# Slag Detection

## Thermal Imaging System to prevent Slag Carryover in Steel Making

- Improved Steel Cleanliness
- Maximized Production Yields
- Reduced Slag Conditioner Costs
- Reduced Processing Time

Automation Technology
Vision Sensors and Systems

# Slag Detection System

**The Slag Detection System serves as a key solution to improve the steel quality and to recuce treatment costs by minimizing the slag carryover during the tapping process.**

The system comprises a thermal camera in a protective enclosure, an application dedicated imaging software for data acquisition, evaluation and system control, a database for the storage of all process-relevant data, a web based user-friendly operator interface and devices for indicating the system status.

## How it Works

During the tapping process the camera monitors the pouring stream. Due to the very different radiation properties of liquid metal and slag, the thermal camera can precisely distinguish between these two materials. This allows an accurate calculation of the slag transfer by evaluating the live thermal image in real-time.
The acceptable content of slag can be preset in the software. As soon as this threshold is reached an alarm will be triggered to stop the tap.
All important data are continuously displayed on the screen in a clearly arranged window. This includes the live thermal image, the slag carryover vs. tap time, the preset alarm threshold for the slag content and the alarm status.

## Advanced Data Management

The slag detection system includes a powerful database for automatically storing the thermal images, the measured slag content as a function of the tap time and the process parameters. This allows an extensive subsequent analysis of the tap process. The database may also be connected to the intranet of the plant to enable data exchange with other data processing systems.

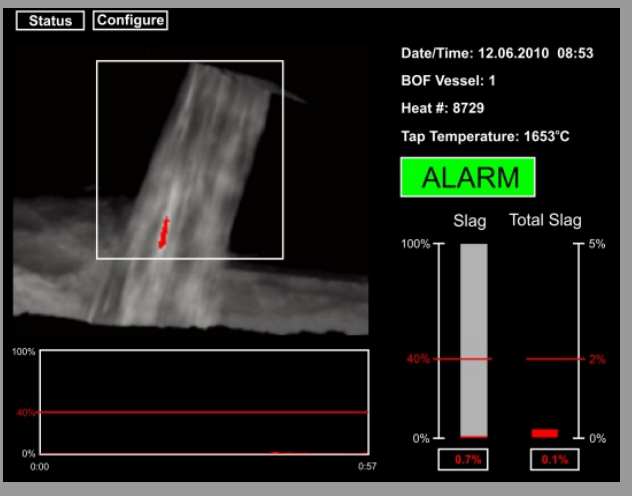
## Various Interfaces

The system features various interfaces for connecting to your process control, data management and visualization. This comprises ODBC for connecting to a database as well as a data-telegram server for the exchange of process related data via LAN. With ist COM/DCOM automation interface the system can be easily connected to a PLC, a process-visualization, or other computers.

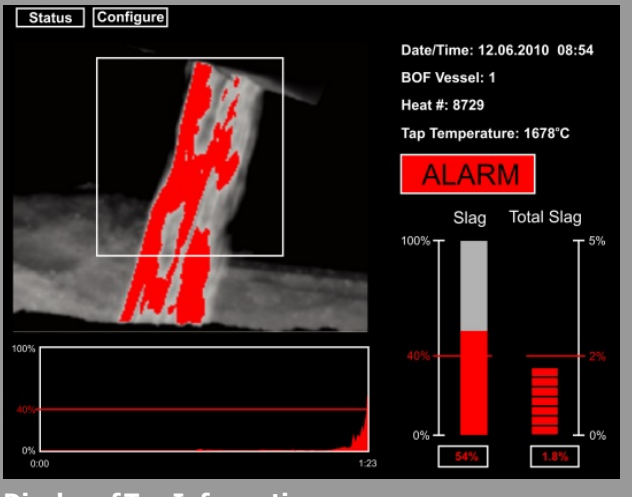
## Designed for steel plants: Robust and Fail-Safe

The whole system is designed for reliable 7/24 operation in the harsh environment of a steel plant. Integrated self-diagnostic functions continuously monitor all components. Any possible functional impairment will be immediately detected and indicated. With its intelligent reconfiguration-functions the system is able to eliminate most malfunctions without any user interaction.

To ensure a reliable operation, the thermal camera is protected by a robust enclosure. The housing is cooled by water, while the protective window at the front of the enclosure is held free of contamination by using an air barrier.



