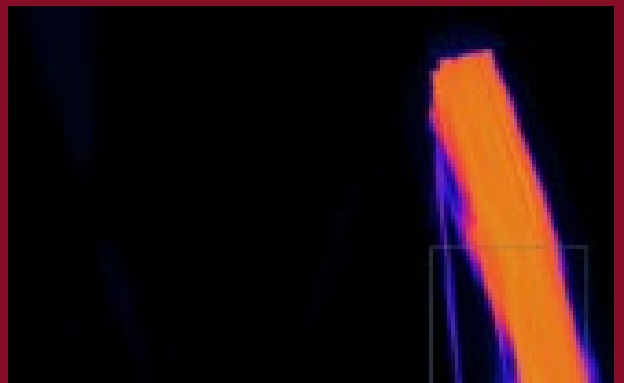
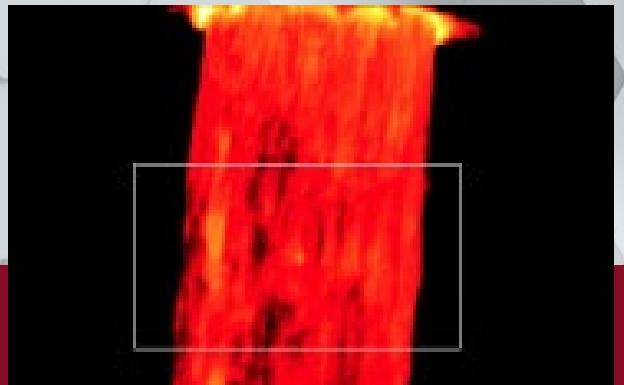


PIEPER



SDS SLAG DETECTION SYSTEM

From 800 °C to 1,800 °C
for Critical Environments

SDS - SLAG DETECTION SYSTEM

The Slag Detection System (SDS) delivers improved yields, high-quality steel and reduces costly downstream processing. There are additional benefits in reduced ladle refractory wear.

At the end of the tap the levels of slag and steel rapidly reverse. Quick termination of the tap after the alarm has been triggered is necessary to prevent excessive levels of slag in the ladle. SDS uses a high-resolution thermal imaging camera to detect the transition between steel and slag. The dedicated thermal imaging camera has been specifically designed to survive in the harsh operating conditions and utilizes a particular wavelength to reduce obscuration caused by smoke and fume. Data is presented to the operator in real time enabling them to make informed decisions about the tapping process and the system provides clear alarm notifications.

SUITABLE FOR A VARIETY OF APPLICATIONS

SDS is suitable for operators of secondary steel making vessels (e.g. EAF, BOF) including stainless steel and can also be used in other smelting operations, e.g. copper and platinum. The system can also be used to indicate freeboard height if required providing a wide field of view.

IMPROVED PRODUCT QUALITY

Using SDS has been demonstrated to improve operator response time and consistency at the end of each tap. This typically results in a reduction in slag depths of up to 25% compared to traditional methods of stream monitoring.

REDUCED DOWNSTREAM PROCESSING COSTS

The cost of additional downstream processing time and materials can be a significant burden on an operating plant. By controlling slag carry-over this costly downstream processing can be reduced or eliminated, improving plant throughput, product quality and operating margins.

