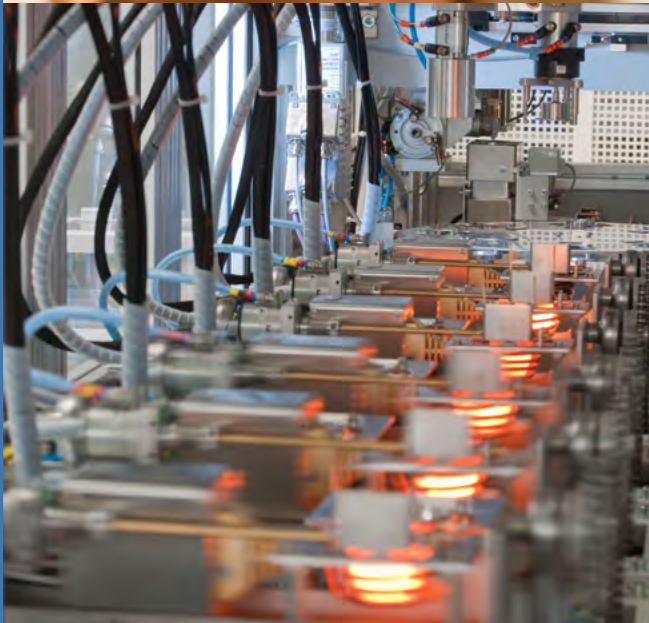




Iron Ore Technical Centre

An Industry Focused Service Offering



RIGHT SOLUTIONS | RIGHT PARTNER

Introduction

The ALS Iron Ore Technical Centre provides a unique integration of analytical, metallurgical, mineralogical and ancillary testing services, specifically focused on the iron ore sector.

Through the establishment of a large purpose-built facility in Perth, Western Australia, ALS has achieved a quantum expansion of analytical and metallurgical testing capacity enabling delivery of best practice standards for turnaround time and technical service.

Perth is a major global mining hub. The ALS Iron Ore Technical Centre is located in the Perth suburb of Wangara, 28km north of the CBD. The site is 10km north of the ALS Metallurgy laboratory at Balcatta and 12km north-west of the ALS Geochemistry laboratory at Malaga. The ALS Iron Ore Technical Centre spans some 14,000m² of real estate; the laboratory service facilities alone are in excess of 7,000m² and readily expandable.

Complementing the ALS Iron Ore Technical Centre investment is a 3,600m² sample preparation facility located in the Perth suburb of Wangara. This high volume sample preparation

facility supports the ALS Iron Ore Technical Centre analytical capacity, current and future, to remove bottle-necks associated with sample preparation.

With state-of-the-art equipment including the Automated Fusion and TGA system (HAG8) and scalable analytical processing capacity in excess of 10,000 samples per day, the establishment of the iron ore Technical Centre demonstrates that ALS is prepared to invest for long term industry demands.

The ALS Iron Ore Technical Centre is not just about capacity – it allows a seamless transition from exploration to metallurgical process development testwork. The same company, the same team, working with industry to ensure that knowledge sharing and optimisation is achieved.

With industry leading expertise in elemental analysis, metallurgy and mineralogy, ALS can provide a wide range of iron ore testing, certification and inspection services to cover project life cycles from exploration, resource definition to process optimisation, pre-feasibility, feasibility and production support services.

Scope of iron ore testing services

Primary Services

- Analytical – Exploration and Resource Definition;
- Metallurgical process development and optimisation;
- Ore characterisation and beneficiation;
- Continuous pilot plant testing;
- Advanced mineralogy including spectral imaging.

Ancillary Services

- Environmental analyses;
- Used oil analysis;
- Shipment certification and inspection of concentrates;
- Mine site laboratories.



The ALS Iron Ore Technical Centre provides unprecedented specialty technical services to the global iron ore sector from a unique, purpose-built facility. Comprehensive tours of the operation are welcomed.



