Occupational Analyses Series

Tool and Die Maker

2005

Trades and Apprenticeship Division

Human Resources
Partnerships Directorate

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The Canadian Council of Directors of Apprenticeship (CCDA) recognizes this Occupational Analysis as the national standard for the occupation of Tool and Die Maker.

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LIST OF RED SEAL NATIONAL OCCUPATIONAL ANALYSES

TITLE	NOC* Code
Appliance Service Technician (1997)	7332
Automotive Painter (2005)	7322
Automotive Service Technician (2005)	7321
Baker (1997)	6252
Boilermaker (2003)	7262
Bricklayer (2000)	7281
Cabinetmaker (2000)	7272
Carpenter (1998)	7271
Concrete Finisher (1995)	7282
Construction Electrician (2003)	7241
Cook (2003)	6242
Electrical Rewind Mechanic (1999)	7333
Electronics Technician – Consumer Products (1997)	2242
Farm Equipment Mechanic (2000)	7312
Floorcovering Installer (2005)	7295
Glazier (2004)	7292
Hairstylist (2005)	6271
Heavy Duty Equipment Technician (2004)	7312
Industrial Electrician (2003)	7242
Industrial Instrument Mechanic (2000)	2243
Industrial Mechanic (Millwright) (1999)	7311
Insulator (Heat and Frost) (2000)	7293
Ironworker (Generalist) (1993)	7264
Lather (Interior Systems Mechanic) (2002)	7284
Machinist (2005)	7231
Metal Fabricator (Fitter) (2003)	7263

Mobile Crane Operator (1997)	7371
Motorcycle Mechanic (1995)	7334
Motor Vehicle Body Repairer (Metal and Paint) (2005)	7322
Oil Burner Mechanic (1997)	7331
Painter and Decorator (2000)	7294
Partsperson (2005)	1472
Plumber (2003)	7251
Powerline Technician (2004)	7244
Recreation Vehicle Mechanic (2000)	7383
Refrigeration and Air Conditioning Mechanic (2004)	7313
Roofer (1997)	7291
Sheet Metal Worker (1997)	7261
Sprinkler System Installer (2003)	7252
Steamfitter – Pipefitter (1996)	7252
Tilesetter (2004)	7283
Tool and Die Maker (2005)	7232
Transport Trailer Technician (2003)	7321
Truck and Transport Mechanic (2000)	7321
Welder (2004)	7265

* National Occupational Classification

Requests for these publications should be forwarded to:

Trades and Apprenticeship Division
Human Resources Partnerships
Human Resources and Skills Development Canada
140 Promenade du Portage, Phase IV, 5th Floor
Gatineau, Quebec K1A 0J9

These publications are also available to order or download online at: **www.red-seal.ca**.

A comparative listing of apprenticeship training programs across Canada may be accessed at **www.ellischart.ca**. The Ellis Chart also lists the current provincial and territorial trade names.

FOREWORD

The first National Conference on Apprenticeship in Trades and Industries, held in Ottawa in 1952, recommended that the federal government be requested to co-operate with provincial and territorial apprenticeship committees and officials in preparing analyses of a number of skilled occupations. To this end, Human Resources and Skills Development Canada (HRSDC) sponsors a program, under the guidance of the Canadian Council of Directors of Apprenticeship (CCDA), to develop a series of occupational analyses.

The Occupational Analysis Program has the following objectives:

- to identify and group the tasks performed by skilled workers in particular occupations;
- to identify those tasks that are performed by skilled workers in every province and territory;
- to develop instruments for use in the preparation of Interprovincial Standards "Red Seal" Examinations and curricula for training leading to the certification of skilled workers;
- to facilitate the mobility, in Canada, of apprentices and skilled workers;
- to supply employers and employees, and their associations, industries, training institutions and governments with analyses of the tasks performed in particular occupations.

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GUIDE TO ANALYSIS

DEVELOPMENT OF ANALYSIS

A draft analysis is developed by a committee of industry experts in the field led by a team of facilitators. This draft analysis identifies all the tasks performed in the occupation.

The draft is translated and reviewed by the NOA Team of HRSDC. A copy of this analysis is then forwarded to provincial/territorial authorities for review by specialists in the field. Their recommendations are assessed and incorporated into the final draft.

The occupational analysis is published in both official languages.

STRUCTURE OF ANALYSIS

To facilitate understanding of the nature of the occupation, the work performed is divided into the following divisions:

BLOCK – is the largest division within the analysis and reflects a distinct operation relevant to the occupation.

TASK – is the distinct activity that, combined with others, makes up the logical and necessary steps the worker is required to perform to complete a specific assignment within a "BLOCK".

SUB-TASK – is the smallest division into which it is practical to subdivide any work activity and, combined with others, fully describes all duties constituting a "TASK".

Supporting Knowledge & Abilities

The elements of skill and knowledge that an individual must acquire to adequately perform the sub-task.

Trends

Any shifts or changes in technology that affect the block.

Related Components

All components related to a specified block are identified under this heading.

Tools and Equipment

All tools and equipment necessary for the tool and die maker to perform the work on all given tasks identified within the block.

Context

A statement written to clarify the intent and meaning of tasks in the analysis.

VALIDATION METHOD

At the request of the Canadian Council of Directors of Apprenticeship (CCDA), the Standardization Sub-committee developed a method for validating the Red Seal National Occupational Analyses.

A draft of the analysis is sent to all jurisdictions for validation. Each jurisdiction rates the sub-tasks and applies percentage ratings to blocks and tasks. This method for the validation of the National Occupational Analysis identifies common core tasks across Canada for a specific occupation. This feature facilitates the weighting of the Interprovincial Standards "Red Seal" Examinations.

DEFINITIONS

YES: the sub-task is performed by workers in the occupation in a specific jurisdiction.

NO: the sub-task is not performed by workers in the occupation in a specific jurisdiction.

BLOCK %: the average number of questions (items), derived from the collective decision made by workers within the occupation from all areas of Canada, that will be placed on an interprovincial examination to assess each block of the analysis.

TASK %: the average number of questions (items), derived from the collective decision made by workers within the occupation from all areas of Canada, that will be placed on an interprovincial examination to assess each task of the analysis.

NV: Not Validated by a province/territory.

ND: Not Designated in a province/territory.

PROVINCIAL/TERRITORIAL ABBREVIATIONS

NL: Newfoundland and Labrador
NS: Nova Scotia
PE: Prince Edward Island
NB: New Brunswick
QC: Quebec
ON: Ontario
MB: Manitoba
SK: Saskatchewan
AB: Alberta
BC: British Columbia
NT: Northwest Territories
YT: Yukon
NU: Nunavut

COMMON CORE

The criteria for determining common core depend on the performance of sub-tasks. If at least 70% of the responding jurisdictions (excluding NVs and NDs) perform a sub-task, it shall be considered common core.

Interprovincial Standards "Red Seal" Examinations are based on the common core identified through this validation process. Validation identifies what will be assessed through the interprovincial examination.

BLOCK AND TASK WEIGHTING (APPENDIX D)

This appendix represents the block and task percentages as submitted by each jurisdiction.

Each jurisdiction, with the use of a provincial/territorial occupational advisory committee, validates the content, places percentages on blocks and tasks, and indicates whether or not the sub-tasks are performed by the skilled workers within the occupation. The results of this exercise are submitted to the NOA Team who then analyzes the data and develops this appendix which provides the individual jurisdictional validation results as well as the national averages of all responses.

PIE CHART (APPENDIX E)

The graph depicts the national percentages assigned to blocks in the analysis.

SCOPE OF THE TOOL AND DIE MAKER OCCUPATION

Tool and die makers make, repair and test dies, cutting tools, jigs, fixtures, gauges, prototypes and specialty tools. In some jurisdictions, they may also build moulds. They lay out, set up, machine, fit and finish metal components. They design and make items to meet exacting standards in dimensions, strength and hardness.

Tool and die makers use many of the same machining tools as machinists such as lathes, milling machines, saws, grinding machines, drilling machines, computer numerical control (CNC) machines and electrical discharge machines (EDM). They also use precision metal-working tools, hand tools and measuring equipment to ensure accuracy and close tolerances. They work from drawings, computer-aided designs, specifications and their own concepts to calculate dimensions, tolerances and types of fit. They must be knowledgeable about the properties of metal, plastic, rubber and composite materials.

Tool and die makers work in tool rooms or machine shops in industries where manufacturing and research is done. These may include industries that specialize in hardware and tooling, machinery equipment, motor vehicle parts, aerospace parts, research and development, high tech equipment or medical equipment. Tool and die makers may also work in mould shops, shipyards, rail yards, refineries, pulp and paper mills, mines, smelters and overhaul shops.

Some tool and die makers may specialize in design, prototyping, heat treating, testing, jig and fixture fabrication, die fabrication, assembly, inspection and programming.

