

Cambridge **NATIONALS LEVEL 1/2**



ENGINEERING MANUFACTURE

R112 Quality control of engineered products

J832/J842

Schemes of work

Version 1

CONTENTS

Introduction	3
Scheme of work (longer term plan – academic year)	
Autumn term	4
Spring term	6
Summer term	8
Scheme of work (medium term plan – more detailed by academic term)	
Autumn term	10
Spring term	13
Summer term	17

INTRODUCTION

This teaching resource, which we've developed with Nationals Engineering teachers, contains two types of schemes of work.

- A **longer term** plan which covers the whole academic year over three terms and suggests the order in which each Learning Outcome (LO) could be taught. Links to other units and LOs within Nationals Engineering are also shown.
- A **medium term** plan which also covers the whole academic year over three terms and suggests the order in which each LO could be taught but also provides classroom activities and any links to other resources which might be useful. We've also included 'Have they got it?' linking to activities other LOs in this unit and/or other units and LOs within Nationals Engineering. This includes performing practical activities by which learners confirm their understanding.

Link to qualification

www.ocr.org.uk/qualifications/cambridge-nationals/engineering-manufacture-level-1-2-award-certificate-j832-j842

See our range of planning and teaching resources on the link below (including delivery guides, project approaches, teaching activities, teacher guides and resources lists).

www.ocr.org.uk/qualifications/cambridge-nationals/engineering-manufacture-level-1-2-award-certificate-j832-j842/planning-and-teaching

See our range of assessment resources on the link below (including past paper, mark schemes, examiners' reports, candidate exemplars and set assignments).

www.ocr.org.uk/qualifications/cambridge-nationals/engineering-manufacture-level-1-2-award-certificate-j832-j842/assessment

Scheme of work (longer term plan – academic year)

	Learning Outcome	Topic area/theme (from R112 specification)	Links to other Cambridge Nationals Engineering units and LOs
Autumn Term	LO1	Reasons for implementing quality control in production: early intercept and waste management.	R110 LO2 – Be able to use processes, tools and equipment safely to make a pre-production product.
	LO1	Reasons for implementing quality control in production: consistency and reduce costs.	R110 LO2 – Be able to use processes, tools and equipment safely to make a pre-production product.
	LO1	Reasons for implementing quality control in production: conformity and reduce returns.	R110 LO2 – Be able to use processes, tools and equipment safely to make a pre-production product.
	LO1	Quality control procedures: quality control and quality assurance.	R109 LO4 – Understand the impact of modern technologies on engineering production. R110 LO2 – Be able to use processes, tools and equipment safely to make a pre-production product.
	LO1	Quality control procedures: quality standards and total quality management.	R109 LO4 – Understand the impact of modern technologies on engineering production. R110 LO2 – Be able to use processes, tools and equipment safely to make a pre-production product.
	LO2	Basic inspection techniques in stages of production: visual checks.	R110 LO2 – Be able to use processes, tools and equipment safely to make a pre-production product. R111 LO3 – Be able to set-up and use CNC equipment to manufacture components.
	LO2	Quality control techniques used in stages of production: application of tolerance and sampling techniques.	R105 LO2 – Understand the requirements of design specifications for the development of a new product. R110 LO2 – Be able to use processes, tools and equipment safely to make a pre-production product. R111 LO3 – Be able to set-up and use CNC equipment to manufacture components.

	Learning Outcome	Topic area/theme (from R112 specification)	Links to other Cambridge Nationals Engineering units and LOs
Autumn Term	LO2	Quality control techniques used in stages of production: comparison and corrective action.	<p>R110 LO2 – Be able to use processes, tools and equipment safely to make a pre-production product.</p> <p>R111 LO3 – Be able to set-up and use CNC equipment to manufacture components.</p>
	LO2	Application of basic inspection techniques in stages of production – visual checks.	<p>R110 LO2 – Be able to use processes, tools and equipment safely to make a pre-production product.</p> <p>R111 LO3 – Be able to set-up and use CNC equipment to manufacture components.</p>
	LO2	Use of inspection equipment in stages of production – part 1 – micrometer and digital vernier calipers.	<p>R110 LO2 – Be able to use processes, tools and equipment safely to make a pre-production product.</p> <p>R111 LO3 – Be able to set-up and use CNC equipment to manufacture components.</p>

