# Agricultural Mechanics Standards and Skills

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## Health & Safety Standards

### Standard 1: Safety and Health in an Agricultural Mechanics Environment

Students will apply health and safety practices in an agricultural mechanic’s shop environment, effectively managing and maintaining equipment and tools, utilizing appropriate personal protective equipment (PPE), adhering to established personal safety protocols, safely handling hazardous materials, and demonstrating preparedness for emergency situations.

#### **Aligned Safety and Essential Credentials:**

* OSHA10 – General Industry
* National Occupational Competency Testing Institute (NOCTI) -Agriculture Mechanics Certification

#### Skills:

* Identify, describe, and demonstrate the effective use of Safety Data Sheets (SDS) to meet documentation requirements.
* Locate emergency equipment (e.g., first aid kit, fire extinguisher), and review the emergency action and response plan, including labels and signage following OSHA’s Hazard Communication Standard (HAZCOM).
* Identify and describe OSHA’s Four High Hazards: falls, electrocution, struck-by (e.g., falling objects, trucks, and cranes), and caught-in or between (e.g., equipment, vehicles, and trench hazards), and explain safety protocols for preventing and addressing these hazards.
* Identify and explain the safety color coding system established by organizations such as OSHA, ANSI (American National Standards Institute), and ASAE (American Society of Agricultural Engineers).
* Demonstrate safe dress and appropriate use of PPE (e.g., gloves, protective clothing, hard hats, proper footwear, knee pads, earplugs, eye protection).
* Demonstrate safe body mechanics, including proper lifting techniques and ergonomics to prevent injury.
* Demonstrate safe use, proper maintenance, and storage of hand and power tools, following manufacturer guidelines.
* Identify and apply safety procedures for working in and around confined spaces, including proper ventilation, atmospheric testing, and rescue procedures.
* Demonstrate safe use of lifts, jacks, and jack stands to prevent vehicle-related accidents.
* Identify electrical hazards in agricultural settings and demonstrate proper grounding, wiring, and equipment checks to prevent electrical accidents.
* Apply Lock-out/Tag-out (LOTO) procedures to prevent accidental machinery energization during maintenance or repair activities.
* Identify and apply safe storage and handling of flammable and combustible materials to reduce fire risks.
* Demonstrate safe handling, application, storage, and disposal of agricultural and hazardous chemicals (e.g., fertilizers, herbicides, pesticides, fuels, oils, solvents, batteries, antifreeze) in compliance with OSHA, EPA, and local, state, and federal environmental safety regulations.
* Apply procedures for containing and cleaning up spills of hazardous materials to prevent environmental contamination and personal harm.
* Demonstrate welding and cutting safety, including the use of PPE, fire-resistant barriers, and proper ventilation.
* Understand and apply fire safety protocols, including the correct selection and use of fire extinguishers (e.g., Class A, Class B, Class C, Class D) identification of fire hazards, and evacuation procedures.

## Technical & Integrated Academic Standards

### Standard 2: Role of Agricultural Mechanics in Society

Students will analyze the evolution of agricultural mechanics, evaluate its impact on food security and sustainability, and examine its role in addressing modern agricultural challenges and shaping the future of food production and environmental stewardship.

#### **Aligned Safety and Essential Credentials**:

* NOCTI Agriculture Mechanics Certification

#### Skills:

1. Identify key innovations in agricultural mechanics and assess their impact on agricultural productivity, demonstrating how these advancements have transformed the field.
2. Compare historical practices with modern techniques in agricultural mechanics to illustrate the profession's evolution.
3. Evaluate the integration of advanced technologies, such as precision agriculture, GPS, and automated machinery, in modern agricultural practices, assessing their impact on enhancing food security, promoting sustainable farming practices, and contributing to economic growth through improved efficiency and reduced resource waste.
4. Examine the impact of the Massachusetts Pesticide Control Act, and the Massachusetts Wetlands Protection Act on the Agricultural Mechanics field.
5. Demonstrate knowledge of national environmental agencies and their guidelines on safety, environmental protection, and sustainable practices, including the Environmental Protection Agency (EPA), the Natural Resource Conservation Service (NRCS), and the Department of Environmental Quality (DEQ).

### Standard 3: Technical Drawings and Project Management

Students will develop the skills to effectively read, interpret, and extract critical information from technical drawings, enabling them to inform project planning and execution in agricultural contexts while incorporating project management principles and sustainability considerations.

