

Bankable Metallurgical Solutions

Testwork Services and Capabilities



RIGHT SOLUTIONS | RIGHT PARTNER

A photograph of an industrial facility at night, illuminated by warm yellow lights. The structure is complex, with multiple levels, walkways, and pipes. The background is dark, making the lights stand out. The overall scene conveys a sense of industrial activity and scale.

Core Values

Our Core Values are simple and we incorporate these in our daily operations, never forgetting the foundations of our success:

- Honesty and Integrity
- Exceeding Client Expectations
- Belief in our Ability
- Hard Work and Continuous Improvement
- Doing it Better
- Celebrating Success
- Safety as a Priority.

Introduction

ALS Metallurgy is part of the ALS Group, a diversified and global analytical laboratory and testing services company.

ALS Metallurgy is the global leader in metallurgical testing and consulting services for mineral process flowsheet development and optimisation.

Extensive bench scale laboratory, large scale pilot plant facilities and expert metallurgists, provide mineral processing, hydrometallurgical, mineralogical and in-plant services to the global resources community.

Our metallurgical solutions are internationally recognised by the mining, engineering and financial sectors for all major commodities:

- Precious metals - gold, silver, platinum group metals
- Base metals - copper, cobalt, lead, zinc, molybdenum, manganese
- Iron ore - hematite, magnetite, goethite, itabirite
- Nickel - laterite & sulphide ores
- Uranium & thorium
- Rare earth minerals & other exotics
- Mineral sands
- Industrial minerals
- Tungsten & tin

ALS Metallurgy has an enviable reputation for delivering the highest quality extractive metallurgical testing service with accurate and timely data, expert support and a culture of safety and innovation.



Company Overview

Australian Laboratory Services (ALS) commenced operations in Brisbane as 'Australian Laboratory Services Pty Ltd' in 1974 as a privately owned company providing analytical services for the oil shale and mineral exploration industries.

Australian Laboratory Services (ALS) provides a broad range of sophisticated, state-of-the-art services to four main market segments, with a total of 13 unique service offerings:

Minerals – Geochemistry | Metallurgy | Mine Site | Inspection

Life Sciences – Environmental | Food | Pharmaceutical
Animal Health | Electronics.

Energy – Coal | Oil & Gas

Industrial – Asset Care | Tribology.

ALS has demonstrated over 30 years of strong business performance with global revenues exceeding \$1.5 billion. ALS continues to remain at the forefront of the testing services industry, building an enviable reputation as the provider of choice on a global scale.

Processing more than 20 million samples per year, our 13,000 staff operate from over 350 locations in 55 countries. We have laboratories strategically located around the world, operating in Australia, Asia, North America, South America, Europe, the Middle East and Africa; and are one of the largest analytical laboratory groups in the world.



40

YEARS IN OPERATION

13K+

STAFF

300+

LOCATIONS

50+

COUNTRIES

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 toward 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 launched a program of Positive Performance Indicators (PPI) in 2010. 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.

