Thermo Scientific ARL SMS-3500 system Automation of twin OES and XRF spectrometers

The Thermo Scientific™ ARL™ SMS-3500 system is a turnkey laboratory workflow automation solution to drive process control laboratories efficiencies in the metals and mining industries. The automation of multiple spectrometers and preparation machines offers new opportunities for users requiring more comprehensive and integrated automation solutions.

An evolution of existing automation solutions

Thermo Scientific robotized spectrometers have been continuously enhanced since the early 90's as a result of customer's feedback and experience. With over 700 systems installed in metals applications around the world, we have an undisputed reputation of performance and durability.

The ARL SMS-3500 system builds on this success and shows:

- Our commitment to look beyond the footprint of stand alone laboratory instrumentation and focus on complete workflow solutions

- Our capacity to use a variety of competences and products such as larger and more powerful robots to deliver new automation solutions at the leading edge of technology

Single source – One partner, one competence, one responsibility

We are unique in designing and manufacturing X-ray fluorescence (XRF) and optical emission spectrometers (OES) with their automation system.

Our competence is not merely limited to one analytical technique or automation but covers complete systems delivered with sample preparation as turnkey packages.

Thermo Fisher
S C I E N T I F I C

Exceptional performance at affordable cost

Double OES configuration
This is typical of primary metals producer's laboratories where two instruments are necessary to permanently provide analysis services and assure fast response times when several urgent samples have to be processed at the same time.

High sample throughput and analysis dependability
In metals applications, this permits to cope with heavy sample workloads. The ARL SMS-3500 system is an affordable alternative to the higher cost of two fully duplicate and separate automated lines, each with its own robot. It simplifies sample handling by providing a single introduction location for all samples with an optional magazine storage function of up to 32 production samples to free the introduction.

Combined XRF and OES analysis
In high alloy and stainless steel, specific aluminum or copper, brass and bronze applications, a single sample analysis is produced with high concentration alloy elements from the ARL 9900 XRF spectrometer and trace and light elements from the ARL iSpark metals analyzer.

Very short response times
Just a few seconds are needed for the ARL SMS-3500 robot to move samples between the system components.

Increased uptime and speed
Complex and time consuming electro-mechanical transfer systems are eliminated. The results are available much faster, which improves production turnover. This is indeed more significant than productivity gains related to labor savings.

ARL SMS-3500 with twin OES and Haas MiniMill preparation machine

### Latest industrial robotics technology with intelligent ARL SMS software
The ARL SMS-3500 system uses our SMS software with enhancements and intelligence to drive simultaneously two spectrometers and two preparation machines. It is equipped with a FANUC robot, the number 1 supplier of industrial robots worldwide.

The ARL SMS-3500 system uses a large floor standing industrial robot with an arm length with gripper of 1614 mm and 6 moving axes. This larger work volume allows the two spectrometers to be installed aside each other. Minimum floor space is necessary for the complete system and short distances between the various components ensure fast operation without any compromise on accessibility for service and maintenance. This also provides increased flexibility in the positioning and interfacing of the sample preparation machine(s).

The ARL SMS-3500 heavy duty robot has an impressive max payload of 10 kg suited for twin spectrometers automation. Given usual production sample weights, this means less solicitation and reduced wear, increased reliability and longer lifetime. Minimum maintenance is required as the ARL SMS-3500 robot uses high-precision, brushless AC-Servo motors and internal cabling. Absolute encoder technology establishes the mechanical origin once for ever when the unit is first turned on.