#### Aligned Safety and Essential Credentials:

* NOCTI Agriculture Mechanics Certification

#### **Skills**:

1. Analyze and interpret various types of technical drawings, including blueprints, schematics, and CAD models.
2. Demonstrate creating detailed scale drawings that include dimensions, materials, and specifications, utilizing design software as applicable.
3. Demonstrate the ability to establish milestones and deadlines for agricultural projects, utilizing software tools as needed, and adjust timelines to accommodate unforeseen challenges.
4. Demonstrate proficiency in preparing and managing project budgets, including cost estimation and resource allocation.
5. Research and analyze sustainable materials and methods relevant to projects, considering their environmental impact throughout the lifecycle, including sourcing and disposal.
6. Demonstrate conducting inspections and assessments to ensure compliance with safety regulations and project specifications.
7. Identify potential issues and develop solutions in real-time during project execution.
8. Ensure selected methods and materials comply with relevant sustainability certifications and guidelines.
9. Evaluate project outcomes and reflect on processes to identify areas for improvement.

### Standard 4: Tools and Equipment for Mechanical Maintenance and Repair

Students will demonstrate proficiency in identifying, operating, maintaining, and inventorying equipment and tools for the repair and maintenance of agricultural mechanical systems, ensuring safety and effectiveness in all procedures.

#### Aligned Safety and Essential Credentials:

* NOCTI Agriculture Mechanics Certification
* EETC - Principles of Small Engine Technology Certification

#### Skills:

1. Identify and explain an appropriate method for inventorying tools and equipment, considering their value and security, to assist with shop organization and cleanliness.
2. Demonstrate proper use, maintenance, and safety practices associated with small hand tools including screwdrivers (flathead, Phillips), pliers (needle-nose, slip-joint), hammers (ball-peen, claw), chisels, utility knives, etc.
3. Identify and demonstrate the proper use of combination wrenches, open-end wrenches, box-end wrenches, pipe wrenches, adjustable wrenches, torque wrenches, and Allen wrenches.
4. Identify and demonstrate the proper use of distinct types of files, hacksaws, thread cutting taps, thread cutting dies, wire brushes, gasket scrapers, and bench vises.
5. Demonstrate the safe use and maintenance of power tools including air impact wrenches, impact sockets, electric soldering irons, and bench grinders.
6. Demonstrate the selection and use of electric drills, including choosing appropriate drill bits and applying correct drilling speeds for various materials.
7. Demonstrate the selection and use of wiring tools, including wire strippers, crimping tools, soldering irons, multimeters, and electrical tape, for troubleshooting electrical issues in agricultural equipment, and apply the appropriate types of solder for specific electrical components.
8. Apply proper techniques for using both precision (vernier calipers, micrometers, depth gauges) and low-precision measuring tools (steel rules, tape measures, squares) in maintenance tasks.
9. Demonstrate the proper use and application of diagnostic tools, including diagnostic scanners, digital multimeters (voltmeter, ohmmeter, ammeter, or wattmeter), compression testers, fuel pressure testers, injector testers, vibration analyzers, smoke machines, and thermal imagers.
10. Demonstrate the use of tools specific to fluid handling, including oil change tools (e.g., oil filter wrenches, oil drain pans, and funnels) and fluid extraction pumps (e.g., manual and electric pumps), to ensure proper maintenance and servicing of agricultural equipment.
11. Utilize tools specific to maintenance and servicing of agricultural equipment, including hydraulic jacks (e.g., floor jacks, bottle jacks) and grease guns (e.g., manual and powered grease guns), to ensure safe and effective operation.
12. Compare and contrast various types of fasteners and their applications.
13. Recognize SAE metric bolt head markings and explain their significance.
14. Identify and describe the function of common nuts, washers, lock washers, and snap rings.
15. Explain and apply the concept of fastener torque, torque sequence, and torque specification charts, utilizing torque angle gauges when necessary.
16. Demonstrate the proper use of torque wrenches and torque angle gauges for accurate fastener installation.

### Standard 5: Hoisting and Rigging

Students will assist with hoisting and rigging actions specific to agricultural applications by identifying the center of gravity of materials to be moved, selecting proper equipment, and communicating effectively with the crane operator. Schools must pursue a variance with the Office of Public Licensure to allow for students to take the Hoisting Licensure exam at 16. Students must pass the test before operating hoisting equipment.

#### Aligned Safety and Essential Credentials:

* MA Hoisting Apprentice License

#### Skills:

1. Explain all working parts of hoisting machinery used in agricultural settings (e.g., tractors, loaders) and the purposes of rigging components (e.g., slings, hooks) to ensure safe operating practices.
2. Utilize rigging component charts specific to agricultural tasks (e.g., moving bales, equipment, or grain bins) to determine the proper type and size of devices required for those tasks.
3. Calculate and apply appropriate sling angle in accordance with industry standards.
4. Use appropriate terminology to communicate with the crane operator by headset or radio.
5. Use correct hand signals for collaborating with the crane operator during a lift.
6. Follow visual instructions on posted signs to ensure safety.