Technical Service Overview

The ALS Iron Ore Technical Centre has been designed and built to accommodate scalable fused bead XRF processing capacity in excess of 10,000 samples per day. With specialist expertise in processing hematite, magnetite and all forms of iron ore, the centre provides extensive ore characterisation, beneficiation, agglomeration (sintering and pelletising) testing and other specialty testing services. The experienced chemists, geologists and metallurgists combine to form a truly integrated team of specialists with globally recognised and respected expertise.



Sample Preparation

Recognising that sample preparation capacity for high volume drilling programmes can often be the limiting factor in the overall analytical process, ALS has established a high volume sample preparation facility in the northern Perth suburb of Wangara to address this issue.

With 3,600m² under roof, this new purpose-built facility increases by 100% sample preparation processing capacity whilst also providing future expansion options. The facility uses the ALS global standard DustBox™ extraction system. Additional workstations have been incorporated to allow a further 25% increase in capacity in the absence of additional infrastructure requirements. Conventional and robotic sample preparation technologies are available.

The size of the facility not only allows sufficient area for operational needs such as sample receipt and sorting-racking, but also provides suitable space for Sample Archive Management, ensuring sample integrity and security is maintained even when processing large sample volumes. With Sample Archive Management now consolidated on a single site, accessioning, retrieval and maintaining the condition of samples have been optimized.

All protocols, practices and procedures in the new preparation facility are in keeping with ISO9001 certification.



Elemental Analysis

Accurate assaying is critical to the success of any iron ore exploration, resource definition and metallurgical testwork programme. X-ray fluorescence spectrometry (XRF) by fused bead is the method of choice for the analysis of oxide iron ores throughout the industry.

The Iron Ore Technical Centre analytical laboratory has been built to accommodate Automated Fusion and TGA systems (HAG8) and scalable simultaneous XRF analysis capacity in excess of 10,000 samples per day. This state of the art technology eliminates manual sample handling thereby reducing the risk of sample mix up and improves health and safety, as operators are not exposed to dust and heat or repetitive manual operations. Being fully automated, there is an improvement in precision and accuracy when compared with manual processing. This technology will improve laboratory efficiency and reduce turnaround times.

LOI is a critical component of iron ore analysis, providing a better understanding of mineral composition of the ore and behaviour during processing. Single temperature or multi-temperature LOI determinations are available and are normally undertaken using a Thermogravimetric Analyser (TGA). Temperatures can be customized as required. This information is particularly valuable when analysing Channel Iron Deposits and Marra Mamba type ores.

Analytes and Ranges (%)			
Al ₂ O ₃	0.01 - 100	Na ₂ O	0.005 - 8
As	0.001 - 1.5	Ni	0.001 - 8
Ba	0.001 - 10	P	0.001 - 10
CaO	0.01 - 40	Pb	0.001 - 2
Cl	0.001 - 6	S	0.001 - 5
Co	0.001 - 5	SiO ₂	0.01 - 100
Cr ₂ O ₃	0.0006 - 10	Sn	0.001 - 1.5
Cu	0.001 - 1.5	Sr	0.001 - 1.5
Fe	0.01 - 75	TiO ₂	0.01 - 30
K ₂ O	0.001 - 6.3	V	0.001 - 5
MgO	0.01 - 40	Zn	0.001 - 1.5
Mn	0.001 - 25	Zr	0.001 - 1

Loss On Ignition (LOI) (0.01%) at 371°C, 425°C, 550°C, 650°C and 1000°C. Moisture at 110°C





Magnetite Analysis – Davis Tube Recovery (DTR)

DTR test procedures are specific to individual magnetite deposits. The test is a two stage process, a pulverising step and the Davis Tube wash. DTR is the most important test for a magnetite deposit.

The DTR test generates the weight recovery/magnetic iron, or proportion of the deposit which is magnetite and the likely grade of concentrate at a given grind size. The DTR test is in effect a pilot run on each part of the deposit.

The integrated team of chemists, mineralogists and magnetite specific metallurgists at the ALS Iron Ore Technical Centre is available to work with you and/or your consultant prior to commencement of any project to determine the optimum DTR protocol.

