Massachusetts Career Technical Education

Diesel Technology Framework

2014

DESE is in the process of updating all CTE Frameworks. This framework was adopted in 2014. More information about the process to update frameworks will be provided in DESE’s CCTE Newsletter.

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# [Strand 2: Technical Knowledge and Skills](#_bookmark0)

##### Diesel Technology Safety and Health

* + 1. Implement safety knowledge and skills according to current industry and OSHA standards.
       1. Demonstrate procedure for safe lift operations.
       2. Demonstrate safe use and storage of hydraulic floor jacks and safety stands.
       3. Identify and comply with environmental concerns relating to refrigerants and coolants according to current industry and OSHA standards.
       4. Describe and demonstrate safety procedures when using pneumatic tools.
       5. Describe and demonstrate safety procedures when using electric tools.
       6. Describe and demonstrate safety procedures when using hand tools.
    2. Performance Example:
       - Students will be able to define OSHA and perform diesel technology tasks safely.

##### Fasteners

* + 1. Compare and contrast fasteners and explain the principle and applications of torque.
       1. Identify all commonly used threaded fasteners.
       2. Identify Society of Automotive Engineers (SAE) metric bolt head markings.
       3. Identify commonly used nuts, washers, flat, and lock washers.
       4. Identify and describe commonly used snap rings.
       5. Explain the concept of fastener torque and torque specifications chart.
       6. Explain what torque sequence refers to.
       7. Describe the various types of torque wrenches, sequences, and basic rules.
    2. Performance Example:
       - Students will be able to identify and compare fasteners.

##### Precise Measuring Equipment

* + 1. Demonstrate measuring procedures.
       1. Describe and use common low precision measuring tools (steel rule, tape measure, ruler, and combination square).
       2. Identify and use an outside and inside caliper.
       3. Identify and use a feeler gauge, hole gauge, telescoping gauge, snap gauge, and dial indicator.
       4. Identify a vernier caliper and demonstrate its use.
       5. Identify an outside/inside micrometer and demonstrate its use.
       6. Identify a depth indicator gauge and demonstrate its use.
    2. Performance Example:
       - Students will demonstrate measurement skills using both the American and metric systems with a variety of tools.

##### Hand Tools

* + 1. Demonstrate the appropriate use of hand tools according to current industry and OSHA standards.
       1. Identify and demonstrate the proper use of screwdrivers and pliers.
       2. Identify and demonstrate the proper use of combination wrenches, open- end wrenches, box-end wrenches, pipe wrenches, and adjustable wrenches.
       3. Identify and demonstrate the proper use of hammers, punches, and chisels.
       4. Identify and demonstrate the proper use of sockets and extensions.
       5. Identify and demonstrate the proper use of torque wrenches.
       6. Identify and demonstrate the proper use of Allen wrenches.
       7. Identify and demonstrate the proper use of various types of files, hacksaws, thread cutting taps, thread cutting dies, wire brushes, gasket scrapers, and bench vises.
    2. Performance Example:
       - Students choose the correct tools and demonstrate the appropriate use of those tools to match the assigned task.

##### Power Tools

* + 1. Demonstrate the appropriate use of power tools according to current industry and OSHA standards.
       1. Drill holes to given specifications using an electric drill.
       2. Identify types of drill bits.
       3. Describe the difference in drilling speed for different metals.
       4. Describe and demonstrate appropriate safety procedures to be followed when using an electric drill.
       5. Identify and explain the purpose of an air impact wrench.
       6. Identify and explain the purpose of impact sockets.
       7. Describe and demonstrate appropriate maintenance needs of an impact wrench.
       8. Describe and demonstrate appropriate safety procedures when using an air impact wrench.
       9. Identify and explain the purpose of an electric soldering iron.
       10. Describe and demonstrate appropriate safety procedures when using an electric soldering iron.
       11. List the type of solder to use when soldering an electrical component.
       12. Identify and explain the purpose of a bench grinder.
       13. Describe and demonstrate appropriate safety procedures when using a bench grinder.
       14. Identify and demonstrate the appropriate use of drill bits, differences in drilling speeds for different metals and drilling holes to specifications.
       15. Identify, explain the purpose and demonstrate the appropriate use of an air impact wrench, maintenance, and impact sockets.
    2. Performance Examples:
       - Students will select and use the proper power tool for the task, while demonstrating appropriate safety procedures.
       - Students will explain the different drill speeds associated with each task.

##### Engine (Mechanical)

* + 1. Diagnose generic engine malfunctions.
       1. Inspect fuel, oil, coolant levels, condition, consumption, leaks, and exhaust leaks; determine needed action.
       2. Interpret engine noises; observe engine smoke color and quantity; determine needed action.
       3. Inspect belts, tensioners, pulleys, and adjust belt(s).
       4. Test for air intake system restriction and leakage; determine needed action.
       5. Perform intake manifold pressure (boost) test, test crankcase pressure, and test cylinder compression.
       6. Diagnose no cranking, cranks but fails to start, hard starting, and starts but does not continue to run problems and determine needed action.
       7. Diagnose surging, rough operation, misfiring, low power, slow deceleration, slow acceleration, and shutdown problems; determine needed action.
       8. Inspect engine mounts for looseness and deterioration.
    2. Performance Example:
       - Students will verify the complaint, road/dyno test vehicle; review driver/customer interview and past maintenance documents (if available); determine further diagnosis.
       - Students will diagnose no cranking, cranks but fails to start, hard starting, and starts but does not continue to run problems; determine needed repairs.

##### Cylinder Head and Related Components

* + 1. Diagnose and repair cylinder head and valve train.
       1. Remove, clean, inspect for visible damage, and replace cylinder head(s) assembly.
       2. Clean and inspect threaded holes, studs, and bolts for serviceability; determine needed action.
       3. Disassemble head and inspect valves, guides, seats, springs, retainers, rotators, locks, and seals; determine needed action.
    2. Performance Example:
       - Students will measure cylinder head deck-to-deck thickness, and check mating surfaces for warpage and surface finish; inspect for cracks/damage; check condition of passages; inspect core, gallery, and plugs; service as needed.

##### Lubrication System

* + 1. Diagnose and repair lubrication systems.
       1. Check engine oil level & test engine oil pressure and check operation of pressure sensor, gauge, and/or sending unit and determine needed action.
       2. Inspect and measure oil pump, drives, inlet pipes, and pick-up screens and determine needed action.
       3. Inspect turbocharger lubrication system and determine needed action.
       4. Determine proper lubricant and perform oil and filter change.
    2. Performance Examples:
       - Students will inspect, measure, repair/replace oil pump, drives, inlet pipes, and screens.

