DIESEL EQUIPMENT TECHNOLOGY

PURPOSE

To evaluate each competitor's preparation for employment and to recognize outstanding students for excellence and professionalism in the field of diesel equipment technology.

ELIGIBILITY

Open to active SkillsUSA members enrolled in programs with diesel equipment technology as the occupational objective.

CLOTHING REQUIREMENTS

NYS SkillsUSA – Mechanic

- White crew neck short- sleeved T-shirt
- Work pants or jeans,
- Leather or steel toed work shoes.
- Long hair must be restrained.
- Safety glasses with side shields or goggles, (Prescription glasses can be used only if they are equipped with side shields and approved by OSHA(Z-87). If not, they must be covered with goggles.)

Note: Contestants must wear their official contest clothing to the contest orientation meeting. Also bring #2 pencil, resume, and safety assurance form.

SAFETY INSTRUCTION AND VERIFICATION OF TRAINING

Important: Both the instructor and the competitor certify by agreeing to enter this competition that the competitor has received instruction in diesel technology and has demonstrated knowledge of the operation and safe use of the following tools, equipment, and machines:

1. Oxyacetylene welding and cutting
2. Drill press
3. Hand tools
4. Hydraulic systems
5. Electric welding
6. Metal grinders

They also certify that NYS SkillsUSA Inc., the national technical committee and national judges are released from all responsibilities relating to personal injury resulting from their use.

Competitors will be removed from the competition if proper training has not been provided and/or they are using the equipment in an unsafe manner.

EQUIPMENT AND MATERIALS

1. Supplied by the technical committee: All materials, tools, and equipment needed for the competition
2. Supplied by the competitor: All competitors must create a one-page resume. See "Resume Requirement" below for guidelines

RESUME REQUIREMENT

Competitors must create a one-page resume to submit at orientation.

DEVICES

Cell phones or other electronic devices not approved by the NYS Chairperson will be collected by the contest chair during the competition. Chairpersons will announce their acceptance by listing it on their standard or at the orientation meeting. In case of emergencies, advisors should allow the competitors to take their phones to the contest areas.

If the competitor uses their device in a manner that compromises the integrity of the competition, the competitor's score may be penalized.

SCOPE OF THE COMPETITION

The competition is defined by industry standards as identified by SkillsUSA technical committee, which includes Air Products, ArvinMeritor Automotive Inc., Caterpillar Inc., Cummins Inc., Detroit Diesel Corp., Eaton Corp., FedEx Freight, International Truck and Engine Corp., J. Jeb Mfg. Co., John Deere Construction and Forestry, Kenworth Truck Co., Meritor WABCO, MTU-Detroit Diesel Inc., National Institute for Automotive Service Excellence, Ohio Technical College, Ryder Systems Inc., United Parcel Service and Volvo Trucks of North America Inc.

KNOWLEDGE PERFORMANCE

All competitors are required to take the SkillsUSA professional development test at orientation.

The competition will include a written exam to assess knowledge of principles, theories and procedures used in diesel equipment technology.

SKILLS PERFORMANCE

The competition will include a series of stations where students will service and repair large diesel engines, transmissions, drivetrains, electrical systems, brakes, hydraulic systems, and cab components used in farm equipment, trucks, and construction equipment.

COMPETITION GUIDELINES

1. Competitors may be assigned problems or projects
2. The following general shop safety rules will be followed:
   a. Safety glasses must be worn at all times when in the work area. If the competitor is taking a written test or is in a job interview, safety glasses can be removed.
   b. No loose clothing is permitted.
   c. Long hair must be tied behind the head or netted.
   d. Gloves must not be worn during operation of machinery, except while doing electric welding and oxyacetylene welding and cutting operations.
   e. Any liquid or grease spilled must be cleaned up immediately and reported to the judge.
   f. All injuries, no matter how slight, must be reported immediately to the judge.
3. In addition, competitors will be judged on general shop skills, problem-solving skills, shop safety and a written test. Points allowed will be assigned by the technical committee based on the difficulty of the assigned task.

