

Agricultural Equipment Technician On-the-Job Training Guide

2021



Online: www.saskapprenticeship.ca

Recognition:

To promote transparency and consistency, portions of 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

STRUCTURE OF THE ON-THE-JOB TRAINING GUIDE

To facilitate understanding of the occupation, this on-the-job training guide 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.

Harmonization: a brief description on the pan-Canadian Harmonization Initiative for the Agricultural Equipment Technician 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.

Block (NOA): 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.

On-the-Job and In-school Training Content for the Agricultural Equipment Technician Trade: a chart which outlines on-the-job examples for apprentices to achieve relevant work experience to prepare for topics of technical training.

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, sales people 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.

Journey person to apprentice ratio for this trade is: 1:2

The information contained in this document serves as a guide for employers and apprentices. Apprenticeship training is mutually beneficial to both employer and apprentice. The employer's investment in training apprentice's results in skilled and certified workers. The document summarizes the tasks to be covered by the apprentice during their on-the-job portion of apprenticeship training. An apprentice spends approximately 85% of their apprenticeship term training on-the-job.

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

EMPLOYER TRAINING RESPONSIBILITY

- promote a safety-conscious workplace
- provide mentored, hands-on practice in the use of tools and equipment
- provide the opportunity for apprentices to service AET systems and products
- further the apprentice’s ability to interpret technical drawings
- ensure that the apprentice can evaluate the end product.

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 journeyperson certification.

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

English is the language of instruction in all apprenticeship programs and is the common language for business in Saskatchewan. Before admission, all apprentices and/or “upgraders” must be able to understand and communicate in the English language. 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 ^❶	Science Credit at Grade Level
Agricultural Equipment Technician	Grade 10	Grade 10
<p>^❶ - (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: 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

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.

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.

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.

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.

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.

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.

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.

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.

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.

HARMONIZATION

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 will take place progressively. Level one to be implemented in 2017/2018, level two 2018/2019, level three 2019/2020, and level four in 2020/2021.

Agricultural Equipment Technician TASK MATRIX CHART

This chart outlines the major work activities, tasks and sub-tasks from the 2012 Agricultural Equipment Technician Red Seal National Occupational Analysis.

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 2017/2018, level two 2018/2019, level three 2019/2020, and level four in 2020/2021.

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.

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.

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.

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.

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.

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

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.	

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.

<p>H-23 Diagnoses harvesting, hay and forage equipment.</p>	<p>23.01 Diagnoses cutting, conditioning, gathering and processing equipment.</p>	<p>23.02 Diagnoses delivery equipment.</p>
<p>H-24 Repairs harvesting, hay and forage equipment.</p>	<p>24.01 Repairs cutting, conditioning, gathering and processing equipment.</p>	<p>24.02 Repairs delivery equipment.</p>
<p>H-25 Diagnoses application and irrigation equipment.</p>	<p>25.01 Diagnoses application equipment.</p>	<p>25.02 Diagnoses irrigation equipment. (Not Common Core)</p>
<p>H-26 Repairs application and irrigation equipment.</p>	<p>26.01 Repairs application equipment.</p>	<p>26.02 Repairs irrigation equipment. (Not Common Core)</p>

ON-THE-JOB AND IN-SCHOOL TRAINING CONTENT FOR THE AGRICULTURAL EQUIPMENT TECHNICIAN 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
Air Conditioning and Heating– Theory <ul style="list-style-type: none"> • discuss refrigerants and lubricants • identify types of heater system malfunctions • identify types of air conditioning system malfunctions • Identify types of HVAC systems • Describe pneumatics systems 		15 hours
Air Conditioning and Heating – Shop <ul style="list-style-type: none"> • troubleshoot heater system malfunctions • troubleshoot air conditioning system malfunctions • evaluate pneumatics suspension systems 		15 hours
<p><i>Mentors can assist the apprentice to prepare for this section of technical training by:</i></p> <ul style="list-style-type: none"> • <i>demonstrating safe handling and selecting of refrigerants and lubricants</i> • <i>identifying the various types of heater system malfunctions</i> • <i>identifying the various types of air conditioning system malfunctions</i> • <i>identifying the various types of heating, ventilation and air conditioning (HVAC) systems</i> • <i>explaining pneumatic systems</i> • <i>providing opportunity to troubleshoot heater system malfunctions</i> • <i>providing opportunity to troubleshoot air conditioning system malfunctions</i> • <i>providing opportunity to evaluate pneumatics systems</i> 		
Electrical - Theory <ul style="list-style-type: none"> • describe the operation of an electrical circuit. • describe the relationship between electricity and magnetism • discuss the construction and properties of series, parallel and series-parallel circuits • describe the operation and function of circuit control devices • identify basic electrical system symbols • describe the difference between analog and digital signals 		15 hours
Electrical – Shop <ul style="list-style-type: none"> • perform boosting procedures • troubleshoot basic electrical circuit problems • repair wiring harness and connectors • use basic electrical system symbols • discuss wet cell batteries • service wet cell batteries 		15 hours

