

City & Guilds Level 3 Diploma in Advanced Manufacturing Engineering (Development Competence) - Machining (1271- 03)

Version 2.1 (August 2025)

Qualification Handbook

Qualification at a glance

Subject area	Mechanical
City & Guilds number	1271
Age group approved	16-19, 19+
Entry requirements	None
Assessment types	Portfolio, Pass / Fail
Approvals	Full Centre and Qualification approval for all new centres. Automatic approval for existing centres offering predecessor qualifications.
Support materials	Qualification handbook
Registration and certification	Consult the Walled Garden/Online Catalogue for last dates

Title and level	GLH	TQT	City & Guilds qualification number	Ofqual accreditation number
1271-03 Level 3 Diploma in Advanced Manufacturing Engineering (Development Competence) - Machining Conventional Machining	456	1830	1271-03	603/1700/0
1271-03 Level 3 Diploma in Advanced Manufacturing Engineering (Development Competence) - Machining CNC Machining	442	1720	1271-03	603/1700/0

Version and date	Change detail	Section
2.0 August 2017	Unit 307 Assessment criteria 2.1 and 2.2 change wording from 'centre lathes' to 'milling machines'	Units

2.1 August 2025

Grading information added

Qualification at a glance

Updated Access arrangements, Sustainability and Quality Assurance sections

Sections 2 and 3

Updated Appendix 2 'General Information'

Appendix 2

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Unit 325	Machining components using CNC electrical discharge machines	141
Unit 326	Setting CNC vertical boring machines	145
Unit 327	Machining components using CNC vertical boring machines	152
Unit 328	Setting CNC horizontal boring machines	156
Unit 329	Machining components using CNC horizontal boring machines	162
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1 Introduction

This document tells you what you need to do to deliver the qualification:

Area	Description
Who is the qualification for?	This qualification is aimed at learners aged 16 and above who would like to develop the skills required to become a Machinist (Advanced Manufacturing Engineering) as part of an apprenticeship.
What does the qualification cover?	<p>Learners will develop skills needed to carry out different machining operations related to advanced manufacturing engineering using manual and/or CNC machines.</p> <p>Learners will develop transferable skills valued by employers such as working efficiently and effectively and contributing to improving business performance. Critically they will learn to carry out tasks to meet regulatory and legal requirements.</p>
What opportunities for progression are there?	Upon completion of the qualification learners will have developed skills required of the Development phase of the Machinist (Advanced Manufacturing Engineering) apprenticeship, supporting their progress to end point assessment.
Who did we develop the qualification with?	This qualification has been developed in collaboration with the Machinist (Advanced Manufacturing Engineering) Trailblazer Group.
Is it part of an apprenticeship framework or initiative?	Yes. This qualification has been developed to be included within the Development phase of the Machinist (Advanced Manufacturing Engineering) apprenticeship.

Structure

Level 3 Diploma in Advanced Manufacturing Engineering (Development Competence) – Machining Conventional Machining

Learners are required to complete the following:

- mandatory units (301, 302, 303)
- plus **one** of the following pairs of units ((304 and 305), (306 and 307), (308 and 309), (310 and 311)).

City & Guilds unit number	Unit title	GLH
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Mandatory

301	Complying with statutory regulations and organisational safety requirements	35
302	Using and interpreting engineering data and documentation	25
303	Working efficiently and effectively in advanced manufacturing and engineering	215

Optional

304	Setting centre lathes	210
305	Machining components using centre lathes	161
306	Setting milling machines	210
307	Machining components using milling machines	161
308	Setting electro-discharge machines	210
309	Machining components using electro-discharge machines	161
310	Setting grinding machines	210
311	Machining components with grinding machines	161

Level 3 Diploma in Advanced Manufacturing Engineering (Development Competence) – Machining CNC Machining

Learners are required to complete the following:

- mandatory units (301, 302, 303)
- plus **one** of the following units (312, 313)
- plus **one** of the following pairs of units ((314 and 315), (316 and 317), (318 and 319), (320 and 321), (322 and 323), (324 and 325), (326 and 327), (328 and 329), (330 and 331), (332 and 333), (334 and 335)).

City & Guilds unit number	Unit title	GLH
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Mandatory

301	Complying with statutory regulations and organisational safety requirements	35
302	Using and interpreting engineering data and documentation	25
303	Working efficiently and effectively in advanced manufacturing and engineering	215

Optional

312	Loading and proving CNC machine tool programs	91
313	Carrying out CNC machine tool programming	231
314	Setting CNC turning machines	140
315	Machining components using CNC turning machines	126
316	Setting CNC milling machines	140
317	Machining components using CNC milling machines	126
318	Setting CNC grinding machines	140
319	Machining components using CNC grinding machines	126
320	Setting CNC punching machines	140
321	Machining components using CNC punching machines	126

Optional

322	Setting CNC laser profiling machines	140
323	Machining components using CNC laser profiling machines	126
324	Setting CNC electro-discharge machines	140
325	Machining components using CNC electro-discharge machines	126
326	Setting CNC vertical boring machines	140
327	Machining components using CNC vertical boring machines	126
328	Setting CNC horizontal boring machines	140
329	Machining components using CNC horizontal boring machines	126
330	Setting CNC gear cutting machines	140
331	Machining components using CNC gear cutting machines	126
332	Setting CNC machining centres	140
333	Machining components using CNC machining centres	126
334	Setting CNC fabrication equipment	140
335	Machining components using CNC fabrication equipment	126

Total Qualification Time

Total Qualification Time (TQT) is the total amount of time, in hours, expected to be spent by a Learner to achieve a qualification. It includes both guided learning hours (which are listed separately) and hours spent in preparation, study and assessment.

Title and level	GLH	TQT
1271-03 Level 3 Diploma in Advanced Manufacturing Engineering (Development Competence) – Machining Conventional Machining	456	1830
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2 Centre requirements

Approval

Centres that are currently approved to offer the relevant predecessor qualifications (1712-30, 1712-31, 1712-32, 1712-60, 1712-61, 1712-62) will receive automatic approval for this qualification. If your centre is not eligible for automatic approval you will require full qualification approval.

New centres will need to gain centre approval. Existing centres who wish to offer this qualification must go through City & Guilds' full Qualification Approval Process. Please refer to the City & Guilds website for further information on the approval process: www.cityandguilds.com.

Resource requirements

Resources

The qualification should be delivered in the workshops and classrooms of a centre with full facilities for machining activities. The machinery, tools, equipment and resources used must be representative of industry standards and there must be sufficient equipment/resources available for each learner to demonstrate their competence individually.

Centre staffing

Staff delivering these qualifications must be able to demonstrate that they meet the following occupational expertise requirements. They should:

- be occupationally competent or technically knowledgeable in the area[s] for which they are delivering training and/or have experience of providing training. This knowledge must be to the same level as the training being delivered
- have recent relevant experience in the specific area they will be assessing
- have credible experience of providing training.

Centre staff may undertake more than one role, eg tutor and assessor or internal verifier, but cannot internally verify their own assessments.

Assessors

Assessment must be carried out by competent assessors. As a minimum, they must hold the Level 3 Award in Assessing Competence in the Work Environment or equivalent such as D32/33, A1/2. They will be expected to regularly review their skills, knowledge and understanding and where applicable undertake continuing professional development to ensure that they are carrying out assessment in sheltered and workplace environments to the most up to date standards.

Assessors must be able to demonstrate that they have verifiable, relevant and sufficient technical competence to evaluate and judge performance and knowledge evidence requirements as set out in the unit assessment criteria. This will be demonstrated by either holding a relevant technical

qualification or by proven industrial experience of the technical areas they are assessing. The assessor's competence must, at least, be at the same level as that required of the unit being assessed.

Internal Quality Assurers

Internal quality assurance must be carried out by competent Internal Quality Assurers (IQAs). As a minimum, they must hold the Level 4 Award in the Internal Quality Assurance of Assessment Processes and Practices or equivalent such as V2 or D35. They must also hold, or at least be familiar with the Level 3 Award in Assessing Competence in the Work Environment or equivalents such as D32/33, A1/2.

IQAs will be expected to regularly review their skills, knowledge and understanding and where applicable undertake continuing professional development to ensure that they are carrying out quality assurance of assessment processes to the most up to date standards. They will also be expected to be conversant with the terminology of the unit against which assessments and quality assurance are carried out.

Continuing Professional Development

Centres must support their staff to ensure that they have current knowledge of the occupational area, that delivery, mentoring, training, assessment and verification is in line with best practice and that it takes account of any national or legislative developments.

Learner entry requirements

City & Guilds does not set entry requirements for these qualifications. However, centres must ensure that candidates have the potential and opportunity to gain the qualifications successfully.

Age restrictions

City & Guilds cannot accept any registrations for learners under 16 as these qualifications are not approved for learners under 16.

Access arrangements, reasonable adjustments and special consideration

City & Guilds has considered the design of this qualification and its assessments in order to best support accessibility and inclusion for all learners. order to best support accessibility and inclusion for all learners. City & Guilds understands however that individuals have diverse learning needs and may require reasonable adjustments to fully participate. Reasonable adjustments, such as additional time or alternative formats, may be provided to accommodate learners with disabilities and support fair access to assessment.

Access arrangements are adjustments that allow candidates with disabilities, special educational needs, and temporary injuries to access the assessment and demonstrate their skills and knowledge without changing the demands of the assessment. These arrangements must be made before assessment takes place.

The Equality Act 2010 requires City & Guilds to make reasonable adjustments where a disabled person would be at a substantial disadvantage in undertaking an assessment.

It is the responsibility of the centre to ensure at the start of a programme of learning that candidates will be able to access the requirements of the qualification.

Special consideration is a post examination adjustment to a candidate's mark or grade to reflect temporary injury, illness or other indisposition at the time of the examination/assessment.

Please refer to the documents 'Joint Council for Qualifications (JCQ) Access Arrangements and Reasonable Adjustments', 'JCQ – A Guide to the special consideration process' and 'Access arrangements – When and how applications need to be made to City & Guilds' for more information. All of these are available on the [City & Guilds website](#)

- and considering options for reuse/salvage as part of plumbing activities wherever possible.

Quality assurance

Approved centres must have effective quality assurance systems to ensure optimal delivery and assessment of qualifications. Quality assurance includes initial centre approval, qualification approval and the centre's own internal procedures for monitoring quality. Centres are responsible for internal quality assurance and City & Guilds is responsible for external quality assurance. All external quality assurance processes reflect the minimum requirements for verified and moderated assessments, as detailed in the Centre Assessment Standards Scrutiny (CASS), section H2 of Ofqual's General Conditions. For more information on both CASS and City & Guilds quality assurance processes visit the [What is CASS?](#) and [Quality Assurance Standards](#) documents on the City & Guilds website.

Standards and rigorous quality assurance are maintained by the use of:

- internal quality assurance
- City & Guilds external quality assurance.

In order to carry out the quality assurance role, Internal Quality Assurers (IQAs) must:

- have appropriate teaching and vocational knowledge and expertise
- have experience in quality management/internal quality assurance
- hold or be working towards an appropriate teaching/training/assessing qualification
- be familiar with the occupation and technical content covered within the qualification.

External quality assurance for the qualification will be provided by City & Guilds. External Quality Assurers (EQAs) are appointed by City & Guilds to approve centres, and to monitor the assessment and internal quality assurance carried out by centres. External quality assurance is carried out to ensure that assessment is valid and reliable, and that there is good assessment practice in centres.

The role of the EQA is to:

- provide advice and support to centre staff

- ensure the quality and consistency of assessments and marking/grading within and between centres by the use of systematic sampling
- provide feedback to centres and to City & Guilds.

3 Delivering the qualification

Initial assessment and induction

An initial assessment of each candidate should be made before the start of their programme to identify:

- if the candidate has any specific training needs
- support and guidance they may need when working towards their qualifications
- any units they have already completed, or credit they have accumulated which is relevant to the qualifications
- the appropriate type and level of qualification.

We recommend that centres provide an induction programme so the candidate fully understands the requirements of the qualification, their responsibilities as a candidate, and the responsibilities of the centre. This information can be recorded on a learning contract.

Support materials

The following resources are available for these qualifications:

Description	How to access
Qualification Handbook	www.cityandguilds.com

Recording documents

Candidates and centres may decide to use a paper-based or electronic method of recording evidence.

City & Guilds endorses several ePortfolio systems, including our own, Learning Assistant, an easy-to-use and secure online tool to support and evidence learners' progress towards achieving qualifications. Further details are available at: www.cityandguilds.com/eportfolios.

City & Guilds has developed a set of *Recording forms* including examples of completed forms, for new and existing centres to use as appropriate. Recording forms are available on the City & Guilds website.

Although new centres are expected to use these forms, centres may devise or customise alternative forms, which must be approved for use by the external verifier, before they are used by candidates and assessors at the centre. Amendable (MS Word) versions of the forms are available on the City & Guilds website.

Sustainability

City & Guilds are committed to net zero. Our ambition is to reduce our carbon emissions by at least 50% before 2030 and develop environmentally responsible operations to achieve net zero by 2040 or

sooner if we can. City & Guilds is committed to supporting qualifications that help our customers to consider sustainability and their environmental footprint.

More information and guidance to support centres in developing sustainable practices through the delivery of City & Guilds qualifications can be found here:

[Our Pathway to Net Zero | City & Guilds \(cityandguilds.com\)](https://www.cityandguilds.com)

Centres should consider their own carbon footprint when delivering this qualification and consider reasonable and practical ways of delivering this qualification with sustainability in mind. This could include:

- reviewing purchasing and procurement processes (such as buying in bulk to reduce the amount of travel time and energy and considering and investing in the use of components that can be reused, instead of the use of disposable or single use consumables)
- reusing components wherever possible
- waste procedures (ensuring that waste is minimised and recycling of components is in place wherever possible)
- minimising water use

4 Assessment

Assessment methods

Candidates must have a completed portfolio of evidence for each unit.

Assessment environment

The evidence put forward for this qualification can only be regarded as valid, reliable, sufficient and authentic if achieved and obtained in the working environment and be clearly attributable to the learner. However, in certain circumstances, simulation/replication of work activities may be acceptable.

The use of high quality, realistic simulations/replication, which impose pressures which are consistent with workplace expectations, should only be used in relation to the assessment of the following:

- rare or dangerous occurrences, such as those associated with health, safety and the environment issues, emergency scenarios and rare operations at work
- the response to faults and problems for which no opportunity has presented for the use of naturally occurring workplace evidence of learners competence
- aspects of working relationships and communications for which no opportunity has presented for the use of naturally occurring workplace evidence of learners' competence.

Simulations/replications will require prior approval from centre's City & Guilds External Quality Assurer and should be designed in relation to the following parameters:

- the environment in which simulations take place must be designed to match the characteristics of the working environment
- competencies achieved via simulation/replication must be transferable to the working environment
- simulations which are designed to assess competence in dealing with emergencies, accidents and incidents must be verified as complying with relevant health, safety and environmental legislation by a competent health and safety/environmental control officer before being used
- simulated activities should place learners under the same pressures of time, access to resources and access to information as would be expected if the activity was real
- simulated activities should require learners to demonstrate their competence using plant and/or equipment used in the working environment
- simulated activities which require interaction with colleagues and contacts should require the learner to use the communication media that would be expected at the workplace
- for health and safety reasons, simulations need not involve the use of genuine substances/materials. Any simulations which require the learner to handle or otherwise deal with materials/substances should ensure that the substitute(s) take the same form as in the workplace.

Evidence requirements

Carrying out assessments

The units were specifically developed to cover a wide range of activities. The evidence produced for the units will, therefore, depend on the learners choice of “bulleted items” listed in the unit assessment criteria. Where the assessment criteria gives a choice of bulleted items (for example ‘any three from five’), assessors should note that learners do not need to provide evidence of the other items to complete the unit (in this example, two) items, particularly where these additional items may relate to other activities or methods that are not part of the learners normal workplace activity or area of expertise.

Minimum performance of evidence requirements

Performance evidence must be the main form of evidence gathered. In order to demonstrate consistent, competent performance for a unit, a minimum of 3 different examples of performance must be provided, and must be sufficient to show that the assessment criteria have been achieved to the prescribed standards.

It is possible that some of the bulleted items in the assessment criteria may be covered more than once. The assessor and learner need to devise an assessment plan to ensure that performance evidence is sufficient to cover all the specified assessment criteria and which maximises the opportunities to gather evidence. Where applicable, performance evidence may be used for more than one unit.

The most effective way of assessing competence, is through direct observation of the learner.

Assessors must make sure that the evidence provided reflects the learner’s competence and not just the achievement of a training programme.

Evidence that has been produced from team activities, for example, maintenance or installation activities is only valid when it clearly relates to the learners specific and individual contribution to the activity, and not to the general outcome(s).

Each example of performance evidence will often contain features that apply to more than one unit, and can be used as evidence in any unit where appropriate. Performance evidence must be a combination of:

- outputs of the learner’s work, such as items that have been manufactured, installed, maintained, designed, planned or quality assured, and documents produced as part of a work activity
- evidence of the way the learner carried out the activities such as witness testimonies, assessor observations or authenticated learner reports, records or photographs of the work/activity carried out, etc.

Competent performance is more than just carrying out a series of individual set tasks. Many of the units contain statements that require the learner to provide evidence that proves they are capable of combining the various features and techniques. Where this is the case, separate fragments of evidence would not provide this combination of features and techniques and will not, therefore, be acceptable as demonstrating competent performance.

If there is any doubt as to what constitutes valid, authentic and reliable evidence, the internal and/or External Quality Assurer should be consulted.

Assessing knowledge and understanding

Knowledge and understanding are key components of competent performance, but it is unlikely that performance evidence alone will provide enough evidence in this area. Where the learner's knowledge and understanding (and the handling of contingency situations) is not apparent from performance evidence, it must be assessed by other means and be supported by suitable evidence.

Knowledge and understanding can be demonstrated in a number of different ways. Oral questioning and practical demonstrations should be used, as these are considered the most appropriate for these units. Assessors should ask enough questions to make sure that the learner has an appropriate level of knowledge and understanding, as required by the unit.

The achievement of the specific knowledge and understanding requirements of the units cannot simply be inferred by the results of tests or assignments from other units, qualifications or training programmes. Where evidence is submitted from these sources, the assessor must, as with any assessment, make sure the evidence is valid, reliable, authentic, directly attributable to the learner, and meets the full knowledge and understanding requirements of the unit.

Where oral questioning is used the assessor must retain a record of the questions asked, together with the learner's answers.

Witness testimonies

Where observation is used to obtain performance evidence, this must be carried out against the unit assessment criteria. Best practice would require that such observation is carried out by a qualified Assessor. If this is not practicable, then alternative sources of evidence may be used. For example, the observation may be carried out against the assessment criteria by someone else that is in close contact with the learner. This could be a team leader, supervisor, mentor or line manager who may be regarded as a suitable witness to the learner's competency. However, the witness must be technically competent in the process or skills that they are providing testimony for, to at least the same level of expertise as that required of the learner. It will be the responsibility of the assessor to make sure that any witness testimonies accepted as evidence of the learner's competency are reliable, auditable and technically valid.

5 Units

Structure of the units

These units each have the following:

- City & Guilds reference number
- Title
- Level
- Guided learning hours (GLH)
- Learning outcomes
- Topics and the related scope of content.

Centres must deliver the full breadth of the range. For the practical assessments for this qualification, centres should ensure that there are sufficient resources to complete the task. They are required to use all the equipment or commodities in the range, unless otherwise specified.

Unit 301

Complying with statutory regulations and organisational safety requirements

Unit level:	Level 3
GLH:	35
Unit aim:	This unit enables the learner to demonstrate that they are competent in being able to deal with statutory regulations and organisational safety requirements, in accordance with approved procedures.
Relationship to NOS:	EUCL3D-001

Learning outcome

The learner will:

- 1 Understand statutory regulations and organisational safety requirements

Assessment criteria

The learner can:

- 1.1 Describe the roles and responsibilities of themselves and others under current legislation
- 1.2 Describe the specific regulations and safe working practices and procedures that apply to their work activities
- 1.3 Describe the warning signs for the nine main groups of hazardous substances defined by Classification, Packaging and Labelling of Dangerous Substances Regulations
- 1.4 Describe how to locate relevant health and safety information for their tasks and the sources of expert assistance when help is needed
- 1.5 Explain what constitutes a hazard in the workplace
- 1.6 Explain responsibilities for dealing with hazards and reducing risks in the workplace
- 1.7 Explain the risks associated with their job role
- 1.8 Explain the importance of applying the appropriate occupational behaviours in the workplace
- 1.9 Explain the implications of not adhering to appropriate occupational behaviours
- 1.10 Describe the first aid facilities available in the working environment
- 1.11 Describe the procedures to be followed in the case of accidents involving injury

- 1.12 Explain what constitutes dangerous occurrences and hazardous malfunctions
 - 1.13 Explain why dangerous occurrences and hazardous malfunctions must be reported even when no one was injured
 - 1.14 Describe workplace emergency procedures
 - 1.15 Describe organisational fire safety policy
 - 1.16 Describe protective clothing and equipment available for individual areas of activity
 - 1.17 Explain how to lift and carry loads safely
 - 1.18 Describe how to prepare and maintain safe working areas, standards and procedures to ensure good housekeeping
 - 1.19 Explain the importance of safe storage of tools, equipment, materials and products
 - 1.20 Describe the extent of their own authority and to whom they should report in the event of problems that they cannot resolve.
-

Range

- (AC1.1)
 - Health and Safety at Work Act 1974
 - The Management of Health and Safety at Work Regulations
 - Workplace Health and Safety and Welfare Regulations
 - Personal Protective Equipment at Work Regulations 1992
 - Manual Handling Operations Regulations
 - Provision and Use of Work Equipment Regulations
 - Display Screen at Work Regulations
 - The Electricity at Work Regulations.

 - (AC1.7)
 - Working environment
 - Tools, materials and equipment used
 - Standard Operating Procedures.

 - (AC1.9)
 - For the employee
 - For the business.

 - (AC1.10)
 - Individual work area
 - Within the organisation
 - (AC1.14)
 - For sounding the emergency alarms
 - For evacuation
 - For escape routes to be used
 - The need to report presence at the appropriate assembly point.

 - (AC1.15)
 - Firefighting procedures
 - Common causes of fire
 - Fire prevention.

 - (AC1.17)
 - With mechanical aids
-

- Without mechanical aids.

Learning outcome

The learner will:

- 2 Be able to comply with statutory regulations and organisational safety requirements

Assessment criteria

The learner can:

- 2.1 Apply duties and responsibilities as an individual under current legislation
- 2.2 Identify within the organisation, appropriate sources of information and guidance on health and safety issues
- 2.3 Identify the warning signs and labels of the main groups of hazardous or dangerous substances
- 2.4 Comply with the appropriate statutory regulations at all times
- 2.5 Identify the appropriate qualified first aiders or appointed person
- 2.6 Identify the location of first aid facilities within the organisation
- 2.7 Identifying the procedures to be followed in the event of injury
- 2.8 Follow organisational procedures in the event of fire and the evacuation of premises
- 2.9 Identify the procedures to be followed in the event of dangerous occurrences or hazardous malfunctions
- 2.10 Comply with emergency requirements their working environment
- 2.11 Demonstrate methods of manual lifting and carrying techniques
- 2.12 Maintain a tidy workplace with exits and gangways free from obstructions
- 2.13 Use tools and equipment safely and only for the purpose intended
- 2.14 Observe organisational safety rules, signs and hazard warnings
- 2.15 Take measures to protect others from harm.

Range

- (AC2.1)
- Health and Safety at Work Act 1974
 - The Management of Health and Safety at Work Regulations
 - Workplace Health and Safety and Welfare Regulations
 - Personal Protective Equipment at Work Regulations 1992
 - Manual Handling Operations Regulations
 - Provision and Use of Work Equipment Regulations
 - Display Screen at Work Regulations
 - The Electricity at Work Regulations.
- (AC2.2)
- Eye protection
 - Personal protective equipment

- COSHH regulations
- Risk assessments.

- (AC2.7)
- To self
 - To others.

- (AC2.10) • Tools and equipment used
- Materials and substances used
 - Working practices that do not follow laid down procedures.

(AC2.11) Two of the following:

- Lifting alone
- With assistance of others
- With mechanical assistance.

