

2024 Powersports and Outdoor Power Equipment

Program Standards

CONTENT STANDARD 1.0: PROFESSIONAL ORGANIZATIONS AND LEADERSHIP

Performance Standard 1.1: Student Leadership in Career Technical Student Organizations (CTSO) and Professional Associations

- 1.1.1 Explore the role of professional organizations and/or associations in the powersports and outdoor power equipment industry.
- 1.1.2 Define the value, role, and opportunities provided through career technical student organizations.
- 1.1.3 Engage in career exploration and leadership development.

CONTENT STANDARD 2.0: BASIC SAFETY

Performance Standard 2.1: Workplace Safety

- 2.1.1 Describe general shop safety rules and procedures.
- 2.1.2 Describe common shop hazards and housekeeping duties.
- 2.1.3 Handle tools and equipment, observing manufacturer guidelines and safety features.
- 2.1.4 Demonstrate safe lifting procedures, lift operation, and use of support equipment (e.g., jacks and jack stand placements, lifts, cribbing, hoists, rigging).
- 2.1.5 Check for proper ventilation to meet work requirements and procedures within the lab/shop area.
- 2.1.6 Identify marked safety areas.
- 2.1.7 Identify the location and the types of fire extinguishers and other fire safety equipment.
- 2.1.8 Demonstrate procedures for using fire extinguishers and other fire safety equipment.
- 2.1.9 Identify the location and use of eye wash stations and first aid kits.
- 2.1.10 Describe the location of and the necessity for posted evacuation routes.
- 2.1.11 Wear required safety glasses, ear protection, gloves, and shoes during lab/shop activities.
- 2.1.12 Wear appropriate clothing for lab/shop activities.
- 2.1.13 Secure hair and jewelry for lab/shop activities.
- 2.1.14 Describe the information on safety data sheets (SDS) and how to access them.
- 2.1.15 Handle, store, and dispose of hazardous and flammable waste and materials.
- 2.1.16 Describe the requirements for reporting workplace safety incidents.

CONTENT STANDARD 3.0: TOOLS, EQUIPMENT, AND FASTENERS

Performance Standard 3.1: Tools and Equipment

- 3.1.1 Identify basic hand tools and their functions.
- 3.1.2 Identify standard and metric tool designations.
- 3.1.3 Clean, store, and maintain hand tools.
- 3.1.4 Identify handheld power tools (e.g., pneumatic, electric) and their functions.
- 3.1.5 Identify shop equipment (e.g., oxy-acetylene torch, arc welding equipment, bench grinder, hydraulic press, parts washers, pressure washers) and their functions.
- 3.1.6 Clean, store, and maintain power tools.

Performance Standard 3.2: Precision Measuring Instruments

- 3.2.1 Define measuring terminology (i.e., units of measurement).
- 3.2.2 Identify measuring instruments (e.g., micrometers, dial calipers, dial gauges, feeler gauge, torque wrench) and their functions.
- 3.2.3 Describe the procedures for yielding accurate readings.

3.2.4 Store and maintain precision measuring tools.

Performance Standard 3.3: Fasteners

- 3.3.1 Identify types of fasteners and their dimensions.
- 3.3.2 Identify thread pitch on fasteners using the thread pitch tool.
- 3.3.3 Record bolt grade and tensile strength.
- 3.3.4 Re-thread tapped holes.
- 3.3.5 Re-thread damaged fasteners.
- 3.3.6 Remove seized fasteners.
- 3.3.7 Describe the application and installation of thread inserts (e.g., heli-coil, time-sert).
- 3.3.8 Demonstrate fastener torque patterns and procedures.
- 3.3.9 Demonstrate fastener retention procedures (e.g., Loctite, lock washers, lock nuts, retainers).

