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Red Seal Occupational Standard

Agricultural Equipment Technician

INTERPROVINCIAL STANDARD
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Canada

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Agricultural Equipment Technician

Title: Agricultural Equipment Technician

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Foreword

The Canadian Council of Directors of Apprenticeship (CCDA) recognizes this Red Seal Occupational Standard (RSOS) as the Red Seal standard for the Agricultural Equipment Technician trade.

Background

The first National Conference on Apprenticeship in Trades and Industries, held in Ottawa in 1952, recommended that the federal government be requested to cooperate with provincial and territorial apprenticeship committees and officials in preparing analyses of a number of skilled occupations. Employment and Social Development Canada (ESDC) sponsors the Red Seal Program, which, under the guidance of the CCDA, develops a national occupational standard for each of the Red Seal trades.

Standards have the following objectives:

- to describe and group the tasks performed by skilled workers;
- to identify which tasks are performed in every province and territory;
- to develop instruments for use in the preparation of Interprovincial Red Seal Examinations and assessment tools for apprenticeship and certification authorities;
- to develop common tools for apprenticeship on-the-job and technical training in Canada;
- to facilitate the mobility of apprentices and skilled workers in Canada;
- to supply employers, employees, associations, industries, training institutions and governments with occupational standards.

Any questions, comments, or suggestions for changes, corrections, or revisions to this standard or any of its related products may be forwarded to:

Trades and Apprenticeship Division
Apprenticeship and Sectoral Initiatives Directorate
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This standard was prepared by the Apprenticeship and Sectoral Initiatives Directorate of ESDC. The coordinating, facilitating and processing of this standard was undertaken by employees of the standards development team of the Trades and Apprenticeship Division and of Saskatchewan, the host jurisdiction for this trade.

Structure of the Occupational Standard

This standard contains the following sections:

Methodology: an overview of the process for development, review, validation and weighting of the standard

Description of the Agricultural Equipment Technician trade: an overview of the trade's duties, work environment, job requirements, similar occupations and career progression

Trends in the Agricultural Equipment Technician trade: some of the trends identified by industry as being the most important for workers in this trade

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

Industry Expected Performance: description of the expectations regarding the level of performance of the tasks, including information related to specific regulations and standards that must be observed

Language Requirements: description of the language requirements for working and studying in this trade in Canada

Pie Chart of Red Seal Examination Weightings: a graph which depicts the national percentages of exam questions assigned to the major work activities

Task Matrix: a chart which outlines graphically the major work activities, tasks and sub-tasks of this standard

Harmonization of Apprenticeship Training: the aspects of apprenticeship training that participating provinces and territories have agreed upon to substantively align apprenticeship systems across Canada

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

Task Descriptor: a general description of the task

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

Skills:

Performance Criteria: description of the activities that are done as the sub-task is performed

Evidence of Attainment: proof that the activities of the sub-task meet the expected performance of a tradesperson who has reached journeyperson level

Range of Variables: elements and examples (not all inclusive) that provide a more in-depth description of a term used in the performance criteria and evidence of attainment

Knowledge:

Learning Outcomes: describes what should be learned relating to a sub-task while participating in technical or in-school training

Learning Objectives: topics to be covered during technical or in-school training in order to meet the learning outcomes for the sub-task

Range of Variables: elements and examples (not all inclusive) that provide a more in-depth description of a term used in the learning outcomes and learning objectives

Appendix A – Acronyms: a list of acronyms used in the standard with their full name

Appendix B – Tools and Equipment / Outils et équipement: a bilingual non-exhaustive list of tools and equipment used in this trade

Appendix C – Glossary / Glossaire: bilingual definitions or explanations of selected technical terms used in the standard

Methodology

Development of the Standard

A draft standard is developed by a broad group of trade representatives, including tradespeople, instructors and employers at a National Workshop led by a team of facilitators. This draft standard breaks down all the tasks performed in the occupation and describes the knowledge and abilities required for a tradesperson to demonstrate competence in the trade.

Harmonization of Apprenticeship Training

An analysis of all provinces' and territories' apprenticeship programs is performed and recommendations are made on harmonizing the name of the trade, the hours of training required and the number of levels of training. Provinces and territories consult with their respective industry stakeholders on these elements and revisions are discussed until consensus is reached. Following the development of the workshop draft of the RSOS, participants discuss and come to consensus on the sequence of training topics, as expressed in the new standard. Their sequencing recommendations are reviewed by stakeholders in participating provinces and territories and further discussions are convened to reach consensus and to identify any exceptions.

Online Survey

Stakeholders are asked to review and validate the activities described in the new standard via an online survey. These stakeholders are invited to participate in this consultation through apprenticeship authorities, as well as national stakeholder groups.

Draft Review

The RSOS development team forwards a copy of the standard to provincial and territorial authorities who consult with industry representatives to review it. Their recommendations are assessed and incorporated into the standard.

Validation and Weighting

Participating provinces and territories also consult with industry to validate and weight the document for the purpose of planning the makeup of the Red Seal Interprovincial Examination for the trade. They validate and weight the major work activities (MWA), tasks and sub-tasks, of the standard as follows:

MWA	Each jurisdiction assigns a percentage of questions to each MWA for an examination that would cover the entire trade.
Tasks	Each jurisdiction assigns a percentage of exam questions to each task within a MWA.
Sub-Tasks	Each jurisdiction indicates, with a YES or NO, whether or not each sub-task is performed by skilled workers within the occupation in its jurisdiction.

The results of this exercise are submitted to the RSOS development team who then analyzes the data and incorporates it into the document. The RSOS provides the individual jurisdictional validation results as well as the national averages of all responses. The national averages for MWA and task weighting guide the Interprovincial Red Seal Examination plan for the trade.

The validation of the RSOS is used to identify common core sub-tasks across Canada for the occupation. If at least 70% of the responding jurisdictions' industry performs a sub-task, it shall be considered common core. Interprovincial Red Seal Examination questions are limited to the common core sub-tasks identified through this validation process.

Definitions for Validation and Weighting

yes	sub-task performed by qualified workers in the occupation in that province or territory
no	sub-task not performed by qualified workers in the occupation in that province or territory
NV	standard Not Validated by that province or territory
ND	trade Not Designated in a province or territory
Not Common Core (Ncc)	sub-task, task or MWA performed less than 70% of responding jurisdictions; these will not be tested by the Interprovincial Red Seal Examination for the trade
National Average %	average percentage of questions assigned to each MWA and task in Interprovincial Red Seal Examination for the trade

Provincial/Territorial Abbreviations

NL	Newfoundland and Labrador
NS	Nova Scotia
PE	Prince Edward Island
NB	New Brunswick
QC	Quebec
ON	Ontario
MB	Manitoba
SK	Saskatchewan
AB	Alberta
BC	British Columbia
NT	Northwest Territories
YT	Yukon Territory
NU	Nunavut

Description of the Agricultural Equipment Technician Trade

"Agricultural Equipment Technician" is this trade's official Red Seal occupational title approved by the CCDA. This standard covers tasks performed by agricultural equipment technicians.

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 spark ignition and compression ignition engines, drive train systems and components, hydraulic, hydrostatic and pneumatic systems, electrical and electronic systems, steering and braking systems, structural components, operator stations 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.

Technology greatly influences the agricultural equipment technician trade. Precision farming equipment has a wide range of applications which include machine control, yield data gathering, application control, product documentation and traceability, auto steering/guidance (Global Navigation Satellite System [GNSS]), field mapping, sectional control, yield mapping, drainage (grade) systems, telematics, and autonomous vehicles. Agricultural equipment technicians must learn and apply how to install, diagnose and repair these precision farm technologies.

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 standard 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, parts technicians or manufacturers' service representatives. Some may also open their own dealerships or businesses.

Trends in the Agricultural Equipment Technician Trade

Technology

Technology is advancing quickly in the agricultural sector. There is an increase in the use of precision farming equipment that uses technologies such as machine control, yield data gathering, application control, product documentation and traceability, auto steering/guidance (GNSS), field mapping, sectional control, yield mapping, drainage (grade) systems, telematics, and autonomous vehicles.

The introduction of electrically driven equipment is affecting the advancement of the industry. This equipment is more energy efficient and increases overall precision capabilities in farming operations.

There is an increase in the standardization of communication protocols (International Organization for Standardization [ISO]) between different manufacturers' connected implements.

Tools and Equipment

Beyond the regular tools of the trade, technicians are using more and more digital interfaces. Electronic devices such as smart phones, tablets and laptops are now essential tools.

Environmental, Legislative and Regulatory

Environmental and emission control regulations have become more stringent and it is expected that they will become more stringent in the future.

As agricultural equipment increasingly spends more time on roads and highways at increased transport speeds and weight, technicians must pay particular attention to maintenance issues such as suspension, wheel torquing and on-road safety systems.

Other

Agricultural equipment technicians have access to a significant amount of client, company and manufacturers' proprietary information. They must be cognizant and respectful of privacy and intellectual property rights and not share information such as photos, specifications and data without consent.

There are concerns in the agricultural equipment technician industry where equipment repairs are performed by people without the benefit of up-to-date recommendations and specifications. Manufacturers' unauthorized repairs and modifications could lead to safety and environmental risks as well as legal liability exposure.

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.

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 following are summaries of the requirements in each of the essential skills, taken from the essential skills profile.

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 safety data sheets (SDS) 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 instill 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, differential pressures and rates of flow. 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 digital communication tools to exchange information with manufacturers, colleagues and clients. They use diagnostic equipment that runs software applications and codes to determine operational data. Technicians use digital devices to connect to service information, diagnose machine faults, download software to program machines, communicate with manufacturers technical support channels in a repair facility or remotely to a customers' piece of equipment.

Continuous Learning

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

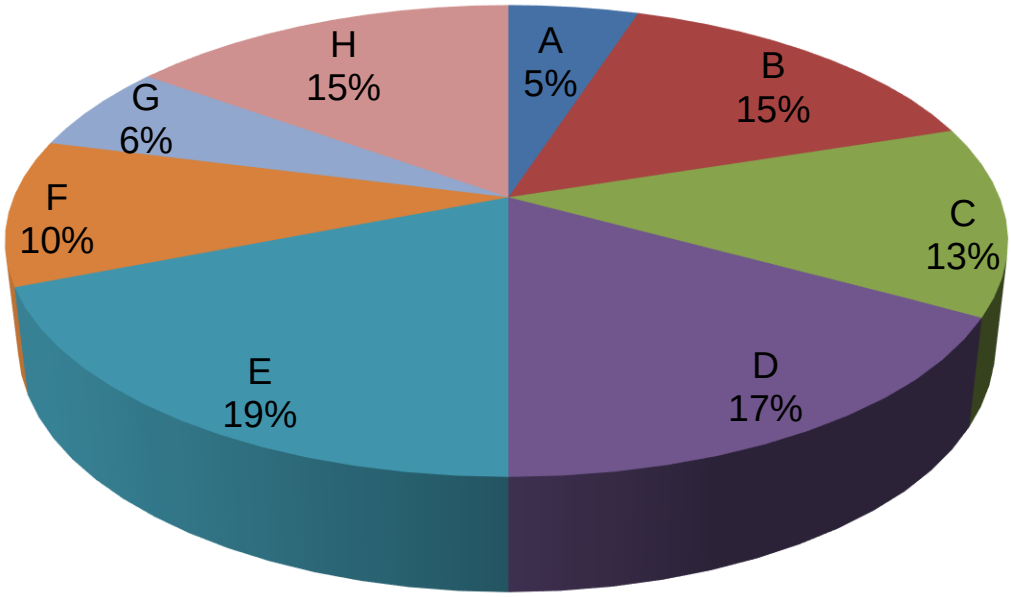
Industry Expected Performance

All tasks must be performed according to the applicable jurisdictional regulations. All health and safety standards must be respected and observed. Work should be performed efficiently and to a high quality without material waste or environmental damage. All requirements of employers, engineers, designers, manufacturers, clients and quality control policies must be met. At a journeyperson level of performance, all tasks must be done with minimal direction and supervision. As a journeyperson progresses in their career, there is an expectation they continue to upgrade their skills and knowledge to maintain pace with industry and promote continuous learning in their trade through mentoring of apprentices.

Language Requirements

It is expected that journeypersons are able to understand and communicate in either English or French, which are Canada's official languages. English or French are the common languages of business as well as languages of instruction in apprenticeship programs.

Pie Chart
of Red Seal Examination Weightings



MWA A	Performs common occupational skills	5%
MWA B	Diagnoses and repairs engines and engine support systems	15%
MWA C	Diagnoses and repairs drive trains	13%
MWA D	Diagnoses and repairs hydraulic, hydrostatic and pneumatic systems	17%
MWA E	Diagnoses and repairs electrical and electronic systems	19%
MWA F	Diagnoses and repairs steering, brakes and suspensions	10%
MWA G	Diagnoses and repairs structural components and operator stations	6%
MWA H	Diagnoses and repairs agricultural equipment	15%

This pie chart represents a breakdown of the interprovincial Red Seal examination. Percentages are based on the collective input from workers from the trade from across Canada. The Task Matrix on the next pages indicates the breakdown of tasks and sub-tasks within each Major Work Activity and the breakdown of questions assigned to the Tasks. The Interprovincial examination for this trade has 125 questions.

Agricultural Equipment Technician

Task Matrix

A – Performs common occupational skills — 5%

Task A-1 Performs safety-related functions 21%	A-1.01 Maintains safe work environment	A-1.02 Uses personal protective equipment (PPE) and safety equipment	
Task A-2 Performs routine work practices 28%	A-2.01 Conducts operational tests	A-2.02 Maintains fluids, lubricants and coolants	A-2.03 Services filters
	A-2.04 Maintains hoses, tubing and fittings	A-2.05 Services bearings, bushings and seals	A-2.06 Uses fasteners, sealants, adhesives and gaskets
	A-2.07 Cleans components	A-2.08 Verifies equipment and component repairs	A-2.09 Performs failure analysis
Task A-3 Organizes work 15%	A-3.01 Uses documentation	A-3.02 Plans daily tasks	
Task A-4 Uses and maintains tools and equipment 25%	A-4.01 Uses tools and equipment	A-4.02 Uses hoisting, lifting and securing equipment	A-4.03 Uses electronic devices and systems for diagnostics and programming
Task A-5 Uses communication and mentoring techniques 11%	A-5.01 Uses communication techniques	A-5.02 Uses mentoring techniques	

B – Diagnoses and repairs engines and engine support systems 15%

Task B-6 Diagnoses engine and engine support systems 58%	**B-6.01 Diagnoses base engines**	**B-6.02 Diagnoses lubrication systems**	**B-6.03 Diagnoses cooling systems**
	B-6.04 Diagnoses intake and exhaust systems	**B-6.05 Diagnoses fuel delivery systems**	**B-6.06 Diagnoses engine management systems**
	B-6.07 Diagnoses emissions control systems		
Task B-7 Repairs engine and engine support systems 42%	**B-7.01 Repairs base engines**	**B-7.02 Repairs lubrication systems**	**B-7.03 Repairs cooling systems**
	B-7.04 Repairs intake and exhaust systems	**B-7.05 Repairs fuel delivery systems**	**B-7.06 Repairs engine management systems**
	B-7.07 Repairs emissions control systems		

C – Diagnoses and repairs drive trains

13%

Task C-8 Diagnoses drive trains **56%**	**C-8.01 Diagnoses dry clutches**	**C-8.02 Diagnoses driveline systems and components**	**C-8.03 Diagnoses wet clutches, transmissions and gear cases**
	C-8.04 Diagnoses differentials and final drives		
Task C-9 Repairs drive trains **44%**	**C-9.01 Repairs dry clutches**	**C-9.02 Repairs driveline systems and components**	**C-9.03 Repairs wet clutches, transmissions and gear cases**
	C-9.04 Repairs differentials and final drives		

D – Diagnoses and repairs hydraulic, hydrostatic and pneumatic systems

17%

Task D-10 Diagnoses hydraulic, hydrostatic and pneumatic systems **60%**	**D-10.01 Diagnoses hydraulic and hydrostatic systems**	**D-10.02 Diagnoses pneumatic systems**
Task D-11 Repairs hydraulic, hydrostatic and pneumatic systems **40%**	**D-11.01 Repairs hydraulic and hydrostatic systems**	**D-11.02 Repairs pneumatic systems**

E – Diagnoses and repairs electrical and electronic systems — 19%

Task E-12 Diagnoses electrical/electronic power and control monitoring systems 63%	E-12.01 Diagnoses electrical power and control monitoring systems	E-12.02 Diagnoses electronic power and control monitoring systems
Task E-13 Repairs electrical/electronic power and control monitoring systems 37%	E-13.01 Repairs electrical power and control monitoring systems	E-13.02 Repairs electronic power and control monitoring systems

F – Diagnoses and repairs steering, brakes and suspensions — 10%

Task F-14 Diagnoses steering and brake systems 26%	F-14.01 Diagnoses steering systems	F-14.02 Diagnoses brake systems	
Task F-15 Repairs steering and brake systems 26%	F-15.01 Repairs steering systems	F-15.02 Repairs brake systems	
Task F-16 Diagnoses track, wheel and suspension systems 24%	F-16.01 Diagnoses track systems	F-16.02 Diagnoses wheel assemblies	F-16.03 Diagnoses suspension systems
Task F-17 Repairs track, wheel and suspension systems 24%	F-17.01 Repairs track systems	F-17.02 Repairs wheel assemblies	F-17.03 Repairs suspension systems

G – Diagnoses and repairs structural components and operator stations

6%

Task G-18 Diagnoses structural components **18%**	**G-18.01 Diagnoses frame components**	**G-18.02 Verifies condition of operator protective structures**	**G-18.03 Diagnoses equipment body**
Task G-19 Repairs structural components **19%**	**G-19.01 Repairs frame components**	**G-19.02 Replaces operator protective structures**	**G-19.03 Repairs equipment body**
Task G-20 Diagnoses climate control systems **33%**	**G-20.01 Diagnoses heating and ventilation systems**	**G-20.02 Diagnoses air conditioning systems**	
Task G-21 Repairs climate control systems **30%**	**G-21.01 Repairs heating and ventilation systems**	**G-21.02 Repairs air conditioning systems**	

H – Diagnoses and repairs agricultural equipment

15%

Task H-22 Prepares agricultural equipment **9%**	**H-22.01 Performs assembly and pre-delivery adjustments on agricultural equipment**	**H-22.02 Performs preparation and installation of agricultural equipment**	**H-22-03 Installs precision farming equipment**
Task H-23 Diagnoses precision farming equipment **13%**	**H-23.01 Diagnoses precision farming equipment on site**	**H-23.02 Diagnoses precision farming equipment remotely**	
Task H-24 Repairs precision farming equipment **10%**	**H-24.01 Repairs precision farming equipment on site**	**H-24.02 Repairs precision farming equipment remotely**	
Task H-25 Diagnoses land preparation, tillage and seeding/planting equipment **12%**	**H-25.01 Diagnoses land preparation and tillage equipment**	**H-25.02 Diagnoses seeding and planting equipment**	
Task H-26 Repairs land preparation, tillage and seeding/planting equipment **11%**	**H-26.01 Repairs land preparation and tillage equipment**	**H-26.02 Repairs seeding and planting equipment**	
Task H-27 Diagnoses harvesting, hay and forage equipment **15%**	**H-27.01 Diagnoses cutting, conditioning, gathering and processing equipment**	**H-27.02 Diagnoses material handling equipment**	
Task H-28 Repairs harvesting, hay and forage equipment **13%**	**H-28.01 Repairs cutting, conditioning, gathering and processing equipment**	**H-28.02 Repairs material handling equipment**	
Task H-29 Diagnoses application and irrigation equipment **9%**	**H-29.01 Diagnoses application equipment**	**H-29.02 Diagnoses irrigation equipment**	
Task H-30 Repairs application and irrigation equipment **8%**	**H-30.01 Repairs application equipment**	**H-30.02 Repairs irrigation equipment**	

Harmonization of Apprenticeship Training

Provincial and territorial apprenticeship authorities are each responsible for their respective apprenticeship programs. In the spirit of continual improvement, and to facilitate mobility among apprentices in Canada, participating authorities have agreed to work towards harmonizing certain aspects of their programs where possible. After consulting with their stakeholders in the trade, they have reached consensus on the following elements. Note that implementation of these elements may vary from jurisdiction to jurisdiction, depending on their own circumstances. For more information on the implementation in any province and territory, please contact that jurisdiction's apprenticeship authority.

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 this trade is 4 (four).

3. Total Training Hours During Apprenticeship Training

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

4. Sequencing Topics and Related Sub-tasks

The topic titles in the table below are placed in a column for each apprenticeship level for technical training. Each topic is accompanied by the sub-tasks and their reference number. The topics in the grey shaded cells represent those that are covered "in context" with other training in the subsequent years.

Level 1	Level 2	Level 3	Level 4 Trade Specific
	Routine Work Practices	Routine Work Practices	Routine Work Practices
	Organizes Work	Organizes Work	Organizes Work
Safety-Related Functions A-1.01 Maintains safe work environment A-1.02 Uses personal protective equipment (PPE) and safety equipment			

Routine Work Practices
A-2.01 Conducts operational tests
A-2.02 Maintains fluids, lubricants and coolants
A-2.03 Services filters
A-2.04 Maintains hoses, tubing and fittings
A-2.05 Services bearings, bushings and seals
A-2.06 Uses fasteners, sealants, adhesives and gaskets
A-2.07 Cleans components
A-2.08 Verifies equipment and components repairs
A-2.09 Performs failure analysis

Organizes Work
A-3.01 Uses documentation
A-3.02 Plans daily tasks

Tools and Equipment
A-4.01 Uses tools and equipment
A-4.02 Uses hoisting, lifting and securing equipment

Tools and Equipment
A-4.03 Uses electronic devices and systems for diagnostics and programming

Communication and Mentoring Techniques
A-5.01 Uses communication techniques
A-5.02 Uses mentoring techniques

Mentoring Techniques
A-5.02 Uses mentoring techniques

Engine and Engine Support Systems (Diagnoses)
B-6.01 Diagnoses base engines
B-6.02 Diagnoses lubrication systems
B-6.03 Diagnoses cooling systems
B-6.04 Diagnoses intake and exhaust systems
B-6.05 Diagnoses fuel delivery systems
B-6.06 Diagnoses engine management systems
B-6.07 Diagnoses emissions control systems

Engine and Engine Support Systems (Diagnoses)
B-6.01 Diagnoses base engines
B-6.02 Diagnoses lubrication systems
B-6.03 Diagnoses cooling systems
B-6.04 Diagnoses intake and exhaust systems
B-6.05 Diagnoses fuel delivery systems
B-6.06 Diagnoses engine management systems
B-6.07 Diagnoses emissions control systems

Engine and Engine Support Systems (Repairs)
B-7.01 Repairs base engines
B-7.02 Repairs lubrication systems
B-7.03 Repairs cooling systems
B-7.04 Repairs intake and exhaust systems
B-7.05 Repairs fuel delivery systems
B-7.06 Repairs engine management systems
B-7.07 Repairs emissions control systems

Engine and Engine Support Systems (Repairs)
B-7.01 Repairs base engine
B-7.02 Repairs lubrication system
B-7.03 Repairs cooling systems
B-7.04 Repairs intake and exhaust system
B-7.05 Repairs fuel delivery system
B-7.06 Repairs engine management systems
B-7.07 Repairs emissions control systems

Drive Train (Diagnoses)
C-8.01 Diagnoses dry clutches
C-8.02 Diagnoses driveline systems and components
C-8.03 Diagnoses wet clutches, transmissions and gear cases
C-8.04 Diagnoses differentials and final drives

Drive Train (Diagnoses)
C-8.01 Diagnoses dry clutches
C-8.02 Diagnoses driveline systems and components
C-8.03 Diagnoses wet clutches, transmissions and gear cases
C-8.04 Diagnoses differentials and final drives

Drive Train (Repairs)
C-9.01 Repairs dry clutches
C-9.02 Repairs driveline systems and components
C-9.03 Repairs wet clutches, transmissions and gear cases.
C-9.04 Repairs differentials and final drives

Drive Train (Repairs)
C-9.01 Repairs dry clutches
C-9.02 Repairs driveline systems and components
C-9.03 Repairs wet clutches, transmissions and gear cases
C-9.04 Repairs differentials and final drives

Hydraulic, Hydrostatic and Pneumatic Systems (Diagnoses)
D-10.02 Diagnoses pneumatic systems

Hydraulic, Hydrostatic and Pneumatic Systems (Diagnoses)
D-10.01 Diagnoses hydraulic and hydrostatic systems

Hydraulic, Hydrostatic and Pneumatic Systems (Repairs)
D-11.02 Repairs pneumatic systems

Hydraulic, Hydrostatic and Pneumatic Systems (Repairs)
D-11.01 Repairs hydraulic and hydrostatic systems

Electrical Power and Control Monitoring Systems (Diagnoses)
E-12.01 Diagnoses electrical power and control monitoring systems

Electrical Power and Control Monitoring Systems (Diagnoses)
E-12.02 Diagnoses electronic power and control monitoring systems

Electrical Power and Control Monitoring Systems (Repairs)
E-13.01 Repairs electrical power and control monitoring systems

Electrical Power and Control Monitoring Systems (Repairs)
E-13.02 Repairs electronic power and control monitoring systems

Steering and Brake Systems (Diagnoses)
F-14.01 Diagnoses steering systems
F-14.02 Diagnoses brake systems

Steering and Brake Systems (Diagnoses)
F-14.01 Diagnoses steering systems

Steering and Brake Systems (Repairs)
F-15.01 Repairs steering systems
F-15.02 Repairs brake systems

Steering and Brake Systems (Repairs)
F-15.01 Repairs steering systems

Track, Wheel and Suspension Systems (Diagnoses)
F-16.01 Diagnoses track systems
F-16.02 Diagnoses wheel assemblies
F-16.03 Diagnoses suspension systems

Track, Wheel and Suspension Systems (Diagnoses)
F-16.01 Diagnoses track systems
F-16.02 Diagnoses wheel assemblies
F-16.03 Diagnoses suspension systems

Track, Wheel and Suspension Systems (Repairs)
F-17.01 Repairs track systems
F-17.02 Repairs wheel assemblies
F-17.03 Repairs suspension systems

Track, Wheel and Suspension Systems (Repairs)
F-17.01 Repairs track systems
F-17.02 Repairs wheel assemblies
F-17.03 Repairs suspension systems

Structural Components (Diagnoses)
G-18.01 Diagnoses frame components
G-18.02 Verifies condition of operator protective structures
G-18.03 Diagnoses equipment body

Structural Components (Diagnoses)
G-18.01 Diagnoses frame components
G-18.02 Verifies condition of operator protective structures
G-18.03 Diagnoses equipment body

Structural Components (Repairs)
G-19.01 Repairs frame components
G-19.02 Replaces operator protective structures
G-19.03 Repairs equipment body

Structural Components (Repairs)
G-19.01 Repairs frame components
G-19.02 Replaces operator protective structures
G-19.03 Repairs equipment body

Climate Control Systems (Diagnoses)
G-20.01 Diagnoses heating and ventilation systems
G-20.02 Diagnoses air conditioning systems

Climate Control Systems (Repairs)
G-21.01 Repairs heating and ventilation systems
G-21.02 Repairs air conditioning systems

Climate Control Systems (Diagnoses)
G-20.01 Diagnoses heating and ventilation systems
G-20.02 Diagnoses air conditioning systems

Climate Control Systems (Repairs)
G-21.01 Repairs heating and ventilation systems
G-21.02 Repairs air conditioning systems

Agricultural Equipment (Prepares)
H-22.03 Installs precision farming equipment

Precision Farming Equipment (Diagnoses)
Introduction
H-23.01 Diagnoses precision farming equipment on site
H-23.02 Diagnoses precision farming equipment remotely

Agricultural Equipment (Prepares)
H-22.01 Performs assembly and pre-delivery adjustments on agricultural equipment
H-22.02 Performs preparation and installation of agricultural equipment
H-22.03 Installs precision farming equipment

Precision Farming Equipment (Diagnoses)
H-23.01 Diagnoses precision farming equipment on site
H-23.02 Diagnoses precision farming equipment remotely

Precision Farming Equipment (Repairs)
H-24.01 Repairs precision farming equipment on site
H-24.02 Repairs precision farming equipment remotely

Land Preparation, Tillage and Seeding/Planting Equipment (Diagnoses)
H-25.01 Diagnoses land preparation and tillage equipment
H-25.02 Diagnoses seeding and planting equipment

Land Preparation, Tillage and Seeding/Planting Equipment (Repairs)
H-26.01 Repairs land preparation and tillage equipment
H-26.02 Repairs seeding and planting equipment

Harvesting, Hay and Forage Equipment (Diagnoses)

H-27.01 Diagnoses cutting, conditioning, gathering and processing equipment

H-27.02 Diagnoses delivery equipment

Harvesting, Hay and Forage Equipment (Repairs)

H-28.01 Repairs cutting, conditioning, gathering and processing equipment

H-28.02 Repairs delivery equipment

Application and Irrigation Equipment (Diagnoses)

H-29.01 Diagnoses application equipment

H-29.02 Diagnoses irrigation equipment

Application and Irrigation Equipment (Repairs)

H-30.01 Repairs application equipment

H-30.02 Repairs irrigation equipment

Major Work Activity A

Performs common occupational skills

Task A-1 Performs safety-related functions

Task Descriptor

Agricultural equipment technicians must adhere to safety procedures and regulations when using personal protective equipment (PPE) and safety equipment. Maintaining a safe work environment is also critical.

A-1.01 Maintains safe work environment

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-1.01.01P	maintain clean work area free of ***hazards***	work area is clean and free of ***hazards*** according to ***jurisdictional safety regulations*** and ***company safety policies and procedures***
A-1.01.02P	perform lock-out procedures	lock-out procedures are performed according to work environment and type of equipment and company policies and procedures
A-1.01.03P	handle, store and dispose of ***hazardous materials***	***hazardous materials*** are handled, stored and disposed of according to ***jurisdictional safety regulations***
A-1.01.04P	perform ***activities***	***activities*** are performed to ensure clear line of sight and area is clear of obstructions

Range of Variables

hazards include: trip hazards, oil spills, chemical spills

jurisdictional safety regulations include: Occupational Health and Safety (OH&S), Workplace Hazardous Materials Information System (WHMIS)

company safety policies and procedures include: evacuation routes, location of safety equipment, emergency exits, safety training, muster points

hazardous materials include: chemicals, refrigerants, high-pressure gases, fluids

activities include: walk around area and equipment, moving obstructions from line of sight, awareness of moving equipment and people on site

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-1.01.01L	demonstrate knowledge of safe work practices	describe safe work practices to maintain a safe work environment
		describe procedures to handle, store and dispose of ***hazardous materials***
A-1.01.02L	demonstrate knowledge of certification and regulatory requirements pertaining to safety	identify and describe ***jurisdictional safety regulations*** to maintain safe work environment
		identify ***components of WHMIS***
		identify and describe jurisdictional requirements for handling and disposing of ***hazardous materials***

Range of Variables

hazardous materials include: chemicals, refrigerants, high-pressure gases, fluids

jurisdictional safety regulations include: OH&S, WHMIS

components of WHMIS include: safety data sheets (SDS), labels, training

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

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-1.02.01P	select and use PPE	PPE is selected and used according to company policies, task and manufacturers' specifications
A-1.02.02P	select and use safety equipment	safety equipment is selected and used according to task and manufacturers' specifications

A-1.02.03P	organize and store PPE and safety equipment	PPE and safety equipment is organized and stored in designated areas according to site plan and, company policies and procedures
A-1.02.04P	report or replace worn, damaged and defective PPE and safety equipment	designated safety representative is notified of worn, damaged and defective PPE and safety equipment

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-1.02.01L	demonstrate knowledge of PPE, their applications, limitations and procedures for use	identify types of PPE and describe their applications, limitations and procedures for use
		describe care and maintenance of PPE
A-1.02.02L	demonstrate knowledge of safety equipment, their applications, limitations and procedures for use	identify types of safety equipment and describe their applications, limitations and procedures for use
		describe care and maintenance of safety equipment
A-1.02.03L	demonstrate knowledge of certification and regulatory requirements for PPE and safety equipment	identify training requirements for PPE and safety equipment
		identify safety manuals, ***standards and regulations*** for PPE and safety equipment

Range of Variables

standards and regulations include: Canadian Standards Association (CSA), OH&S, site specific (company or client), jurisdictional requirements

Task A-2 Performs routine work practices

Task Descriptor

Work practices in this task are common activities which may be performed throughout this trade. Agricultural equipment technicians must adhere to safety procedures and regulations when performing these tasks.

