



**Skilled  
Trades**  
Ontario

**Métiers  
spécialisés**  
Ontario

Apprenticeship  
Curriculum Standard

Mould Maker

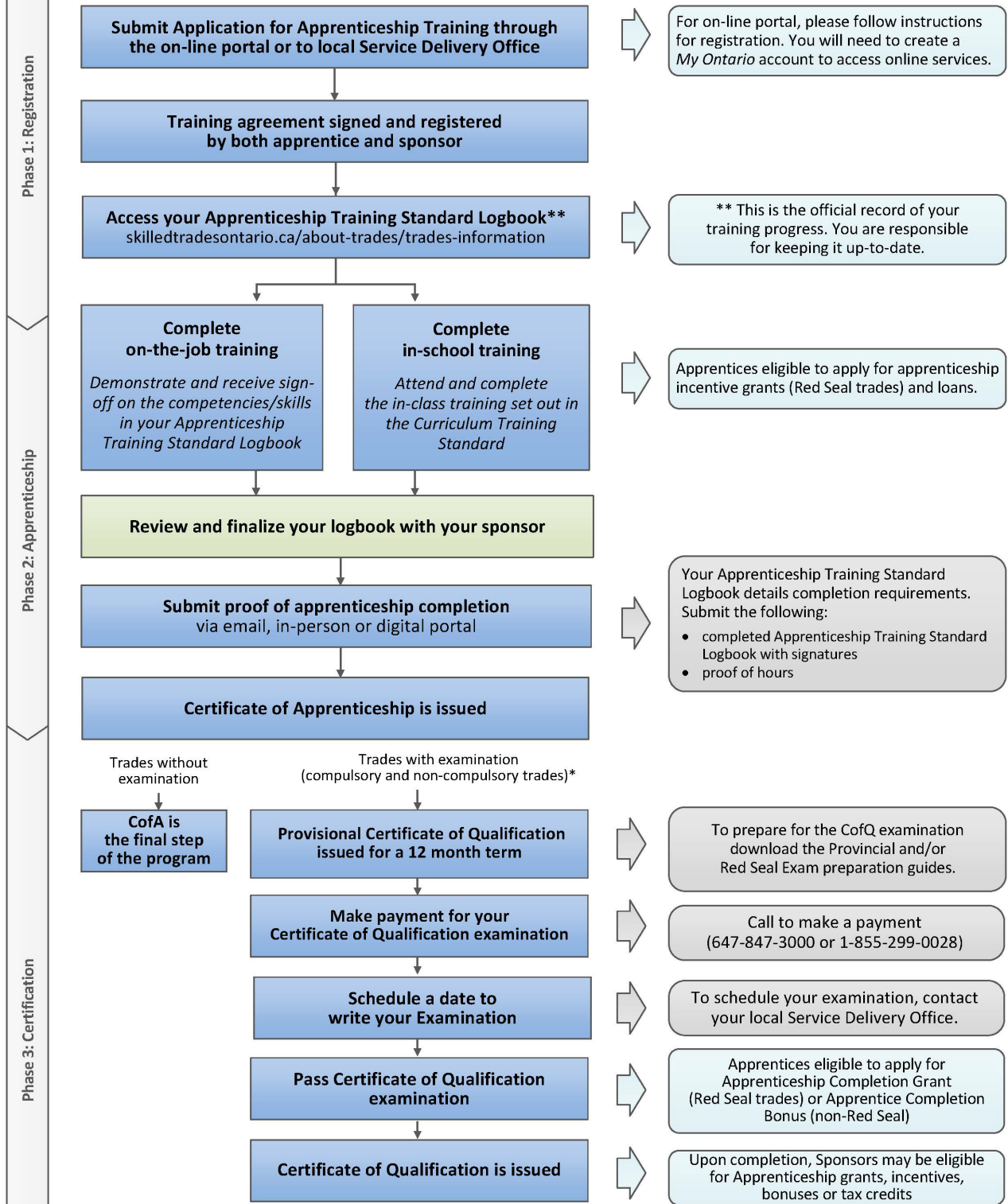
Level 3

431A

2008



# Apprenticeship Pathway to a Certificate of Qualification



\* For a list of trades subject to a certification examination, visit: [skilledtradesontario.ca](http://skilledtradesontario.ca)

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**Please Note:** This Standard has been revised to reflect the visual identity of Skilled Trades Ontario (STO) which replaced the Ontario College of Trades on January 1, 2022. The content of this Standard may refer to the former organization; however, all trade specific information or content remains relevant and accurate based on the original date of publishing.

