Title	**Demonstrate knowledge of engine design factors**		
Level	**5**	**Credits**	**15**

Purpose	People credited with this unit standard are able to demonstrate knowledge of engine design factors.

Classification	Motor Industry > Engines

Available grade	Achieved

Guidance Information

1 Evidence presented for assessment against this unit standard must be consistent with safe working practices and be in accordance with applicable service information, and company requirements and legislative requirements. This includes the knowledge and use of suitable tools and equipment.

2 Legislation, regulations and/or industry standards relevant to this unit standard include but are not limited to the current version of the Health and Safety at Work Act 2015; and any subsequent amendments and replacements.

3 Definitions
Company requirements refer to instructions to staff on policy and procedures that are available in the workplace. These requirements may include – company policies and procedures, work instructions, product quality specifications and legislative requirements.
Service information may include – technical information for a vehicle, machine, or product detailing operation; installation and servicing procedures; manufacturer instructions; technical terms and descriptions; and detailed illustrations.

4 It is recommended that people hold credit for Unit 32322, *Demonstrate knowledge of automotive cylinder head reconditioning practices*, before being assessed against this unit standard.

Outcomes and performance criteria

Outcome 1

Demonstrate knowledge of engine design factors.

Performance criteria

1.1 Conditions determining engine performance and efficiency are explained in relation to engine capabilities.

Range volumetric efficiency, thermal efficiency, mechanical efficiency, specific fuel consumption, influence of compression ratio.

1.2 Performance evaluation terms and their relationship with each other are described.

Range brake horsepower, torque, brake mean effective pressure.

1.3 Factors affecting combustion processes of internal combustion engines are described.

Range volumetric and thermal efficiency, turbulence, combustion chamber surface area compared to swept volume, calculating compression ratio, ignition type, ignition advance, spark plug location, combustion chamber shape, combustion swirl effects, bore – stroke ratio, fuel injection (direct and indirect), fuel type.

1.4 Engine crankcase design is described.

Range structural rigidity, minimum weight, cooling, casting material, wear properties, machining requirements, distortion.

1.5 Engine cylinder design is described.

Range size, shape, length, cubic capacity, wear resistant, transmit heat, dimensionally stable under gas pressure, piston forces, mechanical and thermal distortions encountered in engine assembly and operation, cylinder bore finish.

1.6 Engine crankshaft design is described.

Range rigidity, balance requirements, torsional vibration, vibration dampers, number of main bearing journals, machining, weight.

1.7 Engine crankshaft bearing requirements are described.

Range may include –
physical characteristics – wall thickness, crush, material, machining tolerances and clearances, supporting the crankshaft, controlling the shaft end play, lubrication;
load endurance factors – fatigue resistance, load carrying capacity, compatibility;
surface endurance – compatibility, score resistance, wear resistance, conformability, corrosion resistance, embeddability.

1.8 Engine piston and connecting rod assembly designs are described.

Range may include –
pistons – materials, expansion control, piston pins and retaining methods, piston ring materials, piston ring types, piston ring face coatings;
connecting rods – materials, alternating stresses due to combustion and inertia forces, bending stresses, off-set, weight, balance, lubrication, big end symmetry.

1.9 Valve mechanism designs are described.

Range may include – types (mechanical, hydraulic) layout, valve timing diagrams, cam design (lift curves, opening ramps, closing ramps), cam lift compared to valve lift, followers and tappets, shoe levers and rocker arms, rocker arm geometry, valve springs (single, double), valves, keepers, seals, rotators, cylinder deactivation, variable valve actuation.

1.10 Engine lubrication is described.

Range may include – bearing lubrication and supply, wedge action, oil flow rate, oil pressure, cold starting, thrust and heavy load areas, pump capacity, filters, intake strainers, oil additives, upper cylinder lubrication, oil coolers.

1.11 Engine fuel system design is described.

Range may include – obtaining combustion efficiency for diesel fuelled engines, petrol fuelled engines, and alternative fuelled engines; exhaust emission controls; electronic controls; effects of engine modification; cylinder deactivation.

1.12 Engine cooling system design considerations are described.

Range may include – rate of heat transfer, importance of using specified coolant, water circulation factors, thermostat opening temperatures, radiator requirements.

Planned review date	31 December 2025

Status information and last date for assessment for superseded versions

Process	Version	Date	Last Date for Assessment
Registration	1	25 February 2021	N/A

Consent and Moderation Requirements (CMR) reference	0014

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

Comments on this unit standard

Please contact the MITO New Zealand Incorporated info@mito.org.nz if you wish to suggest changes to the content of this unit standard.