Safety is important at all times. There are risks of injury working with moving machine parts, flying chips, sharp edges and extreme heat from ignited and heated materials. Precautions are required while working with manufacturing chemicals and airborne irritants.

Key attributes for people entering this trade are: communication skills, mechanical aptitude, hand-eye coordination, manual dexterity, an ability to work independently and in teams, logical reasoning ability, an understanding of mathematics and physics, above average spatial ability and the ability to plan and think sequentially as well as multi-dimensionally. The work often requires considerable physical activity. Tool and die makers may work with other professionals such as machinists, mould makers, industrial mechanics (millwrights) and engineers.

Experienced tool and die makers may become business owners, managers or instructors. With additional training, they may transfer their skills to design and engineering responsibilities. Their skills are also transferable to related occupations such as machinist, mould maker, industrial mechanic (millwright) and CNC programmer.

OCCUPATIONAL OBSERVATIONS

The tool and die maker trade is changing rapidly throughout the various industries in Canada and worldwide. Technology is quickly changing the basic trade. Advances in CNC, robotics, laser, exotic materials and composites will continue to impact the trade in future years. Knowledge expectations and skill levels continue to increase in this trade. The tool and die maker must be adaptable and prepared to welcome changing methods and processes through technology.

SAFETY

Safe working procedures and conditions, accident prevention and the preservation of health are of primary importance to industry in Canada. These responsibilities are shared and require the joint efforts of government, employers and employees. It is imperative that all parties are aware of circumstances and conditions that may lead to injury or harm. Safe learning experiences and environments can be created by controlling the variables and behaviours that may contribute to accidents or injury.

It is generally recognized that a safety-conscious attitude and work practices contribute to a healthy, safe and accident-free working environment.

It is imperative to apply and be familiar with the Occupational Health and Safety Acts and Workplace Hazardous Material Information System (WHMIS) Regulations. As well, it is essential to determine workplace hazards and take measures to protect oneself, co-workers, the public and the environment.

As safety education is an integral part of training in all jurisdictions, personal safety practices are not recorded in this document. However, the technical safety aspect relating to each task and sub-task are included throughout this analysis.

ANALYSIS

BLOCK A

OCCUPATIONAL SKILLS

Trends: *Increasing use of computer for communication purposes and data development, retrieval and storage, and the machining of components. Less hand work for tool and die makers as more is being downloading and being machined by CNC.*

Related Components: Quality assurance policies and procedures, national and international standards.

Tools and Equipment: See Appendix A.

Task 1 Uses tools and equipment.

Context: *Tool and die makers use various tools and equipment to complete multiple tasks throughout their trade.*

Sub-task

1.01 Uses hand tools.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

Supporting Knowledge & Abilities

1.01.01	knowledge of types of hand tools
1.01.02	knowledge of imperial and metric systems
1.01.03	ability to apply hand-eye coordination
1.01.04	ability to organize hand tools
1.01.05	ability to maintain hand tools
1.01.06	ability to store hand tools
1.01.07	ability to recognize worn, damaged or defective hand tools

Sub-task

1.02 Uses power tools. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

1.02.01	knowledge of types of power tools such as electric, pneumatic and hydraulic
1.02.02	knowledge of operating procedures
1.02.03	ability to apply hand-eye coordination
1.02.04	ability to organize power tools
1.02.05	ability to maintain power tools
1.02.06	ability to store power tools
1.02.07	ability to recognize worn, damaged or defective power tools

Sub-task

1.03 Uses measuring devices. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

1.03.01	knowledge of types of measuring devices such as micrometers, vernier calipers, protractors, sine bars and gauge blocks
1.03.02	knowledge of imperial and metric systems
1.03.03	knowledge of measuring device calibration
1.03.04	ability to organize measuring devices
1.03.05	ability to maintain measuring devices
1.03.06	ability to store measuring devices
1.03.07	ability to recognize worn, damaged or defective measuring devices

Sub-task

1.04 Uses hoisting and lifting equipment.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

1.04.01	knowledge of types of hoisting and lifting equipment such as jacks, chain hoists and overhead cranes
1.04.02	knowledge of applications of hoisting, lifting and rigging procedures
1.04.03	knowledge of limitations of lifting equipment
1.04.04	knowledge of hoisting and lifting equipment maintenance
1.04.05	ability to apply slings, chains and wire ropes
1.04.06	ability to use hand signals
1.04.07	ability to recognize worn, damaged or defective hoisting and lifting equipment

Sub-task

1.05 Uses layout tools and equipment.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

1.05.01	knowledge of types of layout tools and equipment such as height gauges, angle plates, scribers and surface tables
1.05.02	knowledge of imperial and metric systems
1.05.03	ability to organize layout tools and equipment
1.05.04	ability to maintain layout tools and equipment

1.05.05	ability to store layout tools and equipment
1.05.06	ability to recognize worn, damaged or defective layout tools and equipment

Sub-task

1.06 Uses personal protective equipment (PPE) and safety equipment.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

1.06.01	knowledge of types of PPE such as respiratory, hearing, eye and body protection
1.06.02	knowledge of PPE and safety equipment operations
1.06.03	knowledge of workplace safety and health regulations and legislation
1.06.04	knowledge of location of PPE and safety equipment
1.06.05	ability to inspect and maintain PPE and safety equipment
1.06.06	ability to store PPE and safety equipment
1.06.07	ability to recognize worksite hazards
1.06.08	ability to recognize worn, damaged or defective PPE and safety equipment

Task 2 Organizes work.

Context: Tool and die makers use organizational skills to perform their tasks in a safe, efficient and effective manner.

Sub-task

2.01 Uses documentation.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

2.01.01	knowledge of first and third angle projection
2.01.02	knowledge of symbols such as surface finishes, scales, geometric dimensioning and tolerancing (GDT)
2.01.03	knowledge of types of documentation such as work orders and technical data
2.01.04	ability to use reference material such as Machinery's Handbook, tool specifications and material specifications
2.01.05	ability to read and interpret blueprints, engineering drawings and sketches
2.01.06	ability to draw a sketch
2.01.07	ability to use Computer Aided Design (CAD)
2.01.08	ability to organize and store electronic information

Sub-task

2.02 Maintains safe work environment.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

2.02.01	knowledge of federal, provincial and territorial safety regulations

2.02.02	knowledge of types and operation of fire extinguishing equipment
2.02.03	knowledge of disposal and recycling procedures
2.02.04	knowledge of work hazards such as toxic chemicals and metals, and the improper operation of hand and power tools
2.02.05	knowledge of absorbent materials
2.02.06	knowledge of lockout procedures
2.02.07	ability to recognize potential hazards specific to each machine
2.02.08	ability to handle and store hazardous materials
2.02.09	ability to dispose of hazardous materials such as cutting fluids, oils and metal waste

Sub-task

2.03 Communicates with others. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

2.03.01	knowledge of technical terminology
2.03.02	knowledge of verbal and written communication
2.03.03	ability to use communication equipment and media such as the Internet, email and fax
2.03.04	ability to translate technical information into layperson’s terms
2.03.05	ability to acquire information through questioning
2.03.06	ability to communicate with other related professionals such as engineers, supervisors and co-workers
2.03.07	ability to communicate with customers

Sub-task

2.04 Plans sequence of operations. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

2.04.01	knowledge of machining operations such as turning, milling, grinding, CNC machines and EDM
2.04.02	knowledge of material characteristics such as hardness, toughness and present heat treated conditions
2.04.03	knowledge of time required to complete various operations
2.04.04	knowledge of heat treatment
2.04.05	knowledge of surface finishes
2.04.06	ability to identify heat treatment requirements
2.04.07	ability to plan and prioritize work procedures and practices
2.04.08	ability to calculate machining parameters

Sub-task

2.05 Selects materials. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

2.05.01	knowledge of classifications of materials
2.05.02	knowledge of types of materials such as polymers, ferrous materials, non-ferrous materials and exotic materials
2.05.03	knowledge of material characteristics such as hardness, toughness and existing heat treated conditions

2.05.04	knowledge of identification markings such as American Society of Mechanical Engineering (ASME), American National Standards Institute (ANSI), colour codes and number systems
2.05.05	ability to determine material type, shape and size
2.05.06	ability to visually inspect material for faults such as cracks and deformations

Task 3 Performs benchwork.

Context: Tool and die makers' work on a bench is multi-functional; it takes in many various critical components of the trade from part layout to part fit-up to produce a finished component to exacting standards.

