



# **Agricultural Equipment Technician**

## **Guide to Course Content**

**2021**

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

*Recognition:*

*To promote transparency and consistency, this document has been adapted from the 2012 Agricultural Equipment Technician National Occupational Analysis (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 Agricultural Equipment Technician 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 was implemented progressively. Level one was implemented in 2017/2018, level two 2018/2019, level three 2019/2020, and level four in 2020/2021.

**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 Agricultural Equipment Technician 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.

# DESCRIPTION OF THE AGRICULTURAL EQUIPMENT TECHNICIAN TRADE

*Agricultural equipment technicians set up, maintain, service, diagnose, repair and recondition agricultural equipment.*

This equipment includes tractors and combines, as well as a variety of implements for agricultural functions such as tillage, seeding, planting, harvesting, haying, spraying and application. Agricultural equipment technicians may also work on outdoor power equipment. While they are involved in preventative maintenance, agricultural equipment technicians spend most of their time diagnosing and repairing malfunctioning or out of service equipment, either in the shop or in the field.

Agricultural equipment technicians must be able to service and repair gasoline and diesel engines, drive train systems and components, hydraulic, hydrostatic and pneumatic systems, electrical and electronic systems, steering and braking systems, structural components, operator station and other related support systems. They also assemble and adjust new agricultural equipment, perform scheduled maintenance service such as oil changes, lubrication and tune-ups, take defective units apart, and repair or replace broken, worn-out or faulty parts. Agricultural equipment technicians may specialize in certain types of equipment or in repairing one particular manufacturer's product line.

Agricultural equipment technicians must also have good communication and customer service skills, since they often interact with clients. They teach clients how to operate new equipment, discuss equipment operation, and consult with them to pinpoint problems and determine their specific needs.

Agricultural equipment technicians work in the agriculture sector for equipment manufacturers, dealerships and independent repair shops or on large farms. They can also be self-employed. The equipment they work on and the hours tend to change according to the season.

The work often requires considerable standing, climbing, crouching, balancing on equipment and heavy lifting. Technicians must be able to diagnose complex problems and interpret technical manuals and schematics.

Due to the size and complexity of the equipment, safety is of prime importance. Technicians must practice safe operating procedures and be conscious of the impact on people, equipment, work area and environment when performing their work. There is risk of serious injury when working with agricultural equipment.

This analysis recognizes similarities or overlaps with the work of automotive service technicians, truck and transport mechanics, heavy duty equipment technicians, small engine mechanics and welders. With experience, agricultural equipment technicians may act as mentors and trainers to apprentices in the trade. They may also advance to become shop supervisors, service managers, salespeople or manufacturers' service representatives. Some may also open their own dealerships or businesses.

**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: 8 weeks

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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
Agricultural Equipment Technician	Grade 10	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

Agricultural equipment technicians read documents such as service bulletins, instruction and service manuals, brochures, pamphlets and work orders to diagnose problems, determine repairs and determine operation of machinery. They may also read farm periodicals to broaden their agricultural knowledge. They read safety related information such as Material Safety Data Sheets (MSDS) to learn how to safely handle hazardous materials.

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## DOCUMENT USE

Documents that agricultural equipment technicians work with include work orders, checklists, and service manuals. They also consult and interpret a variety of graphs, charts and technical drawings such as tables, sketches and schematics.

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## WRITING

Agricultural equipment technicians write detailed notes and descriptions about jobs. They must write detailed notes to keep records of their observations and recommendations for themselves, manufacturers, colleagues and clients.

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## ORAL COMMUNICATION

Agricultural equipment technicians use oral communication skills to discuss job details with colleagues, apprentices, manufacturers and clients. They need the ability to translate technical information to common terms. They may also instruct and instil understanding and knowledge of equipment to clients when assisting in setting up new machines.

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## **NUMERACY**

Agricultural equipment technicians use numeracy skills to take a variety of measurements such as tolerances, rates of flow and pressure. They also calculate perimeters, volumes and areas. They may estimate and calculate labour time to prepare repair quotes and invoices.