Unit 302

Using and interpreting engineering data and documentation

Unit level:	Level 3
GLH:	25
Unit aim:	The purpose of this unit is for the learner to demonstrate that they are able to make effective use of text, numeric and graphical information.
Relationship to NOS:	EUCL3D-002

Learning outcome

The learner will:

- 1 Understand how to use engineering data and documentation

Assessment criteria

The learner can:

- 1.1 Describe the information sources used for the documentation and specifications that are used with work activities
- 1.2 Describe how the required documentation is obtained
- 1.3 Explain how to check that obtained documentation is current and valid
- 1.4 Describe how different sources of information can be used to support work activities
- 1.5 Describe the procedure for reporting discrepancies, lost or damaged documentation
- 1.6 Describe are and control procedures for documentation
- 1.7 Explain the importance of returning documentation to the designated location on completion of the work activities
- 1.8 Describe basic drawing conventions that are used
- 1.9 Explain why there needs to be different types of drawings
- 1.10 Explain the interrelationship between different types of drawings
- 1.11 Explain why technical information is presented in different forms
- 1.12 Define the meaning of common symbols and abbreviations used within the working environment/work area

- 1.13 Describe imperial and metric systems of measurement, tolerancing and fixed reference points
- 1.14 Describe the extent of their own responsibility, when to act on their own initiative to find, clarify and evaluate information, and to whom they should report if they have problems that they cannot resolve.
-

Range

- (AC1.4)
- Manuals
 - Tables
 - Charts
 - Planning and quality documentation
 - National and international standards.
- (AC1.10)
- Isometric and orthographic
 - First and third angle
 - Assembly drawings
 - Circuit and wiring diagrams
 - Block and schematic diagrams.
- (AC1.12)
- Wiring and component symbols
 - Surface finish
 - Electronic components
 - Weld symbols
 - Linear and geometric tolerances
 - Pressure and flow characteristics.
-

Learning outcome

The learner will:

- 2 Be able to use engineering data and documentation

Assessment criteria

The learner can:

- 2.1 Use approved sources to obtain the necessary drawings and related specifications
- 2.2 Check the currency and validity of the documentation used
- 2.3 Exercise care and control over the documentation
- 2.4 Extract data required to carry out the required tasks
- 2.5 Source additional information where there are gaps or deficiencies in the information obtained
- 2.6 Deal with problems found with the data and documentation
-

- 2.7 Make valid decisions based on the evaluation of the information extracted from the documentation
- 2.8 Return all documentation to the approved location on completion of the work
- 2.9 Complete all necessary work related documentation
- 2.10 Extract information
- 2.11 Use information extracted from engineering drawings and related documentation

Range

(AC2.10) Extract three of the following:

- Materials or components required
- Dimensions
- Tolerances
- Quality requirements
- Installation requirements
- Customer requirements
- Timescales
- Financial information
- Operating parameters
- Surface texture requirements
- Location/orientation of parts
- Process or treatments required
- Dismantling/assembly sequence
- Inspection/testing requirements
- Number/volumes required
- Repair/service methods
- Method of manufacture
- Weld type and size
- Operations required
- Connections to be made
- Surface finish required
- Shape or profiles
- Fault finding procedures
- Test points
- Safety/risk factors
- Environmental controls
- Technical data
- Resources
- Utility supply details
- Location of services
- Circuit characteristics
- Protective arrangements and equipment
- Other specific related information.

(AC2.11) Use information extracted to include three from the following:

- Standard operating procedures
- Instructions
- Specifications
- Reference materials
- Schedules
- Operation sheets
- Maintenance log reports
- Service/test information/schedules/results
- Planning documentation
- Quality control documents
- Company specific technical instructions
- National, international and organisational standards
- Health and safety standards relating to the activity
- Environmental requirements/information
- Other specific related documentation.

(AC2.11) Use two of the following sources:

- Drawings
- Diagrams
- Manufacturers' manuals
- Approved sketches
- Technical illustrations
- Photographic images/representations
- Technical sales/marketing documentation
- Contractual documentation
- Other specific drawings/documents.

Unit 303

Working efficiently and effectively in advanced manufacturing and engineering

Unit level:	Level 3
GLH:	25
Unit aim:	The purpose of this unit is for learners to develop knowledge, understanding and skills required to work efficiently and effectively in the workplace, in accordance with approved practices and procedures.
Relationship to NOS:	EUCL3D-003

Learning outcome

The learner will:

- 1 Understand how to work efficiently and effectively in advanced manufacturing and engineering

Assessment criteria

The learner can:

- 1.1 Describe the safe working practices and procedures to be followed whilst preparing and tidying up a work area
- 1.2 Describe how to be suitably dressed for the activities to be undertaken
- 1.3 Explain the consequences of failing to report to work on time and returning from breaks on time
- 1.4 Describe the types of attitudes and behaviours that are likely to create conflict or negative responses
- 1.5 Describe the benefits of team working and
- 1.6 Describe the benefits of understanding team objectives
- 1.7 Describe the roles of individual team members and the strengths they bring to the team
- 1.8 Explain the importance of clear communication
- 1.9 Explain the need to change communication styles to meet the needs of the target audience
- 1.10 Explain the importance of maintaining quality whilst adhering to timescales set for work
- 1.11 Explain the importance of seeking additional support and guidance when required

- 1.12 Explain the importance of being open and honest and admitting to any errors and/or mistakes
- 1.13 Explain the need to be flexible in the approach to work,
- 1.14 Explain the need to respond positively to changes or amendments required by the business
- 1.15 Explain the importance of taking an active and positive part in the implementation of any amendments or changes to work requirements
- 1.16 Describe the organisation's policies relating to ethical working and behaviours
- 1.17 Explain the responsibility of individual's to work in an ethical manner
- 1.18 Explain the importance of diversity, inclusion and respect for others
- 1.19 Explain the Personal Protective Equipment (PPE) to be worn for the manufacturing/engineering activities undertaken
- 1.20 Describe the correct use of any equipment used to protect the health and safety of individuals and their colleagues
- 1.21 Describe how to plan and prepare to carry out manufacturing/engineering activities
- 1.22 Describe the procedure for ensuring that all documentation relating to the work being carried out is available, prior to starting the activity
- 1.23 Describe the procedure for ensuring that all tools and equipment are available prior to undertaking the activity
- 1.24 Describe the checks to be carried out to ensure that tools and equipment are in full working order, prior to undertaking the activity
- 1.25 Describe the checks to be carried out to ensure that all materials required are correct and complete, prior to undertaking the activity
- 1.26 Explain how to deal effectively with problems that could arise
- 1.27 Describe the procedure used for making suggestions for improving the business
- 1.28 Explain the importance of taking responsibility for identifying and making suggestions for making business improvements
- 1.29 Describe the role of the individual in developing their own skills and knowledge
- 1.30 Explain the benefits of continuous personal development
- 1.31 Describe the training opportunities that are available in the workplace
- 1.32 Explain the importance of reviewing personal training and development
- 1.33 Describe personal responsibilities for providing evidence of your performance and progress
- 1.34 Explain the importance of maintaining effective working relationships within the workplace
- 1.35 Explain the importance of informing others of activities which may have impact on their work
- 1.36 Describe the difficulties that can occur in working relationships
- 1.37 Explain how to deal with disagreements with others in ways which will help to resolve difficulties and maintain long term relationships
- 1.38 Describe the organisational procedures to deal with and report any problems that can affect working relationships
- 1.39 Describe the current legislation covering discrimination in the workplace

- 1.40 Explain the need to dispose of waste materials and consumables in a safe and environmentally friendly way
- 1.41 Describe where tools and equipment should be stored and located
- 1.42 Explain the importance of returning all tools and documentation to their designated area on completion of work activities
- 1.43 Describe when to act on their own initiative and when to seek help and advice from others
- 1.44 Explain the importance of leaving the work area in a safe condition on completion of your activities.

Range

- (AC1.8)
 - Oral
 - Written
 - Appropriate language
 - Appropriate format.

- (AC1.26)
 - Quality
 - Safety
 - People.

- (AC1.32)
 - With trainers and/or supervisors
 - Comparing skills
 - Setting objectives to overcome any shortfall or address any development needs.

- (AC1.39)
 - Race
 - Religion
 - Gender
 - Sexual orientation
 - Age
 - Disability.

Learning outcome

The learner will:

- 2 Be able to work efficiently and effectively in advanced manufacturing and engineering

Assessment criteria

The learner can:

- 2.1 Adhere to safety procedures in place
- 2.2 Wear the appropriate personal protective equipment for the work area and specific activity being carried out
- 2.3 Use all tools and equipment safely and correctly, and only for their intended purpose
- 2.4 Ensure that the work area is maintained and left in a safe and tidy condition
- 2.5 Apply required occupational behaviours
- 2.6 Ensure the work area is free from hazards and is suitably prepared for the activities to be undertaken
- 2.7 Implement required safety procedures
- 2.8 Obtain required personal protection equipment is obtained
- 2.9 Obtain necessary drawings, specifications and associated documents

- 2.10 Ensure job instructions are obtained and understood
 - 2.11 Obtain required tools, equipment, materials and components
 - 2.12 Checked that personal protective equipment, tools, equipment, materials and components are in a safe and useable condition
 - 2.13 Obtain appropriate authorisation to carry out work activities
 - 2.14 Return tools, equipment, drawings and work instructions to the designated location
 - 2.15 Dispose of waste materials, in line with organisational and environmental requirements
 - 2.16 Complete necessary documentation accurately and legibly
 - 2.17 Identifying, where appropriate, any damaged or unusable tools or equipment
 - 2.18 Deal with problems affecting the manufacturing/engineering activity
 - 2.19 Identify possible opportunities for improving working practices and/or processes
 - 2.20 Contribute to developing personal Continuous Development Plan (CPD)
-

Range

- (AC2.1)
 - For risk assessment
 - COSHH
 - Personal protective equipment (PPE)
 - Other relevant safety regulations.

 - (AC2.5)
 - Personal responsibility and resilience (be disciplined and have a responsible approach to risk, work diligently regardless of how much they are being supervised, accept responsibility for managing time and workload, stay motivated and omitted when facing challenges)
 - Working effectively in team (make an effort to integrate with the team, support other people, consider implications of their own actions on other people and activities, work effectively to get the task completed)
 - Effective communication and interpersonal skills (open and honest communicator, communicate clearly and using appropriate methods, listen well to others, have a positive and respectful attitude)
 - Focus on quality and problem solving (follow instructions and guidance, demonstrate attention to detail, follow a logical approach to problem solving, seek opportunities to improve quality, speed and efficiency)
 - Continuous development (reflect on skills, knowledge and behaviour, seek opportunities to develop, adapt to different situations, environments or technologies, have a positive attitude to feedback and advice).

 - (AC2.18) Related to four of the following:
 - Materials
 - Job specification
 - Timescales
 - Tools and equipment
 - Quality
-

- Safety
- Drawings
- People
- Work activities or procedures
- Other specified problems.

(AC2.19) That impact on one of the following:

- Standard operating procedures
- Quality
- Cost
- Time such as lead or processing time
- Waste
- Energy utilisation
- Equipment performance or condition
- Resource
- Engineering designs

And one of the following:

- Health and safety
- Customer service
- Training and development
- Regulatory compliance
- Supplier relationships
- Communication (internal and/or external)
- Team working
- Other improvement specified by an employer.

- (AC2.20)
- Describe the levels of skill, knowledge and understanding needed for competence in the areas of work expected of them
 - Describe their development objectives/program, and how these were identified
 - Provide information on their expectations and progress towards their identified objectives
 - Use feedback and advice to improve their personal development and performance objectives.

Unit level:	Level 3
GLH:	210
Unit aim:	The purpose of this unit is for learners to develop understanding and skills needed to be competent in preparing and setting up manual centre lathes, in accordance with approved procedures.
Relationship to NOS:	EUCL3D-147

Learning outcome

The learner will:

- 1 Understand how to set centre lathes

Assessment criteria

The learner can:

- 1.1 Describe the specific safety precautions to be taken when setting up lathes
- 1.2 Explain how to minimise risks associated with setting lathes
- 1.3 Describe how to stop the machine
- 1.4 Describe the procedure for restarting the lathe after an emergency
- 1.5 Explain the importance of ensuring the machine is isolated from the power supply before mounting turning tools and workholding devices
- 1.6 Explain the importance of wearing the appropriate protective clothing (PPE) and equipment when setting up lathes
- 1.7 Explain the importance of keeping the work area clean and tidy when setting up lathes
- 1.8 Describe the basic principles of operation of the centre lathe and its accessories
- 1.9 Describe the typical operations that can be performed with a centre lathe and its accessories
- 1.10 Describe how to handle and store turning tools safely and correctly
- 1.11 Describe how to extract and use information from engineering drawings and related specifications in relation to setting up a lathe
- 1.12 Describe how to interpret drawings for setting up a lathe
- 1.13 Define terminology used in turning in relation to the activities undertaken
- 1.14 Describe the range of workholding methods and devices that are used on centre lathes
- 1.15 Describe how to mount and set the workpiece in/on the workholding devices

- 1.16 Describe the different types of turning tools that are used
 - 1.17 Explain factors which determine speeds and feeds to be used
 - 1.18 Explain precautions to be taken when handling and using different types of cutting fluid
 - 1.19 Describe how to set up the centre lathe and its accessories for the particular operations being performed
 - 1.20 Explain the need to conduct trial runs and check that the machine is set up and producing the components correctly
 - 1.21 Explain how to resolve problems that can occur with setting up the workholding devices, tooling and machine operating parameters
 - 1.22 Describe the extent of their own authority when setting up lathes and to whom they should report if they have problems that they cannot resolve.
-

Range

- (AC1.1)
 - Workholding devices and accessories
 - Workpiece
 - Turning tools.

- (AC1.3)
 - Normal situations
 - Emergency situations.

- (AC1.12)
 - First and third angle drawings
 - Imperial and metric systems of measurement
 - Workpiece reference points
 - System of tolerancing.

- (AC1.15)
 - Methods for mounting the workpiece
 - Methods for setting the workpiece
 - Tools that can be used
 - Equipment that can be used.

- (AC1.16)
 - How they are selected
 - How they are prepared
 - How they are mounted to the machine tool holding devices.

- (AC1.17)
 - Material
 - Type of tooling
 - Depth of cut
 - Workpiece rigidity
 - Machine condition
 - Tolerance
 - Finish required.

Learning outcome

The learner will:

- 2 Be able to set centre lathes

Assessment criteria

The learner can:

- 2.1 Obtain and use the appropriate documentation for setting up centre lathes
- 2.2 Adhere to safety procedures in place for setting up centre lathes
- 2.3 Follow safe practice/approved setting-up procedures
- 2.4 Ensure that correctly adjusted machine guards are in place
- 2.5 Check that cutting tools are in a suitable condition
- 2.6 Hold components securely without distortion
- 2.7 Select, mount and secure the workpiece using workholding devices
- 2.8 Use turning tools
- 2.9 Select and mount different types of lathe tools
- 2.10 Use taper turning or profiling methods
- 2.11 Set the machine parameters in accordance with instructions/specifications
- 2.12 Set up the machine to produce internal and external profiles from types of material
- 2.13 Set the machine to produce components to quality and accuracy standards, as applicable to the operations performed
- 2.14 Leave the work area and machine in a safe and appropriate condition on completion of the activities.

Range

- (AC2.2)
- For risk assessment
 - For COSHH
 - For personal protective equipment
 - For other relevant safety regulations and procedures to realise a safe system of work.
- (AC2.7) Use four of the following:
- 3 jaw chuck with hard jaws
 - Drive plate and centres
 - Magnetic or pneumatic devices
 - Chucks with soft jaws
 - Fixtures
 - Fixed/travelling steadies
 - Collet chucks
 - Faceplates
 - Four jaw chucks.

- (AC2.8) Use two of the following groups:
- Solid high speed steel
 - Brazed tungsten carbide
 - Indexible tips (carbide, ceramic or diamond).
- (AC2.9) Use eight of the following:
- Turning
 - Knurling
 - Recessing
 - Twist/core drills
 - Thread chaser
 - Facing
 - Parting off
 - Chamfering
 - Reamers
 - Single point threading
 - Boring
 - Forming
 - Centre drills
 - Taps
 - Other specific tools types.
- (AC2.10) Use two of the following:
- Taper turning attachment
 - Profiling attachment
 - Offset tailstock
 - Compound slide
 - Form tools.
- (AC2.11)
- Position of workpiece
 - Linear feed rate
 - Position of turning tools in relationship to workpiece
 - Depth of cut for roughing and finishing
 - Mechanisms (threading, profiles, taper)
 - Cutting fluid flow rate
 - Workpiece revolutions per minute
 - Machine guards and safety mechanisms.

(AC2.12) To include ten of the following:

- Flat faces
- Drilled holes
- Internal threads
- Chamfers
- Parallel diameters
- Bored holes
- External threads
- Knurls or special finishes
- Stepped diameters
- Reamed holes
- Eccentric features
- Grooves
- Tapered diameters
- Profile forms
- Parting off
- Undercuts.

(AC2.12) To include one of the following:

- Ferrous
- Non-metallic
- Non-ferrous.

(AC2.13) • Components to be free from false tool cuts, burrs and sharp edges

- General dimensional tolerance $\pm 0.15\text{mm}$ or $\pm 0.006''$
- There must be one or more specific dimensional tolerances within $\pm 0.05\text{mm}$ or $\pm 0.002''$
- Surface finish $32\ \mu\text{in}$; $0.8\ \mu\text{m}$
- Reamed / bored holes within H8
- Screw threads BS medium fit
- Angles within ± 0.5 degree.

Unit level:	Level 3
GLH:	161
Unit aim:	The purpose of this unit is for learners to develop understanding and skills needed to be competent in machining using manual centre lathes, in accordance with approved procedures.
Relationship to NOS:	EUCL3D-148

Learning outcome

The learner will:

- 1 Understand how to machine components using centre lathes

Assessment criteria

The learner can:

- 1.1 Describe the safe working practices and procedures to be followed while operating centre lathes
- 1.2 Describe the procedure for checking that machine safety mechanisms function correctly
- 1.3 Describe the operation of the machine controls
- 1.4 Describe how to stop the machine
- 1.5 Describe the procedure for restarting the lathe after an emergency
- 1.6 Describe the Personal Protective Equipment (PPE) to be worn when using centre lathes
- 1.7 Describe where required PPE can be obtained
- 1.8 Explain how to minimise risks associated with turning operations on centre lathes
- 1.9 Explain the importance of keeping the work area clean and tidy when machining on centre lathes
- 1.10 Describe how to extract and use information from engineering drawings and related specifications in relation to machining work to be undertaken on a centre lathe
- 1.11 Describe how to interpret drawings for machining on a centre lathe
- 1.12 Describe the main features of the centre lathes and the accessories that can be used
- 1.13 Describe the types of tooling that can be used for different turning operations
- 1.14 Describe the methods that can be used to position the tooling in relationship to the workpiece
- 1.15 Explain how to overcome the effects of backlash in machine slides and screws

- 1.16 Describe how to handle and store turning tools safely and correctly
 - 1.17 Explain the effect of roughing and finishing cuts on tool life, surface finish and dimensional accuracy
 - 1.18 Explain the application of cutting fluids to different types of materials
 - 1.19 Explain the effects of clamping the workpiece in a chuck/work holding device
 - 1.20 Describe how to recognise machining faults
 - 1.21 Describe how to recognise when tools need re-sharpening
 - 1.22 Describe the quality control procedures and related equipment used
 - 1.23 Explain how to resolve problems that can occur with turning operations when using a centre lathe
 - 1.24 Describe the extent of their own authority when machining with centre lathes and to whom they should report if they have problems that they cannot resolve.
-

Range

- (AC1.3)
 - In hand mode
 - In power mode.
 - (AC1.4)
 - Normal situations
 - Emergency situations.
 - (AC1.11)
 - First and third angle drawings
 - Imperial and metric systems of measurement
 - Workpiece reference points
 - System of tolerancing.
-

Learning outcome

The learner will:

- 2 Be able to machine components using centre lathes

Assessment criteria

The learner can:

- 2.1 Obtain and use the appropriate documentation for machining with centre lathes
 - 2.2 Adhere to safety procedures for machining with centre lathes
 - 2.3 Ensure that correctly adjusted machine guards are in place
 - 2.4 Hold components securely without distortion
 - 2.5 Maintain cutting tools in a suitable condition
 - 2.6 Adjust machine settings, as required, to maintain the required accuracy
-

- 2.7 Produce machined components which combine different operations from different types of material
- 2.8 Carry out checks for accuracy
- 2.9 Produce components that meet quality and accuracy standards applicable to the operations performed
- 2.10 Leave the work area and machine in a safe and appropriate condition on completion of the activities.

Range

- (AC2.2)
- For risk assessment
 - For COSHH
 - For personal protective equipment
 - For other relevant safety regulations and procedures to realise a safe system of work.
- (AC2.7) To include ten of the following:
- Flat faces
 - Drilled holes
 - Internal threads
 - Chamfers
 - Parallel diameters
 - Bored holes
 - External threads
 - Knurls or special finishes
 - Stepped diameters
 - Reamed holes
 - Eccentric features
 - Grooves
 - Tapered diameters
 - Profile forms
 - Parting off
 - Undercuts.
- (AC2.8) To include five of the following:
- Diameters
 - Thread profile and fit
 - Hole size/fit
 - Lengths
 - Surface finish
 - Depths
 - Angle
 - Concentricity
 - Taper
 - Grooves/undercuts.
- (AC2.9)
- Components to be free from false tool cuts, burrs and sharp edges
 - General dimensional tolerance $\pm 0.15\text{mm}$ or $\pm 0.006''$
 - There must be one or more specific dimensional tolerances within $\pm 0.05\text{mm}$ or $\pm 0.002''$
 - Surface finish $32\ \mu\text{in}$; $0.8\ \mu\text{m}$
 - Reamed / bored holes within H8
 - Screw threads BS medium fit

- Angles within +/- 0.5 degree.

Unit level:	Level 3
GLH:	210
Unit aim:	The purpose of this unit is for learners to develop understanding and skills needed to be competent in preparing and setting up manual milling machines, in accordance with approved procedures.
Relationship to NOS:	EUCL3D-149

Learning outcome

The learner will:

- 1 Understand how to set milling machines

Assessment criteria

The learner can:

- 1.1 Describe the specific safety precautions to be taken when setting up milling machines
- 1.2 Explain how to minimise risks associated with setting milling machines
- 1.3 Describe how to stop the machine in an emergency
- 1.4 Describe the operation of the machine controls
- 1.5 Explain the importance of ensuring the machine is isolated from the power supply before mounting milling cutters and workholding devices
- 1.6 Describe the basic principles of operation of different types of milling machines
- 1.7 Describe the typical operations that can be performed with different types of milling machines
- 1.8 Describe how to handle and store milling cutters safely and correctly
- 1.9 Describe how to extract and use information from engineering drawings and related specifications in relation to setting up a milling machine for the work to be undertaken
- 1.10 Describe how to interpret drawings for setting up a milling machine
- 1.11 Define terminology used in milling in relation to the activities undertaken
- 1.12 Describe the range of workholding methods and devices that are used on milling machines
- 1.13 Describe how to mount and set the workpiece in/on the workholding devices
- 1.14 Describe the different types of milling cutters that are used
- 1.15 Explain factors which determine speeds and feeds to be used
- 1.16 Explain precautions to be taken when handling and using different types of cutting fluid
- 1.17 Describe how to set up milling machines for the particular operations being performed

- 1.18 Explain the need to conduct trial runs and check that the machine is set up and running safely
- 1.19 Explain how to resolve problems that can occur with setting up the milling cutters workholding devices and machine operating parameters
- 1.20 Describe the extent of their own authority when setting up lathes and to whom they should report if they have problems that they cannot resolve.
-

Range

- (AC1.1) • Workholding devices and accessories
• Cutters.
- (AC1.4) • In hand mode
• In power mode.
- (AC1.10) • First and third angle drawings
• Imperial and metric systems of measurement
• Workpiece reference points
• System of tolerancing.
- (AC1.15) • Material
• Type of tooling
• Depth of cut
• Workpiece rigidity
• Machine condition
• Tolerance
• Finish required.
-

Learning outcome

The learner will:

- 2 Be able to set milling machines

Assessment criteria

The learner can:

- 2.1 Obtain and use the appropriate documentation for setting up milling machines
- 2.2 Adhere to safety procedures in place for setting up milling machines
- 2.3 Follow safe practice/approved setting-up procedures
- 2.4 Ensure that correctly adjusted machine guards are in place
- 2.5 Check that cutting tools are in a suitable condition
- 2.6 Hold components securely without distortion
-

- 2.7 Prepare milling machines for operation
 - 2.8 Position, align and secure the workpiece
 - 2.9 Select and mount different types of milling cutter
 - 2.10 Set up the machine in accordance with instructions/specifications
 - 2.11 Set up the machine to produce internal and external profiles from types of material
 - 2.12 Set the machine to produce components to quality and accuracy standards, as applicable to the operations performed
 - 2.13 Leave the work area and machine in a safe and appropriate condition on completion of the activities.
-

Range

- (AC2.2)
 - For risk assessment
 - For COSHH
 - For personal protective equipment
 - For other relevant safety regulations and procedures to realise a safe system of work.