AUTOMATIC OPERATIONS

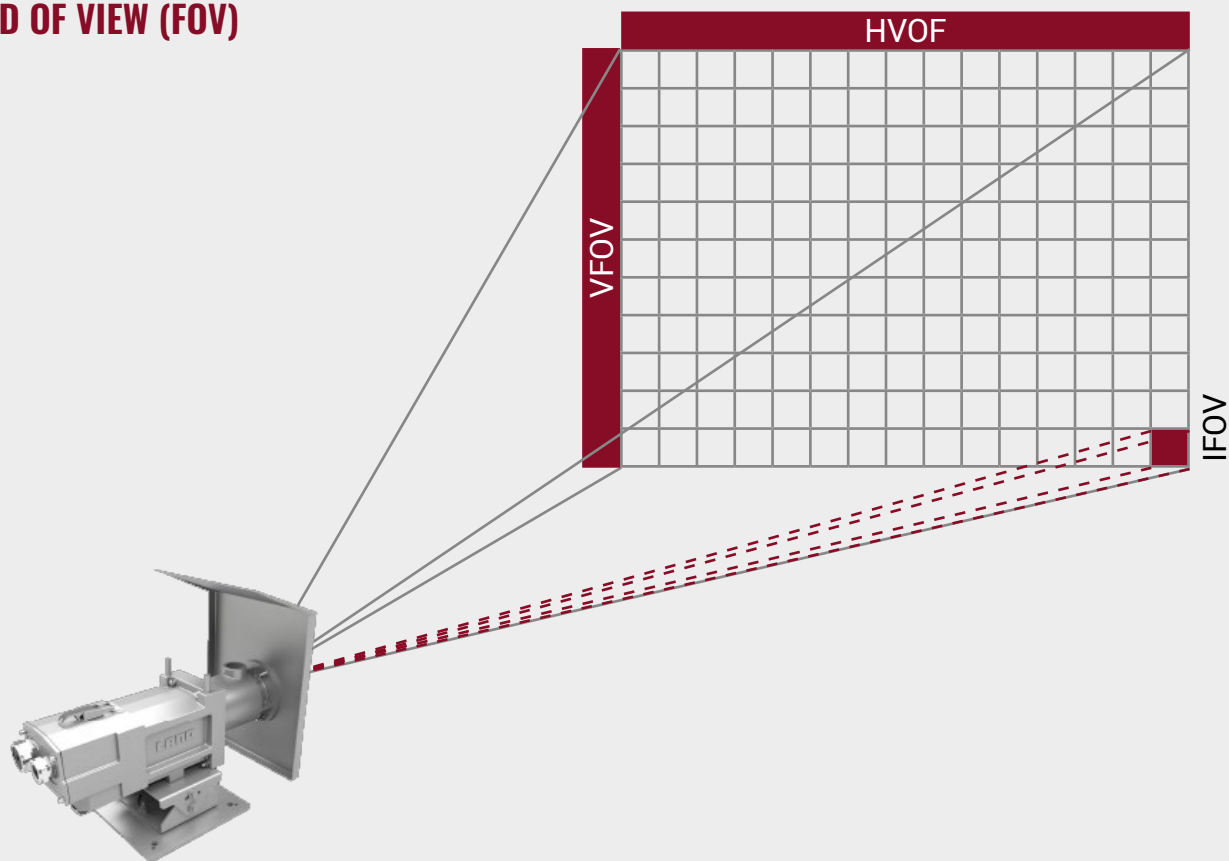
As the tap commences, the application dedicated software records a data log and produces a live graph for quality control. A stream tracking mechanism is included to ensure reliable operation in typical installation conditions. When slag appears, and exceeds an operator defined amount, an alarm is automatically triggered. The system is designed to ensure accurate, real-time detection of steel/slag independent of charge weight and without operator intervention.

KEY FEATURES AND BENEFITS

- Improved production yield
- Lower slag content improves steel quality
- Lower maintenance on BOF/EAF vessel
- Reduced energy costs
- Automatic stream identification and tracking accurately identifies the stream and reduces background interference
- Clear alarm notification sent to the operator
- Alarms generated by the system directly stop the tap before the slag is carried over
- Fully automatic operation
- Accurate detection independent of charge weight
- Reliable alarm independent of the operator
- Improved connectivity through the use of Open Data Interface