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## **THINKING**

Problem solving skills are used by agricultural equipment technicians to diagnose the cause of problems. Agricultural equipment technicians use decision making skills to decide the course of action to recommend after identifying the problem. They plan and organize their work in order to accomplish their tasks efficiently.

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## **WORKING WITH OTHERS**

Agricultural equipment technicians mostly work independently but they may seek advice and assistance from other technicians. At farm sites, they work in close communication with the client.

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## **DIGITAL TECHNOLOGY**

Agricultural equipment technicians use databases to access customer information, specifics of previously completed work and details on parts information and prices. They use communications software such as email to exchange information with manufacturers, colleagues and clients. They use diagnostic equipment that runs software applications and codes to determine operational data. They may access specifications, technical drawings and training materials through the Internet, CDs and DVDs.

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## **CONTINUOUS LEARNING**

Agricultural equipment technicians learn by talking to colleagues, manufacturers and service managers and by reading trade specific publications, operators manuals and repair manuals. They read bulletins about new products and specific problems. They may attend in-house presentations or training from manufacturers. They also continuously learn through a variety of work experiences.

# 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 Agricultural Equipment Technician.

## 2. Number of Levels of Apprenticeship

The number of levels of technical training recommended for the Agricultural Equipment Technician 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 Agricultural Equipment Technician trade is 7200.

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

Implementation for harmonization was implemented progressively. Level one was implemented in 2017/2018, level two 2018/2019, level three 2019/2020, and level four in 2020/2021.

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 (2017/2018 implementation)	Level 2 (2018/2019 implementation)	Level 3 (2019/2020 implementation)	Level 4 (2020/2021 implementation)
Scheduled Maintenance	Scheduled Maintenance	Scheduled Maintenance	Scheduled Maintenance
Operational Testing	Operational Testing	Operational Testing	Operational Testing
Planning and Communication	Planning and Communication	Planning and Communication	Planning and Communication
Safety			
Tools and Equipment			
Hoisting and Lifting			



<b>Level 1</b> (2017/2018 implementation)	<b>Level 2</b> (2018/2019 implementation)	<b>Level 3</b> (2019/2020 implementation)	<b>Level 4</b> (2020/2021 implementation)
Pneumatics	Hydraulics, Hydrostatics and Pneumatics		
Electrical	Electrical	Electrical	Electrical
Frames, Steering and Suspension	Frames, Steering and Suspension		
Brakes			
Structural Components	Structural Components		
Heating, Ventilation and Air Conditioning/ Environmental Controls	Heating, Ventilation and Air Conditioning/ Environmental Controls		
	Agriculture Equipment and Accessories		
	Engines and Engine Support Systems	Engines and Engine Support Systems	
	Drivetrain (Powertrain)	Drivetrain (Powertrain)	

# AGRICULTURAL EQUIPMENT TECHNICIAN TASK MATRIX CHART

This chart outlines the major work activities, tasks and sub-tasks from the 2012 Agricultural Equipment Technician National Occupational Analysis (NOA). Each sub-task details the corresponding essential skill and level of training (apprenticeship year) where the content is delivered in training.

## A - PERFORMS COMMON OCCUPATIONAL SKILLS

A-1 Performs safety-related functions	1.01 Uses personal protective equipment (PPE) and safety equipment.	1.02 Maintains safe work environment.				
A-2 Performs common work practices and procedures.	2.01 Conducts operational tests.	2.02 Maintains fluids, lubricants and coolants.	2.03 Services Filters.	2.04 Maintains hoses, tubing and fittings.	2.05 Services bearings/ bushings and seals.	
	2.06 Uses fasteners, sealing devices, adhesives and gaskets.	2.07 Cleans components.	2.08 Verifies equipment and components repairs.	2.09 Plans daily tasks.	2.10 Performs failure analysis.	
A-3 Uses and maintains tools and equipment.	3.01 Maintains tools and equipment.	3.02 Uses hoisting, lifting and securing equipment.	3.03 Uses computers diagnostics and programming.			