- (AC2.7) Prepare one of the following:
 - Horizontal milling machine
 - Vertical milling machine
 - Universal milling machine
 - Planer/gantry milling machine
 - Boring machine with milling attachments.

- (AC2.8) Use three of the following:
 - Clamping direct to machine table
 - Angle plate
 - Chucks
 - Magnetic or pneumatic devices
 - Vee block and clamps
 - Indexing head/device
 - Machine vice
 - Fixtures
 - Rotary table.

- (AC2.9) To include six of the following:
 - Face mills
 - Slotting cutters
 - Twist drills
 - Slot drills
 - Slab mills/cylindrical cutters
 - Slitting saws

- Boring tools
- Straddle milling
- Side and face cutters
- Profile cutters
- End mills
- Gang milling.

- (AC2.10) • Alignment of workholding device
- Milling cutter revs per minute
 - Position of cutters in relationship to workpiece
 - Machine guards and safety mechanisms
 - Linear/table feed rate
 - Cutting fluid flow rate
 - Depth of cut for roughing and finishing.

(AC2.11) To include eight of the following:

- Flat faces
- Open ended slots
- Bored holes
- Square faces
- Enclosed slots
- Profile forms
- Parallel faces
- Recesses
- Serrations
- Angular faces
- Tees slots
- Indexed or rotated forms
- Steps/shoulders
- Drilled holes
- Special forms.

(AC2.11) To include one of the following:

- Ferrous
- Non-metallic
- Non-ferrous.

- (AC2.12) • Components to be free from false tool cuts, burrs and sharp edges
- General dimensional tolerance $\pm 0.15\text{mm}$ or $\pm 0.006''$
 - There must be one or more specific dimensional tolerances within $\pm 0.05\text{mm}$ or $\pm 0.002''$
 - Surface finish $32\ \mu\text{in}$; $0.8\ \mu\text{m}$
 - Reamed / bored holes within H8
 - Angles within ± 0.5 degree.

Unit level:	Level 3
GLH:	161
Unit aim:	The purpose of this unit is for learners to develop understanding and skills needed to be competent in machining using manual milling machines, in accordance with approved procedures.
Relationship to NOS:	EUCL3D-150

Learning outcome

The learner will:

- 1 Understand how to machine components using milling machines

Assessment criteria

The learner can:

- 1.1 Describe the safe working practices and procedures to be followed while operating milling machines
- 1.2 Describe the procedure for checking that machine safety mechanisms function correctly
- 1.3 Describe the operation of the machine controls
- 1.4 Describe how to stop the machine in an emergency
- 1.5 Describe the Personal Protective Equipment (PPE) to be worn when using milling machines
- 1.6 Describe where required PPE can be obtained
- 1.7 Explain how to minimise risks associated with machining operations on milling machines
- 1.8 Explain the importance of keeping the work area clean and tidy when machining on milling machines
- 1.9 Describe how to extract and use information from engineering drawings and related specifications in relation to machining work to be undertaken on a milling machine
- 1.10 Describe how to interpret drawings for machining on a milling machine
- 1.11 Describe the application of different types of milling machines
- 1.12 Describe the milling techniques that can be used to produce required shapes
- 1.13 Describe the types of milling cutters that can be used to produce required shapes
- 1.14 Describe conventional and climb milling techniques and when each should be used

- 1.15 Describe the methods that can be used to position the workpiece in relationship to the milling cutters
 - 1.16 Explain how to overcome the effects of backlash in machine slides and screws
 - 1.17 Describe how to handle and store cutting tools safely and correctly
 - 1.18 Explain the effect of roughing and finishing cuts on tool life, surface finish and dimensional accuracy
 - 1.19 Explain the application of cutting fluids to different types of materials
 - 1.20 Explain the effects of clamping the workpiece
 - 1.21 Explain how the negative effects of removing material from a workpiece can be overcome
 - 1.22 Describe how to recognise machining faults
 - 1.23 Describe how to recognise when cutters need re-sharpening
 - 1.24 Describe the quality control procedures and related equipment used
 - 1.25 Explain how to resolve problems that can occur with machining operations when using a milling machine
 - 1.26 Describe the extent of their own authority when machining with milling machines and to whom they should report if they have problems that they cannot resolve.
-

Range

- (AC1.3)
- In hand mode
 - In power mode.
- (AC1.10)
- First and third angle drawings
 - Imperial and metric systems of measurement
 - Workpiece reference points
 - System of tolerancing.
- (AC1.11)
- Horizontal
 - Vertical
 - Universal
 - Planer
 - Boring machine with milling attachments.
-

Learning outcome

The learner will:

- 2 Be able to machine components using milling machines

Assessment criteria

The learner can:

- 2.1 Obtain and use the appropriate documentation for machining with milling machines
-

- 2.2 Adhere to safety procedures for machining with milling machines
 - 2.3 Ensure that correctly adjusted machine guards are in place
 - 2.4 Hold components securely without distortion
 - 2.5 Maintain cutting tools in a suitable condition
 - 2.6 Adjust machine settings, as required, to maintain the required accuracy
 - 2.7 Produce machined components which combine different operations from different types of material
 - 2.8 Carry out checks for accuracy
 - 2.9 Produce components that meet quality and accuracy standards applicable to the operations performed
 - 2.10 Leave the work area and machine in a safe and appropriate condition on completion of the activities.
-

Range

- (AC2.2)
- For risk assessment
 - For COSHH
 - For personal protective equipment
 - For other relevant safety regulations and procedures to realise a safe system of work.

(AC2.7) To include eight of the following:

- Flat faces
- Open ended slots
- Profile forms
- Square faces
- Enclosed slots/recesses
- Serrations
- Parallel faces
- Tees slots
- Indexed or rotated forms
- Angular faces
- Drilled holes
- Special forms
- Steps/shoulders
- Bored holes.

(AC2.7) To include one of the following:

- Ferrous
- Non-metallic
- Non-ferrous.

(AC2.8) To include five of the following:

- Dimensions
- Hole size/fit
- Angles
- Slots
- Squareness
- Surface finish
- Flatness
- Recesses.

- (AC2.9)
- Components to be free from false tool cuts, burrs and sharp edges
 - General dimensional tolerance $\pm 0.15\text{mm}$ or $\pm 0.006''$
 - There must be one or more specific dimensional tolerances within $\pm 0.05\text{mm}$ or $\pm 0.002''$
 - Flatness and squareness within $0.001''$ per inch or 0.025mm per 25mm
 - Surface finish $63\ \mu\text{in}$; $1.6\ \mu\text{m}$
 - Bored holes within H8
 - Angles within ± 0.5 degree.

Unit level:	Level 3
GLH:	210
Unit aim:	The purpose of this unit is for learners to develop understanding and skills needed to be competent in preparing and setting up manual electro-discharge machines, in accordance with approved procedures.
Relationship to NOS:	EUCL3D-151

Learning outcome

The learner will:

- 1 Understand how to set electro-discharge machines

Assessment criteria

The learner can:

- 1.1 Describe the specific safety precautions to be taken when setting up electro-discharge machines
- 1.2 Explain how to minimise risks associated with setting electro-discharge machines
- 1.3 Describe how to stop the machine in different situations
- 1.4 Explain the importance of ensuring the machine is isolated from the power supply before mounting electrodes, wires and workholding devices
- 1.5 Explain the importance of wearing appropriate protective clothing when setting electro-discharge machines
- 1.6 Explain the importance of keeping the work area clean and tidy when setting electro-discharge machines
- 1.7 Describe the basic principles of operation of different types of electro-discharge machines
- 1.8 Describe the typical operations that can be performed with different types of electro-discharge machines
- 1.9 Describe how to handle and store electrodes and wires safely and correctly
- 1.10 Describe how to extract and use information from engineering drawings and related specifications in relation to setting up an electro-discharge machine for the work to be undertaken
- 1.11 Describe how to interpret drawings for setting up an electro-discharge machine

- 1.12 Define terminology used in electro-discharge machining in relation to the activities undertaken
 - 1.13 Describe the range of eroded features that are produced on electro-discharge machines
 - 1.14 Describe the range of workholding methods and devices that are used on electro-discharge machines
 - 1.15 Describe the methods used to how to mount and set the workpiece in/on the workholding devices
 - 1.16 Describe how the different types of electrodes and wires used in electro-discharge machining are selected prepare and mounted to the machine tool holding devices
 - 1.17 Explain factors which determine operating parameters
 - 1.18 Explain precautions to be taken when handling and using different types of dielectrics
 - 1.19 Describe how to set up electro-discharge machines for the particular operations being performed
 - 1.20 Explain the need to conduct trial runs and check that the machine is set up and running safely
 - 1.21 Explain how to resolve problems that can occur with setting up for electro-discharge machining
 - 1.22 Describe the extent of their own authority when setting up lathes and to whom they should report if they have problems that they cannot resolve.
-

Range

- (AC1.1)
 - Workholding devices
 - Electrodes or wires.

 - (AC1.3)
 - Normal
 - Emergency.

 - (AC1.11)
 - First and third angle drawings
 - Imperial and metric systems of measurement
 - Workpiece reference points
 - System of tolerancing.

 - (AC1.17)
 - Material
 - Current density
 - Spark frequency
 - Wire speeds and feeds
 - Linear feeds and speeds.

 - (AC1.21)
 - Electrodes
 - Wires
 - Workholding devices
 - Machine operating parameters.
-

Learning outcome

The learner will:

- 2 Be able to set electro-discharge machines

Assessment criteria

The learner can:

- 2.1 Obtain and use the appropriate documentation for setting up electro-discharge machines
- 2.2 Adhere to safety procedures in place for setting up electro-discharge machines
- 2.3 Follow safe practice/approved setting-up procedures
- 2.4 Ensure that correctly adjusted machine guards are in place
- 2.5 Check that cutting tools are in a suitable condition
- 2.6 Hold components securely without distortion
- 2.7 Prepare electro-discharge machines for operation
- 2.8 Position, align and secure the workpiece to the machine table
- 2.9 Select and mount electrodes for roughing and finishing
- 2.10 Set up the machine in accordance with instructions/specifications
- 2.11 Set up the machine to produce internal and external profiles from types of material
- 2.12 Set the machine to produce components to quality and accuracy standards, as applicable to the operations performed
- 2.13 Leave the work area and machine in a safe and appropriate condition on completion of the activities.

Range

- (AC2.2)
- For risk assessment
 - For COSHH
 - For personal protective equipment
 - For other relevant safety regulations and procedures to realise a safe system of work.
- (AC2.7) Prepare one of the following:
- Spark erosion machine
 - Wire erosion machine.
- (AC2.8)
- Clamping direct to machine table
 - Angle plate
 - Chucks
 - Magnetic or pneumatic devices
 - Vee block and clamps
 - Ancillary indexing device

- Machine vice
- Fixtures.

(AC2.9) To include one of the following:

- Plain
- Hollow
- Profile
- Wire.

(AC2.10) • Electrical conditions
• Alignment of electrodes
• Wire tension
• Linear feeds and speeds
• Correct threading of wire through wire guides and feed mechanisms
• Wire speeds
• Dielectric flow rates
• Filtration equipment
• Ventilation and fume extraction
• Safety mechanisms/devices.

(AC2.11) To include six of the following:

- Flat faces
- Convex forms
- Radii/arcs
- Square/rectangular forms
- Square faces
- Profile forms
- Slots
- Angular faces
- Parallel faces
- Holes
- Threads
- Concave forms
- Cavities
- Engraving
- Other special activities.

(AC2.11) To include one of the following:

- Ferrous
- Non-ferrous.

(AC2.12) • Components to be free from false starts and sharp edges
• Dimensional tolerance equivalent to BS EN ISO 286:2010 or BS 1916-1:2009 Grade 9
• Surface texture 32 μin ; 0.8 μm ; 18VDI
• Angles within +/- 0.5 degree.

Unit 309

Machining components using electro-discharge machines

Unit level:	Level 3
GLH:	161
Unit aim:	The purpose of this unit is for learners to develop understanding and skills needed to be competent in machining using manual electro-discharge machines, in accordance with approved procedures.
Relationship to NOS:	EUC3LD-152

Learning outcome

The learner will:

- 1 Understand how to machine components using electro-discharge machines

Assessment criteria

The learner can:

- 1.1 Describe the safe working practices and procedures to be followed while operating electro-discharge machines
- 1.2 Describe the procedure for checking that machine safety mechanisms function correctly
- 1.3 Describe the operation of the machine controls
- 1.4 Describe how to stop the machine in an emergency
- 1.5 Describe the Personal Protective Equipment (PPE) to be worn when using electro-discharge machines
- 1.6 Describe where required PPE can be obtained
- 1.7 Explain how to minimise risks associated with machining operations on electro-discharge machines
- 1.8 Explain the importance of keeping the work area clean and tidy when machining on electro-discharge machines
- 1.9 Describe how to extract and use information from engineering drawings and related specifications in relation to machining work to be undertaken on an electro-discharge machine
- 1.10 Describe how to interpret drawings for machining on an electro-discharge machine

- 1.11 Describe the erosion techniques and electrodes/wires that can be used to produce required forms
 - 1.12 Describe how to dress and reshape electrodes
 - 1.13 Describe the methods that can be used to position the workpiece in relationship to the electrodes/wires
 - 1.14 Explain the importance of checking the position and alignment of the workpiece before commencing erosion operations
 - 1.15 Describe tools and equipment used to check the position and alignment of the workpiece
 - 1.16 Describe how to handle and store electrodes and wires safely and correctly
 - 1.17 Explain the effect of roughing and finishing cuts on tools life, surface finish and dimensional accuracy
 - 1.18 Explain the use of dielectrics and the types of fluid used
 - 1.19 Explain the potential effects of clamping on the workpiece
 - 1.20 Describe how to recognise erosion faults
 - 1.21 Describe how to recognise when electrodes need changing
 - 1.22 Describe the quality control procedures and related equipment used
 - 1.23 Explain how to resolve problems that can occur with machining operations when using an electro-discharge machine
 - 1.24 Describe the extent of their own authority when machining with electro-discharge machines and to whom they should report if they have problems that they cannot resolve.
-

Range

- (AC1.3)
 - In hand mode
 - In power mode.
 - (AC1.10)
 - First and third angle drawings
 - Imperial and metric systems of measurement
 - Workpiece reference points
 - System of tolerancing.
-

Learning outcome

The learner will:

- 2 Be able to machine components using electro-discharge machines

Assessment criteria

The learner can:

- 2.1 Obtain and use the appropriate documentation for machining with electro-discharge machines
-

- 2.2 Adhere to safety procedures for machining with electro-discharge machines
 - 2.3 Ensure that correctly adjusted machine guards are in place
 - 2.4 Hold components securely without distortion
 - 2.5 Maintain cutting tools in a suitable condition
 - 2.6 Adjust machine settings, as required, to maintain the required accuracy
 - 2.7 Rough and finish components which combine different operations from types of material
 - 2.8 Carry out checks for accuracy
 - 2.9 Produce components that meet quality and accuracy standards applicable to the operations performed
 - 2.10 Leave the work area and machine in a safe and appropriate condition on completion of the activities.
-

Range

- (AC2.2)
- For risk assessment
 - For COSHH
 - For personal protective equipment
 - For other relevant safety regulations and procedures to realise a safe system of work.
- (AC2.7) To include six of the following:
- Flat faces
 - Concave forms
 - Profile forms
 - Square/rectangular forms
 - Square faces
 - Convex forms
 - Cavities
 - Angular faces
 - Parallel faces
 - Holes
 - Radii/arcs
 - Threads
 - Engraving
 - Other special activities.
- (AC2.7) To include one of the following:
- Ferrous
 - Non-ferrous.
- (AC2.8) To include five of the following:
- Dimensions
 - Parallelism
-

- Angle/taper
- Squareness
- Surface texture
- Profile.

- (AC2.9)
- Components to be free from false starts and sharp edges
 - Dimensional tolerance equivalent to BS EN ISO 286:2010 or BS 1916-1:2009 Grade 9
 - Surface texture 32 μin ; 0.8 μm ; 1.8VDI
 - Angles within +/- 0.5 degree.

Unit level:	Level 3
GLH:	210
Unit aim:	The purpose of this unit is for learners to develop understanding and skills needed to be competent in preparing and setting up manual grinding machines, in accordance with approved procedures.
Relationship to NOS:	EUCL3D-153

Learning outcome

The learner will:

- 1 Understand how to set grinding machines

Assessment criteria

The learner can:

- 1.1 Describe the specific safety precautions to be taken when setting up grinding machines
- 1.2 Describe grinding machine operative duties under the abrasive wheel regulations
- 1.3 Explain how to minimise risks associated with setting grinding machines
- 1.4 Describe how to stop the machine in different situations
- 1.5 Explain the importance of ensuring the machine is isolated from the power supply before mounting grinding wheels and workholding devices
- 1.6 Explain the importance of wearing appropriate protective clothing when setting grinding machines
- 1.7 Explain the importance of keeping the work area clean and tidy when setting grinding machines
- 1.8 Describe the basic principles of operation of different types of grinding machines
- 1.9 Describe the typical operations that can be performed with different types of grinding machines
- 1.10 Describe how to handle and store grinding wheels safely and correctly
- 1.11 Describe how to extract and use information from engineering drawings and related specifications in relation to setting up a grinding machine for the work to be undertaken
- 1.12 Describe how to interpret drawings for setting up a grinding machine

- 1.13 Define terminology used in grinding in relation to the activities undertaken
 - 1.14 Describe the range of workholding methods and devices that are used on grinding machines
 - 1.15 Describe how to mount and set the workpiece in/on the workholding devices
 - 1.16 Describe the different types of grinding wheels and operations that are used to produce required profiles
 - 1.17 Describe how to check that grinding wheels are in a safe and serviceable conditions
 - 1.18 Describe methods used to mount and secure grinding wheels to machine spindles
 - 1.19 Describe methods used to form the wheels to the required profile
 - 1.20 Explain the need for 'truing up' and dressing of wheels
 - 1.21 Describe how to set up grinding machines for the particular operations being performed
 - 1.22 Explain how types of material affect the speeds and feeds that can be used for grinding operations
 - 1.23 Explain the application of cutting fluids with regard to different types of material
 - 1.24 Explain the need to conduct trial runs and check that the machine is set up and running safely
 - 1.25 Explain how to resolve problems that can occur with setting up the grinding wheels workholding devices and machine operating parameters
 - 1.26 Describe the extent of their own authority when setting up lathes and to whom they should report if they have problems that they cannot resolve.
-

Range

- (AC1.1)
 - Workholding devices and accessories
 - Grinding wheels.
 - (AC1.4)
 - Normal
 - Emergency.
 - (AC1.12)
 - First and third angle drawings
 - Imperial and metric systems of measurement
 - Workpiece reference points
 - System of tolerancing.
-

Learning outcome

The learner will:

- 2 Be able to set grinding machines

Assessment criteria

The learner can:

- 2.1 Obtain and use the appropriate documentation for setting up grinding machines
- 2.2 Adhere to safety procedures in place for setting up grinding machines
- 2.3 Follow safe practice/approved setting-up procedures
- 2.4 Ensure that correctly adjusted machine guards are in place
- 2.5 Check that grinding wheels are in a safe and usable condition
- 2.6 Hold components securely without distortion
- 2.7 Prepare grinding machines for operation
- 2.8 Position and secure workpieces
- 2.9 Select grinding wheel for specific materials and applications
- 2.10 Mount grinding wheels
- 2.11 Test wheels for cracks
- 2.12 Balance wheels
- 2.13 Prepare grinding wheels
- 2.14 Set up the machine to grind different forms from types of material
- 2.15 Set the machine to produce components to quality and accuracy standards, as applicable to the operations performed
- 2.16 Leave the work area and machine in a safe and appropriate condition on completion of the activities.

Range

- (AC2.2)
- For risk assessment
 - For COSHH
 - For personal protective equipment
 - For other relevant safety regulations and procedures to realise a safe system of work.

(AC2.7) To include one of the following:

- Horizontal surface
- External cylindrical
- Universal
- Thread grinding
- Vertical surface
- Internal cylindrical
- Centreless
- Profile grinding
- Roll grinding
- Gear grinding
- Company specification.

(AC2.8) Use four of the following:

- Chucks
- Face plate
- Clamps
- Work rests
- Injector mechanisms
- Collets
- Machine vices
- Angle plates
- Control stops
- Magnetic blocks
- Centres
- Power chucks
- Vee blocks
- Fixtures
- Pots.

(AC2.13) To include two of the following:

- Dressing and 'truing up' grinding wheels
- Relieving the wheels sides
- Wheel forming
- Dressing and 'trueing up' control wheels.

(AC2.14) To include six of the following:

- Internal threads
- Vertical faces
- Tapered diameters
- Vee form threads
- External threads
- Parallel faces
- Counterbores
- Left hand threads
- Angular faces
- Faces square to each other
- Tapered bores
- Right hand threads
- Shoulders and faces
- Parallel bores
- Single start threads
- Slots
- Profile forms
- Multi-start threads
- Other specific thread forms.

(AC2.14) To include one of the following:

- Ferrous
- Non-metallic
- Non-ferrous.

(AC2.15) • Surface texture to 8 μin ; 0.2 μm
• Tolerance to BS EN ISO 286:2010 or BS 1916:2009 Grade 5
• Components to be free from false grinding cuts, burrs and sharp edges
• Company standard.

Unit level:	Level 3
GLH:	161
Unit aim:	The purpose of this unit is for learners to develop understanding and skills needed to be competent in machining using manual grinding machines, in accordance with approved procedures.
Relationship to NOS:	EUCL3D-154

Learning outcome

The learner will:

- 1 Understand how to machine components using grinding machines

Assessment criteria

The learner can:

- 1.1 Describe the safe working practices and procedures to be followed while operating grinding machines
- 1.2 Describe the duties of grinding machine operatives under the abrasive wheels regulations
- 1.3 Explain how to minimise risks associated with machining operations on grinding machines
- 1.4 Describe the procedure for checking that machine safety mechanisms function correctly
- 1.5 Describe the operation of the machine controls
- 1.6 Describe how to stop the machine in an emergency
- 1.7 Describe the Personal Protective Equipment (PPE) to be worn when using grinding machines
- 1.8 Describe where required PPE can be obtained
- 1.9 Explain the importance of keeping the work area clean and tidy when machining on grinding machines
- 1.10 Describe how to extract and use information from engineering drawings and related specifications in relation to machining work to be undertaken on a grinding machine
- 1.11 Describe how to interpret drawings for machining on a grinding machine
- 1.12 Describe how to dress and reshape grinding wheels
- 1.13 Describe the methods that can be used to position the workpiece in relationship to the grinding wheel

- 1.14 Explain the importance of checking the concentricity and/or position/alignment of the workpiece before grinding
 - 1.15 Explain how to overcome the effects of backlash in machine slides and screws
 - 1.16 Describe how to handle and store grinding wheels safely and correctly
 - 1.17 Explain factors which affect the selection of grinding wheel feeds and speeds and depth of cut
 - 1.18 Explain the effect of roughing and finishing cuts on tool life, surface finish and dimensional accuracy
 - 1.19 Explain the application of cutting fluids to different types of materials
 - 1.20 Explain the effects of clamping the workpiece
 - 1.21 Describe how to recognise grinding faults
 - 1.22 Describe how to recognise when grinding wheels need re-dressing/forming
 - 1.23 Describe the quality control procedures and related equipment used
 - 1.24 Explain how to resolve problems that can occur with machining operations when using a grinding machine
 - 1.25 Describe the extent of their own authority when machining with grinding machines and to whom they should report if they have problems that they cannot resolve.
-

Range

- (AC1.5)
- In hand mode
 - In power mode.
- (AC1.11)
- First and third angle drawings
 - Imperial and metric systems of measurement
 - Workpiece reference points
 - System of tolerancing.
-

Learning outcome

The learner will:

- 2 Be able to machine components using grinding machines

Assessment criteria

The learner can:

- 2.1 Obtain and use the appropriate documentation for machining with centre lathes
 - 2.2 Adhere to safety procedures for machining with centre lathes
 - 2.3 Ensure that correctly adjusted machine guards are in place
 - 2.4 Hold components securely without distortion
 - 2.5 Maintain cutting tools in a safe and usable condition
 - 2.6 Adjust machine settings, as required, to maintain the required accuracy
-

- 2.7 Finish ground components from different types of material
- 2.8 Carry out checks for accuracy
- 2.9 Produce components that meet quality and accuracy standards applicable to the operations performed
- 2.10 Leave the work area and machine in a safe and appropriate condition on completion of the activities.