	Learning Outcome	Topic area/theme (from R112 specification)	Links to other Cambridge Nationals Engineering units and LOs
Spring Term	LO2	Use of inspection equipment in stages of production – part 2 – jigs and fixtures.	<p>R110 LO2 – Be able to use processes, tools and equipment safely to make a pre-production product.</p> <p>R111 LO3 – Be able to set-up and use CNC equipment to manufacture components</p>
	LO2	Use of inspection equipment in stages of production – part 3 – gauges and comparators.	<p>R110 LO2 – Be able to use processes, tools and equipment safely to make a pre-production product.</p> <p>R111 LO3 – Be able to set-up and use CNC equipment to manufacture components.</p>
	LO2	Use of inspection equipment in stages of production – part 4 – X-rays and ultrasonics.	R109 LO1 – Know about properties and uses of engineering materials.
	LO2	Techniques for evaluating product: precision and accuracy achieved during making processes, quality of outcome.	<p>R110 LO2 – Be able to use processes, tools and equipment safely to make a pre-production product.</p> <p>R111 LO3 – Be able to set-up and use CNC equipment to manufacture components.</p>
	LO2	Techniques for evaluating product: safety checks and consumer safety.	<p>R105 LO2 – Understand the requirements of design specifications for the development of a new product.</p> <p>R110 LO2 – Be able to use processes, tools and equipment safely to make a pre-production product.</p> <p>R111 LO3 – Be able to set-up and use CNC equipment to manufacture components.</p>
	LO2	Practical evaluation of a product from quality control checks: measurements, compare against specification.	<p>R105 LO2 – Understand the requirements of design specifications for the development of a new product.</p> <p>R110 LO2 – Be able to use processes, tools and equipment safely to make a pre-production product.</p> <p>R111 LO3 – Be able to set-up and use CNC equipment to manufacture components.</p>

	Learning Outcome	Topic area/theme (from R112 specification)	Links to other Cambridge Nationals Engineering units and LOs
Spring Term	LO2	Practical evaluation of a product from quality control checks: measurements, compare against specification.	R110 LO2 – Be able to use processes, tools and equipment safely to make a pre-production product. R111 LO3 – Be able to set-up and use CNC equipment to manufacture components
	LO2	Synoptic links from LO2 to other units.	
	LO3	Modern technologies used in quality control: non-destructive testing – visual, ultrasonic and dye penetrant.	R109 LO1 – Know about properties and uses of engineering materials. R109 LO4 – Understand the impact of modern technologies on engineering production.
	LO3	Modern technologies used in quality control: 3D scanning and CNC measurement checks.	R109 LO4 – Understand the impact of modern technologies on engineering production.

	Learning Outcome	Topic area/theme (from R112 specification)	Links to other Cambridge Nationals Engineering units and LOs
Summer Term	LO3	Modern technologies used in quality control: Computer Integrated Engineering (CIE) and Computer Integrated Manufacture (CIM).	R109 LO4 – Understand the impact of modern technologies on engineering production.
	LO3	Modern technologies used is quality control: robotics, automatic inspection and rejection.	R109 LO4 – Understand the impact of modern technologies on engineering production.
	LO4	Principles of lean manufacturing – introduction.	R109 LO4 – Understand the impact of modern technologies on engineering production.
	LO4	Causes of waste in manufacturing: time, materials, resources, processes, supply, space.	R105 LO3 – Know about the wider influences on the design of new products. R109 LO4 – Understand the impact of modern technologies on engineering production.
	LO4	Categories of waste: TIMWOOD – part 1 – transport, inventory and movement.	R109 LO4 – Understand the impact of modern technologies on engineering production.
	LO4	Categories of waste: TIMWOOD – part 2 – waiting, over processing, over production and defects.	R109 LO4 – Understand the impact of modern technologies on engineering production.
	LO4	Methods of reducing waste: DFMA – part 1 – standardised components, common fixing strategy.	R105 LO2 – Understand the requirements of design specifications for the development of a new product. R109 LO4 – Understand the impact of modern technologies on engineering production.
	LO4	Methods of reducing waste: DFMA – part 2 – complexity reduction, make versus buy, handling and processes.	R105 LO2 – Understand the requirements of design specifications for the development of a new product. R109 LO4 – Understand the impact of modern technologies on engineering production.