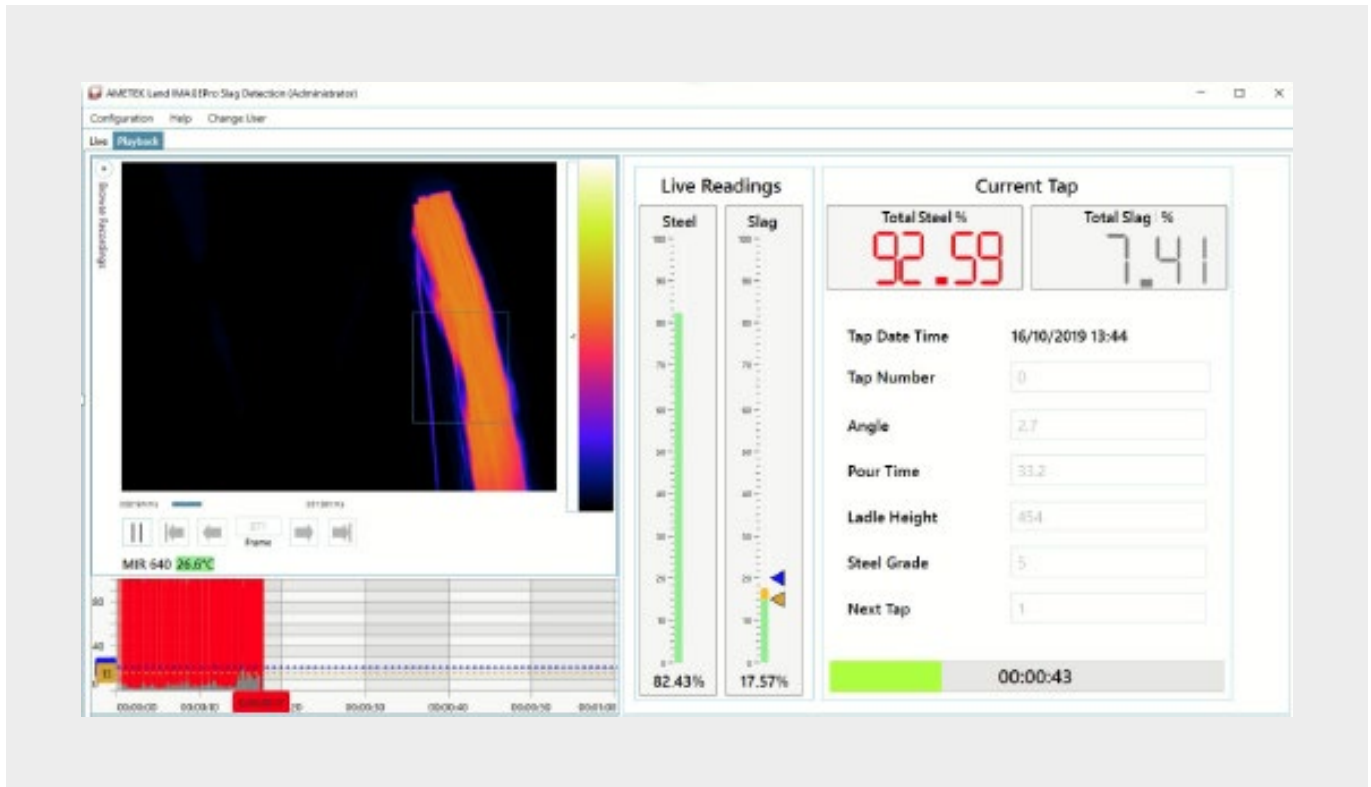
FIELD OF VIEW (FOV)



DISTANCE	4 M			5 M			7.5 M		
	Width	Height	IFOV	Width	Height	IFOV	Width	Height	IFOV
12° x 9°	0.8 m	0.6 m	1.3 mm	1.0 m	0.7 m	1.6 mm	1.5 m	1.1 m	2.3 mm
43° x 33°	3.2 m	2.4 m	4.9 mm	3.9 m	2.9 m	6.1 mm	5.9 m	4.4 m	9.2 mm

DISTANCE	10 M			15 M		
	Width	Height	IFOV	Width	Height	IFOV
12° x 9°	2.1 m	1.5 m	3.3 mm	3.1 m	2.3 m	4.8 mm
43° x 33°	7.8 m	5.9 m	12.2 mm	11.8 m	8.8 m	18.4 mm

IMAGEPRO - SDS APPLICATION SOFTWARE



STEEL/SLAG ALARM LEVELS

Steel/slag alarm percentage, steel/slag alarm status, available via Open Data Interface and relay output module. Process data can also be transferred to the SDS from the steel plant.

AUTOMATIC STREAM TRACKING

Automatically identifies and tracks the stream position within the thermal scene to reduce the effect of background interference.

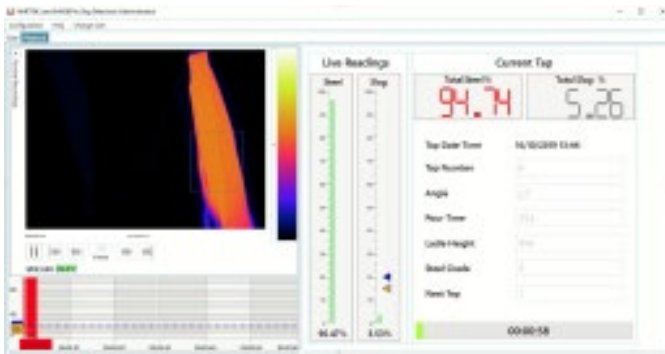
DISPLAY GRAPHICS

Bar and line graphs display the steel and slag percentage versus time. The current and overall steel/slag percentages are shown numerically and in bar charts. The user interface also shows alarm condition status and indicates alarms with color changing. This information, along with the thermal video and all text data, is automatically recorded as soon as the tap commences.