Range

- (AC2.2)
- For risk assessment
 - For COSHH
 - For personal protective equipment
 - For other relevant safety regulations and procedures to realise a safe system of work.
- (AC2.7) To include six of the following:
- Flat faces
 - Parallel diameters
 - Internal threads
 - Vertical faces
 - Tapered diameters
 - Vee form threads
 - External threads
 - Parallel faces
 - Counterbores
 - Left hand threads
 - Angular faces
 - Faces square to each other
 - Tapered bores
 - Right hand threads
 - Shoulders and faces
 - Parallel bores
 - Single start threads
 - Slots
 - Profile forms
 - Multi-start threads
 - Other specific thread forms.
- (AC2.7) To include one of the following:
- Ferrous
 - Non-metallic
 - Non-ferrous.
- (AC2.8) To include five of the following:
- Dimensions
 - Thread form
 - Parallelism
 - Surface texture
 - Squareness
 - Angle/taper
 - Profile
 - Ovality/lobbing

- Concentricity.

(AC2.9)

- Surface texture to 8 μin ; 0.2 μm
- Tolerance to BS EN ISO 286:2010 or BS 1916:2009 Grade 5
- Components to be free from false grinding cuts, burrs and sharp edges
- Company standard.

Unit 312

Loading and proving CNC machine tool programs

Unit level:	Level 3
GLH:	91
Unit aim:	The purpose of this unit is for learners to develop understanding and skills needed to load and prove machine tool programs on Computer Numerical Control (CNC) machine tools, in accordance with approved procedures.
Relationship to NOS:	EUCL3D-155

Learning outcome

The learner will:

- 1 Understand how to load and prove CNC machine tool programs

Assessment criteria

The learner can:

- 1.1 Describe the specific safety precautions to be taken when loading and proving CNC machine tool operating programs
- 1.2 Describe how to start and stop the machine
- 1.3 Explain the importance of wearing the appropriate protective clothing (PPE) and equipment when loading and proving CNC machine tool operating programs
- 1.4 Explain the importance of keeping the work area clean and tidy when loading and proving CNC machine tool operating programs
- 1.5 Explain the importance of storing programs and storage devices safely and correctly in different formats
- 1.6 Describe the methods and procedures used to minimise the chances of infecting a computer with a virus
- 1.7 Explain the implications of a computer becoming infected with a virus
- 1.8 Define computing coding language used in CNC programs
- 1.9 Describe the function keys of the machine computer control system
- 1.10 Describe how to load, execute, edit and exit programs

- 1.11 Describe how to set machine datums for each machine axis being used
 - 1.12 Describe how to deal with faults on the program and computer controlled equipment
 - 1.13 Describe how to enter tooling data
 - 1.14 Describe how to identify tools in relationship to operating programs
 - 1.15 Describe how to conduct machine operation checks
 - 1.16 Explain the need to conduct full dry run and single block run
 - 1.17 Identify the items that need to be checked before allowing the machine to operate in full program mode
 - 1.18 Describe how to extract and use information from engineering drawings and related specifications in relation to loading and proving CNC machine tool operating programs
 - 1.19 Describe how to interpret drawings for loading and proving CNC machine tool programs
 - 1.20 Explain factors that affect feeds and speeds that can be used
 - 1.21 Explain the application of different cutting fluids with regard to a range of different materials
 - 1.22 Explain how to resolve problems that can occur with the loading and editing of the operating program
 - 1.23 Describe the extent of their own authority when setting loading and proving programs and to whom they should report if they have problems that they cannot resolve.
-

Range

- (AC1.2)
 - Normal situations
 - Emergency situations.

 - (AC1.13)
 - Tool datums
 - Positions
 - Lengths
 - Offsets
 - Radius compensation.

 - (AC1.15)
 - Trial runs
 - Single block run
 - Dry run
 - Feed and speed override controls.

 - (AC1.19)
 - First and third angle drawings
 - Imperial and metric systems of measurement
 - Workpiece reference points
 - System of tolerancing.

 - (AC1.20)
 - Type of material
 - Condition of material
 - Workholding method
-

- Tooling used
- Tolerance
- Finish required.

Learning outcome

The learner will:

- 2 Be able to load and prove CNC machine tool programs

Assessment criteria

The learner can:

- 2.1 Obtain and use the appropriate documentation for loading and proving CNC machine tool programs
- 2.2 Adhere to safety procedures in place for loading and proving CNC machine tool programs
- 2.3 Check the currency and validity of required operating program
- 2.4 Prepare the machine controller to accept the operating program
- 2.5 Load the program into the controller safely and correctly
- 2.6 Ensure program media are stored safely and correctly
- 2.7 Operate a CNC machine controller
- 2.8 Check machine and program operates safely and correctly
- 2.9 Leave the work area and machine in a safe and appropriate condition on completion of the activities.

Range

- (AC2.2)
- For risk assessment
 - For COSHH
 - For personal protective equipment
 - For other relevant safety regulations and procedures to realise a safe system of work.
- (AC2.7) Use six of the following:
- Single block run
 - Graphic display
 - Full dry run
 - Search facilities
 - Program save/store facilities
 - Edit facilities
 - Program override controls (speed, feed, tool data)
 - Data input facilities.
- (AC2.8)
- Datums for each machine axis are set in relation to all equipment and tooling used
 - Tools offsets are correctly entered into machine controller
 - Tool change positions are safe and clear of the workpiece and machine equipment
 - The correct tools are selected at the appropriate points in the program

- Tool cutter paths are executed safely and correctly
- All operations are carried out to the programme coordinates
- Any alternations to programs are communicated fully to the appropriate personnel.

Unit level:	Level 3
GLH:	231
Unit aim:	The purpose of this unit is for learners to develop understanding and skills needed to produce, load and prove machine tool programs on Computer Numerical Control (CNC) machine tools, in accordance with approved procedures.
Relationship to NOS:	EUCL3D-156

Learning outcome

The learner will:

- 1 Understand how to carry out CNC machine tool programming

Assessment criteria

The learner can:

- 1.1 Define computing coding language used in CNC programs
- 1.2 Describe how to extract and use information from engineering drawings and related specifications in relation to CNC machine tool programming
- 1.3 Describe how to interpret drawings for CNC machine tool programming
- 1.4 Describe systems of measurement used on CNC drawings
- 1.5 Explain the use of repetitive programs and canned cycles to reduce program size and input time
- 1.6 Describe how to prepare part programs, using operational sequences and machining techniques which avoid unnecessary tool/cutter movements or tool changes
- 1.7 Explain the implications of a computer becoming infected with a virus
- 1.8 Describe how to deal with faults on the program and computer controlled equipment
- 1.9 Describe the extent of their own authority when setting up lathes and to whom they should report if they have problems that they cannot resolve.

Range

(AC1.1) In relation to:

- Machine axes
- Positional information
- Machine management
- Auxiliary functions.

(AC1.3) • First and third angle drawings
• Imperial and metric systems of measurement
• Workpiece zero/reference points
• System of tolerancing.

(AC1.4) • Absolute
• Incremental.

Learning outcome

The learner will:

2 Be able to carry out CNC machine tool programming

Assessment criteria

The learner can:

- 2.1 Obtain and use the appropriate documentation for carrying out CNC machine tool programming
- 2.2 Adhere to safety procedures in place for loading and proving CNC machine tool programs
- 2.3 Use the appropriate reference manuals and programming codes to suit the machine controller
- 2.4 Develop part programs
- 2.5 Prove programs
- 2.6 Check machine and program operates safely and correctly
- 2.7 Leave the work area and machine in a safe and appropriate condition on completion of the activities
- 2.8 Store programs safely and correctly in the appropriate format.

Range

- (AC2.2)
- For risk assessment
 - For COSHH
 - For personal protective equipment
 - For other relevant safety regulations and procedures to realise a safe system of work.
- (AC2.4)
- All necessary positional information
 - Appropriate letter address codes
 - Preparatory commands and machine management/auxiliary functions
 - Repetitive programs (sub-routines, canned cycles, labels)
 - Absolute or incremental systems of measurements
 - Tool/cutter change positions
 - Tool information (lengths, offsets, radius compensation, wire size).
- (AC2.5) Use six of the following:
- Single block run
 - Fully dry run
 - Program save/store facilities
 - Graphic displays
 - Search facilities
 - Edit facilities
 - Programme override controls (speed, feed, tool data)
 - Data input facilities.
- (AC2.6)
- All operations are carried out to the program coordinates
 - Tool change positions are safe and clear of the workpiece and machine equipment
 - The correct tools are selected at the appropriate points in the program
 - Tool cutter paths are executed safely and correctly
 - Auxiliary functions operate at the correct point in the program (cutter start/stop, coolant flow)
 - Programs have been saved in the appropriate format.

Unit level:	Level 3
GLH:	140
Unit aim:	The purpose of this unit is for learners to develop understanding and skills needed to be competent in preparing and setting up Computer Numerical Control (CNC) turning machines or machine centres, in accordance with approved procedures.
Relationship to NOS:	EUCL3D-157

Learning outcome

The learner will:

- 1 Understand how to set CNC turning machines

Assessment criteria

The learner can:

- 1.1 Describe the specific safety precautions to be taken when setting up CNC turning machines
- 1.2 Explain how to minimise risks associated with setting CNC turning machines
- 1.3 Describe how to stop the machine
- 1.4 Describe the procedure for starting the CNC turning machines
- 1.5 Explain the importance of ensuring the machine is isolated from the power supply before mounting cutting tools and workholding devices
- 1.6 Explain the importance of wearing the appropriate protective clothing (PPE) and equipment
- 1.7 Explain the importance of keeping the work area clean and tidy when setting up lathes
- 1.8 Describe how to handle and store cutting tools and CNC programs safely and correctly
- 1.9 Describe how to extract and use information from engineering drawings and related specifications in relation to work undertaken
- 1.10 Describe how to interpret drawings for setting up a lathe
- 1.11 Describe the range of workholding methods and devices that are used on CNC lathes
- 1.12 Explain the importance of setting the workholding device in relationship to the machines datums and reference points
- 1.13 Describe how to set the workholding devices and the tools and equipment used
- 1.14 Describe the typical applications of cutting tools used on CNC lathes

- 1.15 Describe how to check that cutting tools are in a safe and serviceable condition
 - 1.16 Explain factors that determine selection and use of indexable tips
 - 1.17 Describe types of tool holding devices
 - 1.18 Describe methods used to mount and secure cutting tools to the tool holders
 - 1.19 Explain the advantages of using pre-set tooling
 - 1.20 Describe how to set the tooling using setting jigs/fixtures
 - 1.21 Describe how to position and identify tools in relationship to the operating program
 - 1.22 Describe how to place the machine into the correct operating mode
 - 1.23 Describe how to conduct trial runs
 - 1.24 Explain the need for full dry runs and single block runs
 - 1.25 Describe items that need to be checked before allowing the machine to operate in full program run mode
 - 1.26 Explain how type of materials affect feeds and speeds that can be used
 - 1.27 Describe the application of cutting fluids with regard to different materials
 - 1.28 Explain why some materials do not require the use of cutting fluids
 - 1.29 Explain how to resolve problems that can occur with setting up the workholding devices and tooling
 - 1.30 Describe the extent of their own authority when setting up CNC turning machines and to whom they should report if they have problems that they cannot resolve.
-

Range

- (AC1.1)
 - Workholding devices
 - Tooling.

 - (AC1.3)
 - Normal situations
 - Emergency situations.

 - (AC1.10)
 - First and third angle drawings
 - Imperial and metric systems of measurement
 - Workpiece reference points
 - System of tolerancing.

 - (AC1.16)
 - Condition of material
 - Hardness of material
 - Cutting characteristics
 - Tolerances to be achieved
 - Component surface finish
 - Specifications.

 - (AC1.16)
 - Tungsten carbide
 - Ceramic
-

- Diamond.

(AC1.23) Using:

- Single block run
- Dry run
- Feed and speed override controls.

Learning outcome

The learner will:

- 2 Be able to set CNC turning machines

Assessment criteria

The learner can:

- 2.1 Obtain and use the appropriate documentation for setting up centre lathes
- 2.2 Adhere to safety procedures in place for setting up centre lathes
- 2.3 Follow safe practice/approved setting-up procedures
- 2.4 Confirm the operating program has been loading
- 2.5 Check that tooling is in a usable condition
- 2.6 Ensure the workpiece is correctly positioned and secured without distortion
- 2.7 Update program tool data
- 2.8 Ensure that correctly adjusted machine guards are in place
- 2.9 Position and secure workpieces using different workholding methods
- 2.10 Select and mount different types of cutting tool
- 2.11 Prepare tooling for operation
- 2.12 Set up the machine to produce components that combine several different operations
- 2.13 Set the machine to produce components to quality and accuracy standards, as applicable to the operations performed
- 2.14 Leave the work area and machine in a safe and appropriate condition on completion of the activities.

Range

- (AC2.2)
- For risk assessment
 - For COSHH
 - For personal protective equipment
 - For other relevant safety regulations and procedures to realise a safe system of work.
- (AC2.9) Use two of the following:
- Chucks with hard jaws
 - Chucks with soft jaws
 - Fixtures
 - Drive centres
 - Collet chucks
 - Faceplates
 - Magnetic or pneumatic devices
 - Other specific workholding devices.

(AC2.10) Use eight of the following:

- Roughing tool
- Screw-thread tool
- Centre drills
- Reamers
- Finishing tool
- Profiling tools
- Twist/core drills
- Maxi-tipped drills
- Parting off tool
- Form tools
- Boring tools.

(AC2.11) • Position tools in the correct position in the tool posts, turrets, magazine or carousel
• Check tools have a specific tool number in relation to the operating program
• Enter all relevant tool data to the operating program (tool lengths, tool offsets, radius compensation)
• Pre-set tooling using setting jigs/fixtures
• Set tool datum
• Save changes to the program.

(AC2.12) To include ten of the following:

- Parallel diameters
- Internal profiles
- Eccentric diameters
- Stepped diameters
- External profiles
- External screw threads
- Tapered diameters
- Reamed holes
- Tapped holes
- Chamfers and radii
- Flat faces
- Drilled holes
- Internal screw threads
- Internal undercuts
- External undercuts
- Bored holes
- Grooves
- Parting off.

(AC2.13) • General dimensional tolerance $\pm 0.15\text{mm}$ or $\pm 0.006''$
• There must be one or more specific dimensional tolerances within $\pm 0.05\text{mm}$ or $\pm 0.002''$
• Surface finish $32\ \mu\text{in}$; $0.8\ \mu\text{m}$

- Reamed / bored holes within H8
- Screw threads BS medium fit
- Angles within +/- 0.25 degree.

Unit 315

Machining components using CNC turning machines

Unit level:	Level 3
GLH:	126
Unit aim:	The purpose of this unit is for learners to develop understanding and skills needed to be competent in machining using manual CNC turning machines, in accordance with approved procedures.
Relationship to NOS:	EUCL3D-158

Learning outcome

The learner will:

- 1 Understand how to machine components using CNC turning machines

Assessment criteria

The learner can:

- 1.1 Describe the safe working practices and procedures to be followed while operating CNC turning machines
- 1.2 Describe the procedure for checking that machine safety mechanisms function correctly
- 1.3 Describe how to stop the machine
- 1.4 Describe the procedure for starting the machine
- 1.5 Explain the importance of wearing Personal Protective Equipment (PPE) when using CNC turning machines
- 1.6 Explain how to minimise risks associated with turning operations on CNC turning machines
- 1.7 Explain the importance of keeping the work area clean and tidy when machining on CNC turning machines
- 1.8 Describe how to extract and use information from engineering drawings and related specifications in relation to machining work to be undertaken
- 1.9 Describe how to interpret drawings for machining on a centre lathe
- 1.10 Describe the applications of different CNC turning machines
- 1.11 Describe how to use the visual display
- 1.12 Describe how to deal with different types of error messages displayed
- 1.13 State how to find the correct restart point in the program when the machine has stopped before completion

- 1.14 Describe the operation of different hand and automatic modes of machine control
 - 1.15 Describe how to make adjustments to the program operating parameters to take account of tool wear
 - 1.16 Describe how to set and secure the workpiece to the machine
 - 1.17 Describe how to conduct trial runs
 - 1.18 Explain the need for full dry runs and single block runs
 - 1.19 Explain the potential effects of clamping the workpiece
 - 1.20 Explain how material removal can cause distortion of the finished workpiece
 - 1.21 Describe how different types of cutting tools are secured to the machine
 - 1.22 Describe how to handle and store tooling safely and correctly
 - 1.23 Describe how to check that indexable tooling is in a serviceable condition
 - 1.24 Explain the effects of worn tooling on surface finish and tolerances
 - 1.25 Explain the application of cutting fluids to different types of materials
 - 1.26 Describe the quality control procedures and related equipment used
 - 1.27 Explain how to resolve problems that can occur with turning operations
 - 1.28 Describe the extent of their own authority when machining with CNC turning machines and to whom they should report if they have problems that they cannot resolve.
-

Range

- (AC1.3)
 - Normal situations
 - Emergency situations.
 - (AC1.9)
 - First and third angle drawings
 - Imperial and metric systems of measurement
 - Workpiece reference points
 - System of tolerancing.
 - (AC1.17) Using:
 - Single block run
 - Dry run
 - Feed and speed override controls.
-

Learning outcome

The learner will:

- 2 Be able to machine components using CNC turning machines

Assessment criteria

The learner can:

- 2.1 Obtain and use the appropriate documentation for machining with CNC turning machines
 - 2.2 Adhere to safety procedures for machining with CNC turning machines
-

- 2.3 Check that the operating program is at the correct starting point
 - 2.4 Ensure that correctly adjusted machine guards are in place
 - 2.5 Hold components securely without distortion
 - 2.6 Maintain cutting tools in a suitable condition
 - 2.7 Adjust machine settings, as required, to maintain the required accuracy
 - 2.8 Produce machined components which combine different operations
 - 2.9 Carry out checks for accuracy during production
 - 2.10 Produce components that meet quality and accuracy standards applicable to the operations performed
 - 2.11 Leave the work area and machine in a safe and appropriate condition on completion of the activities.
-

Range

- (AC2.2)
- For risk assessment
 - For COSHH
 - For personal protective equipment
 - For other relevant safety regulations and procedures to realise a safe system of work.
- (AC2.8) To include ten of the following:
- Parallel diameters
 - Internal profiles
 - Eccentric features
 - Stepped diameters
 - External profiles
 - External screw threads
 - Tapered diameters
 - Reamed holes
 - Flat faces
 - Drilled holes
 - Internal screw threads
 - Tapped holes
 - Chamfers and radii
 - Bored holes
 - Grooves
 - Parting off
 - External undercuts
 - Internal undercuts.
- (AC2.9) To include five of the following:
- Diameters
 - Lengths/depths
-

- Hole size/fit
- Thread profile and fit
- Surface finish
- Angle/taper
- Concentricity.

- (AC2.10)
- General dimensional tolerance $\pm 0.15\text{mm}$ or $\pm 0.006''$
 - There must be one or more specific dimensional tolerances within $\pm 0.05\text{mm}$ or $\pm 0.002''$
 - Surface finish $32\ \mu\text{in}$; $0.8\ \mu\text{m}$
 - Reamed / bored holes within H8
 - Screw threads BS medium fit
 - Angles within ± 0.5 degree.

Unit level:	Level 3
GLH:	140
Unit aim:	The purpose of this unit is for learners to develop understanding and skills needed to be competent in preparing and setting up Computer Numerical Control (CNC) milling machines, in accordance with approved procedures.
Relationship to NOS:	EUCL3D-159

Learning outcome

The learner will:

- 1 Understand how to set CNC milling machines

Assessment criteria

The learner can:

- 1.1 Describe the specific safety precautions to be taken when setting up CNC milling machines
- 1.2 Explain how to minimise risks associated with setting CNC milling machines
- 1.3 Describe how to stop the machine
- 1.4 Describe the procedure for starting the CNC milling machines
- 1.5 Explain the importance of ensuring the machine is isolated from the power supply before mounting milling tools and workholding devices
- 1.6 Explain the importance of wearing the appropriate protective clothing (PPE) and equipment
- 1.7 Explain the importance of keeping the work area clean and tidy when setting up lathes
- 1.8 Describe how to handle and store milling cutters safely and correctly
- 1.9 Describe how to extract and use information from engineering drawings and related specifications in relation to work undertaken
- 1.10 Describe how to interpret drawings for setting up a CNC machine
- 1.11 Describe the range of workholding methods and devices that are used on CNC milling machines
- 1.12 Explain the importance of setting the workholding device in relationship to the machines axes and reference points

- 1.13 Describe how to set the workholding devices and the tools and equipment used
 - 1.14 Describe the typical applications of different types of cutting tools used on CNC milling machines
 - 1.15 Explain the factors that determine selection and use of indexable tips
 - 1.16 Describe how to check that milling tools are in a safe and serviceable condition
 - 1.17 Describe types of milling tool holding devices
 - 1.18 Describe methods used to mount and secure cutting tools to the tool holders
 - 1.19 Explain the advantages of using pre-set tooling
 - 1.20 Describe how to set the tooling using setting jigs
 - 1.21 Describe how to position and identify tools in relationship to the operating program
 - 1.22 Describe how to place the machine into the correct operating mode
 - 1.23 Describe how to conduct trial runs
 - 1.24 Explain the need for full dry runs and single block runs
 - 1.25 Describe items that need to be checked before allowing the machine to operate in full program run mode
 - 1.26 Explain how type of materials affect feeds and speeds that can be used
 - 1.27 Describe the application of cutting fluids with regard to different materials
 - 1.28 Explain why some materials do not require the use of cutting fluids
 - 1.29 Explain how to resolve problems that can occur with setting up the workholding devices and tooling
 - 1.30 Describe the extent of their own authority when setting up CNC milling machines and to whom they should report if they have problems that they cannot resolve.
-

Range

- (AC1.1)
 - Workholding devices
 - Tooling.

 - (AC1.3)
 - Normal situations
 - Emergency situations.

 - (AC1.10)
 - First and third angle drawings
 - Imperial and metric systems of measurement
 - Workpiece reference points
 - System of tolerancing.

 - (AC1.15)
 - Condition of material supplied
 - Hardness of the material
 - Cutting characteristics of the material
 - Tolerances to be achieved
 - Component surface finish
-

- Specifications.

- (AC1.15) • Tungsten carbide
- Ceramic
 - Diamond.

(AC1.23) Using:

- Single block run
- Dry run
- Feed and speed override controls.

Learning outcome

The learner will:

- 2 Be able to set CNC milling machines

Assessment criteria

The learner can:

- 2.1 Obtain and use the appropriate documentation for setting up centre lathes
- 2.2 Adhere to safety procedures in place for setting up centre lathes
- 2.3 Follow safe practice/approved setting-up procedures
- 2.4 Confirm the operating program has been loading
- 2.5 Check that tooling is in a usable condition
- 2.6 Ensure the workpiece is correctly positioned and secured without distortion
- 2.7 Update program tool data
- 2.8 Ensure that correctly adjusted machine guards are in place
- 2.9 Position and secure workpieces using different workholding methods
- 2.10 Select and mount milling cutters
- 2.11 Prepare tooling for operation
- 2.12 Set up the machine to produce components that combine several different operations
- 2.13 Set the machine to produce components to quality and accuracy standards, as applicable to the operations performed
- 2.14 Leave the work area and machine in a safe and appropriate condition on completion of the activities.

Range

- (AC2.2)
- For risk assessment
 - For COSHH
 - For personal protective equipment
 - For other relevant safety regulations and procedures to realise a safe system of work.
- (AC2.9) Use three of the following:
- Machine vices
 - Pneumatic or magnetic table
 - Ancillary indexing devices
 - Fixtures
 - Direct clamping to machine table
 - Angle plates
 - Chucks

- Other specific workholding devices.

(AC2.10) To include six of the following:

- Face mills
- Side and face cutters
- Twist/core drills
- Reamers
- Special profile cutters
- End mills
- Boring tools
- Slot drills
- Others to be specified (eg dovetail, tee slot, profile).

(AC2.11) • Position tools in the correct position in the magazine or carousel

- Check tools have a specific tool number in relation to the operating program
- Enter all relevant tool data to the operating program (tool lengths, tool offsets, radius compensation)
- Pre-set tooling using setting jigs/fixtures
- Set tool datum
- Save changes to the program.

