2016 Suite

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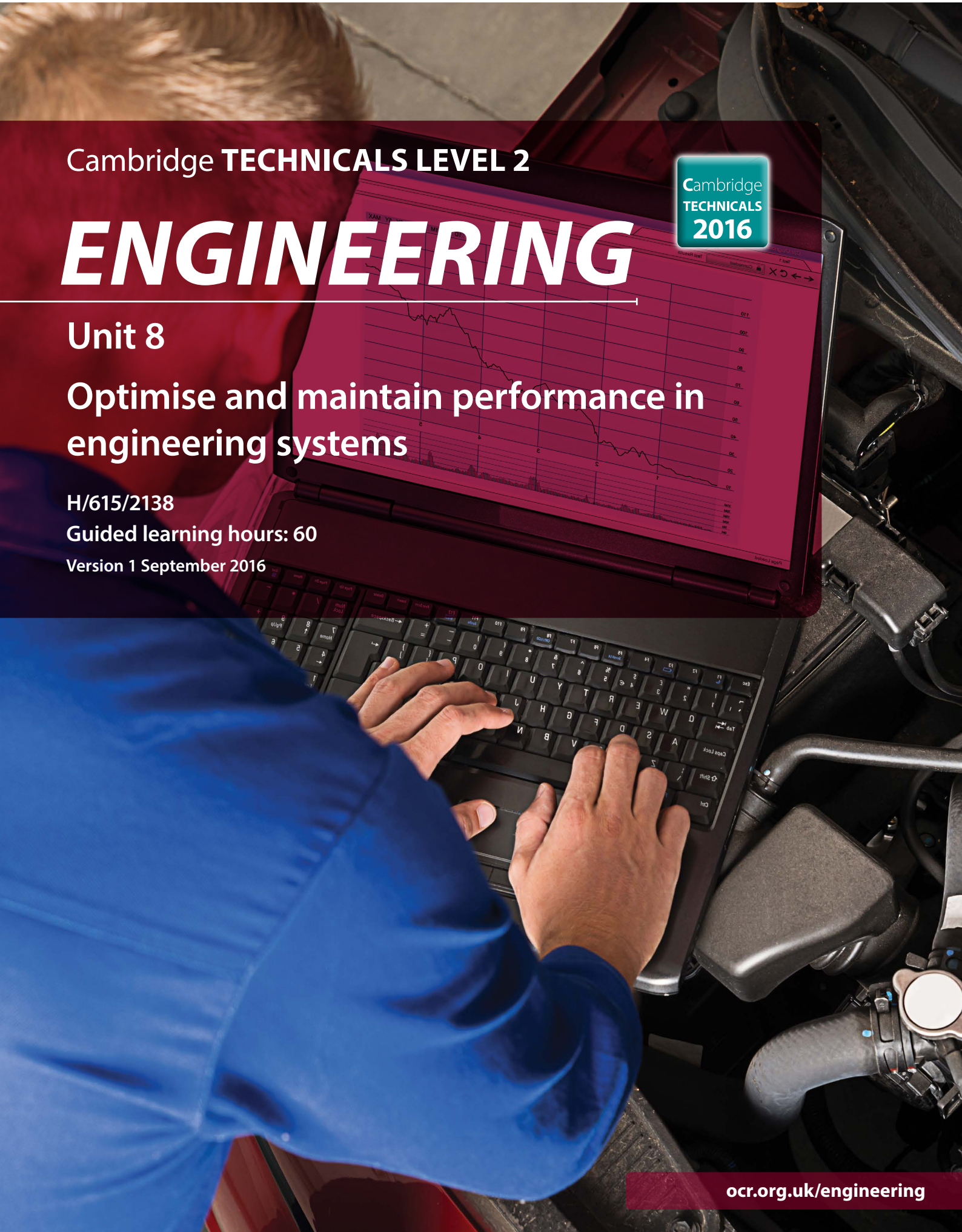

