



Australian Government

MSL975010 Perform fire assay techniques

Release: 1

MSL975010 Perform fire assay techniques

Modification History

Release 1. Supersedes and is equivalent to MSL975010A Perform fire assay techniques

Application

This unit of competency covers the ability to safely extract a range of precious metals from their host matrices in readiness for analysis. The unit also covers the ability to select and/or modify laboratory methods to suit particular ores and to ensure total recovery.

This unit of competency is applicable to laboratory personnel working in the mineral assay industry sector.

While no specific licensing or certification requirements apply to this unit at the time of publication, laboratory operations are governed by relevant legislation, regulations and/or external accreditation requirements. Local requirements should be checked.

Pre-requisite Unit

MSL973011 Perform fire pouring techniques

OR

MSL954002 Prepare mineral samples for analysis

Competency Field

Testing

Unit Sector

Elements and Performance Criteria

Elements describe the essential outcomes.

Performance criteria describe the performance needed to demonstrate achievement of the element.

- | | | |
|---|-----|--|
| 1 Classify ore samples and select fluxing method | 1.1 | Review client request to identify sample/analysis requirements, preparation methods and equipment involved |
| | 1.2 | Inspect samples, compare with specifications, record and report any discrepancies |

- 1.3 Conduct visual and simple chemical tests to identify the type of sample and sulphide concentrations
 - 1.4 Review client sample/analysis history and identify possible chemical interferences
 - 1.5 Decide whether non-standard fluxing is required
 - 1.6 Select sample weight and flux to optimise precious metal recovery and purity
- 2 **Prepare for precious metal recovery**
 - 2.1 Identify hazards and workplace safety procedures associated with the sample, preparation methods, reagents and equipment
 - 2.2 Examine the recommended preparation method to identify the critical steps that will affect the quality of analytical results
 - 2.3 Plan parallel work sequences to optimise the throughput of multiple sets of samples
 - 2.4 Assemble all required equipments, materials, reagents and check they are fit for purpose
- 3 **Recover precious metals from ore sample**
 - 3.1 Weigh required amounts of sample and flux components to achieve an acceptable button and fluid slag
 - 3.2 Select the type and size of pot to suit sample method and client requirements
 - 3.3 Mix charge to ensure homogeneity and optimal collection of precious metal
 - 3.4 Set and monitor furnace temperature/time to ensure complete fusion
 - 3.5 Separate slag and button with minimal loss of lead collector
 - 3.6 Maintain sequencing in order to track samples, buttons and prills throughout the recovery process
 - 3.7 Separate lead collector from the required precious metal and check for contamination, losses and evidence of

		other precious metals
	3.8	Minimise personal exposure to hazards and the release of collectors to the work environment
	3.9	Collate laboratory documentation and the prepared sample and present for analysis
4	Troubleshoot and correct failed recovery	4.1 Monitor all stages of recovery for indicators of potential loss 4.2 Recognise undesirable recovery conditions and decide whether the process requires correction 4.3 Choose an appropriate corrective action and re-start the process 4.4 Document any adjustments made to standard methods and re-sequencing of samples 4.5 Seek advice when problems are beyond scope of responsibility or knowledge
5	Perform daily maintenance of assay equipment	5.1 Segregate and dispose of waste in accordance with workplace requirements 5.2 Grade and inspect pots using established criteria prior to storage for re-use 5.3 Inspect furnaces for cracks, unserviceable components and remove slag 5.4 Inspect and clean extractive systems 5.5 Report defective equipment and consumable requirements to appropriate personnel

Foundation Skills

This section describes those language, literacy, numeracy and employment skills that are essential to performance.

Foundation skills essential to performance are explicit in the performance criteria of this unit of competency.

Range of Conditions

This field allows for different work environments and conditions that may affect performance. Essential operating conditions that may be present (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) are included.

