



ONTARIO COLLEGE OF TRADES

ORDRE DES MÉTIERS DE L'ONTARIO

Apprenticeship
Curriculum Standard

Mould Maker

Level 3

Trade Code: 431A

Date: 2008

Please Note: Apprenticeship Training and Curriculum Standards were developed by the Ministry of Training, Colleges and Universities (MTCU). As of April 8th, 2013, the Ontario College of Trades (College) has become responsible for the development and maintenance of these standards. The College is carrying over existing standards without any changes.

However, because the Apprenticeship Training and Curriculum Standards documents were developed under either the *Trades Qualification and Apprenticeship Act* (TQAA) or the *Apprenticeship and Certification Act, 1998* (ACA), the definitions contained in these documents may no longer be accurate and may not be reflective of the *Ontario College of Trades and Apprenticeship Act, 2009* (OCTAA) as the new trades legislation in the province. The College will update these definitions in the future.

Meanwhile, please refer to the College's website (<http://www.collegeoftrades.ca>) for the most accurate and up-to-date information about the College. For information on OCTAA and its regulations, please visit: <http://www.collegeoftrades.ca/about/legislation-and-regulations>

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Mould Maker – Level 3

Introduction

This curriculum revision for the Level 3 – Mould Maker for the Machining and Tooling trades is based upon the on-the-job performance objectives, located in the industry approved training standard.

The curriculum is organized into 9 reportable subjects. The Program Summary of Reportable Subjects chart summarizes the training hours for each reportable subject.

The curriculum identifies only the learning that takes place off-the-job. The in-school program focuses primarily on the theoretical knowledge and the essential skills required to support the performance objectives of the Apprenticeship Training Standards. Employers/Sponsors are expected to extend the apprentice's knowledge and skills through practical training on the work site. Regular evaluations of the apprentice's knowledge and skills are conducted throughout training to ensure that all apprentices have achieved the learning outcomes identified in the curriculum standard.

It is not the intent of the in-school curriculum to perfect on-the-job skills. The practical portion of the in-school program is used to reinforce theoretical knowledge. Skill training is provided on the job.

Mould Maker – Level 3

Program Summary of Reportable Subjects –Level 3

Number	Reportable Subjects	Hours Total	Hours Theory	Hour Practical
S0640	Applied Trade Calculations, Charts, Tables	18	18	0
S0641	Complex Engineering Drawings/CAD Data	18	9	9
S0642	Metallurgy of Mould Components	6	6	0
S0643	Metrology (Measuring and Checking)	6	6	0
S0644	Ram/Sink Electrical Discharge Machine (EDM) Technology	30	18	12
S0645	Computer Numerical Control (CNC) Technology for Machining Centres	24	20	4
S0646	Thermoplastic Injection Moulding and Die-casting Mould Processes	24	24	0
S0647	Building Processes and Techniques for Thermoplastic Injection Moulds and Die-casting Moulds	84	20	64
S0648	Final-Finishing, Polishing, and Engraving Techniques for Thermoplastic Injection Moulds.	30	10	20
	Total Hours	240	131	109

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Number: **S0640**

Reportable Subject: **APPLIED TRADE CALCULATIONS, CHARTS, TABLES**

Duration: Total 18 hours Theory 18 hours Practical 0 hours

Prerequisites: L1 CC: S0601, S0602, S0603, S0604, S0605, S0606, S0607, S0608, S0609, S0610, S0611
L2: S0629; S0630; S0631; S0632; S0633; S0633; S0634; S0635; S0636; S0637; S0638; S0639

Content: S0640.1 Solve trade-specific problems involving oblique triangles and solve for unknown values. **(4.5 hrs)**
S0640.2 Solve trade-specific problems involving the law of sines and solve for unknown values. **(4.5 hrs)**
S0640.3 Solve trade-specific problems involving the law of cosines and cotangents and solve for unknown values. **(4.5 hrs)**
S0640.4 Solve trade-specific problems involving compound angles. **(4.5 hrs)**

This module is intended to review appropriate mathematical principles to trade-specific applications.

Evaluation & Testing: Assignments related to theory and application skills
Minimum of one mid-term test during the term
Final test at end of term
Periodic quizzes

Mark Distribution:

Theory Testing	Practical Application Testing	Final Assessment
100 %	0%	100%

Instructional and Delivery Strategies: Lecture
Video
Paper based material
CBT
Internet On-Line

Reference Materials: Technology of Machine Tools
Shop Text Books

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S0640.0 Applied Trade Calculations, Charts, Tables

Duration: Total 18 hours Theory 18 hours Practical 0 hours

Cross-Reference to Training Standards: 431A: U5246, U5247, U5248, U5249, U5250, U5251, U5252, U5253, U5254, U5255, U5256, U5257, U5258, U5259

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to: solve trade-specific problems involving oblique triangles; solve trade-specific problems involving the law of sines; solve trade-specific problems involving the law of cosines/cotangents; solve trade-specific problems involving compound angles; and, solve for unknown values.

LEARNING OUTCOMES AND CONTENT

40.1 Solve trade-specific problems involving oblique triangles and solve for unknown values. **(4.5 hrs)**

Describe an oblique triangle.

