

SDS - Slag Detection System

Advanced thermal imaging based slag detection system

LAND Slag Detection System (SDS) uses a high resolution thermal imaging camera to detect the transition between steel and slag. Designed to operate in harsh conditions, it uses a specified infrared wavelength to reduce obscuration caused by smoke and fumes.

SDS is suitable for operators of secondary steel making vessels such as electric arc furnaces and basic oxygen furnaces, including those used for stainless steel. It can also be used in smelting operations for copper and platinum and other tapping processes.

By using additional regions of interest (ROI) together with an additional thermal imaging camera, optional features such as stream position and freeboard height can also be integrated providing advanced process monitoring and control.

ImagePro SDS is an integrated application within the ImagePro thermal imaging software package. As the tap commences, the software records a data log and produces a live graph for quality control. With the multicamera option, users can seamlessly integrate additional imagers into the system and software, enabling them to operate independently from the camera and continuous slag detection system.



FEATURES & BENEFITS

- **Up to 25% reduction in slag depths** compared to traditional methods of stream monitoring.
- **Fully automatic operation** allows alarms generated by the system to directly stop the tap before the slag is carried over.
- **Automatic stream identification and tracking** accurately identifies the stream and reduces background interference.
- **Powerful ImagePro SDS** monitoring and control software includes a full range of functions from a single source.
- **Optional secondary imager** for stream position and freeboard level monitoring and control.

Slag Detection System (SDS) delivers improved yields, higher quality steel and reduces costly downstream processing costs.

See degrees differently.

FIELD OF VIEW

Distance	4m			5m			7.5m			10m			15m		
	Width	Height	IFOV	Width	Height	IFOV	Width	Height	IFOV	Width	Height	IFOV	Width	Height	IFOV
12° x 9° *	0.8 m	0.6 m	1.3 mm	1.1 m	0.8 m	1.6 mm	1.6 m	1.2 m	2.5 mm	2.1 m	1.6 m	3.3 mm	3.2 m	2.4 m	4.9 mm
25° x 19°	1.8 m	1.3 m	2.7 mm	2.2 m	1.7 m	3.4 mm	3.3 m	2.5 m	5.1 mm	4.4 m	3.3 m	6.8 mm	6.7 m	5.0 m	10.2 mm

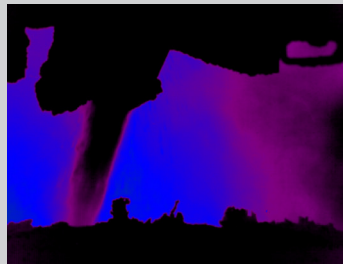
*standard imager FOV option for stream measurements (usual distances 3-5 m)