A-2.01 Conducts operational tests

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-2.01.01P	operate equipment and attachments to verify operation	equipment and attachments are verified to be operational according to application, environmental conditions and manufacturers' specifications
A-2.01.02P	perform ***sensory inspections*** for ***faults***	***sensory inspections*** are performed to identify ***faults***
A-2.01.03P	interpret results of operational test	operational test results are interpreted to identify ***faults*** or repairs required

Range of Variables

sensory inspections include: visual, odour

faults include: damage, improper adjustments, improperly installed attachments or equipment

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-2.01.01L	demonstrate knowledge of operational tests, their characteristics, purposes and applications	identify operational tests, and describe their characteristics, purposes and applications
A-2.01.02L	demonstrate knowledge of conducting operational tests	describe procedures to conduct operational tests
		describe types of ***faults*** identified by conducting operational tests

Range of Variables

faults include: damage, improper adjustments, improperly installed attachments or equipment

A-2.02 Maintains fluids, lubricants and coolants

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

Skills

	Performance Criteria	Evidence of Attainment
A-2.02.01P	select and use tools and equipment	tools and equipment are selected and used according to application
A-2.02.02P	verify ***fluid*** levels	***fluid*** levels are verified
A-2.02.03P	select types and grades of ***fluids*** and ***lubricants***	types and grades of ***fluids*** and ***lubricants*** are selected according to application
A-2.02.04P	perform ***sensory inspections***	***sensory inspections*** are performed to determine if ***fluids*** have been contaminated or compromised
A-2.02.05P	test coolant sample and interpret test results	coolant sample is tested and test results are interpreted and documented
A-2.02.06P	interpret test results of ***liquids***	test results of ***liquids*** are interpreted to identify symptoms of wear or failure of components
A-2.02.07P	drain, refill and top up ***fluids***	***fluids*** are drained, refilled and topped up according to required levels, manufacturers' specifications and service intervals

Range of Variables

fluids include: transmission, coolant, differential, hydraulic, engine oil
lubricants include: synthetic, non-synthetic, organic
sensory inspections include: visual, odour
liquids include: engine oil, hydraulic oil, antifreeze

Knowledge

	Learning Outcomes	Learning Objectives
A-2.02.01L	demonstrate knowledge of ***fluids***, ***lubricants*** and coolants, their characteristics, purposes and applications	identify types and grades of ***fluids***, ***lubricants*** and coolants, and describe their characteristics, purposes and applications
		describe consequences of mixing different types of ***fluids***, ***lubricants*** and coolants
A-2.02.02L	demonstrate knowledge of maintaining ***fluids***, ***lubricants*** and coolants	identify tools and equipment used to maintain ***fluids***, ***lubricants*** and coolants, and describe their applications and procedures for use
		describe procedures to maintain ***fluids***, ***lubricants*** and coolants

		describe procedures to dispose and recycle oil, antifreeze, air conditioning refrigerant, contaminated fuels and filters
A-2.02.03L	demonstrate knowledge of certification requirements to maintain air conditioning refrigerant	describe certification requirements to maintain air conditioning refrigerant
A-2.02.04L	demonstrate knowledge of regulatory requirements pertaining to disposal of oil, antifreeze, air conditioning refrigerant, contaminated fuels and filters	identify and interpret regulations and pertaining to disposal of oil, antifreeze, air conditioning refrigerant, contaminated fuels and filters

Range of Variables

fluids include: transmission, coolant, differential, hydraulic, engine oil

lubricants include: synthetic, non-synthetic, organic

A-2.03 Services filters

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-2.03.01P	locate ***filters*** for ***components***	***filters*** for ***components*** are located
A-2.03.02P	select and use tools and equipment	tools and equipment are selected and used according to application
A-2.03.03P	perform visual inspection of ***filters*** for ***faults***	visual inspection of ***filters*** is performed and ***faults*** are identified
A-2.03.04P	relieve pressure from system before removing ***filters***	pressure is relieved from system before removing ***filters***
A-2.03.05P	clean or replace ***filters***	***filters*** are cleaned or replaced according to ***filter*** condition, manufacturers' specifications and service intervals

Range of Variables

filters include: washout, pre-cleaners, spin-on, canister types, replaceable, inlet screens, inlet strainers, radiator screens

components include: engines, hydraulics, transmission, cab, differentials

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-2.03.01L	demonstrate knowledge of ***filters***, their characteristics, purposes and ***applications***	identify types of ***filters***, and describe their characteristics, purposes and ***applications***
A-2.03.02L	demonstrate knowledge of servicing ***filters***	identify tools and equipment used to service ***filters***, and describe their applications and procedures for use
		describe procedures to service ***filters***
		describe types of ***faults*** identified by conducting visual inspections of ***filters***
		describe procedures to dispose of and recycle oil, antifreeze, contaminated fuels and filters
A-2.03.03L	demonstrate knowledge of regulatory requirements to dispose of oil, antifreeze, contaminated fuels and filters	identify and interpret regulations to dispose of oil, antifreeze, contaminated fuels and filters

Range of Variables

filters include: washout, pre-cleaners, spin-on, canister types, replaceable, inlet screens, inlet strainers, radiator screens

applications include: air, fuel, oil

A-2.04 Maintains hoses, tubing and fittings

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-2.04.01P	relieve pressure from systems before disconnecting hoses, tubing and fittings	pressure from systems is relieved before disconnecting hoses, tubing and fittings
A-2.04.02P	perform visual inspection of hoses, tubing and fittings for ***faults***	visual inspection of hoses, tubing and fittings is performed and ***faults*** are identified and documented
A-2.04.03P	select and use tools and equipment	tools and equipment are selected and used according to application
A-2.04.04P	replace hoses, tubing and fittings	hoses, tubing and fittings are replaced according to manufacturers' specifications
A-2.04.05P	repair or construct hose/tube assemblies	hose/tube assemblies are repaired or constructed according to manufacturers' specifications

Range of Variables

faults include: holes, cracks, breakage, worn

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-2.04.01L	demonstrate knowledge of hoses, tubing and fittings, their characteristics, purposes and applications	identify ***types of hoses, tubing and fittings***, and describe their characteristics, purposes and applications
A-2.04.02L	demonstrate knowledge of maintaining hoses, tubing and fittings	identify tools and equipment used to maintain hoses, tubing and fittings, and describe their applications and procedures for use
		describe procedures to maintain hoses, tubing and fittings
		describe types of ***faults*** identified by conducting visual inspections of hoses, tubing and fittings

Range of Variables

types of hoses, tubing and fittings include: plastic, rubber, neoprene, steel
faults include: holes, cracks, breakage, worn

A-2.05 Services bearings, bushings and seals

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-2.05.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
A-2.05.02P	perform ***sensory inspections*** of bearings, bushings, seals and shafts to identify ***faults***	***sensory inspections*** of bearings, bushings, seals and shafts are performed and ***faults*** are identified and documented
A-2.05.03P	lubricate bearings, bushings and ***seals***	bearings, bushings and ***seals*** are lubricated according to manufacturers' specifications
A-2.05.04P	install wear sleeves	wear sleeves are installed according to application

A-2.05.05P	replace bearings, bushings and ***seals***	bearings, bushings and ***seals*** are replaced according to manufacturers' specifications
A-2.05.06P	adjust bearings and bushings to allowable tolerance	bearings and bushings are adjusted to allowable tolerance according to manufacturers' specifications

Range of Variables

tools and equipment include: bearing and seal drivers, hand tools, arbour press, hydraulic press, bearing heater

sensory inspections include: noise, visual, vibration

faults include: wear, damage

seals include: mechanical, lip-type, packings, O-rings, ceramic, metallic, wear sleeves

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-2.05.01L	demonstrate knowledge of bearings, bushings and ***seals***, their characteristics, purposes and applications	identify types of bearings, bushings and ***seals***, and describe their characteristics, purposes and applications
A-2.05.02L	demonstrate knowledge of servicing bearings, bushings and ***seals***	identify ***tools and equipment*** used to service bearings, bushings and ***seals***, and describe their applications and procedures for use
		describe procedures to service bearings, bushings and ***seals***
		describe types of ***faults*** identified by ***sensory inspections*** of bearings, bushings and ***seals***

Range of Variables

seals include: mechanical, lip-type, packings, O-rings, ceramic, metallic, wear sleeves

tools and equipment include: bearing and seal drivers, hand tools, arbour press, hydraulic press, bearing heater

faults include: wear, damage

sensory inspections include: noise, visual, vibration

A-2.06 Uses fasteners, sealants, adhesives and gaskets

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-2.06.01P	select sealing or gasket material	sealing or gasket material is selected according to application
A-2.06.02P	replace sealants, adhesives and gaskets	sealants, adhesives and gaskets are replaced according to application
A-2.06.03P	replace ***fasteners***	***fasteners*** are replaced according to grade, thread pitch and size
A-2.06.04P	construct gaskets	gaskets are constructed
A-2.06.05P	repair threads	threads are repaired by ***actions***
A-2.06.06P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application

Range of Variables

fasteners include: locking washers, lock nuts, bolts, studs, torque-to-yield bolts
actions include: re-threading, thread insert
tools and equipment include: taps, dies, chasers, thread inserts

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-2.06.01L	demonstrate knowledge of ***fasteners***, sealants, adhesives and gaskets, their characteristics, purposes and applications	identify types of ***fasteners***, sealants, adhesives and gaskets, and describe their characteristics, purposes and applications
A-2.06.02L	demonstrate knowledge of using ***fasteners***, sealants, adhesives and gaskets	identify ***tools and equipment*** used with ***fasteners***, sealants, adhesives and gaskets and describe their applications and procedures for use
		describe procedures for using ***fasteners***, and applying sealants, adhesives and gaskets
		describe torque methods and specifications of ***fasteners***
		identify anaerobic materials, and describe their characteristics, purposes and applications
A-2.06.03L	demonstrate knowledge of regulatory requirements pertaining to adhesives and gaskets	identify and interpret regulations and requirements pertaining to adhesives and gaskets

Range of Variables

fasteners include: locking washers, lock nuts, bolts, studs, torque-to-yield bolts
tools and equipment include: taps, dies, chasers, thread inserts

A-2.07 Cleans components

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-2.07.01P	select and use ***cleaning tools***	***cleaning tools*** are selected and used according to application
A-2.07.02P	select ***cleaning method***	***cleaning method*** is selected according to type and location of repair
A-2.07.03P	select ***cleaning solution and solvents***	***cleaning solution and solvents*** are selected according to task and application
A-2.07.04P	verify area surrounding component is clean and clear of debris	area surrounding component is clean and clear of debris before component removal
A-2.07.05P	verify component has been cleaned	component has been cleaned

Range of Variables

cleaning tools include: parts washers, scrapers, pressure washers, wire wheels, flushing equipment kits
cleaning methods include: scraping, wiping, washing, flushing
cleaning solution and solvents include: brake cleaner, electrical contact cleaner, degreasers

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-2.07.01L	demonstrate knowledge of ***cleaning tools, solutions and solvents***, their characteristics, purposes and applications	identify types of ***cleaning tools, solutions and solvents***, and describe their characteristics, purposes and applications
A-2.07.02L	demonstrate knowledge of ***cleaning methods*** used to clean components	describe methods used for cleaning components
A-2.07.03L	demonstrate knowledge of regulatory requirements pertaining to use and disposal of ***cleaning solution and solvents***	identify and interpret regulations pertaining to use and disposal of ***cleaning solution and solvents***

Range of Variables

cleaning tools include: parts washers, scrapers, pressure washers, wire wheels, flushing equipment kits
cleaning solution and solvents include: brake cleaner, electrical contact cleaner, degreasers
cleaning methods include: scraping, wiping, washing, flushing

A-2.08 Verifies equipment and component repairs

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-2.08.01P	select and use tools and equipment	tools and equipment are selected and used according to application
A-2.08.02P	verify repaired ***component*** operation	repaired ***component*** is verified to be operational according to ***tests*** performed
A-2.08.03P	verify dimensions and pressures	dimensions and pressures are verified according to manufacturers' specifications
A-2.08.04P	perform ***sensory inspections*** to verify repair	***sensory inspections*** are performed to verify repair
A-2.08.05P	verify equipment and attachment operation	equipment and attachments are operated to verify operation according to application, environmental conditions and manufacturers' specifications
A-2.08.06P	interpret and document results of operational test	results of operational test are interpreted to confirm repair is complete and are documented
A-2.08.07P	advise operator of required ***follow-up procedures***	operator is advised of required ***follow-up procedures***

Range of Variables

components include: starters, gear boxes, injectors
tests include: amp draw, voltage, pressure, flow, end-play
sensory inspections include: noise, visual, vibration
follow-up procedures include: re-torques, fluid top ups, break-in periods, readjustments

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-2.08.01L	demonstrate knowledge of verifying equipment and ***component*** repairs	identify tools and equipment used to verify equipment and ***component*** repairs, and describe their applications and procedures for use
		describe procedures for verifying equipment and ***component*** repairs
		identify types of ***tests*** and ***sensory inspections*** performed on repaired ***components***

Range of Variables

components include: starters, gear boxes, injectors
tests include: amp draw, voltage, pressure, flow, end-play
sensory inspections include: noise, visual, vibration

A-2.09 Performs failure analysis

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-2.09.01P	consult customer to identify ***factors***	customer is consulted to identify ***factors***
A-2.09.02P	consult ***factory assistance***	***factory assistance*** is consulted to isolate cause of failure
A-2.09.03P	analyze systems	systems are analyzed to isolate cause of failure
A-2.09.04P	recommend repairs	repairs are recommended according to causes (root, secondary) of failure

Range of Variables

factors include: point and time of failure, operational information
factory assistance includes: email, phone, service bulletins, special procedures

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-2.09.01L	demonstrate knowledge of performing failure analysis	describe procedures to perform failure analysis
		identify ***factory assistance*** to be consulted to isolate cause of failure

Range of Variables

factory assistance includes: email, phone, service bulletins, special procedures

Task A-3 Organizes work

Task Descriptor

Agricultural equipment technicians use a variety of documents to plan and record their work.

A-3.01 Uses documentation

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-3.01.01P	read ***manuals*** in order to locate required ***information***	***manuals*** are read in order to locate required ***information***
A-3.01.02P	use ***electronic devices*** to locate required ***information***	***electronic devices*** are used to locate required ***information***
A-3.01.03P	interpret and apply ***technical information*** to situation	***technical information*** is interpreted and applied to situation
A-3.01.04P	record ***service information***	***service information*** is recorded according to original equipment manufacturer (OEM) requirements and company policies
A-3.01.05P	record ***work-related information***	***work-related information*** is recorded according to OEM requirements and company policies
A-3.01.06P	complete ***safety-related documents***	***safety-related documents*** are completed according to jurisdictional regulations, and company policies and procedures

A-3.01.07P	report completion of documentation to management	completion of documentation is reported to management according to company policies and procedures
A-3.01.08P	follow confidentiality guidelines	confidentiality guidelines are followed according to company policies and procedures

Range of Variables

manuals include: operator, service, parts, safety

information includes: warranties, service, parts

electronic devices include: laptops, smart phones, tablets, data links, OEM communication devices

technical information includes: schematics, drawings, specifications, theory of operation, test results

service information includes: warranty claims, service records, preventative maintenance records, failure analysis using photographs

work-related information includes: hours worked, machine hours, vehicle identification numbers (VIN), parts used, task descriptions

safety-related documents include: accident reports, injury reports, safety inspection reports, workplace

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-3.01.01L	demonstrate knowledge of trade-related documentation and its use	identify ***trade-related information***, and describe their characteristics and applications
		identify information required for service records and maintenance logs
		identify ***safety-related documents***, and describe their characteristics and applications
A-3.01.02L	demonstrate knowledge of procedures to use and complete documentation	describe procedures to complete documentation
A-3.01.03L	demonstrate knowledge of confidentiality guidelines	identify elements of confidentiality guidelines, and describe their characteristics and applications
A-3.01.04L	demonstrate knowledge of regulatory requirements pertaining to use of documentation	identify and interpret regulations pertaining to use of documentation

Range of Variables

trade-related information include: manuals, technical information, work-related information, schematics, drawings

safety-related documents include: accident reports, injury reports, safety inspection reports, workplace hazard reports

A-3.02 Plans daily tasks

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-3.02.01P	determine priorities of tasks	priorities of tasks are determined according to ***factors***
A-3.02.02P	estimate repair times and finish dates	repair times and finish dates are estimated
A-3.02.03P	determine required materials and tools for diagnostics and repairs on service calls	required materials and tools for diagnostics and repairs on service calls are determined
A-3.02.04P	organize work and travel schedules	work and travel schedules are organized

Range of Variables

factors include: logical and efficient sequence, availability of parts

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-3.02.01L	demonstrate knowledge of planning tasks	describe sequence of work
		determine work and travel schedules
		describe importance of time management

Task A-4 Uses and maintains tools and equipment

Task Descriptor

Agricultural equipment technicians must use tools and equipment to perform all tasks in their trade. Handling tools and equipment also includes maintenance.

A-4.01 Uses tools and equipment

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-4.01.01P	organize and store tools and equipment in designated areas	tools and equipment are organized and stored in designated areas according to site plan and company policies
A-4.01.02P	inspect, identify and repair or replace worn, damaged or faulty tools and equipment	worn, damaged or faulty tools and equipment are repaired or replaced according to manufacturers' specifications and company policies
A-4.01.03P	report and dispose of worn, damaged and faulty tools and equipment	worn, damaged and faulty tools and equipment are reported and disposed of according to company policies
A-4.01.04P	sharpen tools and equipment ***accessories***	tools and equipment ***accessories*** are sharpened according to manufacturers' specifications
A-4.01.05P	calibrate measuring, testing and diagnostic tools and equipment	measuring, testing and diagnostic tools and equipment are calibrated according to manufacturers' specifications and are documented
A-4.01.06P	transport welding and cutting equipment	welding and cutting equipment is transported according to Transportation of Dangerous Goods (TDG) Act and ***jurisdictional regulations***
A-4.01.07P	lubricate and clean tools and equipment	tools and equipment are lubricated and cleaned according to manufacturers' specifications

Range of Variables

accessories include: drill bits, scrapers, chisels

jurisdictional regulations include: OH&S, Workers Compensation Board (WCB), jurisdictional road laws

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-4.01.01L	demonstrate knowledge of tools and equipment, their ***accessories***, characteristics, applications, maintenance and procedures for use	identify types of tools and equipment, and their ***accessories***, and describe their characteristics, applications, maintenance and procedures for use
		identify criteria for replacement or repair of tools and equipment
		describe procedures to lubricate and clean tools and equipment
		describe procedures to sharpen tools and equipment ***accessories***
		identify hazards and describe safe work practices pertaining to tools and equipment and their ***accessories***
A-4.01.02L	demonstrate knowledge of measuring, testing and diagnostic tools and equipment, their characteristics, applications, maintenance and procedures for use	identify types of measuring, testing and diagnostic tools and equipment, and describe their characteristics, applications, maintenance and procedures for use
		describe procedures to calibrate measuring, testing and diagnostic tools and equipment
		identify hazards and describe safe work practices pertaining to measuring, testing and diagnostic tools and equipment
A-4.01.03L	demonstrate knowledge of welding and cutting equipment, their characteristics, applications, maintenance and procedures for use	identify types of welding and cutting equipment, and describe their characteristics, applications, maintenance and procedures for use
		describe procedures to transport welding and cutting equipment
		identify hazards and describe safe work practices pertaining to welding and cutting equipment
A-4.01.04L	demonstrate knowledge of certification requirements for use of welding and cutting equipment	describe training and certification requirements for use of welding and cutting equipment
A-4.01.05L	demonstrate knowledge of regulatory requirements pertaining to transport and storage of welding and cutting equipment	identify and interpret regulations pertaining to transport and storage of welding and cutting equipment

Range of Variables

accessories include: drill bits, scrapers, chisels

A-4.02 Uses hoisting, lifting and securing equipment

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-4.02.01P	select hoisting, lifting and securing equipment	hoisting, lifting and securing equipment is selected according to application
A-4.02.02P	interpret tags on ***equipment***	tags on ***equipment*** are interpreted to identify load limits
A-4.02.03P	identify safe lifting locations or tag line points, and weight	safe lifting locations or tag line points, and weight are identified according to manufacturers' specifications
A-4.02.04P	identify, report, document and dispose of worn, damaged and faulty hoisting, lifting and securing equipment	worn, damaged and faulty hoisting, lifting and securing equipment is identified, reported, documented and disposed of according to jurisdictional regulations
A-4.02.05P	identify ***potential hazards*** and implement measures to minimize risk	***potential hazards*** are identified and measures are implemented to minimize risk
A-4.02.06P	operate hoisting, lifting and securing equipment	hoisting, lifting and securing equipment is operated according to manufacturers' specifications

Range of Variables

equipment includes: overhead hoists, chains, slings, tie down straps, shackles, service truck cranes, jacks, support devices

potential hazards include: ceiling heights, overhead wires, uneven surfaces

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-4.02.01L	demonstrate knowledge of hoisting, lifting and securing equipment, their characteristics, applications, limitations and maintenance	identify types of hoisting, lifting and securing equipment, and components, and describe their characteristics, applications, limitations and maintenance
A-4.02.02L	demonstrate knowledge of operating hoisting, lifting and securing equipment	identify ***factors to consider when selecting hoisting, lifting and securing equipment***
		describe procedures to operate hoisting, lifting and securing equipment
		identify ***potential hazards*** and describe ***safe work practices*** pertaining to operation of hoisting, lifting and securing equipment

A-4.02.03L	demonstrate knowledge of certification requirements for operation of hoisting, lifting and securing equipment	describe training and certification requirements for operation of hoisting, lifting and securing equipment
A-4.02.04L	demonstrate knowledge of regulatory requirements pertaining to hoisting, lifting and securing equipment	identify and interpret regulations pertaining to hoisting, lifting and securing equipment

Range of Variables

factors to consider when selecting hoisting, lifting and securing equipment include: load characteristics, environment, safety factors, anchor points, sling angles

potential hazards include: ceiling heights, overhead wires, uneven surfaces

safe work practices include: supervision of lifts, securing work area, communication

A-4.03 Uses electronic devices and systems for diagnostics and programming

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-4.03.01P	use ***software applications***	***software applications*** are used according to manufacturers' recommendations
A-4.03.02P	verify software version, download from manufacturer and upload to controllers	software version is verified, downloaded from manufacturer and uploaded to controllers
A-4.03.03P	select and use ***electronic devices***	***electronic devices*** are selected and used according to application
A-4.03.04P	download and document reports from equipment controller and forward to OEM or customer	reports from equipment controller are downloaded and documented and forwarded to OEM or customer
A-4.03.05P	monitor parameters	parameters are monitored for operational status according to manufacturers' specifications
A-4.03.06P	interpret diagnostic results and reports	diagnostic results and reports are interpreted to determine failure and required repair

Range of Variables

software applications include: OEM diagnostic and operating software, internet-based technical support

electronic devices include: laptops, smart phones, tablets, data links, OEM communication devices

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-4.03.01L	demonstrate knowledge of using ***electronic devices*** for diagnostics and programming	describe ***software applications*** used in diagnostics and programming
		identify types of ***electronic devices*** used in diagnostics and programming, and describe their characteristics, applications and procedures for use
		describe manufacturers' programming and monitoring procedures
		describe elements of diagnostic results and reports
A-4.03.02L	demonstrate knowledge of certification requirements for use of ***electronic devices*** for diagnostics and programming	describe training and certification requirements for use of ***electronic devices*** for diagnostics and programming

Range of Variables

electronic devices include: laptops, smart phones, tablets, data links, OEM communication devices
software applications include: OEM diagnostic and operating software, internet-based technical support

Task A-5 Uses communication and mentoring techniques

Task Descriptor

Learning in the trades is done primarily in the workplace with tradespeople passing on their skills and knowledge to apprentices, as well as sharing knowledge among themselves. Apprenticeship is, and always has been about mentoring – learning workplace skills and passing them on. Because of the importance of this to the trade, this task covers the activities related to communication in the workplace and mentoring skills.

A-5.01 Uses communication techniques

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-5.01.01P	demonstrate communication practices with individuals or in a group	instructions and messages are interpreted by all parties involved in communication
A-5.01.02P	listen using ***active listening*** practices	***active listening*** practices are utilized

A-5.01.03P	communicate clearly using correct industry terminology to ensure understanding	understanding of message is confirmed by both parties
A-5.01.04P	receive and respond to feedback on work completed or performed	response to feedback indicates understanding and corrective measures are taken
A-5.01.05P	receive and respond to instructions	response to instructions indicates understanding
A-5.01.06P	explain and provide feedback	explanation and feedback is provided and task is carried out as directed
A-5.01.07P	use questions to improve communication	questions enhance understanding, on-the-job training and goal setting
A-5.01.08P	participate in safety and information meetings	meetings are attended, information is relayed to workforce, and is applied
A-5.01.09P	send and receive ***electronic messages***	***electronic messages*** are sent and received using professionalism, plain language and clear expressions according to company policies

Range of Variables

active listening includes: hearing, interpreting, reflecting, responding, paraphrasing
electronic messages include: email, text message, social media

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-5.01.01L	demonstrate knowledge of trade terminology	define terminology used in the trade
A-5.01.02L	demonstrate knowledge of effective communication practices	describe importance of using effective verbal and non-verbal communication with ***people in the workplace***
		identify ***sources of information*** to effectively communicate
		identify communication and ***learning styles***
		describe effective listening and speaking skills
		identify ***personal responsibilities and attitudes*** that contribute to on-the-job success
		identify value of equity, diversity and inclusion in workplace

		identify communication that constitutes bullying, ***harassment*** and ***discrimination***
A-5.01.03L	demonstrate knowledge of various communication styles for ***electronic messages***	identify communication styles appropriate to different systems and applications of ***electronic messages***

Range of Variables

people in the workplace include: other tradespeople, colleagues, apprentices, supervisors, clients, jurisdictional representatives, manufacturers

sources of information include: regulations, codes, occupational health and safety requirements, jurisdictional requirements, prints, drawings, specifications, company and client documentation

learning styles include: seeing it, hearing it, trying it

personal responsibilities and attitudes include: asking questions, working safely, accepting constructive feedback, time management and punctuality, respect for others authority, good stewardship of materials, tools and property, efficient work practice

harassment as defined by the Canadian and jurisdictional Human Rights Commissions

discrimination as defined by the Canadian Human Rights Act and jurisdictional human rights laws

electronic messages include: email, text message, social media

A-5.02 Uses mentoring techniques

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-5.02.01P	identify and communicate learning objective and point of lesson	apprentice or learner can explain objective and point of lesson
A-5.02.02P	link lesson to other lessons and job	lesson order and unplanned learning opportunities are defined
A-5.02.03P	demonstrate performance of skill to an apprentice or learner	***steps required to demonstrate skill*** are performed
A-5.02.04P	set up conditions required for an apprentice or learner to practice skill	***practice conditions*** are set up so that skill can be practiced safely by apprentice or learner
A-5.02.05P	assess apprentice or learner's ability to perform tasks with increasing independence	performance of apprentice or learner improves with practice to point where skill can be done with little supervision
A-5.02.06P	give supportive and corrective feedback	apprentice or learner adopts best practice after having been given supportive or corrective feedback
A-5.02.07P	support apprentices or learners in pursuing technical training opportunities	technical training is completed within timeframe prescribed by apprenticeship authority

A-5.02.08P	support anti-***harassment*** in workplace	workplace is ***harassment*** and ***discrimination***-free
A-5.02.09P	assess apprentice or learner suitability to trade during probationary period	apprentice or learner is given feedback that helps them identify their own strengths and weaknesses and suitability for trade

Range of Variables

steps required to demonstrate a skill include: understanding the who, what, where, when, why, and how, explaining, showing, giving encouragement, following up to ensure skill is performed correctly

practice conditions means: guided, limited independence, full independence

harassment as defined by Canadian and jurisdictional Human Rights Commissions

discrimination as defined by Canadian Human Rights Act and jurisdictional human rights laws

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-5.02.01L	demonstrate knowledge of strategies for learning skills in workplace	describe importance of individual experience
		describe shared responsibilities for workplace learning
		determine one's own learning preferences and explain how these relate to learning new skills
		describe importance of different types of skills in workplace
		describe importance of ***essential skills*** in workplace
		identify different ***learning styles***
		identify different ***learning needs*** and strategies to meet them
		identify ***strategies to assist in learning a skill***
A-5.02.02L	demonstrate knowledge of strategies for ***teaching*** workplace ***skills***	identify different roles played by workplace mentor
		describe ***teaching skills***
		explain importance of identifying point of a lesson
		identify how to choose a good time to present lesson
		explain importance of linking lessons
		identify components of the skill (context)
		describe considerations in setting up opportunities for skill practice
		explain importance of providing feedback

	identify techniques for giving effective feedback
	describe a skills assessment
	identify methods of assessing progress
	explain how to adjust a lesson to different situations

Range of Variables

essential skills are: reading, document use, writing, oral communication, numeracy, thinking, working with others, digital technology, continuous learning

learning styles include: seeing it, hearing it, trying it

learning needs include: learning disabilities, learning preferences, language proficiency

strategies to assist in learning a skill include: understanding basic principles of instruction, developing coaching skills, being mature and patient, providing feedback

teaching skills include: identifying point of lesson, linking the lesson, demonstrating the skill, providing practice, giving feedback, assessing skills and progress

Major Work Activity B

Diagnoses and repairs engines and engine support systems

Task B-6 Diagnoses engines and engine support systems

Task Descriptor

The proper diagnosis of engines and supporting systems is critical to ensure optimum engine performance, efficiency and emission compliance. Agricultural equipment technicians need to understand the complexity of the engine and related systems that affect its operation.

