MECHANICAL MANUFACTURING

MACHINING TECHNIQUES NUMERICAL CONTROL MACHINE TOOL OPERATION

DVS 5723

ASP 5724

PROGRAM ANALYSIS TABLES
TABLES OF SPECIFICATIONS
EVALUATION FORMS
INFORMATION ON THE EXAMINATIONS

VOCATIONAL and TECHNICAL EDUCATION

Québec

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1. Letaïef Ellamine wrote Module 25 of *Machining Techniques* and Module 12 of *Numerical Control Machine Tool Operation.*
2. The people listed here participated in the meetings of May 10 and 11, 1999, during which most of the modules of the two programs (27 out of 33) were validated. Most participants also attended the second meeting on October 22, 1999, and the third on May 12, 2000, during which five more modules (*NCMTO* 8, 9, 10 and 12, and *MT* 25) were examined; others joined the team at that time.

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3. Although he could not attend the meeting of May 10 and 11, 1999, Yvan Péloquin submitted his comments in writing.

TABLE 1: SYNOPTIC TABLE OF EXAMINATIONS FOR *MACHINING TECHNIQUES* (5723)

Module code	Module no.		Title of module	Duration of module	Status of examination	Type of evaluation (1)	Duration of examination (2)	Maximum number of candidates (3)		Minimum performance standard		Number of versions
	DVS 5723	AVS 5724										
872 011	1	1	The Trade and the Training Process	15	Local	Pa						
872 024	2		Mathematics Related to Conventional Machining	60	Local	Th						
872 035	3		Interpreting Technical Drawings	75	Local	Th						
872 041	4		Health and Safety	15	Local	Th						
872 054	5		Taking and Interpreting Measurements	60	Local	Pr						
872 066	6		Shop Work	90	Ministry	Pr	5 hours	7		75		3
872 072	7		Materials and Processes	30	Local	Th						
872 083	8		Sketches	45	Local	Pr						
872 096	9		External Cylindrical Turning	90	Local	Pr						
872 105	10		Boring	75	Local	Pr						
872 118	11		Longitudinal and Transverse Machining on a Milling Machine	120	Local	Pr						
872 125	12		Thread Cutting on a Lathe	75	Local	Pr						
872 133	13		Drilling and Reaming Using a Milling Machine	45	Local	Pr						
872 144	14		Surface Grinding	60	Local	Pr						
872 153	15	11	New Types of Work Organization	45	Local	Th						
872 162	16		Introduction to the Workplace	30	Local	Pa						
872 178	17		Angular and Circular Milling on a Milling Machine	120	Local	Pr						
872 182	18	3	Mathematics Related to Numerical Control Machining	30	Local	Th						
872 194	19	4	Manual Programming of a Numerical Control Lathe	60	Local	Pr						
872 206	20	5	Basic Machining on a Numerical Control Lathe	90	Ministry	Pr	4½ hours	5		10	70	3
872 214	21	6	Manual Programming of a Machining Centre	60	Ministry	Pr	3 hours	(4)		60	25	3
872 226	22	7	Basic Machining Using a Machining Centre	90	Local	Pr						
872 238	23		Complex Turning Operations	120	Ministry	Pr	7 hours	All	7	25	60	3
872 248	24		Complex Milling Operations	120	Ministry	Pr	7 hours	All	7	25	60	3
872 255	25		Mass Production (Optional)	75	Local	Pr						
872 265	26		Using a Boring Machine (Optional)	75	Local	Pr						
872 271	27		Entrepreneurship	15	Local	Pa						
872 286	28	13	Entering the Work Force	90	Local	Pa						

(1) Pa: participation examination Th: theory examination Pr: practical examination

(2) Duration of examination per group of candidates. This includes only the time allotted for the actual examination and does not include the time needed to read the instructions.

(3) Maximum number of candidates who can be evaluated at the same time by a given examiner

(4) Depending on the number of workstations available

TABLE 2: SYNOPTIC TABLE OF EXAMINATIONS FOR *NUMERICAL CONTROL MACHINE TOOL OPERATION* (5724)

Module code	Module no.		Title of module	Duration of module	Status of examination	Type of evaluation (1)	Duration of examination (2)	Maximum number of candidates (3)	Minimum performance standard		Number of versions
	DVS 5723	AVS 5724									
872 011	1	1	The Trade and the Training Process	15	Local	Pa					
872 292		2	Interpreting Complex Drawings	30	Local	Th					
872 303	18	3	Mathematics Related to Numerical Control Machining	45	Local	Th					
872 194	19	4	Manual Programming of a Numerical Control Lathe	60	Local	Pr					
872 206	20	5	Basic Machining on a Numerical Control Lathe	90	Ministry	Pr	4½ hours	5	10	70	3
872 214	21	6	Manual Programming of a Machining Centre	60	Ministry	Pr	3 hours	(4)	60	25	3
872 226	22	7	Basic Machining Using a Machining Centre	90	Local	Pr					
872 314		8	Automatic Programming	60	Ministry	Pr	3½ hours	(4)	80		3
872 328		9	Complex Machining on a Numerical Control Lathe	120	Local	Pr					
872 338		10	Complex Machining Using a Machining Centre	120	Ministry	Pr	5 hours	(4)	80		3
872 153	15	11	New Types of Work Organization	45	Local	Th					
872 346		12	Mass Production	90	Local	Pr					
872 354	28	13	Entering the Work Force	60	Local	Pa					

(1) Pa: participation examination Th: theory examination Pr: practical examination
(2) Duration of examination per group of candidates. This includes only the time allotted for the actual examination and does not include the time needed to read the instructions.
(3) Maximum number of candidates who can be evaluated at the same time by a given examiner
(4) Depending on the number of workstations available

Students who have attained one or more of the competencies of the *Machining Techniques* (5723) program will receive recognition for corresponding competencies in one of the programs below, if they pursue their studies in that program.

Table 3 – Equivalents for the *Machining Techniques* Program

FROM →		TO			
MACHINING TECHNIQUES 5723		**Industrial Drafting (DVS) 5725**	**Mechanical Engineering Technology (DCS) 241.A0**	**Numerical Control Machine Tool Operation (AVS) 5724**	**Aircraft Manufacturing Technology (DCS) 280.B0**
872 011	Determine their suitability for the trade and the training process			872 011	
872 024	Solve mathematical problems related to conventional machining				
872 035	Interpret technical drawings	872 035	012F		
872 041	Avoid occupational health and safety risks				
872 054	Take and interpret measurements	872 054	012P		
872 066	Do shop work				
872 072	Interpret technical information related to materials and manufacturing processes				
872 083	Sketch objects		012G		011S
872 096	Perform external cylindrical turning operations		012Q		
872 105	Perform boring operations				
872 125	Cut threads on a lathe				
872 118	Perform longitudinal and transverse machining operations on a milling machine		012R		
872 133	Perform drilling and reaming operations on a milling machine				
872 178	Perform angular and circular milling operations on a milling machine				
872 144	Grind flat surfaces				
872 153	Adapt to new types of work organization	872 153	012X	872 153	0127
872 162	Become familiar with the workplace				
872 182	Solve mathematical problems related to numerical control machining			872 303	
872 194	Program a numerical control lathe manually		0133	872 194	
872 214	Program a machining centre manually		012W	872 214	
872 206	Machine simple parts on a numerical control lathe		012V	872 206	
872 226	Machine simple parts using a machining centre			872 226	
872 238	Perform complex turning operations				
872 248	Perform complex milling operations				
872 255	Mass-produce parts using conventional machining techniques (optional)				
872 265	Perform machining operations using a boring machine (optional)				
872 271	Explore the possibility of starting their own business				
872 286	Enter the work force			872 354	

Students who have attained one or more of the competencies of the *Numerical Control Machine Tool Operation* (5724) program will receive recognition for corresponding competencies in one of the programs below, if they pursue their studies in that program.

Table 4 Equivalents for the *Numerical Control Machine Tool Operation* Program

FROM →		TO			
NUMERICAL CONTROL MACHINE TOOL OPERATION (AVS) 5724		**Industrial Drafting (DVS) 5725**	**Mechanical Engineering Technology (DCS) 241.A0**	**Machining Techniques (DVS)[2] 5723**	**Aircraft Manufacturing Technology (DCS) 280.B0**
872 011	Determine their suitability for the trade and the training process			872 011	
872 292	Interpret complex drawings related to numerical control machine tool operations				
872 303	Solve mathematical problems related to numerical control machining			872 182	
872 194	Program a numerical control lathe manually		0133	872 194	011Z
872 214	Program a machining centre manually		012W	872 214	
872 314	Do automatic programming		0135		
872 206	Machine simple parts on a numerical control lathe		012V	872 206	
872 226	Machine simple parts using a machining centre			872 226	
872 328	Perform complex machining operations on a numerical control lathe				
872 338	Perform complex machining operations using a machining centre				
872 153	Adapt to new types of work organization	872 153	012X	872 153	0127
872 346	Mass-produce parts using numerical control machine tools				
872 354	Enter the work force			872 286	

2. The *Numerical Control Machine Tool Operation* program leads to an Attestation of Vocational Specialization. Students wishing to enrol in this program must have a Diploma of Vocational Studies in *Machining Techniques* or the equivalent scholastic or experiential learning. A student may not study the specialty before enrolling in the basic program. The equivalents in this table are intended merely to indicate the competencies for which a student having obtained a DVS and enrolled in the AVS program would receive recognition.

TABLE 5: DISTRIBUTION OF CRITERION COMPONENTS BY MODULE

Criterion components to be evaluated / List of modules DVS and AVS	5- Taking and Interpreting Measurements (DVS)	6- Shop Work (DVS)	8- Sketches (DVS)	9- External Cylindrical Turning (DVS)	10- Boring (DVS)	11- Longitudinal and Transverse Machining on a Milling Machine (DVS)	12- Thread Cutting on a Lathe (DVS)	13- Drilling and Reaming Using a Milling Machine (DVS)	14- Surface Grinding (DVS)	17- Angular and Circular Milling on a Milling Machine (DVS)	19- Manual Programming of a Numerical Control Lathe (DVS)	4- Manual Programming of a Numerical Control Lathe (AVS)	20- Basic Machining on a Numerical Control Lathe (DVS)	5- Basic Machining on a Numerical Control Lathe (AVS)	21- Manual Programming of a Machining Centre (DVS)	6- Manual Programming of a Machining Centre (AVS)	22- Basic Machining Using a Machining Centre (DVS)	7- Basic Machining Using a Machining Centre (AVS)	23- Complex Turning Operations (DVS)	24- Complex Milling Operations (DVS)	26- Using a Boring Machine (DVS)	8- Automatic Programming (AVS)	9- Complex Machining on a Numerical Control Lathe (AVS)	10- Complex Machining Using a Machining Centre (AVS)
Identified the required tolerances and information		1.1		1.1	1.1		1.1-1.2												1.1-1.2		1.1			
Interpreted technical terms		1.2							1.1															
Completed the sequences of operations				2.1	2.1	1.1		1.1		1.1														
Completed the list of machining parameters		2.2		2.3	2.3	1.3		1.2		1.3														
Completed the list of tools and instruments needed		2.3		2.2	2.2								1.2				1.2							
Chose the appropriate mounting method, cutting tools, fastening method and measuring instruments						1.2				1.2			1.1				1.1							
Wrote up a process sheet																			2.1-2.2 2.3-2.4	1.1-1.2 1.3-1.4				
Calculated taper																			1.3					
Calculated the three-wire method for the external thread and the depth of cut							1.3																	
Edited the program on the machine tool controller													2.1				2.1							
Verified the inclusion and accuracy of the program data													2.2				2.2							
Simulated a toolpath in accordance with the capacity of the machining centre																	5.1					6.3		
Simulated a toolpath in accordance with the capacity of the numerical control lathe													5.1											
Determined the factors that affect the choice of size of grain									2.1															
Determined the factors to be taken into account when choosing a grade of grinding wheel									2.2															
Explained the importance of inspecting the grinding wheel before mounting it									2.3															
Chose the appropriate grinding wheel for the task									2.4															
Described the steps involved in mounting the grinding wheel									2.5															
Identified the feed rates and rpms											1.1				1.1									
Accurately calculated the rectangular and polar coordinates, as applicable											1.2				1.2									
Accurately determined the position of the beginning and end of the toolpaths											1.3				1.3									
Took into account the shape and complexity of the part			1.1-3.1																					
Observed the proportions related to the different shapes			1.2-2.2 3.2																					
Included all the annotations			1.3																					
Drew a neat, precise sketch			1.4-2.3 3.3																					
Took into account the shape and complexity of the part using skewed lines and ellipses			2.1																					
Correctly arranged the dimensions			4.1																					
Dimensioned the drawing for manufacturing			4.2																					
Dimensioned the drawing neatly and clearly			4.3																					
Calibrated and adjusted the measuring instrument	1.1																							
Correctly measured the parts using direct-reading instruments	2.2																							
Correctly measured the parts using indirect-reading instruments	2.1																							
Correctly measured the part using a hardness tester	2.3																							
Converted measurements from one system to the other	3.1																							
Correctly prepared and laid out the part		3.1																	3.1					
Correctly and safely positioned and aligned the workpiece in the installation		4.1		4.1	4.1	3.1			3.1	3.1											3.1		2.2	2.2
Correctly adjusted the machining parameters		5.1		5.1		4.1		3.1		4.1														
Correctly aligned the milling head						3.2		3.2		3.2														
Correctly installed the accessories in accordance with the type of installation				3.1	3.1	2.1		2.1		2.1							3.1				2.1		2.1	2.1