## B – ENGINES AND ENGINE SUPPORT SYSTEMS

B-4 Diagnoses engine and engine support systems.	4.01 Diagnoses base engine.	4.02 Diagnoses lubrication system	4.03 Diagnoses cooling system.	4.04 Diagnoses intake and exhaust system.	4.05 Diagnoses fuel delivery system.
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	4.06 Diagnoses engine management systems.	4.07 Diagnoses emissions control systems.			
B-5 Repairs engine and engine support systems.	5.01 Repairs base engine.	5.02 Repairs lubrication system.	5.03 Repairs cooling system.	5.04 Repairs intake and exhaust system.	5.05 Repairs fuel delivery system.
	5.06 Repairs engine management systems.	5.07 Repairs emissions control systems.			

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## C – DRIVE TRAIN

C-6 Diagnoses drive train.	6.01 Diagnoses dry clutches.	6.02 Diagnoses driveline systems and components.	6.03 Diagnoses wet clutches, transmissions and gear cases.	6.04 Diagnoses differentials and final drives.
C-7 Repairs drive train.	7.01 Repairs dry clutches.	7.02 Repairs driveline systems and components.	7.03 Repairs wet clutches, transmissions and gear cases.	7.04 Repairs differentials and final drives.

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## D – HYDRAULIC, HYDROSTATIC AND PNEUMATIC SYSTEMS

D-8 Diagnoses hydraulic, hydrostatic and pneumatic systems.	8.01 Diagnoses hydraulic and hydrostatic systems.	8.02 Diagnoses pneumatic systems.
D-9 Repairs hydraulic, hydrostatic and pneumatic systems	9.01 Repairs hydraulic and hydrostatic systems.	9.02 Repairs pneumatic systems.

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## E – ELECTRICAL AND ELECTRONIC SYSTEMS

**E-10 Diagnoses electrical/electronic power and control monitoring systems.**

**10.01 Diagnoses electrical power and control monitoring systems.**

**10.02 Diagnoses electronic power and control monitoring systems.**

**E-11 Repairs electrical/electronic power and control monitoring systems.**

**11.01 Repairs electrical power and control monitoring systems.**

**11.02 Repairs electronic power and control monitoring systems.**

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## F – STEERING, SUSPENSION AND BRAKES

**F-12 Diagnoses steering and brake systems.**

**12.01 Diagnoses steering systems.**

**12.02 Diagnoses brake systems**

**F-13 Repairs steering and brake systems.**

**13.01 Repairs steering systems.**

**13.02 Repairs brake systems.**

**F-14 Diagnoses suspension components.**

**14.01 Diagnoses wheels/tracks and track frames.**

**14.02 Diagnoses cushioning devices.**

**F-15 Repairs suspension components.**

**15.01 Repairs wheels/tracks and track frames.**

**15.02 Repairs cushioning devices**

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## G – STRUCTURAL COMPONENTS AND OPERATOR STATION

**G-16 Diagnoses structural components.**

**16.01 Diagnoses frame components.**

**16.02 Verifies condition of roll-over protective structure (ROPS).**

**16.03 Diagnoses equipment body.**

**G-17 Repairs structural components.**

**17.01 Repairs frame components.**

**17.02 Replaces roll-over protective structure (ROPS).**

**17.03 Repairs equipment body.**

**G-18 Diagnoses climate control systems.**

**18.01 Diagnoses heating and ventilation systems.**

**18.02 Diagnoses air conditioning systems.**

**G-19 Repairs climate control systems.**

**19.01 Repairs heating and ventilation systems.**

**19.02 Repairs air conditioning systems.**

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## **H – AGRICULTURAL EQUIPMENT**

