

Diesel Technology Program of Study and Complementary Course Standards



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Office of Career Readiness, Adult Learning, and Education Options
Nevada Department of Education
755 N. Roop Street, Suite 201
Carson City, NV 89701

www.doe.nv.gov

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Vision

All Nevada students are equipped and feel empowered to attain their vision of success

Mission

To improve student achievement and educator effectiveness by ensuring opportunities, facilitating learning, and promoting excellence



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Standards Development Members

Name	Occupation/Title	Stakeholder Affiliation	School/Organization
James Carducci	Instructor	Secondary Educator	North Valley High School, Washoe County School District
Jeremy Coggin	Instructor	Postsecondary Educator	Truckee Meadows Community College, Reno, NV
Wilbur Cothrun	Technical Training Supervisor	Business and Industry Representative	Cashman Equipment Company, Reno, NV
Jason Eager	Instructor	Postsecondary Educator	College of Southern Nevada, Las Vegas, NV
Bertrand Potts	Instructor	Secondary Educator	Southwest Career and Technical Academy, Clark County School District
Brian Sisk	Mobile Maintenance General Foreman	Business and Industry Representative	Nevada Gold Mines, Elko, NV
Michael Whitehead	Instructor	Postsecondary Educator	Great Basin College, Ely

Business and Industry Validation

All CTE standards developed through the Nevada Department of Education are validated by business and industry through one or more of the following processes: (1) the standards are developed by a team consisting of business and industry representatives, or (2) a separate review panel is coordinated with industry experts to ensure the standards include the proper content, or (3) nationally recognized standards currently endorsed by business and industry.

The Diesel Technology standards were validated through active participation of business and industry representatives on the development team.

Introduction

The standards in this document are designed to clearly state what the student should know and be able to do upon completion of a high school Diesel Technology program of study. These standards are designed for a two-credit course sequence that prepares the student for a technical assessment directly aligned to the standards.

These exit-level standards are designed for the student to complete all standards through their completion of a program of study. These standards are intended to guide curriculum objectives for a program of study.

The standards are organized as follows:

- **Content Standards** are general statements that identify major areas of knowledge, understanding, and the skills students are expected to learn in key subject and career areas by the end of the program.
- **Performance Standards** follow each content standard. Performance standards identify the more specific components of each content standard and define the expected abilities of students within each content standard.
- **Performance Indicators** are very specific criteria statements for determining whether a student meets the performance standard. Performance indicators may also be used as learning outcomes, which teachers can identify as they plan their program learning objectives. The indicators are followed by designations that reflect the course sequence (e.g., L1 for the first-year course of a two-year program and L2 for the second-year course, C is to designate the indicators to be taught in the complementary courses) as referenced in the Core Course Sequence table.

The crosswalks and alignments are located in the Program Supplemental Program Resources document. These will show where the performance indicators support the Nevada Academic Content Standards. For individual course descriptions, please reference the Supplemental Program Resource or the Nevada CTE Catalog.

All students are encouraged to participate in the career and technical student organization (CTSO) that relates to the Diesel Technology program. CTSOs are co-curricular national organizations that directly reinforce learning in the CTE classroom through curriculum resources, competitive events, and leadership development. CTSOs provide students the ability to apply academic and technical knowledge, develop communication and teamwork skills, and cultivate leadership skills to ensure college and career readiness.

The Employability Skills for Career Readiness identify the skills needed to be successful in all careers and must be taught as an integrated component of all CTE course sequences. These standards are available in a separate document.

The **Standards Reference Code** is only used to identify or align performance indicators listed in the standards to daily lesson plans, curriculum documents, or national standards. The Standards Reference Code is an abbreviated name for the program, and the content standard, performance standard and performance indicator are referenced in the program standards. This abbreviated code for identifying standards uses each of these items. For example, DT is the Standards Reference Code for Diesel Technology. For Content Standard 2, Performance Standard 3 and Performance Indicator 4 the Standards Reference Code would be DT.2.3.4.

Diesel Technology

Program Information

Program of Study: Diesel Technology
Standards Reference Code: DT
Career Cluster: Transportation, Distribution, and Logistics
Career Pathway(s): Facility & Mobile Equipment Maintenance
Program Length: 2-year, completed sequentially
CTSO: SkillsUSA

Program Structure Required Program of Study Courses

The core course sequencing is provided in the following table. Complementary Courses are available and provided later in this document. The following courses provide a completed program of study. The Lab is a complementary course available concurrently with the Diesel Technology II course.

Core Course Sequence (R) with Lab Course(s) (C)

Required/ Complementary	Course Title	Abbreviated Name
R	Diesel Technology I	DIESEL TECH I
R	Diesel Technology II	DIESEL TECH II
C	Diesel Technology II LAB	DIESEL TECH II L

CONTENT STANDARD 1.0: INTEGRATE CAREER AND TECHNICAL STUDENT ORGANIZATIONS (CTSOs)**Performance Standard 1.1: Explore the History and Organization of CTSOs**

- 1.1.1 Discuss the requirements of CTSO participation/involvement as described in Carl D. Perkins Law (Level 1 (L1), Level 2 (L2), Complementary (C))
- 1.1.2 Research nationally recognized CTSOs (L1, L2, C)
- 1.1.3 Investigate the impact of federal and state government regarding the progression and operation of CTSOs (e.g., Federal Statutes and Regulations, Nevada Administrative Code [NAC], Nevada Revised Statutes [NRS]) (L1, L2, C)

Performance Standard 1.2: Develop Leadership Skills

- 1.2.1 Discuss the purpose of parliamentary procedure (L1, L2, C)
- 1.2.2 Demonstrate the proper use of parliamentary procedure (L1, L2, C)
- 1.2.3 Differentiate between an office and a committee (L1, L2, C)
- 1.2.4 Discuss the importance of participation in local, regional, state, and national conferences, events, and competitions (L1, L2, C)
- 1.2.5 Participate in local, regional, state, or national conferences, events, or competitions (L1, L2, C)
- 1.2.6 Describe the importance of a constitution and bylaws to the operation of a CTSO chapter (L1, L2, C)

Performance Standard 1.3: Participate in Community Service

- 1.3.1 Explore opportunities in community service-related work-based learning (WBL) (L1, L2, C)
- 1.3.2 Participate in a service learning (program related) and/or community service project or activity (L1, L2, C)
- 1.3.3 Engage with business and industry partners for community service (L1, L2, C)

Performance Standard 1.4: Develop Professional and Career Skills

- 1.4.1 Demonstrate college and career readiness (e.g., applications, resumes, interview skills, presentation skills) (L1, L2, C)
- 1.4.2 Describe the appropriate professional/workplace attire and its importance (L1, L2, C)
- 1.4.3 Investigate industry-standard credentials/certifications available within this Career Cluster™ (L1, L2, C)
- 1.4.4 Participate in authentic contextualized instructional activities (L1, L2, C)
- 1.4.5 Demonstrate technical skills in various student organization activities/events (L1, L2, C)

Performance Standard 1.5: Understand the Relevance of Career and Technical Education (CTE)