##### Coolant System

* + 1. Diagnose and repair cooling systems.
       1. Check engine coolant type, additives, freeze level, supplemental coolant additive (SCA) level, condition, and consumption and determine needed action.
       2. Test coolant temperature and check operation of temperature sensor, gauge, and/or sending unit and determine needed action.
       3. Inspect and reinstall/replace pulleys, tensioners and drive belts; adjust drive belts and check alignment.
       4. Inspect thermostat(s), by-passes, housing(s), and seals; replace as needed.
       5. Inspect radiator; pressure test, recover, flush, and refill with recommended coolant/additive package; bleed cooling system.Inspect coolant conditioner/filter assembly, valves, lines, fittings, water pump, hoses, clamps, thermostat, radiator cap, radiator, overflow/surge tanks; determine needed action.
       6. Inspect thermostatic cooling fan system (hydraulic, pneumatic, and electronic) and fan shroud; replace as needed.
    2. Performance Example:
       - Students will inspect and replace thermostat(s), bypasses and seals.
       - Students will inspect thermostat(s), bypasses, housing(s), and seals; replace, as needed.

###### Air Intake and Exhaust System

* + 1. Diagnose and repair air induction and exhaust systems.
       1. Inspect turbocharger(s), wastegate, and piping systems; determine needed action.
       2. Check air induction system: piping, hoses, clamps, and mounting; check for air restrictions and leaks; service or replace air filter as needed.
       3. Remove and reinstall turbocharger/wastegate assembly.
       4. Inspect, clean, and test charge air cooler assemblies; replace as needed.
       5. Inspect exhaust manifold, piping, mufflers, exhaust after-treatment device(s), and mounting hardware; repair or replace as needed.
    2. Performance Examples:
       - Perform air intake system restriction and leakage tests; determine needed repairs.
       - Inspect, service/replace air induction piping, air cleaner, and element; check air restriction.
       - Inspect intake manifold, gaskets, and connections; repair or replace as needed.

##### Fuel System (Mechanical)

* + 1. Diagnose and repair fuel systems.
       1. Check fuel level, quality, and consumption; determine needed action.
       2. Inspect fuel tanks, vents, caps, mounts, valves, screens, crossover system, supply and return lines and fillings; determine needed action.
       3. Inspect, clean, and test fuel transfer (lift) pump, pump drives, screens, fuel/water separators/indicators, filters, heaters, coolers, electronic control module (ECM) cooling plates, and mounting hardware; determine needed action.
       4. Inspect and test low pressure regulator systems (check valves, pressure regulator valves, and restrictive fillings); determine needed action.
       5. Check fuel system for air; determine needed action; prime and bleed fuel system; check primer pump.
    2. Performance Example:
       - Students will be able to identify and explain the fuel system’s major components.

##### Engine Brake and Related Components

* + 1. Diagnose and repair engine brakes.
       1. Inspect and adjust engine compression/exhaust brakes; determine needed action.
       2. Inspect, test, and adjust engine compression/exhaust brake control circuits, switches, and solenoids; repair or replace as needed.
    2. Performance Examples:
       - Students will inspect, test, and adjust engine/exhaust brakes.
       - Students will inspect, test, adjust, and repair/replace engine/exhaust brake control circuits, switches, and solenoids.
       - Students will inspect, repair/replace engine/exhaust brake housing, valves, seals, screens, lines, and fittings.

##### Driveshaft Assemblies

* + 1. Diagnose and repair driveshafts and universal joints.
       1. Inspect, diagnose, service, and replace driveshaft, center support bearings, universal joint, slip joints, yokes, and drive flanges for noise, proper phasing, and vibration problems; determine needed action.
       2. Measure and adjust drive line angles.
    2. Performance Example:
       - Students will demonstrate knowledge of precise measuring tools and be able to diagnose common driveshaft complaints by measuring the drive line angle of a given drive shaft and determining the corrective action.

##### Heavy Duty Axle Service and Repair

* + 1. Diagnose and repair drive axels.
       1. Diagnose drive axle(s) drive unit noise and overheating problems; determine needed action.
       2. Check and repair fluid level & condition, fluid leaks; inspect and replace drive axle housing cover plates, gaskets, sealants, vents, magnetic plugs, and seals.
       3. Remove and replace differential carrier assembly.
       4. Inspect, repair, or replace 2-speed axle shift control system, speedometer adapters, motors, axle shift units, wires, air lines, and connectors.
       5. Inspect power divider (inter-axle differential) assembly; determine needed action.
       6. 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.
       7. Inspect, repair, or replace drive axle lubrication system: pump, troughs, collectors, slingers, tubes, and filters.
       8. Remove, inspect and replace/adjust drive axle shafts, rear wheel seals, and rear wheel bearings.
       9. Inspect and test drive axle temperature gauge and sending unit/sensor; determine needed action.
    2. Performance Example:
       - Students will diagnose unit noise and overheating complaints and perform entry level repairs.

##### Truck Brake Systems

* + 1. Diagnose and repair air brakes.
       1. Diagnose poor stopping, air leaks, premature wear, pulling, grabbing, or dragging problems caused by supply and service system malfunctions; determine needed action.
       2. Check air system build-up time; determine needed action.
       3. Drain air reservoir tanks; check for oil, water, and foreign material; determine needed action.
       4. Inspect air compressor, drive belts, pulleys, tensioners, air cleaner/supply; inspect oil supply and coolant lines, fittings, and mounting brackets; repair or replace as needed.
       5. Inspect and test governor, high pressure relief, air system lines, hoses, fittings, and couplings; replace as needed.
       6. Inspect and test air tank relief (safety) valves, one-way (single) check valves, two-way (double) check-valves, manual and automatic drain valves; replace as needed.
       7. Inspect and clean air drier systems, filters, valves, heaters, wiring, and connectors; repair or replace as needed.
       8. Inspect and test brake application (foot) valve and hand brake, fittings, and mounts; adjust or replace as needed.
       9. Inspect and test stop light and low pressure warning circuit switches, wiring, and connectors; repair or replace as needed.

2.O.01.10 Inspect and test brake relay valve, quick release valve, tractor protection valve, parking brake valve, & air pressure gauges; replace as needed.

* + 1. Performance Example:
       - Students will identify and inspect truck brake systems, then cage and un-cage brake chambers and adjust slack adjusters.

##### Foundation Truck Brakes

* + 1. Diagnose and repair air brake mechanical/foundation problems.
       1. Diagnose poor stopping, brake noise, premature wear, pulling, grabbing, or dragging problems caused by the foundation brake, slack adjuster, and brake chamber problems; determine needed action.
       2. Inspect and test service brake chambers, pushrod, clevis, mounting brackets, manual & automatic slack adjusters, & camshafts repair or replace as needed.
       3. Inspect and measure brake shoe linings or pads, brake drums, and brake rotors; perform needed action.
    2. Performance Example:
       - Students will be able to diagnose poor stopping, brake noise, and inspect, and measure machine drums and rotors.

##### Parking Brake Systems

* + 1. Diagnose and repair parking brakes.
       1. Inspect and test parking (spring) brake application and release valve, parking (spring) brake chamber, diaphragm and seals, parking (spring) brake check valves, lines, hoses, & fittings; replace as needed.
       2. Replace parking (spring) brake chamber; dispose of removed chambers in accordance with local regulations.
       3. Manually release (cage) and reset (uncage) parking (spring) brakes in accordance with manufacturers’ recommendations.
    2. Performance Examples:
       - Students will inspect, test, adjust, repair, or replace brake application (foot) valve, fittings, and mounts.
       - Students will diagnose poor stopping, premature wear, brake noises, air leaks, pulling, grabbing, or dragging problems caused by supply and service system malfunctions; determine needed repairs.

