T Level Technical Qualification in Engineering, Manufacturing, Process and Control (8713-32)

Machining and Toolmaking Technologies (332)

Guide Standard Exemplification Material

Distinction – Sample 2022

First teaching from September 2022
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Contents

Introduction

The sample assessment materials within this document refer to the Machining and Toolmaking Technologies sample occupational specialism assignment. The aim of these materials is to provide centres with examples of knowledge, skills and understanding that attest to distinction grade. The examples provided do not reflect all evidence from the sample assignment as the focus of this material is the quality and standards that need to be achieved rather than the volume of exemplar evidence provided. However, the examples provided are representative of all tasks in the sample assignment. The evidence presented here has been developed to reflect **distinction** grade within each task but is not necessarily intended to reflect the work of a single candidate. It is important to note that in live assessments a candidate's performance is very likely to exhibit a spikey profile and the standard of performance will vary across tasks. A distinction grade will be based on a synoptic mark across all tasks.

The materials in this Guide Standard Exemplification Material (GSEM) are separated into the sections as described below. Materials are presented against a number of tasks from the assignment.

Task

This section details the tasks that the candidate has been asked to carry out, what needs to be submitted for marking and any additional evidence required. Also referenced in this section are the assessment themes the candidates will be marked against when completing the tasks within it. In addition, candidate evidence that has been included or not been included in this GSEM has been identified within this section.

In this GSEM there is candidate evidence from:

- Task 1 - Planning
- Task 2 - Production
- Task 3 - Quality review and evaluation.

Candidate evidence

This section includes exemplars of candidate work, photographs of the work in production (or completed) and practical observation records of the assessment completed by centre assessors. This will be exemplar evidence that was captured as part of the assessment and then internally marked by the centre assessor.

Photographs in this GSEM demonstrate the full process that the candidate has undertaken to complete the bearing assembly. Commentary sections detail where performance is considered to be at a level reflective of a distinction grade. Note, due to the nature of this process, not all individual work activities would provide opportunity to demonstrate a defined level of differentiation beyond a pass – but these images are shown in order to show the cohesiveness of the process being undertaken, and to draw out where differentiation is possible.

Commentary

This section includes detailed comments to demonstrate how the candidate evidence attests to the performance standard of **distinction** by directly correlating to the grade descriptors for this occupational area. Centres can compare the evidence against the performance indicators in the marking grid descriptors within the assessor packs, to provide guidance on the standard of knowledge, skills and understanding that need to be met for **distinction**.

It is important to note that the commentary section is not part of the evidence or assessment but are evaluative statements on how and why that piece of evidence meets a particular standard.

Grade descriptors

To achieve a distinction, a candidate will typically be able to:

Competently and thoroughly interpret technical information, applying technical skills to plan, assess risk and follow safe working methods to practical tasks and procedures to an exemplary standard in response to the requirements of the brief, producing an excellent quality of work that meets tolerances, regulations and standards.

Thoroughly prepare working area, mitigating potential risks prior to commencing tasks and consistently apply exemplary housekeeping techniques during tasks.

Demonstrate exemplary technical practical skills in machining materials to produce components and products using a range of manual and automated equipment and machinery activities that are in line with industry standards and meet the requirements of the brief.

Demonstrate exemplary ability to follow procedures to produce or maintain working components.

Work safely and make informed and appropriate use of tools, materials and equipment within the working environments for machining and commissioning activities.

Identify causes and diagnose problems or common issues related to production control, operating procedures and quality control and have a thorough understanding and the skills to be able resolve and rectify them.

Consistently and accurately use industry and technical terminology across different communication methods with full consideration of technical and non-technical audiences.

Task 1 – Planning

(Assessment themes: Health and safety, Planning and preparation)

For task 1 candidates need to produce the following pieces of evidence:

- a resources list with justifications for the selections and measuring equipment calibration check recorded
- a risk assessment
- a method statement with justifications
- a quality check sheet.

For task 1 candidates will be expected to produce a quality check sheet to use in task 3a during the quality inspection task. This is supporting evidence for assessors to gauge the candidate's planning skills and will not be marked.

No photographic or video evidence is required for task 1.

Candidate evidence

1. Resources list with justifications for the selections and measuring equipment calibration check recorded

Requirements and resources	Task	Quantity	Justification
Tools/equipment/materials/consumables			
Pen and paper	1	N/A	So that I can plan my work and add any notes needed for the job.
Material stock required to produce bearing housing: (Mild steel rectangular bar 55 x75) Shoulder shaft: (Low carbon steel bar 60 mm Dia) Top hat bearing: (Nylon bar 70 mm Dia)	2	3	Stock needed so that it could be cut and filed to size as per specification, and the correct holes drilled and threaded as per drawing specification.
Band saw	2	1	Band saw will allow me to cut the bar stock to an appropriate length for manufacture measured using the steel rule.
File	2	1	The file will allow me to deburr the material.
Steel rule	2 and 3	1	To use when determining the sizes of the material stock and cutting to size on the band saw.
Vertical mill	2	2	This machine will allow production of the bearing housing.
Ø50mm Face cutter	2	1	Used to produce square faces and machining the block to size.
Engineer's square	2 and 3	1	This will allow me to set the work piece square in the vice and to check the work piece is square.
DTI	2	1	This dial test indicator will allow the work piece to be set concentric in the 4 jaw chuck.
Digital callipers	2 and 3	1	Used to measure workpiece during the production and to check the finished dimensions of the workpiece during the quality check upon completion.
Nylon mallet	2	1	Used to produce an impact force to the bar stock to ensure that it is sat firmly on the parallels.
Parallels	2	2	Used to set work piece in the machining vice of a milling machine.
Wobble bar	2	1	Used to find the edge of the work piece prior to machining.
BS3 centre drill (30m/min)	2	1	Used prior to drilling to create an accurate start for the twist drill.
Ø13.7 twist drill (30m/min)	2	1	Used to create a Ø13.7 mm hole as per the drawing.
Ø14 reamer (15m/min)	2	1	Used to create a Ø14 reamed hole.

Centre lathe	2	1	Used to manufacture the top hat bearing.
3 jaw chuck	2	1	Used to hold work piece during manufacture.
4 jaw chuck	2	1	Used to hold the rectangular work piece during manufacture of the bored hole.
Ø25 twist drill (30m/min)	2	1	Used to produce a Ø25 hole.
Boring bar (90m/min) (0.12mm/rev)	2	1	Used in conjunction with the centre lathe to produce the holes in the bearing housing and top hat shaft.
Bore micrometer	2 and 3	1	Used to measure holes in the bearing housing and top hat bearing.
Shim to protect surface finish	2	1	Used to protect the component when using work holding device during manufacture.
Ø5mm twist drill (30m/min)	2	1	Used to produce Ø5mm hole as per the production drawing.
M6 Tap	2	1	Used to produce an M6 thread as per the production drawing.
M6x1-6H thread gauge	2 and 3	1	Used to check the M6 threads produced.
Ø4.2mm twist drill (30m/min)	2	1	Used to produce a Ø4.2mm hole as per the production drawing.
M5 Tap	2	1	Used to produce an M6 thread as per the production drawing.
M5x0.8-6H thread gauge	2	1	Used to check the M6 threads produced.
Feeler gauge	2	1	Used to measure gap widths.
R10 cutter	2	1	Used to produce 10mm radius as per production drawing.
Radius gauge	2 and 3	1	Used to check the machined radius.
Vee block	2	1	Used as a work holding device to set block for machining of chamfer.
Engineer’s blue	2	1	Used to blue the surface of the stock so that the scribed lines are more visible. Can also be used during assembly of the bearing to check for high spots.
Computer access	3	N/A	Needed to write up the report and to note all of the measurements once I have quality checked the workpiece to ensure it is in line with the drawing specification.
Personal Protective Equipment (PPE)			
Gloves	2 and 3	1 (+spares)	To protect the hands from cuts and skin irritation when handling substances. Disposable gloves to be used when handling consumables. Loose fitting gloves must not be worn during machining activities due to entanglement risk. Need to have at least spare one pair in case of replacement.
Barrier cream	2	1	Needed to protect hands from harmful substances and to protect against dermatitis and other skin irritations. For example, when handling workpieces coated with engineer’s blue or working with consumables (oils, liquids, spray lubricants).