Sub-task

3.01 Performs layout.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

Supporting Knowledge & Abilities

3.01.01	knowledge of layout procedures
3.01.02	knowledge of layout media such as dyes, paint, markers and coatings
3.01.03	ability to apply geometry and trigonometry principles
3.01.04	ability to use charts and scientific calculators

Sub-task

3.02 Marks material for identification.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

3.02.01 knowledge of marking procedures such as etching, engraving, colour coding, stamping and bar coding

3.02.02 ability to mark workpiece without compromising the integrity of the workpiece

Sub-task

3.03 Deburrs workpiece.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

3.03.01 knowledge of deburring techniques

3.03.02 ability to use deburring tools such as files, rotary deburring tools, scrapers and abrasive stones

3.03.03 ability to assess and identify burrs and rough edges

3.03.04 ability to remove burrs to meet specifications

Sub-task

3.04 Finishes workpiece.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

3.04.01 knowledge of lapping and honing techniques

3.04.02 knowledge of polishing and blending techniques

3.04.03	knowledge of abrasives
3.04.04	ability to select lapping and honing abrasives
3.04.05	ability to maintain lapping tables and plates

Sub-task

3.05 Inspects workpiece. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

3.05.01	knowledge of required dimensions and dimensional accuracy
3.05.02	knowledge of GDT
3.05.03	ability to perform inspection techniques using equipment such as optical comparator and coordinate measuring machines (CMM)
3.05.04	ability to use non-destructive testing methods and manual measurements

Task 4 Maintains shop machines and shop tooling.

Context: Maintenance of shop machines and shop tools is important to prolong the service life of the machine, to increase its efficiency and to ensure a safe environment.

Sub-task

4.01 Cleans machines. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

4.01.01	knowledge of cleaning solvents
4.01.02	knowledge of machine lockout procedures

4.01.03	knowledge of sensitive components
4.01.04	knowledge of manufacturers' specifications

Sub-task

4.02 Lubricates machines. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

4.02.01	knowledge of types of lubricants
4.02.02	knowledge of lubrication points
4.02.03	knowledge of maintenance schedule
4.02.04	ability to use lubrication equipment such as grease gun, oil gun and oil feeders
4.02.05	ability to check oil levels

Sub-task

4.03 Sharpens cutting tools. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

4.03.01	knowledge of tool geometry such as rake angles, relief angles and chip breakers
4.03.02	knowledge of types of tool sharpening equipment such as tool and cutter, pedestal and drill grinders
4.03.03	ability to set up grinding equipment
4.03.04	ability to perform sharpening operations

Sub-task

4.04 Maintains cutting fluid and coolant.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

4.04.01	knowledge of types of cutting fluids such as oil and water soluble fluids
4.04.02	knowledge of types of coolants and application techniques
4.04.03	knowledge of mixing procedures
4.04.04	ability to maintain concentration of soluble fluids
4.04.05	ability to follow a maintenance schedule
4.04.06	ability to determine when to apply cutting fluid and coolant

BLOCK B

MACHINE SETUP AND OPERATION

Trends: *Equipment and material process are constantly changing through technology with the advancement of solid modelling (CAD/CAM). The software will have the ability to constantly update the CNC program tooling design driven by product. Improved interactive controls feature enhanced automation modes such as automatic measuring, probing and robotic loaders and unloaders. There is an increased use of multi-axes CNC machines. There is also an increased use of high speed CNC machining resulting in higher productivity. Material engineering drives fabrication processes. The effect of this trend on tool and die makers is less responsibility for the machining of the components, as they are being produced more and more by CNC operators. This has meant that tool and die maker skills are increasingly being used for the final fitting and assembly of pre-machined components.*

Related Components: Steel, engineered material, oil, cutting fluid, national and international standards.

Tools and Equipment: See Appendix A.

Task 5 Plans machine operations.

Context: *Tool and die makers need to determine the sequence of machining operations and equipment required to produce the end product in the most efficient manner.*

Sub-task

5.01 Selects tooling, accessories and work holding devices.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

Supporting Knowledge & Abilities

5.01.01 knowledge of types of work holding devices such as vises, V-blocks, drive plates, angle plates and magnetic chucks

5.01.02 knowledge of types of accessories such as rotary tables, indexing heads and sine bar

5.01.03 knowledge of types of cutting tools such as end mills, drills, reamers and grinding wheels

5.01.04 knowledge of capacity of tooling, accessories and holding devices

	5.01.05	knowledge of clamping pressure
	5.01.06	knowledge of limits and capabilities of tooling such as depth and size of cut
	5.01.07	ability to match accessories and work holding devices to workpiece requirements

Sub-task

5.02 Plans machine sequence. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

	5.02.01	knowledge of machining operations such as roughing and finishing
	5.02.02	knowledge of machine capacity
	5.02.03	knowledge of types of machines such as horizontal and vertical mills
	5.02.04	ability to establish the sequence of machining operations

Sub-task

5.03 Sets up work holding devices. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

	5.03.01	knowledge of mounting and aligning techniques and procedures
	5.03.02	ability to position, align and secure work holding device to match workpiece requirements

Sub-task

5.04 Sets up machine tooling and accessories.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

5.04.01	knowledge of types of tooling such as high speed steel (HSS) tooling, carbide tooling and carbide inserts
5.04.02	knowledge of installation and positioning techniques
5.04.03	ability to mount tooling in tool holders
5.04.04	ability to replace inserts
5.04.05	ability to mount tool holder in machines
5.04.06	ability to position, fasten and adjust accessories
5.04.07	ability to join band saw blades
5.04.08	ability to perform calculations such as taper and parallelism correction
5.04.09	ability to perform presetting of machine cutting tools

Sub-task

5.05 Sets up workpiece.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

5.05.01	knowledge of workpiece characteristics such as shape, material and size
5.05.02	knowledge of setup and alignment techniques such as dialling-in workpiece
5.05.03	ability to orientate workpiece

Sub-task

5.06 Selects speeds and feeds. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

5.06.01	knowledge of various work materials
5.06.02	knowledge of the effect of speeds, feeds and depth of cut on finish and tool life
5.06.03	ability to determine rigidity of machine tool, workpiece and setup
5.06.04	ability to calculate speeds and feeds

Sub-task

5.07 Performs calculations. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

5.07.01	knowledge of Cartesian Coordinate System
5.07.02	knowledge of trigonometry
5.07.03	ability to calculate gauge block build-up for sine bar setup
5.07.04	ability to calculate bolt circle
5.07.05	ability to determine how much material to remove
5.07.06	ability to determine the amount of material to be used
5.07.07	ability to calculate tapers
5.07.08	ability to perform thread calculations

Task 6 Operates drill presses.

Context: Tool and die makers use various techniques and rotary tools to produce holes and features in tooling components.

Sub-task

6.01 Drills holes.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

6.01.01 knowledge of drilling techniques such as pecking, centre drilling and deep hole drilling

6.01.02 knowledge of tool geometry and material

6.01.03 ability to recognize tool wear

Sub-task

6.02 Produces hole features.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

6.02.01 knowledge of size and types of screws for selected operation

6.02.02 knowledge of counterbore diameter and corresponding pilot diameter

6.02.03 knowledge of required surface finish

6.02.04 knowledge of tap types such as spiral flute, spiral point and form taps

6.02.05 knowledge of thread types such as Unified National Fine (UNF), Unified National Course (UNC), Acme, National Pipe Taper (NPT), National Pipe Straight (NPS) and metric

6.02.06 knowledge of hole finishing techniques such as honing and reaming

6.02.07 ability to select countersinks and spotfaces

6.02.08	ability to apply cutting fluids for lubrication and chip removal
6.02.09	ability to apply tapping procedures
6.02.10	ability to recognize tool wear

Task 7 Operates lathes.

Context: Tool and die makers use various techniques with stationary and rotary tools to turn diameters, inside and outside contours, holes, threads and tapers.

Sub-task

7.01 Turns surfaces. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

7.01.01	knowledge of required surface finish
7.01.02	knowledge of tool geometry and material
7.01.03	ability to turn internal and external surfaces
7.01.04	ability to recognize tool wear
7.01.05	ability to support workpiece using work holding devices such as chucks, collets and steady rests

Sub-task

7.02 Faces surfaces. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

7.02.01	knowledge of required surface finish
7.02.02	knowledge of tool geometry and material

7.02.03	ability to recognize tool wear
7.02.04	ability to support workpiece using work holding devices such as chucks, collets and steady rests

Sub-task

7.03 Knurls. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

7.03.01	knowledge of required surface finish
7.03.02	knowledge of tools and tool holders
7.03.03	ability to select knurling wheels for pattern and size
7.03.04	ability to recognize tool wear affecting knurling efficiency
7.03.05	ability to verify that knurled surface meets specifications

Sub-task

7.04 Parts off workpiece. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

7.04.01	knowledge of types of parting tools such as carbide and HSS
7.04.02	knowledge of tool geometry
7.04.03	ability to recognize tool wear

Sub-task

7.05 Drills holes with lathes.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

7.05.01	knowledge of drilling techniques such as pecking and deep hole drilling
7.05.02	knowledge of required surface finish
7.05.03	knowledge of tool geometry
7.05.04	ability to recognize tool wear
7.05.05	ability to set up and secure workpiece
7.05.06	ability to apply cutting fluids for cooling and chip removal

Sub-task

7.06 Produces hole features with lathes.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

7.06.01	knowledge of hole finishing techniques such as drilling, reaming, boring and honing
7.06.02	knowledge of required surface finish
7.06.03	ability to recognize tool wear
7.06.04	ability to apply cutting fluids for cooling and chip removal

Sub-task

7.07 Cuts grooves.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

7.07.01	knowledge of grooving tool materials such as carbide and HSS
7.07.02	knowledge of required surface finish
7.07.03	knowledge of tool geometry
7.07.04	ability to recognize tool wear
7.07.05	ability to set up and position workpiece for grooving internal and external surfaces

Sub-task

7.08 Cuts threads.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

7.08.01	knowledge of types of common thread forms such as UNC, NPT, Acme and metric
7.08.02	knowledge of procedures and techniques to produce internal and external threads
7.08.03	knowledge of single and multi-start threads
7.08.04	ability to use die heads and tapping heads
7.08.05	ability to grind cutting tools to produce thread form
7.08.06	ability to set up machine to cut external and internal threads
7.08.07	ability to recognize tool wear

Task 8 Operates milling machines.