Cambridge **TECHNICALS LEVEL 2**

Cambridge TECHNICALS 2016

ENGINEERING

Unit 8

Optimise and maintain performance in engineering systems

H/615/2138

Guided learning hours: 60

Version 1 September 2016

ocr.org.uk/engineering

LEVEL 2

UNIT 8: OPTIMISE AND MAINTAIN PERFORMANCE IN ENGINEERING SYSTEMS
H/615/2138

Guided learning hours: 60

Essential resources required for this unit: access to example documentation for scheduled service and maintenance processes, access to engineering systems, machinery, appliances, vehicles to perform servicing and maintenance procedures, access to a range of tools suitable to be used in performing maintenance operations, access to measuring and diagnostic equipment relative to the type of engineered system or product being maintained.

This unit is internally assessed and externally moderated by OCR.

Unit aim

The aim of this unit is to provide the learner with knowledge and understanding of maintaining engineering systems and products, to optimise their performance.

In this unit you will learn about the business benefits of routine servicing and maintenance, and the consequences of not properly inspecting and maintaining engineered systems and products.

You will be able to work safely to perform scheduled servicing and adjustments to manufacturer's specifications using tools and diagnostic resources. You will follow testing and diagnostic procedures to identify wear and faults to inform corrective actions.

You will also understand how maintenance contributes to sustainability of products, resources and the impact on the environment.

TEACHING CONTENT

The unit content describes what has to be taught to ensure that learners are able to access the highest grade.

Anything which follows an i.e. details what must be taught as part of that area of content.

Anything which follows an e.g. is illustrative, it should be noted that where e.g. is used, learners must know and be able to apply relevant examples to their work though these do not need to be the same ones specified in the unit content.

Learning Outcome The Learner will:		Teaching Content The Learner must be taught:
1. Understand the importance of maintenance to optimise performance	1.1	reasons for maintenance i.e. • maintain product quality/performance • user responsibilities (e.g. user warranty, maintenance schedules required by manufacturer) • function and optimisation (e.g. product life, reliability) • economies (e.g. less product wastage) • legislation (e.g. emission levels, work equipment regulations) • safety (e.g. health and safety regulations)
	1.2	impacts of not maintaining systems or products on user and manufacturer i.e. • inconvenience • loss of production through downtime • damage to i.e. o reputation o personnel (e.g. personal injury) o product (e.g. premature failure) • financial impact
	1.3	know about types of maintenance i.e. • planned or scheduled maintenance (e.g. periodic; safety, statistical, critical; regulatory) • preventative maintenance (e.g. corrective, inspection and cleaning) • predictive maintenance - condition-based monitoring (e.g. thermography; vibration; oil sample) • unscheduled repairs (e.g. reactive, remedial, deferred) • run to failure (e.g. end of life repair, emergency, unscheduled) • modifications (e.g. upgrading; design outs) maintenance of different types of application i.e. • mechanical (e.g. belt replacement, oil change, filter change) • electrical (e.g. PAT testing, recalibration, voltage checks) • fluid Power (e.g. leak tests, operating pressures, filter change)