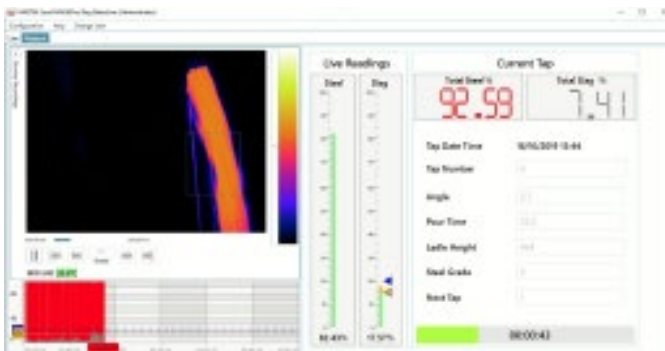
The Slag Detection System is a market leading solution for monitoring and reducing slag carryover in steel facilities. It is proven to reduce slag carryover, save money and improve operator safety.

PREVENTING SLAG CARRYOVER



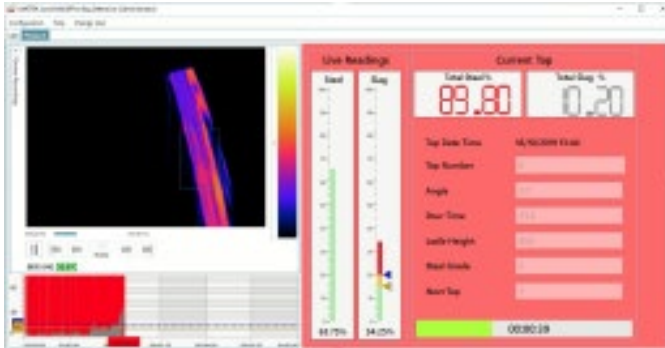
COMMENCES CONTENT MONITORING

1. SDS starts monitoring the steel and slag content continuously after detecting the tapping stream automatically.
2. At the beginning of the tap, the current steel content is 96.47% and the current slag content is 3.53%. These are displayed live in the bar graphs.
3. The remaining tapping time is counted down in the lower right bar.



MONITORS RISING SLAG CONTENT

4. During the tapping process, the current slag content rises to 17.57%, shown in the bar graph, which has changed to yellow (pre-alarm). The current steel content is 82.43%
5. The overall steel content and slag content for the tap so far are shown in the right-hand corner of the screen, and both are continuously updated throughout the tapping process. The overall steel content is now at 92.59%, and the overall slag content is still low at 7.41%. The overall slag alarm level is set to 10%.



TRIGGERS ALARM AND STOP TAP

6. Once the current slag content reaches 34.25%, it triggers the alarm (red). This also shows that the current steel content has fallen to 65.75%.
7. The overall slag content is now 10.2%, and the overall steel content is 89.8%. As the overall slag alarm level has now been triggered, the tapping process has stopped, visually indicated by the right-hand side of the screen turning red.



CONFIRMS OVERALL TAP CONTENT

8. The SDS will now continue to monitor the tapping for slag and steel content during the remainder of the process.
9. At the end of the tapping process, the overall steel content is 87.98%, and the overall slag content is 12.02%. The data is captured and exchanged with the plant control system.

SPECIFICATION AND DESIGN

POWERFUL DETECTION SYSTEM PREVENTS SLAG CARRYOVER

This comprehensive, fully featured system has been developed to provide steel plant engineers and managers with the tools to develop and improve the transfer of steel from one process to another.

SDS offers the steel plant an number of connection methods for on-line control and, more importantly, it automatically records the tap data in three forms for post analyses and future process improvement.

In addition to this, the process imaging workstations comes with software pre-installed and configured to work straight out of the box with minimum setup required.

Once the system hardware is installed in the steel maker, as soon as the systems is turned on, the steel plant can immediately begin to reduce slag carryover.



STRAIGHTFORWARD FIBER-OPTIC CONNECTIVITY

Connecting the image processing system to the plant network via the Open Data Interface allows live data transfer to and from the slag detection system to improve the steel transfer process.

Data that can be input to the SDS includes tap number, alarm level and five unique variables specified by the steel plant such as charge-number, heat-number, steel grade and tap temperature. When used, these data are recorded in the saved text data file.