Context: Tool and die makers use various techniques and rotary tool cutting methods to produce pockets, cavities, slots, holes and various features vertically and horizontally.

Sub-task

8.01 Faces surfaces.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

8.01.01	knowledge of methods of milling such as climb milling and conventional milling
8.01.02	knowledge of required surface finish
8.01.03	knowledge of cutting tool geometry and balancing
8.01.04	ability to machine vertical, horizontal and angled surfaces
8.01.05	ability to recognize tool wear

Sub-task

8.02 Mills profiles and pockets.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

8.02.01	knowledge of types and applications of specialized cutters
8.02.02	knowledge of required surface finish
8.02.03	knowledge of tool geometry and material
8.02.04	knowledge of procedures for cutting pockets, profiles and keyways
8.02.05	ability to recognize tool wear
8.02.06	ability to perform profile calculations

8.02.07	ability to apply cutting fluids to remove chips and to cool workpiece and tools
8.02.08	ability to cut profiles using accessories such as rotary tables and indexing heads

Sub-task

8.03 Drills holes with milling machines.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

8.03.01	knowledge of drilling techniques such as pecking and deep hole drilling
8.03.02	knowledge of tool geometry and composition
8.03.03	ability to recognize tool wear
8.03.04	ability to apply cutting fluids to remove chips and to cool workpiece and tools

Sub-task

8.04 Produces hole features with milling machines.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

8.04.01	knowledge of fastener size and types for selected operation
8.04.02	knowledge of counterbore diameter and corresponding pilot diameter
8.04.03	knowledge of required surface finish
8.04.04	ability to select countersinks and spotfaces
8.04.05	knowledge of types of threads such as UNF, UNC and metric

8.04.06	knowledge of finishing hole techniques such as boring, honing and reaming
8.04.07	ability to apply tapping procedures
8.04.08	ability to recognize tool wear

Task 9 Operates power saws.

Context: Tool and die makers use various techniques, using horizontal and vertical saws to cut a variety of materials into different shapes and sizes.

Sub-task

9.01 Saws straight and angle cuts. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

9.01.01	knowledge of types of saws such as horizontal, vertical and abrasive
9.01.02	knowledge of sawing procedures
9.01.03	ability to cut test piece to verify workpiece dimensions
9.01.04	ability to apply cutting fluid to remove chips and to cool saw blade

Sub-task

9.02 Cuts irregular shapes. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

9.02.01	knowledge of vertical contour band saws
9.02.02	knowledge of sawing procedures
9.02.03	knowledge of blade selection and speed
9.02.04	ability to lay out workpiece

9.02.05	ability to feed material and follow contour layout line
9.02.06	ability to apply cutting fluid to remove chips and to cool saw blade

Task 10 Operates grinders.

Context: Tool and die makers use various grinders to produce accurate and precise finishes to extremely tight tolerances.

Sub-task

10.01 Prepares grinding wheel. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

10.01.01	knowledge of types, materials, grades and sizes of grinding wheels
10.01.02	knowledge of techniques and procedures for storing, handling and mounting grinding wheels
10.01.03	knowledge of balancing techniques and procedures
10.01.04	knowledge of truing and dressing techniques and procedures such as contour dressing and diamond dressing
10.01.05	ability to select truing and dressing tools
10.01.06	ability to visually inspect and ring test grinding wheels
10.01.07	ability to mount grinding wheel and grinding wheel hardware
10.01.08	ability to balance grinding wheels
10.01.09	ability to dress grinding wheels

Sub-task

10.02 Grinds workpiece.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

10.02.01	knowledge of types of surface grinders such as vertical and horizontal spindle
10.02.02	knowledge of grinding techniques required to produce cylindrical and flat surfaces
10.02.03	ability to identify when wheels require dressing
10.02.04	ability to plunge grind and traverse grind

Sub-task

10.03 Grinds profiles.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

10.03.01	knowledge of types of profiles such as vees and radii
10.03.02	knowledge of cylindrical and surface grinding techniques to produce profiles such as angles, radii, recesses, shoulders and special forms
10.03.03	knowledge of types of cylindrical grinders such as universal, external and internal
10.03.04	knowledge of setup and alignment techniques for drive plate, drive dogs, trip dogs, tail stock, centres and chucks
10.03.05	ability to position and secure workpiece between centres
10.03.06	ability to perform internal, external, plunge and traverse grinding

Task 11 Operates CNC machines.

Context: Tool and die makers use CNC machines for its increased capability to make complex shapes with high tolerances more efficiently.

Sub-task

11.01 Inputs program data into control memory.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	no	yes	ND	yes	yes	ND	ND	ND

11.01.01	knowledge of CNC machine control
11.01.02	ability to select, load and retrieve programs
11.01.03	ability to manually input data

Sub-task

11.02 Interprets program codes.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	no	yes	ND	yes	yes	ND	ND	ND

11.02.01	knowledge of programming codes such as G, M and S codes
11.02.02	ability to relate program code to machine movement

Sub-task

11.03 Edits programs.

Supporting Knowledge & Abilities

(NOT COMMON CORE)

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	no	yes	ND	yes	no	ND	ND	ND

11.03.01	knowledge of programming codes such as G, M and S codes

11.03.02	ability to review program to verify accuracy
11.03.03	ability to modify and update program

Sub-task

11.04 Establishes work datum. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	no	yes	ND	yes	yes	ND	ND	ND

11.04.01	knowledge of CNC machine control
11.04.02	knowledge of machine codes to establish work datum
11.04.03	ability to use probe and edge finders
11.04.04	ability to manually adjust machine axes

Sub-task

11.05 Verifies programs. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	no	yes	ND	yes	yes	ND	ND	ND

11.05.01	knowledge of programming codes such as G, M and S codes
11.05.02	ability to perform dry run and single block cycle to check tool path
11.05.03	ability to relate program code to machine movement

Sub-task

11.06 Adjusts offsets.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	no	yes	ND	yes	yes	ND	ND	ND

11.06.01	knowledge of CNC machine control
11.06.02	knowledge of types of offsets and compensations such as length, diameter and tool nose radius
11.06.03	ability to adjust machine offset parameters

Sub-task

11.07 Monitors machining processes.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	no	yes	ND	yes	yes	ND	ND	ND

11.07.01	knowledge of tool life expectancy
11.07.02	knowledge of load monitoring system
11.07.03	knowledge of machine alarms and alarm codes
11.07.04	ability to recognize signs of tool wear such as poor finish, vibration and excessive noise
11.07.05	ability to correct observed problems
11.07.06	ability to recognize chip control problems
11.07.07	ability to ensure cutting fluid delivery
11.07.08	ability to use machine overrides such as rapid override and speed and feed override

Sub-task

11.08 Interrupts program cycle. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	no	yes	ND	yes	yes	ND	ND	ND

11.08.01	knowledge of manual cycle stop procedures
11.08.02	ability to move machine axes to take corrective action

Sub-task

11.09 Restarts program cycle. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	no	yes	ND	yes	yes	ND	ND	ND

11.09.01	knowledge of CNC machine control
11.09.02	ability to locate restart point in program
11.09.03	ability to position machine to avoid collision on restart

Task 12 Operates Electrical Discharge Machines (EDM).

Context: Tool and die makers use electrical discharge machines to accurately remove materials by eroding cavities and contours in hardened and soft ferrous and non-ferrous material in a precise and controlled manner with electrodes and electrical discharges.