TABLE 5: DISTRIBUTION OF CRITERION COMPONENTS BY MODULE

Criterion components to be evaluated / List of modules DVS and AVS	5- Taking and Interpreting Measurements (DVS)	6- Shop Work (DVS)	8- Sketches (DVS)	9- External Cylindrical Turning (DVS)	10- Boring (DVS)	11- Longitudinal and Transverse Machining on a Milling Machine (DVS)	12- Thread Cutting on a Lathe (DVS)	13- Drilling and Reaming Using a Milling Machine (DVS)	14- Surface Grinding (DVS)	17- Angular and Circular Milling on a Milling Machine (DVS)	19- Manual Programming of a Numerical Control Lathe (DVS)	4- Manual Programming of a Numerical Control Lathe (AVS)	20- Basic Machining on a Numerical Control Lathe (DVS)	5- Basic Machining on a Numerical Control Lathe (AVS)	21- Manual Programming of a Machining Centre (DVS)	6- Manual Programming of a Machining Centre (AVS)	22- Basic Machining Using a Machining Centre (DVS)	7- Basic Machining Using a Machining Centre (AVS)	23- Complex Turning Operations (DVS)	24- Complex Milling Operations (DVS)	26- Using a Boring Machine (DVS)	8- Automatic Programming (AVS)	9- Complex Machining on a Numerical Control Lathe (AVS)	10- Complex Machining Using a Machining Centre (AVS)
Positioned the cutting tools					5.1																4.1		3.1	3.1
Correctly positioned the threading tool							2.1																	
Correctly positioned the angle plate on the magnetic table									3.2															
Positioned the part for angle grinding									3.3															
Developed a well-structured program											1.4				1.4									
Accurately inserted the machining parameters for turning operations											1.5													
Accurately inserted the machining parameters for milling operations															1.5									
Observed the sequence of operations											1.6				1.6							5.1		
Observed programming syntax											1.7				1.7									
Observed the appropriate procedure for the hardware in place											2.1				2.1									
Transmitted the entire program to the machine tool controller											3.1				3.1									
Corrected the program as needed											3.2				3.2									
Simulated the toolpaths											4.1				4.1									
Correctly mounted the chuck jaws													3.1											
Correctly mounted the cutting tools and spray nozzles													4.1				4.1							
Adjusted the feed rates and rpms													6.1				6.1							
Adjusted the tool offsets, feed rates, rpms and spray nozzles													4.2				4.2						3.2	3.2
Evaluated the measured dimensions with respect to the dimensions in the drawing	4.1																							
Checked and topped off the fluid levels in the lathe as needed				8.1																				
Trued the grinding wheel									4.1															
Observed the dimensions, tolerances and shape of the part		6.1		6.1	6.1	5.1	3.1-3.2	4.1	5.1	5.1									3.1	2.1	5.1			
Took the required finish into account		6.2		6.2	6.2	5.2	3.3	4.2	5.2	5.2									3.2	2.2	5.2			
Cleaned and deburred the parts		6.3		6.3	6.3	5.3	3.4	4.3	5.3	5.3									3.3	2.3	5.3			
Observed the time limits																			3.4					
Took accurate measurements		7.1		7.1	7.1	6.1	4.1	5.1	6.1	6.1			7.1				7.1		4.1	3.1	6.1		6.1	6.1
Located the reference surfaces																						1.0		
Correctly represented the geometry of the part in accordance with the drawing																						2.1		
Imported a drawing																						3.1		
Correctly determined the toolpaths for each operation																						4.1		
Saved the toolpaths																						4.2		
Simulated the toolpaths																						5.2		
Chose the appropriate postprocessor for the machine tool controller																						6.1		
Translated the toolpaths into machine language																						6.2		
Made the necessary corrections																						6.4		
Defined the toolpaths																							1.1	1.1
Correctly adjusted the zero position of the part																							4.1	4.1
Verified the conformity of the prototype with the drawing and instructions																							4.2	4.2
Safely started up the machining centre in automatic mode																							5.1	5.1
Took corrective measures to solve the problems encountered																							5.2	5.2
Confirmed the corrections with the examiner																							5.3	5.3

Table 6

LIST OF COMPONENTS OF KNOWLEDGE FOR GENERAL COMPETENCIES REINVESTED IN SPECIFIC COMPETENCIES

GENERAL COMPETENCIES

SPECIFIC COMPETENCIES: PRACTICAL MODULES	CRITERION COMPONENTS	THEORY MODULES: 2				3				5
		COMPONENTS OF KNOWLEDGE								
		1.1	1.2	3.1	3.3	5.1	6.1	7.1	8.1	2.1-2.2
96	2.1					1.1	1.1	1.1		7.1
91	2.3					1.1				
110	2.3					1.1				7.1
112	1.3	1.3								6.1
113						1.1 - 1.2				4.1
114	1.2	1.2								5.1
117								1.1		6.1
123	1.3	1.3		1.3						6.1
124	2.3		1.3			1.1 - 1.2				4.1
126	1.3	1.3		1.3						3.1
						1.1				6.1

TABLE 7

LIST OF CRITERION COMPONENTS AND COMPONENTS OF PRACTICAL KNOWLEDGE THAT COULD BE THE SUBJECT OF A QUESTION WHOSE ANSWER APPEARS IN *MACHINERY'S HANDBOOK*

Modules	Criterion Components or Components of Knowledge	Sections of *Machinery's Handbook*, 25th edition
2 Mathematics Related to Conventional Machining	1.1 1.2 1.4 2.1 3.1 to 3.5 4.1 5.1	p. 970 - ... *Speeds and feeds* p. 134 - ... *Wheels and pulleys* p. 85 - ... *Solutions of triangles* p. 2452 - ... *Conversion tables*
3 Interpreting Technical Drawings	2.1 4.1 7.1 5.1	p. 626 - ... *Standard for drawing* p. 635 - ... *Allowances and tolerances*
6 Shop Work	2.1	p. 970 - ... *Speeds and feeds*
7 Materials and Processes	2.1 2.2 6.1 7.1 7.2	p. 404 - ... *Standard steels* p. 482 - ... *Heat-treatment of steel*
9 External Cylindrical Turning	1.1 2.3	p. 635 - ... *Allowances and tolerances* p. 970 - ... *Speeds and feeds*
10 Boring	1.1 2.3	p. 635 - ... *Allowances and tolerances* p. 970 - ... *Speeds and feeds*
11 Longitudinal and Transverse Machining on a Milling Machine	1.3	p. 970 - ... *Speeds and feeds*
12 Thread Cutting on a Lathe	1.1 1.2 1.3	p. 1629 - ... *Threads and threading*
13 Drilling and Reaming Using a Milling Machine	1.3	p. 970 - ... *Speeds and feeds*
14 Surface Grinding	1.1 2.1 2.2 2.4	p. 626 - ... *Standard for drawing* p. 1073 - ... *Grinding wheels*
17 Angular and Circular Milling on a Milling Machine	1.3	p. 970 - ... *Speeds and feeds*
23 Complex Turning Operations	1.1 1.2 1.3 2.3	p. 635 - ... *Allowances and tolerances* p. 1629 - ... *Threads and threading* p. 689 - ... *Tapers* p. 970 - ... *Speeds and feeds*
24 Complex Milling Operations	1.3	p. 970 - ... *Speeds and feeds*
26 Using a Boring Machine	1.1	p. 635 - ... *Allowances and tolerances*

TABLE 8: RECOMMENDED TOLERANCES FOR EXAMINATIONS[1]

Module no.		Title of module and code	Number of measure-ments required	Tolerances required (Imperial units)	Tolerances required (ISO)
MT	NCMTO				
6	—	Shop Work (872 066)	12	Length: ± .015 in. Position: ± .015 in. Depth: ± .010 in.	Length: ± 0.375 mm Position: ± 0.375 mm Depth: ± 0.250 mm
9	—	External Cylindrical Turning (872 096)	12	Length: quality[2] 13 Diameter: quality 12 si + < 1.190 quality 11 si + > 1.190 Chamfer: ± 3° Angle: ± ½°	Length: quality[3] 14 Diameter: quality 13 si + < 30 quality 12 si + > 30 Chamfer: ± 3° Angle: ± ½°
10	—	Boring (872 105)	10	Length: quality 13 Diameter: quality 12 si + < 1.190 quality 11 si + > 1.190 Chamfer: ± 3° Angle: ± ½°	Length: quality 14 Diameter: quality 13 si + < 30 Quality 12 si + > 30 Chamfer: ± 3° Angle: ± ½°
11	—	Longitudinal and Transverse Machining on a Milling Machine (872 118)	10	Width and length: quality 12 si + < 1.190 quality 11 si + > 1.190 Depth: quality 11 Squareness: quality 9 Parallelism: quality 10	Width and length: quality 13 si + < 18 quality 12 si + > 18 and + < 80 quality 11 si + > 80 Depth: quality 12 Squareness: quality 10 Parallelism: quality 11
12	—	Thread Cutting on a Lathe (872 125)	6	Diameter: according to *Machinery's Handbook* or equivalent Length: ± .03125 in. Chamfer: ± 3°	Diameter: according to *Machinery's Handbook* or equivalent Length: ± .750 mm Chamfer: ± 3°

Module no.		Title of module and code	Number of measure-ments required	Tolerances required (Imperial units)	Tolerances required (ISO)
MT	NCMTO				
13	—	Drilling and Reaming Using a Milling Machine (872 133)	10	Position: quality 11 Diameter: quality 12 Depth: quality 13 Boring: quality 10, with boring head	Position: quality 12 si + < 18 11 si + > 18 and + < 80 10 si + > 80 Diameter: quality 11 Depth: quality 13 Boring: quality 10, with boring head
14	—	Surface Grinding (872 144)	6	Width and length: quality 7 Parallelism: quality 6 Squareness: quality 6 Angle: ± 15' (¼°)	Width and length: quality 7 si + < 30 quality 6 si + > 30 Parallelism: quality 5 Squareness: quality 5 Angle: ± 15' (¼°)
17	—	Angular and Circular Milling on a Milling Machine (872 178)	10	Width and length: quality 10 Depth: quality 12 Angle: ± ½°	Width and length: quality 11 si + < 18 quality 10 si + > 18 Angle: ± ½°
20	5	Basic Machining on a Numerical Control Lathe (872 206)	10	Length: quality 11 Diameter: quality 10 Chamfer: ± 3° Angle: ± 15' (¼°)	Length: quality 11 Diameter: quality 11 si + < 18 quality 10 si + > 18 Chamfer: ± 3° Angle: ± 15' (¼°)
22	7	Basic Machining Using a Machining Centre (872 226)	12	Width and length: quality 11 Depth: quality 10 Position: quality 11 Angle: ± ½°	Width and length: quality 11 Depth: quality 10 Position: quality 11 Angle: ± ½°

