



Australian Government

Department of Education, Employment and Workplace Relations

MSL973011A Perform fire pouring techniques

Revision Number: 1

MSL973011A Perform fire pouring techniques

Modification History

Not applicable.

Unit Descriptor

Unit descriptor	This unit of competency covers the ability to follow standard procedures for extracting precious metals from their host matrices in readiness for analysis. Fire pourers are expected to handle routine samples, recognise common sample preparation and cupellation problems and make standard adjustments to fluxes and firings. They are expected to seek advice from their supervisor when non-routine problems arise.
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Application of the Unit

Application of the unit	This unit of competency is applicable to laboratory personnel working in the mineral assay industry sector. Industry representatives have provided case studies to illustrate the practical application of this unit of competency and to show its relevance in a workplace setting. These can be found at the end of this unit of competency under the section 'This competency in practice'.
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Licensing/Regulatory Information

Not applicable.

Pre-Requisites

Prerequisite units		

Prerequisite units		

Employability Skills Information

Employability skills	This unit contains employability skills.
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Elements and Performance Criteria Pre-Content

Elements describe the essential outcomes of a unit of competency.	Performance criteria describe the performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge section and the range statement. Assessment of performance is to be consistent with the evidence guide.
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Elements and Performance Criteria

ELEMENT	PERFORMANCE CRITERIA
1. Plan work for shift	1.1. Review job requests to identify the samples, preparation methods required for each and shift priorities 1.2. Identify hazards, safety equipment/procedures associated with samples, preparation methods, reagents and equipment 1.3. Plan parallel work sequences to optimise the throughput of multiple sets of samples during shift 1.4. Assemble all required equipment, materials, reagents and check they are fit for purpose 1.5. Check pots/cupels and discard those with faults and/or a record of high gold values 1.6. Check that fusion and muffle furnaces are operating at the specified temperatures
2. Prepare sample racks for fusion	2.1. Check samples against accompanying documentation and record/report any discrepancies 2.2. Conduct simple visual/chemical tests for each sample to assess the adequacy of prior sample preparation and possible presence of sulphides or other mineralogy 2.3. Weigh out the recommended amount of sample and add specified identifier to maintain orientation, as necessary 2.4. Weigh out flux components, mix thoroughly with the sample charge and transfer to recommended type/size of pot without loss of material 2.5. Place pots in racks 2.6. Record all required details of sample preparation to ensure traceability of samples 2.7. Seek advice to deal with any situation beyond scope of responsibility or knowledge
3. Obtain acceptable buttons and prills	3.1. Maintain sequencing in order to track samples, buttons and prills throughout the recovery process 3.2. Monitor furnace temperature/time to ensure complete sample fusion 3.3. Remove fused samples from furnace and pour into moulds with minimal loss of material 3.4. Recognise the need for repeat firings due to lead shotting and/or poor fusions 3.5. Separate slag and button with minimal loss of

ELEMENT	PERFORMANCE CRITERIA
	<p>collector</p> <p>3.6. Inspect buttons for matte, brittleness, size and malformed shape</p> <p>3.7. Place acceptable buttons in muffle furnace using cupels that have been previously loaded and preheated</p> <p>3.8. Regularly monitor furnace temperature/time/air flow to ensure efficient cupellation</p> <p>3.9. Recover prills, check identifiers and inspect for contamination, losses and evidence of other precious metals</p> <p>3.10. Complete and collate sample records before presenting prills for analysis</p>
4. Troubleshoot and correct common recovery failures	<p>4.1. Monitor all stages of recovery for indicators of potential loss</p> <p>4.2. Recognise undesirable recovery conditions and decide whether the process requires correction</p> <p>4.3. Apply an established corrective action and restart the process</p> <p>4.4. Document any adjustments made to standard methods and re-sequencing of samples</p> <p>4.5. Seek advice when problems are beyond scope of responsibility or knowledge</p>
5. Perform daily maintenance of assay equipment	<p>5.1. Grade and inspect pots using established criteria prior to storage for re-use</p> <p>5.2. Report defective equipment and consumable requirements to appropriate personnel</p>
6. Maintain a safe work environment	<p>6.1. Use safe work procedures and protective equipment to ensure personal safety and that of others</p> <p>6.2. Minimise the release of collectors to the work environment</p> <p>6.3. Segregate and dispose of wastes in accordance with enterprise requirements</p>

Required Skills and Knowledge

REQUIRED SKILLS AND KNOWLEDGE

This section describes the skills and knowledge required for this unit.