ARL iSpark AutoStand
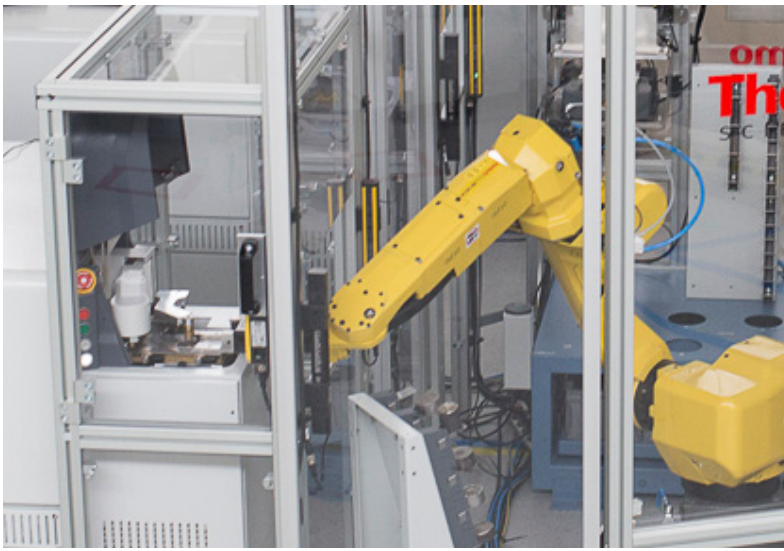
ARL iSpark robot access for automatic analysis

ARL iSpark access for manual analysis

An automation product designed with its users in mind

Simplicity of operation

The ARL SMS-3500 automation software is based on the same platform than our OXSAS analytical software for OES and XRF spectrometers. This common ground provides a unique and standardized software environment which greatly simplifies using fully automated OES and XRF spectrometers. In addition, a single SMS system monitoring screen provides access to the full range of sample tracking and automation user functions.

Flexible instrument integration and comprehensive analysis modes

When two equivalent spectrometers are used with two preparation machines, the samples can be prepared and analyzed simultaneously for optimum sample throughput; sample cross transfer is standard: the samples can be prepared by any of the two preparation machines and analyzed by any of the two spectrometers to reduce response times and to ensure optimum availability around the clock and 365 days per year.

Sequential processing applies to twin XRF and OES configurations when the same sample has to be measured by XRF and OES. Each spectrometer can be used off-line for analytical method development and tests. The instrument accesses for operator and robot are automatically controlled by the SMS software; a simple software command allows switching equipments between automatic and manual modes.

Full compliance with security regulations

The ARL SMS-3500 safety enclosure is designed according to the applicable CE conformity standards. The system is also compatible with robotics application and electromagnetic norms and recommendations.
A separate control box is used to temporarily pause the robot operation and unlock the access doors for a manual

intervention inside the system. The automatic operation can then be quickly resumed without having to restart the system.

Easy service and maintenance

Each instrument or preparation machine can be quickly disconnected without interrupting the automatic system operation. This allows a quick cleaning of the OES stand for instance. In addition, the spectrometers can slide to a separate park position for service or for manual operation over longer time periods. No interruption of the SMS system is needed; the spectrometers supplies must not be disconnected. Sliding the spectrometer back in the SMS and resuming the automatic operation is done in just a few minutes.

More efficient laboratory automation

The integration of separate sample preparation and analysis systems in one or more compact ARL SMS-3500 cells streamlines full laboratory automation. Samples received via automated air tubes can be immediately processed leading to major cost and significant response time savings. These samples can also be temporarily stored and processed by priority.

The result is the most advanced automation solution with unmatched features, performance and reliability


Park position for the ARL iSpark

Material analysis is our job, quality our strength and automation our commmitment

## The ARL SMS-3500 system features as standard

- Complete safety enclosure with computer controlled operator access doors and control box

- Color lamps showing the status of the system and of the instruments

- Comprehensive instrument monitoring procedures to ensure that the spectrometers permanently deliver quality results, avoiding scrap and rework in production

- Early detection of sample presence

- Waiting positions for the temporary storage of prepared samples waiting for analysis to further optimize throughput

- A large magazine for up to 90 setting- up, control samples and type standards which can be shared between the two spectrometers or dedicated to a

specific instrument. Sections of the magazine can also be used for temporary storage of incoming samples

