



Machinist

On-the-Job Training Guide

2024

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Saskatchewan
Apprenticeship and
Trade Certification
Commission

Online: 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

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.

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.

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

It is the employer's or journey person's responsibility to supervise an apprentice's practical skills development until a satisfactory level of proficiency has been reached.

EMPLOYER TRAINING RESPONSIBILITY

- introduce the apprentice to daily practice in approved safety procedures
- provide guided, hands-on, practical experience in the operation of machine tools and equipment
- where possible, expose the apprentice to new technology in the Machinist trade.

Employers should make every effort to expose their apprentices to work experience in as many areas of the trade as possible.

In the On-the-Job Training Guide, in-school instruction is listed first; on-the-job suggestions to help employers assist the apprentice to prepare for in-school training are listed next.

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

Entrance Requirements for Apprenticeship Training

Your grade twelve transcript (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 journey person 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 ①	Science Credit at Grade Level
Machinist	Grade 11	Grade 10
<p>① - (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).</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: - http://www.curriculum.gov.sk.ca/#</p> <p>Individuals not meeting the entrance requirements will be subject to an assessment and any required training</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

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.

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.

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.

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.

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.

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.

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.

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.

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.

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 has taken place progressively. Level one was implemented in 2019/2020, level two 2020/2021, level three and level four in 2021/2022. See Appendix A for the finalized curriculum comparisons.

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
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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
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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
17.05 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

ON-THE-JOB AND IN-SCHOOL TRAINING CONTENT FOR THE MACHINIST TRADE

This chart outlines on-the-job examples for apprentices to achieve relevant work experience to prepare for the topics of technical training. Topics of technical training are provided with the associated learning outcomes.

Level One	8 weeks	240 hours
Benchwork (Theory) <ul style="list-style-type: none"> Identify layout tools Identify hand tools Identify cutting tools Identify power tools Identify layout techniques Identify mechanical hardware 		14 hours
Benchwork (Shop) <ul style="list-style-type: none"> Demonstrate safe care and maintenance of equipment Use layout tools Use hand tools Use cutting tools Use power tools Perform assembly Perform surface refinishing 		34 hours
<p>Mentors can assist the apprentice to prepare for this section of technical training by:</p> <ul style="list-style-type: none"> <i>introducing the use of calipers, micrometers, and other shop precision measuring tools</i> <i>ensuring familiarization with basic layout tools such as the centre punch, scribes and combination square</i> <i>demonstrating the physical properties of metals, such as weight and magnetism</i> 		
Lathes (Theory) <ul style="list-style-type: none"> 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 		12 hours
Lathes (Shop) <ul style="list-style-type: none"> Demonstrate safe care and maintenance of equipment Grind lathe tools Perform external turning Perform internal turning Perform grooving and parting 		54 hours

- Perform knurling
- Cut basic 60-degree screw threads
- Perform taper turning

Mentors can assist the apprentice to prepare for this section of technical training by:

- *ensuring familiarization with the safe and proper operation of the lathe*
- *providing a hands-on opportunity to use the lathe, with exposure to jobs that introduce basic lathe operation, including some or all of the operations listed above*

Power Saws

6 hours

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

Mentors can assist the apprentice to prepare for this section of technical training by:

- *introducing the apprentice to blade selection and usage, changing blades, speeds and feeds when using cutoff machines*

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

Mentors can assist the apprentice to prepare for this section of technical training by:

- *explaining how drilling machines work*
- *providing information on speeds, work-holding practices and machine safety*

Trade Mathematics

18 hours

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

Mentors can assist the apprentice to prepare for this section of technical training by:

- *ensuring that the metric and imperial graduations on measuring tools and instruments are fully understood*

- *requiring the repetitive use of the math required to interpret blueprints and calculate quantities using fractions, decimals, percentages, ratios, perimeters, volumes and areas by hand and using calculators*
- *teaching the 3-4-5 method of squaring and relating this to the Pythagorean theorem*

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

Mentors can assist the apprentice to prepare for this section of technical training by:

- *ensuring the proper use of WHMIS and Safety Data Sheets*
- *identifying hazardous materials in the shop*
- *providing instruction in basic rigging and load lifting including chains, hooks and knots*
- *providing instruction in ladder safety*

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

Mentors can assist the apprentice to prepare for this section of technical training by:

- *assisting in drawing interpretation*

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

Mentors can assist the apprentice to prepare for this section of technical training by:

- *ensuring that the apprentice has a basic familiarization with milling machines*
- *familiarizing the apprentice with vertical milling machine operation*

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

Mentors can assist the apprentice to prepare for this section of technical training by:

- *providing training in the safe and efficient use of pedestal grinders, including wheel identification and wheel selection for material to be ground*
- *assisting the apprentice in the identification of cutting fluids, mixing procedures, and safety practice*
- *introducing the apprentice to blade selection and usage, changing blades and speeds and feeds when using cutoff machines*

Technical Communication for Trades

12 hours

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

Mentors can assist the apprentice to prepare for this section of technical training by:

- *explain safety hazards found in the workplace*
- *provide necessary PPE and explain how to use it properly*
- *offer training such as fall arrest and mobile equipment training as per OH&S requirements*
- *involve apprentice in hazard assessments*

Level Two

8 weeks

240 hours

Mathematics

16 hours

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

Mentors can assist the apprentice to prepare for this section of technical training by:

- *encouraging the repetitive use of math required for use with fractions, decimals, formulae for cutting speed and spur gears, trigonometric functions, Pythagorean Theorem, chordal length, internal and external dovetail requirements and V-groove requirements*
-

