

# DIESEL: ENGINE

## COURSE DESCRIPTION

*Diesel: Engine* is a course offering training in the testing and repairing of diesel engines and related systems. The course introduces fundamental principles of diesel engine operation. Students will learn to perform inspections, tests, and measurements for diagnosis and to perform needed repairs. Course content prepares students to continue in post secondary education, for advanced training in diesel service technology, for entry level employment in diesel engine repair and to take the ASE written test for Diesel Engine.

**Recommended:** Diesel: Electronics, Algebra I or Technical Math, Physical Science or Principles of Technology I

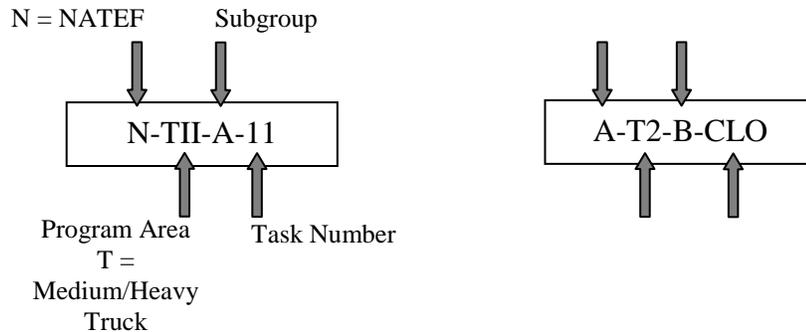
**Required:** A minimum of 195 hours must be dedicated to diesel engines to meet minimum standards set by NATEF.

**Recommended Credits:** 2

**Number of Competencies:** 64 Non-NATEF programs (P-1) Priority 1 Tasks  
115 NATEF certified programs  
95% of P-1  
70% of P-2  
25% of P-3

**Recommended Grade Level(s):** 11<sup>th</sup> or 12<sup>th</sup>

**Notes:** Course is aligned with NATEF tasks list for medium/heavy trucks and AYES curriculum. Items have been organized based on the requirements of the state-required course description format. NATEF tasks are referenced with the corresponding Performance Standards. Additional cognitive objectives covered by the AYES curriculum are also referenced. Codes are as follows:



## **DIESEL: ENGINE STANDARDS**

- 1.0** Students will perform safety examinations and maintain safety records.
- 2.0** Students will demonstrate leadership, citizenship, and teamwork skills required for success in the school, community, and workplace.
- 3.0** Students will integrate reading, writing, math, and science skills and understand the impact of academic achievement in the work place.
- 4.0** Students will properly perform general engine diagnosis.
- 5.0** Students will properly inspect and diagnose cylinder heads and valve trains.
- 6.0** Students will properly diagnose and repair the diesel engine block.
- 7.0** Students will properly diagnose and repair lubrication systems.
- 8.0** Students will properly diagnose and repair cooling system.
- 9.0** Students will properly diagnose and repair air induction and exhaust system.
- 10.0** Students will properly diagnose and repair fuel supply systems.
- 11.0** Students will properly diagnose and repair electronic fuel management system.
- 12.0** Students will properly diagnose and repair engine brake system.

## **DIESEL: ENGINE**

### **STANDARD 1.0**

Students will perform safety examinations and maintain safety records.

### **LEARNING EXPECTATIONS**

The student will:

- 1.1** Demonstrate a positive attitude regarding safety practices and issues.
- 1.2** Use and inspect personal protective equipment.
- 1.3** Inspect, maintain, and employ safe operating procedures with tools and equipment, such as hand and power tools, ladders, scaffolding, and lifting equipment.
- 1.4** Demonstrate continuous awareness of potential hazards to self and others and respond appropriately.
- 1.5** Assume responsibilities under HazCom (Hazard Communication) regulations.
- 1.6** Adhere to responsibilities, regulations, and Occupational Safety & Health Administration (OSHA) policies to protect coworkers and bystanders from hazards.
- 1.7** Adhere to responsibilities, regulations, and Occupational Safety & Health Administration (OSHA) policies regarding reporting of accidents and observed hazards, and regarding emergency response procedures.
- 1.8** Demonstrate appropriate related safety procedures.
- 1.9** Pass with 100 % accuracy a written examination relating to safety issues
- 1.10** Pass with 100% accuracy a performance examination relating to safety.
- 1.11** Maintain a portfolio record of written safety examinations and equipment examinations for which the student has passed an operational checkout by the instructor.

### **PERFORMANCE INDICATORS: EVIDENCE STANDARD IS MET**

The student:

- 1.1A** Is attentive during safety discussions.
- 1.1B** Actively seeks information about safe procedures.
- 1.1C** Responds positively to instruction, advice, and correction regarding safety issues.
- 1.1D** Does not deliberately create or increase hazards, such as by horseplay, practical jokes, or creating distractions.
- 1.1E** Reports to school or work physically ready to perform to professional standards, such as rested, or not impaired by medications, drugs, alcohol, etc.
- 1.2** Selects, inspects, and uses the correct personal protective equipment for the assigned task.
- 1.3A** Inspects power tools for intact guards, shields, insulation, and other protective devices.
- 1.3B** Inspects extension cords for the presence of a functional ground connection, prior to use.
- 1.3C** Operates and maintains tools in accordance with manufacturer's instructions and as required by regulation or company policy.
- 1.3D** Properly places and secures ladders and scaffolding prior to use.
- 1.4A** Is observant of personnel and activities in the vicinity of the work area.
- 1.4B** Warns nearby personnel, prior to starting potentially hazardous actions.
- 1.5A** When asked to use a new hazardous material, retrieves MSDSs (material safety data sheets), and identifies the health hazards associated with the new material.
- 1.5B** Reports hazards found on the job site to the supervisor.