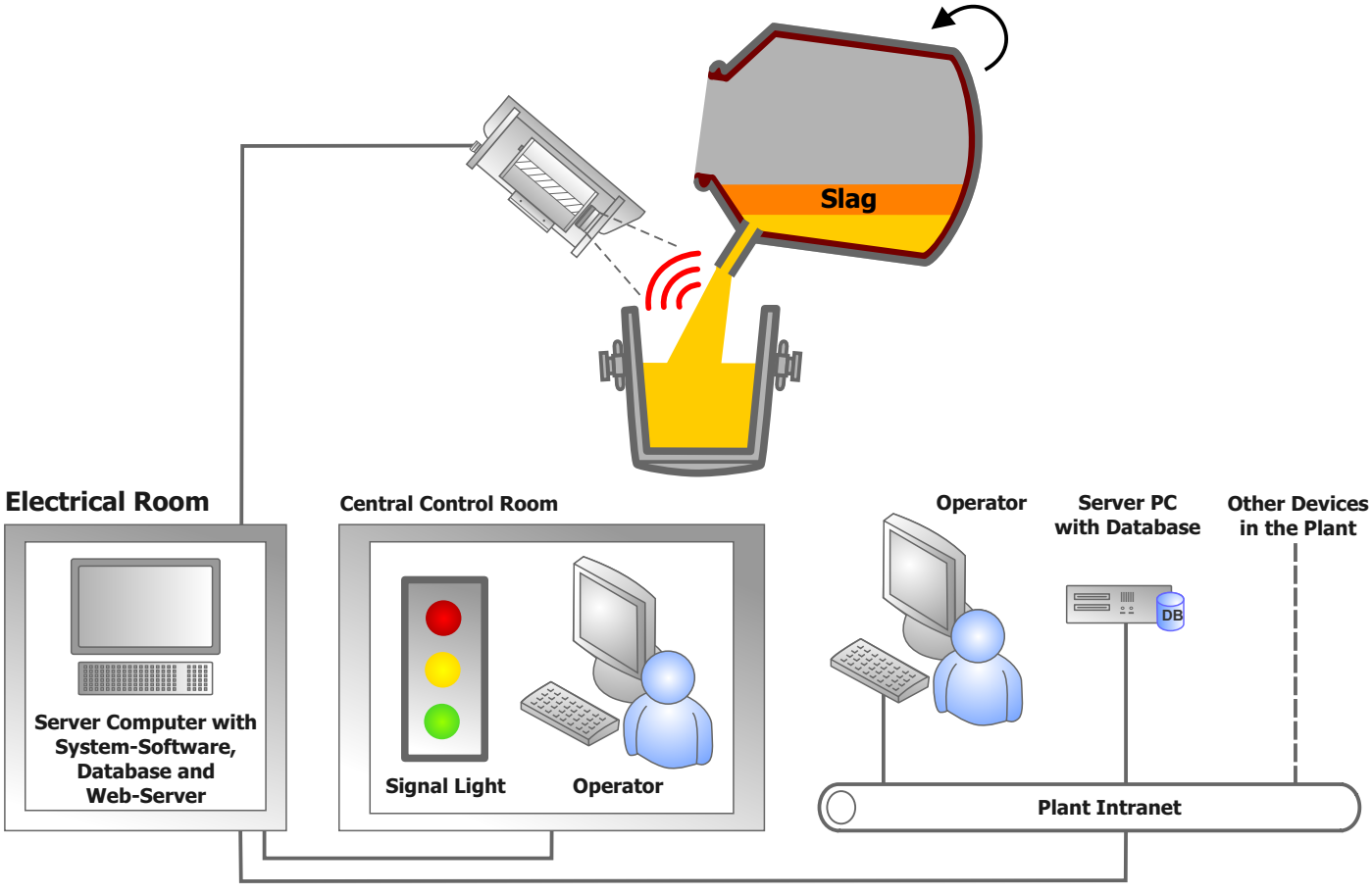

**Display of Tap Information**
Very low slag content in the pouring stream (highlighted in red).




**Display of Tap Information**
Slag content in the pouring stream exceeds the alarm threshold. Alarm ist triggered to stop the tap.

**Thermal Process Control**
The infrared camera enables a clear distinction between liquid metal and slag. To ensure a reliable operation, the monitoring station comes with a water-cooled protective enclosure.