Sub-task

12.01 Determines flushing. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	no	yes	ND	yes	yes	ND	ND	ND

12.01.01	knowledge of types of dielectric fluid
12.01.02	knowledge of fluid pressure

12.01.03	ability to select dielectric fluid for various applications
12.01.04	ability to prevent fires
12.01.05	ability to maintain flushing system
12.01.06	ability to maintain cutting conditions

Sub-task

12.02 Sets cutting conditions. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	no	yes	ND	yes	yes	ND	ND	ND

12.02.01	knowledge of types of electrode material
12.02.02	knowledge of wire diameter and material
12.02.03	knowledge of electrode sizes
12.02.04	knowledge of power setting
12.02.05	ability to select electrode size
12.02.06	ability to select power setting
12.02.07	ability to select electrode materials
12.02.08	ability to monitor control panel

BLOCK C

PROTOTYPES

Trends: *Rapid prototyping is quickly becoming a common process within the industry. Rapid prototyping is a method of prototyping with polymer materials which takes only a few days, compared to other prototyping processes which can take a few weeks.*

Related Components: Steel, engineered material, exotic materials, oil, cutting fluid, national and international standards.

Tools and Equipment: See Appendix A.

Task 13 Builds prototype.

Context: *Tool and die makers build a prototype to confirm design specifications by providing a physical model.*

Sub-task

13.01 Sets up prototype components.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

13.01.01	knowledge of types of alignment tools such as indicators, sine bars and gauge blocks
13.01.02	knowledge of types of clamps
13.01.03	knowledge of work holding devices such as vices and V-blocks
13.01.04	ability to use alignment tools
13.01.05	ability to employ alignment procedures such as clamping and indicating
13.01.06	ability to align components visually

Sub-task

13.02 Joins prototype components. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

13.02.01	knowledge of types of fasteners such as screws and rivets
13.02.02	knowledge of types of adhesives such as temporary and permanent
13.02.03	knowledge of types of solder such as hard and soft
13.02.04	knowledge of types of fits such as press and slide
13.02.05	knowledge of types of joints such as lap and dovetail
13.02.06	ability to install fasteners
13.02.07	ability to develop special tooling aids such as clamps and fasteners
13.02.08	ability to mix adhesives
13.02.09	ability to solder and braze

Task 14 Proves out prototypes.

Context: Tool and die makers use the prototype to verify measurements and inspect and evaluate function. This is integral to ensure it is validated before production.

Sub-task

14.01 Verifies measurements. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

14.01.01	knowledge of types of measuring tools

14.01.02	knowledge of dimensional specifications such as clearances and tolerances
14.01.03	ability to compare prototype measurements with specifications
14.01.04	ability to document prototype measurements

Sub-task

14.02 Inspects prototype.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

14.02.01	knowledge of prototype specifications such as written instructions, photographs and sketches
14.02.02	ability to visually compare prototype with documentation
14.02.03	ability to ensure completeness of prototype

Sub-task

14.03 Evaluates function of prototype.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

14.03.01	knowledge of prototype application
14.03.02	knowledge of types of physical tests such as motion, load and fatigue
14.03.03	ability to mount prototype for testing
14.03.04	ability to perform prototype tests
14.03.05	ability to analyze function and results of tests

BLOCK D

METALLURGY AND MATERIALS

Trends: *The industry is rapidly changing with new steels, alloys and composites coming onto the market. As well, the industry is rapidly embracing specialty coating on steel, carbide and composites. The tool and die maker must be able to adapt to new materials and processes.*

Related Components: Material documentation, national and international standards, scientific reference documentation.

Tools and Equipment: Safety equipment, furnaces, torches, ladles, tongs, quenching mediums, stainless steel wrap, hardness tester, non-destructive testing equipment, grinders, tensile strength tester, deflection tester, shock resistance tester.

Task 15 Heat treats materials.

Context: *Tool and die makers must have knowledge of heat treating required to change the properties of various materials. The processes are used to harden, improve machineability and reduce internal stress. Tool and die makers must be able to perform simple heat treating operations such as torch hardening, quenching and drawing of steels.*

Sub-task

15.01 Selects heating mediums.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	no	yes	yes	ND	yes	yes	ND	ND	ND

Supporting Knowledge & Abilities

15.01.01	knowledge of types of heating mediums such as gas, electric and vacuum furnaces
15.01.02	knowledge of material to be heat treated
15.01.03	ability to follow metallurgical guidelines

Sub-task

15.02 Operates heat treating equipment.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	no	yes	yes	ND	yes	yes	ND	ND	ND

15.02.01 knowledge of effect of heat on the properties of materials

15.02.02 knowledge of induction hardening process

15.02.03 ability to control heat treating equipment temperature parameters

15.02.04 ability to follow manufacturers' guidelines

15.02.05 ability to follow metallurgical guidelines

15.02.06 ability to calibrate settings

15.02.07 ability to put material into equipment

15.02.08 ability to identify hardness gradients according to part colouration

Sub-task

15.03 Quenches materials.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

15.03.01 knowledge of oil quenching procedures

15.03.02 knowledge of water quenching procedures

15.03.03 knowledge of air cooling procedures

15.03.04 ability to remove material from heat treating equipment

15.03.05 ability to place material in quenching mediums

Sub-task

15.04 Tempers materials. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	no	yes	yes	ND	yes	yes	ND	ND	ND

15.04.01	knowledge of effect of reheating on a material such as removing stress and brittleness
15.04.02	ability to follow metallurgical guidelines
15.04.03	ability to identify hardness gradients according to part colouration

Sub-task

15.05 Anneals materials. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	no	yes	yes	ND	yes	yes	ND	ND	ND

15.05.01	knowledge of reheating material to soften
15.05.02	ability to follow metallurgical guidelines
15.05.03	ability to determine condition of steel
15.05.04	ability to reheat hardened material

Sub-task

15.06 Normalizes materials. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	no	yes	yes	ND	yes	yes	ND	ND	ND

15.06.01	knowledge of effect of reheating material to stress relieve
15.06.02	ability to follow metallurgical guidelines

Sub-task

15.07 Carburizes materials.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	no	yes	yes	ND	yes	yes	ND	ND	ND

15.07.01	knowledge of carburizing materials such as carbon powder
15.07.02	ability to process materials by introducing carbon to its surface structure

Task 16 Tests materials.

Context: Tool and die makers must be able to test materials to determine specific characteristics and they must be able to use non-destructive testing (NDT) methods to assess various defects. This is imperative to verify the condition of the material.

Sub-task

16.01 Performs hardness test.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

16.01.01	knowledge of hardness scales and testers such as Rockwell and Brinell
16.01.02	ability to set up testers
16.01.03	ability to set up workpiece
16.01.04	ability to interpret results

Sub-task

16.02 Performs non-destructive testing (NDT). **Supporting Knowledge & Abilities**

(NOT COMMON CORE)

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	no	yes	yes	ND	yes	no	ND	ND	ND

16.02.01	knowledge of types of NDT such as magnaflux, dye penetrant and x-ray
16.02.02	knowledge of NDT procedures
16.02.03	ability to prepare workpiece for NDT
16.02.04	ability to find structural defects such as cracks and surface flaws

Sub-task

16.03 Performs spark test. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	no	ND	ND	ND

16.03.01	knowledge of spark patterns when ground
16.03.02	ability to compare the spark of unknown material to the spark of known material

Sub-task

16.04 Performs tensile strength test. **Supporting Knowledge & Abilities**

(NOT COMMON CORE)

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	no	no	yes	ND	yes	no	ND	ND	ND

16.04.01	knowledge of tensile strength tester
16.04.02	ability to interpret tensile strength graph

Sub-task

16.05 Performs deflection test. **Supporting Knowledge & Abilities**

(NOT COMMON CORE)

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	no	yes	ND	yes	no	ND	ND	ND

16.05.01	knowledge of limits of deflection
16.05.02	ability to apply load to workpiece
16.05.03	ability to interpret the level of deflection

BLOCK E

JIGS, FIXTURES AND DIES

Trends: *CAD and solid modelling is increasingly being used to design jigs, fixtures and dies. Using these solid models, automated programming methods are used to operate CNC machines in the production of these components.*

Related Components: Production part, production equipment.

Tools and Equipment: See Appendix A.

Task 17 Builds jigs, fixtures and dies.