- 1.5.1 Make a connection between program standards to career pathway(s) (L1, L2, C)
- 1.5.2 Explain the importance of participation and completion of a program of study (L1, L2, C)
- 1.5.3 Promote community awareness of local student organizations associated with CTE programs (L1, L2, C)

CONTENT STANDARD 2.0: IDENTIFY AND UTILIZE SAFETY PROCEDURES AND PROPER TOOLS**Performance Standard 2.1: Demonstrate General Lab Safety Rules and Procedures**

- 2.1.1 Describe general shop safety rules and procedures (i.e., safety test) (L1)
- 2.1.2 Utilize safe procedures for handling of tools and equipment (L1)
- 2.1.3 Identify and use proper placement of floor jacks and jack stands (L1)
- 2.1.4 Identify and use proper lifting procedures and proper use of support equipment (e.g., lifts, hoists, rigging, etc.) (L1)
- 2.1.5 Utilize proper ventilation procedures for working within the lab/shop area (L1)
- 2.1.6 Identify marked safety areas (L1)
- 2.1.7 Identify the location and the types of fire extinguishers and other fire safety equipment (L1)
- 2.1.8 Demonstrate knowledge of the procedures for using fire extinguishers and other fire safety equipment (L1)
- 2.1.9 Identify the location and use of eye wash stations (L1)
- 2.1.10 Identify the location of the posted evacuation routes (L1)
- 2.1.11 Comply with the required use of safety glasses, ear protection, gloves, and shoes during lab/shop activities (i.e., personal protection equipment – PPE) (L1)
- 2.1.12 Identify and wear appropriate clothing for lab/shop activities (L1)
- 2.1.13 Secure hair and jewelry for lab/shop activities (L1)
- 2.1.14 Research safety aspects of supplemental restraint systems (SRS), electronic brake control systems, and hybrid vehicle high voltage circuits (L1)
- 2.1.15 Research safety aspects of high voltage circuits (such as high intensity discharge (HID) lamps, ignition systems, fuel injection systems, etc.) (L1)
- 2.1.16 Locate and interpret safety data sheets (SDS) (L1)
- 2.1.17 Prepare time or job cards, reports, or records (e.g., work orders, service reports) (L1)
- 2.1.18 Maintain clean, organized, and uncluttered work area (general housekeeping duties) (L1)
- 2.2.19 Follow verbal instructions to complete work assignments (L1)
- 2.1.20 Follow written instructions to complete work assignments (L1)
- 2.1.21 Perform a risk assessment (includes workplace inspection [walkways clear, outlets functioning], equipment inspections, proposed mitigation measures, etc.) (L1)

Performance Standard 2.2: Identify and Utilize Proper Tools and Fasteners

- 2.2.1 Identify appropriate tools and their proper usage in diesel service applications (includes A/C tools, drive tools, pneumatic tools, power tools, machine tools, and hydraulic tools) (L1)
- 2.2.2 Identify standard and metric designation for bolts and tools (L1)
- 2.2.3 Demonstrate safe handling and use of appropriate tools (L1)
- 2.2.4 Demonstrate proper inspection (prior to use), cleaning, storage, and maintenance of tools and equipment (L1)
- 2.2.5 Demonstrate proper use of precision measuring tools (e.g., micrometer, dial-indicator, dial-caliper, torque wrenches) (L1)
- 2.2.6 Determine proper size, grade, and torque specifications of fasteners (L1)

CONTENT STANDARD 3.0: PERFORM BASIC VEHICLE SERVICE**Performance Standard 3.1: Identify and Utilize Vehicle Service Information**

- 3.1.1 Locate and utilize paper and/or electronic service information (includes technical service bulletins (TSBs), and knowledge of special messages, quotes, service campaigns/recalls, vehicle/service warranty applications, and service interval recommendations) (L1)
- 3.1.2 Locate vehicle identification number (VIN and/or serial number) and production date code (L1)
- 3.1.3 Analyze vehicle identification number (VIN and/or serial number) information (L1)
- 3.1.4 Research other vehicle information labels (such as tire, emissions, etc.) (L1)

Performance Standard 3.2: Prepare a Vehicle for Service and Return to Customer

- 3.2.1 Verify work order/service report to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction (L1)
- 3.2.2 Complete work order/service report to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction (L1)
- 3.2.3 Demonstrate use of the three C's (concern, cause, and correction) (L1)
- 3.2.4 Identify purpose and demonstrate proper use of fender covers, seat covers, and floor mats (L1)
- 3.2.5 Identify the need for vehicle service history and possible resources (L1)
- 3.2.6 Ensure vehicle is prepared to return to customer per school/company policy (floor mats, steering wheel cover, etc.) (L1)

CONTENT STANDARD 4.0: APPLY FUNDAMENTAL CONCEPTS OF DIESEL ENGINES**Performance Standard 4.1: Explore Diesel Engine Fundamentals**

- 4.1.1 Describe the difference of two stroke and four stroke engines and the significance of each stroke (two stroke principle and four stroke principle) (L1)
- 4.1.2 Identify components of a diesel engine (e.g., cylinder block and head, crank shaft, connecting rod, piston and piston rings, bearings, valve train, camshaft) (L1)
- 4.1.3 Describe the difference between spark ignition and compression ignition (L1)
- 4.1.4 Calculate bore, stroke, compression ratio, and displacement (L1)

Performance Standard 4.2: Explore Fuel Systems

- 4.2.1 Identify fuel system design (e.g., inline, rotary, direct injected, pre-combustion chamber, pump and line, unit injection, hydraulic electric unit injection [HEUI], common rail) (L1)
- 4.2.2 Explore the difference of low pressure and high-pressure fuel systems and the importance of fuel system filtration (L1)
- 4.2.3 Perform fuel system maintenance (change fuel filter, priming/bleeding system, etc.) (L2)

Performance Standard 4.3: Identify Air Induction, Exhaust System, and Engine Brake

- 4.3.1 Describe the importance and function of air filters and pre-cleaners (L1)
- 4.3.2 Investigate forced induction systems (L1)
- 4.3.3 Identify the need for optional intercoolers/aftercoolers (charge air coolers [CACs]) and their function (L1)
- 4.3.4 Describe processes to check for exhaust/intake leaks (L2)

Performance Standard 4.4: Introduce Diesel Engine Emissions

- 4.4.1 Explore tier emissions (Tier 1 through Tier 4) (L2)

Performance Standard 4.5: Explore Cooling Systems

- 4.5.1 Explore the need for cooling systems (heat transfer by conduction, convection, and radiation) and their components (L1)
- 4.5.2 Identify the function and components of cooling systems (e.g., water pump, radiator, fan, thermostat) (L1)
- 4.5.3 Compare coolant fluid types/additives and applications (L1)
- 4.5.4 Demonstrate safety practices when working with cooling systems (e.g., thermal burns, fan and belt, pressurized systems) (L1)
- 4.5.5 Perform system pressure test (L2)

