Machinist

Guide to Course Content

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Recognition:
To promote transparency and consistency, this document has been adapted from the 2018 Machinist Red Seal Occupational Standard (Employment and Social Development Canada).

A complete version of the Occupational Standard can be found at www.red-seal.ca

STRUCTURE OF THE GUIDE TO COURSE CONTENT

To facilitate understanding of the occupation, this guide to course content contains the following sections:

Task Matrix: a chart which outlines graphically the major work activities, tasks and sub-tasks of this standard detailing the essential skills and the level of training where the content is covered.

Major Work Activity (MWA): the largest division within the standard that is comprised of a distinct set of trade activities.

Task: distinct actions that describe the activities within a major work activity.

Sub-task: distinct actions that describe the activities within a task.

Training Profile Chart: a chart which outlines the model for Saskatchewan Apprenticeship and Trade Certification Commission (SATCC) technical training.

Technical Training Course Content for the Machinist trade: a chart which outlines the model for SATCC technical training sequencing. For the harmonized level of training, a cross reference to the Harmonized apprenticeship technical training sequencing, at the learning outcome level, is provided.

TRAINING REQUIREMENTS FOR THE MACHINIST TRADE

To graduate from each level of the apprenticeship program, an apprentice must successfully complete the required technical training and compile enough on-the-job experience to total at least 1800 hours each year. Total trade time required is 7200 hours and at least 4 years in the trade.

There are four levels of technical training delivered by Saskatchewan Polytechnic in Saskatoon.

Level One:	8 weeks
Level Two:	8 weeks
Level Three:	8 weeks
Level Four:	6 weeks

The information contained in this guide to course content details the technical training delivered for each level of apprenticeship. An apprentice spends approximately 15% of their apprenticeship term in a technical training institute learning the technical and theoretical aspects of the trade. The hours and percentages of technical and practical training may vary according to class needs and progress.

The content of the technical training components is subject to change without notice.

Entrance Requirements for Apprenticeship Training

Your grade twelve transcripts (with no modified classes) or GED 12 is your guarantee that you meet the educational entrance requirements for apprenticeship in Saskatchewan. In fact, employers prefer and recommend apprentices who have completed high school. This ensures the individual has all of the necessary skills required to successfully complete the apprenticeship program and receive journeyperson certification.

Individuals with “modified” or “general” classes in math or science do not meet our entry requirements. These individuals are required to take an entrance assessment prescribed by the SATCC.

English is the language of instruction in all apprenticeship programs and is the common language for business in Saskatchewan. Before admission, all apprentices and/or “upgraders” must be able to understand and communicate in the English language.

Designated Trade Name	**Math Credit** at the Indicated Grade Level ❶	**Science Credit** at Grade Level
Machinist	Grade 11	Grade 10

❶ - (One of the following) WA – Workplace and Apprenticeship; or F – Foundations; or P – Precalculus, or a Math at the indicated grade level (Modified and General Math credits are not acceptable).

*Applicants who have graduated in advance of 2015-2016, or who do not have access to the revised Science curricula will require a Science at the minimum grade level indicated by trade.

For information about high school curriculum, including Math and Science course names, please see: - http://www.curriculum.gov.sk.ca/#

Individuals not meeting the entrance requirements will be subject to an assessment and any required training

MACHINIST TASK MATRIX

This chart outlines the major work activities, tasks and sub-tasks from the 2018 Machinist Red Seal Occupational Standard (RSOS). Each sub-task details the corresponding essential skill and level of training where the content is covered. *

* Sub Tasks with numbers in the boxes is where the content will be delivered in training.

A – PERFORMS COMMON OCCUPATIONAL SKILLS

Task A-1 Performs safety-related tasks	**1.01** Maintains safe work environment: 1, 2, 3, 4	**1.02** Uses personal protective equipment (PPE) and safety equipment: 1		
Task A-2 Organizes work	**2.01** Interprets documentation: 1	**2.02** Plans sequence of operations: 1		
Task A-3 Uses communication and mentoring techniques	**3.01** Uses communication techniques: 1	**3.02** Uses mentoring techniques: 1		
Task A-4 Processes workpiece material	**4.01** Selects workpiece material: 1, 2	**4.02** Uses hoisting, lifting and rigging equipment: 1	**4.03** Marks workpiece for identification: 1	**4.04** Performs heat treatment: 2, 3
	4.05 Performs quality control of workpiece: 1, 2, 3, 4	**4.06** Deburrs workpiece: 1	**4.07** Sketches parts: 1, 2	