Calculate the values of the unknown sides of oblique triangles.

40.2 Solve trade-specific problems involving the law of sines and solve for unknown values. **(4.5 hrs)**

Describe law of sines.

Calculate the values of unknown sides and angles of oblique triangles using the law of sines:

- values of two angles and one side
- values of two sides and one angle

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- 40.3 Solve trade-specific problems involving the law of cosines and cotangents and solve for unknown values. **(4.5 hrs)**

Describe the law of cosines and cotangents.

Calculate the values of the unknown sides and angles of oblique triangles using the law of cosines and cotangents:

- values of two sides and the included angle
- values of three sides

- 40.4 Solve trade-specific problems involving compound angles. **(4.5 hrs)**

Describe compound angles.

Calculate the values of compound angles for tilt and rotation.

Mould Maker – Level 3

Number: **S0641**

Reportable Subject: **COMPLEX ENGINEERING DRAWINGS/CAD DATA**

Duration: Total 18 hours Theory 9 hours Practical 9 hours

Prerequisites: L1 CC: S0601, S0602, S0603, S0604, S0605, S0606, S0607, S0608, S0609, S0610, S0611
L2: S0629; S0630; S0631; S0632; S0633; S0633; S0634; S0635; S0636; S0637; S0638; S0639

Content: S0641.1 Interpret injection mould component prints. **(3 hrs)**
S0641.2 Interpret injection mould assembly engineering drawings and CAD data. **(3 hrs)**
S0641.3 Interpret injection mould piece-part prints. **(3 hrs)**
S0641.4 Interpret injection mould-specific reference materials, tables, and charts. **(3 hrs)**
S0641.5 Develop an operational plan for building and assembling an injection mould. **(6 hrs)**

Evaluation & Testing: Assignments related to theory and application skills
Minimum of one mid-term test during the term
Final test at end of term
Periodic quizzes

Mark Distribution:

Practical Application Testing	Theory Testing	Final Assessment
50%	50 %	100%

Instructional and Delivery Strategies: Lecture
Video
Paper based material
CBT
Internet On-Line

Reference Materials: Technology of Machine Tools
Shop Text Books

Mould Maker – Level 3

S0641.0 Complex Engineering Drawings/CAD Data

Duration: Total 18 hours Theory 9 hours Practical 9 hours

Cross-Reference to Training Standards: 431A: U5246, U5247, U5248, U5249, U5250, U5251, U5252, U5253, U5254, U5255, U5256, U5257, U5258, U5259

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to interpret mould drawings/CAD data, part/product prints, component prints, mould assembly prints, and mould-making tables and charts; and, develop an operational plan for building and assembling an injection mould.

LEARNING OUTCOMES AND CONTENT

41.1 Interpret injection mould component prints. **(3 hrs)**

Describe types and application of mould components:

- A & B plates
- clamping plates
- ejector plates
- parallels
- sprue bushings
- hot runners
- core inserts
- cavity inserts
- slides
- lifters
- purchased components
- rack and pinion
- springs
- roller bearings
- swivels/universal joints
- seals

Describe the drawing scale of mould components.

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41.1 Continued

Interpret the language of mould component prints, symbols, abbreviations, and specifications:

- bill of material
- graphic shape
- symbols
- scales
- title block
- surface finish
- engineering change notice (ECN)
- detail drawings
- heat-treating

Calculate fractional, decimal, and metric dimensional values:

- shape
- fits
- allowances
- angles
- nominal sizes
- tolerances
- references
- concentricity
- squareness
- parallelism

Interpret injection mould components prints.

41.2 Interpret injection mould assembly engineering drawings and CAD data. **(3 hrs)**

Identify types of mould assembly and sub-assemblies:

- injection
- blow
- die cast

Identify mould assemblies components, dimensions, and fits.

Identify the application of graphic representations:

- detail
- sub-assembly
- assembly

Interpret mould assembly prints.

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41.3 Interpret injection mould piece-part prints. **(3 hrs)**

Interpret the symbols and abbreviations of mould piece-part prints to determine:

- piece-part material
- surface finish
- secondary operations
- dimensions
- general notes

41.4 Interpret injection mould-specific reference materials, tables, and charts. **(3 hrs)**

Interpret mould-specific reference materials, tables, and charts to determine:

- shrinkage
- draft
- ejector detail
- core pins
- cored threads
- cored studs
- springs
- rack
- pinion
- platen data
- hardness

41.5 Develop an operational plan for building and assembling an injection mould. **(6 hrs)**

Interpret drawings and job specifications to determine machining methods and procedures.

Interpret drawings and job specifications to determine operational sequences.

