SKILLEDTRADES BC

PROGRAM OUTLINE

Machinist

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MACHINIST
HARMONIZED PROGRAM OUTLINE

APPROVED BY INDUSTRY

FEBRUARY 2019

BASED ON

RSOS 2017

Developed by
SkilledTradesBC
Province of British Columbia

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Section 1

INTRODUCTION

Machinist

Foreword

The Program Standards for Machinist were updated through a Standards Review project funded by SkilledTradesBC. These revised standards incorporate changes made to the 2017 Red Seal Occupational Standard (RSOS).

This Program Outline is for use in Machinist industry apprenticeship training classes sponsored by SkilledTradesBC and will be used as a curriculum planning guide for instructors in the formal classroom portions of apprenticeship training. Safe working practices, though not always specified in each of the competencies and learning tasks, are an implied part of the program and should be stressed throughout the apprenticeship.

This Program Outline was reviewed and adjusted by a group of Subject Matter Experts (SMEs), during a five day workshop in March 2018. Thanks are extended to the SMEs for their dedication and participation in keeping the Machinist Program Standards technologically current and aligned with the needs of industry.

SAFETY ADVISORY

Be advised that references to the WorkSafeBC safety regulations contained within these materials do not/may not reflect the most recent Occupational Health and Safety Regulation (the current Standards and Regulation in BC can be obtained on the following website: http://www.worksafebc.com)

Please note that it is always the responsibility of any person using these materials to inform him/herself about the Occupational Health and Safety Regulation pertaining to his/her work.

Acknowledgements

Subject Matter Experts (SMEs) retained to assist in the development of the Program Outline:

- Marte Arreola — BCIT
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- Rob Vanderstarren — Customized CNC Solutions Inc.
- Reinhard Wildauer — College of New Caledonia

SkilledTradesBC would like to acknowledge the dedication and hard work of all the industry representatives appointed to identify the training requirements of the Machinist occupation.

How to Use this Document

This Program Outline has been developed for the use of individuals from several different audiences. The table below describes how each section can be used by each intended audience.

Section	Training Providers	Employers/ Sponsors	Apprentices	Challengers
Program Credentialing Model	Communicate program length and structure, and all pathways to completion	Understand the length and structure of the program	Understand the length and structure of the program, and pathway to completion	Understand challenger pathway to Certificate of Qualification
OAC	Communicate the competencies that industry has defined as representing the scope of the occupation	Understand the competencies that an apprentice is expected to demonstrate in order to achieve certification	View the competencies they will achieve as a result of program completion	Understand the competencies they must demonstrate in order to challenge the program
Training Topics and Suggested Time Allocation	Shows proportionate representation of general areas of competency (GACs) at each program level, the suggested proportion of time spent on each GAC, and percentage of time spent on theory versus practical application	Understand the scope of competencies covered in the technical training, the suggested proportion of time spent on each GAC, and the percentage of that time spent on theory versus practical application	Understand the scope of competencies covered in the technical training, the suggested proportion of time spent on each GAC, and the percentage of that time spent on theory versus practical application	
Program Content	Defines the objectives, learning tasks, high level content that must be covered for each competency, as well as defining observable, measureable achievement criteria for objectives with a practical component	Identifies detailed program content and performance expectations for competencies with a practical component; may be used as a checklist prior to signing a recommendation for certification (RFC) for an apprentice	Provides detailed information on program content and performance expectations for demonstrating competency	Allows individual to check program content areas against their own knowledge and performance expectations against their own skill levels
Training Provider Standards	Defines the facility requirements, tools and equipment, reference materials (if any) and instructor requirements for the program	Identifies the tools and equipment an apprentice is expected to have access to; which are supplied by the training provider and which the student is expected to own	Provides information on the training facility, tools and equipment provided by the school and the student, reference materials they may be expected to acquire, and minimum qualification levels of program instructors	Identifies the tools and equipment a tradesperson is expected to be competent in using or operating; which may be used or provided in a practical assessment

Section	Training Providers	Employers/ Sponsors	Apprentices	Challengers
Appendix- Assessment Guidelines	Identifies the percentage weight of theory and practical assessment in technical training		Identifies the percentage weight of theory and practical assessment in technical training	
Appendix– Glossary of Acronyms			Defines program specific acronyms	Defines program specific acronyms
Appendix- Previous Contributors	Provides information on previous contributors to the Program Outline review	Provides information on previous contributors to the Program Outline review	Provides information on previous contributors to the Program Outline review	Provides information on previous contributors to the Program Outline review

Section 2

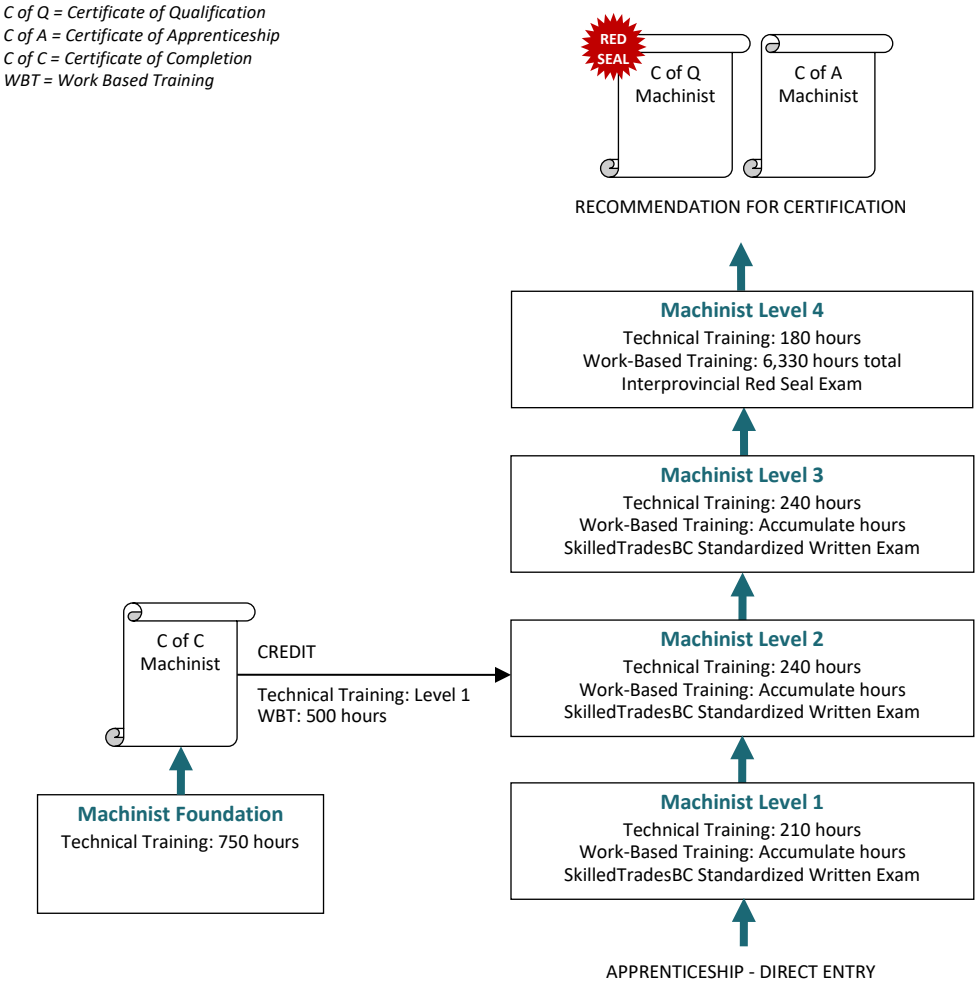
PROGRAM CONTENT

Machinist

Program Credentialing Model

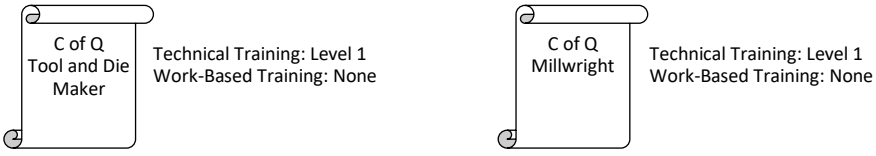
Apprenticeship Pathway

This graphic provides an overview of the Machinist apprenticeship pathway.



CROSS-PROGRAM CREDITS

Individuals who hold the credentials listed below are entitled to receive partial credit toward the completion requirements of this program



Occupational Analysis Chart

MACHINIST

Occupation Description: A Machinist is someone who turns blocks of metal into complex, intricate metal parts for other products. They fit and assemble metal parts and sub-assemblies, ensuring the parts in these products meet exacting standards in size, strength and hardness. A Machinist sets up and operates all machine tools such as Lathes, Milling Machines Saws, Grinding Machines, Drilling and Boring Machines, Shapers, Planers, Precision Measuring tools, Hand and Power tools, and the related attachments and accessories, including C.N.C. machining, selection, use and maintenance of cutting tools.

PERFORM SAFETY RELATED TASKS A	Describe Occupational Health and Safety Regulations A1	Describe WHMIS and Hazardous Materials Safety (HAZMAT) A2	Apply safety practices for shop areas A3	Use lifting equipment A4
	1	1	1 4	1
PERFORM HAND PROCESSES B	Use and maintain hand tools B1	Use layout tools B2	Use and maintain handheld power tools B3	Mark material and workpiece for identification B4
	1	1	1	1
USE APPLIED MATHEMATICS C	Solve problems involving formulas C1	Perform metric/imperial conversions C2	Solve problems involving geometry C3	Solve problems involving mass, area and volume C4	Solve problems involving trigonometry C5
	1 2 3	1	1 2	1	1 2 3
USE MEASURING TOOLS D	Use linear and Vernier scales D1	Use micrometers D2	Use calipers and gauges D3	Use dial indicators and digital readouts D4	Use optical measuring equipment D5
	1	1	1 2 3	1 2 3	1 2
INTERPRET DRAWINGS AND REFERENCE MATERIALS E	Interpret information found on drawings E1	Determine project requirements E2	Sketch machined parts E3	Use Machinery's Handbook and other reference materials E4	Describe fits and tolerances E5
	1	1	1	1 2 3 4	1 2

HARMONIZED PROGRAM OUTLINE
Program Overview

SELECT MATERIALS F	Describe principles of metallurgy F1	Describe characteristics of ferrous metals F2	Describe characteristics of non-ferrous metals F3	Describe characteristics of non-metals F4	Perform heat treating F5	Perform materials testing F6
	1	1	2	2	2 3	3
	Describe the use and maintenance of fuel gas equipment F7					
	1					
REFURBISH COMPONENTS G	Identify fasteners G1	Identify lubricants and sealants G2	Describe bearings, seals and bearing materials G3			
	1	1	3			
USE DRILLING MACHINES H	Describe drilling machines H1	Select and maintain cutting tools H2	Operate and maintain drilling machines H3			
	1	1	1			
USE POWER SAWS I	Describe power saws I1	Select and maintain band saw blades I2	Operate and maintain band saws I3	Operate and maintain other saws I4		
	1	1	1	1		
USE LATHES J	Describe lathes J1	Describe cutting tools and holders J2	Operate and maintain lathes J3	Cut tapers J4	Cut threads J5	Describe vertical lathes J6
	1	1 2	1	1	2 3	3

HARMONIZED PROGRAM OUTLINE
Program Overview

USE MILLING MACHINES K	Describe milling machines K1	Describe cutting tools and holders K2	Use dividing heads and rotary tables K3	Operate and maintain milling machines K4	Describe boring mills K5
	1 2	1 2	2 3	2 3	3
USE SUPPORT MACHINES L	Operate and maintain pedestal grinder L1	Operate and maintain arbor and hydraulic presses L2	Operate and maintain hones and lapping machines L3	Operate and maintain gear cutting machines L4	Operate and maintain electrical discharge machines L5
	1	1	1 2	4	4
USE PRECISION GRINDERS M	Describe types of precision grinders M1	Select abrasives M2	Operate and maintain grinders M3		
	2 3	2	2 3		
USE CNC MACHINES N	Describe CNC turning centres N1	Establish co-ordinate systems and apply programming codes for turning centres N2	Operate and maintain CNC turning centres N3	Describe CNC machining centres N4	Establish co-ordinate systems and apply programming codes for machining centres N5	Operate and maintain CNC machining centres N6
	2	2	2	3	3	3
	Create 2D and 3D models N7	Program using CAM N8				
	3 4	3 4				

Training Topics and Suggested Time Allocation

Training Topics and Suggested Time Allocation shows the proportionate representation of general areas of competency (GACs) at each program level, the suggested proportion of time spent on each GAC, and percentage of time spent on theory versus practical application.

MACHINIST – LEVEL 1

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
Line A	**PERFORM SAFETY RELATED TASKS**	**11%**	**80%**	**20%**	**100%**
A1	Describe Occupational Health and Safety Regulations		✓		
A2	Describe WHMIS and Hazardous Materials Safety (HAZMAT)		✓		
A3	Apply safety practices for shop areas		✓	✓	
A4	Use lifting equipment		✓	✓	
Line B	**PERFORM HAND PROCESSES**	**9%**	**40%**	**60%**	**100%**
B1	Use and maintain hand tools		✓	✓	
B2	Use layout tools		✓	✓	
B3	Use and maintain handheld power tools		✓	✓	
B4	Mark material and workpiece for identification		✓	✓	
Line C	**USE APPLIED MATHEMATICS**	**11%**	**100%**	**0%**	**100%**
C1	Solve problems involving formulas		✓		
C2	Perform metric/imperial conversions		✓		
C3	Solve problems involving geometry		✓		
C4	Solve problems involving mass, area and volume		✓		
C5	Solve problems involving trigonometry		✓		
Line D	**USE MEASURING TOOLS**	**9%**	**40%**	**60%**	**100%**
D1	Use linear and Vernier scales		✓	✓	
D2	Use micrometers		✓	✓	
D3	Use calipers and gauges		✓	✓	
D4	Use dial indicators and digital readouts		✓	✓	
D5	Use optical measuring equipment		✓		
Line E	**INTERPRET DRAWINGS AND REFERENCE MATERIALS**	**8%**	**80%**	**20%**	**100%**
E1	Interpret information found on drawings		✓		
E2	Determine project requirements		✓		
E3	Sketch machined parts		✓	✓	
E4	Use Machinery's Handbook and other reference materials		✓		
E5	Describe fits and tolerances		✓	✓	
Line F	**SELECT MATERIALS**	**8%**	**100%**	**0%**	**100%**
F1	Describe principles of metallurgy		✓		
F2	Describe characteristics of ferrous metals		✓		
F7	Describe the use and maintenance of fuel gas equipment		✓		

