Apprenticeship Manitoba

Manitoba

Agricultural Equipment Technician
Level 2

Rev. April 2019

Apprenticeship Manitoba

Agricultural Equipment Technician

Unit: B1 Welding II

Level: Two

Duration: 28 hours

Theory: 7 hours

Practical: 21 hours

Overview:

This unit builds on Welding I, and provides agricultural equipment technician apprentices with knowledge about metal inert gas (MIG)/gas metal arc welding (GMAW) and shielded metal arc welding (SMAW). The unit begins with terminology, hazards and safe work practices related to welding. The unit covers types of welding and their principles of operation. Finally, the unit provides for an opportunity to demonstrate and test the welds performed using MIG/GMAW and SMAW equipment.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Define terminology associated with welding. a. Metal inert gas (MIG)/gas metal arc welding (GMAW). b. Shielded metal arc welding (SMAW)	**5%**
2. Identify hazards and describe safe work practices pertaining to MIG/GMAW and SMAW. a. Personal b. Shop/facility c. Equipment/vehicle d. Ventilation e. MIG/GMAW equipment f. SMAW equipment	**5%**
3. Describe the MIG/GMAW and SMAW processes and their applications in various environmental conditions.	**10%**
4. Identify MIG/GMAW and SMAW equipment, consumables and accessories and describe their applications and storage requirements. a. Welding unit types b. Rod/wire selection c. Gas/flux types used d. Metal types used	**10%**
5. Describe and perform the procedures used to set-up and adjust MIG/GMAW and SMAW equipment. a. Surface preparation b. Amperage/voltage adjustment/wire feed speed	**10%**

c. Polarity

6.	**Describe the procedures used to inspect and maintain MIG/GMAW and SMAW equipment.**	**5%**
7.	**Perform basic types of welds using MIG/GMAW and SMAW equipment.**	**50%**
8.	**Describe weld defects, their causes and prevention.**	**5%**

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Apprenticeship Manitoba

Agricultural Equipment Technician

Unit: B2 Starting and Charging Systems

Level: Two

Duration: 35 hours

Theory: 7 hours

Practical: 28 hours

Overview:

This unit provides agricultural equipment technician apprentices with further knowledge on electrical systems, with a focus on the wiring harness and the starting and charging systems. The unit begins with terminology and safe work practices for electrical systems, then moves on to the principles of operation of starting and charging systems. Finally, the unit covers the procedures used to inspect, diagnose and service electrical systems, with a focus on the wiring harness and the starting and charging systems.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Define terminology associated with electrical systems. a. Wiring harness • Control circuits • Circuit protection b. Charging c. Starting	**5%**
2. Identify hazards and describe safe work practices pertaining to electrical systems. a. Wiring harness b. Charging c. Starting	**5%**
3. Identify and describe tools and equipment used to service and repair electrical systems. a. Wiring harness repair • Connectors • Test equipment b. Charging repair c. Starting repair	**5%**
4. Explain the principles of operation of starting and charging systems. a. 12/24 V starting and charging systems • Series-parallel configuration • 12 or 24 V configuration	**15%**
5. Identify electrical system components.	**15%**

a. Alternators, including:
   - Regulators

b. Starters, including:
   - Relays
   - Switches
   - Solenoids

c. Wiring harnesses
   - Wires
   - Connectors
   - Circuit protection
   - Power distribution

6. Interpret schematics and symbols. 15%

a. Starting system
b. Charging system
c. Wiring harness

7. Describe and perform procedures used to inspect, diagnose and maintain electrical systems. 20%

a. Wiring harness
   - Voltage drop test
   - Circuit integrity

b. Charging systems
   - Output test
   - Voltage drop test
   - Circuit integrity

c. Starting systems
   - Amperage draw test
   - Voltage drop test
   - Circuit integrity

8. Describe and perform servicing procedures for electrical systems. 20%

a. Wiring harness
   - Circuit integrity
   - Wire and connector repair

b. Charging systems
   - Circuit integrity
   - Alternator repair

c. Starting systems
   - Circuit integrity
   - Starter repair

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Apprenticeship Manitoba

Agricultural Equipment Technician

Unit: B3 Engines and Engine Support Systems I

Level: Two

Duration: 70 hours

Theory: 21 hours

Practical: 49 hours

Overview:

This unit is designed to provide the apprentice with the knowledge about engine support systems and overhaul procedures when working with today's agricultural equipment, including principles and theories of engine operation and classifications of engines. Finally, the unit covers engine component analysis, servicing and repair.