Module no.		Title of module and code	Number of measure-ments required	Tolerances required (Imperial units)	Tolerances required (ISO)
MT	NCMTO				
23	—	Complex Turning Operations (872 238)	14	Diameter: quality 9 Length: quality 12 Taper: 0.001'' per inch of taper length Diameter: threading in accordance with *Machinery's Handbook* or equivalent Chamfer: ± 3°	Diameter: quality 9 si + < 30 quality 8 si + > 30 Length: quality 11 Taper: 0.10° % Diameter: threading in accordance with *Machinery's Handbook* or equivalent Chamfer: ± 3°
24	—	Complex Milling Operations (872 248)	14	Width and length: quality 10 Depth: quality 10 Position: quality 11 Angle: ± 30' (½°)	Width and length: quality 10 Depth: quality 11 Position: quality 11 Angle: ± 30' (½°)
26	—	Using a Boring Machine (872 265)	12	Width and length: quality 10 Depth: quality 10 Position: quality 11 Chamfer: ± 3° Angle: ± 30' (½°)	Width and length: quality 10 Depth: quality 11 Position: quality 11 Chamfer: ± 3° Angle: ± 30' (½°)
—	9	Complex Machining on a Numerical Control Lathe (872 328)	14	Interior and exterior diameters: quality 9 Interior and exterior lengths: quality 11 Taper: 0.001'' per inch of taper length Threading: in accordance with *Machinery's Handbook* or equivalent	Interior and exterior diameters: quality 9 Length: quality 11 Taper: 0.10° % Threading diameter: in accordance with *Machinery's Handbook* or equivalent
—	10	Complex Machining Using a Machining Centre (872 338)	14	Width and length: quality 10 Depth: quality 10 Position: quality 10 Angle: ± 15' (¼°)	Width and length: quality 10 Depth: quality 10 Position: quality 10 Angle: ±15' (¼°)

1. This table replaces earlier tables 8a, 8b, 8c and 8d. It was examined by the Validation Committee and by those responsible for producing ministry and BIM examinations, who reached an agreement with the person at the Ministère responsible for determining the content of local and ministry examinations.

2. See Table 1, *ANSI Standard Tolerances (ANSI B4.1 - 1967, R1987),* on p. 644 of *Machinery's Handbook, 25th Edition.*

3. The *IT GRADES* from the ISO quality ratings are taken from Table 4, *British Standard Limits and Fits (BS 4500:1969), on p. 676 of Machinery's Handbook.*

MACHINING TECHNIQUES (DVS 5723)

NUMERICAL CONTROL MACHINE TOOL OPERATION (AVS 5724)

The Trade and the Training Process

Module 1

872 011

Participation Examination

PROGRAM ANALYSIS (SITUATIONAL OBJECTIVE)

PROGRAMS: Machining Techniques/Numerical Control Machine Tool Operation

MODULE: 1 – THE TRADE AND THE TRAINING PROCESS **CODE:** 872 011

EXPECTED OUTCOME: To determine their suitability for the trade and the training process

Learning Context	LRN. %	EVAL. %	Participation Indicators
PHASE 1: Information on the Trade • Learning about the types of companies that employ machinists and about the different types of work organization. • Describing factory production and the different jobs involved. • Learning about the nature and requirements of the job. • Examining trade-related tasks and operations. • Examining the skills and behaviours needed to practise the trade. • Presenting the information gathered and discussing their views on the trade (i.e. advantages, disadvantages, requirements) at a group meeting.	40	40	• Gather information on most of the topics to be dealt with.

PROGRAM ANALYSIS (SITUATIONAL OBJECTIVE)

PROGRAMS: Machining Techniques/Numerical Control Machine Tool Operation 2/2

MODULE: 1 – THE TRADE AND THE TRAINING PROCESS **CODE:** 872 011

EXPECTED OUTCOME: To determine their suitability for the trade and the training process

Learning Context	LRN. %	EVAL. %	Participation Indicators
PHASE 2: Information on Training and Participation in the Training Process	20	30	
• Learning about the program of study and the training process.			• Express their views on the program of study at a group meeting.
• Discussing the relevance of the program given the work situation.			
• Sharing their initial reactions to the specialized trade and the training program.			
• Learning about the concept of techno-watch and further training.	20	10	
PHASE 3: Evaluation and Confirmation of Their Career Choice	20	20	
• Producing a report.			• Write a report that: - sums up their preferences, aptitudes and interests with respect to the trade; - assesses their career choice by comparing the different aspects and requirements of the trade with their own preferences, aptitudes and interests.

TABLE OF SPECIFICATIONS (SITUATIONAL OBJECTIVE)

PROGRAMS: Machining Techniques/Numerical Control Machine Tool Operation

MODULE: 1 – THE TRADE AND THE TRAINING PROCESS **CODE:** 872 011

EXPECTED OUTCOME: To determine their suitability for the trade and the training process

Participation Indicators	WGT. %	Criterion Components	EVAL. %
PHASE 1			
1. Gather information on most of the topics to be dealt with.	40	1.1 Gather relevant information about at least four topics related to the job market in machining techniques: - size of the company - sector of economic activity - type of clientele - type of production - manufacturing processes - use of equipment employing new technology	10
		1.2 Describe factory production and the different jobs involved: - research into new processes - design and drawing of products - design of transformation methods or processes - optimization of production - etc.	10

TABLE OF SPECIFICATIONS (SITUATIONAL OBJECTIVE)

PROGRAMS: Machining Techniques/Numerical Control Machine Tool Operation 2/3

MODULE: 1 – THE TRADE AND THE TRAINING PROCESS **CODE:** 872 011

EXPECTED OUTCOME: To determine their suitability for the trade and the training process

Participation Indicators	WGT. %	Criterion Components	EVAL. %
		1.3 Give information on the nature of the work and the working conditions: - specific requirements - duties and responsibilities - salaries - opportunities for advancement - etc.	5
		1.4 Give information on trade-related tasks and operations.	5
		1.5 Give information on the skills and behaviours needed to practise the trade.	5
		1.6 Present the information gathered and discuss their views on the trade (i.e. advantages, disadvantages, requirements) at a group meeting.	5
PHASE 2			
2. Express their views on the program of study at a group meeting.	30	2.1 Learn about the program of study and the training process.	10

TABLE OF SPECIFICATIONS (SITUATIONAL OBJECTIVE)

PROGRAMS: Machining Techniques/Numerical Control Machine Tool Operation 3/3

MODULE: 1 – THE TRADE AND THE TRAINING PROCESS **CODE:** 872 011

EXPECTED OUTCOME: To determine their suitability for the trade and the training process

Participation Indicators	WGT. %	Criterion Components	EVAL. %
		2.2 Discuss the relevance of the program given the work situation.	5
		2.3 Share their initial reactions to the trade and the training program.	10
		2.4 Learn about the concept of techno-watch and further training.	5
PHASE 3			
3. Write a report.	30	3.1 State their preferences, aptitudes and interests with respect to the trade.	15
		3.2 Assess their career choice by comparing the different aspects and requirements of the trade with their own preferences, aptitudes and interests.	15

INFORMATION ON THE EVALUATION

PROGRAMS: Machining Techniques/Numerical Control Machine Tool Operation

MODULE: 1 – THE TRADE AND THE TRAINING PROCESS **CODE:** 872 011

EXPECTED OUTCOME: To determine their suitability for the trade and the training process

Items	Comments
Examination Information	Evaluation of the candidates' participation will be based on information gathered at certain times during the learning activities, depending on the type of criterion components. However, a definitive evaluation by criterion component should be done only at the end of the corresponding phase in the learning situation. Final evaluation of the candidates' participation in all of the learning activities should take place at the end of the module. The candidates will be provided with relevant documentation (e.g. information on the trade, report on the analysis of the job situation, training program) and a sample outline of a report.
Information on Criterion Components	The paragraphs below provide further information on the context for applying the criterion components and on their interpretation. During this activity, it is important to clearly indicate to candidates the nature of the information they are to gather and present at the group meeting. Whatever the medium or form used to record information, candidates should be evaluated not on the accuracy, quality or presentation of the information gathered, but rather on whether they took the time to collect a sufficient quantity of information relevant to the topics to be discussed and to organize it for use at a group meeting. At the end of the module, the instructor should provide feedback to students with incorrect perceptions.

INFORMATION ON THE EVALUATION

PROGRAMS: Machining Techniques/Numerical Control Machine Tool Operation

MODULE: 1 – THE TRADE AND THE TRAINING PROCESS **CODE:** 872 011

EXPECTED OUTCOME: To determine their suitability for the trade and the training process

Items	Comments
PHASE 1 **Information on the Trade** Criterion Component 1.1 Gather relevant information about at least four topics related to the job market in machining techniques: - size of the company - sector of economic activity - type of clientele - type of production - manufacturing processes - use of equipment employing new technology	The candidates may select a number of topics related to the job market in machining techniques. The candidates should have compiled a minimum of coherent information about at least four of the topics dealt with, without necessarily providing a complete and accurate portrait of the situation.

INFORMATION ON THE EVALUATION

PROGRAMS: Machining Techniques/Numerical Control Machine Tool Operation 3/6

MODULE: 1 – THE TRADE AND THE TRAINING PROCESS **CODE:** 872 011

EXPECTED OUTCOME: To determine their suitability for the trade and the training process

Items	Comments
Criterion Component 1.2	
Describe factory production and the different jobs involved: - research into new processes - design and drawing of products - design of transformation methods or processes - optimization of production - etc.	The candidates may select a number of steps involved in factory production and different jobs involved. The information gathered should be significant for each of the steps in factory production.
Criterion Component 1.3	
Give information on the nature of the work and the working conditions: - specific requirements - duties and responsibilities - salaries - opportunities for advancement - etc.	The candidates may select a number of topics related to the nature and requirements of the trade, as well as related tasks and operations, and the necessary skills and attitudes.
Criterion Component 1.4	
Give information on trade-related tasks and operations.	

INFORMATION ON THE EVALUATION

PROGRAMS: Machining Techniques/Numerical Control Machine Tool Operation 4/6

MODULE: 1 – THE TRADE AND THE TRAINING PROCESS **CODE:** 872 011

EXPECTED OUTCOME: To determine their suitability for the trade and the training process

Items	Comments
Criterion Component 1.5 Give information on the skills and behaviours needed to practise the trade. Criterion Component 1.6 Present the information gathered and discuss their views on the trade (i.e. advantages, disadvantages, requirements) at a group meeting. **PHASE 2** **Information on Training and Participation in the Training Process** Criterion Component 2.1 Learn about the program of study and the training process. Criterion Component 2.2 Discuss the relevance of the program given the work situation	

INFORMATION ON THE EVALUATION

PROGRAMS: Machining Techniques/Numerical Control Machine Tool Operation 5/6

MODULE: 1 – THE TRADE AND THE TRAINING PROCESS **CODE:** 872 011

EXPECTED OUTCOME: To determine their suitability for the trade and the training process

Items	Comments
Criterion Component 2.3 Share their initial reactions to the trade and the training program.	
Criterion Component 2.4 Learn about the concept of techno-watch and further training.	Candidates should discuss their perception of the usefulness and relevance of various parts of the training process (in light of the job market situation and the requirements of the trade). Evaluation should not focus on the accuracy of their perceptions, but rather on whether they have openly given their opinion on the topics dealt with, providing relevant arguments that take into account the information gathered in a previous step.
PHASE 3 **Evaluation and Confirmation of Their Career Choice**	
Criterion Component 3.1 State their preferences, aptitudes and interests with respect to the trade.	Evaluation should not focus on the quality or presentation of the report, but rather on whether the candidates have included the elements requested.