- 1.6A** Erects shields, barriers, and signage to protect coworkers and bystanders prior to starting potentially hazardous tasks.
- 1.6B** Provides and activates adequate ventilation equipment as required by the task.
- 1.7A** Reports all injuries to self to the immediate supervisor.
- 1.7B** Reports observed unguarded hazards to their immediate supervisor.
- 1.8A** Complies with personal assignments regarding emergency assignments.
- 1.9A** Passes with 100% accuracy a written examination relating specifically to content area.
- 1.10A** Passes with 100% accuracy a performance examination relating specifically to welding tools, equipment and supplies.
- 1.11A** Maintains a portfolio record of written safety examinations and equipment examinations for which the student has passed an operational checkout by the instructor.

### **SAMPLE PERFORMANCE TASKS**

These are sample projects of the type and scale recommended to address one or more of the learning expectations for this standard. Other projects can be used at the instructor's discretion.

- Conduct a practice drill simulating a hazardous solvent spill in which an emergency action plan is to be implemented.
- Instruct a visitor to obviously approach the vicinity of a student conducting a hazardous activity and note the level of awareness demonstrated by the student.
- For a project requiring the use of ladders and/or scaffolding, note the proper placement and securing procedures followed by students.

### **INTEGRATION LINKAGES**

Language Arts, Mathematics, Technical Algebra, Technical Geometry, Algebra, Geometry  
English IV: Communication for Life, SkillsUSA Technical Championships, American Welding Society (AWS), Guide for Training and Qualification of Entry Level Welder, National Center for Construction Education Research (NCCER), Secretary's Commission on Achieving Necessary Skills (SCANS), Professional Development Program, SkillsUSA

## **DIESEL: ENGINE**

### **STANDARD 2.0**

Students will demonstrate leadership, citizenship, and teamwork skills required for success in the school, community, and workplace.

### **LEARNING EXPECTATIONS**

The student will:

- 2.1** Cultivate positive leadership skills.
- 2.2** Participate in the student organization directly related to their program of study as an integral part of classroom instruction.
- 2.3** Assess situations, apply problem-solving techniques and decision-making skills within the school, community, and workplace.
- 2.4** Participate as a team member in a learning environment.
- 2.5** Respect the opinions, customs, and individual differences of others.
- 2.6** Build personal career development by identifying career interests, strengths, and opportunities.

### **PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET**

The student:

- 2.1A** Demonstrates character and leadership using creative-and critical-thinking skills.
- 2.1B** Uses creative thought process by “thinking outside the box.”
- 2.2A** Relates the creed, purposes, motto, and emblem of their student organization, directly related to personal and professional development.
- 2.2B** Plans and conducts meetings and other business according to accepted rules of parliamentary procedure.
- 2.3A** Makes decisions and assumes responsibilities.
- 2.3B** Analyzes a situation and uses the Professional Development Program or career technical student organization materials directly related to the student’s program of study to resolve it.
- 2.3C** Understands the importance of learning new information for both current and future problem solving and decision making.
- 2.4A** Organizes committees and participates in functions.
- 2.4B** Cooperates with peers to select and organize a community service project.
- 2.5A** Researches different customs and individual differences of others.
- 2.5B** Interacts respectfully with individuals of different cultures, genders, and backgrounds.
- 2.5C** Resolves conflicts and differences to maintain a smooth workflow and classroom environment.
- 2.6A** Creates personal career development by identifying career interests, strengths, and opportunities.
- 2.6B** Identifies opportunities for career development and certification requirements.
- 2.6C** Plans personal educational paths based on available courses and current career goals.
- 2.6D** Creates a resumé that reflects student’s skills, abilities, and interests.

## **SAMPLE PERFORMANCE TASKS**

- Create a leadership inventory and use it to conduct a personal assessment.
- Participate in various career technical student organizations' programs and/or competitive events.
- Implement an annual program of work.
- Prepare a meeting agenda for a specific career technical student organization monthly meeting.
- Attend a professional organization meeting.
- Develop a program of study within their career opportunities.
- Participate in the American Spirit Award competition with SkillsUSA.
- Complete *Professional Development Program Level I and Level II*, SkillsUSA.

## **INTEGRATION LINKAGES**

SkillsUSA, *Professional Development Program*; SkillsUSA; Communications and Writing Skills; Teambuilding Skills; Research; Language Arts; Sociology; Psychology; Math; Technical Math; English IV: Communication for Life; Social Studies; Problem Solving; Interpersonal Skills; Employability Skills; Critical-Thinking Skills; Secretary's Commission on Achieving Necessary Skills (SCANS); Chamber of Commerce; Colleges; Universities; Technology Centers; Secretary's Commission on Achieving Necessary Skills (SCANS)

## **DIESEL: ENGINE**

### **STANDARD 3.0**

Students will integrate reading, writing, math, and science skills and understand the impact of academic achievement in the work place.

### **LEARNING EXPECTATIONS**

The student will:

- 3.1** Assume responsibility for accomplishing classroom assignments and workplace goals within accepted time frames.
- 3.2** Develop advanced study skills.
- 3.3** Demonstrate and use written and verbal communication skills.
- 3.4** Read and understand technical documents such as regulations, manuals, reports, forms, graphs, charts, and tables.
- 3.5** Apply the foundations of mathematical principles such as algebra, geometry, and advanced math to solve problems.
- 3.6** Apply basic scientific principles and methods to solve problems and complete tasks.
- 3.7** Understand computer operations and related applications to input, store, retrieve, and output information as it relates to the course.
- 3.8** Research, recognize, and understand the interactions of the environment and *green* issues as they relate to the course work and to a global economy.