B-6.01 Diagnoses base engines

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
B-6.01.01P	identify ***symptoms of problem***	***symptoms of problem*** are identified by consulting with customer or operator
B-6.01.02P	perform sensory inspections to identify ***faults***	sensory inspections are performed to identify ***faults***
B-6.01.03P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application and manufacturers' procedures
B-6.01.04P	remove ***components*** for access	***components*** are removed for access
B-6.01.05P	perform ***tests***	***tests*** are performed according to manufacturers' specifications
B-6.01.06P	interpret test results and compare to manufacturers' specifications	test results are interpreted and compared to manufacturers' specifications
B-6.01.07P	determine ***required actions***	***required actions*** are determined

Range of Variables

symptoms of problem include: leaks, noises, no start, hard start, low power

faults include: intake, exhaust and fluid leaks, abnormal noises

tools and equipment include: temperature measuring devices, compression testers, measuring instruments, pressure measuring devices, dynamometer, fluid analysis sampling devices

components (removed for access) include: panels, shields, hoods

tests include: compression, cylinder leakage, oil pressure, dynamometer checks, fluid sampling for analysis

required actions include: repairs; component replacement of crankshaft bearings, pistons and liners, head gaskets, camshafts, cylinder heads, intake and exhaust valves; further diagnosis

	Knowledge	
	Learning Outcomes	**Learning Objectives**
B-6.01.01L	demonstrate knowledge of base engines, their ***components***, characteristics, applications and operation	identify types of base engines and their ***components***, and describe their characteristics and applications
		describe theory of engine operation
B-6.01.02L	demonstrate knowledge of diagnosing base engines	identify ***tools and equipment*** used to diagnose base engines, and describe their applications and procedures for use
		describe procedures to diagnose base engines
		identify hazards and describe safe work practices while diagnosing base engines
		identify inspections and tests conducted to diagnose base engines
		identify types of ***faults*** identified by conducting inspections of base engines

Range of Variables

components (base engine) include: valves, pistons, blocks, liners, cylinder heads, cam shafts, valve trains, crank shafts, connecting rods, timing gears, bearings, seals, sealants, gaskets

tools and equipment include: temperature measuring devices, compression testers, measuring instruments, pressure measuring devices, dynamometer, fluid analysis sampling devices

faults include: intake, exhaust and fluid leaks, abnormal noises

B-6.02 Diagnoses lubrication systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
B-6.02.01P	identify ***symptoms of problem***	***symptoms of problem*** are identified by consulting with customer or operator
B-6.02.02P	perform sensory inspections of engine oil to identify ***factors***	sensory inspections of engine oil are performed to identify ***factors***
B-6.02.03P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application and manufacturers' procedures
B-6.02.04P	locate ***source of contamination***	***source of contamination*** is located
B-6.02.05P	test oil pressure and interpret results	oil pressure is tested and results are interpreted according to manufacturers' specifications
B-6.02.06P	check for failed, worn, damaged and faulty ***components***	failed, worn, damaged and faulty ***components*** are identified
B-6.02.07P	interpret engine oil test results	engine oil test results are interpreted to determine engine wear and fluid contamination
B-6.02.08P	determine ***required actions***	***required actions*** are determined

Range of Variables

symptoms of problem include: low or high fluid level, low or high oil pressure, external oil leaks, oil dilution, cross-contaminated oil

factors include: colour, level, viscosity, odour

tools and equipment include: pressure gauges, dyes, fluid analysis sampling devices, temperature measuring devices

source of contamination includes: coolant, fuel, water

components include: oil pump, oil cooler, pressure regulator valves, bypass valves, inlet strainers, oil filters

required actions include: repairs, component replacement, further diagnosis

	Knowledge	
	Learning Outcomes	**Learning Objectives**
B-6.02.01L	demonstrate knowledge of lubrication systems, their ***components***, characteristics, applications and operation	identify types of lubrication systems and their ***components***, and describe their characteristics, applications and operation
		describe functions and characteristics of engine oil
		identify ***fluid classifications***

B-6.02.02L	demonstrate knowledge of diagnosing lubrication systems	identify ***tools and equipment*** used to diagnose lubrication systems, and describe their applications and procedures for use
		describe procedures to diagnose lubrication systems
		identify hazards and describe safe work practices while diagnosing lubrication systems
		identify inspections and tests conducted to diagnose lubrication systems
		describe ***factors*** identified by conducting inspection and test of oil
B-6.02.03L	demonstrate knowledge of regulatory requirements pertaining to lubrication systems	identify and interpret regulations pertaining to lubrication systems

Range of Variables

components include: oil pump, oil cooler, pressure regulator valves, bypass valves, inlet strainers, oil filters

fluid classifications include: viscosity, American Petroleum Institute (API), Society of Automotive Engineers (SAE)

tools and equipment include: pressure gauges, dyes, fluid analysis sampling devices, temperature measuring devices

factors include: colour, level, viscosity, odour

B-6.03 Diagnoses cooling systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
B-6.03.01P	identify ***symptoms of problem***	***symptoms of problem*** are identified by consulting with customer or operator
B-6.03.02P	perform sensory inspections of coolant to identify contamination	sensory inspections of coolant are performed to identify contamination by checking colour, level and odour
B-6.03.03P	locate ***source of contamination***	***source of contamination*** is located
B-6.03.04P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application and manufacturers' procedures
B-6.03.05P	use test strips to determine ***coolant condition***	test strips are used to determine ***coolant condition***

B-6.03.06P	check ***components*** to identify ***faults***	***components*** are checked to identify ***faults***
B-6.03.07P	determine ***required actions***	***required actions*** are determined

Range of Variables

symptoms of problem include: coolant leaks, low or high operating temperatures, excessive system pressure, contamination

source of contamination include: oil, fuel, diesel exhaust fluid

tools and equipment include: leak testing equipment, pressure measuring devices, refractometers, temperature measuring devices, coolant test strips, fluid analysis sampling devices, coolant hydrometers

coolant condition includes: pH level, freeze point, diesel coolant additive (DCA) levels, supplemental coolant additives (SCA) levels

components include: oil cooler, thermostats, cooling fan, radiator, hoses, coolant, clamps, seals, sealants, gaskets, fans, fan drives, radiator shrouds, belts, radiator caps, recovery tanks, coolant heaters, sensors, mechanical and electric water pumps, controllers

faults include: leakage, blockages, erosion, corrosion, wear, oxidization, cavitation

required actions include: repairs, component replacement, cooling system flush, further diagnosis

	Knowledge	
	Learning Outcomes	**Learning Objectives**
B-6.03.01L	demonstrate knowledge of ***cooling systems***, their ***components***, characteristics, applications and operation	identify types of ***cooling systems*** and their ***components***, and describe their characteristics, applications and operation
		describe coolant classifications and additives
		describe hazards of pressurized ***cooling systems***
B-6.03.02L	demonstrate knowledge of diagnosing ***cooling systems***	identify ***tools and equipment*** used to diagnose ***cooling systems***, and describe their applications and procedures for use
		describe procedures to diagnose ***cooling systems***
		identify hazards and describe safe work practices while diagnosing ***cooling systems***
		identify inspections and tests conducted to diagnose ***cooling systems***
		identify potential ***faults*** in ***cooling system components***
B-6.03.03L	demonstrate knowledge of regulatory requirements pertaining to ***cooling systems***	identify and interpret regulations pertaining to ***cooling systems***

Range of Variables

cooling systems include: electronically-controlled, mechanically-controlled, liquid and air cooled

components include: oil cooler, thermostats, cooling fan, radiator, hoses, coolant, clamps, seals, sealants, gaskets, fans, fan drives, radiator shrouds, belts, radiator caps, recovery tanks, coolant heaters, sensors, mechanical and electric water pumps, controllers

tools and equipment include: leak testing equipment, pressure measuring devices, refractometers, temperature measuring devices, coolant test strips, fluid analysis sampling devices, coolant hydrometers

faults include: leakage, blockages, erosion, corrosion, wear, oxidization, cavitation

B-6.04 Diagnoses intake and exhaust systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
B-6.04.01P	identify ***symptoms of problem***	***symptoms of problem*** are identified by consulting with customer or operator
B-6.04.02P	perform sensory inspections of ***components*** to identify ***faults***	sensory inspections of ***components*** are performed to identify ***faults***
B-6.04.03P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application and manufacturers' procedures
B-6.04.04P	perform ***specialized testing procedures***	***specialized testing procedures*** are performed according to OEM procedures
B-6.04.05P	test ***components*** to identify ***faults***	***components*** are tested to identify faults according to OEM procedures
B-6.04.06P	determine ***required actions***	***required actions*** are determined

Range of Variables

symptoms of problem include: leakage, restrictions, noise

components include: manifolds, mufflers, catalysts, after-treatment systems, air filters, charge air coolers, turbochargers, piping, hoses, clamps, gaskets, seals, heat shields, sensors, exhaust gas recirculation (EGR) coolers, exhaust brakes, cold weather starting aids, grid heaters, pre-cleaners

faults include: contamination, leakage, wear, noises, odours

tools and equipment include: pressure measuring devices, temperature measuring devices, leak testing equipment, dynamometer

specialized testing procedures include: boost pressures, intake air temperatures, exhaust temperatures, intake and exhaust restrictions, sensor testing

required actions include: repairs, component replacement and adjustments, further diagnosis

	Knowledge	
	Learning Outcomes	**Learning Objectives**
B-6.04.01L	demonstrate knowledge of intake and exhaust systems, their ***components***, characteristics, applications and operation	identify types of intake and exhaust systems and their ***components***, and describe their characteristics, applications and operation
B-6.04.02L	demonstrate knowledge of diagnosing intake and exhaust systems	identify ***tools and equipment*** used to diagnose intake and exhaust systems, and describe their applications and procedures for use
		describe procedures to diagnose intake and exhaust systems
		identify hazards and describe safe work practices while diagnosing intake and exhaust systems
		identify inspections and tests conducted to diagnose intake and exhaust systems
B-6.04.03L	demonstrate knowledge of regulatory requirements pertaining to intake and exhaust systems	identify and interpret regulations pertaining to intake and exhaust systems

Range of Variables

components include: manifolds, mufflers, catalysts, after-treatment systems, air filters, charge air coolers, turbochargers, piping, hoses, clamps, gaskets, seals, heat shields, sensors, exhaust gas recirculation (EGR) coolers, exhaust brakes, cold weather starting aids, grid heaters, pre-cleaners

tools and equipment include: pressure measuring devices, temperature measuring devices, leak testing equipment, dynamometer

B-6.05 Diagnoses fuel delivery systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
B-6.05.01P	identify ***symptoms of problem***	***symptoms of problem*** are identified by consulting with customer or operator
B-6.05.02P	perform sensory inspections of ***components*** to identify ***factors***	sensory inspections of ***components*** are performed to identify ***factors***
B-6.05.03P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application and manufacturers' procedures

B-6.05.04P	interpret fuel system flow schematics	fuel system flow schematics are interpreted to determine system function and component location
B-6.05.05P	perform ***operational tests***	***operational tests*** are performed using OEM specialty tools and procedures to identify faulty components
B-6.05.06P	check ***components*** to identify ***faults***	***components*** are checked to identify ***faults***
B-6.05.07P	determine ***required actions***	***required actions*** are determined

Range of Variables

symptoms of problem include: hard or no starting, poor engine performance, leakage

components include: injection pumps, lines and injectors, filters, transfer pumps, filter heads, fuel piping, high-pressure common rail, sensors, fuel tanks, fuel coolers, check valves

factors include: leaks, air ingress, water deposits, contamination, noises (combustion detonation, misfiring)

tools and equipment include: pressure gauges, vacuum gauges, flow meters, dynamometers, electronic service tools, injector testers

operational tests include: injector cut-out, injector operation, injection pump timing, transfer pump pressure, filter restriction

faults include: wear, damage, leakage, contamination

required actions include: repairs, component replacement, static injection pump timing adjustment, further diagnosis

	Knowledge	
	Learning Outcomes	**Learning Objectives**
B-6.05.01L	demonstrate knowledge of ***fuel delivery systems***, their ***components***, characteristics, applications and operation	identify types of ***fuel delivery systems*** and their ***components***, and describe their characteristics, applications and operation
		identify ***types of fuels*** and describe their characteristics and applications
		identify types of fuel additives and describe their characteristics and applications
B-6.05.02L	demonstrate knowledge of diagnosing ***fuel delivery systems***	identify ***tools and equipment*** used to diagnose ***fuel delivery systems***, and describe their applications and procedures for use
		describe procedures to diagnose ***fuel delivery systems***
		identify ***hazards*** and describe safe work practices while diagnosing ***fuel delivery systems***

		identify ***operational tests*** conducted to diagnose ***fuel delivery systems***
B-6.05.03L	demonstrate knowledge of regulatory requirements pertaining to ***fuel delivery systems***	identify and interpret regulations pertaining to ***fuel delivery systems***

Range of Variables

fuel delivery systems include: mechanically-controlled, electronically-controlled, electronically-controlled-mechanically-delivered, hydraulically-actuated

components include: injection pumps, lines and injectors, filters, transfer pumps, filter heads, fuel piping, high-pressure common rail, sensors, fuel tanks, fuel coolers, check valves

types of fuels include: diesel (winter, summer), biofuel, gasoline, propane, natural gas

tools and equipment include: pressure gauges, vacuum gauges, flow meters, dynamometers, electronic service tools, injector testers

hazards include: extreme high pressure, burns, flammable and explosive materials, high-pressure fluid injection, environmental

operational tests include: injector cut-out, injector operation, injection pump timing, transfer pump pressure, filter restriction

B-6.06 Diagnoses engine management systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
B-6.06.01P	identify ***symptoms of problem***	***symptoms of problem*** are identified by consulting with customer or operator
B-6.06.02P	perform sensory inspections of ***components*** to identify ***faults***	sensory inspections of ***components*** are performed to identify ***faults***
B-6.06.03P	select and use ***electronic diagnostic tools and equipment***	***electronic diagnostic tools and equipment*** are selected and used according to application and manufacturers' procedures
B-6.06.04P	monitor system operation and interpret ***results*** to determine faulty ***components***	system operation is monitored and ***results*** are interpreted to determine faulty ***components*** according to OEM diagnostic procedures
B-6.06.05P	determine ***required repair***	***required repair*** is determined

Range of Variables

symptoms of problem include: engine performance issues, error codes, de-rate situations, hard or no starting, low or high engine temperature operation, poor connections, high resistance

components include: controllers, sensors, solenoids, harnesses, actuators, valves, connectors, switches

faults include: corrosion, moisture, heat damage, shorted wires, open circuits, high resistance, pinched or frayed wires, damaged connectors

electronic diagnostic tools and equipment include: laptops, smart phones, tablets, onboard diagnostics, breakout harnesses, multimeters

results include: abnormal temperature, pressure, speed readings

required repair includes: sensor, actuator and controller replacement or adjustment; software installation and updating; further diagnosis

	Knowledge	
	Learning Outcomes	**Learning Objectives**
B-6.06.01L	demonstrate knowledge of engine management systems, their ***components***, characteristics, applications and operation	identify types of engine management systems and their ***components***, and describe their characteristics, applications and operation
B-6.06.02L	demonstrate knowledge of diagnosing engine management systems	identify ***electronic diagnostic tools and equipment*** used to diagnose engine management systems, and describe their applications and procedures for use
		describe procedures to diagnose engine management systems
		identify hazards and describe safe work practices while diagnosing engine management systems
B-6.06.03L	demonstrate knowledge of regulatory requirements pertaining to engine management systems	identify and interpret regulations pertaining to engine management systems

Range of Variables

components include: controllers, sensors, solenoids, harnesses, actuators, valves, connectors, switches

electronic diagnostic tools and equipment include: laptops, smart phones, tablets, onboard diagnostics, breakout harnesses, multimeters

B-6.07 Diagnoses emissions control systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
B-6.07.01P	identify ***symptoms of problem***	***symptoms of problem*** are identified by consulting with customer or operator
B-6.07.02P	select and use ***electronic diagnostic tools and equipment***	***electronic diagnostic tools and equipment*** are selected and used according to application and manufacturers' procedures
B-6.07.03P	perform visual inspection of diesel exhaust fluid (DEF) delivery and storage components	visual inspection of DEF delivery and storage components is performed to identify leaks, quality and contamination
B-6.07.04P	perform visual inspection of EGR system, diesel particulate filter (DPF), diesel oxidation catalyst (DOC) and selective catalytic reduction (SCR)	visual inspection of EGR system, DPF, DOC and SCR is performed to identify physical damage
B-6.07.05P	interpret diagnostic tests to identify improperly operating ***components***	diagnostic tests are interpreted to identify improperly operating ***components***
B-6.07.06P	determine ***required repair***	***required repair*** is determined

Range of Variables

symptoms of problem include: engine performance issues, error codes, de-rate situations, low or high engine temperature operation

electronic diagnostic tools and equipment include: laptops, breakout harnesses, onboard diagnostics, temperature measuring devices, multimeters

components include: DPF, DOC, SCR, DEF injection nozzle, dosing module, DEF heaters, sensors, filters, pumps, tanks, hoses, pipes, lines, DEF controller

required repair includes: sensor, actuator and controller replacement; emission control system regeneration; software installation and updates; further diagnosis

	Knowledge	
	Learning Outcomes	**Learning Objectives**
B-6.07.01L	demonstrate knowledge of emissions control systems, their ***components***, characteristics, applications and operation	identify emissions control systems and their ***components***, and describe their characteristics, applications and operation
		describe EGR system theory
		describe system theory of DOC, DPF, DEF and SCR

B-6.07.02L	demonstrate knowledge of diagnosing emissions control systems	identify ***electronic diagnostic tools and equipment*** used to diagnose emissions control systems, and describe their applications and procedures for use
		describe procedures to diagnose emissions control systems
		identify ***hazards*** and describe safe work practices while diagnosing emissions control systems
		identify inspections and tests conducted to diagnose emissions control systems
B-6.07.03L	demonstrate knowledge of regulatory requirements pertaining to emissions control systems	identify and interpret regulations pertaining to emissions control systems

Range of Variables

components include: DPF, DOC, SCR, DEF injection nozzle, dosing module, DEF heaters, sensors, filters, pumps, tanks, hoses, pipes, lines, DEF controller

electronic diagnostic tools and equipment include: laptops, breakout harnesses, onboard diagnostics, temperature measuring devices, multimeters

hazards include: high temperatures, carbon monoxide

Task B-7 Repairs engines and engine support systems

Task Descriptor

The effective repair of engines and engine support systems is critical to engine performance, reliability and emission compliance. The engine is the vital part of the machine, as it is the power source for all operations. Agricultural equipment technicians must possess a thorough understanding of these systems.

B-7.01 Repairs base engines

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
B-7.01.01P	prepare equipment for engine removal and reinstallation	equipment is prepared for engine removal and reinstallation by performing ***functions***
B-7.01.02P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application and manufacturers' procedures

B-7.01.03P	remove ***components*** for access	***components*** are removed for access
B-7.01.04P	flush base engine and clean ***components***	base engine is flushed and its ***components*** are cleaned
B-7.01.05P	remove, disassemble and inspect ***components***	***components*** are removed, disassembled and inspected to determine if they should be replaced, or reconditioned and reused according to manufacturers' specifications and procedures
B-7.01.06P	adjust ***components*** for ***factors***	***components*** are adjusted for ***factors*** according to manufacturers' specifications and procedures
B-7.01.07P	rebuild engine by replacing ***components*** to repair ***conditions***	engine is rebuilt by replacing ***components*** to repair ***conditions*** to meet manufacturers' specifications
B-7.01.08P	perform break-in procedure	break-in procedure is performed according to manufacturers' specifications and procedures to increase engine life and reliability
B-7.01.09P	reinstall ***components*** removed for access	***components*** removed for access are reinstalled

Range of Variables

functions include: disconnecting electrical connections, draining fluids, evacuating heating, ventilation and air conditioning (HVAC) system

tools and equipment include: torque wrenches, dial indicators, measuring instruments, lifting devices, safety stands, torque-to-yield gauge, feeler gauges, dynamometers, electronic service tools

components (removed for access) include: hoods, panels, loader frames, loader, cooling package

components (base engine) include: valves, pistons, blocks, liners, cylinder heads, cam shafts, valve trains, crank shafts, connecting rods, timing gears, bearings, seals, sealants, gaskets

components (to be adjusted) include: valves, liners, timing gears

factors include: valve clearance, suitable liner protrusion, gear backlash

conditions include: leaks, wear, physical damage, cavitation (pitting)

	Knowledge	
	Learning Outcomes	**Learning Objectives**
B-7.01.01L	demonstrate knowledge of base engines, their ***components***, characteristics, applications and operation	identify types of base engines and their ***components***, and describe their characteristics and applications
		describe theory of engine operation
B-7.01.02L	demonstrate knowledge of repairing base engines	identify ***tools and equipment*** used to repair base engines, and describe their applications and procedures for use
		describe procedures to repair base engines and their ***components***

	describe break-in procedures
	identify hazards and safe work practices while performing repairs

Range of Variables

components (base engine) include: valves, pistons, blocks, liners, cylinder heads, cam shafts, valve trains, crank shafts, connecting rods, timing gears, bearings, seals, sealants, gaskets

tools and equipment include: torque wrenches, dial indicators, measuring instruments, lifting devices, safety stands, torque-to-yield gauge, feeler gauges, dynamometers, electronic service tools

B-7.02 Repairs lubrication systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
B-7.02.01P	remove ***components*** for access	***components*** are removed for access
B-7.02.02P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application and manufacturers' procedures
B-7.02.03P	flush lubrication system and clean ***components***	lubrication system is flushed and ***components*** are cleaned
B-7.02.04P	remove, disassemble and inspect ***components***	***components*** are removed, disassembled and inspected to determine if they should be replaced according to manufacturers' specifications and procedures
B-7.02.05P	replace worn and damaged ***components***	worn and damaged ***components*** are replaced according to manufacturers' specifications and procedures
B-7.02.06P	reassemble unit after repair	unit is reassembled after repair according to manufacturers' specifications and procedures
B-7.02.07P	reinstall ***components*** removed for access	***components*** removed for access are reinstalled

Range of Variables

components (removed for access) include: panel, shields, hoods, oil pans, timing cover, gear train

tools and equipment include: torque wrenches, OEM specialty tools, pressure measuring devices

components include: oil pump, oil cooler, pressure regulator valves, bypass valves, inlet strainers, oil filters

	Knowledge	
	Learning Outcomes	**Learning Objectives**
B-7.02.01L	demonstrate knowledge of lubrication systems, their ***components***, characteristics, applications and operation	identify types of lubrication systems and their ***components***, and describe their characteristics, applications and operation
		describe functions and characteristics of engine oil
		identify types of ***fluid classifications***
B-7.02.02L	demonstrate knowledge of repairing lubrication systems	identify ***tools and equipment*** used to repair lubrication systems, and describe their applications and procedures for use
		describe procedures to repair lubrication systems and their ***components***
		identify hazards and safe work practices while performing repairs
B-7.02.03L	demonstrate knowledge of regulatory requirements pertaining to lubrication systems	identify and interpret regulations pertaining to lubrication systems

Range of Variables

components include: oil pump, oil cooler, pressure regulator valves, bypass valves, inlet strainers, oil filters

fluid classifications include: viscosity, API, SAE

tools and equipment include: torque wrenches, OEM specialty tools, pressure measuring devices

B-7.03 Repairs cooling systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
B-7.03.01P	remove ***components*** for access	***components*** are removed for access
B-7.03.02P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application and manufacturers' procedures
B-7.03.03P	remove, disassemble and inspect ***components***	***components*** are removed, disassembled and inspected to determine if they should be replaced, or reconditioned and reused according to manufacturers' specifications and procedures
B-7.03.04P	replace worn and damaged ***components***	worn and damaged ***components*** are replaced according to manufacturers' specifications and procedures

B-7.03.05P	flush or replace blocked radiator	blocked radiator is flushed or replaced
B-7.03.06P	verify thermostat operation before installation	thermostat operation is verified before installation
B-7.03.07P	clean and blow out blockages in air-cooled systems	blockages in air-cooled systems are cleaned and blown out to ensure adequate airflow
B-7.03.08P	blow out external radiator blockages	external radiator blockages are blown out
B-7.03.09P	reassemble unit after repair	unit is reassembled after repair according to manufacturers' specifications and procedures
B-7.03.10P	purge air from liquid-cooled system after repair	air is purged from liquid-cooled system after repair
B-7.03.11P	reinstall ***components*** removed for access	***components*** removed for access are reinstalled

Range of Variables

components (removed for access) include: panel, shields, hoods, HVAC components

tools and equipment include: torque wrenches, OEM specialty tools, lifting devices, flushing equipment, coolant handling equipment, temperature measuring devices, thermostat testing equipment

components include: oil cooler, thermostats, cooling fan, radiator, hoses, coolant, clamps, seals, sealants, gaskets, fans, fan drives, radiator shrouds, belts, radiator caps, recovery tanks, coolant heaters, sensors, mechanical and electric water pumps, controllers

	Knowledge	
	Learning Outcomes	**Learning Objectives**
B-7.03.01L	demonstrate knowledge of ***cooling systems***, their ***components***, characteristics, applications and operation	identify types of ***cooling systems*** and their ***components***, and describe their characteristics, applications and operation
		describe coolant classifications and additives
		describe hazards of pressurized ***cooling systems***
B-7.03.02L	demonstrate knowledge of repairing ***cooling systems***	identify ***tools and equipment*** used to repair ***cooling systems***, and describe their applications and procedures for use
		describe procedures to repair ***cooling systems*** and their ***components***
		identify hazards and safe work practices while performing repairs
B-7.03.03L	demonstrate knowledge of regulatory requirements pertaining to ***cooling systems***	identify and interpret regulations pertaining to ***cooling systems***

Range of Variables

cooling systems include: electronically-controlled, mechanically-controlled, liquid and air cooled

components include: oil cooler, thermostats, cooling fan, radiator, hoses, coolant, clamps, seals, sealants, gaskets, fans, fan drives, radiator shrouds, belts, radiator caps, recovery tanks, coolant heaters, sensors, mechanical and electric water pumps, controllers

tools and equipment include: torque wrenches, OEM specialty tools, lifting devices, flushing equipment, coolant handling equipment, temperature measuring devices, thermostat testing equipment

B-7.04 Repairs intake and exhaust systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
B-7.04.01P	remove ***components*** for access	***components*** are removed for access
B-7.04.02P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application and manufacturers' procedures
B-7.04.03P	remove, disassemble and inspect ***components***	***components*** are removed, disassembled and inspected to determine if they should be replaced, or reconditioned and reused according to manufacturers' specifications and procedures
B-7.04.04P	replace worn and damaged ***components***	worn and damaged ***components*** are replaced according to manufacturers' specifications and procedures
B-7.04.05P	adjust ***components*** for ***factors***	***components*** are adjusted for ***factors***
B-7.04.06P	identify ***components for reconditioning***	***components for reconditioning*** are identified
B-7.04.07P	clean and flush ***components***	***components*** are cleaned and flushed
B-7.04.08P	reassemble unit after repair	unit is reassembled after repair
B-7.04.09P	reinstall ***components*** removed for access	***components*** removed for access are reinstalled

Range of Variables

components (removed for access) include: panels, shields, hoods, valve covers

tools and equipment include: torque wrenches, OEM specialty tools, lifting devices, feeler gauges, temperature measuring devices, stethoscope

components include: manifolds, mufflers, catalysts, after-treatment systems, air filters, charge air coolers, turbochargers, piping, hoses, clamps, gaskets, seals, heat shields, sensors, EGR coolers, exhaust brakes, cold weather starting aids, grid heaters, pre-cleaners

components (to be adjusted) include: waste gate, intake and exhaust valve

factors include: travel, clearances

components for reconditioning include: turbochargers, cylinder heads, DPF

components (cleaning and flushing) include: manifolds, charge air coolers, piping, hoses, cylinder heads, air filters, after-treatment systems

	Knowledge	
	Learning Outcomes	**Learning Objectives**
B-7.04.01L	demonstrate knowledge of intake and exhaust systems, their ***components***, characteristics, applications and operation	identify types of intake and exhaust systems and their ***components***, and describe their characteristics, applications and operation
B-7.04.02L	demonstrate knowledge of repairing intake and exhaust systems	identify ***tools and equipment*** used to repair intake and exhaust systems, and describe their applications and procedures for use
		describe procedures to repair intake and exhaust systems
		identify ***types of starting aids*** and describe their characteristics, applications and procedures for use
		identify ***hazards*** and safe work practices while performing repairs
B-7.04.03L	demonstrate knowledge of regulatory requirements pertaining to intake and exhaust systems	identify and interpret regulations pertaining to intake and exhaust systems

Range of Variables

components include: manifolds, mufflers, catalysts, after-treatment systems, air filters, charge air coolers, turbochargers, piping, hoses, clamps, gaskets, seals, heat shields, sensors, EGR coolers, exhaust brakes, cold weather starting aids, grid heaters, pre-cleaners

tools and equipment include: torque wrenches, OEM specialty tools, lifting devices, feeler gauges, temperature measuring devices, stethoscope

types of starting aids include: preheaters, starting fluid, glow plugs

hazards include: carbon monoxide, burns

B-7.05 Repairs fuel delivery systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
B-7.05.01P	remove ***components*** for access	***components*** are removed for access
B-7.05.02P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application and manufacturers' procedures
B-7.05.03P	remove, disassemble and inspect ***components***	***components*** are removed, disassembled and inspected to determine if they should be replaced, or reconditioned and reused according to manufacturers' specifications and procedures
B-7.05.04P	replace worn and damaged ***components***	worn and damaged ***components*** are replaced according to manufacturers' specifications and procedures
B-7.05.05P	adjust injectors and injection pump for static timing	injectors and injection pump are adjusted for static timing according to manufacturers' specifications and procedures
B-7.05.06P	identify ***components for reconditioning***	***components for reconditioning*** are identified
B-7.05.07P	***adjust*** components	components are ***adjusted*** according to manufacturers' specifications and procedures
B-7.05.08P	reassemble unit after repair	unit is reassembled after repair
B-7.05.09P	bleed ***fuel delivery system*** for operation	***fuel delivery system*** is bled for operation
B-7.05.10P	reinstall ***components*** removed for access	***components*** removed for access are reinstalled

Range of Variables

components (removed for access) include: air ducting, valve covers, surge tank, exhaust manifold, panels, shields, hoods

tools and equipment include: torque wrenches, OEM specialty tools, pullers, dial indicators, electronic service tools

components include: injection pumps, lines and injectors, filters, transfer pumps, filter heads, fuel piping, high-pressure common rail, sensors, fuel tanks, fuel coolers, check valves

components for reconditioning include: injection pump, injectors, fuel pumps, fuel coolers, fuel tanks

adjustments include: shimming mechanical injectors, entering calibration values for electronic injectors, setting injector pre-load, confirming high and low throttle (mechanical injection systems), adjusting throttle linkages, performing governor and injector rack control adjustment

fuel delivery systems include: mechanically-controlled, electronically-controlled, electronically-controlled-mechanically-delivered, hydraulically-actuated

	Knowledge	
	Learning Outcomes	**Learning Objectives**
B-7.05.01L	demonstrate knowledge of ***fuel delivery systems***, their ***components***, characteristics, applications and operation	identify types of ***fuel delivery systems*** and their ***components***, and describe their characteristics, applications and operation
		identify ***types of fuels*** and describe their characteristics and applications
		identify types of fuel additives and describe their characteristics and applications
B-7.05.02L	demonstrate knowledge of repairing ***fuel delivery systems***	identify ***tools and equipment*** used to repair ***fuel delivery systems***, and describe their applications and procedures for use
		describe procedures to repair ***fuel delivery systems***
		identify ***hazards*** and safe work practices while performing repairs
B-7.05.03L	demonstrate knowledge of regulatory requirements pertaining to ***fuel delivery systems***	identify and interpret regulations pertaining to ***fuel delivery systems***

Range of Variables

fuel delivery systems include: mechanically-controlled, electronically-controlled, electronically-controlled-mechanically-delivered, hydraulically-actuated

components include: injection pumps, lines and injectors, filters, transfer pumps, filter heads, fuel piping, high-pressure common rail, sensors, fuel tanks, fuel coolers, check valves

types of fuels include: diesel (winter, summer), biofuel, gasoline, propane, natural gas

tools and equipment include: torque wrenches, OEM specialty tools, pullers, dial indicators, electronic service tools

hazards include: extreme high pressure, burns, flammable and explosive materials, high-pressure fluid injection, environmental

B-7.06 Repairs engine management systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
B-7.06.01P	remove ***components*** for access	***components*** are removed for access
B-7.06.02P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application and manufacturers' procedures
B-7.06.03P	remove, disassemble and inspect ***components***	***components*** are removed, disassembled and inspected to determine if they should be replaced, or reconditioned and reused according to manufacturers' specifications and procedures
B-7.06.04P	replace worn and damaged ***components***	worn and damaged ***components*** are replaced according to procedures and manufacturers' specifications
B-7.06.05P	repair ***components***	***components*** are repaired according to manufacturers' specifications and procedures
B-7.06.06P	recalibrate ***components***	***components*** are recalibrated according to manufacturers' specifications and procedures
B-7.06.07P	reassemble unit after repair	unit is reassembled after repair
B-7.06.08P	reinstall ***components*** removed for access	***components*** removed for access are reinstalled

Range of Variables

components (removed for access) include: panels, shields, hoods

tools and equipment include: electronic service tools, multimeters, terminal release tools, temperature measuring devices, pressure measuring devices

components include: controllers, sensors, solenoids, harnesses, actuators, valves, connectors, switches

components (to be repaired) include: connector pins and wires, controllers

components (to be recalibrated) include: sensors, switches, controllers, actuators

	Knowledge	
	Learning Outcomes	**Learning Objectives**
B-7.06.01L	demonstrate knowledge of engine management systems, their ***components***, characteristics, applications and operation	identify types of engine management systems and their ***components***, and describe their characteristics, applications and operation
B-7.06.02L	demonstrate knowledge of repairing engine management systems	identify ***tools and equipment*** used to repair engine management systems, and describe their applications and procedures for use
		describe procedures to repair engine management systems and their ***components***
		describe procedures to recalibrate engine management systems and their ***components***
		identify hazards and safe work practices while performing repairs
B-7.06.03L	demonstrate knowledge of regulatory requirements pertaining to engine management systems	identify and interpret regulations pertaining to engine management systems

Range of Variables

components include: controllers, sensors, solenoids, harnesses, actuators, valves, connectors, switches

tools and equipment include: electronic service tools, multimeters, terminal release tools, temperature measuring devices, pressure measuring devices

components (to be repaired) include: connector pins and wires, controllers

components (to be recalibrated) include: sensors, switches, controllers, actuators

B-7.07 Repairs emissions control systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
B-7.07.01P	remove ***components*** for access	***components*** are removed for access
B-7.07.02P	select and uses ***tools and equipment***	***tools and equipment*** are selected and used according to application and manufacturers' procedures

B-7.07.03P	remove, disassemble and inspect ***components***	***components*** are removed, disassembled and inspected to determine if they should be replaced, or reconditioned and reused according to manufacturers' specifications and procedures
B-7.07.04P	replace worn and damaged ***components***	worn and damaged ***components*** are replaced according to manufacturers' specifications and procedures
B-7.07.05P	identify ***components*** for reconditioning	***components*** for reconditioning are identified
B-7.07.06P	perform parked regenerative cycle for DPF and DOC	parked regenerative cycle for DPF and DOC is performed according to manufacturers' specifications and procedures
B-7.07.07P	reassemble unit after repair	unit is reassembled after repair
B-7.07.08P	verify new DPF and DOC has appropriate controller software	new DPF and DOC has appropriate controller software
B-7.07.09P	flush and clean emission system ***components***	emission system ***components*** are flushed and cleaned
B-7.07.10P	reinstall ***components*** removed for access	***components*** removed for access are reinstalled

Range of Variables

components (removed for access) include: panels, heat shields, covers, hoods

tools and equipment include: OEM specialty tools, lifting devices, electronic service tools, temperature sensing devices, refractometer

components include: DPF, DOC, SCR, DEF injection nozzle, dosing module, DEF heaters, sensors, filters, pumps, tanks, hoses, pipes, lines, DEF controller

components (for reconditioning) include: DPF, DEF controller, DEF injection nozzle, pumps

components (for flushing) include: hoses, pipes, lines, tanks, injectors, pumps

	Knowledge	
	Learning Outcomes	**Learning Objectives**
B-7.07.01L	demonstrate knowledge of emissions control systems, their ***components***, characteristics, applications and operation	identify emissions control systems and their ***components***, and describe their characteristics, applications and operation
B-7.07.02L	demonstrate knowledge of repairing emissions control systems	identify ***tools and equipment*** used to repair emissions control systems, and describe their applications and procedures for use
		describe procedures to repair emissions control systems
		describe procedures to flush and clean ***components***

		identify ***hazards*** and safe work practices while performing repairs
B-7.07.03L	demonstrate knowledge of regulatory requirements pertaining to emissions control systems	identify and interpret regulations pertaining to emissions control systems

Range of Variables

components include: DPF, DOC, SCR, DEF injection nozzle, dosing module, DEF heaters, sensors, filters, pumps, tanks, hoses, pipes, lines, DEF controller

tools and equipment include: OEM specialty tools, lifting devices, electronic service tools, temperature sensing devices, refractometer

components (for flushing) include: hoses, pipes, lines, tanks, injectors, pumps

hazards include: high temperatures, carbon monoxide

Major Work Activity C
Diagnoses and repairs drive trains

Task C-8 Diagnoses drive trains

Task Descriptor

The drive train of agricultural equipment consists of components that transfer power from the engine to the driven components in the form of motion. The drive train allows for different speeds and directions.

