

Agricultural Power Systems, Advanced

8020 36 weeks

Table of Contents

Acknowledgments.....	1
Course Description.....	2
Task Essentials Table.....	2
Curriculum Framework.....	7
SOL Correlation by Task	54
FFA Information	58
Appendix: Credentials, Course Sequences, and Career Cluster Information	60

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Course Description

Suggested Grade Level: 10 or 11 or 12

Students enrolled in this advanced course will gain hands-on experience in the operation, servicing, troubleshooting, and repair of agricultural equipment systems and components necessary for operating an agricultural business.

As noted in [Superintendent's Memo #058-17 \(2-28-2017\)](#), this Career and Technical Education (CTE) course must maintain a maximum pupil-to-teacher ratio of 20 students to one teacher, due to safety regulations. The 2016-2018 biennial budget waiver of the teacher-to-pupil ratio staffing requirement does not apply.

Task Essentials Table

8020	Tasks/Competencies
+	Identify the role of supervised agricultural experiences (SAEs) in agricultural education.
+	Participate in an SAE.
+	Identify the benefits and responsibilities of FFA membership.
+	Describe leadership characteristics and opportunities as they relate to agriculture and FFA.
○	Apply for an FFA degree and/or an agricultural proficiency award.
+	Identify part numbers and place orders, using available resources.
+	Complete work orders, invoices, and requisitions for repairs.
+	Maintain clean and orderly customer and parts areas.

<input checked="" type="checkbox"/>	Use effective communication skills to prepare written estimates of repairs and orally explain repairs and expenses to customers.
<input checked="" type="checkbox"/>	Complete an invoice.
<input checked="" type="checkbox"/>	Identify marked safety areas.
<input checked="" type="checkbox"/>	Identify the location and use of eye wash stations.
<input checked="" type="checkbox"/>	Identify the location of the posted evacuation routes.
<input checked="" type="checkbox"/>	Locate and demonstrate knowledge of safety data sheets (SDS).
<input checked="" type="checkbox"/>	Demonstrate the safe use of chemicals.
<input checked="" type="checkbox"/>	Demonstrate the safe use of standard and metric hand tools.
<input checked="" type="checkbox"/>	Demonstrate the safe use of power tools.
<input checked="" type="checkbox"/>	Demonstrate the safe use of precision standard and metric measuring tools.
<input checked="" type="checkbox"/>	Demonstrate the safe use of protective clothing and equipment.
<input checked="" type="checkbox"/>	Demonstrate the safe use of fire protection equipment.
<input checked="" type="checkbox"/>	Demonstrate the safe use of equipment.
<input checked="" type="checkbox"/>	Demonstrate safe practices in the agricultural mechanics lab/workshop.
<input checked="" type="checkbox"/>	Demonstrate safe use of maintenance equipment.
<input checked="" type="checkbox"/>	Maintain equipment according to manufacturer's instructions.
<input checked="" type="checkbox"/>	Compile a list of parts and supplies necessary to complete a repair or maintenance task.
<input type="checkbox"/>	Perform welding operations.
<input checked="" type="checkbox"/>	Weld with oxyfuel gas welding equipment.
<input type="checkbox"/>	Cut metals, using oxyfuel gas, plasma arc, and other techniques.
<input checked="" type="checkbox"/>	Prepare equipment for painting.
<input checked="" type="checkbox"/>	Select and apply protective coatings.
<input type="checkbox"/>	Prepare a steam and/or high-pressure washer.
<input type="checkbox"/>	Clean equipment with a steam cleaner and/or high-pressure washer.
<input checked="" type="checkbox"/>	Describe the fundamental principles of agricultural mechanical systems.

<input checked="" type="radio"/>	Perform basic service and maintenance tasks on agricultural mechanical systems.
<input checked="" type="radio"/>	Perform diagnosis and troubleshooting tasks for agricultural mechanical systems.
<input checked="" type="radio"/>	Describe basic operating principles of pneumatics.
<input checked="" type="radio"/>	Calculate hydraulic pressure and force, using Pascal's law.
<input checked="" type="radio"/>	Describe the operation of open and closed center hydraulic systems.
<input checked="" type="radio"/>	Describe the theory of hydraulic pumps and motors.
<input type="radio"/>	Disassemble and repair a hydraulic component following the technical manual's instructions.
<input type="radio"/>	Use a flow meter and test gauge to measure the performance of a hydraulic system.
<input type="radio"/>	Troubleshoot and repair a hydraulic-assist transmission.
<input type="radio"/>	Troubleshoot and repair hydrostatic drives.
<input checked="" type="radio"/>	Interpret electrical schematics.
<input checked="" type="radio"/>	Use electrical diagrams to locate components on equipment.
<input checked="" type="radio"/>	Recognize and test electrical components and devices.
<input type="radio"/>	Diagnose electrical systems, using schematics.
<input type="radio"/>	Follow diagnostic and repair procedures.
<input checked="" type="radio"/>	Test the charging circuit.
<input type="radio"/>	Replace an amperage gauge.
<input type="radio"/>	Check the armature and fields of charging circuits.
<input checked="" type="radio"/>	Troubleshoot the ignition switch.
<input checked="" type="radio"/>	Troubleshoot the safety switch.
<input checked="" type="radio"/>	Troubleshoot the solenoid.
<input checked="" type="radio"/>	Troubleshoot glow plugs on diesel engines.
<input checked="" type="radio"/>	Troubleshoot the starter.
<input type="radio"/>	Replace defective parts of the starting circuit.
<input checked="" type="radio"/>	Describe the operation of the components of a fuel system.
<input checked="" type="radio"/>	Describe the operating principles and maintenance of carburetors.

<input checked="" type="radio"/>	Perform diagnostic and repair procedures on various fuel systems.
<input checked="" type="radio"/>	Describe the operating principles and maintenance of a high-pressure fuel injector.
<input type="radio"/>	Perform service to diesel fuel systems.
<input type="radio"/>	Service fuel tanks and lines.
<input checked="" type="radio"/>	Describe the theory of powertrain systems.
<input checked="" type="radio"/>	Describe the operational theory of brakes (wet and dry), torsion dampers, and torque converters.
<input checked="" type="radio"/>	Describe the operational theory of a final drive system.
<input type="radio"/>	Diagnose, disassemble, and reassemble various powertrain systems.
<input type="radio"/>	Diagnose, disassemble, and reassemble brakes (wet and dry), torsion dampers, and torque converters.
<input type="radio"/>	Diagnose, disassemble, and reassemble final drives and differential systems.
<input type="radio"/>	Service power take-off drives.
<input checked="" type="radio"/>	Describe air filtration systems.
<input checked="" type="radio"/>	Service air cleaners (dry and oil bath).
<input type="radio"/>	Inspect and repair intake and induction systems.
<input checked="" type="radio"/>	Describe the principles of heat transfer in liquid- and air-cooled engines.
<input checked="" type="radio"/>	Follow general safety precautions when maintaining cooling systems.
<input checked="" type="radio"/>	Check coolant levels.
<input checked="" type="radio"/>	Test radiator coolant.
<input type="radio"/>	Flush and clean radiator.
<input type="radio"/>	Test and replace thermostat systems.
<input type="radio"/>	Inspect and replace cooling system components.
<input checked="" type="radio"/>	Check the engine crankcase oil level.
<input checked="" type="radio"/>	Select appropriate lubricants based on quality and viscosity designations.
<input checked="" type="radio"/>	Change lubricants and filters.
<input checked="" type="radio"/>	Recycle engine oils.