### **PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET**

The student:

- 3.1A** Uses appropriate time management to achieve goals.
- 3.1B** Arrives at school on time each day.
- 3.1C** Completes assignments and meets deadlines.
- 3.2A** Assesses current personal study skills.
- 3.2B** Demonstrates advanced note-taking ability.
- 3.2C** Formulates appropriate study strategies for given tasks.
- 3.3A** Communicates ideas, information, and messages in a logical manner.
- 3.3B** Fills out forms, reports, logs, and documents to comply with class and project requirements.
- 3.4A** Reads and understands technical documents and uses industry jargons, acronyms, and terminology appropriately.
- 3.4B** Recognizes the meaning of specialized words or phrases unique to the career and industry.
- 3.5A** Utilizes computation in adding, subtracting, multiplying, and dividing of whole numbers, fractions, decimals, and percents.
- 3.5B** Chooses the right mathematical method or formula to solve a problem.
- 3.5C** Performs math operations accurately to complete classroom and lab tasks.
- 3.6A** Understands scientific principles critical to the course.
- 3.6B** Applies scientific principles and technology to solve problems and complete tasks.
- 3.6C** Has knowledge of the scientific method (e.g., identifies the problem, collects information, forms opinions, and draws conclusions).
- 3.7A** Uses basic computer hardware (e.g., PCs, printers) and software to perform tasks as required for the course work.
- 3.7B** Understands capabilities of computers and common computer terminology (e.g.,

- program, operating system).
- 3.7C** Applies the appropriate technical solution to complete tasks.
- 3.7D** Inputs data and information accurately for the course requirements.
- 3.8A** Researches and recognizes *green* trends in career area and industry.
- 3.8B** Examines current environmentally-friendly trends.
- 3.8C** Applies sustainability practices by understanding processes that are non-polluting, conserving of energy and natural resources, and economically efficient.

### **SAMPLE PERFORMANCE TASKS**

- Examine and compile different learning styles for portfolios.
- Create calendars containing all activities and obligations for one month. Discusses how to handle conflicting or competing obligations then complete daily and weekly plans showing tasks, priorities, and scheduling.
- Complete self-assessments of study habits.
- Compute precise and exact measurements.
- Explore study strategies for different subjects and tasks then analyze two homework assignments and select the best strategies for completing them.
- Create “life maps” showing necessary steps or “landmarks” along the path to personal, financial, educational, and career goals.
- Take notes during counselor classroom visits and work in small groups to create flow charts of the path options.
- List attitudes that lead to success then rate individually in these areas. Work together to suggest strategies for overcoming the weaknesses identified own and partners’ self-assessments then share with the class the strategies developed.
- Research the Internet and other technology to collect and analyze data concerning climate change.
- Keep a data file of alternative energy sources and the sources’ impact on the environment.
- Develop a recycling project at home or for the school environment.

### **INTEGRATION LINKAGES**

SkillsUSA, *Professional Development Program*; SkillsUSA; Communications and Writing Skills; Teambuilding Skills; Research; Language Arts; Sociology; Psychology; Math; Technical Math; English IV: Communication for Life; Social Studies; Problem Solving; Interpersonal Skills; Employability Skills; Critical-Thinking Skills; Secretary’s Commission on Achieving Necessary Skills (SCANS); Chamber of Commerce; Colleges; Universities; Technology Centers; Secretary’s Commission on Achieving Necessary Skills (SCANS)

## **DIESEL: ENGINE**

### **STANDARD 4.0**

Students will properly perform general engine diagnosis.

### **LEARNING EXPECTATIONS**

The student will:

- 4.1** Inspect fuel, oil, and coolant levels and condition; determine needed action. P-1
- 4.2** Identify causes of engine fuel, oil, coolant, air, and other leaks; determine needed action. P-1
- 4.3** Listen for engines noises; determine needed action. P-2
- 4.4** Observe engine exhaust smoke color and quantity; determine needed action. P-3
- 4.5** Identify causes of no cranking, cranks but fails to start, hard starting, and starts but does not continue to run problems; determine needed action. P-1
- 4.6** Identify causes of surging, rough operation, misfiring, low power, slow deceleration, slow acceleration, and shutdown problems; determine needed action. P-1
- 4.7** Identify engine vibration problems; determine needed action. P-2
- 4.8** Check and record electronic diagnostic codes and trip/operational data; monitor electronic data; verify customer programmable parameters; clear codes; determine further diagnosis. P-1

### **PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET**

The student:

- 4.1** Inspects fuel, oil, and coolant levels and condition; determines needed action.
- 4.2** Identifies causes of engine fuel, oil, coolant, air, and other leaks; determines needed action.
- 4.3** Listens for engines noises; determines needed action.
- 4.4** Observes engine exhaust smoke color and quantity; determines needed action.
- 4.5** Identifies causes of no cranking, cranks but fails to start, hard starting, and starts but does not continue to run problems; determines needed action.
- 4.6** Identifies causes of surging, rough operation, misfiring, low power, slow deceleration, slow acceleration, and shutdown problems; determines needed action.
- 4.7** Identifies engine vibration problems; determines needed action.
- 4.8** Checks and records electronic diagnostic codes and trip/operational data; monitors electronic data; verifies customer programmable parameters; clears codes; determines further diagnosis.

## **SAMPLE PERFORMANCE TASKS**

- Inspect engine oil and water levels.
- Inspect engine and engine components for water and oil leaks
- Diagnose a customer complaint about engine vibration.
- Test crank pressure and determine needed action.
- Using case scenarios follow strategy based diagnostic procedure to verify the complaint, define the problem, isolate the problem, validate the problem, make the repair, and test the repair. Complete a repair order using technical writing skills and calculate salary earnings based on the repair order description and manufacture allowances for each item on the work order. Calculate manufacturer labor operation time used in the diagnostic process.