Please refer to STO's website: [skilledtradesontario.ca](https://skilledtradesontario.ca) for the most accurate and up to date information. For information about BOSTA and its regulations, please visit [\*\*Building Opportunities in the Skilled Trades Act, 2021 \(BOSTA\)\*\*](#).

Any updates to this publication are available on-line; to download this document in PDF format, please follow the link: [Skilled Trades Ontario.ca](https://skilledtradesontario.ca).

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*Maintained with transfer to Skilled Trades Ontario 2008 (V100)*

## **Preface**

This curriculum standard for the Mould Maker for the Machining and Tooling trade program is based upon the on-the-job performance objectives, located in the industry-approved training standard.

This is the third level of 3 levels of training. The curriculum is organized into 9 reportable subjects. The Reportable Subjects Summary chart (located on page 3) summarizes the training hours for each reportable subject.

The curriculum identifies the learning that takes place in-school. 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 a work site. Regular evaluations of the apprentice's knowledge and skills are conducted throughout training to verify 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.

Please refer to Skilled Trades Ontario website ([www.skilledtradesontario.ca](http://www.skilledtradesontario.ca)) for the most accurate and up-to-date information about Skilled Trades Ontario. For information on *Building Opportunities in the Skilled Trades Act, 2021 (BOSTA)* and its regulations, please visit [Building Opportunities in the Skilled Trades Act, 2021, S.O. 2021, c. 28 - Bill 288 \(ontario.ca\)](http://www.skilledtradesontario.ca/building-opportunities-in-the-skilled-trades-act-2021-s.o.-2021-c.-28-bill-288)

## **Pre-requisites**

In order to advance to Level 2 of the apprenticeship program, an individual must have completed all of the units outlined in Level 1. Similarly, in order to advance to Level 3 of the program, an individual must have completed all of the units outlined in Level 1 and 2.

## **Hours Disclaimer (if applicable)**

It is agreed that Training Delivery Agents (TDAs) may need to make slight adjustments (with cause) according to particular apprentice needs and may deviate from the unit sequencing and the prescribed practical and theoretical hours shown within the standard. However, all TDAs will comply with the hours at the reportable subject level.

Personal and Safety Equipment: Personal protective equipment is at the discretion of the TDA who must conform to Ontario Provincial Health and Safety Regulations.

# **Mould Maker**

## **Level 3**

## Reportable Subject Summary-Level 3

<b>Number</b>	<b>Reportable Subjects</b>	<b>Hours Total</b>	<b>Hours Theory</b>	<b>Hours Practical</b>
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
	<b>Total</b>	<b>240</b>	<b>131</b>	<b>109</b>



Number: S0640  
Title: **Applied Trade Calculations, Charts, Tables**  
Duration: Total Hours: 18 Theory: 18 Practical: 0  
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

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

Reference Materials: Technology of Machine Tools  
Shop Text Books

Number:	S0640.0		
Title:	<b>Applied Trade Calculations, Charts, Tables</b>		
Duration:	Total Hours: 18	Theory: 18	Practical: 0

### 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

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.

<b>Evaluation Structure</b>		
Theory Testing	Practical Application Testing	Final Assessment
100%	0%	100%

<b>Number:</b>	S0641		
<b>Title:</b>	<b>Complex Engineering Drawings/CAD Data</b>		
<b>Duration:</b>	Total Hours: 18	Theory: 9	Practical: 9
<b>Prerequisites:</b>	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		
<b>Content:</b>	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)		
<b>Evaluation &amp; Testing:</b>	Assignments related to theory and application skills Minimum of one mid-term test during the term Final test at end of term Periodic quizzes		

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

**Reference Materials:** Technology of Machine Tools  
Shop Text Books

Number:	S0641.0		
Title:	<b>Complex Engineering Drawings/CAD Data</b>		
Duration:	Total Hours: 18	Theory: 9	Practical: 9

### 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.

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.

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.

