



**Australian Government**

# **MSL973011 Perform fire pouring techniques**

**Release: 1**

# MSL973011 Perform fire pouring techniques

## Modification History

Release 1. Supersedes and is equivalent to MSL973011A Perform fire pouring techniques

## Application

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.

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

Nil

## 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 | <b>Plan work for shift</b> | 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 and 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 and 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 collector
  - 3.6 Inspect buttons for matte, brittleness, size and malformed shape

- |   |                                                          |      |                                                                                                                                                        |
|---|----------------------------------------------------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
|   |                                                          | 3.7  | Place acceptable buttons in muffle furnace using cupels that have been previously loaded and preheated                                                 |
|   |                                                          | 3.8  | Regularly monitor furnace temperature/time/air flow to ensure efficient cupellation                                                                    |
|   |                                                          | 3.9  | Recover prills, check identifiers and inspect for contamination, losses and evidence of other precious metals (e.g. high gold, Platinum and Palladium) |
|   |                                                          | 3.10 | Complete and collate sample records before presenting prills for analysis                                                                              |
| 4 | <b>Troubleshoot and correct common recovery failures</b> | 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  | Apply an established corrective action and restart 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 | <b>Perform daily maintenance of assay equipment</b>      | 5.1  | Grade and inspect pots using established criteria prior to storage for re-use                                                                          |
|   |                                                          | 5.2  | Report defective equipment and consumable requirements to appropriate personnel                                                                        |
| 6 | <b>Maintain a safe work environment</b>                  | 6.1  | Use safe work procedures and personal protective equipment (PPE) to ensure personal safety and that of others                                          |
|   |                                                          | 6.2  | Minimise the release of collectors to the work environment                                                                                             |
|   |                                                          | 6.3  | Segregate and dispose of waste in accordance with workplace requirements                                                                               |

## 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 management 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 (e.g. rotary air blast (RAB), reverse circulation (RC) and aircore)
- slurries, powder concentrates and metallurgical solutions

- dump samples and grab samples

**Sequencing of pots in a rack**

Sequencing of pots in a rack includes, but is not limited to, or more of:

- addition of silver wire or silver nitrate ( $\text{AgNO}_3$ ) mix
- addition of coloured salts (e.g. copper sulphate  $\text{CuSO}_4$ )

**Separation of collectors**

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

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

**Hazards**

Hazards include, but are not limited to, one 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 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 shower/eye wash stations and first aid stations
- 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 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 MSL973011A Perform fire pouring 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 MSL973011 Perform fire pouring 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 extracting precious metals from their host matrices in readiness for analysis on at least three (3) occasions
- interpreting and following standard recovery methods
- maintaining close attention to technical and safety requirements in a physically demanding, hazardous environment
- recognising common sample preparation and cupellation problems and making standard adjustments to fluxes and firings
- recognising non-acceptable characteristics of received and fused samples, buttons and prills
- recognising indicators of poor recovery and applying established corrective actions
- recognising the presence of highly oxidised ores, such as haematite or magnetite, and adjusting the charge weight and flux components to suit
- accurately weighing samples and flux components
- manually handling heavy and hot items of equipment safely
- maintaining sequential control of samples through all recovery stages
- 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
  - visual appearance of samples, buttons and prills
  - corrective actions for specific samples
- planning work flow to ensure efficient sample throughput
- minimising re-work, waste and environmental impacts and disposing of all waste responsibly
- recognising hazards and using workplace safety procedures and safety equipment to work safely at all times.

## Knowledge Evidence

Must provide evidence that demonstrates knowledge of:

- procedures and/or standard methods for:
  - fusion of common mineral ore samples

- cupellation of buttons
- digestion/parting of prills
- function, operation and maintenance of assay equipment used in job role
- criteria for an 'acceptable' button, including:
  - one piece, mass >20 g and <50 g
  - malleable
  - separates cleanly from slag
  - free of undecomposed ore, matte and speiss
- causes of contamination and losses, 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 action, including:
  - 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 three parts silver (Ag) to prill, wrap in lead foil and re-cupel)
- workplace and legal traceability requirements
- relevant hazards and control measures, operation and maintenance of safety equipment, work health and safety (WHS) and environment requirements.

## Assessment Conditions

- Judgement 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:
  - MSL953001 Receive and prepare samples for testing
  - MSL943002 Participate in laboratory or field workplace safety
- Holistic assessment methods include:
  - 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 provide acceptable buttons and prills and troubleshoot and correct common recovery failures
  - written/oral questions about fire pouring techniques, typical recovery 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:
  - a variety of precious metal ore samples and associated fire assay methods, fire assay materials and reagents
  - client requests and documentation, such as client profile, sample identification, sample receipt, storage and analyses, required preparation method and service charges
  - assay equipment, such as:
    - mixing equipment and balances
    - fusion and muffle furnaces and associated spares
    - temperature sensors and hotplates
    - compressed air service, extraction systems and fuel supply lines
    - cupels, pouring equipment, pot loader, trolleys, moulds, tongs and hammers
    - pots, including ceramic, acidic/basic, alumina, zirconia and graphite
- collectors, including litharge or lead (II) oxide (PbO) for pot fusion and silver (AGNO3) for the cupellation
- fluxes, including:
  - bulk fluxes containing lead (II) oxide (PbO), borax, soda ash, silica, silver nitrate and flour
  - non-standard flux additives, such as:
    - flour (oxidising samples)
    - potassium nitrate (reducing samples and sulphides)
    - silica (basic ores)
    - lead as PbO (siliceous ores)
- safety equipment and safe work 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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<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=5c63a03b-4a6b-4ae5-9560-1e3c5f462baa>