

# Machinist

# Guide to Course Content

2019



Online: [www.saskapprenticeship.ca](http://www.saskapprenticeship.ca)

*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](http://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:

**Description of the Machinist trade:** an overview of the trade's duties and training requirements.

**Essential Skills Summary:** an overview of how each of the nine essential skills is applied in this trade.

**Elements of harmonization of apprenticeship training:** includes adoption of Red Seal trade name, number of levels of apprenticeship, total training hours (on-the-job and in-school) and consistent sequencing of technical training content. Implementation for harmonization will take place progressively. Level one to be implemented in 2019/2020, level two 2020/2021, level three 2021/2022, and level four in 2022/2023.

**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.

**Appendix A: Post Harmonization Training Profile Chart:** a chart which outlines the finalized model for SATCC technical training sequencing with a cross reference to the Harmonized apprenticeship technical training sequencing, at the topic level.

The Red Seal Machinist Curriculum Outline, which provides additional detail of the Harmonized technical training, can be found at [www.red-seal.ca](http://www.red-seal.ca)

# DESCRIPTION OF THE MACHINIST TRADE

*Machinists work with metals and other materials and operate lathes, milling machines and other tools to produce shapes to a required finish and size.*

Fully qualified machinists possess the knowledge and abilities to set up and machine using conventional, portable and Computer Numerical Control (CNC) machines that cut or grind metal and other materials into products with precise dimensions. These machines include lathes, milling machines, saws, grinding machines, drilling machines, boring machines, electrical discharge machines (EDM), line borers and portable milling machines.

Machinists work from drawings, specifications and their own measurements to calculate dimensions, tolerances and types of fit. Precise measurements are critical to machinists' work. They must be knowledgeable about the properties of metals and non-metallic materials.

Machinists may work in industries where machines are manufactured, repaired or used. These may include industries that manufacture machinery equipment, motor vehicle or aerospace parts. Machinists produce precision parts that are used in all aspects of manufacturing. They may also work in shipyards, rail yards, refineries, pulp and paper mills, mines, smelters, metal fabricating and repair shops. Some sectors that employ machinists may include oil and gas, medical, research and development and forestry. Shiftwork is common in some companies. Machinists tend to work indoors.

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

Key attributes for people entering this trade are: communication skills, mechanical aptitude, hand-eye coordination, manual dexterity, an ability to work independently and knowledge of mathematics and physics. The work often requires considerable standing and the handling of heavy objects. This standard recognizes similarities or overlaps with the work of other tradespeople such as tool and die makers, mould makers, welders and industrial mechanics (millwrights).

Experienced machinists may move into mentoring or supervisory positions. They may transfer their skills to related occupations such as tool and die maker, mould maker, industrial mechanic (millwright) or CNC programmer.

**Training Requirements:** 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 journeyman 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. Applicants whose first language is not English must have a minimum Canadian Language Benchmark Assessment of six (CLB6).

Note: A CLB assessment is valid for a one-year period from date of issue.

Designated Trade Name	Math Credit at the Indicated Grade Level <sup>❶</sup>	Science Credit at Grade Level
Machinist	Grade 11	Grade 10
<p><sup>❶</sup> - (One of the following) WA – Workplace and Apprenticeship; or F – Foundations; or P – Pre-calculus, or a Math at the indicated grade level (Modified and General Math credits are not acceptable).</p> <p>*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.</p> <p>For information about high school curriculum, including Math and Science course names, please see:  <a href="http://www.curriculum.gov.sk.ca/#">http://www.curriculum.gov.sk.ca/#</a></p> <p><b>Individuals not meeting the entrance requirements will be subject to an assessment and any required training</b></p>		

# ESSENTIAL SKILLS SUMMARY

Essential skills are needed for work, learning and life. They provide the foundation for learning all other skills and enable people to evolve with their jobs and adapt to workplace change.

Through extensive research, the Government of Canada and other national and international agencies have identified and validated nine essential skills. These skills are used in nearly every occupation and throughout daily life in different ways.

A series of CCDA-endorsed tools have been developed to support apprentices in their training and to be better prepared for a career in the trades. The tools can be used independently or with the assistance of a tradesperson, trainer, employer, teacher or mentor to:

- understand how essential skills are used in the trades;
- learn about individual essential skills strengths and areas for improvement; and
- improve essential skills and increase success in an apprenticeship program.

The tools are available online or for order at: [www.esdc.gc.ca/eng/jobs/les/profiles/index.shtml](http://www.esdc.gc.ca/eng/jobs/les/profiles/index.shtml)

The application of these skills may be described throughout this document within the skills and knowledge which support each sub-task of the trade. The most important essential skills for each sub-task have also been identified. The following are summaries of the requirements in each of the essential skills, taken from the essential skills profile. A link to the complete essential skills profile can be found at [www.red-seal.ca](http://www.red-seal.ca).