Task A-5 **Maintains machines, tooling and inspection equipment**	**5.01** **Cleans machines** **1, 2**	**5.02** **Lubricates machines** **1**	**5.03** **Sharpens tooling** **1, 3**	**5.04** **Applies cutting fluid and coolant** **1**
	5.05 **Troubleshoots equipment** **1, 2, 3**	**5.06** **Maintains machine alignment** **1, 2**	**5.07** **Maintains inspection equipment** **1**	

B – PERFORMS BENCHWORK

Task B-6 **Performs hand processes**	**6.01** **Performs layout** **1**	**6.02** **Saws workpiece** **1**	**6.03** **Files workpiece** **1**	**6.04** **Performs hole making operations** **1**
	6.05 **Performs threading operations** **1**	**6.06** **Installs thread inserts** **1**	**6.07** **Broaches workpiece** **1**	**6.08** **Performs pressing operations** **1**
	6.09 **Forms workpiece** **1**	**6.10** **Finishes workpiece** **1**		
Task B-7 **Refurbishes components**	**7.01** **Disassembles components** **1**	**7.02** **Analyzes components** **1, 2**	**7.03** **Assembles components** **2**	

C – MACHINES USING POWER SAWS

Task C-8 Sets up power saws	**8.01** Selects power saw types 1	**8.02** Selects saw blades 1	**8.03** Installs saw blades 1	**8.04** Selects power saw speeds and feeds 1
	8.05 Makes power saw adjustments 1	**8.06** Sets up workpiece on power saw 1		
Task C-9 Operates power saws	**9.01** Saws straight and angle cuts 1	**9.02** Cuts irregular shapes 1		

D – MACHINES USING DRILL PRESS

Task D-10 Sets up drill presses	**10.01** Selects drill press types 1	**10.02** Plans operation of drill presses 1	**10.03** Selects drill press speeds and feeds 1	**10.04** Sets up jigs, fixtures and work holding devices for drill presses 1
	10.05 Sets up tooling for drill presses 1			
Task D-11 Operates drill presses	**11.01** Drills holes using a drill press 1	**11.02** Cuts countersinks, counterbores, chamfers and spot faces using a drill press 1	**11.03** Performs tapping using a drill press 1	**11.04** Finishes holes using a drill press 1

E – MACHINES USING CONVENTIONAL LATHES

Task E-12 Sets up conventional lathes	**12.01** Selects conventional lathe types 1	**12.02** Plans operation of conventional lathes 1, 2	**12.03** Sets up work holding devices for conventional lathes 1, 2	**12.04** Sets up tooling for conventional lathes 1, 2
	12.05 Sets up conventional lathe accessories 1, 2	**12.06** Sets up workpiece on conventional lathe 1, 2	**12.07** Selects conventional lathe speeds and feeds 1	
Task E-13 Operates conventional lathes	**13.01** Faces surfaces using a conventional lathe 1,	**13.02** Turns external surfaces using a conventional lathe 1, 2	**13.03** Drills using a conventional lathe 1	**13.04** Bores holes using a conventional lathe 1, 2
	13.05 Reams holes using a conventional lathe 1	**13.06** Turns tapers using a conventional lathe 1, 2	**13.07** Knurls using a conventional lathe 1	**13.08** Cuts grooves using a conventional lathe 1, 2
	13.09 Cuts threads using a conventional lathe 1, 2	**13.10** Parts off workpiece using a conventional lathe 1		

F – MACHINES USING CONVENTIONAL MILLING MACHINES

Task F-14 Sets up conventional milling machines	**14.01** Selects conventional milling machine types 1, 2	**14.02** Plans operation of milling machines 2, 3	**14.03** Sets up work holding devices for conventional milling machines 2, 3	**14.04** Sets up tooling for conventional milling machines 1, 2, 3
	14.05 Sets up milling accessories 2, 3, 4	**14.06** Sets up workpiece on a conventional milling machine 2, 3	**14.07** Selects conventional milling machine speeds and feeds 2, 3	