The agricultural equipment technician performs a diagnostic analysis to identify the cause of failure to the drive train and its components.

C-8.01 Diagnoses dry clutches

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
C-8.01.01P	identify ***symptoms of problem***	***symptoms of problem*** are identified by consulting with customer or operator
C-8.01.02P	operate equipment	equipment is operated to test clutch operation for ***faults***
C-8.01.03P	perform sensory inspections	sensory inspections are performed to identify ***faults***
C-8.01.04P	select and use ***diagnostic tools and equipment***	***diagnostic tools and equipment*** are selected and used according to application and manufacturers' procedures
C-8.01.05P	determine ***required actions***	***required actions*** are determined

Range of Variables

symptoms of problem include: failure to drive, sluggish operation, slippage, failure to release, noise

faults (detected while operating equipment) include: slipping, dragging, failure to release, failure to drive

faults (detected while conducting sensory inspections) include: wear, adjustment, abnormal noises, odour, clutch dust

diagnostic tools and equipment include: temperature measuring devices, linear measuring devices, stethoscope, feeler gauges, gauge blocks, dial indicators, straightedges

required actions include: repairs, component replacement, adjustment, further diagnosis

	Knowledge	
	Learning Outcomes	**Learning Objectives**
C-8.01.01L	demonstrate knowledge of dry clutches, their ***components***, characteristics, applications and operation	identify ***types of dry clutches*** and their ***components***, and describe their characteristics, applications and operation
C-8.01.02L	demonstrate knowledge of diagnosing dry clutches	identify ***diagnostic tools and equipment*** used to diagnose dry clutches, and describe their applications and procedures for use
		describe procedures to diagnose dry clutches
		identify ***hazards*** and describe safe work practices while diagnosing dry clutches
		identify possible ***faults*** found while operating equipment
		identify possible ***faults*** found while conducting sensory inspections
C-8.01.03L	demonstrate knowledge of regulatory requirements pertaining to hazardous materials	identify and interpret regulations pertaining to hazardous materials

Range of Variables

components include: release bearings, pilot bearings, clutch discs, pressure plate, flywheel, diaphragm, fingers, springs, primary and secondary cylinders, linkages, cross-shafts, clutch pedal or lever

types of dry clutches include: push to release, pull to release, single stage, dual stage, independent, slip, sprag, over-centre

diagnostic tools and equipment include: temperature measuring devices, linear measuring devices, stethoscope, feeler gauges, gauge blocks, dial indicators, straightedges

hazards include: asbestos potential, unexpected motion, clutch dust

faults (detected while operating equipment) include: slipping, dragging, failure to release, failure to drive

faults (detected while conducting sensory inspections) include: wear, adjustment, abnormal noises, odour, clutch dust

C-8.02 Diagnoses driveline systems and components

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
C-8.02.01P	identify ***symptoms of problem***	***symptoms of problem*** are identified by consulting with customer or operator
C-8.02.02P	operate equipment	equipment is operated to test driveline systems for ***faults***
C-8.02.03P	select and use ***diagnostic tools and equipment***	***diagnostic tools and equipment*** are selected and used according to application and manufacturers' procedures
C-8.02.04P	perform sensory inspection on ***components*** to identify ***faults***	sensory inspection is performed on ***components*** to identify ***faults***
C-8.02.05P	determine ***required actions***	***required actions*** are determined

Range of Variables

symptoms of problem include: vibrations, noise, failure to drive, excessive load, overheating

faults (detected while operating equipment) include: slipping, vibration, abnormal noises

diagnostic tools and equipment include: temperature measuring devices, stethoscope, linear measuring devices, dial indicators, spring scale, torque measuring device, angle meters, laser alignment tools, feeler gauges

components include: torque plate, drive shafts, universal joints, sliding couplers, steady bearings (hanger bearings), chains, sprockets, gears, gear boxes, pitman arm, belts, sheaves (fixed, variable), slip clutches, overrunning clutches, tensioners, shielding

faults (detected while conducting sensory inspection) include: misalignment of driveline components, improper driveline angles, odour, excessive play, breakage, wear, bearing temperature

required actions include: repairs, component replacement, adjustments, further diagnosis

	Knowledge	
	Learning Outcomes	**Learning Objectives**
C-8.02.01L	demonstrate knowledge of ***driveline systems***, their ***components***, characteristics, applications and operation	identify ***driveline systems*** and their ***components***, and describe their characteristics, applications and operation
C-8.02.02L	demonstrate knowledge of diagnosing ***driveline systems*** and their ***components***	identify ***diagnostic tools and equipment*** used to diagnose ***driveline systems*** and their ***components***, and describe their applications and procedures for use
		describe procedures to diagnose ***driveline systems*** and their ***components***

		identify ***hazards*** and describe safe work practices while diagnosing ***driveline systems*** and their ***components***
		identify possible ***faults*** found while operating equipment
		identify possible ***faults*** found while conducting sensory inspections
		identify gear wear patterns
C-8.02.03L	demonstrate knowledge of regulatory requirements pertaining to ***driveline systems***	identify and interpret regulations pertaining to ***driveline systems***

Range of Variables

driveline systems include: belt drive, chain drive, shaft drive, gear drive, pitman drive

components include: torque plate, drive shafts, universal joints, sliding couplers, steady bearings (hanger bearings), chains, sprockets, gears, gear boxes, pitman arm, belts, sheaves (fixed, variable), slip clutches, overrunning clutches, tensioners, shielding

diagnostic tools and equipment include: temperature measuring devices, stethoscope, linear measuring devices, dial indicators, spring scale, torque measuring device, angle meters, laser alignment tools, feeler gauges

hazards include: entanglement, pinching, crushing

faults (detected while operating equipment) include: slipping, vibration, abnormal noises

faults (detected while conducting sensory inspection) include: misalignment of driveline components, improper driveline angles, odour, excessive play, breakage, wear, bearing temperature

C-8.03 Diagnoses wet clutches, transmissions and gear cases

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
C-8.03.01P	identify ***symptoms of problem***	***symptoms of problem*** are identified by consulting with customer or operator
C-8.03.02P	operate equipment to identify probable causes of symptoms	equipment is operated to identify probable causes of symptoms
C-8.03.03P	operate equipment to test wet clutches, transmissions and gear cases for ***faults***	equipment is operated to test wet clutches, transmissions and gear cases for ***faults***
C-8.03.04P	select and use ***diagnostic tools and equipment***	***diagnostic tools and equipment*** are selected and used according to application
C-8.03.05P	perform ***diagnostic checks***	***diagnostic checks*** are performed

C-8.03.06P	disassemble wet clutches, transmissions and gear cases to determine ***probable causes of failure***	wet clutches, transmissions and gear cases are disassembled to determine ***probable causes of failure***
C-8.03.07P	determine ***required actions***	***required actions*** are determined

Range of Variables

symptoms of problem include: vibrations, noise, failure to drive, excessive load, overheating, harsh engagement, oil contamination, filter plugging, failure to calibrate

faults (detected while operating equipment) include: slipping, vibration, abnormal noise, engagement quality, error codes, defaulting to neutral, manual shifting issues, abnormal crown and pinion wear, failure to calibrate

diagnostic tools and equipment include: temperature measuring devices, stethoscope, thickness measurement tools, dial indicators, feeler gauges, flow measuring devices, pressure measuring devices, multimeters, electronic service tools, onboard diagnostics

diagnostic checks include: calibration, pressure checks, electrical tests, service codes, synchronizer tests, flow tests

probable causes of failure include: internal leaks, factory defects, damaged piston seals or sealing rings, overloading, aftermarket modifications of horsepower, oil contamination, mechanical failures

required actions include: repairs, adjustments, software installation and updates, component replacement, further diagnosis

	Knowledge	
	Learning Outcomes	**Learning Objectives**
C-8.03.01L	demonstrate knowledge of wet clutches, transmissions and gear cases, their ***components***, characteristics, applications and operation	identify ***types of wet clutches*** and their ***components***, and describe their characteristics, applications and operation
		identify ***types of transmissions*** and describe their characteristics, applications and operation
		identify ***types of gears*** and describe their characteristics, applications and operation
		identify ***types of gear cases*** and describe their characteristics, applications and operation
		identify ***transmission and gear case components***, and describe their characteristics, applications and operation
C-8.03.02L	demonstrate knowledge of diagnosing wet clutches, transmissions and gear cases	identify ***diagnostic tools and equipment*** used to diagnose wet clutches, transmissions and gear cases, and describe their applications and procedures for use
		describe procedures to diagnose wet clutches, transmissions and gear cases
		identify ***hazards*** and describe safe work practices while diagnosing wet clutches, transmissions and gear cases

	identify ***diagnostic checks*** performed to diagnose wet clutches, transmissions and gear cases
	identify possible ***faults*** found in wet clutches, transmissions and gear cases while operating equipment
	identify ***probable causes of failure*** in wet clutches, transmissions and gear cases

Range of Variables

components (wet clutches) include: pistons, seals, carriers, discs, plates, O-rings, springs, hubs, bearings, oil distribution manifolds

types of wet clutches include: hydraulically-applied/spring-released, spring-applied/hydraulically-released

types of transmissions include: manual shift, power shift, infinitely variable, hydraulic and hydrostatic systems

types of gears include: bevel, helical, straight, planetary, spur, worm-and-wheel, rack and pinion

types of gear cases include: reduction, planetary, directional change, angle drives (90 degree and various other angles), power distribution for multiple systems

transmission and gear case components include: seals, bearings (axial, radial, ball, tapered, needle), races, gears, shafts, housings, shims, bushings, snap rings, shift collars, springs, detents, balls, cooling and lubrication nozzles, carriers, shift mechanisms, shift valves, clutch packs, brake packs, interlocks, overrunning clutches

diagnostic tools and equipment include: temperature measuring devices, stethoscope, thickness measurement tools, dial indicators, feeler gauges, flow measuring devices, pressure measuring devices, multimeters, electronic service tools, onboard diagnostics

hazards include: entanglement, pinching, crushing, sudden movements, oil injection potential

diagnostic checks include: calibration, pressure checks, electrical tests, service codes, synchronizer tests, flow tests

faults (detected while operating equipment) include: slipping, vibration, abnormal noise, engagement quality, error codes, defaulting to neutral, manual shifting issues, abnormal crown and pinion wear, failure to calibrate

probable causes of failure include: internal leaks, factory defects, damaged piston seals or sealing rings, overloading, aftermarket modifications of horsepower, oil contamination, mechanical failures

C-8.04 Diagnoses differentials and final drives

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
C-8.04.01P	identify ***symptoms of problem***	***symptoms of problem*** are identified by consulting with customer or operator
C-8.04.02P	operate equipment to test differentials and final drives for ***faults***	equipment is operated to test differentials and final drives for ***faults***

C-8.04.03P	perform sensory inspections to identify ***faults***	sensory inspections are performed to identify ***faults***
C-8.04.04P	select and use ***diagnostic tools and equipment***	***diagnostic tools and equipment*** are selected and used according to application and manufacturers' procedures
C-8.04.05P	determine ***required actions***	***required actions*** are determined

Range of Variables

symptoms of problem include: vibrations, abnormal noises, failure to drive, failure to allow differential action, leaks, overheating, odours

faults include: wear, oil contamination, abnormal odours, mechanical failures (bearings, seals, gears, shafts, housings), abnormal crown and pinion wear

diagnostic tools and equipment include: pressure gauges, jacks, dial indicators, borescope, temperature measuring devices

required actions include: repairs, component replacement, adjustments, further diagnosis

	Knowledge	
	Learning Outcomes	**Learning Objectives**
C-8.04.01L	demonstrate knowledge of differential systems, their ***components***, characteristics, applications and operation	identify ***types of differential systems*** and their ***components***, and describe their characteristics, applications and operation
		describe differential locking systems
C-8.04.02L	demonstrate knowledge of final drives, their ***components***, characteristics, applications and operation	identify ***types of final drives*** and their ***components***, and describe their characteristics, applications and operation
C-8.04.03L	demonstrate knowledge of diagnosing differentials and final drives	identify ***diagnostic tools and equipment*** used to diagnose differentials and final drives, and describe their applications and procedures for use
		describe procedures to diagnose differentials and final drives
		identify ***hazards*** and describe safe work practices while diagnosing differentials and final drives
		identify inspections performed to diagnose differentials and final drives
		identify possible ***faults*** found while performing inspections
		identify possible ***symptoms of problem*** found while operating equipment

Range of Variables

components (differential systems) include: bearings, bevel pinions, shims, gear set, bushings, seals, carriers, thrust washers, shafts, pistons, springs, clutch packs, brake packs, mechanical locks

types of differential systems include: open differential, locking, limited slip

components (final drives) include: gears, bearings, shafts, seals, shims, axles, housings, gaskets, O-rings, universal joints, ball joints, fasteners, bearing adjusters, chains, sprockets, chain tension adjusters

types of final drives include: inboard planetary, outboard planetary, bull-and-pinion (ring-and-pinion), chain-driven, angle drives (90 degree and various other angles)

diagnostic tools and equipment include: pressure gauges, jacks, dial indicators, borescope, temperature measuring devices

hazards include: entanglement, pinching, crushing, sudden movements, oil injection potential

faults include: wear, oil contamination, abnormal odours, mechanical failures (bearings, seals, gears, shafts, housings), abnormal crown and pinion wear

symptoms of problem include: vibrations, abnormal noises, failure to drive, failure to allow differential action, leaks, overheating, odours

Task C-9 Repairs drive trains

Task Descriptor

Agricultural equipment technicians repair drive trains by removing, reconditioning, replacing, installing and adjusting various components of the equipment.

C-9.01 Repairs dry clutches

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
C-9.01.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application and manufacturers' procedures
C-9.01.02P	remove ***components*** for access	***components*** are removed for access
C-9.01.03P	remove, disassemble and inspect ***components***	***components*** are removed, disassembled and inspected to determine if they should be replaced, or reconditioned and reused according to manufacturers' specifications and procedures
C-9.01.04P	replace failed ***components***	failed ***components*** are replaced

C-9.01.05P	assemble, install and align clutches	clutches are assembled, installed and aligned according to manufacturers' specifications and procedures
C-9.01.06P	reinstall ***components*** removed for access	***components*** removed for access are reinstalled

Range of Variables

tools and equipment include: floor jacks, safety stands, specialized splitting stand, measuring tools, alignment tools, gauge blocks, feeler gauges, wedge blocks, bearing removal and installation tools, seal installers

components (removed for access) include: cab, panels, fuel tanks, tilting cabs, loaders, loader frames

components include: release bearings, pilot bearings, clutch discs, pressure plate, flywheel, diaphragm, fingers, springs, primary and secondary cylinders, linkages, cross-shafts, clutch pedal or lever

	Knowledge	
	Learning Outcomes	**Learning Objectives**
C-9.01.01L	demonstrate knowledge of dry clutches, their ***components***, characteristics, applications and operation	identify ***types of dry clutches*** and their ***components***, and describe their characteristics, applications and operation
C-9.01.02L	demonstrate knowledge of repairing dry clutches	identify ***tools and equipment*** used to repair dry clutches, and describe their applications and procedures for use
		describe procedures to disassemble, inspect and reassemble equipment
		describe procedures to repair, replace, assemble, install and align dry clutches and their ***components***
		identify ***hazards*** and safe work practices while performing repairs
C-9.01.03L	demonstrate knowledge of regulatory requirements pertaining to dry clutches	identify and interpret regulations pertaining to dry clutches

Range of Variables

components include: release bearings, pilot bearings, clutch discs, pressure plate, flywheel, diaphragm, fingers, springs, primary and secondary cylinders, linkages, cross-shafts, clutch pedal or lever

types of dry clutches include: push to release, pull to release, single stage, dual stage, independent, slip, sprag, over-centre

tools and equipment include: floor jacks, safety stands, specialized splitting stand, measuring tools, alignment tools, gauge blocks, feeler gauges, wedge blocks, bearing removal and installation tools, seal installers

hazards include: asbestos potential, unexpected motion

C-9.02 Repairs driveline systems and components

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
C-9.02.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application and manufacturers' procedures
C-9.02.02P	remove ***components*** for access	***components*** are removed for access
C-9.02.03P	remove, disassemble and inspect ***components***	***components*** are removed, disassembled and inspected to determine if they should be replaced, or reconditioned and reused according to manufacturers' specifications and procedures
C-9.02.04P	replace failed ***components***	failed ***components*** are replaced
C-9.02.05P	align and phase ***driveline systems*** and ***components***	***driveline systems*** and ***components*** are aligned and phased
C-9.02.06P	reassemble and reinstall ***components***	***components*** are reassembled and reinstalled according to manufacturers' specifications and procedures
C-9.02.07P	reinstall ***components*** removed for access	***components*** removed for access are reinstalled

Range of Variables

tools and equipment include: floor jacks and other lifting devices, safety stands, pullers, installation tools, linear measuring devices, dial indicators, spring scale, torque measuring device, angle meters, laser alignment tools, feeler gauges

components (removed for access) include: safety shields, covers, anti-wrap shields

components include: torque plate, drive shafts, universal joints, sliding couplers, steady bearings (hanger bearings), chains, sprockets, gears, gear boxes, pitman arm, belts, sheaves (fixed, variable), slip clutches, overrunning clutches, tensioners, shielding, drive shaft safety restraints

driveline systems include: belt drive, chain drive, shaft drive, gear drive, pitman drive

	Knowledge	
	Learning Outcomes	**Learning Objectives**
C-9.02.01L	demonstrate knowledge of ***driveline systems***, their ***components***, characteristics, applications and operation	identify ***driveline systems*** and their ***components***, and describe their characteristics, applications and operation
C-9.02.02L	demonstrate knowledge of repairing ***driveline systems*** and their ***components***	identify ***tools and equipment*** used to repair ***driveline systems*** and their ***components***, and describe their applications and procedures for use

		describe procedures to disassemble, inspect and reassemble ***components***
		describe procedures to repair, replace, install, align and phase ***driveline systems*** and their ***components***
		identify ***hazards*** and safe work practices while performing repairs
C-9.02.03L	demonstrate knowledge of regulatory requirements pertaining to ***driveline systems***	identify and interpret regulations pertaining to ***driveline systems***

Range of Variables

driveline systems include: belt drive, chain drive, shaft drive, gear drive, pitman drive

components include: torque plate, drive shafts, universal joints, sliding couplers, steady bearings (hanger bearings), chains, sprockets, gears, gear boxes, pitman arm, belts, sheaves (fixed, variable), slip clutches, overrunning clutches, tensioners, shielding, drive shaft safety restraints

tools and equipment include: floor jacks and other lifting devices, safety stands, pullers, installation tools, linear measuring devices, dial indicators, spring scale, torque measuring device, angle meters, laser alignment tools, feeler gauges

hazards include: entanglement, pinching, crushing

C-9.03 Repairs wet clutches, transmissions and gear cases

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
C-9.03.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
C-9.03.02P	remove ***components*** for access	***components*** are removed for access
C-9.03.03P	remove, disassemble and inspect ***wet clutch, transmission and gear case components***	***wet clutch, transmission and gear case components*** are removed, disassembled and inspected to determine if they should be replaced, or reconditioned and reused according to manufacturers' specifications and procedures
C-9.03.04P	perform repair, reconditioning and replacement of ***wet clutch, transmission and gear case components***	***wet clutch, transmission and gear case components*** are repaired, reconditioned and replaced according to manufacturers' specifications and procedures
C-9.03.05P	reassemble and reinstall ***wet clutch, transmission and gear case components***	***wet clutch, transmission and gear case components*** are reassembled and reinstalled according to manufacturers' specifications and procedures

C-9.03.06P	reinstall ***components*** removed for access	***components*** removed for access are reinstalled
C-9.03.07P	calibrate wet clutches, transmission and gear cases	wet clutches, transmission and gear cases are calibrated according to manufacturers' specifications and procedures

Range of Variables

tools and equipment include: floor jacks and other lifting devices, safety stands, specialized tools, transmission support stand

components (removed for access) include: cab, axle housings, wheels, panels, fuel tanks, tilting cabs, operator protective structures

components (wet clutches) include: pistons, seals, carriers, discs, plates, O-rings, springs, hubs, bearings, oil distribution manifolds

transmission and gear case components include: seals, bearings (axial, radial, ball, tapered, needle), races, gears, shafts, housings, shims, bushings, snap rings, shift collars, springs, detents, balls, cooling and lubrication nozzles, carriers, shift mechanisms, shift valves, clutch packs, brake packs, interlocks, overrunning clutches

	Knowledge	
	Learning Outcomes	**Learning Objectives**
C-9.03.01L	demonstrate knowledge of wet clutches, transmissions and gear cases, their ***components***, characteristics, applications and operation	identify ***types of wet clutches*** and their ***components***, and describe their characteristics, applications and operation
		identify ***types of transmissions*** and describe their characteristics, applications and operation
		identify ***types of gears*** and describe their characteristics, applications and operation
		identify ***types of gear cases*** and describe their characteristics, applications and operation
C-9.03.02L	demonstrate knowledge of repairing wet clutches, transmissions and gear cases	identify ***tools and equipment*** used to repair wet clutches, transmissions and gear cases, and describe their applications and procedures for use
		describe procedures to disassemble, inspect and reassemble wet clutches, transmissions and gear cases
		describe procedures to repair, replace, install and align wet clutches, transmissions and gear cases
		identify ***hazards*** and safe work practices while performing repairs

Range of Variables

components (wet clutches) include: pistons, seals, carriers, discs, plates, O-rings, springs, hubs, bearings, oil distribution manifolds

transmission and gear case components include: seals, bearings (axial, radial, ball, tapered, needle), races, gears, shafts, housings, shims, bushings, snap rings, shift collars, springs, detents, balls, cooling and lubrication nozzles, carriers, shift mechanisms, shift valves, clutch packs, brake packs, interlocks, overrunning clutches

types of wet clutches include: hydraulically-applied/spring-released, spring-applied/hydraulically-released

types of transmissions include: manual shift, power shift, infinitely variable, hydraulic and hydrostatic systems

types of gears include: bevel, helical, straight, planetary, spur, worm-and-wheel, rack and pinion

types of gear cases include: reduction, planetary, directional change, angle drives (90 degree and various other angles), power distribution for multiple systems

tools and equipment include: floor jacks and other lifting devices, safety stands, specialized tools, transmission support stand

hazards include: entanglement, pinching, crushing, sudden movements, oil injection potential

C-9.04 Repairs differentials and final drives

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
C-9.04.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application and manufacturers' procedures
C-9.04.02P	remove ***components*** for access	***components*** are removed for access
C-9.04.03P	remove, disassemble and inspect differential and final drive ***components***	differential and final drive ***components*** are removed, disassembled and inspected to determine if they should be replaced, or reconditioned and reused according to manufacturers' specifications and procedures
C-9.04.04P	replace failed differential and final drive ***components***	failed differential and final drive ***components*** are replaced according to manufacturers' specifications and procedures
C-9.04.05P	assemble and install differential and final drive ***components***	differential and final drive ***components*** are assembled and installed according to manufacturers' specifications and procedures
C-9.04.06P	reinstall ***components*** removed for access	***components*** removed for access are reinstalled

Range of Variables

tools and equipment include: floor jacks and other lifting devices, safety stands, specialized tools, torque wrenches, dial indicators, feeler gauges, spring scale, pullers, transmission support stand, steering lockout, oscillation locks

components (removed for access) include: axle housings, wheels, track systems, frame components, cab

components (differential systems) include: bearings, bevel pinions, shims, gear set, bushings, seals, carriers, thrust washers, shafts, pistons, springs, clutch packs, brake packs, mechanical locks

components (final drives) include: gears, bearings, shafts, seals, shims, axles, housings, gaskets, O-rings, universal joints, ball joints, fasteners, bearing adjusters, chains, sprockets, chain tension adjusters

	Knowledge	
	Learning Outcomes	**Learning Objectives**
C-9.04.01L	demonstrate knowledge of differential systems, their ***components***, characteristics, applications and operation	identify ***types of differential systems*** and their ***components***, and describe their characteristics, applications and operation
		describe differential locking systems
C-9.04.02L	demonstrate knowledge of final drives, their ***components***, characteristics, applications and operation	identify ***types of final drives*** and their ***components***, and describe their characteristics, applications and operation
C-9.04.03L	demonstrate knowledge of repairing differentials, final drives and their ***components***	identify ***tools and equipment*** used to repair differentials, final drives and their ***components***, and describe their applications and procedures for use
		describe procedures to disassemble and reassemble differentials, final drives and their ***components***
		describe procedures to repair, replace, adjust and install differentials, final drives and their ***components***
		identify ***hazards*** and safe work practices while performing repairs

Range of Variables

components (differential systems) include: bearings, bevel pinions, shims, gear set, bushings, seals, carriers, thrust washers, shafts, pistons, springs, clutch packs, brake packs, mechanical locks

types of differential systems include: open differential, locking, limited slip

components (final drives) include: gears, bearings, shafts, seals, shims, axles, housings, gaskets, O-rings, universal joints, ball joints, fasteners, bearing adjusters, chains, sprockets, chain tension adjusters

types of final drives include: inboard planetary, outboard planetary, bull-and-pinion (ring-and-pinion), chain-driven, angle drives (90 degree and various other angles)

tools and equipment include: floor jacks and other lifting devices, safety stands, specialized tools, torque wrenches, dial indicators, feeler gauges, spring scale, pullers, transmission support stand, steering lockout, oscillation locks

hazards include: entanglement, pinching, crushing, sudden movements, oil injection potential

Major Work Activity D

Diagnoses and repairs hydraulic, hydrostatic and pneumatic systems

Task D-10 Diagnoses hydraulic, hydrostatic and pneumatic systems

Task Descriptor

Agricultural equipment technicians must be able to understand the theory of hydraulics, hydrostatic and pneumatic systems. They need to differentiate whether the problem is mechanical, electrical or hydraulic when doing diagnostics and use the proper testing equipment to help identify the problem.

D-10.01 Diagnoses hydraulic and hydrostatic systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
D-10.01.01P	identify ***symptoms of problem***	***symptoms of problem*** are identified by consulting with customer or operator
D-10.01.02P	check if power is being supplied to drive systems	power is checked to see if it is being supplied to drive systems
D-10.01.03P	perform sensory inspections to identify ***faults***	sensory inspections are performed to identify ***faults***
D-10.01.04P	check and retrieve diagnostic service codes	service codes are referred to manuals for instructions on diagnosis
D-10.01.05P	determine system function and component location	system function and component location are determined by interpreting hydraulic system schematics
D-10.01.06P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
D-10.01.07P	remove ***components*** to access diagnostic area	***components*** are removed to access diagnostic area
D-10.01.08P	perform ***tests*** at operating temperature and at rated revolutions per minute (RPM)	***tests*** are performed at operating temperature and at rated RPM according to manufacturers' specifications

D-10.01.09P	interpret ***test*** results and compare to manufacturers' specifications	***test*** results are interpreted and compared to manufacturers' specifications
D-10.01.10P	determine ***required actions***	***required actions*** are determined

Range of Variables

symptoms of problem include: heat, low power, creeping in neutral, abnormal noises, service codes

faults include: leaks, abnormal noises, heat, failed hoses, low power, low pressure, creeping in neutral

tools and equipment include: temperature measuring devices, flow meters, pressure gauges, OEM specialty tools

components (removed for access) include: panels, shields, hoods

tests include: pressure, flow, case drain, temperature

required actions include: repairs, replacement or adjustment of pumps or valves, further diagnosis

	Knowledge	
	Learning Outcomes	**Learning Objectives**
D-10.01.01L	demonstrate knowledge of ***hydraulic*** and ***hydrostatic systems***, their ***components***, characteristics, applications and operation	identify ***hydraulic systems*** and their ***components***, and describe their characteristics, applications and operation
		identify ***hydrostatic systems*** and their ***components***, and describe their characteristics, applications and operation
		describe mechanically-controlled and electronically-controlled ***hydraulic*** and ***hydrostatic systems***
		identify various types of fluids used in ***hydraulic*** and ***hydrostatic systems***
D-10.01.02L	demonstrate knowledge of diagnostic manuals	describe diagnostic information retrieval and its procedures for use
D-10.01.03L	demonstrate knowledge of diagnosing ***hydraulic*** and ***hydrostatic systems*** and their ***components***	identify ***tools and equipment*** used to diagnose ***hydraulic*** and ***hydrostatic systems*** and their ***components***, and describe their applications and procedures for use
		describe procedures to diagnose ***hydraulic*** and ***hydrostatic systems*** and their ***components***
		identify hazards and describe safe work practices while diagnosing ***hydraulic*** and ***hydrostatic systems*** and their ***components***
		identify inspections and ***tests*** performed to diagnose ***hydraulic*** and ***hydrostatic systems*** and their ***components***
		identify possible ***faults*** found while performing inspections and ***tests***

D-10.01.04L	demonstrate knowledge of sensor functions	identify sensor functions and describe their applications
D-10.01.05L	demonstrate knowledge of ***safety bypass systems***	identify ***safety bypass systems*** and describe their applications

Range of Variables

hydraulic systems include: open-centre, closed-centre, blended

hydrostatic systems include: open loop, closed loop, blended, fixed displacement, variable displacement

components (hydraulic systems) include: pumps, rock shafts/three-point hitch, cylinders, motors, actuators, fluids, controllers, wiring harnesses, valves, sensors, gauges, reservoirs, oil coolers, lines and hoses, fittings

components (hydrostatic systems) include: motors, pumps, reservoirs, valves, controllers, oil coolers, lines and hoses, fittings, wiring harnesses, sensors, gauges

tools and equipment include: temperature measuring devices, flow meters, pressure gauges, OEM specialty tools

tests include: pressure, flow, case drain, temperature

faults include: leaks, abnormal noises, heat, failed hoses, low power, low pressure, creeping in neutral

safety bypass systems include: cooler bypass valves, oil filter bypass valves, relief valves

D-10.02 Diagnoses pneumatic systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
D-10.02.01P	identify ***symptoms of problem***	***symptoms of problem*** are identified by consulting with customer or operator
D-10.02.02P	check if power is being supplied to drive systems	power is checked to see if it is being supplied to drive systems
D-10.02.03P	perform sensory inspections to identify ***faults***	sensory inspections are performed to identify ***faults***
D-10.02.04P	check and retrieve diagnostic service codes	service codes are referred to manuals for instructions on diagnosis
D-10.02.05P	determine system function and component location	system function and component location is determined by interpreting pneumatic system schematics
D-10.02.06P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
D-10.02.07P	remove ***components*** to access diagnostic area	***components*** are removed to access diagnostic area
D-10.02.08P	perform ***tests***	tests are performed

D-10.02.09P	interpret ***test*** results and compare to manufacturers' specifications	***test*** results are interpreted and compared to manufacturers' specifications
D-10.02.10P	determine ***required actions***	***required actions*** are determined

Range of Variables

symptoms of problem include: poor braking, service codes, abnormal noises, loss of pressure, soft suspension

faults include: leaks, abnormal noises, heat, broken hoses, low power, low pressure

tools and equipment include: pressure gauges, hand tools, OEM specialty tools, power tools

components (removed for access) include: panels, shields, hoods

tests include: pressure, time, flow

required actions include: repairs, replacement or adjustment of compressors, valves and lines, further diagnosis

	Knowledge	
	Learning Outcomes	**Learning Objectives**
D-10.02.01L	demonstrate knowledge of pneumatic systems, their ***components***, characteristics, applications and operation	identify types of pneumatic systems and their ***components***, and describe their characteristics, applications and operation
D-10.02.02L	demonstrate knowledge of diagnosing pneumatic systems and their ***components***	identify ***tools and equipment*** used to diagnose pneumatic systems and their ***components***, and describe their applications and procedures for use
		describe procedures to diagnose pneumatic systems and their ***components***
		identify hazards and describe safe work practices while diagnosing pneumatic systems and their ***components***
		identify inspections and ***tests*** performed to diagnose pneumatic systems and their ***components***
		identify possible ***faults*** found while performing inspections and ***tests***
D-10.02.03L	demonstrate knowledge of sensor functions	identify sensor functions and describe their applications
D-10.02.04L	demonstrate knowledge of safety bypass systems	identify safety bypass systems and describe their applications

Range of Variables

components (pneumatic) include: hoses, fittings, compressors, valves, lines

tools and equipment include: pressure gauges, hand tools, OEM specialty tools, power tools

tests include: pressure, time, flow

faults include: leaks, abnormal noises, heat, broken hoses, low power, low pressure

Task D-11 Repairs hydraulic, hydrostatic and pneumatic systems

Task Descriptor

Agricultural equipment technicians must use the appropriate tools, measuring devices and procedures to return hydraulic, hydrostatic and pneumatic systems to manufacturers' specifications.