<input checked="" type="radio"/>	Check the transmission or differential lubricant levels on equipment.
<input checked="" type="radio"/>	Check tire pressure, wear, and defects.
<input type="radio"/>	Drain and refill differentials.
<input type="radio"/>	Pack wheel bearings.
<input checked="" type="radio"/>	Describe the differences in the operation of gasoline and diesel engines.
<input type="radio"/>	Use dynamometers.
<input type="radio"/>	Test engine compression.
<input type="radio"/>	Remove, replace, and make operational the equipment power unit.
<input checked="" type="radio"/>	Follow general safety when servicing batteries.
<input checked="" type="radio"/>	Connect and disconnect jumper cables when boosting or charging a battery.
<input checked="" type="radio"/>	Clean battery terminals, cables, and boxes.
<input checked="" type="radio"/>	Replace a battery.
<input type="radio"/>	Measure the voltage of a battery, using a voltmeter.
<input type="radio"/>	Run a load test on a battery.
<input checked="" type="radio"/>	Describe the operating fundamentals of harvesting equipment.
<input type="radio"/>	Perform maintenance, diagnostic, and repair procedures on harvesting equipment.
<input type="radio"/>	Set up and adjust harvesting equipment prior to and during in-field use to optimize performance according to conditions.
<input checked="" type="radio"/>	Describe the fundamentals of machine operation, including tractor compatibility.
<input type="radio"/>	Identify laws associated with tillage, seeding, and chemical applications.
<input type="radio"/>	Demonstrate the ability to set up and adjust tillage, seeding, and chemical application equipment.
<input type="radio"/>	Perform maintenance, diagnostic, and repair procedures on tillage equipment.
<input type="radio"/>	Perform maintenance, diagnostic, and repair procedures on seeding equipment.
<input type="radio"/>	Perform maintenance, diagnostic, and repair procedures on chemical applications equipment.
<input checked="" type="radio"/>	Use modern communication technology.
<input checked="" type="radio"/>	Maintain departmental safety standards and operating procedures.

<input checked="" type="checkbox"/>	Maintain current inventory, using an electronic inventory system.
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Legend: Essential Non-essential Omitted

Note: Competencies 39-43 have been added to ensure compliance with federal legislation: National FFA Organization's Federal Charter Amendments Act (Public Law 116-7, <https://www.congress.gov/116/plaws/publ7/PLAW-116publ7.pdf>). All inquiries may be sent to cte@doe.virginia.gov. Students are provided opportunities for leadership, personal growth, and career success. Instruction is delivered through three major components: classroom and laboratory instruction, supervised agricultural experience (SAE) program, and student leadership (FFA).

Curriculum Framework

Task Number 39

Identify the role of supervised agricultural experiences (SAEs) in agricultural education.

Definition

Identification should include

- defining an SAE program as *an opportunity for students to consider multiple careers and occupations in the agriculture, food, and natural resources (AFNR) industries, learn expected workplace behavior, develop specific skills within an industry, and apply academic and occupational skills in the workplace or a simulated workplace environment*
- researching the Foundational SAE
 - career exploration and planning
 - personal financial planning and management
 - workplace safety
 - employability skills for college and career readiness
 - agricultural literacy
- researching the Immersion SAE
 - entrepreneurship/ownership
 - placement/internships
 - research (experimental, analytical, invention)
 - school business enterprises
 - service learning
- developing a plan to participate in an SAE, based on personal and career goals
- researching available awards and degrees, based on SAE participation.

Teacher resource: [SAE Resources](#), National Council for Agricultural Education

Process/Skill Questions

- What are examples of SAEs related to this course and in the AFNR industries?
- Where can a copy of the Virginia SAE Record Book be found?
- What is an Immersion SAE?
- How does a placement/internship SAE differ from an ownership/entrepreneurship SAE?
- How does an SAE provide relevant work experience and contribute to the development of critical thinking skills?
- How is the SAE an extended individualized instructional component of a student's Career Plan of Study?
- How can an SAE be used to provide evidence of student growth and participation in authentic, work-related tasks?
- What are the four types of SAEs?
- What are the advantages of participating in work-based learning experiences and projects?
- How does one choose an appropriate SAE in which to participate?

Task Number 40

Participate in an SAE.

Definition

Participation should include

- developing, completing, or continuing a plan to participate in an SAE as a work-based learning experience, based on personal and career goals
- documenting experience, connections, positions held, and competencies attained, using the *Virginia SAE Record Book*
- researching available awards and degrees, based on SAE participation.

Teacher resources:

[FFA SAE](#)

[The Agricultural Experience Tracker](#)

[Virginia SAE Record Book](#)

Process/Skill Questions

- What are the advantages of participating in work-based learning experiences and projects?
- How do SAEs help prepare students for the workforce?
- What are some examples of SAEs in AFNR?

Exploring Leadership Opportunities through FFA

Task Number 41

Identify the benefits and responsibilities of FFA membership.

Definition

Identification should include

- benefits
 - listing opportunities to participate in community improvement projects and career development events (CDEs) and leadership development events (LDEs)
 - exploring leadership development opportunities
- responsibilities
 - researching the responsibilities of FFA officers, committees, and members
 - locating resources that guide participation in FFA activities
 - explaining the FFA Creed, Motto, Salute, and mission statement
 - explaining the meaning of the FFA emblem, colors, and symbols
 - explaining significant events and the history of the organization.

Process/Skill Questions

- How does one become an FFA member?
- What is the FFA's mission and how does it accomplish its mission?
- What are the benefits and responsibilities of FFA membership?
- What five FFA activities are available through the local chapter?
- What are some significant events in FFA history? How have these events shaped membership over time?
- What is the FFA program of activities (POA), and how is it used?

Task Number 42

Describe leadership characteristics and opportunities as they relate to agriculture and FFA.

Definition

Description should include

- examples of successful leaders
- types of leadership
 - autocratic
 - participative
 - laissez-faire
 - servant
 - followership
- positive leadership qualities and traits of successful leaders

- opportunities for participating in leadership activities in FFA
- demonstrating methods for conducting an effective meeting.

Process/Skill Questions

- Who are some successful leaders in the agriculture industry?
- What qualities make a successful leader?
- What are leadership traits?
- What is the difference between positive and negative leadership?

Task Number 43

Apply for an FFA degree and/or an agricultural proficiency award.

Definition

Application should include

- identifying types of FFA degrees
 - Greenhand
 - Chapter
 - State
 - American
- identifying proficiency award areas
 - entrepreneurship
 - placement
 - combined
 - agriscience research
- exploring CDEs and LDEs related to this course
- identifying all SAE criteria to be eligible for the award
- identifying the type of award
- applying for an FFA award.

Teacher resource: [FFA Agricultural Proficiency Awards](#)

Process/Skill Questions

- Where are the awards and their application criteria located?
- What are the benefits of winning an FFA award?
- What are the benefits and requirements of an FFA degree?
- What FFA awards are available?
- How does the FFA degree program reward FFA members in all phases of leadership, skills, and occupational development?
- What is the highest degree that can be conferred upon an FFA member at the national level?
- What are the requirements for a Greenhand FFA degree?

Performing Customer Sales Duties

Task Number 44

Identify part numbers and place orders, using available resources.

Definition

Identification should include

- locating the part number either on the equipment or in the manual
- using the correct resources to order a new or replacement part.

Process/Skill Questions

- What skills are needed to accomplish this task?
- What information about the equipment is needed when ordering a part?
- What resources could be used to find the part number?

Task Number 45

Complete work orders, invoices, and requisitions for repairs.

Definition

Completion should include

- name of customer and his/her contact information
- description of complaint or damage
- equipment information
- name, description, and price of needed part(s)
- shipment information
- hourly and total charges for labor, sales tax, and total cost.

Process/Skill Questions

- Why is it necessary to fill out work orders? Invoices? Repair requisitions?
- Why is it important to keep track of labor hours worked?
- What information does an invoice contain?

Task Number 46

Maintain clean and orderly customer and parts areas.

Definition

Maintenance should include

- ensuring a neat and well-maintained office and storage area
- cleaning customer service, shop, and grounds areas
- demonstrating professional workplace/shop behavior and work habits

in accordance with instructor's guidelines.

Process/Skill Questions

- Why is it important to keep tools clean and organized?
 - What are examples of professional workplace/shop behavior? Work habits?
-

Task Number 47

Use effective communication skills to prepare written estimates of repairs and orally explain repairs and expenses to customers.

Definition

Use should include

- proper forms of address
- correct terminology, taking customer's background knowledge into account
- active listening skills
- an accurate description and explanation of repairs and estimated costs.

Process/Skill Questions

- What does the statement, "The customer is always right," mean?
- What methods of communication could be used with the customer?

Task Number 48

Complete an invoice.

Definition

Completion should include

- date
- name of business

- address
- contact number and/or fax number
- itemized charges for service and/or parts
- total price.

Process/Skill Questions

- Why is it important to have both the customer and the employee sign and date the sales slip?
- Why should the business keep a copy of the sales slip?

Applying Safety Practices in the Agricultural Mechanics Lab/Workshop

Task Number 49

Identify marked safety areas.

Definition

Identification should include describing and translating signage and special markings (e.g., floor paint) that identify work and caution areas.