##### Hydraulic Brakes

* + 1. Diagnose and repair hydraulic brakes.
       1. Diagnose poor stopping, premature wear, pulling, dragging and/or pedal feel problems caused by the hydraulic system; determine needed action.
       2. Inspect and test master cylinder for internal/external leaks and damage; replace as needed.
       3. Inspect brake lines, flexible hoses, and fillings for leaks and damage; replace as needed.
       4. Inspect and test brake stop light switch, brake pressure differential valve and warning light circuit switch, bulbs, wiring, and connectors, metering (hold-off), load sensing/proportioning, proportioning, and combination; repair or replace as needed.
       5. Inspect and clean disc brake caliper assemblies; replace as needed.
       6. Inspect/test brake fluid; bleed and/or flush system; determine proper fluid type.
    2. Performance Example:
       - Student will inspect and diagnose poor stopping, premature wear, brake noises, air leaks, pulling, grabbing, or dragging problems caused by supply and service systems malfunctions; and determine needed repairs.

###### Mechanical Brakes

* + 1. Diagnose and repair mechanical brake foundation problems.
       1. Check parking brake operation; inspect and measure transmission mounted or driveline mounted parking brake drums and shoe linings, cables, adjusters, and backing plates; perform needed action.
    2. Performance Example:
       - Student will inspect and adjust the parking brake mechanisms.

###### Diesel Services – Hydraulic Brake System Components

* + 1. Diagnose and repair power assist units.
       1. Diagnose stopping problems caused by the brake assist (booster) system; determine needed action.
       2. Inspect, test, repair, or replace power brake assist (booster), hoses, and control valves; determine proper fluid type.
       3. Check emergency (back-up, reserve) brake assist system.
    2. Performance Example:
       - Student will inspect, diagnose, and repair the brake assist booster.

##### Anti Brake System

* + 1. Diagnose and repair air and hydraulic antilock brake systems (ABS) and automatic traction control (ATC).
       1. Monitor antilock brake system (ABS) warning light operation (includes dash mounted trailer ABS warning light); determine needed action.
       2. Diagnose antilock brake system (ABS) electronic control(s) and components using self-diagnosis and/or specified test equipment (scan tool, personal computer/PC); determine needed action.
       3. Inspect, test, and replace antilock brake system (ABS) air, hydraulic, electrical, and mechanical components; perform needed action.
       4. Bleed the ABS hydraulic circuits following manufacturers’ procedures.
       5. Diagnose automatic traction control (ATC) electronic control(s) and components using self-diagnosis and/or specified test equipment (scan tool) PC computer; determine needed action.
    2. Performance Examples:
       - Students will diagnose poor stopping, pulling, premature wear, noise, or dragging complains caused by hydraulic system problems; determine needed repairs.
       - Students will diagnose antilock brake system (ABS) electronic control(s) and components using self-diagnosis and/or recommended test equipment; determine needed repairs.

##### Power Steering System

* + 1. Diagnose and repair steering systems.
       1. Diagnose fixed and driver adjustable steering column and shaft, shaft U- joint(s), slip joints, bearings, bushings, and seals; phase shaft U-joints for noise, looseness, and binding problems; determine needed action.
       2. Inspect and align pitman arm, drag link, tie rod ends, and tube, steering arms; replace as needed.
       3. Check and adjust wheel stops.
       4. Lubricate steering linkage joints, as needed.
       5. Check and adjust cab mounting and ride height.
       6. Center the steering wheel, as needed.
       7. Disable and enable supplemental restraint system (SRS) in accordance with manufacturers’ recommended procedures.
    2. Performance Example:
       - Student will properly identify adjustable and fixed steering.

##### Power Steering System Units

* + 1. Diagnose and repair steering units.
       1. Diagnose power steering system noise, steering binding, darting/oversteer, reduced wheel cut, steering wheel kick, pulling, non-recovery, turning effort, looseness, hard steering, overheating, fluid leakage, and fluid aeration problems; determine needed action.
       2. Determine recommended type of power steering fluid; check level and condition; determine needed action. Flush and refill power steering system.
       3. Perform power steering system pressure, temperature, and flow tests; determine needed action.
       4. Inspect, adjust, service, or replace power steering reservoir including filter, seals, and gaskets, power steering pump & mounting bracket, pulleys, tensioners, drive belts, system cooler, lines, hoses, clamps, and fittings; determine needed action.
    2. Performance Examples:
       - Students will perform power steering system pressure and flow tests; determine needed repairs.
       - Students will inspect, adjust, or replace drag link (relay rod) and tie rod ends (ball and adjustable socket type).
  1. Suspension Systems
     1. Diagnose and repair suspension systems.
        1. Inspect front axles, U-bolts, and nuts; determine needed action.
        2. Inspect and service king pin, steering knuckle bushings, locks, bearings, seals, and covers; determine needed action.
        3. Inspect shock absorbers, bushings, brackets, and mounts; replace as needed.
        4. Inspect leaf springs, center bolts, clips, eye bolts and bushings, shackles, slippers, insulators, brackets, and mounts; determine needed action.
        5. Inspect torque arms, bushings, and mounts; determine needed action.
        6. Inspect axle aligning devices such as radius rods, track bars, stabilizer bars, and related bushings, mounts, shims, and cams; determine needed action.
        7. Inspect walking beams, center (cross) tube, bushings, mounts, load pads, and saddles/caps; replace as needed.
        8. Inspect and test air suspension pressure regulator and height control valves, lines, hoses, dump valves, and fittings; adjust, repair or replace as needed.
        9. Inspect and test air springs, mounting plates, springs, suspension arms, and bushings; replace as needed.

2.X.01.10 Measure vehicle ride height; determine needed action.

* + 1. Performance Example:
       - Student will inspect service, adjust, or replace kingpin, steering knuckle bushings, locks, bearings, seals, and covers.

##### Wheels and Tires

* + 1. Diagnose and repair wheel adjustment problems.
       1. Diagnose vehicle wandering, pulling, shimmy, hard steering, and off-center steering wheel problem(s); adjust and repair as needed.
       2. Check toe; adjust as needed.
       3. Check rear axle(s) alignment (thrustline/centerline) and tracking; adjust or repair as needed.
       4. Check front axle alignment (centerline); adjust or repair as needed.
    2. Performance Example:
       - Student will diagnose wheel shimmy and hard steering.

##### Tire Repair

* + 1. Diagnose and repair wheel and tire problems.
       1. Diagnose unusual tire wear patterns, check tread depth, mismatched tread design; determine needed action.
    2. Performance Examples:
       - Students will check and adjust caster.
       - Students will check and adjust toe.

##### 2.AA Vehicle Chassis Frame

2.AA.01 Service and repair frames.

2.AA.01.01 Inspect and adjust fifth wheel, pivot pins, bushings, locking jaw mechanisms, and mounting bolts; determine needed action.