D-11.01 Repairs hydraulic and hydrostatic systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
D-11.01.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
D-11.01.02P	remove ***components*** to access repair area	***components*** are removed to access repair area
D-11.01.03P	repair or replace hydraulic ***components***	hydraulic ***components*** are repaired or replaced
D-11.01.04P	clean valves, motors, hoses and components after catastrophic failure	valves, motors, hoses and components are cleaned to prevent further damage or repeat failure
D-11.01.05P	adjust pumps and valves for pressure and flow	valves are adjusted for pressure and flow according to manufacturers' specifications
D-11.01.06P	reassemble unit after repair	unit is reassembled after repair according to OEM assembly procedures
D-11.01.07P	verify system operations	system operations are verified to OEM standards

Range of Variables

tools and equipment include: hand tools, OEM specialty tools, oil reclamation, power tools

components (removed for access) include: panels, hoods, shields

components (hydraulic systems) include: pumps, rock shafts/three-point hitch, cylinders, motors, actuators, fluids, controllers, wiring harnesses, valves, fittings, oil coolers, sensors

	Knowledge	
	Learning Outcomes	**Learning Objectives**
D-11.01.01L	demonstrate knowledge of ***hydraulic*** and ***hydrostatic systems***, their ***components***, characteristics, applications and operation	identify ***hydraulic systems*** and their ***components***, and describe their characteristics, applications and operation
		identify ***hydrostatic systems*** and their ***components***, and describe their characteristics, applications and operation
		describe mechanically-controlled and electronically-controlled ***hydraulic*** and ***hydrostatic systems***
D-11.01.02L	demonstrate knowledge of repairing ***hydraulic*** and ***hydrostatic systems*** and their ***components***	identify ***tools and equipment*** used to repair ***hydraulic*** and ***hydrostatic systems*** and their ***components***, and describe their applications and procedures for use
		describe procedures to disassemble and reassemble ***hydraulic*** and ***hydrostatic systems***
		describe procedures to repair and replace ***hydraulic*** and ***hydrostatic system components***
		identify hazards and safe work practices while performing repairs
		describe verification procedures for system operations

Range of Variables

hydraulic systems include: open centre, closed centre, blended

hydrostatic systems include: open loop, closed loop, blended, fixed displacement, variable displacement

components (hydraulic systems) include: pumps, rock shafts/three-point hitch, cylinders, motors, actuators, fluids, controllers, wiring harnesses, valves, fittings, oil coolers, sensors

components (hydrostatic systems) include: motors, pumps, reservoirs, valves, controllers, oil coolers, lines and hoses, fittings, wiring harnesses, sensors, gauges

tools and equipment include: hand tools, OEM specialty tools, oil reclamation, power tools

D-11.02 Repairs pneumatic systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
D-11.02.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
D-11.02.02P	remove ***components*** to access repair area	***components*** are removed to access repair area
D-11.02.03P	repair or replace pneumatic ***components***	pneumatic ***components*** are repaired or replaced
D-11.02.04P	adjust valves for pressure and operating height for suspension	valves are adjusted for pressure and operating height for suspension according to manufacturers' specifications
D-11.02.05P	reassemble unit after repair	unit is reassembled after repair according to OEM assembly procedures
D-11.02.06P	verify ***system operations***	***system operations*** are verified to OEM standards

Range of Variables

tools and equipment include: hand tools, OEM specialty tools, power tools
components (removed for access) include: panels, hoods, shields
components (pneumatic systems) include: hoses, fittings, compressors, valves, lines
system operations include: air brakes, air suspension, debris blow-off systems

	Knowledge	
	Learning Outcomes	**Learning Objectives**
D-11.02.01L	demonstrate knowledge of pneumatic systems, their ***components***, characteristics, applications and operation	identify types of pneumatic systems and their ***components***, and describe their characteristics, applications and operation
D-11.02.02L	demonstrate knowledge of repairing pneumatic systems and their ***components***	identify ***tools and equipment*** used to repair pneumatic systems and their ***components***, and describe their applications and procedures for use
		describe procedures to disassemble and reassemble pneumatic systems
		describe procedures to repair and replace pneumatic system ***components***

	identify hazards and safe work practices while performing repairs
	describe verification procedures for ***system operations***

Range of Variables

components (pneumatic systems) include: hoses, fittings, compressors, valves, lines
tools and equipment include: hand tools, OEM specialty tools, power tools
system operations include: air brakes, air suspension, debris blow-off systems

Major Work Activity E

Diagnoses and repairs electrical and electronic systems

Task E-12 Diagnoses electrical/electronic power and control monitoring systems

Task Descriptor

Electrical and electronic systems are integrated and support each other. These integrated systems are diagnosed together.

E-12.01 Diagnoses electrical power and control monitoring systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
E-12.01.01P	identify ***symptoms of problem***	***symptoms of problem*** are identified by consulting with customer or operator
E-12.01.02P	operate equipment to reproduce symptoms	equipment is operated to reproduce symptoms
E-12.01.03P	perform sensory inspection on ***components*** to identify ***faults***	sensory inspection on ***components*** is performed to identify ***faults***
E-12.01.04P	remove ***components*** to access diagnostic area	***components*** are removed to access diagnostic area
E-12.01.05P	select and use ***tools and testing equipment***	***tools and testing equipment*** are selected and used according to application
E-12.01.06P	perform ***tests and diagnostics***	***tests and diagnostics*** are performed
E-12.01.07P	interpret schematics to locate ***components***	schematics are interpreted to locate ***components***
E-12.01.08P	interpret test results for Controller Area Network (CAN) bus systems	test results for ***CAN bus systems*** are interpreted
E-12.01.09P	interpret results to determine ***required actions***	results are interpreted to determine ***required actions***

Range of Variables

symptoms of problem include: service codes, low voltage, high voltage, sensory indicators

components (electrical power and control monitoring systems) include: batteries, fuses, relays, actuators, alternators, switches, harnesses, diodes, connectors

faults include: corrosion, burnt components, broken wire connections, damaged harnesses, damaged controllers

components (removed for access) include: panels, seats, fuel tanks

tools and testing equipment include: multimeters, laptops, onboard diagnostic systems, OEM specialty tools

tests and diagnostics include: circuit tests, component tests, service code diagnostics

components (to be located on schematics) include: sensors, wiring, power modules, controllers, relays, fuses, switches, grounds

CAN bus systems include: 2-wire CAN, 4-wire CAN

required actions include: cleaning connections, replacing components, soldering wires, further diagnosis

	Knowledge	
	Learning Outcomes	**Learning Objectives**
E-12.01.01L	demonstrate knowledge of electrical power and control monitoring systems, their ***components***, characteristics, applications and operation	identify types of electrical power and control monitoring systems, and their ***components***, and describe their characteristics, applications and operation
		describe electrical subsystems and describe their characteristics, applications and operation
		describe basic electrical theory such as Ohm's law
		identify ***integrated implement control systems and monitors***
		identify gauges of electrical wiring and types of connectors
		identify ***equipment accessories and options***
E-12.01.02L	demonstrate knowledge of diagnosing electrical power and control monitoring systems and their ***components***	identify ***tools and testing equipment*** used to diagnose electrical power and control monitoring systems and their ***components***, and describe their applications and procedures for use
		describe procedures to diagnose electrical power and control monitoring systems and their ***components***
		identify hazards and describe safe work practices while diagnosing electrical power and control monitoring systems and their ***components***
		identify inspections, ***tests and diagnostics*** performed to diagnose electrical power and control monitoring systems and their ***components***

	interpret results of ***tests and diagnostics***
	identify possible ***faults*** found while performing ***tests and diagnostics***
	identify ***diagnostic resources***
	interpret schematics and flow charts

Range of Variables

components (electrical power and control monitoring systems) include: batteries, fuses, relays, actuators, alternators, switches, harnesses, diodes, connectors

integrated implement control systems and monitors include: active implement guidance, passive implement guidance, ISO monitoring

equipment accessories and options include: Global Navigation Satellite System (GNSS), data collection, automated steering, entertainment systems

tools and testing equipment include: multimeters, laptops, onboard diagnostic systems, OEM specialty tools

tests and diagnostics include: circuit tests, component tests, service code diagnostics

faults include: corrosion, burnt components, broken wire connections, damaged harnesses, damaged controllers

diagnostic resources include: technical manual, manufacturer technical assistance, qualified trade experts

E-12.02 Diagnoses electronic power and control monitoring systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
E-12.02.01P	identify ***symptoms of problem***	***symptoms of problem*** are identified by consulting with customer or operator
E-12.02.02P	operate equipment to reproduce symptoms	equipment is operated to reproduce symptoms
E-12.02.03P	perform sensory inspection of ***components*** to identify ***faults***	***components*** are inspected to identify ***faults***
E-12.02.04P	gather diagnostic information	diagnostic information is gathered by retrieving service codes
E-12.02.05P	perform ***diagnostics***	***diagnostics*** are performed
E-12.02.06P	interpret test results for ***CAN bus systems***	test results for ***CAN bus systems*** are interpreted
E-12.02.07P	interpret schematics to locate ***components***	schematics are interpreted to locate ***components***
E-12.02.08P	remove ***components*** to access diagnostic area	***components*** are removed to access diagnostic area

E-12.02.09P	select and use ***tools and testing equipment***	***tools and testing equipment*** are selected and used according to identified ***symptoms***
E-12.02.10P	interpret ***diagnostic*** results to determine ***required actions***	***diagnostic*** results are interpreted to determine ***required actions*** according to OEM specification or further diagnosis

Range of Variables

symptoms of problem include: service codes, low voltage, sensory indicators

components (electronic power and control monitoring systems) include: batteries, fuses, relays, CAN bus components, Local Interconnect Network (LIN) bus components, controllers, printed circuit boards, multi-function controls, sensors, wiring, power modules, switches, grounds, terminators

faults include: corrosion, burnt components, broken wire connections, damaged harnesses

diagnostics include: circuit tests, component tests, data recordings, service code diagnostics

CAN bus systems include: 2-wire CAN, 4-wire CAN

components (removed for access) include: panels, seats, fuel tanks

tools and testing equipment include: multimeters, laptops, onboard diagnostic systems, OEM specialty tools

symptoms include: service code, malfunction

required actions include: repairing, downloading software, replacing component, resetting

	Knowledge	
	Learning Outcomes	**Learning Objectives**
E-12.02.01L	demonstrate knowledge of electronic power and control monitoring systems, their ***components***, characteristics, applications and operation	identify types of electronic power and control monitoring systems, and their ***components***, and describe their characteristics, applications and operation
		identify integrated implement control systems and monitors
		identify ***equipment accessories and options***
E-12.02.02L	demonstrate knowledge of diagnosing electronic power and control monitoring systems and their ***components***	identify ***tools and testing equipment*** used to diagnose electronic power and control monitoring systems and their ***components***, and describe their applications and procedures for use
		describe procedures to diagnose electronic power and control monitoring systems and their ***components***
		identify hazards and describe safe work practices while diagnosing electronic power and control monitoring systems and their ***components***
		identify inspections and ***diagnostics*** performed to diagnose electronic power and control monitoring systems and their ***components***
		interpret results of ***diagnostics***

	identify possible ***faults*** found while performing ***diagnostics***
	identify ***diagnostic resources***
	interpret schematics and flow charts

Range of Variables

components (electronic power and control monitoring systems) include: batteries, fuses, relays, CAN bus components, Local Interconnect Network (LIN) bus components, controllers, printed circuit boards, multi-function controls, sensors, wiring, power modules, switches, grounds, terminators

equipment accessories and options include: GNSS, data collection, automated steering, entertainment systems

tools and testing equipment include: multimeters, laptops, onboard diagnostic systems, OEM specialty tools

diagnostics include: circuit tests, component tests, data recordings, service code diagnostics

faults include: corrosion, burnt components, broken wire connections, damaged harnesses

diagnostic resources include: technical manual, manufacturer technical assistance, qualified trade experts

Task E-13 Repairs electrical/electronic power and control monitoring systems

Task Descriptor

Electrical and electronic systems are integrated and support each other. These integrated systems are repaired together.

E-13.01 Repairs electrical power and control monitoring systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
E-13.01.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
E-13.01.02P	replace failed electrical ***components***	failed electrical ***components*** are replaced
E-13.01.03P	repair ***components***	***components*** are repaired according to manufacturers' specifications

E-13.01.04P	repair harness assemblies	harness assemblies are repaired by replacing damaged wires, connectors and pins according to manufacturers' specifications
E-13.01.05P	reinstall ***components***	***components*** are reinstalled according to manufacturers' specifications
E-13.01.06P	verify repairs	repairs are verified to OEM standards

Range of Variables

tools and equipment include: onboard diagnostics, electronic connection interface, OEM specialty tools

components include: starters, solenoids, alternators, batteries, actuators, switches, relays, terminators, harnesses, fuses, connectors, terminals, terminating resistor, connector pins, wires, loom, harness supports, lights

components (to be reinstalled) include: panels, seats, fuel tanks

	Knowledge	
	Learning Outcomes	**Learning Objectives**
E-13.01.01L	demonstrate knowledge of electrical power and control monitoring systems, their ***components***, characteristics, applications and operation	identify types of electrical power and control monitoring systems, and their ***components***, and describe their characteristics, applications and operation
		describe electrical subsystems and describe their characteristics, applications and operation
		describe basic electrical theory such as Ohm's law
		identify integrated implement control systems and monitors
		identify gauges of electrical wiring and types of connectors
		identify ***equipment accessories and options***
E-13.01.02L	demonstrate knowledge of repairing electrical power and control monitoring systems and their ***components***	identify ***tools and equipment*** used to repair electrical power and control monitoring systems and their ***components***, and describe their applications and procedures for use
		describe procedures to repair, replace and reinstall electrical power and control monitoring system ***components***
		identify hazards and safe work practices while performing repairs
		describe procedures to verify repairs

Range of Variables

components include: starters, solenoids, alternators, batteries, actuators, switches, relays, terminators, harnesses, fuses, connectors, terminals, terminating resistor, connector pins, wires, loom, harness supports, lights

equipment accessories and options include: GNSS, data collection, automated steering, entertainment systems

tools and equipment include: onboard diagnostics, electronic connection interface, OEM specialty tools

E-13.02 Repairs electronic power and control monitoring systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
E-13.02.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
E-13.02.02P	replace failed electronic ***components***	failed electronic ***components*** are replaced according to manufacturers' specifications
E-13.02.03P	reprogram or recalibrate ***components***	***components*** are reprogrammed or recalibrated according to manufacturers' specifications
E-13.02.04P	reinstall ***components***	***components*** are reinstalled according to manufacturers' specifications
E-13.02.05P	verify repairs	repairs are verified to OEM standards

Range of Variables

tools and equipment include: onboard diagnostics, electronic communication interface, OEM specialty tools, digital devices, multimeters

components include: CAN bus components (controllers, printed circuit boards, multi-function controls)

components (to be reprogrammed or recalibrated) include: controllers, displays, sensors

	Knowledge	
	Learning Outcomes	**Learning Objectives**
E-13.02.01L	demonstrate knowledge of electronic power and control monitoring systems, their ***components***, characteristics, applications and operation	identify types of electronic power and control monitoring systems, and their ***components***, and describe their characteristics, applications and operation
		identify integrated implement control systems and monitors
		identify ***equipment accessories and options***

E-13.02.02L	demonstrate knowledge of repairing electronic power and control monitoring systems and their ***components***	identify ***tools and equipment*** used to repair electronic power and control monitoring systems and their ***components***, and describe their applications and procedures for use
		describe procedures to repair, replace, reprogram, recalibrate and reinstall electronic power and control monitoring system ***components***
		identify hazards and safe work practices while performing repairs
		describe procedures to verify repairs

Range of Variables

components include: CAN bus components (controllers, printed circuit boards, multi-function controls)

equipment accessories and options include: GNSS, data collection, automated steering, entertainment systems

tools and equipment include: onboard diagnostics, electronic communication interface, OEM specialty tools, digital devices, multimeters

Major Work Activity F

Diagnoses and repairs steering, brakes and suspension

Task F-14 Diagnoses steering and brake systems

Task Descriptor

To ensure safe equipment operation, steering and brake systems need to perform within operating parameters and according to manufacturers' specifications. Agricultural equipment technicians perform diagnostic analysis to identify the cause of the fault.

F-14.01 Diagnoses steering systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
F-14.01.01P	identify ***symptoms of problem***	***symptoms of problem*** are identified by consulting with customer or operator
F-14.01.02P	perform sensory inspections on ***components*** to identify ***faults***	sensory inspections are performed on ***components*** to identify ***faults***
F-14.01.03P	remove ***components*** to access diagnostic area	***components*** are removed to access diagnostic area
F-14.01.04P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
F-14.01.05P	interpret schematics	schematics are interpreted to isolate ***faults***
F-14.01.06P	interpret results to determine ***required actions***	results are interpreted to determine ***required actions***
F-14.01.07P	verify steering system function	steering system function is verified

Range of Variables

symptoms of problem include: loose, wandering, high-effort steering, sensitive

components (steering systems) include: steering motors, pumps, actuators, steering linkages, priority valves, hoses, lines, control valves

faults include: leaks, binding, deformities, abnormal noises

components (removed for access) include: panels, hoods, tires

tools and equipment include: pressure gauges, dial indicators, tape measures, OEM specialty tools, temperature measuring devices

required actions include: repair, replacement, calibration and adjustment of components, further diagnosis

	Knowledge	
	Learning Outcomes	**Learning Objectives**
F-14.01.01L	demonstrate knowledge of steering systems, their ***components***, characteristics, applications and operation	identify ***types of steering systems***, and their ***components***, and describe their characteristics, applications and operation
		describe allowable tolerances
F-14.01.02L	demonstrate knowledge of diagnosing steering systems and their ***components***	identify ***tools and equipment*** used to diagnose steering systems and their ***components***, and describe their applications and procedures for use
		describe procedures to diagnose steering systems and their ***components***
		identify hazards and describe safe work practices while diagnosing steering systems and their ***components***
		identify inspections performed to diagnose steering systems and their ***components***
		identify possible ***faults*** found while performing inspections on ***components***
		interpret schematics

Range of Variables

components (steering systems) include: steering motors, pumps, actuators, steering linkages, priority valves, hoses, lines, control valves

types of steering systems include: hydraulic, mechanical, hydrostatic, electronic

tools and equipment include: pressure gauges, dial indicators, tape measures, OEM specialty tools, temperature measuring devices

faults include: leaks, binding, deformities, abnormal noises

F-14.02 Diagnoses brake systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
F-14.02.01P	identify ***symptoms of problem***	***symptoms of problem*** are identified by consulting with customer or operator
F-14.02.02P	perform sensory inspections on ***components*** to identify ***faults***	sensory inspections are performed on ***components*** to identify ***faults***
F-14.02.03P	remove ***components*** to access diagnostic area	***components*** are removed to access diagnostic area
F-14.02.04P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
F-14.02.05P	interpret schematics to isolate cause of ***faults***	schematics are interpreted to isolate cause of ***faults***
F-14.02.06P	disassemble brake system	brake system is disassembled to access brake pads and cylinders
F-14.02.07P	interpret results to determine ***required actions***	results are interpreted to determine ***required actions***
F-14.02.08P	verify brake system function	brake system function is verified

Range of Variables

symptoms of problem include: weak, soft, harsh and sensitive braking; abnormal noise; sensory observations

components (brake systems) include: pads, shoes, rotors, calipers, valves, controls (pedals, primary cylinders, control valves), drums, actuators (hydraulic, mechanical), discs, accumulators

faults include: leaks, cracking, binding, heat points, abnormal noises, dragging

components (removed for access) include: panels, wheels, tires, brake housings, final drives

tools and equipment include: pressure gauges, dial indicators, vernier calipers

required actions include: replacement, calibration and adjustment of components, further diagnosis

	Knowledge	
	Learning Outcomes	**Learning Objectives**
F-14.02.01L	demonstrate knowledge of brake systems, their ***components***, characteristics, applications and operation	identify ***types of brake systems*** and their ***components***, and describe their characteristics, applications and operation
		describe allowable tolerances
F-14.02.02L	demonstrate knowledge of diagnosing brake systems and their ***components***	identify ***tools and equipment*** used to diagnose brake systems and their ***components***, and describe their applications and procedures for use

		describe procedures to diagnose brake systems and their ***components***
		identify hazards and describe safe work practices while diagnosing brake systems and their ***components***
		identify inspections performed to diagnose brake systems and their ***components***
		identify possible ***faults*** found while performing inspections on ***components***
		interpret schematics
F-14.02.03L	demonstrate knowledge of disassembling and reassembling brake systems	describe procedures to disassemble and reassembling brake systems

Range of Variables

components (brake systems) include: pads, shoes, rotors, calipers, valves, controls (pedals, primary cylinders, control valves), drums, actuators (hydraulic, mechanical), discs, accumulators

types of brake systems include: hydraulic, mechanical, hydrostatic, air

tools and equipment include: pressure gauges, dial indicators, vernier calipers

faults include: leaks, cracking, binding, heat points, abnormal noises, dragging

Task F-15 Repairs steering and brake systems

Task Descriptor

To ensure safe operation of equipment, steering and brake systems need to perform within operating parameters. Agricultural equipment technicians repair steering and brake systems by removing, repairing, replacing, installing and adjusting various components of the equipment according to manufacturers' specifications and recommendations.

F-15.01 Repairs steering systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
F-15.01.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
F-15.01.02P	replace steering ***components***	steering ***components*** are replaced according to manufacturers' specifications

F-15.01.03P	recondition ***components***	***components*** are reconditioned according to manufacturers' specifications
F-15.01.04P	lubricate and adjust ***components***	***components*** are lubricated and adjusted according to manufacturers' specifications
F-15.01.05P	reinstall ***components***	***components*** are reinstalled according to manufacturers' specifications
F-15.01.06P	verify repair	repairs are verified to manufacturers' specifications

Range of Variables

tools and equipment include: pressure gauges, dial indicators, tape measures, OEM specialty tools, temperature measuring devices

components include: steering motors, pumps, actuators, steering linkages, priority valves, hoses, lines, control valves

components (to be reinstalled) include: panels, wheels, tires

	Knowledge	
	Learning Outcomes	**Learning Objectives**
F-15.01.01L	demonstrate knowledge of steering systems, their ***components***, characteristics, applications and operation	identify ***types of steering systems*** and their ***components***, and describe their characteristics, applications and operation
		describe allowable tolerances
F-15.01.02L	demonstrate knowledge of repairing steering systems and their ***components***	identify ***tools and equipment*** used to repair steering systems and their ***components***, and describe their applications and procedures for use
		describe procedures to repair, replace, recondition, lubricate and adjust steering system ***components***
		identify hazards and safe work practices while performing repairs
		describe procedures to verify repairs

Range of Variables

components include: steering motors, pumps, actuators, steering linkages, priority valves, hoses, lines, control valves

types of steering systems include: hydraulic, mechanical, hydrostatic, electrical

tools and equipment include: pressure gauges, dial indicators, tape measures, OEM specialty tools, temperature measuring devices

F-15.02 Repairs brake systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

Skills

	Performance Criteria	Evidence of Attainment
F-15.02.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
F-15.02.02P	replace brake system ***components***	brake system ***components*** are replaced
F-15.02.03P	bleed and adjust ***components***	***components*** are bled and adjusted according to manufacturers' specifications
F-15.02.04P	recondition ***components***	***components*** are reconditioned to manufacturers' specifications
F-15.02.05P	adjust ***components***	***components*** are adjusted to manufacturers' specifications
F-15.02.06P	calibrate and adjust park brakes	park brakes are calibrated and adjusted to manufacturers' specifications
F-15.02.07P	verify brake system function	brake system function is verified

Range of Variables

tools and equipment include: brake pliers, wrenches, brake bleeders

components include: pads, shoes, rotors, calipers, valves, controls (pedals, primary cylinders, control valves), drums, actuators (hydraulic, mechanical), discs, accumulators

Knowledge

	Learning Outcomes	Learning Objectives
F-15.02.01L	demonstrate knowledge of brake systems, their ***components***, characteristics, applications and operation	identify ***types of brake systems***, and their ***components***, and describe their characteristics, applications and operation
		describe allowable tolerances
		identify ***materials of brakes*** and describe their characteristics and applications
F-15.02.02L	demonstrate knowledge of repairing brake systems and their ***components***	identify ***tools and equipment*** used to repair braking systems and their ***components***, and describe their applications and procedures for use
		describe procedures to repair, replace, recondition, lubricate, adjust and calibrate brake system ***components***
		identify hazards and safe work practices while performing repairs
		describe procedures to verify repairs

Range of Variables

components include: pads, shoes, rotors, calipers, valves, controls (pedals, primary cylinders, control valves), drums, actuators (hydraulic, mechanical), discs, accumulators

types of brake systems include: hydraulic, mechanical, hydrostatic

materials of brakes include: bronze, fibre, brass, ceramic, asbestos

tools and equipment include: brake pliers, wrenches, brake bleeders

Task F-16 Diagnoses track, wheel and suspension systems

Task Descriptor

The suspension on agricultural equipment allows for operator comfort, and helps improve traction and steering. Diagnostic analysis is performed by agricultural equipment technicians to identify the cause of the component fault.

F-16.01 Diagnoses track systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
F-16.01.01P	identify ***symptoms of problem***	***symptoms of problem*** are identified by consulting with customer or operator
F-16.01.02P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
F-16.01.03P	perform ***checks*** on ***components***	***checks*** on ***components*** are performed
F-16.01.04P	perform sensory inspections on ***components*** to identify ***faults***	sensory inspections are performed to identify ***faults***
F-16.01.05P	interpret results to determine ***required actions***	results are interpreted to determine ***required actions***

Range of Variables

symptoms of problem include: slippage, vibration, misalignment, uneven wear pattern

tools and equipment include: jacks, hand tools, hoisting equipment, measuring devices, power tools, OEM specialty tools

checks include: measuring alignments, tension, wear patterns

components include: rubber tracks, support wheels, tensioning systems

faults include: abnormal noises, wear, vibrations, oil leaks

required actions include: repairs, component replacement, further diagnosis

	Knowledge	
	Learning Outcomes	**Learning Objectives**
F-16.01.01L	demonstrate knowledge of track systems, their ***components***, characteristics, applications and operation	identify types of track systems and their ***components***, and describe their characteristics, applications and operation
		describe allowable tolerances
F-16.01.02L	demonstrate knowledge of diagnosing track systems and their ***components***	identify ***tools and equipment*** used to diagnose track systems and their ***components***, and describe their applications and procedures for use
		describe procedures to diagnose track systems and their ***components***
		identify hazards and describe safe work practices while diagnosing track systems and their ***components***
		identify inspections performed to diagnose track systems
		identify possible ***faults*** found while performing inspections

Range of Variables

components include: rubber tracks, support wheels, tensioning systems

tools and equipment include: jacks, hand tools, hoisting equipment, measuring devices, power tools, OEM specialty tools

faults include: abnormal noises, wear, vibrations, oil leaks

F-16.02 Diagnoses wheel assemblies

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
F-16.02.01P	identify ***symptoms of problem***	***symptoms of problem*** are identified by consulting with customer or operator
F-16.02.02P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
F-16.02.03P	perform ***checks*** on ***wheel assemblies***	***checks*** on ***wheel assemblies*** are performed

F-16.02.04P	perform sensory inspections on ***wheel assemblies*** to identify ***faults***	sensory inspections are performed to identify ***faults***
F-16.02.05P	interpret results to determine ***required actions***	results are interpreted to determine ***required actions***

Range of Variables

symptoms of problem include: vibration, road lope, power hop, mis-tracking

tools and equipment include: jacks, hand tools, hoisting equipment, measuring devices, power tools, OEM specialty tools, pressure gauges

checks include: pressure, tire bulges, wear pattern, operation, ballasting

wheel assemblies include: hubs, wedges, rims, bias tires, radial tires

faults include: abnormal noises, wear, vibrations

required actions include: repairs, component replacement, further diagnosis

	Knowledge	
	Learning Outcomes	**Learning Objectives**
F-16.02.01L	demonstrate knowledge of ***wheel assemblies***, their characteristics, applications and operation	identify types of ***wheel assemblies*** and describe their characteristics, applications and operation
		describe allowable tolerances
F-16.02.02L	demonstrate knowledge of diagnosing ***wheel assemblies***	identify ***tools and equipment*** used to diagnose ***wheel assemblies*** and describe their applications and procedures for use
		describe procedures to diagnose ***wheel assemblies***
		identify hazards and describe safe work practices while diagnosing ***wheel assemblies***
		identify inspections performed to diagnose ***wheel assemblies***
		identify possible ***faults*** found while performing inspections

Range of Variables

wheel assemblies include: hubs, wedges, rims, bias tires, radial tires

tools and equipment include: jacks, hand tools, hoisting equipment, measuring devices, power tools, OEM specialty tools, pressure gauges

faults include: abnormal noises, wear, vibrations

F-16.03 Diagnoses suspension systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
F-16.03.01P	identify ***symptoms of problem***	***symptoms of problem*** are identified by consulting with customer or operator
F-16.03.02P	select and use ***diagnostic tools and equipment***	***diagnostic tools and equipment*** are selected and used according to application
F-16.03.03P	perform ***checks*** on ***components***	***checks*** on ***components*** are performed according to manufacturers' specifications
F-16.03.04P	perform sensory inspections on ***components*** to identify ***faults***	sensory inspections are performed according to manufacturers' specifications to identify ***faults***
F-16.03.05P	interpret results to determine ***required actions***	results are interpreted to determine ***required actions***

Range of Variables

symptoms of problem include: harsh/rough ride, poor traction, power hop, service codes

diagnostic tools and equipment include: pressure gauges, adapter fittings, nitrogen gas, hand tools, power tools

checks include: testing for accumulator charge or failure, air pressure

components include: air bags, shocks, accumulators, fittings, hoses, sensors, controllers, cylinders, compressors

faults include: leaks, cracks, tears, wear

required actions include: repairs, component replacement, further diagnosis

	Knowledge	
	Learning Outcomes	**Learning Objectives**
F-16.03.01L	demonstrate knowledge of ***suspension systems***, their ***components***, characteristics, applications and operation	identify ***suspension systems*** and their ***components***, and describe their characteristics, applications and operation
F-16.03.02L	demonstrate knowledge of diagnosing ***suspension systems*** and their ***components***	identify ***diagnostic tools and equipment*** used to diagnose ***suspension systems*** and their ***components***, and describe their applications and procedures for use
		describe procedures to diagnose ***suspension systems*** and their ***components***
		identify hazards and describe safe work practices while diagnosing ***suspension systems*** and their ***components***

	identify inspections performed to diagnose ***suspension system components***
	identify possible ***faults*** found while performing inspections

Range of Variables

suspension systems include: front axles, cab suspension, loader suspension, track suspension, seats

components include: air bags, shocks, accumulators, fittings, hoses, sensors, controllers, cylinders, compressors

diagnostic tools and equipment include: pressure gauges, adapter fittings, nitrogen gas, hand tools, power tools

faults include: leaks, cracks, tears, wear

Task F-17 Repairs track, wheel and suspension systems

Task Descriptor

Agricultural equipment technicians repair suspensions to maintain operation of equipment, to minimize damage to other components and to reduce fatigue of the operator.