INFORMATION ON THE EVALUATION

PROGRAMS: Machining Techniques/Numerical Control Machine Tool Operation

MODULE: 1 – THE TRADE AND THE TRAINING PROCESS **CODE:** 872 011

EXPECTED OUTCOME: To determine their suitability for the trade and the training process

Items	Comments
Criterion Component 3.2	
Assess their career choice by comparing the different aspects and requirements of the trade with their own preferences, aptitudes and interests.	The candidates should evaluate their career choice by indicating in their report the aspects or requirements of the trade that led them to choose to become machinists. In addition, they must specify at least three aspects or requirements that, in their opinion, are directly related to their preferences, interests and aptitudes. At this point, their perceptions and opinions do not have to be objective or particularly realistic.
Pass/Fail Condition	Successful completion of 8 of the 12 criterion components, including Criterion Components 1.1, 1.3, 2.3, 3.1 and 3.2

PARTICIPATION EVALUATION FORM

Programs: MACHINING TECHNIQUES
NUMERICAL CONTROL MACHINE
TOOL OPERATION
Program codes: 5723
5724

Module: 1 – THE TRADE AND THE TRAINING PROCESS
Module code: 872 011

Candidate's name: _____ **Permanent code:** _____

School: _____ **Date:** _____

Phases	Participation Indicators	Mark	
		YES	NO
1. Information on the Trade	**1. Gather information on most of the topics to be dealt with**		
	1.1 Gather relevant information about at least four topics related to the job market in machining techniques	☐	☐
	1.2 Describe factory production and the different jobs involved	☐	☐
	1.3 Give information on the nature of the work and the working conditions	☐	☐
	1.4 Give information on trade-related tasks and operations	☐	☐
	1.5 Give information on the skills and behaviours needed to practise the trade	☐	☐
	1.6 Present the information gathered and discuss their views on the trade (i.e. advantages, disadvantages, requirements) at a group meeting	☐	☐
2. Information on Training and Participation in the Training Process	**2. Express their views on the program of study at a group meeting**		
	2.1 Learn about the program of study and the training process	☐	☐
	2.2 Discuss the relevance of the program given the work situation	☐	☐
	2.3 Share their initial reactions to the trade and the training program	☐	☐
	2.4 Learn about the concept of techno-watch and further training	☐	☐

Phases	Participation Indicators	Mark	
		YES	NO
3. Evaluation and Confirmation of Their Career Choice	**3. Write a report** 3.1 State their preferences, aptitudes and interests with respect to the trade	☐	☐
	3.2 Assess their career choice by comparing the different aspects and requirements of the trade with their own preferences, aptitudes and interests	☐	☐

Pass/fail condition: successful completion of 8 of the 12 criterion components, including Criterion Components 1.1, 1.3, 2.3, 3.1 and 3.2

Pass: ☐ Fail: ☐

Examiner's name: _____

MACHINING TECHNIQUES

5723

Mathematics Related to Conventional Machining

Module 2

872 024

Theory Examination

INFORMATION ON THE EXAMINATION

1 GENERAL INFORMATION

The aim of this examination is to evaluate the candidates' ability to do mathematical calculations related to conventional machining.

This examination is to be administered in the classroom, to the entire class.

Candidates must solve mathematical problems related to the following components of knowledge:

- rpms
- feed rates
- cutting times
- gears and pulleys
- points of tangency
- values of angles
- polar and rectangular coordinates
- imperial and metric systems of measurement

2 MINIMUM PERFORMANCE STANDARD

The minimum performance standard for this examination is 80 out of a possible 100 marks.

Since the candidates are allowed to use a calculator, they must provide all of their calculations for each of the problems. Answers without supporting calculations will not be accepted.

3 DURATION

The suggested duration of the examination is two hours.

PROGRAM ANALYSIS AND TABLE OF SPECIFICATIONS (BEHAVIOURAL OBJECTIVE)

872 024 – Mathematics Related to Conventional Machining (Module 2)

Specifications of the Expected Behaviour	Duration (%)	Performance Indicators	W_i	Components of Knowledge	W_c	NQ
1 Do calculations related to machining parameters.	25	1 Accurate calculation of machining parameters	25	1.1 Calculation of rpm of workpiece or tool based on a given cutting speed in both the imperial and metric systems of measurement	10	2
				1.2 Calculation of the feed rate of a milling machine table	5	1
				1.3 Calculation of cutting times	5	1
				1.4 Calculation of gear and pulley ratios	5	1
2 Do calculations related to conventional machining operations.	65	2 Calculations related to the Pythagorean theorem	10	2.1 Calculation of the value of points of tangency to determine the missing dimensions in a production drawing	10	2
		3 Calculations related to trigonometric functions	45	3.1 Calculation of value of angle for taper turning	10	2
				3.2 Calculation of depth of cut to lengthen a taper	10	2

W_i: relative weighting of indicators

W_c: relative weighting of components of knowledge

NQ: number of questions

PROGRAM ANALYSIS AND TABLE OF SPECIFICATIONS (BEHAVIOURAL OBJECTIVE)

872 024 – Mathematics Related to Conventional Machining (Module 2)

Specifications of the Expected Behaviour	Duration (%)	Performance Indicators	W_i	Components of Knowledge	W_c	NQ
				3.3 Calculation of the coordinates necessary to perform operations using a milling machine	10	2
				3.4 Calculations related to the grinding of a V block	5	1
				3.5 Calculations related to the verification of angles	10	2
		4 Calculations related to triangles	10	4.1 Problem-solving using the law of sines and cosines	10	2
3 Convert measurements from the metric to the imperial system and vice versa.	10	5 Calculations related to conversion formulae	10	5.1 Calculation of conversions from the imperial to the metric system	10	2

W_i: relative weighting of indicators

W_c: relative weighting of components of knowledge

NQ: number of questions

MACHINING TECHNIQUES

5723

Interpreting Technical Drawings

Module 3

872 035

Theory Examination

INFORMATION ON THE EXAMINATION

1 GENERAL INFORMATION

The aim of this examination is to evaluate the candidates' ability to interpret technical drawings related to conventional and numerical control machining.

This examination is to be administered in the classroom, to the entire class.

The candidates must visualize complete parts, interpret their dimensioning, find complementary information and determine the function of the different components.

2 MINIMUM PERFORMANCE STANDARD

The minimum performance standard for this examination is 80 out of a possible 100 marks.

3 DURATION

The suggested duration of the examination is two hours.

PROGRAM ANALYSIS AND TABLE OF SPECIFICATIONS (BEHAVIOURAL OBJECTIVE)

872 035 – Interpreting Technical Drawings (Module 3)						
Specifications of the Expected Behaviour	**Duration (%)**	**Performance Indicators**	**W_i**	**Components of Knowledge**	**W_c**	**NQ**
1 Visualize a complete part.	40	Accurate differentiation among the types of projections: - American and European orthographic projections - axonometric projections		Differentiated among the types of projections		
		1 Proper identification of views and sections	15	1.1 Adequately identified the views in American or European projections	5	1
				1.2 Adequately identified the different types of views	5	1
				1.3 Adequately identified the different types of sections	5	1
		2 Accurate interpretation of lines and hatching lines	5	2.1 Correctly interpreted the different lines and hatching lines	5	1
		3 Relevant association of lines, points and surfaces in different views	10	3.1 Correctly associated the lines, points and surfaces in different views	10	2

W_i: relative weighting of indicators

W_c: relative weighting of components of knowledge

NQ: number of questions

PROGRAM ANALYSIS AND TABLE OF SPECIFICATIONS (BEHAVIOURAL OBJECTIVE)

872 035 – Interpreting Technical Drawings (Module 3)						
Specifications of the Expected Behaviour	**Duration (%)**	**Performance Indicators**	**W_i**	**Components of Knowledge**	**W_c**	**NQ**
2 Interpret the dimensioning.	30	4 Thorough identification of information needed for the job	15	4.1 Correctly identified: - dimensions - form and positioning tolerances and runout - nomenclature of threads - fit tolerances	15	3
		5 Determination of value of dimensions and tolerances	15	5.1 Correctly determined the value of the dimensions and tolerances	15	3
3 Find complementary information in technical drawings.	20	6 Proper identification of information	10	6.1 Correctly identified the information contained in the title block, list of terms used and annotations	10	2
		7 Accurate interpretation of symbols, codes and abbreviations	10	7.1 Correctly interpreted the symbols, codes and abbreviations	10	2

W_i: relative weighting of indicators

W_c: relative weighting of components of knowledge

NQ: number of questions

PROGRAM ANALYSIS AND TABLE OF SPECIFICATIONS (BEHAVIOURAL OBJECTIVE)

872 035 – Interpreting Technical Drawings (Module 3)

Specifications of the Expected Behaviour	Duration (%)	Performance Indicators	W_i	Components of Knowledge	W_c	NQ
4 Determine the function of the components of an assembly.	10	8 Thorough identification of the components of an assembly	10	8.1 Correctly identified the components of an assembly in an assembly drawing	10	2
		9 Recognition of the function of each component	10	9.1 Identified the function of each component in the assembly drawing	10	2

W_i: relative weighting of indicators

W_c: relative weighting of components of knowledge

NQ: number of questions

MACHINING TECHNIQUES

5723

Health and Safety

Module 4

872 041

Theory Examination

INFORMATION ON THE EXAMINATION

1 GENERAL INFORMATION

The aim of this examination is to evaluate the candidates' ability to apply occupational health and safety rules.

This examination is to be administered in the classroom, to the entire class.

The candidates must answer questions about occupational health and safety.

2 INFORMATION ON CRITERION COMPONENTS

Criterion Component 1.1

The most common symbols are: corrosive, explosive and flammable.

Criterion Component 5.1

This criterion component requires a learning situation.

3 MINIMUM PERFORMANCE STANDARD

The minimum performance standard for this examination is 70 out of a possible 100 marks.

4 DURATION

The duration of the examination is one hour.

PROGRAM ANALYSIS AND TABLE OF SPECIFICATIONS (BEHAVIOURAL OBJECTIVE)

872 041 – Health and Safety (Module 4)

Specifications of the Expected Behaviour	Duration (%)	Performance Indicators	W_i	Components of Knowledge	W_c	NQ
1 Identify the aspects of health and safety legislation that apply to work in mechanical manufacturing shops.	20	1 Recognition of the rights and obligations of the parties involved	10	1.1 Identified the rights and obligations of employers and workers	10	2
2 Recognize the risks present in a machine shop and their effects on health and safety.	25	2 Recognition of the main causes of stress and of the risks inherent in the trade	15	2.1 Identified the symbols denoting hazardous materials	5	1
				2.2 Identified the effects of hazardous materials on health	5	1
				2.3 Identified the risks inherent in the trade	5	1
		3 Accurate interpretation of WHMIS data sheets	10	3.1 Interpreted the information contained in WHMIS data sheets	10	2

W_i: relative weighting of indicators

W_c: relative weighting of components of knowledge

NQ: number of questions

PROGRAM ANALYSIS AND TABLE OF SPECIFICATIONS (BEHAVIOURAL OBJECTIVE)

872 041 – Health and Safety (Module 4)

Specifications of the Expected Behaviour	Duration (%)	Performance Indicators	W_i	Components of Knowledge	W_c	NQ
3 Determine means of preventing accidents.	25	4 Choice of relevant measures for: - setting up the shop and the workstation - performing trade-related operations	50	Listed the safety measures related to the set-up of the shop and the workstation		
				4.1 Identified two specific safety measures related to machining using a conventional lathe	10	1
				4.2 Identified two specific safety measures related to machining using a conventional milling machine	10	1
				4.3 Identified two specific safety measures related to machining using a drilling machine	10	1
				4.4 Identified two specific safety measures related to machining using a bench grinder	10	1
				4.5 Identified two specific safety measures related to machining using a band mill	10	1

W_i: relative weighting of indicators

W_c: relative weighting of components of knowledge

NQ: number of questions

PROGRAM ANALYSIS AND TABLE OF SPECIFICATIONS (BEHAVIOURAL OBJECTIVE)

872 041 – Health and Safety (Module 4)

Specifications of the Expected Behaviour	Duration (%)	Performance Indicators	W_i	Components of Knowledge	W_c	NQ
		5 Proper choice of personal and other safety gear	5	5.1 Identified the safety measures posted in a machine shop	5	1
4 Determine what to do in an emergency situation.	20	6 Choice of appropriate strategy	10	6.1 Chose an appropriate strategy for a given situation	10	2
5 Convey information on health and safety to colleagues.	10	Persuasive message		Interpreted the meaning of the symbol on the label		

W_i: relative weighting of indicators

W_c: relative weighting of components of knowledge

NQ: number of questions

MACHINING TECHNIQUES

5723

Taking and Interpreting Measurements

Module 5

872 054

Practical Examination

INFORMATION ON THE EXAMINATION

1 GENERAL INFORMATION

The aim of this examination is to evaluate the candidates' ability to take and interpret measurements.