(AC2.13) To include nine of the following:

- Flat faces
- Holes on pitch circles
- External profiles
- Steps/shoulders
- Parallel faces
- Holes linearly pitched
- Enclosed slots/recesses
- Angular faces
- Circular/curved profiles
- Internal profiles
- Open ended slots
- Special forms (eg concave, convex)
- Faces that are square to each other.

Unit 317

Machining components using CNC milling machines

Unit level:	Level 3
GLH:	126
Unit aim:	The purpose of this unit is for learners to develop understanding and skills needed to be competent in machining using manual CNC milling machines, in accordance with approved procedures.
Relationship to NOS:	EUCL3D-160

Learning outcome

The learner will:

- 1 Understand how to machine components using CNC milling machines

Assessment criteria

The learner can:

- 1.1 Describe the safe working practices and procedures to be followed while operating CNC milling machines
- 1.2 Describe the procedure for checking that machine safety mechanisms function correctly
- 1.3 Describe how to stop the machine
- 1.4 Describe the procedure for starting the machine
- 1.5 Explain the importance of wearing Personal Protective Equipment (PPE) when using CNC milling machines
- 1.6 Explain how to minimise risks associated with milling operations on CNC milling machines
- 1.7 Explain the importance of keeping the work area clean and tidy when machining on CNC milling machines
- 1.8 Describe how to extract and use information from engineering drawings and related specifications in relation to machining work to be undertaken
- 1.9 Describe how to interpret drawings for machining on a centre lathe
- 1.10 Describe the applications of different CNC milling machines
- 1.11 Describe how to use the visual display
- 1.12 Describe how to deal with different types of error messages displayed

- 1.13 State how to find the correct restart point in the program when the machine has stopped before completion
 - 1.14 Describe the operation of different hand and automatic modes of machine control
 - 1.15 Describe how to make adjustments to the program operating parameters to take account of tool wear
 - 1.16 Describe how to set and secure the workpiece to the machine
 - 1.17 Describe how to conduct trial runs
 - 1.18 Explain the need for full dry runs and single block runs
 - 1.19 Explain the effects of clamping the workpiece in a chuck/work holding device
 - 1.20 Explain the potential effects of clamping the workpiece
 - 1.21 Explain how material removal can cause distortion of the finished workpiece
 - 1.22 Describe how different types of cutting tools are secured to the machine
 - 1.23 Describe how to handle and store tooling safely and correctly
 - 1.24 Describe how to check that milling cutters are in a serviceable condition
 - 1.25 Explain the effects of worn tooling on finished work
 - 1.26 Explain the application of cutting fluids to different types of materials
 - 1.27 Describe the quality control procedures and related equipment used
 - 1.28 Explain how to resolve problems that can occur with CNC milling operations
 - 1.29 Describe the extent of their own authority when machining with CNC milling machines and to whom they should report if they have problems that they cannot resolve.
-

Range

- (AC1.3)
 - Normal situations
 - Emergency situations.
 - (AC1.9)
 - First and third angle drawings
 - Imperial and metric systems of measurement
 - Workpiece reference points
 - System of tolerancing.
 - (AC1.17) Using:
 - Single block run
 - Dry run
 - Feed and speed override controls.
-

Learning outcome

The learner will:

- 2 Be able to machine components using CNC milling machines
-

Assessment criteria

The learner can:

- 2.1 Obtain and use the appropriate documentation for machining with CNC milling machines
- 2.2 Adhere to safety procedures for machining with CNC milling machines
- 2.3 Check that the operating program is at the correct starting point
- 2.4 Ensure that correctly adjusted machine guards are in place
- 2.5 Hold components securely without distortion
- 2.6 Maintain cutting tools in a safe and usable condition
- 2.7 Adjust machine settings, as required, to maintain the required accuracy
- 2.8 Produce machined components which combine different operations
- 2.9 Carry out checks for accuracy during production
- 2.10 Produce components that meet quality and accuracy standards applicable to the operations performed
- 2.11 Leave the work area and machine in a safe and appropriate condition on completion of the activities.

Range

- (AC2.2) • For risk assessment
• For COSHH
• For personal protective equipment
• For other relevant safety regulations and procedures to realise a safe system of work.
- (AC2.8) To include nine of the following:
- Flat faces
 - Holes on pitch circles
 - External profiles
 - Steps/shoulders
 - Parallel faces
 - Holes linearly pitched
 - Enclosed slots/recesses
 - Angular faces
 - Circular/curved profiles
 - Internal profiles
 - Open ended slots
 - Tapped holes
 - Special forms (eg concave, convex)
 - Faces that are square to each other.
- (AC2.9) To include six of the following:
- Diameters

- Hole size/fit
- Slots
- Squareness
- Surface finish
- Angles
- Flatness
- Recesses.

- (AC2.10)
- Components to be free from false tool cuts, burrs and sharp edges
 - General dimensional tolerance $\pm 0.15\text{mm}$ or $\pm 0.006''$
 - There must be one or more specific dimensional tolerances within $\pm 0.05\text{mm}$ or $\pm 0.002''$
 - Surface finish $32\ \mu\text{in}$; $0.8\ \mu\text{m}$
 - Reamed / bored holes within H8
 - Screw threads BS medium fit
 - Angles/tapers within ± 0.5 degree
 - Flatness and squareness $0.001''$ per inch of 0.025mm per 25mm .

Unit level:	Level 3
GLH:	140
Unit aim:	The purpose of this unit is for learners to develop understanding and skills needed to be competent in preparing and setting up Computer Numerical Control (CNC) grinding machines, in accordance with approved procedures.
Relationship to NOS:	EUCL3D-161

Learning outcome

The learner will:

- 1 Understand how to set CNC grinding machines

Assessment criteria

The learner can:

- 1.1 Describe the specific safety precautions to be taken when setting up CNC grinding machines
- 1.2 Explain how to minimise risks associated with setting CNC grinding machines
- 1.3 Describe how to stop the machine
- 1.4 Describe the procedure for starting the CNC grinding machines
- 1.5 Describe the Grinding Wheel Regulations covering the use and operation of grinding wheels and equipment
- 1.6 Explain the importance of ensuring the machine is isolated from the power supply before mounting grinding wheels and workholding devices
- 1.7 Explain the importance of wearing the appropriate protective clothing (PPE) and equipment
- 1.8 Explain the importance of keeping the work area clean and tidy when setting up CNC grinding machines
- 1.9 Describe how to handle and store grinding wheels safely and correctly
- 1.10 Describe how to extract and use information from engineering drawings and related specifications in relation to work undertaken
- 1.11 Describe how to interpret drawings for setting up a CNC machine
- 1.12 Describe the range of workholding methods and devices that are used on CNC grinding machines

- 1.13 Explain the importance of setting the workholding device in relationship to the machines datums and reference points
 - 1.14 Describe how to set the workholding devices and the tools and equipment used
 - 1.15 Describe the typical applications of different types of grinding wheels used on CNC grinding machines
 - 1.16 Describe how to check that grinding wheels are in a safe and serviceable condition
 - 1.17 Explain the material conditions that determine selection and use of silicon carbide, aluminium oxide and diamond wheels
 - 1.18 Explain how to select the correct grade and type of grinding wheel for the materials being machined
 - 1.19 Describe types of grinding tool holding devices
 - 1.20 Describe methods used to mount and secure grinding wheels to the machine spindle and tool holders
 - 1.21 Explain the advantages of using pre-set tooling
 - 1.22 Describe how to set the tooling using setting jigs
 - 1.23 Describe how to position and identify tools in relationship to the operating program
 - 1.24 Describe how to place the machine into the correct operating mode
 - 1.25 Describe how to conduct trial runs
 - 1.26 Explain the need for full dry runs and single block runs
 - 1.27 Describe items that need to be checked before allowing the machine to operate in full program run mode
 - 1.28 Explain how type of materials affect feeds and speeds that can be used
 - 1.29 Describe the application of cutting fluids with regard to different materials
 - 1.30 Explain why some materials do not require the use of cutting fluids
 - 1.31 Explain how to resolve problems that can occur with setting up the workholding devices and tooling
 - 1.32 Describe the extent of their own authority when setting up CNC grinding machines and to whom they should report if they have problems that they cannot resolve.
-

Range

- (AC1.1)
- Workholding devices
 - Tooling.
- (AC1.3)
- Normal situations
 - Emergency situations.
- (AC1.11)
- First and third angle drawings
 - Imperial and metric systems of measurement
 - Workpiece reference points
-

- System of tolerancing.

(AC1.25) Using:

- Single block run
- Dry run
- Feed and speed override controls.

Learning outcome

The learner will:

- 2 Be able to set CNC grinding machines

Assessment criteria

The learner can:

- 2.1 Obtain and use the appropriate documentation for setting up centre lathes
- 2.2 Adhere to safety procedures in place for setting up centre lathes
- 2.3 Follow safe practice/approved setting-up procedures
- 2.4 Confirm the operating program has been loading
- 2.5 Check that the grinding wheels are in a safe and usable condition
- 2.6 Ensure the workpiece is correctly positioned and secured without distortion
- 2.7 Update program tool data
- 2.8 Ensure that correctly adjusted machine guards are in place
- 2.9 Position and secure workpieces using different workholding methods
- 2.10 Select, mount and dress different types of feature on grinding wheels
- 2.11 Prepare tooling for operation
- 2.12 Set up the machine to produce components that combine several different operations
- 2.13 Set the machine to produce components to quality and accuracy standards, as applicable to the operations performed
- 2.14 Leave the work area and machine in a safe and appropriate condition on completion of the activities.

Range

- (AC2.2)
- For risk assessment
 - For COSHH
 - For personal protective equipment
 - For other relevant safety regulations and procedures to realise a safe system of work.
- (AC2.9) Use six of the following:
- Chucks
 - Machine vices
 - Centres
 - Mandrels/arbours
 - Collets
 - Faceplates
 - Fixtures

- Power chucks/blocks
- Clamps
- Vee blocks
- Angle plates
- Other specific workholding arrangements.

(AC2.10) To include five of the following:

- Rough grinding
- Finish grinding
- For thread grinding
- For gear grinding
- Male radius
- Angels
- Component form profile
- Female radius.

(AC2.11) • Pre-set grinding wheels/spindles using balancing units and setting jigs/fixtures

- Set tool datum
- Position grinding wheels/spindles in the correct position in the machine spindle, magazine or carousel
- Check wheel have a specific tool number in relation to the operating program
- Enter all relevant tool data to the operating program (wheel/spindle position offsets)
- Save changes to the program.

(AC2.12) To include eight of the following:

- Plain diameters
- Internal profiles
- External profiles
- Parallel bored
- Stepped diameters
- Eccentric diameters
- Tapered bores
- Tapered diameters
- External screw threads
- Involute forms
- Helical forms
- Flat faces and shoulders
- Radii (including gear root)
- Chamfers (including gear tip chamfers)
- Curvic couplings
- Special forms (eg concave, convex)
- Internal/external undercuts/bearing tracks.

(AC2.13) • Dimensional tolerance equivalent to BS EN 20286 or BS 1916 Grade 7

- Flatness and squareness 0.0005" per inch or 0.012mm per 25mm
- Angles within +/- 0.25 degree
- Surface finish 16 μm ; 0.4 μm
- Ground bores / holes within H8
- Screw threads BS medium fit

- Company standard
- Spur and helical gears to current BS or ISO standards.

Unit 319

Machining components using CNC grinding machines

Unit level:	Level 3
GLH:	126
Unit aim:	The purpose of this unit is for learners to develop understanding and skills needed to be competent in machining using CNC grinding machines, in accordance with approved procedures.
Relationship to NOS:	EUCL3D-162

Learning outcome

The learner will:

- 1 Understand how to machine components using CNC grinding machines

Assessment criteria

The learner can:

- 1.1 Describe the safe working practices and procedures to be followed while operating CNC grinding machines
- 1.2 Describe the procedure for checking that machine safety mechanisms function correctly
- 1.3 Describe how to stop the machine
- 1.4 Describe the procedure for starting the machine
- 1.5 Explain the importance of wearing Personal Protective Equipment (PPE) when using CNC grinding machines
- 1.6 Explain how to minimise risks associated with horizontal boring operations on CNC grinding machines
- 1.7 Explain the importance of keeping the work area clean and tidy when machining on CNC grinding machines
- 1.8 Describe how to extract and use information from engineering drawings and related specifications in relation to machining work to be undertaken
- 1.9 Describe how to interpret drawings for machining
- 1.10 Describe the applications of different types of CNC grinding machines
- 1.11 Describe how to use the visual display
- 1.12 Describe how to deal with different types of error messages displayed

- 1.13 State how to find the correct restart point in the program when the machine has stopped before completion
 - 1.14 Describe the operation of different hand and automatic modes of machine control
 - 1.15 Describe how to conduct trial runs
 - 1.16 Explain the need for full dry runs and single block runs
 - 1.17 Describe how to make adjustments to the program operating parameters to take account of wheel wear
 - 1.18 Describe how to set and secure the grinding wheels to the machine
 - 1.19 Describe the safe and correct handling and storage of grinding wheels
 - 1.20 Describe how to check the grinding wheel is in a serviceable condition
 - 1.21 Explain the potential effects of worn/burnished tooling on workpiece surface finish and tolerances
 - 1.22 Explain the application of cutting fluids with regard to different materials being machined
 - 1.23 Explain the potential effects of clamping the workpiece
 - 1.24 Explain how material removal can cause distortion of the finished workpiece
 - 1.25 Explain how to resolve problems that can occur with grinding operations
 - 1.26 Describe the quality control procedures and related equipment used
 - 1.27 Describe the extent of their own authority when machining with CNC grinding machines and to whom they should report if they have problems that they cannot resolve.
-

Range

- (AC1.3)
 - Normal situations
 - Emergency situations.

 - (AC1.9)
 - First and third angle drawings
 - Imperial and metric systems of measurement
 - Workpiece reference points
 - System of tolerancing.

 - (AC1.15) Using:
 - Single block run
 - Dry run
 - Feed and speed override controls.
-

Learning outcome

The learner will:

- 2 Be able to machine components using CNC grinding machines
-

Assessment criteria

The learner can:

- 2.1 Obtain and use appropriate documentation
 - 2.2 Adhere to safety procedures in place
 - 2.3 Check that the operating program is at the correct starting point
 - 2.4 Ensure that correctly adjusted machine guards are in place
 - 2.5 Hold components securely without distortion
 - 2.6 Check the grinding wheels are correctly dressed and in a safe and usable condition
 - 2.7 Adjust machine settings, as required, to maintain the required accuracy
 - 2.8 Produce ground components which combine different operations
 - 2.9 Carry out checks for accuracy during production
 - 2.10 Produce components that meet quality and accuracy standards applicable to the operations performed
 - 2.11 Leave the work area and machine in a safe and appropriate condition on completion of the activities.
-

Range

- (AC2.2)
- For risk assessment
 - For COSHH
 - For personal protective equipment
 - For other relevant safety regulations and procedures to realise a safe system of work.
- (AC2.8) To include eight of the following:
- Plain diameters
 - Internal profiles
 - External profiles
 - Parallel bores
 - Stepped diameters
 - Tapered bores
 - Tapered diameters
 - External screw threads
 - Involute forms
 - Helical forms
 - Flat faces and shoulders
 - Radii (including gear root)
 - Chamfers (including gear tip chamfers)
 - Curvic couplings
 - Special forms (eg concave, convex)
 - Internal/external undercuts/bearing tracks.
-

(AC2.9) To include five of the following:

- Dimensions
- Profile
- Surface texture
- Ovality/lobbing
- Parallelism
- Concentricity
- Angle/taper
- Hole size
- Squareness
- Thread form.

(AC2.10) • Dimensional tolerance equivalent to BS EN 20286 or BS 1916 Grade 7

- Flatness and squareness 0.0005" per inch or 0.012mm per 25mm
- Angles within +/- 0.25 degree
- Surface texture 16 μ in; 0.4 μ m
- Ground bores/holes within H8
- Screw threads BS medium fit
- Company standards
- Spur and helical gears to current BS or ISO standards.

Unit level:	Level 3
GLH:	140
Unit aim:	The purpose of this unit is for learners to develop understanding and skills needed to be competent in preparing and setting up Computer Numerical Control (CNC) punching machines, in accordance with approved procedures.
Relationship to NOS:	EUCL3D-163

Learning outcome

The learner will:

- 1 Understand how to set CNC punching machines

Assessment criteria

The learner can:

- 1.1 Describe the specific safety precautions to be taken when setting up CNC punching machines
- 1.2 Explain how to minimise risks associated with setting CNC punching machines
- 1.3 Describe how to stop the machine
- 1.4 Describe the procedure for starting the CNC punching machines
- 1.5 Explain the importance of ensuring the machine is isolated from the power supply before mounting punching tools and workholding devices
- 1.6 Explain the importance of wearing the appropriate protective clothing (PPE) and equipment
- 1.7 Explain the importance of keeping the work area clean and tidy when setting up lathes
- 1.8 Describe how to extract and use information from engineering drawings and related specifications in relation to work undertaken
- 1.9 Describe how to interpret drawings for setting up a CNC machine
- 1.10 Describe the range of workholding methods and devices that are used on CNC punching machines
- 1.11 Explain the importance of setting the workholding device in relationship to the machine datums and reference points
- 1.12 Describe how to set the workholding devices and the tools and equipment used

- 1.13 Describe the typical applications of different types of punching tools used on CNC punching machines
 - 1.14 Describe how to check that punching tools are in a safe and serviceable condition
 - 1.15 Explain the material conditions that determine selection and use of high speed steel and tungsten carbide tooling
 - 1.16 Select the correct grade and type of punching wheel for the materials being machined
 - 1.17 Describe types of tool holding devices
 - 1.18 Describe methods used to mount and secure punching tools to the and tool holders
 - 1.19 Explain the advantages of using pre-set tooling
 - 1.20 Describe how to set the tooling using setting jigs
 - 1.21 Describe how to position and identify tools in relationship to the operating program
 - 1.22 Describe how to place the machine into the correct operating mode
 - 1.23 Describe how to conduct trial runs
 - 1.24 Explain the need for full dry runs and single block runs
 - 1.25 Describe items that need to be checked before allowing the machine to operate in full program run mode
 - 1.26 Explain how type of materials affect feeds and speeds that can be used
 - 1.27 Describe the application of cutting fluids with regard to different materials
 - 1.28 Explain why some materials do not require the use of cutting fluids
 - 1.29 Explain how to resolve problems that can occur with setting up the workholding devices and tooling
 - 1.30 Describe the extent of their own authority when setting up CNC punching machines and to whom they should report if they have problems that they cannot resolve.
-

Learning outcome

The learner will:

- 2 Be able to set CNC punching machines

Assessment criteria

The learner can:

- 2.1 Obtain and use the appropriate documentation for setting up centre lathes
- 2.2 Adhere to safety procedures in place for setting up centre lathes
- 2.3 Follow safe practice/approved setting-up procedures
- 2.4 Confirm the operating program has been loading
- 2.5 Check that the tooling is in a usable condition
- 2.6 Ensure the workpiece is correctly positioned and secured without distortion
- 2.7 Update program tool data

- 2.8 Ensure that correctly adjusted machine guards are in place
- 2.9 Position and secure workpieces using different workholding methods
- 2.10 Select and mount tooling
- 2.11 Prepare tooling for operation
- 2.12 Set up the machine to produce components that combine several different operations
- 2.13 Set the machine to produce components to quality and accuracy standards, as applicable to the operations performed
- 2.14 Leave the work area and machine in a safe and appropriate condition on completion of the activities.

Unit 321

Machining components using CNC punching machines

Unit level:	Level 3
GLH:	126
Unit aim:	The purpose of this unit is for learners to develop understanding and skills needed to be competent in machining using manual CNC punching machines, in accordance with approved procedures.
Relationship to NOS:	EUCL3D-164

Learning outcome

The learner will:

- 1 Understand how to machine components using CNC punching machines

Assessment criteria

The learner can:

- 1.1 Describe the safe working practices and procedures to be followed while operating CNC punching machines
- 1.2 Describe the procedure for checking that machine safety mechanisms function correctly
- 1.3 Describe how to stop the machine
- 1.4 Describe the procedure for starting the machine
- 1.5 Explain the importance of wearing Personal Protective Equipment (PPE) when using CNC punching machines
- 1.6 Explain how to minimise risks associated with punching operations on CNC punching machines
- 1.7 Explain the importance of keeping the work area clean and tidy when machining on CNC punching machines
- 1.8 Describe how to extract and use information from engineering drawings and related specifications in relation to machining work to be undertaken
- 1.9 Describe how to interpret drawings for machining
- 1.10 Describe the applications of CNC punching machines
- 1.11 Describe how to use the visual display
- 1.12 Describe how to deal with different types of error messages displayed

- 1.13 State how to find the correct restart point in the program when the machine has stopped before completion
 - 1.14 Describe the operation of different hand and automatic modes of machine control
 - 1.15 Describe how to make adjustments to the program operating parameters to take account of tool wear
 - 1.16 Describe how to set and secure the workpiece to the machine
 - 1.17 Describe how to conduct trial runs
 - 1.18 Explain the need for full dry runs and single block runs
 - 1.19 Explain the potential effects of clamping the workpiece
 - 1.20 Explain how material removal can cause distortion of the finished workpiece
 - 1.21 Describe how different types of punching tools are secured to the machine
 - 1.22 Describe how to handle and store tooling safely and correctly
 - 1.23 Describe how to check that punches are in a serviceable condition
 - 1.24 Describe the quality control procedures and related equipment used
 - 1.25 Explain how to resolve problems that can occur with punching operations
 - 1.26 Describe the extent of their own authority when machining with CNC punching machines and to whom they should report if they have problems that they cannot resolve.
-

Range

- (AC1.3)
 - Normal situations
 - Emergency situations.

 - (AC1.9)
 - First and third angle drawings
 - Imperial and metric systems of measurement
 - Workpiece reference points
 - System of tolerancing.

 - (AC1.17) Using:
 - Single block run
 - Dry run
 - Feed and speed override controls.
-

Learning outcome

The learner will:

- 2 Be able to machine components using CNC punching machines

Assessment criteria

The learner can:

- 2.1 Obtain and use the appropriate documentation for machining with CNC punching machines
 - 2.2 Adhere to safety procedures for machining with CNC punching machines
 - 2.3 Check that the operating program is at the correct starting point
 - 2.4 Ensure that correctly adjusted machine guards are in place
 - 2.5 Hold components securely without distortion
 - 2.6 Maintain punching tools are in a safe and usable condition
 - 2.7 Adjust machine settings, as required, to maintain the required accuracy
 - 2.8 Produce machined components which combine different operations
 - 2.9 Carry out checks for accuracy during production
 - 2.10 Produce components that meet quality and accuracy standards applicable to the operations performed
 - 2.11 Leave the work area and machine in a safe and appropriate condition on completion of the activities.
-

Range

- (AC2.2) • For risk assessment
• For COSHH
• For personal protective equipment
• For other relevant safety regulations and procedures to realise a safe system of work.
- (AC2.8) To include five of the following:
- Holes linearly pitched
 - Louvres
 - Holes radially pitched
 - Swages
 - Internal curved profiles
 - Internal square profiles
 - Other specific applications.
- (AC2.9) To include five of the following:
- Dimensions of punched features
 - Accuracy of profiles
 - Position of features
 - Flatness/freedom from excessive distortion
 - Hole positions linearly pitched
 - Accuracy of louvres and swages
 - Hole positions radially pitched.
-

- (AC2.10)
- Dimensional tolerance equivalent to BS EN 20286 or BS 1916 Grade 9
 - Components free from deformity, burrs and sharp edges.