THE CRITICAL ADVANTAGE



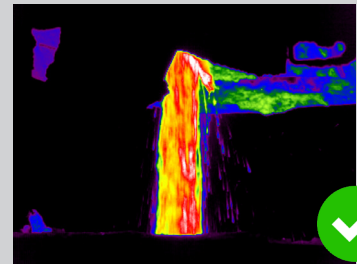
VISIBLE VIEW

Not possible to detect the tapping stream



LWIR IMAGER

Not suitable as smoke, particles and hot gases are present



MWIR IMAGER

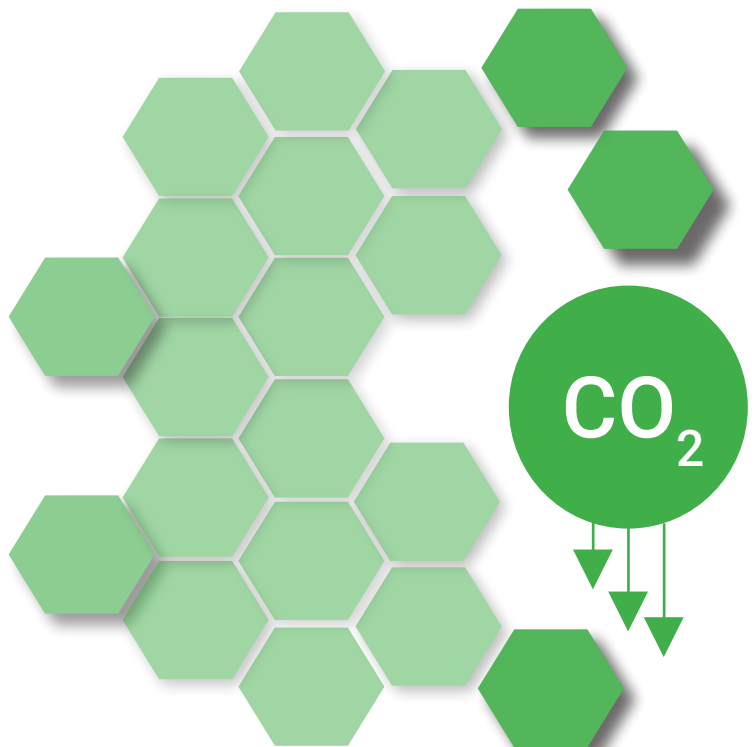
Best solution, providing the clearest view of the stream

GREEN STEEL PRODUCTION

Slag detection in green steel production is a critical process aimed at identifying and monitoring the presence of slag during its initial stages of production.

Slag is undesirable as it can negatively affect steel quality and lead to costly production issues. Various sensors and monitoring systems are employed to detect and analyze the composition and amount of slag in the steel melt. This information helps steelmakers take timely corrective actions to ensure the production of high-quality steel with minimal waste, contributing to more sustainable and efficient steel manufacturing processes.

Green steel is crucial to decarbonization efforts because it offers a pathway to significantly reduce carbon emissions in the steel industry, conserve resources, improve energy efficiency, stimulate innovation and economic growth, and meet the growing demand for environmentally sustainable products in a carbon-constrained world.



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IMAGEPRO - SDS APPLICATION SOFTWARE