The candidates must do the steps of the examination in order.

2 DESCRIPTION OF THE EXAMINATION

The candidates must take and interpret measurements.

To demonstrate the required competency, the candidates must accurately calibrate a measuring instrument, correctly measure parts, convert measurements from the metric to the imperial system or vice versa, and compare the measured dimensions with the dimensions in the drawing.

3 PROCEDURE FOR THE EVALUATION

This examination comprises four steps:

Step 1: The candidates must calibrate a measuring instrument.

Step 2: The candidates must verify at least two mechanical parts (one cylindrical and the other prismatic) involving approximately 10 measurements.

The measurements will be in the imperial system for one part and in the metric system for the other.

It is recommended that:

- three measurements be taken using indirect-reading measuring instruments, for example an outside or inside caliper
- six measurements be taken using direct-reading measuring instruments, for example a micrometer, a vernier or a ruler
- one measurement be taken with a hardness tester

Step 3: The candidates must convert dimensions from the imperial to the metric system or vice versa.

Step 4: The candidates must evaluate the quality of the part taking into account the specifications in the drawing.

3.1 STEPS IN THE PROCEDURE

Before the examination

Explain the procedure to the candidates.

Measurements must be taken using direct-reading and indirect-reading measuring instruments.

The measuring instruments used must be calibrated to within required tolerances.

Use an inspection checklist.

During the examination

Step 1

Check the calibration of the candidates' measuring instruments.

Record the result on the performance evaluation form.

N.B.: The candidates must successfully complete Step 1 before proceeding to Step 2.

Step 2

The candidates must measure the mechanical parts using the measuring instruments.

This step will be verified when the examination is being corrected.

Record the result on the performance evaluation form.

Step 3

The candidates must convert the dimensions (five measurements) from the imperial to the metric system or vice versa.

This step will be verified when the examination is being corrected.

Record the result on the performance evaluation form.

Step 4

The candidates must accept or reject the part and justify their decision on a work sheet.

This step will be verified when the examination is being corrected.

Record the result on the performance evaluation form.

The examination may be conducted using a few parts that are either consistent or inconsistent with the drawing. Manufactured parts can also be used.

The examination should be administered to groups of eight candidates at a time.

3.2 MINIMUM PERFORMANCE STANDARD

The minimum performance standard for this examination is 90 out of a possible 100 marks.

3.3 DURATION

The suggested duration of the examination is two hours.

PERFORMANCE EVALUATION FORM

MACHINING TECHNIQUES	Program code: 5723
5 – Taking and Interpreting Measurements	Module code: 872 054

Candidate's name: _____

School: _____ Permanent code: _____

Date of examination: _____ RESULT: PASS ❑ FAIL ❑

Examiner's signature: _____

OBSERVATION	YES	NO	RESULT
1 Accurate calibration and adjustment of measuring instruments and devices			
1.1 Calibrated and adjusted the measuring instrument (Precision ± .00002" / Micrometer ± 0.05 mm)	❑	❑	**0 or 15**
2 Accurate readings			
2.1 Correctly measured the parts using indirect-reading measuring instruments (One error permitted) (Precision ± 1/64" / ± 0.5 mm; Micrometer ± .002" / ± 0.051 mm)	❑	❑	**0 or 25**

OBSERVATION	YES	NO	RESULT
2.2 Correctly measured the parts using direct-reading measuring instruments (One error permitted) Precision ± .0005" / ± 0.013 mm Vernier ± .001" / ± 0.025 mm	❑	❑	0 or 40
2.3 Correctly measured the part using a hardness tester (Precision: ± 2 Rc)	❑	❑	0 or 10
3 Accurate conversion of dimensions in the metric and imperial systems of measurement 3.1 Converted measurements from one system to the other	❑	❑	0 or 5
4 Appropriate evaluation 4.1 Appropriately evaluated the part on the basis of the dimensions measured and the dimensions specified in the drawing	❑	❑	0 or 5
	Total:		**/100**

Minimum performance standard: 90 marks

Note for the examiner:

- First check off the YES or NO box for each component observed.
- Then circle the number corresponding to the result, giving full marks or 0 for each of the components. For example, for a component worth 10 marks, even if half the boxes checked off are YES boxes, the result is 0.

Comments: _____

_____

PROGRAM ANALYSIS AND TABLE OF SPECIFICATIONS (BEHAVIOURAL OBJECTIVE)

872 054 – Taking and Interpreting Measurements (Module 5)

Specifications of the Expected Behaviour	Duration (%)	Performance Indicators	W_i	Criterion Components	W_c	STR.
1 Plan the work.	30	Accurate interpretation of the drawings		Correctly interpreted the dimensions, tolerances and instructions in the drawing		
		Appropriate choice of measuring instruments and devices		Chose the appropriate instruments for the precision and complexity of the part		
		Proper positioning of part and choice of fastenings for the part to be measured		Properly positioned the part and chose the appropriate fastenings for the measurements to be taken		
		Organized arrangement of instruments and devices		Adequately prepared the work area		

W_i: relative weighting of indicators W_c: relative weighting of criterion components STR.: evaluation strategy (TH: theory, PT: product, PS: process)

PROGRAM ANALYSIS AND TABLE OF SPECIFICATIONS (BEHAVIOURAL OBJECTIVE)

872 054 – Taking and Interpreting Measurements (Module 5)

Specifications of the Expected Behaviour	Duration (%)	Performance Indicators	W_i	Criterion Components	W_c	STR.
2 Prepare the measuring instruments and devices, as well as the part to be measured.	15	Precise inspection of instruments and devices		Carefully inspected the instruments and devices		
		1 Accurate calibration and adjustment of measuring instruments and devices	10	1.1 Calibrated and adjusted the measuring instrument	15	PS
3 Measure parts of various shapes.	40	2 Accuracy of readings	80	2.1 Correctly measured the parts using indirect-reading measuring instruments	25	PT
				2.2 Correctly measured the parts using direct-reading measuring instruments	40	PT
				2.3 Correctly measured the part using a hardness tester	10	PT
		3 Accurate conversion of dimensions in the metric and imperial systems of measurement	5	3.1 Converted measurements from one system to the other	5	PT

W_i: relative weighting of indicators W_c: relative weighting of criterion components STR.: evaluation strategy (TH: theory, PT: product, PS: process)

PROGRAM ANALYSIS AND TABLE OF SPECIFICATIONS (BEHAVIOURAL OBJECTIVE)

872 054 – Taking and Interpreting Measurements (Module 5)

Specifications of the Expected Behaviour	Duration (%)	Performance Indicators	W_i	Criterion Components	W_c	STR.
		Correct use of method for converting hardness scales		Converted measurements of hardness from one system to the other		
4 Compare the measurements taken with the drawings and specifications.	10	4 Appropriate evaluation	5	4.1 Appropriately evaluated the part on the basis of the dimensions measured and the dimensions specified in the drawing	5	PT
5 Perform regular maintenance on measuring instruments and devices.	5	Careful cleaning of instruments and devices		Adequately cleaned the measuring instruments and devices		
				Lubricated the instruments and devices at the appropriate points		
		Proper storage of instruments and devices		Properly put away the instruments and devices		

W_i: relative weighting of indicators W_c: relative weighting of criterion components STR.: evaluation strategy (TH: theory, PT: product, PS: process)

MACHINING TECHNIQUES

5723

Shop Work

Module 6

872 066

Practical Examination

INFORMATION ON THE EXAMINATION

1 GENERAL INFORMATION

The aim of this examination is to evaluate the candidates' ability to do shop work.

The candidates must do the steps of the examination in order and have their work evaluated at certain points.

The examination is to be administered in the shop to a maximum of seven candidates at a time.

The candidates must take safety precautions throughout the examination. Any major omission will result in the immediate termination of the examination.

Candidates who refuse to clean the machine tool and work area after the examination will fail the examination.

2 DESCRIPTION OF THE EXAMINATION

The candidates must complete a process sheet from which certain information has been omitted.

The candidates must perform shaping, laying out, sawing, drilling, boring, counterboring, chamfering, broaching and tapping operations, in accordance with the shape and tolerances in the production drawing.

3 EXAMINATION PROCEDURE

3.1 STEPS IN THE EXAMINATION

PART 1: Planning the work

Explain the procedure to the candidates.

Make sure that each candidate has received the documentation for Part 1 of the examination:

- questions
- drawings
- incomplete process sheet

- nomographs
- *Machinery's Handbook* or equivalent

The candidates must complete a work sheet on the following topics:

- technical terms
- tolerances
- required information

The candidates must also verify the information in the process sheet and add any missing information, such as:

- tools required
- machining parameters

Correct the process sheet and make sure that the candidates have a completed sheet for Part 2 of the examination.

The suggested duration of Part 1 of the examination is 30 minutes.

Record the result on the performance evaluation form.

PART 2: Machining the part

Before Part 2

Make sure that each candidate has:

- the drawings, process sheet and candidate's booklet
- the tools needed to machine the part

Make sure that the machine tools are in good working order.

The suggested duration of Part 2 of the examination is four and a half hours.

During Part 2

Verify whether the candidates have:

Step 1:
- carefully prepared the part to be machined by preparing reference surfaces
- laid out the part to be machined in accordance with the drawing

- respected the sharpness of the lines

Record the result on the performance evaluation form.

Step 2:
- correctly installed the accessories, in accordance with the mounting method
- correctly and safely positioned and aligned the workpiece in the installation

Record the result on the performance evaluation form.

Step 3:
- correctly adjusted the machining parameters.

Record the result on the performance evaluation form.

Step 4:
- properly cleaned the work station and surrounding area
- properly put away the tools and accessories

Step 5:
- filled out and signed the measurement sheet

After Part 2

Verify whether the candidates:

- respected the dimensions, tolerances and shape of the part
- took the required finish into account
- deburred and cleaned the part
- correctly measured the dimensions of the part

Record the result on the performance evaluation form.

3.2 MINIMUM PERFORMANCE STANDARD

The minimum performance standard for this examination is 75 out of a possible 100 marks.

3.3 DURATION

The suggested duration of the examination is five hours, i.e. 30 minutes for Part 1 and four and a half hours for Part 2.