Mineralogy

Production of a high grade iron ore requires a thorough knowledge of the mineralogical parameters that may impact beneficiation. This is particularly important in choosing the method of upgrading via comminution, gravity, flotation and/or other beneficiation processes given that mineralogical parameters (for example, particle density and shape) significantly influence the efficiency of upgrading processes.

Process mineralogical studies form an integral part of the economic and technical evaluation of iron ore deposits. When conducted on a routine basis throughout the life cycle of the mine, these studies continue to assist the identification of process improvement opportunities. An accurate understanding of the mineralogical characteristics provides great value to geological, geometallurgical, metallurgical and marketing teams.

The ALS team of highly experienced mineralogists and technicians works closely with our metallurgists to provide high quality results and fast-turnaround times.

The ALS integrated mineralogical approach using QEMSCAN®, MLA, X-ray diffraction (XRD), HyLogging™ and optical microscopy provides clients with an accurate quantitative understanding of the mineralogical variability within a deposit.

HyLogging™

ALS was the first commercial laboratory to install HyLogging™ spectral analysis technology for rapid, automated scanning of iron ore drill core, chips and powder. This technology is used for a range of applications from logging and archiving core, mineral exploration, and mine planning, to geometallurgy and mineral processing.

HyLogging™ is part of the family of hyperspectral testing services offered by ALS covering field and laboratory based options, data interpretation and web access.

The instrument generates digital images and surface spectra which is interpreted by software to produce mineralogical information. The high resolution digital images allow geologists to visually characterise the colour and texture of the materials being logged. Macro images of core sections and drill hole mosaics (composite images of core trays arranged in order of depth) are produced to allow geologists to identify changes in colour and structure over the full depth of the drill hole.

Derived data is readily exported into three-dimension (3D) visualisation and mine planning packages to allow geologists to combine multiple drill-hole results and accurately characterise and map mineral systems relevant to geometallurgical and geotechnical requirements.

The HyLogging™ instrument can log on average 150m of core per day scanning for iron oxide/hydroxide group minerals; aluminium/silicates/magnesium hydroxide group minerals; sulphates; carbonates and more.

Chip samples can be measured in their original trays and are scanned in groups of sixty samples, allowing approximately 2,000–3,000 samples to be logged per day.



Metallurgical Testwork

The ALS Iron Ore Technical Centre provides comprehensive metallurgical testing for hematite and magnetite ores.

Iron ore extractive metallurgy is becoming increasingly complicated, especially with more complex geology and declining ore grades. Successful beneficiation of low grade ores requires the chemical composition, physical properties, mineralogy and metallurgical characteristics be thoroughly investigated.

The increased exploitation of low grade iron ore deposits containing magnetite has led to an increased demand for complex beneficiation circuits. In line with the emergence in the last decade of magnetite projects, the ALS Iron Ore Technical Centre offers an enormous capability and increased capacity in this sector.

ALS can provide large scale, continuous integrated pilot facilities for confirmation of batch test data. Our expert magnetite team of chemists and metallurgists can work with you and your consultants to optimise existing magnetite beneficiation circuits or provide crucial data for feasibility studies, mine planning and marketing purposes.