2.AA.01.02 Inspect sliding fifth wheel, tracks, stops, locking systems, air cylinders, springs, lines, hoses, and controls.

2.AA.01.03 Inspect frame and frame members for cracks, breaks, corrosion, distortion, elongated holes, looseness, and damage; determine needed repairs.

2.AA.01.04 Inspect, repair, or replace pintle hooks and thaw bars.

1. AA.01 Performance Example:
   * Students will inspect, adjust, service, repair, or replace fifth wheel, pivot pins, bushings, locking jaw mechanisms, and mounting bolts.

##### 2.BB General Electrical System

2.BB.01 Diagnose and repair general electrical system problems.

2.BB.01.01 Read, interpret, and diagnose electrical/electronic circuit problems using wiring diagrams.

2.BB.01.02 Check continuity in electrical/electronic circuits using appropriate test equipment.

2.BB.01.03 Check applied voltages, circuit voltages, and voltage drops in electrical/electronic circuits using a digital multimeter (DMM).

2.BB.01.04 Check current flow in electrical/electronic circuits and components using a digital multimeter (DMM) or clamp-on ammeter.

2.BB.01.05 Check resistance in electrical/electronic circuits and components using a digital multimeter (DMM).

2.BB.01.06 Find shorts, grounds, and opens in electrical/electronic circuits.

2.BB.01.07 Diagnose parasitic (key-off) battery drain problems.

2.BB.01.08 Inspect and test fusible links, circuit breakers, relays, solenoids, and fuses; replace as needed.

1. BB.01 Performance Examples:
   * Students will check continuity in electrical/electronic circuits using appropriate test equipment.
   * Students will check applied voltages, circuit voltages, and voltage drops in electrical/electronic circuits using a digital multimeter (DMM), or clamp-on ammeter.
   * Students will check current flow in electrical/electronic circuits and components using an ammeter, digital multimeter (DMM), or clamp-on ammeter.

**2.CC Batteries**

2.CC.01 Diagnose and repair batteries according to current industry and OSHA standards.

2.CC.01.01 Perform battery load and capacitance test; determine needed action.

2.CC.01.02 Determine battery state of charge using an open circuit voltage test.

2.CC.01.03 Inspect, clean, and service battery, battery cables, connectors battery box, mounts, and hold downs; replace as needed.

2.CC.01.04 Charge battery using slow or fast charge method as appropriate.

2.CC.01.05 Jump start a vehicle using jumper cables and a booster battery or auxiliary power supply.

**2.DD Starting Systems**

1. CC.01 Performance Examples:
   * Students will perform battery load test; determine needed service.
   * Students will determine battery state of charge by measuring terminal post voltage using a digital multimeter (DMM).
   * Students will determine battery state of charge using an open circuit voltage test.

2.DD.01 Diagnose and repair starting systems.

2.DD.01.01 Perform starter circuit cranking voltage and voltage drop tests; determine needed action.

2.DD.01.02 Inspect and test components (key switch, push button and/or magnetic switch) and wires in the starter control circuit; replace as needed.

2.DD.01.03 Inspect and test starter relays and solenoids/switches; replace as needed.

2.DD.01.04 Remove and replace starter; inspect flywheel ring gear or flex plate.

1. DD.01 Performance Examples:
   * Students will perform starter circuit voltage drop tests; determine needed repairs.
   * Students will inspect, test, and replace components (key switch, push button, and/or magnetic switch) and wires in the starter control circuit.
   * Students will inspect, test, and replace starter relays and solenoids/switches.

###### 2.EE Charging Systems

2.EE.01 Diagnose and repair charging systems.

2.EE.01.01 Diagnose instrument panel mounted volt meters and/or indicator lamps that show a no charge, low charge, or overcharge condition; determine needed action.

2.EE.01.02 Diagnose the cause of a no charge, low charge, or overcharge condition; determine needed action.

2.EE.01.03 Inspect and replace alternator drive belts, pulleys, fans, tensioners, and mounting brackets; adjust drive belts and check alignment.

2.EE.01.04 Perform charging system voltage and amperage output tests; determine needed action.

2.EE.01.05 Perform charging circuit voltage drop tests; determine needed action.

2.EE.01.06 Remove and replace alternator.

2.EE.01.07 Inspect, repair, or replace connectors and wires in the charging circuit.

1. EE.01 Performance Examples:
   * Students will diagnose the cause of a no charge, low charge, or overcharge condition; determine needed repairs.
   * Students will perform charging circuit voltage drop tests; determine needed repairs.

**2.FF Lighting Systems**

2.FF.01 Diagnose and repair lighting systems.

2.FF.01.01 Diagnose the cause of brighter than normal, intermittent, dim, or no headlight and daytime running light (DRL) operation.

2.FF.01.02 Test, aim, and replace headlights.

2.FF.01.03 Test headlight and dimmer circuit switches, relays, wires, terminals, connectors, sockets, and control components; repair or replace as needed.

2.FF.01.04 Inspect and test switches, bulbs/LEDs, sockets, connectors, terminals, relays, and wires of parking, clearance, and taillight circuits; repair or replace as needed.

2.FF.01.05 Inspect and test instrument panel light circuit switches, relays, bulbs, sockets, connectors, terminals, wires, and printed circuits/control modules; repair or replace as needed.

2.FF.01.06 Inspect and test interior cab light circuit switches, bulbs, sockets, connectors, terminals, and wires; repair or replace as needed.

2.FF.01.07 Inspect and test tractor-to-trailer multi-wire connector(s); repair or replace as needed.

2.FF.01.08 Inspect and test turn signal and hazard circuit flasher(s), switches, relays, bulbs/LEDs, sockets, connectors, terminals, and wires; repair or replace as needed.

2.FF.01.09 Inspect, test, and adjust backup lights and warning device circuit switches, bulbs/LEDs, sockets, horns, buzzers, connectors, terminals, and wires; repair or replace as needed.

1. FF.01 Performance Examples:
   * Students will check headlights, daytime running lights, parking, clearance, tail, cab, and dash lights.
   * Students will test, repair, and replace headlight and dimmer switches, wires, connectors, terminals, sockets, relays, and control components.
   * Students will inspect, test, repair or replace top lights, turn signals, hazard lights, and backup lights.
   * Students will inspect, test, adjust, repair or replace stoplight circuit switches, bulbs, sockets, connectors, terminals, relays, and wires.
   * Students will inspect, test, repair or replace turn signal and hazard circuit flashers, switches, bulbs, sockets, connectors, terminals, relays, and wires.

**2.GG Warning Systems**

2.GG.01 Diagnose and repair gauges and warning systems.

2.GG.01.01 Perform diagnostic procedure with vehicle’s on-board computer, using recommended electronic diagnostic equipment and tools (including PC based software and/or data scan tools); determine needed action.

2.GG.01.02 Diagnose the cause of intermittent, high, low, or no gauge readings; determine needed action.

2.GG.01.03 Diagnose the cause of data bus-driven gauge malfunctions; determine needed action.

2.GG.01.04 Inspect and test gauge circuit sending units, gauges, connectors, terminals, and wires; repair or replace as needed.

