Instructional Framework

Diesel Engine Repair

47.0600.40

This Instructional Framework identifies, explains, and expands the content of the standards/measurement criteria, and, as well, guides the development of multiple-choice items for the Technical Skills Assessment. This document corresponds with the Technical Standards endorsed on January 22, 2020.

Domain 1: Electrical and Electronics **Instructional Time: 30 – 35%**	
STANDARD 13.0 PERFORM GENERAL ELECTRICAL/ELECTRONIC SYSTEM DIAGNOSIS AND REPAIR	
13.1 Research vehicle service information, including vehicle service history, service precautions, and technical service bulletins	• Vehicle service information • Service history • Technical service bulletins • Service precautions

13.2 Demonstrate knowledge of electrical/electronic series, parallel, and series-parallel circuits using principles of electricity (Ohm's Law)	• Ohm's Law
	• Circuit types
	  ○ Series
	  ○ Parallel
	  ○ Series parallel

13.3 Demonstrate proper use of test equipment when measuring source voltage, voltage drop (including grounds), current flow, continuity, and resistance	• Use digital multimeter
	  ○ Open circuit voltage
	  ○ Source voltage
	  ○ Voltage drop
	  ○ Ammeter
	  ○ Continuity
	  ○ Resistance

13.4 Demonstrate knowledge of the causes and effects of shorts, grounds, opens, and resistance problems in electrical/electronic circuits	• Effect on circuit caused by
	  ○ Open
	  ○ Short to ground
	  ○ Short to voltage

	○ Excessive resistance ○ Low resistance
13.5 Use wiring diagrams to trace electrical/electronic circuits	• Identify diagram types • Power condition • Always on voltage • Switched voltage ○ Power side switching ○ Ground side switching
13.6 Measure parasitic (key-off) battery drain	• Determine maximum parasitic draw
13.7 Demonstrate knowledge of the function, operation, and testing of fusible links, circuit breakers, relays, solenoids, diodes, and fuses	• Circuit over-current hazards ○ Fusible links ○ Circuit breakers ○ Fuses ○ Diodes
13.8 Inspect, repair (including solder repair), and/or replace connectors, seals, terminal ends, and wiring; verify proper routing and securement	• Inspect ○ Moisture intrusion ○ Connection • Repair ○ Terminals ○ Crimping procedure ○ Solder connectors ○ Heat shrink
13.9 Use appropriate electronic service tool(s) and procedures to check, record, and clear diagnostic codes; interpret digital multimeter (DMM) readings	• Scan tool usage • Digital multimeter (DMM) usage • Instrument cluster
13.1 Check for malfunctions caused by faults in the data bus communications network	• Scan tool • Oscilloscope

13.11 Identify electrical/electronic system components and configuration	• Switches • Relays • Modules
STANDARD 14.0 PERFORM BATTERY DIAGNOSIS AND REPAIR	
14.1 Identify battery type and system configuration	• Series • Parallel • Series/parallel • Maintenance free batteries
14.2 Confirm proper battery capacity for application; perform battery state-of-charge test; perform battery capacity test, determine needed action	• Open circuit voltage test • Hydrometer test • Load test • Cell imbalance
14.3 Inspect battery, battery cables, connectors, battery boxes, mounts, and hold-downs; determine needed action	• Connections • Corrosion • Security
14.4 Charge battery using appropriate method for battery type	• Fast charge • Slow charge • Charge amperage
14.5 Jump-start vehicle using a booster battery and jumper cables or using an appropriate auxiliary power supply	• Jump start safety • Jumper cable procedure • Jump pack procedure

14.6 Identify low voltage disconnect (LVD) systems	• Identify
	  ○ Battery isolator
	  ○ Low voltage switches and relays

STANDARD 15.0 PERFORM STARTING SYSTEM DIAGNOSIS AND REPAIR	
15.1 Demonstrate understanding of starter system operation	• Cranking circuit • Solenoid • Motor • Pinion • Ring gear • Over-running clutch

15.2 Perform starter circuit cranking voltage and voltage drop tests	• Perform
	  ○ Voltage test
	  ○ Voltage drop test

15.3 Inspect starter control circuit switches, relays, connectors, terminals, wires, and harnesses (including over-crank protection)	• Inspect
	  ○ Ignition/start switches
	  ○ Solenoid
	  ○ Over-crank thermal breaker