Process/Skill Questions

- What are the different types of work zones?
 - How do you know if additional safety equipment or clothing is needed to enter a safety area?
 - How are walkways identified in the lab/workshop area?
-

Task Number 50

Identify the location and use of eye wash stations.

Definition

Identification should include describing the signage and operating procedures for the unit.

Process/Skill Questions

- What is the color of the sign that signifies an eye wash station?
- When should you use an eye wash station?

- What safety equipment provides additional eye protection?
-

Task Number 51

Identify the location of the posted evacuation routes.

Definition

Identification should include

- events that could trigger an evacuation
- the location and interpretation of the posted evacuation route
- the destination and procedures for evacuation.

Process/Skill Questions

- What route should be followed in the event of an evacuation?
 - Where is the evacuation route posted?
 - Why is it important to establish a meeting place in the case of an evacuation?
-

Task Number 52

Locate and demonstrate knowledge of safety data sheets (SDS).

Definition

Demonstration should include identifying

- the location of the sheets within the agricultural mechanics lab/workshop and the purpose they serve
- the administration's (ownership's) responsibility for workers' health and safety
- laws/regulations and practices affecting workers' health and safety
- health and safety hazards
- health and safety programs the responsibility for environmental stewardship
- environmental laws, regulations, and practices
- sustainability initiatives.

Process/Skill Questions

- What environmental concerns should an industry address?
- What environmentally friendly practices and resources are available to an industry?
- What methods can be used to motivate employees to become involved in effective health, safety, and environmental practices?

Task Number 53

Demonstrate the safe use of chemicals.

Definition

Demonstration should include the different types of solvents, soaps, cleaning solutions, fuel, oils, greases, specialty additives, and gasses.

Demonstration should also emphasize the correct use, the hazards, and the precautions associated with each, in accordance with manufacturers' instructions and government regulations.

Process/Skill Questions

- Why is it important to read the manufacturer's directions when using chemicals?
- What may be the effects of using chemicals incorrectly?
- Where should chemicals be stored within the lab/workshop?
- What is an SDS?

Task Number 54

Demonstrate the safe use of standard and metric hand tools.

Definition

Demonstration should include the various types of hand tools (including specialty tools, fasteners, and measuring tools) used in agricultural mechanics. Demonstration should emphasize the correct use, the hazards, the precautions, and the maintenance procedures associated with each, in accordance with manufacturers' instructions and government regulations. Hand tools should include

- common end wrenches
- various socket set components
- various wrenches
- various screwdrivers
- various styles of pliers
- various hammers
- various punches and chisels
- specialty cutting tools (e.g., hack saw, tubing cutter, hand reamer, file)
- specialty electrical system tools (e.g., volt/ohmmeter, dwell/tachometer, continuity light, timing light, remote starter switch)
- battery specialty tools (e.g., cable puller, terminal and post cleaner, battery lifting or carrying strap)
- lubrication specialty tools (e.g., transmission funnel, oil filter-removing tool, grease gun)
- other miscellaneous specialty tools (e.g., air nozzles, C-clamp, puller set, pressure gauge, screw extractor).

Process/Skill Questions

- Why is it important to use the proper hand tool for each job?
 - When a wrench is used, why should it always be pulled toward the body?
 - Why is it necessary to keep hand tools clean and free of grease?
-

Task Number 55

Demonstrate the safe use of power tools.

Definition

Demonstration should include the various types of power tools (including pneumatic and electric tools) encountered in agricultural mechanics.

Demonstration should emphasize the correct use, the hazards, the precautions, and the maintenance procedures associated with each, in accordance with manufacturers' instructions and government regulations. Power tools should include

- air impact gun
- air hammer
- air ratchet
- air drill
- drop light
- electric drill
- electric grinder.

Process/Skill Questions

- What is the purpose of a dead man switch and/or kill switch on power tools? What is the purpose of an emergency stop (e-stop) or emergency power off (EPO) on power tools?
 - When should adjustments be made to power tools?
 - Why is training on the use of a power tool necessary before using it?
-

Task Number 56

Demonstrate the safe use of precision standard and metric measuring tools.

Definition

Demonstration should include micrometers, dial indicators, torque wrenches, and other manufacturers' specialty tools.

Process/Skill Questions

- How does heat affect the micrometer?
 - Why are standard and quality tools necessary when repairing agricultural machinery and equipment?
 - What is torque? Why is proper torque important?
-

Task Number 57

Demonstrate the safe use of protective clothing and equipment.

Definition

Demonstration should include the types of protective clothing and equipment (e.g., protection of the eyes, respiratory system, auditory functions, feet, hands, and body) and grooming/hygiene (e.g., precautions related to hair length; loose clothing/jewelry; greasy hands, shoes, or clothing; dirty or scratched eye protection).

Demonstration should include the correct use, the hazards, and the precautions associated with each, in accordance with manufacturers' instructions and government regulations concerning hazardous material and lab safety.

Process/Skill Questions

- What hazards exist due to loose-fitting clothing or long hair?
 - When is it advisable to use goggles in an agricultural mechanics lab/workshop?
 - Would it ever be necessary to wear ear protection in an agricultural mechanics lab/workshop?
 - Why are steel-toed boots and shoes worn in agricultural mechanics labs/workshops?
-

Task Number 58

Demonstrate safe use of fire protection equipment.

Definition

Demonstration should include

- different types of fires encountered in the agricultural science and mechanics field (Class A, B, C, and D)
- appropriate types of extinguishers to use with each fire
- hazards and the precautions associated with each
- fire emergency procedures that follow government regulations and instructor's guidelines.

Process/Skill Questions

- What are the different types of fire extinguishers?
- Is the fire extinguisher in your lab/workshop appropriate for all types of fires? Explain.

- What procedure should students follow in case of an emergency or accident?
-

Task Number 59

Demonstrate the safe use of equipment.

Definition

Demonstration should include the different types of equipment used in the agricultural mechanics field, along with the correct use, the hazards, and the precautions associated with each, in accordance with manufacturer's specifications and instructor's guidelines. Equipment should include

- pneumatic equipment (e.g., tire machine, pneumatic jack)
- hydraulic equipment (e.g., floor jack, lift rack, hydraulic press, engine hoist)
- electrical equipment (e.g., bench grinder, drill press, battery testers and chargers).

Process/Skill Questions

- What are unsafe uses of air compressors in the agricultural lab/workshop?
 - What is the safest way to hold a part in a vise?
 - When is the cleaning tank used?
-

Task Number 60

Demonstrate safe practices in the agricultural mechanics lab/workshop.

Definition

Demonstrating safe practices must include

- passing written tests with 100% accuracy on
 - general lab/workshop safety
 - safety and operating procedures for all tools, equipment, and machinery
 - the major parts of all tools, equipment, and machinery
- passing a proficiency/performance test with 100% accuracy for all tools, equipment, and machinery
- following manufacturer's instructions and reviewing safety manuals, when applicable
- following all safety guidelines and procedures when using tools, equipment, and machinery in the agricultural mechanics lab/workshop
- selecting appropriate personal protective equipment (PPE) for the operation of concern
- following the safety standards and regulations of the U.S. Environmental Protection Agency (EPA), Occupational Safety and Health Administration (OSHA), the Equipment and Engine Training Council (EETC) Education Committee, and Safety Data Sheets (SDS).

Process/Skill Questions

- What information should be sent with emergency responders to the hospital with the student if a chemical is splashed in an eye or wound?
- Are state and national safety standards followed in school labs/workshops? Explain.
- What agency requires labs/workshops and businesses to use the services of companies such as Safety Clean?
- What are the dangers of running an engine in a confined space without proper ventilation?
- Why is it important to achieve 100% accuracy on tests regarding safety and operating procedures before using tools, equipment, and machinery?

Performing General Mechanical Maintenance Skills and Procedures

Task Number 61

Demonstrate safe use of maintenance equipment.

Definition

Demonstration should include

- operating hand tools safely and correctly
- following manufacturer's instructions for all equipment.

Process/Skill Questions

- Why is it important to follow safety procedures with equipment?
- Why is it important to report any damaged or broken equipment to the instructor?

Task Number 62

Maintain equipment according to manufacturer's instructions.

Definition

Maintenance should include

- use of resources to obtain manufacturer's specifications
- use of diagnostic equipment
- selection and use of measuring tools
- demonstration of proper torquing procedures

- performing repairs and adjustments, as needed.