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## READING

Machinists require strong reading skills to gather information from forms and labels. They also need to read longer texts such as notes, letters, process sheets, manuals (*Machinery's Handbook*), specifications, regulations, reports, data collection, books and charts.

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## DOCUMENT USE

Document use is a significant essential skill for this trade. Machinists need to be able to refer to and interpret several types of documents such as inspection reports, work orders, charts, sketches, drawings, set-up sheets and job travellers. They also need to be able to enter information or create these documents.

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## WRITING

Writing skills are used by machinists to record job procedures, write work-related requests, record tooling lists and setup sheets, and record work instructions and process sheets.

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## ORAL COMMUNICATION

Some tasks performed by machinists require oral communication skills, including exchanging technical information with co-workers in their trade and other trades, discussing work with supervisors, interacting with clients and instructing less-experienced machinists and apprentices.

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## **NUMERACY**

Numeracy skills are very important in the everyday work of machinists. Machinists frequently calculate measurements and dimensions of raw materials and finished products to make sure they match specifications. They must calculate speeds and feeds for the machines that they operate. Layout of workpieces requires strong geometry and trigonometry skills.

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## **THINKING**

Machinists must plan, make allowances and corrections, and determine the best sequence of work processes. They use problem solving skills to assess and adjust machining processes according to unforeseen circumstances. Machinists must make decisions and use critical thinking about the materials, processes or tools to use for specific jobs. They may initiate design changes. They may be responsible for scheduling and delegating tasks to apprentices or junior machinists.

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## **WORKING WITH OTHERS**

Much of machinists' work may be done independently such as interpreting, planning, producing and repairing parts. Machinists may work with other machinists to carry out new or complex tasks, or work on larger jobs. They may also work with engineering staff and computer programming staff.

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## **DIGITAL TECHNOLOGY**

Machinists may use computers and CAD software in their work. They may use computers to access database information, reference electronic manuals and resources, communicate with others or perform Internet research. Certain equipment such as CMM and CNC machines require digital technology skills.

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## **CONTINUOUS LEARNING**

Machinists are required to stay abreast of new technologies, products and trends in the machining industry.

# ELEMENTS OF HARMONIZATION FOR APPRENTICESHIP TRAINING

At the request of industry, the Harmonization Initiative was launched in 2013 to *substantively align* apprenticeship systems across Canada by making training requirements more consistent in the Red Seal trades. Harmonization aims to improve the mobility of apprentices, support an increase in their completion rates and enable employers to access a larger pool of apprentices.

As part of this work, the Canadian Council of the Directors of Apprenticeship (CCDA) identified four main harmonization priorities in consultation with industry and training stakeholders:

## 1. Trade name

The official Red Seal name for this trade is Machinist.

## 2. Number of Levels of Apprenticeship

The number of levels of technical training recommended for the Machinist trade is four.

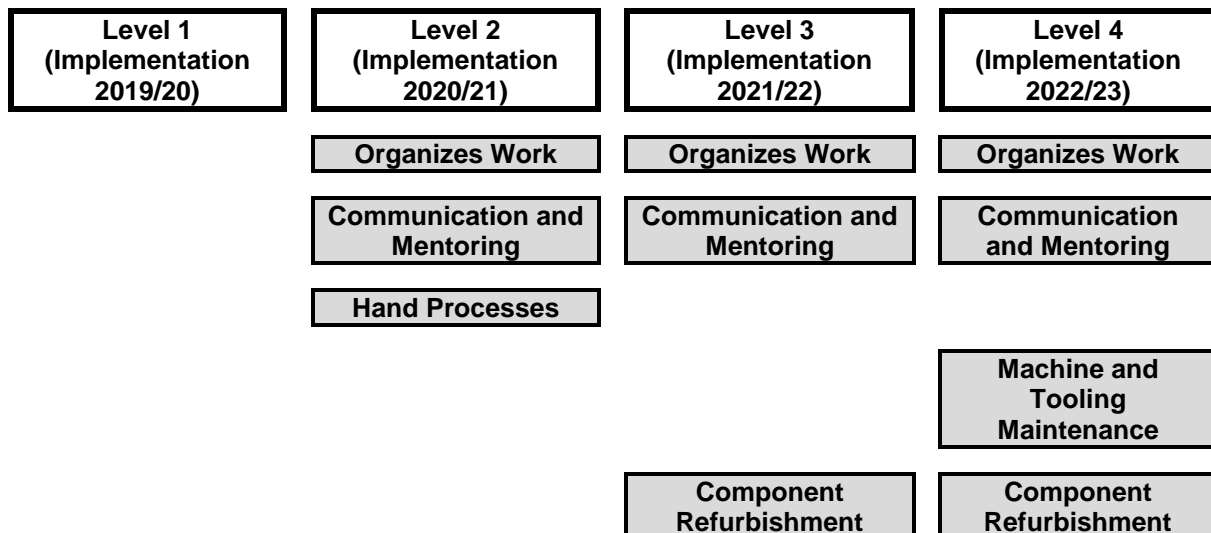
## 3. Total Training Hours during Apprenticeship Training

The total hours of training, including both on-the-job and in-school training for the Machinist trade is 7200.