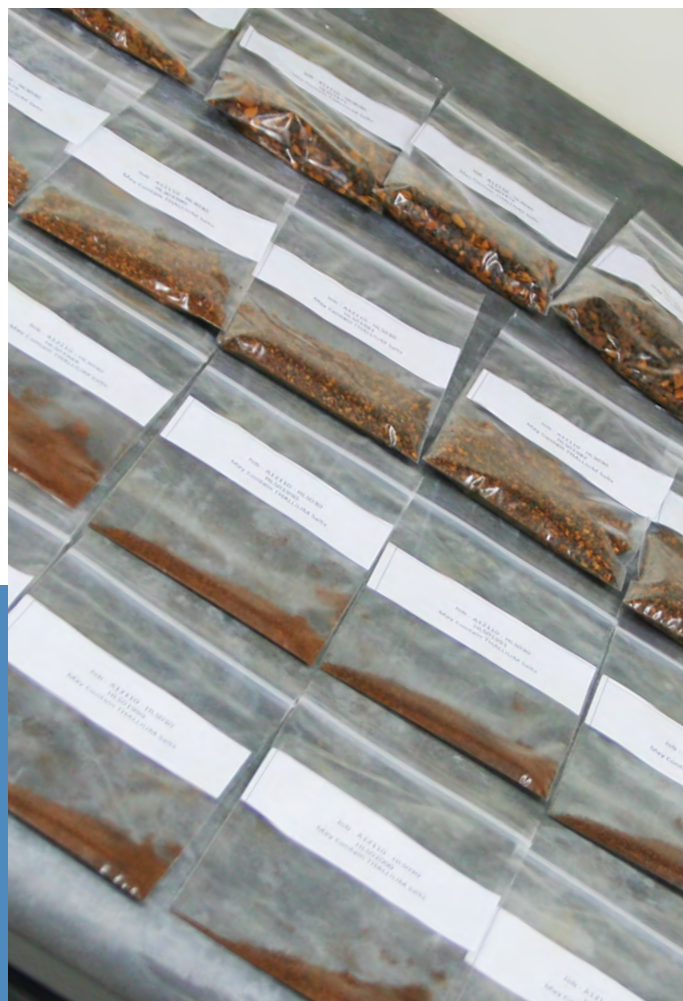
The ALS Iron Ore Technical Centre accommodates a range of industry standard testing services including:

- 15 metre automated drop tower to estimate lump/fines ratios and the particle size distribution expected from blasting and processing;
- Lump and fines products – beneficiation testwork or characterisation using standards accepted by the International Standards Organisation, Japanese Industrial Standards and Japanese Steel Mills:
 - ISO/JIS iron ore physical testing;
 - Tumble Strength (ISO/JIS);
 - ISO/JIS/JSM iron ore thermal testing;
 - Reduction Disintegration Index (ISO/JSM);
 - Reducibility (ISO/JIS);
 - Decrepitation Index (ISO/JSM).
- Hematite sample preparation for chemical and metallurgical analysis;
- Fibrous material preparation area in an enclosed building;
- Wet preparation area for hematite and magnetite;
- Large scale preparation area for pilot scale and bulk testing;
- Magnetite testing, including wet and dry magnetic separation (LIMS);
- Pilot facilities for jigging, DMS, spiraling and WHIMS/SLon;
- Beneficiation testing – spirals, up-current classifiers, jigging, WHIMS and SLon;
- Flotation testing – direct and reverse for silica removal;
- Davis Tube Recovery (DTR) – stage pulverise and optimisation tests versus grind size;
- Magnetic susceptibility;
- On-site short term warehousing;
- HyLogging™ spectral imaging analysis;
- Bulk density, apparent relative density and true SG measurements.



In addition to the standard services, the ALS Iron Ore Technical Centre offers the following:

- Alternative technology core scanning services;
- Increased spiral and gravity separation capacity;
- Increased HMS capacity including HMS cyclones;
- Ore sorting technologies;
- Automated Specific Gravity analysis;
- Agglomeration including pellet and sinter testing;
- Wet and dry rare earth drum capacity;
- Advanced screen testing;
- Full pilot capacity for magnetite processing;
- Full pilot capacity for hematite beneficiation;
- Materials handling testing;
- Core cutting services;
- Magnetic susceptibility testing including Satmagan;
- Bulk drying capacity;
- Core tray lay out and photograph services;
- Automated sample preparation;
- Iron ore Technical training services;
- Secure Web based data portal – ALS Webtrieve™, CoreViewer™.