**H-20 Prepares agricultural equipment.**

**20.01 Performs assembly and pre-delivery adjustments on agricultural equipment.**

**20.02 Installs agricultural equipment.**

**H-21 Diagnoses land preparation tillage and seeding/planting implements.**

**21.01 Diagnoses land preparation and tillage implements.**

**21.02 Diagnoses seeding planting implements.**

**H-22 Repairs land preparation, tillage and seeding/planting implements.**

**22.01 Repairs land preparation and tillage implements.**

**22.02 Repairs seeding and planting implements.**

**H-23 Diagnoses harvesting, hay and forage equipment.**

**23.01 Diagnoses cutting, conditioning, gathering and processing equipment.**

**23.02 Diagnoses delivery equipment.**

**H-24 Repairs harvesting, hay and forage equipment.**

**24.01 Repairs cutting, conditioning, gathering and processing equipment.**

**24.02 Repairs delivery equipment.**

**H-25 Diagnoses application and irrigation equipment.**

**25.01 Diagnoses application equipment.**

**25.02 Diagnoses irrigation equipment.  
(Not Common Core)**

**H-26 Repairs application and irrigation equipment.**

**26.01 Repairs application equipment.**

**26.02 Repairs irrigation equipment. (Not Common Core)**



# TRAINING PROFILE CHART

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

Level One	Transcript Code	Hours
Air Conditioning and Heating	AIR 100 - Theory	15
	AIR 101 - Shop	15
Electrical	ELEC 122 - Theory	30
	ELEC 123 - Shop	30
Diesel Fuel Systems	ENGN 117 - Theory	15
	ENGN 118 - Shop	15
Basic Hydraulics	HYDR 105 - Theory	30
	HYDR 106 - Shop	30
Seeding and Tillage Equipment	MACH 173 - Theory	15
	MACH 174 - Shop	15
Powertrains 1	TRNM 105 - Theory	15
	TRNM 106 - Shop	15
		240

Level Two	Transcript Code	Hours
Electrical Systems	ELEC 274 - Theory	30
	ELEC 275 - Shop	30
Engine Operation and System Components	ENGN 274 - Theory	30
	ENGN 275 - Shop	30
Harvesting, Hay and Forage	MACH 270 - Theory	30
	MACH 271 - Shop	30
Sprayers and Applicators	MACH 272 - Theory	15
	MACH 273 - Shop	15
Powertrains 2	TRNM 270 - Theory	15
	TRNM 271 - Shop	15
		240

Level Three	Transcript Code	Hours
Electrical/Electronic Intro	ELEC 388 - Theory	15
	ELEC 389 - Shop	15
Diesel Fuel Systems Diagnostics	ENGN 388 - Theory	15
	ENGN 389 - Shop	15
Hydraulic Systems	HYDR 388 - Theory	20
	HYDR 389 - Shop	40
Powertrains Advanced	TRNM 388 - Theory	25
	TRNM 389 - Shop	35
OFC/SMAW Welding	WELD 372 - Theory	30
	WELD 373 - Shop	30
		240

Level Four	Transcript Code	Hours
Electrical/Electronic Diagnosis	ELEC 490 - Theory	35
	ELEC 491 - Shop	25
Advanced Engines and Overhaul	ENGN 486 - Theory	25
	ENGN 487 - Shop	35
Hydraulic System Diagnostics	HYDR 486 - Theory	15
	HYDR 487 - Shop	45
Machinery Diagnosis	MACH 486 - Theory	20
	MACH 487 - Shop	10
Equipment Performance	TRNM 486- Theory	20
	TRNM 487 - Shop	10
		240



# 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 National Occupational Analysis (NOA) apprenticeship technical training sequencing, at the learning outcome level, is provided.

<b>Level One</b>	<b>8 weeks</b>	<b>240 hours</b>
<b>Air Conditioning and Heating – Theory</b> <ul style="list-style-type: none"> <li>• discuss refrigerants and lubricants</li> <li>• identify types of heater system malfunctions</li> <li>• identify types of air conditioning system malfunctions</li> <li>• Identify types of HVAC systems</li> <li>• Describe pneumatics systems</li> </ul>		<b>15 hours</b>
<b>Air Conditioning and Heating – Shop</b> <ul style="list-style-type: none"> <li>• troubleshoot heater system malfunctions</li> <li>• troubleshoot air conditioning system malfunctions</li> <li>• evaluate pneumatics suspension systems</li> </ul>		<b>15 hours</b>
<b>Electrical – Theory</b> <ul style="list-style-type: none"> <li>• describe the operation of an electrical circuit.</li> <li>• describe the relationship between electricity and magnetism</li> <li>• discuss the construction and properties of series, parallel and series-parallel circuits</li> <li>• describe the operation and function of circuit control devices</li> <li>• identify basic electrical system symbols</li> <li>• Describe the difference between analog and digital signals</li> </ul>		<b>15 hours</b>
<b>Electrical – Shop</b> <ul style="list-style-type: none"> <li>• perform boosting procedures</li> <li>• troubleshoot basic electrical circuit problems</li> <li>• repair wiring harness and connectors</li> <li>• use basic electrical system symbols</li> <li>• discuss wet cell batteries</li> <li>• service wet cell batteries</li> </ul>		<b>15 hours</b>
<b>Diesel Fuel Systems – Theory</b> <ul style="list-style-type: none"> <li>• discuss the procedure to evaluate air induction systems</li> <li>• discuss the procedure to maintain fuel systems</li> <li>• discuss the repair of low and high-pressure fuel system components</li> <li>• explain diesel engine combustion chamber designs</li> <li>• discuss the repair of diesel fuel injectors</li> <li>• discuss internal and external threading operations</li> <li>• discuss the procedure to perform compression and leak tests on a diesel engine.</li> </ul>		<b>15 hours</b>
<b>Diesel Fuel Systems – Shop</b> <ul style="list-style-type: none"> <li>• perform compression and leak down tests on a diesel engine</li> <li>• evaluate an air induction system</li> </ul>		<b>15 hours</b>