F-17.01 Repairs track systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
F-17.01.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
F-17.01.02P	remove tracks and disassemble track system ***components***	tracks are removed and track system ***components*** are disassembled
F-17.01.03P	replace worn and damaged ***components***	worn and damaged ***components*** are replaced
F-17.01.04P	recondition ***components***	***components*** are reconditioned to manufacturers' specifications
F-17.01.05P	align tensioning idlers on track systems	tensioning idlers are aligned on track systems

F-17.01.06P	assemble and install ***components***	***components*** are assembled and installed according to manufacturers' specifications
F-17.01.07P	verify repair	repair is verified according to manufacturers' specifications

Range of Variables

tools and equipment include: jacks, hand tools, hoisting equipment, measuring devices

components include: idlers, pins, bushings, rubber tracks, support wheels, drive wheels, fasteners, tension systems

	Knowledge	
	Learning Outcomes	**Learning Objectives**
F-17.01.01L	demonstrate knowledge of track systems, their ***components***, characteristics, applications and operation	identify types of track systems and their ***components***, and describe their characteristics, applications and operation
		describe allowable tolerances
F-17.01.02L	demonstrate knowledge of repairing track systems and their ***components***	identify ***tools and equipment*** used to repair track systems and their ***components***, and describe their applications and procedures for use
		describe procedures to repair, replace, recondition and align track system ***components***
		identify hazards and safe work practices while performing repairs
		describe procedures to verify repairs

Range of Variables

components include: idlers, pins, bushings, rubber tracks, support wheels, drive wheels, fasteners, tension systems

tools and equipment include: jacks, hand tools, hoisting equipment, measuring devices

F-17.02 Repairs wheel assemblies

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
F-17.02.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
F-17.02.02P	remove ***wheel assemblies***	***wheel assemblies*** are removed

F-17.02.03P	replace worn and damaged ***components***	worn and damaged ***components*** are replaced
F-17.02.04P	assemble and install ***components***	***components*** are assembled and installed according to manufacturers' specifications
F-17.02.05P	verify ***installation*** and repair	***installation*** and repair is verified according to manufacturers' specifications

Range of Variables

tools and equipment include: jacks, hand tools, hoisting equipment, measuring devices, power tools
wheel assemblies include: hubs, wedges, rims, bias tires, radial tires
components include: fasteners, rims, tires
installation includes: alignment, re-torquing, checking run-out, inflation

	Knowledge	
	Learning Outcomes	**Learning Objectives**
F-17.02.01L	demonstrate knowledge of ***wheel assemblies***, their ***components***, characteristics, applications and operation	identify types of ***wheel assemblies*** and their ***components***, and describe their characteristics, applications and operation
		describe allowable tolerances
F-17.02.02L	demonstrate knowledge of repairing ***wheel assemblies*** and their ***components***	identify ***tools and equipment*** used to repair ***wheel assemblies*** and their ***components***, and describe their applications and procedures for use
		describe procedures to repair, replace and align ***wheel assemblies*** and their ***components***
		identify ***hazards*** and safe work practices while performing repairs
		describe procedures to verify repairs of ***wheel assemblies*** and their ***components***

Range of Variables

wheel assemblies include: hubs, wedges, rims, bias tires, radial tires
components include: fasteners, rims, tires
tools and equipment include: jacks, hand tools, hoisting equipment, measuring devices, power tools
hazards include: heating or welding wheel assemblies (pyrolysis), lifting and handling of wheel assemblies, over-inflation of tires, possibility of calcium chloride within tire

F-17.03 Repairs suspension systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
F-17.03.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
F-17.03.02P	remove and recondition ***suspension systems***	***suspension systems*** are removed and reconditioned
F-17.03.03P	remove and disassemble ***components***	***components*** are removed and disassembled
F-17.03.04P	replace damaged ***components***	damaged ***components*** are replaced according to manufacturers' specifications
F-17.03.05P	recharge accumulator with nitrogen	accumulator is recharged with nitrogen according to manufacturers' specifications
F-17.03.06P	assemble and install ***components***	***components*** are assembled and installed according to manufacturers' specifications
F-17.03.07P	verify suspension system function	suspension system function is verified according to manufacturers' specifications

Range of Variables

tools and equipment include: regulators, jacks, OEM specialty tools

suspension systems include: front axles, cab suspension, loader suspension, track suspension, seats

components include: air bags, shocks, accumulators, fittings, hoses, sensors, controllers, cylinders, compressors

	Knowledge	
	Learning Outcomes	**Learning Objectives**
F-17.03.01L	demonstrate knowledge of ***suspension systems***, their ***components***, characteristics, applications and operation	identify ***suspension systems*** and their ***components***, and describe their characteristics, applications and operation
		describe allowable tolerances
F-17.03.02L	demonstrate knowledge of repairing ***suspension systems*** and their ***components***	identify ***tools and equipment*** used to repair ***suspension systems*** and their ***components***, and describe their applications and procedures for use
		describe procedures to repair, replace, recondition, assemble and install ***suspension system components***

	identify hazards and safe work practices while performing repairs
	describe procedures to verify repairs of ***suspension systems*** and their ***components***

Range of Variables

suspension systems include: front axles, cab suspension, loader suspension, track suspension, seats

components include: air bags, shocks, accumulators, fittings, hoses, sensors, controllers, cylinders, compressors

tools and equipment include: regulators, jacks, OEM specialty tools

Major Work Activity G

Diagnoses and repairs structural components and operator stations

Task G-18 Diagnoses structural components

Task Descriptor

The structural components on agricultural equipment enclose and/or support the operator and the equipment. For safety purposes and operator comfort, agricultural equipment technicians perform sensory inspections to verify integrity of the structural components.

G-18.01 Diagnoses frame components

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
G-18.01.01P	identify ***symptoms of problem***	***symptoms of problem*** are identified by consulting with customer or operator
G-18.01.02P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
G-18.01.03P	perform visual inspection on ***structural components*** to identify ***faults***	visual inspection is performed on ***structural components*** to identify ***faults***
G-18.01.04P	consult technical drawings or factory assistance to verify dimensions	technical drawings or factory assistance are consulted to verify dimensions according to manufacturers' specifications
G-18.01.05P	interpret results to determine ***required actions***	results are interpreted to determine ***required actions***

Range of Variables

symptoms of problem include: operational issues, steering/shifting improperly, damage
tools and equipment include: tape measures, levels, squares
structural components include: glass, frame, cab mounts, doors
faults include: cracks, fatigue, damage
required actions include: repairs, component replacement, further diagnosis

	Knowledge	
	Learning Outcomes	**Learning Objectives**
G-18.01.01L	demonstrate knowledge of ***frame components***, their characteristics, applications and operation	identify types of ***frame components*** and describe their characteristics, applications and operation
		describe allowable tolerances
		identify types and properties of metals
G-18.01.02L	demonstrate knowledge of ***structural components***, their characteristics, applications and operation	identify types of ***structural components*** and describe their characteristics, applications and operation
G-18.01.03L	demonstrate knowledge of diagnosing ***frame components***	identify ***tools and equipment*** used to diagnose ***frame components*** and describe their applications and procedures for use
		describe procedures to diagnose ***frame components***
		identify hazards and describe safe work practices while diagnosing ***frame components***
		identify inspections performed to diagnose ***frame components***
		identify possible ***faults*** found while performing inspections

Range of Variables

frame components include: pivot points, frame rails, gussets, flanges, connecting members
structural components include: glass, frame, cab mounts, doors
tools and equipment include: tape measures, levels, squares
faults include: cracks, fatigue, damage

G-18.02 Verifies condition of operator protective structures

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
G-18.02.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
G-18.02.02P	consult technical drawings or factory assistance to verify dimensions	technical drawings or factory assistance are consulted to verify dimensions according to manufacturers' specifications

G-18.02.03P	perform sensory inspection to identify ***faults***	sensory inspection is performed to identify ***faults***
G-18.02.04P	interpret results to determine ***required actions***	results are interpreted to determine ***required actions***

Range of Variables

tools and equipment include: levels, tape measures, squares

faults include: cracks, fatigue, loose components, damaged operator protective structures (roll-over protective structure [ROPS] and falling-object protective structure [FOPS])

required actions include: component replacement, further diagnosis

	Knowledge	
	Learning Outcomes	**Learning Objectives**
G-18.02.01L	demonstrate knowledge of ***operator protective structures***, their characteristics, applications and operation	identify ***operator protective structures*** and describe their characteristics, applications and operation
G-18.02.02L	demonstrate knowledge of verifying condition of ***operator protective structures***	identify ***tools and equipment*** used to verify condition of ***operator protective structures*** and describe their applications and procedures for use
		describe procedures to verify condition of ***operator protective structures***
		identify hazards and describe safe work practices while verifying condition of ***operator protective structures***
		identify inspections performed to verify condition of ***operator protective structures***
		identify possible ***faults*** found while performing inspections

Range of Variables

operator protective structures include: ROPS, FOPS

tools and equipment include: levels, tape measures, squares

faults include: cracks, fatigue, loose components, damaged operator protective structures (roll-over protective structure [ROPS] and falling-object protective structure [FOPS])

G-18.03 Diagnoses equipment body

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
G-18.03.01P	perform sensory inspections to identify ***faults***	sensory inspections are performed to identify ***faults***
G-18.03.02P	operate equipment to reproduce symptoms	equipment is operated to reproduce symptoms
G-18.03.03P	interpret results to determine ***required actions***	results are interpreted to determine ***required actions***

Range of Variables

faults include: cracks, fatigue, loose or missing fasteners, air leaks, water leaks, cab noises
required actions include: repairs, component replacement, further diagnosis

	Knowledge	
	Learning Outcomes	**Learning Objectives**
G-18.03.01L	demonstrate knowledge of equipment body ***components***, their characteristics, applications and operation	identify equipment body ***components***, and describe their characteristics, applications and operation
G-18.03.02L	demonstrate knowledge of diagnosing equipment body ***components***	describe procedures to diagnose equipment body ***components***
		identify hazards and describe safe work practices while diagnosing equipment body ***components***
		identify inspections performed to diagnose equipment body ***components***
		identify possible ***faults*** found while performing inspections

Range of Variables

components include: hoods, screens, shields, glass, tin work, roof
faults include: cracks, fatigue, loose or missing fasteners, air leaks, water leaks, cab noises

Task G-19 Repairs structural components

Task Descriptor

Structural components require repair or replacement when they are damaged. Frame components must be at the manufacturers' specifications to operate properly. Body equipment is restored for functional and aesthetic purposes. Operator protective structures are not altered or repaired. Therefore, any failure results in a replacement.

G-19.01 Repairs frame components

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
G-19.01.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application and manufacturers' procedures
G-19.01.02P	remove and disassemble ***frame components***	***frame components*** are removed and disassembled according to manufacturers' specifications
G-19.01.03P	prepare ***frame components*** for repair using ***processes***	***frame components*** are prepared for repair using ***processes***
G-19.01.04P	weld and cut ***frame components***	***frame components*** are welded and cut
G-19.01.05P	fasten ***frame components*** using ***methods***	***frame components*** are fastened using ***methods***
G-19.01.06P	assemble and install ***frame components***	***frame components*** are assembled and installed according to manufacturers' specifications
G-19.01.07P	***prepare surface*** for painting	surface is prepared for painting
G-19.01.08P	paint ***frame components***	***frame components*** are painted according to manufacturers' recommendation

Range of Variables

tools and equipment include: torches, welders, hand tools
frame components include: pivot points, frame rails, gussets, flanges, connecting members
processes include: gouging, grinding, cutting
methods include: bolting, plating
prepare surface include: cleaning, grinding, sanding, priming

	Knowledge	
	Learning Outcomes	**Learning Objectives**
G-19.01.01L	demonstrate knowledge of ***frame components***, their characteristics, applications and operation	identify types of ***frame components*** and describe their characteristics, applications and operation
		describe allowable tolerances
		identify types and properties of metals
		identify reinforcement methods
G-19.01.02L	demonstrate knowledge of repairing ***frame components***	identify ***tools and equipment*** used to repair ***frame components***, and describe their applications and procedures for use
		describe procedures to remove and disassemble ***frame components***
		describe procedures to repair, assemble and install ***frame components***
		describe procedures to weld and cut ***frame components***
		describe procedures to prepare ***frame component*** surfaces for painting
		describe procedures to paint ***frame components***
		identify hazards and safe work practices while performing repairs

Range of Variables

frame components include: pivot points, frame rails, gussets, flanges, connecting members
tools and equipment include: torches, welders, hand tools

G-19.02 Replaces operator protective structures

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

Skills

	Performance Criteria	Evidence of Attainment
G-19.02.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application and manufacturers' procedures
G-19.02.02P	remove ***components*** to access ***operator protective structure***	***components*** are removed to access ***operator protective structure*** according to manufacturers' specifications
G-19.02.03P	install ***operator protective structures***	***operator protective structures*** are installed according to manufacturers' specifications

Range of Variables

tools and equipment include: hoisting equipment, hand tools
components include: cab roof, doors, glass, electronics
operator protective structures include: ROPS, FOPS

Knowledge

	Learning Outcomes	Learning Objectives
G-19.02.01L	demonstrate knowledge of ***operator protective structures***, their characteristics, applications and operation	identify ***operator protective structures*** and describe their characteristics, applications and operation
G-19.02.02L	demonstrate knowledge of replacing ***operator protective structures***	identify ***tools and equipment*** used to replace ***operator protective structures*** and describe their applications and procedures for use
		describe procedures to replace ***operator protective structures***
		identify hazards and safe work practices while replacing ***operator protective structures***

Range of Variables

operator protective structures include: ROPS, FOPS
tools and equipment include: hoisting equipment, hand tools

G-19.03 Repairs equipment body

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
G-19.03.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application and manufacturers' procedures
G-19.03.02P	remove and disassemble equipment body components	equipment body components are removed and disassembled according to manufacturers' specifications
G-19.03.03P	replace or recondition worn and damaged ***components***	worn and damaged ***components*** are replaced or reconditioned according to manufacturers' specifications
G-19.03.04P	weld and cut body components	body components are welded and cut according to manufacturers' specifications
G-19.03.05P	***prepare surface*** for painting	surface is prepared for painting according to company policies, procedures and limitations
G-19.03.06P	paint body components	body components are painted according to manufacturers' recommendation and company policies, procedures and limitations
G-19.03.07P	remove body components and prepare for transfer to relevant trade for painting	body components are removed and prepared for transfer to relevant trade for painting according to company policies and procedures

Range of Variables

tools and equipment include: hand tools, hoisting equipment, finishing tools
components include: panels, hoods, roofs, fenders, hinges, brackets, glass, electronics
prepare surface includes: cleaning, grinding, sanding, priming

	Knowledge	
	Learning Outcomes	**Learning Objectives**
G-19.03.01L	demonstrate knowledge of equipment body ***components***, their characteristics, applications and operation	identify equipment body ***components***, and describe their characteristics, applications and operation
		identify ***reinforcement methods***
		identify ***properties of materials***

G-19.03.02L	demonstrate knowledge of repairing equipment body ***components***	identify ***tools and equipment*** used to repair equipment body ***components***, and describe their applications and procedures for use
		describe procedures to remove and disassemble equipment body components
		describe procedures to repair, replace and recondition equipment body ***components***
		describe procedures to weld and cut equipment body components
		describe procedures to prepare equipment body component surfaces for painting
		describe procedures to paint equipment body components
		identify ***bonding agents*** used for repairs
		identify hazards and safe work practices while performing repairs

Range of Variables

components include: panels, hoods, roofs, fenders, hinges, brackets, glass, electronics
reinforcement methods include : bracing, fibreglass repair, gussets, fish plates, plastic welding
properties of materials include: metal, fibreglass, plastics
tools and equipment include: hand tools, hoisting equipment, finishing tools
bonding agents include: silicone, weather stripping glue, foam adhesive

Task G-20 Diagnoses climate control systems

Task Descriptor

Climate control systems maintain interior cab temperature to optimize comfort as requested by the operator. Diagnostic analyses are performed by agricultural equipment technicians to identify the cause of the malfunction in the climate control system.

G-20.01 Diagnoses heating and ventilation systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
G-20.01.01P	identify ***symptoms of problem***	***symptoms of problem*** are identified by consulting with customer or operator
G-20.01.02P	select and use ***diagnostic tools and equipment***	***diagnostic tools and equipment*** are selected and used according to application and manufacturers' procedures
G-20.01.03P	check ***components*** for ***faults***	***components*** are checked for ***faults***
G-20.01.04P	perform sensory inspections to identify ***faults***	sensory inspections are performed to identify ***faults***
G-20.01.05P	interpret results to determine ***required actions***	results are interpreted to determine ***required actions***

Range of Variables

symptoms of problem include: inconsistent heat and air flow, noisy, odours

diagnostic tools and equipment include: temperature gauges, multimeters

components include: dampers, thermostats, water pumps, heater core, cab filters, air ducting

faults include: improper heat levels, improper airflow, leaking heater cores, burnt resistors

faults (detected while conducting sensory inspections) include: odours, plugged heater cores, air leaks, noisy fans

required actions include: repair, component replacement, further diagnosis

	Knowledge	
	Learning Outcomes	**Learning Objectives**
G-20.01.01L	demonstrate knowledge of heating and ventilation systems, their ***components***, characteristics, applications and operation	identify heating and ventilation systems and their ***components***, and describe their characteristics, applications and operation
G-20.01.02L	demonstrate knowledge of diagnosing heating and ventilation systems and their ***components***	identify ***diagnostic tools and equipment*** used to diagnose heating and ventilation systems and their ***components***, and describe their applications and procedures for use
		describe procedures to diagnose heating and ventilation systems and their ***components***
		identify hazards and describe safe work practices while diagnosing heating and ventilation systems and their ***components***
		identify inspections performed to diagnose heating and ventilation systems and their ***components***
		identify possible ***faults*** found while performing inspections

Range of Variables

components include: dampers, thermostats, water pumps, heater core, cab filters, air ducting

diagnostic tools and equipment include: temperature gauges, multimeters

faults (detected while conducting sensory inspections) include: odours, plugged heater cores, air leaks, noisy fans

G-20.02 Diagnoses air conditioning systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
G-20.02.01P	identify ***symptoms of problem***	***symptoms of problem*** are identified by consulting with customer or operator
G-20.02.02P	select and use ***diagnostic tools and equipment***	***diagnostic tools and equipment*** are selected and used according to application and manufacturers' procedures
G-20.02.03P	check ***components*** for ***faults***	***components*** are checked for ***faults***

G-20.02.04P	perform sensory inspections to identify ***faults***	sensory inspections are performed to identify ***faults***
G-20.02.05P	operate system to test system pressures	system is operated according to manufacturers' specifications to test system pressures
G-20.02.06P	interpret results to determine ***required actions***	results are interpreted to determine ***required actions***

Range of Variables

symptoms of problem include: inconsistent cooling and airflow, noises, odours

diagnostic tools and equipment include: thermometers, pressure gauges, refrigerant identification tester, leak detection tools

components include: thermostat control, condensers, evaporators, compressors, receiver-dryers, thermal expansion valves, water valves, hoses, switches, temperature sensors, electronics

faults include: improper temperature levels, improper airflow, leaking cores, plugged cores, burnt resistors, ruptured hoses, failed compressors

faults (detected while conducting sensory inspections) include: abnormal noises, leaks, odours, noisy fans

required actions include: repair, component replacement, further diagnosis

	Knowledge	
	Learning Outcomes	**Learning Objectives**
G-20.02.01L	demonstrate knowledge of air conditioning systems, their ***components***, characteristics, applications and operation	identify air conditioning systems and their ***components***, and describe their characteristics, applications and operation
		identify ***types of refrigerants*** and describe their characteristics, applications and operation
		identify safety risks pertaining to refrigerants
G-20.02.02L	demonstrate knowledge of diagnosing air conditioning systems and their ***components***	identify ***diagnostic tools and equipment*** used to diagnose air conditioning systems and their ***components***, and describe their applications and procedures for use
		describe procedures to diagnose air conditioning systems and their ***components***
		identify hazards and describe safe work practices while diagnosing air conditioning systems and their ***components***
		identify inspections performed to diagnose air conditioning systems and their ***components***
		identify possible ***faults*** found while performing inspections

G-20.02.03L	demonstrate knowledge of training and certification requirements pertaining to air conditioning systems and refrigerants	describe training and certification requirements pertaining to air conditioning systems and refrigerants
G-20.02.04L	demonstrate knowledge of regulatory requirements pertaining to air conditioning systems and refrigerants	identify and interpret regulations pertaining to air conditioning systems and refrigerants

Range of Variables

components include: thermostat control, condensers, evaporators, compressors, receiver-dryers, thermal expansion valves, water valves, hoses, switches, temperature sensors, electronics

types of refrigerants include: R-12/R134a/R1234yf, refrigerant blends

diagnostic tools and equipment include: thermometers, pressure gauges, refrigerant identification tester, leak detection tools

faults (detected while conducting sensory inspections) include: abnormal noises, leaks, odours, noisy fans

Task G-21 Repairs climate control systems

Task Descriptor

Agricultural equipment technicians repair climate control systems by adjusting, repairing or replacing components.

G-21.01 Repairs heating and ventilation systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
G-21.01.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
G-21.01.02P	remove ***components*** to access repair area	***components*** are removed to access repair area
G-21.01.03P	remove and disassemble heating and ventilation ***components***	heating and ventilation ***components*** are removed and disassembled according to manufacturers' specifications
G-21.01.04P	perform ***repairs*** on ***components***	***repairs*** are performed on ***components***
G-21.01.05P	assemble and install ***components***	***components*** are assembled and installed according to manufacturers' specifications

Range of Variables

tools and equipment include: vacuum cleaners, compressed air
components (removed for access) include: cab roof, seats, floor mats
components include: fans, resistors, motors, valves, heater cores, electronics
repairs include: cleaning, replacing, calibrating, reprogramming

	Knowledge	
	Learning Outcomes	**Learning Objectives**
G-21.01.01L	demonstrate knowledge of heating and ventilation systems, their ***components***, characteristics, applications and operation	identify heating and ventilation systems and their ***components***, and describe their characteristics, applications and operation
G-21.01.02L	demonstrate knowledge of repairing heating and ventilation systems and their ***components***	identify ***tools and equipment*** used to repair heating and ventilation systems and their ***components***, and describe their applications and procedures for use
		describe procedures to remove and disassemble heating and ventilation system ***components***
		describe procedures to repair, replace, clean, calibrate, reprogram, assemble and install heating and ventilation system ***components***
		identify hazards and safe work practices while performing repairs

Range of Variables

components include: fans, resistors, motors, valves, heater cores, electronics
tools and equipment include: vacuum cleaners, compressed air

G-21.02 Repairs air conditioning systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
G-21.02.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application and manufacturers' procedures
G-21.02.02P	identify and recover refrigerant	refrigerant is identified and recovered according to jurisdictional regulations
G-21.02.03P	remove ***components*** to access repair area	***components*** are removed to access repair area

G-21.02.04P	perform ***repairs*** on air conditioning ***components***	***repairs*** are performed on air conditioning ***components***
G-21.02.05P	assemble and install ***components***	***components*** are assembled and installed according to manufacturers' specifications
G-21.02.06P	recharge system with refrigerant	system is recharged with refrigerant according to manufacturers' specifications

Range of Variables

tools and equipment include: pressure gauges, recovery devices, vacuum pumps, hand tools, refrigerant identifier

components (removed for access) include: panels, cab roof, seats, floor mats, electronics

repairs include: cleaning, replacing, calibrating, reprogramming

components include: thermostats, condensers, evaporators, compressors, receiver-dryers, thermal expansion valves, hoses, switches, temperature sensors, electronics

	Knowledge	
	Learning Outcomes	**Learning Objectives**
G-21.02.01L	demonstrate knowledge of air conditioning systems, their ***components***, characteristics, applications and operation	identify air conditioning systems and their ***components***, and describe their characteristics, applications and operation
		identify ***types of refrigerants*** and describe their characteristics, applications and operation
		identify safety risks pertaining to refrigerants
G-21.02.02L	demonstrate knowledge of repairing air conditioning systems and their ***components***	identify ***tools and equipment*** used to repair air conditioning systems and their ***components***, and describe their applications and procedures for use
		describe procedures to remove and disassemble air conditioning system ***components***
		describe procedures to repair, replace, reprogram, calibrate, assemble and install air conditioning system ***components***
		describe procedures to recover and recharge air conditioning system with refrigerant
		identify hazards and safe work practices while performing repairs
G-21.02.03L	demonstrate knowledge of training and certification requirements pertaining to air conditioning systems and refrigerants	describe training and certification requirements pertaining to air conditioning systems and refrigerants
G-21.02.04L	demonstrate knowledge of regulatory requirements pertaining to air conditioning systems and refrigerants	identify and interpret regulations pertaining to air conditioning systems and refrigerants

Range of Variables

components include: thermostats, condensers, evaporators, compressors, receiver-dryers, thermal expansion valves, hoses, switches, temperature sensors, electronics

types of refrigerants include: R-12/R134a/R1234yf, refrigerant blends

tools and equipment include: pressure gauges, recovery devices, vacuum pumps, hand tools, refrigerant identifier

Major Work Activity H

Diagnoses and repairs agricultural equipment

Task H-22 Prepares agricultural equipment

Task Descriptor

Agricultural equipment technicians assemble and install agricultural and precision farming equipment according to manufacturers' specifications. They adjust the equipment to fit the use and operating need of the customer.

H-22.01 Performs assembly and pre-delivery adjustments on agricultural equipment

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
H-22.01.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application and manufacturers' procedures
H-22.01.02P	assemble individual ***components*** or ***implements***	individual ***components*** or ***implements*** are assembled to create finished piece of equipment according to manufacturers' specifications
H-22.01.03P	verify assembly completion	assembly completion is verified by checking operation, parts list and requested options
H-22.01.04P	ballast equipment	equipment is ballasted to ensure optimal power transfer
H-22.01.05P	verify equipment ***performance***	equipment ***performance*** is verified
H-22.01.06P	verify that items on pre-delivery inspection (PDI) checklist have been completed	items on PDI checklist have been completed according to manufacturers' specifications

Range of Variables

tools and equipment include: lifting equipment, power tools, hand tools

components include: loaders, three-point hitches, air packages, hydraulic accessories, power take-off (PTO) drivelines

implements include: balers, headers, seeding and tillage equipment, rakes

performance includes: horsepower, torque, hydraulics pressure and flow, RPM

	Knowledge	
	Learning Outcomes	**Learning Objectives**
H-22.01.01L	demonstrate knowledge of ***agricultural equipment***, their ***components***, ***implements***, characteristics, applications and operation	identify types of ***agricultural equipment*** and their ***components*** and ***implements***, and describe their characteristics, applications and operation
		identify ***classes of drive lines***
		identify hydraulic and electric connections and adapters
		identify hydraulic flow and pressure specifications
H-22.01.02L	demonstrate knowledge of assembling and adjusting ***agricultural equipment components*** and ***implements***	identify ***tools and equipment*** used to assemble and adjust ***agricultural equipment components*** and ***implements***, and describe their applications and procedures for use
		describe procedures to assemble, adjust and disassemble ***agricultural equipment components*** and ***implements***
		identify hazards and describe safe work practices while assembling and adjusting ***agricultural equipment components*** and ***implements***
		describe procedures to ballast ***agricultural equipment***
		identify procedures to perform PDIs on equipment
		identify procedures to carry out ***performance*** testing of equipment
		identify adjustments for clearances, speed and conditions according to types of crops
		describe wheel and drive train torque procedures

Range of Variables

agricultural equipment include: combines, tractors, swather units, sprayers (towed, high-clearance), forage harvesters, seeding equipment

components include: loaders, three-point hitches, air packages, hydraulic accessories, power take-off (PTO) drivelines

implements include: balers, headers, seeding and tillage equipment, rakes

classes of drive lines include: 540, 1000 RPM

tools and equipment include: lifting equipment, power tools, hand tools

performance includes: horsepower, torque, hydraulics pressure and flow, RPM

H-22.02 Performs preparation and installation of agricultural equipment

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
H-22.02.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application and manufacturers' procedures
H-22.02.02P	clean ***agricultural equipment***	***agricultural equipment*** is cleaned using ***products and methods***
H-22.02.03P	***prepare agricultural equipment***	***agricultural equipment*** is prepared according to manufacturers' specifications prior to repair or installation
H-22.02.04P	prepare surfaces for proper fit	surfaces are prepared for proper fit using ***methods*** to remove rust and paint
H-22.02.05P	verify ***implements*** and ***components*** are operational	***implements*** and ***components*** are operational
H-22.02.06P	locate power sources on equipment	power sources are located on equipment to activate control unit
H-22.02.07P	assemble ***implements, components*** and ***accessories***	***implements, components*** and ***accessories*** are assembled according to manufacturers' procedures
H-22.02.08P	attach and detach ***implements, components*** and ***accessories*** to and from equipment	***implements, components*** and ***accessories*** are attached and detached to and from equipment according to manufacturers' procedures
H-22.02.09P	verify equipment ***performance***	equipment ***performance*** is verified

Range of Variables

tools and equipment include: hand tools, power tools, measuring tools

agricultural equipment includes: combines, tractors, swather units, sprayers (towed, high-clearance), forage harvesters, seeding equipment

products and methods include: using disinfectants and sanitizers, using pressure washer, using backpack blower

prepare agricultural equipment includes: release hydraulic pressure and spring tension, support weight, verify zero energy state

methods include: cleaning, grinding, buffing, using chemicals

implements include: balers, headers, mowers, seeding tools, tillage tools

components include: loaders, three-point hitches, air packages

accessories include: monitor, electronic devices, optional packages, crop dividers

performance includes: horsepower, torque, hydraulics pressure and flow, RPM (sickle-speed, drum speed, fan speed, shaft speed)

	Knowledge	
	Learning Outcomes	**Learning Objectives**
H-22.02.01L	demonstrate knowledge of ***agricultural equipment***, their ***components***, ***implements***, ***accessories***, characteristics, applications and operation	identify types of ***agricultural equipment*** and their ***components, implements*** and ***accessories***, and describe their characteristics, applications and operation
		identify ***classes of drive lines***
		identify hydraulic and electric connections and adapters
		identify hydraulic flow and pressure specifications
H-22.02.02L	demonstrate knowledge of preparing and installing ***agricultural equipment components***, ***implements*** and ***accessories***	identify ***tools and equipment*** used to prepare and install ***agricultural equipment components***, ***implements*** and ***accessories***, and describe their applications and procedures for use
		describe procedures to prepare and install ***agricultural equipment components***, ***implements*** and ***accessories***
		describe procedures to clean and disinfect ***agricultural equipment***
		describe procedures to attach and detach ***agricultural equipment components***, ***implements*** and ***accessories***
		identify hazards and describe safe work practices while assembling, attaching and detaching ***agricultural equipment components***, ***implements*** and ***accessories***
		describe procedures to prepare surfaces for installation
		identify procedures to carry out ***performance*** testing of equipment

	identify adjustments for clearances, speed and conditions according to types of crops
	describe wheel and drive train torque procedures

Range of Variables

agricultural equipment includes: combines, tractors, swather units, sprayers (towed, high-clearance), forage harvesters, seeding equipment

components include: loaders, three-point hitches, air packages

implements include: balers, headers, mowers, seeding tools, tillage tools

accessories include: monitor, electronic devices, optional packages, crop dividers

classes of drive lines include: 540, 1000 RPM

tools and equipment include: hand tools, power tools, measuring tools

performance includes: horsepower, torque, hydraulics pressure and flow, RPM (sickle-speed, drum speed, fan speed, shaft speed)

H-22.03 Installs precision farming equipment

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
H-22.03.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application and manufacturers' procedures
H-22.03.02P	prepare surfaces for proper fit	surfaces are prepared for proper fit
H-22.03.03P	locate power sources on equipment and determine harness route	power sources are located on equipment and harness route is determined
H-22.03.04P	install ***components and accessories***	***components and accessories*** are installed according to manufacturers' specifications
H-22.03.05P	program, configure and calibrate ***components and accessories***	***components and accessories*** are programmed, configured and calibrated according to manufacturers' specifications
H-22.03.06P	verify ***components and accessories*** are ***operational***	***components and accessories*** are ***operational***

Range of Variables

tools and equipment include: hand tools, power tools, measuring tools

components and accessories include: receivers, displays, sensors, control units, antenna, wiring harnesses

operational includes: communicating online, operator inputs are functioning, GNSS functioning (Global Positioning System [GPS], GLONASS [Russian satellite system], Galileo)

	Knowledge	
	Learning Outcomes	**Learning Objectives**
H-22.03.01L	demonstrate knowledge of precision farming equipment, their ***components and accessories***, characteristics, applications and operation	identify precision farming equipment and their ***components and accessories***, and describe their characteristics, applications and operation
H-22.03.02L	demonstrate knowledge of precision farming and describe its characteristics, applications and ***advantages***	explain precision farming and describe its characteristics, applications and ***advantages***
		explain precision farming ***agronomic data***
		explain ***agronomic data*** confidentiality
H-22.03.03L	demonstrate knowledge of installing precision farming equipment ***components and accessories***	identify ***tools and equipment*** used to install precision farming equipment ***components and accessories***, and describe their applications and procedures for use
		describe procedures to install, program, configure and calibrate precision farming equipment ***components and accessories***
		identify hazards and describe safe work practices while installing precision farming equipment ***components and accessories***
		describe procedures to prepare surfaces for installation
H-22.03.04L	demonstrate knowledge of regulatory requirements pertaining to precision farming	identify and interpret ***regulations*** pertaining to precision farming

Range of Variables

components and accessories include: receivers, displays, sensors, control units, antenna, wiring harnesses

advantages include: increased productivity, efficiency, traceability and accountability

agronomic data includes: yield maps, weather maps, soil conductivity, soil testing, prescriptions

tools and equipment include: hand tools, power tools, measuring tools

regulations include: Personal Information Protection and Electronic Documents Act (PIPEDA)

Task H-23 Diagnoses precision farming equipment

Task Descriptor

Precision farming equipment is a system that allows the operator to guide and control equipment, map an area, vary rates, eliminate overlaps or misses, to maximize yields and efficiency. The equipment includes a GNSS, yield monitors, moisture meters, mobile weather station applications and guided steering. Agricultural equipment technicians diagnose precision farming equipment to identify failures and faults on site and remotely.