Pre-defined User Interface

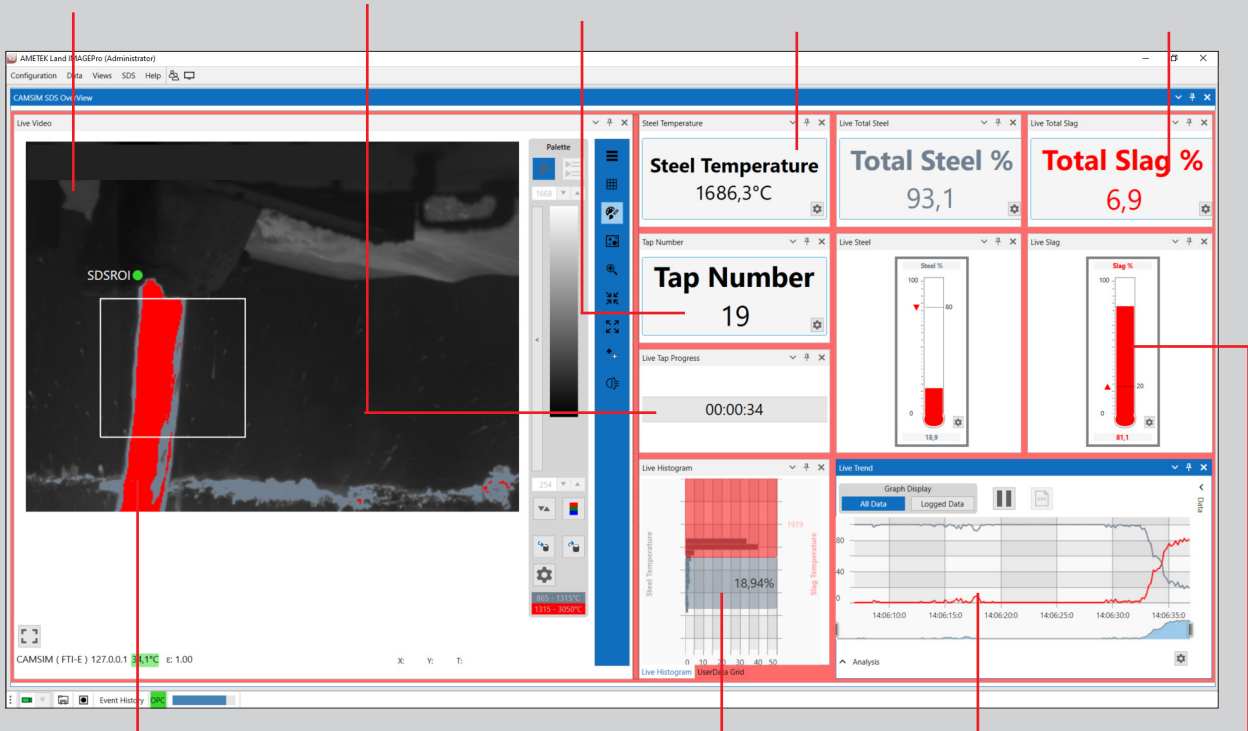
Live Thermal Image

TAP Time

TAP Number

Steel Temperature

Slag%/Steel% Values



Stream Tracking

Multi Histogram

Slag%/Steel%
Trend Graph

Slag%/Steel%
Gauges

TAP TIME

Monitors and counts the actual and final tapping time.

TAP NUMBER

Current tap number is automatically incremented or based on a in/out tag.

STEEL TEMPERATURE

Monitors the actual steel temperatures, based on emissivity settings.

SLAG%/STEEL% VALUES

Cumulative slag and steel percentages over the whole tapping process.

SLAG%/STEEL% GAUGES

Actual steel and slag %.

SLAG%/STEEL% TREND GRAPH

Time trend graph of the actual steel and slag levels.

MULTI HISTOGRAM

Clearly monitors the ongoing change and levels of steel and slag contents.

STREAM TRACKING

Automatic and intelligent stream tracking by continuously following the actual tapping stream.

LIVE THERMAL IMAGE

Live image of the MWIR-640 SDS thermal imager.

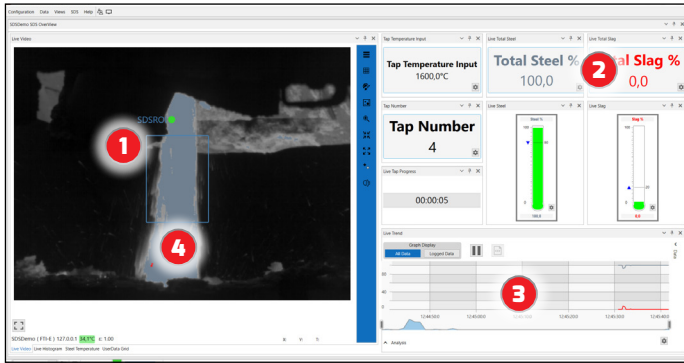
The Second Generation Slag Detection System represents a further development of LAND's market-leading solution for monitoring and reducing slag carryover in steel facilities.

This system is proven to reduce slag carryover, save money, improve operator safety, and contribute to the reduction of energy consumption and emissions in the process of decarbonizing steel production, based on hundreds of reliably operating field installations.

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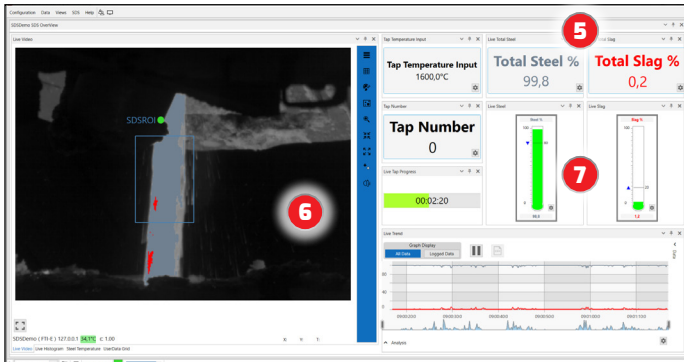
HOW SLAG CARRYOVER IS PREVENTED

