SIROLL SIAS
Automated surface inspection for flat products

Simple, reliable and accurate surface quality control

Metals Technologies
Putting surface quality under control

Your challenge:
the right surface quality in a constantly evolving environment

Flat-rolled steel producers are facing a trend towards zero-defect tolerances regarding surface quality. This trend, initiated by customers in the automobile industry, is now becoming the norm in other industries too: packaging, "white goods" (appliance) and more. Such performance requires a perfect knowledge and control of the production. Yet, the introduction of new processes (e.g., thin-slab and strip casting) and the development of new steel grades (e.g., ultra-high-strength steels) have introduced a lot of changes in the way steel is made, making this more difficult to achieve. In addition, the push towards high throughput rates and yields makes it impossible to rely on time-consuming, traditional quality control practices. From a quality management (ISO) perspective, it is necessary to standardize "surface quality" like any other product characteristic. Today, surface quality can often be evaluated only subjectively, by specialists with years of experience in product inspection. Standardization in this field can therefore only occur if process knowledge and the understanding of defects are emphasized and accurately characterized, and if a repeatable, reliable measurement is performed.

Our solution:
On-line surface quality control

SIAS detects and automatically classifies all surface defects visible on the strip:
- Inclusions such as shells, slivers, seams
- Mechanical damage: pinch marks, cracks, holes, scratches, etc.
- Scale: descaling problem, rolled-in scale, unpickled patch, etc.
- Repeating defects: roll marks, dents, pick-ups, etc.
- Coating defects: dross, arc spots, anode marks, etc.

Results are displayed to the operator, and stored in the form of coil reports mapping the defects on every coil.

The implementation of SIAS is simple and straightforward, and serves two purposes: to monitor the process and its impact on the strip surface, and to collect accurate, reliable data on the surface quality of the products coming from the line or mill. The SIAS solution is successfully operated in all flat-product rolling and processing applications:
- Hot mills
- Pickling lines
- Cold mills
- Continuous annealing lines
- Metallic coating lines
  - Continuous galvanizing lines
  - Electrolytic galvanizing lines
  - Electrolytic tinning lines
- Color-coating lines
- Stainless steel lines
Advantages of surface inspection systems for SIROLL plants SIAS

■ Perfect knowledge of everything you deliver –
100% surface-quality control provides the possibility to evaluate in real-time the product with requirements.

■ Increased productivity –
Inspection is performed without stopping or slowing down the line, and re-inspection is drastically reduced. If a defect occurs, its origin is rapidly identified and eliminated (e.g., scale, roll marks). Harmful defects are detected before they cause any damage downstream.

■ Fast, simple and reliable –
through a user-friendly interface, SIAS can be easily and quickly adapted to any application, and customized to user requirements. The powerful classification tool allows repeatable and reliable performance.

■ Maintenance friendly –
the system requires only minimal maintenance thanks to its lean design and modular architecture. Remote service is available, and local service is guaranteed through the Siemens VAI network.
SIROLL SIAS technology
vision for quality

SIROLL SIAS,
the best surface quality gauge in the industry

High-end cameras, optics and lighting provide a sharp, fine-resolution image of the strip surface. The sensor components have been carefully selected for their technical performance, reliability, ease of use and maintainability.

The image is processed for defects identification: detection of flaws, automatic classification and severity grading.

The system is PC-based for easy integration into the user’s network, and user-friendly administration. Remote access is possible from any connected PC, to configure the system and monitor its operation.

SIAS HMIs have been designed together with world-class steelmakers to match the specifics of every application. SIAS results are organized into three categories:

■ Defects: size, position, type and severity
■ Defect images
■ Context, or follow-up, information: mill/line speed, product texture, image brightness, camera and sensitivity settings which allow a good understanding of inspection conditions.

All results are available to the inspector in real-time, allowing immediate reaction. Results storage is done according to the state of the art, in an open database structure, for later review and studies.

The whole system can be fully administered via a user-friendly, fully graphic HMI interface that requires no computing.
Empowering tools to make the most out of surface quality data
The SIAS system integrates all of the features that allow users to extract desired information from the collected data.

Consistent data storage
All SIAS inspection results are stored together with context information on the product, the process and the environment. This is a key for quality procedures and allows users to make decisions with full knowledge of the conditions of inspection. Through the SIAS coil-grading software, the quality department can determine instantly whether a coil surface quality matches the requirements of the customer – and what action to take if this is not the case.