Learning Outcome The Learner will:		Teaching Content The Learner must be taught:
	1.4	design for maintenance and repair i.e. • unit replacement (e.g. sealed units, standard components, access to components) • common fixing strategy (e.g. disassembly, access to components) • replaceable parts strategy i.e. o Original Equipment Manufacturer (OEM) parts o pattern parts
2. Be able to plan maintenance to optimise performance	2.1	use reliability data to produce a maintenance schedule for engineered systems i.e. • Mean Time Between failures (MTBF) • Mean Time To Repair (MTTR) • Mean Time To Failure (MTTF) use calculations to determine reliability of system or component present reliability data (e.g. Mean, Mode, Median)
	2.2	produce a scheduled maintenance plan to include i.e. • sequence of operation of maintenance (e.g. efficiency and timing of tasks) • maintenance frequency (e.g. time based, operational based)
3. Be able to perform maintenance operations	3.1	use manuals and data to perform maintenance procedures i.e. • Follow manufacturer's manuals, data and instructions • interpret diagrams and visual information (e.g. pictorial, video, audio) • apply measurements and volumes (e.g. correct oil volume, adjustable clearances and tensions) • timely ordering of consumables, components and replacement parts
	3.2	use tools and equipment to perform servicing and maintenance i.e. • select and use PPE • select and safely use tools (e.g. hand tools and equipment, electrical equipment, power tools, calibration and measuring equipment) • safe use of specialist equipment (e.g. jacks, vehicle ramps, lifts, hydraulic press) • diagnostic equipment i.e. o multi-meters, electrical /electronic measuring o manufacturer's diagnostic equipment

Learning Outcome The Learner will:		Teaching Content The Learner must be taught:
	3.3	perform maintenance procedures on mechanical, electrical or fluid power applications i.e. Maintenance safety requirements for working on mechanical, electrical or fluid power applications e.g. • mechanical guards, mechanical-electrical safeguards and interlocks • electrical supply, risks, isolation of supply • working with compressed air • fluids under high pressure • disposal procedures for waste materials and components inspection, replacement, replenishment and adjustment e.g. • fluids and lubricants i.e. o levels, contamination, replacement cycle • consumables • filters, drains, traps, breathers, air passages • belts and drive components • gaskets and seals • security of fittings, panels, guards, safeguards, cables, plugs • replacement service items (e.g. filters, belts, braking system parts) • safe handling and disposal of fluids, consumables
	3.4	perform procedures to optimise product /system performance i.e.: • use manufacture's system and procedures through i.e. o system checks o disassembly/assembly o adjustments/calibration o torque settings, tension, load o cleaning, (e.g. selection of cleaners, degreasing agents) • testing i.e.: o use of manuals, data sheets and service plan data o interpret circuit diagrams o confirm expected values o use of expert systems o confirm maintenance activity success
	3.5	recording maintenance operations i.e. • Record maintenance and servicing outcomes • Necessary repairs and replacement • recommend remedial actions • changes to frequency of inspection/servicing/replacement • advising customers; internal/external • completing servicing and maintenance records (e.g. maintenance and servicing documentation) • servicing logs, and recording and communicating faults • maintaining electronic records, databases

Learning Outcome The Learner will:		Teaching Content The Learner must be taught:
4. Be able to perform unscheduled repair procedures	4.1	identify causes of premature failure in mechanical, electrical and fluid power systems i.e. • maladjustment • mal-operation • overheating, excess operational temperature • stress fracture, fatigue • overloading, seizure • water ingress, contamination • corrosion, dirt, cleanliness • leaks e.g. o compressed air o hydraulic fluids o lubricants o fuels o coolants • lubrication failure, fouling, vibration • brush and contact wear • bearing and bush failure
	4.2	perform diagnostic procedures on mechanical, electrical or fluid power applications i.e. • fault finding , i.e. o visual inspection • the six point fault finding technique i.e. o test o analyse o locate fault o determine cause o repair o re-test

GRADING CRITERIA

Learning Outcome	Pass	Merit	Distinction
The learner will:	The assessment criteria which are the pass requirements for this unit.	To achieve a merit the evidence must show that, in addition to the pass criteria, the candidate is able to:	To achieve a distinction the evidence must show that, in addition to the pass and merit criteria, the candidate is able to:
1. Understand the importance of maintenance to optimise performance	P1: Explain the reasons for maintenance and repair and the implications of not maintaining an engineering system or product		
2. Be able to plan maintenance to optimise performance	P2: Prepare a sequence of maintenance tasks as part of a scheduled maintenance plan.	M1: Use data to produce a scheduled maintenance plan to maintain or improve system reliability.	D1: Use calculations to determine reliability of systems or components to inform a maintenance strategy.
3. Be able to perform maintenance operations	P3: Work safely to perform maintenance procedures and system checks using manufacturer's instructions. Complete servicing and maintenance records.	M2: Perform inspection and replacement of serviceable items using manuals, making adjustments where necessary.	D2: Use diagnostic equipment to obtain data to confirm expected values. Provide advice on serviceable items requiring attention and any changes in maintenance frequency.
4. Be able to perform unscheduled repair procedures	P4: Perform system tests to identify cause of system failure and perform repairs.	M3: Analyse the cause of a premature failure in an electrical, mechanical or fluid power system.	