Required skills

Required skills include:

- accurately weighing samples and flux components
- manual handling of heavy/hot items of equipment
- hand-eye coordination during pouring and knocking up buttons
- recognising non-acceptable characteristics of received and fused samples, buttons and prills
- applying standard methods and procedures and approved variations

Required knowledge

Required knowledge includes:

- procedures for:
 - fusion of common mineral oresamples
 - cupellation of buttons
 - digestion/partingof prills
- function, operation and maintenance of assay equipment
- hazards, control measures, operation and maintenance of safety equipment
- enterprise and/or legal traceability requirementsrelevant to job role
- health, safety and environment requirements relevant to job role

Evidence Guide

EVIDENCE GUIDE	
<p>The Evidence Guide provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge, range statement and the Assessment Guidelines for the Training Package.</p>	
Overview of assessment	
Critical aspects for assessment and evidence required to demonstrate competency in this unit	<p>Assessors should ensure that candidates can:</p> <ul style="list-style-type: none"> • recognise hazards and work safely at all times • interpret and follow standard recovery methods • maintain close attention to technical and safety requirements in a physically demanding/hazardous environment • maintain sequential control of samples through all recovery stages • plan work flow to ensure efficient sample throughput • recognise indicators of poor recovery and apply established corrective actions • minimise rework, waste and environmental impacts • dispose of all waste responsibly.
Context of and specific resources for assessment	<p>This unit of competency is to be assessed in the workplace or simulated workplace environment.</p> <p>This unit of competency may be assessed with:</p> <ul style="list-style-type: none"> • <i>MSL953001A Receive and prepare samples for testing</i> • <i>MSL943002A Participate in laboratory/field workplace safety.</i> <p>Resources may include:</p> <ul style="list-style-type: none"> • a variety of precious metal ore samples • fire assay methods • fire assay equipment, materials and reagents • safety equipment.
Method of assessment	<p>The following assessment methods are suggested:</p> <ul style="list-style-type: none"> • 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 peers, clients and supervisors • written/oral questioning about fire pouring

EVIDENCE GUIDE	
	<p>techniques, typical problems and corrective actions.</p> <p>In all cases, practical assessment should be supported by questions to assess underpinning knowledge and those aspects of competency which are difficult to assess directly.</p> <p>Where applicable, reasonable adjustment must be made to work environments and training situations to accommodate ethnicity, age, gender, demographics and disability.</p> <p>Access must be provided to appropriate learning and/or assessment support when required.</p> <p>The language, literacy and numeracy demands of assessment should not be greater than those required to undertake the unit of competency in a work like environment.</p>
This competency in practice	<p>Industry representatives have provided the case study below to illustrate the practical application of this unit of competency and show its relevance in a workplace setting.</p> <p>Mineral processing</p> <p>A laboratory routinely determines the 'total' gold concentration of its clients' samples. A technician is preparing a rack of samples for the day's first pour. He/she monitors the furnace temperature and assembles the necessary pots, cupels and other equipment. He/she checks the client's specifications for the first sample and notices that it is dark grey. The technician recognises that this colour often indicates a high sulphide content and follows the established procedure for adjusting the flux recipe and sample charge weight to compensate. He/she carefully mixes the sample and flux and places the pot in the rack, carefully noting its position. The technician prepares the remaining samples, blanks, and check samples according to requirements. A satisfactory fusion and pour is obtained for all samples except for one that shows some 'lead shotting'. The technician adjusts the flux and sample charge weight and repeats the process. The repeat sample provides an acceptable button. He/she cupels the button to separate the precious metal from the first collector (lead). The prill is placed in a numbered container for subsequent digestion and analysis by atomic absorption spectroscopy (AAS).</p>

Range Statement

RANGE STATEMENT

The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Bold italicised wording, if used in the performance criteria, is detailed below. Essential operating conditions that may be present with training and assessment (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) may also be included.

Codes of practice

Where reference is made to industry codes of practice, and/or Australian/international standards, it is expected the latest version will be used

Standards, codes, procedures and/or enterprise requirements

Standards, codes, procedures and/or enterprise requirements may include:

- Australian and international standards, such as:
 - AS 3895.1-1991 Methods for the analysis of copper, lead, zinc, gold and silver ores - Determination of gold (Fire assay-Flame AAS method)
 - AS ISO 17025-2005 General requirements for the competence of testing and calibration laboratories
 - AS/NZS ISO 14000 Set:2005 Environmental management standards set
 - AS/NZS ISO 9000 Set:2008 Quality management systems set
- calibration and maintenance schedules
- enterprise recording and reporting procedures
- enterprise sampling procedures for specific samples, sites and clients
- environmental legislation and regulations
- equipment manuals and warranty, supplier catalogues and handbooks
- equipment startup, operation and shutdown procedures
- industry codes of practice
- material safety data sheets (MSDS)
- occupational health and safety (OHS) national standards and codes of practice
- principles of good laboratory practice (GLP)

