Title	**Demonstrate knowledge of engineering tool steels and surface treatment of steels**		
Level	**5**	**Credits**	**7**

Purpose	People credited with this unit standard are, for tool steel, able to demonstrate knowledge of types and uses; microstructure; heat treatment processes; dimensional and shape stability; and demonstrate knowledge of surface treatment principles and surface treatment processes for steels.

Classification	Mechanical Engineering > Engineering - Materials

Available grade	Achieved

Explanatory notes

1 Reference
Health and Safety at Work Act 2015 and supporting Regulations.

2 Definitions
Surface treatment – induction-hardening, case-hardening, laser, and electron beam hardening techniques.
Tool steels – die steels and high-speed steels.

3 Assessment information
Examples/evidence given must be within the context of mechanical engineering or manufacturing. Numerous reference texts and training manuals on engineering material science are available and may be used; however no one textbook or source of information is envisaged.

Outcomes and evidence requirements

Outcome 1

Demonstrate knowledge of tool steel types and uses.

Evidence requirements

1.1 Classifications of tool steels are described in terms of production requirements.

Range high speed tool steels, cold working tool steels, hot working tool steels, plastic mould steels, shock resistant steels.

1.2 Typical applications of tool steel are described.

Range hand tools and equipment for cutting, shaping, forming, blanking, drilling, coining.

Outcome 2

Demonstrate knowledge of tool steel microstructure.

Evidence requirements

2.1 The microstructure of tool steels is described in terms of the arrangement of primary and alloying elements in the steel matrix.

Range primary elements – iron and carbon;
alloying elements may include but are not limited to – chromium, molybdenum, vanadium, tungsten, nickel.

2.2 The role of alloying elements is described in terms of the desired physical properties of tool steels.

Range may include but is not limited to – wear, erosion resistance, hardenability, toughness versus hardness.

2.3 The relationship between the primary and alloying elements is described in terms of the formation of carbide particles.

2.4 The necessity for even distribution of carbides in tool steel is described in terms of the integrity of the finished product.

2.5 The effect of heating on the carbides is described in terms of subsequent hardening.

Range methods include – hand, spray, immersion, ultrasonic.

Outcome 3

Demonstrate knowledge of tool steel heat treatment processes.

Evidence requirements

3.1 Stages of the heat treatment process are described in terms of their purpose and effect on the steel's microstructure.

Range annealing, normalising, austenising, quenching, tempering.

3.2 Quenching media for tool steels are described in terms of advantages and disadvantages for selected steel types.

Range may include but is not limited to – oil, martempering bath, air.

3.3 Quenching rate is described in terms of its effect on the formation of soft spots and quenching cracks.

3.4 Protection of tools during the heat treatment process is described in terms of possible effects of atmospheric oxidation and decarburisation.

3.5 Double/triple-tempering of tool steel is described in terms of its purpose.

3.6 Tempering methods and temperature are described in terms of effect on tool steel hardness, toughness, and dimensional change.

3.7 Materials suppliers' data is referred to for information on depth of hardening for tool steel components at given diameters.

3.8 Cautions associated with welding of tool steels are described in terms of maintaining desired properties and microstructure.

Range weld deposit and heat-affected zone, formation of carbides.

Outcome 4

Demonstrate knowledge of tool steel dimensional and shape stability.

Evidence requirements

4.1 Tool steels are described in terms of potential distortion occurring in the hardening and tempering stage.

4.2 Means of reducing distortion are described.

Range design simplicity, stress relieving, heating rate during hardening, grade of steel, quenching rate, tempering temperature.

4.3 Types of stresses are described in terms of their effect on tool steel distortion.

Range machining stresses, thermal stresses, transformation stresses.

Outcome 5

Demonstrate knowledge of surface treatment principles for steels.

Evidence requirements

5.1 Surface treatment processes are described in terms of their objective in achieving a combination of mechanical properties.

Range includes but is not limited to – hardness, ductility, strength, shock resistance.

5.2 Surface treatment methods are contrasted in terms of their role in achieving selective hardening.

Range localised hardening material, localised heat treatment process.

Outcome 6

Demonstrate knowledge of surface treatment processes for steels.

Evidence requirements

6.1 Each process is described in terms of how it achieves surface hardness.

Range includes but is not limited to – equipment, media, temperature, duration of treatment, exposed and protected surfaces.

6.2 Examples of temperature and time effects of heat treatment in relation to case depth are given by reference to relevant treatment diagrams.

6.3 Host metal types are identified in terms of how they respond to specific heat treatment processes.

Range metal types include but are not limited to – plain carbon steels, low alloy steels, tool steels.

6.4 Surface heat treatment processes are related to specific metal properties.

Range includes but is not limited to – hardness, wear resistance, fatigue resistance, case depth.

6.5 Precautions to be taken during heat treatments are identified in terms of equipment and personal safety.

6.6 Limitations of heat treatment processes are identified and related to steel and end use.

Range cracking, distortion.

Replacement information	This unit standard replaced unit standard 20800.

Planned review date	31 December 2021

Status information and last date for assessment for superseded versions

Process	Version	Date	Last Date for Assessment
Registration	1	17 November 2011	31 December 2017
Review	2	8 December 2016	N/A

Consent and Moderation Requirements (CMR) reference	0013

This CMR can be accessed at http://www.nzqa.govt.nz/framework/search/index.do.

Please note
Providers must be granted consent to assess against standards (accredited) by NZQA, before they can report credits from assessment against unit standards or deliver courses of study leading to that assessment.

Industry Training Organisations must be granted consent to assess against standards by NZQA before they can register credits from assessment against unit standards.

Providers and Industry Training Organisations, which have been granted consent and which are assessing against unit standards must engage with the moderation system that applies to those standards.

Requirements for consent to assess and an outline of the moderation system that applies to this standard are outlined in the Consent and Moderation Requirements (CMR). The CMR also includes useful information about special requirements for organisations wishing to develop education and training programmes, such as minimum qualifications for tutors and assessors, and special resource requirements.

Comments on this unit standard

Please contact Competenz on qualifications@competenz.org.nz if you wish to suggest changes to the content of this unit standard.