## 4. Consistent sequencing of training content (at each level) using the most recent Occupational Standard

Implementation for harmonization will take place progressively. Level one to be implemented in 2019/2020, level two 2020/2021, level three 2021/2022, and level four in 2022/2023. See Appendix A for the finalized curriculum comparisons.

White boxes are “Topics,” grey boxes are “In Context”. 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.





Level 1 (Implementation 2019/20)	Level 2 (Implementation 2020/21)	Level 3 (Implementation 2021/22)	Level 4 (Implementation 2022/23)
Safety-Related Tasks	Safety-Related Tasks	Safety-Related Tasks	Safety-Related Tasks
Organizes Work			
Communication and Mentoring			
Workpiece Material Processing	Workpiece Material Processing	Workpiece Material Processing	Workpiece Material Processing
Machine and Tooling Maintenance	Machine and Tooling Maintenance	Machine and Tooling Maintenance	
Hand Processes			
Components (Introduction)	Component Refurbishment		
Power Saw Setup			
Power Saw Operation			
Drill Press Setup			
Drill Press Operation			
Conventional Lathe Setup	Conventional Lathe Setup		
Conventional Lathe Operation	Conventional Lathe Operation		
Conventional Milling Machine (Introduction)	Conventional Milling Machine Setup	Conventional Milling Machine Setup	Conventional Milling Machine Setup
	Conventional Milling Machine Operation	Conventional Milling Machine Operation	Conventional Milling Machine Operation
	Precision Grinding Machine Setup	Precision Grinding Machine Setup	
	Precision Grinding Machine Operation	Precision Grinding Machine Operation	
	CNC Programming	CNC Programming	CNC Programming
	CNC Machine Setup	CNC Machine Setup	CNC Machine Setup
	CNC Machine Operation	CNC Machine Operation	CNC Machine Operation

# MACHINIST TASK MATRIX CHART

This chart outlines the major work activities, tasks and sub-tasks from the 2018 Machinist Red Seal Occupational Standard. 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. The Task Matrix Chart will be updated every year until Harmonization implementation is complete. Implementation for harmonization will take place progressively. Level one to be implemented in 2019/2020, level two 2020/2021, level three 2021/2022, and level four in 2022/2023.

## A - PERFORMS COMMON OCCUPATIONAL SKILLS

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

**Task A-5**  
Maintains machines, tooling and inspection equipment

<b>5.01 Cleans machines</b>  1	<b>5.02 Lubricates machines</b>  1	<b>5.03 Sharpens tooling</b>  1
<b>5.04 Applies cutting fluid and coolant</b>  1	<b>5.05 Troubleshoots equipment</b>  1	<b>5.06 Maintains machine alignment</b>  1
<b>5.07 Maintains inspection equipment</b>  1		

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## B - PERFORMS BENCHWORK

**Task B-6**  
Performs hand processes

<b>6.01 Performs layout</b>  1	<b>6.02 Saws workpiece</b>  1	<b>6.03 Files workpiece</b>  1
<b>6.04 Performs hole making operations</b>  1	<b>6.05 Performs threading operations</b>  1	<b>6.06 Installs thread inserts</b>  1
<b>6.07 Broaches workpiece</b>  1	<b>6.08 Performs pressing operations</b>  1	<b>6.09 Forms workpiece</b>  1
<b>6.10 Finishes workpiece</b>  1		

**Task B-7 Refurbishes components**

<b>7.01 Disassembles components</b>  1	<b>7.02 Analyzes components</b>  1	<b>7.03 Assembles components</b>
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## C – MACHINES USING POWER SAWS

<b>Task C-8</b> <b>Sets up power saws</b>	<b>8.01 Selects power saw types</b>  <p style="text-align: center;">1</p>	<b>8.02 Selects saw blades</b>  <p style="text-align: center;">1</p>	<b>8.03 Installs saw blades</b>  <p style="text-align: center;">1</p>
	<b>8.04 Selects power saw speeds and feeds</b>  <p style="text-align: center;">1</p>	<b>8.05 Makes power saw adjustments</b>  <p style="text-align: center;">1</p>	<b>8.06 Sets up workpiece on power saw</b>  <p style="text-align: center;">1</p>
<b>Task C-9</b> <b>Operates power saws</b>	<b>9.01 Saws straight and angle cuts</b>  <p style="text-align: center;">1</p>	<b>9.02 Cuts irregular shapes</b>  <p style="text-align: center;">1</p>	