## **INTEGRATION LINKAGES**

Science, Math, Math for Technology, Technology Literacy, Applied Communications, Problem-Solving, National Institute for Automotive Service Excellence (ASE), National Automotive Technician Education Foundation (NATEF), Occupational Safety and Health Administration (OSHA), Tennessee Occupational Safety and Health Administration (TOSHA), Environmental Protection Agency (EPA), SkillsUSA, Secretary's Commission on Achieving Necessary Skills (SCANS)

## **DIESEL: ENGINE**

### **STANDARD 5.0**

Students will properly inspect and diagnose cylinder heads and valve trains.

### **LEARNING EXPECTATIONS**

The student will:

- 5.1** Remove, clean, and inspect for visible damage and replace cylinder head(s) assembly. P-1
- 5.2** Clean and inspect threaded holes, studs, and bolts for serviceability; determine needed action. P-1
- 5.3** Inspect cylinder head for cracks/damage; check mating surfaces for warpage; check condition of passages; inspect core/expansion and gallery plugs; determine needed action. P-1
- 5.4** Disassemble head and inspect valves, guides, seats, springs, retainers, rotators, locks, and seals; determine needed action. P-3
- 5.5** Measure valve head height relative to deck and valve face-to-seat contact; determine needed action. P-3
- 5.6** Inspect injector sleeves and seals; measure injector tip or nozzle protrusion; determine needed action. P-3
- 5.7** Inspect valve train components; determine needed action. P-3
- 5.8** Disassemble cylinder head. P-3
- 5.9** Inspect, measure, and replace/reinstall overhead camshaft; measure/adjust end play and Backlash. P-2
- 5.10** Inspect cam followers; determine needed action. P-2
- 5.11** Adjust valve bridges (crossheads); adjust valve clearances and injector settings. P-1

### **PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET**

The student:

- 5.1** Removes, cleans, and inspects for visible damage and replaces cylinder head(s) assembly.
- 5.2** Cleans and inspects threaded holes, studs, and bolts for serviceability; determines needed action.
- 5.3** Inspects cylinder head for cracks/damage; checks mating surfaces for warpage; checks condition of passages; inspects core/expansion and gallery plugs; determines needed action.
- 5.4** Disassembles head and inspect valves, guides, seats, springs, retainers, rotators, locks, and seals; determines needed action.
- 5.5** Measures valve head height relative to deck and valve face-to-seat contact; determines needed action.
- 5.6** Inspects injector sleeves and seals; measures injector tip or nozzle protrusion; determines needed action.
- 5.7** Inspects valve train components; determines needed action.
- 5.8** Disassembles cylinder head.
- 5.9** Inspects, measures, and replaces/reinstalls overhead camshaft; measures/adjusts end play and backlash.
- 5.10** Inspects cam followers; determines needed action.
- 5.11** Adjusts valve bridges (crossheads); adjusts valve clearances and injector settings.

## **SAMPLE PERFORMANCE TASKS**

- Observe and determine necessary action for a cracked cylinder head.
- Remove, clean, inspect, and replace the cylinder head(s) assembly.
- Using case scenarios follow strategy based diagnostic procedure to verify the complaint, define the problem, isolate the problem, validate the problem, make the repair, and test the repair.
- Complete a repair order using technical writing skills and calculate salary earnings based on the repair order description and manufacture allowances for each item on the work order.
- Calculate manufacturer labor operation time used in the diagnostic process.

## **INTEGRATION LINKAGES**

Science, Math, Math for Technology, Technology Literacy, Applied Communications, Problem-Solving, National Institute for Automotive Service Excellence (ASE), National Automotive Technician Education Foundation (NATEF), Occupational Safety and Health Administration (OSHA), Tennessee Occupational Safety and Health Administration (TOSHA), Environmental Protection Agency (EPA), SkillsUSA, Secretary's Commission on Achieving Necessary Skills (SCANS)

## **DIESEL: ENGINE**

### **STANDARD 6.0**

Students will properly diagnose and repair the diesel engine block.

### **LEARNING EXPECTATIONS**

The students will:

- 6.1** Perform crankcase pressure test; determine needed action. P-1
- 6.2** Remove, inspect, service, and install pans, covers, gaskets, seals, wear rings, and crankcase ventilation components. P-2.
- 6.3** Disassemble, clean, and inspect engine block for cracks/damage; measure mating surfaces for warpage; check condition of passages; core/expansion and gallery plugs; inspect threaded holes; studs, dowel pins, and bolts for serviceability; determine needed action. P-2
- 6.4** Inspect cylinder sleeve counterbore and lower bore; check bore distortion; determine needed action P-2
- 6.5** Clean, inspect and measure cylinder walls and liners for wear and damage; determine needed action. P-2
- 6.6** Replace/reinstall cylinder liners and seals; check and adjust liner height (protrusion) P-2
- 6.7** Inspect in-block camshaft bearings for wear and damage; determine needed action. P-3
- 6.8** Inspect, measure, and replace/reinstall in-block camshaft; measure/adjust end play. P-3
- 6.9** Clean and inspect crankshaft for surface cracks and journal damage; check condition of oil passages; check passage plugs; measure journal diameter; determine needed action. P-2
- 6.10** Inspect main bearings for wear patterns and damage; replace as needed; check bearing clearances; check and correct crankshaft end play. P-2
- 6.11** Inspect, install, and time gear backlash; determine needed action. P-2
- 6.12** Inspect connecting rod and bearings for wear patterns; measure pistons, pins, retainers, and bushings; perform needed action. P-2
- 6.13** Determine piston-to-cylinder wall clearance; check ring-to-groove fit and end gap; install rings on piston. P-3
- 6.14** Assemble pistons and connecting rods; install in block; install rodbearings and check clearances. P-2
- 6.15** Check condition of piston cooling jets (nozzles); determine needed action. P-2
- 6.16** Inspect and measure crankshaft vibration damper; determine needed action. P-3
- 6.17** Install and align flywheel housing; inspect flywheel housing(s) to transmission housing/engine mating surface(s) and measure flywheel housing face and bore runout; determine needed action. P-3
- 6.18** Inspect flywheel/flex plate (including ring gear) and mounting surfaces for cracks and wear; measure runout; determine needed action. P-2