- Support of conditioning samples for OES stand cleaning purpose

- Rotation of standards by the robot before re-preparation using any of the two preparation machines, to avoid any bias in the prepared surface over time

- Filing of selected samples on a chute (e.g. bad samples)

- Sample sorting and filing in 8 boxes

- Inverting device to invert standards and samples upside down before/after preparation, if necessary

- Manual introduction position to introduce/remove standards from the system and introduce production sample
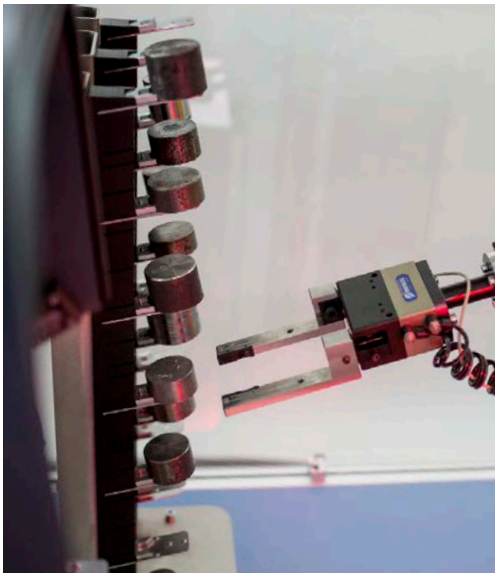
Fixed magazine for standards

Manual introduction position
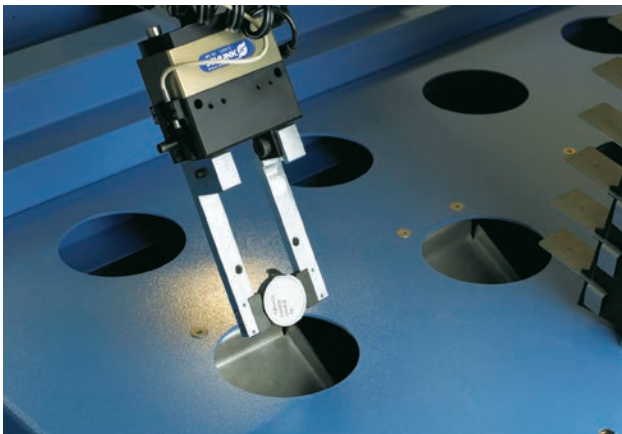
Production or SCT Sample filing in a box

Production or SCT Sample filing on a chute

Scalable solution to meet your specific needs

A full range of options including

- A sample introduction magazine function for processing of up to 32 production samples by priority

- Choice of the sample preparation machine to obtain high quality, reproducible sample analysis surfaces

- Support of oxides associated with metal production (mineral ores, sinters, baths, slags and blast furnace slags)

- Up to 5 production sample shapes

- Sample registration via terminal or network

- Registration from the list of production samples announced by other computers

- Registration using sample identification parameters recorded on a network disk

- Labeling of production samples on the analysis surface or on their back

- Vision system to evaluate prepared sample surface quality and reject bad samples without analysis trials. For OES, selection of the best spark positions in case of difficult samples

- Sample collections and batches; to facilitate the registration and processing of repetitive series of samples (for instance, samples from aluminum electrolytic baths)

- Remote control of the automated ARL OES and XRF spectrometers

- Additional digital signals to those supplied as standard for communication of alarms to external visual or acoustic devices

- Automatic re-preparation of samples which cannot be analyzed

- Sample radioactivity detection (RMS)

- Chronological filing of production samples on 3 chutes in addition to the chute supplied as standard