Safety boots or safety shoes	All	1 pair	Needed to be worn in the workshop to prevent injury to feet if any objects are dropped.
Overalls or coat	All	1 pair	Needed to protect yourself and clothing form dirt and debris from the work carried out. Ensure no loose clothing is worn around the machinery due to risk of entanglement.
Safety glasses	2	1 pair	Needed to protect eyes from swarf and dust. To be worn at all times.
Technical Information/documentation			
Assignment brief	All	Needed for technical drawings and tolerances and assessment information.	
Calibration record	2 and 3	Needed to check that the equipment used is within calibration and up to date.	
User manuals	2	Needed for the vertical miller, centre lathe and CNC lathe. To check operation instruction, safety information and maintenance instructions to check for suitable oils and lubricants.	
Risk assessment	All	This is a document that I will prepare to record the risks and hazards that may present during the creation of the bearing assembly. I will mitigate against the risks to reduce the likelihood of injury.	
COSHH data sheets	2	Needed for the hazardous substances which need to be used to ensure correct safety precautions can be followed e.g. engineer’s blue, anti-corrosion spray treatment.	
Method statement	2 and 3	This will be used during the tasks to ensure the correct sequence of operations is followed to ensure the quality requirements can be met.	
Quality check sheet	3	Needed to record measurements of finished workpiece to check it is within drawing specification.	
General Workshop resources			
Waste disposal bins	All	Waste to be segregated to ensure all waste is disposed of correctly and to ensure materials can be recycled and hazardous substances are disposed of with registered waste carriers.	
First aid kit	2 and 3	Needed in the case of any minor injury when carrying out the task.	
Eye wash station	2 and 3	In case of emergencies, access to an eye wash station to treat any eye incidents to minimise injury before seeking medical treatment.	
Warning signs and notices	2 and 3	To inform people of required PPE requirements, fire exits, first aid information and any hazards in the workshop such as wet floors spillages etc.	
Dust pan and brushes and spill kits	2 and 3	Needed to clean work area and to clear up any spillages that may occur.	
Mop and bucket	2 and 3	To clean up any spillages and clean the work area once job has been completed.	

Calibration of measuring equipment
All measuring equipment has been checked for calibration against the workshop record. Last calibration date was November 2021.

Commentary

The candidate has carried out a thorough analysis covering all factors relevant to the brief with all justifications provided. They have applied their understanding to produce a comprehensive list of resources required, demonstrating comprehensive technical knowledge of the requirements required for producing the bearing assembly.

The candidate has listed amounts for each resource that they have planned to use and has given detailed justifications for their selections and has given an indication of the intended use. The candidate has given consideration for other resources that should be available in the workshop, for example, access to a first aid kit and the provision of an eye wash station.

The candidate has recognised the need to refer to supporting technical documentation in order to complete the task and has provided a range of technical documentation types including the assignment brief for the technical drawings and tolerance information and copies of user manuals for the two types of lathes and milling machine.

The candidate has demonstrated planning for safe working by identifying the correct PPE and stating why each piece should be used, including providing guidance on when gloves should not be used, for example, not to wear loose fitting gloves when operating the machinery due to entanglement risk. They have included the use of a barrier cream to prevent dermatitis from handling materials with the substances such as engineer's blue and drilling fluids.

1. Risk assessment

Machining and work area

Hazard	Risk	Control	Likelihood	Severity
Revolving machinery (mills and lathes) and workpieces.	Risk of cutting, crushing, shearing and entanglement.	Carry out all safety checks prior to use. Guards in place on milling machine and lathes, all guarding checked before use, including fixed and removable guards and protection devices. Correct fitting PPE to be worn at all times. No jewellery to be worn. Long hair should be tied back. Ensure the machinery (mill or lathe) being used has stopped or is turned off and isolated before working inside the machine. Comply with PUWER regulations.	2	3
Ejected swarf, cutters or workpieces from machinery (mills and lathes).	Ejected debris coming off the drill or tooling, from working materials. Getting swarf in your eyes or cutting your hands when removing. Minor burns or scalds from hot swarf.	When using mills or lathes, instruction should be given on correct set up techniques, adequate supervision from trained staff/personnel. Guards are used and checked, use additional magnetic screen guard when machining. Eye protection to be worn at all times with correct PPE. Areas kept clean and tidy; shadow boards provided. Use correct work holding devices to secure workpieces to prevent them being ejected and damaged.	3	2
Chuck keys left in chucks.	Risk of flying out when lathe started causing eye or bodily injuries.	Always check for and remove chuck keys before use, guards are checked, limit switch on chuck guard stops machine from starting unless guard is closed stopping the chuck key from being left in chuck. Eye protection to be worn at all times along with correct PPE, first aid available at all times.	3	2

Fitting mating parts or measure workpiece whilst workpiece is in the chuck, or general handling and tool changing.	Cuts and puncture injuries. Eye injuries.	Machines (mills and lathes) must be turned off and isolated before tool removal, ensure any tools in tailstock chuck are removed or tailstock is moved clear, ensure any turning tools are moved clear, fully trained staff to monitor and offer help when required, PPE available at all times, first aid available at all times.	3	2
Hazardous substances.	Injuries to eyes, skin conditions by absorption (dermatitis), respiratory conditions by inhalation (asthma), spillages (slips and falls)	All oils, lubricants, fluids and substances (engineer's blue) used in the machining process are COSHH assessed and stored in correct facilities and locked away when not in use. PPE to be worn when handling oils or substances (non-absorbent gloves, clothing etc), use masks to avoid inhaling any fumes or irritants. First aid is available if required. New operators supervised when using hazardous substances.	2	2
Moving around the workshop and work areas.	Slips, trips and falls resulting in bodily or musculoskeletal injuries or disorders.	Painted pedestrian walkways are marked out adequate lighting exists, correct footwear worn at all times, spillages cleared asap – signage available, no trailing cables in the area, keep areas clean and tidy, ensure good standard of housekeeping around equipment and local area, no material or equipment placed in pathways. Manage and dispose of all waste to avoid build up in the work area.	3	2
Hot swarf.	Burns and scalds	PPE worn at all times, adequate supervision, use of guarding to avoid damage to eyes. First aid available at all times. Use a brush to clean swarf away from the moving parts of the machine avoiding contact with fingers or hands.	2	2
Noise	Hearing damage	If noise levels are beyond the safe workshop limit, ear protection should be worn. Refer to Noise at Work Regulations.	3	1
Manual handling	Musculoskeletal injuries	Ensure training has been given. Use correct manual handling techniques are used by everyone in the workshop and ensure there is mechanical assistance available if required for	3	1

		larger and heavier materials per the manual handling regulations.		

Likelihood		Severity	
1	Very unlikely to happen	1	Minor injury
2	Unlikely to happen	2	Major injury
3	Possible to happen	3	Loss of limb
4	Likely to happen	4	Death of an individual
5	Very likely to happen	5	Multiple death

Commentary

The candidate has demonstrated a thorough knowledge and understanding of the different types of risks and hazards associated with machining activities. The candidate has considered and identified all the major hazards and associated risks for each of the tasks based on the types of machinery used which includes a milling machine and lathes. The candidate has identified where the workshop set up has a role to play in managing risk, for example, the painting of the workshop floor for thoroughfares which is typical in an industrial workshop. They also understand the importance of PPE to protect from unwanted contact with swarf and coolants.

The candidate has demonstrated an excellent understanding of the mitigations required that can minimise the risks and hazards and has identified thorough detail for the controls necessary.

The potential for harm and probability of occurrence has have been identified throughout. The likelihood and severity has also been identified in respect of the hazards and risks occurring based on machining operations the candidate will be using for the task.

1. Method statement

Bearing housing

Operation No.	Description	Machine, Tools and Equipment	Speeds and feeds	Process	Quality checks
1	Gather required information and conduct a risk assessment	Drawings Risk assessment proforma	NA	Obtain the brief and drawings from supervisor and extract the required information and perform a risk assessment on the mill and lathe in the workshop.	NA
2	Obtain material and cut to required length	Bandsaw File Steel rule	NA	Obtain material 63.5mmX3.5mm mild steel from stores. Cut to 55mm in length on the bandsaw. Deburr.	Check final overall dimensions are correct with a steel rule.
3	Conduct standard workshop machine safety checks (SOP)	Vertical Mill SOP machine set up	NA	Reference safety checklist, tick off all boxes and hand them back to the supervisor.	NA
4	Box material to 60mmX60mmX50 mm	Vertical mill Ø50mm Face cutter Engineer’s square DTI Digital callipers Mallet Parallels	1200rpm	Place material with stock faces on parallels and fixed jaw of vice. Tap down job until parallels both do not move. Touch on with the face cutter and take an equal amount off each face until the block measures 60mmx60mm. Stand sawn end on parallels and use engineer’s square and DTI to set block square. Face off with face cutter and take down to 50mm OAL.	Check block size with digital callipers and engineer’s square.
5	Ream Ø14 hole for reference for setting up the 4-jaw chuck.	Parallels Mallet Wobble bar BS3 centre drill (30m/min) Ø13.7 twist drill (30m/min) Ø14 reamer (15m/min) Digital callipers	200rpm 3418rpm (1800) 697rpm 341rpm	Lay part with 10mm protruding at the top of the vice. 60x60 face up. Use wobble bar to find the centre of the block. Centre drill, drill and then ream the hole.	Check for hole centrality with digital callipers

