

Agricultural Mechanics Career Development Event

(test resources are from National FFA)

RULES OF THE CONTEST

The state FFA Agricultural Mechanics contest is structured for a four-person team. All students will complete the same comprehensive test. The hands-on portion will consist of two students who compete in the electrical or the mechanical area. Within each specialized area, two students complete a specialized test in their selected area, and then complete the hands-on portion in that same area. All students complete the hands on portion INDIVIDUALLY. Teams of three can specialize in just ONE area, mechanical or electrical. Students NEED safety glasses, if they show up without that, they will NOT be allowed to participate in the contest.

SAFETY EQUIPMENT. Each contestant will be responsible for all personal safety equipment including:

- a. INDUSTRIAL QUALITY EYE PROTECTION. No contestant will be allowed to participate in the performance skills events of the contest without "eye protection devices" (spectacles or goggles) that meet the standards of the American National Standard Practice for Occupational and Education Eye and Face Protection, Z87.1-1979 (Or Z87.1-1968) and any subsequent revisions thereof, approved by the American National Standards Institute, Inc. Industrial quality eye protection lenses and frames according to the new standard will be marked with either the manufacturer's logo and/or Z87 logo. Dress eyewear lenses (spectacles and sunglasses) beginning January 1, 1972, were fitted with impact-resistant lenses in accordance with the Federal Food, Drug and Cosmetic Act. These DO NOT QUALIFY as Industrial Quality Eye Protection. The descriptions of style A, B, and C Industrial Quality Eye Protection are as follows:

Style A--Safety spectacles without side shields. They are for limited hazard use requiring only frontal protection. The addition of accessory side shields, which are not firmly secured, does not upgrade Style A to a Style B or C.

Style B--Safety spectacles with wire mesh, perforated plastic or non-perforated side shields. The side shields shall be tapered with an anatomical periphery extending at least halfway around the circumference of the lens frame.

Style C--Safety spectacles with semi- or flat-fold side shields, which must be firmly secured to the frame.

INDUSTRIAL QUALITY EYE PROTECTION FOR THOSE NOT WEARING PRESCRIPTION GLASSES SHALL BE THE STYLE "B"

Protection level for those wearing Style "A" or prescription industrial quality glasses may be improved by wearing additional goggles. Style "C" glasses do not provide maximum protection from the top and bottom angles. Those wearing prescription eyewear, which are not industrial quality, must also wear goggles while performing in the contest skill areas.

- b. CLOTHING. Each contestant shall wear coveralls, a shop coat or uniform for this event. Clothing must be in good repair and fit properly. Long sleeves and long pants clothing must be worn when welding or cutting. No open toed shoes will be allowed, along with loose fitting clothing, or jewelry. Hair needs to be pulled into a ponytail.
 - c. SPECIALIZED SAFETY EQUIPMENT. Welding equipment such as helmets, goggles, face shields and gloves will be furnished.
2. Tools and Equipment. All tools and equipment will be furnished for the contest. Contestants must use the tools and equipment furnished at the contest site for all instructional areas.
 3. Written Materials. All written materials will be furnished for the contest. Contestants should provide clipboards and sharpened pencils. Electronic calculators, which may be programmable, are allowed and encouraged. Personal computers may be provided for problem solving activities.

Each team member is designated to follow one of two specific subject tracks:

- A. Mechanical (subsections to include Ag Power, Machinery and MetalWorking)
- B. Electrical

The contest is conducted in two parts:

1. The comprehensive about the agricultural mechanics and electrical industry and specialized test in either mechanical or electrical (60 min)
2. The hands-on skills test (120 min)

POINTS BREAKDOWN

Each individual person on the team can earn up to 300 points.

Comprehensive test is worth 100 points (50 questions, 2 points each)

Specialized test is worth 50 points (25 questions, 2 points each)

Hands on skills "test" is worth 150 points.