STANDARD 16.0 PERFORM CHARGING SYSTEM DIAGNOSIS AND REPAIR	
16.1 Identify and understand operation of the generator (alternator)	• Induction principle • Rectification • Voltage regulator

16.2 Check instrument panel mounted voltmeters and/or indicator lamps	• Test
	  ○ Voltmeters
	  ○ Check lamps

16.3 Inspect generator (alternator) drive belt condition; check pulleys and tensioners for wear; check fans and mounting brackets; verify proper belt alignment	• Identify belt type • Tensioner • Types of belt wear • Bearing
16.4 Inspect cables, wires, and connectors in the charging circuit	• Corrosion • Insulation

	• Connections • Check resistance

16.5 Perform charging system voltage and amperage output tests; perform AC ripple test	• Perform
	  ○ Voltage output test
	  ○ Current output test
	  ○ Ripple test
	• Determine needed action

STANDARD 17.0 PERFORM LIGHTING SYSTEM DIAGNOSIS AND REPAIR	

17.1 Inspect for brighter-than-normal, intermittent, dim, or no-light operation; determine needed action	• Inspect
	  ○ Brighter-than-normal
	  ○ Intermittent
	  ○ Dim
	  ○ No-light operation
	• Determine cause
	• Determine needed action

17.2 Test, replace, and aim headlights	• Headlights
	  ○ Test
	  ○ Replace
	  ○ Aim

17.3 Inspect cables, wires, and connectors in the lighting systems	• Lighting Systems: cables, wires, and connectors
	  ○ Connection
	  ○ Cuts
	  ○ Abrasion
	  ○ Moisture intrusion

17.4 Inspect tractor-to-trailer multi-wire connectors, cables, and holders	• Tractor-to-trailer multi-wire connectors, cables, and holders
	  ○ Connection
	  ○ Cuts
	  ○ Abrasions
	  ○ Moisture intrusion
	  ○ Proper mounting

Domain 2: Inspections **Instructional Time: 25 – 30%**	
STANDARD 2.0 PERFORM PRE-TRIP INSPECTION	

2.1 Research vehicle service information, including fluid type, vehicle service history, service precautions, and technical service bulletins	• Vehicle service information
	• Service history
	• Work orders
	• Required customer information
	• Vehicle information online resources
	  ○ Mitchell
	  ○ ALLDATA
	• Fluid types

2.2 Inspect level and condition of fuel, oil, diesel exhaust fluid (DEF), and coolant	• Level and condition
	  ○ Fuel
	  ○ Oil
	  ○ Diesel Exhaust Fluid (DEF)
	  ○ Coolant

2.3 Inspect engine assembly for fuel, oil, coolant, air, and other leaks	• Identify leaks
	  ○ Fuel
	  ○ Oil
	  ○ Coolant
	  ○ Air
	  ○ Other

2.4 Check engine operation (starting and running) including noise, vibration, smoke, etc.	• Idle/governor speed • Abnormal noise • Black smoke • White smoke • Blue smoke
2.5 Use appropriate electronic service tool(s) and procedures to check, record, and clear diagnostic codes; check and record trip/operational	• Scan tool usage • Digital multimeter (DMM) usage • Instrument cluster

data; reset maintenance monitor (if applicable); interpret digital multimeter (DMM) readings	
2.6 Identify and evaluate system components, configurations, and types of the following: cylinder head(s), valve train, engine block, engine lubrication, engine cooling, air induction, exhaust, fuel, and engine braking	• Engine configurations • Cylinder head configurations • Turbocharger configurations • Engine brake configurations • Intercooler identification • Exhaust after treatment system
STANDARD 3.0 PERFORM LUBRICATION SYSTEM PM	
3.1 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	• Test and inspect oil pressure • Inspect oil pressure sensor • Inspect operation of temperature sensor
3.2 Check engine oil level, condition, and consumption; take engine oil sample	• Inspect oil level and condition • Perform oil sample procedure
3.3 Determine proper lubricant; perform oil and filter service	• Perform oil and filter service and inspection • Lubricant identification
STANDARD 4.0 PERFORM COOLING SYSTEM PM	

4.1 Check engine coolant type, level, condition, and test coolant for freeze protection and additive package concentration	• Engine coolant
	  ○ Proper coolant type
	  ○ Inspect level
	  ○ Condition
	  ○ Use of hydrometer and PH strips