Process/Skill Questions

- How can equipment adjustments be located quickly in the manual?
- What is an example of an adjustment that would have to be made to equipment?
- What is an example of a repair that would have to be made to equipment?

Task Number 63

Compile a list of parts and supplies necessary to complete a repair or maintenance task.

Definition

Compilation should include

- planning the repair or maintenance task
- identifying parts and supplies needed for the planned task
- gathering all necessary parts, supplies, and tools.

Process/Skill Questions

- What should be the first concern when planning a repair or maintenance task?
 - Why is it important to know what is needed before beginning the repair or maintenance task?
-
-

Performing Welding/Cutting Operations

Task Number 64

Perform welding operations.

Definition

Performance could include

- using oxyfuel gas welding
- using shielded metal arc welding (SMAW), gas metal arc welding (GMAW), or gas tungsten arc welding (GTAW).

Process/Skill Questions

- What ventilation precautions should be taken?
 - How is welding with oxyfuel gas torches different from welding with electrical equipment?
-

Task Number 65

Weld with oxyfuel gas welding equipment.

Definition

Welding should include

- adhering to oral and written instructions
- wearing personal protective equipment (PPE)
- setting gauge(s)
- choosing the correct welding rod material (e.g., bronze, brass, lead)
- applying principles of operation.

Process/Skill Questions

- How do you determine which rod material to use?
 - What PPE should be worn when welding?
-

Task Number 66

Cut metals, using oxyfuel gas, plasma arc, and other techniques.

Definition

Cutting should include

- adhering to welding assignment
- following all specified safety procedures
- wearing PPE
- using different cutting techniques
- examining cut surfaces
- shutting down equipment.

Process/Skill Questions

- Why are so many ways to cut metal needed?
- Why is it important to always perform a leak test before using a torch?

Applying Protective Coatings

Task Number 67

Prepare equipment for painting.

Definition

Preparation should include

- sanding to remove old paint
- cleaning to prepare the surfaces
- masking to cover areas not being painted.

Process/Skill Questions

- What PPE should be used when painting?
- What are some examples of masking materials?
- What is the best method for removing rust?

Task Number 68

Select and apply protective coatings.

Definition

Procedure should include choosing the appropriate protective coating for the job and following the manufacturer's instructions.

Process/Skill Questions

- When should protective coatings be applied?
- What are the steps for applying protective coatings?
- What is the value of protective coatings?

Task Number 69

Prepare a steam and/or high-pressure washer.

Definition

Preparation should include

- following safety precautions with electricity, chemicals, and water
- setting up and taking down in accordance with manufacturer's instructions
- wearing PPE.

Process/Skill Questions

- What precautions should be used when using a steam or high-pressure washer?
 - What is the purpose of a steam washer? High-pressure washer?
-

Task Number 70

Clean equipment with a steam cleaner and/or high-pressure washer.

Definition

Cleaning should include

- using safety with electricity, hot water, and hot parts
- covering critical parts
- disposing of runoff chemicals and grease.

Process/Skill Questions

- What PPE should be used when cleaning equipment?
 - What damage can occur due to improper use of a steam cleaner or high-pressure washer?
-
-

Maintaining and Servicing Agricultural Mechanical Systems

Task Number 71

Describe the fundamental principles of agricultural mechanical systems.

Definition

Description should include

- hydraulic
- electrical (ignition/starting/charging)
- pneumatic
- fuel
- powertrains (e.g., clutches, differentials, transmissions, axles)
- coolant
- air intake
- lubrication
- heating, ventilation, and air conditioning (HVAC).

Task Number 72

Perform basic service and maintenance tasks on agricultural mechanical systems.

Definition

Performance should include the following systems:

- hydraulic
- electrical (ignition/starting/charging)
- pneumatic
- fuel
- powertrains (e.g., clutches, differentials, transmissions, axles)
- coolant
- air intake
- lubrication
- HVAC

Task Number 73

Perform diagnosis and troubleshooting tasks for agricultural mechanical systems.

Definition

Performance should include the following systems:

- hydraulic
- electrical (ignition/starting/charging)
- pneumatic
- fuel
- powertrains (e.g., clutches, differentials, transmissions, axles)
- coolant
- air intake
- lubrication
- HVAC

Task Number 74

Describe basic operating principles of pneumatics.

Definition

Description should include

- list of pneumatic operating procedures
- use of air or other gases to transfer force
- systems are simple, compact, and flexible.

Process/Skill Questions

- What are pneumatics?
- What are pneumatic cylinders?

Task Number 75

Calculate hydraulic pressure and force, using Pascal's law.

Definition

Calculation should include computing hydraulic pressure and force with the equation $P = F/A$. Whereas, $P =$ pressure, $F =$ force, and $A =$ area.

Process/Skill Questions

- What is Pascal's law?
- What is the difference between force and pressure?

Task Number 76

Describe the operation of open and closed center hydraulic systems.

Definition

Description should include

- how to adjust open and closed center hydraulic systems
- following manufacturer's instructions to diagnose problems.

Process/Skill Questions

- What is the difference between open and closed center systems?
- What applications require open center systems? Closed center systems?

Task Number 77

Describe the theory of hydraulic pumps and motors.

Definition

Description should include the following:

- Hydraulic pumps supply fluid to the other parts of the hydraulic system. There are different types of hydraulic pumps (e.g., gear, vane, piston).
- Hydraulic motors receive the power from moving fluid and can convert the power of fluid under pressure into a rotary power.

Process/Skill Questions

- How do hydraulic systems work?
- How is the motor size related to the pump size?
- What is meant by positive displacement?

Task Number 78

Disassemble and repair a hydraulic component following the technical manual's instructions.

Definition

Demonstration should include executing an overhaul of a hydraulic component, following the technical manual's instructions and instructor's guidelines.

Process/Skill Questions

- How is a hydraulic component repaired?
- What safety precautions should be used when disassembling a hydraulic component?

Task Number 79

Use a flow meter and test gauge to measure the performance of a hydraulic system.

Definition

Use should include

- calibrating the meter and gauge
- applying the meter and gauge according to manufacturers' specifications.

Process/Skill Questions

- What is a flow meter, and why is it used?
- What would cause a low flow rate?
- What test gauges would be used to measure the performance of a hydraulic system?

Task Number 80

Troubleshoot and repair a hydraulic-assist transmission.

Definition

Demonstration should include

- performing diagnostic tests
- repairing hydraulic-assist transmission according to manufacturer's instructions.

Process/Skill Questions

- What are some common repairs needed for a hydraulic-assist transmission?
- What steps would be used to diagnose problems in a hydraulic-assist transmission?

Task Number 81

Troubleshoot and repair hydrostatic drives.

Definition

Demonstration should include

- performing diagnostic tests
- repairing hydrostatic drives according to manufacturer's instructions.

Process/Skill Questions

- What are the most common repairs for a hydrostatic transmission?

- What steps would be used to diagnose problems in a hydrostatic transmission?

Maintaining and Servicing Electrical/Ignition Circuits

Task Number 82

Interpret electrical schematics.

Definition

Interpretation should include explaining drawings, including symbols, using terminology.

Process/Skill Questions

- What is an electrical schematic?
- What is the difference between a schematic and a diagram?
- What is used to represent the components in each schematic?

Task Number 83

Use electrical diagrams to locate components on equipment.

Definition

Use should include labeling electrical components on the diagrams.

Process/Skill Questions

- How are electrical diagrams interpreted?
- How does the schematic help to determine the correct way to connect the components?

Task Number 84

Recognize and test electrical components and devices.

Definition

Procedures should include identifying, analyzing, and testing electrical components and devices, using an appropriate meter.

Process/Skill Questions

- What tools are needed to test electrical components?
- What safety precautions should always be followed when testing electrical components?

Task Number 85

Diagnose electrical systems, using schematics.

Definition

Diagnosis should include

- locating the schematic for the electrical system
- checking the components that might be causing the problem in an orderly fashion.

Process/Skill Questions

- What test equipment should be used to diagnose systems?
- How are electrical schematics interpreted?

Task Number 86

Follow diagnostic and repair procedures.

Definition

Demonstration should include applying standard diagnostic and repair procedures to check and adjust systems as needed.

Process/Skill Questions

- Why is it important to follow standard diagnostic and repair procedures?
- What safety precautions must be followed when repairing systems?