# System Setup




## Configuration of a Typical Slag Monitoring System

- Thermal camera in protective enclosure for monitoring of the tapping processes
- Server computer with software for real-time processing of thermal images, data management and display of tap data
- Indicating device for alarm status, e.g. signal light

## Key Advantages :

- Improved steel quality
- Higher production yield
- Reduced treatment costs
- Reduced processing time

## Key Features :

- Fully automated measurement sequence
- 100% Traceability: Automatic storage of images, measured slag transfer and tap related data
- Advanced data management and tap analysis with database and web server
- Various interfaces for connecting to your process control, data management and visualization
- Robust and fail-safe design for continuous operation in steel plants

# Slag Detection - Technical Data

## Thermal Camera

Maintenance-free thermal camera with un-cooled detector. The camera is consistently designed for industrial applications, featuring intelligent processing functions and a Standard-GigE-Interface for data exchange. It is calibrated with an extended measurement range of up to 2000°C for measuring absolute temperatures with high accuracy.

| | |
|---|---|
| Type | IRSX-I Industrial Infrared Camera |
| Temperature Measurement Range | +600°C to +2000°C |
| Field of View | 6.2° x 5°<br>other lenses available on request |
| Frame Rate | 50 Hz |
| Interface | Gigabit Ethernet |
| Ambient Temperature Range | -40°C to +60°C |
| Weight | 930 g with lens 6.2° x 5° |
| Dimensions | 55mm x 55mm x 150mm with lens 6.2° x 5° |
| Protection Class | IP67 |

## Camera Enclosure

Double-chamber protective enclosure, manufactured from stainless steel. An air barrier installed at the front side effectively prevents dust formations at the durable Germanium window. All connection cables are guided through one cable gland with a high-temperature-resistant hose at the rear of the enclosure. Equipped with a wall mount with manually adjustable joint, the enclosure can be easily installed in any required position.

| | |
|---|---|
| Type | IRCamSafe AIW 168 |
| Enclosure Material | Stainless Steel |
| Coolant | Water or air |
| Protective Window | Ø70mm x 3mm |
| Air Barrier | Adjustable air flow, supply pressure 1 - 3 bar |
| Cable Protection | Heat resistant hose, configurable length. Resistance to thermal load: up to +1640°C |
| Ambient Temperature Range | -0°C to +350°C |
| Weight | 10.5 kg |
| Dimensions | Ø168mm x 505mm |
| Protection Class | IP67 |
| Mounting Bracket | Heavy duty bracket with joint, made from stainless steel. Load rating 45 kg. |

## Other Components

| | |
|---|---|
| Server Computer | Industry standard server computer, 19"metal case for rack installation. The server computer hosts the infrared monitoring software, the database and the web-server |
| IRCamSafe Controller | Integrated inside the camera enclosure. The board gives a significantly reduced installation effort, allowing a direct connection to mains power and Ethernet without any additional connection cabinet. It features various sensors to continuously monitor the ambient conditions in the enclosure, thus ensuring a safe operation of the camera.<br>■ 4 Port Switch with 2x LWL-LC 100Base-FX or 2x RJ45(10/100) Up-Links<br>■ 2 internal sensors for temperature; sensors for pressure and humidity<br>■ Supports a ring structure of the network for lower cabling complexity<br>■ Switchable camera power and heater via Modbus-TCP/IP (controlled by the monitoring software) |

## Interfaces

| | |
|---|---|
| Web-Server | Ethernet Link |
| ODBC | OPC |
| Modbus-TCP | SQL Database |
| Digital I/O, 24V Input/Output,Galvanic-isolated (Fieldbus Module) | |

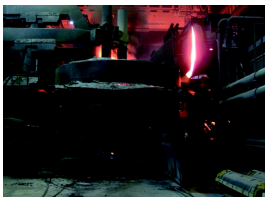
## Data Link of Camera and Computer

Gigabit Ethernet

- Up to 90m with Industrial Ethernet Cable
- Up to 500m with Multi-Mode Glass Fiber Cable
- Up to several km with Single Mode Glass Fiber Cable

## Other Solutions for Steel Industry

**Temperature Monitoring for Continuous Casting**



**EAF Transformer Monitoring**

**Ladle Refractory Monitoring**

**Torpedocar Monitoring**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