Metallurgical Testwork Services & Capabilities

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COMMUNITION	GEOMETALLURGY	GRAVITY SEPARATION
Autogenous Media Competency	Geology, Mineralogy, Metallurgy Production Mapping	Cyclone Separation
Bond Abrasion Index		Dense Media Separation (DMS)
Bond Ball Mill Work Index		Ericson Cone Heavy Media Separation
Bond Impact Crushing Work Index		Falcon Concentrator
Bond Rod Mill Work Index		Heavy Liquid Separation (HLS)
Comparative Ball Mill Index		Jigging – Allmineral Alljig®
Grind Establishment		Kelsey Jig
High Pressure Grinding Rolls (HPGR) – Batch & Pilot		Knelson Concentrator
JK Drop-Weight		Manual Panning
Levin Open Circuit Grindability		Spiral Rig
Metso Jar Mill		Superpanner
Point Load		Teeter Column
SABC – Pilot		Up-Current Classifier – Allmineral Miniflux®
SAG Mill Comminution (SMC)		Wilfley Table
SAGDesign – Starkey		
Ultra Fine Grinding – IsaMill™, Metso Verti-mill, Stirred Media Detritor (SMD), Deswik, Metprotech		
Unconfined Compressive Strength		
FLOTATION	GOLD	HEAVY LIQUID SEPARATION (HLS)
Base Metal Flotation	Activox®	TMF/Clerici's Solution up to 4.05SG
Batch & Bench Scale Flotation	Agitated Cyanide Leaching – Vat & Bottle Roll	
Column Flotation	Bacterial Leaching	
Controlled Potential Sulphidisation (CPS)	BIOX® Bacterial Oxidation	
Deslime Flotation	Carbon Activity	
Flash Flotation	Carbon Characterisation	
Flotation Kinetics Rate	Carbon Desorption Studies	
Grind & Regrind	Carbon Elution & Electrowinning	
Iron Ore Flotation	Carbon-In-Leach (CIL) – Batch & Pilot	
Large Scale Flotation – 10 to 50kg	Carbon-In-Pulp (CIP) – Batch & Pilot	
Locked Cycle Flotation	Carbon Loading Studies	
Pilot Flotation Plant – Multi-Circuit/Capacity Options	Cyanide Detoxification	
Pilot Flotation Plant – Transportable/Site Optimisation Work	Diagnostic Gold Analysis	
Reverse Flotation	Flocculation/Settling	
Sulphide/Non-Sulphide/Oxide Flotation	Flotation	
XStrata Technology – Jameson Cell Flotation	Gold Department Studies/Process Mineralogy	
	Gravity Separation	
	GRG Studies	
	Heap Leaching Amenability	
	Lime Demand	
	Mercury Amalgamation	
	Merrill-Crowe Zinc Cementation	
	Oxygen Enhanced Leaching	
	Oxygen Uptake Rate Determination	
	Preg-Robbing Characterisation	
	Pressure Oxidation	
	Rheology	
	Roasting – Batch & Pilot	
	Ultra Fine Grinding – Batch & Pilot	
		HYDROMETALLURGY
		Acid & Alkaline Leaching
		Agglomeration & Percolation
		Agitation Leaching – Batch & Pilot
		Atmospheric Leaching – Batch & Pilot
		Bacterial Leaching
		Bottle Roll Leaching
		Diagnostic Leaching
		Electrowinning Circuit – Fully Integrated
		Heap Leaching – Batch & Pilot
		Precipitation
		Pressure Leaching – Batch Autoclave Pressure Acid (PAL)
		Resin-In-Pulp – Batch & Pilot
		Resin-In-Solution – Batch & Pilot
		Resin-Ion-Exchange – Batch & Pilot
		Solution Purification
		Solvent Extraction – Mixer-Settler Batch Laboratory & Pilot
		Vat Leaching

IRON ORE

Allmineral Alljig® Laboratory Jigging Unit
Allmineral Miniflux® Up-Current Classifier
Autogenous/Semi-Autogenous Grinding (AG/SAG) – Batch & Continuous
Automated Drop Tower – 15m Drop – Lump/Fine Ratio
Beneficiation – Gravity, Magnetic, Flotation
Bulk Density/Apparent Relative Density/True SG
Davis Tube Recovery (DTR)
Davis Tube Separation versus Grind Size
Ericson Cone Heavy Media Separation
Flotation
HyLogger™ Core Mineral Analysis
ISO/JSM Decrepitation
ISO/JIS Reducibility
ISO/JSM Reduction Disintegration Index
ISO/JIS Tumble Strength
Magnetic Separation – Dry & Wet LIMS Separation – Batch & Pilot
Magnetic Separation – WHIMS (ERIEZ, SLON) – Batch & Pilot
Midrex Acceptance
Permmroll High Gauss Separator
Pilot Scale Crushing, Screening & Splitting Plant
Scrubbing – Batch & Pilot
Spiral Rig
Stratification Jig
Wifley Table Gravity Separation