- Pneumatic introduction slide

- Local or remote manual sample introduction door

- Handling and cooling of hot samples (Max. 850°C) using air or/and water media.
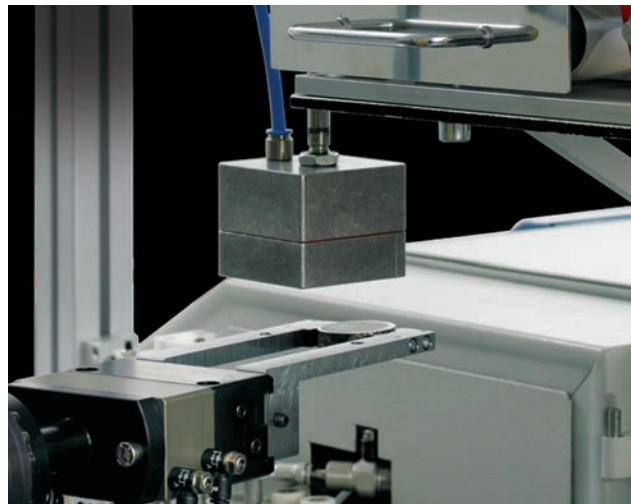
Vision system
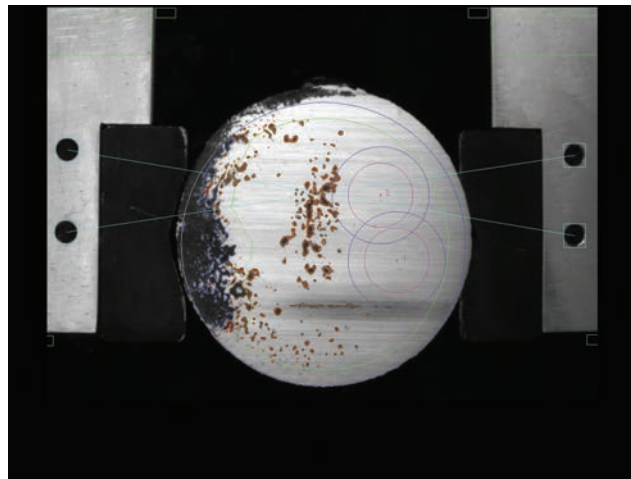
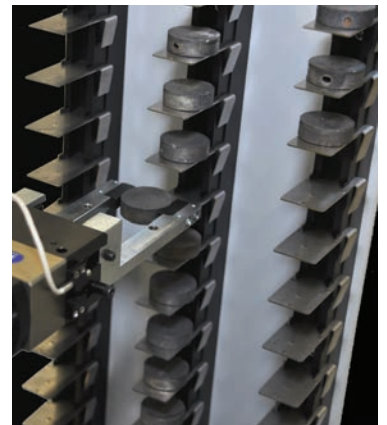Spark position evaluation with vision system

SMS Cooling

Manual sample introduction door

Labeling system

Temporary storage of incoming samples

Top class sample preparation solutions

Tightly integrated and double sample preparation machine support

The ARL SMS-3500 system robot has a direct access to the milling machine to save sample preparation time. This is done via a separate access side door avoiding extra hardware to bring samples and standards in and out of the milling machine. And up to two sample preparation machines are supported which further reduces response times, increases sample processing cadence and improves the availability of automatic sample preparation in highly critical production control environments.

An open architecture for sample preparation

High quality, reproducible and reliable sample preparation is an essential component of the automated spectrometer system which contributes directly to the analytical performance and the system uptime.

Metals sample preparation has undergone a significant evolution in recent years. Milling has become the preferred preparation technique.

Fully aware of the market expectation to have a choice of sample preparation solutions and brands, we propose several sample preparation alternatives allowing customers to select the best solution depending on their preferences, needs and budgets.

This includes the Haas Mini Mill with Thermo Scientific ARL PrepControl™ and Thermo Scientific ARL EasyPrep™ software and the well-regarded milling machines designed exclusively for this application by specialized traditional manufacturers (refer to the separate product specifications).