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
Line G	**REFURBISH COMPONENTS**	**3%**	**100%**	**0%**	**100%**
G1	Identify fasteners		✓		
G2	Identify lubricants and sealants		✓		
Line H	**USE DRILLING MACHINES**	**9%**	**40%**	**60%**	**100%**
H1	Describe drilling machines		✓		
H2	Select and maintain cutting tools		✓	✓	
H3	Operate and maintain drilling machines		✓	✓	
Line I	**USE POWER SAWS**	**3%**	**40%**	**60%**	**100%**
I1	Describe power saws		✓		
I2	Select and maintain band saw blades		✓	✓	
I3	Operate and maintain band saws		✓	✓	
I4	Operate and maintain other saws		✓	✓	
Line J	**USE LATHES**	**20%**	**40%**	**60%**	**100%**
J1	Describe lathes		✓		
J2	Describe cutting tools and holders		✓		
J3	Operate and maintain lathes		✓	✓	
J4	Cut tapers		✓	✓	
Line K	**USE MILLING MACHINES**	**3%**	**100%**	**0%**	**100%**
K1	Describe milling machines		✓		
K2	Describe cutting tools and holders		✓		
Line L	**USE SUPPORT MACHINES**	**6%**	**50%**	**50%**	**100%**
L1	Operate and maintain pedestal grinders		✓	✓	
L2	Operate and maintain arbour and hydraulic presses		✓	✓	
L3	Operate and maintain hones and lapping machines		✓		
	Total Percentage for Machinist Level 1	**100%**			

Training Topics and Suggested Time Allocation

MACHINIST – LEVEL 2

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
Line C	**USE APPLIED MATHEMATICS**	**11%**	**100%**	**0%**	**100%**
C1	Solve problems involving formulas		✓		
C3	Solve problems involving geometry		✓		
C5	Solve problems involving trigonometry		✓		
Line D	**USE MEASURING TOOLS**	**4%**	**40%**	**60%**	**100%**
D3	Use calipers and gauges		✓	✓	
D4	Use dial indicators and digital readouts		✓	✓	
D5	Use optical measuring equipment		✓	✓	
Line E	**INTERPRET DRAWINGS AND REFERENCE MATERIALS**	**2%**	**100%**	**0%**	**100%**
E4	Use Machinery's Handbook and other reference materials		✓		
E5	Describe fits and tolerances		✓		
Line F	**SELECT MATERIALS**	**7%**	**80%**	**20%**	**100%**
F3	Describe characteristics of non-ferrous metals		✓		
F4	Describe characteristics of non-metals		✓		
F5	Perform heat treating		✓	✓	
Line J	**USE LATHES**	**14%**	**40%**	**60%**	**100%**
J2	Describe cutting tools and holders		✓		
J5	Cut threads		✓	✓	
Line K	**USE MILLING MACHINES**	**18%**	**40%**	**60%**	**100%**
K1	Describe milling machines		✓		
K2	Describe cutting tools and holders		✓		
K3	Use dividing heads and rotary tables		✓	✓	
K4	Operate and maintain milling machines		✓	✓	
Line L	**USE SUPPORT MACHINES**	**2%**	**60%**	**40%**	**100%**
L3	Operate and maintain hones and lapping machines		✓	✓	
Line M	**USE PRECISION GRINDERS**	**10%**	**50%**	**50%**	**100%**
M1	Describe types of precision grinders		✓		
M2	Select abrasives		✓	✓	
M3	Operate and maintain grinders		✓	✓	
Line N	**USE CNC MACHINES**	**32%**	**50%**	**50%**	**100%**
N1	Describe CNC turning centres		✓		
N2	Establish co-ordinate systems and apply programming codes for turning centres		✓	✓	
N3	Operate and maintain CNC turning centres		✓	✓	
	Total Percentage for Machinist Level 2	**100%**			

Training Topics and Suggested Time Allocation

MACHINIST – LEVEL 3

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
Line C	**USE APPLIED MATHEMATICS**	**5%**	**100%**	**0%**	**100%**
C1	Solve problems involving formulas		✓		
C5	Solve problems involving trigonometry		✓		
Line D	**USE MEASURING TOOLS**	**5%**	**30%**	**70%**	**100%**
D3	Use calipers and gauges		✓	✓	
D4	Use dial indicators and digital readouts		✓	✓	
Line E	**INTERPRET DRAWINGS AND REFERENCE MATERIALS**	**7%**	**100%**	**0%**	**100%**
E4	Use Machinery's Handbook and other reference materials		✓		
Line F	**SELECT MATERIALS**	**9%**	**80%**	**20%**	**100%**
F5	Perform heat treating		✓	✓	
F6	Perform materials testing		✓	✓	
Line G	**REFURBISH COMPONENTS**	**3%**	**100%**	**0%**	**100%**
G3	Describe bearings, seals and bearing materials		✓		
Line J	**USE LATHES**	**9%**	**30%**	**70%**	**100%**
J5	Cut threads		✓	✓	
J6	Describe vertical lathes		✓		
Line K	**USE MILLING MACHINES**	**12%**	**40%**	**60%**	**100%**
K3	Use dividing heads and rotary tables		✓	✓	
K4	Operate and maintain milling machines		✓	✓	
K5	Describe boring mills		✓		
Line M	**USE PRECISION GRINDERS**	**9%**	**30%**	**70%**	**100%**
M1	Describe types of precision grinders		✓		
M3	Operate and maintain grinders		✓	✓	
Line N	**USE CNC MACHINES**	**41%**	**50%**	**50%**	**100%**
N4	Describe CNC machining centres		✓		
N5	Establish co-ordinate systems and apply programming codes for machining centres		✓	✓	
N6	Operate and maintain CNC machining centres		✓	✓	
N7	Create 2D and 3D models		✓		
N8	Program using CAM		✓		
	Total Percentage for Machinist Level 3	**100%**			

Training Topics and Suggested Time Allocation

MACHINIST – LEVEL 4

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
Line A	**PERFORM SAFETY RELATED TASKS**	**2%**	**100%**	**0%**	**100%**
A3	Apply safety practices for shop areas		✓		
Line E	**INTERPRET DRAWINGS AND REFERENCE MATERIALS**	**7%**	**100%**	**0%**	**100%**
E4	Use Machinery's Handbook and other reference materials		✓		
Line L	**USE SUPPORT MACHINES**	**33%**	**50%**	**50%**	**100%**
L4	Operate and maintain gear cutting machines		✓	✓	
L5	Operate and maintain EDM		✓	✓	
Line N	**USE CNC MACHINES**	**58%**	**30%**	**70%**	**100%**
N7	Create 2D and 3D models		✓	✓	
N8	Program using CAM		✓	✓	
	Total Percentage for Machinist Level 4	**100%**			

Section 3

PROGRAM CONTENT

Machinist

Level 1

Machinist

Line (GAC): A PERFORM SAFETY RELATED TASKS

Competency: A1 Describe Occupational Health and Safety Regulations

Objectives

To be competent in this area, the individual must be able to:

- Describe the Federal-Provincial Occupational Health and Safety Regulations.

LEARNING TASKS	CONTENT
1. Define terms used in Federal-Provincial Occupational Health and Safety Regulations	• Workers Compensation Act • Industrial Health and Safety Regulations • Federal Regulations • Other Federal jurisdictions • WHMIS (Workplace Hazardous Materials Information System) Definitions, Section 1 of the Act

2. Describe the Occupational Health and Safety Regulations	• Housekeeping
	  ○ Confined Space
	  ○ Material Storage
	  ○ Ladders/Scaffolding
	  ○ Fall Arrest
	  ○ WHMIS
	  ○ Lockout/Tagout procedures
	  ○ Ventilation requirements
	  ○ Chemical and Biological substances
	  ○ Noise, vibration, radiation and temperature
	  ○ Personal protective equipment requirements
	  ○ Accident reporting requirements

Line (GAC): A PERFORM SAFETY RELATED TASKS

Competency: A2 Describe Workplace Hazardous Materials Information System (WHMIS) Regulations and Hazardous Materials Safety (HAZMAT)

Objectives

To be competent in this area, the individual must be able to:

- Describe the HAZMAT (Hazardous Materials Safety) and the WHMIS regulations.
- Interpret material information sheets (SDS (Safety Data Sheets) and HAZMAT).
- Apply knowledge of WHMIS and HAZMAT regulations to maintain a safe working environment.

LEARNING TASKS	CONTENT
1. Describe HAZMAT regulations for the transportation of hazardous materials	• Signage • Reporting incidents • Safe handling and cleanup procedures • Transporting
2. State the legislation that requires suppliers of hazardous materials to provide SDS and label products as a condition of sale and importation	• Hazardous Product Act • Controlled Products Regulations • Ingredient Disclosure List • Hazardous Materials Information Review Act • Hazardous Material Information Review Regulations

3. State the work purpose of the Workplace Hazardous Materials Information System (WHMIS)	• Protection of Canadian workers from the adverse effects of hazardous materials through the provision of relevant information while minimizing the economic impact on industry and the disruption of trade
	• Recognition of rights
	  ○ Workers
	  ○ Employers
	  ○ Suppliers
	  ○ Regulations

4. Describe the key elements of WHMIS	• Safety Data Sheets (SDSs) • Labeling of containers of hazardous materials • Worker educational programs

5. Describe the responsibilities of suppliers under WHMIS	• Provide
	  ○ SDSs
	  ○ Labels

6. Describe the responsibilities of employers under WHMIS	• Provide ○ SDSs

LEARNING TASKS	CONTENT
	○ Labels ○ Work education programs in the workplace
7. Describe information to be disclosed on a SDS	• Hazardous ingredients • Preparation information • Product information • Physical data • Fire or explosion • Reactivity data • Toxicological properties • Preventive measures • First Aid measures
8. Identify symbols found on WHMIS labels and their meaning	• Compressed gases • Flammable and combustible materials • Oxidizing materials • Poisonous and infectious materials ○ Materials causing immediate and serious side effects ○ Materials causing other toxic effects ○ Biohazardous infectious materials • Corrosive materials • Dangerously reactive materials
9. Apply WHMIS regulations as they apply to hazardous materials used in the shop	• Use, storage and disposal of ○ Solvents ○ Cutting fluids ○ Materials – Metals – Plastic ○ Caustic cleaners ○ Cleaning solutions ○ Alcohol used for cleaning ○ Oxy-acetylene ○ Asbestos ○ Tracer dyes
10. Maintain safe working area	• HAZMAT • WHMIS

Line (GAC): A PERFORM SAFETY RELATED TASKS

Competency A3 Apply safety practices for shop areas

Objectives

To be competent in this area, the individual must be able to:

- Apply personal safety measures.
- Identify and use shop emergency equipment.
- Prevent, identify and extinguish various classes of fires.

LEARNING TASKS	CONTENT

1. Apply personal safety precautions and procedures	• Personal apparel
	  ○ Clothing
	  ○ Hair and beards
	  ○ Jewellery
	• Personal protection
	  ○ Head
	  ○ Hands
	  ○ Lungs
	  ○ Eyes
	  ○ Ears
	  ○ Feet
	• Safety meeting
	• Housekeeping
	• Equipment and machine lock-out
	• Ventilation systems
	• Adequate lighting
	• Clear-headed
	  ○ Substance abuse
	  ○ Sleep deprivation
	  ○ Personal distractions
	• Horseplay
	• Respect for others safety
	• Constant awareness of surroundings
	• Lifting
	• WorkSafe BC requirements
	• Electrical isolation

2. Lock-out equipment prior to service	• Lock and tag
	• Secure other systems
	  ○ Mechanical
	  ○ Hydraulic
	• Pneumatic

LEARNING TASKS	CONTENT
3. Locate shop emergency equipment and means of egress	• Emergency shutoffs • Fire control systems • Eye wash facilities • Emergency exits • First aid facilities • Emergency contact phone numbers • Evacuation procedures • Outside meeting place • Disaster meeting place
4. Describe the conditions necessary to support a fire	• Air • Fuel • Heat
5. Describe the classes of fires according to the materials being burned	• Class A • Class B • Class C • Class D • Symbols and colours
6. Apply preventative fire safety precautions when working near, handling or storing flammable liquids or gases, combustible materials and electrical apparatus	• Solvents • Heat treatment salts • Oxygen • Acetylene • LPG and CNG • Ventilation ○ Purging • Lubricants • Oily rags • Combustible metals • Aerosols
7. Describe the considerations and steps to be taken prior to fighting a fire	• Warning others and fire departments • Evacuation of others • Containable fire • Personal escape route • Training

8. Describe the procedure for using a fire extinguisher	• P.A.S.S.
	  ○ Pull
	  ○ Aim
	  ○ Squeeze
	  ○ Sweep

LEARNING TASKS	CONTENT

9. Explain how a mentor can help an apprentice	• Acceptance of constructive criticism
	• Listening skills
	• Accountability
	• Patience
	• Share
	  ○ Experiences
	  ○ Knowledge
	• Pride in trade

Line (GAC): A PERFORM SAFETY RELATED TASKS

Competency A4 Use lifting equipment

Objectives

To be competent in this area, the individual must be able to:

- Apply the Occupational Health and Safety Regulation to lifting and blocking applications.
- Select, use and maintain lifting, securing and blocking equipment.

LEARNING TASKS	CONTENT
1. Apply the Occupational Health and Safety Regulation	• Parts 14 and 15
2. Determine load masses	• Types • Capacities • Manufacturer's specification • Estimation

3. Select, use and maintain securing equipment	• Types
	  ○ Clamps
	  ○ Material racks
	  ○ Blocking
	• Load capacities

4. Select, use and maintain wire ropes, chains and lifting straps	• Types • Capacities • Rigging attachments • Lifting attachments
5. Use visual and sound signals	• Occupational Health and Safety Regulation (Part 15)

6. Select, use and maintain hoisting equipment	• Types
	• Capacities
	• Operation
	• Equipment storage
	• Visual inspection
	  ○ Expiry date
	  ○ Damage
	  ○ Defects

7. Lift, hoist and move loads	• Determine safe working load • Determine correct slinging procedure
8. Manoeuvre large objects	• Flipping • Rotating • Centre of gravity • Sling or chain placement

Line (GAC): B PERFORM HAND PROCESSES

Competency: B1 Use and maintain hand tools

Objectives

To be competent in this area, the individual must be able to:

- Select, use and maintain hand tools.
- Select, use and maintain appropriate guarding and personal protective equipment.

LEARNING TASKS	CONTENT

1. Use protective equipment associated with the use of tools and shop equipment	• Personal protection
	  ○ Head
	  ○ Hands
	  ○ Lungs
	  ○ Eyes
	  ○ Ears
	  ○ Feet
	  ○ Clothing
	• Screening
	• Guarding
	• Ventilation
	• Clean up
	• Lock out

2. Select, use and maintain hand tools	• Plan sequence of operations
	• Wrenches
	• Screwdrivers
	• Cutting
	  ○ Saws
	  ○ Abrasives
	  ○ Files
	  ○ Taps and dies
	• Hammers
	• Chisels/punches
	• Clamping tools
	• Pullers
	• Vises

Achievement Criteria

Performance — The learner will be able to produce a drill-point gauge.