	Learning Outcome	Topic area/theme (from R112 specification)	Links to other Cambridge Nationals Engineering units and LOs
Summer Term	LO4	Sustainable design: material reduction and life cycle analysis.	<p>R105 LO3 – Know about the wider influences on the design of new products.</p> <p>R109 LO4 – Understand the impact of modern technologies on engineering production.</p>
	LO4	Sustainable design: end of life disposal and recycled materials.	<p>R105 LO3 – Know about the wider influences on the design of new products.</p> <p>R109 LO4 – Understand the impact of modern technologies on engineering production.</p>

Scheme of work (medium term plan – more detailed by academic term)

	Event	Learning Outcome	Topic area/subtopic Area (from R112 specification)	Suggestions for delivery/activities (including scope and depth)	'Have they got it?' – internal unit links with commentary	Useful external resources
Autumn Term	1	LO1	Reasons for implementing quality control in production: early intercept and waste management.	Learners could be introduced to quality control procedures used in production. Learners could be given a case study to identify why early interception of problems within a manufacturing process is important, and how it contributes to less waste being generated.	R112 LO1 – Learners will be able to explain the reasons for implementing quality control in production to identify quality issues early, and to minimise waste.	www.youtube.com/watch?v=18cN8MZvJRA provides a short video introduction to quality control. The following website provides case studies and further resources highlighting the reasons for undertaking quality control during production: www.infinityqs.com/resources/case-studies
	2	LO1	Reasons for implementing quality control in production: consistency and reduce costs.	Learners could be introduced to consistency of finished products or components, and how implementing quality control can lead to reduced costs during production. Learners could be given a selection of components and be asked to comment on how the consistency of each batch can be maintained including the benefit to the company.	R112 LO1 – Learners can explain how implementing quality control leads to more consistent product quality, thereby reducing costs to the manufacturer.	
	3	LO1	Reasons for implementing quality control in production: conformity and reduce returns.	Learners could be introduced to product standards and regulations and could research how these are applied when manufacturing products. They could research how products should conform to British Standards and European Standards, and how this is confirmed through quality checks. They could investigate how performing quality checks leads to fewer returned products, impacting customer perceptions and company reputation.	R112 LO1 – Learners can explain the reasons why products need to conform to standards and how this is ensured using quality control. They will also be able to explain how quality control leads to less defective products and hence less returns.	The BSI website includes details about the purpose of product standards: www.bsigroup.com/en-GB/about-bsi/