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Number: **S0642**

Reportable Subject: **METALLURGY OF MOULD COMPONENTS**

Duration: Total 6 hours Theory 6 hours Practical 0 hours

Prerequisites: L1 CC: S0601, S0602, S0603, S0604, S0605, S0606,
S0607, S0608, S0609, S0610, S0611
L2: S0629; S0630; S0631; S0632; S0633; S0633;
S0634; S0635; S0636; S0637; S0638; S0639

Content: S0642.1 Describe safe working procedures when setting up and operating heat-treating equipment. **(1 hr)**
S0642.2 Describe ferrous metal heat-treating processes. **(5 hrs)**

Evaluation & Testing: Assignments related to theory and application skills
Minimum of one mid-term test during the term
Final test at end of term
Periodic quizzes

Mark Distribution:

Theory Testing	Practical Application Testing	Final Assessment
100 %	0%	100%

Instructional and Delivery Strategies: Lecture
Video
Paper based material
CBT
Internet On-Line

Reference Materials: Technology of Machine Tools
Shop Text Books
Basic and Advanced Mould Making

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S0642.0 Metallurgy of Mould Components

Duration: Total 6 hours Theory 6 hours Practical 0 hours

Cross-Reference to Training Standards: 431A: U5248, U5249, U5250, U5251, U5252, U5253, U5254, U5255, U5256, U5258, U5259

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to describe ferrous metal heat-treating processes.

LEARNING OUTCOMES AND CONTENT

42.1 Describe safe working procedures when setting up and operating heat-treating equipment. (1 hr)

Identify potential safety hazards which may occur during the setting up and operating of heat-treating equipment.

Describe safe working habits while performing heat-treating including:

- protective clothing
- protective equipment and gear
- temperatures
- ventilation
- excessive heat
- storage
- handling of equipment
- fire hazards

Mould Maker – Level 3

42.2 Describe ferrous metal heat-treating processes. (5 hrs)

Describe the process and advantages of metal heat-treating processes:

- nitriding alloy steels
- gas carburizing parts
- liquid carburizing of steel
- induction hardening

Describe the methodology and procedures for metal heat-treating processes:

- types of gases
- hardness
- toughness
- strength
- type of furnace
- quenching media
- quenching procedures
- heat-treating specifications
- machinability
- workpiece materials

Mould Maker – Level 3

Number: **S0643**

Reportable Subject: **METROLOGY (MEASURING AND CHECKING)**

Duration: Total 6 hours Theory 6 hours Practical 0 hours

Prerequisites: L1 CC: S0601, S0602, S0603, S0604, S0605, S0606, S0607, S0608, S0609, S0610, S0611
L2: S0629; S0630; S0631; S0632; S0633; S0633; S0634; S0635; S0636; S0637; S0638; S0639

Content: S0643.1 Describe safe working procedures when setting up and operating measuring and checking equipment.
S0643.2 Describe the fundamentals of measuring, checking, and gauging equipment. **(1 hr)**
S0643.3 Describe the components, adjusting mechanisms, and working principles of an optical comparator and coordinate measuring machines (CMM). **(1 hr)**
S0643.4 Describe measuring and checking techniques using an optical comparator. **(2 hrs)**
S0643.5 Describe the functions and operating principles of coordinate measuring machines (CMM). **(2 hrs)**

Evaluation & Testing: Assignments related to theory and application skills
Minimum of one mid-term test during the term
Final test at end of term
Periodic quizzes

Mark Distribution:

Theory Testing	Practical Application Testing	Final Assessment
100 %	0%	100%

Instructional and Delivery Strategies: Lecture
Video
Paper based material
CBT
Internet On-Line

Reference Materials: Technology of Machine Tools
Shop Text Books

Mould Maker – Level 3

S0643.0 Metrology (Measuring and Checking)

Duration: Total 6 hours Theory 6 hours Practical 0 hours

Cross-Reference to Training Standards: 431A: U5247, U5248, U5249, U5250, U5251, U5252, U5253, U5254, U5255, U5256, U5257, U5258, U5259

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to: demonstrate inspection and checking techniques using measuring and checking equipment; and, describe measuring and checking techniques using optical comparators and coordinate measuring machine (CMM).

LEARNING OUTCOMES AND CONTENT

43.1 Describe safe working procedures when setting up and operating measuring and checking equipment.

Identify potential safety hazards which may occur during the set-up and operating of measuring and checking equipment.

Demonstrate safe work habits including:

- protective clothing
- protective equipment and gear
- good housekeeping
- operation procedures
- lubricants
- securing workpieces
- stabilizing workpieces
- storage of equipment
- handling of equipment
- lock-out procedures
- tagging procedures

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43.2 Describe the fundamentals of measuring, checking, and gauging equipment. **(1 hr)**

Describe measuring, checking, and gauging equipment:

- compound sine plate
- sine bar and sine plate
- precision rollers and balls
- precision cylindrical square
- precision level
- plug, ring, snap gauges
- profilometer
- tooling balls
- dial test gauges
- mechanical comparator
- coordinate measuring machine (CMM)

43.3 Describe the components, adjusting mechanisms, and working principles of an optical comparator and coordinate measuring machine (CMM). **(1 hr)**

Describe the parts of an optical comparator:

- illumination mechanism
- surface illumination
- table
- dials
- mylars
- screen
- micrometer dial
- read out
- angular settings/adjustments
- linear settings/adjustments
- locks
- magnification
- on/off

Describe the parts of a CMM:

- granite work table
- bridge
- head
- probe
- computer
- CAD surface data
- printer
- software interface
- joystick

Mould Maker – Level 3

43.4 Describe measuring and checking techniques using an optical comparator.
(2 hrs)

Describe cleaning techniques of workpiece surfaces.