A total team can earn up to 1200 points

Tiebreakers are:

- 1) Hands on Skills
- 2) Comprehensive Test
- 3) Specialized Test
4. The contest, will include the following subject matter for each of the two instructional areas:
 - a. **Mechanical (Agricultural Power, Machinery & Metal Working):**
 - Compact and Utility Tractor Power
 - Small Engine Power
 - Agricultural Machinery
 - Metal Working
 - b. **Electrical:**
 - Electric Power
 - Controls
 - Circuits

COMPETENCIES

The 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 contest. The skill may also be suggested by an "Understanding".

MECHANICAL

1. Compact and Utility Tractor Power

Understanding

- a. Identify the recommended service and maintenance operations from the operator's manual.
- b. Describe the importance of customer relations and communications.
- c. Operating principles of two-stroke and four-stroke cycle engines.
- d. Describe how to repair a specific component or system.
- e. Select repair parts using manufacturer's catalogs, microforms, microfiche or computers.
- f. Select fuels, lubricants, hydraulic fluids and coolants.
- g. Identify the importance of oil analysis as a management tool.
- h. Operation of and interpreting circuit diagrams and flow charts in electrical, hydraulic, fuel, oil, cooling and intake and exhaust systems.
- i. Identify the function and operating principle of tractor clutches, transmissions, control devices and brakes.
- j. Principles of power transmission.

- k. Identify the parts and functions of electrical, hydraulic, lubrication, cooling, governor and fuel systems.
- l. Interpret horsepower, torque and other power measurement criteria.
- m. Interpret metric units in measurements.
- n. Comprehend cab and environment controls (air conditioning and heating).
- o. Comparing costs of ownership, lease, rental, and custom agreements.
- p. Comparing costs of alternative machine uses.

Performance

- a. Perform recommended periodic service jobs (as found in operator's manuals).
- b. Use measuring tools and test instruments thickness and telescoping gauges, dial indicator, compression tester, torque wrench, VOA (volt-ohm-amp)-meter, DMM (digital multimeter) timing devices, tachometer and dynamometer.
- c. Test and service batteries, charging, lighting, warning and cranking systems.
- d. Test and service cooling systems.

2. Small Engine Power

Understanding

- a. Identify operating principles of two-stroke and four-stroke spark or compression ignition engines.
- b. Select engine repair parts using manufacturer's catalogs, microforms, microfiches or computers.
- c. Interpret and follow recommended service and maintenance schedules.
- d. Explain the functions and operating principles of fuel, lubricating, governor, cooling, and electrical systems.
- e. Identify the use and function of engine repair tools.
- f. Select fuels and lubricants.
- g. Evaluate practices and procedures for storing an engine.
- h. Evaluate engine performance under load and no-load operation.
- i. Locate adjustment data and specifications in the operator's manual.
- j. Evaluate engine parts for replacement or servicing.

Performance

- a. Identify and use engine overhaul equipment, including valve, cylinder, piston, seal and bearing tools.
- b. Identify and use measuring tools and test instruments such as micrometer, thickness gauge, telescoping and small hole gauge, dial indicator, compression tester, torque wrench, tachometer, coil-condenser tester, ignition timing tester, ignition circuit tester and VOA (volt-ohm-amp)-meter or DMM (digital multimeter).
- c. Identify, and use tools to service and maintain fuel, air intake and exhaust, cooling, and lubrication systems.
- d. Assemble and adjust ignition and fuel systems.

3. Agricultural Machinery

Understanding

- a. Using operator's manuals.
- b. Identifying safe machinery operating practices.
- c. Interpreting and following recommended service and maintenance schedules.
- d. Selecting lubricants for machinery and equipment.
- e. Identifying machinery parts and functions.
- f. Selecting machinery parts and functions.
- g. Comparing costs of use, ownership, lease rental and custom alternatives.