	Event	Learning Outcome	Topic area/subtopic Area (from R112 specification)	Suggestions for delivery/activities (including scope and depth)	'Have they got it?' – internal unit links with commentary	Useful external resources
Autumn Term	4	LO1	Quality control procedures: quality control and quality assurance.	Learners could be introduced to quality control (QC) and quality assurance (QA). Learners could research how quality control and quality assurance are used by companies that manufacture, install or service engineered products. They should research the difference between each.	R112 LO1 – Learners will understand the difference between quality control and quality assurance, and how they are implemented during manufacture.	asq.org/quality-resources/quality-assurance-vs-control provides an overview of QA and QC, explaining the difference between them.
	5	LO1	Quality control procedures: quality standards and total quality management.	Learners could be introduced to more advanced quality procedures including application of quality standards and Total Quality Management (TQM). They could identify particular quality standards applicable to manufacturing, and could investigate common causes of errors in production of engineered products and discuss how TQM could be used to reduce these.	R112 LO1 – Learners will understand how using quality standards and a TQM system could improve product quality.	https://asq.org/quality-resources/learn-about-standards provides a good introduction to quality standards sixsigmastudyguide.com/total-quality-management-and-six-sigma/ provides a good introduction to Total Quality Management.
	6	LO1	Basic inspection techniques in stages of production: visual checks.	Learners could be introduced to the first basic inspection technique used in production – visual inspection. They could be provided with a range of components and asked to undertake a basic review of their visual appearance and finish.	R112 LO2 – Learners will understand how visual inspection can be used to perform quality checks including its benefits and disadvantages.	www.youtube.com/watch?v=Ncguc7THEUY shows visual inspection of welds.
	7	LO2	Quality control techniques used in stages of production: application of tolerance and sampling techniques.	Learners could be introduced to tolerance and sampling techniques. Learners could be provided with engineering drawings for components and asked to interpret key manufacturing details including why tolerances are applied and how they will be checked during production. This could lead to the idea of sampling.	R112 LO2 – Learners will understand why components need to be manufactured to given tolerances, and how this can be checked during production. They will also understand why it is not necessary to check every component and why sampling can be used.	www.youtube.com/watch?v=o0_xv-xKprE is a short video explaining tolerances, limits, and fits. qualityinspection.org/sampling-plans-china provides an overview of different product sampling techniques. Includes a video.

	Event	Learning Outcome	Topic area/subtopic Area (from R112 specification)	Suggestions for delivery/activities (including scope and depth)	'Have they got it?' – internal unit links with commentary	Useful external resources
Autumn Term	8	LO2	Quality control techniques used in stages of production: comparison and corrective action.	Learners could be introduced to comparison and corrective action requirements used in quality control. Learners could review a batch of components comparing each against a set of requirements and then advising what corrective action would need to be carried out.	R112 LO2 – Learners will understand how quality can be checked through comparison with set requirements, and how to suggest and make corrective actions.	Search the Internet for 'surface finish comparator' to see how quality of surface finish can be checked through comparison with set criteria.
	9	LO2	Application of basic inspection techniques in stages of production - visual checks.	Learners could be introduced to practical quality control techniques used during production starting with visual checks. Learners could be given a quality check list. Using a list of specification points, learners could be shown how to visually inspect a product or component looking for faults and discrepancies, such as surface imperfections or poor quality of finish.	R112 LO2 – Learners will be able to practically perform a visual inspection against given check points, making recommendations.	
	10	LO2	Use of inspection equipment in stages of production – part 1 – micrometer and digital vernier calipers.	Learners could be introduced to more advanced inspection techniques including the use of measuring equipment such as the micrometer and digital vernier caliper. Learners could be given a batch of components and asked to carry out practical inspection. Measurements using different types of measuring equipment could be taken, with readings compared with expected values. Findings could be tabulated.	R112 LO2 – Learners will be able to practically select relevant measuring equipment and perform quality control checks on given components, making a summary of findings with recommendations.	The following website introduces the top 10 measuring instruments, along with videos showing how they are used: gaugehow.com/2019/05/26/mechanical-measuring-instruments