### **PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET**

The student:

- 6.1** Performs crankcase pressure test; determines needed action.
- 6.2** Removes, inspects, services, and installs pans, covers, gaskets, seals, wear rings, and crankcase ventilation components.

- 6.3 Disassembles, cleans, and inspects engine block for cracks/damage; measures mating surfaces for warpage; checks condition of passages; core/expansion and gallery plugs; inspects threaded holes; studs, dowel pins, and bolts for serviceability; determines needed action.
- 6.4 Inspects cylinder sleeve counterbore and lower bore; checks bore distortion; determines needed action
- 6.5 Cleans, inspects, and measures cylinder walls and liners for wear and damage; determines needed action.
- 6.6 Replaces/reinstalls cylinder liners and seals; checks and adjusts liner height (protrusion)
- 6.7 Inspects in-block camshaft bearings for wear and damage; determines needed action.
- 6.8 Inspects, measures, and replaces/reinstalls in-block camshaft; measures/adjusts end play.
- 6.9 Cleans and inspects crankshaft for surface cracks and journal damage; checks condition of oil passages; checks passage plugs; measures journal diameter; determines needed action.
- 6.10 Inspects main bearings for wear patterns and damage; replaces as needed; checks bearing clearances; checks and corrects crankshaft end play.
- 6.11 Inspects, installs, and times gear backlash; determines needed action.
- 6.12 Inspects connecting rod and bearings for wear patterns; measures pistons, pins, retainers, and bushings; performs needed action.
- 6.13 Determines piston-to-cylinder wall clearance; checks ring-to-groove fit and end gap; installs rings on piston.
- 6.14 Assembles pistons and connecting rods; installs in block; installs rod bearings and checks clearances.
- 6.15 Checks condition of piston cooling jets (nozzles); determines needed action.
- 6.16 Inspects and measures crankshaft vibration damper; determines needed action.
- 6.17 Installs and aligns flywheel housing; inspects flywheel housing(s) to transmission housing/engine mating surface(s) and measures flywheel housing face and bore runout; determines needed action.
- 6.18 Inspects flywheel/flex plate (including ring gear) and mounting surfaces for cracks and wear; measures runout; determines needed action.

### **SAMPLE PERFORMANCE TASKS**

- Remove pan and determine and perform required service.
- Diagram the components of an engine block.
- Clean cylinder liners and determine if repair is needed. Using case scenarios follow strategy based diagnostic procedure to verify the complaint, define the problem, isolate the problem, validate the problem, make the repair, and test the repair. Complete a repair order using technical writing skills and calculate salary earnings based on the repair order description and manufacture allowances for each item on the work order. Calculate manufacturer labor operation time used in the diagnostic process.

### **INTEGRATION LINKAGES**

Science, Math, Math for Technology, Technology Literacy, Applied Communications, Problem-Solving, National Institute for Automotive Service Excellence (ASE), National Automotive Technician Education Foundation (NATEF), Occupational Safety and Health Administration (OSHA), Tennessee Occupational Safety and Health Administration (TOSHA), Environmental Protection Agency (EPA), SkillsUSA, Secretary's Commission on Achieving Necessary Skills (SCANS)

## **DIESEL: ENGINE**

### **STANDARD 7.0**

Students will properly diagnose and repair lubrication systems.

### **LEARNING EXPECTATIONS**

The student will:

- 7.1 Test engine oil pressure and check operation of pressure sensor, gauge, and/or sending unit; test engine oil temperature and check operation of temperature sensor; determine needed action. P-1
- 7.2 Check engine oil level and condition; determine needed action. P-1
- 7.3 Inspect and measure oil pump, drives, inlet pipes, and pick-up screens; check gear drive clearances; determine needed action. P-3
- 7.4 Inspect oil pressure regulator valve(s), by-pass and pressure relief valve(s), oil thermostat, and filters; determine needed action. P-3
- 7.5 Inspect, clean, and test oil cooler and components; determine needed action. P-3
- 7.6 Inspect turbocharger lubrication and cooling system; determine needed action. P-2
- 7.7 Determine proper lubricant and perform oil and filter change. P-1

### **PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET**

The student:

- 7.1 Tests engine oil pressure and checks operation of pressure sensor, gauge, and/or sending unit; tests engine oil temperature and checks operation of temperature sensor; determines needed action.
- 7.2 Checks engine oil level and condition; determines needed action.
- 7.3 Inspects and measures oil pump, drives, inlet pipes, and pick-up screens; checks gear drive clearances; determines needed action.
- 7.4 Inspects oil pressure regulator valve(s), by-pass and pressure relief valve(s), oil thermostat, and filters; determines needed action.
- 7.5 Inspects, cleans, and tests oil cooler and components; determines needed action.
- 7.6 Inspects turbocharger lubrication and cooling system; determines needed action.
- 7.7 Determines proper lubricant and performs oil and filter change.