## D – MACHINES USING DRILL PRESSES

<b>Task D-10</b> <b>Sets up drill presses</b>	<b>10.01 Selects drill press types</b>  <p style="text-align: center;">1</p>	<b>10.02 Plans operation of drill presses</b>  <p style="text-align: center;">1</p>	<b>10.03 Selects drill press speeds and feeds</b>  <p style="text-align: center;">1</p>
	<b>10.04 Sets up jigs, fixtures and work holding devices for drill presses</b>  <p style="text-align: center;">1</p>	<b>10.05 Sets up tooling for drill presses</b>  <p style="text-align: center;">1</p>	
<b>Task D-11</b> <b>Operates drill presses</b>	<b>11.01 Drills holes using a drill press</b>  <p style="text-align: center;">1</p>	<b>11.02 Cuts countersinks, counterbores, chamfers and spot faces using a drill press</b>  <p style="text-align: center;">1</p>	<b>11.03 Performs tapping using a drill press</b>  <p style="text-align: center;">1</p>
	<b>11.04 Finishes holes using a drill press</b>  <p style="text-align: center;">1</p>		

## E – MACHINES USING CONVENTIONAL LATHES

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

## F – MACHINES USING CONVENTIONAL MILLING MACHINES

<b>Task F-14</b> <b>Sets up conventional milling machines</b>	<b>14.01 Selects conventional milling machine types</b>  <b>1</b>	<b>14.02 Plans operation of milling machines</b>	<b>14.03 Sets up work holding devices for conventional milling machines</b>
	<b>14.04 Sets up tooling for conventional milling machines</b>  <b>1</b>	<b>14.05 Sets up milling accessories</b>	<b>14.06 Sets up workpiece on a conventional milling machine</b>
	<b>14.07 Selects conventional milling machine speeds and feeds</b>		
<b>Task F-15</b> <b>Operates conventional milling machines</b>	<b>15.01 Mills surfaces using a conventional milling machine</b>	<b>15.02 Mills profiles and pockets using a conventional milling machine</b>	<b>15.03 Mills slots, grooves and keyways using a conventional milling machine</b>
	<b>15.04 Cuts gears and splines using a conventional milling machine</b>	<b>15.05 Drills holes using a conventional milling machine</b>	<b>15.06 Reams holes using a conventional milling machine</b>
	<b>15.07 Cuts countersinks, counterbores, chamfers and spot faces using a conventional milling machine</b>	<b>15.08 Performs tapping using a conventional milling machine</b>	<b>15.09 Bores holes using a conventional milling machine</b>

## G – MACHINES USING PRECISION GRINDING MACHINES

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

# TRAINING PROFILE CHART

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

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

Level Two	Transcript Code	Hours
Technical Drawing and Blueprint Reading	DRFT 283	24
Computer Numerical Control	MACH 283	24
Materials/Heat Treatment	MACH 285	17
Precision Grinding Machine – (Theory)	MACH 290	12
Precision Grinding Machine – (Shop)	MACH 291	15
Lathes Operations (Theory)	MACH 292	15
Lathes Operations (Shop)	MACH 293	42
Milling (Theory)	MACH 294	21
Milling (Shop)	MACH 295	54
Mathematics	MATH 258	16
		240



<b>Level Three</b>	<b>Transcript Code</b>	<b>Hours</b>
Power Transmission	MACH 383	24
CNC Machining	MACH 386	42
Mathematics	MATH 386	16
Technical Drawing and Blueprint Reading	PRNT 385	16
Cutting Tool Technology	TOOL 381	20
Machine Tools (Theory)	TOOL 383	18
Machine Tools (Shop)	TOOL 384	90
		240

<b>Level Four</b>	<b>Transcript Code</b>	<b>Hours</b>
CNC Machining	MACH 483	44
Material Select/Heat Treatment	MATH 481	12
Blueprint Reading	PRNT 485	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. For the harmonized level of training, a cross reference to the Red Seal Occupational Standard (RSOS) apprenticeship technical training sequencing, at the learning outcome level, is provided.

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.

Implementation for harmonization will take place progressively. Level one to be implemented in 2019/2020, level two 2020/2021, level three 2021/2022, and level four in 2022/2023.