Conditions — The learner will be given:

- Material
- Measuring tools
- Layout tools
- Files
- Hacksaws
- Drills

Criteria — The learner will be evaluated on:

- Accuracy
- Tolerances
- Finish

Line (GAC): B PERFORM HAND PROCESSES

Competency: B2 Use layout tools

Objectives

To be competent in this area, the individual must be able to:

- Perform layout procedures.

LEARNING TASKS	CONTENT
1. Select layout tools	• Layout dye • Scribers • Dividers • Centre punch • Height gauges • Rulers • Combination set • Surface gauge • V-blocks • Angle plates
2. Describe layout procedures	• Material selection ○ Adequate stock size • Establish procedures steps • Datum points • Datum faces • Tool selection
3. Perform layout procedures	• As in Learning Task 1 and 2

Line (GAC): B PERFORM HAND PROCESSES

Competency: B3 Use and maintain handheld power tools

Objectives

To be competent in this area, the individual must be able to:

- Describe handheld power tool safety.
- Select, use and maintain handheld power tools and accessories.

LEARNING TASKS	CONTENT
1. Describe handheld power tool safety	• Personal protective equipment • Guards • Electrical cords • Operating procedures ○ Securing work • Compressed air • Tool maintenance

2. Select handheld power tools	• Electric
	  ○ Cutting
	  ○ Grinding
	  ○ Drilling
	• Pneumatic
	  ○ Cutting
	  ○ Grinding
	  ○ Drilling

3. Select and maintain handheld power tool accessories	• Grinding disk speeds
	• Burr speeds
	• Cut-off wheels
	• Abrasive discs
	• Saw blades
	  ○ Band
	  ○ Circular

4. Use handheld power tools	• As in learning tasks 2 and 3

Line (GAC): B PERFORM HAND PROCESSES

Competency: B4 Mark material and workpiece for identification

Objectives

To be competent in this area, the individual must be able to:

- Identify and describe marking procedures.
- Mark material and workpiece without causing functional damage.

LEARNING TASKS	CONTENT
1. Identify and describe material and workpiece marking procedures	• Etching • Engraving • Colour coding • Stamping
2. Mark material and workpiece	• Engraving • Colour coding • Ink stamping • Acid etching

Line (GAC): C USE APPLIED MATHEMATICS

Competency: C1 Solve problems involving formulas

Objectives

To be competent in this area, the individual must be able to:

- Perform calculations using formulas.
- Solve problems using algebra.
- Calculate ratios.

LEARNING TASKS	CONTENT
1. Use formulas	• Trigonometry • Feeds and Speeds • Circumference • Area • Volume • Mass • Tapers
2. Use a scientific calculator	• Brackets • Memory • Fractions • Percentages • Conversions • Trigonometry • Inversion • Power • Roots • Constants
3. Use algebra	• Proportions • Transpose formulas
4. Apply ratios	• Direct • Inverse

Line (GAC): C USE APPLIED MATHEMATICS

Competency: C2 Perform metric/imperial conversions

Objectives

To be competent in this area, the individual must be able to:

- Perform metric/imperial conversions.

LEARNING TASKS	CONTENT
1. Define metric units	• Length • Mass • Volume • Temperature
2. Define metric prefixes	• Place value • Scientific notation
3. Define imperial units	• Length • Mass • Volume • Temperature
4. Calculate conversions	• Length • Mass • Volume • Temperature

Line (GAC): C USE APPLIED MATHEMATICS

Competency: C3 Solve problems involving geometry

Objectives

To be competent in this area, the individual must be able to:

- Identify types of angular geometric principles.
- Perform geometric constructions.

LEARNING TASKS	CONTENT
1. Identify geometric principles	• Bisect lines • Bisect angles • Right angles • Perpendicular lines • Parallel lines • Arcs • Tangents
2. Describe geometric figures	• Circle • Sphere • Rectangle • Triangle • Trapezoid • Ellipse

3. Perform geometric constructions	• Generate basic geometric figures
	  ○ Circle
	  ○ Rectangle
	  ○ Triangle
	  ○ Trapezoid
	• Perpendicular bisector of a line
	• Perpendicular at point on a line segment
	• Lines parallel to a given line
	• Bisect a given angle
	• Tangents to a circle
	• Divide a line segment

Line (GAC): C USE APPLIED MATHEMATICS

Competency: C4 Solve problems involving mass, area and volume

Objectives

To be competent in this area, the individual must be able to:

- Calculate mass, area and volume.

LEARNING TASKS	CONTENT

1. Calculate mass	• Weight
	  ○ Steel
	  ○ Aluminum
	  ○ Fluids
	• Specific Gravity

2. Calculate area	• Two dimensional geometric shapes
3. Calculate volume	• Three dimensional geometric shapes

Line (GAC): C USE APPLIED MATHEMATICS

Competency: C5 Solve problems involving trigonometry

Objectives

To be competent in this area, the individual must be able to:

- Apply trigonometry applications.

LEARNING TASKS	CONTENT
1. Describe trigonometry	• Pythagoras theorem • Triangles • Sine • Cosine • Tangent
2. Use applied trigonometry	• Bolt circles • Layout procedures ○ Chords

Line (GAC): D USE MEASURING TOOLS

Competency: D1 Use linear and Vernier scales

Objectives

To be competent in this area, the individual must be able to:

- Use linear and Vernier scales.

LEARNING TASKS	CONTENT

1. Describe linear and Vernier scales	• Imperial rule
	• Metric rule
	• Decimal rule
	• Caliper and Height Gauges
	  ○ Vernier
	  ○ Dial
	  ○ Digital
	• Protractor
	• Care and maintenance

2. Use linear and Vernier scales	• Imperial rule
	• Metric rule
	• Decimal rule
	• Caliper and Height Gauges
	  ○ Vernier
	  ○ Dial
	  ○ Digital
	• Protractor
	• Care and maintenance

Line (GAC): D USE MEASURING TOOLS

Competency: D2 Use micrometers

Objectives

To be competent in this area, the individual must be able to:

- Use and maintain a micrometer.

LEARNING TASKS	CONTENT

1. Describe micrometers	• Types
	  ○ Outside
	  ○ Inside
	  ○ Depth
	  ○ Thread
	• Parts
	• Calibrate
	• Care and Maintenance

2. Use micrometers	• Types
	  ○ Outside
	  ○ Inside
	  ○ Depth
	  ○ Thread
	• Parts
	• Calibrate
	• Care and Maintenance

Line (GAC): D USE MEASURING TOOLS

Competency: D3 Use calipers and gauges

Objectives

To be competent in this area, the individual must be able to:

- Use calipers and gauges.

LEARNING TASKS	CONTENT

1. Describe calipers	• Types
	  ○ Inside
	  ○ Outside
	  ○ Hermaphrodite
	  ○ Transfer

2. Describe gauges	• Types
	  ○ Radius
	  ○ Telescopic

3. Use calipers	• Types
	  ○ Inside
	  ○ Outside
	  ○ Hermaphrodite
	  ○ Transfer

4. Use gauges	• Types
	  ○ Radius
	  ○ Telescopic

Line (GAC): D USE MEASURING TOOLS

Competency: D4 Use dial indicators and digital readouts

Objectives

To be competent in this area, the individual must be able to:

- Use dial indicators.

LEARNING TASKS	CONTENT

1. Describe dial indicators	• Types and features
	  ○ Clock type
	  ○ Finger type
	• Graduations
	• Accessories
	• Care and maintenance

2. Use dial indicators	• True workpiece ○ Lathe • Comparing measurements • Setting up • Measuring • Workpiece inspection • Care and maintenance

Line (GAC): D USE MEASURING TOOLS

Competency: D5 Use optical measuring equipment

Objectives

To be competent in this area, the individual must be able to:

- Describe optical measuring equipment.

LEARNING TASKS	CONTENT

1. Describe optical comparators	• Types
	  ○ Profiles
	  ○ Reflection
	• Components
	  ○ Light source
	  ○ Screen
	  ○ Lenses
	  ○ Table with micrometer adjustment
	  ○ Centre
	  ○ Vise
	  ○ Angle plate
	• Applications
	  ○ Measuring
	  – Thread forms
	  – Profiles
	  – Engraving
	  – Angles
	  – Radii

Line (GAC): E INTERPRET DRAWINGS AND REFERENCE MATERIALS

Competency: E1 Interpret information found on drawings

Objectives

To be competent in this area, the individual must be able to:

- Identify information found on drawings.

LEARNING TASKS	CONTENT

1. Identify lines found in drawings	• Line types
	  ○ Solid
	  ○ Centre
	  ○ Hidden
	  ○ Extension
	  ○ Dimension
	  ○ Section
	  ○ Construction
	• Purpose
	• Application

2. Identify symbols found in drawings	• Symbol types
	  ○ Surface finish
	  ○ Welding
	  ○ Datum
	  ○ Geometric tolerance
	  ○ Diameter
	  ○ ISO
	• Purpose
	• Application

3. Identify views and projections	• Types
	• Orthographic projections
	  ○ 1st and 3rd angle
	  ○ Isometric views
	  ○ Oblique views
	  ○ Shop Sketches (working drawings)
	• Purpose
	• Application

LEARNING TASKS	CONTENT

4. Interpret title block information	• Scale
	• Revisions
	• Date
	• Material
	  ○ Type
	  ○ Size
	• Tolerances
	• Projection type
	• Measurement system

Line (GAC): E INTERPRET DRAWINGS AND REFERENCE MATERIALS

Competency: E2 Determine project requirements

Objectives

To be competent in this area, the individual must be able to:

- Determine project requirements from a drawing or sample.
-

LEARNING TASKS	CONTENT

1. Determine project requirements	• Drawing / sample assessment
	  ○ Requirements
	  – Tooling
	  – Benchwork
	  – Machines
	  – Materials
	  – Fixturing
	• QC / QA

Line (GAC): E INTERPRET DRAWINGS AND REFERENCE MATERIALS

Competency: E3 Sketch machined parts

Objectives

To be competent in this area, the individual must be able to:

- Sketch and dimension an orthographic drawing from an existing part.
- Sketch and dimension an orthographic drawing from an isometric or oblique view.

LEARNING TASKS	CONTENT
1. Sketch and dimension an orthographic drawing from an existing part	• Information required for part manufacture • Necessary views • Dimensioning • Material • Tolerances
2. Sketch and dimension an orthographic drawing from an isometric or oblique view	• Information required for part manufacture • Necessary views • Dimensioning • Material • Tolerances

Achievement Criteria

Performance The learner will be able to sketch an isometric and orthographic drawing.

Conditions The learner will be given:

- Part / drawing
- Ruler
- Graph paper

Criteria The learner will be evaluated on:

- Clarity
- Neatness
- Dimensioning

Line (GAC): E INTERPRET DRAWINGS AND REFERENCE MATERIALS

Competency: E4 Use Machinery's Handbook and other reference materials

Objectives

To be competent in this area, the individual must be able to:

- Identify and locate information in the Machinery's Handbook.
- Use other reference materials and resources to locate information.

LEARNING TASKS	CONTENT

1. Identify information found in the Machinery's Handbook	• Types
	  ○ Charts
	  ○ Tables
	  ○ Threads

2. Locate information in the Machinery's Handbook	• Familiarization with book layout • Index • Section tabs • Tables • Thread data • Fits and tolerances • Formulas • Speeds and feeds

3. Use other reference materials	• Tooling catalogues
	• Trade specific magazines
	• Trade bulletins
	• Internet
	• Machine manuals
	• Job plan
	  ○ Machine limitations
	• Quality Control Documentation
	  ○ Inspection sheets
	  ○ Blueprints

Line (GAC): E INTERPRET DRAWINGS AND REFERENCE MATERIALS

Competency: E5 Describe fits and tolerances

Objectives

To be competent in this area, the individual must be able to:

- Describe fits and tolerances.

LEARNING TASKS	CONTENT

1. Describe fits and tolerances	• Standards
	  ○ ANSI
	  ○ ISO
	• Types
	  ○ Fits
	  ○ Tolerances
	• Applications

2. Describe surface finishes	• Types
	• Methods of Measurement
	  ○ Comparative
	  ○ Stylus
	• Applications

Line (GAC): F SELECT MATERIALS

Competency: F1 Describe principles of metallurgy

Objectives

To be competent in this area, the individual must be able to:

- Describe the manufacture of iron and steel.

LEARNING TASKS	CONTENT
1. Describe smelting process	• Coke • Iron ore • Limestone • Process

2. Describe steel manufacturing processes	• Pig iron
	• Cast iron
	• Hot rolled & cold rolled
	  ○ Plain carbon steel
	  ○ Alloy Steel

Line (GAC): F SELECT MATERIALS

Competency: F2 Describe characteristics of ferrous metals

Objectives

To be competent in this area, the individual must be able to:

- Describe the SAE and AISI classifications.
- Identify steel characteristics by their designations.

LEARNING TASKS	CONTENT
1. Describe Society of Automotive Engineers (SAE) and American Iron and Steel Institute (AISI) classifications	• Plain carbon steels • Standard alloy steels • Tool steels • Stainless steels • Numbering system

2. Identify steel characteristics by their designations	• Carbon content
	• Alloying elements
	• Physical properties:
	  ○ Wear resistance
	  ○ Weight
	  ○ Flexibility
	  ○ Hardness
	  ○ Toughness
	  ○ Corrosion resistance
	  ○ Ductility
	  ○ Machinability
	  ○ Conductivity
	  ○ Thermal
	  ○ Electrical
	• Applications

Line (GAC): F SELECT MATERIALS

Competency: F7 Describe the use and maintenance of fuel gas equipment

Objectives

To be competent in this area, the individual must be able to:

- Describe the operation and maintenance of fuel gas equipment.

LEARNING TASKS	CONTENT

1. Describe the operation and maintenance of fuel gas equipment	• Safety considerations
	• System set-up
	• Torch Operations
	  ○ Welding
	  ○ Cutting
	  ○ Soldering
	  ○ Brazing
	• Oxyacetylene and MAPP gas
	  ○ Flashback arrestors
	  ○ Regulators
	• Propane
	  ○ Liquid and gas
	  ○ Temperature
	  ○ Ventilation
	• Maintenance of fuel gas equipment
	• Storage of fuel gas equipment
	  ○ Recognizing worn, damaged or defective fuel gas equipment

Line (GAC): G REFURBISH COMPONENTS

Competency: G1 Identify fasteners

Objectives

To be competent in this area, the individual must be able to:

- Identify fasteners for applications.

LEARNING TASKS	CONTENT

1. Identify fastener types	• Rivets
	• Dowels/pins
	• Threaded fasteners
	  ○ Metric/Imperial
	  ○ Grades/Markings
	• Washers
	• Locking devices
	• Retainers

Line (GAC): G REFURBISH COMPONENTS

Competency: G2 Identify lubricants and sealants

Objectives

To be competent in this area, the individual must be able to:

- Describe lubricants and sealants and their applications

LEARNING TASKS	CONTENT

1. Describe lubricants	• Purpose
	• Types
	  ○ Oils
	  ○ Greases
	  ○ Dry Lubricants
	• Applications

2. Describe sealants	• Purpose • Types • Applications

Line (GAC): H USE DRILLING MACHINES

Competency: H1 Describe drilling machines

Objectives

To be competent in this area, the individual must be able to:

- Describe drilling machines and their applications.