Move to Centre lathe					
6	Conduct standard workshop machine safety checks (SOP)	Centre lathe SOP machine set up.	NA	Reference safety checklist, tick off all boxes and hand them back to the supervisor.	NA
7	Bore Ø40-40.05 hole	4-jaw chuck DTI Ø25 twist drill (30m/min) Boring bar (90m/min)(0.12mm/rev) Shim to protect surface finish Bore Micrometer	382rpm 716rpm Feed (0.12 mm/rev)	Set up part with 60x60 face facing out. Use the DTI sitting on the saddle to clock in the Ø14 reamed hole. Use the DTI on the tool post to check the 4 outside faces are correct and match the reamed hole centrality, alter if required. Drill Ø25mm hole through part. Bore the Ø40mm hole with the boring bar.	Check size with bore micrometer. Adjust accordingly.
Move back to Vertical Mill					
8	Drill and tap 2 x M6x1 thread	Parallels Mallet Wobble bar BS3 centre drill (30mm/min) Ø5mm twist drill (30m/min) M6 Tap M6x1-6H thread gauge	200rpm 3418rpm (1800) 1910rpm by hand	Have the top 60x50 side up and tap down onto the parallels. Use the wobble bar to index the hole positions 44mm about the centre. Centre drill, drill and tap the M6 holes in both positions. Deburr.	Check positions of the thread with a digital calliper and the thread with a M6x1 - 6H thread gauge.
9	Drill and tap M5x0.8 thread	Parallels Mallet Wobble bar BS3 centre drill (30mm/min) Ø4.2mm twist drill (30m/min) M5 Tap M5x0.8-6H thread gauge	200rpm 3418rpm (1800) 2274rpm By hand	Have the bottom 60x50 side up and tap down onto the parallels with a mallet. Use the wobble bar to index into the middle of the block. Centre drill, drill and tap the M5 thread until it breaks through to the middle bore. Deburr this area fully.	Check positions of the thread with a digital calliper and the thread with a M5x0.8 - 6H thread gauge.
10	Mill R10 right edge	Parallels Mallet Feeler gauge R10 cutter Radius gauge	318rpm	Identify the correct edge of the block for the R10 radius, use the feeler gauge to datum the bottom and the side of the R10 cutter. Mill off in steps.	Use the R10 radius gauge to check the profile of the edge.

11	Mill 8x45°	Parallels Mallet vee block Vernier height gauge Engineer's blue Digital callipers Protractor Ø50mm Face cutter	1200rpm	Mark the correct edge with the 8x45° angle. Use the engineer's blue and the vernier height gauge for this. Place the block with the correct edge up on the vee block which will be held in the vice. Use the face cutter to mill to the marked line.	Use the digital callipers to measure the length of the angle and protractor to check the angle.
12	Inspect part and tidy down	Calibrated measuring equipment Inspection documents	NA	Complete the inspection document and assemble the part ready for assessment handover. Fully clean down the machine putting hand tools and measuring equipment back into designated places and cleaning all swarf of machine and placing it in swarf bin. Reinstate area.	NA

Top hat bearing

Operation No.	Description	Machine, Tools and Equipment	Speeds and feeds	Process	Quality checks
1	Gather required information and conduct a risk assessment	Drawings Risk assessment proforma	NA	Obtain the drawings from lecturer and extract the required information and perform a risk assessment on the XYZ mill and lathe in workshop.	NA
2	Obtain material and cut to required length	Bandsaw File Steel rule	NA	Obtain material Ø60 nylon from stores. Cut to 120mm in length on the bandsaw or use an offcut that is longer than 100mm in length. Deburr.	Check final overall dimensions are correct with a steel rule.
3	Conduct standard workshop machine safety checks (SOP)	Centre lathe SOP machine set up.	NA	Reference safety checklist, tick off all boxes and hand them back to the supervisor.	DTI ensures chuck is not running out and will affect the overall specification of the part.
4	Chuck material	Manual Lathe Steel rule	NA	Load material into 3 jaw chuck with 65mm	Check with steel rule

		3 jaw chuck		protruding from the chuck.	
5	Face to clean	Carbide side and face cutter (80m/min)	1320 rpm 0.2 feed	Touch on zero DRO wind off and place a 0.2mm cut on and face to clean.	NA
6	Centre drill and process drill	BS4 Ø28mm jobber drill (30m/min)	1500rpm 340 rpm	Centre drill to produce a BS4 centre drilled hole, drill Ø28 hole 60mm deep.	Use the probe end of the digital calliper to check length.
7	Turn bore to Ø30mm	DTI Boring bar (80m/min) Digital vernier Bore Micrometer	636rpm (0.12 mm/rev)	Qualify tool on front face zero the DRO. Take a skim off the internal bore and qualify the size, recalibrate the DRO. Take the finished cut to final depth.	Use the digital calliper to check size but bore mic to confirm final size is within tolerance. +0.1/-0
8	Rough turn external diameter Ø40 & Ø55 to length	Rough side and face cutter (80m/min) 25-50 micrometer 50-75 micrometer digital calliper	Ø55 463rpm Ø40 636 rpm	Qualify the z and x of the tool and recalibrate the DRO. Turn Ø55 diameter to 60mm, then take 2mm cuts to turn the Ø40mm to 50mm. Leave 1mm on diameter and 0.2mm on length.	Check the diameters using the relevant micrometers. Use the digital calliper to check the length.
9	Finish turn external diameter Ø40 & Ø55 to length	Finish side and face cutter (100m/min) 25-50 micrometer 50-75 micrometer digital calliper	Ø55 579rpm Ø40 796rpm	Qualify the z and x of the tool and recalibrate the DRO. Turn Ø55 diameter to 60mm, then take 0.5mm cuts to turn the Ø40mm to 50mm. Fit the bearing housing to the Ø40mm to create a push fit.	Check the diameters using the relevant micrometers. Use the digital calliper to check the length. Paying attention to the tolerances.
10	Produce the 1x45 chamfer	Chamfer tool (30m/min) Steel rule	238rpm	Touch on the front edge and zero the Z datum on the DRO. Move in 1mm on the Z.	Check with a steel rule.
11	Part off to length	Parting tool (30m/min) Digital calliper	238rpm	Qualify the parting tool and part off to 55.2mm. Leaving 0.2 for finishing.	Check overall length with digital callipers.
12	Face to length 55mm	Finish side and face cutter (100m/min) Shim	579rpm	Using shim to protect the faces, face to length.	Check overall length with digital callipers.

13	Produce the 1x45 chamfer	Chamfer tool (30m/min) Steel rule	238rpm	Touch on the front edge and zero the Z datum on the DRO. Move in 1mm on the Z.	Check with a steel rule.
14	Inspect and clean down	Calibrated measuring equipment Inspection documents	NA	Complete the inspection document and assemble the part ready for assessment handover. Fully clean down the machine putting hand tools and measuring equipment back into designated places and cleaning all swarf of machine and placing it in swarf bin. Separate the nylon waste. Reinstate area.	NA

Shoulder shaft

Operation No.	Description	Machine, Tools and Equipment	Speeds and feeds	Process	Quality checks
1	Gather required information and conduct a risk assessment	Drawings Risk assessment proforma	NA	Obtain the drawings from lecturer and extract the required information and perform a risk assessment on the XYZ SLX in the workshop.	NA
2	Obtain material and cut to required length	Bandsaw File Steel rule	NA	Obtain material Ø50 mild steel from stores. Cut to 120mm in length on the bandsaw. Deburr.	Check final overall dimensions are correct with a steel rule.
3	Conduct standard workshop machine safety checks (SOP)	Centre lathe SOP machine set up.	NA	Reference safety checklist, tick off all boxes and hand them back to the supervisor.	NA
4	Load material	XYZ SLX 3 jaw chuck Steel rule	NA	Load material in chuck with 70mm protruding from the face of jaws.	Steel rule to verify.
5	Check tools	Tools are in the magazine	NA	Manually use the machine to verify the front of the part is at zero and the diameter is set correctly.	NA
6	Simulate program	NA	NA	Call up the program and run the visual simulation.	NA
7	Run program in	Safe mode	NA	To verify the program,	NA

	tracking mode			run it in tracking mode as a first instance. Make sure the tool will not hit the chuck at the furthest extent.	
8	Full run on CNC	NA	NA	When confident change to full run CNC, make sure the coolant is running.	NA
9	Finish part	File	NA	Retrieve the part from the coolant box and file off pip.	Check the diameters using the relevant micrometers. Use the digital calliper to check the length.
10	Inspect part and tidy down	Calibrated measuring equipment Inspection documents	NA	Complete the inspection document and assemble the part ready for assessment handover. Fully clean down the machine putting hand tools and measuring equipment back into designated places and cleaning all swarf from the machine and placing it in the swarf bin. Reinstate area.	NA

Commentary

The candidate has demonstrated that they can analyse and interpret engineering and manufacturing requirements by comprehensively and thoroughly analysing the brief and interpreting the technical drawings in order to plan the work and identifying procedures to be followed.