- h. Selecting correct speed and load.
- i. Identifying parts and functions of hydraulic systems.
- j. Determining hydraulic cylinder load and speed.
- k. Testing electrical and electronic sensing devices.
- l. Determining field (acreage) capacity of machinery.
- m. Preparing machinery for storage.

Performance

- a. Identify and use tools and test instruments such as micrometer, dial indicator, torque wrench, and tachometers.
- b. Identify and use testing equipment including meters, tachometers, and timing devices.
- c. Operating and servicing hydraulically controlled machinery.
- d. Identify and use impact and pneumatic tools.

4. Metal Working

1. HOT AND COLD METAL

Understanding

- a. Identify various types and shapes of metal.
- b. Identify the procedure for heat-treating tools.
- c. Select soldering equipment and tools.
- d. Prepare metals for soldering.
- e. Identify hand metal working tools by types and sizes.
- f. Determine tap and drill sizes.
- g. Select files and saw blades.
- h. Read metalworking plans and prints.
- i. Identify safety practices for metal striking and machine tools.

Performance

- a. Identify, understand and use common tools for metal cutting (reference identification list)

5. Metal Fabrication

1. ARC SMAW, GMAW, GTAW, AND FCAW WELDING

Understanding

- a. Identify safety practices in arc welding.
- b. Select arc welding machines and accessories.
- c. Read drawings and welding symbols.
- d. Control distortion in arc welding.
- e. Select appropriate electrodes and wires.
- f. Select hard surfacing alloys.
- g. Prepare materials and equipment for arc welding.
- h. Test weld quality and strength.
- i. Select shielding gasses.
- j. Describe and science of welding processes.

Performance

- a. Identify metals (see reference list)

- b. Lay out and prepare metals for arc welding.
- c. Start up, shut down and securing equipment.

ELECTRICAL

1. Electric Power

Understanding

- a. Select motors based upon type of application.
- b. Interpret motor nameplate data.
- c. Interpret motor wiring connection diagrams.
- d. Service electric motors.
- e. Identify motor drives.
- f. Identify motor parts.
- g. Identify methods of providing motor protection.

Performance

- a. Troubleshoot electric motor circuits using proper testing equipment.
- b. Connect a dual voltage motor to the power source.
- c. Disassemble and reassemble an electric motor.
- d. Provide suitable motor over-current protection.
- e. Check the running amperage and voltage of an electric motor.

2. Electric Controls

Understanding

- a. Interpret wiring and ladder diagrams
- b. Identify and describe basic principles of controls including thermostats, humidistats, magnetic relays, timers, pressure, limit, float and sail switches.
- c. Identify the differences between magnetic and manual motor starters.
- d. Service motor starters.

3. Electric Circuits

Understanding

- a. Using appropriate standards for agricultural wiring including the National Electrical Code (NEC), OSHA, and American Society of Agricultural Engineers (ASAE)
- b. Planning safe electrical circuits.
- c. Selecting type and size of conductor for a specific application.
- d. Calculating voltage drop.
- e. Reading a kilowatt-hour meter.
- f. Identifying the characteristics of single- and three-phase circuits.
- g. Selecting adequate and appropriate lighting.
- h. Using Ohms, power and other application laws.
- i. Identifying sources, solutions and measuring techniques of stray voltage.

Performance

- a. Using safe wiring practices and proper materials for specific applications.
- b. Reading schematics and sketching wiring circuits.
- c. Splicing and terminating conductors.

- d. Installing attachment plugs and cord connector bodies.
- e. Measuring voltage, amperage, resistance and wattage.
- f. Installing electrical circuits, switching devices, lighting outlets, receptacles and ground-fault circuit interrupters.
- g. Measuring voltage, current resistors, and power
- h. Identify the NEMA rated plugs and receptacles
- i. Identify common wiring materials

SUGGESTED REFERENCES

The primary goals of the National Agricultural Mechanics Committee is to promote quality agricultural mechanics instructional programs in agricultural education. The following list of suggested references and indicative of books and manuals useful for contest preparation. Test questions will be "generic" in nature and found in several specific sources. It is the responsibility of the National Committee to reflect mechanization and technological practices in the agricultural production and processing industry.