Mini Mill magazine with up to 10 milling heads with automatic milling head change in 5 seconds

Color touch screen for semi automatic operation using the ARL EasyPrep software

A generic automation solution

Even more capabilities than the other ARL SMS systems

The family of ARL SMS automation products consists of:

- The ARL SMS-Omega for the automation of the ARL OPTIM'X entry level WDXRF spectrometer

- The ARL SMS-PFX for the ARL PERFORM'X WDXRF spectrometer

- The ARL SMS-XY manipulator based system for XRF applications

- The ARL SMS-2300/2500 robotized systems for single OES or XRF spectrometer and sample preparation automation

- The ARL SMS-3500 system for the automation of twin OES and/or XRF spectrometers with double preparation machine support

The same set of core SMS software sources is used to generate any of these versions.

This maximizes the synergy between applications, reduces development and testing efforts and facilitates maintenance work. Most important, it permits supplying the same software to all customers irrelevant of the specific hardware configuration.

This unique strategy assures full maintainability and upgradeability to protect the installed base from obsolescence and allow customers to keep pace with the fast evolution of the technology, at minimum cost.

ARL SMS-XY for X-ray spectrometer

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Built-in intelligence to manage your samples and avoid mistakes and delays

A unique laboratory productivity enhancement tool for metals and mining applications

The ARL SMS-3500 system is a great step forward in advancing process control in the metals and mining industries.

Best use of your resources

The ARL SMS-3500 system is designed to manage your samples to ensure the shortest response times given their priorities and the sample preparation, and analysis resources available at any time. With a single sample introduction position, the operators are released from the selection of the specific equipment to process a sample. Efficient back-up procedures are automatically applied when necessary to avoid any discontinuity in the analytical services.

An affordable automation solution

Expensive peripherals like vision or sample labeling can be shared between two instruments. A single set of up to 90 standards is necessary for the monitoring of two OES or XRF instruments. A single robot and SMS automation workstation are necessary. Expensive electromechanical sample transfer devices are not needed anymore to provide cross transfer between any of the two spectrometers and any sample preparation machine.

The right automation solution for your specific application

The family of Thermo Scientific SMS automation solutions sets new standards for manually operated instruments to match, and makes automation even more indispensable to advance your quality control capabilities. You can now choose the automation solution best suited to your needs.

The ARL SMS systems are true products manufactured and maintained according to ISO 9001-2000 procedures alongside our reputed metals analyzers and XRF spectrometers. As designers of the spectrometers producing the analyses, the only deliverable of the process, we are best able to supply and support instrument and laboratory workflow automation solutions, as single source.

Our automation specialists are available to evaluate your application and to advise on solutions.

Furthermore, economical justification tools are available to evaluate the savings and estimate how quickly your investments will pay back.
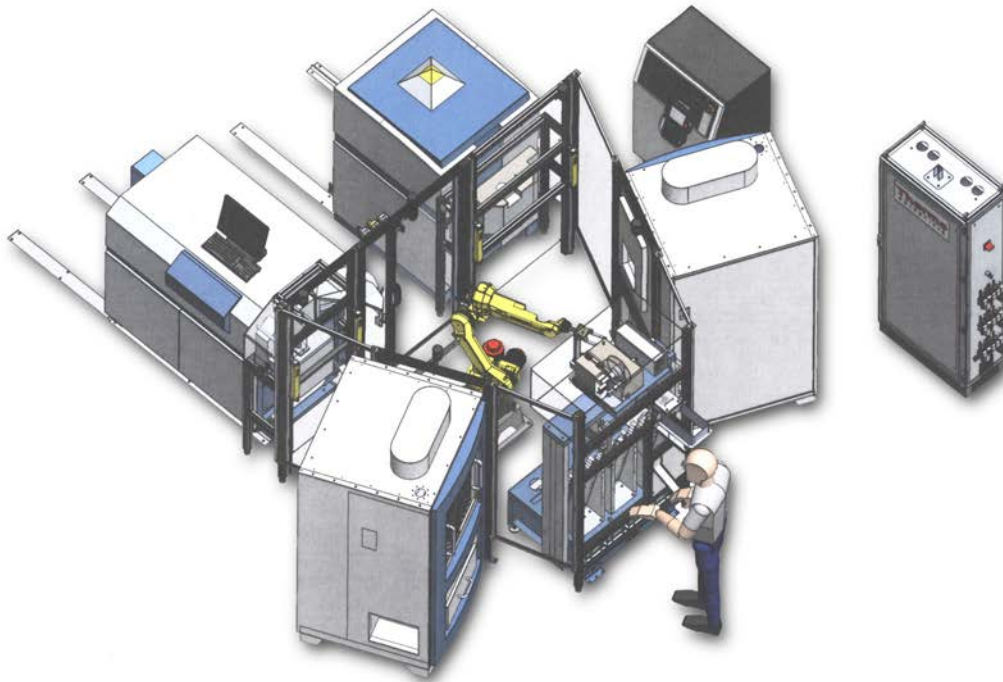
The ARL SMS-3500 with twin XRF and OES spectrometers and two preparation machines