The method statement has been developed into an operation sheet, which is typical of a machining environment; it is well structured and contains logical and sequential steps for the three parts with a detailed list of tools and machines that are required. This shows a comprehensive understanding of planning for the work.

The comprehensive method statement shows a thorough understanding of the processes and technical practical skills in machining materials to produce components and products using a range of manual and automated equipment and machinery activities that are in line with industry standards and meet the requirements of the brief. The level of detail is comprehensive, detailing the process that can be followed in order to create the part with attention to the different speeds and feeds for different tooling.

The candidate has also considered any possible problems and implications that may occur in the process, using the method statement to record important process stages. For example, setting and checking the computer numerically controlled (CNC) parameters to avoid risking any damage to the machine, if the parameters were off. The quality checks in the last column help to monitor the dimensional accuracy throughout the task and alterations to part as required.

1. Quality check sheet

Bearing housing

Drawing Size	Tolerance	Equipment Used	Actual Size	Candidate Inspection		Comments
				Satisfactory	Unsatisfactory	
60mmx60mmm	±0.25	Digital calliper				
50mm	±0.25	Digital calliper				
⌀40	+0.1 -0.0	Digital bore micrometer				
M5x0.8-6H	Gauge	M5x0.8 - 6H thread gauge				
M6x1 - 6H	Gauge	M6x1 - 6H thread gauge				
8x45°	±0.25	Steel rule				
R6	±0.25	R6 gauge				

Top hat bearing

Drawing Size	Tolerance	Equipment Used	Actual size	Candidate Inspection		Comments
				Satisfactory	Unsatisfactory	
5mm	±0.25	Digital calliper				
55mm	+0.0 -0.2	Digital calliper				
⌀30	+0.1 -0.0	Bore micrometer				
⌀40	+0.0 -0.1	Micrometer				
⌀55	±0.25	Micrometer				
1x45°	±0.25	Steel rule				

Shoulder shaft

Drawing Size	Tolerance	Equipment Used	Actual size	Learner Inspection		Comments
				Satisfactory	Unsatisfactory	
4mm	±0.25	Digital calliper				
1.6mm	+0.14 -0.0	Digital calliper				
55mm	+0.2 -0.0	Digital calliper				
63mm	±0.25	Digital calliper				
⌀28.6	+0.0 -0.21	Blade micrometer				
⌀30	+0.0 -0.1	Micrometer				
⌀45	±0.25	Micrometer				
1x45°	±0.25	Steel rule				
R1	±0.25	R1 gauge				

Task 2 – Production

(Assessment themes: Health and safety, Production (measuring and marking out, cutting components, techniques and methods, tools and equipment).

For task 2, candidates need to produce the following pieces of evidence:

- bearing assembly consisting of:
  - bearing housing
  - top hat bearing
  - shoulder shaft.

For task 2, assessors will need to produce the following pieces of supporting evidence:

- assessor observation:
  - set up and use of manual and pre-programmed CNC workshop machinery
  - the production of the individual bearing assembly components
  - tool skills, application and usage
  - checks carried out before, during and after production
  - work area prior to, during and on completion of tasks.

Note: For the purpose of this GSEM, the assessor observation has been captured on one form. In delivery, assessors may choose to capture their observations on more than one form.

Photographic evidence required:

- photographic evidence of the prepared work area – *illustrated in task 2 photographic evidence section below (photographs 1 - 7)*
- photographic evidence showing the construction of the bearing assembly *- Illustrated in task 2 photographic evidence section below (photographs 8 - 27)*
- photographic evidence of the completed bearing assembly – *illustrated in task 2 photographic evidence section below (photograph 28).*

Note: Additional photographs may be used to capture other elements of the machining processes.

Photographs in this GSEM demonstrate the full process that the candidate has undertaken to complete the bearing assembly. Commentary sections detail where performance is considered to be at a level reflective of a distinction grade. Note, due to the nature of this process, not all individual work activities would provide opportunity to demonstrate a defined level of differentiation beyond a pass – but these images are shown in order to show the cohesiveness of the process being undertaken, and to draw out where differentiation is possible.

2. Photographic evidence - Production

Work area, prior to, during and on completion of production activities (photographs 1 – 7)

Photograph 1 – showing the mill area prepared.

Photograph 2 – showing the lathe area cleaned of all metal swarf to enable nylon swarf to be collected and disposed of separately. Work station showing all tools and equipment stored.

Photograph 3 - showing the CNC lathe prior to machining.

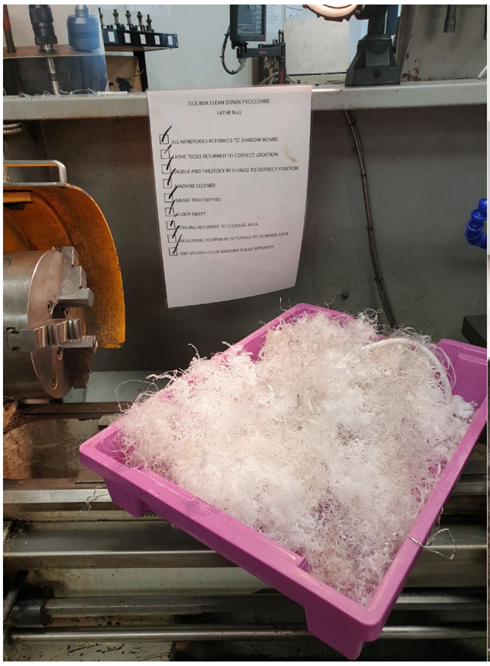
Photograph 4 and 5 – showing the work area on completion of activities, reinstated.

Mill area -

Photograph 6 and 7 – showing the removal, correct material segregation and disposal of waste.

Manual Lathe

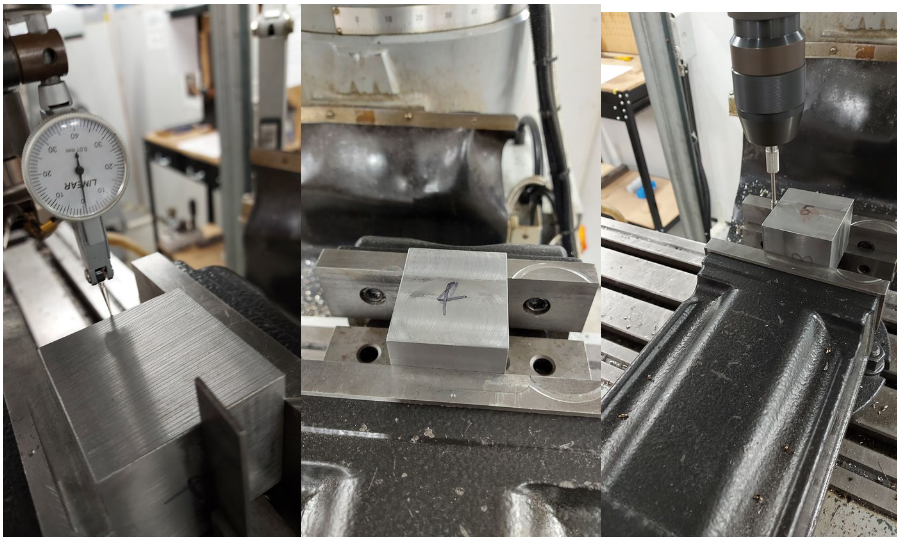
CNC Lathe



Production of bearing assembly components (photographs 8 – 27)

Bearing housing

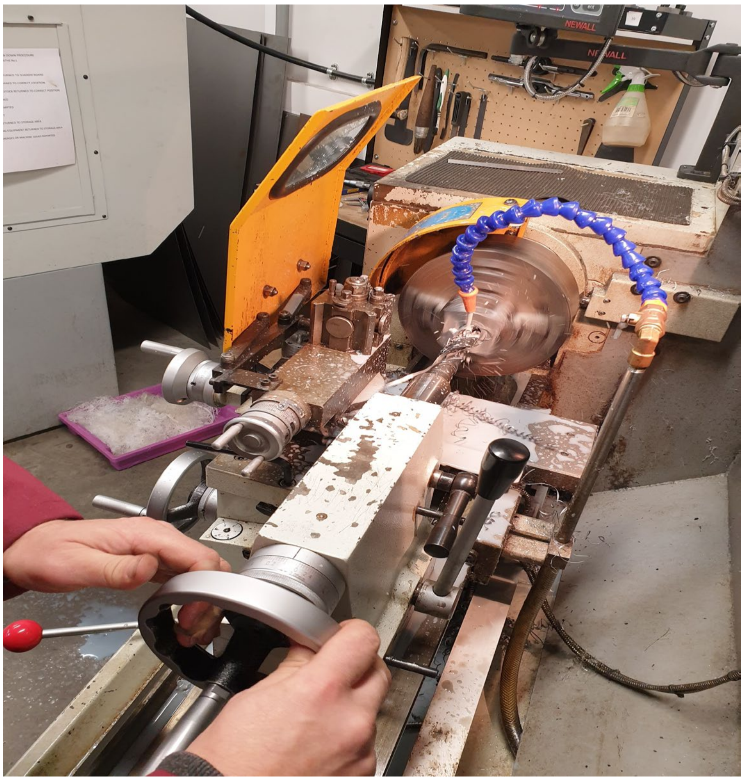
Photograph 8, 9 and 10 – showing the machining of the 4 faces using a face cutter.