Task F-15 Operates conventional milling machines	**15.01** Mills surfaces using a conventional milling machine 2, 3	**15.02** Mills profiles and pockets using a conventional milling machine 2, 3	**15.03** Mills slots, grooves and keyways using a conventional milling machine 2, 3	**15.04** Cuts gears and splines using a conventional milling machine 2, 3, 4
	15.05 Drills holes using a conventional milling machine 2	**15.06** Reams holes using a conventional milling machine 2	**15.07** Cuts countersinks, counterbores, chamfers and spot faces using a conventional milling machine 2	**15.08** Performs tapping using a conventional milling machine 2
	15.09 Bores holes using a conventional milling machine 2, 3			

G – MACHINES USING PRECISION GRINDING MACHINES

Task G-16 Sets up precision grinding machines	**16.01** Selects precision grinding machine types 2, 3	**16.02** Plans operation of grinding machines 2, 3	**16.03** Sets up work holding devices for precision grinding machines 2, 3	**16.04** Mounts grinding wheel 2, 3
	16.05 Sets up grinding accessories 2, 3	**16.06** Sets up workpiece on precision grinding machines 2, 3	**16.07** Selects precision grinding machine speeds and feeds 2, 3	
Task G-17 Operates precision grinding machines	**17.01** Grinds flat surfaces using a surface grinder 2	**17.02** Grinds profiles 3	**17.03** Grinds internal and external cylindrical and tapered surfaces 3	**17.04** Grinds tools and cutters 3
	17.05 Finishes holes using a honing machine 3			

H – MACHINES USING COMPUTER NUMERICAL CONTROL (CNC) MACHINES

Task H-18 **Performs CNC programming**	18.01 Creates process documentation 2, 3	18.02 Creates manual input program 2, 3	18.03 Transfers program to and from control memory 2	**18.04** **Optimizes program** 3, 4
	18.05 Creates 2D and 3D models 3, 4	18.06 Programs using computer-aided manufacturing (CAM) 3, 4		
Task H-19 **Sets up CNC machines**	19.01 Selects tooling and tool holders for CNC machines 2, 3	19.02 Sets up tooling and tool holders on CNC machines 2, 3	19.03 Sets up workpieces on CNC machines 2, 3, 4	**19.04** **Establishes work datum** 2, 3
	19.05 Verifies program 2			
Task H-20 **Operates CNC machines**	20.01 Adjusts offsets 2, 3, 4	20.02 Monitors machining processes 2	20.03 Interrupts program cycle 2	**20.04** **Restarts program cycle** 2

TRAINING PROFILE CHART

This Training Profile Chart represents Saskatchewan Apprenticeship and Trade Certification Commission (SATCC) technical training at the topic level.

SATCC Level One	Transcript Code	Hours
Technical Drawing and Blueprint	DRFT 188	20
Power Saws	MACH 177	6
Lathes	MACH 175 (Theory)	12
	MACH 176 (Shop)	54
Milling	MACH 189	24
Materials and Measurement	MACH 192	8
Drilling	MACH 178 (Theory)	6
	MACH 193 (Shop)	8
Safety and Basic Shop Mechanics	ME 183	24
Technical Communication for Trades	TCOM 109	12
Benchwork	TOOL 173 (Theory)	14
	TOOL 174 (Shop)	34
Trade Mathematics (Exceed)	MATH 179	18
		240

SATCC Level Two	Transcript Code	Hours
Technical Drawing and Blueprint Reading	DRFT 283	24
Computer Numerical Control Operation and Programming	MACH 283	24
Materials/Heat Treatment	MACH 285	15
Precision Grinding	MACH 290 (Theory)	12
	MACH 291 (Shop)	14
Lathe	MACH 292 (Theory)	15
	MACH 293 (Shop)	42
Milling	MACH 294 (Theory)	20
	MACH 295 (Shop)	52
Refurbishment	MACH 296	6
Mathematics (Exceed)	MATH 258	16
		240

SATCC Level Three	Transcript Code	Hours
Power Transmission	MACH 383	24
CNC Machining	MACH 386	56
Technical Drawing and Blueprint Reading	PRNT 385	16
Cutting Tool Technology	TOOL 381	20
Machine Tools	TOOL 383 (Theory)	18
	TOOL 384 (Shop)	90
Mathematics (Exceed)	MATH 386	16
		240

SATCC Level Four	Transcript Code	Hours
CNC Machining	MACH 483	56
Material Select/Heat Treatment	MATE 481	12
Advanced Machine Tool (Theory)	TOOL 482	35
Advanced Machine Tool (Shop)	TOOL 484	77
		180

TECHNICAL TRAINING COURSE CONTENT

This chart outlines the model for Saskatchewan Apprenticeship and Trade Certification Commission (SATCC) technical training sequencing.