Performance Standard 4.6: Explore Lubrication Needs and Procedures

- 4.6.1 Explore the need for lubrication (e.g., cooling, friction reduction) (L1)
- 4.6.2 Identify the function and components of lubrication (e.g., oil pan, oil pump, pickup tube, filter, pressure regulator, oil coolers, bypass valve, fluid flow pathways) (L1)
- 4.6.3 Compare viscosity and grades of lubricants (e.g., American Petroleum Institute [API] rating/service category) (L1)
- 4.6.4 Change engine oil and filters; visually check oil for coolant or fuel contamination; inspect and clean magnetic drain plugs (multi-point inspection) (L2)

CONTENT STANDARD 5.0: APPLY CONCEPTS OF DIESEL ENGINE REPAIR**Performance Standard 5.1: Perform Cylinder Head and Valve Train Service, Evaluation, and Repair with Supervision**

- 5.1.1 Remove and inspect cylinder head for cracks/damage; check mating surfaces for warpage; check condition of passages; inspect core/expansion and gallery plugs; determine needed action (L2)
- 5.1.2 Disassemble head and inspect valves, guides, seats, springs, retainers, locks, and seals; determine needed action (L2)
- 5.1.3 Reassemble cylinder head (L2)
- 5.1.4 Inspect, measure, and replace/reinstall overhead camshaft; measure/adjust end play and backlash (L2)
- 5.1.5 Adjust valve bridges (crossheads); adjust valve clearances and injector settings (L2)
- 5.1.6 Reinstall cylinder head and torque in sequence, as per manufacturers specifications (L2)

Performance Standard 5.2: Perform Engine Block Service, Evaluation, and Repair with Supervision

- 5.2.1 Remove, inspect, service, and install pans, covers, gaskets, seals, wear rings, and crankcase ventilation components (L2)
- 5.2.2 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 (L2)
- 5.2.3 Clean, inspect, and measure cylinder walls or liners for wear and damage; determine needed action (L2)
- 5.2.4 Inspect in-block camshaft bearings for wear and damage; determine needed action (L2)
- 5.2.5 Inspect, measure, and replace/reinstall in-block camshaft; measure/adjust end play (L2)
- 5.2.6 Clean and inspect crankshaft for surface cracks and journal damage; check condition of oil passages; check passage plugs; measure journal diameter; determine needed action (L2)
- 5.2.7 Inspect main bearings for wear and damage; check bearing clearances; check crankshaft end play (L2)
- 5.2.8 Inspect, install, and time gear train; measure gear backlash; determine needed action (L2)
- 5.2.9 Inspect connecting rod and bearings for wear patterns; measure pistons, pins, retainers, and bushings (L2)
- 5.2.10 Determine piston-to-cylinder wall clearance; check ring-to-groove fit and end gap; install rings on pistons (L2)
- 5.2.11 Assemble pistons and connecting rods; install in block; install rod bearings and check clearances (L2)
- 5.1.12 Check condition of piston cooling jets (nozzles); determine needed action (L2)
- 5.2.13 Inspect crankshaft vibration damper; determine needed action (L2)
- 5.2.14 Inspect flywheel/flexplate (including ring gear) and mounting surfaces for cracks and wear; measure runout; determine needed action (L2)

CONTENT STANDARD 6.0: EXPLORE FUNDAMENTAL CONCEPTS OF DRIVETRAINS**Performance Standard 6.1: Explore Drivetrain Fundamentals**

- 6.1.1 Explore the functions and purpose of a drivetrain (L1)
- 6.1.2 Examine gear types (e.g., planetary gear sets, straight cut, helical, hypoid and amboid) (L1)
- 6.1.3 Identify gear ratios and compound ratios and the effects on performance (L1)
- 6.1.4 Calculate gear ratios and compound ratios (L1)

Performance Standard 6.2: Explore Manual Transmissions

- 6.2.1 Explain the way a manual transmission works (e.g., main shaft, counter shaft, splitters) (L1)
- 6.2.2 Justify gear ratios (1st, 2nd, 3rd, etc.) for performance/application (L1)
- 6.2.3 Discuss synchronizer function (L1)
- 6.2.4 Identify manufacturer recommended fluids (L1)

Performance Standard 6.3: Explore Automatic Transmissions

- 6.3.1 Explain the way an automatic transmission works (L1)
- 6.3.2 Discuss gear sets (e.g., compound planetary gear sets) (L1)
- 6.3.3 Discuss clutch packs, bands, and one-way clutches (roller and sprag) and how they function (L1)
- 6.3.4 Examine torque converter function (e.g., lockup converter clutch, retarder) (L1)
- 6.3.5 Discuss electrical and hydraulic controls for automatic transmissions (L1)
- 6.3.6 Identify manufacturer recommended fluids (L1)

Performance Standard 6.4: Explore Drivelines, Differentials, and Axles

- 6.4.1 Explore the need of drivelines and their function (e.g., u-joints/slip joints, yokes, constant velocity [CV] joints) (L1)
- 6.4.2 Explore the needs and functions of differentials (e.g., open end, limited slip, locker) (L1)
- 6.4.3 Identify differential components (e.g., pinion gears, ring gears, housings, bearings) (L1)
- 6.4.4 Identify axles components (e.g., shaft, housings, wheel bearings) (L1)
- 6.4.5 Explore axle types and differences (e.g., semi-floating, full-floating, drop out style, cast center section) (L1)
- 6.4.6 Identify manufacturer recommended fluids (L1)

CONTENT STANDARD 7.0: EXPLORE FUNDAMENTAL CONCEPTS OF HYDRAULICS**Performance Standard 7.1: Investigate General Hydraulic System Operation**

- 7.1.1 Design basic system (e.g., log splitter, floor jack, hydraulic press) (L2)
- 7.1.2 Build basic system with schematic symbols (L2)
- 7.1.3 Discuss different hydraulic systems and components (e.g., pumps, reservoirs, pressure controls, actuators, open/closed loop) (L2)

CONTENT STANDARD 8.0: ANALYZE HYDRAULIC SYSTEMS

Performance Standard 8.1: Examine Hoses, Fittings, and Connections

- 8.1.1 Diagnose causes of component leakage, damage, and restriction; determine needed action (L2)
- 8.1.2 Inspect hoses and connections (length, size, routing, bend radii, and protection); repair or replace as needed (L2)
- 8.1.3 Inspect and replace fitting seals and sealants (L2)

CONTENT STANDARD 9.0: EXPLORE FUNDAMENTAL CONCEPTS OF ELECTRICAL AND ELECTRONIC SYSTEMS**Performance Standard 9.1: Explore General Electrical Systems**