<b>Evaluation Structure</b>		
Theory Testing	Practical Application Testing	Final Assessment
50%	50%	100%



Number:	S0642
Title:	<b>Metallurgy of Mould Components</b>
Duration:	Total Hours: 6                      Theory: 6                      Practical: 0
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

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

<b>Number:</b>	S0642.0		
<b>Title:</b>	<b>Metallurgy of Mould Components</b>		
<b>Duration:</b>	Total Hours: 6	Theory: 6	Practical: 0

### 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

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

<b>Evaluation Structure</b>		
Theory Testing	Practical Application Testing	Final Assessment
100%	0%	100%

<b>Number:</b>	S0643
<b>Title:</b>	<b>Metrology (Measuring and Checking)</b>
<b>Duration:</b>	Total Hours: 6                      Theory: 6                      Practical: 0
<b>Prerequisites:</b>	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
<b>Content:</b>	S0642.1 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)
<b>Evaluation &amp; Testing:</b>	Assignments related to theory and application skills Minimum of one mid-term test during the term Final test at end of term Periodic quizzes

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

Number:	S0643.0		
Title:	<b>Metrology (Measuring and Checking)</b>		
Duration:	Total Hours: 6	Theory: 6	Practical: 0

### 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

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

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.

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

<b>Number:</b>	S0644
<b>Title:</b>	<b>Ram/Sink Electrical Discharge Machining (EDM) Technology</b>
<b>Duration:</b>	Total Hours: 30                      Theory: 18                      Practical: 12
<b>Prerequisites:</b>	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
<b>Content:</b>	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)
<b>Evaluation &amp; Testing:</b>	Assignments related to theory and application skills Minimum of one mid-term test during the term Final test at end of term Periodic quizzes

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

**Reference Materials:**                      Technology of Machine Tools  
Shop Text Books



Number:	S0644.0		
Title:	<b>Ram/Sink Electrical Discharge Machining (EDM) Technology</b>		
Duration:	Total Hours: 30	Theory: 18	Practical: 12

### 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

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.

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

44.6 Describe EDM machining procedures. (8 hrs)

Describe procedures for producing ribs or slots.

Describe procedures for sharpening pocket corners.

<b>Evaluation Structure</b>		
Theory Testing	Practical Application Testing	Final Assessment
60%	40%	100%

Number:	S0645
Title:	<b>Computerized Numerical Control CNC Technology for Machining Centres</b>
Duration:	Total Hours: 24                      Theory: 20                      Practical: 4
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

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

Reference Materials:                      Technology of Machine Tools  
Shop Text Books

Number:	S0645.0		
Title:	<b>Computerized Numerical Control CNC Technology for Machining Centres</b>		
Duration:	Total Hours: 24	Theory: 20	Practical: 4

### 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

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.

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

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

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

Number:	S0646		
Title:	<b>Thermoplastic Injection Moulding and Die-Casting Mould Processes</b>		
Duration:	Total Hours: 24	Theory: 24	Practical: 0
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 injection 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		

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

Reference Materials: Shop Text Books  
Basic and Advanced Mould Making

Number:	S0646.0		
Title:	<b>Thermoplastic Injection Moulding and Die-Casting Mould Processes</b>		
Duration:	Total Hours: 24	Theory: 24	Practical: 0

### 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

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

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

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

Number:	S0647
Title:	<b>Building Processes and Techniques for Thermoplastic Injection Moulds and Die-Casting Moulds</b>
Duration:	Total Hours: 84                      Theory: 20                      Practical: 64
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)

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

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

Number:	S0647.0		
Title:	<b>Building Processes and Techniques for Thermoplastic Injection Moulds and Die-Casting Moulds</b>		
Duration:	Total Hours: 84	Theory: 20	Practical: 64

### 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



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

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

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

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.

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.

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

Number:	S0648		
Title:	<b>Final-Finishing, Polishing, and Engraving Techniques for Thermoplastic Injection Moulds</b>		
Duration:	Total Hours: 30	Theory: 10	Practical: 20
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		

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

Reference Materials:                           Shop Text Books  
  Basic and Advanced Mould Making

Number:	S0648.0		
Title:	<b>Final-Finishing, Polishing, and Engraving Techniques for Thermoplastic Injection Moulds</b>		
Duration:	Total Hours: 30	Theory: 10	Practical: 20

### 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

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



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

- 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)

<b>Evaluation Structure</b>		
Theory Testing	Practical Application Testing	Final Assessment
30%	70%	100%



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