PERFORMANCE EVALUATION FORM

MACHINING TECHNIQUES	Program code: 5723
6 – Shop Work	Module code: 872 066

Candidate's name: _____

School: _____ Permanent code: _____

Date of examination: _____ RESULT: PASS ❑ FAIL ❑

Examiner's signature: _____

OBSERVATION	YES	NO	RESULT
PART 1: Planning the work			
1 Using the drawings, identify and interpret information contained on the process sheet			
1.1 Identified the appropriate tolerances and information, such as:			
- technical terms	❑	❑	
- tolerances	❑	❑	
- required information	❑	❑	**0 or 4**
1.2 Interpreted technical terminology related to:			
- tapping	❑	❑	
- broaching	❑	❑	
- tolerances	❑	❑	**0 or 4**

OBSERVATION	YES	NO	RESULT
2 Using the drawings, complete the process sheet			
2.1 Completed the list of machining parameters:			
- rpm	❑	❑	0 or 4
2.2 Completed the list of tools and instruments needed:			
- cutting tools	❑	❑	
- layout instruments	❑	❑	0 or 4
RESULT FOR PART 1			/16
PART 2: Machining the part			
3 Preparation of surfaces and laying out of workpiece to be machined			
3.1 Correctly prepared and laid out the workpiece	❑	❑	0 or 10
4 Proper positioning and alignment of workpiece			
4.1 Correctly and safely positioned and aligned the workpiece in the installation:			
- positioning	❑	❑	
- alignment	❑	❑	
- safety	❑	❑	0 or 4
5 Adjustment of machining parameters			
5.1 Correctly adjusted the machining parameters:			
- rpm	❑	❑	0 or 5
6 Machining in conformity with drawings			
6.1 Observed the dimensions, tolerances and shape of the part	❑	❑	0 or 40

OBSERVATION	YES	NO	RESULT
6.2 Took the required finish into account	❑	❑	0 or 10
6.3 Deburred and cleaned the part	❑	❑	0 or 5
7 Accurate measurements taken			
7.1 Controlled the quality of the part:			
- accurate measurements	❑	❑	
- signed inspection sheet	❑	❑	0 or 10
PASS/FAIL CONDITIONS			
Tidied up the workstation and surrounding area	❑	❑	
Observed health and safety rules	❑	❑	
RESULT FOR PART 2			/84
Total:			/100
Minimum performance standard: 75			

Note for the examiner:

- First check off the YES or NO box for each component observed.
- Then circle the number corresponding to the result, giving full marks or 0 for each of the components. For example, for a component worth 10 marks, even if half the boxes checked off are YES boxes, the result is 0.

Comments: _____

_____

PROGRAM ANALYSIS AND TABLE OF SPECIFICATIONS (BEHAVIOURAL OBJECTIVE)

872 066 – Shop Work (Module 6)

Specifications of the Expected Behaviour	Duration (%)	Performance Indicators	W_i	Criterion Components	W_c	STR.
1 Identify, in the drawings, process sheets and manuals, the information needed for the job.	25	1 Using the drawings, identify and interpret information contained on the process sheet	8	1.1 Identified the appropriate tolerances and information	4	TH
				1.2 Interpreted technical terminology	4	TH
		2 Using the drawings, complete the process sheet	8	2.1 Completed the list of machining parameters	4	TH
				2.2 Completed the list of tools and instruments needed	4	TH
2 Lay out workpieces.	10	3 Preparation of surfaces and laying out of workpiece to be machined	10	3.1 Correctly prepared and laid out the workpiece	10	PT
3 Mount the workpiece.	5	4 Proper positioning and alignment of workpiece	4	4.1 Correctly and safely positioned and aligned the workpiece in the installation	4	PS
4 Prepare the workstation.	5	5 Adjustment of machining parameters	5	5.1 Correctly adjusted the machining parameters	5	PS

W_i: relative weighting of indicators W_c: relative weighting of criterion components STR.: evaluation strategy (TH: theory, PT: product, PS: process)

PROGRAM ANALYSIS AND TABLE OF SPECIFICATIONS (BEHAVIOURAL OBJECTIVE)

872 066 – Shop Work (Module 6)

Specifications of the Expected Behaviour	Duration (%)	Performance Indicators	W_i	Criterion Components	W_c	STR.
5 Perform the following operations: - deburring - sanding - polishing - sawing - drilling - sharpening - boring - counterboring - chamfering - tapping - facing - broaching	45	Conformity with process sheet		Followed the process sheet		
		6 Machining in conformity with drawings	55	6.1 Observed the dimensions, tolerances and shape of the part	40	PT
				6.2 Took the required finish into account	10	PT
				6.3 Deburred and cleaned the part	5	PT
		Safe use of tools and equipment		Took the appropriate safety precautions for all operations		
6 Control the quality of the machined part.	5	7 Accurate measurements taken	10	7.1 Controlled the quality of the part: - accurate measurements - signed inspection sheet	10	PT
7 Perform regular maintenance on machines, devices, accessories and tools.	5	Proper cleaning of workstations and storage of tools and accessories		Properly cleaned the workstations and put away the tools and accessories		

W_i: relative weighting of indicators W_c: relative weighting of criterion components STR.: evaluation strategy (TH: theory, PT: product, PS: process)

MACHINING TECHNIQUES

5723

Materials and Processes

Module 7

872 072

Theory Examination

INFORMATION ON THE EXAMINATION

1 GENERAL INFORMATION

The aim of this examination is to evaluate the candidates' ability to interpret technical information related to materials and manufacturing processes.

This examination is to be administered in the classroom, to the entire class.

All types of documentation are permitted.

2 INFORMATION ON COMPONENTS OF KNOWLEDGE

Component of Knowledge 3.1
Examples of chemical elements include sulphur, molybdenum and chromium.

Component of Knowledge 4.1
Very hot or very cold temperatures

Component of Knowledge 5.1
Products such as machine tool housings, boat hulls, ball bearings and rings

Component of Knowledge 6.1
Type of manufacturing process

Component of Knowledge 7.1
This component of knowledge should deal with three types of hardening.

Component of Knowledge 7.2
For this component of knowledge, there should be two types of surface treatments in the answer.

3 MINIMUM PERFORMANCE STANDARD

The minimum performance standard for this examination is 75 out of a possible 100 marks.

4 DURATION

The suggested duration of this examination is two hours.

PROGRAM ANALYSIS AND TABLE OF SPECIFICATIONS (BEHAVIOURAL OBJECTIVE)

872 072 – Materials and Processes (Module 7)

Specifications of the Expected Behaviour	Duration (%)	Performance Indicators	W_i	Components of Knowledge	W_c	NQ
1 Describe materials.	45	1 Proper identification of information in drawings and documentation	10	1.1 Identified in the drawing the materials for the parts to be machined	10	2
		2 Accurate interpretation of material identification codes	10	2.1 Determined the composition of a low-carbon steel	5	1
				2.2 Determined the composition of a medium-carbon alloy steel	5	1
		3 Appropriate links between the chemical composition of the materials and their physical properties	10	3.1 Determined the transformation of physical properties resulting from the addition of a chemical element to a steel	10	2
		Appropriate identification of the dangers associated with the handling of certain materials		Determined the dangers inherent in the handling of certain materials		

W_i: relative weighting of the indicators

W_c: relative weighting of the components of knowledge

NQ: number of questions

PROGRAM ANALYSIS AND TABLE OF SPECIFICATIONS (BEHAVIOURAL OBJECTIVE)

872 072 – Materials and Processes (Module 7)

Specifications of the Expected Behaviour	Duration (%)	Performance Indicators	W_i	Components of Knowledge	W_c	NQ
		4 Recognition of the behaviour of materials	10	4.1 Explained the reaction of a material after exposure to a variety of temperatures	10	2
		4 Appropriate association of materials with their applications in different manufacturing sectors	10	5.1 Associated the type of material used with the manufacture of certain products	10	2
2 Differentiate among the processing methods presented in the documentation.	30	6 Accurate distinction between the first and second levels of processing of materials	10	6.1 Selected the different levels of processing	10	2
		7 Proper differentiation between heat treatments and surface treatments	10	7.1 Selected the main heat treatments	5	1
				7.2 Selected the main surface treatments	5	1
		Appropriate links between processing methods and their effects on the properties of the materials		Listed the effects of a processing method on the properties of the materials		

W_i: relative weighting of the indicators W_c: relative weighting of the components of knowledge NQ: number of questions

PROGRAM ANALYSIS AND TABLE OF SPECIFICATIONS (BEHAVIOURAL OBJECTIVE)

872 072 – Materials and Processes (Module 7)

Specifications of the Expected Behaviour	Duration (%)	Performance Indicators	W_i	Components of Knowledge	W_c	NQ
3 Interpret information related to the dimensions of different types of stock.	25	8 Appropriate association between processing methods and the surface finishes specified in the technical drawings	10	8.1 Associated the processing method with the finish specified in the drawing	10	2
		Accurate distinction among the commercial types of stock		Identified an H section Identified a T section		
		9 Appropriate identification of dimensions	10	9.1 Identified the dimensions of various profiles	10	2
		10 Accurate interpretation of dimensional tolerances	10	10.1 Identified the dimensional tolerances of a workpiece made out of cold-rolled steel	5	1
				10.2 Identified the dimensional tolerances of a workpiece made out of hot-rolled steel	5	1

W_i: relative weighting of the indicators

W_c: relative weighting of the components of knowledge

NQ: number of questions

MACHINING TECHNIQUES

5723

Sketches

Module 8

872 083

INFORMATION ON THE EXAMINATION

1 GENERAL INFORMATION

The aim of this examination is to evaluate the candidates' ability to sketch objects freehand.

This examination is to be administered in the classroom, to the entire class.

The candidates must make sketches including the following:

- orthographic projections
- axonometric projections
- sectional views
- auxiliary views
- partial views

The candidates must dimension certain sketches.

2 MINIMUM PERFORMANCE STANDARD

The minimum performance standard for this examination is 80 out of a possible 100 marks.

3 DURATION

The suggested duration of the examination is two hours.

PERFORMANCE EVALUATION FORM

MACHINING TECHNIQUES	Program code:	5723
8 – Sketches	Module code:	872 083

Candidate's name: _____

School: _____ Permanent code: _____

Date of examination: _____ RESULT: PASS ❑ FAIL ❑

Examiner's signature: _____

OBSERVATION	YES	NO	RESULT
1 Conformity with standards and conventions related to orthographic projections			
1.1 Took into account the shape and complexity of the part to be sketched	❑	❑	**0 or 15**
1.2 Observed the proportions of the different shapes sketched	❑	❑	**0 or 10**
1.3 Included all annotations	❑	❑	**0 or 5**
1.4 Drew a neat, accurate sketch	❑	❑	**0 or 5**
2 Conformity with standards and conventions related to axonometric projections			
2.1 Took into account the shape and complexity of the part to be sketched, including skewed lines and ellipses	❑	❑	**0 or 5**
2.2 Observed the proportions of the different shapes sketched	❑	❑	**0 or 5**
2.3 Drew a neat, accurate sketch	❑	❑	**0 or 5**

OBSERVATION				RESULT
		YES	NO	
3	Conformity with standards and conventions related to sectional, auxiliary and partial views			
3.1	Took into account the shape and complexity of the part to be sketched	❑	❑	**0 or 10**
3.2	Observed the proportions of the different shapes sketched	❑	❑	**0 or 10**
3.3	Drew a neat, accurate sketch	❑	❑	**0 or 5**
4	Conformity with standards and conventions related to extension lines, dimension lines and conventional and absolute dimensioning			
4.1	Correctly arranged the dimensions	❑	❑	**0 or 10**
4.2	Dimensioned the sketch for manufacturing	❑	❑	**0 or 10**
4.3	Dimensioned the sketch neatly and clearly	❑	❑	**0 or 5**
		Total:		**/100**

Minimum performance standard: 80 marks

Note for the examiner:

- First check off the YES or NO box for each component observed.
- Then circle the number corresponding to the result, giving full marks or 0 for each of the components. For example, for a component worth 10 marks, even if half the boxes checked off are YES boxes, the result is 0.