Context: *Tool and die makers must be able to build jigs, fixtures and dies into functional tooling for the production and assembly of precision engineered products. In some jurisdictions, tool and die makers may also build moulds.*

Sub-task

17.01 Verifies dimensions of jig, fixture and die components.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

Supporting Knowledge & Abilities

17.01.01	knowledge of specifications such as standard hardware fits and clearances
17.01.02	knowledge of die specifications such as cutting clearances as determined by material used
17.01.03	ability to compare measurements to specifications
17.01.04	ability to ensure die clearances

Sub-task

17.02 Positions jig, fixture and die components.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

17.02.01 knowledge of assembly specifications

17.02.02 ability to plan sequence of assembly

17.02.03 ability to align and clamp components in position

17.02.04 ability to check position of components

Sub-task

17.03 Fastens jig, fixture and die components together.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

17.03.01 knowledge of types of fasteners such as screws and dowels

17.03.02 knowledge of types of fits such as slide and press

17.03.03 ability to install fasteners

Sub-task

17.04 Sets jig, fixture and die clearance.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

17.04.01 knowledge of types of dies such as cutting and forming

17.04.02	knowledge of clearance setting practices such as inserting material between working faces
17.04.03	knowledge of material properties such as composition and thickness
17.04.04	knowledge of types of gauging material such as plastic, plasticine and metal
17.04.05	ability to compare actual clearances and specifications with physical or visual aids
17.04.06	ability to determine and make adjustments

Sub-task

17.05 Installs engineered products. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

17.05.01	knowledge of types of compression devices such as springs, compressed gas cylinders and urethane
17.05.02	knowledge of types of non-compression devices such as punch retainers, pilots, punches and buttons
17.05.03	knowledge of pre-loads on die springs, compressed gas cylinders and urethane
17.05.04	ability to use safe pre-load application methods
17.05.05	ability to verify installation of non-compression devices

Sub-task

17.06 Sets jig, fixture and die timing.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

17.06.01 knowledge of types of mechanisms such as cams, stock lifters and slide blocks

17.06.02 knowledge of types of jigs, fixtures and dies such as progressive, compound, form, drill jig, weld jig, and assembly fixture

17.06.03 knowledge of specified sequence of operations

17.06.04 ability to determine and make timing adjustments

17.06.05 ability to compare timing of sequence of operations to each other

Sub-task

17.07 Builds moulds.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	no	yes	ND	yes	yes	ND	ND	ND

17.07.01 knowledge of types of moulds such as injection, blow and rotary

17.07.02 knowledge of types of moulding machines

17.07.03 knowledge of cavities and cores

17.07.04 knowledge of gates and runners

17.07.05 knowledge of ejector systems

17.07.06 knowledge of temperature control fluid lines used for heating and cooling

17.07.07 knowledge of draft angles

17.07.08 knowledge of venting of mould cavities

17.07.09	knowledge of types of plastics and rubbers
17.07.10	knowledge of plastic shrinkage
17.07.11	knowledge of mould shut-offs
17.07.12	knowledge of surface finish
17.07.13	knowledge of polishing techniques
17.07.14	ability to operate moulding machines for try out purposes
17.07.15	ability to control mould temperatures
17.07.16	ability to adjust gates to maximize the injection process
17.07.17	ability to calculate shrinkage
17.07.18	ability to adjust cam movement
17.07.19	ability to install and adjust hydraulic and pneumatic system

Task 18 Repairs and maintains jigs and fixtures.

Context: Tool and die makers have to ensure that production tooling maintains the required accuracy. It is essential that they recognize the need for repair and maintenance of the jigs and fixtures.

Sub-task

18.01 Identifies condition of jigs and fixtures.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

18.01.01	knowledge of application of jigs and fixtures
18.01.02	knowledge of production part specifications
18.01.03	knowledge of types of defects such as worn bushings, broken clamps and worn guide surfaces

18.01.04	ability to evaluate production part for non-conformance to specifications
18.01.05	ability to compare jigs and fixtures to specifications
18.01.06	ability to record defects

Sub-task

18.02 Assembles/disassembles jigs and fixtures.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

18.02.01	knowledge of assembly/disassembly sequence of jigs and fixtures
18.02.02	knowledge of types of fasteners such as screws and dowels
18.02.03	knowledge of types of accessories such as hydraulic and pneumatic
18.02.04	ability to organize, label and store components
18.02.05	ability to remove accessories to access jigs and fixtures
18.02.06	ability to check clearances and align components

Sub-task

18.03 Cleans jigs and fixtures.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

18.03.01	knowledge of cleaning agents such as solvents and degreasers
18.03.02	knowledge of material characteristics and cleaning requirements

18.03.03 knowledge of cleaning tools, techniques and procedures

18.03.04 ability to remove residues such as grease, dirt and oil from component surface and recesses

Sub-task

18.04 Corrects faulty components.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

18.04.01 knowledge of types of tooling hardware such as bushings and hinges

18.04.02 knowledge of jigs and fixtures specifications such as material types, properties and dimensions

18.04.03 ability to fabricate and recondition components

18.04.04 ability to install and fit new or reconditioned components

18.04.05 ability to decide replacement method such as fabricating, reconditioning and purchasing

Sub-task

18.05 Verifies dimensional accuracy.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

18.05.01 knowledge of functions of jigs and fixtures such as guiding drills and guiding routers

18.05.02 knowledge of original specifications of jigs and fixtures

18.05.03 ability to compare actual measurements to specifications

Task 19 Repairs and maintains dies.

Context: Tool and die makers have to ensure that production tooling maintains the required accuracy. It is essential that they recognize the need for repair and maintenance of dies.

Sub-task

19.01 Evaluates production parts.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

Supporting Knowledge & Abilities

19.01.01	knowledge of parts specifications such as dimensions, finish and edge quality
19.01.02	knowledge of types of defects such as burrs and cracks
19.01.03	ability to compare part quality with specifications and master part
19.01.04	ability to record observations and substandard conditions

Sub-task

19.02 Verifies clearances are set to material requirements.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

Supporting Knowledge & Abilities

19.02.01	knowledge of material composition and thickness
19.02.02	knowledge of types of die processes such as cutting, forming and drawing
19.02.03	ability to compare current dimensions with original specifications
19.02.04	ability to apply alternate measuring techniques such as using malleable materials

Sub-task

19.03 Verifies timing of die mechanisms.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

19.03.01	knowledge of types of die mechanisms such as cams, strippers and stock pushers
19.03.02	knowledge of function and sequence of die operation
19.03.03	ability to identify timing fault
19.03.04	ability to record timing fault

Sub-task

19.04 Identifies repair procedures.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

19.04.01	knowledge of types of repair procedures such as disassembling, resurfacing, adjusting timing of die mechanisms and sharpening
19.04.02	knowledge of accessories such as pneumatic actuators and micro-switches
19.04.03	knowledge of specifications of die components
19.04.04	ability to analyze information recorded during evaluation
19.04.05	ability to develop repair procedure
19.04.06	ability to decide on repair procedure

Sub-task

19.05 Reconditions die components. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

19.05.01	knowledge of repair procedures such as sharpening, adjusting, timing and polishing
19.05.02	knowledge of reconditioning tools such as hones, grinders and laps
19.05.03	ability to fabricate new components
19.05.04	ability to adjust timing of die mechanisms
19.05.05	ability to sharpen die and punch sections
19.05.06	ability to polish surfaces
19.05.07	ability to confirm completeness of recondition procedure
19.05.08	ability to replace standard components

Sub-task

19.06 Assembles dies. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

19.06.01	knowledge of assembly sequence of dies
19.06.02	knowledge of types of fasteners such as screws and dowels
19.06.03	knowledge of types of accessories such as nitrogen, hydraulic and pneumatic
19.06.04	ability to organize, label and store components
19.06.05	ability to remove accessories to access dies
19.06.06	ability to check clearances and align components

Sub-task

19.07 Modifies dies to enhance productivity.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

19.07.01	knowledge of production improvement factors such as change of die material and coating
19.07.02	knowledge of material strip layout
19.07.03	knowledge of metal properties of die components and production part
19.07.04	knowledge of current production values such as batch sizes and sharpening cycle
19.07.05	ability to identify die changes that will lead to increased productivity
19.07.06	ability to record modification plans
19.07.07	ability to fabricate die components
19.07.08	ability to prepare die components for coatings
19.07.09	ability to compare improved productivity with original throughput

Task 20 Proves out jigs, fixtures and dies.

Context: New and reconditioned jigs, fixtures and dies must be proved out before being put into service. This ensures their safety, functionality and accuracy.

