Unit 25: Engine and Vehicle Design and Performance

Unit code: A/601/1494

QCF level: 5

Credit value: 15

Aim

This unit will develop learners' knowledge of engine and vehicle design and will enable them to evaluate engine and vehicle performance.

Unit abstract

This unit will examine the aspects of design that relate to the function of engines, with a particular emphasis on performance. Learners will examine vehicle design for light and heavy vehicles with a view to understanding performance curves and other data used to evaluate vehicle performance. Learners will also appreciate possible future developments in vehicle engineering and in particular the use of new technologies, materials and design method.

Learners are introduced to engine design features, operating parameters and the likely effects when these are varied or altered. They then investigate engine performance and will analyse the data obtained from engine trials. Learners are introduced to the design features of light and heavy vehicles with particular emphasis on aerodynamics and transmission systems. They will then evaluate vehicle performance under different operating conditions and interpret vehicle performance curves.

Learning outcomes

On successful completion of this unit a learner will:

1 Understand engine design features

2 Be able to evaluate engine performance

3 Understand vehicle design features

4 Be able to evaluate vehicle performance.

Unit content

1 **Understand engine design features**

Engine design features: eg cylinder bore diameter, stroke length, con-rod to crank ratio, the number and arrangements of cylinders, overall engine dimensions, piston design, compression ratio, combustion chambers, camshaft design, crankshaft design, use of emerging technologies in engine design, new materials, alternate and multi fuel engine design (Electric, Compressed Natural Gas (CNG), Liquid Natural Gas (LNG), gasoline-electrical hybrid)

2 **Be able to evaluate engine performance**

Performance characteristics: torque; power; mechanical efficiency; thermal efficiency; volumetric efficiency; mean effective pressure; specific fuel consumption; emission control assessment

Engine performance mapping: graphical account of the role of map data; mapping procedure; visual interpretation of a fuel map and ignition map; fuel/ignition maps for different engine performance applications eg economy, power and torque

Performance curves: curves eg for spark ignition (SI), combustion ignition (CI) and pressure charged, rotary engines; engine test at various engine speeds; critical evaluation of air/fuel ratio; torque, power; exhaust emissions; fuel consumption; significance of the standards used to measure engine power eg BSAU, DIN, SAE, EEC; application of engine performance curves and design to the selection of appropriate power units for specific tasks

3 **Understand vehicle design features**

Features of vehicle design: light and heavy vehicles; body type; body shapes and design; aerodynamic devices; transmission; 5-speed; 6-speed; range change; splitter; four-wheel drive; multiple axles; chassis; laden weight; unladen weight; power to weight ratio; use and applications of new technologies, materials and design methods

4 **Be able to evaluate vehicle performance**

Performance monitoring: tractive effort; tractive resistance; air; rolling and gradient eg power available, power required

Performance characteristics: performance curves for different vehicles; tractive effort available for different combinations; tractive effort required for types of vehicle eg in laden, unladen conditions; acceleration possible with different combinations of engines; transmissions and vehicles; gradeability; the change in engine speed that results when changing from one gear ratio to another eg various gear ratios and transmission units; the effects of a change in engine speed produced by a gear change on engine torque, power and fuel consumption, the road speed of a vehicle

Vehicle performance curves: for selecting appropriate vehicles from data calculated

Air resistance: air resistance using the formula $R_A = K V^2 A$; air resistance variation with engine speed and its effects on fuel economy; Cd, CdA, typical values for light and heavy vehicles; methods used to reduce air resistance of vehicles

Learning outcomes and assessment criteria

Learning outcomes On successful completion of this unit a learner will:	Assessment criteria for pass The learner can:
LO1 Understand engine design features	1.1 identify and discuss the engine design features that contribute to the selection of an engine for a given application 1.2 analyse the effects of altering engine design features for a given application
LO2 Be able to evaluate engine performance	2.1 determine the performance characteristics of a given engine 2.2 carry out and record the outcomes of an engine performance mapping procedure 2.3 interpret performance curves and select and justify the use of an appropriate engine for a given application
LO3 Understand vehicle design features	3.1 discuss the features of vehicle design that contribute to the selection of a vehicle for a given application 3.2 analyse the effects of altering the features of vehicle design for a given application
LO4 Be able to evaluate vehicle performance	4.1 explain the terms used in vehicle performance monitoring 4.2 determine the performance characteristics of a given vehicle 4.3 perform calculations to determine vehicle air resistance and explain the effects of air resistance on engine speed and fuel economy 4.4 interpret performance curves and select an appropriate vehicle from given information.

Guidance

Links

This unit has links with *Unit 74: Vehicle Fault Diagnosis*, *Unit 75: Vehicle Systems and Technology* and *Unit 79: Vehicle Electronics*.

Essential requirements

Centres will need to provide access to suitable engine test facilities and manufacturers' manuals and performance data.

Employer engagement and vocational contexts

Delivery would benefit from visits to motor industry test facilities for engines and/or vehicles and the attendance of guest speakers with experience of engine/vehicle design, testing or refurbishment.

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