2.GG.01.05 Inspect and test warning devices (lights and audible), circuit sending units, bulbs/LEDs, sockets, connectors, wires, and printed circuits/control.

1. GG.01 Performance Example:
   * Students will inspect, test, adjust, repair, or replace gauge circuit sending units, gauges, connectors, terminals, and wires.

##### 2.HH Related Electrical Areas

2.HH.01 Diagnose and repair related electrical systems.

2.HH.01.01 Diagnose the cause of constant, intermittent, or no horn operation; determine needed action.

2.HH.01.02 Inspect and test horn circuit relays, horns, switches, connectors, and wires; repair or replace as needed.

2.HH.01.03 Diagnose the cause of constant, intermittent, or no wiper operation; diagnose the cause of wiper speed control and/or park problems; determine needed action.

2.HH.01.04 Inspect and test wiper motor, resistors, park switch, relays, switches, connectors, and wires; repair or replace as needed.

2.HH.01.05 Inspect wiper motor transmission linkage, arms, and blades; adjust or replace as needed.

2.HH.01.06 Inspect and test sideview mirror motors, heater circuit grids, relays, switches, connectors, terminals, and wires; repair or replace as needed.

2.HH.01.07 Inspect and test heater and alternating current (A/C) electrical components including: A/C clutches, motors, resistors, relays, switches, connectors, terminals, and wires; repair or replace as needed.

2.HH.01.08 Diagnose the cause of slow, intermittent, or no power side window operation; determine needed action.

2.HH.01.09 Inspect and test motors, switches, relays, connectors, terminals, and wires of power side window circuits; repair or replace as needed.

2.HH.01.10 Inspect and test engine cooling fan electrical control components; repair or replace as needed.

1. HH.01 Performance Example:
   * Students will inspect, test, repair, or replace heater and A/C electrical components including: A/C clutches, motors, resistors, relays, switches, controls, connectors, terminals, and wires.

##### Cab and Hood

* + 1. Inspect cab and hood.
       1. Inspect ignition key condition and operation of ignition switch.
       2. Check warning indicators.
       3. Check instruments; record oil pressure and system voltage.
       4. Check mechanical, electronic, and emergency shutdown operation.
       5. Check mechanical and electronic engine speed controls.
       6. Check heater, ventilation, and air conditioning (HVAC) controls.
       7. Check operation of all accessories.
       8. Extract engine monitoring information using diagnostic tool or on-board diagnostic system.
    2. Performance Example:
       - Student will perform pre-trip inspection of the cab interior and hood area.

###### 2.JJ Safety Equipment

2.JJ.01 Inspect safety equipment.

2.JJ.01.01 Check operation of electric/air horns and back-up warning devices.

2.JJ.01.02 Check condition and documentation of safety flares, spare fuses, triangles, fire extinguisher, and all required decals.

2.JJ.01.03 Inspect seat belts and sleeper restraints.

1. JJ.01 Performance Example:
   * Student will be able to identify and inspect horns, seat belts, sleeper restraints, and safety equipment.

**2.KK Hardware**

2.KK.01 Inspect and service hardware.

2.KK.01.01 Check wiper and washer operation.

2.KK.01.02 Inspect windshield glass for cracks or discoloration; check sun visor.

2.KK.01.03 Check seat condition, operation, and mounting.

2.KK.01.04 Check door glass and window operation.

2.KK.01.05 Inspect steps and grab handles.

2.KK.01.06 Inspect mirrors, mountings, brackets, and glass.

2.KK.01.07 Record all observed physical damage.

2.KK.01.08 Lubricate all cab and hood grease fittings.

2.KK.01.09 Inspect and lubricate door and hood hinges, latches, strikers, lock cylinders, safety latches, linkages, and cables.

2.KK.01.10 Inspect cab mountings, hinges, latches, linkages, and ride height; service as needed.

2.KK.01.11 Inspect tilt cab hydraulic pump, lines, and cylinders for leakage; inspect safety devices; service as needed.

1. KK.01 Performance Example:
   * Student will be able to conduct a pre-trip inspection on vehicle hardware.

##### 2.LL Heavy-Duty Ventilation and Air Conditioning Systems

2.LL.01 Diagnose and repair heating, ventilation, & air conditioning (HVAC).

2.LL.01.01 Inspect A/C condenser and lines for condition and visible leaks; check mountings.

2.LL.01.02 Inspect A/C compressor and lines for condition and visible leaks; check mountings.

2.LL.01.03 Check A/C system condition and operation; check A/C monitoring system, if applicable.

2.LL.01.04 Check HVAC air inlet filters and ducts; service as needed.

1. LL.01 Performance Example:
   * Student will be able inspect the heating and AC systems and identify the possible defects.

***Advanced Technical Skills in Diesel Technology***

*Students that wish to excel and broaden their knowledge may apply their Diesel Technology knowledge and skills in the following areas noted below. These technical competencies are not required, but rather are supplemental.*

**2.MM\* Engine Malfunctions**

2.MM.01\* Diagnose generic engine malfunctions.

2.MM.01.01\* Check, record, and clear electronic diagnostic (fault) codes, monitor electronic data; determine needed action.

2.MM.01.02\* Check electrical wiring, routing, and hold-down clamps, including Engine Control Module/Powertrain Control Module (ECM/PCM).

1. MM.01 Advanced Performance Example:
   * Student will inspect, test, repair, or replace heater and A/C electrical components including: A/C clutches, motors, resistors, relays, switches, controls, connectors, terminals, and wires.

##### 2.NN\* Cylinder Head and Related Components

2.NN.01\* Diagnose and repair cylinder head and valve train.

2.NN.01.01\* Inspect and adjust valve bridges (crossheads) and guides; perform needed action.

2.NN.01.02\* Inspect pushrods, rocker arms, rocker arm shafts, cam followers, electronic wiring harness, and brackets for wear, bending, cracks, looseness, and blocked oil passages; perform needed action.

2.NN.01.03\* Adjust valve clearance.

1. NN.01 Advanced Performance Example:
   * Student will inspect valve train and adjust valve clearances.

**2.OO\* Engine Block**

2.OO.01\* Diagnose and repair engine block.

2.OO.01.01\* Remove, inspect, service and install pans, covers, vents, gaskets, seals and wear rings.

2.OO.01.02\* 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.

2.OO.01.03\* Inspect cylinder walls or sleeve and counterbore and lower bore for wear and damage; determine needed action.

2.OO.01.04\* Replace/reinstall cylinder liners and seals; check and adjust liner height (protrusion).

2.OO.01.05\* Inspect in-block camshaft, camshaft bearings for wear and damage; measure/adjust end play; determine needed action.

2.OO.01.06\* Clean and inspect crankshaft for surface cracks and journal damage; check condition of oil passages and vibration damper; check passage plugs; measure journal diameter determine needed action.

2.OO.01.07\* Inspect main bearings and connecting rod bearings for wear patterns and damage; replace as needed; check bearing clearances; check and adjust crankshaft end play.

2.OO.01.08\* Inspect, install, and time gear train, measure gear backlash; determine needed action.