### Standard 6: Fundamentals of Agricultural Machinery and Equipment

Students will identify and operate agricultural machinery, apply safety protocols, leverage modern technologies, and evaluate the environmental and economic impacts to promote sustainable and efficient farming practices.

#### Aligned Safety and Essential Credentials:

* NOCTI Agriculture Mechanics Certification

#### Skills:

1. Identify and describe various types of agricultural machinery, including tractors, harvesters, tillage equipment, planting and seeding equipment, and sprayers, explaining their key components and how each contributes to overall agricultural operations, productivity, and efficiency.
2. Compare different types of tillage equipment, such as plows, harrows, and cultivators, by outlining their components, operational mechanisms, and suitability for various soil conditions and crop types.
3. Explain and implement safety precautions for specific agricultural equipment prior to use, including conducting a safety assessment of the shop area, identifying the location of safety equipment and safety inspections on equipment to ensure all safety systems are functioning properly.
4. Demonstrate the proper operation of agricultural equipment, including tractors, by performing pre- and post-trip inspections and starting and stopping the equipment.
5. Utilize common hand signals established by the American Society of Agricultural and Biological Engineers (ASABE) to communicate effectively on the job site during the operation of agricultural equipment.
6. Demonstrate attaching implements to a tractor by making necessary hitch and PTO adjustments to ensure proper alignment and safe operation.
7. Establish appropriate ballast and tire pressure and adjust wheel tread spacing to optimize tractor stability and performance when using various implements.
8. Identify and describe the role of technology, including GPS, remote sensing devices, and automation, in modern agricultural machinery operations to enhance precision and efficiency.
9. Demonstrate proper preparation of equipment for winter storage by cleaning, lubricating, and applying protective measures for cold climates, ensuring protection from freezing temperatures.
10. Assess the environmental and economic impacts of machinery use on agricultural operations, including fuel efficiency, soil compaction, and resource conservation.

### Standard 7: General Maintenance of Agricultural Equipment and Machinery

Students will understand the importance of regular maintenance in optimizing the performance and longevity of agricultural machinery by applying maintenance techniques such as routine inspections, preventive servicing, diagnostics, and repairs, while promoting sustainability, cost-efficiency, and the responsible use of resources.

#### Aligned Safety and Essential Credentials:

* NOCTI Agriculture Mechanics Certification

#### Skills:

1. Identify and describe the common maintenance requirements for various types of agricultural machinery, including lubrication, filter changes, tire maintenance, and fluid checks.
2. Differentiate between various types of fluids, including motor oils, hydraulic oils, gear oils, greases, and antifreeze, and determine the correct use of "on and off" fluids to ensure efficient operation and maintenance of agricultural equipment.
3. Perform routine inspections to assess the condition of machinery parts, such as belts, hoses, bearings, and hydraulic systems, for signs of wear, damage, or failure.
4. Conduct preventive maintenance procedures, including cleaning, greasing, and checking fluid levels, to extend the lifespan of agricultural machinery and minimize downtime.
5. Replace or repair damaged or worn-out components, such as blades, belts, and filters, by following manufacturer guidelines and using appropriate tools and techniques.
6. Create a maintenance schedule for agricultural equipment based on manufacturer recommendations and operational demands to ensure timely service and reduce the risk of breakdowns.
7. Demonstrate safe handling and storage of replacement parts, lubricants, and other maintenance materials to prevent contamination or injury.
8. Explain the environmental and economic benefits of proactive machinery maintenance, such as reducing fuel consumption, minimizing soil damage, and avoiding costly repairs.

### Standard 8: Agricultural Equipment and Machinery Engine Systems Maintenance and Repair

Students will demonstrate proper skills and techniques for conducting preventive maintenance checks and performing repairs on agricultural equipment systems to optimize performance, enhance longevity, and ensure operational efficiency.

#### Aligned Safety and Essential Credentials:

* NOCTI Agriculture Mechanics Certification
* EETC - Principles of Small Engine Technology Certification