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<b>Level One</b>	<b>8 weeks</b>	<b>240 hours</b>
<b>Technical Drawing and Blueprint Reading</b>		<b>20 hours</b>
<ul style="list-style-type: none"><li>• use manual drafting instruments</li><li>• demonstrate orthographic drawing skills (third angle projection)</li><li>• use dimensioning systems</li><li>• apply tolerances, section and auxiliary views</li><li>• demonstrate isometric sketching</li><li>• locate surfaces, features and dimensions on engineering drawing</li></ul>		
<b>RSOS topics covered in this section of training:</b>		
<b>A-2 Organizes Work</b>		
A-2.01 <b>Interprets documentation</b>		
<ul style="list-style-type: none"><li>• drawings and their applications</li><li>• interpreting and extracting information from drawing features</li><li>• reference materials and their use</li><li>• demonstrate knowledge of calculations</li></ul>		
A-4.07 <b>Sketches Parts</b>		
<ul style="list-style-type: none"><li>• sketching and its application</li></ul>		
<hr/>		
<b>Power Saws</b>		<b>6 hours</b>
<ul style="list-style-type: none"><li>• demonstrate safe care and maintenance of equipment</li><li>• identify sawing machines</li><li>• use power saws</li></ul>		
<b>RSOS topics covered in this section of training:</b>		
<b>C-8 Sets Up Power Saws</b>		
C-8.01 Selects power saw types		
<ul style="list-style-type: none"><li>• applications, maintenance and safe procedures for use</li></ul>		
C-8.02 Selects saw blades		
<ul style="list-style-type: none"><li>• saw blades, their applications, maintenance and procedures for use</li></ul>		
C-8.03 Installs saw blades		
<ul style="list-style-type: none"><li>• saw blades, their applications, maintenance and procedures for use</li></ul>		
C-8.04 Selects power saw speeds and feeds		
<ul style="list-style-type: none"><li>• power saws, their applications, maintenance and procedures for use</li></ul>		
C-8.05 Makes power saw adjustments		
<ul style="list-style-type: none"><li>• power saws, their applications, maintenance and procedures for use</li></ul>		

C-8.06 Sets up workpiece on power saw

- power saws, their applications, maintenance and procedures for use
- use of measuring devices

### **C-9 Operates Power Saws**

C-9.01 Saws straight and angle cuts

- power saws, their applications, maintenance and procedures for use
- safe work practices and procedures related to the use of power saws and saw blades

C-9.02 Cuts irregular shapes

- power saws, their applications, maintenance and procedures for use
- safe work practices and procedures related to the use of power saws

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### **Drilling Machine – Theory**

**6 hours**

- demonstrate safe care and maintenance of equipment
- identify drilling machines
- identify drilling tools
- identify work holding devices and methods
- identify speeds and feeds for drilling

### **Drilling Machine– Shop**

**8 hours**

- identify drilling machines
- identify drilling tools
- operate drilling machines
- use countersinking and counterboring tools
- use reamers
- identify power tapping and boring operations
- sharpen twist drills
- describe cutting fluids

### **RSOS topics covered in this section of training:**

#### **D-10 Sets Up Drill Presses**

D-10.01 Selects drills press types

- drill press tooling and drill presses, their applications, maintenance and procedures for use

D-10.02 Plans operation of drill presses

- drill press tooling and drill presses, their applications, maintenance and procedures for use

D-10.03 Selects drill press speeds and feeds

- drill press tooling and drill presses, their applications, maintenance and procedures for use

D-10.04 Sets up jigs, fixtures and work holding devices for drill presses

- jigs, fixtures and work holding devices, their applications, maintenance and procedures for use

D-10.05 Sets up tooling for drill presses

- drill press tooling and drill presses, their applications, maintenance and procedures for use

#### **D-11 Operates Drill Presses**

D-11.01 Drills holes using a drill press

- drill press tooling and drill presses, their applications, maintenance and procedures for use
- safe work practices and procedures
- measurements pertaining to drilling operations
- calculations pertaining to drilling operations

D-11.02 Cuts countersinks, counterbores, chamfers and spot faces using a drill press

- drill press tooling and drill presses, their applications, maintenance and procedures for use
- measurements pertaining to countersinks, counterbores, chamfers and spot faces
- calculations pertaining to countersinks, counterbores, chamfers and spot faces

D-11.03 Performs tapping using a drill press

- drill press tapping tooling, its applications, maintenance and procedures for use

D-11.04 Finishes holes using a drill press

- hole finishing tooling, their applications, maintenance and procedures for use
- measurements pertaining to hole finishing operations
- calculations pertaining to hole finishing operation

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## **Lathes – Theory**

**12 hours**

- identify types of turning machines
- identify cutting tools
- identify work holding devices
- identify steady rests and follower rests
- calculate taper information
- identify taper cutting processes
- calculate thread dimensions
- prepare job plans

## **Lathes – Shop**

**54 hours**

- grind lathe tools
- perform external turning
- perform internal turning
- perform grooving and parting
- use steady rest and follow rest
- perform knurling
- cut basic 60-degree screw threads
- perform taper turning
- demonstrate safe care and maintenance of equipment
- perform drilling and reaming