Sub-task

20.01 Sets up jigs, fixtures and dies.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

20.01.01	knowledge of types of presses such as punch press, brake press and hydraulic press

20.01.02	knowledge of press tool operations
20.01.03	knowledge of types of machine tools and their operations
20.01.04	ability to install and align tools into press or machine
20.01.05	ability to connect accessory systems such as stock feeders, hydraulic lines and pneumatic clamps

Sub-task

20.02 Verifies production part material.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

20.02.01	knowledge of production part specifications such as composition and thickness
20.02.02	knowledge of material properties
20.02.03	knowledge of material classifications such as ANSI, Society Of Automotive Engineers (SAE) and UNS
20.02.04	ability to identify materials by physical properties
20.02.05	ability to interpret material identification such as conformance documents and trace identification tags

Sub-task

20.03 Develops blank.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

20.03.01	knowledge of part geometry

20.03.02	knowledge of material composition and thickness
20.03.03	knowledge of types of dies, jigs and fixtures such as draw dies, form dies, trim dies, checking fixture, assembly fixture, and drill jig
20.03.04	ability to evaluate material changes such as thinning, thickening, folding and flow
20.03.05	ability to determine draw radius
20.03.06	ability to determine profile geometry

Sub-task

20.04 Cycles equipment with jigs, fixtures and dies.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

20.04.01	knowledge of different modes of press operations
20.04.02	knowledge of strip layout, stock progression and feed mechanism
20.04.03	ability to operate press
20.04.04	ability to perform press adjustments such as shut height, pressure pads and counterbalance
20.04.05	ability to operate machine tool at reduced rate
20.04.06	ability to load the production material

Sub-task

20.05 Evaluates production part.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

20.05.01	knowledge of part specifications

	20.05.02	knowledge of tool layout
	20.05.03	ability to examine and measure part
	20.05.04	ability to confirm that part conforms to specifications
	20.05.05	ability to confirm tool function

Sub-task

20.06 Checks tool for damage.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

	20.06.01	knowledge of jig, fixture and die function and operation
	20.06.02	knowledge of critical areas to check for damage
	20.06.03	ability to visually inspect tools for damage such as cracks, breaks and deformities
	20.06.04	ability to use optical aids such as loupe eyeglasses

Sub-task

20.07 Ensures machine and tool are operating within expected parameters.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	yes	yes	yes	ND	yes	yes	ND	ND	ND

	20.07.01	knowledge of production expectations such as production part volume and consistency
	20.07.02	knowledge of stock handling equipment
	20.07.03	ability to adjust mechanisms such as stock feeders and limit switches

APPENDICES

TOOLS AND EQUIPMENT

Safety Equipment

dust mask
eye wash station
fire blanket
fire extinguishers
fire hoses
first aid station
goggles/safety glasses/
face shield
hand protection
hearing protectors
protective head gear
respirators
safety barrier tapes
safety boots

Hand Tools

abrasive stones
Allen keys
bearing extractor
brushes
chisels
chuck key
clamps
deburrers
dressing stick
drill drift
drill gauge
file cards
file handles
files
grease guns
hacksaws and blades
hammers/mallets
hand reamers
honing stones
lapping plate
layout die
loupe eyeglass
magnifying screens and glasses
metal stamps
oil cans/guns
oil feeders
pliers
spotting blue
punches and bars
rasps
scrapers
screwdrivers
soft jaws
tap extractors
tap wrenches
temperature sticks
tin snips
torch tip lighters
wheel dressers (hand held)
wrenches

Power Tools

air grinder
bench grinder
die grinder
disc grinder
drill press
portable drill
power saws

Machine Tools

abrasive cut-off saw
band saw
computer numerical control (CNC) machine tools
die spotting press
drilling machines
electrical discharge machine (EDM)
grinders
hydraulic/mechanical press
jig bore
lathe
milling machines

Cutting Tools

abrasive wheels
boring bars
boring heads
broaches
counterbore
countersink
drill bits
EDM electrodes
grinding wheels
knurling tools
milling cutters
reamers
saw blades
spotfacers
taps and die
turning tools

Layout Equipment

combination set
dividers and trammels
etchers
hermaphrodite calipers
layout dye
layout table
punches
scribers
squares
surface gauges
surface plates / surface tables
vernier height gauge

Measuring Tools

angle gauge blocks
angle plate
bore gauge
calipers
combination square
coordinate measuring machine (CMM)
deflection tester
depth gauge
dial indicators
die maker square
electronic measuring devices
feeler gauge
gauge blocks
hardness tester
height micrometer
measuring rods
measuring tape
micrometers
non-destructive testing equipment
optical comparator
optical flats
precision blocks
precision level
protractor
radius gauge
refractometer
sine bar (compound)

Measuring Tools (continued)

sine plate (compound)
small hole gauge
squares
steel rules
surface finish comparator
surface plate
telescopic gauge
temperature block
tensile strength tester
thread gauge
three wire thread measuring pins
tool ball
tooling presetters
trammel
transfer type instruments
vernier caliper
vernier height gauge
vernier protractor

Heat Treating Equipment

furnaces
ladles
quenching mediums
tongs
torches
stainless steel wrap

Accessories and Work Holding Devices

adaptors
angle plates
arbour press
arbours
centre and edge finders
centres
chucks
clamps
collets
crane
degreasing tanks
die light
dividing head
drill chuck
drive dogs
drive plate
faceplates
follower/travelling rest
grinding attachment
grinding wheel balancers
grinding wheel dressers
hoists
indexing heads
jacks
lathe centres
lathe dogs
machine vise
mandrels
parallels
precision stops
quick change toolpost
relieving attachments
rotary grinding attachments
rotary table
shim stock
slings
spacers
steady rest
tail stock
taper sleeves
taper turning attachment
tapping head
tool holders
trip dogs
turret toolpost
V-block
vises

GLOSSARY

anneal	softening hardened steel through the heat treating process
boring	a machining process that produces a cylindrical or conical hole using a single point tool
Brinell	a scale for measuring hardness
carburize	the process of impregnating the surface of steel with carbon
computer numerical control (CNC)	the control of a machine tool using coded instructions
die	a device for cutting or forming material to produce a finished product
drill press	a machine used to produce holes in workpieces; reaming, tapping, spotfacing and countersinking can also be performed on drill presses
fixture	a work holding device to position a workpiece
grinder	a machine that removes material from workpieces using abrasive wheels
heat treatment	the heating and cooling of metals to modify their mechanical properties
induction hardening	a method of hardening the surface of a soft steel part by inducing heat with the aid of an electric induction coil
jig	a device that holds a piece in position to guide a cutting tool
knurling	using a tool to produce a pattern on the diameter of a workpiece in a lathe
lathe	a machine that holds and rotates the workpiece; a cutting tool is moved on slideways to cut cylindrical, tapered or threaded features on a workpiece
Machinery's Handbook	a reference book used in manufacturing by professionals such as engineers, toolmakers and machinists
mill	a machine that cuts surfaces and contours by holding the workpiece against a rotating cutter with single or multiple cutting edges
mould	tool used to manufacture components in large quantities
normalize	removing internal stress from the metal
prototype	a test product manufactured with non-production tools to assist in the development of an end product

proves out	procedure to test out prototypes, jigs, fixtures and dies for function
quench	to cool heated material at a pre-determined rate to set the material hardness
Rockwell tester	a tester for the measurement of hardness using the Rockwell scales
saw	a machine used to cut materials using a multi-tooth blade
spotface	a flat surface at 90° to a hole
tapping	cutting threads within a hole using a cutting tool called a tap
temper	a method of changing the hardness of steel parts by first heating to a low temperature then cooling; tempering improves toughness
threading die	a cutting tool to cut external threads

LIST OF ACRONYMS

ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineering
CAD	Computer Aided Design
CAM	Computer Aided Manufacturing
CMM	coordinate measuring machine
CNC	Computer Numerical Control
EDM	Electrical Discharge Machine
G code	preparatory command
GDT	geometric dimensioning and tolerancing
HSS	high speed steel
M Code	miscellaneous function command
NDT	non-destructive testing
NPS	National Pipe Straight
NPT	National Pipe Taper
S Code	spindle speed control
SAE	Society of Automotive Engineers
UNC	Unified National Course (a thread system for course threads)
UNF	Unified National Fine (a thread system for fine threads)
UNS	Universal Numbering System
WHMIS	Workplace Hazardous Materials Information System

BLOCK AND TASK WEIGHTING

BLOCK A OCCUPATIONAL SKILLS

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	NV	15	NV	NV	20	15	15	ND	10	15	ND	ND	ND	15%

Task 1 Uses tools and equipment.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	NV	35	NV	NV	20	25	50	ND	50	40	ND	ND	ND	37%

Task 2 Organizes work.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	NV	25	NV	NV	30	25	10	ND	10	20	ND	ND	ND	20%

Task 3 Performs benchwork.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	NV	25	NV	NV	30	40	30	ND	25	20	ND	ND	ND	28%

Task 4 Maintains shop machines and shop tooling.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	NV	15	NV	NV	20	10	10	ND	15	20	ND	ND	ND	15%

BLOCK B MACHINE SETUP AND OPERATION

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	NV	30	NV	NV	25	15	35	ND	40	30	ND	ND	ND	29%

Task 5 Plans machine operations.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	NV	20	NV	NV	10	40	5	ND	20	10	ND	ND	ND	18%

Task 6 Operates drill presses.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	NV	5	NV	NV	10	5	10	ND	10	7	ND	ND	ND	8%

Task 7 Operates lathes.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	NV	14	NV	NV	20	10	20	ND	10	13	ND	ND	ND	14%

Task 8 Operates milling machines.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	NV	14	NV	NV	20	20	20	ND	10	20	ND	ND	ND	17%

Task 9 Operates power saws.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	NV	5	NV	NV	10	5	5	ND	10	7	ND	ND	ND	7%

Task 10 Operates grinders.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	NV	14	NV	NV	10	20	15	ND	10	13	ND	ND	ND	14%

Task 11 Operates CNC machines.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	NV	14	NV	NV	10	0	15	ND	20	20	ND	ND	ND	13%

Task 12 Operates Electrical Discharge Machines (EDM).