4.2 Verify coolant temperature; check operation of temperature and level sensors, gauge, and/or sending unit	• Run engine and verify proper coolant temperature • Test and inspect level sensor, sending units for proper operation

4.3 Inspect and reinstall/replace pulleys, tensioners and drive belts; adjust drive belts and check alignment	• Perform pulley, tensioner and belt inspection • Verify proper belt and pulley alignment
4.4 Recover coolant, flush, and refill with recommended coolant/additive package; bleed cooling system	• Perform cooling system flush, refill with proper coolant • Add coolant additive package • Bleed cooling system
4.5 Inspect coolant conditioner/filter assembly for leaks; inspect valves, lines, and fittings; replace as needed	• Verify coolant conditioner/filter is not leaking • Verify cooling system fittings and valves are not leaking
4.6 Inspect water pump, hoses, and clamps	• Visually inspect water pump for leaks • Visually inspect hoses and clamps for leaks
4.7 Inspect, and pressure test cooling system(s); pressure test cap, tank(s), and recovery systems; inspect radiator and mountings	• Perform pressure test of the cooling system • Perform pressure test on cooling system cap • Visually inspect radiator mounts

4.8 Inspect thermostatic cooling fan system (hydraulic, pneumatic, and electronic) and fan shroud	• Verify proper function of cooling fans
	  ○ Hydraulic
	  ○ Pneumatic
	  ○ Electronic
	• Inspect fan shroud for cracks and function

4.9 Identify engine block heater(s)	• Verify the location of the block heater on the engine (If applicable)
STANDARD 5.0 PERFORM AIR INDUCTION AND EXHAUST SYSTEM PM	

5.1 Inspect turbocharger(s), wastegate(s), and piping systems	• Leaks
	  ○ Exhaust
	  ○ Intake air
	  ○ Piping
	  ○ Lubrication
	• Proper operation

5.2 Check air induction system including cooler assembly, piping, hoses, clamps, and mountings; replace air filter as needed; reset restriction indicator (if applicable)	• Intake air filter
	  ○ Inspect
	  ▪ Clamps
	  ▪ Hoses
	  ▪ Mounts
	  ○ Replace
	• Check air restriction
	• Reset restriction indicator

5.3 Inspect intake manifold, gaskets, and connections	• Inspect
	  ○ Leaks
	  ○ Abrasions
	  ○ Cuts
	  ○ Bumps

5.4 Inspect engine exhaust system, exhaust gas recirculation (EGR) system, and exhaust after treatment systems [e.g., Diesel Exhaust Fluid (DEF), Selective Catalyst Reduction (SCR), Diesel Particulate Filter (DPF)] for leaks, mounting, proper routing, and damaged or missing components	• Diesel Exhaust Fluid (DEF) • Selective Catalyst Reduction (SCR) • Diesel Particulate Filter (DPF)
5.5 Inspect crankcase ventilation system; service as needed	• Positive Crankcase Ventilation (PCV) valve • Crankcase breather
5.6 Inspect engine compression and/or exhaust brake housing, valves, seals, lines, and fittings	• Compression brake • Exhaust brake
STANDARD 6.0 PERFORM FUEL SYSTEM PM	
6.1 Check fuel level and condition	• Fuel condition • Level of fuel

6.2 Inspect fuel tanks, vents, caps, mounts, valves, screens, crossover system, hoses, lines, and fittings	• Condition of
	  ○ Fuel tanks
	  ○ Vents

	○ Caps ○ Mounts ○ Valves ○ Screens ○ Crossover system ○ Hoses ○ Lines and fittings
6.3 Inspect low pressure fuel system components (fuel pump, pump drives, screens, fuel/water separators/indicators, hoses, lines, filters, heaters, coolers, ECM cooling plates, check valves, pressure regulator valves, restrictive fittings, and mounting hardware)	• Operation of low pressure fuel system components ○ Fuel pump ○ Pump drives ○ Screens ○ Fuel/water separators/indicators ○ Hoses ○ Lines ○ Filters ○ Heaters ○ Coolers ○ ECM cooling plates ○ Check valves ○ Pressure regulator valves ○ Restrictive fittings ○ Mounting hardware
6.4 Replace fuel filter; prime and bleed fuel system	• Perform fuel filter replacement • Prime and bleed fuel system
6.5 Properly discharge a high-pressure fuel system	• Verify proper discharge procedures in service information
6.6 Inspect high pressure fuel system components (fuel pump, pump drives, hoses, injection lines, filters, hold- downs, fittings, seals, and mounting hardware)	• Condition of high pressure fuel system components ○ Fuel pump ○ Pump drives ○ Hoses ○ Injection lines ○ Filters ○ Hold-downs ○ Fittings