STANDARDS AND COMPETENCIES

DET 1.0—Demonstrate competencies related to using precision measurements in diesel equipment technology

1.1. Interpret and follow verbal instructions
1.2. Interpret and follow written instructions
1.3. Read and explain basic prints
1.4. Use dial indicator
1.5. Calibrate dial indicator
1.6. Use valve spring compressor to remove valve from head
1.7. Use valve spring compressor to install valve in head Use
1.8. metric micrometers
1.9. Use U.S. standard micrometers
1.10. Record metric measurements correctly
1.11. Record U.S. standards correctly
1.12. Use bore gauge correctly
1.13. Compare readings taken with standards to determine if part is within manufacturer's tolerances
1.14. Use dial calipers
1.15. Calibrate dial calipers
1.16. Use an inside telescoping gauge
1.17. Use a depth micrometer

DET 2.0—Demonstrate competencies needed to complete live engine troubleshooting

2.1. Inspect fuel, oil and coolant levels, condition, and consumption; determine needed action
2.2. Diagnose causes of engine fuel, oil, coolant, air, and other leaks; determine needed action
2.3. Interpret engine noises; determine needed action
2.4. Observe engine exhaust smoke color and quantity; determine needed action
2.5. Perform air intake system restriction and leakage tests; determine needed action
2.6. Perform intake manifold pressure (boost) test; determine needed action
2.7. Perform exhaust back pressure test; determine needed action
2.8. Perform crankcase pressure test; determine needed action
2.9. Diagnose no cranking, cranks but fails to start, hard starting and starts but does not continue to run problems; determine needed action
2.10. Diagnose surging, rough operation, misfiring, low power, slow deceleration, slow acceleration, and shutdown problems; determine needed action
2.11. Diagnose engine vibration problems; determine needed action
2.12. Check, record, and clear electronic diagnostic (fault) codes; monitor electronic data; determine needed action
2.13. Perform cylinder compression test; determine needed action
2.14. Test engine oil pressure and check operation of pressure sensor, gauge and/or sending unit; determine needed action
2.15. Check engine coolant type, level, condition, and consumption; determine needed action
2.16. Test coolant temperature and check operation of temperature sensor, gauge and/or sending unit; determine needed action
2.17. Inspect thermostatic cooling fan system (hydraulic, pneumatic, and electronic) and fan shroud; replace as needed

2.18. Inspect turbocharger(s), wastegate and piping systems; determine needed action
2.19. Check air induction system: piping, hoses, clamps and mounting; check for air restrictions and leaks; service or replace air filter as needed
2.20. Remove and reinstall turbocharger/wastegate assembly
2.21. Inspect intake manifold, gaskets, and connections; replace as needed
2.22. Inspect, clean and test charge air cooler assemblies; replace as needed
2.23. Inspect exhaust manifold, piping, mufflers, exhaust after-treatment device(s) and mounting hardware; repair or replace as needed
2.24. Inspect and test pre-heater/inlet air heater, or glow plug system and controls; perform needed action
2.25. Inspect and test exhaust gas recirculation (EGR) system; determine needed action
2.26. Check fuel level, quality, and consumption; determine needed action
2.27. Inspect fuel tanks, vents, caps, mounts, valves, screens, crossover system and supply and return lines and fittings; determine needed action
2.28. Inspect, clean and test fuel transfer (lift) pump, pump drives, screens, fuel/water separators/indicators, filters, heaters, coolers, ECM cooling plates and mounting hardware; determine needed action
2.29. Inspect and test low pressure regulator systems (check valves, pressure regulator valves and restrictive fittings); determine needed action
2.30. Check fuel system for air; determine needed action; prime and bleed fuel system; check primer pump
2.31. Inspect, test, and adjust engine fuel shut-down devices and controls; determine needed action
2.32. Inspect high-pressure injection lines, hold downs, fittings, and seals; replace as needed
2.33. Inspect and diagnose electronic fuel management system
2.34. Inspect and test power and ground circuits and connections; measure and interpret voltage, voltage drop, amperage and resistance readings using a digital multi-meter (DMM); determine needed action
2.35. Interface with vehicle's on-board computer; perform diagnostic procedures using recommended electronic diagnostic equipment and tools (to include PC based software and/or data scan tools); determine needed action
2.36. Locate and use relevant service information (to include diagnostic procedures, flow charts and wiring diagrams)
2.37. Inspect and replace electrical connector terminals, seals, and locks
2.38. Inspect and test switches, sensors, controls, actuator components and circuits; adjust or replace as needed
2.39. Using recommended electronic diagnostic tools (to include PC based software and/or data scan tools), access and change customer parameters
2.40. Inspect, test, and adjust electronic unit injectors (EUI); determine needed action
2.41. Remove and install electronic unit injectors (EUI) and related components; recalibrate ECM (if applicable)
2.42. Perform cylinder contribution test using recommended electronic diagnostic tool
2.43. Perform engine timing sensor calibration (if applicable)
2.44. Perform on-engine inspections and tests on hydraulic electronic unit injectors and system electronic controls; determine needed action
2.45. Inspect and adjust engine compression/ exhaust brakes; determine needed action