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	NV	14	NV	NV	10	0	10	ND	10	10	ND	ND	ND	9%

BLOCK C PROTOTYPES

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	NV	5	NV	NV	20	5	10	ND	20	15	ND	ND	ND	13%

Task 13 Builds prototype.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	NV	60	NV	NV	70	50	60	ND	50	70	ND	ND	ND	60%

Task 14 Proves out prototypes.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	NV	40	NV	NV	30	50	40	ND	50	30	ND	ND	ND	40%

BLOCK D METALLURGY AND MATERIALS

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	NV	10	NV	NV	5	5	5	ND	10	10	ND	ND	ND	7%

Task 15 Heat treats materials.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	NV	70	NV	NV	30	80	70	ND	50	70	ND	ND	ND	62%

Task 16 Tests materials.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	NV	30	NV	NV	70	20	30	ND	50	30	ND	ND	ND	38%

BLOCK E JIGS, FIXTURES AND DIES

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	NV	40	NV	NV	30	60	35	ND	20	30	ND	ND	ND	36%

Task 17 Builds jigs, fixtures and dies.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	NV	60	NV	NV	30	30	60	ND	50	40	ND	ND	ND	45%

Task 18 Repairs and maintains jigs and fixtures.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	NV	10	NV	NV	20	20	10	ND	10	20	ND	ND	ND	15%

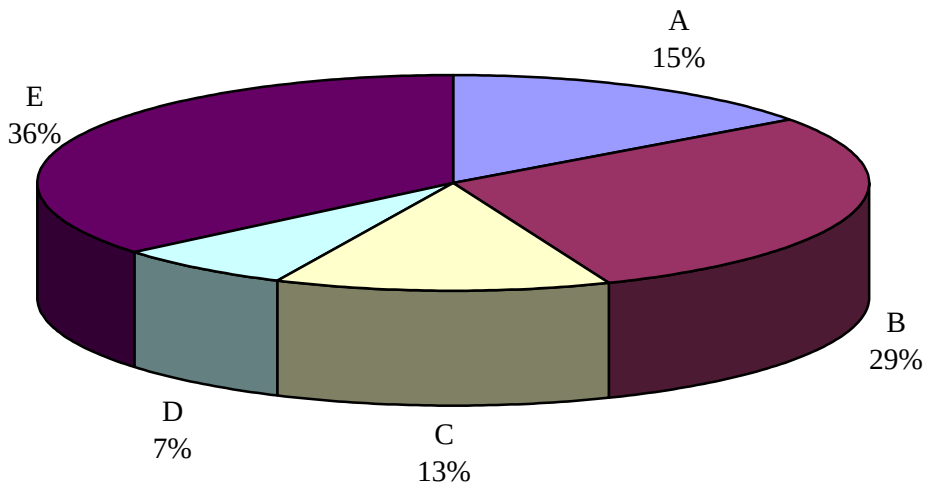
Task 19 Repairs and maintains dies.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	NV	10	NV	NV	25	20	10	ND	10	20	ND	ND	ND	16%

Task 20 Proves out jigs, fixtures and dies.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	NV	20	NV	NV	25	30	20	ND	30	20	ND	ND	ND	24%

PIE CHART*



TITLES OF BLOCKS

Block A	Occupational Skills	Block D	Metallurgy and Materials
Block B	Machine Setup and Operation	Block E	Jigs, Fixtures and Dies
Block C	Prototypes		

* Average percentage of the total number of questions on an interprovincial examination, assigned to assess each block of the analysis, as derived from the collective input from workers within the occupation from all areas of Canada. Interprovincial examinations typically have from 100 to 150 multiple-choice questions.

TASK PROFILE CHART – TOOL AND DIE MAKER (2005)

BLOCKS	TASKS	SUB-TASKS					
A **OCCUPATIONAL SKILLS**	**1. Uses tools and equipment.**	1.01 Uses hand tools.	1.02 Uses power tools.	1.03 Uses measuring devices.	1.04 Uses hoisting and lifting equipment.	1.05 Uses layout tools and equipment.	1.06 Uses personal protective equipment (PPE) and safety equipment.
	2. Organizes work.	2.01 Uses documentation.	2.02 Maintains safe work environment.	2.03 Communicates with others.	2.04 Plans sequence of operations.	2.05 Selects materials.	
	3. Performs benchwork.	3.01 Performs layout.	3.02 Marks material for identification.	3.03 Deburrs workpiece.	3.04 Finishes workpiece.	3.05 Inspects workpiece.	
	4. Maintains shop machines and shop tooling.	4.01 Cleans machines.	4.02 Lubricates machines.	4.03 Sharpens cutting tools.	4.04 Maintains cutting fluid and coolant.		
B **MACHINE SETUP AND OPERATION**	**5. Plans machine operations.**	5.01 Selects tooling, accessories and work holding devices.	5.02 Plans machine sequence.	5.03 Sets up work holding devices.	5.04 Sets up machine tooling and accessories.	5.05 Sets up workpiece.	5.06 Selects speeds and feeds.
		5.07 Performs calculations.					
	6. Operates drill presses.	6.01 Drills holes.	6.02 Produces hole features.				
	7. Operates lathes.	7.01 Turns surfaces.	7.02 Faces surfaces.	7.03 Knurls.	7.04 Parts off workpiece.	7.05 Drills holes with lathes.	7.06 Produces hole features with lathes.

BLOCKS	TASKS	SUB-TASKS					
		7.07 Cuts grooves.	7.08 Cuts threads.				
	8. Operates milling machines.	8.01 Faces surfaces.	8.02 Mills profiles and pockets.	8.03 Drills holes with milling machines.	8.04 Produces hole features with milling machines.		
	9. Operates power saws.	9.01 Saws straight and angle cuts.	9.02 Cuts irregular shapes.				
	10. Operates grinders.	10.01 Prepares grinding wheel.	10.02 Grinds workpiece.	10.03 Grinds profiles.			
	11. Operates CNC machines.	11.01 Inputs program data into control memory.	11.02 Interprets program codes.	11.03 Edits programs. **(NOT COMMON CORE)**	11.04 Establishes work datum.	11.05 Verifies programs.	11.06 Adjusts offsets.
		11.07 Monitors machining processes.	11.08 Interrupts program cycle.	11.09 Restarts program cycle.			
	12. Operates Electrical Discharge Machines (EDM).	12.01 Determines flushing.	12.02 Sets cutting conditions.				
C PROTOTYPES	**13. Builds prototype.**	13.01 Sets up prototype components.	13.02 Joins prototype components.				
	14. Proves out prototypes.	14.01 Verifies measurements.	14.02 Inspects prototype.	14.03 Evaluates function of prototype.			

TOOL AND DIE MAKER (2005)

	BLOCKS	TASKS	SUB-TASKS					
D	**METALLURGY AND MATERIALS**	**15. Heat treats materials.**	15.01 Selects heating mediums.	15.02 Operates heat treating equipment.	15.03 Quenches materials.	15.04 Tempers materials.	15.05 Anneals materials.	15.06 Normalizes materials.
			15.07 Carburizes materials.					
		16. Tests materials.	16.01 Performs hardness test.	16.02 Performs non-destructive testing (NDT). **(NOT COMMON CORE)**	16.03 Performs spark test.	16.04 Performs tensile strength test. **(NOT COMMON CORE)**	16.05 Performs deflection test. **(NOT COMMON CORE)**	
E	**JIGS, FIXTURES AND DIES**	**17. Builds jigs, fixtures and dies.**	17.01 Verifies dimensions of jig, fixture and die components.	17.02 Positions jig, fixture and die components.	17.03 Fastens jig, fixture and die components together.	17.04 Sets jig, fixture and die clearance.	17.05 Installs engineered products.	17.06 Sets jig, fixture and die timing.
			17.07 Builds moulds.					
		18. Repairs and maintains jigs and fixtures.	18.01 Identifies condition of jigs and fixtures.	18.02 Assembles/ disassembles jigs and fixtures.	18.03 Cleans jigs and fixtures.	18.04 Corrects faulty components.	18.05 Verifies dimensional accuracy.	
		19. Repairs and maintains dies.	19.01 Evaluates production parts.	19.02 Verifies clearances are set to material requirements.	19.03 Verifies timing of die mechanisms.	19.04 Identifies repair procedures.	19.05 Reconditions die components.	19.06 Assembles dies.
			19.07 Modifies dies to enhance productivity.					

TOOL AND DIE MAKER (2005)

BLOCKS	TASKS	SUB-TASKS					
	20. Proves out jigs, fixtures and dies.	20.01 Sets up jigs, fixtures and dies.	20.02 Verifies production part material.	20.03 Develops blank.	20.04 Cycles equipment with jigs, fixtures and dies.	20.05 Evaluates production part.	20.06 Checks tool for damage.
		20.07 Ensures machine and tool are operating within expected parameters.					