LEARNING TASKS	CONTENT

1. Describe drilling machines	• Types
	  ○ Sensitive
	  ○ Radial arm
	  ○ Magnetic base
	  ○ Upright
	• Machine size
	• Applications

2. Identify the parts of the drilling machines	• Column • Table • Base • Spindle • Chuck • Quill feed • Power feed

3. Describe work holding devices	• Types
	  ○ V-block
	  ○ Vise
	  ○ Angle plate
	  ○ Jigs and fixtures
	  – Drill bushings
	• Clamps and hold-downs

Line (GAC): H USE DRILLING MACHINES

Competency: H2 Select and maintain cutting tools

Objectives

To be competent in this area, the individual must be able to:

- Select and maintain cutting tools.

LEARNING TASKS	CONTENT

1. Select cutting tools	• Types
	  ○ Drills
	  ○ Reamers
	  ○ Countersinks
	  ○ Counterbores
	  ○ Spot facer
	  ○ Taps
	  ○ Boring bars
	  ○ Hole saws

2. Maintain cutting tools	• Drill sharpening
	  ○ Point-angle
	  ○ Flat bottom
	  ○ Split point
	  ○ Web thinning
	  ○ Brassing
	• Boring tools

Line (GAC): H USE DRILLING MACHINES

Competency: H3 Operate and maintain drilling machines

Objectives

To be competent in this area, the individual must be able to:

- Perform clamping and fixturing.
- Operate and maintain drilling machine.

LEARNING TASKS	CONTENT
1. Calculate speeds (RPM) and feeds	• Surface speed • Diameter of cutter • Chip load

2. Perform clamping	• Safety concerns
	• Types
	  ○ V-blocks
	  ○ Vises
	  ○ Angle plates
	  ○ Jigs and fixtures
	  – Drill bushings
	• Clamps and hold-downs

3. Install and remove tooling	• Types
	  ○ Chucks
	  ○ Sleeves
	  ○ Tapping heads
	  ○ Boring bar
	• Accessories
	  ○ Drift
	  ○ Chuck key

LEARNING TASKS	CONTENT
3. Operate drilling machines	• Layout material • Centre punch • Pulling a drill • Pilot drill • Drill • Chamfer • Ream • Counter bore • Tap
5. Maintain drilling machines	• Lubricate • Clean • Housekeeping
6. Describe the purpose and usage of cutting fluids with drilling machines	• Lubrication • Cooling • Chip removal • Tool life

7. Select types of cutting fluids for specific applications	• Types
	  ○ Straight oils
	  ○ Soluble oils
	  ○ Semi-synthetic
	  ○ Synthetic
	  ○ Misting

Achievement Criteria

Performance — The learner will be able to drill and tap a block to specifications.

Conditions — The learner will be given:

- Material
- Measuring tools
- Layout tools
- Drills
- Taps

Criteria — The learner will be evaluated on:

- Accuracy
- Tolerances
- Finish

Line (GAC): I USE POWER SAWS

Competency: I1 Describe power saws

Objectives

To be competent in this area, the individual must be able to:

- Describe power saws and their applications.

LEARNING TASKS	CONTENT

1. Describe power saws	• Types
	  ○ Band saw
	  – Vertical
	  – Horizontal
	  ○ Cold saws
	  ○ Reciprocating
	  ○ Abrasive saw
	• Parts
	• Accessories

2. Describe power saw applications	• Cut off • Contour

3. Describe work holding devices	• Types
	  ○ V-block
	  ○ Vises
	  ○ Fixtures

Line (GAC): I USE POWER SAWS

Competency: I2 Select and maintain band saw blades

Objectives

To be competent in this area, the individual must be able to:

- Select and maintain band saw blades.

LEARNING TASKS	CONTENT

1. Select band saw blades	• Materials Type
	  ○ Thickness
	  ○ Shape
	• Tooth selection
	• Pitch selection
	  ○ Variable pitch
	• Blade types
	  ○ Bi-metal
	  ○ Carbon

2. Maintain band saw blades	• Butt weld • Silver solder • Storage procedures

Line (GAC): I USE POWER SAWS

Competency: I3 Operate and maintain band saws

Objectives

To be competent in this area, the individual must be able to:

- Install and remove blades.
- Operate and maintain band saws.

LEARNING TASKS	CONTENT

1. Set speeds and feeds	• Material
	  ○ Type
	  ○ Size
	  ○ Profile
	• Blade
	  ○ Size
	  ○ Type
	  ○ Pitch
	  ○ Tooth style
	  ○ Tooth set

2. Perform clamping	• Types
	  ○ V-block
	  ○ Vise
	  ○ Fixtures

3. Install and remove blades	• Clamps and hold-downs
	• Blade
	  ○ Inspection
	  ○ Direction
	  ○ Alignment
	  ○ Tension
	  ○ Break in procedures
	  ○ Coiling
	• Guide selection
	• Clean guide wheels and guides
	• Cut-off

LEARNING TASKS	CONTENT

4. Operate band saws	• Cut-off
	  ○ Speed and feed
	  ○ Power feed
	  ○ Coolants and lubricants
	  ○ Clamping
	  ○ Work support aids
	• Contour
	  ○ Speed and feed
	  ○ Power feed
	  ○ Coolants and lubricants
	  ○ Cutting aids
	  ○ Circle attachment
	• Pusher

5. Quality control for component	• First article inspection
	• Verify
	  ○ Material
	  ○ Drawing
	  – Revision
	  ○ Traceability
	• Dimensional conformance
	• Measuring tools calibrated

6. Maintain band saws	• Lubricate • Clean • Housekeeping
7. Describe the purpose and usage of cutting fluids with band saws	• Lubrication • Cooling • Chip removal • Tool life

8. Select types of cutting fluids for applications	• Types
	  ○ Straight oils
	  ○ Soluble oils
	  ○ Semi-synthetic
	  ○ Synthetic
	  ○ Misting

Line (GAC): I USE POWER SAWS

Competency: I4 Operate and maintain other saws

Objectives

To be competent in this area, the individual must be able to:

- Operate and maintain cold saws, abrasive saws, and reciprocating saws.

LEARNING TASKS	CONTENT

1. Operate and maintain cold saws	• Set speeds
	• Work holding
	• Blade selection
	• Blade removal and installation
	• Operation
	• Maintenance
	  ○ Lubricate
	  ○ Clean
	  ○ Housekeeping

2. Operate and maintain abrasive saws	• Work holding
	• Wheel removal and installation
	• Operations
	• Maintenance
	  ○ Lubricate
	  ○ Clean
	• Housekeeping

Line (GAC): J USE LATHES

Competency: J1 Describe lathes

Objectives

To be competent in this area, the individual must be able to:

- Describe lathes and their applications.
- Identify parts of lathes and their functions.

LEARNING TASKS	CONTENT

1. Describe lathes	• Types
	  ○ Engine
	  ○ Turret
	  ○ Vertical
	  – Boring
	  – Turret
	  ○ Tool room
	  ○ Screw type
	  ○ Swiss
	  ○ CNC
	• Size
	  ○ Swing
	  ○ Length

2. Identify the parts of the lathe and their function	• Bed
	  ○ Ways
	  ○ Gap
	• Headstock
	  ○ Spindle
	  ○ Speed change
	  ○ Spindle nose style
	• Feed system
	  ○ Feed shaft
	  ○ Lead screw
	  ○ Change gears
	  ○ Quick change gearbox
	• Carriage
	  ○ Saddle
	  ○ Compound slide
	  ○ Cross slide
	  ○ Apron
	  ○ Thread chasing dial
	  ○ Feed levers

LEARNING TASKS	CONTENT

	• Tailstock
	  ○ Quill
	  ○ Clamps
	  ○ Adjustment

3. Describe lathe accessories	• Face plate
	• Steady rest
	• Follower rest
	• Cat head
	• Spider
	• Taper turning attachment
	• Radius cutting attachment
	• Tool post
	  ○ American style
	  ○ Square/Four-way box
	  ○ Quick change
	  ○ Boring bar holder
	• Chuck
	  ○ Three-jaw
	  ○ Four-jaw
	  ○ Six-jaw
	  ○ Collet
	  ○ Magnetic
	• Centers

4. Describe lathe applications	• Turning
	• Drilling
	• Boring
	• Threading
	  ○ Internal
	  ○ External
	• Facing
	• Tapers
	• Knurling
	• Contour
	• Profile
	• Parting
	• Spring winding
	• Radius turning

Line (GAC): J USE LATHES

Competency: J2 Describe cutting tools and holders

Objectives

To be competent in this area, the individual must be able to:

- Describe tool geometry.
- Describe cutting tools and holders and their applications.

LEARNING TASKS	CONTENT
1. Describe tool geometry	• Rake • Relief • Cutting edge angles • Nose radius • Chip breaker

2. Describe types of cutters	• Cutter materials
	  ○ HSS
	  ○ Carbide
	• Turning
	• Knurling
	• Part off
	• Form
	• Threading
	• Brazed carbide

3. Describe types of holders	• External • Boring bars • Parting tools • Jacobs chuck
4. Describe cutter applications	• Facing • OD/ID turning • Drilling operations • Grooving • Forming • Threading • Knurling • Parting

Line (GAC): J USE LATHES

Competency: J3 Operate and maintain lathes

Objectives

To be competent in this area, the individual must be able to:

- Calculate RPM.
- Operate and maintain lathes.

LEARNING TASKS	CONTENT
1. Calculate speeds (RPM) and feeds	• Surface speed • Diameter of work • Chip load
2. Determine depth of cut	• Rigidity • Horsepower • Tooling

3. Support and clamp workpiece	• Material
	  ○ Size
	  ○ Shape
	• Machining operation
	• Rigidity
	• Power

4. Install and remove tooling	• Select tool for application • Maintain tool • Tool height • Tool angle

5. Operate lathes	• Plan sequence of operation
	• Set-up sequence
	  ○ Mounting workpiece
	  ○ Truing workpiece
	  ○ Balancing workpiece
	  ○ Centering workpiece
	• Roughing
	  ○ Speeds and feeds
	  ○ Cutters
	  ○ Depth of cut
	  ○ Measuring
	  ○ Material allowance for finishing

LEARNING TASKS	CONTENT

	• Finishing
	  ○ Speeds and feeds
	  ○ Cutter
	  ○ Depth of cut
	  ○ Deburring
	  ○ Measuring
	• Operations
	  ○ Facing
	  ○ Turning
	  ○ Drilling
	  ○ Boring
	  ○ Tapers
	  ○ Knurling
	  ○ Parting
	  ○ Forming
	  ○ Radius
	  ○ Chamfer

6. Quality control for component	• First article inspection
	• Verify
	  ○ Material
	  ○ Drawing
	  – Revision
	  ○ Traceability
	• Dimensional conformance
	• Measuring tools calibrated

7. Maintain lathes	• Lubricate • Clean • Housekeeping • Coolant / cutting fluid
8. Describe the purpose and usage of cutting fluids with lathes	• Lubrication • Cooling • Chip removal • Tool life

9. Select types of cutting fluids for applications	• Types
	  ○ Straight oils
	  ○ Soluble oils
	  ○ Semi-synthetic
	  ○ Synthetic

Achievement Criteria

Performance	Using a lathe, the learner will be able to turn diameters and shoulders to specifications.
Conditions	The learner will be given: • Drawing • Material • Tools and equipment • Measuring tools
Criteria	The learner will be evaluated on: • Accuracy • Tolerances • Finish

Line (GAC): J USE LATHES

Competency: J4 Cut Tapers

Objectives

To be competent in this area, the individual must be able to:

- Cut and measure tapers.

LEARNING TASKS	CONTENT

1. Describe tapers	• Standard
	  ○ Morse
	  ○ Jarno
	  ○ Milling machine (NMTB)

2. Describe methods of cutting tapers	• Taper attachment
	  ○ Plain
	  ○ Telescoping
	• Compound slide
	• Tailstock offset

3. Calculate tapers	• Taper angle
	  ○ Center line
	  ○ Included
	• Taper per inch/foot
	• Taper (metric)
	• Calculate tailstock offset

4. Cut tapers	• Plan sequence of operation
	• Set-up sequence
	  ○ Angle set-up
	  ○ Mounting workpiece
	  ○ Truing workpiece
	  ○ Balancing workpiece
	  ○ Centering workpiece
	• Roughing
	  ○ Speeds and feeds
	  ○ Tools
	  ○ Depth of cut
	  ○ Measuring
	  ○ Material allowance for finishing
	• Finishing
	  ○ Speeds and feeds
	  ○ Depth of cut

LEARNING TASKS	CONTENT
	○ Deburring ○ Measuring • Measure ○ Gauge ○ Micrometer ○ Dial indicator

Achievement Criteria

Performance — Using a lathe, the learner will be able to turn tapers to specifications

Conditions — The learner will be given:

- Drawing
- Material
- Tools and equipment
- Measuring tools

Criteria — The learner will be evaluated on:

- Accuracy
- Tolerances
- Finish

Line (GAC): K USE MILLING MACHINES

Competency: K1 Describe milling machines

Objectives

To be competent in this area, the individual must be able to:

- Describe milling machines and their accessories.

LEARNING TASKS	CONTENT

1. Describe types of milling machines	• Vertical spindle
	  ○ Ram type
	  ○ Ram turret
	  ○ Gear head
	• Horizontal spindle
	  ○ Plain
	  ○ Universal
	• Planer mill
	• Bed mill
	• CNC

2. Identify the parts of the milling machine and their function	• Base • Column • Knee • Saddle • Table • Spindle nose • Quill • Backlash eliminator • Over arm support • Ram • Turret

Line (GAC): K USE MILLING MACHINES

Competency: K2 Describe cutting tools and holders

Objectives

To be competent in this area, the individual must be able to:

- Describe cutting tools and holders.

LEARNING TASKS	CONTENT

1. Describe types of cutters and holders	• Horizontal and vertical
	  ○ Face mill
	  ○ End mill
	• Arbor
	  ○ Style C
	• Holders
	  ○ Morse taper
	  ○ Collet
	  ○ End mill

Line (GAC): L USE SUPPORT MACHINES

Competency: L1 Operate and Maintain Pedestal Grinders

Objectives

To be competent in this area, the individual must be able to:

- Operate and maintain pedestal grinders.