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

- explaining the operation of an electrical circuit
- explaining the relationship between electricity and magnetism
- identifying the construction and properties of series, parallel and series-parallel circuits
- explaining the operation and function of circuit control devices
- identifying basic electrical system symbols
- providing opportunity to perform boosting procedures
- providing opportunity to troubleshoot basic electrical circuit problems
- providing opportunity to repair wiring harness and connectors
- to demonstrate the understanding of basic electrical wiring symbols
- providing opportunity to perform a wet battery service

Diesel Fuel Systems– Theory

15 hours

- discuss the procedure to evaluate air induction systems
- discuss the procedure to maintain fuel systems
- discuss the repair of low and high-pressure fuel system components
- explain diesel engine combustion chamber designs
- discuss the repair of diesel fuel injectors
- discuss internal and external threading operations
- discuss the procedure to perform compression and leak tests on a diesel engine.

Diesel Fuel Systems– Shop

15 hours

- perform compression and leak down tests on a diesel engine
- evaluate an air induction system
- 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

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

- explaining the procedure to evaluate air induction systems
- explaining the procedure to maintain fuel systems
- explaining the repair of low and high-pressure fuel system components
- describing diesel engine combustion chamber designs
- explaining the repair of diesel fuel injectors
- explaining internal and external threading operations
- explaining the procedure to perform compression and leak tests on a diesel engine
- providing instruction on performing a compression and leak down tests on a diesel engine
- providing opportunity to evaluate an air induction system
- providing instruction on servicing a fuel pump
- providing opportunity to repair low and high-pressure fuel system components
- providing instruction on inspecting diesel engine combustion chamber designs
- providing opportunity to service diesel fuel injectors

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

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- 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

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

- *explaining lifting and hoisting procedures*
- *explaining basic hydraulic system symbols*
- *explaining hoses and fittings*
- *explaining the operation and function of hydraulic pumps*
- *explaining the operation and function of pressure control valves*
- *explaining the operation and function of flow control valves*
- *explaining the operation and function of directional control valves*
- *explaining the operation and function of basic hydraulic brakes*
- *explaining the operation and function of hydraulic actuators*
- *demonstrating lifting and hoisting procedures*
- *providing opportunity to inspect hydraulic brake components*
- *providing opportunity to service hydraulic systems*
- *providing opportunity to repair cylinders and motors*
- *providing opportunity to install hydraulic system components*
- *providing instruction on 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

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

- explaining anhydrous ammonia safety and the operation of anhydrous applicators
- explaining the principles and theory of operation for seed carts, seeding tools and tillage equipment
- demonstrating equipment adjustments for various seeding rates and field conditions
- explaining basic hydraulic and electrical principles as they apply to seeding and tillage equipment
- explaining basic global positioning system functions
- providing opportunity to perform pre-delivery and service requirements for various types of seed carts, seeding tools and tillage equipment by using manufacturer's procedures
- understanding the operating principles of various components on seed carts, seeding tools and tillage equipment
- understanding the operating principles of hydraulic and electrical components for seeding and tillage equipment
- inspecting global positioning system components for variable rate metering

Powertrains 1 -Theory

15 hours

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

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

- explaining the construction and operation of clutch linkages and transmission brakes
- identifying clutch system components
- demonstrating safety precautions while separating tractors
- explaining the steering axles and their functions
- providing instruction on the procedures to support, block and lift equipment
- providing instruction on splitting a tractor to repair or replace components
- providing opportunity to adjust clutch linkages and transmission brakes
- providing opportunity to perform inspections of clutch system components
- providing opportunity to align clutch components and flywheel

Level Two

8 weeks

240 hours

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

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

- *explaining electrical systems and testing equipment*
 - *identifying capacitors, diodes and transmitters*
 - *explaining the components, operation and repair of ignition systems*
 - *explaining the components, operation and repair of charging systems*
 - *explaining the components, operation and repair of starting systems*
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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

