

Minnesota FFA Agricultural Technology & Mechanical Systems

Career Development Event

Revised 12/2022

The CDE will include the five recognized areas of subject matter in agricultural mechanics: Agricultural Tractor & Equipment; Engine Systems; Metal Fabrication; Electrical Circuits, Motors & Controls; and Building Construction, Concrete, Masonry & Plumbing. Each contestant will be tested in all five areas and the state CDE will try to correspond with the National Ag Tech & Mech Systems CDE Theme each year. The CDE evaluation will involve a written examination, problem solving situations, and performance skills.

Contest Rules

1. All contestants must have had instruction in agricultural mechanics in their vocational agriculture classes.
2. A team representing a school shall consist of four members.
3. Each contestant will work individually. The scores of the top three team members will determine the team winner.
4. Each contestant should bring several sharp pencils and a hand held non-programmable calculator.
5. Each contestant will provide his or her own safety equipment (coveralls, gloves, and industrial quality eye wear as specified by Minnesota law). Official dress is **not** required for this event.
6. The team scoring will be based upon the 900 possible points earned by the three contestants.

Tiebreakers: The following technique will be used to break a tie between individuals and/or teams:

1. Regions may decide on the most appropriate tiebreaker for their qualifying contest
2. Total of the written examination scores; if still tied:
3. Total the problem solving & performance skills scores for:
 - A. Metal Fabrication; if still tied
 - B. Agricultural tractor and equipment; if still tied
 - C. Engine systems; if still tied
 - D. Building Construction, Concrete, Masonry and Plumbing; if still tied
 - E. Electrical Circuits, Motors and Controls

Instructional Areas

The CDE instructional areas will be:

Agricultural Tractor & Equipment

- | | |
|---|-------------------------------|
| 1. Agricultural Tractor and Equipment | |
| 2. Engine Systems | |
| 3. Metal Fabrication | 2023 Utility Tractor |
| 4. Electrical Circuits, Motors and Controls | 2024 Forage Harvester |
| 5. Building Construction & Plumbing / Concrete, Masonry & Land Leveling | 2025
Compact Diesel <35 HP |

Subject Rotation:

Odd Years:

Agricultural Tractor and Equipment (See above) **Utility Tractor- New Holland Workmaster 95, 105, or 120**

(A physical machine is not required; questions may be based on the operator's manual)

Engine Systems (Engine Systems)

Metal Fabrication – (Fuel Gas Welding & Cutting (problem solving only), MIG, Cold Metal) (Because we will use the Pipefitters Training Facility, proper equipment will not be available. SMAW will be used for the skill portion of the CDE)

Electric Motors, Controls, and Sensing Devices

Concrete, Masonry, and Plumbing

Even Years:

Agricultural Tractor and Equipment (See above)

(A physical machine is not required; questions may be based on the operator's manual)

Engine Systems (Engine Systems)

Metal Fabrication – (SMAW, TIG, Plasma, Hot Metal)

Electrical Circuits

Building Construction and Surveying

CDE Time Schedule

The CDE will be conducted in six- 30 minute sessions involving the following:

1.	Written Examination (10 questions from each of the five areas)	30 minutes
2.	Agricultural Tractor & Equipment (Problem solving & performance skills)	30 minutes
3.	Engine Systems (Problem solving & performance skills)	30 minutes
4.	Metal Fabrication (Problem solving & performance skills)	30 minutes
5.	Electrical Circuits, Motors & Controls (Problem solving & performance skills)	30 minutes
6.	Building Construction, Concrete, Masonry & Plumbing (Prob. solving & skills)	30 minutes

CDE Points

Each contestant will be evaluated on their performance on each of the activities:

1.	Written Examination (50 questions)	50 points
2.	Agricultural Tractor & Equipment (Problem solving & performance skills)	50 points
3.	Engine Systems (Problem solving & performance skills)	50 points
4.	Metal Fabrication (Problem solving & performance skills)	50 points
5.	Electrical Circuits, Motors & Controls (Prob. solving & performance skills)	50 points
6.	Building Construction, Concrete, Masonry & Plumbing (Prob. solving & skills)	50 points

Total Points- 300 points

Each of the five problem solving and performance skill areas will have three points allotted for appropriate attire of the contestant. Additional points may be deducted for unsafe use of equipment by the contestant.

COMPETENCIES

Following is a list of the subject matter statements with specific informational knowledge and skills identified for each unit. Examination questions will be developed primarily from statements classified as "Understandings". Problem solving activities may be listed under both "Understanding" and "Performance". Those classified as "Performance" will be the primary basis as possible skills (hands-on) competition for the CDE. The skill may also be suggested by an "Understanding".