Data output form the system can be transmitted at up to 50 frames per second. This information includes steel slag percentage, alarm status, sensor temperature and communications status.

The SDS Power Supply Unit (PSU) is supplied with fiber-optic 1 GB copper Ethernet connectivity

(fiber-optic) for easy installation and integration into existing plant systems.

OBSERVE CRITICAL TAP INFORMATION

Pre-installed on the powerful image processing workstation, the display allows users to observe critical tap information such as the live thermal image, steel and slag percentages, time versus percentage graph, alarm level and alarm status.

Secondary information such as tap number, sensor temperature, communications status, tap duration, steel/slag ratio and record status are less prominent so as to not distract the user during the tap. External inputs from the plant can be also be easily monitored and recorded with the SDS data.

VIEW THE TAP INFORMATION THROUGHOUT THE PLANT

Multiple users can remotely view the live tap anywhere on the plant network by using the remote viewer option in IMAGEPro-SDS.

At the end of the tap the video, text data and graph are saved by tap number for later analysis and, if needed, be automatically deleted after a user defined number of days.

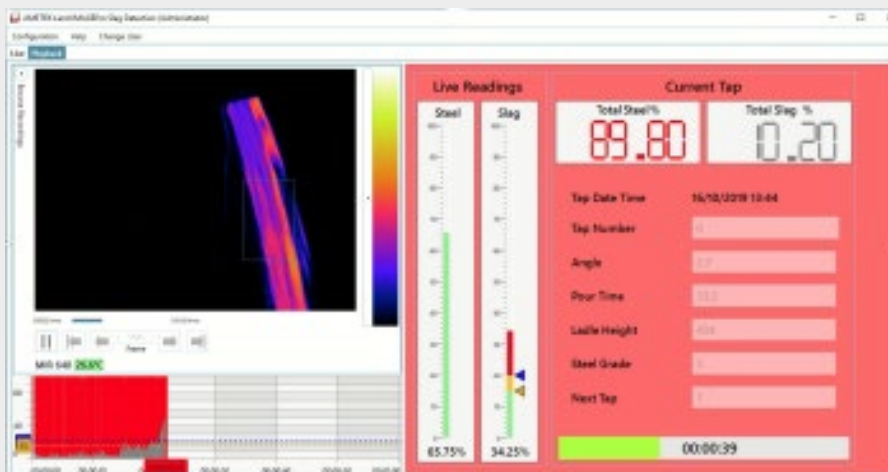
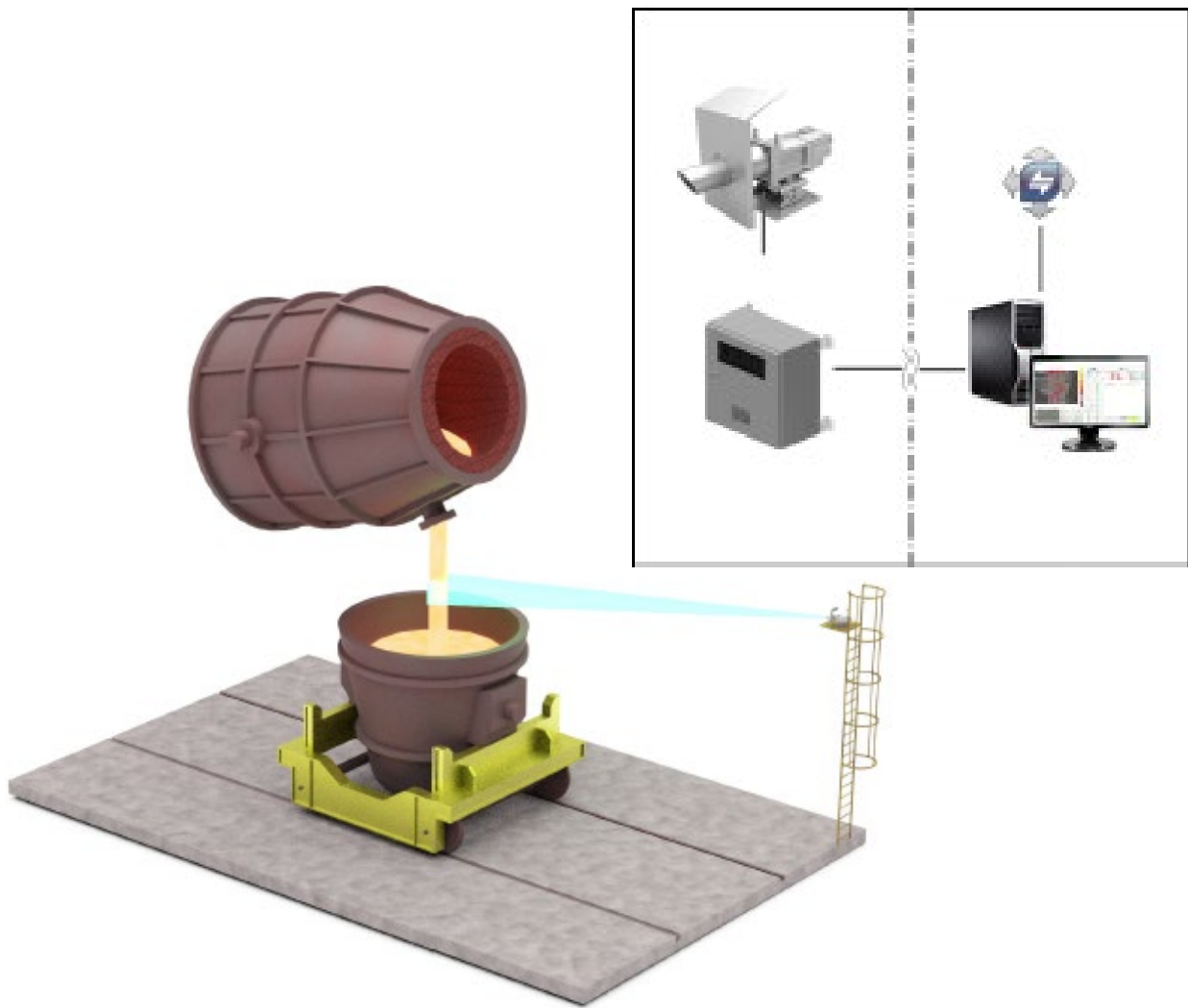
Data can be transmitted between the plant and the slag detection system via hardware modules or ethernet (modbus TCP) all of which are controlled by the Open Data Interface.