- 9.1.1 Read and interpret electrical/electronic circuits using wiring diagrams (L1)
- 9.1.2 Explain electricity at the atomic level (how energy moves) (L1)
- 9.1.3 Explain positive and negative electrical charges and how like charges repel and opposite charges attract (L1)
- 9.1.4 Explain electron theory and conventional theory (L1)
- 9.1.5 Explain voltage, current, and resistance (i.e., the volt, amp, and Ohm) (L1)
- 9.1.6 Introduce Ohm's Law and how it is used in electrical calculations (L1)
- 9.1.7 Explain how electricity and magnetism are related and how electromagnetic induction is used (L1)
- 9.1.8 Explain Direct Current (DC) and Alternating Current (AC) (L1)
- 9.1.9 Describe series circuits and parallel circuits and build circuits on the training boards (L1)
- 9.1.10 Introduce the multi-meter and its functions and perform some basic measurements on circuits and components (L1)
- 9.1.11 Discuss circuit faults and how to measure them (opens, shorts, high resistance) (L2)
- 9.1.12 Discuss source and load testing vs. voltage drop testing (L2)
- 9.1.13 Introduce components (wires, connectors, fuses, circuit breakers, relays, lamps, solenoids switches, diodes, capacitors, transistors, resistors) introduce schematic symbols for each (L2)
- 9.1.14 Build basic circuits on simulator boards and perform tests (L2)
- 9.1.15 Demonstrate the ability to identify circuit design and components using an electrical schematic (L2)
- 9.1.16 Demonstrate the ability to perform wire crimping, soldering, and heat shrinking for electrical connections and repairs (L2)
- 9.1.17 Explain the fundamentals of battery starting and charging systems (L2)

Performance Standard 9.2: Explore General Electronic Systems

- 9.2.1 Explain the fundamentals of electronic systems with inputs, controls, and outputs (L2)
- 9.2.2 Introduce the function of SAE data link standards (L2)
- 9.2.3 Explain the function of input components (switches, sensors, senders) and input signals (analog, digital, PWM, etc.) (L2)
- 9.2.4 Introduce the concepts of sensor diagnostics (includes downloaded information for all system functions including emission, speed, performance, etc.) (L2)

CONTENT STANDARD 10.0: EXPLORE FUNDAMENTALS OF HYDRAULIC AND AIR BRAKES**Performance Standard 10.1: Investigate Hydraulic Brakes for Service**

- 10.1.1 Check master cylinder fluid level and condition (L1)
- 10.1.2 Inspect brake lines, fittings, flexible hoses, and valves for leaks and damage (L1)
- 10.1.3 Check parking brake operation; inspect parking brake application and holding devices; adjust as needed (L1)
- 10.1.4 Check operation of hydraulic system: pedal travel, pedal effort, pedal feel (L1)
- 10.1.5 Inspect calipers/wheel cylinders for leakage, binding, and damage (L1)
- 10.1.6 Inspect brake assist system (booster), hoses and control valves; check reservoir fluid level and condition (L1)
- 10.1.7 Inspect and record brake pad/lining condition, thickness, and contamination (L1)
- 10.1.8 Inspect and record condition of brake rotors/drums (L1)
- 10.1.9 Check antilock brake system wiring, connectors, seals, and harnesses for damage and proper routing (L1)

Performance Standard 10.2: Introduce Fundamentals of Air Brakes

- 10.2.1 Explore the fundamentals of air brakes (L2)
- 10.2.2 Explore the components of air brakes (L2)

CONTENT STANDARD 11.0: ANALYZE BRAKE SYSTEMS**Performance Standard 11.1: Assess Hydraulic Brakes**

- 11.1.1 Identify poor stopping, premature wear, pulling, dragging, balance, or pedal feel problems; determine needed action (L2)
- 11.1.2 Inspect and test master cylinder for internal/external leaks and damage; determine needed action (L2)
- 11.1.3 Inspect hydraulic system brake lines, flexible hoses, and fittings for leaks and damage; determine needed action (L2)
- 11.1.4 Inspect disc brake caliper assemblies; determine needed action (L2)
- 11.1.5 Inspect and measure rotors; determine needed action (L2)
- 11.1.6 Inspect and measure disc brake pads; inspect mounting hardware; determine needed action (L2)
- 11.1.7 Check parking brake operation; inspect parking brake application and holding devices; determine needed action (L2)

Performance Standard 11.2: Assess Hydraulic Brakes – Mechanical/Foundation Brakes

- 11.2.1 Identify poor stopping, brake noise, premature wear, pulling, grabbing, dragging, or pedal feel problems caused by mechanical components; determine needed action (L2)

CONTENT STANDARD 12.0: EXPLORE FUNDAMENTALS OF TIRES, WHEELS, STEERING, AND SUSPENSION**Performance Standard 12.1: Assess Tires and Wheels for Service**

- 12.1.1 Inspect tires for wear patterns, pressure, tread depth, and proper mounting and determine needed action (L1)
- 12.1.2 Inspect tires for cuts, cracks, bulges, and sidewall damage (L1)
- 12.1.3 Inspect valve caps and stems; determine needed action (L1)
- 12.1.4 Measure and record tread depth; probe for imbedded debris (L1)
- 12.1.5 Check and record air pressure; adjust air pressure in accordance with manufacturers' specifications (L1)
- 12.1.6 Check wheel mounting hardware; determine needed action (L1)
- 12.1.7 Inspect tires, wheels/rims for proper application (size, load range, position, and tread design); determine needed action (L1)
- 12.1.8 Inspect wheels for cracks, damage, and proper hand hold alignment (L1)
- 12.1.9 Check tire matching (diameter and tread) on single and dual tire applications (L1)
- 12.1.10 Identify wheel/tire vibration, shimmy, pounding, hop (tramp) problems; determine needed action (L1)
- 12.1.11 Check operation of tire pressure monitoring system (TPMS); determine needed action (L1)
- 12.1.12 Remove and install steering and drive axle wheel/tire assemblies; torque mounting hardware to specifications with torque wrench (L1)

Performance Standard 12.2: Perform Wheel Bearing Service and Repair

- 12.2.1 Inspect and service wheel bearings according to manufactures specifications (L1)
- 12.2.2 Identify, inspect, or replace unitized/preset hub bearing assemblies (L2)

Performance Standard 12.3: Assess Steering Systems – Linkage

- 12.3.1 Inspect steering linkage components (L2)
- 12.3.2 Check and adjust steering (wheel) stops (L2)

CONTENT STANDARD 13.0: PERFORM PREVENTATIVE MAINTENANCE INSPECTION AND SERVICE**Performance Standard 13.1: Perform Engine Preventative Maintenance Inspection (PMI) and Service**

- 13.1.1 Check engine fluids and seals (oil level, coolant, leaks while off and running) and determine action (L2)
- 13.1.2 Inspect belts, tensioners, and pulleys (tension, alignment) and determine action (L2)
- 13.1.3 Check engine compartment (mounts, wiring harnesses/connectors) and determine action (L2)
- 13.1.4 Perform lube, oil, filter (LOF) service (multi-point inspection) (L2)

Performance Standard 13.2: Investigate Fuel Systems for Service

- 13.2.1 Check fuel tanks, mountings, lines, caps, and vents (L2)
- 13.2.2 Drain water from fuel system (L2)
- 13.2.3 Service water separator/fuel heater; replace fuel filter(s); prime and bleed fuel system (L2)

Performance Standard 13.3: Investigate Intake and Exhaust Systems for Service

- 13.3.1 Perform multi-point inspection for exhaust and intake systems (exhaust system mountings, air induction system, turbocharger, filters, crankcase ventilation system) (L2)
- 13.3.2 Inspect diesel exhaust fluid (DEF) system, to include tanks, lines, gauge, pump, and filter (L2)

Performance Standard 13.4: Investigate Cooling Systems for Service

- 13.4.1 Perform multi-point inspection for cooling systems (fan clutch operation, radiator, fan assembly and shroud, radiator cap, hoses and clamps, recovery system, coolant filter, water pump) (L2)

Complementary Courses

State Complementary Skill Standards

State complementary skill standards are designed to clearly state what the student should know and be able to do upon completion of a **one-year** complementary course related to their career and technical education (CTE) program of study. **Completion of the qualifying Program of Study is required prior to enrollment in a complementary course.**

Employability Skills for Career Readiness Standards

Students have completed all program content standards and will pursue advanced study through investigation and in-depth research.