1. Agricultural Tractor and Equipment*Problem Solving*

- a) Safety and Maintenance
- b) Identifying machinery parts and functions.
- c) Using manufacturer's operator and service manuals.
- d) Identifying and computing, chemical application, seed and fertilizer rates, harvest losses, and machinery capacity, efficiency and acreage.
- e) Preparing machinery for storage.
- f) Identifying safe machinery operating practices.
- g) Determining hydraulic cylinder load and speed.
- h) Identifying parts & functions of hydraulic, climate control, electrical, computer, & monitoring systems.
- i) Interpreting and following recommended service and maintenance schedules.
- j) Testing electrical and electronic sensing devices.
- k) Identifying the safe operation practices for field and highway conditions.
- l) Determining component drive speeds.
- m) Checking and servicing universal joints.

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Performance Skills

- a) Safety and maintenance
- b) Installing, adjusting, and servicing belt and chain drives.
- c) Adjusting and calibrating seeding, fertilizing, spraying, harvesting, and processing machinery.
- d) Making hitch adjustments on pull type and mounted tillage tools.
- e) Adjusting and aligning power take-off drives.
- f) Adjusting operating depth or height for harvesting and tillage machinery.
- g) Adjusting clearance or spacing of machinery components to meet crop and field conditions.
- h) Operating and servicing hydraulically controlled machinery.
- i) Servicing spraying equipment, nozzles, and pumps.
- j) Testing and servicing electrical circuits and sensing devices.
- k) Demonstrating the ASAE hand signals for operating agricultural equipment.
- l) Servicing hydraulic, climate control, electrical, computer, and monitoring systems.

2. Engine Systems (two and four stroke & gas and diesel)

Problem Solving

- a) Safety and Maintenance
- b) Selecting engine repair parts from the manufacturer's hard copy or computerized manual and identifying the use and function of engine repair tools.
- c) Identifying the operating principles of the two and four stroke & gas and diesel engine.
- d) Interpreting and following recommended service and maintenance schedules.
- e) Explaining the function and operating principles of the fuel, lubrication, governor, cooling, starting, charging, and ignition systems.
- f) Selecting fuels, lubricants, and coolants.
- g) Evaluating the practices and procedures for storing an engine.
- h) Evaluating engine performance in load and no load operation.
- i) Evaluating engine parts and making service recommendations.
- j) Operation and interpretation of circuit diagrams and flowcharts for: electrical, hydraulic, fuel, oil, cooling, intake and exhaust systems.

Performance Skills

- a) Safety and Maintenance
- b) Servicing, maintaining and operating the engine.
- c) Using measuring tools and test instruments such as the micrometer, thickness gauge, dial indicator, compression tester, torque wrench, tachometer, ignition circuit tester, multi-meter, and timing devices.
- d) Servicing the air cleaner, cooling, fuel, lubrication, charging, lighting, warning, and cranking system.
- e) Identify, assembling and adjusting the fuel, compression, and ignition systems.
- f) Operating the engine and adjusting or checking ignition timing, engine speed, and carburetor adjustments.
- g) Troubleshooting, evaluating, and replacing valves, ignition, governor, and carburetor parts.
- h) Using engine overhaul equipment, including valve, cylinder, piston, and bearing tools.
- i) Read schematics and following wiring circuits.

3. Metal Fabrication

Problem Solving

- a) Safety and Maintenance
- b) Selecting appropriate welding equipment and consumables (i.e. wire, electrodes, hard surfacing alloys, gas, etc.)
- c) Controlling distortion.
- d) Preparing materials and equipment for welding and cutting.
- e) Reading blueprints and welding symbols.
- f) Testing welds for quality and strength of joint.
- g) Assembling welding and cutting equipment.
- h) Identifying the procedure of checking equipment for leaks.
- i) Securing/shutting down the equipment.
- j) Describe the science of welding and cutting processes.
- k) Describe cylinder sizes and gas flow extraction rates. Calculate the volume of acetylene that can be delivered per cylinder per hour.
- l) Explain the functions of flashback arresters and reverse flow check valves.
- m) Identifying hand metal working tools by type and use.
- n) Determining tap and drill sizes.
- o) Choosing files and saw blades.
- p) Identifying the procedure for hardening and tempering common tools.
- q) Selecting abrasives for grinding and sharpening.
- r) Identifying appropriate shape of cutting edges for metal cutting tools.
- s) Identifying safety practices for using keen edge tools and grinding equipment.
- t) Identifying kinds of metal
- u) Identify the torch flame for specific welding or cutting operations.
- v) Estimate and calculate welding materials costs.