### **SAMPLE PERFORMANCE TASKS**

- Change oil filter.
- Diagram an engine lubrication system.
- Check engine oil and add or change as indicated.
- Using case scenarios follow strategy based diagnostic procedure to verify the complaint, define the problem, isolate the problem, validate the problem, make the repair, and test the repair. Complete a repair order using technical writing skills and calculate salary earnings based on the repair order description and manufacture allowances for each item on the work order. Calculate manufacturer labor operation time used in the diagnostic process.

## **INTEGRATION LINKAGES**

Science, Math, Math for Technology, Technology Literacy, Applied Communications, Problem-Solving, National Institute for Automotive Service Excellence (ASE), National Automotive Technician Education Foundation (NATEF), Occupational Safety and Health Administration (OSHA), Tennessee Occupational Safety and Health Administration (TOSHA), Environmental Protection Agency (EPA), SkillsUSA, Secretary's Commission on Achieving Necessary Skills (SCANS)

## **DIESEL: ENGINE**

### **STANDARD 8.0**

Students will properly diagnose and repair cooling systems.

### **LEARNING EXPECTATIONS**

The student will:

- 8.1** Check engine coolant type, level, condition, and consumption; test coolant for freeze protection and additive package concentration; determine needed action. P-1
- 8.2** Test coolant temperature and check operation of temperature and level sensors, gauge, and /or sending unit; determine needed action. P-1
- 8.3** Inspect and reinstall/replace pulleys, tensioners, and drive belts; adjust drive belts and check alignment. P-1
- 8.4** Inspect thermostat(s), by-pass housing(s), and seals; replace as needed. P-2
- 8.5** Recover, flush, and refill with recommended coolant/additive package; bleed cooling system. P-1
- 8.6** Inspect coolant conditioner/filter assembly for leaks; inspect valves, lines, and fittings; replace as needed. P-1
- 8.7** Inspect water pump and hoses; replace as needed. P-1
- 8.8** Inspect, clean, and pressure test radiator, pressure cap, tank(s), and recovery systems; determine needed action. P-1
- 8.9** Inspect thermostatic cooling fan system (hydraulic, pneumatic, and electronic) and fan shroud; replace as needed. P-1

### **PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET**

The student:

- 8.1** Checks engine coolant type, level, condition, and consumption; tests coolant for freeze protection and additive package concentration; determines needed action.
- 8.2** Tests coolant temperature and checks operation of temperature and level sensors, gauge, and /or sending unit; determines needed action.
- 8.3** Inspects and reinstalls/replaces pulleys, tensioners, and drive belts; adjusts drive belts and checks alignment.
- 8.4** Inspects thermostat(s), by-pass housing(s), and seals; replaces as needed.
- 8.5** Recovers, flushes, and refills with recommended coolant/additive package; bleeds cooling system.
- 8.6** Inspects coolant conditioner/filter assembly for leaks; inspects valves, lines, and fittings; replaces as needed.
- 8.7** Inspects water pump and hoses; replaces as needed.
- 8.8** Inspects, cleans, and pressure tests radiator, pressure cap, tank(s), and recovery systems; determines needed action.
- 8.9** Inspects thermostatic cooling fan system (hydraulic, pneumatic, and electronic) and fan shroud; replaces as needed.

## **SAMPLE PERFORMANCE TASKS**

- Diagram the engine cooling system.
- Check coolant and performs any service indicated.
- Using case scenarios follow strategy based diagnostic procedure to verify the complaint, define the problem, isolate the problem, validate the problem, make the repair, and test the repair.
- Complete a repair order using technical writing skills and calculate salary earnings based on the repair order description and manufacture allowances for each item on the work order.
- Calculate manufacturer labor operation time used in the diagnostic process.

## **INTEGRATION LINKAGES**

Science, Math, Math for Technology, Technology Literacy, Applied Communications, Problem-Solving, National Institute for Automotive Service Excellence (ASE), National Automotive Technician Education Foundation (NATEF), Occupational Safety and Health Administration (OSHA), Tennessee Occupational Safety and Health Administration (TOSHA), Environmental Protection Agency (EPA), SkillsUSA, Secretary's Commission on Achieving Necessary Skills (SCANS)

## **DIESEL: ENGINE**

### **STANDARD 9.0**

Students will properly diagnose and repair air induction and exhaust system.

### **LEARNING EXPECTATIONS**

The student will:

- 9.1** Perform air intake system restriction and leakage tests; determine needed action. P-1
- 9.2** Perform intake manifold pressure (boost) test; determine needed action. P-1
- 9.3** Perform exhaust back pressure test; determine needed action. P-2
- 9.4** Inspect turbocharger(s), waste gate, and piping systems; determine needed action. P-2
- 9.5** Inspect and test turbocharger(s) (variable ratio/geometry VGT), pneumatic, hydraulic, electronic controls, and actuators. P-3
- 9.6** Check air induction system: piping, hoses, clamps, and mounting; service or replace air filter as needed. P-1
- 9.7** Remove and reinstall turbocharger/wastegate assembly. P-3
- 9.8** Inspect intake manifold, gaskets, and connections; replace as needed. P-3
- 9.9** Inspect, clean, and test charge air cooler assemblies; inspect aftercooler assemblies; replace as needed. P-2
- 9.10** Inspect exhaust manifold, piping, mufflers, and mounting hardware; repair or replace as needed. P-2
- 9.11** Inspect exhaust after treatment devices; determine necessary action. P-3
- 9.12** Inspect and test preheater/inlet air heater, or glow plug system and controls; perform needed action. P-2
- 9.13** Inspect and test exhaust gas recirculation (EGR) system including EGR valve, cooler, piping, filter, electronic sensors, controls, and wiring; determine needed action. P-3

