TN Department of Education | College, Career and Technical Education

May 2024

Agricultural Power and Equipment

Primary Career Cluster:	Agriculture, Food, & Natural Resources
Consultant:	CTE.Standards@tn.gov
Course Code(s):	C18H13
Prerequisite(s):	*Principles of Agricultural Mechanics* (C18H12)
Credit:	1
Grade Level:	11
Elective Focus - Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, & Natural Resources courses.
POS Concentrator:	This course satisfies one out of two required courses to meet the Perkins V concentrator definition, when taken in sequence in the approved program of study.
Programs of Study and Sequence:	This is the third course in the *Agricultural Engineering, Industral, and Mechanical Systems* program of study.
Aligned Student Organization(s):	FFA: http://www.tnffa.org
Coordinating Work-Based Learning:	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html.
Promoted Tennessee Student Industry Credentials:	Credentials are aligned with postsecondary and employment opportunities and with the competencies and skills that students acquire through their selected program of study. For a listing of promoted student industry credentials, visit https://www.tn.gov/education/educators/career-and-technical-education/student-industry-certification.html.
Teacher Endorsement(s):	048, 150, 448, and 950
Required Teacher Certifications/Training:	None
Teacher Resources:	https://www.tn.gov/education/educators/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html Best for All Central: https://bestforall.tnedu.gov/

Course at a Glance

CTE courses provide students with an opportunity to develop specific academic, technical, and 21st century skills necessary to be successful in career and in life. In pursuit of ensuring every student in Tennessee achieves this level of success, we begin with rigorous course standards which feed into intentionally designed programs of study.

Students engage in industry relevant content through general education integration and experiences such as career and technical student organizations (CTSO) and work-based learning (WBL). Through these experiences, students are immersed with industry standard content and technology, solve industry-based problems, meaningfully interact with industry professionals and use/produce industry specific, informational texts.

Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for your students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course, note this is not an exhaustive list.

- Participate in CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry specific skills that involve teamwork and project management.
- Participate in FFA career and leadership events (CDE/LDE) that align with this course including Agriscience Fair, Agricultural Issues, Agricultural Technology and Mechanical Systems, Employment Skills, Environmental & Natural Resources, and Land Evaluation.

Using Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1-1.3** | During a visit to an industry site have the manager talk about safety in the workplace.
- **Standards 2.1-3.6** | Have the students work with an equipment and/or mechanical technician on a real project.
- **Standards 4.1-4.3** | Have the students work with a hydraulic technician in the field.
- **Standards 5.1-5.2** | Contact a Geographic Information Systems (GIS) technician to work with students on projects requiring precision GIS technology.

Course Description

Agricultural Power and Equipment is an applied course in agricultural engineering with special emphasis on laboratory activities involving small engines, tractors, and agricultural equipment. The standards in this course address navigation, maintenance, repair, and overhaul of electrical motors, hydraulic systems, and fuel-powered engines, as well as exploration of a wide range of careers in agricultural mechanics. Upon completion of this course, proficient students will be able to pursue advanced training in agricultural engineering and related fields at a postsecondary institution.

Course Standards

1. Safety and Occupational Trends

1.1 Safety: Review common **laboratory safety procedures for tool and equipment operation** in the agricultural power and equipment laboratories, including, but not limited to, personal protective equipment, accident prevention, and control procedures. Demonstrate the ability to follow safety and operational procedures in a lab setting and complete a safety test with 100 percent accuracy.

1.2 Occupational Trends: Investigate occupation **trends in agricultural power and equipment, and related occupations**. Compare and contrast the knowledge, skills, and abilities necessary for employment, as well as the typical level of education required.

1.3 Supervised Agricultural Experience: Investigate opportunities to **expand and diversify an immersion Supervised Agricultural Experience (SAE)** program as related to agriculture power and equipment. Accurately maintain an active recordkeeping system and apply proper financial recordkeeping skills to summarize records by completing SAE related applications and reports.

2. Engine and Motor Mechanics

2.1 Performance: Compare and contrast the **first and second laws of thermodynamics** as applied to the study of combustion engines. Analyze the theory of operation and efficiency of internal combustion engines with regard to fuels, engine displacement, ignition, lubrication, and cooling.