- service fuel systems
- repair low and high-pressure fuel system components
- inspect diesel engine combustion chamber designs
- service diesel fuel injectors
- inspect internal and external threads

### **Basic Hydraulics – Theory**

**30 hours**

- read basic hydraulic systems symbols
- identify hoses and fittings
- explain the operation of hydraulic pumps
- explain the operation of pressure control valves
- explain the operation of flow control valves
- explain the operation of directional control valves
- explain the operation of basic hydraulic brakes
- explain the operation of hydraulic actuators

### **Basic Hydraulics – Shop**

**30 hours**

- inspect hydraulic brake components
- service hydraulic systems
- repair cylinders and motors
- install hydraulic system components
- perform basic troubleshooting procedures on a hydraulic system

### **Seeding and Tillage Equipment – Theory**

**15 hours**

- describe anhydrous ammonia safety and the operation of anhydrous applicators
- describe the principles and theory of operation for seed carts, seeding tools, and tillage equipment
- describe equipment adjustments for various seeding rates and field conditions
- describe basic hydraulic and electrical principles as they apply to seeding and tillage equipment
- explain basic global positioning system functions

### **Seeding and Tillage Equipment – Shop**

**15 hours**

- perform pre-delivery and service requirements for various types of seed carts, seeding tools, and tillage equipment by using manufacturer's procedures.
- apply operating principles of various components on seed carts, seeding tools, and tillage equipment
- apply the operating principles of hydraulic and electrical components for seeding and tillage equipment
- inspect global positioning system components for variable rate metering

### **Powertrains 1 – Theory**

**15 hours**

- explain lifting and hoisting procedures
- describe the construction and operation of clutch linkages and transmission brakes
- describe clutch system components
- describe safety precautions when separating tractors
- describe steering axles and their functions
- describe theory of gears, gear ratios and bearing construction

## Powertrains 1 – Shop

15 hours

- perform lifting and hoisting procedures
- perform procedures to support, block, and lift equipment
- split tractor to repair or replace components
- adjust clutch linkages and transmission brakes
- perform inspection of clutch system components
- align clutch components and flywheel

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### Level One topics that are taught in context:

- safety
- planning and communication
- operational testing
- scheduled maintenance

*For details regarding the In Context Topic, see page 25*

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## Level Two

8 weeks

240 hours

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### Electrical Systems – Theory

30 hours

- describe the operation of capacitors, diodes, and transistors
- describe the operation of the charging system components
- describe the operation of the starting system components
- describe the evolution of network systems on modern agricultural equipment

### Electrical Systems – Shop

30 hours

- test capacitors, diodes and transistors
  - repair charging system and components
  - repair starting system components
  - Explain how to connect a CAN BUS implement to a CAN BUS tractor using the ISO connector
- 