Sub-tasks listed are the minimum to be covered in a topic. Related sub-tasks not listed may be used as a reference and taught “in context” in other topics.

Level One — 8 weeks — 240 hours

Benchwork (Theory) — **14 hours**

- Identify layout tools
- Identify hand tools
- Identify cutting tools
- Identify power tools
- Identify layout techniques
- Identify mechanical hardware

Benchwork (Shop) — **34 hours**

- Demonstrate safe care and maintenance of equipment
- Use layout tools
- Use hand tools
- Use cutting tools
- Use power tools
- Perform assembly
- Perform surface refinishing

RSOS topics covered in this section of training:

A-4 Processes Workpiece Material
A-4.06 Deburrs workpiece

Lathes (Theory) — **12 hours**

- Identify turning machine features
- Identify work holding devices
- Identify cutting tools
- Identify speeds and feeds
- Identify turning to size operations
- Compare taper turning methods
- Calculate thread dimensions
- Prepare job plans

Lathes (Shop) **54 hours**

- Demonstrate safe care and maintenance of equipment
- Grind lathe tools
- Perform external turning
- Perform internal turning
- Perform grooving and parting
- Perform knurling
- Cut basic 60-degree screw threads
- Perform taper turning

RSOS topics covered in this section of training:

E-12 Sets Up Conventional Lathes
E-12.01 Selects conventional lathe types
E-12.02 Plans operation of conventional lathes
E-12.03 Sets up work holding devices for conventional lathes
E-12.04 Sets up tooling for conventional lathes
E-12.05 Sets up conventional lathe accessories
E-12.06 Sets up workpiece on conventional lathe
E-12.07 Selects conventional lathe speeds and feeds

E-13 Operates Conventional Lathes
E-13.01 Faces surfaces using a conventional lathe
E-13.02 Turns external surfaces using a conventional lathe
E-13.03 Drills using a conventional lathe
E-13.04 Bores holes using a conventional lathe
E-13.05 Reams holes using a conventional lathe
E-13.07 Knurls using a conventional lathe
E-13.08 Cuts grooves using a conventional lathe
E-13.09 Cuts threads using a conventional lathe
E-13.10 Parts off workpiece using a conventional lathe

Power Saws **6 hours**

- Identify sawing machines
- Demonstrate safe care and maintenance of equipment
- Use power saws

RSOS topics covered in this section of training:

C-8 Sets Up Power Saws
C-8.01 Selects power saw types
C-8.02 Selects saw blades
C-8.03 Installs saw blades
C-8.04 Selects power saw speeds and feeds
C-8.05 Makes power saw adjustments
C-8.06 Sets up workpiece on power saw

C-9 Operates Power Saws
C-9.01 Saws straight and angle cuts
C-9.02 Cuts irregular shapes

Drilling (Theory) **6 hours**

- Identify drilling machines
- Identify hole making tools
- Identify work holding devices and methods
- Identify speeds and feeds for drilling
- Describe cutting fluids

Drilling (Shop) **8 hours**

- Demonstrate safe care and maintenance of equipment
- Perform drilling operations
- Use countersinking and counter boring tools
- Use reamers
- Identify power tapping and boring operations
- Sharpen twist drills

RSOS topics covered in this section of training:

D-10 Sets Up Drill Presses
D-10.01 Selects drills press types
D-10.02 Plans operation of drill presses
D-10.03 Selects drill press speeds and feeds
D-10.04 Sets up jigs, fixtures and work holding devices for drill presses
D-10.05 Sets up tooling for drill presses

D-11 Operates Drill Presses
D-11.01 Drills holes using a drill press
D-11.02 Cuts countersinks, counterbores, chamfers and spot faces using a drill press
D-11.03 Performs tapping using a drill press
D-11.04 Finishes holes using a drill press

Trade Mathematics **18 hours**

- Use basic mathematics
- Convert between imperial and metric systems
- Use basic algebra
- Use basic geometry and trigonometry
- Perform trade calculations

This section of training exceeds the minimum sequencing as set out in the Machinist RSOS.