	Event	Learning Outcome	Topic area/subtopic Area (from R112 specification)	Suggestions for delivery/activities (including scope and depth)	'Have they got it?' – internal unit links with commentary	Useful external resources
Spring Term	1	L02	Use of inspection equipment in stages of production – part 2 – jigs and fixtures.	Learners could be introduced to the use of jigs and fixtures and how they are used to ensure quality when manufacturing products and components. Learners could be given the task of manufacturing a component, and without using measuring equipment, asked to confirm if their product meets set requirements by using a measurement jig.	R112 L02 – Learners understand how jigs and fixtures are used to ensure and check the quality of manufactured components.	Search the Internet for 'measuring jigs' or 'measurement jigs'.
	2	L02	Use of inspection equipment in stages of production – part 3 – gauges and comparators.	In this session, learners will continue with their review of the use of inspection equipment in quality control. Components could be reviewed using gauges to determine if they meet set requirements.	R112 L02 – Learners understand the use of gauges and comparators when inspecting manufactured components.	Range of videos on www.youtube.com search for 'measuring gauge' www.youtube.com/watch?v=K1oqWxtfmTc shows an optical comparator being used to measure a component.
	3	L02	Use of inspection equipment in stages of production – part 4 – X-rays and ultrasonics.	Learners could be introduced to advanced non-destructive testing (NDT) methods – X-ray & ultrasonic. Learners could be shown videos explaining how each is used within production. Learners could identify strengths and weakness of each method.	R112 L02 – Learners can explain the basic principles of x-ray and ultrasonic inspection techniques.	A range of YouTube videos show NDT techniques taking place www.youtube.com/watch?v=lcWjZbXifkM shows X-ray inspection; www.youtube.com/watch?v=UM6XKvXWVFA shows ultrasonic examination.

	Event	Learning Outcome	Topic area/subtopic Area (from R112 specification)	Suggestions for delivery/activities (including scope and depth)	'Have they got it?' – internal unit links with commentary	Useful external resources
Spring Term	4	LO2	Techniques for evaluating product: precision and accuracy achieved during making processes, quality of outcome.	Learners could be introduced to precision and accuracy during production, including the difference in meaning of each term. Learners could be given a demonstration of manual versus CNC manufacture. They could compare which is most accurate, and the quality of outcome, explaining reasons for their answers.	R112 LO2 – Learners will be able to explain the difference between precision and accuracy, and why both are important measures of quality during production.	www.mathsisfun.com/accuracy-precision.html explains the difference between precision and accuracy.
	5	LO2	Techniques for evaluating product: safety checks and consumer safety.	Learners could be introduced to methods of quality control checks based on product and consumer safety. Learners could review a manufactured product and identify issues that could impact safe operation or the health and safety of a user.	R112 LO2 – Learners can understand the importance of confirming through quality checks that products meet safety requirements, and how this is important for the consumer.	
	6	LO2	Practical evaluation of a product from quality control checks: measurements, compare against specification.	Learners could safely carry out a full evaluation of products or components they have previously manufactured comparing sizes, finish, quality of outcome etc. against pre-issued drawing and specification. Results could be tabulated including a written interpretation of the outcome.	R112 LO2 – Learners will understand how measurements can be used to confirm quality of a component or product against specified values. They could also undertake a practical quality activity.	Health and safety in engineering: www.hse.gov.uk/engineering Includes a useful workshop guide booklet on to health and safety in engineering workshops.
	7	LO2	Practical evaluation of a product from quality control checks: measurements, compare against specification.	Learners will continue their practical evaluation of a product or component from the previous session.	R112 LO2 – Learners will understand how measurements can be used to confirm quality of a component or product against specified values. They could also undertake a practical quality activity.	The UK Government website outlines the reasons why manufacturers need to ensure that their products meet safety requirements: www.gov.uk/guidance/product-safety-advice-for-businesses#demonstrating-compliance

	Event	Learning Outcome	Topic area/subtopic Area (from R112 specification)	Suggestions for delivery/activities (including scope and depth)	'Have they got it?' – internal unit links with commentary	Useful external resources
Spring Term	8	LO2	Synoptic links from LO2 to other units.	In this session, learners could review work completed in LO2 of this unit and make links to other units in the specification (especially units R109, R110 and R111).	<p>R109 LO1 – Learners could relate quality control techniques to materials testing processes especially NDT techniques.</p> <p>R110 LO2 / R110 LO3 - Learners could relate back to practical quality control performed when manufacturing components using manual and CNC techniques.</p>	
	9	LO3	Modern technologies used in quality control: non-destructive testing – visual, ultrasonic and dye penetrant.	Learners could be introduced to a range of non-destructive testing (NDT) methods. Learners could be shown videos of products undergoing NDT using the following methods: visual inspection, ultrasonic testing and dye penetrant testing. Learners could identify the reasons for performing NDT as compared with destructive testing. They could identify products or materials each method is most suitable for together with advantages and limitations of each technique.	R112 LO3 – Learners will be able to explain basic NDT techniques, including what applications they are used for.	<p>The British Institute of Non-Destructive Testing (BINDT) website includes a range of useful videos www.bindt.org/videos/</p> <p>YouTube videos showing NDT techniques taking place are useful: www.youtube.com/watch?v=UM6XKvXWVFA (ultrasonic inspection);</p> <p>www.youtube.com/watch?v=xEK-c1pkTUI (dye penetrant inspection);</p> <p>www.youtube.com/watch?v=3nJKO3NdWDo (visual inspection)</p>