Unit level:	Level 3
GLH:	140
Unit aim:	The purpose of this unit is for learners to develop understanding and skills needed to be competent in preparing and setting up Computer Numerical Control (CNC) laser profiling machines, in accordance with approved procedures.
Relationship to NOS:	EUCL3D-165

Learning outcome

The learner will:

- 1 Understand how to set CNC laser profiling machines

Assessment criteria

The learner can:

- 1.1 Describe the specific safety precautions to be taken when setting up CNC laser profiling machines
- 1.2 Explain how to minimise risks associated with setting CNC laser profiling machines
- 1.3 Describe how to stop and close down the machine
- 1.4 Describe the procedure for starting the CNC laser profiling machines
- 1.5 Explain the importance of ensuring the machine is isolated from the power supply before working with machinery
- 1.6 Explain the importance of wearing the appropriate protective clothing (PPE) and equipment
- 1.7 Explain the importance of keeping the work area clean and tidy when setting up lathes
- 1.8 Describe the basic principles of laser profiling
- 1.9 Describe key components and features of laser profiling equipment
- 1.10 Describe how to extract and use information from engineering drawings and related specifications in relation to work undertaken
- 1.11 Describe how to interpret drawings for setting up a CNC machine
- 1.12 Describe the range of workholding methods and devices used on laser profiling machines
- 1.13 Describe how to set the components in relationship to the machine datums and operating parameters
- 1.14 Describe how to set up laser equipment to achieve component specification

- 1.15 Describe how to place the machine into the correct operating mode
 - 1.16 Describe how to conduct trial runs
 - 1.17 Explain the need for full dry runs and single block runs
 - 1.18 Explain how material conditions affect the operating conditions used
 - 1.19 Explain how to resolve problems that can occur with laser cutting activities
 - 1.20 Describe the extent of their own authority when setting up CNC laser profiling machines and to whom they should report if they have problems that they cannot resolve.
-

Range

- (AC1.1)
 - When working with high power laser beams
 - Ventilation and fume extraction
 - Machine safety devices.

- (AC1.3)
 - Normal situations
 - Emergency situations.

- (AC1.8)
 - Role and nature of laser beams
 - Methods of generating laser beams
 - Guiding and optical focussing laser optics
 - Parameters and how variances influence component features, quality and output
 - Forming component profile
 - Process principles
 - Terminology.

- (AC1.9)
 - Types of laser beam generator
 - Beam characteristics
 - Power ranges
 - Beam guiding and focusing arrangements
 - Power sources
 - Materials and thickness capabilities
 - Facilities for manipulation the components for machining
 - Safety features.

- (AC1.11)
 - First and third angle drawings
 - Imperial and metric systems of measurement
 - Workpiece reference points
 - System of tolerancing.

- (AC1.16) Using:
 - Single block run
 - Dry run
 - Feed and speed override controls.

Learning outcome

The learner will:

- 2 Be able to set CNC laser profiling machines

Assessment criteria

The learner can:

- 2.1 Obtain and use the appropriate documentation for setting up centre lathes
- 2.2 Adhere to safety procedures in place for setting up centre lathes
- 2.3 Follow safe practice/approved setting-up procedures
- 2.4 Confirm the operating program has been loading
- 2.5 Ensure that the laser lens is in a clean and usable condition
- 2.6 Ensure the workpiece is correctly positioned and secured without distortion
- 2.7 Update program tool data
- 2.8 Ensure that correctly adjusted machine guards are in place
- 2.9 Position and secure workpieces using different workholding methods
- 2.10 Set up the machine to produce components with different features
- 2.11 Set the machine to produce components to quality and accuracy standards, as applicable to the operations performed
- 2.12 Leave the work area and machine in a safe and appropriate condition on completion of the activities.

Range

- (AC2.2)
- For risk assessment
 - For COSHH
 - For personal protective equipment
 - For other relevant safety regulations and procedures to realise a safe system of work.

- (AC2.9) Use three of the following:
- Machine vices
 - Direct clamping to machine table
 - Chucks
 - Indexing tables/devices
 - Fixtures
 - Other specific workholding devices.

And use three of the following:

- Optical system

- Laser positioning
- Laser alignment
- Profiling parameters
- Cutting speeds.

(AC2.10) To include six of the following:

- Square/rectangular profiles
- Holes linearly positioned
- Angular profiles
- Holes radially positioned
- Curved profiles
- Slots and apertures
- Circles
- Ellipses
- Other specific features.

(AC2.11) • Dimensional tolerance equivalent to BS EN 20286 BS 1916 Grade 7

- Angles within +/- 0.25 degree
- Surface texture within 63 μin ; 1.6 μm .

Unit 323

Machining components using CNC laser profiling machines

Unit level:	Level 3
GLH:	126
Unit aim:	The purpose of this unit is for learners to develop understanding and skills needed to be competent in machining using CNC laser profiling machines, in accordance with approved procedures.
Relationship to NOS:	EUCL3D-166

Learning outcome

The learner will:

- 1 Understand how to machine components using CNC laser profiling machines

Assessment criteria

The learner can:

- 1.1 Describe the safe working practices and procedures to be followed while operating CNC laser profiling machines
- 1.2 Describe the procedure for checking that machine safety mechanisms function correctly
- 1.3 Describe how to stop the machine
- 1.4 Describe the procedure for starting the machine
- 1.5 Explain the importance of wearing Personal Protective Equipment (PPE) when using CNC laser profiling machines
- 1.6 Explain how to minimise risks associated with laser profiling operations on CNC laser profiling machines
- 1.7 Explain the importance of keeping the work area clean and tidy when machining on CNC laser profiling machines
- 1.8 Describe how to extract and use information from engineering drawings and related specifications in relation to machining work to be undertaken
- 1.9 Describe how to interpret drawings for machining
- 1.10 Describe how to use the visual display
- 1.11 Describe how to deal with different types of error messages displayed
- 1.12 State how to find the correct restart point in the program when the machine has stopped before completion

- 1.13 Describe the operation of different hand and automatic modes of machine control
 - 1.14 Describe how to conduct trial runs
 - 1.15 Explain the need for full dry runs and single block runs
 - 1.16 Describe how to make adjustments to the program operating parameters to take account of tool wear
 - 1.17 Describe how to set and secure the workpiece to the machine
 - 1.18 Explain the potential effects of clamping the workpiece
 - 1.19 Explain how material removal can cause distortion of the finished workpiece
 - 1.20 Explain the importance of storing material away from electromagnetic forces
 - 1.21 Describe how to monitor the machine during the cutting process
 - 1.22 Explain how to resolve problems that can occur with laser profiling operations
 - 1.23 Describe the quality control procedures and related equipment used
 - 1.24 Describe the extent of their own authority when machining with CNC laser profiling machines and to whom they should report if they have problems that they cannot resolve.
-

Range

- (AC1.3)
 - Normal situations
 - Emergency situations.

 - (AC1.9)
 - First and third angle drawings
 - Imperial and metric systems of measurement
 - Workpiece reference points
 - System of tolerancing.

 - (AC1.14) Using:
 - Single block run
 - Dry run
 - Feed and speed override controls.
-

Learning outcome

The learner will:

- 2 Be able to machine components using CNC laser profiling machines

Assessment criteria

The learner can:

- 2.1 Obtain and use the appropriate documentation for machining with CNC laser profiling machines
 - 2.2 Adhere to safety procedures for machining with CNC laser profiling machines
-

- 2.3 Check that the operating program is at the correct starting point
 - 2.4 Ensure that correctly adjusted machine guards are in place
 - 2.5 Hold components securely without distortion
 - 2.6 Check the laser lens for cleanliness and suitability
 - 2.7 Adjust machine settings, as required, to maintain the required accuracy
 - 2.8 Produce machined components with different features
 - 2.9 Carry out checks for accuracy during production
 - 2.10 Produce components that meet quality and accuracy standards applicable to the operations performed
 - 2.11 Leave the work area and machine in a safe and appropriate condition on completion of the activities.
-

Range

- (AC2.2)
- For risk assessment
 - For COSHH
 - For personal protective equipment
 - For other relevant safety regulations and procedures to realise a safe system of work.
- (AC2.8) To include six of the following:
- Square/rectangular profiles
 - Holes linearly positioned
 - Angular profiles
 - Holes radially positioned
 - Curved profiles
 - Slots and apertures
 - Circles
 - Ellipses
 - Other specific features.
- (AC2.9) To include five of the following:
- Dimensions
 - Angles
 - Position of features
 - Profiles
 - Hole positioned linearly
 - Flatness/freedom from distortion
 - Hole positioned radially.
- (AC2.10)
- Dimensional tolerance equivalent to BS EN 20286 or BS 1916 Grade
 - Angles within +/- 0.25 degree
 - Surface texture within 63µin; 1.6µm.

Unit level:	Level 3
GLH:	140
Unit aim:	The purpose of this unit is for learners to develop understanding and skills needed to be competent in preparing and setting up Computer Numerical Control (CNC) electro-discharge machines, in accordance with approved procedures.
Relationship to NOS:	EUCL3D-167

Learning outcome

The learner will:

- 1 Understand how to set CNC electro-discharge machines

Assessment criteria

The learner can:

- 1.1 Describe the specific safety precautions to be taken when setting up CNC electro-discharge machines
- 1.2 Explain how to minimise risks associated with setting CNC electro-discharge machines
- 1.3 Describe how to stop the machine
- 1.4 Describe the procedure for starting the CNC electro-discharge machines
- 1.5 Explain the importance of ensuring the machine is isolated from the power supply before mounting electrodes. Cartridge holders and workholding devices
- 1.6 Explain the importance of wearing the appropriate protective clothing (PPE) and equipment
- 1.7 Explain the importance of keeping the work area clean and tidy when setting up lathes
- 1.8 Describe how to handle and store electrodes, wires and electrode cartridges/holders safely and correctly
- 1.9 Describe how to extract and use information from engineering drawings and related specifications in relation to work undertaken
- 1.10 Describe how to interpret drawings for setting up a CNC machine
- 1.11 Describe the range of workholding methods and devices that are used on CNC electrical-discharge machines
- 1.12 Explain the importance of setting the workholding device in relationship to the machines datums and reference points

- 1.13 Describe the eroded features produced on CNC electro-discharge machines
 - 1.14 Describe how to check that electrodes and wires are in a safe and serviceable condition
 - 1.15 Explain the material conditions that determine the use of different types of electrodes/wires
 - 1.16 Explain how to select the correct grade and type of electrode/wire for the materials and profiles being machined
 - 1.17 Describe types of electrode tool holding devices
 - 1.18 Describe methods used to load, secure and set the electrodes/wire in the electrode cartridge/holder/feed mechanism and the machine head/wire guides
 - 1.19 Describe how to position and identify tools in relationship to the operating program
 - 1.20 Describe how to place the machine into the correct operating mode
 - 1.21 Describe how to conduct trial runs
 - 1.22 Explain the need for full dry runs and single block runs
 - 1.23 Describe typical faults that occur when electrical discharge machining and die sinking
 - 1.24 Describe items that need to be checked before allowing the machine to operate in full program run mode
 - 1.25 Explain how type of materials affect feeds and voltage that can be used
 - 1.26 Describe the application of dielectric fluids with regard to different materials
 - 1.27 Explain how to resolve problems that can occur with setting up electrodes/wires in the electrode cartridge/holder/feed mechanism and with using workholding devices
 - 1.28 Describe the extent of their own authority when setting up CNC electro-discharge machines and to whom they should report if they have problems that they cannot resolve.
-

Range

- (AC1.1)
 - Workholding devices
 - Tooling.

- (AC1.3)
 - Normal situations
 - Emergency situations.

- (AC1.10)
 - First and third angle drawings
 - Imperial and metric systems of measurement
 - Workpiece reference points
 - System of tolerancing.

- (AC1.21) Using:
 - Single block run
 - Dry run
 - Feed and speed override controls.

Learning outcome

The learner will:

- 2 Be able to set CNC electro-discharge machines

Assessment criteria

The learner can:

- 2.1 Obtain and use the appropriate documentation for setting up centre lathes
- 2.2 Adhere to safety procedures in place for setting up centre lathes
- 2.3 Follow safe practice/approved setting-up procedures
- 2.4 Confirm the operating program has been loading
- 2.5 Check that electrode or wire is of the correct type and in a usable condition
- 2.6 Check that the dielectric fluid is at an appropriate level
- 2.7 Ensure the workpiece is correctly positioned and secured without distortion
- 2.8 Update program tool data
- 2.9 Ensure that correctly adjusted machine guards are in place
- 2.10 Position and secure workpieces using different workholding methods
- 2.11 Select, load and set different types of electrodes
- 2.12 Prepare tooling for operation
- 2.13 Set up the machine to produce components that combine several different operations
- 2.14 Set the machine to produce components to quality and accuracy standards, as applicable to the operations performed
- 2.15 Leave the work area and machine in a safe and appropriate condition on completion of the activities.

Range

- (AC2.2)
- For risk assessment
 - For COSHH
 - For personal protective equipment
 - For other relevant safety regulations and procedures to realise a safe system of work.
- (AC2.10) Use three of the following:
- Direct clamping to machine table
 - Angle plates
 - Chucks
 - Pneumatic or magnetic table
 - Vee block and clamps
 - Ancillary indexing devices
 - Machine vices

- Fixtures
- Other specific workholding devices.

(AC2.11) To include one of the following:

- Plain electrodes
- Profile electrodes
- Hollow electrodes
- Wires.

(AC2.12) • Pre-set electrodes in tooling cartridges/holders manually or by using setting jigs/fixtures

- Load and thread wire through wire feed mechanism and wire guides
- Position electrode cartridges/holders in correct position on machine head or magazine/docking station
- Check electrode cartridges/holders/wire have a specific tool number or technology setting in relation to the operating program
- Enter all relevant wire data to the operating program
- Set tool/wire datum point
- Save changes to the program.

(AC2.13) To include ten of the following:

- Flat faces
- Parallel faces
- Tapered faces
- Angular faces
- Open ended slots/recesses
- Faces that are square to each other
- Holes on pitch circles
- Internal profiles
- Enclosed slots/recesses
- Linear holes
- External profiles
- Tapered holes
- Special profiles (eg concave, convex)
- Parallel and tapered steps/shoulders/slots
- Circular/curved profiles (internal and external)
- Other special forms or activities.

(AC2.14) • Dimensional tolerance equivalent to BS EN 20286 or BS Grade 7

- Flatness and squareness 0.001" per inch or 0.025mm per 25mm
- Components to be free from false starts and sharp edges
- Surface finish 32 μin ; 0.8 μm ; 18VDI
- Machined holes within H8
- Angles within +/- 0.25 degree.

Unit 325

Machining components using CNC electrical discharge machines

Unit level:	Level 3
GLH:	126
Unit aim:	The purpose of this unit is for learners to develop understanding and skills needed to be competent in machining using CNC electrical discharge machines, in accordance with approved procedures.
Relationship to NOS:	EUCL3D-168

Learning outcome

The learner will:

- 1 Understand how to machine components using CNC electrical discharge machines

Assessment criteria

The learner can:

- 1.1 Describe the safe working practices and procedures to be followed while operating CNC electrical discharge machines
- 1.2 Describe the procedure for checking that machine safety mechanisms function correctly
- 1.3 Describe how to stop the machine
- 1.4 Describe the procedure for starting the machine
- 1.5 Explain the importance of wearing Personal Protective Equipment (PPE) when using CNC electrical discharge machines
- 1.6 Explain how to minimise risks associated with electrical discharge operations on CNC electrical discharge machines
- 1.7 Explain the importance of keeping the work area clean and tidy when machining on CNC electrical discharge machines
- 1.8 Describe how to extract and use information from engineering drawings and related specifications in relation to machining work to be undertaken
- 1.9 Describe how to interpret drawings for machining
- 1.10 Describe how to use the visual display
- 1.11 Describe how to deal with different types of error messages displayed

- 1.12 State how to find the correct restart point in the program when the machine has stopped before completion
 - 1.13 Describe the applications of different types of CNC electrical discharge machines
 - 1.14 Describe the operation of different hand and automatic modes of machine control
 - 1.15 Describe how to conduct trial runs
 - 1.16 Explain the need for full dry runs and single block runs
 - 1.17 Describe how to make adjustments to the program operating parameters to take account of electrode wear
 - 1.18 Describe how different types of electrode/wire are secured to the machine
 - 1.19 Describe the safe and correct handling and storage of tooling
 - 1.20 Describe how to check that the electrode/wire is in a serviceable conditions
 - 1.21 Explain the effects that worn tooling can have on the workpiece surface finish and tolerances
 - 1.22 Describe how to set and secure the workpiece to the machine
 - 1.23 Explain the potential effects of clamping the workpiece
 - 1.24 Explain how material removal can cause distortion of the finished workpiece
 - 1.25 Describe the procedures and equipment used for dressing and reshaping electrodes
 - 1.26 Explain the application of dielectric and ionised fluids with regard to different materials being machined
 - 1.27 Explain how to resolve problems that can occur with electrical discharge operations
 - 1.28 Describe the quality control procedures and related equipment used
 - 1.29 Describe the extent of their own authority when machining with CNC electrical discharge machines and to whom they should report if they have problems that they cannot resolve.
-

Range

- (AC1.3)
 - Normal situations
 - Emergency situations.

- (AC1.15) Using:
- Single block run
 - Dry run
 - Feed and speed override controls.
-

Learning outcome

The learner will:

- 2 Be able to machine components using CNC electrical discharge machines
-

Assessment criteria

The learner can:

- 2.1 Obtain and use the appropriate documentation for machining with CNC electrical discharge machines
- 2.2 Adhere to safety procedures for machining with CNC electrical discharge machines
- 2.3 Ensure that correctly adjusted machine guards are in place
- 2.4 Hold components securely without distortion
- 2.5 Check the electrode or wire is in place and in a usable condition
- 2.6 Ensure that the dielectric fluid is at an appropriate level
- 2.7 Adjust machine settings, as required, to maintain the required accuracy
- 2.8 Produce machined components which combine different operations
- 2.9 Carry out checks for accuracy during production
- 2.10 Produce components that meet quality and accuracy standards applicable to the operations performed
- 2.11 Leave the work area and machine in a safe and appropriate condition on completion of the activities.

Range

- (AC2.2)
- For risk assessment
 - For COSHH
 - For personal protective equipment
 - For other relevant safety regulations and procedures to realise a safe system of work.
- (AC2.8) To include ten of the following:
- Flat faces
 - External profiles
 - Holes on pitch circles
 - Angular faces
 - Internal profiles
 - Linear holes (rows, angles)
 - Tapered faces
 - Enclosed slots/recesses
 - Special profiles (eg concave, convex)
 - Parallel faces
 - Open ended slots/recesses
 - Faces square to each other
 - Tapered holes
 - Parallel and tapered steps/shoulders/slots
 - Engraving
 - Circular/curved profiles (internal or external)

- Threads
- Other special forms or activities.

(AC2.9) To include five of the following:

- Dimensions
- Parallelism
- Squareness
- Profiles
- Position
- Angle/taper
- Surface texture.

- (AC2.10)
- Dimensional tolerance equivalent to BS EN 20286 or BS 1916 Grade 7
 - Flatness and squareness 0.001" per inch or 0.025mm per 25mm
 - Components to be free from false starts and sharp edges
 - Machined holes within H8
 - Angles within +/- 0.25 degree
 - Surface texture within 32 μ m; 0.8 μ m; 18VDI.

Unit level:	Level 3
GLH:	140
Unit aim:	The purpose of this unit is for learners to develop understanding and skills needed to be competent in preparing and setting up Computer Numerical Control (CNC) vertical boring machines, in accordance with approved procedures.
Relationship to NOS:	EUCL3D-169

Learning outcome

The learner will:

- 1 Understand how to set CNC vertical boring machines

Assessment criteria

The learner can:

- 1.1 Describe the specific safety precautions to be taken when setting up CNC vertical boring machines
- 1.2 Explain how to minimise risks associated with setting CNC vertical boring machines
- 1.3 Describe how to stop the machine
- 1.4 Describe the procedure for starting the CNC vertical boring machines
- 1.5 Explain the importance of ensuring the machine is isolated from the power supply before mounting cutting tools and workholding devices
- 1.6 Explain the importance of wearing the appropriate protective clothing (PPE) and equipment
- 1.7 Explain the importance of keeping the work area clean and tidy when setting up lathes
- 1.8 Describe how to extract and use information from engineering drawings and related specifications in relation to work undertaken
- 1.9 Describe how to interpret drawings for setting up a CNC machine
- 1.10 Describe the range of workholding methods and devices that are used on CNC vertical boring machines
- 1.11 Explain the importance of setting the workholding device in relationship to the machines datums and reference points
- 1.12 Describe how to set the workholding devices and the tools and equipment used

- 1.13 Describe the typical applications of different types of cutting tools used on CNC vertical boring machines
 - 1.14 Describe how to check that cutting tools are in a safe and serviceable condition
 - 1.15 Explain the factors that determine selection and use of indexable tips
 - 1.16 Describe types of tool holding devices
 - 1.17 Describe methods used to mount and secure cutting tools to the tool holders
 - 1.18 Explain the advantages of using pre-set tooling
 - 1.19 Describe how to set the tooling using setting jigs/fixtures
 - 1.20 Describe how to position and identify tools in relationship to the operating program
 - 1.21 Describe how to place the machine into the correct operating mode
 - 1.22 Describe how to conduct trial runs
 - 1.23 Explain the need for full dry runs and single block runs
 - 1.24 Describe items that need to be checked before allowing the machine to operate in full program run mode
 - 1.25 Explain how type of materials affect feeds and speeds that can be used
 - 1.26 Describe the application of cutting fluids with regard to different materials
 - 1.27 Explain why some materials do not require the use of cutting fluids
 - 1.28 Explain how to resolve problems that can occur with setting up the workholding devices and tooling
 - 1.29 Describe the extent of their own authority when setting up CNC vertical boring machines and to whom they should report if they have problems that they cannot resolve.
-

Range

- (AC1.1)
 - Workholding devices
 - Tooling.

- (AC1.3)
 - Normal situations
 - Emergency situations.

- (AC1.9)
 - First and third angle drawings
 - Imperial and metric systems of measurement
 - Workpiece reference points
 - System of tolerancing.

- (AC1.15)
 - Condition of material supplied
 - Hardness of the material
 - Cutting characteristics of the material
 - Tolerances to be achieved
 - Component surface finish
 - Specifications.

- (AC1.15) • Tungsten carbide
• Ceramic
• Diamond.

- (AC1.22) Using:
- Single block run
 - Dry run
 - Feed and speed override controls.

Learning outcome

The learner will:

- 2 Be able to set CNC vertical boring machines

Assessment criteria

The learner can:

- 2.1 Obtain and use the appropriate documentation for setting up centre lathes
- 2.2 Adhere to safety procedures in place for setting up centre lathes
- 2.3 Follow safe practice/approved setting-up procedures
- 2.4 Confirm the operating program has been loading
- 2.5 Check that tooling is in a usable condition
- 2.6 Ensure the workpiece is correctly positioned and secured without distortion
- 2.7 Update program tool data
- 2.8 Ensure that correctly adjusted machine guards are in place
- 2.9 Position and secure workpieces using different workholding methods
- 2.10 Select and mount vertical boring tools
- 2.11 Prepare tooling for operation
- 2.12 Set up the machine to produce components that combine several different operations
- 2.13 Set the machine to produce components to quality and accuracy standards, as applicable to the operations performed
- 2.14 Leave the work area and machine in a safe and appropriate condition on completion of the activities.

Range

- (AC2.2)
- For risk assessment
 - For COSHH
 - For personal protective equipment
 - For other relevant safety regulations and procedures to realise a safe system of work.
- (AC2.9) Use four of the following:
- Direct clamping to machine table
 - Indexing/rotating device
 - Machine vices
 - Vee block and clamps
 - Three jaw chucks, soft jaws
 - Four jaw chucks
 - Three jaw chucks, hard jaws

- Pneumatic or magnetic table
- Fixtures
- Angle plates
- Other specific workholding devices.

(AC2.10) To include eight of the following:

- Boring bars
- Profiling
- Boring tools
- Turning tools
- Form tools
- Reamers
- Chamfering tools
- Centre drills
- Grinding wheels
- Recessing tools
- Twist/core drills
- Milling cutters.

(AC2.11) • Position tools in the correct position in the tool posts, turrets, magazine or carousel

- Check tools have a specific tool number in relation to the operating program
- Enter all relevant tool data to the operating program (tool lengths, tool offsets, radius compensation)
- Pre-set tooling using setting jigs/fixtures
- Set tool datum
- Save changes to the program.

(AC2.12) To include ten of the following:

- Plain internal/external diameters
- Internal and external profiles
- Screw threads
- Stepped diameters
- Internal bores
- Tapered diameters
- Drilled holes
- Chamfers and radii
- Special forms (eg concave, convex)
- Reamed holes
- Bored holes
- Tapped holes
- Flat faces
- Angular faces
- Eccentric diameters
- Internal/external undercuts.

(AC2.13) • General dimensional tolerance $\pm 0.15\text{mm}$ or $\pm 0.006''$

- There must be one or more specific dimensional tolerance within $\pm 0.05\text{mm}$ or $\pm 0.002''$
- Surface finish $32\ \mu\text{in}$; $0.8\ \mu\text{m}$

- Reamed and bored holes within H8
- Screw threads BS medium fit
- Angles within +/- 0.25 degree
- Flatness and squareness 0.001" per inch or 0.025mm per 25mm.

