMD front end parts is a critical parameter. However, up to now in all inquiries it was possible to upgrade and adapt the RMD system to any mill layout, independent of its model. In our applications we principally have two alternative mounting situations: the sensor "looks" onto the foil surface either from top of the shape control roll, or from underneath the tucking roll.

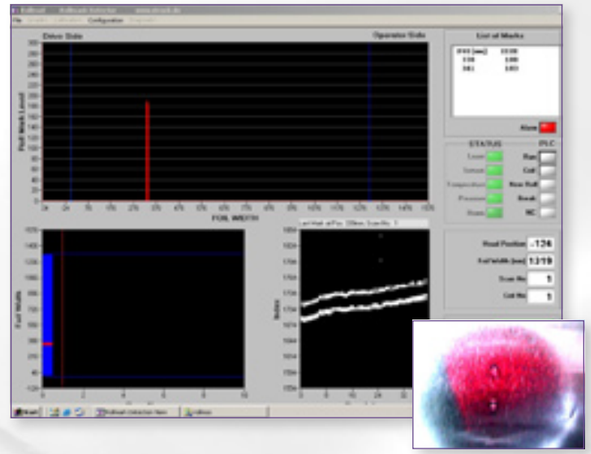
RMD Sensor Heads: Inspection from Bottom or Top

Inspection:	Surface Reflection
Light Source:	Laser Light
Sensor:	Photo Cells
Inspection Width:	3mm per step
Distance to strip:	typ. 4mm
Scan Time:	Cross Web ca. 5min
Sensor Head Dimension:	ca. 110 x 110 x50mm (adapted to mill geometry)
Detection Efficiency:	typ. 80% .. to 95%
Temperature:	<100° C (at sensor head)
Atmosphere:	Kerosene Vapour
Miscellaneous:	fire resistant ("short" mill fires) mill handling proof

RMD Technical Data

RMD - Results

The operation and the operator interface are straight forward and easy to use. The main screen shows any roll mark occurrence as a vertical bar inside a graph that represents the foil width. The height of the bar gives the relative defect size and its x-position indicates the position on the foil (referenced, to the foil edge). The system status and rolling history information are provided.



Operator Interface with Roll Mark Defect just occurred

The operators screen shot shows an example of a roll mark event that exceeds an "alarm" (severity) threshold right at the beginning of a coil. Typically the operator immediately stops the mill if such alarm signal comes up (beeper or flash light).
That particular example occurred in a universal foil mill during the pre-finish pass (exit gauge ca.13µm). Savings were ca. 6 tons of reject material and approx. 1 hour production time. The characteristic of the displayed track is an indication for a double mark and the mill slip variation.
Typical alarm thresholds are determined during commissioning within the first week of operation. Settings may vary depending on product type and rolling passes.