Photograph 11, 12 and 13 – showing the wobble bar into the centre and centre drilled, 13.7 drill and 14 reamer.

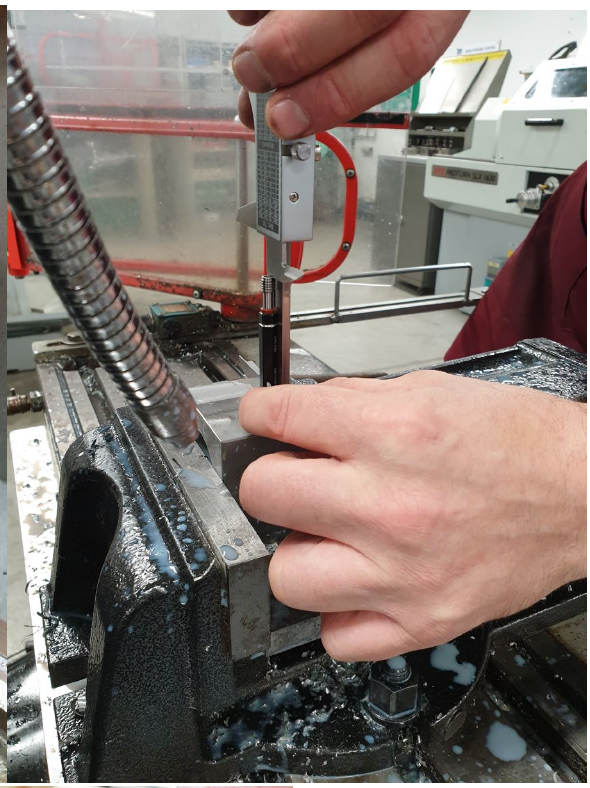
Photographs 14 and 15 – showing a small plug was made that fitted into the 14mm reamed hole, this gave a gauge to get it clocked in centrally, it was then rechecked with the plunger dial test indicator (DTI) on the 4 faces and minor adjustment made to make sure it was central.


Photograph 16 – showing the drilled out hole to 28mm, swarf was consistently removed using safe methods. Boring bar tip was replaced before using it as it was worn.



Photographs 17, 18 and 19 – showing the bored out bearing housing until nylon top hat was a push fit. Using the bore micrometer to help get close to the size before using the component as a final fit.

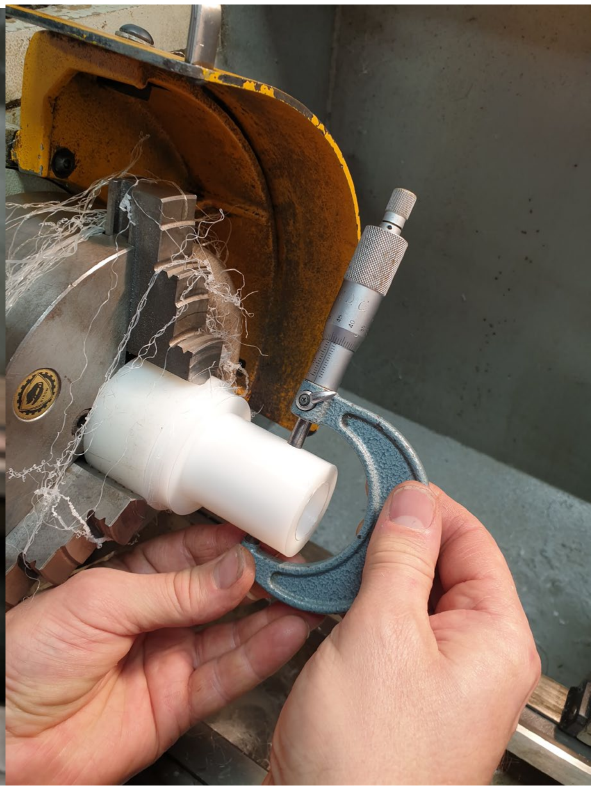
The thread gauge was bottomed out in M6 holes, digital calliper was used to determine depth of the thread. R6 gauge was used to confirm the radius was cut correctly.


Nylon top hat bearing

Photograph 20 – showing cleanliness of tool change over maintained throughout manufacturing.

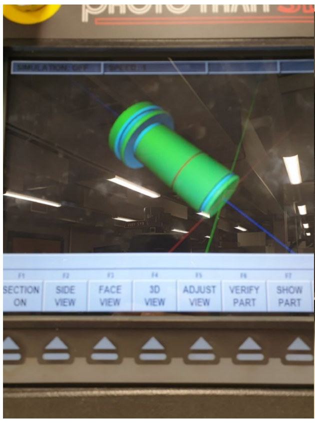
Photograph 21 and 22 – showing in-production accuracy checks being taken. Measuring the internal diameter with a bore mic and the external with an external micrometer.



Shoulder shaft (CNC machined)

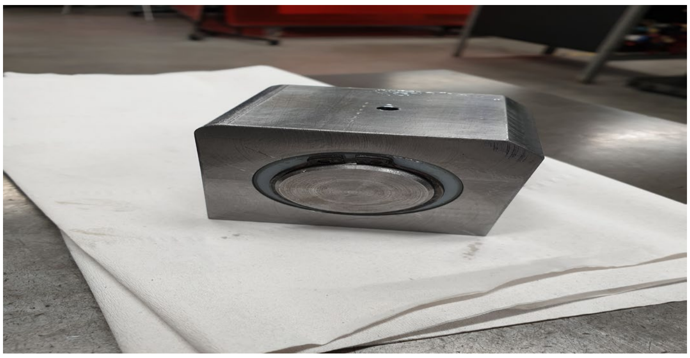
Photographs 23 and 24 – showing a tool change, the tool tip had wear and the tip was changed, the bar was chucked into the right distance from the chuck.

Photographs 25, 26 and 27 – showing the preparation of the CNC lathe. The program simulation was run to see the general outlook of the part. The program was then run but in tracking mode to start with to prove first pass. The program was then changed to CNC mode. Coolant was turned on and part run with the 4 tools being changed at the right time.



Completed bearing assembly

Photograph 28 - showing the completed bearing assembly, all components correctly seated.



2. Practical observation form – Producing the bearing assembly components

Assessment ID	Qualification number
8713-332	8713-332
Candidate name	**Candidate number**
Candidate A	CG12345
Centre name	**Assessment theme**
City & Guilds	Planning & preparation, Production, Health & safety, Assembly

Complete the table below referring to the relevant marking grid, found in the assessment pack. Do not allocate marks at this stage.

Task	**Notes –** *detailed, accurate and differentiating notes which identify areas of strength and weakness are necessary to distinguish between different qualities of performance and to facilitate accurate allocation of marks once all evidence has been submitted.*
Setting up and preparing the materials, tools and equipment for machining.	The candidate prepared their work area at the beginning of the session. Attention was particularly paid to the manual centre lathe when setting up for the nylon top hat as all waste needed to be kept separate. All tools and measuring equipment referenced in the operation sheet were located and placed locally so footfall around the workshop was minimised. The standard workshop SOP was followed to make the milling machine and lathes ready for use. All measuring tools were calibrated, a quick reference check to a slip gauge or zero was made. All machine guarding was in place.
Manual machining operation	They inspected and prepared the material ready for the next process. All work was deburred effectively. The candidate worked confidently when using processes to remove material from each workpiece; they followed their operation plan and consistently altered the speed and feed rate as dictated in the plan. When boxing up, indexing to the stated position or proving out a tool; they used the correct process to produce the correct parameters for the task. The bearing housing part was prepared and squared on the mill. All faces machined using a face cutter. A wobble bar used to find and drill the centre. Moving to the manual lathe, the candidate used a small plug within the 14mm reamed hole to give a gauge to clock in centrally, which was checked using the plunger DTI on all four faces. A minor adjustment made to make it central. The hole was drilled out to 28mm, swarf consistently removed. Boring bar tip was worn and replaced. The bearing housing was bored out until the nylon top hat was a push fit. A bore micrometer was used to check the size before using the component to check the final fit. Thread gauge was bottomed out in M6 holes, digital calliper used to determine depth of thread. R6 gauge used to confirm radius was cut correctly.