Standards, codes, procedures and/or workplace requirements

Standards, codes, procedures and/or workplace requirements include the latest version of one or more of:

- Australian and international standards covering the requirements for the competence of testing and calibration laboratories; laboratory safety; quality and environmental management; analysis of specific ores and determination of gold; and labelling, storage, handling and transport of hazardous materials
- national work health and safety (WHS) standards and codes of practice, national environmental protection measures, and national measurement regulations and guidelines
- specific codes, guidelines and procedures, such as National Association of Testing Authorities (NATA) accreditation requirements, and principles of good laboratory practice (GLP)
- workplace documents, such as standard operating procedures (SOPs); quality and equipment manuals; maintenance schedules; material safety data sheets (MSDS) and safety procedures; material, production and product specifications; production and laboratory schedules; workplace recording and reporting procedures; and waste minimisation and safe disposal procedures
- recovery methods and procedures for specific samples, sites and clients (labelling, preparation, storage, transport and disposal), and published preparation methods

Samples

Samples include, but are not limited to, one or more of:

- solids, such as rocks, minerals, soils, sands and stream sediments
- core and other drill samples, such as rotary air blast (RAB), reverse circulation (RC) and aircore
- slurries, powder concentrates and metallurgical solutions
- dump samples and grab samples

Fluxes

Fluxes include, but are not limited to, one or more of:

- bulk fluxes containing PbO, borax, soda ash, silica, silver nitrate and flour
- non-standard flux additives such as:
 - flour (oxidising samples)
 - nitre (reducing samples, sulphides)

- silica (basic ores)
- PbO (siliceous ores)
- exotic additives, such as calcium fluoride (CaF₂) (refractory ores)
- nickel sulphide (NiS), nickel carbonate (NiCO₃), sulphur, borax and soda ash)

Sequencing of pots in a rack Sequencing of pots in a rack includes one or more of:

- addition of silver wire
- addition of coloured salts, such as copper (Cu)
- position of reagent blanks, standards and check samples

Collectors Collectors include one or more of:

- lead (Pb), nickel sulphide (NiS), bismuth (Bi) and tin (Sn)

Separation of collectors Separation of collectors include one or more of:

- cupellation
- digestion
- parting, annealing and weighing for a gravimetric finish

Waste Waste includes, but is not limited to, one or more of:

- rejected pots and cupels
- slag and furnace material
- disposable personal protective equipment

Hazards Hazards include, but are not limited to, or more of:

- dust, silica, slag, glass shards and molten flux
- chemicals, such as hydrofluoric acid, bromine, perchloric acid, aqua regia, cyanide, lead-based compounds, free-mercury and nickel compounds
- noise and vibration
- crushing, entanglement and cuts associated with moving machinery
- manual handling of hot/heavy loads, such as pots, racks and trolleys
- heat exhaustion/stress and fatigue

Workplace safety procedures

Workplace safety procedures include, but are not limited to, one or more of:

- ensuring access to service shut-off points, fire-extinguishers/fire hoses, safety showers/eye wash stations and a first aid station
- recognising and observing hazard warnings and safety signs
- labelling samples, reagents and hazardous materials
- using direct extraction and fume hoods
- providing guards for moving machinery parts
- providing noise insulation
- using personal protective equipment (PPE), such as dust masks, heat resistant mittens, safety face shields with tinted visor, coats, ear muffs, safety boots, heat-reflective clothing and latex gloves for flux handling
- following established manual handling procedures
- regularly cleaning equipment and work areas
- reporting abnormal emissions, discharges and airborne contaminants, such as noise, light, solids, liquids, water/wastewater, gasses, smoke, vapour, fumes, odour and particulates, to appropriate personnel

WHS and environmental management requirements

WHS and environmental management requirements include:

- complying with WHS and environmental management requirements at all times, which may be imposed through state/territory or federal legislation. These requirements must not be compromised at any time
- applying standard precautions relating to the potentially hazardous nature of samples

Unit Mapping Information

Release 1. Supersedes and is equivalent to MSL975010A Perform fire assay techniques

Links

Companion Volume implementation guides are found in VETNet -

<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=5c63a03b-4a6b-4ae5-9560-1e3c5f462baa>

Assessment Requirements for MSL975010 Perform fire assay techniques

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Performance Evidence

Evidence of competence in this unit must satisfy all of the requirements of the elements and performance criteria, and include demonstration of:

- safely performing fire assay techniques to extract a range of precious metals from their host matrices in readiness for analysis on at least three (3) occasions
- interpreting and closely following standard recovery methods
- selecting and modifying laboratory methods to suit particular ores and to ensure total recovery
- accurately weighing samples and flux components
- maintaining close attention to technical and safety requirements in a physically demanding hazardous environment
- maintaining sequential control of samples through all recovery stages
- optimising work flow to ensure efficiency of recovery for multiple client samples
- recognising and identifying the cause of non-acceptable received and fused samples, buttons and prills
- identifying indicators of poor recovery and contamination
- applying knowledge of mineral chemistry and fire assay techniques to solve recovery and contamination problems
- keeping accurate and complete records, including:
 - pour sheets (date, time, client, pour number and preparation method)
 - number of pots, positions of sample, blank and check in rack
 - adjustments made to standard preparation methods for specific samples
 - analytical method
 - assay data
- minimising rework, waste and environmental impacts
- safely collecting and disposing of all waste responsibly
- recognising hazards, using workplace safety procedures and safety equipment to work safely at all times.