Performance Skill

- a) Safety and Maintenance
- b) Welding basic joints in all positions.
- c) Adjust machines for different metals, joints and thickness.
- d) Start-up and shut down for welding equipment.
- e) Layout and prepare metal for welding or cutting.
- f) Fuse and braze welding basic joints on mild steel and cast iron.
- g) Cut mild steel, including pipe, all shapes with plasma, gas, or arc.
- h) Join steel pipe, tubing or shapes by welding.
- i) Cutting threads with taps and dies.
- j) Laying out and drilling holes with twist drill.
- k) Operating power tools such as drills and saws.

4. Electrical Circuits

Problem Solving

- a) Safety and Maintenance
- b) Understanding the National Electrical Code requirements for wiring, especially for harsh environments found in agricultural processing, livestock, and poultry confinement areas.
- c) Planning an electrical circuit.
- d) Selecting type and size of conductor. 4.4
- e) Calculating voltage drop of conductor.

- f) Determining electrical power requirements.
- g) Reading the kilowatt hour meter.
- h) Identifying the characteristics of single and three-phase circuits.
- i) Identifying the function of over-circuit and ground-fault protection.
- j) Determining volt, amp, and ohms relationships (Ohm's and other application laws).
- k) Selecting proper over-current protection devices.
- l) Utilizing electric power efficiently by component demand.
- m) Select adequate and appropriate lighting fixtures.
- n) Interpret wiring diagrams.

Performance Skills

- a) Safety and Maintenance
- b) Wiring 115/230 volt service outlets.
- c) Wiring switches.
- d) Measuring electric circuits for voltage, current flow, resistance, and wattage.
- e) Installing ground-fault circuit interrupters.
- f) Installing electrical circuits, devices, and appliances.
- g) Troubleshooting electrical circuits.
- h) Attaching conductors to terminals.
- i) Installing attachment plugs and cord connector bodies.
- j) Making proper splices and connections.
- k) Read schematics and sketch wiring circuits.

5. Electric Motors, Controls, and Sensing Devices

Problem Solving

- a) Safety and Maintenance
- b) Selecting motors and generators based upon type of application.
- c) Interpreting motor nameplate data.
- d) Interpreting motor wiring connection diagrams.
- e) Identify service requirements of the electric motor.
- f) Identifying motors and motor parts.
- g) Identifying methods of providing motor protection.
- h) Interpreting Hp, Pf, torque, and other motor selection relationships.
- i) Interpreting wiring diagrams.
- j) Selecting controls for electric motors.
- k) Identifying types of controls by nomenclature and use, including thermostats, humidistats, photoelectric cells, magnetic relays, timers, pressure switches, and time delay equipment.
- l) Setting controls such as timers and switches for the desired performance.
- m) Using low-voltage electric control equipment.
- n) Describing basic principles of solid state controls.

Performance Skills

- a) Safety and Maintenance
- b) Troubleshooting electric motor circuits.
- c) Connecting a dual voltage motor to power source.
- d) Changing the direction of motor rotation.
- e) Providing suitable motor over-current protection. 4.5

- f) Servicing and lubricating an electric motor.
- g) Determining and calculating Hp, Pf, torque, and other motor operating relationships.
- h) Installing switch controls on motors.
- i) Installing timer circuit, thermal protection and solid state delay relay controls.
- j) Installing a low-voltage motor control system.
- k) Installing a sensing device (thermostats, humidistats, photoelectric cells, etc.).

6. Buildings Construction (Wood or Metal)

Problem Solving

- a) Safety and Maintenance
- b) Select and evaluate building sites.
- c) Selecting and applying wood framing, roofing, insulation, and vapor barrier materials.
- d) Selecting hand, electric and pneumatic carpentry tools and equipment.
- e) Figuring a bill of materials.
- f) Reading blueprints and working drawings.
- g) Identifying structural parts of buildings
- h) Selecting paint, finishing, and preservative materials for building materials.
- i) Identifying environmental problems in livestock buildings and crop processing buildings.
- j) Selecting kinds and grades of lumber, plywood, and panels.
- k) Identify structural components for each alternative construction style.
- l) Interpret lumber and manufactured wood product grade stamps.
- m) Selecting abrasives for sanding and finishing.
- n) Identifying appropriate shape of cutting edges for wood tools.
- o) Identifying safety practices for using keen edge tools and grinding equipment.