Safety and Basic Shop Mechanics **24 hours**

- Describe WHMIS
- Describe Occupational Health and Safety
- Perform basic rigging and hoisting techniques

- Set up oxy-acetylene equipment
- Use oxy-acetylene equipment

RSOS topics covered in this section of training:

A-1 Performs Safety-Related Tasks
A-1.01 Maintains safe work environment
A-1.02 Uses personal protective equipment (PPE) and safety equipment

A-4 Process Workpiece Material
A-4.02 Uses hoisting, lifting and rigging equipment

Technical Drawing and Blueprint Reading **20 hours**

- Use manual drafting instruments
- Demonstrate orthographic drawing skills (third angle projection)
- Use dimensioning systems
- Apply tolerances, section and auxiliary views
- Demonstrate isometric sketching
- Locate surfaces, features and dimensions on engineering drawing

RSOS topics covered in this section of training:

A-2 Organizes Work
A-2.01 Interprets documentation

A-4 Processes workpiece material
A-4.07 Sketches Parts

- Identify types of sketches and their purpose
- Describe basic sketching techniques and types of views
- Identify dimensions used in creating sketches
- Describe how to interpret and extract information from parts to create a sketch

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Milling **24 hours**

- Identify vertical milling machines cutting tools
- Identify vertical milling machine operations
- Identify work holding devices and methods
- Perform vertical milling machine operations
- Demonstrate safe care and maintenance of equipment

RSOS topics covered in this section of training:

F-14 Sets Up Conventional Milling Machine Types
F-14.01 Selects conventional milling machine types

Materials and Measurement — 8 hours

- Recognize measurement systems
- Read steel rules
- Read vernier scale instruments
- Read micrometers
- Describe comparison measuring tools
- Describe gauge block use
- Read angular measuring tools
- Identify materials
- Identify surface finish
- Identify non-metals

RSOS topics covered in this section of training:

B-6 Performs Hand Processes
B-6.01 Performs layout

Technical Communication for Trades — 12 hours

- Solve common grammatical errors to meet technical writing requirements
- Write shop documentation
- Demonstrate knowledge of effective workplace communications

RSOS topics covered in this section of training:

A-3 Uses Communication and Mentoring Techniques
A-3.01 Uses communication techniques
A-3.02 Uses mentoring techniques

Level Two — 8 weeks — 240 hours

Mathematics — 16 hours

- Use basic algebra
- Use basic geometry and trigonometry
- Perform trade calculations

This section of training exceeds the minimum sequencing as set out in the Machinist RSOS.

Technical Drawing and Blueprint Reading — 24 hours

- Use manual drafting instruments
- Demonstrate orthographic drawing skills
- Use various drawing commands in CAD drafting
- Use various editing commands in CAD drafting
- Place dimensions on drawings
- Find dimensional data on technical drawings
- Apply tolerances to sectional and auxiliary views

RSOS topics covered in this section of training:

A-4 Processes workpiece material
A-4.07 Sketches part

Computer Numerical Control Operation and Programming — 24 hours

- Demonstrate safe care and maintenance of equipment
- Describe movement principles
- Examine turning machine programming
- Perform turning machine set up and operation
- Examine machining centre programming
- Perform machining centre set up and operation
- Describe applications of CAD/CAM systems

RSOS topics covered in this section of training:

H-18 Performs CNC programming
H-18.01 Creates process documentation
H-18.02 Creates manual input program
H-18.03 Transfers program to and from control memory

H-19 Sets up CNC machines
H-19.01 Selects tooling and tool holders for CNC machines
H-19.02 Sets up tooling and tool holders for CNC machines
H-19.03 Sets up workpiece on CNC machines
H-19.04 Establishes work datum
H-19.05 Verifies program

H-20 Operates CNC machines
H-20.01 Adjusts offsets
H-20.02 Monitors machining processes
H-20.03 Interrupts program cycle
H-20.04 Restarts program cycle

Materials/Heat Treatment **15 hours**

- Demonstrate safe care and maintenance of equipment
- Identify properties of materials
- Perform hardening and tempering
- Describe annealing, normalizing, and stress relieving processes
- Perform hardness testing

RSOS topics covered in this section of training:

A-4 Processes workpiece material
A-4.01 Selects workpiece material
A-4.04 Performs heat treatment
A-4.05 Performs quality control of workpiece

Precision Grinding (Theory) **12 hours**

- Identify grinding machines
- Identify grinding wheels
- Describe grinding wheel use
- Describe cutting fluids
- Develop job plans for grinding projects.