Unit 327

Machining components using CNC vertical boring machines

Unit level:	Level 3
GLH:	126
Unit aim:	The purpose of this unit is for learners to develop understanding and skills needed to be competent in machining using CNC vertical boring machines, in accordance with approved procedures.
Relationship to NOS:	EUCL3D-170

Learning outcome

The learner will:

- 1 Understand how to machine components using CNC vertical boring machines

Assessment criteria

The learner can:

- 1.1 Describe the safe working practices and procedures to be followed while operating CNC vertical boring machines
- 1.2 Describe the procedure for checking that machine safety mechanisms function correctly
- 1.3 Describe how to stop the machine
- 1.4 Describe the procedure for starting the machine
- 1.5 Explain the importance of wearing Personal Protective Equipment (PPE) when using CNC vertical boring machines
- 1.6 Explain how to minimise risks associated with vertical boring operations on CNC vertical boring machines
- 1.7 Explain the importance of keeping the work area clean and tidy when machining on CNC vertical boring machines
- 1.8 Describe how to extract and use information from engineering drawings and related specifications in relation to machining work to be undertaken
- 1.9 Describe how to interpret drawings for machining
- 1.10 Describe how to use the visual display
- 1.11 Describe how to deal with different types of error messages displayed

- 1.12 State how to find the correct restart point in the program when the machine has stopped before completion
 - 1.13 Describe the applications of different types of CNC vertical boring machines
 - 1.14 Describe the operation of different hand and automatic modes of machine control
 - 1.15 Describe how to conduct trial runs
 - 1.16 Explain the need for full dry runs and single block runs
 - 1.17 Describe how to make adjustments to the program operating parameters to take account of tool wear
 - 1.18 Describe how different types cutting tool are secured to the machine
 - 1.19 Describe the safe and correct handling and storage of tooling
 - 1.20 Describe how to check that the indexible tooling is in a serviceable conditions
 - 1.21 Explain the effects that worn tooling can have on the workpiece surface finish and tolerances
 - 1.22 Describe how to set and secure the workpiece to the machine
 - 1.23 Explain the potential effects of clamping the workpiece
 - 1.24 Explain how material removal can cause distortion of the finished workpiece
 - 1.25 Explain the application of cutting fluids with regard to different materials being machined
 - 1.26 Explain how to resolve problems that can occur with vertical boring operations
 - 1.27 Describe the quality control procedures and related equipment used
 - 1.28 Describe the extent of their own authority when machining with CNC vertical boring machines and to whom they should report if they have problems that they cannot resolve.
-

Range

- (AC1.3) • Normal situations
• Emergency situations.
- (AC1.9) • First and third angle drawings
• Imperial and metric systems of measurement
• Workpiece reference points
• System of tolerancing.
- (AC1.15) Using:
• Single block run
• Dry run
• Feed and speed override controls.

Learning outcome

The learner will:

- 2 Be able to machine components using CNC vertical boring machines

Assessment criteria

The learner can:

- 2.1 Obtain and use the appropriate documentation for machining with CNC vertical boring machines
- 2.2 Adhere to safety procedures for machining with CNC vertical boring machines
- 2.3 Check that the operating program is at the correct starting point
- 2.4 Ensure that correctly adjusted machine guards are in place
- 2.5 Hold components securely without distortion
- 2.6 Check the cutting tools are in a usable condition
- 2.7 Adjust machine settings, as required, to maintain the required accuracy
- 2.8 Produce machined components which combine different operations
- 2.9 Carry out checks for accuracy during production
- 2.10 Produce components that meet quality and accuracy standards applicable to the operations performed
- 2.11 Leave the work area and machine in a safe and appropriate condition on completion of the activities

Range

- (AC2.2)
- For risk assessment
 - For COSHH
 - For personal protective equipment
 - For other relevant safety regulations and procedures to realise a safe system of work.
- (AC2.8) To include ten of the following:
- Plain internal/external diameters
 - External and internal profiles
 - Screw threads
 - Stepped diameters
 - Internal bores
 - Tapered diameters
 - Drilled holes
 - Chamfers and radii
 - Special forms (eg concave, convex)
 - Reamed holes

- Bored holes
- Tapped holes
- Flat faces
- Angular faces
- Eccentric diameters
- Internal/external undercuts.

(AC2.9) To include five of the following:

- External diameters
- Thread fit
- Internal diameters
- Slot/recess width
- Lengths/depths
- Surface finish
- Reamed hole size/fit
- Flatness of faces
- Taper/angles
- Squareness of faces.

- (AC2.10)
- General dimensional tolerance $\pm 0.15\text{mm}$ or $\pm 0.006''$
 - There must be one or more specific dimensional tolerances within $\pm 0.05\text{mm}$ or $\pm 0.002''$
 - Flatness and squareness $0.001''$ per inch or 0.025mm per 25mm
 - Reamed and bored holes within H8
 - Angles within ± 0.25 degree
 - Surface finish $32\mu\text{in}$; $0.8\mu\text{m}$
 - Screw threads BS medium fit.

Unit level:	Level 3
GLH:	140
Unit aim:	The purpose of this unit is for learners to develop understanding and skills needed to be competent in preparing and setting up Computer Numerical Control (CNC) horizontal boring machines, in accordance with approved procedures.
Relationship to NOS:	EUCL3D-171

Learning outcome

The learner will:

- 1 Understand how to set CNC horizontal boring machines

Assessment criteria

The learner can:

- 1.1 Describe the specific safety precautions to be taken when setting up CNC horizontal boring machines
- 1.2 Explain how to minimise risks associated with setting CNC horizontal boring machines
- 1.3 Describe how to stop the machine
- 1.4 Describe the procedure for starting the CNC horizontal boring machines
- 1.5 Explain the importance of ensuring the machine is isolated from the power supply before mounting cutting tools and workholding devices
- 1.6 Explain the importance of wearing the appropriate protective clothing (PPE) and equipment
- 1.7 Explain the importance of keeping the work area clean and tidy when setting up lathes
- 1.8 Describe how to extract and use information from engineering drawings and related specifications in relation to work undertaken
- 1.9 Describe how to interpret drawings for setting up a CNC machine
- 1.10 Describe the range of workholding methods and devices that are used on CNC horizontal boring machines
- 1.11 Explain the importance of setting the workholding device in relationship to the machines datums and reference points
- 1.12 Describe how to set the workholding devices and the tools and equipment used

- 1.13 Describe the typical applications of different types of cutting tools used on CNC horizontal boring machines
 - 1.14 Describe how to check that cutting tools are in a safe and serviceable condition
 - 1.15 Explain the factors that determine selection and use of indexable tips
 - 1.16 Describe types of tool holding devices
 - 1.17 Describe methods used to mount and secure cutting tools to the tool holders
 - 1.18 Explain the advantages of using pre-set tooling
 - 1.19 Describe how to set the tooling using setting jigs/fixtures
 - 1.20 Describe how to position and identify tools in relationship to the operating program
 - 1.21 Describe how to place the machine into the correct operating mode
 - 1.22 Describe how to conduct trial runs
 - 1.23 Explain the need for full dry runs and single block runs
 - 1.24 Describe items that need to be checked before allowing the machine to operate in full program run mode
 - 1.25 Explain how type of materials affect feeds and speeds that can be used
 - 1.26 Describe the application of cutting fluids with regard to different materials
 - 1.27 Explain why some materials do not require the use of cutting fluids
 - 1.28 Explain how to resolve problems that can occur with setting up the workholding devices and tooling
 - 1.29 Describe the extent of their own authority when setting up CNC horizontal boring machines and to whom they should report if they have problems that they cannot resolve.
-

Range

- (AC1.1)
 - Workholding devices
 - Tooling.

- (AC1.3)
 - Normal situations
 - Emergency situations.

- (AC1.9)
 - First and third angle drawings
 - Imperial and metric systems of measurement
 - Workpiece reference points
 - System of tolerancing.

- (AC1.15)
 - Condition of material supplied
 - Hardness of the material
 - Cutting characteristics of the material
 - Tolerances to be achieved
 - Component surface finish
 - Specifications.

- (AC1.15) • Tungsten carbide
• Ceramic
• Diamond.

- (AC1.22) Using:
- Single block run
 - Dry run
 - Feed and speed override controls.

Learning outcome

The learner will:

- 2 Be able to set CNC horizontal boring machines

Assessment criteria

The learner can:

- 2.1 Obtain and use the appropriate documentation for setting up centre lathes
- 2.2 Adhere to safety procedures in place for setting up centre lathes
- 2.3 Follow safe practice/approved setting-up procedures
- 2.4 Confirm the operating program has been loading
- 2.5 Check that tooling is in a usable condition
- 2.6 Ensure the workpiece is correctly positioned and secured without distortion
- 2.7 Update program tool data
- 2.8 Ensure that correctly adjusted machine guards are in place
- 2.9 Position and secure workpieces using different workholding methods
- 2.10 Select and mount horizontal boring tools
- 2.11 Prepare tooling for operation
- 2.12 Set up the machine to produce components that combine several different operations
- 2.13 Set the machine to produce components to quality and accuracy standards, as applicable to the operations performed
- 2.14 Leave the work area and machine in a safe and appropriate condition on completion of the activities.

Range

- (AC2.2)
- For risk assessment
 - For COSHH
 - For personal protective equipment
 - For other relevant safety regulations and procedures to realise a safe system of work.
- (AC2.9) Use four of the following:
- Direct clamping to machine table
 - Indexing/rotating device
 - Four jaw chucks
 - Machine vices
 - Vee block and clamps
 - Fixtures
 - Three jaw chucks, soft jaws

- Three jaw chucks, hard jaws
- Angle plates
- Pneumatic or magnetic table
- Other specific workholding devices.

(AC2.10) To include eight of the following:

- Boring tools
- Chamfering tools
- Facing tools
- Taps
- Milling cutters
- Turning tools
- Recessing tools
- Twist/core drills
- Reamers
- Forming tools.

(AC2.11) • Position tools in the correct position in the tool posts, turrets, magazine or carousel

- Check tools have a specific tool number in relation to the operating program
- Enter all relevant tool data to the operating program (tool lengths, tool offsets, radius compensation)
- Pre-set tooling using setting jigs/fixtures
- Set tool datum
- Save changes to the program.

(AC2.12) To include eight of the following:

- Bored holes through the workpiece
- Square and parallel faces
- Grooves/undercuts
- Bored holes to a depth
- Angular faces
- Drilled holes
- External diameters
- Slots
- Reamed holes
- Flat faces
- Indexed or rotated forms
- Tapped holes
- Internal and external profiles.

(AC2.13) • General dimensional tolerance $\pm 0.15\text{mm}$ or $\pm 0.006''$

- There must be one or more specific dimensional tolerance within $\pm 0.05\text{mm}$ or $\pm 0.002''$
- Surface finish $32\ \mu\text{in}$; $0.8\ \mu\text{m}$
- Reamed and bored holes within H8
- Screw threads BS medium fit
- Angles within ± 0.25 degree
- Flatness and squareness $0.001''$ per inch or 0.025mm per 25mm .

Unit 329

Machining components using CNC horizontal boring machines

Unit level:	Level 3
GLH:	126
Unit aim:	The purpose of this unit is for learners to develop understanding and skills needed to be competent in machining using CNC horizontal boring machines, in accordance with approved procedures.
Relationship to NOS:	EUCL3D-172

Learning outcome

The learner will:

- 1 Understand how to machine components using CNC horizontal boring machines

Assessment criteria

The learner can:

- 1.1 Describe the safe working practices and procedures to be followed while operating CNC horizontal boring machines
- 1.2 Describe the procedure for checking that machine safety mechanisms function correctly
- 1.3 Describe how to stop the machine
- 1.4 Describe the procedure for starting the machine
- 1.5 Explain the importance of wearing Personal Protective Equipment (PPE) when using CNC horizontal boring machines
- 1.6 Explain how to minimise risks associated with horizontal boring operations on CNC horizontal boring machines
- 1.7 Explain the importance of keeping the work area clean and tidy when machining on CNC horizontal boring machines
- 1.8 Describe how to extract and use information from engineering drawings and related specifications in relation to machining work to be undertaken
- 1.9 Describe how to interpret drawings for machining
- 1.10 Describe how to use the visual display
- 1.11 Describe how to deal with different types of error messages displayed

- 1.12 State how to find the correct restart point in the program when the machine has stopped before completion
 - 1.13 Describe the applications of different types of CNC horizontal boring machines
 - 1.14 Describe the operation of different hand and automatic modes of machine control
 - 1.15 Describe how to conduct trial runs
 - 1.16 Explain the need for full dry runs and single block runs
 - 1.17 Describe how to make adjustments to the program operating parameters to take account of tool wear
 - 1.18 Describe how different types cutting tool are secured to the machine
 - 1.19 Describe the safe and correct handling and storage of tooling
 - 1.20 Describe how to check that the indexible tooling is in a serviceable conditions
 - 1.21 Explain the effects that worn tooling can have on the workpiece surface finish and tolerances
 - 1.22 Describe how to set and secure the workpiece to the machine
 - 1.23 Explain the potential effects of clamping the workpiece
 - 1.24 Explain how material removal can cause distortion of the finished workpiece
 - 1.25 Explain the application of cutting fluids with regard to different materials being machined
 - 1.26 Explain how to resolve problems that can occur with horizontal boring operations
 - 1.27 Describe the quality control procedures and related equipment used
 - 1.28 Describe the extent of their own authority when machining with CNC horizontal boring machines and to whom they should report if they have problems that they cannot resolve.
-

Range

- (AC1.3) • Normal situations
• Emergency situations.
- (AC1.9) • First and third angle drawings
• Imperial and metric systems of measurement
• Workpiece reference points
• System of tolerancing.
- (AC1.15) Using:
• Single block run
• Dry run
• Feed and speed override controls.

Learning outcome

The learner will:

- 2 Be able to machine components using CNC horizontal boring machines

Assessment criteria

The learner can:

- 2.1 Obtain and use the appropriate documentation for machining with CNC horizontal boring machines
- 2.2 Adhere to safety procedures for machining with CNC horizontal boring machines
- 2.3 Check that the operating program is at the correct starting point
- 2.4 Ensure that correctly adjusted machine guards are in place
- 2.5 Hold components securely without distortion
- 2.6 Check the cutting tools are in a usable condition
- 2.7 Adjust machine settings, as required, to maintain the required accuracy
- 2.8 Produce machined components which combine different operations
- 2.9 Carry out checks for accuracy during production
- 2.10 Produce components that meet quality and accuracy standards applicable to the operations performed
- 2.11 Leave the work area and machine in a safe and appropriate condition on completion of the activities

Range

- (AC2.2)
- For risk assessment
 - For COSHH
 - For personal protective equipment
 - For other relevant safety regulations and procedures to realise a safe system of work.
- (AC2.8) To include eight of the following:
- Bored holes through the workpiece
 - Slots
 - Indexed or rotated forms
 - Bored holes to a depth
 - Grooves/undercuts
 - Tapered holes
 - Drilled holes
 - External diameters
 - Reamed holes
 - Flat faces

- Tapped holes
- Square and parallel faces
- Internal and external profiles.

(AC2.9) To include five of the following:

- External diameters
- Thread fit
- Internal diameters
- Slot/recess width
- Lengths/depths
- Surface finish
- Reamed hole size/fit
- Flatness of faces
- Taper/angles
- Squareness of faces.

- (AC2.10)
- General dimensional tolerance $\pm 0.15\text{mm}$ or $\pm 0.006''$
 - There must be one or more specific dimensional tolerances within $\pm 0.05\text{mm}$ or $\pm 0.002''$
 - Flatness and squareness $0.001''$ per inch or 0.025mm per 25mm
 - Reamed and bored holes within H8
 - Angles within ± 0.25 degree
 - Surface finish $32\mu\text{in}$; $0.8\mu\text{m}$
 - Screw threads BS medium fit.

Unit level:	Level 3
GLH:	140
Unit aim:	The purpose of this unit is for learners to develop understanding and skills needed to be competent in preparing and setting up Computer Numerical Control (CNC) gear cutting machines, in accordance with approved procedures.
Relationship to NOS:	EUCL3D-173

Learning outcome

The learner will:

- 1 Understand how to set CNC gear cutting machines

Assessment criteria

The learner can:

- 1.1 Describe the specific safety precautions to be taken when setting up CNC gear cutting machines
- 1.2 Explain how to minimise risks associated with setting CNC gear cutting machines
- 1.3 Describe how to stop the machine
- 1.4 Describe the procedure for starting the CNC gear cutting machines
- 1.5 Explain the importance of ensuring the machine is isolated from the power supply before mounting cutting tools and workholding devices
- 1.6 Explain the importance of wearing the appropriate protective clothing (PPE) and equipment
- 1.7 Explain the importance of keeping the work area clean and tidy when setting up CNC machines
- 1.8 Describe how to handle and store cutting cutters safely and correctly
- 1.9 Describe how to extract and use information from engineering drawings and related specifications in relation to work undertaken
- 1.10 Describe how to interpret drawings for setting up a CNC machine
- 1.11 Describe the range of workholding methods and devices that are used on CNC gear cutting machines
- 1.12 Explain the importance of setting the workholding device in relationship to the machines datums and reference points

- 1.13 Describe how to set the workholding devices and the tools and equipment used
 - 1.14 Describe the typical applications of different types of cutting tools used on CNC gear cutting machines
 - 1.15 Describe the typical applications of different types of gears
 - 1.16 Describe how to check that cutting tools are in a safe and serviceable condition
 - 1.17 Explain the factors that determine selection and use of indexable tips
 - 1.18 Describe types of cutting tool holding devices
 - 1.19 Describe methods used to mount and secure cutting tools to the tool holders
 - 1.20 Explain the advantages of using pre-set tooling
 - 1.21 Describe how to set the tooling using setting jigs
 - 1.22 Describe how to position and identify tools in relationship to the operating program
 - 1.23 Describe how to place the machine into the correct operating mode
 - 1.24 Describe how to conduct trial runs
 - 1.25 Explain the need for full dry runs and single block runs
 - 1.26 Describe items that need to be checked before allowing the machine to operate in full program run mode
 - 1.27 Explain how type of materials affect feeds and speeds that can be used
 - 1.28 Describe the application of cutting fluids with regard to different materials
 - 1.29 Explain why some materials do not require the use of cutting fluids
 - 1.30 Explain how to resolve problems that can occur with setting up the workholding devices and tooling
 - 1.31 Define gear nomenclature
 - 1.32 Describe the extent of their own authority when setting up CNC gear cutting machines and to whom they should report if they have problems that they cannot resolve.
-

Range

- (AC1.1)
 - Workholding devices
 - Tooling.
 - (AC1.3)
 - Normal situations
 - Emergency situations.
 - (AC1.10)
 - First and third angle drawings
 - Imperial and metric systems of measurement
 - Workpiece reference points
 - System of tolerancing.
 - (AC1.17)
 - Condition of material supplied
 - Hardness of the material
 - Cutting characteristics of the material
-

- Tolerances to be achieved
- Component surface finish
- Specifications.

- (AC1.17) • Tungsten carbide
- Ceramic
 - Diamond.

- (AC1.24) Using:
- Single block run
 - Dry run
 - Feed and speed override controls.

Learning outcome

The learner will:

- 2 Be able to set CNC gear cutting machines

Assessment criteria

The learner can:

- 2.1 Obtain and use the appropriate documentation for setting up centre lathes
- 2.2 Adhere to safety procedures in place for setting up centre lathes
- 2.3 Follow safe practice/approved setting-up procedures
- 2.4 Confirm the operating program has been loading
- 2.5 Check that tooling is in a usable condition
- 2.6 Ensure the workpiece is correctly positioned and secured without distortion
- 2.7 Update program tool data
- 2.8 Ensure that correctly adjusted machine guards are in place
- 2.9 Position and secure workpieces using different workholding methods
- 2.10 Select and mount cutting tools
- 2.11 Prepare tooling for operation
- 2.12 Set up the machine to produce components that combine features
- 2.13 Set the machine to produce components to quality and accuracy standards, as applicable to the operations performed
- 2.14 Leave the work area and machine in a safe and appropriate condition on completion of the activities.

Range

- (AC2.2)
- For risk assessment
 - For COSHH
 - For personal protective equipment
 - For other relevant safety regulations and procedures to realise a safe system of work.

(AC2.9) Use four of the following:

- Arbors
- Chucks
- Collets
- Centres
- Face plates
- Mandrels
- Pots
- Fixtures
- Clamps.

(AC2.10) To include three of the following:

- Hobs
- Bevel gear cutting tools
- Spline/serration cutting tools
- Shaving tools
- Rack cutting tools
- Other specific cutting tools
- Fly tools.

(AC2.11) • Position tools in the correct position in the turrets, magazine or carousel

- Check tools have a specific tool number in relation to the operating program
- Enter all relevant tool data to the operating program (tool lengths, tool offsets)
- Set tool datum
- Pre-set tooling using setting jigs/fixtures
- Save changes to the program.

(AC2.12) To include four of the following:

- External spur gears
- Internal helical gears
- Serrations
- Internal spur gears
- Straight splines
- Bevel gears
- External helical gears
- Involute splines
- Racks
- Worm gears.

(AC2.13) • Components to be free from false tool cuts, burrs and sharp edges

- Straight splines and serrations to current BS or ISO standards
- Involute splines to current BS or ISO standards
- Surface texture 32 μin ; 0.8 μm
- Contact pattern
- Backlash
- Company/customer requirements.

Unit 331

Machining components using CNC gear cutting machines

Unit level:	Level 3
GLH:	126
Unit aim:	The purpose of this unit is for learners to develop understanding and skills needed to be competent in machining using CNC gear cutting machines, in accordance with approved procedures.
Relationship to NOS:	EUCL3D-174

Learning outcome

The learner will:

- 1 Understand how to machine components using CNC gear cutting machines

Assessment criteria

The learner can:

- 1.1 Describe the safe working practices and procedures to be followed while operating CNC gear cutting machines
- 1.2 Describe the procedure for checking that machine safety mechanisms function correctly
- 1.3 Describe how to stop the machine
- 1.4 Describe the procedure for starting the machine
- 1.5 Explain the importance of wearing Personal Protective Equipment (PPE) when using CNC gear cutting machines
- 1.6 Explain how to minimise risks associated with gear cutting operations on CNC gear cutting machines
- 1.7 Explain the importance of keeping the work area clean and tidy when machining on CNC gear cutting machines
- 1.8 Describe how to extract and use information from engineering drawings and related specifications in relation to machining work to be undertaken
- 1.9 Describe how to interpret drawings for machining
- 1.10 Describe how to use the visual display

- 1.11 Describe how to deal with different types of errors messages displayed
 - 1.12 State how to find the correct restart point in the program when the machine has stopped before completion
 - 1.13 Describe the applications of different types of CNC gear cutting machines
 - 1.14 Describe the operation of different hand and automatic modes of machine control
 - 1.15 Describe how to conduct trial runs
 - 1.16 Explain the need for full dry runs and single block runs
 - 1.17 Describe how to make adjustments to the program operating parameters to take account of tool wear
 - 1.18 Describe how different types cutting tool are secured to the machine
 - 1.19 Describe the safe and correct handling and storage of tooling
 - 1.20 Describe how to check that the indexible tooling is in a serviceable conditions
 - 1.21 Explain the effects that worn tooling can have on the workpiece surface finish and tolerances
 - 1.22 Describe how to set and secure the workpiece to the machine
 - 1.23 Explain the potential effects of clamping the workpiece
 - 1.24 Explain how material removal can cause distortion of the finished workpiece
 - 1.25 Explain the application of cutting fluids with regard to different materials being machined
 - 1.26 Explain how to resolve problems that can occur with gear cutting operations
 - 1.27 Describe the quality control procedures and related equipment used
 - 1.28 Describe the extent of their own authority when machining with CNC gear cutting machines and to whom they should report if they have problems that they cannot resolve.
-

Range

- (AC1.3) • Normal situations
• Emergency situations.
- (AC1.9) • First and third angle drawings
• Imperial and metric systems of measurement
• Workpiece reference points
• System of tolerancing.
- (AC1.15) Using:
• Single block run
• Dry run
• Feed and speed override controls.

Learning outcome

The learner will:

- 2 Be able to machine components using CNC gear cutting machines

Assessment criteria

The learner can:

- 2.1 Obtain and use the appropriate documentation for machining with CNC gear cutting machines
- 2.2 Adhere to safety procedures for machining with CNC gear cutting machines
- 2.3 Check that the operating program is at the correct starting point
- 2.4 Ensure that correctly adjusted machine guards are in place
- 2.5 Hold components securely without distortion
- 2.6 Check the cutting tools are in a usable condition
- 2.7 Adjust machine settings, as required, to maintain the required accuracy
- 2.8 Produce machined components with different features
- 2.9 Carry out checks for accuracy during production
- 2.10 Produce components that meet quality and accuracy standards applicable to the operations performed
- 2.11 Leave the work area and machine in a safe and appropriate condition on completion of the activities.