### **PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET**

- 9.1** Performs air intake system restriction and leakage tests; determines needed action.
- 9.2** Performs intake manifold pressure (boost) test; determines needed action.
- 9.3** Performs exhaust back pressure test; determines needed action.
- 9.4** Inspects turbocharger(s), waste gate, and piping systems; determines needed action.
- 9.5** Inspects and tests turbocharger(s) (variable ratio/geometry VGT), pneumatic, hydraulic, electronic controls, and actuators.
- 9.6** Checks air induction system: piping, hoses, clamps, and mounting; services or replaces air filter as needed.
- 9.7** Removes and reinstalls turbocharger/wastegate assembly.
- 9.8** Inspects intake manifold, gaskets, and connections; replaces as needed.
- 9.9** Inspects, cleans, and tests charge air cooler assemblies; inspects aftercooler assemblies; replaces as needed.
- 9.10** Inspects exhaust manifold, piping, mufflers, and mounting hardware; repairs or replaces as needed.
- 9.11** Inspects exhaust after treatment devices; determines necessary action.
- 9.12** Inspects and tests preheater/inlet air heater, or glow plug system and controls; performs needed action.
- 9.13** Inspects and tests exhaust gas recirculation (EGR) system including EGR valve, cooler, piping, filter, electronic sensors, controls, and wiring; determines needed action.

## **SAMPLE PERFORMANCE TASKS**

- Diagram the engine exhaust system.
- Check turbocharger operation and perform any service indicated.
- Using case scenarios follow strategy based diagnostic procedure to verify the complaint, define the problem, isolate the problem, validate the problem, make the repair, and test the repair.
- Complete a repair order using technical writing skills and calculate salary earnings based on the repair order description and manufacture allowances for each item on the work order.
- Calculate manufacturer labor operation time used in the diagnostic process.

## **INTEGRATION LINKAGES**

Science, Math, Math for Technology, Technology Literacy, Applied Communications, Problem-Solving, National Institute for Automotive Service Excellence (ASE), National Automotive Technician Education Foundation (NATEF), Occupational Safety and Health Administration (OSHA), Tennessee Occupational Safety and Health Administration (TOSHA), Environmental Protection Agency (EPA), SkillsUSA, Secretary's Commission on Achieving Necessary Skills (SCANS)

## **DIESEL: ENGINE**

### **STANDARD 10.0**

Students will properly diagnose and repair fuel supply system.

### **LEARNING EXPECTATIONS**

The student will:

- 10.1** Check fuel level and condition; determine needed action. P-1
- 10.2** Perform fuel supply and return system tests; determine needed action. P-1
- 10.3** Inspect fuel tanks, vents, caps, mounts, valves, screens, crossover system, supply and return lines and fittings; determine needed action. P-1
- 10.4** 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. P-1
- 10.5** Inspect and test low pressure regulator systems (check valves, pressure regulator valves, and restrictive fittings); determine needed action. P-1
- 10.6** Check fuel system for air; determine needed action; prime and bleed fuel system; check primer pump. P-1

### **PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET**

The student:

- 10.1** Checks fuel level and condition; determines needed action.
- 10.2** Performs fuel supply and return system tests; determines needed action.
- 10.3** Inspects fuel tanks, vents, caps, mounts, valves, screens, crossover system, supply and return lines and fittings; determines needed action.
- 10.4** Inspects, cleans, and tests fuel transfer (lift) pump, pump drives, screens, fuel/water separators/indicators, filters, heaters, coolers, ECM cooling plates, and mounting hardware; determines needed action.
- 10.5** Inspects and tests low pressure regulator systems (check valves, pressure regulator valves, and restrictive fittings); determines needed action.
- 10.6** Checks fuel system for air; determines needed action; primes and bleeds fuel system; checks primer pump.

### **SAMPLE PERFORMANCE TASKS**

- Diagnose problem with fuel system and perform indicated action.
- Change fuel filter.
- Use appropriate service information to properly diagnose electronic fuel management system.
- Using case scenarios follow strategy based diagnostic procedure to verify the complaint, define the problem, isolate the problem, validate the problem, make the repair, and test the repair.
- Complete a repair order using technical writing skills and calculate salary earnings based on the repair order description and manufacture allowances for each item on the work order.
- Calculate manufacturer labor operation time used in the diagnostic process.

## **INTEGRATION LINKAGES**

Science, Math, Math for Technology, Technology Literacy, Applied Communications, Problem-Solving, National Institute for Automotive Service Excellence (ASE), National Automotive Technician Education Foundation (NATEF), Occupational Safety and Health Administration (OSHA), Tennessee Occupational Safety and Health Administration (TOSHA), Environmental Protection Agency (EPA), SkillsUSA, Secretary's Commission on Achieving Necessary Skills (SCANS)

## **DIESEL: ENGINE**

### **STANDARD 11.0**

Students will properly diagnose and repair electronic fuel management system.