Identify features to be measured and/or checked.

Describe measurement and checking of geometric features.

Describe recording techniques.

43.5 Describe the functions and operating principles of a coordinate measuring machine (CMM). **(2 hrs)**

Describe cleaning techniques of workpiece surfaces.

Describe calibration/orientation techniques.

Identify features to be measured and/or checked.

Describe recording techniques.

Mould Maker – Level 3

Number: **S0644**

Reportable Subject: **RAM/SINK ELECTRICAL DISCHARGE MACHINING (EDM) TECHNOLOGY**

Duration: Total 30 hours Theory 18 hours Practical 12 hours

Prerequisites: L1 CC: S0601, S0602, S0603, S0604, S0605, S0606, S0607, S0608, S0609, S0610, S0611
L2: S0629; S0630; S0631; S0632; S0633; S0633; S0634; S0635; S0636; S0637; S0638; S0639

Content: S0644.1 Describe safe working procedures when setting up and operating an EDM machine.
S0644.2 Identify machine controls, dielectric fluid requirements, and settings of ram/sink type EDM machines. **(5 hrs)**
S0644.3 Describe the assembly of EDM electrodes and holders. **(6 hrs)**
S0644.4 Describe the operational characteristics of ram/sink EDM. **(5 hrs)**
S0644.5 Describe EDM techniques to produce mould components. **(6 hrs)**
S0644.6 Describe EDM machining procedures. **(8 hrs)**

Evaluation & Testing: Assignments related to theory and application skills
Minimum of one mid-term test during the term
Final test at end of term
Periodic quizzes

Mark Distribution:

Theory Testing	Practical Application Testing	Final Assessment
60%	40%	100%

Instructional and Delivery Strategies: Lecture
Video
Paper based material
CBT
Internet On-Line

Reference Materials: Technology of Machine Tools
Shop Text Books

Mould Maker – Level 3

S0644.0 Ram/Sink Electrical Discharge Machining (EDM) Technology

Duration: Total 30 hours Theory 18 hours Practical 12 hours

Cross-Reference to Training Standards: 431A: U5255, U5257, U5258, U5259

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to describe ram/sink EDM machining for the fabrication of mould components.

LEARNING OUTCOMES AND CONTENT

44.1 Describe safe working procedures when setting up and operating an EDM machine.

Identify potential safety hazards which may occur during EDM set-up and operating procedures.

Demonstrate safe working habits including:

- protective clothing
- protective equipment and gear
- good housekeeping
- securing workpiece
- stabilizing workpiece
- start-up
- shut-down
- dielectric fluids
- lock out procedures
- tagging procedures

Mould Maker – Level 3

44.2 Identify machining controls, dielectric fluid requirements and settings of ram/sink type EDM machines. **(5 hrs)**

Describe the features and capabilities of ram/sink EDM:

- type
- workholding devices
- dielectric fluid
- electrodes
- holders

Identify machine controls, dielectric fluid, and operating principles of the EDM:

- application
- polarity
- table travel
- resistance capacity
- pulse type
- rotary impulse
- table movements

Describe feed control values and the graduations of micrometer collars.

44.3 Describe assembly of EDM electrodes and holders. **(6 hrs)**

Describe the machining characteristics of electrode materials:

- brass
- copper
- tungsten
- graphite

Describe required machining and manual methods to produce electrodes.

Describe electrode overburn allowances by determining:

- electrode material
- workpiece material
- removal rate

Describe the location and size of flushing channels and/or holes.

Describe the holding requirements.

Calculate the wear ratio of the electrode materials.

Mould Maker – Level 3

44.4 Describe the operational characteristics of ram/sink EDM. **(5 hrs)**

Identify EDM ram/sink operations by determining:

- application
- machining sequence
- workholding device
- travel limiting stops
- machining ratios
- feed
- electrode supporting requirements
- size
- cutting capacity

44.5 Describe EDM techniques to produce mould components. **(6 hrs)**

Identify the sequence to machine a component.

Identify the number of electrodes required by determining:

- workpiece stock removal
- electrode material
- workpiece material
- surface finish
- degree of accuracy
- flushing conditions

Describe overburn.

Describe EDM cutting arc conditions:

- shorted arc
- D/C arc
- open arc
- erratic cutting
- transistor failure
- excessive heat

Identify ram/sink EDM procedures to produce mould surfaces and shapes:

- flat
- contours
- angles
- slots
- holes

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44.6 Describe EDM machining procedures. **(8 hrs)**

Describe procedures for producing ribs or slots.

Describe procedures for sharpening pocket corners.