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

Mentors can assist the apprentice to prepare for this section of technical training by:

- *exposing the apprentice to more complex drawings, including tolerance*
 - *allowing the apprentice to use Auto CAD drafting where possible*
-

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

Mentors can assist the apprentice to prepare for this section of technical training by:

- *allowing the apprentice to develop programs and perform dry runs*
-

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

Mentors can assist the apprentice to prepare for this section of technical training by:

- *explaining oven operation and safety, quenching mediums and oxidation colours, (when and where possible)*
 - *ensuring awareness of the properties that can be achieved by heat treatment of various steels*
-

<p>Precision Grinding (Theory)</p> <ul style="list-style-type: none"> • Identify grinding machines • Identify grinding wheels • Describe grinding wheel use • Describe cutting fluids • Develop job plans for grinding projects. 	12 hours
<p>Precision Grinding (Shop)</p> <ul style="list-style-type: none"> • Demonstrate safe care and maintenance of equipment • Service precision grinders • Perform grinding wheel service • Operate precision grinders <p>Mentors can assist the apprentice to prepare for this section of technical training by:</p> <ul style="list-style-type: none"> • <i>ensuring the apprentice has an understanding of safety issues</i> • <i>introducing the operation of cylindrical and horizontal grinders (when and where available)</i> • <i>explaining wheel selection, mounting, work holding devices, feeds and speeds, measurement and safety</i> 	14 hours
<p>Lathe Operations (Theory)</p> <ul style="list-style-type: none"> • Identify carbide tooling • Identify precision tapers • Identify tapered threads • Identify steady rests and follower rests 	15 hours
<p>Lathe Operations (Shop)</p> <ul style="list-style-type: none"> • 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 <p>Mentors can assist the apprentice to prepare for this section of technical training by:</p> <ul style="list-style-type: none"> • <i>continuing to familiarize the apprentice with lathe operation</i> 	42 hours
<p>Milling (Theory)</p> <ul style="list-style-type: none"> • 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 	20 hours
<p>Milling (Shop)</p> <ul style="list-style-type: none"> • Demonstrate safe care and maintenance of equipment • Perform vertical milling operations • Perform horizontal milling machine operations • Use indexing devices 	52 hours

Mentors can assist the apprentice to prepare for this section of technical training by:

- *continuing to familiarize the apprentice with milling operation*

Refurbishment

6 hours

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

Mentors can assist the apprentice to prepare for this section of technical training by:

- *Familiarizing them with work pertaining to gear boxes*
- *Supervise the apprentice as they work through various stages of refurbishment*
- *Teach the apprentice proper order of of dismantling and reassembling gear boxes*
- *Identify working components with the apprentice*

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

Mentors can assist the apprentice to prepare for this section of technical training by:

- *familiarizing the apprentice with transmitting threads and involving them in work processes*
 - *introducing and working with the apprentice through key related work*
 - *allowing the apprentice to work with splines, shaft couplings, clutches and gears with supervision*
-

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

Mentors can assist the apprentice to prepare for this section of technical training by:

- *supervising the apprentice's to CNC work activities*
 - *working with the apprentice when analyzing part drawings*
 - *explaining programs and complex g-codes*
 - *familiarizing the apprentice with CAM processes*
-

Trade Mathematics

16 hours

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

Mentors can assist the apprentice to prepare for this section of technical training by:

- *encouraging the repetitive use of math required for use with fractions, decimals, formulae for cutting speed and spur gears, trigonometric functions, Pythagorean Theorem, chordal length, internal and external dovetail requirements and V-groove requirements*
-

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

Mentors can assist the apprentice to prepare for this section of technical training by:

- *supervising the apprentice as they independently work through blueprints and technical drawings*
- *introducing the apprentice to complex plans*
- *allowing the apprentice to work with CAD systems*

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

Mentors can assist the apprentice to prepare for this section of technical training by:

- *providing supervised work with cutting tools*
- *reviewing tool failure situations*
- *allowing the apprentice to work through metal removal tasks*

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

Mentors can assist the apprentice to prepare for this section of technical training by:

- *having the apprentice expand their lathe working responsibilities while under guidance*
- *allowing the apprentice to set up and operate precision grinders*
- *teaching boring mill tasks*

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

Mentors can assist the apprentice to prepare for this section of technical training by:

- *assuring the apprentice is displaying proper maintenance and safe care techniques before and after equipment use*
- *allowing the apprentice to set up and perform regular machining activities*
- *having the apprentice perform supervised material testing*
- *keeping a record of quality assurance*

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

Mentors can assist the apprentice to prepare for this section of technical training by:

- *allowing the apprentice to develop programs and practice a dry run*
 - *providing access to reference materials for CNC milling operations*
-

Material Select / Heat Treatment

12 hours

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

Mentors can assist the apprentice to prepare for this section of technical training by:

- *having the apprentice choose selection of appropriate steels*
 - *having the apprentice oversee heat treatment of steels*
 - *explaining sources for information and assistance with heat treating processes when necessary*
-

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

Mentors can assist the apprentice to prepare for this section of technical training by:

- *allowing the apprentice independence when working with precision part production*
- *letting the apprentice plan work tasks*
- *having the apprentice oversee precision grinding, lathe, milling and indexing operations*

Consider apprenticeship training as an investment in the future of your company and in the future of your workforce. Ultimately, skilled and certified workers increase your bottom line.

Get involved in the apprenticeship training system. Your commitment to training helps to maintain the integrity of the trade.

Do you have employees who have been working in the trade for a number of years but don't have trade certification?

Contact your local apprenticeship office for details on how they might obtain the certification they need.

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