### **RSOS topics covered in this section of training:**

#### **E-12 Sets Up Conventional Lathes**

E-12.01 Selects conventional lathe types

- conventional lathes, their accessories, attachments and applications

E-12.02 Plans operation of conventional lathes

- conventional lathes, their maintenance and procedures for use

E-12.03 Sets up work holding devices for conventional lathes

- work holding devices, their maintenance and procedures for use

E-12.04 Sets up tooling for conventional lathes

- cutting tools, their maintenance and procedures for use

E-12.05 Sets up conventional lathe accessories

- conventional lathe accessories, their maintenance and procedures for use

E-12.06 Sets up workpiece on conventional lathe

- workpiece setup

E-12.07 Selects conventional lathe speeds and feeds

- lathe speeds and feeds
- calculations required to adjust machine controls

#### **E-13 Operates Conventional Lathes**

E-13.01 Faces surfaces using a conventional lathe

- facing operations

E-13.02 Turns external surfaces using a conventional lathe

- turning operations

E-13.03 Drills using a conventional lathe

- drilling operations using a conventional lathe

E-13.04 Bores holes using a conventional lathe

- boring operations

E-13.05 Reams holes using a conventional lathe

- reaming operations

E-13.07 Knurls using a conventional lathe

- knurling operations

E-13.08 Cuts grooves using a conventional lathe

- grooving operations

E-13.09 Cuts threads using a conventional lathe

- threading operations
- E-13.10 Parts off workpiece using a conventional lathe
- parting off operations
- 

## **Milling**

**24 hours**

- identify vertical milling machines
- identify basic vertical milling machine cutting tools
- identify work holding devices and methods
- perform basic vertical milling machine operations
- demonstrate safe care and maintenance of equipment

### **RSOS topics covered in this section of training:**

#### **A-5 Maintains Machines, Tooling and Inspection Equipment**

##### A-5.01 Cleans machines

- cleaning agents, their applications, and procedures for use

##### A-5.02 Lubricates machines

- lubricants, their applications and procedures for use

##### A-5.05 Troubleshoots Equipment

- machines, troubleshooting and procedures for use

##### A-5.06 Maintains machine alignment

- maintenance and alignment of machines

#### **F-14 Sets Up Conventional Milling Machine Types**

##### F-14.01 Selects conventional milling machine types

- conventional milling machine types, parts, accessories, attachments, and applications
- 

## **Measure, Materials and Cutting Fluid**

**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:**

#### **A-5 Maintains Machines, Tooling and Inspection Equipment**

##### A-5.01 Cleans machines

- cleaning agents, their applications, and procedures for use

##### A-5.02 Lubricates machines

- lubricants, their applications and procedures for use

##### A-5.04 Applies cutting fluid and coolant

- cutting fluids and coolants, their applications, and procedures for use

#### **B-6 Performs Hand Processes**

##### B-6.01 Performs layout

- basic layout and its application
  - basic layout tools, their applications, maintenance and procedures for use
  - precision layout and its applications
  - precision layout tools, their applications, maintenance and procedures for use
-

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**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

- safe work practices
- regulatory requirements pertaining to safety

A-1.02 Uses personal protective equipment (PPE) and safety equipment

- PPE and safety equipment, their applications, maintenance and procedures for use

**A-4 Process Workpiece Material**

A-4.02 Uses hoisting, lifting and rigging equipment

- hoisting, lifting and rigging equipment, their applications, limitations and procedures for use
- hoisting, lifting and rigging techniques

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**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

- trade terminology
- effective communication practices

A-3.02 Uses mentoring techniques

- strategies for learning skills in the workplace
- strategies for teaching workplace skills

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**Benchwork (Theory)****14 hours**

- identify mechanical hardware
- calculate hole spacing
- calculate tap drill size
- select grinding wheels

**RSOS topics covered in this section of training:****B-6 Performs Hand Processes**

B-6.01 Performs layout

- basic layout and its application
- basic layout tools, their applications, maintenance and procedures for use
- precision layout and its applications
- precision layout tools, their applications, maintenance and procedures for use

**B-7 Refurbishes Components**

B-7.01 Disassembles components

- procedures used for refurbishing components

## **Benchwork (Shop)**

**34 hours**

- use semi precision layout tools
- use precision layout tools
- use non-cutting hand tools
- operate presses and pullers
- use metal cutting hand tools
- use thread cutting tools
- use power tools

### **RSOS topics covered in this section of training:**

#### **A-4 Processes Workpiece Material**

##### **A-4.06 Deburrs workpiece**

- hand and power tools for deburring and the techniques used

#### **B-6 Performs Hand Processes**

##### **B-6.02 Saws workpiece**

- safe work practices and procedures
- hand saws, their applications, maintenance and procedures for use

##### **B-6.03 Files workpiece**

- safe work practices and procedures
- filing tools, their applications, maintenance and procedures for use

##### **B-6.04 Performs hole making operations**

- drilling, reaming and countersink operations

##### **B-6.05 Performs threading operations**

- safe work practices and procedures
- threads and their applications
- procedures used to measure and gauge threads