Complementary Course Standards Contributing Members

Course Contribution(s)	Name	Occupation/Title	Stakeholder Affiliation	School/Organization
Diesel Applied Concepts	James Carducci	Instructor	Secondary Educator	North Valleys High School, Washoe County School District
Diesel Applied Concepts	Jeremy Coggin	Instructor	Postsecondary Educator	Truckee Meadows Community College, Reno
Diesel Applied Concepts	Wilbur Cothrun	Technical Training Supervisor	Business and Industry Representative	Cashman Equipment Company, Reno
Diesel Applied Concepts	Jason Eager	Instructor	Postsecondary Educator	College of Southern Nevada, Las Vegas
Diesel Applied Concepts	Bertrand Potts	Instructor	Secondary Educator	Southwest Career and Technical Academy, Clark County School District
Diesel Applied Concepts	Brian Sisk	Mobile Maintenance General Foreman	Business and Industry Representative	Nevada Gold Mines, Elko
Diesel Applied Concepts	Michael Whitehead	Instructor	Postsecondary Educator	Great Basin College, Ely

Business and Industry Validation

All CTE standards developed through the Nevada Department of Education are validated by business and industry through one or more of the following processes: (1) the standards are developed by a team consisting of business and industry representatives, or (2) a separate review panel is coordinated with industry experts to ensure the standards include the proper content, or (3) nationally recognized standards currently endorsed by business and industry.

The Diesel Applied Concepts complementary standards for Diesel Technology program of study were validated through active participation of business and industry representatives on the development team.

Complementary Course Information for Diesel Technology

Program Information

Qualifying Program of Study: Diesel Technology

Career Cluster: Transportation, Distribution, and Logistics

Career Pathway(s): Facility & Mobile Equipment Maintenance

CTSO: SkillsUSA

Grade Level: 11-12

Program Structure for Complementary Courses

The complementary courses are provided in the following table. **The qualifying program of study must be completed prior to enrolling in the complementary courses** (except labs that are done concurrently with the second-year course). A program does not have to utilize the complementary courses for students to complete their program of study.

Complementary Courses

Required/ Complementary	Course Title	Abbreviated Name
C	Diesel Applied Concepts	DIESEL CONCEPTS
C	Diesel Technology Advanced Studies	DIESEL TECH AS
C	Industry-Recognized Credential – Diesel Technology	IRC DIESEL TECH
C	CTE Work Experience – Transportation, Distribution, and Logistics	WORK EXPER TRANS

Complementary Course Standards

Diesel Applied Concepts

CONTENT STANDARD 1.0 APPLY FUNDAMENTAL CONCEPTS OF DIESEL ENGINES

Performance Standard 1.1: Identify Safety Hazards Related to Diesel Engines

- 1.1.1 Explore safety hazards related to diesel engines and all related systems

Performance Standard 1.2: Perform Preliminary Engine Inspection

- 1.2.1 Inspect fuel, oil, diesel exhaust fluid (DEF) and coolant levels, and condition; determine needed action
- 1.2.2 Identify engine fuel, oil, coolant, air, and other leaks; determine needed action
- 1.2.3 Observe engine exhaust smoke color and quantity
- 1.2.4 Check record electronic diagnostic codes

Performance Standard 1.3: Perform Lubrication Systems Service and Repair

- 1.3.1 Check engine oil level, condition, and consumption; determine needed action
- 1.3.2 Inspect and measure oil pump drives, inlet pipes and pick-up screens
- 1.3.3 Determine proper lubricant and oil filter requirements
- 1.3.4 Perform oil and filter change

Performance Standard 1.4: Perform Cooling Systems Service and Repair

- 1.4.1 Check engine coolant type, level, condition, and consumption; test coolant for freeze protection and additive package concentration; determine needed action
- 1.4.2 Test coolant temperature and check operation of temperature and level sensors, gauge, and/or sending unit; determine needed action
- 1.4.3 Inspect and reinstall/replace pulleys, tensioners and drive belts; adjust drive belts and check alignment
- 1.4.4 Recover coolant, refill with recommended coolant/additive package, and bleed cooling system per manufacturers specification
- 1.4.5 Inspect coolant conditioner/filter assembly for leaks; inspect valves, lines, and fittings; replace as needed
- 1.4.6 Inspect water pump and coolant hoses; replace as needed
- 1.4.7 Inspect, clean, and pressure test radiator. Pressure test cap, tank(s), and recovery systems; determine needed action
- 1.4.8 Inspect thermostatic cooling fan system (hydraulic, pneumatic, and electronic) and fan shroud; replace as needed

Performance Standard 1.5: Inspect Air Induction and Exhaust Systems

- 1.5.1 Check air induction system: piping, hoses, clamps, and mounts; service or replace air filter as needed
- 1.5.2 Inspect intake manifold, gaskets, and connections; determine needed action
- 1.5.3 Inspect charge air cooler assemblies; determine needed action
- 1.5.4 Inspect exhaust manifold, piping, mufflers, and mounting hardware; determine needed action

Performance Standard 1.6: Perform Fuel Supply Systems Service

- 1.6.1 Check fuel level and condition; determine needed action
- 1.6.2 Inspect fuel tanks, vents, caps, mounts, valves, screens, crossover system, supply and return lines and fittings; determine needed action
- 1.6.3 Inspect primary fuel delivery system; determine needed action

Performance Standard 1.7: Explore Diesel Engine Performance

- 1.7.1 Explore diesel engine performance curves including high idle, low idle, full load, full torque, droop, lug, and overrun/overspeed.
- 1.7.2 Explore mechanical and electronic governors
- 1.7.3 Explore the injection of fuel into the cylinder and timing and how it affects performance
- 1.7.4 Explore the concept of boost pressure, fuel delivery, and horsepower
- 1.7.5 Understand how air/atmospheric pressure affects performance
- 1.7.6 Disassemble and assemble fuel system components and turbochargers with supervision

