



Australian Government

Department of Education, Employment and Workplace Relations

MSATCM506A Monitor blast furnace operations

Revision Number: 1

MSATCM506A Monitor blast furnace operations

Modification History

Not applicable.

Unit Descriptor

Unit Descriptor	This unit covers the knowledge and skills needed to monitor and control the operation of blast iron furnace
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Application of the Unit

Application of the unit	In a typical scenario, a technician will be required to utilise a 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.
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Licensing/Regulatory Information

Not applicable.

Pre-Requisites

Pre-requisite Units	MSATCM304A	<i>Interpret basic binary phase diagrams</i>
	MSATCM406A	<i>Apply basic chemistry principles to metallurgy</i>
	MSATCM501A	<i>Calculate and predict chemical outcomes in metallurgical situations</i>

Employability Skills Information

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

Not applicable.

Elements and Performance Criteria

ELEMENT	PERFORMANCE CRITERIA
1. Access/interrogate SCADA system	1.1.Find all relevant screens and information within SCADA system 1.2.Interpret and acknowledge messages 1.3.Input and output information as required
2. Make required changes.	2.1.Adjust production / process in response to SCADA information in accordance with procedures 2.2.Apply metallurgical principles to determine and prioritise required actions in accordance with standard operating procedures 2.3.Record adjustments and variations to specifications / schedules and report to appropriate personnel 2.4.All events outside of parameters or standard operating procedures is immediately referred to appropriate personnel for remedial action

Required Skills and Knowledge

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Required skills:

- Carry out all work according to OH&S practices
- Read, interpret and follow information on work specifications, standard operating procedures and work instructions and other reference material
- Maintain accurate records
- Meet specifications for furnace output
- Communicate within the workplace
- Apply techniques for Increasing Blast Furnace Productivity including:
 - blast temperature
 - blast humidity
 - blast volume
 - hydrogen injection
 - oxygen enrichment
 - top pressure
 - burden control/raw materials
 - size control

Required knowledge:

Competency includes sufficient knowledge of:

- Coal
- Proximate and ultimate analysis classification of coal for metallurgical coke
- Coke
 - coal carbonisation
 - technical aspects of coke making
 - coke model, coke manufacture
 - by-product ovens
 - sequence of battery operations
 - coke properties - caking and swelling
 - quality control tests for coke
 - (crucible swelling number and Gray-king coke type)
 - coke strength and abrasion, resistance CRS - reactivity tests.
- Other Fuels
 - blast furnace gas - uses
 - coke oven gas - uses
 - fuel oil - injection of auxiliary fuels

REQUIRED SKILLS AND KNOWLEDGE

- tar and pitch
- IronOre
 - mineralogical characteristics
 - sources of iron, locations of ore
 - chemical analysis - ore quality desirable, unwanted impurities
 - desirable properties for iron making
 - mining/preliminary treatment (ore beneficiation)
 - ore handling
 - blending/stacking (chevron/step stacking)
 - essential characteristics of iron ore -
 - reducibility/strength size distribution -
 - lump ore - direction charging
 - fine ore - need for agglomeration for good permeability
 - testing and quality control of iron ores for iron making resistance to fines generation
 - drying handling and charging resistance to decrepitation
 - low temperature reduced degradation
 - (Nagoyal test) height temperature
 - reducibility (Gakushin test)
 - softening under load
 - cohesive zone of (BF)
- Ore Agglomeration
 - Need for agglomeration, sources of fines, aims for agglomeration
- Pelletising
 - use of pelletising; size and quality of ore
 - pelletising process
 - quality control needs for pellets
 - abrasion index, RDI index
- Sintering
 - sintering process
 - proportioning of raw materials
 - size of ores, blending, moisture
 - limestone and coke
 - mixing and granulation
 - sinter characteristics, sinter quality
 - size, strength, reducibility
 - chemistry (basicity ratio)
 - quality control tests for sinter
 - sieving and sizing

REQUIRED SKILLS AND KNOWLEDGE

- sinter tumble test (abrasion test)
- low temperature reduction, degradation (reduction degradation index - RDI), high temperature reducibility
- Miscellaneous Raw Materials
 - Fluxes: Limestone, fluorspar, quartzite
 - manganese ore, air/tonnage oxygen, water
- Iron Blast Furnace Operations
 - general description and function of blast furnace including charged materials
 - blast furnace terminology
 - blast furnace chemistry (reduction chemistry and gaseous v's solid reduction)
 - thermodynamics of iron making (physio chemical principles)
 - free energy charges; Ellingham
 - diagram/oxygen potential
 - equilibrium/equilibrium
 - constant/activity
 - dependence of coke/oxygen reaction and gas composition
- Blast furnace slags
 - slag/metal reactions
 - slag formation reactions
- Construction and Design of Blast Furnaces
 - furnace construction/furnace profile layout and function of processing units associated with the blast furnace
 - charging and distribution
 - ore blending, raw material bins
 - raw material control and charges
 - furnace filling
 - use of moveable armour
 - refractories and cooling systems
 - choice of refractory materials for furnace lining
 - method of cooling/under hearth
 - cooling/stave cooling
 - campaign life determinants - link between refractories and cooling system
 - blower stations:
 - hot blast stoves, tuyeres
 - gas cleaning equipment , dust extraction
 - cast house layout
 - slag/metal
 - flow-slag disposal