LEARNING TASKS	CONTENT
1. Identify abrasives and their applications	• Aluminum dioxide • Silicon carbide • Cubic boron nitride (CBN) • Diamond
2. Describe the Standard Marking System	• Grit • Grade • Structure • Bond

3. Operate and maintain pedestal grinder to sharpen a drill	• Personal Protective Equipment
	• Wheel
	  ○ Selection
	  ○ Safe operating speed
	  ○ Ring test
	  ○ Mounting
	  ○ Guards
	  ○ Tool rest
	  ○ Truing and dressing
	• Maintenance
	  ○ Cleaning
	  ○ Visual inspection
	• Housekeeping

Achievement Criteria

Performance Using a pedestal grinder, the learner will be able to sharpen a drill to specifications.

Conditions The learner will be given:

- Drills
- Tools and equipment
- Measuring tools

Criteria

The learner will be evaluated on:

- Hole size produced
- Proper drill geometry

Line (GAC): L USE SUPPORT MACHINES

Competency: L2 Operate and maintain arbor and hydraulic presses

Objectives

To be competent in this area, the individual must be able to:

- Operate and maintain arbor and hydraulic presses.

LEARNING TASKS	CONTENT

1. Operate arbor presses	• Safety precautions
	  ○ Guards
	  ○ Personal protective equipment
	  ○ Housekeeping
	• Press set-up
	  ○ Work piece alignment
	• Fixturing

2. Maintain arbor presses	• Lubricate • Clean • Housekeeping

3. Operate hydraulic presses	• Safety precautions
	  ○ Guards
	  ○ Personal protective equipment
	  ○ Housekeeping
	• Press set-up
	  ○ Work piece alignment
	  ○ Fixturing
	  ○ Table
	  ○ Adjustment
	  ○ Alignment
	  ○ Securement
	  ○ Ram positioning
	• Relationship between force, pressure and area

4. Maintain hydraulic presses	• Hydraulics
	  ○ Inspection
	  ○ Fluid levels
	• Lubricate
	• Clean
	• Housekeeping

Line (GAC): L USE SUPPORT MACHINES

Competency: L3 Operate and maintain hones and lapping machines

Objectives

To be competent in this area, the individual must be able to:

- Describe hones and lapping machines.

LEARNING TASKS	CONTENT

1. Describe hones and lapping machines	• Hones
	  ○ Purpose
	  ○ Construction
	  ○ Applications
	• Lapping machines
	  ○ Purpose
	  ○ Construction
	  ○ Applications

Level 2

Machinist

Line (GAC): C USE APPLIED MATHEMATICS

Competency: C1 Solve Problems Involving Formulas

Objectives

To be competent in this area, the individual must be able to:

- Perform calculations using formulas.

LEARNING TASKS	CONTENT
1. Use formulas	• Chords • Pitch circles

Line (GAC): C USE APPLIED MATHEMATICS

Competency: C3 Solve problems involving geometry

Objectives

To be competent in this area, the individual must be able to:

- Solve geometric problems.

LEARNING TASKS	CONTENT

1. Solve geometric problems	• Point of tangency
	• Corresponding angles
	  ○ Complimentary angles
	  ○ Supplimentary angles

Line (GAC): C USE APPLIED MATHEMATICS

Competency: C5 Solve problems involving trigonometry

Objectives

To be competent in this area, the individual must be able to:

- Apply trigonometry applications.

LEARNING TASKS	CONTENT

1. Use applied trigonometry	• Layout procedures
	  ○ Chords
	  ○ Bolt-hole pattern
	• Sine bar calculations

Line (GAC): D USE MEASURING TOOLS

Competency: D3 Use calipers and gauges

Objectives

To be competent in this area, the individual must be able to:

- Use gauges.
- Describe gauge blocks and sine bars

LEARNING TASKS	CONTENT

1. Describe gauges	• Types
	  ○ Thread
	  ○ Plug
	  ○ Taper
	  ○ Snap
	  ○ Ring

2. Use gauges	• Types
	  ○ Thread
	  ○ Plug
	  ○ Taper
	  ○ Snap
	  ○ Ring

3. Describe gauge blocks	• Types • Materials • Grades
4. Describe sine bars	• Types • Sizes

Line (GAC): D USE MEASURING TOOLS

Competency: D4 Use dial indicators and digital readouts

Objectives

To be competent in this area, the individual must be able to:

- Use dial indicators and digital readouts.

LEARNING TASKS	CONTENT
1. Use dial indicators	• True workpiece ○ Milling machine • Workpiece inspection • Comparing measurements • Setting up • Measuring • Workpiece inspection • Care and maintenance

2. Describe digital readouts	• Types
	  ○ Manual
	  ○ Programmable
	• Parts
	• Uses
	  ○ Lathe
	  ○ Milling machine
	• Care and maintenance

3. Use digital readouts	• Presets • Types • Manual • Programmable • Lathe • Milling machine • Care and maintenance

Line (GAC): D USE MEASURING TOOLS

Competency: D5 Use optical measuring equipment

Objectives

To be competent in this area, the individual must be able to:

- Use optical measuring equipment.

LEARNING TASKS	CONTENT

1. Use optical comparators	• Applications
	  ○ Measuring
	  – Thread forms
	  – Profiles
	  – Angles
	  – Radii
	  – Dimensions

Line (GAC): E INTERPRET DRAWINGS AND REFERENCE MATERIALS

Competency: E4 Use Machinery's Handbook and other reference materials

Objectives

To be competent in this area, the individual must be able to:

- Identify and locate information found in the Machinery's Handbook.

LEARNING TASKS	CONTENT
1. Identify information found in the Machinery's Handbook	• Types ○ Materials
2. Locate information in the Machinery's Handbook	• Material information • Advanced thread data • Fits and tolerances • Formulas • Speeds and feeds

3. Use other reference materials	• Job plan
	  ○ Machine limitations
	• Quality Control Documentation
	  ○ Inspection sheets
	  ○ Blueprints

Line (GAC): E INTERPRET DRAWINGS AND REFERENCE MATERIALS

Competency: E5 Describe fits and tolerances

Objectives

To be competent in this area, the individual must be able to:

- Describe geometric dimensions and tolerances.

LEARNING TASKS	CONTENT

1. Describe geometric dimensions and tolerances	• Application
	  ○ Concentricity
	  ○ Roundness
	  ○ Parallelism
	  ○ Angularity
	  ○ Line and surface
	  ○ Flatness
	  ○ Perpendicularity
	  ○ Runout
	  ○ Total runout
	  ○ Datums

Line (GAC): F SELECT MATERIALS

Competency: F3 Describe characteristics of non-ferrous metals

Objectives

To be competent in this area, the individual must be able to:

- Describe the characteristics of non-ferrous metals.

LEARNING TASKS	CONTENT

1. Describe the classification of aluminum alloys	• Designations
	  ○ Alloys
	  ○ Temper
	• Physical properties
	  ○ Wear resistance
	  ○ Weight
	  ○ Flexibility
	  ○ Hardness
	  ○ Toughness
	  ○ Corrosion resistance
	  ○ Ductility
	  ○ Machinability
	  ○ Conductivity
	  ○ Thermal
	  ○ Electrical
	• Applications

2. Describe the UNS classifications of copper alloys	• Alloys
	• Physical properties
	  ○ Wear resistance
	  ○ Weight
	  ○ Flexibility
	  ○ Hardness
	  ○ Toughness
	  ○ Corrosion resistance
	  ○ Ductility
	  ○ Machinability
	  ○ Conductivity
	  ○ Thermal
	  ○ Electrical

	• Heat treatment

LEARNING TASKS	CONTENT

	• Applications
	  ○ Electrical components
	  ○ Brass
	  ○ Ornamental castings
	  ○ Bronze
	  ○ Bearings
	• Physical properties
	  ○ Wear resistance
	  ○ Weight
	  ○ Flexibility
	  ○ Hardness
	  ○ Toughness
	  ○ Corrosion resistance
	  ○ Ductility
	  ○ Machinability
	  ○ Conductivity
	  ○ Thermal
	  ○ Electrical

3. Describe the characteristics of other non-ferrous metals	• Designations
	  ○ Alloys
	  ○ Temper
	• Physical properties
	  ○ Wear resistance
	  ○ Weight
	  ○ Flexibility
	  ○ Hardness
	  ○ Toughness
	  ○ Corrosion resistance
	  ○ Ductility
	  ○ Machinability
	  ○ Conductivity
	  ○ Thermal
	  ○ Electrical
	• Heat treatment
	• Applications

Line (GAC): F SELECT MATERIALS

Competency: F4 Describe characteristics of non-metals

Objectives

To be competent in this area, the individual must be able to:

- Describe the characteristics of non-metals.

LEARNING TASKS	CONTENT

1. Describe plastics	• Types
	• Properties
	  ○ Machinability
	  ○ Thermal expansion
	  ○ Hardness
	  ○ Corrosion resistance
	  ○ Moisture absorption
	• Applications

Line (GAC): F SELECT MATERIALS

Competency: F5 Perform heat treating

Objectives

To be competent in this area, the individual must be able to:

- Describe heat treating and surface treatment.

LEARNING TASKS	CONTENT

1. Describe surface treatments	• Plating
	  ○ Chrome
	  ○ Gold
	  ○ Nickel
	  ○ Brass
	  ○ Copper
	• Anodizing
	• Bluing
	• Spray welding

2. Describe heat treating equipment	• Oxy-acetylene
	• Furnaces
	  ○ Gas
	  ○ Electric
	• Induction

3. Describe heat treating	• Case hardening • Through hardening • Normalizing • Annealing • Flame hardening • Induction hardening • Tempering ○ Colours

Line (GAC): J USE LATHES

Competency: J2 Describe cutting tools and holders

Objectives

To be competent in this area, the individual must be able to:

- Describe the use of advanced cutting tools.

LEARNING TASKS	CONTENT

1. Describe the use of advanced cutting tools	• Materials
	  ○ Coated carbide
	  ○ Cermet
	  ○ Ceramic
	  ○ CBN
	  ○ PCD
	• Indexable insert numbering system
	  ○ Shape
	  ○ Dimensions
	  ○ Geometry
	• Threading inserts
	  ○ Lay down
	  ○ Full profile
	  ○ Stand up
	  ○ General purpose
	  ○ Multi-pitch

Line (GAC): J USE LATHES

Competency: J5 Cut threads

Objectives

To be competent in this area, the individual must be able to:

- Calculate imperial threads.
- Cut and measure imperial threads.

LEARNING TASKS	CONTENT

1. Describe threads	• Types
	  ○ Standard
	  – Unified
	  – Metric
	  – Acme
	  – Pipe
	  – Whitworth
	  – API
	  ○ Non-standard
	  – Multiple start
	• Theory
	  ○ Angle
	  ○ Pitch
	  ○ Lead
	  ○ Thread form
	  ○ Lead angle
	• Measurement
	  ○ Three-wire
	  ○ Nut
	  ○ Snap gauge
	  ○ Micrometer
	  ○ Optical comparator

2. Describe methods of threading	• Internal
	  ○ Compound offset
	  ○ Compound (90 degrees)
	  ○ Graduation
	  ○ Tapping
	  ○ Metric threads
	• External
	  ○ Compound offset
	  ○ Compound (90 degrees)
	  ○ Graduation

LEARNING TASKS	CONTENT
	○ Dies ○ Tapered (NPT)
3. Calculate threads	• Pitch • Lead • Depth of thread • Angle • Pitch diameter • Minor diameter • Major diameter • Three-wire
4. Cut threads	• Inch / metric • Plan sequence of operation ○ Engagement points (chasing dial) ○ Speed, lead and depth of cut ○ Tool choice ○ Tool alignment • Set-up sequence ○ Mounting workpiece ○ Truing workpiece ○ Balancing workpiece ○ Centering workpiece • Roughing ○ Depth of cut ○ Measuring ○ Material allowance for finishing • Finishing ○ Depth of cut ○ Deburring ○ Measuring • Measuring ○ Gauge ○ Micrometer ○ Three-wire ○ Optical comparator

Achievement Criteria

Performance Using a lathe, the learner will be able to calculate, cut and measure imperial threads.

Conditions The learner will be given:

- Drawing
- Material
- Tools and equipment
- Measuring tools

Criteria The learner will be evaluated on:

- Accuracy
- Tolerances
- Finish

Line (GAC): K USE MILLING MACHINES

Competency: K1 Describe milling machines

Objectives

To be competent in this area, the individual must be able to:

- Describe milling machine accessories.
- Describe work holding devices.
- Describe milling applications.

LEARNING TASKS	CONTENT

1. Describe milling machine accessories	• Rotary table
	• Dividing head
	• Vertical milling heads
	  ○ Plain
	  ○ Universal

2. Describe work holding devices	• Clamp and hold-downs
	• Vises
	  ○ Plain
	  ○ Swivel
	  ○ Compound
	  ○ Shaft
	• Dividing heads
	  ○ Plain
	  ○ Universal
	• Rotary table
	• Sine table
	• Fixtures
	• Angle plates
	• V-blocks

3. Describe milling machine applications	• Mill
	  ○ Flat surfaces
	  ○ Shapes
	  ○ Keyways
	  ○ Slots
	  ○ Hole making
	  ○ Counter bore
	  ○ Counter sink
	  ○ Spot face
	  ○ Angles
	  ○ Radii

LEARNING TASKS	CONTENT
	○ Dovetails ○ Gears and racks ○ Helical contours ○ Gang milling ○ Straddle milling • Indexing heads • Rotary tables

Line (GAC): K USE MILLING MACHINES

Competency: K2 Describe cutting tools and holders

Objectives

To be competent in this area, the individual must be able to:

- Describe cutting tools and holders and their applications.

LEARNING TASKS	CONTENT

1. Describe types of cutters	• Horizontal and vertical
	  ○ Plain milling
	  ○ Side and face
	  ○ Stagger tooth
	  ○ Form cutters
	  ○ Face mill
	  ○ End mill
	  ○ Woodruff
	  ○ Dovetail
	  ○ Slitting
	  ○ Thread cutters

2. Describe cutter applications	• Flat surfaces
	  ○ Face milling
	  ○ Plain milling
	• Slots / Keyseat
	  ○ End milling
	  ○ Side and face cutting
	  ○ Stagger tooth cutting
	  ○ Woodruff keyseat cutting
	• Shapes
	  ○ Gear teeth cutting
	  ○ Form relief cutting
	  ○ Splines
	  ○ T-slots
	  ○ Dovetails
	  ○ Gang milling
	• Drill
	  ○ Ream
	  ○ Bore
	  ○ Counter bore
	  ○ Counter sink
	  ○ Spot face

LEARNING TASKS	CONTENT

3. Describe tool holding devices	• Arbours
	  ○ Styles A, B and C
	• Holders
	  ○ Morse taper
	  ○ Collet
	  ○ End mill
	• Boring heads
	  ○ Plain
	  ○ Facing

Line (GAC): K USE MILLING MACHINES

Competency: K3 Use dividing heads and rotary tables

Objectives

To be competent in this area, the individual must be able to:

- Use dividing heads and rotary tables.