Specifications

Spectrometers supported

Optical Emission (OES)	ARL iSpark metals analyzer
X-Ray Fluorescence (XRF)	ARL 9900 series XRF or Workstation / ARL PERFORM'X

Samples

Robot payload		Max 10 kg
Production samples - Metals	Shape	Lollypop single and dual thickness, oval (spemis), disks, cylindrical or slightly conical. ASTM aluminum. Parallel surfaces required for XRF
	Dimensions	Tolerance within ± 1 mm
	Thickness	8-60 mm for OES, 8-30 mm for XRF (8 mm minimum after preparation)
Production samples - Powder	Shape	Pellets in steel rings (51.5 x 8 mm or 40 x 14 mm) - Fused beads on metallic supports
Setting-up samples, control samples, type standards (SCT). Conditioning samples	Shape	Metals: disks, cylindrical or conical (max. 3° cone angle) Powder: pellets in steel rings, fused beads on metallic supports
	Dimension	32-52 mm in diameter for XRF; smaller samples (> 25 mm in diameter) by OES only
	Height	8-60 mm for OES, 8-30 mm for XRF (8 mm minimum after preparation)
	Storage magazine	45 samples (3 sectors of 15, 11 or 8 positions each with respectively up to 60, 45 or 30mm thick standards). Option for 90 samples.
Sample introduction magazine (option)		For the storage of up to 32 production samples before processing

Sample preparation

For ferrous samples	Milling - Cup wheel and belt grinding
For non-ferrous samples	Milling or sawing and milling
For powder samples	Crusher, grinding mill, pelletizing press. Fusion machine / Sample introduction systems available as options

Typical production sample manipulation times

Loading in the milling machine (from the SMS sample introduction slide or door)	8 sec
Transfer from the milling machine to the metals analyzer stand or XRF lift	7 sec
Sample shifting for another spark (OES)	5 sec
Sample filing and robot move to the next sample	6 sec
Sample labeling (option)	8 sec
Sample surface analysis by a vision system (option)	2 sec
Stand and electrode cleaning (OES)	The cleaning before or after the sample analysis is done in hidden time (the cleaning operates in parallel and independently of the robot)

Typical production sample manipulation times

Power*	400 V + 10% 3-phases with neutral and earth / 50-60 Hz + 2% / Earth < 1 Ohm /16 A switch breaker / 4.5 kvA
Compressed air	1 m³/hour maximum at 6-10 bar (not applicable if using SMS Cooling)
Typical weight*	~800 kg
Typical size* (LxWxH)	4750 mm x 2750 mm x 1900 mm

* Varies depending on the configuration. Without the spectrometers and sample preparation.

Find out more at **www.thermofisher.com/elemental**

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Certified System
ISO 9001
QMI-SAI Global

Thermo Fisher Scientific Ecublens SARL, Switzerland is ISO 9001 certified