2.46. Inspect, test, and adjust engine compression/exhaust brake control circuits, switches, and solenoids; repair or replace as needed
2.47. Inspect engine compression/exhaust brake housing, valves, seals, screens, lines, and fittings; repair or replace as needed
2.48. Read and follow written directions
2.49. Comprehend and follow verbal directions
2.50. Diagnose engine-related problems
2.51. Comprehend and follow diagnostic procedures
2.52. Use basic diagnostic tools
2.53. Comprehend and follow general safety requirements
2.54. Demonstrate knowledge of safety requirements when working around running engines
2.55. Demonstrate knowledge of pre-trip inspection before starting engine (fuel, coolant, oil, belts, etc.)
2.56. Explain the basic operations of a diesel engine (key, throttle control, gauge cluster)
2.57. Explain the principles of the four-cycle (stroke) engine (intake, compression, power, exhaust)
2.58. Describe related environmental concerns (fuel/oil/filter disposal)
2.59. Use basic computer operating skills and diagnostic programs

DET 3.0 (Standard 7)—Demonstrate competencies related to drive line component and system diagnosis and repair

3.1. Distinguish lubricant leaks and lubricant seeps per specifications
3.2. Remove and replace drive axle housing cover plates, gaskets, sealants, vents, magnetic plugs, and seals
3.3. Remove and replace drive axle carrier assembly from drive axle housing
3.4. Remove and replace axle shafts
3.5. Check drive axle fluid level and condition
  3.5.1. Determine needed service
  3.5.2. Add proper type of lubricant
3.6. Remove and replace driveline yokes
3.7. Disassemble carrier assembly internal/external components
3.8. Inspect carrier assembly components to determine reuse, to include but not limited to: spider gears, cross, side gears, thrust washers, case halves, bearings, ring gear, pinion, inter-axle differential case assembly components, driver-controlled differential lock components, inter-axle differential lock components, drive axle lubrication system pump, troughs, collectors, slingers, tubes, filters, driveline yoke, spigot bearing, adjusting rings, carrier case, and planetary gear-type two-speed axle assembly including: case, idler pinion, pins, thrust washers, sliding clutch gear, shift fork, pivot, seals, cover and springs
3.9. Inspect, repair, or replace two-speed axle shift control system, speedometer adapters, motors, axle shift units, wires, air lines and connectors
3.10. Inspect, adjust, repair, or replace air operated power divider (inter-axle differential) lockout assembly including diaphragms, seals, springs, yokes, pins, lines, hoses, fittings, and controls
3.11. Assemble carrier assembly internal/external components
3.12. Inspect, adjust, or replace ring gear thrust block/bolt
3.13. Assemble drive pinion assembly in carrier housing and adjust bearing preload to specification

3.14. Assemble drive pinion assembly in carrier housing and adjust pinion depth to specification
3.15. Check, and if possible, set ring gear run-out to specification
3.16. Assemble main differential, check rotating resistance, and adjust to specification
3.17. Install main differential case and ring gear and set bearing preload to specification
3.18. Remove and replace the ring gear from the flange case half of the main differential case
3.19. Check and interpret ring gear and pinion tooth contact pattern; determine needed action; if necessary, adjust to specification
3.20. Set ring and pinion gear backlash to specification
3.21. Assemble main differential lock components
3.22. Assemble inter-axle differential components
3.23. Check input shaft end play, adjust as necessary per specifications
3.24. Adjust ring gear thrust screw clearance per specifications
3.25. Clean, inspect, lubricate, and replace wheel bearings; replace seals and wear rings; adjust drive axle wheel bearings to specifications
3.26. Diagnose drive axle for wheel bearing noise and damage; perform needed action
3.27. Inspect and test drive axle temperature gauge and sending unit/sensor; determine needed action
3.28. Diagnose drive axle(s)/drive unit noise, vibration, and overheating problems; determine needed action

DET 4.0 (Standard 9)—Demonstrate knowledge of basic hydraulic theory and demonstrate competencies needed to inspect, diagnose and service hydraulic systems