	○ Seals ○ Mounting hardware
STANDARD 7.0 PERFORM DRIVE TRAIN PM	
7.1 Research vehicle service information, including fluid type, vehicle service history, service precautions, and technical service bulletins	• Use service information to verify ○ Fluid type ○ Vehicle service history ○ Service precautions ○ Technical service bulletins
7.2 Identify drive train components, transmission type, and configuration	• Inspect ○ Vehicle drivetrain components ○ Transmission type ○ Configuration
7.3 Inspect and adjust clutch, clutch brake, linkage, cables, levers, brackets, bushings, pivots, springs, and clutch safety switch (includes push-type and pull-type); check pedal height and travel; determine needed action	• Inspect the following components ○ Clutch ○ Clutch brake ○ Levers ○ Brackets ○ Pivots ○ Springs ○ Switches • Test and inspect pedal height and travel
7.4 Inspect clutch master cylinder fluid level; check clutch master cylinder, slave cylinder, lines, and hoses for leaks and damage; determine needed action	• Inspect for leaks and condition ○ Master cylinder ○ Slave cylinder ○ Lines ○ Hoes
7.5 Inspect transmission shifter and linkage; inspect transmission mounts, insulators, and mounting bolts	• Verify condition and operation of the following components ○ Shifter and linkage ○ Mounts ○ Insulators

	○ Mounting bolts
7.6 Inspect transmission for leakage; determine needed action	• Identify any leaks from transmission
7.7 Replace transmission cover plates, gaskets, seals, and cap bolts; inspect seal surfaces and vents; determine needed action	• Remove transmission cover and inspect ○ Gaskets ○ Seals ○ Bolts ○ Vents
7.8 Check transmission fluid level and condition; determine needed action	• Verify proper oil level in transmission
7.9 Inspect transmission breather; inspect transmission oil filters, coolers and related components; determine needed action	• Perform inspection and location of transmission breather • Perform inspection and location of transmission filter and cooler
7.1 Inspect speedometer components	• Gauge/digital display • Speedometer drive • Speed sensor
7.11 Inspect and test function of REVERSE light, neutral start, and warning device circuits	• Verify the function of the following ○ REVERSE lights ○ Neutral start switch ○ Warning device circuits
7.12 Inspect, service, and/or replace driveshafts, slip joints, yokes, drive flanges, support bearings, universal joints, boots, seals, and retaining/mounting hardware; check phasing of all shafts	• Properly service or replace ○ Driveshafts ○ Slip joints ○ Yokes ○ Drive flanges ○ Support bearings ○ Universal joints ○ Boots ○ Seals

	○ Retaining/mounting hardware
7.13 Identify power takeoff components (PTOs)	• Locate and identify the power take off (PTO) and its components
7.14 Check for fluid leaks; inspect drive axle housing assembly, cover plates, gaskets, seals, vent/breather, and magnetic plugs	• Visual inspection of drive axle for fluid leaks • Visual inspection of axle housing, cover plates, gaskets, seals, breathers and magnetic drain plugs
7.15 Check drive axle fluid level and condition; check drive axle filter; determine needed action	• Verify proper drive axle fluid level • Inspect drive axle filter (If applicable)
7.16 Inspect air-operated power divider (inter-axle differential) assembly including: diaphragms, seals, springs, yokes, pins, lines, hoses, fittings, and controls	• Verify operation of air operated power divider • Inspect the following components of the power divider ○ Diagrams ○ Seals ○ Springs ○ Yokes ○ Pins ○ Lines ○ Hoses ○ Fittings ○ Controls
7.17 Inspect drive axle shafts; determine needed action	• Visually inspect drive axle ○ Dents ○ Missing weights and hardware
7.18 Remove and replace wheel assembly; check rear wheel seal and axle flange for leaks; determine needed action	• Perform wheel assembly removal and inspect ○ Wheel seals ○ Axle flange leakage
7.19 Inspect electric two-speed motor and wiring for proper function	• Proper function ○ Electric two-speed motor and wiring