Comments: _____

_____

PROGRAM ANALYSIS AND TABLE OF SPECIFICATIONS (BEHAVIOURAL OBJECTIVE)

872 083 – Sketches (Module 8)

Specifications of the Expected Behaviour	Duration (%)	Performance Indicators	W_i	Criterion Components	W_c	STR.
1 Sketch orthographic projections.	30	1 Conformity with standards and conventions related to orthographic projections, such as: - choice and arrangement of views - observance of proportions - dimensions and annotations - lines	35	1.1 Took into account the shape and complexity of the part to be sketched	15	PT
				1.2 Observed the proportions of the different shapes sketched	10	PT
				1.3 Included all annotations	5	PT
				1.4 Drew a neat, accurate sketch	5	PT
2 Sketch axonometric projections.	30	2 Conformity with standards and conventions related to axonometric projections, such as: - isometric drawings - oblique projections	15	2.1 Took into account the shape and complexity of the part to be sketched, including skewed lines and ellipses	5	PT
				2.2 Observed the proportions of the different shapes sketched	5	PT
				2.3 Drew a neat, accurate sketch	5	PT

W_i: relative weighting of indicators W_c: relative weighting of criterion components STR.: evaluation strategy (TH: theory, PT: product, PS: process)

PROGRAM ANALYSIS AND TABLE OF SPECIFICATIONS (BEHAVIOURAL OBJECTIVE)

872 083 – Sketches (Module 8)

Specifications of the Expected Behaviour	Duration (%)	Performance Indicators	W_i	Criterion Components	W_c	STR.
3 Sketch sectional, auxiliary and partial views.	25	3 Conformity with standards and conventions related to: - sectional views - auxiliary views - partial views	25	3.1 Took into account the shape and complexity of the part to be sketched	10	PT
				3.2 Observed the proportions of the different shapes sketched	10	PT
				3.3 Drew a neat, accurate sketch	5	PT
4 Dimension the sketch.	15	4 Conformity with standards and conventions related to: - extension lines - dimension lines - conventional and absolute dimensioning	25	4.1 Correctly arranged the dimensions	10	PT
				4.2 Dimensioned the sketch for manufacturing	10	PT
				4.3 Dimensioned the sketch neatly and clearly	5	PT

W_i: relative weighting of indicators W_c: relative weighting of criterion components STR.: evaluation strategy (TH: theory, PT: product, PS: process)

MACHINING TECHNIQUES

5723

External Cylindrical Turning

Module 9

872 096

Practical Examination

INFORMATION ON THE EXAMINATION

1 GENERAL INFORMATION

The aim of this examination is to evaluate the candidates' ability to perform external cylindrical turning operations.

The candidates must do the steps of the examination in order.

The examination is divided into two parts.

Part 1 should be administered in the classroom, to the entire class.

Part 2 should be administered to a maximum of eight candidates at a time.

The candidates must take safety precautions throughout the examination. Any major omission will result in the immediate termination of the examination.

Candidates who refuse to clean the machine tool and work area after the examination will fail the examination.

2 DESCRIPTION OF THE EXAMINATION

PART 1: Preparing the work

To demonstrate the required competency, the candidates must:

- find in *Machinery's Handbook* or its equivalent the basic dimensions and the dimensional tolerances
- complete a process sheet

PART 2: Machining the part

To demonstrate the required competency, the candidates must perform moderately complex external cylindrical turning operations, in accordance with the process sheet and production drawing.

The part must require the following machining operations:

- roughing
- finishing
- grooving

- knurling (optional)
- chamfering

3 EXAMINATION PROCEDURE

3.1 STEPS IN THE EXAMINATION

PART 1: Preparing the work

Before Part 1

Explain the procedure to the candidates.

Make sure that each candidate has received the documentation for Part 1 of the examination:

- *Machinery's Handbook* or equivalent
- work sheets to complete the process sheet
- nomographs and drawing of the part

The suggested duration of Part 1 of the examination is 30 minutes.

During Part 1

The candidates must search for information in *Machinery's Handbook* or its equivalent and do the calculations necessary to machine the part. Then they must complete the process sheet.

After Part 1

Fill out Part 1 of the performance evaluation form.

PART 2: Machining the part

Before Part 2

Make sure that each candidate:

- has a copy of the drawing, process sheet and candidate's booklet
- has the tools needed to machine the part

- follows the steps set out in the candidate's booklet

The suggested duration of Part 2 of the examination is four and a half hours.

During Part 2

Verify whether the candidates have:

- correctly mounted the accessories, according to the type of installation
- correctly and safely positioned and aligned the workpiece in the installation
- checked the fluid levels on the lathe and topped them off if necessary

Record the result on Part 2 of the performance evaluation form.

After Part 2

Verify whether the candidates:

- observed the dimensions, tolerances and shape of the part
- took the required finish into account
- deburred the part
- correctly measured the dimensions of the part

Record the result on Part 2 of the performance evaluation form.

3.2 MINIMUM PERFORMANCE STANDARD

The minimum performance standard for Part 1 is 20 out of a possible 25 marks.

The minimum performance standard for Part 2 is 60 out of a possible 75 marks.

Candidates who fail one part of the examination can retake that part.

3.3 DURATION

The suggested duration of the examination is five hours, i.e. 30 minutes for Part 1 and four and a half hours for Part 2.

PERFORMANCE EVALUATION FORM

MACHINING TECHNIQUES	Program code:	5723
9 – External Cylindrical Turning	Module code:	872 096

Candidate's name: _____

School: _____ Permanent code: _____

Date of examination: _____ RESULT: PASS ☐ FAIL ☐

Examiner's signature: _____

OBSERVATION	YES	NO	RESULT
PART 1: Preparing the work			
1 Calculation of dimensions			
1.1 Calculated the maximum and minimum dimensions of the part to be machined	☐	☐	**0 or 10**
2 Complete the process sheet			
2.1 Complete the list of machining operations:			
- routines	☐	☐	
- subroutines	☐	☐	
- operations	☐	☐	**0 or 5**
2.2 Completed the list of measuring and testing instruments	☐	☐	**0 or 5**
2.3 Calculated the machining parameters:			
- rpm	☐	☐	**0 or 5**
RESULT FOR PART 1			**/25**

OBSERVATION	YES	NO	RESULT
PART 2: Machining the part			
3 Mounting of accessories in accordance with the type of installation			
3.1 Mounted the accessories in accordance with the type of installation The examiner should evaluate the work at this point.	❑	❑	**0 or 5**
4 Proper positioning and alignment of workpiece			
4.1 Correctly and safely positioned and aligned the workpiece on the lathe:			
- workpiece centred in the chuck	❑	❑	
- alignment of centres	❑	❑	**0 or 5**
The examiner should evaluate the work at this point.			
5 Adjustments in conformity with process sheet			
5.1 Correctly adjusted the machining parameters	❑	❑	**0 or 10**
6 Machining in conformity with drawing			
6.1 Observed the dimensions, within tolerances	❑	❑	**0 or 25**
6.2 Took the required finish into account	❑	❑	**0 or 10**
6.3 Deburred the part	❑	❑	**0 or 5**
7 Accurate measurements taken			
7.1 Correctly measured the dimensions of the part:			
- accurate measurements	❑	❑	
- signed inspection sheet	❑	❑	**0 or 10**
8 Careful inspection of fluid levels in the lathe			
8.1 Checked the fluid levels in the lathe and topped them off as needed	❑	❑	**0 or 5**

OBSERVATION			RESULT
	YES	NO	
PASS/FAIL CONDITIONS			
Tidied up the workstation and surrounding area	❑	❑	
Observed health and safety rules	❑	❑	
RESULT FOR PART 2			/75

PART 1	PART 2
RESULT / 25	RESULT / 75
Minimum performance standard: 20	Minimum performance standard: 60
Pass ☐ ☐ YES NO	Pass ☐ ☐ YES NO

Note for the examiner:

- First check off the YES or NO box for each component observed.
- Then circle the number corresponding to the result, giving full marks or 0 for each of the components. For example, for a component worth 10 marks, even if half the boxes checked off are YES boxes, the result is 0.

Comments: _____

_____

PROGRAM ANALYSIS AND TABLE OF SPECIFICATIONS (BEHAVIOURAL OBJECTIVE)

872 096 – External Cylindrical Turning (Module 9)						
Specifications of the Expected Behaviour	**Duration (%)**	**Performance Indicators**	**W_i**	**Criterion Components**	**W_c**	**STR.**
- chamfering - knurling - parting off		Safe use of lathe and tools		Took the appropriate safety precautions for all operations		
6 Control the quality of the machined part.	10	7 Accurate measurements taken	10	7.1 Correctly measured the dimensions of the part	10	PT
7 Perform daily maintenance on the lathe, accessories and cutting tools.	5	Proper cleaning and storage of the machine tool, tools and accessories, and proper cleaning of work area		Cleaned and put away the equipment and materials, and tidied up the work area		
		8 Careful inspection of fluid levels in the lathe	5	8.1 Checked the fluid levels in the lathe and topped them off as needed	5	PT

W_i: relative weighting of indicators W_c: relative weighting of criterion components STR.: evaluation strategy (TH: theory, PT: product, PS: process)

MACHINING TECHNIQUES

5723

Boring

Module 10

872 105

Practical Examination

INFORMATION ON THE EXAMINATION

1 GENERAL INFORMATION

The aim of this examination is to evaluate the candidates' ability to perform boring operations.

The candidates must do the steps of the examination in order.

Part 1 of the examination should be administered in the classroom, to the entire class.

Part 2 of the examination should be administered to a maximum of eight candidates at a time.

The candidates must take safety precautions throughout the examination. Any major omission will result in the immediate termination of the examination.

Candidates who refuse to clean the machine tool and work area after the examination will fail the examination.

2 DESCRIPTION OF THE EXAMINATION

The examination is divided into two parts.

PART 1: Preparing the work

To demonstrate the required competency the candidates must:

- find the dimensional tolerances in *Machinery's Handbook* or its equivalent
- complete a process sheet

PART 2: Machining the part

To demonstrate the required competency, the candidates must perform moderately complex boring operations, in accordance with the process sheet and production drawing.

The part must require the following machining operations:

- roughing
- finishing
- reaming
- boring
- chamfering
- drilling

3 EVALUATION PROCEDURE

3.1 STEPS IN THE EXAMINATION

PART 1: Preparing the work

Before Part 1

Explain the procedure to the candidates.

Make sure that each candidate has received the documentation for Part 1 of the examination:

- *Machinery's Handbook* or equivalent
- work sheets to complete the process sheet
- nomographs and drawing of the part

The suggested duration of Part 1 of the examination is 30 minutes.

During Part 1

The candidates must search for information in *Machinery's Handbook* or its equivalent and do the calculations necessary to machine the part. Then they must complete the process sheet.

After Part 1

Fill out Part 1 of the performance evaluation form.

PART 2: Machining the part

Before Part 2

Make sure that each candidate:

- has a copy of the drawing, process sheet and candidate's booklet
- has the tools needed to machine the part
- follows the steps set out in the candidate's booklet

The suggested duration of Part 2 of the examination is three and a half hours.

During Part 2

Verify whether the candidates have:

- correctly mounted the accessories, according to the type of installation
- correctly and safely positioned and aligned the workpiece in the installation
- positioned the cutting tools at the height of the rotation axis

Record the result on Part 2 of the performance evaluation form.

After Part 2

Verify whether the candidates:

- observed the dimensions, tolerances and shape of the part
- took the required finish into account
- deburred the part
- correctly measured the dimensions of the part

Record the result on Part 2 of the performance evaluation form.

3.2 MINIMUM PERFORMANCE STANDARD

The minimum performance standard for Part 1 is 20 out of a possible 25 marks.

The minimum performance standard for Part 2 is 60 out of a possible 75 marks.

Candidates who fail one part of the examination can retake that part.

3.3 DURATION

The suggested duration of the examination is four hours, i.e. 30 minutes for Part 1 and three and a half hours for Part 2.