H-23.01 Diagnoses precision farming equipment on site

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
H-23.01.01P	identify ***symptoms of problem***	***symptoms of problem*** are identified by consulting with customer or operator
H-23.01.02P	operate equipment to reproduce symptoms	equipment is operated to reproduce symptoms
H-23.01.03P	perform sensory inspection of ***components and accessories*** for signs of ***faults***	***components and accessories*** are inspected for signs of ***faults***
H-23.01.04P	gather diagnostic information	diagnostic information is gathered by retrieving service codes
H-23.01.05P	perform ***diagnostics***	***diagnostics*** are performed
H-23.01.06P	interpret test results for CAN bus systems	test results for CAN bus systems are interpreted
H-23.01.07P	interpret schematics to locate ***components and accessories***	schematics are interpreted to locate ***components and accessories***
H-23.01.08P	remove ***components*** to access diagnostic area	***components*** are removed to access diagnostic area
H-23.01.09P	select and use ***tools and testing equipment***	***tools and testing equipment*** are selected and used according to identified ***symptoms***
H-23.01.10P	interpret ***diagnostic*** results to determine ***required actions***	***diagnostic*** results are interpreted to determine ***required actions*** according to manufacturers' specification or further diagnosis

Range of Variables

symptoms of problem include: product rate control issues, auto-guidance systems not working, inconsistent communication/data transfer

components and accessories include: batteries, fuses, relays, telematics communication devices, controllers, printed circuit boards, sensors, wiring, power modules, switches, grounds, terminators, receivers, displays, antennas

faults include: corrosion, burnt components, broken wire connections, damaged harnesses

diagnostics include: circuit tests, component tests, communication tests, data recordings, service code diagnostics, software compatibility, software updates, network configurations

components (removed for access) include: panels, seats, roof, shields

tools and testing equipment include: multimeters, electronic devices (laptops, smart phones, tablets), onboard diagnostic systems, OEM specialty tools, hand tools, power tools

symptoms include: service code, sensory observation

required actions include: repairing, downloading software, replacing components, reconfiguring components

	Knowledge	
	Learning Outcomes	**Learning Objectives**
H-23.01.01L	demonstrate knowledge of precision farming equipment, their ***components and accessories***, characteristics, applications and operation	identify precision farming equipment and their ***components and accessories***, and describe their characteristics, applications and operation
		describe pin connections and wiring harnesses
H-23.01.02L	demonstrate knowledge of diagnosing precision farming equipment ***components and accessories*** on site	identify ***tools and testing equipment*** used to diagnose precision farming equipment ***components and accessories*** on site, and describe their applications and procedures for use
		describe procedures to diagnose precision farming equipment ***components and accessories*** on site
		identify hazards and describe safe work practices while diagnosing precision farming equipment ***components and accessories*** on site
		identify inspections and ***diagnostics*** performed to diagnose precision farming equipment ***components and accessories*** on site
		identify possible ***faults*** found while performing inspections and ***diagnostics***
		interpret results of ***diagnostics***
		identify ***diagnostic resources***
		interpret schematics and flow charts

Range of Variables

components and accessories include: batteries, fuses, relays, telematics communication devices, controllers, printed circuit boards, sensors, wiring, power modules, switches, grounds, terminators, receivers, displays, antennas

tools and testing equipment include: multimeters, electronic devices (laptops, smart phones, tablets), onboard diagnostic systems, OEM specialty tools, hand tools, power tools

diagnostics include: circuit tests, component tests, communication tests, data recordings, service code diagnostics, software compatibility, software updates, network configurations

faults include: corrosion, burnt components, broken wire connections, damaged harnesses

diagnostic resources include: technical manual, manufacturer technical assistance

H-23.02 Diagnoses precision farming equipment remotely

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
H-23.02.01P	communicate remotely with customer or operator to identify ***symptoms of problem***	***symptoms of problem*** are identified by consulting remotely with customer or operator
H-23.02.02P	observe remotely equipment to reproduce symptoms	equipment is operated to reproduce symptoms
H-23.02.03P	gather diagnostic information	diagnostic information is gathered by retrieving service codes and observing ***issues*** remotely using ***electronic devices*** or onboard telecommunication systems
H-23.02.04P	advise customer or operator to perform sensory inspection of ***components and accessories*** for signs of ***faults***	customer or operator is advised to perform sensory inspection of ***components and accessories*** for signs of ***faults***
H-23.02.05P	perform ***diagnostics*** remotely while operator is running equipment	***diagnostics*** are performed remotely by retrieving codes and data point recordings while operator is running equipment
H-23.02.06P	direct operator to view CAN bus system	operator is directed to view CAN bus system to verify if system is online
H-23.02.07P	interpret schematics to locate ***components and accessories***	schematics are interpreted to locate ***components and accessories***
H-23.02.08P	interpret ***diagnostic*** results to determine ***required actions***	***diagnostic*** results are interpreted to determine ***required actions*** according to manufacturers' specification or further diagnosis

Range of Variables

symptoms of problem include: product rate control issues, auto-guidance systems not working, inconsistent communication/data transfer

issues include: settings, configuration, signal strengths, in-range faults, tolerance stack-up, operating parameters

electronic devices include: laptops, smart phones, tablets

components and accessories include: batteries, fuses, relays, telematics communication devices, controllers, printed circuit boards, sensors, wiring, power modules, switches, grounds, terminators, receivers, displays, antenna

faults include: corrosion, burnt components, broken wire connections, damaged harnesses

diagnostics include: communication tests, data recordings, service code diagnostics, software compatibility, software updates, network configurations

required actions include: repairing, downloading software, replacing components, reconfiguring components, ensuring equipment necessary for repairs is available or ordered

	Knowledge	
	Learning Outcomes	**Learning Objectives**
H-23.02.01L	demonstrate knowledge of precision farming equipment, their ***components and accessories***, characteristics, applications and operation	identify precision farming equipment and their ***components and accessories***, and describe their characteristics, applications and operation
		describe pin connections and wiring harnesses
H-23.02.02L	demonstrate knowledge of diagnosing precision farming equipment ***components and accessories*** remotely	identify ***electronic devices*** used to diagnose precision farming equipment ***components and accessories*** remotely, and describe their applications and procedures for use
		describe procedures to diagnose precision farming equipment ***components and accessories*** remotely
		identify hazards and describe safe work practices while diagnosing precision farming equipment ***components and accessories*** remotely
		identify inspections and ***diagnostics*** performed to diagnose precision farming equipment ***components and accessories*** remotely
		identify possible ***faults*** found while performing inspections and ***diagnostics*** remotely
		interpret results of ***diagnostics***
		identify ***diagnostic resources***
		interpret schematics and flow charts

Range of Variables

components and accessories include: batteries, fuses, relays, telematics communication devices, controllers, printed circuit boards, sensors, wiring, power modules, switches, grounds, terminators, receivers, displays, antenna

electronic devices include: laptops, smart phones, tablets

diagnostics include: communication tests, data recordings, service code diagnostics, software compatibility, software updates, network configurations

faults include: corrosion, burnt components, broken wire connections, damaged harnesses

diagnostic resources include: technical manual, manufacturer technical assistance

Task H-24 Repairs precision farming equipment

Task Descriptor

Precision farming equipment is a system that allows the operator to guide and control equipment, map an area, vary rates, eliminate overlaps or misses, to maximize yields and efficiency. The equipment includes a GNSS, yield monitors, moisture meters, mobile weather station applications and guided steering.

Agricultural equipment technicians repair and adjust precision farming equipment on site and remotely according to customer needs and preferences. The technician must perform repairs to optimize the performance of the equipment and to minimize operational costs and down time for the customer.

H-24.01 Repairs precision farming equipment on site

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
H-24.01.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application and manufacturers' procedures
H-24.01.02P	remove ***components and accessories***	***components and accessories*** are removed according to manufacturers' specifications
H-24.01.03P	replace failed electronic ***components and accessories***	failed electronic ***components and accessories*** are replaced according to manufacturers' specifications

H-24.01.04P	reprogram and recalibrate ***components and accessories***	***components and accessories*** are reprogrammed and recalibrated according to manufacturers' specifications
H-24.01.05P	reinstall ***components and accessories***	***components and accessories*** are reinstalled according to manufacturers' specifications

Range of Variables

tools and equipment include: multimeters, electronic devices (laptops, smart phones, tablets), onboard diagnostic systems, OEM specialty tools, hand tools, power tools

components and accessories (to be removed and reinstalled) include: roof, panels, shields, seats

components and accessories (to be replaced) include: batteries, fuses, relays, telematics communications, controllers, printed circuit boards, sensors, wiring, power modules, switches, grounds, terminators, receivers, displays, antennas

components and accessories (to be reprogrammed and recalibrated) include: controllers, power modules, displays, printed circuit boards, sensors, receivers, telematics communications

	Knowledge	
	Learning Outcomes	**Learning Objectives**
H-24.01.01L	demonstrate knowledge of precision farming equipment, their ***components and accessories***, characteristics, applications and operation	identify precision farming equipment and their ***components and accessories***, and describe their characteristics, applications and operation
		describe pin connections and wiring harnesses
H-24.01.02L	demonstrate knowledge of repairing precision farming equipment ***components and accessories*** on site	identify ***tools and equipment*** used to repair precision farming equipment ***components and accessories*** on site, and describe their applications and procedures for use
		describe procedures to remove and disable precision farming equipment ***components and accessories***
		describe procedures to repair, replace, adjust, reprogram and recalibrate precision farming equipment ***components and accessories***
		identify hazards and safe work practices while performing repairs

Range of Variables

tools and equipment include: multimeters, electronic devices (laptops, smart phones, tablets), onboard diagnostic systems, OEM specialty tools, hand tools, power tools

components and accessories include: batteries, fuses, relays, telematics communications, controllers, printed circuit boards, sensors, wiring, power modules, switches, grounds, terminators, receivers, displays, antennas

H-24.02 Repairs precision farming equipment remotely

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
H-24.02.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application and manufacturers' procedures
H-24.02.02P	direct customer to remove ***components and accessories***	customer is directed to remove ***components and accessories*** according to manufacturers' specifications
H-24.02.03P	direct customer to replace basic electronic ***components and accessories***	customer is directed to replace basic electronic ***components and accessories*** according to manufacturers' specifications
H-24.02.04P	reprogram and update ***components and accessories***	***components and accessories*** are reprogrammed and updated according to manufacturers' specifications
H-24.02.05P	direct customer to reinstall ***components and accessories***	customer is directed to reinstall ***components and accessories*** according to manufacturers' specifications
H-24.02.06P	direct customer to verify that ***components and accessories*** are functional	customer is directed to verify that ***components and accessories*** are functional

Range of Variables

tools and equipment include: electronic devices (laptops, smart phones, tablets), software and apps, onboard diagnostic systems

components and accessories (to be removed and reinstalled) include: roof, panels, shields, seats, displays, antennas

components and accessories (to be replaced) include: batteries, fuses, relays, grounds, terminators, receivers, antennas, displays, sensors

components and accessories (to be reprogrammed and updated) include: controllers, power modules, displays, receivers, telematics communications

	Knowledge	
	Learning Outcomes	**Learning Objectives**
H-24.02.01L	demonstrate knowledge of precision farming equipment, their ***components and accessories***, characteristics, applications and operation	identify precision farming equipment and their ***components and accessories***, and describe their characteristics, applications and operation
		describe pin connections and wiring harnesses

H-24.02.02L	demonstrate knowledge of repairing precision farming equipment ***components and accessories*** remotely	identify ***tools and equipment*** used to repair precision farming equipment ***components and accessories*** remotely, and describe their applications and procedures for use
		describe procedures to remove and disable precision farming equipment ***components and accessories***
		describe procedures to repair, replace, adjust, reprogram and recalibrate precision farming equipment ***components and accessories***
		identify hazards and safe work practices while performing repairs
		describe communication skills required to direct customers remotely

Range of Variables

tools and equipment include: electronic devices (laptops, smart phones, tablets), software and apps, onboard diagnostic systems

components and accessories include: batteries, fuses, relays, grounds, terminators, receivers, antennas, displays, sensors, controllers, power modules, telematics communications

Task H-25 Diagnoses land preparation, tillage and seeding/planting equipment

Task Descriptor

Farming practices, soil conditions and crop selection affect land preparation and tillage implements and seeding/planting requirements. Agricultural equipment technicians must understand these conditions, as well as the implement characteristics, to be able to diagnose failures. Visual acuity is important for both alignment and levelling of the equipment. Technicians must be up to date on the latest developments of seeding and tillage practices.

H-25.01 Diagnoses land preparation and tillage equipment

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
H-25.01.01P	identify ***symptoms of problem***	***symptoms of problem*** are identified by consulting with customer or operator
H-25.01.02P	interpret schematics to isolate cause of failure	schematics are interpreted to isolate cause of failure
H-25.01.03P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application and manufacturers' procedures
H-25.01.04P	perform visual inspection on ***components*** to identify ***faults***	visual inspection is performed on ***components*** to identify ***faults***
H-25.01.05P	inspect common wear points to determine ***components*** to be replaced	common wear points are inspected to determine ***components*** to be replaced
H-25.01.06P	verify tire pressure	tire pressure is verified
H-25.01.07P	check draft by measuring equipment offset	draft is checked by measuring equipment offset according to manufacturers' specifications
H-25.01.08P	interpret results to determine ***required actions***	results are interpreted to determine ***required actions***

Range of Variables

symptoms of problem include: depth control issues, tracking issues, field finish incorrect

tools and equipment include: hand tools, diagnostic tools and equipment

components include: actuators, frames, linkages, ground engaging tools or points, sensors, wiring harnesses

faults include: leaks, missing or damaged components, manufacturer defects

required actions include: repair; component replacement, calibration and adjustment; further diagnosis

	Knowledge	
	Learning Outcomes	**Learning Objectives**
H-25.01.01L	demonstrate knowledge of ***land preparation and tillage equipment***, their ***components***, characteristics, applications and operation	identify types of ***land preparation and tillage equipment*** and their ***components***, and describe their characteristics, applications and operation
		explain ***land preparation and tillage equipment*** drafting
		identify ***types of depth control systems*** and describe their characteristics, applications and operation
		describe horsepower requirements
H-25.01.02L	demonstrate knowledge of diagnosing ***land preparation and tillage equipment*** and their ***components***	identify ***tools and equipment*** used to diagnose ***land preparation and tillage equipment*** and their ***components***, and describe their applications and procedures for use
		describe procedures to diagnose ***land preparation and tillage equipment*** and their ***components***
		identify hazards and describe safe work practices while diagnosing ***land preparation and tillage equipment*** and their ***components***
		identify inspections performed to diagnose ***land preparation and tillage equipment*** and their ***components***
		identify possible ***faults*** found while performing inspections

Range of Variables

land preparation and tillage equipment include: cultivators, sub-soilers, discs

components include: actuators, frames, linkages, ground engaging tools or points, sensors, wiring harnesses

types of depth control systems include: hydraulic, electrical, mechanical

tools and equipment include: hand tools, diagnostic tools and equipment

faults include: leaks, missing or damaged components, manufacturer defects

H-25.02 Diagnoses seeding and planting equipment

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
H-25.02.01P	identify ***symptoms of problem***	***symptoms of problem*** are identified by consulting with customer or operator
H-25.02.02P	interpret schematics and technical drawings to isolate cause of failure	schematics and technical drawings are interpreted to isolate cause of failure
H-25.02.03P	perform sensory inspection on ***components*** to identify ***faults***	sensory inspection is performed on ***components*** to identify ***faults***
H-25.02.04P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
H-25.02.05P	check for faulty wiring harnesses, connectors and ***sensors***	wiring harnesses, connectors and ***sensors*** are checked
H-25.02.06P	verify monitor settings	monitor settings are verified to confirm seeding and planting operation
H-25.02.07P	verify hydraulic function	hydraulic function is verified to confirm seeding and planting operation
H-25.02.08P	measure seed depth and uniformity	seed depth and uniformity is measured by performing seed bed inspection
H-25.02.09P	inspect common wear points	common wear points are inspected to determine ***components*** to be replaced
H-25.02.10P	test ***pressures***	***pressures*** are tested
H-25.02.11P	check seeding and planting equipment for level to verify operation	seeding and planting equipment are checked for level to verify operation
H-25.02.12P	calibrate seeding implement	seeding implement is calibrated to determine application rate by weighing and calculating density of product
H-25.02.13P	compare calculated seed rate to actual seed rate	calculated seed rate is compared to actual seed rate
H-25.02.14P	interpret results to determine ***required actions***	results are interpreted to determine ***required actions***

Range of Variables

symptoms of problem include: seed and fertilizer placement (depth and spacing) issues
components include: hoses, clutches, metering devices, ground engaging tools or points
faults include: leaks, missing or damaged components, manufacturer defects
tools and equipment include: hand tools, diagnostic tools, gauges, multimeters
sensors are: analog and digital (e.g., air velocity, speed, bin level)
pressures include: tire, hydraulic, vacuum, airflow
required actions include: repair; component replacement, calibration and adjustment; further diagnosis

	Knowledge	
	Learning Outcomes	**Learning Objectives**
H-25.02.01L	demonstrate knowledge of ***seeding and planting equipment***, their ***components***, characteristics, applications and operation	identify ***seeding and planting equipment*** and their ***components***, and describe their characteristics, applications and operation
		describe pin connections and wiring harnesses
		describe depth and seed metering control units
		identify ***types of packers*** and describe their characteristics, applications and operation
		describe opener spacing requirements
		identify hydraulic system requirements
		identify horsepower requirements
		identify types of crops
		identify hazards associated with treated seeds, chemicals and fertilizers
H-25.02.02L	demonstrate knowledge of diagnosing ***seeding and planting equipment*** and their ***components***	identify ***tools and equipment*** used to diagnose ***seeding and planting equipment*** and their ***components***, and describe their applications and procedures for use
		describe procedures to diagnose ***seeding and planting equipment*** and their ***components***
		identify hazards and describe safe work practices while diagnosing ***seeding and planting equipment*** and their ***components***
		identify inspections performed to diagnose ***seeding and planting equipment*** and their ***components***
		identify possible ***faults*** found while performing inspections

Range of Variables

seeding and planting equipment include: volumetric metering, singulation metering, drills, row crop planters, air drills, planters, broadcast spreaders

components include: hoses, clutches, metering devices, ground engaging tools or points

types of packers include: rubber, steel

tools and equipment include: hand tools, diagnostic tools, gauges, multimeters

faults include: leaks, missing or damaged components, manufacturer defects

Task H-26 Repairs land preparation, tillage and seeding/planting equipment

Task Descriptor

Agricultural equipment technicians repair and adjust tillage and seeding/planting equipment to minimize operational cost and optimize performance of the equipment, depending on soil conditions and crop type, and according to customer needs and preferences.

H-26.01 Repairs land preparation and tillage equipment

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
H-26.01.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application and manufacturers' procedures
H-26.01.02P	remove and lock out ***components*** to access repair area	***components*** are removed and locked out to access repair area
H-26.01.03P	adjust level and tire pressures	level and tire pressures are adjusted according to manufacturers' specifications
H-26.01.04P	perform basic welding repairs	basic welding repairs are performed to restore to manufacturers' specifications
H-26.01.05P	replace ***components***	***components*** are replaced
H-26.01.06P	adjust level stops mechanically and hydraulically	level stops are adjusted mechanically and hydraulically
H-26.01.07P	reinstall ***components***	***components*** are reinstalled according to manufacturers' specifications

Range of Variables

tools and equipment include: hand tools, power tools
components (to be removed, locked out and reinstalled) include: actuators, linkages, shields
components include: bearings, shafts, ground engaging tools or points, sensors, wiring harnesses

	Knowledge	
	Learning Outcomes	**Learning Objectives**
H-26.01.01L	demonstrate knowledge of ***land preparation and tillage equipment***, their ***components***, characteristics, applications and operation	identify types of ***land preparation and tillage equipment*** and their ***components***, and describe their characteristics, applications and operation
		explain ***land preparation and tillage equipment*** drafting
		identify ***types of packers*** and describe their characteristics, applications and operation
H-26.01.02L	demonstrate knowledge of repairing ***land preparation and tillage equipment*** and their ***components***	identify ***tools and equipment*** used to repair ***land preparation and tillage equipment*** and their ***components***, and describe their applications and procedures for use
		describe procedures to remove and lock out ***land preparation and tillage equipment components***
		describe procedures to repair, replace and adjust ***land preparation and tillage equipment components***
		describe basic welding procedures to repair ***land preparation and tillage equipment components***
		identify ***types of depth control systems*** and describe their characteristics, applications and operation
		identify hazards and safe work practices while performing repairs

Range of Variables

land preparation and tillage equipment include: cultivators, high-speed discs, breaking discs, sub-soilers
components include: bearings, shafts, ground engaging tools or points, sensors, wiring harnesses
types of packers include: rubber, steel
tools and equipment include: hand tools, power tools
components (to be removed, locked out and reinstalled) include: actuators, linkages, shields
types of depth control systems include: hydraulic, electrical, mechanical

H-26.02 Repairs seeding and planting equipment

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

Skills

	Performance Criteria	Evidence of Attainment
H-26.02.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application and manufacturers' procedures
H-26.02.02P	remove ***components*** to access repair area	***components*** are removed to access repair area
H-26.02.03P	adjust level and tire pressures	level and tire pressures are adjusted according to manufacturers' specifications
H-26.02.04P	rebuild ***metering parts***	***metering parts*** are rebuilt
H-26.02.05P	replace ***metering components***	***metering components*** are replaced
H-26.02.06P	replace ***seed bed preparation and finishing wear items***	***seed bed preparation and finishing wear items*** are replaced
H-26.02.07P	replace seed distribution hoses and tubes	seed distribution hoses and tubes are replaced according to manufacturers' specifications
H-26.02.08P	set and calibrate ***sensors***	***sensors*** are set and calibrated according to manufacturers' specifications
H-26.02.09P	adjust air plenums and dampers	air plenums and dampers are adjusted according to manufacturers' specifications

Range of Variables

tools and equipment include: hand tools, power tools
components (removed for access) include: covers, shields
metering parts include: metering wheels, metering rolls, augers, planter discs, variable rate drives
metering components include: bearings, brushes, bushings, scrapers
seed bed preparation and finishing wear items include: packers, ground engaging tools or points
sensors include: velocity, speed, rate, pressure, force

Knowledge

	Learning Outcomes	Learning Objectives
H-26.02.01L	demonstrate knowledge of ***seeding and planting equipment***, their components, characteristics, applications and operation	identify ***seeding and planting equipment*** and their components, and describe their characteristics, applications and operation
		explain ***seeding and planting equipment*** drafting

		identify types of ***metering parts*** and ***metering components***, and describe their characteristics, applications and operation
		identify ***types of packers*** and describe their characteristics, applications and operation
		describe land preparation for various crops
H-26.02.02L	demonstrate knowledge of repairing ***seeding and planting equipment*** and their components	identify ***tools and equipment*** used to repair ***seeding and planting equipment*** and their components, and describe their applications and procedures for use
		describe procedures to remove and disable ***seeding and planting equipment*** components
		describe procedures to repair, replace, adjust, set and calibrate ***seeding and planting equipment*** components
		identify ***types of depth control systems*** and describe their characteristics, applications and operation
		identify ***hazards*** and safe work practices while performing repairs

Range of Variables

seeding and planting equipment include: air drills, planters, broadcast spreaders
metering parts include: metering wheels, metering rolls, augers, planter discs, variable rate drives
metering components include: bearings, brushes, bushings, scrapers
types of packers include: rubber, steel
tools and equipment include: hand tools, power tools
types of depth control systems include: hydraulic, electrical, mechanical
hazards include: seed treatments, pesticides, fertilizers

Task H-27 Diagnoses harvesting, hay and forage equipment

Task Descriptor

Harvesting, hay and forage equipment collects, processes and delivers crops and products. To improve the operation and functioning of the equipment, agricultural equipment technicians should understand the principles of harvesting, hay and forage equipment.

H-27.01 Diagnoses cutting, conditioning, gathering and processing equipment

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
H-27.01.01P	identify ***symptoms of problem***	***symptoms of problem*** are identified by consulting with customer or operator
H-27.01.02P	select and use ***diagnostic tools and equipment***	***diagnostic tools and equipment*** are selected and used according to application and manufacturers' procedures
H-27.01.03P	perform sensory inspections on ***components*** to identify ***faults***	sensory inspections are performed on ***components*** to identify ***faults***
H-27.01.04P	remove ***components*** to access diagnostic area	***components*** are removed to access diagnostic area according to manufacturers' specifications
H-27.01.05P	interpret schematics to isolate cause of ***faults***	schematics are interpreted to isolate cause of ***faults***
H-27.01.06P	verify monitor and equipment settings to match crop type	monitor and equipment settings are verified to match crop type
H-27.01.07P	interpret results to determine ***required actions***	results are interpreted to determine ***required actions***

Range of Variables

symptoms of problem include: condition of cut, condition of crimp, material loss, material flow, bunching, sensory observed symptoms (vibration, noise, burnt smell, excess heat), under threshing, over threshing, grain damage, separation losses, cleaning shoe losses, clean grain sample

diagnostic tools and equipment include: infrared temperature sensor, thermal imaging camera, electronic devices (laptops, smart phones, tablets), software and apps, onboard diagnostic systems, multimeters, OEM specialty tools, hand tools, power tools

components include: rollers, knives, threshing elements, tines, belts, drive lines, bearings

faults include: wear, damage, misalignment, abnormal noises

components (removed for access) include: shields, drive lines, panels

required actions include: repair; component replacement, calibration and adjustment; further diagnosis

	Knowledge	
	Learning Outcomes	**Learning Objectives**
H-27.01.01L	demonstrate knowledge of ***cutting, conditioning, gathering and processing equipment***, their ***components***, characteristics, applications and operation	identify types of ***cutting, conditioning, gathering and processing equipment,*** and their ***components***, and describe their characteristics, applications and operation
		identify types of crops
		describe equipment usage according to different crops and crop conditions
		describe reel position and finger timing
		describe ***productivity monitoring systems*** and describe their characteristics, applications and operation
H-27.01.02L	demonstrate knowledge of diagnosing ***cutting, conditioning, gathering and processing equipment***, and their ***components***	identify ***diagnostic tools and equipment*** used to diagnose ***cutting, conditioning, gathering and processing equipment***, and their ***components***, and describe their applications and procedures for use
		describe procedures to diagnose ***cutting, conditioning, gathering and processing equipment***, and their ***components***
		identify hazards and describe safe work practices while diagnosing ***cutting, conditioning, gathering and processing equipment***, and their ***components***
		identify inspections performed to diagnose ***cutting, conditioning, gathering and processing equipment***, and their ***components***
		identify possible ***faults*** found while performing inspections

Range of Variables

cutting, conditioning, gathering and processing equipment include: cutting and conditioning equipment (sickles, rotary discs, rollers, flails); gathering equipment (balers, headers [draper, pickup, auger, flex, rigid, row crop], forage harvesters, grain carts); processing equipment (combines, feeders, dryers, mixers)

components include: rollers, knives, threshing elements, tines, belts, drive lines, bearings

productivity monitoring systems include: moisture, protein, yield, weight

diagnostic tools and equipment include: infrared temperature sensor, thermal imaging camera, electronic devices (laptops, smart phones, tablets), software and apps, onboard diagnostic systems, multimeters, OEM specialty tools, hand tools, power tools

faults include: wear, damage, misalignment, abnormal noises

H-27.02 Diagnoses material handling equipment

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
H-27.02.01P	identify ***symptoms of problem***	***symptoms of problem*** are identified by consulting with customer or operator
H-27.02.02P	select and use ***diagnostic tools and equipment***	***diagnostic tools and equipment*** are selected and used according to application and manufacturers' procedures
H-27.02.03P	perform sensory inspection on ***components*** to identify ***faults***	sensory inspection is performed on ***components*** to identify ***faults***
H-27.02.04P	interpret schematics to isolate cause of ***faults***	schematics are interpreted to isolate cause of ***faults***
H-27.02.05P	remove ***components*** to access diagnostic area	***components*** are removed to access diagnostic area
H-27.02.06P	interpret results to determine ***required actions***	results are interpreted to determine ***required actions***

Range of Variables

symptoms of problem include: material loss, material flow, sensory observed symptoms (vibration, noises, burnt smell, excess heat)

diagnostic tools and equipment include: infrared temperature sensor, thermal imaging camera, electronic devices (laptops, smart phones, tablets), software and apps, onboard diagnostic systems, multimeters, OEM specialty tools, hand tools, power tools

components include: rollers, knives, belts, drive lines, bearings, chains

faults include: wear, damage, misalignment, abnormal noise

components (removed for access) include: shields, covers, belts, panels

required actions include: repairs; component replacement, calibration and adjustment; further diagnosis

	Knowledge	
	Learning Outcomes	**Learning Objectives**
H-27.02.01L	demonstrate knowledge of ***material handling equipment***, their ***components***, characteristics, applications and operation	identify ***material handling equipment,*** and their ***components***, and describe their characteristics, applications and operation
		identify types of crops
		describe scales and describe their characteristics, applications and operation
H-27.02.02L	demonstrate knowledge of diagnosing ***material handling equipment*** and their ***components***	identify ***diagnostic tools and equipment*** used to diagnose ***material handling equipment*** and their ***components***, and describe their applications and procedures for use
		describe procedures to diagnose ***material handling equipment*** and their ***components***
		identify hazards and describe safe work practices while diagnosing ***material handling equipment*** and their ***components***
		identify inspections performed to diagnose ***material handling equipment*** and their ***components***
		identify possible ***faults*** found while performing inspections

Range of Variables

material handling equipment includes: grain carts, high-dump wagons, manure spreader, grain auger, conveyors, mix wagons, hay transport equipment

components include: rollers, knives, belts, drive lines, bearings, chains

diagnostic tools and equipment include: infrared temperature sensor, thermal imaging camera, electronic devices (laptops, smart phones, tablets), software and apps, onboard diagnostic systems, multimeters, OEM specialty tools, hand tools, power tools

faults include: wear, damage, misalignment, abnormal noise

Task H-28 Repairs harvesting, hay and forage equipment

Task Descriptor

Agricultural equipment technicians adjust harvesting, hay and forage equipment according to customer needs and preferences. The technician must perform repairs to optimize the performance of the equipment and to minimize operational costs and down time for the customer.

H-28.01 Repairs cutting, conditioning, gathering and processing equipment

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
H-28.01.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application and manufacturers' procedures
H-28.01.02P	remove ***components*** to access repair area	***components*** are removed to access repair area according to manufacturers' specifications
H-28.01.03P	replace ***components***	***components*** are replaced according to manufacturers' specifications
H-28.01.04P	recondition ***components***	***components*** are reconditioned according to manufacturers' specifications
H-28.01.05P	prepare surface and surrounding area	surface and surrounding area are prepared using safety precautions to weld damaged components
H-28.01.06P	align or adjust ***components***	***components*** are aligned and adjusted according to manufacturers' specifications and crop conditions

Range of Variables

tools and equipment include: hand tools, power tools, measuring tools

components (removed for access) include: shields, drive lines, panels

components (to be replaced) include: bearings, belts, threshing elements, drivelines, chains, knives, kernel processor

components (to be reconditioned) include: gear cases, rollers, knives, threshing elements, guards, clutches (slip, drive)

components (to be aligned or adjusted) include: knife and finger timing, belt and chain tension, drive sheaves (variable speed, hydraulic, electric), kernel processor

	Knowledge	
	Learning Outcomes	**Learning Objectives**
H-28.01.01L	demonstrate knowledge of ***cutting, conditioning, gathering and processing equipment***, their ***components***, characteristics, applications and operation	identify types of ***cutting, conditioning, gathering and processing equipment,*** and their ***components***, and describe their characteristics, applications and operation
		identify types of crops
		describe equipment usage according to different crops and crop conditions
		describe reel position and finger timing
		describe ***productivity monitoring systems*** and describe their characteristics, applications and operation
H-28.01.02L	demonstrate knowledge of repairing ***cutting, conditioning, gathering and processing equipment***, and their ***components***	identify ***tools and equipment*** used to repair ***cutting, conditioning, gathering and processing equipment***, and their ***components***, and describe their applications and procedures for use
		describe procedures to remove and disable ***cutting, conditioning, gathering and processing equipment components***
		describe procedures to repair, replace, recondition, align and adjust ***cutting, conditioning, gathering and processing equipment***, and their ***components***
		describe basic welding procedures to repair ***cutting, conditioning, gathering and processing equipment components***
		identify hazards and safe work practices while welding components
		identify hazards and safe work practices while performing repairs

Range of Variables

cutting, conditioning, gathering and processing equipment include: cutting and conditioning equipment (sickles, rotary discs, rollers, flails); gathering equipment (balers, headers [draper, pickup, auger, flex, rigid, row crop], forage harvesters, grain carts); processing equipment (combines, feeders, dryers, mixers)

productivity monitoring systems include: moisture, protein, yield, weight

tools and equipment include: hand tools, power tools, measuring tools

components include: bearings, belts, threshing elements, drivelines, chains, knives, kernel processor, gear cases, rollers, guards, clutches (slip, drive)

H-28.02 Repairs material handling equipment

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
H-28.02.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application and manufacturers' procedures
H-28.02.02P	recondition ***components***	***components*** are reconditioned to manufacturers' specifications
H-28.02.03P	replace ***components***	***components*** are replaced according to manufacturers' specifications
H-28.02.04P	prepare surface and surrounding area	surface and surrounding area are prepared using safety precautions to weld damaged components
H-28.02.05P	align or adjust ***components***	***components*** are aligned or adjusted according to manufacturers' specifications and crop conditions

Range of Variables

tools and equipment include: hand tools, power tools, welding equipment, measuring tools

components (to be reconditioned) include: gear cases, auger flightings, shafts, drive lines

components (to be replaced) include: bearings, belts, chains, auger flightings, load cells, monitor

components (to be aligned or adjusted) include: bearings, belts, chains, drive lines, drive sheaves (variable speed, hydraulic, electric)

	Knowledge	
	Learning Outcomes	**Learning Objectives**
H-28.02.01L	demonstrate knowledge of ***material handling equipment***, their ***components***, characteristics, applications and operation	identify ***material handling equipment*** and their ***components***, and describe their characteristics, applications and operation
		identify types of crops
		describe scales and describe their characteristics, applications and operation
H-28.02.02L	demonstrate knowledge of repairing ***material handling equipment*** and their ***components***	identify ***tools and equipment*** used to repair ***material handling equipment*** and their ***components***, and describe their applications and procedures for use
		describe procedures to repair, replace, recondition, align and adjust ***material handling equipment*** and their ***components***

	describe basic welding procedures to repair ***material handling equipment components***
	identify hazards and safe work practices while welding components
	identify hazards and safe work practices while performing repairs

Range of Variables

material handling equipment includes: grain carts, high-dump wagons, manure spreaders, grain augers, conveyors, mix wagons, hay transport equipment

tools and equipment include: hand tools, power tools, welding equipment, measuring tools

components include: bearings, belts, chains, auger flightings, load cells, monitor, gear cases, shafts, drive lines, drive sheaves (variable speed, hydraulic, electric)

Task H-29 Diagnoses application and irrigation equipment

Task Descriptor

Application and irrigation equipment applies product to help produce greater crop yield and lower disease. Agricultural equipment technicians diagnose application and irrigation equipment to identify failures and faults.