Maintaining and Servicing the Charging Circuit

Task Number 87

Test the charging circuit.

Definition

Test should include operating a voltmeter, ammeter, and/or carbon pile to analyze the charging system.

Process/Skill Questions

- What is a carbon pile?
- How is a voltmeter used to test the output of a charging circuit?
- How is an ammeter used to test the output of a charging circuit?

Task Number 88

Replace an amperage gauge.

Definition

Demonstration should include

- following manufacturer's instructions for replacement
- testing the new gauge in the circuit.

Process/Skill Questions

- What is an amperage gauge?
- What is the difference between a voltmeter and an amperage gauge?
- How is an amperage gauge connected in the circuit?

Task Number 89

Check the armature and fields of charging circuits.

Definition

Check should include identifying the armature and positive and negative fields.

Process/Skill Questions

- What are electrical fields?
- How is the armature checked for a complete circuit?

Maintaining and Servicing the Starting Circuit

Task Number 90

Troubleshoot the ignition switch.

Definition

Troubleshooting should include

- following the manufacturer's directions
- identifying why the ignition switch will not work
- making necessary adjustments or repairs.

Process/Skill Questions

- How does an ignition switch work?
- What type of testing device would be used to test the ignition switch?

Task Number 91

Troubleshoot the safety switch.

Definition

Troubleshooting should include

- following the manufacturer's directions
- identifying why safety switch will not work
- making necessary adjustments or repairs.

Process/Skill Questions

- What are some symptoms of a faulty safety switch?
- What does a safety switch do?

Task Number 92

Troubleshoot the solenoid.

Definition

Troubleshooting should include

- following the manufacturer's directions
- identifying why the solenoid will not work
- making necessary adjustments or repairs.

Process/Skill Questions

- What is a solenoid?
- What is the purpose of a solenoid in a starting circuit?

Task Number 93

Troubleshoot glow plugs on diesel engines.

Definition

Troubleshooting should include

- following the manufacturer's directions
- identifying why glow plugs will not work
- making necessary adjustments or repairs.

Process/Skill Questions

- What function do glow plugs have?
- What are some symptoms of bad glow plugs?

Task Number 94

Troubleshoot the starter.

Definition

Troubleshooting should include

- following the manufacturer's directions
- identifying why starter will not work
- making necessary adjustments or repairs.

Process/Skill Questions

- What would cause a starter to fail?
- How can a faulty starter be tested?

Task Number 95

Replace defective parts of the starting circuit.

Definition

Replacement should include

- following the manufacturer's directions

- executing the exchange of faulty parts.

Process/Skill Questions

- How are starter circuit parts replaced?
- What is the first thing to be done before replacing any components in a starting circuit?

Maintaining and Servicing Fuel Systems

Task Number 96

Describe the operation of the components of a fuel system.

Definition

Description should include

- fuel cap
- fuel tank
- fuel pump
- fuel lines
- fuel filter
- fuel injectors or carburetor
- positive crankcase ventilation (PCV) valve
- crankcase ventilation (CCV) filter
- air filter
- mass airflow sensor
- powertrain control module.

Process/Skill Questions

- How many types of fuels are used in internal combustion engines?
- What determines the best fuel for an application?

Task Number 97

Describe the operating principles and maintenance of carburetors.

Definition

Description should include identifying how a carburetor works (i.e., fuel is pumped to the carburetor and it mixes the fuel with air) and how to take care of it (e.g., adjustments, overhaul kit).

Process/Skill Questions

- What is meant by *carburetor overhaul*?
- What determines the air-to-fuel ratio in a carburetor?
- How can the carburetor be adjusted?
- Why would adjustments need to be made?

Task Number 98

Perform diagnostic and repair procedures on various fuel systems.

Definition

Performance should include

- following manufacturer's instructions
- troubleshooting for possible problems
- repairing or replacing as needed.

Process/Skill Questions

- How are various fuel systems different?
- Which fuel system would need the higher fuel pressure to operate? Why?

Task Number 99

Describe the operating principles and maintenance of a high-pressure fuel injector.

Definition

Description should include

- purpose of fuel injectors—add fuel to the air
- types of fuel injectors
 - throttle body—one fuel injector is used to supply fuel to all of the engine's cylinders
 - port—there is one fuel injector for each cylinder
- how to maintain them according to manufacturer's specifications.

Process/Skill Questions

- Why have fuel injectors become more popular in vehicles?
- What symptoms would the engine exhibit when the fuel injector is clogged?

Task Number 100

Perform service to diesel fuel systems.

Definition

Performance should include

- following manufacturer's instructions for scheduled maintenance
- checking the various systems
 - engine
 - cooling
 - fuel
 - hydraulic
 - chassis.

Process/Skill Questions

- What are the differences between a diesel and a gas fuel system?
- What would be the procedures to replace the filters in a diesel system?
- What is the function of the injector pump on a diesel system?

Task Number 101

Service fuel tanks and lines.

Definition

Service should include

- checking the tanks and lines for damage
- cleaning the tanks and lines.

Process/Skill Questions

- Why is it important to service fuel tanks and lines?
 - What is the best way to remove rust from the inside of a fuel tank?
-
-

Maintaining and Servicing the Powertrain

Task Number 102

Describe the theory of powertrain systems.

Definition

Description may include

- definition of *powertrain*
- purpose of a powertrain
- components of a powertrain system
- development of the powertrain for different types of engines and the trends that followed.

Process/Skill Questions

- What is the difference between a powertrain and a drivetrain?
- What are the major components of a powertrain?

Task Number 103

Describe the operational theory of brakes (wet and dry), torsion dampers, and torque converters.

Definition

Description should include outlining the function and the components of brakes, torsion dampers, and torque converters.

Process/Skill Questions

- What would determine the stopping power of a braking system?
- What is the difference between a wet and a dry brake system?

Task Number 104

Describe the operational theory of a final drive system.

Definition

Description should include outlining the function and the components of the final drive system.

Process/Skill Questions

- What determines the output speed of the final drive system?
- What are the various types of final drive systems?

Task Number 105

Diagnose, disassemble, and reassemble various powertrain systems.

Definition

Procedures should include

- troubleshooting
- disassembling
- reassembling

various powertrain systems.

Process/Skill Questions

- What types of measuring devices would be used to determine defective parts?
 - When inspecting parts, what visual defects could be expected?
-

Task Number 106

Diagnose, disassemble, and reassemble brakes (wet and dry), torsion dampers, and torque converters.

Definition

Procedures should include

- troubleshooting
- disassembling
- reassembling

brakes, torsion dampers, and torque converters.

Process/Skill Questions

- How is the measurement of wear on wet and dry brakes determined?
 - What troubleshooting steps should be completed for torque converters?
-

Task Number 107

Diagnose, disassemble, and reassemble final drives and differential systems.

Definition

Procedures should include

- troubleshooting
- disassembling
- reassembling

final drives and differential systems.

Process/Skill Questions

- What is a differential?
 - What determines the differential output ratio?
-

Task Number 108

Service power take-off drives.

Definition

Service should include performing maintenance and repairs on power take-off drives, according to manufacturer's instructions.

Process/Skill Questions

- How are power take-off drives serviced?
- What precautions should be taken when taking off a power take-off drive?

Maintaining and Servicing the Air Intake System

Task Number 109

Describe air filtration systems.

Definition

Description should include labeling how air filtration systems work and why they are necessary.

Process/Skill Questions

- Why does air need to be filtered?
- What are different filtering methods?

Task Number 110

Service air cleaners (dry and oil bath).

Definition

Service should include cleaning and/or replacing the filter.

Process/Skill Questions

- What is the difference between a dry filter and an oil bath filter?
 - How is an oil bath filter serviced?
-

Task Number 111

Inspect and repair intake and induction systems.

Definition

Procedures should include

- checking all seals and gaskets
- repairing when necessary.

Process/Skill Questions

- What is an induction system?
 - What could happen when a seal goes bad?
-
-

Maintaining and Servicing the Cooling System

Task Number 112

Describe the principles of heat transfer in liquid- and air-cooled engines.

Definition

Description should include labeling how heat is reduced and/or removed from engines.

Process/Skill Questions

- How does heat leave an engine?
- What is the purpose of adding antifreeze to the cooling system?

Task Number 113

Follow general safety precautions when maintaining cooling systems.