	Event	Learning Outcome	Topic area/subtopic Area (from R112 specification)	Suggestions for delivery/activities (including scope and depth)	'Have they got it?' – internal unit links with commentary	Useful external resources
Spring Term	10	L03	Modern technologies used in quality control: 3D scanning and CNC measurement checks.	Learners could be introduced to how 3D scanning and CNC measurement techniques are used within quality control. Learners could research both methods and explain how each could be used in different applications.	R112 L03 – Learners will be able to explain how 3D scanning and CNC checks are used in quality control.	Search www.youtube.com for '3D scanning'

	Event	Learning Outcome	Topic area/subtopic Area (from R112 specification)	Suggestions for delivery/activities (including scope and depth)	'Have they got it?' – internal unit links with commentary	Useful external resources
Summer Term	1	LO3	Modern technologies used in quality control: Computer Integrated Engineering (CIE) and Computer Integrated Manufacture (CIM).	Learners could be introduced to how computers are used in quality control during design and manufacturing. Learners could research CIE/ CIM and determine how computer-aided design (CAD) and computer-aided manufacturing (CAM) work together to improve quality techniques used in production. Case studies of CIE/CIM could be useful.	R112 LO3 – Learners will be able to explain the terms CIE and CIM, and can identify a range of applications where CIE/CIM including the benefit they bring to ensuring quality during design and manufacturing.	www.youtube.com/watch?v=Sx_j50K5gZo provides a brief introduction to CIM. The following video, related to materials on the technologystudy.com website shows CIM: www.youtube.com/watch?v=edplvB_Xvso
	2	LO3	Modern technologies used in quality control: robotics, automatic inspection and rejection.	Learners could be shown videos of how robotics and automatic inspection are used in high volume manufacturing for quality control. They could summarise each technique, including its relative advantages and disadvantages.	R112 LO3 – Learners can understand how robotics and automatic inspection/ rejection are used in quality control, including applications.	www.youtube.com search for 'robotics in manufacturing'
	3	LO4	Principles of lean manufacturing – introduction.	Learners could be introduced to the principles of lean manufacturing. Learners could be given a practical activity whereby they assemble/ disassemble a product then look at ways they could improve the speed of production without affecting the quality.	R112 LO4 – Learners can identify what lean manufacturing is and how it influences the production of a product to eliminate waste.	www.youtube.com search for what is 'lean manufacturing'. www.youtube.com/watch?v=J4v-HjY3R0Y provides an introduction to lean manufacturing including TIMWOOD www.youtube.com/watch?v=rwiuKzfS0C4 also provides an introduction to lean manufacturing and TIMWOOD including key Japanese terminology.

