

Title	Demonstrate knowledge of engine design factors and machining practices		
Level	4	Credits	20

Purpose	People credited with this unit standard are able to demonstrate knowledge of engine design factors, and engine machining practices.
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Classification	Motor Industry > Engines
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Available grade	Achieved
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Guidance Information

Definitions

Company requirements refer to instructions to staff on policy and procedures which are documented in memo or manual format and are available in the workplace. These requirements include but are not limited to – company specifications and procedures, work instructions, manufacturer specifications, product quality specifications, and legislative requirements.

Service information may include but is not limited to – technical information of a vehicle, machine, or product detailing operation; installation and servicing procedures; manufacturer instructions and specifications; technical terms and descriptions; and detailed illustrations. This can be accessed in hard copy or electronic format and is normally sourced from the manufacturer.

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 considerations are described in accordance with engine service information.
- Range structural rigidity, minimum weight, cooling, casting material, wear properties, machining requirements, distortion, construction type.
- 1.5 Engine cylinder design requirements are described in accordance with engine service information.
- 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 requirements are described in accordance with engine service information.
- Range rigidity, balance requirements, torsional vibration, vibration dampers, number of main bearing journals, machining, weight.
- 1.7 Engine crankshaft bearing requirements are described in accordance with engine service information.
- Range 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, embedability.
- 1.8 Engine piston and connecting rod assembly design considerations are described in accordance with engine service information.
- Range pistons – materials, expansion control, piston pins and retaining methods, piston ring materials, types and 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 design considerations are described in accordance with engine service information.
- Range 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 considerations are described in accordance with engine service information.
- Range bearing lubrication and supply, wedge action, oil flow rate, oil pressure, cold starting, thrust and heavy load areas, pump capacity, filters, intake strainers, air filtration, oil additives, upper cylinder lubrication, oil coolers.
- 1.11 Engine fuel system design considerations are described in accordance with engine service information.
- Range 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 in accordance with engine service information.
- Range rate of heat transfer, importance of using specified coolant, water circulation factors, thermostat opening temperatures, radiator requirements.

Outcome 2

Demonstrate knowledge of engine machining practices.

- 2.1 Dismantling, cleaning, and inspection procedures are described in accordance with company requirements.
- Range pre-cleaning using chemical wash or steam cleaner to facilitate the dismantling process, dismantling in a logical sequence, the use of parts trays, keeping tools in good clean condition, using the right tool for the job, numbering and marking items to ensure correct relationship at re-assembly, using the hot tank cleaning method, laying parts out for inspection, consulting the job sheet or card and planning the work, labelling specific components.

2.2 Cylinder head and valve mechanism machining practices are described in accordance with service information.

Range visual examination before removing carbon; removing carbon; examining for cracks and distortion; assessment of valves, seats, and guides; repairing cracks; corrosion repairs; straightening; align boring camshaft tunnels; fitting guides and resizing integral guides; measuring clearances; valve seat reconditioning; valve seat insert replacement; testing valve springs; valve seat and valve refacing; seat throating; seat contact; surface grinding and milling; metal removal limits; rocker gear reconditioning; head assembly procedures.

2.3 Camshaft re-grinding procedures are described in accordance with service information.

Range determining camshaft wear and damage by visual examination and measurement, checking for straightness, cam lobe terminology, considerations when regrinding (base circle concentricity, concentricity of bearing journals, phasing of ramps, taper on cam lobes, compatible finish, cam follower radius), straightening and centring a camshaft, re-grinding of journals, setting up a camshaft for grinding with appropriate master cam and index plate, grinding cam lobe profiles, increasing lift, building up lobes using hard facing deposits, phosphate treatment.

2.4 Cylinder block machining and cylinder sleeving procedures are described in accordance with service information.

Range cylinder boring machines (portable bar, overhead boring machine), block resurfacing, align boring main tunnels, measuring bore sizes and determining amount of metal to be removed, tool sharpening and setting, setting up and machining the bores, honing the cylinder bore, fitting cylinder liners and sleeves (dry liners with interference fit, slip-in wet and dry flanged sleeves, sealing rings, adjusting protrusion height), repairing stud and bolt threaded holes.

2.5 Piston assembly reconditioning procedures are described in accordance with service information.

Range piston finishing practices, piston skirt profiles and shape (hot and cold), piston ring land clearance, piston stability and noise, gudgeon pin off-set, piston skirt finish, oversize replacement pistons, machining ring grooves, re-ringing, piston clearances, gudgeon pin location, gudgeon pin clearance and fits, rebushing, reaming and honing small-ends, fitting rods to pistons, fitting rings to pistons.

- 2.6 Connecting rod reconditioning procedures are described in accordance with service information.
- Range big-end inspection (bolts or screws, rough threads, stretching, cap and rod flat surfaces for burrs and roughness, measuring bearing housing diameter for ovality and taper, checking crush), big-end re-sizing, small-end resizing, aligning connecting rods.
- 2.7 Crankshaft re-grinding procedures are described in accordance with service information.
- Range determining crankshaft wear and damage by visual examination and measurement, checking for straightness, crack testing, regrinding machines, re-grinding of crankpins and mains, fillet rolling, reclamation of damaged journals, hardening, journal finish, oil hole chamfers, polishing, balancing.
- 2.8 Engine bearing technology and fitting procedures are described in accordance with service information.
- Range big end and main bearing types (precision inserts, needle rollers, semi-finished), bearing material, bearing crush, free spread, locating lugs, parting line relief, oil holes and grooves, thrust bearings, camshaft bearings, bearing clearances, bearing fitting procedures.
- 2.9 Engine component balancing requirements are described in accordance with service information.
- Range static balance, dynamic balance, typical balancing procedures.
- 2.10 Engine gasket and seal requirements are described in accordance with service information.
- Range gasket materials, construction of cylinder head gaskets, gasket fitting procedures, oil seal design, seal fitting procedures.

This unit standard is expiring. Assessment against the standard must take place by the last date for assessment set out below.

Status information and last date for assessment for superseded versions

Process	Version	Date	Last Date for Assessment
Registration	1	25 September 1997	31 December 2020
Review	2	28 February 2001	31 December 2020
Review	3	25 June 2007	31 December 2020
Rollover and Revision	4	26 November 2007	31 December 2020
Review	5	30 August 2018	31 December 2023
Review	6	25 February 2021	31 December 2023

Consent and Moderation Requirements (CMR) reference

0014

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