Objectives and Content:	**Percent of Unit Mark (%)**

1. Review terminology associated with engines and engine support systems, and their components. — **10%**

a. Cooling
b. Lubrication
c. Diesel fuel supply systems
d. Intake and exhaust
e. Starting aids
f. Base engine components
   - Cylinder block
   - Cylinder head
   - Valve train
   - Pistons and connecting rods
   - Crankshaft

2. Identify hazards and describe safe work practices pertaining to engines and engine support systems. — **5%**

3. Identify and describe tools and equipment used to service and repair engines and engine support systems. — **5%**

4. Explain the operating principles of engine components and their support systems. — **30%**

a. Engine support systems
   - Cooling (liquid-cooled, air-cooled)
   - Lubrication (fluids and filters, friction-type bearings)
   - Diesel fuel supply systems
   - Intake and exhaust (naturally-aspirated, forced induction)
   - Starting aids (ether starting systems, engine warming systems)
b. Base engine components

- Cylinder block
- Cylinder head
- Valve train
- Pistons and connecting rods
- Crankshaft

5. Describe and perform procedures used to diagnose and repair engines. 25%

a. Cooling
   - Coolant testing

b. Lubrication
   - Oil pressure testing
   - Oil and oil filter analysis

c. Diesel fuel supply systems

d. Intake and exhaust

e. Starting aids

f. Measuring clearances and diameters
   - Crankshaft
   - Camshaft
   - Piston and rings
   - Oil clearance

g. Bore measurement

h. Visual inspections
   - Cracks and physical wear
   - Cavitation erosion

i. Crack detection methods
   - Magnetic
   - Penetrating dyes

6. Describe and perform overhaul procedures for diesel engines. 25%

a. In-frame overhaul

b. Complete overhaul

c. Component reconditioning
   - Cylinder block
   - Cylinder head and valves
   - Connecting rods
   - Crankshaft

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Apprenticeship Manitoba

Agricultural Equipment Technician

Unit: B4 Powertrain Fundamentals

Level: Two

Duration: 49 hours

Theory: 7 hours

Practical: 42 hours

Overview:

This unit provides agricultural equipment technician apprentices with knowledge about powertrains. The unit covers such topics as the safe work practices, tools and equipment and the principles of operation for powertrain systems. The unit also covers the procedures to inspect, diagnose and maintain powertrain systems and components, and the related servicing procedures.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Define terminology associated with powertrain components. a. Single countershaft transmissions b. Power takeoffs (PTOs) • Engine-driven • Transmission-driven c. Transfer cases d. Drivelines e. Clutches • Wet • Dry	**10%**
2. Identify hazards and describe safe work practices pertaining to powertrain components. a. Single countershaft transmissions b. Power takeoffs (PTOs) • Engine-driven • Transmission-driven c. Transfer cases d. Drivelines e. Clutches	**10%**
3. Identify powertrain components and their operation. a. Single countershaft transmissions • Synchronizers • Collar clutches • Detents • Interlocks	**20%**

- Shifting mechanism
- Input/output/countershaft

b. Power takeoffs (PTOs)
- Shift mechanisms (manual, hydraulic and air)
- Gear mechanisms
- Output shafts (high speed, low speed)

c. Transfer cases
- Shift mechanisms (manual, hydraulic and air)
- Gear mechanisms
- Output shafts (high speed, low speed)

d. Drivelines
- Shafts and yokes
- Universal joints
- Support (hangar) bearings

e. Clutches
- Flywheel/pressure plate (push and pull)
- Clutch disc
- Bearings (release/pilot)

4. Identify and describe tools and equipment used to service and repair powertrain components. 10%
Describe powertrain component removal and installation procedures.

a. Component removal and installation equipment
b. Bearing and shaft removal and installation equipment
c. Dial indicator, angle and clearance measurement tools

5. Describe powertrain component removal and installation procedures. 10%

a. Single countershaft transmissions
b. Power takeoffs (PTOs)
c. Transfer cases
d. Drivelines
e. Clutches