Performance Standard 1.8: Introduce Diesel Engine Emissions

- 1.8.1 Explore the key exhaust emissions reduced by new emissions technology
- 1.8.2 Explore crank case ventilation and Exhaust Gas Recirculation (EGR)
- 1.8.3 Examine the function of After Treatment Systems (catalyst, Diesel Particulate Filter [DPF])
- 1.8.4 Explore the regeneration of soot inside the Diesel Particulate Filter [DPF]
- 1.8.5 Examine the function of the SCR, diesel exhaust fluid (DEF), and the pump, injector, heated lines, NOx sensors, and electronics
- 1.8.6 Explore the emissions system inducements (warnings, derates, and shutdowns)

CONTENT STANDARD 2.0: APPLY CONCEPTS OF DRIVE TRAIN REPAIR**Performance Standard 2.1: Identify Safety Hazards Related to Drive Train Repair**

- 2.1.1 Explore safety hazards related to drive trains

Performance Standard 2.2: Analyze Drive Train for Service

- 2.2.1 Perform manual transmission disassembly and assembly with supervision
- 2.2.2 Perform automatic transmission disassembly and assembly with supervision
- 2.2.3 Perform universal joint replacement with supervision
- 2.2.4 Perform differential disassembly and assembly with ring and pinion setup with supervision
- 2.2.5 Perform axle removal and installation with supervision

Performance Standard 2.3: Analyze Drive Train for Service

- 2.3.1 Check clutch linkage/cable and levers for looseness or binding, lubricate release/throw-out bearing as required
- 2.3.2 Check hydraulic clutch slave and master cylinders, lines, fittings, hoses, and fluid level
- 2.3.3 Check transmission case, seals, filter, hoses, lines and cooler for cracks and leaks
- 2.3.4 Inspect transmission breather
- 2.3.5 Inspect transmission mounts
- 2.3.6 Check transmission oil level, type, and condition; add proper type of lubricant as needed
- 2.3.7 Inspect U-joints, yokes, driveshafts, boots/seals, center bearings, and mounting hardware for looseness, damage, and proper phasing
- 2.3.8 Inspect axle housing(s) for cracks and leaks
- 2.3.9 Inspect axle breather(s)
- 2.3.10 Lubricate all drive train grease fittings
- 2.3.11 Check drive axle(s) oil level, type, and condition; add proper type of lubricant as needed
- 2.3.12 Check transmission wiring, connectors, seals, and harnesses for damage and proper routing
- 2.3.13 Check pedal height and travel, inspect clutch safety switch
- 2.3.14 Measure driveline angles; determine necessary action

CONTENT STANDARD 3.0: ANALYZE ELECTRIC AND ELECTRONIC SYSTEMS**Performance Standard 3.1: Identify Safety Hazards Related to Electric and Electronic Systems**

- 3.1.1 Explore safety hazards related to electric and electronic systems

Performance Standard 3.2: Explore Fundamental Concepts of Electrical and Electronic Systems

- 3.2.1 Explain the function of Electronic Control Modules (ECMs) and the logic that happens inside (ECM, ECU, PCM, BCM, etc.)
- 3.2.2 Explain the function of input components (switches, senders, and sensors) and the signal types and diagnostics that are performed on these components
- 3.2.3 Explain the function of output components (solenoids, lights, relays, etc.)
- 3.2.4 Describe the logic of Diagnostic Trouble Codes (DTS's)

Performance Standard 3.3: Perform General Electrical Systems Service

- 3.3.1 Read and interpret electrical/electronic circuits using wiring diagrams
- 3.3.2 Check continuity in electrical/electronic circuits using appropriate test equipment
- 3.3.3 Check applied voltages, circuit voltages, and voltage drops in electrical/electronic circuits using appropriate test equipment
- 3.3.4 Check current flow in electrical/electronic circuits and components using appropriate test equipment
- 3.3.5 Check resistance in electrical/electronic circuits and components using appropriate test equipment
- 3.3.6 Locate shorts, grounds, and opens in electrical/electronic circuits
- 3.3.7 Identify parasitic (key-off) battery drain problems; perform tests; determine needed action
- 3.3.8 Inspect and test fusible links, circuit breakers, relays, solenoids, and fuses; replace as needed
- 3.3.9 Check frequency and pulse width signal in electrical/electronic circuits using appropriate test equipment

Performance Standard 3.4: Perform Battery Service

- 3.4.1 Identify battery type; perform appropriate battery load test; determine needed action
- 3.4.2 Determine battery state of charge using an open circuit voltage test
- 3.4.3 Inspect, clean, and service battery; replace as needed
- 3.4.4 Inspect and clean battery boxes, mounts, and hold downs; repair or replace as needed
- 3.4.5 Charge battery using appropriate method for battery type
- 3.4.6 Inspect, test, and clean battery cables and connectors; repair or replace as needed
- 3.4.7 Jump start a vehicle using jumper cables and a booster battery or appropriate auxiliary power supply using proper safety procedures
- 3.4.8 Perform battery load test and/or capacitance test; determine needed action

Performance Standard 3.5: Perform Starting System Service

- 3.5.1 Perform starter circuit cranking voltage and voltage drop tests; determine needed action
- 3.5.2 Inspect and test components (key switch, push button and/or magnetic switch) and wires and harnesses in the starter control circuit; replace as needed
- 3.5.3 Inspect and test, starter relays and solenoids/switches; replace as needed
- 3.5.4 Remove and replace starter; inspect flywheel ring gear or flex plate
- 3.5.5 Perform starter current draw test; determine needed action

Performance Standard 3.6: Perform Charging System Diagnosis and Repair

- 3.6.1 Test instrument panel mounted volt meters and/or indicator lamps; determine needed action
- 3.6.2 Identify causes of a no charge, low charge, or overcharge problems; determine needed action
- 3.6.3 Inspect and replace alternator drive belts, pulleys, fans, tensioners, and mounting brackets; adjust drive belts and check alignment
- 3.6.4 Perform charging system voltage and amperage output tests; perform AC ripple test; determine needed action
- 3.6.5 Perform charging circuit voltage drop tests; determine needed action
- 3.6.6 Remove and replace alternator
- 3.6.7 Inspect, repair, or replace cables, wires, and connectors in the charging circuit

Performance Standard 3.7: Perform Lighting Systems Diagnosis and Repair

- 3.7.1 Identify causes of brighter than normal, intermittent, dim, or no headlight and daytime running light (DRL) operation
- 3.7.2 Test, replace, and aim headlights
- 3.7.3 Test headlight and dimmer circuit switches, relays, wires, terminals, connectors, sockets, and control components/modules; repair or replace as needed
- 3.7.4 Inspect and test switches, bulbs/LEDs, sockets, connectors, terminals, relays, wires, and control components/modules of parking, clearance, and taillight circuits; repair or replace as needed
- 3.7.5 Inspect and test tractor-to-trailer multi-wire connector(s); repair or replace as needed
- 3.7.6 Inspect, test, and adjust stoplight circuit switches, bulbs/LEDs, sockets, connectors, terminals, wires and control components/modules; repair or replace as needed
- 3.7.7 Inspect and test turn signal and hazard circuit flasher(s), switches, relays, bulbs/LEDs, sockets, connectors, terminals, wires and control components/modules; repair or replace as needed
- 3.7.8 Inspect and test reverse lights and warning device circuit switches, bulbs/LEDs, sockets, horns, buzzers, connectors, terminals, wires and control components/modules; repair or replace as needed