CONTENT STANDARD 4.0: IDENTIFICATION

Performance Standard 4.1: Unit, Equipment, and Component Identification

- 4.1.1 Locate equipment VIN, HIN, serial number, production data code, model number, and spec number.
- 4.1.2 Identify additional equipment (e.g., tires, emissions, engines, transmissions) information labels.
- 4.1.3 Access service and parts identification resources (e.g., service manuals, parts diagrams).
- 4.1.4 Identify power and fuel sources (e.g., battery, diesel, gas, propane) and associated hazards.
- 4.1.5 Describe the safe operation and use of powersports and outdoor power equipment (e.g., handheld equipment, powersports vehicles, marine applications, lawn care equipment).

CONTENT STANDARD 5.0: ENGINE REPAIR, LUBRICATION, AND COOLING

Performance Standard 5.1: Engine Principles and Design

- 5.1.1 Describe the theory of operation and functions of two-stroke and four-stroke engines and their relative advantages and disadvantages.
- 5.1.2 Describe how engines are rated (e.g., displacement, horsepower, torque).
- 5.1.3 Describe the engine configurations found on powersports and outdoor power equipment.
- 5.1.4 Identify the component parts used in a four-stroke engine.

Performance Standard 5.2: Lubrication and Cooling Systems

- 5.2.1 Define the four key purposes of lubrication.
- 5.2.2 Describe the types of oil and how oil is classified.
- 5.2.3 Describe the lubrication systems used in two-stroke and four-stroke engines.
- 5.2.4 Perform engine oil and filter change using proper fluid type per manufacturer specification.
- 5.2.5 Describe the function of cooling systems and their operation.
- 5.2.6 Describe the types of coolants and how coolants are classified.
- 5.2.7 Describe the cooling systems (e.g., air, oil, water) and components used on powersports, marine, and outdoor power equipment.
- 5.2.8 Perform a cooling system pressure test.
- 5.2.9 Identify causes of engine overheating.
- 5.2.10 Inspect and/or test coolant.
- 5.2.11 Drain and recover coolant, flush and refill the cooling system, use the proper fluid type per manufacturer specification, and blow air as required.
- 5.2.12 Describe the operation of marine cooling system components (e.g., circulation and raw water pumps, thermostats, heat exchangers).
- 5.2.13 Inspect the radiator for damage and proper function.
- 5.2.14 Remove, inspect, and replace the thermostat and gasket/seal.

- 5.2.15 Inspect and test the electrical or mechanical fan, fan shroud, and air dams, determining needed action.
- 5.2.16 Inspect auxiliary coolers, determining needed action.
- 5.2.17 Inspect and test cooling system electrical components (e.g., temperature sensor, fan switch, oil temperature sensor).

Performance Standard 5.3: Two-Stroke and Four-Stroke Engine Inspection and Repair

- 5.3.1 Access and interpret vehicle service information.
- 5.3.2 Verify customer complaints (e.g., lack of power, hard starting, oil leak, oil consumption, overheating) to determine the course of action.
- 5.3.3 Inspect engine assembly for fuel, oil, coolant, and other leaks, determining needed action.
- 5.3.4 Inspect the bearings, bushings, and seals used in an engine.
- 5.3.5 Verify engine mechanical timing.
- 5.3.6 Inspect engine mounts and alignment procedures.
- 5.3.7 Remove, disassemble, and inspect the cylinder head according to the manufacturer's specifications and procedures.
- 5.3.8 Inspect and adjust valve train components according to manufacturer's specifications.
- 5.3.9 Inspect and measure cylinder walls/sleeves for damage, wear, and ridges, determining needed action.
- 5.3.10 Inspect and measure piston skirts and ring lands, determining needed action.
- 5.3.11 Identify piston-to-bore clearance.
- 5.3.12 Inspect, measure, and install piston rings.
- 5.3.13 Disassemble and inspect the engine block, cleaning and preparing components for reassembly.
- 5.3.14 Inspect and measure the crankshaft, connecting rods, and bearings for reuse according to the manufacturer's specifications.
- 5.3.15 Inspect the auxiliary shaft and support bearings (e.g., balance shaft, intermediate shaft, idler shaft, counterbalance shaft/gear) for damage and wear.
- 5.3.16 Reassemble the complete engine according to the manufacturer's specifications.