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

- *identifying the construction and operation of various engine systems*
 - *explaining the operation of two and four-stroke engines*
 - *explaining cooling and lubrication systems*
 - *explaining intake and exhaust systems*
 - *providing opportunity to test, disassemble, inspect and assemble small diesel engines*
 - *providing opportunity to inspect cylinder heads, rods, pistons and sleeves*
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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

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- 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
- perform adjustments on harvesting equipment for various harvesting conditions
- inspect yield monitoring and satellite based yield mapping components

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

- *providing instruction on the diagnoses, inspection, repair, and adjustment of balers (round, square), bale processors, forage harvesters, mower conditioners, bale wagons, and mix mills*
- *explain the theory of combine operations*
- *providing instruction on the diagnoses, inspection, repair, and adjustment of combine harvesting equipment (conventional, rotary)*
- *explaining electrical and hydraulic principles that apply to combines*
- *explaining basic principles of global position systems as applied to combines*

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

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

- *explaining the theory of operation of sprayer systems*
- *demonstrating pre-delivery, inspection, repair and calibration of sprayer systems*
- *demonstrating the safe handling of spray products*
- *explaining dry box applicators and anhydrous ammonia applicators*
- *explaining the basic principles of global position systems as applied to sprayers and applicators*

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

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

- *explaining the components, operation, repair and adjustment of manual hydraulic, wet and dry, disc and drum brake systems*
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- explaining basic principles of differentials, final drives, planetary drives, and MFWD axles

Level Three

8 weeks

240 hours

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

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

- explaining electrical system wiring, circuits, and testing
- providing instruction on the operation and testing of microcomputers, sensor circuits, output devices and on-board diagnostic procedures
- interpreting schematic drawings
- providing opportunity to perform diagnostic procedures on electrical/electronic circuits

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

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

- providing instruction on the diagnoses of diesel injection and fuel system malfunctions

- *providing opportunity to remove, repair and replace injection system components*
 - *providing instruction on the diagnoses, inspection and repair intake and exhaust systems, inter/after coolers and turbochargers*
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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 lift 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

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

- *explaining open and closed centre hydraulic systems*
 - *providing instruction on testing and diagnoses of hydraulic pumps (gear, vane, piston), control valves (pressure regulating, priority, flow dividers, directional, steering, brake), hydraulic cylinders, rockshafts*
 - *explaining hydrostatic transmission systems*
-

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)

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

- *explaining the components, operation, repair and adjustment of gear transmissions*
 - *explaining the components, operation, repair and adjustment of hydraulic assist and power-shift transmissions*
 - *providing instruction on the inspection, testing, repair, adjustments and calibration of power train components*
-

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)

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

- *identifying basic oxy-acetylene equipment*
- *explaining basic oxy-acetylene equipment*
- *explaining basic SMAW welding equipment*
- *explaining basic GMAW welding equipment*
- *providing instruction on filler rod welding in various positions*
- *providing instruction on cutting torch operation*
- *providing instruction on basic arc welding equipment*
- *providing opportunity to perform weld a variety of metal thicknesses using different types of rods and in various positions*

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

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

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

- *providing instruction on reviewing electrical principles, theories, systems and components*
- *providing instruction on operations of the communications systems (CAN, ISO Bus) used on agricultural equipment*
- *providing opportunity using various computer systems for diagnostic evaluation and adjustments*

- *providing opportunity to diagnose and repair faulty communication 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

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

- *providing instruction on testing, diagnoses, inspection, and performing major overhaul procedures on large displacement engines*
- *providing opportunity to use computers to diagnose faults and test engine systems*
- *providing opportunity to diagnose diesel fuel systems, injectors, injection pumps, governors and electronic engine controls for fuel system control*

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

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

- *explaining the construction and operation of mobile hydraulic systems*
- *providing opportunity to perform major diagnostics of hydraulics systems and components*

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

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

- *providing instruction on the operation, adjustment and diagnostic procedures for seeding, tillage, hay and forage, harvesting, material handling equipment*

Equipment Performance - Theory

15 hours

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

Equipment Performance – Shop

15 hours

- use a dynamometer
- evaluate torque and horsepower curves

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

- *providing instruction on performing tractor pre-delivery*
- *providing instruction on the methods, components and procedures for ballasting tractors*
- *providing instruction on performing tractor dynamometer testing*
- *explaining the theory of continuously variable transmissions*
- *explaining the theory and operation of clutches, steering, brakes, differentials, MFWD, standard and power-shift transmissions*
- *explaining the steps used in a diagnostic procedure*

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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