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Number: **S0645**

Reportable Subject: **COMPUTERIZED NUMERICAL CONTROL CNC TECHNOLOGY FOR MACHINING CENTRES**

Duration: Total 24 hours Theory 20 hours Practical 4 hours

Prerequisites: L1 CC: S0601, S0602, S0603, S0604, S0605, S0606, S0607, S0608, S0609, S0610, S0611
L2: S0629; S0630; S0631; S0632; S0633; S0633; S0634; S0635; S0636; S0637; S0638; S0639

Content: S0645.1 Describe safe working procedures when setting up and operating CNC machining centres.
S0645.2 Describe operating principles and applications of CNC machining centres. **(2 hrs)**
S0645.3 Describe part programming methods, set-up sheets, tooling lists, part program manuscripts, and input media for a CNC machining centres. **(2 hrs)**
S0645.4 Describe circular interpolation methods. **(4 hrs)**
S0645.5 Develop a plan for CNC programming. **(2 hrs)**
S0645.6 Demonstrate procedures for entering and verifying programs for a CNC machining centre. **(14 hrs)**

Evaluation & Testing: Assignments related to theory and application skills
Minimum of one mid-term test during the term
Final test at end of term
Periodic quizzes

Mark Distribution:

Theory Testing	Practical Application Testing	Final Assessment
75%	25%	100%

Mould Maker – Level 3

Instructional and Delivery Strategies:	Lecture Video Paper based material CBT Internet On-Line
Reference Materials:	Technology of Machine Tools Shop Text Books

Mould Maker – Level 3

S0645.0 Computerized Numerical Control CNC Technology for Machining Centres

Duration: Total 24 hours Theory 20 hours Practical 4 hours

Cross-Reference to Training Standards: 431A: U5254, U5255, U5256, U5257, U5258, U5259

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to describe numerically controlled machining centres techniques and demonstrate procedures for entering and verifying a CNC program to perform linear and circular interpolation machining operations.

LEARNING OUTCOMES AND CONTENT

45.1 Describe safe working procedures when setting up and operating CNC machining centres.

Identify potential safety hazards which may occur during the setting up and operation of CNC machining centres.

Identify safe working habits including:

- protective clothing
- protective equipment and gear
- good housekeeping
- start-up procedures
- shut-off procedures
- securing workpiece/cutting tools
- stabilizing workpiece/cutting tools
- lubricants
- fire hazards
- lock out procedures
- tagging procedures

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45.2 Describe operating principles and applications of CNC machining centres. **(2 hrs)**

Describe the capabilities of CNC machining centres:

- types of equipment
- editing capability
- program path ability
- processing power

Describe operating principles, applications, major features and functions of CNC machining centres.

Describe the major features of a CNC manufacturing process.

45.3 Describe part programming methods, set-up sheets, tooling lists, part program manuscripts, and input media for a CNC machining centres. **(2 hrs)**

Identify required documentation for CNC machining:

- set-up sheet and tooling list
- part program manuscript
- input media

Describe the individual components of a part program manuscript:

- sequence and tool numbers
- preparatory and miscellaneous functions
- axis motions and feed rates
- spindle speeds

Identify alternative word and block structures that exist within the part program code:

- decimal point programming
- block delete
- comments

Describe the individual components of a set-up sheet:

- part zero position
- part location
- clamp and fixture locations

Describe the individual components of a tooling list.

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45.3 Continued

Describe the common means of producing part program files:

- manual programming
- CAM system
- conversational programming

Describe manual interruption and manual data input on a machining centre:

- single block operation
- feedhold
- emergency stop
- line command execution
- set-up applications

Describe program data override:

- rapid motion override
- spindle speed override
- feedrate override
- dry run operation
- manual absolute setting
- practical applications

45.4 Describe circular interpolation methods. **(4 hrs)**

Describe circular interpolation planes:

- X - Y plane
- Z - X plane
- Y - Z plane
- arc centre modifiers

Describe circular interpolation commands:

- arc modifiers and describe
- radius
- quadrants
- circles
- cutter radius compensation

Mould Maker – Level 3

45.5 Develop a plan for CNC programming. **(2 hrs)**

Interpret documentation to determine:

- workpiece material specifications
- method of routing instructions
- special fixturing requirements

Plan sequence of machining by identifying:

- order of operations
- tooling requirements
- workpiece set-up
- stabilizing workpiece

45.6 Demonstrate procedures for entering and verifying programs for a CNC machining centre. **(14 hrs)**

Demonstrate use of preparatory commands (G-Codes).

Demonstrate use of G-Codes in a block.

Demonstrate use of M-Codes.

Demonstrate use of codes to specify dimensions.

Demonstrate use of codes to specify cutting medium function.

Demonstrate use of codes to specify reference

Demonstrate use of codes to produce a conforming part.

Demonstrate use of common machine function controls:

- mode selector
- rapid, feedrate and spindle overrides
- single block
- manual feed functions
- soft keys
- offset registers
- e-pack systems

Mould Maker – Level 3

Number: **S0646**

Reportable Subject: **THERMOPLASTIC INJECTION MOULDING AND DIE-CASTING MOULD PROCESSES**

Duration: Total 24 hours Theory 24 hours Practical 0 hours

Prerequisites: L1 CC: S0601, S0602, S0603, S0604, S0605, S0606, S0607, S0608, S0609, S0610, S0611
L2: S0629; S0630; S0631; S0632; S0633; S0633; S0634; S0635; S0636; S0637; S0638; S0639

Content: S0646.1 Describe types of thermoplastic injection moulding and die-casting mould processes. **(6 hrs)**
S0646.2 Describe tooling used in thermoplastic and die-cast moulds. **(6 hrs)**
S0646.3 Identify thermoplastic injection moulding and die-casting mould piece-part materials. **(6 hrs)**
S0646.4 Identify thermoplastic injection moulding and die-casting mould machines and equipment. **(6 hrs)**