4.1. Demonstrate knowledge of fluids (e.g., fluids have no shape of their own, are practically incompressible, apply equal pressure in all directions and provide great increases in work force)
4.2. Explain the function of a reservoir, pump, filters, relief valve, control valve and a cylinder in relation to each other both descriptively and schematically
4.3. Describe a basic, but complete, open center hydraulic system, explaining the operation of the system, the route of fluid during the use of a function and the route of the fluid while the machine is running when no hydraulic function is being used
4.4. Describe a basic, but complete, closed center hydraulic system, explaining the operation of the system, the route of fluid during the use of a function and the route of the fluid while the machine is running when no hydraulic function is being used
4.5. Identify open and closed center systems and the benefits of those applications on vocational equipment
4.6. Describe the purpose of a charge circuit
4.7. Explain the differences between hydraulic and hydrostatic systems
4.8. Identify hydraulic and hydrostatic applications and the benefits of those applications on vocational equipment
4.9. Exhibit the ability to select the proper hose for a given function, taking into consideration the flow needed, pressures to be used, routing, clamping, fittings required and pulsating of lines
4.10. Identify and select various fittings and thread styles (O-ring boss, NPT, NPTF, British, Metric, O-ring flange, ORFS, etc.)
4.11. Describe the use of various filters in hydraulic and hydrostatic systems

4.12. Understand oils and show familiarity with various fluids and their effects on hydraulic systems
4.13. Describe the applications and reactions of various types of sealants with different types of hydraulic systems
4.14. Practice good hydraulic maintenance and safety practices
4.15. Describe proper contamination control procedures dealing with hydraulics
4.16. Follow the proper manufacturer's cleaning/flushing procedures

DET5.0(Standard11)—Perform basic shop skills

5.1. Demonstrate reading comprehension skills
5.2. Comprehend and follow verbal directions
5.3. Identify root cause of engine component failures
5.4. Identify root cause of transmission component failures
5.5. Identify root cause of carrier component failures
5.6. Interpret oil analysis readings
5.7. Identify root cause of elevated oil analysis readings
5.8. Identify mechanical type failures
5.9. Identify operator error type failures
5.10. Identify environmental type failures

DET 6.0 (Standard 13) — Demonstrate the competencies to diagnose, service and repair HVAC systems in a given situation at the operator environment station

6.1. Verify the need for service or repair of HVAC systems based on unusual operating noises; determine needed action
6.2. Verify the need for service or repair of HVAC systems based on unusual visual, smell and touch conditions; determine needed action
6.3. Identify system type and components (cycling clutch orifice tube — CCOT, expansion valve) and conduct performance test(s) on HVAC systems; determine needed action
6.4. Diagnose the cause of temperature control problems in the A/C system; determine needed action
6.5. Identify refrigerant type and check for contamination; determine needed action
6.6. Diagnose A/C system problems indicated by pressure gauge and temperature readings; determine needed action
6.7. Diagnose A/C system problems indicated by visual, aural, smell and touch procedures; determine needed action
6.8. Perform A/C system leak test; determine needed action
6.9. Evacuate A/C system using appropriate equipment
6.10. Internally clean contaminated A/C system components and hoses
6.11. Charge A/C system with refrigerant
6.12. Identify lubricant type needed for system application
6.13. Diagnose, service and repair compressor and clutch components in a HVAC system
    6.13.1. Diagnose A/C system problems that cause protection devices (pressure, thermal and electronic) to interrupt system operation; determine needed action
    6.13.2. Inspect, test, and replace A/C system pressure and thermal and electronic protection devices
    6.13.3. Inspect and replace A/C compressor drive belts, pulleys, and tensioners; adjust belt tension and check alignment

6.13.4. Inspect, test, service and replace A/C compressor clutch components or assembly
6.13.5. Inspect and correct A/C compressor lubricant level (if applicable)
6.13.6. Inspect, test, and replace A/C compressor
6.13.7. Inspect, repair, or replace A/C compressor mountings and hardware