START OF THE TAPPING PROCESS



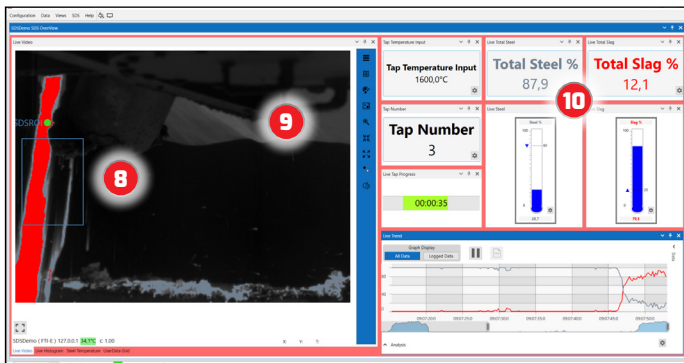
1. The automatic or input based tap detection starts the slag detection process and tracks the tapping stream during the whole tapping process.
2. Slag and steel percentages are monitored continuously as cumulative and instantaneous values.
3. Graphs and gauges clearly monitor the detected steel/slag levels.
4. The live thermal image continuously provides a process view.

DURING THE TAPPING PROCESS



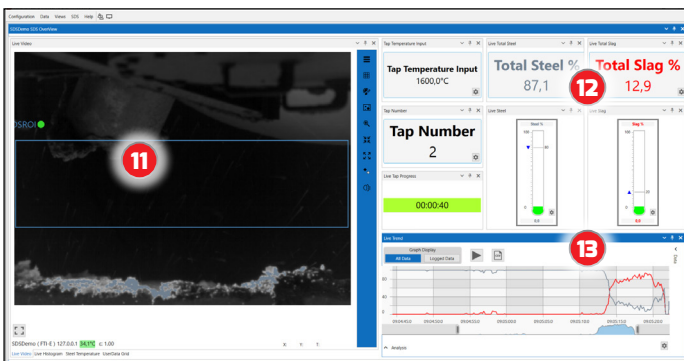
5. During the whole tapping process the steel and slag levels are accurately measured and monitored, while compared with pre-defined threshold levels.
6. The ongoing tapping process is clearly monitored to the operator.
7. The cumulative level values show the actual tapping process status together with customer defined values, such as tap numbers and further data.

CLEARLY MONITORED ALARM STATUS



8. In case any threshold levels are exceeded, the software surface turns to red and clearly monitors an alarm stage.
9. With the digital and analog I/O interfacing the tapping control system stops the tapping process safely.
10. The alarm status is continuously captured.

END OF TAPPING PROCESS



11. The system automatically detects the end of the tapping process or uses an external input.
12. With the detected end of a tapping process the tapping time and overall slag and steel levels are monitored and captured.
13. Interfacing options continuously provide these data points to the control system.

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SPECIFICATION & DESIGN

Powerful detection system prevents slag carry-over

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 a number of connection methods for on-line control and, more importantly, it automatically records the tap data in three forms for post analysis and future process improvement.

In addition to this, the process imaging workstation comes with software pre-installed and configured to work straight out of the box with minimum set-up required. Once the system hardware is installed in the steel plant, as soon as the system is turned on, the steel plant can immediately begin to reduce slag carryover.

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 I/O modules or EtherNet (Modbus TCP/IP) or OPC UA, all of which are controlled by the Open Data Interface.

Freeboard level and stream position monitoring

Using multiple imagers in the system, based on full ImagePro functionality and process control options.

Straightforward fibre-optic connectivity

Connecting the image processing system to the plant network via multiple interfacing, using ethernet interface protocols such as Modbus, TCP/IP or OPC UA, apart from free configureable I/O modules, configured in 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 from the system can be transmitted at high speed up to 60 fps - based on the new advanced MWIR-640 SDS thermal imager. This information includes steel slag percentage, alarm status, sensor temperature and communications status.