Comminution and Beneficiation

The ALS Iron Ore Technical Centre offers a comprehensive range of crushing and grinding capabilities:

- Autogenous media competency;
- Bond abrasion index;
- Bond ball mill work index;
- Bond impact crushing work index;
- Bond rod mill work index;
- Comparative work index;
- High pressure grinding rolls (HPGR) up to 10tph;
- Inferred work index;
- JK drop-weight test and SAG mill comminution (SMC) test;
- Levin open circuit grindability;
- Pilot SABC (AG/SAG) up to 4tph;
- Point load test;
- SAGDesign (Starkey);
- Ultra fine grinding;
- Unconfined compressive strength.

Piloting Facilities

With an extensive, flexible piloting facility, plus a dedicated piloting team, we can configure a range of continuous circuits incorporating:

- Bulk crushing and screening;
- AG/SAG milling;
- Ball milling;
- HPGR;
- Hydrocyclones;
- Spiral Pilot Rig;
- Magnetic separation;
- Dense medium cyclone plant;
- Gravity separation;
- Flotation;
- Scrubbing;
- Dewatering and tailings management.

Equipment used for characterisation and beneficiation testwork includes:

- Screening and cyclosizing;
- Ericson cone heavy media separation;
- Dense medium cyclone separation;
- Heavy liquid separation up to 4.05SG;
- Alljig® laboratory jigging unit;
- Spiral test rig;
- Wilfley table;
- Miniflux® fluidised bed separator;
- Flotation – direct and reverse;
- Laboratory scale and bulk LIMS, WHIMS and Slon;
- Thermal characterisation.



Webtrieve™

Direct secure access to data is available to clients of the ALS Iron Ore Technical Centre through the online data retrieval system, Webtrieve™, to track and monitor service delivery of analytical tasks and QA/QC information.

ALS is committed to providing Open Lab™ access to laboratories via an online encrypted account allowing secure data access in real time.

The ALS Open Lab™ policy and this highly integrated business system are unique in the industry and distinguish ALS as the company that delivers unrivalled client solutions.

The consolidated offering of the ALS Global Enterprise Management System (GEMS), CoreViewer™ and Webtrieve™ with 3D orebody software packages such as Leapfrog, Maptek's Vulcan™ and Micromine, set ALS as a clear leader in this space. ALS is the only laboratory group in the world which can provide this level of integration.



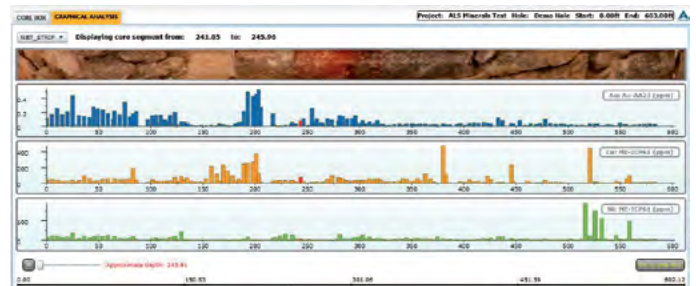
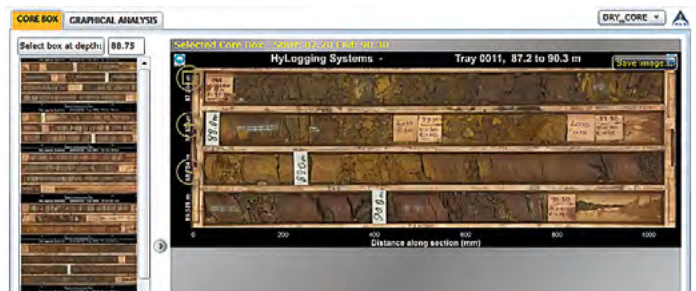
Webtrieve™ and CoreViewer™ provide unique value-add innovations that can be demonstrated at the ALS Iron Ore Technical Centre.