STANDARD 12.0 PERFORM FRAME AND FIFTH WHEEL PM	

12.1 Inspect, service, and/or adjust fifth wheel, pivot pins, bushings, locking mechanisms, mounting hardware, air lines, and fittings	• Inspect, service, and/or adjust
	  ○ Fifth wheel
	  ○ Bushings
	  ○ Locking bar
	  ○ Locking jaws

12.2 Inspect frame and frame members for cracks, breaks, corrosion, distortion, elongated holes, looseness, poor weld conditions, and damage	• Inspect frame and frame members for
	  ○ Cracks
	  ○ Brakes
	  ○ Welds
	  ○ Distortion
	  ○ Corrosion

12.3 Inspect frame hangers, brackets, and cross members	• Mounting • Security • Cracks
12.4 Check pintle hook, eye wear, and mounting (if applicable)	• Verify insert for pintle hook is free of corrosion or debris • Verify the pintle hook moves freely
12.5 Identify trailer kingpin wear	• Measure kingpin diameter

Domain 3: Brakes **Instructional Time: 15 – 20%**	
STANDARD 8.0 PERFORM AIR BRAKE SYSTEM PM	
8.1 Research vehicle service information, including fluid type, vehicle service history, service precautions, and technical service bulletins	• Vehicle service information • Service history • Work orders • Required customer information • Vehicle information online resources

	○ Mitchell ○ ALLDATA • Fluid Types
8.2 Identify brake system components and configurations (including air and hydraulic systems, parking brake, power assist, and vehicle dynamic brake systems)	• Brake system components and configurations ○ Air and hydraulic systems ○ Parking brake ○ Power assist ○ Vehicle dynamic brake systems
8.3 Identify brake performance problems caused by the mechanical/foundation brake system (air and hydraulic)	• Run-out condition (rotors and drums) • Uneven friction surface wear • Springs • Caliper piston • Drum brake cylinder
8.4 Inspect air supply system components such as compressor, governor, air drier, tanks, and lines; inspect service system components such as lines, fittings, mountings, and valves (hand brake/trailer control, brake relay, quick release, tractor protection, emergency/spring brake control/modulator, pressure relief/safety)	• Inspect ○ Compressor drive ○ Governor ○ Lines and fittings ○ Pressure relief valve ○ Pressure safety valve ○ Supply and wet tank ○ Air dryer ○ Relay valves ○ Quick release valve ○ Tractor protection valve
8.5 Verify proper gauge operation and readings; verify low pressure warning alarm operation; perform air supply system tests such as pressure build-up, governor settings, and leakage; drain air tanks and check for contamination	• Gauge operation and readings • Low pressure warning alarm operation • Air supply system tests ○ Pressure build-up ○ Governor settings ○ Leakage • Air tanks ○ Drain

	○ Check for contamination
8.6 Inspect service brake chambers, diaphragms, clamps, springs, pushrods, clevises, and mounting brackets; determine needed action	• Inspect and determine needed action ○ Service brake chambers ○ Diaphragms ○ Clamps ○ Springs ○ Pushrods ○ Clevises ○ Mounting brackets
8.7 Identify slack adjuster type; inspect slack adjusters; determine needed action	• Slack adjuster ○ Types ○ Inspection ○ Determine needed action
8.8 Check camshafts (S-cams), tubes, rollers, bushings, seals, spacers, retainers, brake spiders, shields, anchor pins, and springs; determine needed action	• Camshafts (S-cams) ○ Inspection ○ Determine needed action
8.9 Inspect rotor and mounting surface; measure rotor thickness, thickness variation, and lateral runout; determine needed action	• Inspect rotor mounting surface • Measure ○ Rotor thickness ○ Lateral runout ○ Thickness variation • Determine needed action
8.10 Inspect, clean, and adjust air disc brake caliper assemblies; inspect and measure disc brake pads; inspect mounting hardware; perform needed action	• Brake caliper assemblies ○ Clean and inspect ▪ Brake pads ▪ Mounting hardware ○ Measure ▪ Pad thickness • Perform needed action

8.11 Remove brake drum; clean and inspect brake drum and mounting surface; measure brake drum diameter; measure brake lining thickness; inspect brake lining condition; determine needed action	• Brake drum
	  ○ Clean and inspect
	  ▪ Drum
	  ▪ Mounting surface
	  ▪ Lining
	  ○ Measure
	  ▪ Diameter
	  ▪ Lining thickness
	• Perform needed action

8.12 Inspect and check parking (spring) brake chamber for leaks; determine needed action	• Parking (spring) brake chamber
	  ○ Inspect
	  ○ Check for leaks
	  ○ Determine needed action