Knowledge Evidence

Must provide evidence that demonstrates knowledge of:

- chemical and physical principles relating to:
 - fusion of mineral ores

- cupellation
- parting and digestion processes
- expected physical and chemical properties of materials at each recovery stage
- standard methods for the fire assay of a range of precious metal ores relevant to job role
- criteria for an 'acceptable' button, including:
 - one piece, mass >20g and <50g
 - malleable
 - separates cleanly from slag
 - free of undecomposed ore, matte and speiss
- causes of contamination, including:
 - poorly made cupels
 - base metals (copper (Cu), nickel (Ni), zinc (Zn) and bismuth (Bi))
 - arsenic (As), sulphur (S), antimony (Sb), selenium (Se), tellurium (Te) and chromium (Cr)
 - scoria
 - sprouting
- indicators of potential loss and the corrective actions, including:
 - viscous slag (check furnace temperature, adjust flux and lower charge weight)
 - lead shotting (adjust flux and lower charge weight to compensate for high oxides, silicates and chromites)
 - sulphides (adjust fusion time and adjust sample weight and/or flux)
 - matte, speiss (adjust sample weight and flux)
 - incomplete fusion (adjust sample weight and/or flux)
 - unacceptable button (adjust sample weight and/or flux)
 - inquartation (add 3 parts silver (Ag) to prill, wrap in lead foil and re-cupel)
- workplace safety procedures and operation of safety equipment
- function and operation of assay/equipment used as part of job role
- workplace and/or legal traceability requirements
- relevant hazards, work health and safety (WHS) and environment requirements.

Assessment Conditions

- Judgment of competence must be based on holistic assessment of the evidence. Assessment methods must confirm consistency of performance over time, rather than a single assessment event.
- This unit of competency is to be assessed in the workplace or a simulated workplace environment. A simulated workplace environment must reflect realistic operational workplace conditions that cover all aspects of workplace performance, including the environment, task skills, task management skills, contingency management skills and job role environment skills.
- Foundation skills are integral to competent performance of the unit and should not be assessed separately.

- Assessment processes and techniques must be appropriate to the language, literacy and numeracy requirements of the work being performed and the needs of the candidate.
- Knowledge evidence may be collected concurrently with performance evidence or through an independent process, such as workbooks, written assessments or interviews (provided a record is kept in each case).
- This unit of competency may be assessed with:
 - MSL975020 Apply routine spectrometric techniques
- Holistic assessment methods include:
 - observation of the candidate
 - review of quality control performance and analytical results traceable to assay samples prepared by the candidate
 - review of sample records prepared by the candidate
 - feedback from supervisors, peers and/or clients about the candidate's ability to safely and efficiently extract a range of precious metals from their host matrices in readiness for analysis, provide acceptable buttons and prills, and troubleshoot and correct common recovery failures
 - written/oral questioning about relevant mineral chemistry principles, precious metal recovery steps, typical problems and corrective actions.
- Access is required to instruments, equipment, materials, workplace documentation, procedures and specifications associated with this unit, including, but not limited to:
 - client requests/documentation, including client profile, sample identification, sample receipt, storage and analyses, and required preparation method/and service charges
 - a variety of precious metal ore samples
 - fire assay methods, examples of assay records, equipment, materials and reagents
 - assay equipment, including:
 - mixing equipment and balances
 - fusion and muffle furnaces and associated spares
 - temperature sensors and hotplates
 - compressed air service, extraction systems and fuel supply lines
 - pots, cupels, pouring equipment, pot loader, trolleys, moulds, tongs and hammers
 - safety equipment and workplace safety procedures.
- Assessors must satisfy the assessor competency requirements that are in place at the time of the assessment as set by the VET regulator.
- The assessor must demonstrate both technical competence and currency.
- Technical competence can be demonstrated through:
 - relevant VET or other qualification/Statement of Attainment AND/OR
 - relevant workplace experience.
- Currency can be demonstrated through:
 - performing the competency being assessed as part of current employment OR
 - having consulted with a laboratory about performing the competency being assessed within the last twelve months.

Links

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