2.OO.01.09\* Assemble pistons and connecting rods, install in block, install rod bearings and check clearances.

2.OO.01.10\* Check condition of piston cooling jets (nozzles); determine needed action.

1. OO.01 Advanced Performance Example:
   * Student will inspect cylinder sleeve counterbore and lower bore; check bore distortion; determine needed service.

##### 2.PP\* Air Intake and Exhaust System

2.PP.01\* Diagnose and repair air induction and exhaust systems.

2.PP.01.01\* Inspect and test preheater/inlet air heater, or glow plug system and controls; perform needed action.

2.PP.01.02\* Inspect and test exhaust gas recirculation (EGR) system; determine needed action.

2.PP.01.03\* State all applicable emission standards for diesel systems.

1. PP.01 Advanced Performance Example:
   * Student will state all applicable emission standards for diesel systems.

**2.QQ\* Electronic Fuel System**

2.QQ.01\* Diagnose and repair electronic fuel management systems.

2.QQ.01.01\* Inspect and test power and ground circuits and connections; measure and interpret voltage, voltage drop, amperage, and resistance readings using a digital multimeter (DMM); determine needed action.

2.QQ.01.02\* Perform diagnostic procedures with vehicle’s on-board computer, using recommended electronic diagnostic equipment and tools (to include PC based software and/or data scan tools); determine needed action.

2.QQ.01.03\* Locate and use relevant service information (to include diagnostic procedures, flow charts, and wiring diagrams).

2.QQ.01.04\* Inspect and replace electrical connector terminals, seals, and locks. 2.QQ.01.05\* Inspect and test switches, sensors, controls, actuator components, and

circuits; adjust or replace as needed.

2.QQ.01.06\* Access and change customer parameters using recommended electronic diagnostic tools (to include PC based software and/or data scan tools.

2.QQ.01.07\* Inspect, test, and adjust electronic unit injectors (EUI); determine needed action.

2.QQ.01.08\* Remove and install electronic unit injectors (EUI) and related components; recalibrate ECM (if applicable).

2.QQ.01.09\* Perform cylinder contribution test utilizing recommended electronic diagnostic tool.

2.QQ.01.10\* Perform on-engine inspections and tests on hydraulic electronic unit injectors and system electronic controls; determine needed action.

2.QQ.01.11\* Perform on-engine inspections and tests on hydraulic electronic unit injector high-pressure oil supply and control systems; determine needed action.

2.QQ.01.12\* Perform on-engine inspections and tests on distributor-type injection pump electronic controls; determine needed action.

2.QQ.01.13\* Perform on-engine inspections and tests on in-line type injection pump electronic controls; determine needed action.

2.QQ.01.14\* Perform on-engine inspections and tests on common rail type injection systems; determine needed action.

1. QQ Advanced Performance Example:
   * Students will inspect, clean, test, repair/replace fuel transfer (lift) pump, pump drives, screens, fuel/water separators/indicators, filters, heaters and associated mounting hardware.
   * Students will inspect, clean, test fuel transfer (lift) pump, pump drives, screens, water separators, filters, heaters and mounting hardware; determine needed repairs.

**2.RR\* Clutches**

2.RR.01\* Diagnose and repair clutches.

2.RR.01.01\* Diagnose clutch noise, binding, slippage, pulsation, vibration, grabbing, dragging, and chatter problems; determine needed action.

2.RR.01.02\* Inspect and adjust clutch linkage, cables, levers, brackets, bushings, pivots, springs, and clutch safety switch (includes push and pull-type assemblies); check pedal height and travel; perform needed action.

2.RR.01.03\* Inspect, adjust, repair, or replace hydraulic clutch slave and master cylinders, lines, and hoses; bleed system.

2.RR.01.04\* Inspect, adjust, lubricate, or replace release (throw-out) bearing, sleeve, bushings, springs, housing, levers, release fork, fork pads, rollers, shafts, and seals.

2.RR.01.05\* Inspect, adjust, and replace single-disc clutch pressure plate and clutch disc. 2.RR.01.06\* Inspect, adjust, and replace two-plate clutch pressure plate, clutch discs,

intermediate plate, and drive pins/lugs.

2.RR.01.07\* Inspect and/or replace clutch brake assembly; inspect input shaft and bearing retainer; perform needed action.

2.RR.01.08\* Inspect, adjust, and replace self-adjusting/continuous-adjusting clutch mechanisms.

2.RR.01.09\* Inspect and replace pilot bearing.

2.RR.01.10\* Inspect flywheel mounting area on crankshaft, rear main oil seal, and measure crankshaft end play; determine needed action.

2.RR.01.11\* Inspect flywheel and starter ring gear and measure flywheel face and pilot bore runout; determine needed action.

2.RR.01.12\* Inspect flywheel housing(s) to transmission housing/engine mating surface(s) and measure flywheel housing face and bore runout; determine needed action

1. RR Advanced Performance Example:
   * Students will diagnose clutch noise, binding, slippage, pulsation, vibration, grabbing, dragging, and chatter problems; determine needed action.

**2.SS\* Transmissions**

2.SS.01\* Diagnose and repair transmissions.

2.SS.01.01\* Diagnose transmission noise, shifting, lockup, jumping-out-of-gear, overheating, and vibration problems; determine needed action.

2.SS.01.02\* Diagnose transmission component failure cause, both before and during disassembly procedures; determine needed action.

2.SS.01.03\* Inspect, adjust, service, repair, or replace transmission shift controls both air and hydraulic.

2.SS.01.04\* Inspect for leakage and replace transmission cover plates, gaskets, seals, and cap bolts; inspect seal surfaces and vents; repair as needed.

2.SS.01.05\* Check transmission fluid level and condition; determine needed service; add lubricant according to manufacturer’s specifications.

2.SS.01.06\* Inspect, adjust, and replace transmission shift lever, cover, rails, forks, levers, bushings, sleeves, detents, interlocks, springs, and lock bolts/safety wires.

2.SS.01.07\* Remove and reinstall transmission.

2.SS.01.08\* Inspect input-output-reverse idler shafts, gears, thrust washers, spacers, bearings, retainers, keys, and slingers; replace as needed.

2.SS.01.09\* Inspect synchronizer hub, sleeve, keys (inserts), springs, blocking rings, synchronizer plates, blocker pins, and sliding clutches; replace as needed.

2.SS.01.10\* Inspect transmission oil filters and coolers; replace as needed.

2.SS.01.11\* Inspect mechanical and electronic speedometer components; temperature gauge and sending unit; determine needed action.

2.SS.01.12\* Inspect and test function of backup light, neutral start, and warning device circuits; repair as needed.

2.SS.01.13\* Inspect, test operation of, adjust, repair, or replace automated mechanical transmission and manual electronic shift controls, shift, range and splitter solenoids, shift motors, indicators, speed and range sensors, electronic/transmission control units (ECU/TCU), neutral/in gear and reverse switches, and wiring harnesses.

2.SS.01.14\* Diagnose automated mechanical & automatic transmission problems using appropriate diagnostic tools and procedures; check and record diagnostic codes, clear codes, and interpret digital multimeter (DMM) readings; determine needed repairs.