Midwest Plan Service - Electronic copy available for \$38.00 at:

<https://store.extension.iastate.edu/product/2711>

Kline Book - free source

https://data.kleintools.com/sites/all/product_assets/documents/brochures/klein/KleinTools_Proper-Use-and-Care-of-Hand-Tools_98016.pdf

Test will be made up from a combination of the last five years of national FFA tests.

ELECTRIFICATION AND ELECTRIC POWER

General Texts:

- a. National Electrical Code, 1993 Edition - - NFPA

Electric Motors

- a. Electric Motors: Selection, Protection, Drives--AAVIM
- b. How Electric Motors Start and Run--AAVIM
- c. Electric Motors: Principles, Controls, Service and Maintenance--Hobar
- d. Electric Power: Motors, Controls and Generators--Goodheart-Wilcox
- e. Electricity 3 and 4--Delmar

Electric Controls

- a. Electric Controls and Basic Controls Used in Agricultural Production--Hobar
- b. Electrical Farm Equipment Guide--NFEC
- c. Electric Motors: Principles, Controls, Service and Maintenance--Hobar

Electrical Circuits

- a. Agricultural Wiring Handbook--NFEC
- b. Electrical Wiring System for Livestock and Poultry Facilities--NFEC
- c. Check Stray Voltage on Farms--NFEC
- d. Electrical Construction Wiring--American Technical Publishers, Inc.
- e. Fundamentals of Electricity--American technical Publishers, Inc.
- f. Understanding Electricity and Electrical Terms--AAVIM
- g. Understanding and Using Electric Circuits--Interstate
- h. Electricity 1 and 2--Delmar
- i. Agricultural Electrification--Delmar
- j. Fundamentals of Electricity for Agriculture--AVI Publishing Co.

- k. Basic Electricity and Practical Wiring--Hobar
- l. Farm Wiring Handbook--Hobar

AGRICULTURAL POWER AND MACHINERY

General Texts:

- a. FMO Safety--John Deere
- b. Agricultural Power and Machinery--McGraw-Hill
- c. Mechanics in Agriculture--Interstate

Tractor Power

- a. Safe Tractor Operation and Daily Care--AAVIM
- b. Specifications for Tune-up and Service of Farm Tractors--AAVIM
- c. Fuels and Lubricants--AAVIM
- d. Operating Tractors for Grounds Keeping--AAVIM
- e. FOS--John Deere
 - Engines
 - Electrical
 - Power Trains
 - Compact Equipment Series
 - Air Conditioning
 - Hydraulics
 - Tires and Tacks
 - Fuels, Lubricants & Coolants
- f. FMO--John Deere
 - Preventive Maintenance
 - Tractor Safety
- g. Diesel Fundamentals--Goodheart-Wilcox
- h. Understanding and Measuring Power--AAVIM

Small Engine Power

- a. Care and Operation of Small Gasoline Engines--AAVIM
- b. Small Engines, Operation, Maintenance and Repair--AAVIM
- c. Service and Repair Instructions--Briggs and Stratton Corporation
- d. Small Gasoline Engines--Hobar
- e. Air Cooled Engines Mechanics Training Manual, Form TM-6/2-ESA
- f. Small Gas Engines--Goldheart-Wilcox
- g. Step-by-Step Small Engine Repair Series--UMC-IML

METAL WORKING

General Texts:

- a. Agricultural Mechanics: Fundamentals and Applications -- Delmar
- b. Modern Agriculture Mechanics -- Interstate
- c. Developing Shop Safety Skills -- AAVIM
- d. Power Tool Safety and Operation -- Hobar
- e. Safety in the Shop: No. 3022a -- Vo-Ag Service
- f. Working in Agricultural Mechanics -- McGraw-Hill
- g. Agricultural Mechanics I Lesson Plans -- UMC-IML
- h. Agricultural Mechanics II Less Plans -- UMC-IML

Arc Welding

- a. Welding-FOS--John Deere
- b. Welding Skills and Practices--American Technical Publishers, Inc.
- c. Metals and Welding--Hobar
- d. Shielded Metal Arc Welding, No. 3004a--Vo Ag Service
- e. Modern Welding--Goodheart-Wilcox
- f. Welding Technology--American Technical Publishers, Inc.