6. Describe and perform procedures used to diagnose and repair powertrains. 40%

a. Single countershaft transmissions
- Fluid analysis
- Failure analysis (gears/synchronizers/bearings)
- Component overhaul

b. Power takeoffs (PTOs)
- Component overhaul

c. Transfer cases
- Component overhaul

d. Drivelines
- Angle measurement
- Phasing
- Balance
- Failure analysis

e. Clutches
- Adjustment
- Failure analysis

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Apprenticeship Manitoba

Agricultural Equipment Technician

Unit: B5 Electronics I: Fundamentals

Level: Two
Duration: 28 hours
Theory: 7 hours
Practical: 21 hours

Overview:

This unit provides agricultural equipment technician apprentices with knowledge about electronics. The unit begins with terminology, hazards and safe work practices. The unit also covers the principles of operation electronic systems. Finally, the unit provides for an opportunity to interpret schematics and symbols, and to demonstrate procedures used to inspect, diagnose and service electronic systems.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Define terminology associated with electronic systems.	**5%**
a. Semi-conductors b. Sensors c. Control modules d. Communication	
2. Identify hazards and describe safe work practices pertaining to electronic systems.	**5%**
a. High voltage • Shock/electrocution • Capacitor discharge b. Static electricity • Semi-conductor damage c. Test equipment • Meter impedance • Insulation value d. Personal protective equipment (PPE)	
3. Identify and describe tools and equipment used to service and repair electronic systems.	**10%**
a. Semi-conductors • Digital volt-ohm meter (DVOM) b. Sensors • DVOM c. Control modules d. Communication	
4. Explain the principles of operation of electronic systems and their components.	**15%**

a. Semi-conductors
   - Diodes
   - Transistors
   - Capacitors
   - Resistors

b. Sensors
   - Temperature
   - Pressure
   - Position
   - Speed

c. Control modules
   - Integrated circuits
   - Source or ground controlled output circuits

d. Communication
   - Controller network

5. Interpret schematics and symbols for electronic system components. 15%

a. Semi-conductors
b. Sensors

6. Describe and demonstrate procedures used to inspect and diagnose electronic systems. 35%

a. Sensors
   - Input (reference voltage)
   - Signal output
   - Out-of-range faults

b. Communication and controller network
   - Network testing

c. Controller output systems
   - Pulse width modulation
   - Out-of-range faults

7. Describe and demonstrate servicing procedures for electronic systems. 15%

a. Sensors
   - Removal and replacement
   - Calibration and adjustment

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Apprenticeship Manitoba

Agricultural Equipment Technician

Unit: B6 Agricultural Equipment I: Fundamentals

Level: Two

Duration: 70 hours

Theory: 35 hours

Practical: 35 hours

Overview:

This unit provides the apprentice with knowledge about crop equipment and implements. The unit begins by covering terminology and safe work practices for crop equipment. The unit covers the types (tillage, seeding and planting; haying; spraying; and harvesting) and operating principles of crop equipment.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Define terminology associated with agricultural equipment. a. Seeding and ground-engaging equipment b. Spraying equipment c. Livestock equipment d. Harvesting equipment	**10%**
2. Identify hazards and describe safe work practices pertaining to agricultural equipment.	**10%**
3. Describe the components and operation of agricultural equipment. a. Seeding and ground-engagement equipment • Tillage and land preparation equipment • Planters • Air seeders (precision openers and variable rate air carts) • Conventional vs. zero-till seeding practices b. Spraying equipment • Liquid sprayer • Granular broadcast applicator c. Livestock equipment • Cutting (sickle knife, rotary disc) • Baler (square, round) • Forage harvester d. Harvesting equipment • Gathering (swather, straight-cut header) • Processing (conventional, rotary)	**40%**
4. Describe the components and operation of agricultural tractors. a. Drive configuration and steering systems	**20%**

- Two-wheel
- Four-wheel
- Track
- Tractor setup
- Steering systems, geometry, and alignment
- GPS-guidance systems and components

b. Tractor setup
- Ballasting procedures (weight distribution)
- Three-point hitch operation
- Front-end loader

c. Tractor tires
- Types
- Inflation
- Safety procedures

5. Describe the components and operation of agricultural drive types. 20%

a. Power take-off (PTO)
- U-joint types
- Alignment

b. Belt drives
- Pulleys (standard, torque-sensing)
- Types
- Adjustment and alignment

c. Chains
- Sprockets
- Types
- Adjustment and alignment

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