##### **B-6.06 Installs thread inserts**

- safe work practices and procedures
- thread inserts and their applications
- procedures used to measure and gauge threads

##### **B-6.07 Broaches workpiece**

- safe work practices and procedures
- broaches and broaching equipment, their applications, set up and procedures for use

##### **B-6.08 Performs pressing operations**

- safe work practices and procedures
- press equipment, their applications, maintenance and procedures for use

##### **B-6.09 Forms workpiece**

- safe work practices and procedures
- heating processes used in machining operations and their applications
- bending processes used in machining operations and their applications

#### **B-7 Refurbishes Components**

##### **B-7.02 Analyzes components**

- procedures used to analyze components
- calculations required to measure components
- procedures used to prepare documentation

##### **B-7.03 Assembles components**

- procedures used for assembling components
  - calculations required to measure components
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**Trade Mathematics****18 hours**

- use basic mathematics
- convert between imperial and metric systems
- use basic algebra
- use basic geometry and trigonometry

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

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**Level Two****8 weeks****240 hours**

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**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
- 

**Computer Numerical Control Operation and Programming****24 hours**

- describe principles of CNC lathe programming
  - operate a CNC lathe manually
  - plan a job for the CNC lathe
  - write CNC Code for roughing toolpath
  - write CNC Code for finishing toolpath
  - write CNC Code for threading toolpath
  - operate simulated CNC control
  - operate CNC machine
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**Materials/Heat Treatment****17 hours**

- perform hardness testing
  - perform hardening and tempering
  - describe annealing, normalizing, and stress relieving processes
  - identify properties of materials
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**Precision Grinding Machine (Theory)****12 hours**

- identify grinding machines
  - identify grinding wheels
  - select grinding wheels
  - develop job plans for grinding projects
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**Precision Grinding Machine (Shop)****15 hours**

- perform grinding wheel service
- service precision grinder
- operate precision grinders
- apply grinding wheels



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**Lathes Operations (Theory) 15 hours**

- determine appropriate carbide tool selection
- calculate machining time
- calculate required taper information
- calculate required thread information

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**Lathes Operation (Shop) 42 hours**

- use work holding devices
- use lathe tooling
- perform basic lathe operations
- perform internal taper turning
- cut screw threads
- use lathe accessories
- services lathes

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**Milling (Theory) 21 hours**

- identify milling machines applications
- identify vertical milling machine cutting tools
- select speeds and feeds for vertical milling machines
- select cutting tools holders for horizontal milling machines
- select speeds and feeds for horizontal milling machines
- determine machining time

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**Milling (Shop) 54 hours**

- perform set-ups on vertical milling machines
- perform vertical milling machine operations
- use an offset boring head
- perform set-ups on horizontal milling machines
- service horizontal milling machines
- perform horizontal milling machine operations
- operate indexing devices

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**Mathematics 16 Hours**

- use basic algebra
- use basic geometry and trigonometry
- perform trade calculations

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**Level Three 8 weeks 240 hours**

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**Power Transmission 24 hours**

- identify power transmitting threads
- measure power transmitting threads
- classify keyed drives
- apply tolerances to keys and keyseats
- identify splines
- identify common shaft coupling arrangements
- identify common types of clutches
- identify types of gears

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**CNC Machining** **42 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

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**Mathematics** **16 hours**

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

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**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

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**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

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**Machine Tools (Theory)** **18 hours**

- apply knowledge of milling cutter technology
- explain the construction of the horizontal boring mill
- explain horizontal boring mill operations
- plan horizontal boring mill (HDM) work
- explain abrasive technology.

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**Machine Tools (Shop)** **90 hours**

- operate engine lathe
- operate milling machine
- operate surface grinder
- operate horizontal boring mill

<b>Level Four</b>	<b>6 weeks</b>	<b>180 hours</b>
<b>CNC Machining</b> <ul style="list-style-type: none"> <li>• set tool offsets</li> <li>• calculate coordinates</li> <li>• construct a CNC program</li> <li>• run CNC program</li> <li>• demonstrate mill programming</li> <li>• program a 3 axis mill using CAM</li> <li>• machine a part using CAM</li> </ul>		<b>44 hours</b>
<b>Material Select / Heat Treatment</b> <ul style="list-style-type: none"> <li>• discuss properties of materials</li> <li>• discuss materials testing</li> <li>• discuss properties of tool steels</li> <li>• discuss heat treatment of steel</li> </ul>		<b>12 hours</b>
<b>Blueprint Reading</b> <ul style="list-style-type: none"> <li>• find part shape and dimensional data on working assembly drawings</li> <li>• use pictorial assembly drawings</li> <li>• identify special features and adjacent parts on a drawing</li> <li>• use print reading techniques on complex part drawings</li> <li>• apply tolerance and finishes to technical drawings</li> </ul>		<b>12 hours</b>
<b>Advanced Machine Tool (Theory)</b> <ul style="list-style-type: none"> <li>• discuss dividing head operations</li> <li>• explain bevel gear milling</li> <li>• identify common cam nomenclature</li> <li>• discuss interference fits</li> <li>• interpret standard fits</li> <li>• explain helical milling</li> </ul>		<b>35 hours</b>
<b>Advanced Machine Tool (Shop)</b> <ul style="list-style-type: none"> <li>• perform heat treatment operations on tool steel</li> <li>• inspect hardened tool steel</li> <li>• plan jobs</li> <li>• perform precision grinding operations</li> <li>• perform lathe operations</li> <li>• perform milling and indexing operations</li> </ul>		<b>77 hours</b>