Off-line analysis
The storage of SIAS results in SQL-compatible database structures paves the way for defect studies, such as trending on groups of coils, e.g., by grades or by dates. The reports that can be edited from the SIAS provide all the synthetic information for plant managers to monitor the performance of their production units. The fully graphic and intuitive SIAS interfaces make it a flexible tool that can be easily adapted by the operator to new production conditions or requirements.
SIROLL SIAS for rolling mills
new perspectives in quality management

Hot mills
SIAS for hot mills was optimized to cope with the specifics of surface quality control in the hot mill environment: high production pace, hard visual control, varying product aspects.

The SIAS technology opens outstanding perspectives in terms of quality management at the hot mill. First, it brings major improvements in terms of safety and efficiency of quality control and customer relationship management.

In addition to the immediate benefits linked to the control of scale and roll-mark defects, SIAS allows a perfect adjustment of production constraints to achieve the required level of surface quality. The result is fewer and more adapted production rules, and better quality.

Features:
- Water-cooled, tight, rugged camera unit housing
- High-power sodium lamps
- Auto-adaptive settings for inspection of many different product grades
- Special Interfaces adapted to high rolling speed and production pace
- Simple system administration through fully graphical user interfaces
- Live display with possibility to freeze 60 meters of strip image at full resolution and scroll up and down, zoom-in, etc.
- Auto-freeze image display on strip heads and tails

Main benefits:
- Elimination of unnoticed production of defective material
- Warnings for downstream processes (holes, edge cracks)
- Improvement of surface quality control practices and increased safety
- Yield improvement
- Data available on 100% of the strip surface for surface quality studies and process optimization
Cold mills
The SIAS solution for cold mills includes the “SAFE HOUSE” exclusive enclosure, designed to provide mechanical protection for the SIAS sensors and to make the environment clean and proper for surface inspection.

Similar to at the hot mill, surface inspection at the cold mill introduces a revolution in terms of quality management and mill operation. With a direct feedback on surface quality, mill operation can be focused on real issues and precautionary measures can be optimized, increasing output and yield.

Features:
■ Specific camera set-up for maximum performance
■ Complete environment and mechanical protection through “SAFE HOUSE” exclusive design
■ Fully graphic interface and image-based classification editor for fast and simple configuration and commissioning
■ Total visual feedback through “live display” feature: freeze/zoom in/out functions

Main benefits:
■ Weld monitoring
■ Real-time reporting
■ Increased line/mill productivity
■ Immediate detection of “defect crises” such as roll marks or scratches
■ Improved quality control efficiency
SIROLL SIAS for processing lines

quality management from the shop floor

Surface inspection on processing lines detects both defects from upstream (incoming material) and defects from the process. It performs final product quality control and allows optimizing process parameters and production practices to reduce defect occurrence.

The SIAS solution for processing lines is based on a compact, standard, modular design. The optical arrangement system and installation configuration are then adapted to take into account each application’s characteristics (i.e., type of material to be inspected and defects) and the line’s specific mechanical constraints.

Features:
- Automatic sensitivity adaptation to product changes (brightness/texture)
- Texture analysis module for specific coatings
- Total visual feedback through “Live Display” feature
- Open, SQL database archiving
- Fully graphic interface and image-based classification editor
- Preset detection and classification from past experience
- Real-time reporting: no delay between defect occurrence and reporting
- Tablet
- On-line coil-grading

Metallic coating lines

SIAS is the worldwide leading solution in surface quality control of exposed-quality galvanized products for the automotive industry. For critical applications in the automotive, packaging or appliance markets, SIAS provides synthetic, highly accurate information on surface quality.

The coil-grading module automatically confirms if the coil surface quality matches customer requirements.

For specific applications, extra-modules are available to customize results or add performance:
- Specific module for inspection of line-marked products (differential coating)
- Density calculation of micro-defects (e.g., micro-dross, zinc grain) and real-time reporting of density variation
- Edges/holes channel for 100% reliability in hole classification
- Texture analysis to monitor spangle uniformity
Continuous annealing lines
At the continuous annealing line SIAS prevents defective materials from being further processed at the electrolytic galvanizing line or in any other downstream process.

Pickling lines
SIAS picks up all major surface defects early in pickling lines before the value-adding processes. It provides warnings on pickling issues (e.g., under-pickling). A result of SIAS is that the pickling speed can be optimized. On coupled pickling line-tandem mills, additional benefits can be expected from an early detection of defects right before cold rolling: the potentially harmful defects are reported to the mill operator who can take action (slow down or open stands), eliminating defects-induced strip breaks.

Color coating lines
SIAS ensures high resolution inspection of painted surface at the line exit. Thanks to the system of built-in flexibility, it can be easily tuned to adapt automatically to the widest range of product colors and aspects. Thanks to automatic classification, possible origin of defects (roll coat, oven, dryer or gloss film application) is rapidly identified.