1. SS Advanced Performance Example:
   * Students will diagnose transmission noise, shifting, lockup, jumping out of gear, overheating and vibration problems, determine needed action.

# [Embedded Academic Crosswalks](#_bookmark0)

### [Embedded English Language Arts and Literacy](#_bookmark0)

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| CTE  Learning Standard Number | Strand Coding Designation Grades ELAs  Learning Standard Number | | Text of English Language Arts Learning Standard |
| 2.EE.01 | | RI Grades 11-12 #7 | Integrate and evaluate multiple sources of information presented in different media or formats (e.g. visually, quantitatively) as well as in words in order to address a question or solve a problem.  Performance Example:   * Students using the aid of a digital multimeter (DMM), online diagrams, and text books will be able   to diagnose the cause of brighter than normal, intermittent, dim, or no headlight and daytime running light (DRL) operation.  Performance Example:  Students will discuss ways to identify and prevent workplace/school violence. |
| 2.NN.07 | | W Grades 9-10 #2d | Use precise language and domain-specific vocabulary to manage the complexity of the topic.  Performance Example:   * Students will utilize visuals handed to them by their instructor to visually inspect main bearings and connecting rod bearings for wear patterns and damage; the students will then utilize online   data along with micrometers to measure bearing clearances. |
| 4.A.01 | | W Grades 9-12 #7 | Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.  Performance Example:   * Students will utilize online webpages/sites to evaluate industries, organizations, and careers   based on multiple sources of research and information. They will then provide written and verbal feedback to the instructor. |
| 6.A.01  6A.03 | | SL Grades 9-12 #5 | Make strategic use of digital media (e.g. textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning and evidence and to add interest. Integrate and evaluate multiple sources of information presented in different media or formats (e.g. visually, quantitatively) as well as in words in order to address a question or solve a problem.  Performance Example:   * Students will demonstrate proficiency in the use of computers and applications, as well as an understanding of the concepts underlying hardware, software, and connectivity during activities such as career cruising, motor all data online, and during construction of related power point projects. |

[Embedded Mathematics](#_bookmark0)

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| CTE  Learning Standard Number | Math Content Conceptual Category and Domain Code Learning Standard Number | Text of Mathematics Learning Standard | |
| 2.A.05 | Introductory Physics, High School 1.5 | Use a free-body force diagram to show forces acting on a system consisting of a pair of interacting objects. For a diagram with only co- linear forces, determine the net force acting on a system and between the objects.  Performance Example:  Students will be asked to identify, explain, and demonstrate outside/inside micrometer. | |
| 2.I.01 | Introductory Physics, High School 3.2 | Explain how heat energy will move from a higher temperature to a lower temperature until equilibrium is reached.  Performance Example:   * Using Digital Multi-meter digital-multimeter (DMV’s) and electrical diagrams, students will be able to check operation of electric/air horns and back-up warning devices. Students will also utilize Ohm’s Law to   calculate electrical differences. | |
| 2.I.05 | Introductory Physics, High School 3.3 | Describe the relationship between average molecular kinetic energy and temperature. Recognize that energy is absorbed when a substance changes from a solid to a liquid to a gas, and that energy is released when a substance changes from a gas to a liquid to a solid. Explain the relationships among evaporation, condensation, cooling, and warming.  Performance Example:  Students will be required to measure angles and then mount exhaust piping and hardware so that the exhaust system operates properly. | |
| 2.L.01 | Introductory Physics, High School 5.1 | Recognize that an electric charge tends to be static on insulators.  Performance Example:   * Students will perform inspection, diagnoses, service, and replacement of the driveshaft, center support bearings, universal joint, slip joints, yokes, and drive flanges. Students will demonstrate proper phasing of   the driveshaft to prevent vibration. | |
| 2.L.02 | Introductory Physics, High School 5.3 | Analyze simple arrangements of electrical components in both series and parallel circuits. Recognize symbols and understand the functions of common circuit elements (battery, connecting wire, switch, fuse, resistance) in a schematic diagram.  Performance Example:  Students will demonstrate the ability to measure and adjust drive line angles. | |
| 2.G.01  2.G.02  2.G.03  2.G.04 | 6.RP3 | Use ratio and rate reasoning to solve real-world and mathematical problems e.g. by reasoning about tables of equivalent rations, tape diagrams, double number line diagrams, or equations.  Performance Example:  Students will demonstrate proper diagnosis and repair of the lubrication systems through information in their student manuals. | |
| 2.L.01 | 5.NBT3 | Read, write, and compare decimals to thousandths.  Performance Example:  Students will measure angles using the proper tool. | |
| 2.M.01 | 5.NBT7 | Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.  Performance Example:  Students will be able to check fluid levels and leakage along with diagnosing driveline noise. | |
| 2.M.02 | A-CED4 | Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.  Performance Example:  Students’ will be able to read and interpret the compression ratios they receive during compression testing of a cylinder. | |
| 2.N.02 | 5.NF1 | Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators.  Performance Example:  Students’ will be able to read and interpret driveline angles and adjust according to their readings. | |
| 2.N.10 | 5.NBT7 | Add, subtract, multiply, and divide decimals to hundredths, using | |
| 2.N.11 |  | concrete models or drawings and strategies based on place value,  properties of operations, and/or the relationship between addition | |
| 2.N.12 |  | and subtraction; relate the strategy to a written method and explain the reasoning used.  Performance Example:  Students will be able to physically identify all airbrake components, adjust air pressure, adjust leveling valves, and diagnose air leaks. | |
| 2.P.02 | 4.MD7 | Recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts. Solve addition and subtraction problems to find unknown angles on a diagram in real-world and mathematical problems, e.g., by using an equation with a symbol for the unknown angle measure.  Performance Example:  Students will perform caging and un-caging of air brake chambers safely. | |
| 2.S.02 | 5.NBT7 | Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.  Performance Example:  Students will inspect and diagnose power booster. | |
| 2.P.02 | 4.MD7 | Recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts. Solve addition and subtraction problems to find unknown angles on a diagram in real-world and mathematical problems, e.g., by using an equation with a symbol for the unknown angle measure.  Performance Example:  Students will perform caging and un-caging of air brake chambers safely. | |
| 2.S.03 | 5.NF1 | Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators.  Performance Example:  Students will inspect emergency back- up reserve brake system. | |
| 2.BB.02  2.BB.03  2.BB.04 | 5.NBT7  5.NF1  4.MD7 | Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.  Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators.  Recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts. Solve addition and subtraction problems to find unknown angles on a diagram in real-world and mathematical problems, e.g., by using an equation with a symbol for the unknown angle measure.  Performance Example:  Students will inspect and adjust the fifth wheel pivot pins, and bushings. | |
| 2.CC.01 | 5.NF1 | Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators.  Performance Example:   * Students will check continuity in electrical circuits using appropriate test equipment. Students will perform a voltage drop tests. Inspect, test, and replace components (key switch, push button, and/or magnetic switch and wires in the starter control circuit Inspect, test, and replace starter relays and   solenoids/switches. | |
| 2.GG.01 | A-CED4 | Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.  Performance Example:  Students will diagnose the cause of brighter than normal headlamps and the reasoning behind the fault. | |
| 5.NBT7  5.NF1 | Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.  Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators.  Performance Example:  Students will measure interference angles of valves and adjust valve clearances. | Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators.  Performance Example:  Students’ will perform tests on the air compressor and be able to adjust the air governor. | |
| 5.NBT7 | Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.  Performance Example:  Students will measure and adjust clutch pedal free play. | Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.  Performance Example:  Students will be able to physically identify all airbrake components, adjust air pressure, adjust leveling valves, and diagnose air leaks. | |
| 2.P.02 | 4.MD7 | Recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts. Solve addition and subtraction problems to find unknown angles on a diagram in real-world and mathematical problems, e.g., by using an equation with a symbol for the unknown angle measure.  Performance Example:  Students will perform caging and un-caging of air brake chambers safely. | |
| 2.N.02 | 5.NF1 | Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators.  Performance Example:  Students will perform tests on the air compressor and be able to adjust the air governor. | |
| 2.N.10 | 5.NBT7 | Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.  Performance Example: Students will be able to physically identify all airbrake components, adjust air pressure, adjust leveling valves, and diagnose air leaks. | |
| 2.P.02 | 4.MD7 | Recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts. Solve addition and subtraction problems to find unknown angles on a diagram in real-world and mathematical problems, e.g., by using an equation with a symbol for the unknown angle measure.  Performance Example:  Students will perform caging and un-caging of air brake chambers safely. |
| 2.S.03 | 5.NF1 | Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators.  Performance Example:  Students will inspect emergency back- up reserve brake system. |
| 2.BB.02  2.BB.03  2.BB.04 | 5.NBT7  5.NF1  4.MD7 | Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.  Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators.  Recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts. Solve addition and subtraction problems to find unknown angles on a diagram in real-world and mathematical problems, e.g., by using an equation with a symbol for the unknown angle measure.  Performance Example:  Students will inspect and adjust the fifth wheel pivot pins, and bushings. |
| 2.CC.01 | 5.NF1 | Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators.  Performance Example:   * Students will check continuity in electrical circuits using appropriate test equipment. Students will perform a voltage drop tests. Inspect, test, and replace components (key switch, push button, and/or magnetic switch and wires in the starter control circuit Inspect, test, and replace starter relays and   solenoids/switches. |
| 2.GG.01 | A-CED4 | Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.  Performance Example:  Students will diagnose the cause of brighter than normal headlamps and the reasoning behind the fault. |
| 2.OO.03 | 5.NBT7  5.NF1 | Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.  Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators.  Performance Example:  Students will measure interference angles of valves and adjust valve clearances. |

