



Australian Government

MEM48017 Monitor blast furnace operations

MEM48017 Monitor blast furnace operations

Modification History

Release	Comments
2	Metadata updated.
1	This unit of competency was first released in MEM Manufacturing and Engineering Release 3.0.

Application

This unit of competency defines the knowledge and skills required to monitor and control the operation of blast iron furnace.

It applies where a technician will be required to utilise a Supervisory Control and Data Acquisition (SCADA) system to monitor the melting of iron ores and associated materials within a blast furnace, ensuring that quantities, temperatures and all procedures are used in accordance with parameters provided and standard operating procedures (SOPs).

Licensing/Regulatory Information

No licensing, legislative or certification requirements apply to this unit at the time of publication.

Pre-requisite unit(s)

MEM48004 Interpret basic binary phase diagrams

MEM48011 Apply basic chemical principles to metallurgy

MEM48012 Calculate and predict chemical outcomes in metallurgical situations

Competency field(s)

Metallurgy

Unit sector(s)

N/A

Elements and Performance Criteria

Elements	Performance criteria
<i>Elements describe the essential outcomes.</i>	<i>Performance criteria describe the performance needed to demonstrate achievement of the element.</i>
1. Determine job requirements	1.1 Follow standard operating procedures (SOPs) 1.2 Comply with work health and safety (WHS) requirements at all times 1.3 Use appropriate personal protective equipment (PPE) in accordance with SOPs 1.4 Identify job requirements from work information
2. Access and use SCADA system	2.1 Find all relevant screens and information within SCADA system 2.2 Interpret and acknowledge messages 2.3 Input and output information according to work requirements
3. Make required changes	3.1 Adjust production and/or process in response to SCADA information in accordance with procedures 3.2 Apply metallurgical principles to determine and prioritise required actions in accordance with SOPs 3.3 Record adjustments and variations to specifications and/or schedules and report to appropriate personnel 3.4 Refer all events outside of parameters or SOPs to appropriate personnel for remedial action immediately

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.

Supervisory Control and Data Acquisition (SCADA) system includes one or more of the following:	• field instrumentation • field controller (RTU or PLC) • human-machine interface (HMI) • network connectivity • data storage on-site or cloud.
Techniques for increasing blast furnace productivity include:	• blast temperature • blast humidity • blast volume • hydrogen injection • oxygen enrichment • top pressure • burden control and raw materials • size control.

Unit Mapping Information

Current Code and Title	Previous Code and Title	Comments	Equivalence
MEM48017 Monitor blast furnace operations	MSATCM506A Monitor blast furnace operations		Equivalent

Assessment Requirements for MEM48017 Monitor blast furnace operations

Modification History

Release	Comments
2	Metadata updated.
1	This unit of competency was first released in MEM Manufacturing and Engineering Release 3.0.

Performance Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy the requirements of the elements and performance criteria and include:

- following work instructions, standard operating procedures (SOPs) and safe work practices
- identifying and interpreting specifications, safety procedures and other reference material to monitor blast furnace operations
- meeting specifications for furnace output
- applying techniques for increasing blast furnace productivity on at least two occasions
- communicating within the workplace
- maintaining accurate records.

Note: Where a volume and/or frequency is not specified, demonstration must be provided at least once.

Knowledge Evidence

Evidence required to demonstrate the required knowledge for this unit must be relevant to and satisfy the requirements of the elements and performance criteria and include knowledge of:

- safe work practices and procedures and use of personal protective equipment (PPE)
- supervisory control and data acquisition (SCADA) systems
- metallurgical principles
- proximate and ultimate analysis classification of coal for metallurgical coke
- coke including:
 - coal carbonisation
 - technical aspects of coke making

- coke model
- coke manufacture
- by-product ovens
- sequence of battery operations
- coke properties including caking and swelling
- quality control tests for coke
- crucible swelling number and Gray-King coke type
- coke strength after reaction (CSR), abrasion resistance and reactivity tests
- other fuels including:
 - blast furnace gas uses
 - coke oven gas uses
 - fuel oil including injection of auxiliary fuels
 - tar and pitch
- iron ore including:
 - mineralogical characteristics
 - sources of iron and locations of ore
 - chemical analysis including desirable ore quality and unwanted impurities
 - desirable properties for iron making
 - mining and preliminary treatment (ore beneficiation)
 - ore handling
 - blending and stacking including chevron and step stacking
 - essential characteristics of iron ore
 - reducibility, strength, size and distribution
 - lump ore including direction charging
 - fine ore including need for agglomeration for good permeability
 - testing and quality control of iron ores for resistance to fines generation
 - drying handling and charging resistance to decrepitation
 - low temperature reduced degradation
 - height temperature (Nagoyal test)
 - reducibility (Gakushin test)
 - softening under load
 - cohesive zone of blast furnace (BF) ore agglomeration including:
 - need for agglomeration
 - sources of fines