LEARNING TASKS	CONTENT

1. Describe dividing heads	• Construction
	  ○ Hole plates
	  ○ Chuck
	  ○ Centre
	  ○ Foot stock
	  ○ Head/gear ratio
	• Applications
	  ○ Milling
	  – Hexagons
	  – Keyways
	• Indexing
	  ○ Direct
	  ○ Simple
	  ○ Angular
	  ○ Differential
	• Universal dividing heads

2. Use dividing heads	• Plan sequence of operation
	• Angular alignment
	• Linear alignment
	• Determine indexing
	  ○ Direct
	  ○ Simple
	  ○ Angular
	• Calculate number of rotations and divisions
	• Select circle on hole plate
	• Set sector arms

LEARNING TASKS	CONTENT

3. Describe rotary tables	• Construction
	  ○ Hole plates
	  ○ Chuck
	  ○ Head/gear ratio
	  ○ Angular increments
	• Indexing
	  ○ Direct
	  ○ Simple
	  ○ Angular
	• Applications
	  ○ Milling
	  – Contours
	  – Drilling hole patterns
	  – Radii

4. Use rotary tables	• Plan sequence of operation
	• Workpiece alignment
	• Milling spindle alignment
	• Cutter offset
	• Fixtures
	• Determine indexing
	  ○ Direct
	  ○ Simple
	  ○ Angular
	• Calculate number of rotations and divisions
	• Select circle on hole plate
	• Set sector arms

Achievement Criteria

Performance — Using a milling machine and dividing head, the learner will be able to calculate, cut and produce a hexagon.

Conditions — The learner will be given:

- Drawing
- Material
- Tools and equipment
- Measuring tools

Criteria — The learner will be evaluated on:

- Accuracy
- Tolerances
- Finish

Line (GAC): K USE MILLING MACHINES

Competency: K4 Operate and maintain milling machines

Objectives

To be competent in this area, the individual must be able to:

- Operate and maintain milling machines.

LEARNING TASKS	CONTENT
1. Calculate speeds (RPM) and feeds	• Surface speed • Diameter of cutter • Chip load
2. Determine depth of cut	• Rigidity • Horsepower • Tooling

3. Select work holding device and secure the work	• Work holding devices
	  ○ Clamp and hold-downs
	  ○ Vises
	  ○ Dividing heads
	  ○ Rotary table
	  ○ Sine table
	  ○ Fixtures
	  ○ Angle plates
	  ○ V-blocks

4. Install and remove tooling	• Application
	  ○ Cutter
	  ○ Holder

LEARNING TASKS	CONTENT

5. Operate milling machines	• Plan sequence of operation
	• Align machine
	  ○ Spindle alignment
	  ○ Table alignment
	  ○ Accessory alignment
	• Set-up sequence
	  ○ Mounting workpiece
	  ○ Aligning workpiece
	• Climb verses conventional
	• Roughing
	  ○ Speeds and feeds
	  ○ Cutters
	  ○ Depth of cut
	  ○ Measuring
	  ○ Material allowance for finishing
	• Finishing
	  ○ Speeds and feeds
	  ○ Cutters
	  ○ Depth of cut
	  ○ Debur
	  ○ Chamfer
	  ○ Measuring

6. Quality control for component	• First article inspection
	• Verify
	  ○ Material
	  ○ Drawing
	  – Revision
	  ○ Traceability
	• Dimensional conformance
	• Measuring tools calibrated

7. Maintain milling machines	• Lubricate • Clean • Housekeeping • Coolant / cutting fluid

LEARNING TASKS	CONTENT
8. Describe the purpose and usage of cutting fluids with milling machines	• Lubrication • Cooling • Chip removal • Tool life

9. Select types of cutting fluids for specific applications	• Types
	  ○ Straight oils
	  ○ Soluble oils
	  ○ Semi-synthetic
	  ○ Synthetic

Achievement Criteria

Performance — Using a milling machine, the learner will be able to machine a block square and bore a hole to specifications.

Conditions — The learner will be given:

- Drawing
- Material
- Tools and equipment
- Measuring tools

Criteria — The learner will be evaluated on:

- Accuracy
- Tolerances
- Finish

Line (GAC): L USE SUPPORT MACHINES

Competency: L3 Operate and maintain hones and lapping machines

Objectives

To be competent in this area, the individual must be able to:

- Operate and maintain hones.
- Describe lapping.

LEARNING TASKS	CONTENT

1. Operate and maintain hones	• Safety precautions
	  ○ Guards
	  ○ Personal protective equipment
	  ○ Housekeeping
	• Positioning tool
	• Securing workpieces
	• Speeds and feeds
	• Cleaning
	• Lubrication

2. Describe lapping	• Lapping compounds • Charging • Cleaning

Achievement Criteria

Performance — Using a honing machine, the learner will be able to hone a bore to specifications.

Conditions — The learner will be given:

- Drawing
- Material
- Tools and equipment
- Measuring tools

Criteria — The learner will be evaluated on:

- Accuracy
- Tolerances
- Finish

Line (GAC): M USE PRECISION GRINDERS

Competency: M1 Describe types of precision grinders

Objectives

To be competent in this area, the individual must be able to:

- Describe types of precision surface grinders and their applications.
- Describe tool and cutter grinders.

LEARNING TASKS	CONTENT

1. Describe precision grinders	• Surface
	  ○ Horizontal spindle
	  – Purpose
	  – Construction
	  – Operation
	  ○ Vertical spindle
	  – Purpose
	  – Construction
	  – Operation
	• Tool and cutter
	  ○ Purpose
	  ○ Construction
	  ○ Operation

Line (GAC): M USE PRECISION GRINDERS

Competency: M2 Select abrasives

Objectives

To be competent in this area, the individual must be able to:

- Select abrasives and applications.
- Describe the Standard Marking System.

LEARNING TASKS	CONTENT
1. Identify abrasives and applications	• Aluminum oxide • Silicon carbide • Cubic boron nitride (CBN) • Diamond

2. Describe the Standard Marking System	• Grit
	• Grade
	• Structure
	• Bond
	• Thickness
	  ○ Diamond
	  ○ CBN

3. Select abrasives for applications	• Workpiece material
	  ○ Hardness
	  ○ Toughness
	  ○ Grindability
	• Surface finish requirements
	• Abrasive characteristics
	  ○ Friability
	• Machine type
	• Area of contact
	• Shape

Line (GAC): M USE PRECISION GRINDERS

Competency: M3 Operate and maintain grinders

Objectives

To be competent in this area, the individual must be able to:

- Operate and maintain surface grinders.

LEARNING TASKS	CONTENT
1. Mount grinding wheel	• Ring test • Balance / truing • Mounting • Guard

2. Operate and maintain surface grinders	• Workpiece material
	  ○ Type
	  ○ Size
	• Calculate work speeds and feeds
	• Rigidity
	• Workholding devices
	  ○ Magnetic chuck
	  ○ Fixture
	  ○ Vise
	• Set-up sequence
	• Roughing and finishing
	  ○ Dressing
	  ○ Depth of cut
	  ○ Step over
	• Maintenance
	  ○ Cleaning
	  ○ Lubricating
	  ○ Housekeeping

3. Quality control for component	• First article inspection
	• Verify
	  ○ Material
	  ○ Drawing
	  – Revision
	  ○ Traceability
	• Dimensional conformance
	• Measuring tools calibrated

Achievement Criteria

Performance	Using a surface grinder, the learner will be able to grind a block square to specifications.
Conditions	The learner will be given: • Drawing • Material • Tools and equipment • Measuring tools
Criteria	The learner will be evaluated on: • Accuracy • Tolerances • Finish

Line (GAC): N USE CNC MACHINES

Competency: N1 Describe computer numerical control (CNC) turning centres

Objectives

To be competent in this area, the individual must be able to:

- Describe CNC turning centres.

LEARNING TASKS	CONTENT

1. Describe CNC turning centres	• Components
	  ○ Controller
	  ○ Tool changer / turret
	  ○ Chuck / collet
	  ○ Spindle
	• Principles of operation
	  ○ Computer control
	  ○ Axis
	• Applications
	  ○ Turning
	  ○ Drilling
	  ○ Boring
	  ○ Facing
	  ○ Tapers
	  ○ Knurling
	  ○ Grooving
	  ○ Parting
	  ○ Threading
	  – Internal
	  – External
	  ○ Contours

Line (GAC): N USE CNC MACHINES

Competency: N2 Establish co-ordinate systems and apply programming codes for turning centres

Objectives

To be competent in this area, the individual must be able to:

- Create a manual input program.

LEARNING TASKS	CONTENT

1. Describe co-ordinate systems	• Types
	  ○ Rectangular
	  ○ Polar
	• Machine co-ordinates
	• Work co-ordinates
	• Positioning
	  ○ Absolute
	  ○ Incremental

2. Describe programming codes	• Absolute
	• Incremental
	• Codes
	  ○ G & M
	  ○ Circular interpolation
	  ○ Linear interpolation
	  ○ Tool nose radius compensation
	• Auxillary addresses
	• Alarms
	• Canned cycles
	  ○ Rough and finish
	  – Turning
	  – Facing
	  ○ Threading
	  ○ Grooving
	  ○ Drilling

3. Describe program writing procedures	• Program format
	  ○ Sequence of commands
	  ○ Order of information

4. Plan a sequence of operation	• Workpiece drawing interpretation • Material selection • Machining order of operations

LEARNING TASKS	CONTENT
	• Tooling • Define datum • Entry and exit points

5. Create manual input program	• Calculate
	  ○ Program points
	  ○ Speeds and feeds
	• Safety blocks
	• Programming code use
	• Format structure
	• Interpret and review

Achievement Criteria

Performance — The learner will be able to manually create a program.

Conditions — The learner will be given:
- Drawing
- Simulator (preferred)

Criteria — The learner will be evaluated on:
- Structure
- Accuracy
- Syntax

Line (GAC): N USE CNC MACHINES

Competency: N3 Operate and maintain CNC turning centre

Objectives

To be competent in this area, the individual must be able to:

- Program, operate and maintain CNC turning centre.

LEARNING TASKS	CONTENT

1. Start-up CNC turning centre	• Start-up procedures
	  ○ Power on
	  ○ Home axis
	  ○ Warm up

2. Set-up tooling	• Tooling
	  ○ Selection
	  ○ Installation
	• Offsets

3. Set-up the workpiece	• Hydraulic chucks / collet ○ Clamping pressure • Secure work • Offsets
4. Verify the program	• Graphics simulation • Dry run

LEARNING TASKS	CONTENT

5. Operate CNC turning centre	• Rapid override
	• Optional stop on
	• Single block
	• Monitor machining processes
	  ○ Machine alarms and codes
	  ○ Signs of tool wear (vibration, noise)
	  ○ Overrides (rapid, speed and feed)
	  ○ Chip control problems
	  ○ Cutting fluid delivery
	• Cycle interruption
	  ○ Stop procedures
	  ○ Corrective actions
	  ○ Cycle restart
	• Adjust offset parameters
	  ○ Length
	  ○ Diameter
	  ○ Tool nose radius
	• Program restart

6. Quality control for component	• First article inspection
	• Verify
	  ○ Material
	  ○ Drawing
	  – Revision
	  ○ Traceability
	• Dimensional conformance
	  ○ Measuring tools calibrated

Achievement Criteria

Performance	The learner will be able to set up and operate a CNC turning centre to produce a part to specifications.
Conditions	The learner will be given: • Material • Tools and equipment • Drawing
Criteria	The learner will be evaluated on: • Set up • Safety procedures followed • Accuracy • Tolerances • Finish

Level 3

Machinist

Line (GAC): C USE APPLIED MATHEMATICS

Competency: C1 Solve problems involving formulas

Objectives

To be competent in this area, the individual must be able to:

- Calculate ratios.

LEARNING TASKS	CONTENT

1. Apply ratios	• Pulley
	• Gear
	• Mechanical advantage
	  ○ Levers
	  ○ Incline plane
	  ○ Screws

Line (GAC): C USE APPLIED MATHEMATICS

Competency: C5 Solve problems involving trigonometry

Objectives

To be competent in this area, the individual must be able to:

- Apply trigonometry applications.

LEARNING TASKS	CONTENT

1. Use applied trigonometry	• Measurements
	  ○ Internal/external taper
	  ○ Pin in V
	  ○ Dovetails

Line (GAC): D USE MEASURING TOOLS

Competency: D3 Use calipers and gauges

Objectives

To be competent in this area, the individual must be able to:

- Use gauge blocks.

LEARNING TASKS	CONTENT
1. Use gauge blocks	• Care and cleaning • Calculate combinations • Wear blocks • Wringing • Sine bar

Line (GAC): D USE MEASURING TOOLS

Competency: D4 Use dial indicators and digital readouts

Objectives

To be competent in this area, the individual must be able to:

- Use dial indicators and digital readouts.

LEARNING TASKS	CONTENT
1. Use dial indicators	• True workpiece ○ Grinders • Workpiece inspection • Comparing measurements • Setting up • Measuring • Workpiece inspection • Care and maintenance

2. Use digital readouts	• Presets
	• Types
	  ○ Manual
	  ○ Programmable
	• Uses
	  ○ Grinders
	  – Surface
	  – Cylindrical
	• Care and maintenance

Line (GAC): E INTERPRET DRAWINGS AND REFERENCE MATERIALS

Competency: E4 Use Machinery's Handbook and other reference materials

Objectives

To be competent in this area, the individual must be able to:

- Identify and locate information in the Machinery's Handbook.

LEARNING TASKS	CONTENT

1. Identify information found in the Machinery's Handbook	• Types
	  ○ Heat treatment
	  ○ Helical milling

2. Locate information in the Machinery's Handbook	• Formulas • Speeds and feeds • Heat treatment

3. Use other reference materials	• Job plan
	• Quality control documentation
	  ○ Inspection sheets
	  ○ Blueprints

Line (GAC): F SELECT MATERIALS

Competency: F5 Perform heat treating

Objectives

To be competent in this area, the individual must be able to:

- Perform heat treating and oxy-acetylene processes.

LEARNING TASKS	CONTENT
1. Perform heat treating processes	• Normalizing • Annealing • Flame hardening • Induction hardening • Tempering

2. Perform oxy-acetylene processes	• Safety
	• System set-up
	• Torch operation
	  ○ Heating
	  ○ Heat treating

Achievement Criteria

Performance — The learner will be able to harden and temper a workpiece to specifications.

Conditions — The learner will be given:

- Specifications
- Tools and equipment
- Workpiece

Criteria — The learner will be evaluated on:

- Rockwell hardness

Line (GAC): F SELECT MATERIALS

Competency: F6 Perform materials testing

Objectives

To be competent in this area, the individual must be able to:

- Describe the physical properties and characteristics of steel.
- Perform hardness testing.

LEARNING TASKS	CONTENT
1. Describe the physical properties and characteristics of steel	• Hardness • Tensile strength • Shear strength
2. Describe destructive testing methods	• Hardness • Tensile • Impact
3. Describe non-destructive testing	• Dye penetrant tests • Magnetic particle inpection • Ultrasound • X-ray
4. Perform hardness tests	• Rockwell

Achievement Criteria

Performance — Using a Rockwell hardness tester, the learner will be able to measure the hardness of a heat-treated workpiece.