ASSESSMENT GUIDANCE

Feedback to learners: you can discuss work-in-progress towards summative assessment with learners to make sure it's being done in a planned and timely manner. It also provides an opportunity for you to check the authenticity of the work. You must intervene if you feel there's a health and safety risk.

Learners should use their own words when producing evidence of their knowledge and understanding. When learners use their own words it reduces the possibility of learners' work being identified as plagiarised. If a learner does use someone else's words and ideas in their work, they must acknowledge it, and this is done through referencing. Just quoting and referencing someone else's work will not show that the learner knows or understands it. It has to be clear in the work how the learner is using the material they have referenced to inform their thoughts, ideas or conclusions.

For more information about internal assessment, including feedback, authentication and plagiarism, see the centre handbook. Information about how to reference is in the OCR Guide to Referencing available on our website: http://www.ocr.org.uk/i-want-to/skills-guides/.

P1
Evidence could be in the form of a written report identifying types of maintenance for mechanical, electrical and fluid power, the reasons for maintenance and the implications of not maintaining an engineered system or product.

P2
Learners should produce a maintenance schedule for a given engineered product or system, detailing a sequence of operations to perform maintenance tasks as part of a scheduled maintenance plan.

M1
Learners must produce a scheduled maintenance plan which identifies frequency and sequence of operation using reliability data, and suggests any appropriate changes. Evidence could be in the form of a maintenance plan that includes system maintenance or improved system reliability.

D1
Learners must use calculations of MTBF/MTTF to inform a maintenance schedule and produce a strategy report showing calculations and findings.

P3
Learners should list necessary safe working practices and procedures and identify and record potential risks to self and others. Evidence should be in the form of videos or annotated photographic evidence used to show maintenance procedures being carried out and use of tools and equipment. This should be supported by the use of observation and witness statements.

M2
Evidence should be in the form of photographs or video footage (supported by accompanying annotations and witness statements) of learners performing inspection and replacement of serviceable items, using manuals and making adjustments where necessary.

D2
Learners must demonstrate the use of diagnostic equipment to obtain data that confirm expected values and demonstrate where they have provided advice on serviceable items that require attention and any changes to maintenance frequency. Evidence should be in the form of data sheets, screen shots and print outs. This should be supported by photographs or video footage with accompanying annotations, which should be supported by witness statements.

P4
Tutors will need to ensure that learners are provided with an electrical, mechanical or fluid power system which enables learners to perform system tests to identify system failure and its cause and to perform repairs.

Evidence should be in the form of photographs or video footage with accompanying annotations, which should be supported by witness statements detailing learners being observed in performing an inspection and identifying probable causes of component /system failure. Learners should record their findings in a report which details the causes of premature failure in mechanical, electrical or fluid power systems.

M3
Tutors will need to ensure that learners are provided with an electrical, mechanical or fluid power system which enables learners to perform system tests to identify system failure and its cause and to perform repairs.

Learners should use the test data of functionality from P4 to analyse the cause of the premature failure in an electrical, mechanical or fluid power system, comparing the recorded data against expected or specified values. Evidence of the analysis of the cause of a premature failure in an electrical, mechanical or fluid power system should be in the form of a written report or presentation (including detailed speaker notes) that includes data that learners have gathered and used.