CONTENT STANDARD 4.0: ANALYZE BRAKE SYSTEMS**Performance Standard 4.1: Identify Safety Hazards Related to Brake Systems**

- 4.1.1 Explore safety hazards related to brake systems

Performance Standard 4.2: Assess Air Brakes – Air Supply and Service Systems

- 4.2.1 Identify poor stopping, air leaks, premature wear, pulling, grabbing, dragging, or balance problems caused by supply and service system malfunctions; determine needed action
- 4.2.2 Check air system build-up time; determine needed action
- 4.2.3 Drain air reservoir/tanks; check for oil, water, and foreign material; determine needed action
- 4.2.4 Inspect air system lines, hoses, fittings, and couplings; repair or replace as needed
- 4.2.5 Inspect and test air tank relief (safety) valves, one-way (single) check valves
- 4.2.6 Inspect and test brake application (foot/treadle) valve, fittings, and mounts; check pedal operation; determine needed action
- 4.2.7 Inspect and test stop light circuit switches, wiring, and connectors; determine needed action
- 4.2.8 Inspect and test emergency (spring) brake control valve(s)
- 4.2.9 Inspect and test low pressure warning devices, wiring, and connectors; determine needed action
- 4.2.10 Inspect and test air pressure gauges, lines, and fittings; determine needed action

Performance Standard 4.3: Assess Air Brakes – Mechanical and Foundation Brakes

- 4.3.1 Identify 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
- 4.3.2 Inspect service brake chambers, pushrod, clevis, and mounting brackets
- 4.3.3 Identify type and inspect slack adjusters
- 4.3.4 Inspect camshafts, tubes, rollers, bushings, seals, spacers, retainers, brake spiders, shields, anchor pins, and springs; determine needed action
- 4.3.5 Inspect and measure brake shoes or pads; determine needed action
- 4.3.6 Inspect and measure brake drums or rotors; determine needed action

Performance Standard 4.4: Assess Air Brakes- Parking Brakes

- 4.4.1 Inspect parking (spring) brake check valves, lines, hoses, and fittings
- 4.4.2 Inspect and test parking (spring) brake application and release valve
- 4.4.3 Manually release (cage) and reset (uncage) parking (spring) brakes in accordance with manufacturers' recommendations

Performance Standard 4.5: Examine Air Brakes for Service

- 4.5.1 Check operation of parking brake
- 4.5.2 Record air governor cut-in and cut-out setting (psi)
- 4.5.3 Check operation of air reservoir/tank drain valves
- 4.5.4 Check air system for leaks (brakes released)
- 4.5.5 Check air system for leaks (brakes applied)
- 4.5.6 Test one-way and double-check valves
- 4.5.7 Check low air pressure warning devices
- 4.5.8 Check tractor protection valve
- 4.5.9 Test air pressure build-up time

- 4.5.10 Inspect coupling air lines, holders, and gladhands
- 4.5.11 Check brake chambers and air-lines for secure mounting and damage
- 4.5.12 Check operation of air drier
- 4.5.13 Inspect and record brake shoe/pad condition, thickness, contamination
- 4.5.14 Inspect and record condition of brake drums/rotors
- 4.5.15 Check antilock brake systems wiring, connectors, seals, and harnesses for damage and proper routing
- 4.5.16 Check operation and adjustment of brake automatic slack adjusters (ASA), check and record push rod stroke
- 4.5.17 Lubricate all brake component grease fittings
- 4.5.18 Check condition and operation of hand brake (trailer) control valve, if amicable
- 4.5.19 Drain air tanks and check for contamination
- 4.5.20 check condition of pressure relief (safety) valves

Performance Standard 4.6: Diagnose Air and Hydraulic Anti-Lock Braking Systems (ABS) and Automatic Traction Control (ATC) Systems

- 4.6.1 Observe anti-lock braking system (ABS) warning light operation (includes trailer and dash mounted trailer ABS warning light); determine needed action
- 4.6.2 Diagnose anti-lock braking system (ABS) electronic control(s) and components; determine needed action
- 4.6.3 Identify poor stopping and wheel lock-up problems caused by failure of the anti-lock braking system (ABS); determine needed action
- 4.6.4 Test and check operation of anti-lock braking system (ABS) components; determine needed action
- 4.6.5 Test anti-lock braking system (ABS) wheel speed sensors and circuits; determine needed action
- 4.6.6 Bleed the anti-lock braking system ABS hydraulic circuits

Performance Standard 4.7: Assess Hydraulic Brakes – Hydraulic System

- 4.7.1 Inspect and test metering (hold-off), load sensing/proportioning, proportioning, and combination valves; determine needed action
- 4.7.2 Inspect and test brake pressure differential valve and warning light circuit switch, bulbs/LEDs, wiring, and connectors; determine needed action
- 4.7.3 Inspect/test brake fluid; bleed and/or flush system; determine proper fluid type

Performance Standard 4.8: Assess Hydraulic Brakes – Hydraulic System

- 4.8.1 Identify stopping problems caused by the brake assist (booster) system; determine needed action
- 4.8.2 Inspect, test, repair, or replace hydraulic brake assist (booster), hoses, and control valves; determine proper fluid type
- 4.8.3 Check emergency (back-up, pressure reserve) brake assist system

CONTENT STANDARD 5.0: PERFORM SUSPENSION, STEERING, AND CHASSIS SERVICE**Performance Standard 5.1: Identify Safety Hazards Related to Performing Suspension, Steering, and Chassis Service**

- 5.1.1 Explore safety hazards related to performing suspension, steering, and chassis service

Performance Standard 5.2: Assess Steering Systems - Column

- 5.2.1 Identify causes of fixed and driver adjustable steering column and shaft noise, looseness, and binding problems; determine needed action
- 5.2.2 Inspect steering shaft U-joint(s), slip joints, bearings, bushings, and seals; phase shaft; determine needed action
- 5.2.3 Remove the steering wheel (includes steering wheels equipped with electrical/electronic controls and components); install and center the steering wheel. Inspect, test, replace and calibrate steering angle sensor
- 5.2.4 Disable and enable supplemental restraint system (SRS) in accordance with manufacturers' procedures

Performance Standard 5.3: Assess Steering Systems - Units

- 5.3.1 Identify causes of 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
- 5.3.2 Determine recommended type of power steering fluid; check level and condition; determine needed action
- 5.3.3 Flush and refill power steering system; purge air from system