Conditions — The learner will be given:

- Tools and equipment
- Workpiece

Criteria — The learner will be evaluated on:

- Correct use of equipment

Line (GAC): G REFURBISH COMPONENTS

Competency: G3 Describe bearings, seals and bearing materials

Objectives

To be competent in this area, the individual must be able to:

- Describe bearings, seals and bearing materials.

LEARNING TASKS	CONTENT

1. Describe bearings	• Types of bearings
	  ○ Friction
	  ○ Anti-friction
	• Principles of operation
	  ○ Sliding
	  ○ Rolling
	• Types of loads
	  ○ Radial
	  ○ Thrust
	  ○ Combination

2. Describe friction bearings	• Types
	  ○ Bushing
	  ○ Sleeve
	  ○ Split
	• Housing styles
	  ○ Flange
	  ○ Pillow block

3. Describe friction bearing materials	• Types • Applications

4. Describe anti-friction bearings	• Construction
	  ○ Rolling elements
	  – Ball
	  – Roller
	  – Spherical
	  – Cylindrical
	  – Tapered roller
	• Bearing codes

5. Describe types of seals	• Types • Applications

Line (GAC): J USE LATHES

Competency: J5 Cut threads

Objectives

To be competent in this area, the individual must be able to:

- Use gear ratio applications on lathes.

LEARNING TASKS	CONTENT
1. Describe advanced thread cutting	• Introduction to Acme • Stub Acme • Square thread • Modified square thread • Tapered (NPT)
2. Use gear ratio applications on lathes	• Change back gears for feeds and threads • Calculate gear ratios

Achievement Criteria

Performance — Using a lathe, the learner will be able to calculate, cut and measure metric threads.

Conditions — The learner will be given:

- Drawing
- Material
- Tools and equipment
- Measuring tools

Criteria — The learner will be evaluated on:

- Accuracy
- Tolerances
- Finish

Line (GAC): J USE LATHES

Competency: J6 Describe vertical lathes

Objectives

To be competent in this area, the individual must be able to:

- Describe vertical lathes.

LEARNING TASKS	CONTENT

1. Describe vertical lathes	• Types
	  ○ Mill
	  ○ Turret lathe
	• Components
	  ○ Mill
	  – Chuck / table
	  – Ram
	  – Bridge
	  – Column
	  – Cross rail
	  ○ Turret lathe
	  – Chuck / table
	  – Ram slide
	  – Bridge
	  – Column rail
	  – Turret
	• Accessories
	  ○ Jaws
	  ○ Clamps
	• Operations
	  ○ Boring
	  ○ Turning
	  ○ Taper
	  ○ Facing
	  ○ Drilling

Line (GAC): K USE MILLING MACHINES

Competency: K3 Use dividing heads and rotary tables

Objectives

To be competent in this area, the individual must be able to:

- Apply advanced applications using a dividing head.

LEARNING TASKS	CONTENT

1. Describe the advanced use of dividing heads	• Applications
	  ○ Milling
	  – Splines / serrations
	  – Helical milling

2. Apply advanced applications for using a dividing head	• Mill
	  ○ Splines / serrations
	  ○ Helical milling

Achievement Criteria

Performance: Using a milling machine and dividing head, the learner will be able to calculate, cut and measure splines and a helical groove.

Conditions: The learner will be given:

- Drawing
- Material
- Tools and equipment
- Measuring tools

Criteria: The learner will be evaluated on:

- Accuracy
- Tolerances
- Finish

Line (GAC): K USE MILLING MACHINES

Competency: K4 Operate and maintain milling machines

Objectives

To be competent in this area, the individual must be able to:

- Operate milling machines.

LEARNING TASKS	CONTENT

1. Operate milling machines	• Plan sequence of operation
	• Operations
	  ○ Mill
	  – Radii
	  – Dovetails
	  – Helical contours
	  – Splines / serrations

Achievement Criteria

Performance: Using a milling machine, the learner will be able to machine radii and dovetails.

Conditions: The learner will be given:

- Drawing
- Material
- Tools and equipment
- Measuring tools

Criteria: The learner will be evaluated on:

- Accuracy
- Tolerances
- Finish

Line (GAC): K USE MILLING MACHINES

Competency: K5 Describe boring mills

Objectives

To be competent in this area, the individual must be able to:

- Describe horizontal boring mills.

LEARNING TASKS	CONTENT

1. Describe horizontal boring mills	• Types
	  ○ Table
	  ○ Saddle
	  ○ Planer
	• Components
	  ○ Bed
	  ○ Saddle
	  ○ Table
	  – Fixed
	  – Rotary
	  ○ Columns
	  ○ Tool heads
	  ○ Facing slides
	  ○ Spindles
	  ○ Outboard support
	• Accessories
	  ○ Boring heads
	  ○ Star wheel feed attachment
	  ○ Measuring devices
	  ○ Optics
	  ○ Digital readouts
	  ○ Line boring attachment
	• Operations
	  ○ Drilling
	  ○ Boring
	  ○ Line boring
	  ○ Facing
	  ○ Milling
	  ○ Threading
	• Layout of castings
	• Layout of fabrication
	• Work holding devices

Line (GAC): M USE PRECISION GRINDERS

Competency: M1 Describe types of precision grinders

Objectives

To be competent in this area, the individual must be able to:

- Describe precision grinders and their applications.

LEARNING TASKS	CONTENT

1. Describe grinders	• Centreless
	  ○ Purpose
	  ○ Construction
	  ○ Operation
	• Cylindrical
	  ○ Internal
	  – Purpose
	  – Construction
	  – Operation
	  ○ External
	  – Purpose
	  – Construction
	  – Operation

Line (GAC): M USE PRECISION GRINDERS

Competency: M3 Operate and maintain grinders

Objectives

To be competent in this area, the individual must be able to:

- Operate and maintain cylindrical grinders.

LEARNING TASKS	CONTENT

1. Operate and maintain cylindrical grinders	• Workpiece material
	  ○ Type
	  ○ Size
	• Calculate work speeds and feeds
	• Wheel
	  ○ Selection
	  ○ Balancing
	  ○ Truing and dressing
	• Rigidity
	• Work holding devices
	  ○ Chucks, faceplates, collets
	  ○ Between centres
	  – Drive dog
	  ○ Steady rest/follower rest
	• Set-up sequence
	  ○ Mounting workpiece
	  ○ Truing workpiece
	• Roughing and finishing
	  ○ Dressing
	  ○ Depth of cut
	  ○ Traverse speed
	• Maintenance
	  ○ Cleaning
	  ○ Lubricating
	  ○ Housekeeping

Achievement Criteria

Performance	Using a cylindrical grinder, the learner will be able to grind an external cylindrical feature to specifications.
Conditions	The learner will be given:

- Drawing
- Material
- Tools and equipment
- Measuring tools

Criteria The learner will be evaluated on:

- Accuracy
- Tolerances
- Finish

Line (GAC): N USE CNC MACHINES

Competency: N4 Describe computer numerical control (CNC) machining centres

Objectives

To be competent in this area, the individual must be able to:

- Describe CNC machining centres.

LEARNING TASKS	CONTENT

1. Describe CNC machining centres	• Components
	  ○ Controller
	  ○ Tool changer
	  ○ Table
	  ○ Spindle
	• Principles of operation
	  ○ Computer control
	  ○ Axis
	• Applications
	  ○ Facing
	  ○ Drilling
	  ○ Boring
	  ○ Tapping
	  ○ Profiling
	  ○ Engraving

Line (GAC): N USE CNC MACHINES

Competency: N5 Establish co-ordinate systems and apply programming codes for machining centres

Objectives

To be competent in this area, the individual must be able to:

- Create a manual input program.

LEARNING TASKS	CONTENT

1. Describe co-ordinate systems	• Types
	  ○ Rectangular
	  ○ Polar
	• Machine co-ordinates
	• Work co-ordinates
	• Positioning
	  ○ Absolute
	  ○ Incremental

2. Describe programming codes	• Absolute
	• Incremental
	• Codes
	  ○ G & M
	  ○ Circular interpolation
	  ○ Linear interpolation
	  ○ Cutter radius compensation
	• Auxillary addresses
	• Alarms
	• Canned cycles
	  ○ Drilling
	  ○ Tapping
	  ○ Boring

3. Describe program writing procedures	• Program format
	  ○ Sequence of commands
	  ○ Order of information

4. Plan a sequence of operation	• Workpiece drawing interpretation • Material selection • Machining order of operations • Tooling • Define datum • Entry and exit points

LEARNING TASKS	CONTENT

5. Create manual input program	• Calculate
	  ○ Program points
	  ○ Speeds and feeds
	• Safety blocks
	• Programming code use
	• Format structure
	• Interpret and review

Achievement Criteria

Performance — The learner will be able to manually create a program.

Conditions — The learner will be given:
- Drawing
- Simulator (preferred)

Criteria — The learner will be evaluated on:
- Structure
- Accuracy
- Syntax

Line (GAC): N USE CNC MACHINES

Competency: N6 Operate and maintain CNC machining centres

Objectives

To be competent in this area, the individual must be able to:

- Program, operate and maintain a CNC machining centre.

LEARNING TASKS	CONTENT

1. Start-up CNC machining centre	• Start-up procedures
	  ○ Power on
	  ○ Home axis
	  ○ Warm up

2. Set-up tooling	• Tooling
	  ○ Selection
	  ○ Installation
	• Offsets

3. Set-up the workpiece	• Vises • Tombstones • Fixtures • Secure work • Offsets
4. Verify the program	• Graphics simulation • Dry run

LEARNING TASKS	CONTENT

5. Operate CNC machining centre	• Rapid override
	• Optional stop on
	• Single block
	• Monitor machining processes
	  ○ Machine alarms and codes
	  ○ Signs of tool wear (vibration, noise)
	  ○ Overrides (rapid, speed and feed)
	  ○ Chip control problems
	  ○ Cutting fluid delivery
	• Cycle interruption
	  ○ Stop procedures
	  ○ Corrective actions
	  ○ Cycle restart
	• Adjust work offset parameters
	• Adjust tool offset parameters
	  ○ Length
	  ○ Radius (diameter)
	• Program restart

6. Quality control for component	• First article inspection
	• Verify
	  ○ Material
	  ○ Drawing
	  – Revision
	  ○ Traceability
	• Dimensional conformance
	• Measuring tools calibrated

Achievement Criteria

Performance — The learner will be able to set up and operate a CNC machining centre to produce a part to specifications.

Conditions — The learner will be given:
- Material
- Tools and equipment
- Drawing

Criteria — The learner will be evaluated on:
- Set up
- Safety procedures followed
- Accuracy
- Tolerances
- Finish

Line (GAC): N USE CNC MACHINES

Competency: N7 Create 2D and 3D Models

Objectives

To be competent in this area, the individual must be able to:

- Describe 2D and 3D models.

LEARNING TASKS	CONTENT
1. Describe 2D and 3D models	• CAD software • Complex shapes

Line (GAC): N USE CNC MACHINES

Competency: N8 Program using CAM

Objectives

To be competent in this area, the individual must be able to:

- Describe CAM.

LEARNING TASKS	CONTENT
1. Describe CAM	• CAM software • Generating code

Level 4

Machinist

Line (GAC): A PERFORM SAFETY RELATED TASKS

Competency A3 Apply safety practices for shop areas

Objectives

To be competent in this area, the individual must be able to:

- Describe mentoring techniques.

LEARNING TASKS	CONTENT

1. Describe characteristics of being a journeyperson / mentor	• Listening skills
	• Supportive
	• Guidance
	  ○ Positive reinforcement
	  ○ Discipline / constructive criticism
	• Patience
	• Leadership
	• Share
	  ○ Experiences
	  ○ Knowledge
	• Pride in trade

Line (GAC): E INTERPRET DRAWINGS AND REFERENCE MATERIALS

Competency: E4 Use Machinery's Handbook and other reference materials

Objectives

To be competent in this area, the individual must be able to:

- Locate information in the Machinery's Handbook and other reference materials.

LEARNING TASKS	CONTENT
1. Locate information in the Machinery's Handbook	• Formulas • Splines • Cams • Gears

2. Use other reference materials	• Job plan
	  ○ Machine limitations
	• Quality Control Documentation
	  ○ Inspection sheets
	  ○ Blueprints

Line (GAC): L USE SUPPORT MACHINES

Competency: L4 Operate and maintain gear cutting machines

Objectives

To be competent in this area, the individual must be able to:

- Operate and maintain gear cutting machines.

LEARNING TASKS	CONTENT

1. Describe gear cutting machines	• Types
	  ○ Gear hobbing
	  ○ Gear shaper
	• Purpose
	• Construction
	• Applications

2. Operate and maintain gear cutting machines	• Safety precautions
	  ○ Guards
	  ○ Personal protective equipment
	  ○ Housekeeping
	• Positioning and securing workpiece
	• Coolant
	• Cutters
	• Cleaning
	• Lubrication

Achievement Criteria

Performance — The learner will be able to set up and operate a gear cutting machine to produce a part to specifications.

Conditions — The learner will be given:

- Material
- Tools and equipment
- Drawing

Criteria — The learner will be evaluated on:

- Accuracy
- Tolerances
- Finish

Line (GAC): L USE SUPPORT MACHINES

Competency: L5 Operate and maintain electrical discharge machines

Objectives

To be competent in this area, the individual must be able to:

- Operate and maintain electric discharge machines.

LEARNING TASKS	CONTENT

1. Describe electrical discharge machines	• Types
	  ○ Ram
	  ○ Wire
	• Purpose
	• Construction
	• Applications

2. Operate and maintain electrical discharge machines	• Safety precautions
	  ○ Personal protective equipment
	  ○ Housekeeping
	• Positioning and securing workpiece
	• Mounting and aligning electrode
	• Surface finish
	• Spark gap
	• Electrode size
	• Control setting
	• Flushing
	• Cleaning

Line (GAC): N USE CNC MACHINES

Competency: N7 Create 2D and 3D models

Objectives

To be competent in this area, the individual must be able to:

- Create 2D and 3D models

LEARNING TASKS	CONTENT
1. Describe interface	• Menus • Toolbars
2. Establish co-ordinate system	• Planes • Datum
3. Create geometry	• Points • Lines • Circles • Arcs
4. Edit geometry	• Trim • Extend • Delete • Copy
5. Geometry dimensioning	• Inch / metric
6. Create solid	• Extrude • Revolve
7. Save file	• Formats

Achievement Criteria

Performance The learner will be able to create a 2D and a 3D model using software.

Conditions The learner will be given:

- Drawing

Criteria The learner will be evaluated on:

- Completion in time allotted
- Accuracy

Line (GAC): N USE CNC MACHINES

Competency: N8 Program using CAM

Objectives

To be competent in this area, the individual must be able to:

- Generate a tool paths using CAM software.