8.13 Inspect and test parking (spring) brake check valves, lines, hoses, and fittings; determine needed action	• Parking (spring) brake check
	  ○ Inspect
	  ○ Check valves, lines, hoses and fittings
	  ○ Determine needed action

8.14 Inspect and test parking (spring) brake application and release valve; determine needed action	• Parking (spring) brake application and release valve
	  ○ Inspect
	  ○ Test
	  ○ Determine needed action

8.15 Manually release (cage) and reset (uncage) parking (spring) brakes	• Manually release(cage) and reset(uncage) parking brake chamber springs
	  ○ Safety
	  ○ Use of cage bolt

8.16 Observe antilock brake system (ABS) warning light operation including trailer and dash mounted trailer ABS warning light	• Antilock brake system (ABS) warning light
	  ○ Observe operation
	  ▪ Trailer
	  ▪ Dash mounted trailer

8.17 Observe automatic traction control (ATC) and electronic stability control (ESC) warning light operation	• Observe warning light operation
	  ○ Automatic traction control (ATC)
	  ○ Electronic stability control (ESC)

8.18 Identify steering angle calibration	• Use scan tool to reset steering angle sensor
STANDARD 9.0 PERFORM HYDRAULIC BRAKE SYSTEM PM	
9.1 Check master cylinder fluid level and condition; determine proper fluid type for application	• Visually inspect master cylinder fluid level and verify proper fluid type

9.2 Inspect hydraulic brake system components for leaks and damage	• Visually inspect hydraulic brake system for leaks
	  ○ Master cylinder
	  ○ Hydraulic lines
	  ○ Calipers
	  ○ Wheel cylinders
	  ○ Hoses
	  ○ Valves

9.3 Check hydraulic brake system operation including pedal travel, pedal effort, and pedal feel	• Perform operation tests
	  ○ Pedal travel
	  ○ Pedal effort
	  ○ Pedal feel

9.4 Inspect rotor and mounting surface; measure rotor thickness, thickness variation, and lateral runout; determine needed action	• Visually inspect brake rotor and mounting surface
	  ○ Measure
	  ▪ Rotor thickness
	  ▪ Lateral runout
	  ▪ Thickness variation

9.5 Inspect and clean disc brake caliper assemblies; inspect and measure disc brake pads; inspect mounting hardware; determine needed action	• Brake caliper assemblies
	  ○ Clean and inspect
	  ▪ Brake Pads
	  ▪ Mounting hardware
	  ○ Measure

	▪ Pad thickness • Perform needed action
9.6 Remove brake drum; clean and inspect brake drum and mounting surface; measure brake drum diameter; measure brake lining thickness; inspect brake lining condition; inspect wheel cylinders; determine needed action	• Brake drum ○ Clean and inspect ▪ Drum ▪ Mounting surface ▪ Lining ○ Measure ▪ Diameter ▪ Lining thickness • Determine needed action
9.7 Check parking brake operation; inspect parking brake application and holding devices	• Check parking brake operation • Check application • Inspect ○ Mounting ○ Brackets ○ Cable
9.8 Check brake assist/booster system (vacuum) hoses and control valves; check fluid level and condition (if applicable)	• Verify operation of brake assist/booster • Inspect fluid condition and level
9.9 Check brake assist/booster system (hydraulic) hoses, accumulator, and control valves; check fluid level and condition (if applicable)	• Visually inspect ○ Brake booster ○ Hydraulic lines and hoses ○ Accumulator ○ Control valves ○ Fluid level
9.10 Check operation of emergency (back-up/reserve) brake assist system	• Emergency (back-up/reserve) brake assist system ○ Operation
9.11 Observe antilock brake system (ABS) warning light operation	• Warning light operation ○ Antilock brake system (ABS)

9.12 Observe automatic traction control (ATC) and electronic stability control (ESC) warning light operation	• Warning light operation
	  ○ Automatic traction control (ATC)
	  ○ Electronic stability control (ESC) warning light operation

9.13 Identify steering angle calibration	• Use scan tool to reset steering angle sensor
STANDARD 10.0 PERFORM SUSPENSION AND STEERING SYSTEMS PM	

10.1 Research vehicle service information, including fluid type, vehicle service history, service precautions, technical service bulletins, special service message(s)	• Vehicle service information
	• Service history
	• Work orders
	• Required customer information
	• Vehicle information online resources
	  ○ Mitchell
	  ○ ALLDATA
	• Fluid Types