#### Skills:

1. Identify the equipment identification number (EIN) and model number for use in warranty claims, parts ordering, locating relevant repair manuals, and accessing and updating maintenance records.
2. Diagnose common issues and malfunctions in agricultural equipment using diagnostic tools and by identifying mechanical, electrical, or hydraulic problems.
3. Identify and service components of an air induction system, including all parts of the intake system, and perform maintenance on a wet-type air filter.
4. Explain the functions of a turbocharger and charge air cooler in optimizing engine performance.
5. Evaluate and maintain both air-cooled and liquid-cooled systems by identifying components, checking fluid levels, and selecting appropriate antifreeze.
6. Check and inspect cooling systems for proper function, performing tests to ensure adequate freeze protection, and identifying any maintenance needs.
7. Explain the use and benefits of diesel coolant additives (DCA) in enhancing the performance and longevity of cooling systems.
8. Evaluate various types of fuel systems, explain their differences, and discuss how engine management influences their performance and efficiency.
9. Analyze the purpose of each component in carburetor and fuel injection systems and their interrelationships within the fuel system.
10. Analyze the different types of fuel pumps and evaluate their functions and applications within various fuel systems.
11. Compare and contrast various types of fuels (gasoline, diesel, alternative fuels) and their impact on engine performance and environmental factors.
12. Analyze the principles of hydraulics and apply them to the operation and maintenance of hydraulic systems.
13. Identify major components of hydraulic systems and explain their functions within the overall system.
14. Differentiate between various types of hydraulic pumps and evaluate their applications in different hydraulic systems.
15. Evaluate and optimize hydraulic systems through testing, adjustment, and repair.
16. Describe the functions of various types of transmissions and evaluate their applications in agricultural machinery.
17. Differentiate between different types of clutches, explaining their roles in transmission systems.
18. Demonstrate proper techniques to service and adjust a transmission and clutch to ensure optimal performance and functionality.
19. Explain the electrical principles that govern charging, starting, and ignition systems.
20. Identify and understand the operation of the generator (alternator) and its role within the vehicles and/or machinery charging system.
21. Explain the function of a starter motor, detailing its role in initiating the engine's operation by converting electrical energy from the battery into mechanical energy.
22. Identify different types of batteries and assess their applications within ignition systems.
23. Demonstrate proper techniques to repair ignition systems to restore functionality.
24. Analyze the different types of spark plugs, their functions, and how they interact within ignition systems.
25. Demonstrate troubleshooting, diagnosing, and repairing faulty components within electrical systems (e.g., voltage, amperage, resistance, and wattage) by applying systematic diagnostic methods and tools to ensure proper operation.
26. Demonstrate proper procedures to disassemble, clean, and reassemble an electric motor, ensuring careful disconnection of all electrical wiring and labeling each wire and terminal for easy reassembly.
27. Examine the differences between mechanical and electronic governors in
28. small engines, including their operation, applications, and advantages.
29. Explain how the governor system works to maintain a consistent engine speed under varying load conditions, discussing the relationship between throttle position and governor response.

### Standard 9: Gas and Diesel Engine Operation and Repair

Students will demonstrate skills in operating, maintaining, and repairing gas and diesel engines, follow preventive maintenance practices, and adhere to industry safety and environmental standards.

#### Aligned Safety and Essential Credentials:

* NOCTI Agriculture Mechanics Certification
* EETC - Principles of Small Engine Technology Certification

#### Skills:

1. Describe the operating principles of 2-stroke and 4-stroke engines, highlighting their differences and applications and advantages in various agricultural contexts.
2. Identify and diagram the major internal components of both gas and diesel engines, explaining their functions within the engine systems, including the fuel system, oil and lubrication systems, ignition system, electrical system, cooling system, emissions system, and governor system.
3. Develop a maintenance schedule for gas and diesel engines, incorporating checks for fluid levels, filters, and belts, and demonstrating preventive measures that enhance engine performance.
4. Use appropriate diagnostic tools identify issues then repair, adjust, or replace engine parts effectively, following industry standards and safety protocols.
5. Demonstrate safe procedures for starting and shutting down diesel engines, checking for leaks, and ensuring proper ventilation.
6. Explain what constitutes normal combustion in a four-stroke engine, including key terms such as "stoichiometric ratio," "ignition timing," and "combustion efficiency."
7. Demonstrate tuning gas and diesel engines for optimal performance, adjusting timing, fuel injection, and other variables to improve efficiency and power.
8. Explain the operation of fuel systems and emission control mechanisms in gas and diesel engines and perform routine checks and maintenance on these systems.
9. Discuss the importance of adhering to emissions standards and how they relate to warranty coverage for fuel systems and emission control mechanisms in gas and diesel engines.
10. Disassemble and reassemble a small or large gas engine, following proper procedures to maintain component integrity.
11. Explain the importance of torque sequence and gap setting on key components during the assembly process.
12. Disassemble and reassemble a small or large diesel engine, ensuring adherence to technical specifications and safety protocols.
13. Conduct a performance test on assembled engines to evaluate functionality and efficiency.
14. Investigate alternative fuel sources (e.g., biodiesel, ethanol) and emerging engine technologies (e.g., hybrid or electric systems) and evaluate their potential for agricultural applications.
15. Demonstrate adherence to safety standards and environmental regulations when working with gas and diesel engines, including proper disposal of hazardous materials (e.g., oil, coolant).

### Standard 10: Tools and Equipment for Construction Projects

Students will demonstrate the proper use of construction tools and techniques in new construction, building maintenance and repair projects, including welding, masonry, and irrigation system maintenance, while applying safety protocols and best practices.