SYNOPTIC ASSESSMENT AND LINKS BETWEEN UNITS

It will be possible for learners to make connections between other units over and above the unit containing the key tasks for synoptic assessment, please see section 6 of the centre handbook for more detail.

Synoptic assessment grid

This unit and specific LO	Related unit	Related LO
Unit 8 LO1Understand the importance of maintenance to optimise performance	Unit 4	LO1 1.1, 1.2, 1.3
Unit 8 LO2 Be able to plan maintenance to optimise performance	Unit 3	LO1 1.1, 1.2, 1.3 LO2 2,1
	Unit 4	LO1 1.1, 1.2, 1.3
	Unit 7	LO2 2.1, 2.2 LO3 3.1, 3.2, 3.3 LO4 4.2, 4.3
Unit 8 LO3 Be able to perform maintenance operations	Unit 1	LO1 1.1, 1.2, 1.3, 1.4
	Unit 2	LO1 1.1, 1.2 LO4 4.1, 4.2, 4.3, 4.4, 4.6, 4.7
	Unit 3	LO1 1.1, 1.2, 1.3 LO2 2,1
	Unit 4	LO1 1.1, 1.2, 1.3 LO2 2.1 LO3 3.1, 3.2
	Unit 7	LO2 2.1, 2.2 LO3 3.1, 3.2, 3.3 LO4 4.2, 4.3

This unit and specific LO	Related unit	Related LO
Unit 8 LO4 Be able to perform unscheduled repair procedures	Unit 1	LO1 1.1, 1.2, 1.3, 1.4
	Unit 2	LO1 1.1, 1.2 LO4 4.1, 4.2, 4.3, 4.4, 4.6, 4.7
	Unit 3	LO1 1.1, 1.2, 1.3 LO2 2,1
	Unit 4	LO1 1.1, 1.2, 1.3
	Unit 5	LO4 4.1
	Unit 7	LO2 2.1, 2.2 LO3 3.1, 3.2, 3.3 LO4 4.2, 4.3

MEANINGFUL EMPLOYER INVOLVEMENT - A REQUIREMENT FOR TECHNICAL CERTIFICATE QUALIFICATIONS

These qualifications have been designed to be recognised as Technical certificates in performance tables in England. It is a requirement of these qualifications for centres to secure employer involvement through delivery and/or assessment of these qualifications for every learner.

The minimum amount of employer involvement must relate to at least one or more of the elements of the mandatory content. This unit is mandatory in the System Engineering pathway.

Eligible activities and suggestions/ideas that may help you in securing meaningful employer involvement for this unit are given in the table below.

Please refer to the Qualification Handbook for further information including a list of activities that are not considered to meet this requirement.

Meaningful employer involvement – eligible activities	Suggestion/ideas for centres when delivering this unit
1. Students undertake structured work-experience or work-placements that develop skills and knowledge relevant to the qualification.	Placements with engineering firms working with maintenance department, both electrical and mechanical maintenance engineers, carrying out planned preventative maintenance and unplanned maintenance activities.
2. Students undertake project(s), exercises(s) and/or assessments/examination(s) set with input from industry practitioner(s).	Measure and inspection of production equipment/tooling, using industry standard equipment, to determine if the production equipment requires maintenance interventions.
3. Students take one or more units delivered or co-delivered by an industry practitioner(s). This could take the form of master classes or guest lectures.	Input from practicing Maintenance engineers involved in production equipment optimisation and maintenance. Input to include examples of methodology and working documentation within professional commercial engineering practice.

You can find further information on employer involvement in the delivery of qualifications in the following documents:

- Employer involvement in the delivery and assessment of vocational qualifications
- DfE work experience guidance

To find out more
ocr.org.uk/engineering
or call our Customer Contact Centre on **02476 851509**

Alternatively, you can email us on **vocational.qualifications@ocr.org.uk**

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