METALLURGICAL ANALYTICAL SERVICES

Aqua Regia Gold Analysis
Atomic Absorption Spectrometry (AAS)
Carbon, Sulphur by CS 2000
Check & Referee Assaying
Classical Chemical Analysis
Comprehensive Water Analysis
Diagnostic Gold Analysis
FeO by Titration
Fire Assay Gold, Platinum & Palladium Analysis
Inductively Coupled Plasma – Mass Spectroscopy (ICPMS)
Inductively Coupled Plasma – Optical Emission Spectroscopy (ICPOES)
Non-Carbonate Carbon by CS 2000
Ore Grade Elemental Analysis
Sample Preparation
Selective Digestion Techniques
Shipment Samples
Specific Gravity – Helium Pycnometer
Sulphur Speciation
Thermogravimetric Analysis – Loss on Ignition (LOI)
X-Ray Fluorescence (XRF) – Fusion

MINERALOGICAL SERVICES

Environmental SEM
HyLogger™ Core/Chip Mineral Analysis
Mineral Analysis – QEMSCAN®
Process Mineralogy Studies/Monthly Composite Analysis
Traditional Optical Microscopy
X-Ray Diffraction (XRD)

PILOT PLANT – LARGE SCALE TESTING

Assays – In-House – Rapid Turn Around
Atmospheric Leach
Autogenous/Semi-Autogenous Grinding (AG/SAG) Batch & Continuous
Automatic Data Recording System
Ball/Rod Grinding & Re-Grind Mills
Bivi-TEC® Screen
Bulk Sample Hazardous/Non-Hazardous Preparation Facility
Bulk Sample Preparation – Crushing, Screening, Grinding, Splitting
Bulk Sample Preparation – 200 Tonne Blending Facility
CIL/CIP
Crushing Equipment
Dense Media Separation Pilot Plant – Transportable/Site Work
Electrowinning Circuit – Fully Integrated
Engineering Work Shop Facilities
Filtration Technologies
Flash Flotation
Flotation – Conventional & Column
Flotation – Xstrata Technology Jameson Cell
Gravity Separation
Grinding Equipment
Heap Leaching
High Pressure Grinding Rolls (HPGR)
Hydrocyclone Separation
Magnetic Separation – Dry & Wet LIMS Separation
Magnetic Separation – WHIMS (ERIEZ, SLON)
On-Site Pilot Plant Operations
Pilot Flotation Plant – Multi-Circuit/Capacity Options
Pilot Flotation Plant – Transportable/Site Optimisation Work
Pilot Scale Crushing, Screening & Splitting Plant
Screening – Wet & Dry
Solvent Extraction – Pilot Scale Mixer-Settler
Spiral Plant
Tailings Facility
Tanks – Agitated, Water Storage
Thickeners
Ultra Fine Grinding – IsaMill™ & Deswik
XRF – Desk Top – Pilot Control Samples
XRF – Hand Held – Pilot Control Samples

PYROMETALLURGY

Batch Roasting – Muffle & Rotary Midrex
Dorr-Oliver Pilot Scale Fluidised Bed Reactor – Continuous

SAMPLE PREPARATION /SIZING

Attritioning
Blending
Bulk Density
Bulk Sample Hazardous/Non-Hazardous Preparation Facility
Compositing
Crushing
Cyclosizing
Desliming
Grinding
Laser Sizing
Moisture Content Determination
Particle Size Distribution Analysis
Pulp Density Determination
RoboLab Sample Preparation
Screening – Wet/Dry
SG True Mineral, Apparent/In-Situ
Size-by-Size Analysis
Splitting

SLURRY CHARACTERISATION

Filtration
Rheology
Slurry Flocculation & Settling
Transportable Moisture Limit (TML)

OTHER SERVICES

Approvals for Radioactive Ore Processing & Storage – C Class Radiation License
Australian Quarantine & Inspection Service (AQIS) Approved
Dangerous Goods License
On-Site Plant Optimisation Studies & Technical Assistance
Sample Storage – Large Scale – Ambient Temperature Storage
Sample Storage – Large Scale – On-Site Purpose Built Cold Storage



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