PERFORMANCE EVALUATION FORM

MACHINING TECHNIQUES	Program code: 5723
10 – Boring	Module code: 872 105

Candidate's name: _____

School: _____ Permanent code: _____

Date of examination: _____ RESULT: PASS ❑ FAIL ❑

Examiner's signature: _____

OBSERVATION	YES	NO	RESULT
PART 1: Preparing the work			
1 Calculation of dimensions			
1.1 Calculated the maximum and minimum dimensions of the part to be machined	❑	❑	**0 or 10**
2 Complete the process sheet			
2.1 Completed the list of machining operations:			
- routines	❑	❑	
- subroutines	❑	❑	
- operations	❑	❑	**0 or 5**
2.2 Completed the list of measuring and testing instruments	❑	❑	**0 or 5**
2.3 Calculated the machining parameters:			
- rpm	❑	❑	**0 or 5**
RESULT FOR PART 1			**/25**

OBSERVATION	YES	NO	RESULT
PART 2: Machining the part			
3 Mounting of accessories in accordance with the type of installation			
3.1 Mounted the accessories in accordance with the type of installation The examiner should evaluate the work at this point.	❑	❑	**0 or 10**
4 Proper positioning and alignment of workpiece			
4.1 Correctly and safely positioned and aligned the workpiece on the boring mill: - workpiece centred in chuck The examiner should evaluate the work at this point.	❑	❑	**0 or 5**
5 Proper positioning of cutting tools			
5.1 Properly positioned the cutting tools The examiner should evaluate the work at this point.	❑	❑	**0 or 5**
6 Machining in conformity with drawing			
6.1 Observed the dimensions, within tolerances	❑	❑	**0 or 25**
6.2 Took the required finish into account	❑	❑	**0 or 10**
6.3 Deburred the part	❑	❑	**0 or 10**
7 Accurate measurements taken			
7.1 Controlled the quality of the part: - accurate measurements	❑	❑	
- signed inspection sheet	❑	❑	**0 or 10**
PASS/FAIL CONDITIONS			
Tidied up the workstation and surrounding area	❑	❑	
Observed health and safety rules	❑	❑	
RESULT FOR PART 2			**/75**

PART 1	PART 2
RESULT / 25	RESULT / 75
Minimum performance standard: 20	Minimum performance standard: 60
Pass ☐ YES ☐ NO	Pass ☐ YES ☐ NO

Note for the examiner:

- First check off the YES or NO box for each component observed.
- Then circle the number corresponding to the result, giving full marks or 0 for each of the components. For example, for a component worth 10 marks, even if half the boxes checked off are YES boxes, the result is 0.

Comments: _____

_____

PROGRAM ANALYSIS AND TABLE OF SPECIFICATIONS (BEHAVIOURAL OBJECTIVE)

872 105 – Boring (Module 10)

Specifications of the Expected Behaviour	Duration (%)	Performance Indicators	W_i	Criterion Components	W_c	STR.
1 Identify, in the drawings and manuals, the information needed for the job.	20	Accurate interpretation of symbols, codes, abbreviations and technical terms Proper identification of information in the list of terms used, the title block and the annotations		Correctly interpreted the drawing		
		1 Calculation of dimensions	10	1.1 Calculated the maximum and minimum dimensions of the part to be machined	10	TH
2 Develop the process sheet.	10	2 Complete the process sheet	15	2.1 Completed the list of machining operations	5	TH
				2.2 Completed the list of measurement and testing instruments	5	TH
				2.3 Calculated the machining parameters	5	TH
3 Mount the workpiece on the boring mill.	5	3 Mounting of accessories in accordance with the type of installation	10	3.1 Mounted the accessories in accordance with the type of installation	10	PS

W_i: relative weighting of indicators W_c: relative weighting of criterion components STR.: evaluation strategy (TH: theory, PT: product, PS: process)

PROGRAM ANALYSIS AND TABLE OF SPECIFICATIONS (BEHAVIOURAL OBJECTIVE)

872 105 – Boring (Module 10)

Specifications of the Expected Behaviour	Duration (%)	Performance Indicators	W_i	Criterion Components	W_c	STR.
		4 Proper positioning and alignment of workpiece	5	4.1 Correctly and safely positioned and aligned the workpiece on the boring mill	5	PS
4 Prepare the boring mill and the workstation.	5	5 Proper positioning of cutting tools	5	5.1 Properly positioned the cutting tools	5	PS
		Adjustments in conformity with process sheet		Correctly adjusted the machining parameters		
5 Perform boring operations, such as: - drilling - reaming - boring - chamfering - grooving	45	Conformity with process sheet		Followed the process sheet		
		6 Machining in conformity with drawing	45	6.1 Observed the dimensions, within tolerances	25	PT
				6.2 Took the required finish into account	10	PT
				6.3 Deburred the part	10	PT

W_i: relative weighting of indicators W_c: relative weighting of criterion components STR.: evaluation strategy (TH: theory, PT: product, PS: process)

PROGRAM ANALYSIS AND TABLE OF SPECIFICATIONS (BEHAVIOURAL OBJECTIVE)

872 105 – Boring (Module 10)

Specifications of the Expected Behaviour	Duration (%)	Performance Indicators	W_i	Criterion Components	W_c	STR.
		Safe use of boring mill and tools		Took the appropriate safety precautions for all the operations		
6 Control the quality of the machined part.	10	7 Accurate measurements taken	10	7.1 Controlled the quality of the part	10	PT
7 Perform regular maintenance on the boring mill, accessories and cutting tools.	5	Proper cleaning and storage of the machine tool, tools and accessories, and proper cleaning of work area		Cleaned and put away the equipment and materials, and tidied up the work area		

W_i: relative weighting of indicators W_c: relative weighting of criterion components STR.: evaluation strategy (TH: theory, PT: product, PS: process)

MACHINING TECHNIQUES

5723

Longitudinal and Transverse Machining on a Milling Machine

Module 11

872 118

Practical Examination

INFORMATION ON THE EXAMINATION

1 GENERAL INFORMATION

The aim of this examination is to evaluate the candidates' ability to perform milling operations on a vertical milling machine.

The candidates must do the steps of the examination in order and have their work evaluated at certain points.

The examination is divided into two parts.

Part 1 is to be administered in the classroom, to the entire class.

Pare 2 is to be administered in the shop, to a maximum of seven candidates at a time.

The candidates must take safety precautions throughout the examination. Any major omission will result in the immediate termination of the examination.

Candidates who refuse to clean the machine tool and work area after the examination will fail the examination.

2 DESCRIPTION OF THE EXAMINATION

In Part 1, the candidates must complete a process sheet for the part to be machined, in accordance with the production drawing.

In Part 2, to demonstrate the required competency, the candidates must machine a moderately complex part requiring roughing, grooving and surfacing operations in accordance with the process sheet and the drawing. The part will be machined using only graduated drums.

3 EXAMINATION PROCEDURE

3.1 STEPS IN THE EXAMINATION

PART 1: Preparing the work

Before Part 1

Explain the procedure to the candidates.

Make sure that each candidate has received the documentation for Part 1 of the examination:

- drawing
- manuals
- *Machinery's Handbook* or equivalent
- incomplete process sheets

The suggested duration of Part 1 of the examination is one hour.

During Part 1

The candidates must complete a process sheet for the part to be machined, in accordance with the drawing.

After Part 1

Correct Part 1.

Record the result on Part 1 of the performance evaluation form.

PART 2: Machining the part

Before Part 2

Make sure that each candidate has:

- the drawing, the process sheet and the candidate's booklet
- the tools needed to machine the part

The suggested duration of Part 2 of the examination is four hours.

During Part 2

Verify whether the candidates have:

Step 1:
- correctly mounted the accessories in accordance with the type of installation
- correctly and safely positioned and aligned the workpiece in the milling machine

- correctly aligned the milling head

Record the result on Part 2 of the performance evaluation form.

Step 2:
- correctly adjusted the machining parameters

Record the result on Part 2 of the performance evaluation form.

Step 3:
- properly cleaned the workstation and surrounding area
- properly put away the tools and accessories

Step 4:
- filled out and signed the measurement sheet

Record the result on Part 2 of the performance evaluation form.

After Part 2

Verify whether the candidates:

- observed the dimensions, tolerances and shape of the part
- took the required finish into account
- deburred and cleaned the part
- correctly measured the dimensions of the part

Record the result on Part 2 of the performance evaluation form.

3.2 MINIMUM PERFORMANCE STANDARD

The minimum performance standard for Part 1 is 15 out of a possible 20 marks.

The minimum performance standard for Part 2 is 65 out of a possible 80 marks.

Candidates who fail one part of the examination can retake that part.

3.3 DURATION

The suggested duration of the examination is five hours, i.e. one hour for Part 1 and four hours for Part 2.

PERFORMANCE EVALUATION FORM

MACHINING TECHNIQUES	Program code: 5723
11 – Longitudinal and Transverse Machining on a Milling Machine	Module code: 872 118

Candidate's name: _____

School: _____ Permanent code: _____

Date of examination: _____ RESULT: PASS ❑ FAIL ❑

Examiner's signature: _____

OBSERVATION	YES	NO	RESULT
PART 1: Preparing the work			
1 Development of process sheet			
1.1 Completed the list of machining operations:			
- routines	❑	❑	
- subroutines	❑	❑	
- operations	❑	❑	**0 or 10**
1.2 Chose the appropriate:			
- cutting tools	❑	❑	
- measuring instruments	❑	❑	**0 or 5**
1.3 Calculated the machining parameters:			
- rpm	❑	❑	
- feed rate (if applicable)	❑	❑	**0 or 5**
RESULT FOR PART 1			**/20**

PROGRAM ANALYSIS AND TABLE OF SPECIFICATIONS (BEHAVIOURAL OBJECTIVE)

872 118 – Longitudinal and Transverse Machining on a Milling Machine (Module 11)

Specifications of the Expected Behaviour	Duration (%)	Performance Indicators	W_i	Criterion Components	W_c	STR.
1 Identify, in the drawings and manuals, the information needed for the job.	5	In the drawings: - accurate interpretation of symbols, codes, abbreviations and technical terms - proper identification of information in the list of terms used, the title block and the annotations		Identified the relevant information in the drawings		
2 Develop the process sheet.	20	1 Development of process sheet	20	1.1 Completed the list of machining operations	10	TH
				1.2 Chose the appropriate: - cutting tools - measuring instruments	5	TH
				1.3 Calculated the machining parameters	5	TH
3 Mount the workpiece on the milling machine.	10	2 Mounting of accessories in accordance with the type of installation	15	2.1 Mounted the accessories in accordance with the type of installation	5	PS

W_i: relative weighting of indicators W_c: relative weighting of criterion components STR.: evaluation strategy (TH: theory, PT: product, PS: process)

PROGRAM ANALYSIS AND TABLE OF SPECIFICATIONS (BEHAVIOURAL OBJECTIVE)

872 118 – Longitudinal and Transverse Machining on a Milling Machine (Module 11)

Specifications of the Expected Behaviour	Duration (%)	Performance Indicators	W_i	Criterion Components	W_c	STR.
		3 Proper positioning and alignment of workpiece and milling head		3.1 Correctly and safely positioned and aligned the workpiece in the vise	5	PT
				3.2 Correctly aligned the milling head	5	PT
4 Prepare the milling machine and the workstation.	5	4 Adjustments in conformity with process sheet	10	4.1 Correctly adjusted the machining parameters	10	PS
5 Perform longitudinal and transverse machining operations, such as: - facing - straight grooving - peripheral milling - face milling - gang milling	50	Conformity with process sheet		Followed the process sheet		
		5 Machining in conformity with drawing	45	5.1 Observed the dimensions, tolerances and shape of the part	30	PT
				5.2 Took the required finish into account	10	PT
				5.3 Deburred and cleaned the part	5	PT
		Proper use of tools and equipment		Took the appropriate safety precautions for all operations		

W_i: relative weighting of indicators W_c: relative weighting of criterion components STR.: evaluation strategy (TH: theory, PT: product, PS: process)

PROGRAM ANALYSIS AND TABLE OF SPECIFICATIONS (BEHAVIOURAL OBJECTIVE)

872 118 – Longitudinal and Transverse Machining on a Milling Machine (Module 11)

Specifications of the Expected Behaviour	Duration (%)	Performance Indicators	W_i	Criterion Components	W_c	STR.
6 Control the quality of the machined part.	5	6 Accurate measurements taken	10	6.1 Controlled the quality of the part: - accurate measurements - signed inspection sheet	10	PT
7 Perform regular maintenance on the milling machine, accessories and cutting tools.	5	Proper cleaning of workstation and surrounding area Proper storage of tools and accessories		Properly cleaned the workstation and surrounding area Properly put away the tools and accessories		

W_i: relative weighting of indicators W_c: relative weighting of criterion components STR.: evaluation strategy (TH: theory, PT: product, PS: process)