RANGE STATEMENT	
	<ul style="list-style-type: none"> • production and laboratory schedules • quality manuals, training manuals, induction manuals • standard operating procedures (SOPs) and published preparation methods
Samples	<p>Samples may include:</p> <ul style="list-style-type: none"> • solids, such as rocks, minerals, soils, sands and stream sediments • core and other drill samples (e.g. rotary air blast (RAB), reverse circulation (RC) and aircore) • slurries, powder concentrates and metallurgical solutions • dump samples and grab samples
Client requests/documentation	<p>Client requests/documentation may include:</p> <ul style="list-style-type: none"> • client profile, sample identification, sample receipt, storage and analyses • required preparation method/and service charges
Consideration of mineralogy	<p>Consideration of mineralogy may include:</p> <ul style="list-style-type: none"> • recognising presence of highly oxidised ores, such as haematite or magnetite • adjusting charge weight and flux components to suit
Assay equipment	<p>Assay equipment may include:</p> <ul style="list-style-type: none"> • 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
Hazards	<p>Hazards may include:</p> <ul style="list-style-type: none"> • 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

RANGE STATEMENT	
	<ul style="list-style-type: none"> • noise and vibration • crushing, entanglement and cuts associated with moving machinery • manual handling of heavy loads, such as pots, racks and trolleys • heat exhaustion/stress and fatigue
Safety equipment and procedures	<p>Safety equipment and procedures may include:</p> <ul style="list-style-type: none"> • ensuring access to service shut-off points, fire extinguishers/fire hose, safety shower/eye wash stations and first aid station • recognising and observing hazard warnings and safety signs • labelling of samples, reagents and hazardous materials • direct extraction and fume hoods • guards for moving machinery parts • noise insulation • using personal protective equipment, 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 • regular cleaning of equipment and work areas using enterprise procedures • reporting of abnormal emissions, discharges and airborne contaminants, such as noise, light, solids, liquids, water/waste water, gasses, smoke, vapour, fumes, odour and particulates to appropriate personnel
Fluxes	<p>Fluxes may include:</p> <ul style="list-style-type: none"> • bulk fluxes containing lead (II) oxide (PbO), borax, soda ash, silica, silver nitrate and flour • non-standard flux additives, such as: <ul style="list-style-type: none"> • flour (oxidising samples) • potassium nitrate (reducing samples and sulphides) • silica (basic ores) • lead as PbO (siliceous ores)

RANGE STATEMENT	
Pots	<p>Pots may include:</p> <ul style="list-style-type: none"> ceramic, acidic/basic, alumina, zirconia and graphite
Sequencing of pots in a rack	<p>Sequencing of pots in a rack may include</p> <ul style="list-style-type: none"> addition of silver wire or silver nitrate (AGNO₃) mix addition of coloured salts (e.g. copper sulphate CuSO₄)
Collectors	<p>Collectors may include:</p> <ul style="list-style-type: none"> litharge or lead (II) oxide (PbO) for pot fusion silver (AGNO₃) for the cupellation
Criteria for an 'acceptable' button	<p>Criteria for an 'acceptable' button could include:</p> <ul style="list-style-type: none"> one piece, mass >20 g and <50 g malleable separates cleanly from slag free of undecomposed ore, matte and speiss
Other precious metals	<p>Other precious metals may include:</p> <ul style="list-style-type: none"> high gold, Platinum and Palladium
Separation of collectors	<p>Separation of collectors may include:</p> <ul style="list-style-type: none"> cupellation digestion parting, annealing and weighing for a gravimetric finish
Contamination and losses	<p>Contamination and losses may be caused by:</p> <ul style="list-style-type: none"> 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
Records	<p>Records may include:</p> <ul style="list-style-type: none"> pour sheets - date, time, client, pour number and preparation method

RANGE STATEMENT	
	<ul style="list-style-type: none"> • number of pots, positions of sample, blank and check in rack • visual appearance of samples, buttons and prills • corrective actions for specific samples
Indicators of potential loss and the corrective action	<p>Indicators of potential loss and the corrective action may include:</p> <ul style="list-style-type: none"> • viscous slag - check furnace temperature, adjust flux and lower charge weight • lead shotting - adjust flux, lower charge weight to compensate for high oxides, silicates and chromites • sulphides - adjust fusion time, 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
Waste	<p>Waste may include:</p> <ul style="list-style-type: none"> • rejected pots and cupels • slag, furnace material • disposable personal protective equipment
Occupational health and safety (OHS) and environmental management requirements	<p>OHS and environmental management requirements:</p> <ul style="list-style-type: none"> • all operations must comply with enterprise OHS and environmental management requirements, which may be imposed through state/territory or federal legislation - these requirements must not be compromised at any time • all operations assume the potentially hazardous nature of samples and require standard precautions to be applied • where relevant, users should access and apply current industry understanding of infection control issued by the National Health and Medical Research Council (NHMRC) and State and Territory Departments of Health

Unit Sector(s)

Unit sector	Testing
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Competency field

Competency field	
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Co-requisite units

Co-requisite units		