H-29.01 Diagnoses application equipment

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
H-29.01.01P	identify ***symptoms of problem***	***symptoms of problem*** are identified by consulting with customer or operator
H-29.01.02P	perform sensory inspection on ***components*** to identify ***faults***	sensory inspections are performed on ***components*** to identify ***faults***
H-29.01.03P	select and use ***diagnostic tools and equipment***	***diagnostic tools and equipment*** are selected and used according to application and manufacturers' procedures
H-29.01.04P	remove ***components*** to access diagnostic area	***components*** are removed to access diagnostic area
H-29.01.05P	check fluids for levels and contamination	fluids are checked for levels and contamination

H-29.01.06P	interpret schematics to isolate cause of failure	schematics are interpreted to isolate cause of failure
H-29.01.07P	calculate ***delivery rate inputs*** of ***products***	***delivery rate inputs*** of ***products*** are calculated
H-29.01.08P	compare calculated delivery rate to actual delivery rate	calculated delivery rate is compared to actual delivery rate
H-29.01.09P	verify ***monitor settings***	***monitor settings*** are verified to match ***application equipment***
H-29.01.10P	check ***wear points***	***wear points*** are checked
H-29.01.11P	interpret results to determine ***required actions***	results are interpreted to determine ***required actions***

Range of Variables

symptoms of problem include: inconsistent application rates, diagnostic codes, sensory observed symptoms (vibration, noises, burnt smell, excess heat)

components include: gear cases, flow meters, booms, drive lines, floor chains, pumps (hydraulic, hydrostatic, solution), motors (hydrostatic, solution), engines, nutrient sensors

faults include: leaks, damage, structural deformities, cracks, damaged pumps, plugged strainers, nozzles and solenoids

diagnostic tools and equipment include: infrared temperature sensor, thermal imaging camera, electronic devices (laptops, smart phones, tablets), software and apps, onboard diagnostic systems, multimeters, OEM specialty tools, hand tools, power tools

components (removed for access) include: panels, covers, shields

delivery rate inputs include: flow, volume, distance, weight, speed, pressure

products include: chemical solutions, granular, organic waste

monitor settings include: rate controller, flow meters, boom calibration, air velocity

application equipment includes: pull-type, self-propelled, hitch-mounted

wear points include: pivot points, pads, chains, sprockets

required actions include: repairs; component replacement, calibration and adjustment; further diagnosis

	Knowledge	
	Learning Outcomes	**Learning Objectives**
H-29.01.01L	demonstrate knowledge of ***application equipment***, their ***components***, characteristics, applications and operation	identify types of ***application equipment*** and their ***components***, and describe their characteristics, applications and operation
		identify ***productivity monitoring systems*** and describe their characteristics, applications and operation
		identify chemical types of pesticides, herbicides and fungicides
		identify type and size of application nozzles
		identify ***granular application equipment operating systems*** and describe their characteristics, applications and operation

		identify types of ***granular application equipment*** and describe their characteristics, applications and operation
		describe ***common failures of granular application equipment***
		identify ***liquid application equipment operating systems*** and describe their characteristics, applications and operation
		identify types of ***liquid application equipment*** and describe their characteristics, applications and operation
		describe ***common failures of liquid application equipment***
H-29.01.02L	demonstrate knowledge of diagnosing ***application equipment*** and their ***components***	identify ***diagnostic tools and equipment*** used to diagnose ***application equipment*** and their ***components***, and describe their applications and procedures for use
		describe procedures to diagnose ***application equipment*** and their ***components***
		identify ***hazards*** and describe safe work practices while diagnosing ***application equipment*** and their ***components***
		identify inspections performed to diagnose ***application equipment*** and their ***components***
		identify possible ***faults*** found while performing inspections

Range of Variables

application equipment includes: pull-type, self-propelled, hitch-mounted

components include: gear cases, flow meters, booms, drive lines, floor chains, pumps (hydraulic, hydrostatic, solution), motors (hydrostatic, solution), engines, nutrient sensors

productivity monitoring systems include: weight, product delivery rate, flow rate, boom pressure

granular application equipment operating systems include: agitation systems, delivery chain systems, delivery rating systems

granular application equipment includes: pull-type, self-propelled, hitch-mounted

common failures of granular application equipment include: worn chains, shafts, delivery tubes and bearings

liquid application equipment operating systems include: agitation systems, loading systems, pumps, solution tanks, solution controls, delivery rating systems

liquid application equipment includes: pull-type, self-propelled, hitch-mounted

common failures of liquid application equipment include: pumps, valves, distribution hoses and tubes, booms, nozzles

diagnostic tools and equipment include: infrared temperature sensor, thermal imaging camera, electronic devices (laptops, smart phones, tablets), software and apps, onboard diagnostic systems, multimeters, OEM specialty tools, hand tools, power tools

hazards include: hydraulic pressure and spring tension, supported weight, chemical exposure, organic waste, frost bite (anhydrous ammonia)

faults include: leaks, damage, structural deformities, cracks, damaged pumps, plugged strainers, nozzles and solenoids

H-29.02 Diagnoses irrigation equipment

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	no	no	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
H-29.02.01P	identify ***symptoms of problem***	***symptoms of problem*** are identified by consulting with customer or operator
H-29.02.02P	perform sensory inspection on ***components*** to identify ***faults***	sensory inspection is performed on ***components*** to identify ***faults***
H-29.02.03P	select and use ***diagnostic tools and equipment***	***diagnostic tools and equipment*** are selected and used according to application
H-29.02.04P	calculate ***delivery rate inputs*** of water	***delivery rate inputs*** of water are calculated by matching pump output and nozzle diameter
H-29.02.05P	verify calculated delivery rate to actual delivery rate	calculated delivery rate is compared to actual delivery rate
H-29.02.06P	interpret results to determine ***required actions***	results are interpreted to determine ***required actions***

Range of Variables

symptoms of problem include: inconsistent application rates, diagnostic codes, sensory observed symptoms (vibration, noise, burnt smell, excess heat, plugged nozzles)

components include: gear cases, pipes, nozzles, pumps, engines, irrigation lines, nutrient sensors

faults include: leaks, plugging, deformities

diagnostic tools and equipment include: infrared temperature sensor, thermal imaging camera, electronic devices (laptops, smart phones, tablets), software and apps, onboard diagnostic systems, multimeters, OEM specialty tools, hand tools, power tools

delivery rate inputs include: flow, volume, distance, weight, speed, pressure

required actions include: repairs; component replacement, calibration and adjustment; further diagnosis

	Knowledge	
	Learning Outcomes	**Learning Objectives**
H-29.02.01L	demonstrate knowledge of ***irrigation equipment***, their ***components***, characteristics, applications and operation	identify ***irrigation equipment*** and their ***components***, and describe their characteristics, applications and operation
		identify ***irrigation methods***
		identify type and size of irrigation nozzles
H-29.02.02L	demonstrate knowledge of diagnosing ***irrigation equipment*** and their ***components***	identify ***diagnostic tools and equipment*** used to diagnose ***irrigation equipment*** and their ***components***, and describe their applications and procedures for use
		describe procedures to diagnose ***irrigation equipment*** and their ***components***
		identify hazards and describe safe work practices while diagnosing ***irrigation equipment*** and their ***components***
		identify inspections performed to diagnose ***irrigation equipment*** and their ***components***
		identify possible ***faults*** found while performing inspections

Range of Variables

irrigation equipment include: pumps, motors, pipes, control systems

components include: gear cases, pipes, nozzles, pumps, engines, irrigation lines, nutrient sensors

irrigation methods include: flood, manual, wheel move, pivot

diagnostic tools and equipment include: infrared temperature sensor, thermal imaging camera, electronic devices (laptops, smart phones, tablets), software and apps, onboard diagnostic systems, multimeters, OEM specialty tools, hand tools, power tools

faults include: leaks, plugging, deformities

Task H-30 Repairs application and irrigation equipment

Task Descriptor

Agricultural equipment technicians adjust application and irrigation equipment to optimize performance. Technicians repair defective application and irrigation system components. They must be aware of potential hazards associated with chemicals and organic waste processed with this equipment.

H-30.01 Repairs application equipment

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	yes	yes	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
H-30.01.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application and manufacturers' procedures
H-30.01.02P	decontaminate sprayers	sprayers are decontaminated to neutralize residue from previous product
H-30.01.03P	set equipment	equipment is set by aligning and levelling components according to manufacturers' specifications and crop conditions
H-30.01.04P	adjust rate controller for ***factors***	rate controller is adjusted for ***factors*** for optimal performance
H-30.01.05P	prepare surface and surrounding area	surface and surrounding area are prepared using safety precautions to weld damaged components
H-30.01.06P	recondition ***components***	***components*** are reconditioned by replacing packings and seal kits according to manufacturers' specifications
H-30.01.07P	replace and calibrate flow meters, pressure sensors and switches	flow meters, pressure sensors and switches are replaced and calibrated to meet manufacturers' specifications
H-30.01.08P	replace ***components***	***components*** are replaced according to manufacturers' specifications

Range of Variables

tools and equipment include: hand tools, power tools, measuring tools

factors include: volume, distance, speed, pressure, weight, flow

components (to be reconditioned) include: gear cases, pumps, motors, valves, actuators, suspension, steering, sensors

components (to be replaced) include: sprayer, sprayer nozzles, strainers, delivery tubes, sensors, manure spreaders, granular application equipment

	Knowledge	
	Learning Outcomes	**Learning Objectives**
H-30.01.01L	demonstrate knowledge of ***application equipment***, their ***components***, characteristics, applications and operation	identify types of ***application equipment*** and their ***components***, and describe their characteristics, applications and operation
		describe ***productivity monitoring systems*** and describe their characteristics, applications and operation
		identify type and size of application nozzles
		identify ***granular application equipment operating systems*** and describe their characteristics, applications and operation
		identify types of ***granular application equipment*** and describe their characteristics, applications and operation
		describe ***common failures of granular application equipment***
		identify ***liquid application equipment operating systems*** and describe their characteristics, applications and operation
		identify types of ***liquid application equipment*** and describe their characteristics, applications and operation
		describe ***common failures of liquid application equipment***
		identify chemical types of pesticides, herbicides and fungicides
H-30.01.02L	demonstrate knowledge of repairing ***application equipment*** and their ***components***	identify ***tools and equipment*** used to repair ***application equipment*** and their ***components***, and describe their applications and procedures for use
		describe procedures to repair ***application equipment*** and their ***components***
		describe basic welding procedures to repair ***application equipment*** and their ***components***

	identify hazards and safe work practices while welding components
	identify ***hazards*** and safe work practices while performing repairs

Range of Variables

application equipment include: pull-type, self-propelled

components include: gear cases, pumps, motors, valves, actuators, suspension, steering, sensors, sprayer, sprayer nozzles, strainers, delivery tubes, manure spreaders, granular application equipment

productivity monitoring systems include: weight, product delivery rate, flow rate, boom pressure

granular application equipment operating systems include: agitation systems, delivery chain systems, delivery rating systems

granular application equipment includes: pull-type, self-propelled, hitch mounted

common failures of granular application equipment include: worn chains, shafts, delivery tubes and bearings

liquid application equipment operating systems include: agitation systems, loading systems, pumps, solution tanks, solution controls, delivery rating systems

liquid application equipment includes: pull-type, self-propelled, hitch-mounted

common failures of liquid application equipment include: pumps, valves, distribution hoses and tubes, booms, nozzles

tools and equipment include: hand tools, power tools, measuring tools

hazards include: hydraulic pressure and spring tension, supported weight, chemical exposure, organic waste

H-30.02 Repairs irrigation equipment

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
NV	yes	NV	NV	NV	yes	yes	no	no	ND	NV	NV	ND

	Skills	
	Performance Criteria	**Evidence of Attainment**
H-30.02.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application and manufacturers' procedures
H-30.02.02P	set equipment	equipment is set by aligning and levelling components according to manufacturers' specifications and crop conditions
H-30.02.03P	prepare surface and surrounding area	surface and surrounding area are prepared using safety precautions to weld damaged components
H-30.02.04P	recondition ***components***	***components*** are reconditioned by replacing packings and seal kits according to manufacturers' specifications

H-30.02.05P	replace ***components***	***components*** are replaced according to manufacturers' specifications
H-30.02.06P	adjust rate controller for volume, speed, pressure and rate	rate controller is adjusted for volume, speed, pressure and rate according to manufacturers' and customers' specifications

Range of Variables

tools and equipment include: hand tools, power tools, measuring tools
components (to be reconditioned) include: gear cases, pumps, motors, valves, sensors
components (to be replaced) include: nozzles, impellers, piping, sensors

	Knowledge	
	Learning Outcomes	**Learning Objectives**
H-30.02.01L	demonstrate knowledge of ***irrigation equipment***, their ***components***, characteristics, applications and operation	identify ***irrigation equipment*** and their ***components***, and describe their characteristics, applications and operation
		identify ***irrigation methods***
		identify type and size of irrigation nozzles
H-30.02.02L	demonstrate knowledge of repairing ***irrigation equipment*** and their ***components***	identify ***tools and equipment*** used to repair ***irrigation equipment*** and their ***components***, and describe their applications and procedures for use
		describe procedures to repair, replace, recondition, align and adjust ***irrigation equipment*** and their ***components***
		describe basic welding procedures to repair ***irrigation equipment components***
		identify hazards and safe work practices while welding components
		identify ***hazards*** and safe work practices while performing repairs

Range of Variables

irrigation equipment includes: pumps, motors, pipes, control systems
components include: gear cases, pumps, motors, valves, sensors***,*** nozzles, impellers, piping
irrigation methods include: flood, manual, wheel move, pivot
tools and equipment include: hand tools, power tools, measuring tools
hazards include: hydraulic pressure and spring tension, supported weight, chemical exposure, organic waste

Appendix A
Acronyms

API	American Petroleum Institute
CAN	Controller Area Network
DCA	Diesel Coolant Additive
DEF	Diesel Exhaust Fluid
DOC	Diesel Oxidation Catalyst
DPF	Diesel Particulate Filter
EGR	Exhaust Gas Recirculation
FOPS	Falling-Object Protective Structure
GLONASS	Global Navigation Satellite System (maintained by Russian government)
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HVAC	Heating, Ventilation and Air Conditioning
ISO	International Organization for Standardization
LIN	Local Interconnect Network
MIG	Metal-arc Inert Gas
OEM	Original Equipment Manufacturer
OH&S	Occupational Health and Safety
PIPEDA	Personal Information Protection and Electronic Documents Act
PPE	Personal Protective Equipment
ROPS	Roll-Over Protective Structure
SDS	Safety Data Sheet
SAE	Society of Automotive Engineers
SCA	Supplemental Coolant Additives
SCR	Selective Catalytic Reduction
TDG	Transportation of Dangerous Goods
VIN	Vehicle Identification Number
WCB	Workers Compensation Board
WHMIS	Workplace Hazardous Materials Information System

Appendix B
Tools and Equipment / Outils et équipement

Personal Protective Equipment and Safety Equipment / Équipement de protection individuelle et équipement de sécurité

aprons	tabliers
caging devices	dispositifs de blocage
carbon monoxide sensors	détecteurs de monoxyde de carbone
coveralls	combinaisons de travail
dust masks	masques antipoussière
ear plugs	bouche oreilles
emergency shower	douche d'urgence
exhaust ventilation	installation de ventilation
eye wash station	douche oculaire
face shields	écran facial
fall arrest system	dispositifs antichute
fall protection system	dispositifs de protection contre les chutes
fire blanket	couverture anti-feu
fire extinguisher	extincteurs
first aid kit	trousse de premiers soins
gloves (chemical, welding, latex, nitrile, heavy duty)	gants (de protection contre les produits chimiques, de soudeur, de latex, de caoutchouc nitrile, de qualité industrielle)
goggles	lunettes étanches
guard rails	garde-corps
hard hats	casques de sécurité
hearing protection	protecteurs d'oreilles
high visibility apparel	vêtements de haute visibilité
masks (particulate)	masques (particules)
respirators (chemical, particulate)	respirateurs (produits chimiques, particules)
safety footwear	chaussures de sécurité
safety glasses	lunettes de sécurité
seat belts	ceintures de sécurité
shop ventilation	ventilation d'atelier
vehicle lock-out systems (tags and locks)	systèmes de verrouillage (étiquettes et verrous)
welding curtain	écran de soudeur
welding personal protective gear	équipement de protection individuelle pour le soudeur
wheel chocks	cales de roue

Hand Tools / Outils à main

aprons	tabliers
chisels	burins
crimpers	pinces à sertir
crow foot	clé à ergots
electrical terminal tool kit	trousse d’outils pour bornes électriques
extractors	extracteurs
files	limes
fin comb	peigne fin
hammers	marteaux
hex wrenches	clées hexagonale
inspection lights and mirrors	lampes et miroirs d’examen
magnetic pick-up tools	doigts de ramassage aimantés
magnifying glass	loupe
pick sets	ensembles de pioches
pliers	pinces
pry bars	leviers
punches	poinçons
saws	scies
screwdrivers	tournevis
socket sets	jeu de douilles
test lights	lampes-témoins
tire gauges	contrôleurs de pression de pneus
wire strippers	pince à dénuder
wrenches	clés

Power Tools / Outils mécaniques

air/cordless hammers	marteaux pneumatiques ou sans fil
air/cordless ratchets	cliquets pneumatiques ou sans fil
air/cordless wrenches	clés à chocs pneumatiques ou sans fil
blow gun	soufflette
cut-off saw	ébouteuse
die grinders	meule pneumatique à rectifier les matrices
drills	perceuses
grinders	meuleuse
grinding wheels	meules
lighting devices (trouble lights, flood lights)	appareils d’éclairage (lampes baladeuses, projecteur pour illumination)
sanders	ponceuses
soldering iron/gun	fer ou pistolet à souder

Measuring, Testing and Diagnostic Equipment / Instruments de mesure et matériel d'essai et de diagnostic

air conditioning test gauges	jauges d'essai de systèmes de climatisation
alternator test stands	bancs d'essai d'alternateurs
angle meters	inclinomètres
battery testers (hydrometers, load)	contrôleurs de charge de batteries
bore gauge	calibre d'alésage
borescope	endoscope
breakout harnesses	testeurs de faisceaux
calipers (dial, Vernier, digital)	pieds à coulisse (à cadran, verniers, numériques)
circuit continuity testers	contrôleur de continuité
compression test kit	trousse d'essai de compression
computer engine analyzers	analyseurs de moteurs gérés par ordinateur
computer interface connector	connecteur d'interface ordinateur
coolant test strips	bandelettes réactives pour liquide de refroidissement
cylinder liner service tool kit	trousse d'outils d'entretien de chemises de cylindre
depth micrometers	micromètres de profondeur
diagnostic receptacles	prises de diagnostic
dial indicators	comparateurs à cadran
diesel fuel injection nozzle testers	appareils de vérification d'injecteurs de carburant diesel
digital/mechanical pressure test gauges	manomètres d'essai numériques ou mécaniques
dynamometer	dynamomètre
electronic control circuit diagnostic testers	appareils de vérification électroniques de diagnostic de circuits de commande
electronic leak detectors	détecteurs électroniques de fuites
electronic service tools	outils d'entretien électronique
feeler gauges	jauges d'épaisseur
flow meter kits (analog/digital)	débitmètres et accessoires (analogiques, numériques)
fluid analysis sampling devices	appareils d'échantillonnage pour l'analyse de fluides
fluorescent dyes and black lights	lumières fluorescentes et noires
fuel consumption meter	débitmètre totalisateur
gauge blocks	cales étalons
hole gauges	calibres d'alésage
hydrometer (coolant, diesel exhaust fluid (DEF), fuel, electrolyte)	densimètre (liquide de refroidissement, fluide d'échappement diesel [FED], carburant, électrolyte)
ignition analyzers	analyseur d'allumage
infrared temperature sensors	capteurs de température à infrarouge
inside/outside micrometers	micromètres d'intérieur et d'épaisseur

laptop computer	ordinateur portatif
laser alignment tools	outils d’alignement laser
leak testing equipment	matériel de détection de fuites
manometers	manomètres
multimeters (analog/digital)	multimètres (analogiques/numériques)
plastigage	jauges plastiques
power shift transmission test kits	matériel d’essai pour transmissions à changement de vitesses sous charge
pressure test kits	matériel d’essais manométriques
radiator pressure tester and pressure pumps	appareil de vérification de pression du radiateur et de la pompe de mise en pression
refractometers	réfractomètres
refrigerant identifiers	identificateurs de liquide de réfrigération
ring groove wear gauges	jauge d’usure de gorges de piston
rulers	règles
spark testers	appareils de vérification d’étincelles
sprayer nozzle tester	appareil de vérification de buses de pulvérisateurs
spring compression tester	appareil de vérification de compression de ressorts
spring scale	balance à ressort
squares	équerres
starting/charging analyzers	analyseur d’allumage
stethoscope	stéthoscope
stop watches	chronomètres
straight-edges	règles de précision
tachometer (digital photo/strobe light)	tachymètres (numériques, photométriques, stroboscopiques)
tape measure	ruban à mesurer
taper gauges	vérificateur coniques
telescoping gauge sets	jauges télescopiques
thermometer	thermomètre
thermo-probes	sondes thermométriques
timing tools	outils de réglage à l'allumage
torque angle gauge	indicateur d’angle de couple
torque wrenches	clés dynamométriques
transmission services and adjusting tools	outils pour entretien et réglage des boîtes de vitesses
vacuum pump kits	pompes à vide et accessoires

Shop Equipment / Machines d’atelier

articulation lockout	dispositifs de braquage des points d’articulation
battery chargers	chargeurs de batteries
bearing heater	chauffe-paliers
belt lacing tools	outils pour attache-courroie
bushing, bearing and seal driver sets	outils pour poser et retirer les douilles, roulements et bagues d’étanchéité
C-frame presses	presses à col-de-cygne
clutch alignment tools	outils d’alignement de l’embrayage
cylinder deglazing tool	outils de déglaçage des cylindres
degreasing and steam cleaning equipment	matériel de dégraissage et de nettoyage à la vapeur
dowel pullers	extracteurs de goujons
drill press	foreuse
engine rotation tools	outils de rotation du moteur
heat gun	pistolets thermiques
hone set (flexible cylinder hone, rigid hones)	outils de pierrage (à bras flexible et rigide)
horizontal bandsaw	scie à ruban horizontale
hose crimpers	pinces à sertir pour tuyaux flexibles
hydraulic hose assembly equipment	matériel de raccordement de tuyaux hydrauliques
hydraulic pumps	pompes hydrauliques
hydraulic rams	actionneurs hydrauliques
hydraulic service benches	établis hydrauliques de réparation
hydraulic shop presses	presses hydrauliques d’atelier
lathe	tour
lube bucket pumps	pompes à godets de graissage
lubrication and oiling equipment	matériel de graissage
open throat presses	presses à montants ouverts
oscillation locks	dispositifs de braquage de l’oscillation
painting equipment	matériel de peinture
parts washers and brushes	bacs de dégraissage et brosses
pin bushing drivers	bague du tourillon
post-lock pullers	extracteurs de bornes
pressure washer	laveuse à pression
puller sets and components	jeux d’extracteurs et accessoires
recovery and recycling equipment (fuel, oil, antifreeze, refrigerant)	matériel de récupération et de recyclage (carburant, huile, antigel, réfrigérant)
ring compressors	colliers à segments de piston
ring expanders	pinces à segments de piston
ring groove cleaners	outils de nettoyage pour gorges de segments
rivet presses	presses à riveter
roll bed shop presses	presses à col-de-cygne

rotary hand pumps	pompes rotatives à main
seal installers	outils d’installation pour joints d’étanchéité
service trucks	camions-ateliers
slide hammers	marteaux à inertie
starting and charging analysers	analyseur d’allumage
thread insert kits	trousse d’écrous rapportés
thread repair kits	trousse pour réparation de filets
tube and pipe bending and flaring tools	outils à cintrer et à évaser les tubes et les tuyaux
vacuum cleaner	aspirateur
vices	étaux
water pump service tools	outils d’entretien de pompes à eau
wedge blocks	cales biseautées
work benches	établis

Specialty Tools and Equipment / Outil et équipement spécialisés

air conditioning fitting kits (with tees, caps, reducers, elbows, tubes, adapters)	matériel de montage pour systèmes de climatisation (tés, chapeaux, raccords de réduction, tubes, adaptateurs)
air conditioning test equipment kits	appareillage d’essai de systèmes de climatisation
camshaft service tools	outils d’entretien d’arbres à cames
compressor specialty tools	outils spéciaux pour compresseurs
differential/final drive and axle specialty tools	outils spéciaux pour différentiel et transmissions finales
flushing equipment kits	matériel de purge
hydrostatic drive specialty tools	outils spéciaux pour transmissions hydrostatiques
injection pump service tools	outils d’entretien de pompes d’injection
nitrogen accumulator charging kits	matériel de charge d’accumulateurs d’azote
nozzle service tools, nozzle pullers	outils d’entretien d’injecteurs et extracteurs d’injecteurs
oil transfer units (with or without vacuum pump or filtration unit)	appareils de transfert d’huile (avec ou sans pompe à vide ou bloc de filtration)
refrigerant evacuation pumps	pompes d’évacuation de fluide frigorigène
refrigerant reclaiming and recovery equipment	matériel de récupération de fluide frigorigène
valve magnetic follower holder kits	aimants de retenue pour supports de poussoirs à soupapes
valve refacers	rectifieuses de soupapes
valve reseating tool kits	outillage de rectification des sièges de soupapes
valve seat cutters	fraiseuses de sièges de soupapes
valve seat grinders	rodeurs de sièges de soupapes
valve spring depressors/compressors	dépresseurs/compresseurs de ressort de soupapes
wiring harness repair tools (crimpers, heat shrink tools, soldering and de-soldering tools)	outils de réparation des faisceaux de fils (pinces à sertir, outils de rétraction thermique, outils de soudage et de dessoudage)

Hoisting, Lifting and Securing Equipment / Matériel de hissage, de levage et d'échafaudage

A-frames	cadres en A
blocking	matériaux d’assujettissement
engine repair stands with component adapter sets	bancs de réparation de moteurs avec adaptateurs
forklifts	chariots élévateurs à fourche
hoisting equipment	matériel de levage
holding fixtures	dispositifs de fixation
hydraulic jacking system (air/electric/manual)	système de crics hydrauliques (à action pneumatique-électrique, manuelle)
lift trucks	chariots élévateurs
lifting brackets, hooks and eyes	supports et crochets de levage
lifting chains/slings	chaînes et élingues de levage
load levellers	compensateurs de variation de la charge
load positioning sling	élingue de positionnement
mobile floor cranes	grues d'atelier sur roues
overhead cranes	ponts roulants
service jacks with special adapters	crics d’entretien avec adaptateurs spéciaux
support stands	béquilles-support
tractor splitting stands	bancs de réparation pour tracteurs
wheel and axle lifts	appareils de levage et de chargement (treuil)

Welding and Cutting Equipment / Matériel de soudage et de coupage

electric arc welding and cutting equipment (with power supply, welding machine, electrode holder, ground clamps)	matériel de soudage/découpage à l’arc (câble d’alimentation, machine à souder, porte-électrodes, prises de masse)
metal-arc inert gas (MIG) welder	machine de soudage à l'arc sous protection de gaz inerte avec fil-électrode fusible (MIG)
oxy-acetylene welding/cutting equipment (with cylinders, pressure regulators, welding torch, hoses)	matériel de soudage oxyacétylénique et d’oxycoupage (bouteilles de gaz, régulateurs de pression, chalumeaux, tuyaux souples)
plasma cutting (with electrical current and air, hoses, welders)	découpage au plasma (courant électrique et air, tuyaux souples, soudeuses)
tungsten inert gas (TIG) welder	dispositifs de soudage au tungstène sous gaz inerte (TIG)

Appendix C
Glossary / Glossaire

ballast	the placement of metal or liquid weight on a machine for both traction and lifting to ensure proper weight distribution.	**lest**	poids de métal ou liquide placé sur une machine afin d'assurer une répartition du poids appropriée pour la traction et le levage
base engine	assembled block and head including internal components and gear trains.	**moteur standard**	assemblage comprenant le bloc et la culasse du moteur, ainsi que les organes internes et les trains d'engrenages
driveline	the connection between a power source and a driven component.	**arbre de transmission**	connexion entre une source d'alimentation et un organe entraîné
drive train	the mechanically driven components, from the flywheel to the ground, that receives power, torque and speed from the engine to create movement (of the machine).	**transmission**	organes à entraînement mécanique, du volant moteur jusqu'au sol, qui reçoivent la puissance, le couple et la vitesse du moteur pour créer le mouvement (de la machine)
electrical systems	starting, charging, lighting and accessory circuits without computer control modules.	**systèmes électriques**	circuits de démarrage, de charge, d'éclairage et d'accessoires sans modules de commande par ordinateur
electronic systems	electrical systems operated via computerized electronic control modules and related sensors and wiring.	**systèmes électroniques**	circuits électriques exploités au moyen de ECM informatisés; incluent les capteurs et le câblage connexe
headers	device, attached and powered by a harvester or traction unit, used to gather crop from field.	**becs cueilleurs**	dispositif fixé sur une récolteuse ou sur un appareil à traction et alimenté par celui-ci; il est utilisé pour recueillir les récoltes dans un champ
hydrostatic system	a hydraulic system which uses fluid under pressure to transmit power through tubes or hoses to machine drive components such as wheel or track drives. It provides infinite speed at a finite pressure.	**système hydrostatique**	système hydraulique qui utilise les fluides sous pression pour la transmission de la puissance qui s'effectue par des tubes ou des tuyaux flexibles à des organes de transmission de machine comme aux entraînements à roues ou à chenilles; il fournit une vitesse infinie à une pression définie

implement	a towed or mounted piece of machinery controlled from the traction unit.	**instrument**	équipement attelé à la machinerie et dont le contrôle s’effectue à partir de l’appareil à traction
precision farming equipment	systems allowing the operator to guide and control machinery, map an area, vary rates and eliminate overlaps or misses. The equipment includes a global positioning system, yield monitors, moisture meters, and guided steering.	**machinerie agricole de précision**	systèmes qui permettent à l’opérateur de guider et de contrôler la machinerie, de faire le mappage d’une zone, de varier les débits et d’éliminer les chevauchements ou les ratés; la machinerie comprend un système de positionnement mondial, des capteurs de rendement, des humidimètres et une direction guidée
structural component	a component that supports as well as allows equipment to retain its rigidity.	**élément de structure**	composant qui supporte le matériel et qui lui permet de garder sa rigidité
suspension	systems that support the main frame and other components which dampens shock load from the ground and may include cabs, booms, belts, track frame, axle, cab seats and wheel assemblies.	**suspension**	systèmes qui supportent le châssis principal et d’autres composants qui amortissent l’effet de choc du sol; peuvent comprendre les cabines, les flèches, les courroies, le train de roulement, l’essieu, les sièges de cabines et les ensembles roues