- g. Basic Arc Welding--Delmar
- h. Arc Welding--AAVIM
- i. Arc Welding--Basic Fundamentals--Goodheart-Wilcox
- j. Gas Tungsten Arc Welding Handbook--Goodheart-Wilcox
- k. Welding: Principles and Applications--Delmar
- l. Arc Welding--UMC-IML

Hot Metal and Cold Metal

- a. Metals and Welding--Hobar
- b. Ferrous Metals-Properties, Identification and Treatment: No. 3041--Vo Ag Service
- c. Modern Metal Working--Goodheart-Wilcox
- d. Sharpening Hand Tools: No. 3005--Vo Ag Service
- e. Soldering for Home, Farm and Shop, Applications No. 3027--Vo Ag Service
- f. Metalwork Technology and Practice--McKnight Publishing

ADDRESSES OF PUBLISHERS

1. AAVIM, 120 Driftmeier Engineering Center, Athens, GA 30602
2. Ag Education Department, University of Arizona, Tucson, AZ 85721
3. American Technical Publishers, Inc., 12235 S. Laramie, Alsip, IL 60658
4. The AVI Publishing Co., Inc., P.O. Box 831, Westfork, CT 06881
5. Briggs-Stratton Corporation, P.O. Box 702, Milwaukee, WI 53201
6. Delmar Publishers, Inc., 2 Computer Drive West, Box 15-015, Albany, NY 12212-9985
7. Engine Service Association (ESA), 700 N. Plankinton Ave., Suite 333, Milwaukee, WI 53203
8. Goodheart-Wilcox, 123 West Taff Drive, South Holland, IL 60473
9. Harper & Row Publications, 10 East 53rd Street, New York, NY 10222
10. Hobar Publications, 1234 Tiller Lane, St. Paul, MN 55112
11. Interstate Printers and Publishers, P.O. Box 50, Danville, IL 61832-0050
12. Iowa State University Press, 2121 S. State Avenue, Ames, IA 50010
13. John Deere Service Training, John Deere Road, Dept. 150 Moline, IL 61265-8098
14. John Wiley and Sons, P.O. Box 6793, Somerset, NJ 08873-9977
15. McGraw-Hill Book Company, 1221 Avenue of the Americas, New York, NY 10020
16. Reston Publishing Company, A Prentice-Hall Company, Reston, VA 22090
17. South-Western Publishing Co., 5101 Madison Road, Cincinnati, OH 45227
18. The Ohio State University, Ohio Ag. Ed. Curr. Mat. Serv., 2120 Fyffe Road, Columbus, OH 43210
19. University of Missouri-Columbia-IML, 10 Industrial Ed. Bldg., Columbia, MO 65211
20. Vocational Agriculture Service, College of Agriculture, University of Illinois, 1401 S. Maryland Drive, Urbana, IL 61801
21. American Society of Agricultural Engineers, 2950 Miles Road, St. Joseph, MI 49085
22. Stanley Tool Company, 600 Myrtle Service, New Britain, CT 06050
23. McKnight Publishing Co., Box 2854, Bloomington, IL 61701
24. Midwest Plan Service, 122 Davidson Hall, Iowa State University, Ames, IA 50011
25. National Fire Protection Association (NFPA), Battermarch Park, Quincy, MA 02269
26. National Food and Energy Council (NFEC), 409 Vandiver West, Suite 202, Columbia, MO 65202