Precision Grinding (Shop) **14 hours**

- Demonstrate safe care and maintenance of equipment
- Service precision grinders
- Perform grinding wheel service
- Operate precision grinders

RSOS topics covered in this section of training:

G-16 Machines using precision grinding machines
G-16.01 Selects precision grinding machine types
G-16.02 Plans operation of grinding machines
G-16.03 Sets up work holding devices for precision grinding machines
G-16.04 Mounts grinding wheel
G-16.05 Sets up grinding accessories
G-16.06 Sets up workpiece on precision grinding machines
G-16.07 Selects precision grinding machine speeds and feeds

G-17 Operates precision grinding machines
G-17.01 Grinds flat surfaces using a surface grinder

Lathe Operations (Theory) **15 hours**

- Identify carbide tooling
- Identify precision tapers
- Identify tapered threads
- Identify steady rests and follower rests

Lathe Operations (Shop) **42 hours**

- Demonstrate safe care and maintenance of equipment
- Cut precision tapers
- Cut a tapered thread
- Use a steady rest
- Use a follower rest
- Perform internal sleeving

RSOS topics covered in this section of training:

A-5 Maintains machines, tooling and inspection equipment
A-5.05 Troubleshoots equipment
A-5.06 Maintains machine alignment

E-12 Sets up conventional lathes
E-12.02 Plans operation of conventional lathes
E-12.03 Sets up holding devices for conventional lathes
E-12.04 Sets up tooling for conventional lathes
E-12.05 Sets up conventional lathe accessories
E-12.06 Sets up workpiece on conventional lathe

E-13 Operates conventional lathes
E-13.02 Turns external surfaces using a conventional lathe
E-13.04 Bores holes using a conventional lathe
E-13.06 Turns tapers using a conventional lathe
E-13.08 Cuts groves using a conventional lathe
E-13.09 Cuts threads using a conventional lathe

Milling (Theory) **20 hours**

- Identify milling machine types
- Identify vertical milling machine cutting tools
- Identify vertical milling operations
- Identify horizontal milling cutting tools
- Identify horizontal milling operations
- Identify work holding devices and methods

Milling (Shop) **52 hours**

- Demonstrate safe care and maintenance of equipment
- Perform vertical milling operations
- Perform horizontal milling machine operations
- Use indexing devices

RSOS topics covered in this section of training:

A-5 Maintains machines, tooling and inspection equipment
A-5.05 Troubleshoots equipment
A-5.06 Maintains machine alignment

F-14 Machines using conventional milling machines
F-14.01 Selects conventional milling machine types
F-14.02 Plans operation of milling machines
F-14.03 Sets up work holding devices for conventional milling machines
F-14.04 Sets up tooling for conventional milling machines
F-14.05 Sets up milling accessories
F-14.06 Sets up workpiece on a conventional milling machine
F-14.07 selects conventional milling machine speeds and feeds

F-15 Operates conventional milling machines
F-15.02 Mills profiles and pockets using conventional milling machines
F-15.03 Mills slots, grooves and keyways using a conventional milling machine
F-15.04 Cuts gears and splines using conventional milling machines (indexing calculations)
F-15.05 Drills holes using a conventional milling machine
F-15.06 Reams holes using a conventional milling machine
F-15.07 Cuts countersinks, counterbores, chamfers and spot faces using conventional milling machines
F-15.08 Performs tapping using a conventional milling machine
F-15.09 Bores holes using a conventional milling machine

Refurbishment **6 hours**

- Demonstrate safe care and maintenance of equipment
- Disassemble gear box
- Analyze components
- Assemble gear box

RSOS topics covered in this section of training:

B-7 Refurbishes components
B-7.02 Analyzes components
B-7.03 Assembles components

Level Two topics that may be taught in context:

Organizes work
Communication and mentoring
Hand processes

For details regarding the in-context topics, see page 44

Level Three — 8 weeks — 240 hours

Power Transmission — 24 hours

- Identify power transmitting threads
- Measure power transmitting threads
- Classify keyed drives
- Apply tolerances to keys and key seats
- Identify splines
- Identify common shaft coupling arrangements
- Identify common types of clutches
- Identify types of gears

RSOS topics covered in this section of training:

A-4 Processes workpiece material
A-4.05 Performs quality control

F-15 Operates conventional milling machines
F-15.03 Mills slots, grooves and keyways using a conventional milling machine
F-15.04 Cuts gears and splines using a conventional milling machine

CNC Machining — 56 hours

- Describe the 2 axis coordinate grid
- Describe key tool positions
- Describe basic CNC codes
- Describe tool offsets
- Set tool offsets on the CNC lathe
- Make a point sketch from a part drawing
- Manually compensate for tool radius
- Describe complex g-codes
- Write a part program for the CNC lathe using multiple repetitive cycles for roughing, finishing, and threading
- Program using CAM
- Machine a part using CAM

RSOS topics covered in this section of training:

H-18 Machines using computer numerical control (CNC) machines
H-18.01 Creates process documentation
H-18.02 Creates manual input program
H-18.04 Optimizes program
H-18.05 Creates 2D and 3D models
H-18.06 Programs using CAM

H-19 Sets up CNC machines
H-19.01 Selects tooling and tool holders for CNC machines
H-19.02 Sets up tooling and tool holders on CNC machines

H-19.03 Sets up workpiece on CNC machines
H-19.04 Establishes work datum

H-20 Operates CNC machines
H-20.01 Adjusts offsets

Trade Mathematics **16 hours**

- Use mathematics in machine shop applications
- Use machine shop formulae
- Use trigonometric principles in a variety of machine shop formulae

This section of training exceeds the minimum sequencing as set out in the Machinist RSOS.

Technical Drawings and Blueprint Reading **16 hours**

- Find data for machining of parts on engineering drawings
- Locate surfaces, features, and dimensions on combined sectional engineering drawings
- Identify surfaces, features and machining dimensions from auxiliary sectional engineering drawings
- Find machining data on detail sections and assembly drawings on engineering drawings
- Use various drawing commands in CAD drafting
- Use various editing commands in CAD drafting
- Create 2D and 3D models

RSOS topics covered in this section of training:

A-4 Processes workpiece material
A-4.07 Sketches part

H-18 Machines using computer numerical control (CNC) machines
H-18.05 Creates 2D and 3D models

Cutting Tool Technology **20 hours**

- Discuss cutting tool materials
- Select cutting tool geometries
- Identify common causes of tool failure
- Discuss hole making tools
- Discuss surface texture
- Optimize metal removal rates

RSOS topics covered in this section of training:

A-5 Maintains machines, tooling and inspection equipment
A-5.05 Troubleshoots equipment

Machine Tools (Theory) **18 hours**

- Explain conventional lathe setups and operations
- Explain conventional milling machine setups and operations
- Explain horizontal boring mill (HBM) setups and operations
- Explain precision grinder setups and operations

Machine Tools (Shop) **90 hours**

- Demonstrate safe care and maintenance of equipment
- Perform conventional lathe setups and operations
- Perform conventional milling machine setups and operations
- Perform horizontal boring mill (HBM) setups and operations
- Perform precision grinder setups and operations
- Perform materials testing
- Record quality assurance measurements

RSOS topics covered in this section of training:

F-14 Machines using conventional milling machines
F-14.02 Plans operation of milling machines
F-14.03 Sets up work holding devices for conventional milling machines
F-14.04 Sets up tooling for conventional milling machines
F-14.05 Sets up milling accessories
F-14.06 Sets up workpiece on a conventional milling machine
F-14.07 Selects conventional milling machine speeds and feeds

F-15 Operates conventional milling machines
F-15.01 Mills surfaces using a conventional milling machine
F-15.02 Mills profiles and pockets using a conventional milling machine
F-15.03 Mills slots, grooves and keyways using a conventional milling machine
F-15.04 Cuts gears and splines using a conventional milling machine
F-15.09 Bores holes using a conventional milling machine