#### Aligned Safety and Essential Credentials:

* NOCTI Agriculture Mechanics Certification

#### Skills:

1. Demonstrate proper use and maintenance of fastening, clamping, and dismantling tools (e.g., bench clamps, pneumatic nail gun).
2. Demonstrate the proper use and techniques for hand tools commonly used in agricultural construction, including screwdrivers, hammers, pliers, fence pliers, wire cutters, wire tensioners, wrenches, utility knives, shovels, posthole diggers, and sledgehammers.
3. Identify and demonstrate the use of sawing tools, including circular saws, table saws, reciprocating saws, power miter saws, and radial arm saws.
4. Apply accurate measuring and marking techniques using tools such as tape measures, levels (spirit and rotary lasers) squares, and chalk lines.
5. Use and maintain drilling and boring tools (e.g., portable drill, drill press).
6. Use and maintain planing, smoothing, and shaping tools (e.g., power sanders, planers, routers, scrapers).
7. Demonstrate the safe use and maintenance of extension and step ladders.
8. Demonstrate the proper use and techniques of masonry tools, including trowels, masonry chisels, masonry saws, jointers, levels, plumb bobs, brick hammers, and concrete mixers.
9. Demonstrate the selection and proper use of welding PPE (personal protective equipment), including welding helmets, gloves, jackets, safety glasses, and steel-toe boots.
10. Demonstrate the proper use and maintenance of welding equipment, including stick welders (SMAW), MIG welders (GMAW), TIG welders (GTAW), and flux-cored arc welding machines (FCAW).
11. Demonstrate the proper use of oxy-fuel cutting torches or plasma cutters for cutting metal, including the safe use of gas cylinders for oxy-acetylene welding and cutting operations.
12. Utilize pressure regulators and gauges to control gas flow for welding applications.
13. Demonstrate proper use of ground clamps and electrode holders for electric arc welding.
14. Demonstrate the use of chipping hammers and wire brushes for slag removal after welding.
15. Apply proper techniques for using angle grinders for cutting, grinding, and prepping metal surfaces.
16. Utilize C-clamps, welding magnets, and ground clamps to hold and position metal pieces during welding, ensuring proper grounding for the welding machine.
17. Identify and describe tools and equipment required for welding plastics.
18. Demonstrate the proper use of both hand tools (including pipe wrenches, pipe threading, and pipe cutting tools) and power tools (such as air compressors, power drills, electrical multimeters, and plumber's torches) specifically for plumbing and irrigation projects**.**
19. Identify and describe the uses of milling machines and lathes.
20. Identify and describe the functions of surveying equipment and tools used in site location and preparation.

### Standard 11: Fundamental Carpentry Skills

Students will demonstrate basic carpentry skills in agricultural mechanics by effectively identifying materials, interpreting blueprints, executing calculations, and constructing and finishing carpentry projects.

#### Aligned Safety and Essential Credentials:

* NOCTI Agriculture Mechanics Certification

#### Skills:

1. Identify building materials used in carpentry and describe their appropriate applications in agricultural construction.
2. Read and interpret construction blueprints, working drawings, and building codes to execute tasks according to specifications.
3. Accurately estimate the quantity, costs, and materials needed for carpentry tasks.
4. Perform precise carpentry-related mathematical calculations for cutting, measuring, and material estimation.
5. Measure and layout carpentry tasks accurately according to design specifications.
6. Properly store lumber and other building materials for future use, ensuring material integrity.
7. Check structures to ensure they are square, plumb, and level to meet construction standards.
8. Select and correctly install fasteners and hardware appropriate for various carpentry tasks.
9. Describe the lumber grading and marking systems and their implications for selecting quality materials.
10. Describe various joinery techniques and their applications in carpentry.
11. Demonstrate the ability to create and assemble different types of joints (e.g., butt joints, dovetail joints, mortise and tenon).
12. Select appropriate finishing materials and techniques based on the intended use of the project.
13. Demonstrate techniques for sanding, staining, and sealing wood surfaces to enhance appearance and durability.

### Standard 12: Fundamentals of Agricultural Structures, Building, Maintenance, and Repair

Students will develop an understanding of agricultural construction and the necessary skills by conducting site surveys, detailing site preparation, analyzing structural components, selecting appropriate materials, and applying modern techniques to construction projects.