### Engine Operation and System Components – Theory

30 hours

- explain the principles of combustion
- describe the operation of a two-stroke cycle and four-stroke cycle engine
- explain the difference between air-cooled and liquid-cooled engines
- identify methods to repair damaged threads
- discuss the inspection of cooling system components
- explain precision measuring tools
- discuss splash and pressurized lubrication systems
- discuss the inspection of cylinder heads
- describe the inspection of internal engine components
- describe operation of emission systems

### Engine Operation and System Components – Shop

30 hours

- examine the components of a four-stroke cycle engine
  - examine air-cooled and liquid-cooled engines
  - perform internal and external threading procedures
  - inspect cooling system components
  - use hydraulic presses and pullers
  - inspect cylinder heads
  - use precision measuring tools
  - inspect internal engine components
  - reassemble engine
- 

### Harvesting, Hay and Forage – Theory

30 hours

- describe the construction of belts, chains and power take off (PTO) shafts
- describe hydrostatic drive systems
- describe the theory of operation for combines
- describe the theory of operation for combine component monitoring
- describe yield monitoring and satellite-based yield mapping components and sensors
- describe the operation of hay and forage equipment

### Harvesting, Hay and Forage – Shop

30 hours

- inspect belts, chains and PTO shafts
  - inspect basic hydrostatic drive systems
  - inspect components on hay and forage equipment
  - repair harvesting equipment components
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- perform adjustments on harvesting equipment for various harvesting conditions
- inspect yield monitoring and satellite-based yield mapping components

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**Sprayers and Applicators – Theory** **15 hours**

- describe the pneumatic suspension systems
- describe the operation of sprayer and applicator systems
- identify the steps for safe handling of chemicals

**Sprayers and Applicators – Shop** **15 hours**

- perform pre-delivery and inspection of sprayers
- inspect pneumatic suspension systems
- inspect sprayer systems
- calibrate sprayer systems

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**Powertrains 2 – Theory** **15 hours**

- describe various gearbox types
- describe planetary drives, bull pinion and front wheel assist axles
- discuss steering geometry
- describe advanced brake systems

**Powertrains 2 – Shop** **15 hours**

- inspect various gearbox types
- inspect front wheel assist axle assemblies
- inspect steering geometry
- inspect inboard and outboard final drives
- inspect hydraulic brake components
- inspect brake assemblies

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**Level Two topics that are taught in context:**

- safety
- planning and communication
- operational testing
- scheduled maintenance

***For details regarding the In Context Topic, see page 25***

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## Level Three

8 weeks

240 hours

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### Electrical and Electronics – Theory

15 hours

- identify electrical schematics
- describe the operation of control circuits
- describe the operation of circuit protection devices
- describe the operation of sensor circuits
- describe the operation of controllers
- describe the four faults in an electrical system
- explain Controller Area Network (CAN) BUS and its functions

### Electrical and Electronics – Shop

15 hours

- perform test procedures
  - perform circuit protection tests
  - perform sensor circuits tests
  - test controllers
  - troubleshoot the four faults in an electrical system
  - troubleshoot electrical systems using on-board diagnostic procedures
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### Diesel Fuel System Diagnostics – Theory

30 hours

- discuss the removal and installation of injection system components
- compare injection system timing methods
- discuss turbochargers
- explain the removal and installation of electronic injectors
- discuss fuel delivery control methods
- discuss emission control process
- discuss methods used to diagnose fuel and emission system problems

### Diesel Fuel System Diagnostics – Shop

30 hours

- complete the removal and installation of injection components
  - perform injection system timing
  - analyze fuel system components
  - evaluate turbochargers
  - perform the removal and installation of electronic injectors.
  - troubleshoot electronic fuel systems
  - troubleshoot emission system components
  - perform diagnosis and repair of fuel systems
- 

### Hydraulic Systems – Theory

15 hours

- describe the operation of a hydrostatic steering system
- describe the operation of a power brake system
- describe pneumatic and hydraulic trailer braking systems
- describe the operation of a 3-point hitch system
- describe the operation of a hydrostatic transmission

### Hydraulic Systems – Shop

15 hours

- evaluate steering control valves
  - evaluate power brake control valves
  - evaluate 3-point hitch components
  - evaluate hydrostatic transmission components
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**Powertrains 3 Advanced - Theory****30 hours**