2.2 Fuel Delivery Systems: Classify **fuel delivery systems**. Compare and contrast the applications of carburetors and fuel injection systems in agricultural equipment.

2.3 Engine Performance: Evaluate and optimize **engine performance** under load and no-load operation, considering the effects of air temperature, humidity, fuel quality, and engine tuning.

2.4 Electric Motors: Identify **major components of electric motors**. Classify electric motors based on **power source**. Differentiate the appropriate use of **battery-electric and gasoline-powered small equipment**.

2.5 Motor Performance: Evaluate and optimize **electric motor performance** under load and no-load operation, considering the effects of the input power measurements, amperage, and slip load.

2.6 Power Unit Selection: Recommend the correct **engine or motor horsepower (hp)** for specific tasks or procedures (e.g., using a three-phase 5 hp electric motor in order to drive a 125-foot conveyor belt for lifting grain to a 60-foot silo).

2.7 Troubleshooting: Demonstrate the ability to **troubleshoot single-cylinder engines and electric motors**. Create a written estimate of repairs, including parts, labor, time, and total cost.

3. Agricultural Machinery

3.1 Machinery Selection: Recommend the appropriate machinery for a given agricultural application by matching the **mechanical need to the scale and magnitude of the specific task**. Justify the recommendation based on availability of parts, operational costs, maintenance, safety, and total cost. For example, recommend the appropriate tractor for a specified task based on power ratings, engine and transmission systems, hydraulic capabilities, hitching, and ballasting.

3.2 Power Sources: Research the types of **power sources for modern machinery** as related to agricultural equipment. Differentiate their characteristics and applications, base price, availability, and accessories needed for each power source (e.g., lubricants, fuel, batteries, cooling system, etc.).

3.3 Low Voltage: Analyze the use of **low-voltage sensors in agricultural equipment**. Research how the use of sensors can increase the **efficiency of agricultural equipment**. Demonstrate the ability to troubleshoot and repair low-voltage wiring to control sensors or other accessories.

3.4 Maintenance and Repair: Demonstrate the ability to **maintain, troubleshoot, and repair agricultural equipment,** and create a written estimate of repairs including itemization of parts, labor, time, and total cost.

3.5 Precision Machinery: Compare and contrast the **types and functions of precision and advanced technologies** (e.g., geographic information systems [GIS], global positioning systems [GPS], and unmanned aerial vehicles [UAV]) available to the agriculture industry).

3.6 Safe Operation: Demonstrate in a live setting or in a presentation the ability to **safely operate agriculture equipment**, including precision-operated equipment if available.

4. Hydraulics and Pneumatics

4.1 System Components: Identify and explain the **components and operational theory of a basic hydraulic and pneumatics system** used in an agriculture setting.

4.2 Designing Systems: Design a hydraulic or pneumatic system to perform a specific task, applying the **principles of fluid kinematics and hydrostatics** to outline how the system functions. The design should include specifications for pumps, pipes/line, and flow rates/air pressure.

4.3 Maintenance and Repair: Troubleshoot and repair **hydraulic and/or pneumatic power and control systems** used in agricultural equipment such as piston-driven lifts and compression devices (e.g., shears, crushers). Document the parts and labor involved and draft an itemized repair bill using a spreadsheet or invoicing software.

5. Navigation and Surveying

5.1 Precision Technology: Explain how agricultural enterprises **employ geographic information systems (GIS) and global positioning systems (GPS) in their work,** including GIS software, GPS receivers, data acquisition, and spatial analysis of data. Debate the legal, ethical, and economic implications of the use of these emerging technologies with regards to maximizing the efficiency and efficacy of agricultural processes, citing specific textual evidence from case studies and news media.

5.2 Precision Surveying: Correctly and safely use **precision surveying instruments** (e.g., laser, GPS, GIS, etc.) to make measurements of large acreages. Compile a written survey report for use by a lay reader, supplementing the narrative with charts, graphs, and other visual representations to aid comprehension.

Standards Alignment Notes

References to other standards include:

- SAE for All: Evolving the Essentials: All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- AFNR: National Agriculture, Food, & Natural Resources (AFNR) Career Cluster Content Standards. Students engaged in activities outlined above should be able to demonstrate fluency in Standards in CS, PST, ABS, NRS, PS, and ESS at the conclusion of the course.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.