Definition

Procedure should include complying with all safety rules at all times and following the instructor's and manufacturer's guidelines.

Process/Skill Questions

- What safety issues are present when working on cooling systems?
- What PPE should be worn when servicing a cooling system?

Task Number 114

Check coolant levels.

Definition

Check should include maintaining coolant levels at all access points according to manufacturer's specifications.

Process/Skill Questions

- Where are the coolant levels checked?
 - Should the coolant level be tested when hot or cold? Explain.
-

Task Number 115

Test radiator coolant.

Definition

Test should include looking at the overflow tank next to the radiator to see if there is enough coolant. Note: Most tanks have markings on the side to indicate the high and low levels of coolant needed.

Process/Skill Questions

- How can one determine the quality of the coolant?
 - What test instruments are used to determine whether the coolant meets manufacturer's specifications?
 - What safety precautions should be taken if coolant is spilled?
-

Task Number 116

Flush and clean radiator.

Definition

Procedures should include using techniques to empty and properly refill a radiator according to manufacturer's specifications.

Process/Skill Questions

- What precautions should be used when disposing of coolant?
 - What steps should be followed when flushing a cooling system?
-

Task Number 117

Test and replace thermostat systems.

Definition

Procedures should include

- removing the thermostat
- conducting a thermostat test
- making repairs as needed.

Process/Skill Questions

- What is a thermostat? What function does it serve?
 - What steps are used to replace a thermostat?
-

Task Number 118

Inspect and replace cooling system components.

Definition

Procedures should include

- servicing all hoses and fittings
- replacing as needed.

Process/Skill Questions

- What should be looked for when inspecting a cooling system?
 - How often should the cooling system be inspected?
-
-

Maintaining and Servicing the Lubrication System

Task Number 119

Check the engine crankcase oil level.

Definition

Check should include calibrating oil levels in the appropriate manner according to manufacturer's specifications.

Process/Skill Questions

- How often should the oil be checked?
 - What steps are used to check the oil?
-

Task Number 120

Select appropriate lubricants based on quality and viscosity designations.

Definition

Selection should comply with the engine manufacturer's specifications.

Process/Skill Questions

- What is *viscosity*?
 - What determines the different ratings of oil?
 - What are the advantages of a synthetic oil?
-

Task Number 121

Change lubricants and filters.

Definition

Change should include following manufacturer's specifications.

Process/Skill Questions

- Why is it necessary to change lubricants?
 - What are the steps for changing lubricants and filters?
-

Task Number 122

Recycle engine oils.

Definition

Recycling should include locating a recycling center and taking used oil there.

Process/Skill Questions

- What is the best way to store used motor oil before recycling?
- What are the environmental hazards of not disposing of oil correctly?

Maintaining and Servicing Differentials, Transmissions, and Axles

Task Number 123

Check the transmission or differential lubricant levels on equipment.

Definition

Check should include calibrating oil levels according to manufacturer's specifications.

Process/Skill Questions

- How is the transmission fluid level checked on equipment?
 - How are differential lubricant levels checked on equipment?
 - How is the correct lubricant determined for use in a specific a transmission?
-

Task Number 124

Check tire pressure, wear, and defects.

Definition

Check should include performing maintenance of air pressure and wear following manufacturer's specifications. It should also include identifying defects on tires.

Process/Skill Questions

- What does *PSI* mean?
 - How would too much tire pressure affect the tire? How would too little tire pressure affect the tire?
-

Task Number 125

Drain and refill differentials.

Definition

Draining and refilling differentials should include emptying and installing new fluids according to manufacturer's specifications.

Process/Skill Questions

- How is differential fluid changed?
- Based on the removed lubricant, what is a visual symptom of a bad differential?

Task Number 126

Pack wheel bearings.

Definition

Packing should include lubricating the wheel bearings with proper grease.

Process/Skill Questions

- How is grease packed into bearings?
 - What can happen if too much grease is put into the wheel bearings?
-
-

Testing, Servicing, and Repairing the Power Unit

Task Number 127

Describe the differences in the operation of gasoline and diesel engines.

Definition

Description should include listing the operating principles of gasoline engines and diesel engines.

Process/Skill Questions

- How are gasoline and diesel engines different?
- Why is the compression of a diesel engine higher than a gasoline engine?

Task Number 128

Use dynamometers.

Definition

Use should include performing horsepower and torque tests on engines.

Process/Skill Questions

- What is a dynamometer?
- How does a dynamometer measure horsepower? Torque?
- What is the difference between horsepower and torque?

Task Number 129

Test engine compression.

Definition

Testing should include performing a compression test on each cylinder.

Process/Skill Questions

- Why is compression important to operation?
 - What are causes of low compression?
-

Task Number 130

Remove, replace, and make operational the equipment power unit.

Definition

Procedures should include manipulating an engine exchange.

Process/Skill Questions

- How is a power unit removed?
 - What safety precautions should be followed when removing a power unit?
-
-

Maintaining and Servicing Storage Battery

Task Number 131

Follow general safety when servicing batteries.

Definition

Procedure should include

- inspecting the battery for any damage
- disconnecting the battery ground wire before charging
- following manufacturer's specifications
- wearing PPE.

Process/Skill Questions

- Why would a battery need to be serviced?
- Why is it important to wear eye protection when working with batteries?
- What is a hydrometer?

Task Number 132

Connect and disconnect jumper cables when boosting or charging a battery.

Definition

Connection should include installing jumper cables according to the vehicle manufacturer's specifications. It should include the following steps:

- Make sure all electrical devices are off before connecting cables.
- Put the red jumper cable on the positive terminal of the dead battery and the other end on the positive terminal of the good battery.
- Put the black jumper cable on the engine block or frame of the dead battery and the other end on the negative terminal of the good battery.
- Turn the key in the ignition of the “dead” car
- Disconnect the jumper cables.

Process/Skill Questions

- What possible problems could occur if the cables are not hooked up correctly?
- How are the jumper cables disconnected?

Task Number 133

Clean battery terminals, cables, and boxes.

Definition

Cleaning should include removing all corrosion from battery terminals, cables, and boxes.

Process/Skill Questions

- When should the battery terminals be cleaned?
 - What is used to clean the battery?
 - What protective clothing should be worn when cleaning the terminals, cables, and boxes?
-

Task Number 134

Replace a battery.

Definition

Replacement should include

- selecting the correct battery for replacement
- removing the old battery for core replacement
- adjusting cables and clamps to proper torque, according to manufacturer's specifications.

Process/Skill Questions

- How tight should cables and clamps be?
 - What safety precautions should be taken when tightening battery cables and hold-down clamps?
 - What should be looked for when visually inspecting the battery cables and hold-down clamps?
-

Task Number 135

Measure the voltage of a battery, using a voltmeter.

Definition

Measurement should include calibrating the battery voltage by attaching voltmeter leads to the appropriate battery terminals.

Process/Skill Questions

- What reading should one get from a properly charged battery?
- Is a good battery determined only by a proper voltage? Why, or why not?

Task Number 136

Run a load test on a battery.

Definition

Run should include checking voltage on battery while the battery is doing work.

Process/Skill Questions

- What is a load test?
- How would a defective battery respond during a load test?

Maintaining and Servicing Harvesting Systems

Task Number 137

Describe the operating fundamentals of harvesting equipment.

Definition

Description should include giving examples of how different harvest equipment works.

Process/Skill Questions

- How is harvesting equipment operated?
- What are the different purposes of harvesting equipment?

Task Number 138

Perform maintenance, diagnostic, and repair procedures on harvesting equipment.

Definition

Procedures should include troubleshooting, fixing, and maintaining harvesting equipment according to manufacturer's specifications.

Process/Skill Questions

- What maintenance should be done on harvesting equipment?
- When should preventative maintenance be performed on harvesting equipment?

Task Number 139

Set up and adjust harvesting equipment prior to and during in-field use to optimize performance according to conditions.

Definition

Procedures should include calibrating equipment to maximize yields.

Process/Skill Questions

- How is harvesting equipment set up to optimize field use?
 - What safety precautions should be observed when adjusting harvesting equipment?
-
-

Maintaining and Servicing Tillage, Seeding, and Chemical Application Systems

Task Number 140

Describe the fundamentals of machine operation, including tractor compatibility.

Definition

Description should include outlining how to operate machines and listing how to match tractor to implement.