CONTENT STANDARD 6.0: ELECTRICAL/ELECTRONIC SYSTEMS

Performance Standard 6.1: Electricity Fundamentals

- 6.1.1 Describe the importance of safety procedures when working with electrical systems.
- 6.1.2 List electrical circuits' types and basic components (e.g., source, conductor, load, protection devices, switches).
- 6.1.3 Define the terms voltage, current, and resistance.
- 6.1.4 Describe the principles of magnetism and magnetic fields.
- 6.1.5 Calculate voltage, current, and resistance for series and parallel circuits using Ohm's law.
- 6.1.6 Identify electrical and electronic components (e.g., conductors, fuses, circuit breakers, resistors, diodes).
- 6.1.7 Describe schematics, their purpose, and how to read a wiring diagram.

Performance Standard 6.2: Battery Charging and Starting

- 6.2.1 Describe the various types of batteries used in powersports, marine, and outdoor power equipment.
- 6.2.2 Verify battery capacity for the vehicle application by performing state of charge and battery capacity and load tests and determining the needed action.
- 6.2.3 Service battery (i.e., fill battery cells, check battery cables, connectors, clamps, hold-downs, charge battery), according to manufacturer's recommendations.
- 6.2.4 Jump-start vehicle, using jumper cables and a booster battery or an auxiliary power supply.

- 6.2.5 Describe the theory of charging systems and types of charging systems (e.g., permanent magnet, electromagnet).
- 6.2.6 Identify the components in a charging system (e.g., source, alternator, regulator, rectifier) and their functions.
- 6.2.7 Perform a charging system output test to determine the needed action.
- 6.2.8 Diagnose (troubleshoot) the charging system for undercharge, no-charge, or overcharge conditions.
- 6.2.9 Remove, inspect, and/or replace the alternator.
- 6.2.10 Identify the components of manual start systems (e.g., kick start, pull start, crank start).
- 6.2.11 Describe the components and operation of an electric start system.

Performance Standard 6.3: Electrical/Electronic Systems Diagnosis and Repair

- 6.3.1 Determine and verify proper operation of system/circuit according to manufacturer's specifications.
- 6.3.2 Measure source voltage, voltage drop, current flow, and resistance using a multimeter.
- 6.3.3 Describe shorts, grounds, opens, and resistance problems in electrical/electronic circuits.
- 6.3.4 Test an electrical circuit using a test light.
- 6.3.5 Perform starter current draw tests, determining needed action.
- 6.3.6 Compare electrical and engine mechanical problems resulting in slow or no-crank conditions.
- 6.3.7 Check the operation of electrical circuits using fused jumper wires.
- 6.3.8 Diagnose (troubleshoot) electrical/electronic circuit problems using wiring diagrams.
- 6.3.9 Diagnose the cause(s) of excessive key-off battery drain (e.g., parasitic draw) and determine the needed action.
- 6.3.10 Inspect and test fusible links, circuit breakers, and fuses, determining needed action.
- 6.3.11 Inspect, test, repair, and/or replace components, connectors, terminals, harnesses, switches, and wiring in electrical/electronic systems, including necessary solder repairs.
- 6.3.12 Inspect and test gauges and gauge sending units (e.g., speedometers, fuel gauges, voltmeter) for causes of abnormal readings, determining needed action.