#### Aligned Safety and Essential Credentials:

* NOCTI Agriculture Mechanics Certification

#### Skills:

1. Read and interpret maps, including property, township, zoning, and topographical maps, to inform site evaluation and planning for new construction projects.
2. Demonstrate the set up and operation of surveying equipment, ensuring precision in distance and angle measurements to determine the suitability of a building site for new construction.
3. Apply mathematical formulas to analyze collected data, such as determining elevation changes and calculating areas, which are essential for site preparation and leveling.
4. Analyze and differentiate the structural components of a building, such as beams, columns, walls, roofs, and foundations and explain their roles in the overall stability of the structure, and how they interact with one another to support the building’s integrity.
5. Identify and select suitable materials for framing agricultural structures (e.g., wood, metal, or composite materials) based on structural requirements and environmental considerations.
6. Identify and compare various framing methods and terms (e.g., gable, hip, truss, balloon, and platform) and their applications in construction.
7. Select appropriate materials for building projects, design layouts, and execute precise cuts for structural components.
8. Evaluate various siding materials, articulate their applications in different agricultural contexts, and demonstrate effective installation methods for those materials.
9. Demonstrate preparation and application techniques of paint and other finishing materials for a professional finish.
10. Demonstrate precision install of windows and exterior doors, including adherence to industry standards.
11. Demonstrate the installation and/or repair of a light switch, verifying that the circuit and boxes are properly grounded and attaching the wires to the terminals correctly.
12. Evaluate code requirements for insulation and vapor barriers, discussing their importance in building design.
13. Identify and compare various roofing materials and their applications in agricultural settings and evaluate installation methods to ensure compliance with industry best practices.
14. Evaluate the specific ventilation needs of different agricultural structures (e.g., livestock barns, greenhouses, storage facilities) based on factors such as animal type, crop requirements, and seasonal variations.
15. Identify and select suitable ventilation equipment (e.g., exhaust fans, intake vents, thermostats) based on the design specifications, airflow requirements, and energy efficiency considerations.
16. Calculate and justify the quantity and cost of concrete needed for specific projects.
17. Prepare forms for concrete application, demonstrating precision and adherence to safety standards.
18. Demonstrate mixing, placing, finishing, and curing concrete, evaluating the quality of the final product.
19. Examine advancements in materials science, including high-performance insulation and green building materials, and their applications in agricultural settings.
20. Analyze and integrate smart technology solutions, such as precision agriculture technologies for energy-efficient systems and water conservation methods, into building design.
21. Research and discuss renewable energy systems (e.g., solar panels, wind turbines) for agricultural buildings and their integration into construction plans.
22. Demonstrate and assess the use and maintenance of pump-jack staging and wall brackets for safety and efficiency.
23. Demonstrate and evaluate the use and maintenance of roof brackets to ensure safe installation.
24. Layout and cut rough stairs, demonstrating accuracy in measurements and cuts.
25. Layout and cut a common rafter, ensuring structural integrity and compliance with design specifications.
26. Examine various types of agricultural fences (e.g., barbed wire, woven wire, post and rail, electric fences), along with the appropriate materials for each and their applications.
27. Design a fence layout, considering factors such as land contours, purpose (e.g., livestock containment, property boundaries), and local regulations.
28. Demonstrate the techniques for splicing barbed wire and applying proper tensioning methods to effectively repair and secure a broken section of fence.

### Standard 13: Fundamentals of Welding and Metalwork

Students will gain foundational knowledge and practical skills in welding and metalwork by selecting and preparing materials, employing various welding techniques, and integrating modern technologies and sustainable practices for effective project execution.