- describe standard gear transmissions
- describe power shift transmissions
- describe transmission diagnostics procedures
- describe continuously variable transmission (CVT) operation
- describe CVT calibration

**Powertrains 3 Advanced – Shop****30 hours**

- perform the disassembly and inspection of gear transmissions and transfer cases
- perform the disassembly and inspection of power shift transmissions
- diagnose power shift transmission components
- Calibrate continuously variable transmission (CVT)

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**Welding – Theory****30 hours**

- describe the safe assembly, operations, shut down and equipment for oxy-fuel cutting (OFC) and plasma arc cutting (PAC)
- describe the safe assembly, operations, shut down and equipment for Gas Metal Arc Welding (GMAW)
- describe the safe assembly, operations, shut down and equipment for Shield Metal Arc Welding (SMAW)

**Welding – Shop****30 hours**

- demonstrate the safe set up, operation and maintenance when performing oxy-fuel cutting (OFC)
- demonstrate the safe set up, operation and maintenance when plasma arc cutting (PAC)
- demonstrate the safe set up, operation and maintenance when performing Gas Metal Arc Welding (GMAW) in multiple positions on various gauges of metal
- demonstrate the safe set up, operation and maintenance when performing Shield Metal Arc Welding (SMAW)

**Level Three topics that are taught in context:**

- safety
- planning and communication
- operational testing
- scheduled maintenance

***For details regarding the in Context Topic, see page 25***

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**Level Four****8 weeks****240 hours**

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**Electrical and Electronic Diagnosis – Theory****30 hours**

- describe the operations of communication systems
- identify faulty communication system
- identify faulty electrical and electronic circuits
- discuss diagnostic procedures on charging, starting and monitoring systems

**Electrical and Electronic Diagnosis – Shop****30 hours**

- connect diagnostic equipment to machinery following manufacturer's procedures
  - analyze information received from diagnostic equipment
  - repair faulty communication system
  - discuss diagnostic procedures on charging, starting and monitoring systems
- 

**Engine and Engine Support – Theory****30 hours**

- discuss cylinder heads
- discuss pistons, rods and sleeves
- discuss valve train components
- discuss cylinder block, crankshaft and bearings
- discuss the use of sealing components
- discuss vibration dampeners, flywheels and inertia balancers
- discuss the assembled engine

**Engine and Engine Support – Shop****30 hours**

- evaluate cylinder heads
  - evaluate pistons, rods and sleeves
  - evaluate valve train components
  - evaluate cylinder block, crankshaft and bearings
  - evaluate sealing components
  - evaluate vibration dampeners, flywheels and inertia balancers
  - perform repair procedures
- 

**Hydraulic System Diagnostics – Theory****30 hours**

- interpret hydraulic system test procedures
- analyze hydraulic schematic diagrams
- analyze hydrostatic drive systems

**Hydraulic System Diagnostics – Shop****30 hours**

- develop a diagnostic plan and record sheet
  - perform hydraulic and powertrain system diagnostics
  - interpret hydraulic schematic diagrams
- 

**Machinery Diagnosis – Theory****15 hours**

- describe the diagnostic procedures for Heating, Ventilation and Air Conditioning (HVAC) systems
- describe diagnostic procedures for agricultural equipment

**Machinery Diagnosis – Shop****15 hours**

- analyze the operation of the Heating, Ventilation and Air Conditioning (HVAC) system



- analyze the operation of agricultural equipment

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**Equipment Performance – Theory****15 hours**

- evaluate clutches, steering, brakes, differentials, and planetaries
- evaluate the importance of pre-delivery procedures
- compare methods of ballasting tractors
- evaluate the use of the dynamometer to test horsepower and torque
- plan diagnostic procedures
- evaluate the importance of pre-delivery procedures

**Equipment Performance – Shop****15 hours**

- use a dynamometer
- evaluate torque and horsepower curves

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**Level Four topics that are taught in context:**

- safety
- planning and communication
- operational testing
- scheduled maintenance

*For details regarding the In Context Topic, see page 25*

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# 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.