### **LEARNING EXPECTATIONS**

The student will:

- 11.1** Inspect and test power and ground circuits and connections; measure and interpret voltage drop, ampere, and resistance readings using a digital multimeter (DMM); determine needed action. P-1
- 11.2** 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. P-1
- 11.3** Check and record electronic diagnostic codes and trip/operational data; monitor electronic data; clear codes; determine further diagnosis. P-1
- 11.4** Locate and use relevant service information (to include diagnostic procedures, flow charts, and wiring diagrams). P-1
- 11.5** Inspect and replace electrical connector terminals, seals, and locks. P-1
- 11.6** Inspect and test sensors, controls, actuator components, and circuits; adjust or replace as needed. P-1
- 11.7** Using recommended electronic diagnostic tools (to include PC based software and/or data scan tools), access and interpret customer programmable parameters. P-1
- 11.8** Inspect, test, and adjust electronic unit injectors (EUI); determine needed action. P-2
- 11.9** Remove and install electronic unit injectors (EUI) and related components; recalibrate ECM if (applicable). P-2
- 11.10** Perform cylinder contribution test utilizing recommended electronic diagnostic tool. P-1
- 11.11** Perform on-engine inspections and tests on hydraulic electronic unit injectors and system electronic controls; determine needed action. P-2
- 11.12** Perform on-engine inspections and tests on hydraulic electronic unit injector high pressure oil supply and control systems; determine needed action. P-2
- 11.13** Perform on-engine inspections and tests on common rail type injection system; determine needed action. P-3
- 11.14** Inspect high pressure injection lines, hold downs, fittings and seals; determine needed action. P-3

### **PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET**

The student:

- 11.1** Inspects and tests power and ground circuits and connections; measures and interprets voltage drop, ampere, and resistance readings using a digital multimeter (DMM); determines needed action.
- 11.2** Interfaces with vehicle's on-board computer; performs diagnostic procedures using recommended electronic diagnostic equipment and tools (to include PC based software and/or data scan tools); determines needed action.
- 11.3** Checks and records electronic diagnostic codes and trip/operational data; monitors electronic data; clears codes; determines further diagnosis.
- 11.4** Locates and uses relevant service information (to include diagnostic procedures, flow charts, and wiring diagrams).

- 11.5** Inspects and replaces electrical connector terminals, seals, and locks.
- 11.6** Inspects and tests sensors, controls, actuator components, and circuits; adjusts or replaces as needed.
- 11.7** Using recommended electronic diagnostic tools (to include PC based software and/or data scan tools), accesses and interprets customer programmable parameters.
- 11.8** Inspects, tests, and adjusts electronic unit injectors (EUI); determines needed action.
- 11.9** Removes and installs electronic unit injectors (EUI) and related components; recalibrates ECM if (applicable).
- 11.10** Performs cylinder contribution test utilizing recommended electronic diagnostic tool.
- 11.11** Performs on-engine inspections and tests on hydraulic electronic unit injectors and system electronic controls; determines needed action.
- 11.12** Performs on-engine inspections and tests on hydraulic electronic unit injector high pressure oil supply and control systems; determines needed action.
- 11.13** Performs on-engine inspections and tests on common rail type injection system; determines needed action.
- 11.14** Inspects high pressure injection lines, hold downs, fittings and seals; determines needed action.

### **SAMPLE PERFORMANCE TASKS**

- Complete a diesel engine repair order and calculate salary based on manufacture labor operation time.
- Use reference materials to determine procedures for diagnosing and testing engines.
- Work as a team member to develop a diagnostic strategy.
- Use schematics and diagrams to execute a task.

### **INTEGRATION LINKAGES**

Science, Math, Math for Technology, Technology Literacy, Applied Communications, Problem-Solving, National Institute for Automotive Service Excellence (ASE), National Automotive Technician Education Foundation (NATEF), Occupational Safety and Health Administration (OSHA), Tennessee Occupational Safety and Health Administration (TOSHA), Environmental Protection Agency (EPA), SkillsUSA, Secretary's Commission on Achieving Necessary Skills (SCANS)

## **DIESEL: ENGINE**

### **STANDARD 12.0**

Students will properly diagnose and repair engine brake system.

### **LEARNING EXPECTATIONS**

The student will:

- 12.1** Inspect and adjust engine compression/exhaust brakes; determine needed action. P-3
- 12.2** Inspect, test, and adjust engine compression/exhaust brake control circuits, switches, and solenoids; repair or replace as needed. P-3
- 12.3** Inspect engine compression/exhaust brake housing, valves, seals, lines, and fittings; repair or replace as needed. P-3

### **PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET**

The student:

- 12.1** Inspects and adjusts engine compression/exhaust brakes; determines needed action.
- 12.2** Inspects, tests, and adjusts engine compression/exhaust brake control circuits, switches, and solenoids; repairs or replaces as needed.
- 12.3** Inspects engine compression/exhaust brake housing, valves, seals, lines, and fittings; repairs or replaces as needed.

### **SAMPLE PERFORMANCE TASKS**

- Complete a diesel engine repair order and calculate salary based on manufacture labor operation time.
- Use reference materials to determine procedures for diagnosing and testing engines.
- Work as a team member to develop a diagnostic strategy.
- Use schematics and diagrams to execute a task.

### **INTEGRATION LINKAGES**

Science, Math, Math for Technology, Technology Literacy, Applied Communications, Problem-Solving, National Institute for Automotive Service Excellence (ASE), National Automotive Technician Education Foundation (NATEF), Occupational Safety and Health Administration (OSHA), Tennessee Occupational Safety and Health Administration (TOSHA), Environmental Protection Agency (EPA), SkillsUSA, Secretary's Commission on Achieving Necessary Skills (SCANS)

## **DIESEL: ENGINE**

### **SAMPLING OF AVAILABLE RESOURCES**

*T2 Diesel Engine Curriculum Module*, AYES Corporation, [www.ayes.org](http://www.ayes.org)

*2001 Medium/Heavy Duty Truck Task List*, National Automotive Technicians Education Foundation (NATEF), [www.natef.org](http://www.natef.org)

*Diesel Technology: Workplace Skills*, Instructional Materials Laboratory (IML), University of Missouri

*Diesel Technology: Safety Skills*, Instructional Materials Laboratory (IML), University of Missouri

*Curriculum Integrator*, CORD Communications, Waco, Texas 110108

*Diesel Technology*, Goodheart-Willcox, 2001.