	Event	Learning Outcome	Topic area/subtopic Area (from R112 specification)	Suggestions for delivery/activities (including scope and depth)	'Have they got it?' – internal unit links with commentary	Useful external resources
Summer Term	4	LO4	Causes of waste in manufacturing: time, materials, resources, processes, supply, space.	Learners could investigate the causes of waste during manufacturing including time, resources, processes, supply and space. They could consider how these impact the manufacturer and society, and methods by which they can be reduced. Case studies showing cause of waste and how it can be minimised could be useful.	R112 LO4 – Learners can identify causes of waste in manufacturing operation, including its impact and how it can be reduced.	This short video shows how Toyota developed manufacturing to reduce waste during manufacture and storage of components: www.youtube.com/watch?v=F5vtCRFRAK0
	5	LO4	Categories of waste: TIMWOOD – part 1 – transport, inventory and movement.	Learners will be introduced to the 7 categories of waste. Learners could research into the meaning of TIMWOOD. Learners could explain how TIMWOOD could be used to make production more efficient and to minimise waste. Learners could review in detail transport of materials, stock holding and movement of parts, workers, and materials during manufacture.	R112 LO4 – Learners understand what TIMWOOD is and what each letter stands for. Learners will understand how transport of products and components, stock levels and movement of materials can impact on production times and costs to a company.	The following website provides a detailed explanation of TIMWOOD, including a downloadable poster: leanmanufacturingtools.org/77/the-seven-wastes-7-mudas/
	6	LO4	Categories of waste: TIMWOOD – part 2 – waiting, over processing, over production and defects.	Learners could review the remaining parts of TIMWOOD in detail. Learners could investigate how excess waiting times for operations, carrying out over processing and production and having defects impact the efficient of manufacturing. Case studies showing TIMWOOD principles being applied in real production settings could be useful.	R112 LO4 – Learners understand what TIMWOOD is and what each letter stands for. Learners understand how waiting time, over processing and over production and defects can impact on efficiency, quality and cost of production.	
	7	LO4	Methods of reducing waste: DFMA – part 1 – standardised components, common fixing strategy.	Learners could be introduced to the principles of Design for Manufacturing and Assembly (DFMA). Learners could carry out a practical investigation on a simple product. Learners could identify how standard components and common fixings have been used to ensure consistent and accurate assembly and to minimise waste.	R112 LO4 – Learners understand the basic principles of DFMA and can explain how standard components and common fixings are used to reduce errors when assembling products and minimise waste.	www.wevalgo.com/know-how/r-n-d/dfma provides a brief overview of DFMA.

	Event	Learning Outcome	Topic area/subtopic Area (from R112 specification)	Suggestions for delivery/activities (including scope and depth)	'Have they got it?' – internal unit links with commentary	Useful external resources
Summer Term	8	LO4	Methods of reducing waste: DFMA – part 2 – complexity reduction, make versus buy, handling and processes.	Learners will continue their investigation of DFMA by considering complexity reduction, make versus buy and handling and processes. Learners could carry out a further product investigation. Learners could look at how the product could be re-designed to make production or assembly simpler. They could investigate the advantages and disadvantages of manufacturing the product using bought-in parts. Finally processes used for the manufacture of the product could be considered.	R112 LO4 – Learners understand the basic principles of DFMA and can explain how reducing the complexity of products, considering buying-in parts, and handling and processes impact quality and cost.	
	9	LO4	Sustainable design: material reduction and life cycle analysis.	Learners could be introduced to sustainable design and manufacturing, including life cycle of a product (life cycle analysis LCA). They could consider the life cycle of a typical product, including how this impacts the use of raw materials, how they are processed and ultimately how they are recycled or disposed of. They could research into the principle of sustainable design and how the design of a product could be changed to reduce the amount or type of materials used during its manufacture.	R112 LO4 – Learners can explain with examples the life cycle of a products, and the need to consider material reduction to ensure products are sustainably designed and manufactured.	www.youtube.com search for 'life cycle analysis'
	10	LO4	Sustainable design: end of life disposal and recycled materials.	Learners could research what happens to products at the end of their life, and how materials can be recycled or disposed of safely. A product investigation could be carried out, such as a mobile phone. Learners could identify what materials have been used to manufacture the phone, and how these are recycled or disposed of at end of life. They could consider the environmental impacts of recycling or disposal into landfill.	R112 LO4 – Learners can explain what happens to products at the end of their life (i.e. recycling, reuse, disposal), and why it is important that materials can be recycled or disposed of safely.	www.youtube.com search for 'sustainable design'

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