#### [Physical Science (Chemistry)](#_bookmark0)

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| CTE  Learning Standard Number | Subject Area, Topic Heading and  Learning Standard Number | Text of Chemistry Learning Standard |
| 2.D.01C | Chemistry, High School 1.1 | Identify and explain physical properties (e.g., density, melting point, boiling point, conductivity, malleability)  Performance Examples:   * Students will select the correct tool to drill a 5/16 hole and select the proper tap to thread the hole. * Students will select the correct tools and supplies to solder an electrical connection and will explain the   soldering procedure to include: safety, preparation, joining the wires mechanically, tinning, soldering and then sleeving. |

#### [Physical Science (Physics)](#_bookmark0)

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| CTE  Learning Standard Number | Subject Area, Topic Heading and  Learning Standard Number | Text of Physics Learning Standard |

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| 2.A.01 | Introductory Physics, High School 1.5 | | Use a free-body force diagram to show forces acting on a system consisting of a pair of interacting objects. For a diagram with only co- linear forces, determine the net force acting on a system and between the objects.  Performance Example:  Students will be asked to identify, explain, and demonstrate safe use of hand, power, electric, and pneumatic tools. | |
| 2.I.01 | | Introductory Physics, High School 3.2 | | Explain how heat energy will move from a higher temperature to a lower temperature until equilibrium is reached.  Performance Example:  Students will explain low and high temperatures of the lubrication system and the effects it has on the components. |
| 2.L.01 | | Introductory Physics, High School 5.1 | | Recognize that an electric charge tends to be static on insulators and can move on and in conductors. Explain that energy can produce a separation of charges.  Performance Example:  Students will identify major components in the fuel system and explain their purpose. |
| 2.O.03 | | Introductory Physics, High School 2.1 | | Interpret and provide examples that illustrate the law of conservation of energy.  Performance Example:  Students will perform an inspection and diagnose drive axle(s), drive unit noise and overheating noise. |
| 2.HH.04 | | Introductory Physics, High School 5.2 | | Develop qualitative and quantitative understandings of current, voltage, resistance, and the connections among them (Ohm’s law).  Performance Example:  Students will explain and demonstrate ohms law utilizing digital multi-meters (DMM). |

#### [Technology/Engineering](#_bookmark0)

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| CTE  Learning Standard Number | Subject Area, Topic Heading and  Learning Standard Number | | Text of Technology/Engineering Learning Standard |
| 2.C.01.04 – 2.C.16.06 | Technology/Engineering, High School , 2.5 | Identify and demonstrate the safe and proper use of common hand tools, power tools, and measurement devices used in construction.  Performance Example:  Students will demonstrate measurement skills using both American and metric system using variety of tools. | |
| 2.L.01 | Technology/Engineering, High School , 5.1 | Explain how to measure and calculate voltage, current, resistance, and power consumption in a series circuit and in a  parallel circuit. Identify the instruments used to measure voltage, current, power consumption, and resistance.  Performance Example:  Students will perform inspections on the fuel pump and determine needed action. | |
| 2.U.01 | Technology/Engineering, High School , 3.2 | Explain the differences and similarities between hydraulic and pneumatic systems, and explain how each relates to manufacturing and transportation systems.  Performance Example:  Students will be able to diagnose stopping issues utilizing a vacuum gauge. | |
| 2.EE.01  2.EE.02 | Technology/Engineering, High School , 5.1, 5.2 | Explain how to measure and calculate voltage, current, resistance, and power consumption in a series circuit and in a parallel circuit. Identify the instruments used to measure voltage, current, power consumption, and resistance. Identify and explain the components of a circuit, including sources, conductors, circuit breakers, fuses, controllers, and loads.  Examples of some controllers are switches, relays, diodes, and variable resistors.  Performance Example:  Students will perform a starter circuit voltage drop; determine needed action. | |
| 2.EE.03 | Technology/Engineering, High School , 5.3 | Explain the relationships among voltage, current, and resistance in a simple circuit, using Ohm’s law.  Performance Example:  Students will explain Ohm’s law as it relates to voltage drops. | |

[Industry Recognized Credentials](#_bookmark0) (Licenses and Certifications/Specialty Programs)

National Institute for Automotive Service Excellence (ASE)

Occupational Safety and Health Administration (OSHA) 10 hour General Industry Card

* Graduates of this program can expect to be able to find positions in the diesel field as entry level technicians and with experience and continued education will be able to work their way to becoming Master Technicians.