Performance Standard 5.4: –Investigate Suspension Systems

- 5.4.1 Inspect front axles and attaching hardware; determine needed action
- 5.4.2 Inspect kingpins, steering knuckle bushings, locks, bearings, seals, and covers; determine needed action
- 5.4.3 Inspect shock absorbers, bushings, brackets, and mounts; determine needed action
- 5.4.4 Inspect leaf springs, center bolts, clips, pins and bushings, shackles, U-bolts, insulators, brackets, and mounts; determine needed action
- 5.4.5 Inspect axle aligning devices such as radius rods, track bars, stabilizer bars, torque arms, related bushings, mounts, shims, and cams; determine needed action
- 5.4.6 Inspect and test air suspension pressure regulator and height control valves, lines, hoses, dump valves, and fittings; determine needed action
- 5.4.7 Inspect air springs, mounting plates, springs, suspension arms, and bushings
- 5.4.8 Measure and adjust ride height; determine needed action

Performance Standard 5.5: –Perform Wheel Alignment Diagnosis, Adjustment, and Repair

- 5.5.1 Identify causes of vehicle wandering, pulling, shimmy, hard steering, and off-center steering wheel problems; adjust or repair as needed
- 5.5.2 Check and adjust camber
- 5.5.3 Check and adjust caster
- 5.5.4 Check and adjust toe settings
- 5.5.5 Check rear axle(s) alignment (thrust line/centerline) and tracking; adjust or repair as needed
- 5.5.6 Identify turning/Ackerman angle (toe-out-on-turns) problems; determine needed action
- 5.5.7 Check front axle alignment (centerline); adjust or repair as needed

Performance Standard 5.6: Investigate Suspension and Steering Systems for Service

- 5.6.1 Check steering wheel operation for free play and binding
- 5.6.2 Check power steering pump, mounting, and hoses for leaks, condition, and routing; check fluid level
- 5.6.3 Inspect steering gear for leaks and secure mounting.
- 5.6.4 Inspect steering shaft U-joints, pinch bolts, splines, pitman arm-to-steering sector shaft, tie rod ends, and linkages
- 5.6.5 Check kingpins for wear
- 5.6.6 Check wheel bearings for looseness and noise and perform wheel bearing adjustment with supervision
- 5.6.7 Check oil level and condition in all non-drive hubs; check for leaks.
- 5.6.8 Inspect springs, pins, hangers, shackles, spring U-bolts, and insulators
- 5.6.9 Inspect shock absorbers for leaks and secure mounting
- 5.6.10 Inspect air suspension springs, mounts, hoses, valves, linkage, and fittings for leaks and damage
- 5.6.11 Check and record suspension ride height
- 5.6.12 Lubricate all suspension and steering grease fittings
- 5.6.13 Check axle locating components (radius, torque, and/or track rods)

Performance Standard 5.7: Analyze Frame and Fifth Wheel for Service

- 5.7.1 Inspect fifth wheel mounting, bolts, air lines, and locks
- 5.7.2 Test operation of fifth wheel locking device; adjust if necessary
- 5.7.3 Check quarter fenders, mud flaps, and brackets
- 5.7.4 Check pintle hook assembly and mounting, if applicable
- 5.7.5 Lubricate all fifth wheel grease fittings and plate, if applicable
- 5.7.6 Inspect frame and frame members for cracks and damage

CONTENT STANDARD 6.0: ANALYZE HYDRAULIC SYSTEMS**Performance Standard 6.1: Identify Safety Hazards Related to Hydraulic Systems**

- 6.1.1 Explore safety hazards related to hydraulic systems

Performance Standard 6.2: Investigate Fundamentals of Hydraulic Principals

- 6.2.1 Introduce Pascal's law and flow vs. pressure concepts. Explain the Force/Pressure/Area calculations
- 6.2.2 Identify basic components of a hydraulic system (reservoir, pump, valves, actuators, and lines)
- 6.2.3 Identify schematic symbols of the basic components
- 6.2.4 Identify basic valve types (pressure, flow, direction)
- 6.2.5 Identify basic pump designs (gear, vane, piston)
- 6.2.6 Identify actuators (linear, rotary)
- 6.2.7 Identify fittings and hose connection types

Performance Standard 6.3. Investigate General System Operation

- 6.3.1 Identify system type (closed and open) and verify proper operation
- 6.3.2 Read and interpret system diagrams and schematics

Performance Standard 6.4: Assess Hydraulic Pumps

- 6.4.1 Perform hydraulic pump disassembly and assembly (gear, vane, and piston style)
- 6.4.2 Identify causes of pump failure, unusual pump noises, temperature, flow, and leakage problems
- 6.4.3 Determine pump type, rotation, and drive system

Performance Standard 6.5: Perform Filtration and Reservoirs (Tanks) Service

- 6.5.1 Identify type of filtration system; verify filter application and flow direction
- 6.5.2 Service filters and breathers
- 6.5.3 Identify causes of system contamination; determine needed action
- 6.5.4 Check reservoir fluid level and condition; determine needed action
- 6.5.5 Inspect reservoir, sight glass, vents, caps, mounts, valves, screens, supply and return lines

Performance Standard 6.6: Evaluate Actuators for Service

- 6.6.1 Identify actuator type (single/double acting, multi-stage/telescopic, and motors)
- 6.6.2 Identify the cause of seal failure; determine needed repairs
- 6.6.3 Identify the cause of incorrect actuator movement and leakage (internal and external); determine needed repairs
- 6.6.4 Inspect actuator mounting, frame components, and hardware for looseness, cracks, and damage; determine needed action
- 6.6.5 Inspect actuators for dents, cracks, damage, and leakage; determine needed action
- 6.6.6 Purge and/or bleed system in accordance with manufacturers' recommended procedures
- 6.6.7 Perform actuator disassembly and assembly with supervision

CONTENT STANDARD 7.0: Analyze Heating, Ventilation and Air Conditioning (HVAC) Systems**Performance Standard 7.1: Identify Safety Hazards Related to HVAC systems**

- 7.1.1 Explore safety hazards related to HVAC systems

Performance Standard 7.2: Explore Heating, Ventilation and Air Conditioning (HVAC) Systems

- 7.2.1 Explore concepts of heat and heat transfer
- 7.2.2 Explore concepts of boiling, condensing, and latent heat
- 7.2.3 Explore concepts of refrigerant properties, vapor pressure, and saturation temperature
- 7.2.4 Explore concepts of refrigerant system operation and components
- 7.2.5 Explore concepts of orifice tube, thermostatic expansion valve, and H-block expansion valve systems
- 7.2.6 Explore HVAC temperature control systems with thermostats, water valves, and blend doors
- 7.2.7 Explore HVAC electronic control systems
- 7.2.8 Explore EPA section 609 requirements for proper refrigerant handling

Performance Standard 7.3: Examine Heating, Ventilation and Air Conditioning (HVAC) Systems for Service

- 7.3.1 Inspect A/C condenser and lines for condition and visible leaks; check mountings
- 7.3.2 Inspect A/C compressor and lines for condition and visible leaks; check mountings
- 7.3.3 Check A/C system condition and operation; check A/C monitoring system, if applicable
- 7.3.4 Check HVAC air inlet filters and ducts; service as needed
- 7.3.5 Identify HVAC service tooling and equipment with supervision
- 7.3.6 Perform HVAC system recovery and recharge with supervision
- 7.3.7 Perform HVAC system performance check with supervision