10.2 Disable and enable supplemental restraint system (SRS); verify indicator lamp operation	• Disable Supplemental Restraint System (SRS) • Enable SRS system • Verify lamp operation

10.3 Identify suspension and steering system components and configurations	• Identify suspension
	  ○ Leaf spring
	  ○ Air bags
	  ○ Independent
	• Identify steering
	  ○ Three piece
	  ○ Rack and pinion

10.4 Check steering wheel for free play, binding, and proper centering; inspect and service steering shaft U-joint(s), slip joint(s), bearings, bushings, and seals; phase steering shaft	• Inspect steering wheel and column for
	  ○ Free play
	  ○ Binding
	  ○ Proper centering
	• Inspect steering shaft

10.5 Check operation of tilt and telescoping steering column	• Check operation • Inspect intermediate shaft • Lubricate

10.6 Check cab mounting	• Inspect
	  ○ Bolts
	  ○ Brackets
	  ○ Bushings

10.7 Check power steering pump and gear operation, mountings, lines, and hoses; check fluid level and condition; service filter; inspect system for leaks	• Visually inspect power steering pump and gear operation
	• Inspect
	  ○ Mounting
	  ○ Lines
	  ○ Hoses
	  ○ Fluid level and condition
	  ○ Leaks

10.8 Flush and refill power steering system; purge air from system	• Perform power steering system flush ○ Purge air from system

10.9 Inspect tie rod ends, ball joints, kingpins, pitman arms, idler arms, and other steering linkage components; lubricate as needed	• Visually inspect
	  ○ Tie rod ends
	  ○ Ball joints
	  ○ Kingpins
	  ○ Pitman arms
	  ○ Idler arms
	  ○ Universal joints
	  ○ Intermediate steering shafts
	• Lubricate moving joints

10.10 Inspect shock absorbers, bushings, brackets, and mounts; determine needed action	• Inspect
	• Shock absorbers
	  ○ Mounting
	  ○ Leaks
	• Bushings
	• Brackets

	• Mounts • Determine needed action
10.11 Inspect leaf springs, center bolts, clips, pins, bushings, shackles, U-bolts, insulators, brackets, and mounts; determine needed action	• Visually inspect leaf springs and components ○ Center bolts ○ Clips ○ Pins ○ Bushings ○ Shackles ○ U-bolts ○ Insulators ○ Brackets ○ Mounts
10.12 Inspect axle and axle aligning devices such as: radius rods, track bars, stabilizer bars, and torque arms; inspect related bushings, mounts, and shims	• Visually inspect axle and axle aligning devises ○ Radius rods ○ Track bars ○ Stabilizer bars ○ Torque arms
10.13 Inspect tandem suspension equalizer components	• Visually inspect tandem suspension equalizer components
10.14 Inspect and test air suspension pressure regulator and height control valves, lines, hoses, dump valves, and fittings; check and record ride height	• Visually inspect and check operation of the air suspension components ○ Pressure regulator ○ Height control valves ○ Lines ○ Hoses ○ Dump valves ○ Fittings
10.15 Inspect air springs, mounting plates, springs, suspension arms, and bushings	• Visually inspect ○ Air springs ○ Mounting plates ○ Springs ○ Suspension arms

	○ Bushings
STANDARD 11.0 PERFORM TIRE AND WHEEL PM	
11.1 Demonstrate understanding of alignment angles	• Toe • Castor • Camber • Steering Axis Inclination (SAI)
11.2 Inspect tire condition; identify tire wear patterns; measure tread depth; verify tire matching (diameter and tread); inspect valve stem and cap; set tire pressure	• Inspect tire condition • Identify wear patterns • Measure tread depth • Verify tire matching ○ Diameter ○ Tread type • Inspect valve stem/cap • Tire pressure ○ Measure • Inflate/Deflate to proper pressure
11.3 Identify wheel/tire vibration, shimmy, pounding, and hop (tramp) problems	• Identify wheel/tire vibration ○ Shimmy ○ Pounding ○ Hop (tramp)
11.4 Check wheel mounting hardware; check wheel condition; remove and install wheel/tire assemblies (steering and drive axle); torque fasteners to manufacturer's specification using torque wrench	• Check wheel mounting hardware • Check wheel condition • Remove and install wheel/tire assemblies (steering and drive axle) • Torque fasteners to manufacturer's specification using torque wrench