Workorder ID	Client Code	ISU	Client Project	Received Date	Received Qty	Type	# of Samples	# of Boxes	Status	Results	Cert
SD13117369	QUA	ALS Demo PO	ALS Demo Proj est	2013-06-27	6	Drill Core	71	1	View		
SD13117365	QUA	ALS Demo PO	ALS Demo Proj est	2013-06-27	6	Drill Core	71	1	View		
SD13114549	QUA	ALS Demo PO	ALS Demo Proj est	2013-06-24	19	Drill Core	71	1	View		
SD13114325	QUA	ALS Demo PO	ALS Demo Proj est	2013-06-21	11	Drill Core	71	1	View		
SD13114322	QUA	ALS Demo PO	ALS Demo Proj est	2013-06-21	12	R.C Drill Ch ip	71	1	View		

CoreViewer™

ALS offers via our state-of-the-art Webtrieve™ the capability to submit core photos, manage and archive them, and plot geochemical data alongside the photograph.

- Core images rendered into single down-hole and depth registered images;
- View core photos with analytical data;
- Interrogation of analytical anomalies;
- Enables interactive inspections of geotechnical and geological features;
- Long term on-line photo archival;
- Secure, encrypted Webtrieve™ data system.



Core Box Photo

Analytical and Hyperspectral Data

CoreViewer™

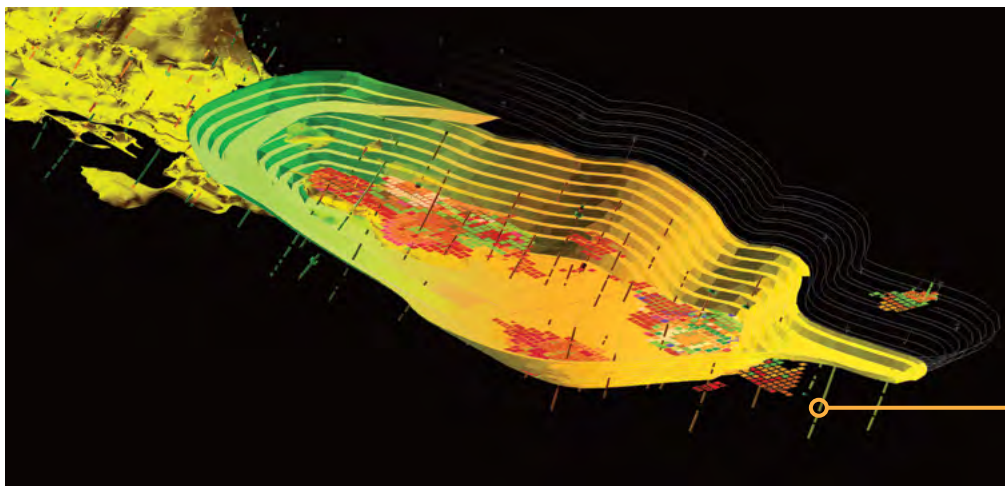
Rapid 3D Ore Model Visualization with Core Data

ALS Webtrieve™ can interface directly with Leapfrog, Maptek's Vulcan™ and Micromine 3D ore model software.

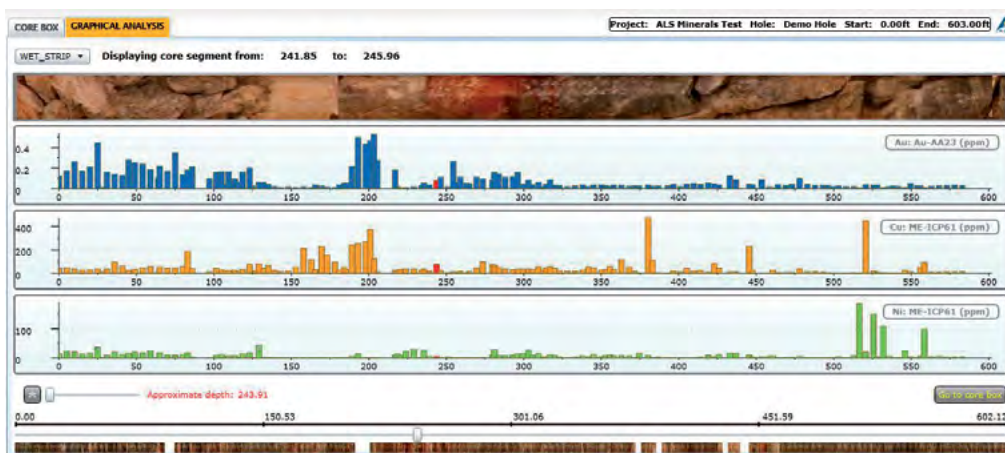
Users of Leapfrog, Maptek's Vulcan™ and Micromine 3D mine planning and geological modeling software can now access core images and geochemistry directly in their 3D geological model, simply by clicking at any point on a drill hole in the model.