Process/Skill Questions

- What are the fundamentals of machine operations?
- What would determine the size of the tractor needed to operate the implement?

Task Number 141

Identify laws associated with tillage, seeding, and chemical applications.

Definition

Identification should include listing the federal, state, and local government laws and the agencies that govern tilling, seeding, and chemical application.

Process/Skill Questions

- Who should be contacted to get up-to-date information about tillage, seeding, and chemical application laws?
- Who is responsible for ensuring these laws are followed?
- What are the certification categories (e.g., private applicator, commercial applicator, registered technician)?

Task Number 142

Demonstrate the ability to set up and adjust tillage, seeding, and chemical application equipment.

Definition

Demonstration should include assembling and calibrating tillage equipment (e.g., roto tillers, discs), seeding equipment (e.g., drills, broadcasters), and chemical applicators (e.g., sprayers, foggers, spreaders).

Process/Skill Questions

- How is tillage equipment adjusted?
 - What determines the speed of operation of the equipment?
-

Task Number 143

Perform maintenance, diagnostic, and repair procedures on tillage equipment.

Definition

Procedures should include servicing, troubleshooting, and fixing tillage equipment (e.g., grease fittings or repair tines on tiller).

Process/Skill Questions

- What maintenance should be performed on tillage equipment?
 - How is the use of lubricant determined?
-

Task Number 144

Perform maintenance, diagnostic, and repair procedures on seeding equipment.

Definition

Procedures should include servicing, troubleshooting, and fixing seeding equipment (e.g., grease fittings, replace drill heads).

Process/Skill Questions

- What maintenance should be performed on seeding equipment?
 - How is a drill head replaced?
-

Task Number 145

Perform maintenance, diagnostic, and repair procedures on chemical applications equipment.

Definition

Procedures should include servicing, troubleshooting, and fixing chemical applicators (e.g., replace faulty nozzles, grease bearings).

Process/Skill Questions

- What maintenance should be performed on chemical application equipment?
 - What safety procedures should be followed when repairing chemical applicator equipment?
-
-

Performing Administrative and Clerical Duties

Task Number 146

Use modern communication technology.

Definition

Use should include procedures for written, verbal, and electronic communications, along with appropriate use of electronic media.

Process/Skill Questions

- Why is it important to be able to use current communication technology?
 - What duties would require using communication technology?
 - How can improper use of electronic media impact employment status?
-

Task Number 147

Maintain departmental safety standards and operating procedures.

Definition

Maintenance should include

- using safety standards (e.g., OSHA regulations) in the classroom or lab
- conducting regular inspections of equipment and work areas
- identifying and exhibiting attitudes and habits appropriate for work
- developing an emergency action plan.

Process/Skill Questions

- Who is responsible for maintaining safety standards?
- How can failure to adhere to safety standards affect operating procedures?

Task Number 148

Maintain current inventory, using an electronic inventory system.

Definition

Maintenance should include keeping a list of supplies and equipment and conducting a physical count.

Process/Skill Questions

- What are the advantages and disadvantages of maintaining inventory records electronically?
 - Why must the inventory always be kept up-to-date?
-

SOL Correlation by Task

39	Identify the role of supervised agricultural experiences (SAEs) in agricultural education.	English: 10.3, 10.5, 11.3, 11.5, 12.3, 12.5
40	Participate in an SAE.	English: 10.5, 10.8, 11.5, 11.8, 12.5, 12.8
41	Identify the benefits and responsibilities of FFA membership.	English: 10.5, 10.6, 10.7, 10.8, 11.5, 11.6, 11.7, 11.8, 12.5, 12.6, 12.7, 12.8
42	Describe leadership characteristics and opportunities as they relate to agriculture and FFA.	English: 10.5, 11.5, 12.5 History and Social Science: VUS.8, VUS.9, VUS.10, VUS.11, WHII.8, WHII.10, WHII.11
43	Apply for an FFA degree and/or an agricultural proficiency award.	English: 10.5, 11.5, 12.5
44	Identify part numbers and place orders, using available resources.	English: 10.5, 11.5, 12.5 Mathematics: A.1, A.4
45	Complete work orders, invoices, and requisitions for repairs.	
46	Maintain clean and orderly customer and parts areas.	
47	Use effective communication skills to prepare written estimates of repairs and orally explain repairs and expenses to customers.	English: 10.1, 10.5, 10.6, 11.1, 11.5, 11.6, 12.1, 12.5, 12.6
48	Complete an invoice.	Mathematics: A.1, A.4
49	Identify marked safety areas.	
50	Identify the location and use of eye wash stations.	
51	Identify the location of the posted evacuation routes.	
52	Locate and demonstrate knowledge of safety data sheets (SDS).	English: 10.5, 11.5, 12.5
53	Demonstrate the safe use of chemicals.	Science: CH.1
54	Demonstrate the safe use of standard and metric hand tools.	
55	Demonstrate the safe use of power tools.	
56	Demonstrate the safe use of precision standard and metric measuring tools.	
57	Demonstrate the safe use of protective clothing and equipment.	
58	Demonstrate the safe use of fire protection equipment.	
59	Demonstrate the safe use of equipment.	
60	Demonstrate safe practices in the agricultural mechanics lab/workshop.	English: 10.5, 11.5 History and Social Science: GOVT.16 Science: CH.1
61	Demonstrate safe use of maintenance equipment.	English: 10.5, 11.5, 12.5
62	Maintain equipment according to manufacturer's instructions.	English: 10.5, 11.5, 12.5

63	Compile a list of parts and supplies necessary to complete a repair or maintenance task.	
64	Perform welding operations.	
65	Weld with oxyfuel gas welding equipment.	
66	Cut metals, using oxyfuel gas, plasma arc, and other techniques.	
67	Prepare equipment for painting.	
67	Select and apply protective coatings.	English: 10.5, 11.5, 12.5
69	Prepare a steam and/or high-pressure washer.	
70	Clean equipment with a steam cleaner and/or high-pressure washer.	
71	Describe the fundamental principles of agricultural mechanical systems.	English: 10.5, 11.5, 12.5 Science: PH.1a
72	Perform basic service and maintenance tasks on agricultural mechanical systems.	Science: PH.1a
73	Perform diagnosis and troubleshooting tasks for agricultural mechanical systems.	Science: PH.1a
74	Describe basic operating principles of pneumatics.	English: 10.5, 11.5, 12.5
75	Calculate hydraulic pressure and force, using Pascal's law.	Mathematics: A.1, A.4 Science: PH.1a, PH.7a
76	Describe the operation of open and closed center hydraulic systems.	English: 10.5, 11.5, 12.5 Science: PH.1a
77	Describe the theory of hydraulic pumps and motors.	English: 10.5, 11.5, 12.5
78	Disassemble and repair a hydraulic component following the technical manual's instructions.	English: 10.5, 11.5, 12.5
79	Use a flow meter and test gauge to measure the performance of a hydraulic system.	Science: PH.1a, PH.7a
80	Troubleshoot and repair a hydraulic-assist transmission.	Science: PH.7a
81	Troubleshoot and repair hydrostatic drives.	Science: PH.11c
82	Interpret electrical schematics.	English: 10.5, 11.5, 12.5 Science: PH.11c
83	Use electrical diagrams to locate components on equipment.	Science: PH.11c
84	Recognize and test electrical components and devices.	Science: PH.1, PH.11c
85	Diagnose electrical systems, using schematics.	Science: PH.11c
86	Follow diagnostic and repair procedures.	English: 10.5, 11.5, 12.5
87	Test the charging circuit.	Science: PH.1a, PH.11c
88	Replace an amperage gauge.	English: 10.5, 11.5, 12.5
89	Check the armature and fields of charging circuits.	Science: PH.1a, PH.11c
90	Troubleshoot the ignition switch.	English: 10.5, 11.5, 12.5
91	Troubleshoot the safety switch.	English: 10.5, 11.5, 12.5
92	Troubleshoot the solenoid.	English: 10.5, 11.5, 12.5 Science: PH.4a