Domain 4: Safety **Instructional Time: 15 – 20%**	
STANDARD 1.0 PERFORM AUTOMOTIVE SHOP AND SAFETY TASKS	

1.1 Identify general shop safety rules and procedures	• General shop rules
	• General shop procedures
	• Types of hazards
	  ○ Horseplay
	  ○ Slips/trips/falls protection

1.2 Utilize safe procedures for handling of tools and equipment	• General tool safety
	• Safe procedures for handling of tools and equipment
	  ○ Hand tools
	  ○ Electrical power tools
	  ○ Precision measurement tools
	  ○ Pneumatics

1.3 Identify and use proper placement of floor jacks and jack stands	• Identify jack designs • Safe procedures for jacks • Wheel chocks • Proper use of jack stands
1.4 Identify and use proper procedures for safe lift operation	• Safe procedures for lift operations • Vehicle placement/weight distribution • Safe lift • Safety locks
1.5 Utilize proper ventilation procedures for working within the lab/shop area	• Safe procedures for proper ventilation within lab/shop areas • CO/Exhaust hazards • Ventilation fan/system switch location
1.6 Identify marked safety areas	• Marked safety areas • OSHA Color codes • Lockout tagout

1.7 Identify the location and the types of fire extinguishers and other fire safety equipment	• Fire extinguishers and other fire safety equipment
	  ○ Location
	  ○ Types

1.8 Demonstrate knowledge of the procedures for using fire extinguishers and other fire safety equipment	• Correct procedure for using a fire extinguisher ○ PASS technique • Classes of fire

1.9 Identify the location and use of eye wash stations and/or showers	• Eye wash stations and showers
	  ○ Location
	  ○ Use
	  ■ Buddy system

1.10 Identify the location of the posted evacuation routes	• Location of the posted evacuation routes

1.11 Comply with the required use of safety glasses, ear protection, gloves, and shoes during lab/shop activities	• Proper PPE
	  ○ Safety glasses
	  ○ Ear protection
	  ○ Gloves
	  ○ Proper Shoes

1.12 Identify and wear appropriate clothing for lab/shop activities	• Proper PPE
	  ○ Shirts
	  ○ Pants

1.13 Secure hair and jewelry for lab/shop activities	• Secure hair • No jewelry
1.14 Demonstrate awareness of the safety aspects of supplemental restraint systems (SRS), electronic brake control systems, and hybrid vehicle high voltage circuits	• Supplemental Restraint Systems (SRS) systems • Supplemental Restraint Systems (SRS) safing sensor • Electronic brake control • Hybrid high voltage systems • High voltage protection

1.15 Demonstrate awareness of the safety aspects of high voltage circuits (such as high intensity discharge (HID) lamps, ignition systems, injection systems, etc.)	• High voltage safety procedures • Ignition systems • Injection systems • High intensity discharge (HID) lamps

1.16 Locate and demonstrate knowledge of safety data sheets (SDS)	• Safety Data Sheets (SDS) usage
	• Right to know
	  ○ Employer responsibilities
	  ○ Employee responsibilities

1.17 Identify tools and their usage in transportation applications	• Tool usage • Identify • Flat wrenches • Ratchets/sockets • Screwdrivers • Pliers • Hammers
1.18 Identify standard and metric designation	• Standard designation • Metric designation • Identify • Convert between standard and metric
1.19 Demonstrate safe handling and use of appropriate tools	• Safety of tools • General tool safety • Tool uses
1.20 Demonstrate proper cleaning, storage, and maintenance of tools and equipment	• Tool maintenance • Proper cleaning and general care procedures • Storage/organization • Air tools • Power tools
1.21 Demonstrate proper use of precision measuring tools (i.e., micrometer, dial-indicator, dial-caliper)	• Proper Use ○ Micrometer

	○ Dial-indicator ○ Dial-caliper
1.22 Identify information necessary and the service requested on a repair order	• Service requests • Information on repair • Vehicle Identification Number (VIN) • Mileage/hours • Complaint/Cause/Corrective action
1.23 Identify high-pressure fluids systems' safety	• Information on repair near high pressure • Hazards • Appropriate Personal Protective Equipment (PPE)
1.24 Identify high-temperature components' safety	• Information on repair near high temperatures • Hazards • Appropriate Personal Protective Equipment (PPE)