Seamless integration of ALS Webtrieve™ and 3D ore model software offers a user many distinct benefits. The software users can view source information as part of their ore body model, quickly visualize core data in 3D. This speeds interpretation, aids collaboration and provides rapid validation for geological and engineering decisions in the complex mine planning and design process.

This cloud-based technology allows users to securely access stored data remotely where web access is available.



Click on the drill hole you want to view.



Your selection opens with photos and data in your browser.





Quality

ALS understands the value of data quality and integrity to exploration and mining companies. Our processes are designed to ensure clients receive the best quality assay data to assist informed decision making. The ALS quality program consists of a series of checks and balances with monitoring at senior management levels. Our global information management system provides oversight and access to all processes. The online Webtrieve™ tool provides client access to this quality information.

All ALS Geochemistry facilities are accredited to the higher of ISO 9001-2008 or ISO 17025 standards as appropriate to the services offered at each location.



Health, Safety and Environment

Being an employee of ALS is about putting safety first. Globally, ALS is committed to a safe work culture.

Safety Management

As part of this global approach, ALS has developed an industry leading standard for managing health, safety and environmental issues.

At a local level, safety is a part of all work instructions however, some are specifically set to achieve policy objectives. The focus of the Safety Management System is to continually improve HSE performance and therefore documentation is constantly reviewed. Procedures and policies are specifically targeted to safety in laboratories and related activities and as such are designed to comply with the requirements of industry best practice. Procedures are available upon request.

ALS is very proactive with respect to safety reporting. Real time reporting of NMI, MTI, FAI and LTI with a series of automated alerts is available to staff, HSE operatives and management alike.

Assessment of Safety Performance

Not satisfied with an improved performance in HSE 'lag' statistics, ALS operates a program of Positive Performance Indicators (PPI). The PPI program assesses and actively reports the performance of individuals and operations from a proactive HSE perspective with respect to Leadership, Training, Injury Management and Process Compliance. The program and web based reporting tool encourages and rewards ownership and transparency of HSE issues.

Protection of the Environment

ALS has Extensive procedures and policies to ensure Protection of the Environment. Specific procedures and policies address the following issues:

- Waste Management, Monitoring and Maintenance;
- Disaster Management plans for spills;
- Management of Solid waste, with recycling where possible.

Iron Ore Technical Centre

An Industry Focused Service Offering

With industry leading expertise in elemental analysis, metallurgy and mineralogy, ALS can provide a wide range of iron ore testing, certification and inspection services to cover project life cycles from exploration, resource definition to process optimisation, pre-feasibility, feasibility and production support services.

Contact us

26 Rigali Way, Wangara,
Western Australia, Australia 6065

P +61 8 9406 1300

F +61 8 6305 0367

E ALSIronOre@alsglobal.com

Scope of iron ore testing services:

Primary Services

- Analytical – Exploration and Resource Definition;
- Metallurgical process development and optimisation;
- Ore characterisation and beneficiation;
- Continuous pilot plant testing;
- Advanced mineralogy including spectral imaging.

Ancillary Services

- Environmental analyses;
- Used oil analysis;
- Shipment certification and inspection of concentrates;
- Mine site laboratories.



RIGHT SOLUTIONS
RIGHT PARTNER

www.alsglobal.com/iotc