



Australian Government

Department of Education, Employment and Workplace Relations

MSATCM516A Select non metallic materials for engineering applications

Revision Number: 1

MSATCM516A Select non metallic materials for engineering applications

Modification History

Not applicable.

Unit Descriptor

Unit Descriptor	This unit covers recognising common non-metallic materials used in engineering, assisting in the selection of a material for a specific application, and using test results to evaluate the properties of materials.
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Application of the Unit

Application of the unit	This unit applies to metallurgist technician level activities in manufacturing and engineering environments where the metallurgist is also required to select or assist in the selection of non metallic materials.
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Licensing/Regulatory Information

Not applicable.

Pre-Requisites

Pre-requisite Units	

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. Identify common non metallic engineering materials by their principal properties	1.1. The principal properties of thermosetting and thermoplastic polymers are identified. 1.2. The principal properties of ceramics and composite materials are identified. 1.3. The effects of different types of bonding in materials are identified. 1.4. The effects of mechanical and thermal processes on the principal properties of materials are identified.
2. Select non metallic materials for specific applications	2.1. The engineering requirement for the specific application is determined in consultation with others. 2.2. Material is selected based on the requirement and consideration of principal properties and further processing. 2.3. Selection is confirmed according to standard operating procedures
3. Verify selected non metallic material as fit for purpose	3.1. Appropriate tests for the required properties are identified. 3.2. Testing of materials is arranged with appropriate persons, if necessary. 3.3. Test results are analysed and material choices are confirmed or modified as appropriate.

Required Skills and Knowledge

REQUIRED SKILLS AND KNOWLEDGE

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

Required skills:

- undertake research
- select/carry out tests appropriate to the material
- communicate
- document
- plan and sequence operations
- read, interpret and follow information on written job instructions, specifications, standard operating procedures, charts, lists, drawings and other applicable reference documents

Required knowledge:

Competency includes sufficient knowledge of:

- principles involved in selecting non metallic materials
- compromises made to accommodate cost against properties

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 select non metallic materials for engineering applications. 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:

- describe common non metallic materials and their properties
- match common non -metallic materials to engineering applications
- identify and arrange tests for common non metallic materials.

Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge, and be capable of applying the competency in new and different situations and contexts.

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,

EVIDENCE GUIDE**Resource implications**

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.

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

Codes of practice/standards	Where reference is made to industry codes of practice, and/or Australian/international standards, it is expected the latest version will be used.
Common engineering non metallic materials and required properties include:	• Structure of Materials • Descriptions of general non-crystalline features and shoer range order. Use as examples: • linear polymers: e.g., polyethylene, PVC, polystyrene • elastomer: e.g., natural rubber (polyisoprene), (acrylonitrile butadiene) • three dimensional networks • thermosetting polymers: e.g. Phenol formaldehyde, epoxides • inorganic glasses: e.g., oxide glasses, silica, borosilicate • gels: e.g., asphalt and Portland cement • Polymers and plastics: • description of the basic structural unit 'mer', monomer, polymer. • addition and condensation polymerisation, briefly, with examples. • distinguish between thermoplastics and thermosets with six examples of each. • discuss crystallinity in polymers with examples of crystalline polymers eg, HDPE, nylon, PP, PTFE and amorphous polymers e.g: PVC, polystyrene, PMMA. • relate to crystallinity to mechanical properties like rigidity and thermal transitions. • additives, to include fillers, reinforcements, plasticizers, UV stabilisers, anti-oxidants, lubricants, colourings and flame retardants. • Plastics and polymers processing and use: • Emphasise the use of additives to vary polymer properties a tailor polymer to appropriate uses. Processing descriptions to include compounding, injection moulding, extrusion, blow moulding, and

RANGE STATEMENT

	compression moulding. - Describe the use of the major polymers in the above areas highlighting properties of importance in selected applicants by example, eg, polymers used as binders in foundry sands, dielectrical properties for electrical, low cost for agriculture, low permeability of water, oxygen for food packaging and freezer packaging. - Ceramic materials: - Describe ceramic structures of AX type with various co-ordination numbers (relate to ionic radii) use simple examples only eg, CsCl, NaCl, ZnS, Ax_2, and A_2X_3 types briefly with examples; two metal compounds briefly eg, BaTiO₃. - Detailed structure of SiO₄, tetrahedra as the basic structural unit and relate the importance to bricks, cement, glass, crockery, technical insulators. - Describe silica SiO₂ and quartz. Mention refractory nature but problem of cracking under temperature change due to structural changes. Vitreous or fused silica and properties compared to silica and especially uses with temperature change. - Introduce binary (eg, MgO-Al₂O₃) and ternary diagrams (eg, MgO-Al₂O₃-SiO₂) - Manufacture of ceramic articles: - raw materials: clays, flints, feldspars, - effect of water, shaping by pressure fabrication, hydroplastic forming and slip casting. - drying and shrinkage, refer to brick and earthenware product manufacture. - describe sintering (fixing) and associated shrinkage. - engineering ceramics: eg, silicon nitride, silicon carbide. - Glass: - describe the vitreous or glassy state and the basic structural unit SiO_4 tetrahedra. - describes glass formers, glass modifiers and intermediates and their role in glass structure. examples of each. - properties of glass: viscosity, mechanical, optical. - special glass treatments: tempered glass, compare properties with normal annealed glass, effect of compression stresses in surface material. - explain devitrification of glass and accompanying
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	changes in properties. glass ceramics: applications. • Fibres: • fibres and whiskers, metallic and non-metallic • carbon fibres, glass, Al₂O₃, SiC fibres • specific modulus and relation to strength to weight ration • discuss economic viability of fibres • Composite materials: • define and give examples, including concrete, wood fibre composites, glass reinforced plastics, foams, reinforced rubbers (tyres). • describe the structure of fibre composite and function of fibre composites in actual applications: eg, aerospace, sporting goods. • briefly cover concrete, portland cement and raw materials. • define hydraulic cement mention the importance of portland cement, compositions and use. • factors affecting concrete strength: eg, mixing, measuring, water/cement ration, aggregate/cement ration, aggregate strength and proportions and curing conditions. • Adhesives: • briefly describe adhesion and adhesives. • describe surface properties of liquids and solids especially wetting and non-wetting conditions, include surface tension briefly and relate to choice of adhesive and substrate.
Appropriate tests	Tests which can be undertaken by a technician within the organisation as well as those required to be undertaken by external organisations, including simple tests
Required properties	Properties to be tested include: • tensile strength • compression • shear characteristics • torsion • hardness • impact resistance • fatigue resistance • creep resistance • visual appearance and colour • magnetic properties

RANGE STATEMENT	
	corrosion resistance
Appropriate persons	Internal technicians and/or external organisations

Unit Sector(s)

Unit Sector	Metallurgy
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Competency field

Competency Field	
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Co-requisite units

Co-requisite Units		