6.14. Diagnose, service and repair evaporator, condenser, and related components in a HVAC system
6.14.1. Correct system lubricant level when replacing the evaporator, condenser, receiver/drier or accumulator/drier and hoses
6.14.2. Inspect A/C system hoses, lines, filters, fittings, and seals; determine needed action
6.14.3. Inspect A/C condenser for proper air flow
6.14.4. Inspect and test A/C system condenser and mountings; determine needed action
6.14.5. Inspect and replace receiver/drier or accumulator/drier
6.14.6. Inspect and test cab/sleeper refrigerant solenoid, expansion valve(s); check placement of thermal bulb (capillary tube); determine needed action
6.14.7. Inspect and replace orifice tube
6.14.8. Inspect and test cab/sleeper evaporator core; determine needed action
6.14.9. Inspect, clean and repair evaporator housing and water drain; inspect and service or replace evaporator air filter
6.14.10. Identify and inspect A/C system service ports (gauge connections); determine needed action
6.14.11. Diagnose system failures resulting in refrigerant loss from the A/C system high pressure relief device; determine needed action

6.15. Diagnose, service, and repair heating and engine cooling components in a HVAC system
6.15.1. Diagnose the cause of outlet air temperature control problems in the HVAC system; determine needed action
6.15.2. Diagnose window fogging problems; determine needed action
6.15.3. Perform engine cooling system tests for leaks, protection level, contamination, coolant level, coolant type, temperature, and conditioner concentration; determine needed action
6.15.4. Inspect engine cooling and heating system hoses, lines, and clamps; determine needed action
6.15.5. Inspect and test radiator, pressure cap, and coolant recovery system (surge tank); determine needed action
6.15.6. Inspect water pump for leaks and bearing play; determine needed action
6.15.7. Inspect and test thermostats, by-passes, housings, and seals; determine needed repairs
6.15.8. Recover, flush and refill with recommended coolant/additive package; bleed cooling system
6.15.9. Inspect thermostatic cooling fan system (hydraulic, pneumatic, and electronic) and fan shroud; replace as needed
6.15.10. Inspect and test heating system coolant control valve(s) and manual shut-off valves; determine needed action
6.15.11. Inspect and flush heater core; determine needed action

6.16. Diagnose, service and repair electrical operating systems and related control components in a HVAC system
- 6.16.1. Diagnose the cause of failures in HVAC electrical control systems; determine needed action
- 6.16.2. Inspect and test A/C heater blower motors, resistors, switches, relays, modules, wiring, and protection devices; determine needed action
- 6.16.3. Inspect and test A/C compressor clutch relays, modules, wiring, sensors, switches, diodes, and protection devices; determine needed action
- 6.16.4. Inspect and test A/C-related electronic engine control systems; determine needed action.
- 6.16.5. Inspect and test engine cooling/condenser fan motors, relays, modules, switches, sensors, wiring and protection devices; determine needed action
- 6.16.6. Inspect and test electric actuator motors, relays/modules, switches, sensors, wiring and protection devices; determine needed action
- 6.16.7. Inspect and test HVAC system electrical control panel assemblies; determine needed action

6.17. Diagnose, service and repair air, vacuum and mechanical operating systems and related control components in a HVAC system
- 6.17.1. Diagnose the cause of failures in HVAC air, vacuum and mechanical switches and controls; determine needed action
- 6.17.2. Inspect and test HVAC system air/vacuum/mechanical control panel assemblies; determine needed action
- 6.17.3. Inspect, test, and adjust HVAC system air/vacuum/mechanical control cables and linkages; determine needed action
- 6.17.4. Inspect and test HVAC system vacuum actuators (diaphragms/motors) and hoses; determine needed action
- 6.17.5. Inspect and test HVAC system vacuum reservoir(s), check valve(s) and restrictors; determine needed action
- 6.17.6. Inspect, test, and adjust HVAC system ducts, doors, and outlets; determine needed action

6.18. Demonstrate knowledge of refrigerant recovery, recycling, and handling procedures in accordance with published EPA and appropriate SAE "J" standards for R-12, R-134a and EPA approved refrigerant blends
- 6.18.1. Maintain and verify correct operation of certified equipment
- 6.18.2. Identify (by label application or use of a refrigerant identifier) and recover A/C system refrigerant
- 6.18.3. Recycle refrigerant
- 6.18.4. Handle, label and store refrigerant
- 6.18.5. Test recycled refrigerant for non-condensable gases

6.19. Perform various tasks by navigating vehicle dash controls, including onboard diagnostics, user settings, display settings, etc.
- 6.19.1. (ELD) Electronic Logging Device – navigation from the operator environment with understanding of Federal Mandate
- 6.19.2. (CMS) Collision Mitigation Systems – Functional alert systems and notifications in operator environment
- 6.19.3. (ESC) Electronic Stability Control – Functional alert system and notifications in operator environment.

6.20. Perform various tasks by navigating vehicle sound system controls