G-16 Machines using precision grinding machines
G-16.01 Selects precision grinding machine types
G-16.02 Plans operation of grinding machines
G-16.03 Sets up work holding devices for precision grinding machines
G-16.04 Mounts grinding wheel
G-16.05 Sets up grinding accessories
G-16.06 Sets up workpiece on precision grinding machines
G-16.07 Selects precision grinding machines speeds and feeds

G-17 Operates precision grinding machines
G-17.02 Grinds profiles
G-17.03 Grinds internal and external cylindrical and tapered surfaces
G-17.04 Grinds tools and cutters
G-17.05 Finishes holes using a honing machine

Level Three topics that may be taught in context:

Organizes work
Communication and mentoring
Component refurbishment

For details regarding the in-context topics, see page 44

Level Four — 6 weeks — 180 hours

CNC Machining — 56 hours

- Set tool offsets
- Calculate coordinates
- Construct a CNC program
- Run CNC program
- Demonstrate mill programming
- Program a 3-axis mill using CAM
- Machine a part using CAM

RSOS topics covered in this section of training:

H-18 Machines using computer numerical control (CNC) machines
H-18.04 Optimizes program
H-18.05 Creates 2D and 3D models
H-18.06 Programs using CAM

H-19 Sets up CNC machines
H-19.03 Sets up workpiece on CNC machines

H-20 Operates CNC machines
H-20.01 Adjusts offsets

Material Select / Heat Treatment — 12 hours

- Discuss properties of materials
- Discuss materials testing
- Discuss properties of tool steels
- Discuss heat treatment of steel

RSOS topics covered in this section of training:

A-4 Processes workpiece material
A-4.04 Performs heat treatment
A-4.05 Performs quality control of workpiece

Advanced Machine Tool (Theory) — 35 hours

- Discuss dividing head operations
- Explain bevel gear milling
- Identify common cam terminology
- Discuss interference fits
- Interpret standard fits
- Explain helical milling

Advanced Machine Tool (Shop) — 77 hours

- Perform heat treatment operations on tool steel
- Inspect hardened tool steel

- Plan jobs
- Perform precision grinding operations
- Perform lathe operations
- Perform milling and indexing operations

RSOS topics covered in this section of training:

F-14 Machines using conventional milling machines
F-14.05 Sets up milling accessories

F-15 Operates conventional milling machines
F-15.04 Cuts gears and splines using a conventional milling machine

H-18 Performs CNC programing
H-18.04 Optimizes program
H-18.05 Creates 2D and 3D models
H-18.06 Programs using CAM

H-19 Sets up CNC machines
H-19.03 sets up workpiece on CNC machines

H-20 Operates CNC machines
H-20.01 adjusts offsets

Level Four topics that may be taught in context:

Organizes work
Communication and mentoring
Machine and tool maintenance
Component refurbishment

For details regarding the in-context topics, see page 44

In Context Topics

In context means learning that has already taken place and is being applied to the applicable task. Learning outcomes for in context topics are accomplished in other topics in that level.

Organizes work

A-2 Organizes work
A-2.01 Interprets documentation
A-2.02 Plans sequence of operations

Communication and mentoring

A-3 Use communication and mentoring techniques
A-3.01 Uses communication techniques
A-3.02 Uses mentoring techniques

Machine and tooling maintenance

A-5 Maintains Machines, Tooling and Inspection Equipment
A-5.01 Cleans machines
A-5.02 Lubricates machines
A-5.03 Sharpens tooling
A-5.04 Applies cutting fluid and coolant
A-5.05 Troubleshoots Equipment
A-5.06 Maintains machine alignment
A-5.07 Maintains inspection equipment

Hand processes

B-6 Performs Hand Processes
B-6.01 Performs layout
B-6.02 Saws workpiece
B-6.03 Files workpiece
B-6.04 Performs hole making operations
B-6.05 Performs threading operations
B-6.06 Installs thread inserts
B-6.07 Broaches workpiece
B-6.08 Performs pressing operations
B-6.09 Forms workpiece

Component refurbishment

B-7 Refurbishes Components
B-7.01 Disassembles components
B-7.02 Analyzes components
B-7.03 Assembles components

Exceed Topics

Throughout this guide to course content there are topics which exceed the minimum scope of work as set out in the Machinist RSOS. Industry in Saskatchewan has deemed certain topics to fall within the scope of work of the Machinist trade in Saskatchewan and therefore require technical training to cover these topics.