# APPENDIX A: POST HARMONIZATION TRAINING PROFILE CHART

This chart which outlines the finalized model for SATCC technical training sequencing with a cross reference to the Harmonized apprenticeship technical training sequencing, at the topic level.

Implementation for harmonization will take place progressively. Level one to be implemented in 2019/20, level two 2020/2021, level three 2021/2022, and level four in 2022/2023.

SATCC Level One	Transcript Code	Hours	Pan-Canadian Harmonized Level One
Technical Drawing and Blueprint	DRFT 188	20	Organizes Work
Power Saws	MACH AAA	6	Power Saw Setup
			Power Saw Operation
Lathes	MACH 175 (Theory)	12	Conventional Lathe Setup
	MACH 176 (Shop)	54	Conventional Lathe Operation
Milling	MACH 189	24	Conventional Milling Machine (Introduction) Machine and Tooling Maintenance
Measure, Materials and Cutting Fluid	MACH 192	8	Workpiece Material Processing
Drilling Machines	MACH BBB (Theory)	6	Drill Press Setup
	MACH 193 (Shop)	8	Drill Press Operation
Safety and Basic Shop Mechanics	ME 183	24	Safety-Related Tasks
Technical Communication for Trades	TCOM AAA	12	Communication and Mentoring Techniques
Benchwork	TOOL 173 (Theory)	14	Processes Workpiece Material
	TOOL 174 (Shop)	34	Hand Processes Components (Introduction)
Trade Mathematics (Exceed)	MATH 179	18	
		240	

SATCC Level Two	Transcript Code	Hours	Pan-Canadian Harmonized Level Two
			Organizes Work (In-Context)
			Communication and Mentoring (In-Context)
			Hand Processes (In-Context)
Technical Drawing and Blueprint Reading	DRFT 283	24	CNC Programming
Computer Numerical Control	MACH 285	24	CNC Machine Setup
			CNC Machine Operation
Materials/Heat Treatment	MACH 285	17	Workpiece Material Processing
Precision Grinding Machine	MACH 290 (Theory)	12	Precision Grinding Machine Setup
	MACH 291 (Shop)	15	Precision Grinding Machine Operation Safety-Related Tasks

Lathes Operation	MACH 292 (Theory)	15	Conventional Lathe Setup
	MACH 293 (Shop)	42	Conventional Lather Operation Machine and Tooling Maintenance
Milling	MACH 294 (Theory)	21	Conventional Milling Machine Setup
	MACH 295 (Shop)	54	Conventional Milling Machine Operation Machine and Tooling Maintenance
Refurbishment	MACH CCC	6	Component Refurbishment
Mathematics (Exceed)	MATH 258	16	
		240	

SATCC Level Three	Transcript Code	Hours	Pan-Canadian Harmonized Level Three
			Organizes Work (In-Context)
			Communication and Mentoring (In-Context)
			Component Refurbishment (In-Context)
Power Transmission	MACH 383	24	Conventional Milling Machine Operation
CNC Machining	MACH 386	56	CNC Machine Setup
			CNC Machine Operation
Technical Drawing and Blueprint Reading	PRNT 385	16	CNC Programming
Cutting Tool Technology	TOOL 381	20	Machine and Tooling Maintenance
Machine Tools	TOOL 383 (Theory)	18	Precision Grinding Machine Setup
	TOOL 384 (Shop)	90	Precision Grinding Machine Operation Safety-Related Tasks
Mathematics (Exceed)	MATH 258	16	
		240	

SATCC Level Four	Transcript Code	Hours	Pan-Canadian Harmonized Level Four
			Organizes Work (In-Context)
			Communication and Mentoring (In-Context)
			Machine and Tooling Maintenance (In-Context)
			Component Refurbishment (In-Context)
CNC Machining	MACH 483	56	CNC Programming
			CNC Machine Shop
			CNC Machine Operation
Material Select/Heat Treatment	MATH 481	12	Workpiece Material Processing
Advanced Machine Tool (Theory)	TOOL 482	35	Conventional Milling Machine Setup
Advanced Machine Tool (Shop)	TOOL 484	77	Conventional Milling Machine Operation Safety-Related Tasks
		180	

### 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.