## **Safety**

- uses personal protective equipment (PPE) and safety equipment
- maintains a safe work environment

## **Planning and Communication**

- communications with others
- plans daily tasks

## **Operational Testing**

- conducts operational tests
- performs failure analysis

## **Scheduled Maintenance**

- maintains fluids, lubricants and coolants
- service filters
- maintain hoses, tubing and fittings
- service bearings/bushings and seals
- uses fasteners, sealing devices, adhesives and gaskets



# 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 was implemented progressively. Level one was implemented in 2017/2018, level two 2018/2019, level three 2019/2020, and level four in 2020/2021.

SATCC Level One	Transcript Code	Hours	Pan-Canadian Harmonized Level One
			Scheduled Maintenance (In-Context)
Air Conditioning and Heating	AIR 100 - Theory	15	Operational Testing (In-Context)
	AIR 101 - Shop	15	Planning and Communication (in-Context)
Electrical	ELEC 122- Theory	30	Safety
	ELEC 123 - Shop	30	Tools and Equipment
Diesel Fuel Systems	ENGN 117- Theory	15	Hoisting and Lifting
	ENGN 118- Shop	15	Hydraulic Systems
Basic Hydraulics	HYDR 105 - Theory	30	Frames, Steering And Suspension
	HYDR 106 - Shop	30	Brakes
Seeding and Tillage Equipment	MACH 173 - Theory	315	Structural Components
	MACH 174 - Shop	15	Heating, Ventilation and Air - Conditioning/Environment Controls
Powertrains 1	TRNM 105 - Theory	15	Pneumatics
	TRNM 106 - Shop	15	Electrical 1
		240	

SATCC Level Two	Transcript Code	Hours	Pan-Canadian Harmonized Level Two
			Scheduled Maintenance (In-Context)
			Operational Testing (In-Context)
			Planning and Communication (In-Context)
Electrical Systems	ELEC 274 - Theory	30	Engine and Engine Support Systems
	ELEC 275- Shop	30	Electrical 2
Engine Operation and System Components	ENGN 274- Theory	30	Drivetrain (Powertrain)
	ENGN 275 - Shop	30	Hydraulics, Hydrostatics and Pneumatics - advanced
Harvesting, Hay and Forage	MACH 270- Theory	30	Frames, Steering and Suspension
	MACH 271 - Shop	30	Structural Components and Accessories
Sprayers and Applicators	MACH 272- Theory	15	Agricultural Equipment and Accessories
	MACH 273 - Shop	15	
Powertrains 2	TRNM 270 -Theory	15	
	TRNM 271 - Shop	15	
		240	

SATCC Level Three	Transcript Code	Hours	Pan-Canadian Harmonized Level Three
			Scheduled Maintenance (In-Context)
			Operational Testing (In-Context)
			Planning and Communication (In-Context)
Electrical and Electronics	ELEC 388 - Theory	15	Heating, Ventilation and Air Conditioning/Environmental Controls
	ELEC 389 - Shop	15	
Diesel Fuel Systems	ENGN 388 -Theory	30	Engines and Engine Support Systems
	ENGN 389 -Shop	30	
Hydraulic Systems	HYDR 388 -Theory	15	Drivetrain (Powertrain)
	HYDR 389 -Shop	15	
Powertrains 3 Advanced	TRNM 388- Theory	30	
	TRNM 389 - Shop	30	
Welding	WELD 372- Theory	30	
	WELD 373- Shop	30	
		240	

SATCC Level Four	Transcript Code	Hours	Pan-Canadian Harmonized Level Three
			Scheduled Maintenance (In-Context)
			Operational Testing (In-Context)
			Planning and Communication (In-Context)
Electrical and Electronic Diagnosis	ELEC 490 - Theory	30	Electrical
	ELEC 491 - Shop	30	
Engine and Engine Support	ENGN 486 -Theory	30	Engines and Engine Support Systems
	ENGN 487 -Shop	30	
Hydraulic System Diagnostics	HYDR 486 -Theory	30	Drivetrain (Powertrain)
	HYDR 487 -Shop	30	
Machinery Diagnosis	MACH 486 -Theory	15	
	MACH 487 -Shop	15	
Equipment Performance	TRNM 486 -Theory	15	
	TRNM 487 -Shop	15	
		240	

### Exceed Topics

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