	The top hat bearing was machined on the manual lathe. The internal diameter was measured with a bore micrometer and the external with an external micrometer. In-production checks of the workpieces were continual in order to ascertain whether parameters required altering.
CNC operation	The candidate set the shoulder shaft stock up correctly on the CNC lathe. Tooling was selected and changed over at the allocated times. The roughing tool required a tip change; this was safely changed. The program simulation was run in tracking mode, checking the setup of the part. The program was then changed to CNC mode and monitored. Coolant was turned on; all four tools were safely changed during the program. On completion, the CNC machine was cleaned of all swarf and left in a ready state for the next user. All debris was disposed of in accordance with waste procedures and waste management regulations.
Tools and equipment	The candidate completed thorough checks of all the tools and equipment used. All tools and equipment were checked for cleanliness and serviceability. A damaged tip was replaced, the old tip was placed in the broken tooling section. Cleaning of the tip bed area was thorough. Candidate checked the tip was correctly seated.
	A workshop SOP was followed to set up the machinery, all safety and serviceability checks completed before the use of each machine. Particular attention was paid to the run out of the 3-jaw chuck, the centrality of the bore when setting up the bearing housing in the 4-jaw chuck and the parallelism of the vice on the mill. Work holding devices were cleaned of debris in between operations, no swarf trapped in the vice.
	All machines were thoroughly cleaned after use and reinstated the work area. All swarf removed and placed in a designated bin for safe disposal. Nylon swarf was disposed of separately. No contamination with the metal disposal. All tools and measuring equipment were wiped clean, checked and returned to the shadow board and designated storage areas.
	The candidate demonstrated the optimum method to use for each tool, using the correct speeds and feeds to achieve a good surface finish. The internal bore was to the desired surface finish and tolerance; however this could have been improved. The 4-jaw chuck left a few surface marks; a shim was used to protect this which was the corrective action used to avoid marks in the industry.
	All measuring tools calibrated effectively. Used a range of measuring tools continually throughout the production process to check the dimensions of the machined components. Dimensions checked against the drawings; adjustments were made to the machining parameters to achieve the correct dimensions.
Assembly	On completion of the machining for the three components, the candidate completed checks on the final fit of the components, no additional adjustments were required. The bearing assembly was finished with an even coating of an anti-corrosive surface treatment. This completed the task.

Health and safety	Health and safety was followed throughout all tasks, all control measures and a safe system of work were in place. Correct PPE was worn throughout. Machine guards were utilised throughout. The candidate followed a SOP for machine isolation when changing tooling and cleaning down the machinery. The work area was reinstated, all tools and equipment were cleaned, checked and returned to their shadow board or to the appropriate storage location. All waste correctly segregated and disposed of according to the type of waste.

Assessor signature	**Date**
Assessor A	**17.12.2021**

Commentary

The observation evidence shows the candidate has demonstrated their comprehensive understanding and knowledge of preparing the work area and mitigating potential risks prior to commencing tasks and consistently applying exemplary housekeeping techniques during tasks, with consideration for the different disposal requirements of the materials being machined. The candidate demonstrated a comprehensive knowledge and understanding of the materials being used and how to prepare them, what tooling would give the best possible finish and their disposal requirements.

The candidate demonstrated comprehensive understanding of measurement, specifically when preparing the materials for machining and throughout the production process to check for accuracy. For example, the candidate showed comprehensive knowledge and understanding of how to take measurements and used a small plug to fit in the hole within the bearing housing in order to correctly clock it and to then check it with a plunger dial test indicator (DTI). See photographs 14 and 15 in the photographic evidence section. This was good practice.

The candidate demonstrated exemplary ability to follow procedures to produce or maintain working components by utilising the standard workshop standard operating procedure (SOP), using their comprehensive knowledge, and understanding to set up the work area to enable to machining activities to commence safely. Making well informed decisions regarding the selection of tools, the comprehensive checks made on the tools to achieve the best possible standard of the finished bearing assembly.

The candidate demonstrated exemplary technical practical skills in machining the materials to produce the bearing assembly individual components using a range of manual and automated equipment and machinery activities that met the requirements of the brief. Material deburring and cutting techniques and methods were demonstrated, all material removal was carried out with a comprehensive understanding of the need for accuracy.

The candidate demonstrated setting the parameters of both a manual mill and lathe and a computer numerically controlled (CNC) lathe, showing understanding of correct parameter setting and the need for adjustments, for example, checking the speeds and feeds and making adjustments to ensure the best finish was achieved.

The candidate demonstrated their understanding of the machining process to identify causes and diagnose problems within the machining process and demonstrated the knowledge, understanding and the skills to be able resolve and rectify them. For example, the nylon material to be machined for the top hat bearing was difficult to machine as the material is prone to large amounts of swarf and the candidate was able to clear excess swarf from the tooling to ensure the machine was not compromised. They also understood that the nylon material when machined would produce tooling marks and to use a shim to minimise these marks to ensure the final component was a good quality and did not compromise the fit within the bearing housing.

The candidate demonstrated their ability to work safely and to follow safe operating practices throughout the machining, showing a comprehensive knowledge and understanding of health and safety. They demonstrated a high regard for safety by following a safe system of work. The machinery was used with care and the longevity was protected. For example, by cleaning down each machine during and after use, they protected the moving parts of the machine from build-up and avoided any blockages which could have damaged the machinery if allowed to build-up.

The candidate's comprehensive application of tool skills and the accuracy of their machining resulted in a high-quality finish with few surface defects, the surface sufficiently treated and met the specification of the finished assembly.

Task 3a – Quality review

(Assessment themes: Health and safety, Quality review and evaluation (quality review, reporting, recording and handover)

For task 3a, candidates need to produce the following piece of evidence:

- completed quality check sheet.

For task 3a, assessors will need to produce the following pieces of supporting evidence:

- assessor observation:
  - use of measuring equipment
  - checks for tolerances and accuracy

Photographic evidence required:

- photographic evidence of the bearing assembly components and fully assembled bearing assembly – *Illustrated in task 3 photographic evidence section below (photographs 29 – 32)*

Video evidence required:

- video evidence demonstration showing the fit of the components to form the bearing assembly – Illustrated in task 3 video evidence section below (video 1)

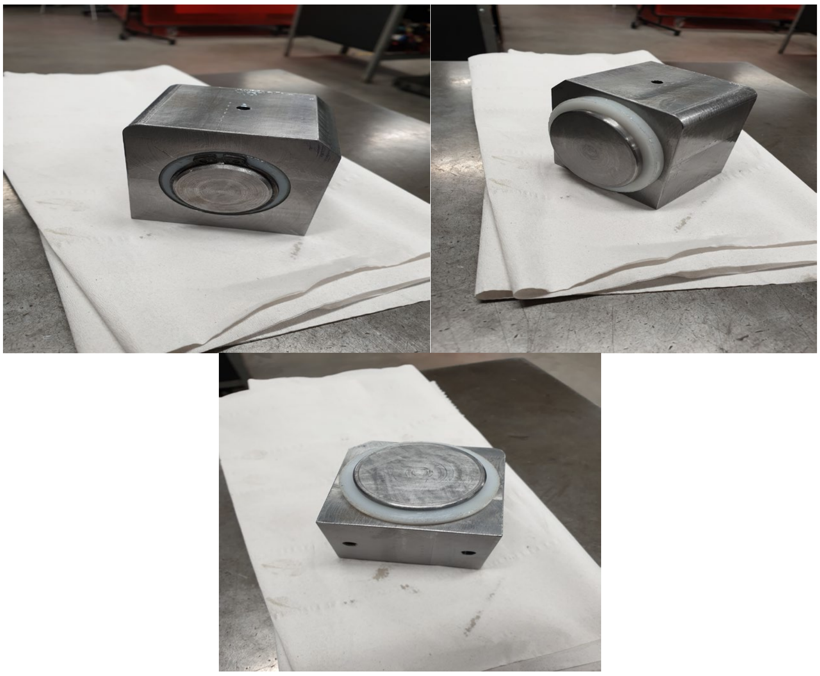
The following task 3a supporting evidence has not been included for this version of the GSEM:

Video evidence

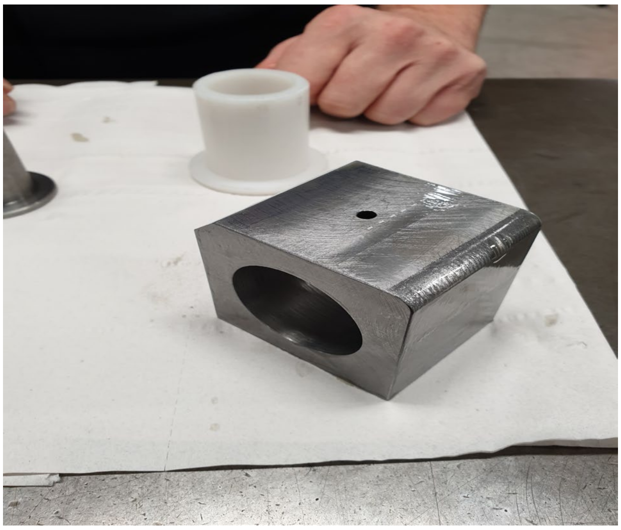
- video evidence showing the fit of the components to form the bearing assembly.