Evaluation & Testing: Assignments related to theory and application skills
Minimum of one mid-term test during the term
Final test at end of term
Periodic quizzes

Mark Distribution:

Theory Testing	Practical Application Testing	Final Assessment
100%	0%	100%

Instructional and Delivery Strategies: Lecture
Video
Paper based material
CBT
Internet On-Line

Reference Materials: Shop Text Books
Basic and Advanced Mould Making

S0646.0 Thermoplastic Injection Moulding and Die-Casting Mould Processes

Duration: Total 24 hours Theory 24 hours Practical 0 hours

Cross-Reference to Training Standards: 431A: U5256, U5257, U5258, U5259

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to: describe the types of thermoplastic injection moulding and die cast mould processes; describe tooling used in thermoplastic injection moulding and die-casting mould operations; identify thermoplastic injection moulding and die-casting mould piece-part materials; identify thermoplastic injection moulding and die-casting mould machines and equipment;

LEARNING OUTCOMES AND CONTENT

46.1 Describe types of thermoplastic injection moulding and die-cast mould processes. **(6 hrs)**

Describe thermoplastic processes:

- injection
- blow
- thermo-vacuum
- extrusion
- die cast

Calculate elements and dimensions of mould components:

- material shrinkage values
- effect on part
- clearances
- draft angles
- radii on the core cavity
- cam or slide travel
- length
- bearing surfaces
- horn or cam pins
- hydraulic and mechanical travel
- clearances
- sliding CAM assemblies
- contraction and expansion

Mould Maker – Level 3

46.1 Continued

Interpret engineering drawings, CAD data, component prints, assembly, mould, and part drawings to verify mould component features.

Describe procedures for producing mould component details.

Describe verification procedures of mould component stock materials.

46.2 Describe tooling used in thermoplastic injection and die-cast moulds. **(6 hrs)**

Describe operational and design parameters of thermoplastic moulds:

- injection
- multi cavity
- family
- three plate
- hot runner

Describe operational and design parameters of thermo-set compression and transfer moulds:

- semi-positive
- positive
- landed plunger
- flash mould
- split wedge
- pot transfer
- sleeve transfer

Describe operational and design parameters of die-cast moulds:

- low temperature alloys (zinc)
- high temperature alloys (aluminums)

Describe operational and design parameters of vacuum/thermo-forming tools:

- pressure assisted vacuum forming
- free blowing
- rubber bag assisted forms
- product assisted (blister packaging)

Describe operational and design parameters of extruding tools:

- sheet extrusion
- tube/pipe extrusion
- profile extrusion
- wire coating
- continuous mould extrusion i.e. Big “O” Pipe

Mould Maker – Level 3

46.3 Identify thermoplastic injection moulding and die-casting mould piece-part materials. **(6 hrs)**

Describe types and characteristics of thermoplastic piece-part materials:

- thermoplastics
 - ABS
 - styrene/polystyrene
 - acrylic
 - nylon
 - polyethylene
 - polypropylene
 - vinyl

Describe types and characteristics of die-casting mould piece-part materials:

- metal alloys
 - aluminum
 - magnesium
 - zinc
 - copper
 - bronze
 - brass

46.4 Identify thermoplastic injection moulding and die-casting mould machines and equipment. **(6 hrs)**

Identify the types of processing and machining used in thermoplastic moulds and die-casting processes:

- injection moulding machine
- die-casting machine
- vacuum forming machine
- extruder
- blow moulding machine
- rota-moulding machine

Mould Maker – Level 3

Number: **S0647**

Reportable Subject: **BUILDING PROCESSES AND TECHNIQUES FOR THERMOPLASTIC INJECTION MOULDS AND DIE-CASTING MOULDS**

Duration: Total 84 hours Theory 20 hours Practical 64 hours

Prerequisites: L1 CC: S0601, S0602, S0603, S0604, S0605, S0606, S0607, S0608, S0609, S0610, S0611
L2: S0629; S0630; S0631; S0632; S0633; S0633; S0634; S0635; S0636; S0637; S0638; S0639

Content:

- S0647.1 Interpret engineering drawings, CAD data, component prints, assembly, mould, and part drawings to verify thermoplastic injection moulds and die-casting mould component features. **(4 hrs)**
- S0647.2 Interpret documentation to determine elements and features of thermoplastic injection moulds and die-casting moulds. **(3 hrs)**
- S0647.3 Demonstrate sketching techniques to produce a detailed thermoplastic injection mould or die-casting mould component. **(12 hrs)**
- S0647.4 Identify thermoplastic injection mould or die-casting mould stock materials. **(4 hrs)**
- S0647.5 Describe tooling aids used during the thermoplastic injection mould and die-casting mould building process. **(3 hrs)**
- S0647.6 Describe design parameters of thermoplastic injection mould and die-casting mould components. **(3 hrs)**
- S0647.7 Identify the machining processes used to produce thermoplastic injection moulds and die-casting mould components and tooling aids. **(3 hrs)**
- S0647.8 Identify workholding devices. **(2 hrs)**
- S0647.9 Develop a plan for the thermoplastic injection mould and die-casting mould building process. **(5 hrs)**
- S0647.10 Demonstrate procedures for building thermoplastic injection mould components for the assembly process. **(32 hrs)**
- S0647.11 Demonstrate the assembly of injection mould components. **(8 hrs)**
- S0647.12 Describe injection mould spotting. **(5 hrs)**