93	Troubleshoot glow plugs on diesel engines.	English: 10.5, 11.5, 12.5
94	Troubleshoot the starter.	English: 10.5, 11.5, 12.5
95	Replace defective parts of the starting circuit.	English: 10.5, 11.5, 12.5 Science: PH.11c
96	Describe the operation of the components of a fuel system.	English: 10.5, 11.5, 12.5 Science: PH.1a
97	Describe the operating principles and maintenance of carburetors.	English: 10.5, 11.5, 12.5
98	Perform diagnostic and repair procedures on various fuel systems.	English: 10.5, 11.5, 12.5
99	Describe the operating principles and maintenance of a high-pressure fuel injector.	English: 10.5, 11.5, 12.5
100	Perform service to diesel fuel systems.	English: 10.5, 11.5, 12.5
101	Service fuel tanks and lines.	
102	Describe the theory of powertrain systems.	English: 10.3, 10.5, 11.3, 11.5, 12.3, 12.5 Science: PH.1a
103	Describe the operational theory of brakes (wet and dry), torsion dampers, and torque converters.	English: 10.5, 11.5, 12.5
104	Describe the operational theory of a final drive system.	English: 10.5, 11.5, 12.5
105	Diagnose, disassemble, and reassemble various powertrain systems.	
106	Diagnose, disassemble, and reassemble brakes (wet and dry), torsion dampers, and torque converters.	
107	Diagnose, disassemble, and reassemble final drives and differential systems.	
108	Service power take-off drives.	English: 10.5, 11.5, 12.5
109	Describe air filtration systems.	English: 10.5, 11.5, 12.5
110	Service air cleaners (dry and oil bath).	
111	Inspect and repair intake and induction systems.	
112	Describe the principles of heat transfer in liquid- and air-cooled engines.	English: 10.5, 11.5, 12.5
113	Follow general safety precautions when maintaining cooling systems.	English: 10.5, 11.5, 12.5 History and Social Science: GOVT.15, GOVT.16
114	Check coolant levels.	
115	Test radiator coolant.	
116	Flush and clean radiator.	
117	Test and replace thermostat systems.	
118	Inspect and replace cooling system components.	
119	Check the engine crankcase oil level.	
120	Select appropriate lubricants based on quality and viscosity designations.	
121	Change lubricants and filters.	
122	Recycle engine oils.	Science: ES.6d

123	Check the transmission or differential lubricant levels on equipment.	
124	Check tire pressure, wear, and defects.	
125	Drain and refill differentials.	
126	Pack wheel bearings.	
127	Describe the differences in the operation of gasoline and diesel engines.	English: 10.5, 11.5, 12.5 Science: PH.7a
128	Use dynamometers.	Science: PH.7a
129	Test engine compression.	
130	Remove, replace, and make operational the equipment power unit.	
131	Follow general safety when servicing batteries.	English: 10.5, 11.5, 12.5 History and Social Science: GOVT.15, GOVT.16
132	Connect and disconnect jumper cables when boosting or charging a battery.	
133	Clean battery terminals, cables, and boxes.	
134	Replace a battery.	
135	Measure the voltage of a battery, using a voltmeter.	Science: PH.11c
136	Run a load test on a battery.	Science: PH.11c
137	Describe the operating fundamentals of harvesting equipment.	English: 10.5, 11.5, 12.5
138	Perform maintenance, diagnostic, and repair procedures on harvesting equipment.	
139	Set up and adjust harvesting equipment prior to and during in-field use to optimize performance according to conditions.	
140	Describe the fundamentals of machine operation, including tractor compatibility.	English: 10.5, 11.5, 12.5
141	Identify laws associated with tillage, seeding, and chemical applications.	English: 10.5, 11.5, 12.5 History and Social Science: GOVT.9, GOVT.15
142	Demonstrate the ability to set up and adjust tillage, seeding, and chemical application equipment.	
143	Perform maintenance, diagnostic, and repair procedures on tillage equipment.	
144	Perform maintenance, diagnostic, and repair procedures on seeding equipment.	
145	Perform maintenance, diagnostic, and repair procedures on chemical applications equipment.	
146	Use modern communication technology.	
147	Maintain departmental safety standards and operating procedures.	History and Social Science: GOVT.15, GOVT.16 Science: CH.1a

148	Maintain current inventory, using an electronic inventory system.	
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FFA Information

The National FFA is an organization dedicated to preparing members for leadership and careers in the science, business, and technology of agriculture. Local, state, and national activities and award programs provide opportunities to apply knowledge and skills acquired through agriculture education.

For additional information about the student organization, see the [National FFA website](#) and the [Virginia FFA Association website](#).

The following leadership development events are available for this course:

- [Agricultural Issues](#)
- [Employment Skills](#)
- [Extemporaneous Public Speaking](#)
- [Parliamentary Procedure](#)
- [Prepared Public Speaking](#)

The following career development events are available for this course:

- [Agricultural Communications](#)
- [Agricultural Sales](#)
- [Agronomy](#)
- [Agricultural Technology & Mechanical Systems](#)
- [Dairy Cattle Evaluation and Management](#)
- [Environmental & Natural Resources](#)
- [Farm and Agribusiness Management](#)
- [Floriculture](#)
- [Food Science and Technology](#)
- [Forestry](#)
- [Horse Evaluation](#)
- [Marketing Plan](#)
- [Meats Evaluation and Technology](#)
- [Nursery/Landscape](#)
- [Poultry Evaluation](#)
- [Veterinary Science](#)

Green Building Infusion Units

The Green Building Infusion Unit (GBIU) was designed to encourage teachers to infuse instructional units on green building knowledge and skills into designated CTE courses. The infusion unit is not mandatory, and, as such, the tasks/competencies are marked as “optional,” to be taught at the instructor’s discretion.

Entrepreneurship Infusion Units

Entrepreneurship Infusion Units may be used to help students achieve additional, focused competencies and enhance the validated tasks/competencies related to identifying and starting a new business venture. Because the unit is a complement to certain designated courses and is not mandatory, all tasks/competencies are marked “optional.”

Appendix: Credentials, Course Sequences, and Career Cluster Information

Industry Credentials: Only apply to 36-week courses

- Agriculture Mechanics Assessment
- College and Work Readiness Assessment (CWRA+)
- Customer Service Specialist (CSS) Examination
- EETC Technician Certification Tests
- National Career Readiness Certificate Assessment
- Power Equipment Technology Examination
- Small Engine Technology Assessment
- Workplace Readiness Skills for the Commonwealth Examination

Concentration sequences: *A combination of this course and those below, equivalent to two 36-week courses, is a concentration sequence. Students wishing to complete a specialization may take additional courses based on their career pathways. A program completer is a student who has met the requirements for a CTE concentration sequence and all other requirements for high school graduation or an approved alternative education program.*

- Agricultural Business Fundamentals I (8022/36 weeks)
- Agricultural Business Management III (8026/36 weeks)
- Agricultural Business Operations II (8024/36 weeks)
- Agricultural Fabrication and Emerging Technologies (8019/36 weeks)
- Agricultural Power Systems (8018/36 weeks)
- Agricultural Structural Systems (8017/36 weeks)
- Applied Agricultural Concepts (8073/36 weeks)
- Applied Agricultural Concepts (8072/18 weeks)
- Introduction to Power, Structural, and Technical Systems (8016/36 weeks)
- Small Engine Repair (8082/36 weeks)
- Small Engine Repair (8021/18 weeks)

Career Cluster: Agriculture, Food and Natural Resources	
Pathway	Occupations
Agribusiness Systems	Agricultural Products Sales Representative Farm Products Purchasing Agent and Buyer Farm, Ranch Manager Farmer/Rancher Feed, Farm Supply Store Sales Manager Sales Manager
Environmental Service Systems	Agricultural Products Sales Representative Environmental Compliance Inspector Environmental Sampling and Analysis Technician Hazardous Materials Handler Recycling Coordinator Secondary School Teacher
Natural Resources Systems	Geological Technician Logging Equipment Operator
Plant Systems	Machine Setter, Operator
Power, Structural, and Technical Systems	Agricultural Engineer Agricultural Equipment Operator

Career Cluster: Agriculture, Food and Natural Resources	
Pathway	Occupations
	Agricultural Equipment Parts Manager Agricultural Equipment Parts Salesperson Machinist Parts Manager Welder

Career Cluster: Science, Technology, Engineering and Mathematics	
Pathway	Occupations
Engineering and Technology	Agricultural Engineer Civil Engineer Civil Engineering Technician Commercial and Industrial Designer Engineer Industrial Engineer Industrial Engineering Technician Machine Setter, Operator Manufacturing Systems Engineer Mechanical Drafter Mechanical Engineer Mechanical Engineering Technician Technical Writer