AUTOMATIC STREAM TRACKING

Another key feature of the SDS is automatic stream tracking. The dedicated slag detection image processing software has the option to track the width and position of the stream regardless of the position of the sensor unit.

When viewing the stream from an acute angle, its position will change during the different phases of the tap - the software accurately tracks any movement that may occur as the pour takes place, only measuring from the area identified as the stream. This reduces any errors caused by background heat sources in the field of view.

CONTINUOUS MONITORING AND CLEAR VIEWS



REMOTE VIEWER

Remote connections allow viewing of live tap information anywhere on the plant network.

LANGUAGE

The software offers local language support.

SPECIFICATIONS

SDS Camera Unit	
Measurement range:	800 to 1.800 °C
Image resolution:	640 x 480 pixels
Spectral response:	3.9 µm
Frame rate:	50 frames/second
Detector:	Microbolometer Focal Plane Array
Optics:	12° x 9° / 43° x 33°
Focus range:	4 m to infinity
Protection window:	Sapphire (available as spare part)
Accuracy:	±2% of measured value
Temperature resolution:	0.5 °C (800 °C blackbody temperature)
Enclosure:	Water cooling and air purged enclosure with heat protection shield
Sighting Tube:	Design significantly reduces the risk of direct impact of liquid steel/metals against the field
Dimensions:	560 x 215 x 235 mm
Weight:	10 kg
Environmental Rating:	IP65
SDS camera supply	
Connection:	Local connection interface between camera unit and image processing system
Services:	Water, instrument air, power input, located to the rear of the enclosure
Power supply unit (PSU)	
Components and connections:	Power supply, Ethernet communications (switch), Fibre optic data connection (option)
IP Rating:	IP65 / NEMA 4
Size:	380 x 380 x 211 mm
Weight:	15 kg
UL Approval:	Listed to UL508A & CSA-C22.2 No. File Number E499440
Image Processing Unit	
Slag/steel detection:	Alarm activation when a preset percentage of either slag or steel/metal detected within defined window
User display:	Front page information display and location identifier. External data displayed via interface input
Automatic functions:	Auto tap detection, stream tracking, steel/slag ratio, thermal video and video file recording, log file of all data including tap number, clear display of steel/slag percentage (bars, numbers and graphs) alarm colors etc.)
Software:	IMAGEPro-SDS - Advanced Image Processing and Application Software
Interfacing:	Open Data Interface, Modbus TCP, Moxa I/O unit

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