Mould Maker – Level 3

Evaluation & Testing: Assignments related to theory and application skills
Minimum of one mid-term test during the term
Final test at end of term
Periodic quizzes

Mark Distribution:

Theory Testing	Practical Application Testing	Final Assessment
25%	75%	100%

Instructional and Delivery Strategies: Lecture
Video
Paper based material
CBT
Internet On-Line

Reference Materials: Technology of Machine Tools
Shop Text Books
Basic and Advanced Mould Making

Mould Maker – Level 3

S0647.0 Building Processes and Techniques for Thermoplastic Injection Moulds and Die-Casting Moulds

Duration: Total 84 hours Theory 20 hours Practical 64 hours

Cross-Reference to Training Standards: 431A: U5256, U5257, U5258, U5259

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to: plan for thermoplastic injection moulding or die-casting mould building process; describe the fitting and assembling of thermoplastic injection moulds and die-casting mould components; produce thermoplastic injection or die-casting mould components; and, describe mould spotting techniques.

LEARNING OUTCOMES AND CONTENT

47.1 Interpret engineering drawings, CAD data, component prints, assembly, mould, and part drawings to verify the thermoplastic injection mould and die-casting mould component features. **(4 hrs)**

Interpret documentation to determine mould component construction.

Interpret part prints to determine:

- dimensions
- sizes
- tolerances
- limits
- fits
- shapes
- allowances
- surface finish
- draft angle
- material shrinkage

Interpret documentation to verify component features by identifying:

- inserts
- cavities
- cores/plunger
- slides
- lifters
- pins

Mould Maker – Level 3

47.2 Interpret documentation to determine elements and features of thermoplastic injection moulds and die-casting moulds. **(3 hrs)**

Calculate material shrinkage values and verify dimensions.

Interpret product-specific tables and charts to determine:

- clearances
- draft angles
- radii on the core and cavity
- shrinkage allowance for material

Calculate cam or slide travel by identifying:

- angle
- length
- bearing surfaces
- horn pins
- cam pins

Calculate travel distances of hydraulic or mechanical moving components:

- ejector pins
- lifter plate
- slides

Interpret job specifications to determine:

- clearances
- lubrication
- applications
- sliding cam assemblies

47.3 Demonstrate sketching techniques to produce a detailed thermoplastic injection mould or die-casting mould component. **(12 hrs)**

Demonstrate sketching procedures using piece-part specifications for thermoplastic injection mould and die-casting mould component details:

- shape
- dimensions
- tolerances
- finishes
- clearances

Mould Maker – Level 3

47.4 Identify thermoplastic injection and die-casting mould stock materials. **(4 hrs)**

Interpret engineering drawings to determine required stock materials:

- type
- grade
- dimensions
- surface condition
- hardening ability
- heat treatments

Select stock material.

47.5 Describe tooling aids used during the thermoplastic injection mould and die-casting mould building process. **(3 hrs)**

Describe the operating principles and design parameters of tooling aids:

- jigs
- fixtures
- templates

47.6 Describe the design parameters of thermoplastic injection moulds and die-casting mould components. **(3 hrs)**

Describe operating principles and design parameters of thermoplastic injection moulds or die-casting mould components:

- inserts
- cavities
- cores
- slides
- lifters
- water lines
- hot runner system

Mould Maker – Level 3

- 47.7 Identify the machining processes used to produce thermoplastic injection mould and die-casting mould components and tooling aids. **(3 hrs)**

Identify machining processes used for the production of thermoplastic injection moulds and die-casting mould components and tooling aids:

- turning
- milling
- grinding
- CNC
- EDM

- 47.8 Identify workholding devices. **(2 hrs)**

Identify workholding devices:

- grinding mandrel
- precision vises
- angle plates
- sine bars
- grinding chucks and jigs
- magnetic workholder

- 47.9 Develop a plan for the thermoplastic injection and die-casting mould building process. **(5 hrs)**

Develop a plan for the thermoplastic injection mould and die-casting mould building process that identifies:

- application
- workpiece material
- heat-treating
- thermoplastic mould components
- die-casting mould components
- machine tools
- machining procedures
- machining processes
- machine accessories
- tooling aids
- mould building sequence
- fitting procedures
- assembly procedures
- fabrication processes
- finishing procedures
- engraving procedures
- time lines

Mould Maker – Level 3

47.10 Demonstrate procedures for building thermoplastic injection mould components for the assembly process. **(32 hrs)**

Interpret engineering drawings and documentation to identify thermoplastic injection mould components:

- top clamping plate
- locating ring
- cavity retainer plate
- core retainer plate
- support plate
- bottom clamping plate
- parallels
- ejector retainer plate
- ejector plate
- spacer buttons
- pillars
- sprue bushing
- sprue puller pin
- return pin
- leader pin
- bushing

Describe the operating principles and design characteristics of thermoplastic injection mould components.