The SDS Power Supply Unit (PSU) is supplied with the option of fibre-optic or 1 GB copper Ethernet connectivity for easy installation and integration into existing plant systems, based on typical used fiber types

Automatic stream tracking

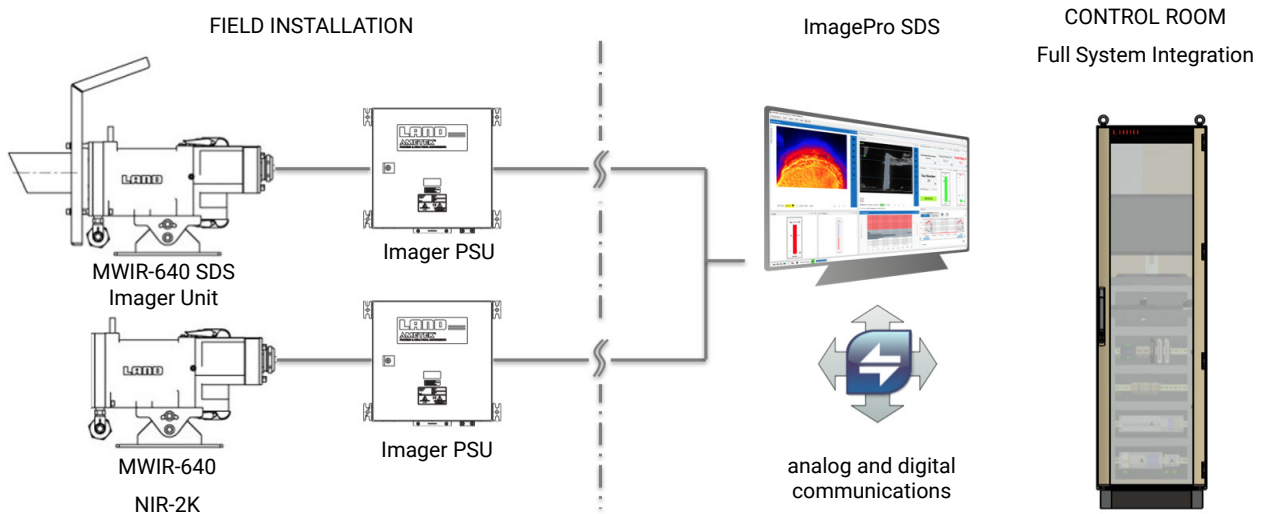
Another key feature of the SDS is automatic and intelligent stream tracking. The dedicated slag detection image processing software has the option to track the width and position of the stream regardless of the position of the sensor unit.

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.