#### Aligned Safety and Essential Credentials:

* NOCTI Agriculture Mechanics Certification

#### Skills:

1. Select and prepare materials, tools, and equipment for welding and cutting based on the task at hand, ensuring their suitability for achieving effective results.
2. Demonstrate the setup, operation, shutdown, and securing of welding and cutting equipment.
3. Read metalworking plans, prints, drawings, and welding symbols, developing the ability to interpret technical documents critical for successful project execution.
4. Estimate and calculate welding and cutting material costs, applying mathematical reasoning to budget effectively for projects.
5. Layout and prepare metal for welding and/or cutting, demonstrating spatial awareness and accuracy to enhance the quality of the final product.
6. Identify various types and shapes of metal to make informed choices for specific applications.
7. Control distortion in arc welding, employing techniques to minimize warping and ensure structural integrity in welded components.
8. Demonstrate basic joint welding using Shielded Metal Arc Welding (SMAW, also known as Stick Welding), Gas Metal Arc Welding (GMAW, commonly known as MIG Welding), Gas Tungsten Arc Welding (GTAW, commonly known as TIG Welding), and Flux-Cored Arc Welding (FCAW) creating strong, reliable joints essential for structural applications.
9. Demonstrate execution of a horizontal square groove butt weld using SMAW, selecting electrodes; attaching ground clamp; setting amperage, gap, and tack; and position the metal correctly.
10. Apply proper techniques to cut mild steel, including pipes, using an oxyacetylene cutting torch to achieve accurate measurements and clean edges for effective assembly.
11. Demonstrate brazing techniques to join basic joints, utilizing brazing to connect dissimilar metals and enhance the versatility of projects.
12. Demonstrate basic welding joints out of position (e.g., vertical, horizontal, overhead) using SMAW and GMAW, adapting techniques to various orientations.
13. Apply non-destructive testing (NDT) methods to evaluate weld integrity and ensure compliance with industry standards.
14. Select and apply hard surfacing materials and alloys, recognizing their importance in enhancing durability and resistance to wear in agricultural applications.
15. Analyze contemporary materials (e.g., composites, advanced alloys) for their applications in welding, understanding how they differ from traditional materials.
16. Identify different types of plastics (e.g., PVC, ABS, polyethylene) and their respective welding requirements.
17. Demonstrate proper preparation techniques for plastic components, including cleaning, cutting, and aligning pieces for welding.
18. Explain and demonstrate various plastic welding techniques, such as hot air welding, ultrasonic welding, and solvent welding, explaining the specific applications and advantages of each method.
19. Select appropriate materials, tools, and equipment for hot and cold metalworking, ensuring that choices align with project requirements.
20. Apply knowledge of material properties to choose suitable metals for projects based on their strength.
21. Select soldering equipment and supplies to create durable electrical and plumbing connections.
22. Demonstrate preparing and soldering copper joints to ensure leak-proof connections in plumbing systems.
23. Demonstrate preparing and soldering electrical connections for safe and effective electrical systems.
24. Demonstrate joining metals with appropriate fasteners and explain the significance of selecting the right fasteners for maintaining structural integrity.
25. Determine tap and drill sizes, applying accurate measurements to ensure compatibility and functionality of fastened components.
26. Demonstrate how to layout and drill holes with a twist drill, ensuring accurate openings for fasteners or assembly.
27. Demonstrate repairing damaged threads while maintaining the integrity of threaded connections.
28. Demonstrate the technique to cut threads with taps and dies to meet specified requirements, ensuring precise and compatible threads for assembly.
29. Select appropriate abrasives for grinding and sharpening and prepare the equipment to ensure optimal performance for achieving desired finishes.
30. Demonstrate how to recondition chainsaws, horticultural tools, and turf cutting tools utilizing precision sharpening technologies.
31. Demonstrate how to recondition rotary lawn mower blades to maintain equipment performance and enhance cutting efficiency.
32. Examine the use of additive manufacturing techniques to create custom metal components for agricultural equipment, evaluating their potential benefits and applications in enhancing equipment functionality and efficiency.

### Standard 14: Fundamentals of Irrigation Systems

Students will gain an understanding of irrigation systems by analyzing various technologies, selecting appropriate solutions for specific needs, and applying plumbing skills to design, fabricate, and maintain efficient, environmentally compliant irrigation practices.

#### Aligned Safety and Essential Credentials:

* NOCTI Agriculture Mechanics Certification

#### Skills:

1. Explain the fundamental concepts of irrigation systems, their components and functions within agricultural practices.
2. Compare and contrast various irrigation systems, analyzing their benefits to assess the suitability of different technologies and methods for specific agricultural applications.
3. Select an appropriate irrigation system tailored to specific climate conditions and agricultural needs, justifying the choice based on efficiency and resource management.
4. List and evaluate cost factors associated with different irrigation systems.
5. Summarize environmental protection regulations relevant to the development and operation of irrigation systems, ensuring compliance with legal and ecological standards.
6. Identify the impacts of natural occurrences such as erosion and weathering on the effectiveness and sustainability of irrigation systems.
7. Demonstrate plumbing skills necessary for the fabrication and maintenance of irrigation systems.
8. Identify jobs requiring a licensed plumber to ensure compliance with regulations.
9. Understand the principles of backflow prevention and the installation of backflow prevention devices.
10. Develop and implement maintenance protocols for irrigation systems to ensure long-term efficiency and functionality.
11. Demonstrate service and maintenance of pumps, valves, and other components critical to water systems in agriculture.
12. Demonstrate troubleshooting techniques for common irrigation system issues, ensuring optimal system performance and water efficiency.
13. Describe the various types of pipes and fittings used in irrigation systems.
14. Select appropriate pipe threading and cutting tools for the chosen irrigation model.
15. Demonstrate the ability to cut and assemble plastic pipe to specified dimensions, ensuring compliance with project requirements and quality standards.
16. Demonstrate the ability to cut and assemble steel pipe to specified dimensions, ensuring accuracy and precision in alignment with project specifications.
17. Demonstrate the effective connection of flare and compression fittings, ensuring leak-proof joints through proper techniques.
18. Demonstrate soldering techniques for copper fittings, ensuring the creation of durable and secure joints in plumbing applications.
19. Evaluate the use of smart irrigation technologies, including sensors and automation, to optimize water usage in agricultural practices.
20. Demonstrate techniques for implementing water conservation practices in irrigation systems, such as rainwater harvesting and drip irrigation methods.
21. Analyze soil types and their impact on irrigation choices, demonstrating how to select appropriate irrigation methods based on specific crop needs.