Performance Skills

- a) Safety and Maintenance
- b) Identifying, selecting, and applying construction materials, lumber, fasteners and hardware.
- c) Using and servicing hand, electric and pneumatic carpentry tools and measuring instruments for construction.
- d) Laying out, cutting, and framing walls, floors, trusses, rafters, braces, and other structural components.
- e) Leveling and laying out a building foundation.
- f) Constructing buildings or building components.
- e) [Differential Leveling](#)
- g) Select and apply appropriate siding, insulation and vapor barrier materials.

7. Concrete, Masonry, and Plumbing

Problem Solving

- a) Safety and Maintenance
- b) Planning footings, foundations, floors, and flatwork.
- c) Identify procedures for mixing and placing concrete in cold or hot weather.
- d) Selecting materials, components and tools for concrete and masonry construction.
- e) Determining quantity and cost of materials for concrete job.
- f) Determining the water-cement ratio and aggregate for a job.
- g) Identify materials and techniques to reinforce concrete and masonry construction.

- h) Constructing forms for concrete.
- i) Estimate “Redi-mix” concrete. 4.6
- j) Identify techniques for placing, finishing and curing concrete and masonry units.
- k) Identify concrete additives to increase strength and reduce cracking.
- l) Identify concrete additives to control hydration rate.
- m) Identifying pipe fittings by types.
- n) Selecting pipe threading and cutting tools.
- o) Selecting types of pipe and tubing.
- p) Calculating length of pipe.
- q) Reading plans, interpreting drawings and symbols, and figuring bills of material.
- r) Selecting soldering equipment and tools.
- s) Identify manufactured form systems for poured-in-place foundation walls.

Performance Skills

- a) Safety and Maintenance
- b) Laying out a building foundation.
- c) Use traditional, electronic and laser tools in concrete and masonry construction
- d) Making a slump test.
- e) Determining moisture in sand.
- f) Placing anchor bolts.
- g) Identify concrete and masonry finishing tools, components, and equipment.
- h) Preparing a site for flatwork, concrete, and block buildings.
- i) Select and calculate aggregates, water, Portland cement, lime, concrete and mortar mixes.
- j) Select, prepare and place concrete or masonry reinforcement.
- k) Identifying plumbing components.
- l) Cutting and joining pipe and plumbing materials (copper, steel, plastic).
- m) Connecting flare and compression fittings. (copper, steel, plastic)
- n) Sweating soldering copper fittings.
- o) Calculating plumbing material costs.
- p) Determine pump capacity and system requirements.

8. Safety Certification (this school year) **must be on file with Regional CDE Rep to compete.**

- a) Student completed power tool safety unit
- b) Passed a Safety Test (100%) on file in district
- c) Viewed Instructor Demo (Student’s Signature and Date)
- d) Instructor viewed student's safe operation (Instructor’s Signatue and Date)

Safety Instruction Verification for Agricultural Mechanics CDE

FFA Member _____ School _____

For school Year _____ to _____

Tools: Circle the power tools covered by this safety verification form:

Arc Welder/MIG/TIG, Drill, Propane Torch,
Circular Saw, Miter Saw, Other _____

I viewed my teacher demonstrate the safe use of the power tools listed on _____
Date

Student's Signature _____

The FFA member has passed, with 100%, the power tool safety tests for the tools listed on
_____. A copy of the completed test is on file at the school district.
Date

The FFA member demonstrated the proper safe use of the power tools listed on _

Date

Instructor's Signature _____

School verification- (if part of school policy)

I verify that the above safety instruction took place and all the information is correct.

Administrator's Signature _____ Date _____

SUGGESTED REFERENCES (Revised 7/20)

FMO and FOS manuals. John Deere

Tractor and Machinery Operator's Manuals

Agricultural Power and Technology – Pearson Prentice Hall Interstate

Mechanical Technology in Agriculture - Pearson Prentice Hall Interstate

Introduction to Agricultural Mechanics - Pearson Prentice Hall Interstate

Agricultural Mechanics Fundamentals and Applications - Delmar Publishers

Modern Agricultural Mechanics - Pearson Prentice Hall Interstate

Small Engines – Briggs and Stratton Corporation

Power Tool Safety and Operation - Hobar

Modern Carpentry - Goodheart Willcox

Home Wiring – Step by Step Guide – Guide Book Company

National Electrical Code (2020 edition) - NFPA.

National FFA Agricultural Mechanics web site: <https://www.ffa.org/participate/cdes/agricultural-technology/>