LEARNING TASKS	CONTENT
1. Describe interface	• Menus • Toolbars
2. Import geometry	• Edit • Establish origin
3. Select machine	• Lathe • Mill
4. Plan sequence of operations	• Machining sequence
5. Determine tooling	• Select • Define
6. Select machining operations	• According to planned sequence

7. Create tool path	• Select
	  ○ Geometry
	  ○ Tool
	  ○ Parameters

8. Verify program	• Backplot • Verify • Render
9. Create G-code	• Post-processor selection • Code verification
10. Save program	• Format

Achievement Criteria

Performance The learner will be able to create tool paths and generate a G-code program using software.

Conditions The learner will be given:

- Drawing

Criteria The learner will be evaluated on:

- Completion in time allotted
- Accuracy
- Functional program using a simulator

Section 4

ASSESSMENT GUIDELINES

Assessment Guidelines – Level 1

Assessment Guidelines are the percentage weight of theory and practical assessment in technical training

Level 1 Grading Sheet: Subject Competency and Weightings

PROGRAM: IN-SCHOOL TRAINING:	MACHINIST LEVEL 1		
LINE	**SUBJECT COMPETENCIES**	**THEORY WEIGHTING**	**PRACTICAL WEIGHTING**
A	PERFORM SAFETY RELATED TASKS	15%	0%
B	PERFORM HAND PROCESSES	10%	20%
C	USE APPLIED MATHEMATICS	10%	0%
D	USE MEASURING TOOLS	10%	0%
E	INTERPRET DRAWINGS AND REFERENCE MATERIALS	8%	20%
F	SELECT MATERIALS	8%	0%
G	REFURBISH COMPONENTS	5%	0%
H	USE DRILLING MACHINES	8%	20%
I	USE POWER SAWS	6%	0%
J	USE LATHES	10%	30%
K	USE MILLING MACHINES	2%	0%
L	USE SUPPORT MACHINES	8%	10%
	Total	**100%**	**100%**
In-school theory / practical subject competency weighting		60%	40%
Final in-school mark		IN-SCHOOL %	

In-school Mark Combined theory and practical subject competency multiplied by	80%
Standard Level Exam (SLE) Mark The exam score is multiplied by	20%
Final Level Mark	**FINAL%**

Assessment Guidelines – Level 2

Level 2 Grading Sheet: Subject Competency and Weightings

PROGRAM: IN-SCHOOL TRAINING:	MACHINIST LEVEL 2		
LINE	**SUBJECT COMPETENCIES**	**THEORY WEIGHTING**	**PRACTICAL WEIGHTING**
C	USE APPLIED MATHEMATICS	11%	0%
D	USE MEASURING TOOLS	5%	0%
E	INTERPRET DRAWINGS AND REFERENCE MATERIALS	5%	0%
F	SELECT MATERIALS	10%	0%
J	USE LATHES	15%	20%
K	USE MILLING MACHINES	15%	20%
L	USE SUPPORT MACHINES	4%	15%
M	USE PRECISION GRINDERS	10%	20%
N	USE CNC MACHINES	25%	25%
	Total	**100%**	**100%**
In-school theory / practical subject competency weighting		60%	40%
Final in-school mark		IN-SCHOOL %	

In-school Mark Combined theory and practical subject competency multiplied by	80%
Standard Level Exam (SLE) Mark The exam score is multiplied by	20%
Final Level Mark	**FINAL%**

Assessment Guidelines – Level 3

Level 3 Grading Sheet: Subject Competency and Weightings

PROGRAM: IN-SCHOOL TRAINING:	MACHINIST LEVEL 3		
LINE	**SUBJECT COMPETENCIES**	**THEORY WEIGHTING**	**PRACTICAL WEIGHTING**
C	USE APPLIED MATHEMATICS	7%	0%
D	USE MEASURING TOOLS	5%	0%
E	INTERPRET DRAWINGS AND REFERENCE MATERIALS	5%	0%
F	SELECT MATERIALS	5%	10%
G	REFURBISH COMPONENTS	3%	0%
J	USE LATHES	10%	10%
K	USE MILLING MACHINES	20%	25%
M	USE PRECISION GRINDERS	15%	15%
N	USE CNC MACHINES	30%	40%
	Total	**100%**	**100%**
In-school theory / practical subject competency weighting		60%	40%
Final in-school mark		IN-SCHOOL %	

In-school Mark Combined theory and practical subject competency multiplied by	80%
Standard Level Exam (SLE) Mark The exam score is multiplied by	20%
Final Level Mark	**FINAL%**

Assessment Guidelines – Level 4

Level 4 Grading Sheet: Subject Competency and Weightings

PROGRAM: IN-SCHOOL TRAINING:	MACHINIST LEVEL 4 / FINAL LEVEL		
LINE	**SUBJECT COMPETENCIES**	**THEORY WEIGHTING**	**PRACTICAL WEIGHTING**
A	PERFORM SAFETY RELATED TASKS	5%	0%
E	INTERPRET DRAWINGS AND REFERENCE MATERIALS	20%	0%
L	USE SUPPORT MACHINES	25%	40%
N	USE CNC MACHINES	50%	60%
	Total	**100%**	**100%**
In-school theory / practical subject competency weighting		60%	40%

Final in-school Mark Apprentices must achieve a minimum 70% as the final in-school percentage score to be eligible to write the Interprovincial Red Seal or SkilledTradesBC CofQ exam.	IN-SCHOOL %

All apprentices who complete Level 4 of the Machinist program with a FINAL level percentage score of 70% or greater will write the Interprovincial Red Seal examination as their final assessment.

SkilledTradesBC will enter the apprentices' Machinist Interprovincial Red Seal examination percentage score in SkilledTradesBC Portal.

A minimum percentage score of 70% on the examination is required for a pass.

Section 5

TRAINING PROVIDER STANDARDS

Facility Requirements

Classroom Area

- 900 sq. ft. for a class size of 12 - 16 students, with moveable tables and chairs
- Instructional media to include multimedia projector, projection screen, DVD player, and whiteboard

Shop Area

- 175 sq. ft. per student
- Well heated and ventilated
- 22 ft. high ceilings
- Lighting appropriate to detailed work
- 200 sq. ft. clean-up / waste area

Lab Requirements

- See Shop Area

Student Facilities

- 20 sq. ft. per student for tools storage (indoors)
- Student locker and changeroom facilities

Instructor's Office Space

- 150 sq. ft. per instructor, with a desk, chairs and materials storage / filing system

Other

- 200 sq. ft. raw materials storage (may be outdoors)

Tools and Equipment

Shop Equipment

Required

- Band saw (horizontal and vertical)
- Computer numeric control (CNC) simulator
- Drilling machines
- Grinders (cylindrical, surface, pedestal)
- Hydraulic press
- Indexing heads
- Lathe (engine, CNC)
- Milling machines (vertical, horizontal Milling centres, CNC)

Recommended

- Hobbing machine
- Key seater
- Abrasive cut-off saw
- Boring machines (horizontal and vertical)
- Electrical discharge machine (EDM)
- Grinders (tool and cutter, tool post profile)
- Milling machines (universal)

Shop (Facility) Tools

Standard Tools

- Abrasive cut off wheels
- Air grinder
- Air-driven hand tools
- Boring bars
- Boring heads
- Broaches
- Carbides (brazed, inserts, solid)
- Changeable pilot counterbores
- Circular saw
- Dies
- Disc grinder
- Drills (centre, spade, twist drill, oil hole, straight, fluid gun drills, hard steel drill, anular cutters, step drill, saw type hole cutter)
- Grinding wheels (aluminum oxide, silicon, carbide, boron carbide, cubicboron nitride, diamond, buffing wheels)
- Knurling tools (straight, tangential, diamond)
- Milling cutters (dovetail, gear, keyway, end mill T-slot, woodruff, side and face, chamfer, slitting saws, flycutters, formed, angle face, cemented carbide, carbide insert, solid carbide
- Reamers (machine, hand, spiral flute, straight, flute, expandable, rose, taper)
- Spotfacers
- Taps
- Portable key seater
- Cold saw
- Disk grinder

Hand Tools

- Acetylene torch
- Allen keys
- Arbor press
- Bearing extractor
- Brushes
- Buffing wheels
- Chisels
- Chuck key
- Clamps
- Cloths
- Deburrers
- Die stock
- Drill drift
- Drill gauge
- Dressing stick
- Emery cloth
- File cards
- File handles
- Files
- Grease guns
- Hacksaws and blades
- Hand broaches
- Hand reamers
- Hammers/mallets
- Honing stones
- Lapping plate
- Oil cans/guns
- Pliers
- Scrapers (flat, bearing)
- Screwdrivers
- Socket wrenches
- Soft jaws
- Tap extractors
- Tap wrenches
- Torch tip lighters
- Vises
- Wheel dressers (hand held)
- Wrenches

Measuring and Layout Tools

- Angle plate
- Bore gauge
- Combination square
- Coordinate measuring machine (cmm)
- Depth gauge
- Dial indicators and magnetic base
- Digital readout
- Dividers
- Drill gauge
- Electronic measuring devices
- Etchers
- Feeler gauge
- Gauge blocks
- Gauge pins
- Gear measuring wire
- Go-no-go gauge (threads, diametrical)
- Height gauge
- Hermaphrodite calipers
- Inside calipers
- Layout dye
- Measuring rods
- Measuring tape
- Optical comparator
- Outside calipers
- Plug/ring gauge
- Precision blocks
- Precision level
- Protractor (universal, bevel, Vernier)
- Punches (centre, prick, transfer)
- Radius gauge
- Scale (steel, rule, hook rule)
- Scribers
- Sine bar
- Sine plate
- Small hole gauge
- Snap gauge
- Square (solid, adjustable, cylindrical)
- Surface finish comparator
- Surface gauge
- Surface plate
- Telescopic gauge
- Three wire set
- Transfer caliper
- Vernier caliper (dial, digital)

Set Up Accessories

- Adaptors
- Angle plates
- Arbors
- Centre and edge finders
- Centres (dead, half, rotating, spring)
- Chucks (3-jaw, 4-jaw, 6-jaw, magnetic, tail stock)
- Colletts
- Crane
- Degreasing tanks
- Dividing head
- Drill chuck
- Face plates
- Follower/travelling rest
- Grinding attachments
- Hoists
- Lathe dogs
- Machine vise
- Mandrels
- Parallels
- Quick change toolpost
- Rotary table
- Shim stock
- Slings
- Spacers
- Steady rest
- Taper sleeve
- Taper turning attachment
- Tapping head
- Tool holders
- Turret toolpost
- Vee block
- Wheel balancers

Safety Equipment

- Eye wash station
- Face shield
- Required fire suppression equipment
- Required first aid coverage and equipment
- Safety barrier tapes

Specialty Tools

Software

- CAD/CAM software

Student Equipment (supplied by school)

Required

- Dust mask
- Hearing protectors

Student Tools (supplied by student)

Required

- Safety boots
- Safety glasses

Recommended

- Personal protective equipment (as determined by WorkSafeBC)
- Personal hearing protection

Reference Materials

Required Reference Materials

- Individualized Learning Machinist Modules from Alberta Learning.
  - BC Level 1 and 2 package
- WorkSafe BC Regulations Online
- Technology of Machine Tools and Workbook
- Machinery's Handbook
- Haas Programming Manual
- Haas Operator Manual

Recommended Resources

- Interpret Engineering Drawings (Canadian Edition)
- SKF Bearing Maintenance Handbook by the SKF Bearing Corporation
- Mathematics for Machine Technology, Smith
- Engineer's Black Book: Machinist and Manufacturing Reference Guide, Pat Rapp

Suggested Texts

- IPT Trade Handbooks Series
- Machine Tool Practices

Instructor Requirements

Occupation Qualification

The instructor must possess:

- Machinist Red Seal certification

Work Experience

A minimum of 10 years' experience working in the industry as a journeyperson.

Instructional Experience and Education

It is preferred that the instructor also possesses one of the following:

- Provincial (BC) Instructor Diploma or completion of a similar Trainer Training/Instructional Methods program, plus
- 2 years of supervisory or administrative experience
- Experienced user of CAD/CAM software

Appendices

Appendix A
Acronyms

AED	Automated external defibrillator
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
BSP	British standard pipe
CAD	Computer-aided design
CAM	Computer- aided manufacturing
CBN	Cubic boron nitride
CMM	Coordinate measuring machine
CNC	Computer numerical control
EDM	Electrical discharge machines
FPM	Feet per minute
HSS	High speed steel
IPM	Inches per minute
ISO	International Standards Organization
MPM	Metres per minute
MTR	Material test report
NDT	Non-destructive testing
NPS	National Pipe Straight
NPT	National Pipe Taper
PLC	Programmable logic controller
PPE	Personal protective equipment
RPM	Revolutions per minute
SAE	Society of Automotive Engineers
SDS	Safety data sheets
SFPM	Surface feet per minute
SMPM	Surface metres per minute
UN	Unified National
UNC	Unified National Course (a thread system for course threads)
UNF	Unified National Fine (a thread system for fine threads)
UNS	Unified National Special
WHMIS	Workplace Hazardous Materials Information System

Appendix B
Previous Contributors

Subject Matter Experts retained to assist in the development of the 2014 Program Outline:

- James Cai — BC Institute of Technology
- Ron Metcalfe — Murrey Latta Progressive Machine
- David Peare — Patton and Cooke
- Dave Sanford — Howe Sound Pulp and Paper (retired)
- Daniel Smith — Howe Sound Pulp and Paper

The Program Outline was prepared with the advice and direction of an industry steering committee convened initially by the RTO (Resource Training Organization). Members include:

- Steve Anderson — Department of National Defense
- Danny Bradford — BC Federation of Labour
- Larry Dosalph — Teck
- Ralph Finch — Thompson Rivers University
- Dana Goedbloed — Kwantlen Polytechnic University
- Wayne Muzylowski — West Fraser (Eurocan Pulp and Paper)
- James Piwek — Teck
- Brad Smith — Catalyst Paper
- Cindy Soderstom — CAODC (Rig Tech Trade)
- Gene Von Matt — Elk Valley Coal
- Wayne Wetmore — Enform Training
- Trevor Williams — BC Institute of Technology

Subject Matter Experts retained to assist in the development of 2008 Program Outline:

- Dave Baker — Kodak Graphic Communication
- James Cai — BC Institute of Technology
- Tim Duthie — Elk Valley Coal Corp
- Paul Ghotra — CIMtech Mfg Inc
- Alastair Haythornthwaite — International Association of Machinists DL 250
- Uwe zum Hingst — Zum Hingst Technologies Inc.
- John MacKinnon — Avcorp Industries Inc.
- Gary Markham — Raute Wood Ltd.
- Dave Sanford — Howe Sound Pulp and Paper
- Richard Turnbull — Department of National Defense
- Tim Walls — Pazmac Enterprises
- Guy Walton — Kodak Graphic Communication
- Reinhard Wildauer — College of New Caledonia