3a. Photographic evidence – Quality inspection

Photograph 29 - 31 showing the completed bearing assembly consisting of the three parts (bearing housing, shoulder shaft and top hat bearing).



Photograph 32 - showing the completed bearing housing with minimal tool marks achieved.



Candidate evidence

3a. Completed quality check sheet

Bearing housing

Drawing Size	Tolerance	Equipment Used	Actual Size	Learner Inspection		Comment
				Satisfactory	Unsatisfactory	
60mmx60mm	±0.25	Digital calliper	60x60.03	✓		within tolerance – some minor tool marks to surface
50mm	±0.25	Digital calliper	50.03	✓		within tolerance
Ø40	+0.1 -0.0	Bore micrometer	40.025	✓		within tolerance
M5x0.8-6H	Gauge	M5x0.8 - 6H thread gauge	Gauge all through	✓		NA
M6x1 - 6H	Gauge	M6x1 - 6H thread gauge	Gauge depth 13.97	✓		within tolerance
8x45°	±0.25	Steel rule	7.9x7.9	✓		within tolerance
R6	±0.25	R6 gauge	R6	✓		within tolerance

Top hat bearing

Drawing Size	Tolerance	Equipment Used	Actual size	Learner Inspection		Comment
				Satisfactory	Unsatisfactory	
5mm	±0.25	Digital calliper	4.87	✓		within tolerance unable to remove all surface tool marks due to nature of material (nylon)
55mm	+0.0 -0.2	Digital calliper	54.93	✓		within tolerance
Ø30	+0.0 -0.1	Bore micrometer	29.95	✓		within tolerance
Ø40	+0.0 -0.1	Micrometer	39.97	✓		within tolerance
Ø55	±0.25	Micrometer	55.12	✓		within tolerance
1x45°	±0.25	Steel rule	1x1	✓		within tolerance

Shoulder shaft

Drawing Size	Tolerance	Equipment Used	Actual size	Learner Inspection		Comment
				Satisfactory	Unsatisfactory	
4mm	±0.25	Digital calliper	3.8	✓		within tolerance
1.6mm	+0.14 -0.0	Digital calliper	1.7	✓		within tolerance
55mm	+0.2 -0.0	Digital calliper	55.15	✓		within tolerance
63mm	±0.25	Digital calliper	62.99	✓		within tolerance
Ø28.6	+0.0 -0.21	Blade micrometer	28.5	✓		within tolerance
Ø30	+0.0 -0.1	Micrometer	29.91	✓		within tolerance
Ø45	±0.25	Micrometer	44.97	✓		within tolerance
1x45°	±0.25	Steel rule	1X1	✓		within tolerance
R1	±0.25	R1 gauge	R1	✓		within tolerance

3a. Practical observation form – Quality inspection

Assessment ID	Qualification number
8713-332	**8713-332**
Candidate name	**Candidate number**
Candidate A	**CG12345**
Centre name	**Assessment theme**
City & Guilds	**Quality review and evaluation**

Complete the table below referring to the relevant marking grid, found in the assessment pack. Do not allocate marks at this stage.

Task	**Notes –** *detailed, accurate and differentiating notes which identify areas of strength and weakness are necessary to distinguish between different qualities of performance and to facilitate accurate allocation of marks once all evidence has been submitted.*
Quality inspection and application of measuring equipment	Measuring tools were selected, calibration checks were completed on the measuring equipment before use. Each component part was measured using the appropriate measuring tool. The candidate checked the dimensions against the technical drawing and checked the adherence to the given tolerance. All dimensions and findings were recorded on their quality check sheet. Visual checks were completed, the final surface finish was closely examined.
The completed bearing assembly	The candidate assembled the bearing housing, in order and correct orientation. The circlip was added and the CNC shaft was still able to rotate freely due to the fact the unilateral tolerances were adhered to when manufacturing the parts. The bearing assembly was correctly assembled, no free play in the assembly which was good. All tolerances within the specification were met. The unilateral tolerance was adhered to, the candidate had stayed close to the nominal size in order to create the push fit for the nylon top hat into the bearing housing. The CNC shaft had a slightly looser fit, but still a running fit was achieved as the difference in parts was just 0.14mm. Overall an excellent part with excellent dimensional accuracy and a good surface finish. There were very few defects, but those visible were identified and a solution offered. The defects did not affect the operation of the assembly or go outside the specified tolerances.

Assessor signature	Date
Assessor A	**18.12.2021**

Commentary

This commentary also covers the completion of the quality check sheet.

The observation evidence has captured that the candidate undertook the quality inspection of the machined bearing assembly components and complete assembly.

The candidate utilised measuring equipment to perform the checks on each of the components to record the final dimensions and to check for compliance with tolerances against the brief.

The candidate performed dimensional checks, a fitting check and a surface check for defects, recording their findings on their check sheet (from task 1). The completed quality check sheet could then be utilised within their quality inspection report.

The candidate has made no changes to the form showing a good understanding of planning and what is required for a quality check. The check sheet contains a comprehensive level of information, is set out clearly and shows the candidate has recorded the findings and provided additional observations from their quality inspection.

All dimensions and components were checked for accuracy against the dimensions and tolerances in the given specification and recorded. All dimensions were within the given tolerances.

All detectable defects were identified, recorded and attributed to a process or procedural deficiency, for example, citing the choice of nylon for the material as a contributing factor for the machining of the top hat bearing.

Task 3b – Evaluation and recording

(Assessment themes: Health and safety, Quality review and evaluation (quality review, reporting, recording and handover)

For task 3b, candidates need to produce the following piece of evidence:

- completed quality inspection report.

Candidate evidence

3b. Quality inspection report

Quality Inspection Report

Introduction

The assignment was to create a new bearing assembly to be used in a roller assembly of a bespoke conveyor system. Technical drawings were provided within the brief. The bearing assembly was to be manufactured and when completed, quality inspected.

Production process

The bearing assembly was made up of three main components: the bearing housing, shoulder shaft and top hat bearing. The bearing housing and shoulder shaft were manufactured using low carbon mild steel and the top hat bearing was to be manufactured out of nylon.

The bearing housing was manufactured using the milling machine and a manual lathe. The stock material was first prepared and squared on the milling machine. A face cutter was used to cut all four sides which was then checked with a DTI gauge for squareness. A reference hole was added to the middle of the workpiece to be able to clock it when it was transferred to the lathe and it also give the drill some relief. A wobble bar was used to find the centre of the block to enable the hole to be drilled centrally. The holes were bored on the lathe to the required sizes. In-production checks were carried out to check the amount of material removed and to ensure the internal and external bore measurements were accurate. This was achieved using micrometers. Minor adjustments were made to the bearing housing to enable the required push fit for the nylon top hat bearing. A chamfer was machined using a 45-degree setting piece and a carbide tipped end mill.

The top hat bearing was manufactured from nylon using the manual lathe. The nylon was machined using a range of tooling to remove the material. Due to the properties of the material it created a lot of excess swarf when machined which had to be cleared from the moving parts to prevent damage to the lathe. The external bore was checked with a micrometer to ensure a good fit into the bearing housing.

The shoulder shaft was manufactured using the CNC lathe. The CNC lathe was set up to machine the part and the tooling on the lathe was changed at intervals to achieve the dimensions and finish as required in the specification. The program simulation was run first to check the general outlook of the part, then run in tracking mode before being changed to full CNC mode to machine the part. Coolants were used during the machining and 4 tools were changed during the manufacture. In-production checks were made to ensure the required dimensions had been met.

The individual components were adjusted accordingly to ensure the fit met the specification. The final assembly was treated with an anti-corrosion spray treatment.

Quality inspection

I carried out a full quality inspection on the completed bearing assembly. This included a visual check; dimensional accuracy check and functionality test of the bearing assembly.

I prepared my work area and collected my tools and equipment. I selected a digital Vernier calliper to measure the finished dimensions of the individual components. The Vernier calliper was checked and calibrated.

I completed a visual check of the completed bearing assembly. There were some surface marks on the bearing housing from the jaws of the vice. These were caused during the production of the component and were not removable by polishing. The nylon top hat bearing showed some residual tooling marks. A shim was used to minimise this during the manufacture but this was not able to remove all tooling marks.