Stainless steel lines
In the high-added-value stainless steel market, SIAS is a key component of global equipment, essential to high quality and productivity. SIAS can be applied to bright annealing lines and annealing and pickling lines as well as integrated stainless steel lines, skin-pass mills and tension levelers. SIAS will alarm operators about all surface defects (harmful defects for the lines and/or unacceptable defects for required quality).

Main benefits:
- 24/7 inspection of 100% of strip top and bottom surfaces at high resolution, independent of line speed
- Early detection of defects before value-adding processes
- Line productivity increases - no speed reduction for quality control
- Huge reduction in manual re-inspection (if applicable)
- Fully traceable measurement of the coil surface quality
- Immediate decision on coil allocation
- Feed-back to upstream processes: steelmaking hot and cold rolling
- Process improvement
- Prevention of downstream defect damages
- Enhanced customer relationship management
Life-cycle partnership for surface quality

Siemens VAI life-cycle services
Surface quality being one of the main components in the value of steel products, the associated control system needs to be constantly operational and reliable.

As for other products in the SIROLL family, users of SIAS benefit from the worldwide presence of the Siemens group. Siemens VAI supports SIAS along its complete life-cycle, from the installation phase and throughout the system operation, to guarantee a consistent surface quality control.

The following services are available to SIAS customers:
- Spare parts management and supply, from a set of standard spares, with on-demand replacement and repair
- Preventive maintenance visits, organized periodically to prevent or detect at an early stage any efficiency loss of the equipment, on the basis of thorough diagnostics
- Hotline and remote maintenance services; software updates
- On-demand on-site intervention

Those services are proposed on the basis of a yearly package that may be customized to specific customer requirements.

SIAS experts are also available to assist in adapting the system settings to any evolution in production practices or customer requirements. This is done following a rigorous methodology, developed and enhanced through years of experience, and supported by highly efficient and user-friendly tools.
## Excellence from experience

### Selected success stories with SIROLL SIAS

<table>
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<tr>
<th>Customer</th>
<th>Line Type</th>
<th>Our solution</th>
<th>The result</th>
<th>Technical data</th>
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<tr>
<td>NLMK, Lipetsk, Russia</td>
<td>Hot-strip mill 2,000 mm</td>
<td>High-resolution single-camera inspection of top and bottom strip surfaces; live display HMI and multiple-resolution inspection</td>
<td>Detection and classification performance &gt;90%; direct impacts on casting regimes (defect correction), hot-mill operation (roll changes) and cold-mill operation (cut entry material or speed reduction)</td>
<td>5,300,000 tpy; thickness 1.2 to 16 mm; max. strip speed: 1,200 m/min; product types: carbon steel, low-alloyed steel, electric steel (GO, NGO)</td>
</tr>
<tr>
<td>ArcelorMittal, Dofasco, Hamilton, Canada</td>
<td>Coupled pickling-cold mill</td>
<td>Top and bottom side inspection at the exit of the pickling section, before intermediate looper and cold mill with real-time interface</td>
<td>ArcelorMittal Dofasco have experienced an approximately 1% increase at the No. 1 coupled pickling-cold mill in working ratio (available line time) due to reduced incidences of defect strip breaks and mill stops</td>
<td>Max. strip speed (at inspection point): 200 m/min; strip temperature up to 85°C; max. strip width: 1,638 mm</td>
</tr>
<tr>
<td>Salzgitter Flachstahl, Salzgitter, Germany</td>
<td>Hot-dip galvanizing line</td>
<td>SIAS with high-resolution inspection and density analysis module</td>
<td>Reliably identifies and eliminates serious strip surface defects such as slivers and holes prior to delivery to the client; Monitor surface quality 100% on-line under maximum stress conditions; Investigates and rates claims due to surface defects even afterwards (a posteriori); Detect defects systematically, to allocate the same to events or states/conditions and take targeted corrective actions; Systematically investigates and understands the causes of defects</td>
<td>Thickness: 0.3 to 2.0 mm; max. strip speed (at inspection point): 210 m/min.; max. strip width: 1,900 mm; lateral strip movement: ± 25 mm; lateral strip movement speed: 10 mm/s</td>
</tr>
<tr>
<td>Ugine ALZ, Gueugnon, France</td>
<td>Skin-pass mill</td>
<td>Top and bottom sides inspection at the exit of the mill, before the coiler</td>
<td>60% increase in quality-control efficiency for production increase of 180T/week; improved reactivity to process-induced defects, leading to a 20T/week-increase</td>
<td>Product types: 2B (stainless steel bright annealing skin pass) and BA (stainless steel annealing and pickling skin pass); max. inspection width: 1,800 mm; max. strip speed: 360 m/min</td>
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