Demonstrate turning of thermoplastic injection mould components.

Demonstrate milling of thermoplastic injection mould components.

Demonstrate grinding of thermoplastic injection mould components.

Describe EDM techniques to produce thermoplastic injection mould components.

Mould Maker – Level 3

47.11 Demonstrate the assembly of injection mould components. **(8 hrs)**

Identify types of mould assemblies:

- injection
- blow
- die cast
- thermo vacuum forming
- extrusion

Describe hand and power tools used for assembly procedures.

Identify the sequence of mould component assembly.

Demonstrate the assembly of thermoplastic injection mould components.

47.12 Describe thermoplastic injection mould spotting. **(5 hrs)**

Determine the alignment of mould workfaces and parts of assembled mould.

Describe the set up and operation of a spotting press:

- safety devices
- activating controls
- deactivating controls
- clamping pressure
- lowering
- raising
- work table

Identify mould spotting equipment:

- honing tools
- transfer blue
- polishing tools
- grinding tools
- burrs

Identify the mould assembly features including:

- wall thickness
- seal off at parting lines
- pin locations
- alignment of mould components
- slide movement

Identify the functionality of the assembled thermoplastic injection mould.

Mould Maker – Level 3

Number: **S0648**

Reportable Subject: **FINAL-FINISHING, POLISHING, AND ENGRAVING TECHNIQUES FOR THERMOPLASTIC INJECTION MOULDS**

Duration: Total 30 hours Theory 10 hours Practical 20 hours

Prerequisites: L1 CC: S0601, S0602, S0603, S0604, S0605, S0606, S0607, S0608, S0609, S0610, S0611
L2: S0629; S0630; S0631; S0632; S0633; S0633; S0634; S0635; S0636; S0637; S0638; S0639

Content: S0648.1 Describe thermoplastic injection mould component final-finishing and polishing processes and techniques. **(10 hrs)**
S0648.2 Describe surface engraving procedures and methods. **(5 hrs)**
S0648.3 Demonstrate surface finish verification procedures and methods. **(15 hrs)**

Evaluation & Testing: Assignments related to theory and application skills
Minimum of one mid-term test during the term
Final test at end of term
Periodic quizzes

Mark Distribution:

Theory Testing	Practical Application Testing	Final Assessment
30%	70%	100%

Instructional and Delivery Strategies: Lecture
Video
Paper based material
CBT
Internet On-Line

Reference Materials: Shop Text Books
Basic and Advanced Mould Making

Mould Maker – Level 3

S0648.0 Final-Finishing, Polishing, and Engraving Techniques for Thermoplastic Injection Moulds

Duration: Total 30 hours Theory 10 hours Practical 20 hours

Cross-Reference to Training Standards: 431A: U5256, U5257, U5258, U5259

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to demonstrate final-finishing, polishing, and engraving techniques.

LEARNING OUTCOMES AND CONTENT

48.1 Describe thermoplastic injection mould component final-finishing and polishing processes and techniques. **(10 hrs)**

Describe final-finishing and polishing processes used to ensure surface conformity by determining:

- internal radii
- external radii
- contours
- inside/outside corners
- surface finish

Select final-finishing and polishing processes and equipment:

- vapour honing
- lapping
- stoning
- blast cleaning
- compounds
- polishing
- deburring

Mould Maker – Level 3

48.1 Continued

Select honing processes by determining:

- honing application
- dressing honing stones
- finish allowance
- surface finish
- material removal
- type of honing stone
- speed
- stroking procedures
- holding and mounting procedures

Demonstrate hand or power polishing processes by determining:

- types of surface
- rough finishing
- finish polishing
- finish allowance
- surface finish
- polishing pressure
- type of material
- type of abrasive tool
- shaping
- speeds
- abrasives
- material removal

Demonstrate use of abrasive powders and compounds to polish surface by determining:

- types
- grit sizes
- polishing characteristics
- rough finishing
- finish polishing
- thinners for diamond compound
- lubricators for diamond compound
- surface finish
- grain size
- material removal
- speeds

Mould Maker – Level 3

48.1 Continued

Describe the use of abrasive polishing discs and wheels by determining:

- types
- shapes
- sizes
- holding characteristics
- mounting characteristics
- composition
- cutting characteristics
- shaping characteristics
- speeds
- rough finishing
- finish polishing
- material removal
- surface finishes
- disc
- sleeve

Describe the process of polishing or finishing using diamond compounds by determining:

- types
- shapes
- polishing operations
- rough finishing
- finish polishing
- grit sizes
- micron sizes for diamond compound
- thinners
- lubricators
- material removal

Describe the blasting process for polishing and finishing by determining:

- sand blasting procedures
- glass bead process
- liquid honing process
- vapour honing process
- surface finish
- material removal
- pressures

Mould Maker – Level 3

48.2 Describe surface engraving procedures and methods. **(5 hrs)**

Describe features and capabilities of a pantograph.

Describe features and capabilities of computer driven lasers.

Describe features and capabilities of computer numerical control systems.

Describe features and capabilities of acid etching.

48.3 Demonstrate surface finish verification procedures and methods. **(15 hrs)**