REQUIRED SKILLS AND KNOWLEDGE

- blast furnace sensors
 - computer control
 - sensors and interpretation
 - human eye
 - tuyere/casting condition
 - thermocouples
 - hot metal
 - stoves
 - brickwork
 - tip temperature probes
 - pressure tapping
 - level detectors
 - flow meters
 - flow rate of gases/hot blast
 - chemical analysis
- composition of metal slag and waste gases
- Principles of Iron Making
 - furnace filling
 - mechanism of charging and of distribution segregation effects
 - blast furnace zones of operations
 - physical movement through the furnace
 - counter current process
 - solids/gas and temperature profile five internal zones lumpy/granular zone, cohesive zone, active coke zone raceway
 - hearth and deadman
 - lumpy/granular zone-zone formation
 - cohesive zone-zone formation
 - active coke zone-zone formation
 - importance of coke properties
 - zone chemistry - effects of metal, coke, alkalis and fluxes/slag.
 - raceway
 - 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
 - (deadman boundary residence time of coke)
 - gas/liquid flow, liquid levels

REQUIRED SKILLS AND KNOWLEDGE

- floating levels, floating of coke bed
- liquid permeability
- effect of casting rate
- fluidity of slag and metal
- liquid flow: effect on lining wear.
- hot metal and slag chemistry
 - hot metal - optimisation of hot metal
 - composition control of carbon, silicon, manganese, sulphur, phosphorus
- slag - mechanism of slag formation
 - optimisation of slag chemistry
 - requirements of a good slag -melting point, basicity, viscosity
 - ability to remove unwanted materials, (de sulphurising power)
 - slag volume
- requirements for effective and efficient operation
 - importance of raw material quality and quantities
 - burden distribution , tuyere injectants, fuel rate
 - elimination of irregularities
- Post Iron making Practices
 - reasons for post iron making productivity
 - control of unwanted elements
 - control of hot metal, composition for BOS
 - steelmaking and balance of exothermic reactions
 - de sulphurising, dephosphorisation, desiliconising
 - lime, magnesium, aluminium
 - importance of injectants and slag formers, significance of slag partitioning

Evidence Guide

EVIDENCE GUIDE

The Evidence Guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for the Training Package.

Overview of assessment

A person who demonstrates competency in this unit must be able to monitor blast furnace operations. Critical aspects for assessment and evidence are required to demonstrate competency in this unit.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

It is essential that competence is demonstrated in the ability to:

- use OH&S practices
- explain the general principles of iron making
- monitor the operation of a blast furnace under direction and consistently achieve required furnace output specification

Relationship to other units

This unit may be assessed concurrently with other relevant units.

Assessment method and context

Assessors must be satisfied that the person can consistently perform the unit as a whole, as defined by the elements, performance criteria, skills and knowledge. A holistic approach should be taken to the assessment.

Assessors should gather sufficient, fair, valid, reliable, authentic and current evidence from a range of sources. Sources of evidence may include direct observation, reports from supervisors, peers and colleagues, project work, samples, organisation records and questioning. Assessment should not require language, literacy or numeracy skills beyond those required for the unit.

The assessee will have access to all techniques, procedures, information, resources and aids which would normally be available in the workplace.

The method of assessment should be discussed and agreed with the assessee prior to the commencement of assessment.

Resource implications

This section should be read in conjunction with the range of variables for this unit of competency.

EVIDENCE GUIDE

Resources required include suitable access to an operating plant or equipment that allows for appropriate and realistic simulation. A bank of case studies/scenarios and questions will also be required to the extent that they form part of the assessment method. Questioning may take place either in the workplace, or in an adjacent, quiet facility such as an office or lunchroom. No other special resources are required.

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.

SCADA system	System Control and Data Acquisition is a general term applied to a number of systems which automatically collect critical process data, perform required mathematical manipulations on it and then make control decisions and/or give required information to personnel for action. In the continuous manufacturing sector, the SCADA system may be integrated into other sophisticated computer control systems such as DCS (Distributed control system). Organisations may simply refer to their SCADA as the DCS or other similar term (such as the proprietary name of the computer system). SCADA systems may provide information from outside of the process, such as stock/material levels in a location. This information may all be accessed by the SCADA system and the employee using it in order to make production rate and other control decisions (either automatically or human assisted) about their own process.
Metallurgical principles relate to	• preparation and selection of raw materials • characteristics of iron ore • pelletising • sintering • iron blast furnace operations • blast furnace slags • principles of iron making • techniques for increasing blast furnace productivity

Unit Sector(s)

Unit Sector	Metallurgy
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Competency field

Competency Field	
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Co-requisite units

Co-requisite Units		