Range

- (AC2.2)
- For risk assessment
 - For COSHH
 - For personal protective equipment
 - For other relevant safety regulations and procedures to realise a safe system of work.

(AC2.8) To include four of the following:

- External spur gears
- Involute splines
- Internal spur gears
- Serrations
- External helical gears
- Bevel gears
- Internal helical gears
- Racks
- Straight splines
- Work gears.

(AC2.9) To include five of the following:

- Gear blanks
- Involute form
- Lead and helix angle
- Composite error rolling test
- Gear tooth thickness
- Surface texture
- Backlash
- Contact pattern.

- (AC2.10)
- Components to be free from false tool cuts, burrs and sharp edges
 - Straight splines and serrations to current BS or ISO standards
 - Spur and helical gears to current BS or ISO standards
 - Involute splines to current BS or ISO standards
 - Tolerance to current BS or ISO standards
 - Surface texture $32\mu\text{in};r\ 0.8\mu\text{m}$
 - Company/customer requirements.

Unit level:	Level 3
GLH:	140
Unit aim:	The purpose of this unit is for learners to develop understanding and skills needed to be competent in preparing and setting up Computer Numerical Control (CNC) machining centres, in accordance with approved procedures.
Relationship to NOS:	EUCL3D-175

Learning outcome

The learner will:

- 1 Understand how to set CNC machining centres

Assessment criteria

The learner can:

- 1.1 Describe the specific safety precautions to be taken when setting up CNC machining centres
- 1.2 Explain how to minimise risks associated with setting CNC machining centres
- 1.3 Describe how to stop the machine
- 1.4 Describe the procedure for starting the CNC machining centres
- 1.5 Explain the importance of ensuring the machine is isolated from the power supply before mounting milling tools and workholding devices
- 1.6 Explain the importance of wearing the appropriate protective clothing (PPE) and equipment
- 1.7 Explain the importance of keeping the work area clean and tidy when setting up lathes
- 1.8 Describe how to handle and store milling cutters safely and correctly
- 1.9 Describe how to extract and use information from engineering drawings and related specifications in relation to work undertaken
- 1.10 Describe how to interpret drawings for setting up a CNC machine
- 1.11 Describe the range of workholding methods and devices that are used on CNC machining centres
- 1.12 Explain the importance of setting the workholding device in relationship to the machines datums and reference points
- 1.13 Describe how to set the workholding devices and the tools and equipment used

- 1.14 Describe the typical applications of different types of cutting tools used on CNC machining centres
 - 1.15 Explain the factors that determine selection and use of indexable tips
 - 1.16 Describe how to check that cutting tools are in a safe and serviceable condition
 - 1.17 Describe types of milling tool holding devices
 - 1.18 Describe methods used to mount and secure cutting tools to the tool holders
 - 1.19 Explain the advantages of using pre-set tooling
 - 1.20 Describe how to set the tooling using setting jigs/fixtures
 - 1.21 Describe how to position and identify tools in relationship to the operating program
 - 1.22 Describe how to place the machine into the correct operating mode
 - 1.23 Describe how to conduct trial runs
 - 1.24 Explain the need for full dry runs and single block runs
 - 1.25 Describe items that need to be checked before allowing the machine to operate in full program run mode
 - 1.26 Explain how type of materials affect feeds and speeds that can be used
 - 1.27 Describe the application of cutting fluids with regard to different materials
 - 1.28 Explain why some materials do not require the use of cutting fluids
 - 1.29 Explain how to resolve problems that can occur with setting up the workholding devices and tooling
 - 1.30 Describe the extent of their own authority when setting up CNC machining centres and to whom they should report if they have problems that they cannot resolve.
-

Range

- (AC1.1)
 - Workholding devices
 - Tooling.

- (AC1.3)
 - Normal situations
 - Emergency situations.

- (AC1.10)
 - First and third angle drawings
 - Imperial and metric systems of measurement
 - Workpiece reference points
 - System of tolerancing.

- (AC1.15)
 - Condition of material supplied
 - Hardness of the material
 - Cutting characteristics of the material
 - Tolerances to be achieved
 - Component surface finish
 - Specifications.

- (AC1.15) • Tungsten carbide
• Ceramic
• Diamond.

- (AC1.23) Using:
- Single block run
 - Dry run
 - Feed and speed override controls.

Learning outcome

The learner will:

- 2 Be able to set CNC machining centres

Assessment criteria

The learner can:

- 2.1 Obtain and use the appropriate documentation for setting up centre lathes
- 2.2 Adhere to safety procedures in place for setting up centre lathes
- 2.3 Follow safe practice/approved setting-up procedures
- 2.4 Confirm the operating program has been loading
- 2.5 Check that tooling is in a usable condition
- 2.6 Ensure the workpiece is correctly positioned and secured without distortion
- 2.7 Update program tool data
- 2.8 Ensure that correctly adjusted machine guards are in place
- 2.9 Position and secure workpieces using different workholding methods
- 2.10 Select and mount cutting tools
- 2.11 Prepare tooling for operation
- 2.12 Set up the machine to produce components that combine several different operations
- 2.13 Set the machine to produce components to quality and accuracy standards, as applicable to the operations performed
- 2.14 Leave the work area and machine in a safe and appropriate condition on completion of the activities

Range

- (AC2.2)
- For risk assessment
 - For COSHH
 - For personal protective equipment
 - For other relevant safety regulations and procedures to realise a safe system of work.
- (AC2.9) Use four of the following:
- Direct clamping to machine table
 - Chucks with soft jaws
 - Indexing/rotating device
 - Pneumatic or magnetic table
 - Vee blocks and clamps
 - Collet chucks
 - Machine vices
 - Jigs and fixtures

- Chucks with soft jaws
- Angle plates
- Other specific workholding devices.

(AC2.10) To include eight of the following:

- Turning tools
- Twist/core drills
- Slotting cutters
- Slot drills
- Boring tools
- Reamers
- Slitting saws
- Grinding wheels
- Facing tools
- Recessing/undercutting tools
- End mills
- Taps
- Thread cutting tools
- Face mills
- Knurling tools
- U drills
- Parting off tools
- Others specific types of tools.

(AC2.11) • Position tools in the correct position in the turrets, magazine or carousel
• Check tools have a specific tool number in relation to the operating program
• Enter all relevant tool data to the operating program (tool lengths, tool offsets, radius compensation)
• Pre-set tooling using setting jigs/fixtures
• Set tool datum
• Save changes to the program.

(AC2.12) To include ten of the following:

- External diameters
- Square and parallel faces
- Grooves/undercuts
- Reamed holes
- Tapered diameters
- Angular faces
- Tapped holes
- Shoulders/steps
- Indexed or rotated forms
- Drilled
- Slots
- Internal and external profiles
- Holes
- Tapered holes
- Bored holes

- Flat faces.

- (AC2.13)
- Components to be free from false tool cuts, burrs and sharp edges
 - General dimensional tolerance $\pm 0.15\text{mm}$ or $\pm 0.006''$
 - There must be one or more specific dimensional tolerance within $\pm 0.05\text{mm}$ or $\pm 0.002''$
 - Surface finish $32 \mu\text{in}$; $0.8 \mu\text{m}$
 - Reamed / bored holes within H8
 - Screw threads BS medium fit
 - Angles/tapers within ± 0.25 degree
 - Flatness and squareness $0.001''$ per inch or 0.025mm per 25mm .

Unit 333

Machining components using CNC machining centres

Unit level:	Level 3
GLH:	126
Unit aim:	The purpose of this unit is for learners to develop understanding and skills needed to be competent in machining using CNC machining centres, in accordance with approved procedures.
Relationship to NOS:	EUCL3D-176

Learning outcome

The learner will:

- 1 Understand how to machine components using CNC machining centres

Assessment criteria

The learner can:

- 1.1 Describe the safe working practices and procedures to be followed while operating CNC machining centres
- 1.2 Describe the procedure for checking that machine safety mechanisms function correctly
- 1.3 Describe how to stop the machine
- 1.4 Describe the procedure for starting the machine
- 1.5 Explain the importance of wearing Personal Protective Equipment (PPE) when using CNC machining centres
- 1.6 Explain how to minimise risks associated with horizontal boring operations on CNC machining centres
- 1.7 Explain the importance of keeping the work area clean and tidy when machining on CNC machining centres
- 1.8 Describe how to extract and use information from engineering drawings and related specifications in relation to machining work to be undertaken
- 1.9 Describe how to interpret drawings for machining
- 1.10 Describe how to use the visual display
- 1.11 Describe how to deal with different types of error messages displayed

- 1.12 State how to find the correct restart point in the program when the machine has stopped before completion
 - 1.13 Describe the applications of different types of CNC machining centres
 - 1.14 Describe the operation of different hand and automatic modes of machine control
 - 1.15 Describe how to conduct trial runs
 - 1.16 Explain the need for full dry runs and single block runs
 - 1.17 Describe how to make adjustments to the program operating parameters to take account of tool wear
 - 1.18 Describe how different types cutting tool are secured to the machine
 - 1.19 Describe the safe and correct handling and storage of tooling
 - 1.20 Describe how to check that the indexible tooling is in a serviceable conditions
 - 1.21 Explain the effects that worn tooling can have on the workpiece surface finish and tolerances
 - 1.22 Describe how to set and secure the workpiece to the machine
 - 1.23 Explain the potential effects of clamping the workpiece
 - 1.24 Explain how material removal can cause distortion of the finished workpiece
 - 1.25 Explain the application of cutting fluids with regard to different materials being machined
 - 1.26 Explain how to resolve problems that can occur with horizontal boring operations
 - 1.27 Describe the quality control procedures and related equipment used
 - 1.28 Describe the extent of their own authority when machining with CNC machining centres and to whom they should report if they have problems that they cannot resolve.
-

Range

- (AC1.3)
 - Normal situations
 - Emergency situations.
 - (AC1.9)
 - First and third angle drawings
 - Imperial and metric systems of measurement
 - Workpiece reference points
 - System of tolerancing.
 - (AC1.15) Using:
 - Single block run
 - Dry run
 - Feed and speed override controls.
-

Learning outcome

The learner will:

- 2 Be able to machine components using CNC machining centres

Assessment criteria

The learner can:

- 2.1 Obtain and use the appropriate documentation for machining with CNC machining centres
 - 2.2 Adhere to safety procedures for machining with CNC machining centres
 - 2.3 Check that the operating program is at the correct starting point
 - 2.4 Ensure that correctly adjusted machine guards are in place
 - 2.5 Hold components securely without distortion
 - 2.6 Check the cutting tools are in a usable condition
 - 2.7 Adjust machine settings, as required, to maintain the required accuracy
 - 2.8 Produce machined components which combine different operations
 - 2.9 Carry out checks for accuracy during production
 - 2.10 Produce components that meet quality and accuracy standards applicable to the operations performed
 - 2.11 Leave the work area and machine in a safe and appropriate condition on completion of the activities.
-

Range

- (AC2.2)
- For risk assessment
 - For COSHH
 - For personal protective equipment
 - For other relevant safety regulations and procedures to realise a safe system of work.
- (AC2.8) To include ten of the following:
- External diameters
 - Square and parallel faces
 - External threads
 - Tapered diameters
 - Angular faces
 - Grooves
 - Shoulders and steps
 - Slots
 - Undercuts
 - Bored holes
 - Indexed or rotated forms
 - Drilled
 - Tapered holes
 - Internal profiles
 - Holes
 - External profiles
 - Reamed holes
-

- Flat faces
- Tapped holes
- Internal threads.

(AC2.9) To include five of the following:

- External diameters
- Thread fit
- Internal diameters
- Slot/recess width and position
- Lengths/depths
- Surface finish
- Reamed hole size/fit
- Flatness of faces
- Taper/angles
- Squareness of faces.

- (AC2.10)
- General dimensional tolerance $\pm 0.15\text{mm}$ or $\pm 0.006''$
 - There must be one or more specific dimensional tolerances within $\pm 0.05\text{mm}$ or $\pm 0.002''$
 - Components must be free from false tool cuts, burrs and sharp edges
 - Flatness and squareness $0.001''$ per inch or 0.025mm per 25mm
 - Reamed and bored holes within H8
 - Angles within ± 0.25 degree
 - Surface finish $32\mu\text{in}$; $0.8\mu\text{m}$
 - Screw threads BS medium fit.

Unit level:	Level 3
GLH:	140
Unit aim:	The purpose of this unit is for learners to develop understanding and skills needed to be competent in preparing and setting up Computer Numerical Control (CNC) fabrication equipment, in accordance with approved procedures.
Relationship to NOS:	EUCL3D-177

Learning outcome

The learner will:

- 1 Understand how to set CNC fabrication equipment

Assessment criteria

The learner can:

- 1.1 Describe the specific safety precautions to be taken when setting up CNC fabrication machines
- 1.2 Explain how to minimise risks associated with setting CNC fabrication machines
- 1.3 Describe how to stop the machine
- 1.4 Describe the procedure for starting the CNC fabrication machines
- 1.5 Explain the importance of ensuring the machine is isolated from the power supply before mounting cutting and forming tools and workholding devices
- 1.6 Explain the importance of wearing the appropriate protective clothing (PPE) and equipment
- 1.7 Explain the importance of keeping the work area clean and tidy when setting up lathes
- 1.8 Describe how to handle and store cutting and forming tools safely and correctly
- 1.9 Describe how to extract and use information from engineering drawings and related specifications in relation to work undertaken
- 1.10 Describe how to interpret drawings for setting up a CNC machine
- 1.11 Describe the range of workholding methods and devices that are used on CNC fabrication machines
- 1.12 Explain the importance of setting the workholding device in relationship to the machines datums and reference points
- 1.13 Describe how to set the workholding devices and the tools and equipment used

- 1.14 Describe the typical applications of different types of cutting and forming tools used on CNC fabrication machines
 - 1.15 Describe how to check that cutting and forming tools are in a safe and serviceable condition
 - 1.16 Describe types of tool holding devices
 - 1.17 Describe methods used to mount and secure cutting and forming tools to the tool holders
 - 1.18 Explain the advantages of using pre-set tooling
 - 1.19 Describe how to set the tooling using setting jigs/fixtures
 - 1.20 Describe how to position and identify tools in relationship to the operating program
 - 1.21 Describe how to place the machine into the correct operating mode
 - 1.22 Describe how to conduct trial runs
 - 1.23 Explain the need for full dry runs and single block runs
 - 1.24 Describe items that need to be checked before allowing the machine to operate in full program run mode
 - 1.25 Explain how type of materials affect feeds and speeds that can be used
 - 1.26 Explain how to resolve problems that can occur with setting up the workholding devices and tooling
 - 1.27 Describe the extent of their own authority when setting up CNC fabrication machines and to whom they should report if they have problems that they cannot resolve.
-

Range

- (AC1.1)
 - Workholding devices
 - Tooling.

 - (AC1.3)
 - Normal situations
 - Emergency situations.

 - (AC1.10)
 - First and third angle drawings
 - Imperial and metric systems of measurement
 - Workpiece reference points
 - System of tolerancing.

 - (AC1.22) Using:
 - Single block run
 - Dry run
 - Feed and speed override controls.
-

Learning outcome

The learner will:

- 2 Be able to set CNC fabrication equipment
-

Assessment criteria

The learner can:

- 2.1 Obtain and use the appropriate documentation for setting up fabrication machines
 - 2.2 Adhere to safety procedures in place for setting up fabrication machines
 - 2.3 Follow safe practice/approved setting-up procedures
 - 2.4 Confirm the operating program has been loading
 - 2.5 Check that tooling is in a usable condition
 - 2.6 Update program tool data
 - 2.7 Ensure that correctly adjusted machine guards are in place
 - 2.8 Position and secure workpieces using different workholding methods
 - 2.9 Select and mount cutting tools
 - 2.10 Prepare tooling for operation
 - 2.11 Set up the machine to produce components that combine several different operations
 - 2.12 Make trial components to quality and accuracy standards, as applicable to the operations performed
 - 2.13 Leave the work area and machine in a safe and appropriate condition on completion of the activities
-

Range

- (AC2.2) • For risk assessment
• For COSHH
• For personal protective equipment
• For other relevant safety regulations and procedures to realise a safe system of work.
- (AC2.8) Use two of the following:
• Clamps and stops
• Pneumatic chucks
• Jigs and fixtures
• Other specific workholding devices.
- (AC2.9) To include two of the following:
• Shearing blades
• Hole punching tools
• Forming tools
• Nibbling tools
• Bending tools
• Cutting heads/nozzles.
- (AC2.10) • Pre-set tooling using setting jigs/fixtures
• Set tool datum
-

- Position tools in the correct position in the tool-posts, turrets, magazine or carousel
- Check tools have a specific tool number in relation to the operating program
- Enter all relevant tool data to the operating program (tool lengths, tool offsets, radius compensation)
- Save changes to the program.

(AC2.11) To include five of the following:

- Straight cuts
- Square/rectangular profiles
- Curved profiles
- Internal profiles
- Angular profiles
- Holes linearly pitched
- Holes radially pitched
- Louvres
- Swages
- Bends at 90°
- Bends of various angles
- Multi-bend plate work
- Curved plates
- Slots and apertures
- Circles/ellipses
- Other specific operations.

- (AC2.12)
- Dimensional accuracy is within specification tolerance
 - Components to be free from deformity, burrs and sharp edges
 - Profiles confirm to specification/template requirements.

Unit 335

Machining components using CNC fabrication equipment

Unit level:	Level 3
GLH:	126
Unit aim:	The purpose of this unit is for learners to develop understanding and skills needed to be competent in machining using CNC fabrication equipment, in accordance with approved procedures.
Relationship to NOS:	EUCL3D-178

Learning outcome

The learner will:

- 1 Be able to machine components using CNC fabrication equipment

Assessment criteria

The learner can:

- 1.1 Check that the operating program is at the correct starting point
- 1.2 Ensure that correctly adjusted machine guards are in place
- 1.3 Hold components securely without distortion
- 1.4 Check the cutting tools are in a suitable condition
- 1.5 Set plate/section datums and position the machine
- 1.6 Update program tool data
- 1.7 Adjust machine settings, as required, to maintain the required accuracy
- 1.8 Produce machined components which combine different operations
- 1.9 Carry out checks for accuracy during production
- 1.10 Produce components that meet quality and accuracy standards applicable to the operations performed
- 1.11 Leave the work area and machine in a safe and appropriate condition on completion of the activities.

Range

(AC1.8) To include five of the following:

- Straight cuts
- Square/rectangular profiles
- Curved profiles
- Internal profiles
- Angular profiles
- Holes linearly pitched
- Holes radially pitched
- Louvres
- Swages
- Bends at 90°
- Bends of various angles
- Multi-bend plate work
- Curved plate
- Slots and apertures
- Circles/ellipses
- Other specific features.

(AC1.9) To include five of the following:

- Linear dimensions
- Vertical dimensions
- Position of features
- Accuracy of hole/slot dimensions
- Accuracy of profiles
- Flatness/freedom from excessive distortion
- Accuracy of louvres and swages.

(AC1.10) • Dimensional accuracy is within tolerance
 • Components conform to the required shape/geometry or profile
 • Components are free from deformity, burrs and sharp edges.

Learning outcome

The learner will:

2 Understand how to machine components using CNC fabrication equipment

Assessment criteria

The learner can:

- 2.1 Describe the safe working practices and procedures to be followed while operating CNC fabrication equipment
- 2.2 Describe the procedure for checking that machine safety mechanisms function correctly
- 2.3 Describe how to stop the machine
- 2.4 Describe the procedure for starting the machine

- 2.5 Explain the importance of wearing Personal Protective Equipment (PPE) when using CNC fabrication equipment
 - 2.6 Explain how to minimise risks associated with horizontal boring operations on CNC fabrication equipment
 - 2.7 Explain the importance of keeping the work area clean and tidy when machining on CNC fabrication equipment
 - 2.8 Describe how to extract and use information from engineering drawings and related specifications in relation to machining work to be undertaken
 - 2.9 Describe how to interpret drawings for machining
 - 2.10 Describe how to use the visual display
 - 2.11 Describe how to deal with different types of error messages displayed
 - 2.12 State how to find the correct restart point in the program when the machine has stopped before completion
 - 2.13 Describe the applications of different types of CNC fabrication equipment and the different operations that can be performed
 - 2.14 Describe the operation of different hand and automatic modes of machine control
 - 2.15 Describe how to conduct trial runs
 - 2.16 Explain the need for full dry runs and single block runs
 - 2.17 Describe how to make adjustments to the program operating parameters
 - 2.18 Describe how to set and secure the workpiece to the machine
 - 2.19 Explain the potential effects of clamping the workpiece
 - 2.20 Explain how material removal can cause distortion of the finished workpiece
 - 2.21 Explain how to resolve problems that can occur with horizontal boring operations
 - 2.22 Describe the quality control procedures and related equipment used
 - 2.23 Describe the extent of their own authority when machining with CNC fabrication equipment and to whom they should report if they have problems that they cannot resolve.
-

Range

- (AC2.3) • Normal situations
• Emergency situations.
- (AC2.9) • First and third angle drawings
• Imperial and metric systems of measurement
• Workpiece reference points
• System of tolerancing.
- (AC2.15) Using:
• Single block run
• Dry run
-

- Feed and speed override controls.

Appendix 1 Relationships to other qualifications

Links to other qualifications

This qualification is part of a suite that contributes to the delivery and assessment of the on-programme element of the Machinist (Advanced Manufacturing Engineering) apprenticeship. The qualifications in the suite are:

- 1272-02 Level 2 Diploma in Machining (Foundation Knowledge)
- 1272-03 Level 3 Diploma in Machining (Development Knowledge)
- 1271-02 Level 2 Diploma in Advanced Manufacturing Engineering (Foundation Competence)
- 1271-03 Level 3 Diploma in Advanced Manufacturing Engineering (Development Competence) Machining

Literacy, language, numeracy and ICT skills development

This [these] qualification[s] can develop skills that can be used in the following qualifications:

- Functional Skills (England) – see www.cityandguilds.com/functionalskills
- Essential Skills (Northern Ireland) – see www.cityandguilds.com/essentialskillsni
- Essential Skills Wales – see www.cityandguilds.com/esw

Appendix 2 Sources of general information

The following documents contain essential information for centres delivering City & Guilds qualifications. They should be referred to in conjunction with this handbook. To download the documents and to find other useful documents, go to www.cityandguilds.com or click on the links below:

Centre handbook: quality assurance standards

This document is for all approved centres and provides guidance to support their delivery of our qualifications. It includes information on:

- centre quality assurance criteria and monitoring activities
- administration and assessment systems
- centre-facing support teams at City & Guilds/ILM
- centre quality assurance roles and responsibilities.

The centre handbook should be used to ensure compliance with the terms and conditions of the centre contract.

Centre assessment: quality assurance standards

This document sets out the minimum common quality assurance requirements for our regulated and non-regulated qualifications that feature centre-assessed components. Specific guidance will also be included in relevant qualification handbooks and/or assessment documentation.

It incorporates our expectations for centre internal quality assurance and the external quality assurance methods we use to ensure that assessment standards are met and upheld. It also details the range of sanctions that may be put in place when centres do not comply with our requirements or actions that will be taken to align centre marking/assessment to required standards. Additionally, it provides detailed guidance on the secure and valid administration of centre assessments.

Access arrangements: when and how applications need to be made to City & Guilds

This provides full details of the arrangements that may be made to facilitate access to assessments and qualifications for candidates who are eligible for adjustments in assessment.

The **centre document library** also contains useful information on such things as:

- conducting examinations
- registering learners
- appeals and malpractice.

Useful contacts

Please visit the **contact us** section of the City & Guilds website.

City & Guilds

For almost 150 years, we have worked with people, organisations and economies to help them identify and develop the skills they need to thrive. We understand the life-changing link between skills development, social mobility, prosperity and success. Everything we do is focused on developing and delivering high-quality training, qualifications, assessments and credentials that lead to jobs and meet the changing needs of industry.

We partner with our customers to deliver work-based learning programmes that build competency to support better prospects for people, organisations and wider society. We create flexible learning pathways that support lifelong employability because we believe that people deserve the opportunity to (re)train and (re)learn again and again – gaining new skills at every stage of life, regardless of where they start.

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