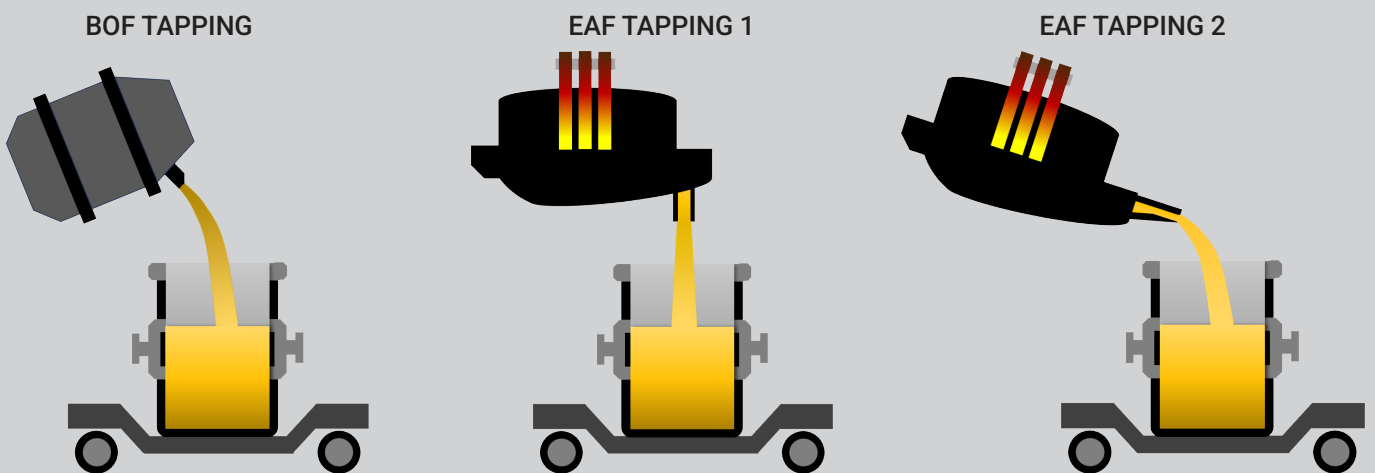


See degrees differently.

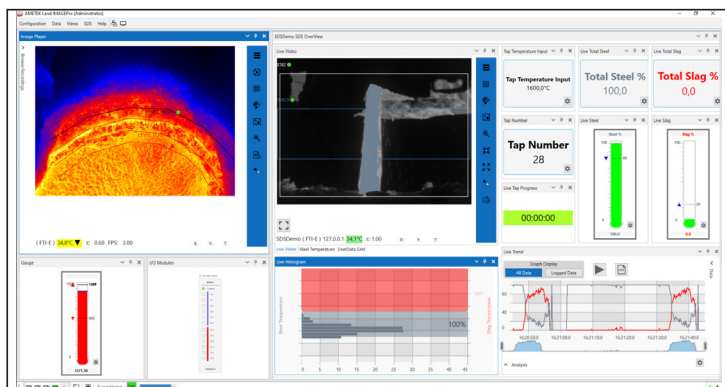
SYSTEM OVERVIEW



TYPICAL TAPPING PROCESSES



MULTI CAMERA OPTION



ImagePro SDS is an integrated application within the advanced ImagePro thermal imaging software package. With the optional multi-camera license, users can seamlessly integrate additional imagers into the system and software, enabling them to operate independently from the camera and continuous slag detection system.

For instance, you can incorporate extra MWIR-640 and NIR-656/-2K industrial imagers to capture real-time freeboard levels on-site. This comprehensive approach allows for simultaneous recording, visualisation, and control of both processes within a centralized application

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SDS SYSTEM SPECIFICATION SHEET
SPECIFICATIONS

SDS SYSTEM SPECIFICATIONS

MWIR-640-SDS CAMERA UNIT

Measurement Range:	500 to 1800 °C / 932 to 3272 °F
Pixel Resolution:	640 x 480 pixels
Pixel Size / Pitch:	17 µm
Spectral Response:	3.9 µm
Max Frame Rate:	HF: 60 Hz* / LF: 7.5 Hz
Optic (HFOV x VFOV):	12° x 9° / 25° x 19°
Focus Range:	0.75 m to infinity (12° FoV) 0.5 m to infinity (25° FoV)
Accuracy:	1% of reading
Noise:	0.5 °C RMS @ 500 °C, 12° FoV
Dimensions:	Approx. 450 mm/17.7 " x 373 mm/14.7 " x 215 mm/8.5 " (Full imager enclosure)
Power Rating:	12 to 24 V DC +/-10% 12 W / IEEE 802.3 at PoE+
Weight:	10 kg / 22 lb
Environmental Rating:	IP66 / NEMA 4
Compliance:	EMC (EN 61326-1)

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

PSU (POWER SUPPLY UNIT)

Components & Connections:	Power supply, Ethernet communications (switch) Fibre optic data connection (option)
IP Rating:	IP65 / NEMA 4
Size:	380 x 380 x 211 mm / 15 x 15 x 8.3 in.
Weight:	15 kg / 33 lbs.

IMAGE PROCESSING UNIT

Slag/Steel Detection:	Alarm activation when a pre-set 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:	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 colours, etc.)
Software:	ImagePro SDS - Advanced Image Processing and Application Software
Interfacing:	Open Data Interface, Modbus TCP/IP, Moxa I/O unit

* 60 Hz instruments are subject to different export restrictions in different authorities and countries around the world. All sales must be subject to export licence review.



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