## Employability Standards

### Standard 15: Employability Skills

Students will demonstrate professional communication, critical thinking, problem-solving, professionalism, teamwork, and collaboration within the context of the Agricultural Mechanics field.

#### Aligned Safety and Essential Credentials:

* NOCTI Agriculture Mechanics Certification

#### Skills:

1. Demonstrate effective communication and interpersonal skills to provide exceptional customer service across various platforms, including face-to-face interactions, telephone conversations, written, and electronic correspondence.
2. Demonstrate facilitating project meetings, providing clear updates and soliciting feedback to ensure alignment and progress.
3. Analyze complex problems and develop effective solutions, applying critical thinking and problem-solving techniques relevant to the agricultural mechanic’s field.
4. Collaborate effectively in teams to achieve common goals, demonstrating coordination and cooperation with other professionals in the agricultural mechanic’s field.
5. Apply effective time management techniques, including task prioritization, deadline management, and efficient workload handling.
6. Demonstrate ethical behavior and adhere to industry standards, ensuring safety, compliance, and integrity in all professional activities.

## Entrepreneurship Standards

### Standard 16: Entrepreneurship

Students will be able to describe opportunities for entrepreneurship and evaluate the value proposition of business ownership in the Agricultural Mechanics field.

#### Aligned Safety and Essential Credentials:

* NOCTI Agriculture Mechanics Certification

#### Skills:

1. Evaluate the licensing, regulatory, and tax implications of self-employment and business ownership in the agricultural mechanic field compared to W-2 employment.
2. Understand current job trends, education and skill requirements, and potential areas of growth within the modern agriculture power and systems technologies field.
3. Assess the impact of technological advancements on business opportunities and strategies in agricultural mechanics, including the integration of new tools, software, and diagnostic equipment, and how these innovations can drive business growth and efficiency.

## Digital Literacy Standards

### Standard 17: Digital Literacy

Students will demonstrate digital literacy skills in Agricultural Mechanics, including the use of diagnostic software, data management, technical documentation, and digital communication, to effectively carry out maintenance and repair tasks in modern Agricultural Mechanics.

#### Skills:

1. Demonstrate communicating and collaborating digitally with team members, customers, and suppliers using email, messaging apps, and video conferencing tools.
2. Demonstrate the use of Building Information Modeling (BIM) software for planning and managing agricultural construction projects.
3. Utilize online resources, forums, and troubleshooting software to diagnose and solve technical issues with agricultural machinery.
4. Utilize modern technology, such as computerized maintenance management systems (CMMS) or mobile apps, to track maintenance activities, monitor equipment health, and schedule future maintenance tasks.

## Credentials of Value

### Safety Credentials

* OSHA 10 General Industry, OSHA

### Essential Credentials

* Agriculture Mechanics Certification, National Occupational Competency Testing Institute (NOCTI)
* Principles of Small Engine Technology Certificate, Equipment and Engine Training Council (EETC)
* MA Hoisting Apprentice License, Commonwealth of MA

### Supplemental Credentials

* ASE Entry-level Engine Repair Certification, National Institute for Automotive Service Excellence (ASE)
* ASE Entry-level Electrical/Electronic Systems, National Institute for Automotive Service Excellence (ASE)
* ASE Entry-level General Diesel Engine, National Institute for Automotive Service Excellence (ASE)
* ASE Light Vehicle Diesel Engines Certification, National Institute for Automotive Service Excellence (ASE)
* ASE Master Truck Equipment Technician, National Institute for Automotive Service Excellence (ASE)
* AWS Certified Welder, American Welding Society
* AWS SENSE Entry-Level Welder, American Welding Society
* Hot Works Safety Certification, National Fire Protection Association
* Pesticide Applicator - Private Certification (License for Agriculture Students must be 18), Commonwealth of MA
* First Aid, CPR, and AED Certification, American Heart Association
* OSHA 30 Hour Certification, OSHA
* OSHA 10 Hour – Construction, OSHA
* Confined Space Entry Training for Construction Certificate, OSHA
* Competent Person Fall Protection Certificate, OSHA
* 1-Hour Fall Protection Certificate, OSHA
* Excavation Safety Course, OSHA
* Electric Pallet Jack Certification (Electric and Manual), OSHA
* Forklift Certification - Stand Up, OSHA
* Forklift Certification - Sit Down, OSHA

### Supplemental Credentials – Postsecondary

* EPA 608 Technician Certification, Environmental Protection Agency (EPA)
* LEED Green Associate, U.S. Green Building Council (USGBC)