To check the functionality, I checked the fit of the components by spinning the assembly to check the bearing operated correctly. The fit was good, the bearing was free running and there was no free play in the assembly.

I disassembled the bearing assembly and used the vernier digital callipers and micrometers to carry out dimensional checks on the individual component parts. All components were measured. The finished dimensions were recorded on the quality check sheet. I repeated this process for each component part. I checked the brief and the technical drawings to confirm the required tolerances. All tolerances were met. A copy of my quality check sheet is included below:

Bearing housing

Drawing Size	Tolerance	Equipment Used	Actual Size	Learner Inspection		
				Satisfactory	Unsatisfactory	Comment
60mmx60mm	±0.25	Digital calliper	60x60.03	✓		within tolerance – some minor tool marks to surface
50mm	±0.25	Digital calliper	50.03	✓		within tolerance
ø40	+0.1 -0.0	Bore micrometer	40.025	✓		within tolerance
M5x0.8-6H	Gauge	M5x0.8 - 6H thread gauge	Gauge all through	✓		NA
M6x1 - 6H	Gauge	M6x1 - 6H thread gauge	Gauge depth 13.97	✓		within tolerance
8x45°	±0.25	Steel rule	7.9x7.9	✓		within tolerance
R6	±0.25	R6 gauge	R6	✓		within tolerance

Top hat bearing

Drawing Size	Tolerance	Equipment Used	Actual size	Learner Inspection		
				Satisfactory	Unsatisfactory	Comment
5mm	±0.25	Digital calliper	4.87	✓		within tolerance unable to remove all surface tool marks due to nature of material (nylon)
55mm	+0.0 -0.2	Digital calliper	54.93	✓		within tolerance
ø30	+0.0 -0.1	Bore micrometer	29.95	✓		within tolerance
ø40	+0.0 -0.1	Micrometer	39.97	✓		within tolerance
ø55	±0.25	Micrometer	55.12	✓		within tolerance
1x45°	±0.25	Steel rule	1x1	✓		within tolerance

Shoulder shaft

Drawing Size	Tolerance	Equipment Used	Actual size	Learner Inspection		
				Satisfactory	Unsatisfactory	Comment
4mm	±0.25	Digital calliper	3.8	✓		within tolerance
1.6mm	+0.14 -0.0	Digital calliper	1.7	✓		within tolerance
55mm	+0.2 -0.0	Digital calliper	55.15	✓		within tolerance
63mm	±0.25	Digital calliper	62.99	✓		within tolerance
ø28.6	+0.0 -0.21	Blade micrometer	28.5	✓		within tolerance
ø30	+0.0 -0.1	Micrometer	29.91	✓		within tolerance
ø45	±0.25	Micrometer	44.97	✓		within tolerance
1x45°	±0.25	Steel rule	1X1	✓		within tolerance
R1	±0.25	R1 gauge	R1	✓		within tolerance

Evaluation

If I was to remake this bearing assembly again, I would like to improve the overall finish on the bore by spending longer checking the setup of the machine and workpiece before committing to removing material. For example, by doing more trial cuts before boring down to size. I ran out of time to do this as I had already removed the required material before I could improve the finish. I would like to improve my adherence to tolerances and be exact or within 0.2mm for all dimensions, as the design of the assembly is dependent upon accuracy in order to achieve the required push fit of the nested components. I could also manipulate the speeds and feeds more to get a better finish.

I would also change the order in which I created the components. I would produce the top hat bearing first as it would be easier to pair with the bearing housing and the nylon material is cheaper than mild steel, so any mistakes or reworking of the component would be cheaper and less time consuming to reproduce. Any adjustments to the fit could be made to the shoulder shaft on the CNC lathe if needed.

I was happy with the surface finishes I was able to achieve, however, I could improve the finish of the top hat bearing by using a thicker shim to prevent the teeth marks from the jaws which would allow a better surface finish.

Conclusion

The design of the bearing assembly is good and would be suitable for the purpose it was intended but I would suggest the designers consider making a test piece or setter which could be made up to the same size to get it near to clocking first of all before you put the first one in, minimising the jaw marks.

I would also consider replacing the bearing material to another material, such as brass as the nylon was difficult to machine and the nylon created a lot of excess swarf which had to be regularly cleared away from the moving parts to prevent damage to the lathe.

Commentary

The candidate has given a comprehensive description of the methods and techniques undertaken to produce the bearing assembly and the process of performing the quality inspection.

The evaluation is thorough and the candidate has identified a comprehensive range of improvements to their own performance and has provided a suggestion to improve the design and manufacturing process. For example, the candidate has identified that they would like to improve their adherence to tolerances to be either exact or within 0.2mm for all dimensions as the design is dependent upon accuracy to achieve the required fit. This shows a comprehensive understanding of the need to adhere to tolerances and how tolerances can affect the end product.

The report contains accurate information and the correct industry terminology has been used throughout the report. The report is laid out correctly with an overview of the given task, an overview of the production process undertaken, an account of the processes taken during the quality testing and has evaluated their performance. The candidate has concluded the report with their suggestions for process improvements. The inclusion of the completed quality check sheet gives the finished sizes of the components and has captured the key data showing whether the components have met the required dimensions.

Task 3c – Handover meeting

(Assessment themes: Health and safety, Quality review and evaluation (quality review, reporting, recording and handover)

For task 3c, candidates must provide the following materials:

- completed bearing assembly
- quality inspection report (from task 3b).

For task 3c, assessors will need to produce the following pieces of supporting evidence:

- assessor observation:
    - handover meeting.

Video evidence required

- video evidence showing the handover meeting – *Illustrated in task 3 video evidence section below (video 2)*

The following task 3c supporting evidence has not been included for this version of the GSEM:

Video evidence

- video evidence showing the handover meeting.

3c. Practical observation form – Handover meeting

Assessment ID	Qualification number
8713-332	**8713-332**
Candidate name	**Candidate number**
Candidate A	**CG12345**
Centre name	**Assessment theme**
City & Guilds	**Quality review and evaluation**

Complete the table below referring to the relevant marking grid, found in the assessment pack. Do not allocate marks at this stage.

Task - Handover	**Notes –** *detailed, accurate and differentiating notes which identify areas of strength and weakness are necessary to distinguish between different qualities of performance and to facilitate accurate allocation of marks once all evidence has been submitted.*
Handover meeting	The candidate showed a comprehensive knowledge and understanding of all the operating procedures to manufacture the parts for the bearing housing assembly. Each component and process was described in detail and the candidate explained why the component parts were manufactured in that order (bearing housing, top hat bearing then shoulder shaft). The component parts were well manufactured and when assembled, the bearing was free running. They reiterated the need to produce each component to the given tolerances and how the design of the assembly is dependent upon accuracy, stating that this would determine the fit of the components and the completed assembly. They explained the assembly and explained how each component was machined to meet the tolerance, specifically describing the order in which the components were machined and the need to achieve the push fit in the bearing housing. They demonstrate how the components fitted together and how the limits were met. They said if they were to do it again, they would change the order, producing the top hat bearing first as this would be easier to pair with the bearing housing and cheaper and easier to remake if needed. The shoulder shaft could then be tweaked on the CNC lathe if needed. The candidate identified two elements that they would like to improve and explained how they would remedy this if they were to manufacture the components again. They would use a thicker shim to prevent the teeth marks from the hard jaws and would attempt a better bore finish by manipulating the speeds and feeds to get the better finish. They also suggested using brass or bronze in place of the nylon due to

	the excess swarf it created when machined and the unsatisfactory finish they were able to achieve on the top hat bearing. The candidate displayed good communication skills, using positive body language and conducted themselves with professionalism whilst in the handover meeting. They spoke clearly and used the correct industrial terminology to discuss the manufacturing processes and the limits and fits achieved.

Assessor signature	Date
Assessor A	**17.12.2021**

Commentary

The observation evidence has captured the requirements of the handover assessment themes.

The account of the handover is very good, indicating the candidate had shown comprehensive subject knowledge and understanding in accurately describing in detail the processes undertaken and how they achieved the desired push fit. The candidate demonstrated the assembly of the components and the operation of the completed assembly which was free running.

They gave a summary of the activities undertaken and the problems they incurred and how they resolved them. For example, the difficulty of machining the nylon material for the top hat bearing and the large amount of swarf created. Another example of problem solving was seen during the machining of the bearing housing, where they put a reference hole in the middle of the bearing housing stock to allow them to clock it when it was transferred from the manual milling machine to the manual lathe.

They gave a summary of potential improvements, for example, reducing the surface marks on the bearing housing by using a thicker shim to prevent the teeth of the hard jaws from marking the surface. They also explained how they may change the order in which the components were manufactured in order to have more control of the limits and fits.

The report states that the candidate demonstrated very good communication skills, presented themselves professionally, spoke clearly and used the correct industry terminology at the appropriate level throughout.