- aims for agglomeration
- pelletising including:
 - use of pelletising and size and quality of ore
 - pelletising process
 - quality control needs for pellets
 - abrasion index
 - reduction degradation index (RDI)
- sintering including:
 - sintering process
 - proportioning of raw materials
 - size of ores, blending and moisture
 - limestone and coke
 - mixing and granulation
 - sinter characteristics and quality
 - size, strength and reducibility
 - chemistry (basicity ratio)
 - quality control tests for sinter
 - sieving and sizing
 - sinter tumble test (abrasion test)
 - low temperature reduction, RDI and high temperature reducibility
- miscellaneous raw materials including:
 - fluxes, limestone, fluorspar and quartzite
 - manganese ore, air and tonnage oxygen and water
- iron blast furnace operations including:
 - general description and function of blast furnace including charged materials
 - blast furnace terminology
 - blast furnace chemistry (reduction chemistry and gaseous versus solid reduction)
 - thermodynamics of iron making (physio-chemical principles)
 - free energy charges (Ellingham)
 - oxygen potential diagram
 - equilibrium and equilibrium
 - constant and activity
 - dependence of coke and/or oxygen reaction and gas composition

- blast furnace slags including:
 - slag and or metal reactions
 - slag formation reactions
- construction and design of blast furnaces including:
 - furnace construction
 - furnace profile layout
 - function of processing units associated with the blast furnace
 - charging and distribution
 - ore blending and raw material bins
 - raw material control and charges
 - furnace filling
 - use of moveable armour
 - refractories and cooling systems including:
 - choice of refractory materials for furnace lining
 - method of cooling and under hearth
 - cooling and stave cooling
 - campaign life determinants including link between refractories and cooling system
 - blower stations including hot blast stoves and tuyeres
 - gas cleaning equipment and dust extraction
 - cast house layout including:
 - metal slag
 - flow-slag disposal
 - blast furnace sensors including:
 - computer control
 - sensors and interpretation
 - human eye
 - tuyere and casting condition
 - thermocouples
 - hot metal
 - stoves
 - brickwork
 - tip temperature probes
 - pressure tapping

- level detectors
 - flow meters
 - flow rate of gases and hot blast
 - chemical analysis
- composition of metal slag and waste gases
- principles of iron making including:
 - furnace filling including mechanism of charging and of distribution segregation effects
 - blast furnace zones of operations including:
 - physical movement through the furnace
 - counter current process
 - solids, gas and temperature profile five internal zones lumpy or granular zone, cohesive zone and active coke zone raceway
 - hearth and deadman
 - lumpy and granular zone-zone formation
 - cohesive zone-zone formation
 - active coke zone-zone formation
 - importance of coke properties
 - zone chemistry and effects of metal, coke, alkalis and fluxes and slag
 - raceway including:
 - physical structure
 - raceway model-factor affecting shape-blast parameters
 - combustion in raceway
 - importance of coke additives to replace coke to improve control and production
 - hearth and deadmen-zone formation including:
 - deadman boundary residence time of coke
 - gas and liquid flow and liquid levels
 - floating levels and floating of coke bed
 - liquid permeability
 - effect of casting rate
 - fluidity of slag and metal
 - liquid flow and effect on lining wear
 - hot metal and slag chemistry including:
 - hot metal including optimisation of hot metal

- composition control of carbon, silicon, manganese, sulphur and phosphorus
- slag and mechanism of slag formation including:
 - optimisation of slag chemistry
 - requirements of a good slag melting point, basicity and viscosity
 - ability to remove unwanted materials (de sulphurising power)
 - slag volume
- requirements for effective and efficient operation including:
 - importance of raw material quality and quantities
 - burden distribution, tuyere injectants and fuel rate
 - elimination of irregularities
- post iron making practices including:
 - reasons for post iron making productivity
 - control of unwanted elements
 - control of hot metal and composition for basic oxygen steel making (BOS) steel making and balance of exothermic reactions
 - de-sulphurising, dephosphorisation and desiliconising
 - lime, magnesium and aluminium
 - importance of injectants and slag formers and significance of slag partitioning.

Assessment Conditions

- Assessors must:
 - have vocational competency in monitoring blast furnace operations at least to the level being assessed with relevant industry knowledge and experience
 - satisfy the assessor requirements in the *Standards for Registered Training Organisations 2015* or its replacement and comply with the *National Vocational Education and Training Regulator Act 2011*, its replacement or equivalent legislation covering VET regulation in a non-referring state/territory as the case requires.
- Where possible, assessment must occur in operational workplace situations. Where this is not possible or where personal safety or environmental damage are limiting factors, assessment must occur in a sufficiently rigorous simulated environment that reflects realistic operational workplace conditions that cover all aspects of workplace performance, including environment, task skills, task
- management skills, contingency management skills and job role environment skills.
- Conditions for assessment must include access to all tools, equipment, materials and documentation required including relevant workplace procedures, product and manufacturing specifications.

- 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.

Link

Companion volumes, including implementation guides, are found on the national training register - <https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=45a7f1d5-61a5-447a-9688-7abbd7e1a5c7>.