CONTENT STANDARD 7.0: FUEL, IGNITION, AND ENGINE MANAGEMENT SYSTEMS

Performance Standard 7.1: Fuel Systems

- 7.1.1 Describe fuel requirements by type (e.g., octane ratings and factors that affect these ratings, additives, and ethanol percentage).
- 7.1.2 Describe the operation of a fuel system.
- 7.1.3 Describe the theory and operation of a carburetor and its circuits.
- 7.1.4 Identify components/circuits of a carbureted fuel system.
- 7.1.5 Perform carburetor repair and adjustment.
- 7.1.6 Describe the theory and operation of electronic fuel injection.
- 7.1.7 Identify the components of electronic fuel injection.
- 7.1.8 Inspect and test the fuel pump(s) and pump control system for pressure, regulation, and volume, determining what action is needed.
- 7.1.9 Replace fuel filter(s) where applicable.
- 7.1.10 Inspect, service, or replace air filters, filter housings, and intake ductwork.
- 7.1.11 Inspect the throttle body, air induction system, intake manifold, and gaskets for vacuum leaks and/or unmetered air.
- 7.1.12 Inspect, test, service, and/or replace the positive crankcase ventilation (PCV) filter/breather, valve, tubes, orifices, and hoses, determining the needed action.

Performance Standard 7.2: Ignition Systems

- 7.2.1 Describe the common components found in all types of ignition systems.
- 7.2.2 Describe the operation of battery-powered, magneto-powered, and electronic ignition systems.

- 7.2.3 Diagnose (troubleshoot) ignition system-related problems such as no-starting, hard starting, engine misfire, poor drivability, spark knock, power loss, poor mileage, and emissions concerns, determining needed action.
- 7.2.4 Remove and replace spark plugs, inspecting secondary ignition components for wear and damage.

Performance Standard 7.3: Exhaust, Emissions and Computer Controls

- 7.3.1 Describe the functions of exhaust system components.
- 7.3.2 Describe procedures for inspecting and servicing exhaust systems.
- 7.3.3 Describe the function of a turbocharger.
- 7.3.4 Describe the different types of emission control systems (e.g., catalytic converter).
- 7.3.5 Identify the types of pollutants that engines create.
- 7.3.6 Describe the various sensors and components used in computer-controlled engines.
- 7.3.7 Interpret diagnostic trouble codes (DTC).
- 7.3.8 Access service information to perform step-by-step (troubleshooting) diagnosis.
- 7.3.9 Inspect integrity of the exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tail pipe(s), and heat shields, determining needed action.
- 7.3.10 Describe the operation of turbocharger/supercharger systems.

CONTENT STANDARD 8.0: DRIVES, CLUTCHES, AXLES, AND TRANSMISSION SYSTEMS

Performance Standard 8.1: Drives, Clutches, Axles, and Transmissions Components and Repair

- 8.1.1 Identify the components and their functions within the primary drive system of powersports, marine, and outdoor power equipment.
- 8.1.2 Describe the types of clutches used in powersports and outdoor power equipment.
- 8.1.3 Describe the types of final drive systems.
- 8.1.4 Identify the major parts of a primary drive, transmission, and final drive assembly.
- 8.1.5 Describe the operating principles of a primary drive, clutch, transmission, and final drive.
- 8.1.6 Trace power flow through a primary drive, transmission, and final drive.
- 8.1.7 Check fluid level in a transmission equipped with/without a dip-stick.
- 8.1.8 Inspect and adjust external shift linkage/cable and transmission range sensor/switch (e.g., neutral, park, gear position sensor).
- 8.1.9 Inspect for leakage, replacing external seals, gaskets, and bushings as needed.
- 8.1.10 Drain and replace fluid and filter(s), using proper fluid type, per manufacturer specification.
- 8.1.11 Inspect powertrain mounts.
- 8.1.12 Describe the operational characteristics of a continuously variable transmission (CVT).
- 8.1.13 Drain and refill manual transmission/transaxle and final drive unit, using proper fluid type, per manufacturer specification.
- 8.1.14 Diagnose clutch noise, binding, slippage, pulsation, and chatter, determining needed action.
- 8.1.15 Inspect clutch linkage, cables, automatic adjuster mechanisms, brackets, bushings, pivots, and springs, determining needed action.
- 8.1.16 Inspect and/or replace clutch pressure plate assembly, clutch disc, release (throw-out) bearing, and linkage.
- 8.1.17 Check for leaks, adjust, and bleed clutch master cylinder, refilling with proper fluid type, per manufacturer specification, as needed.
- 8.1.18 Diagnose constant-velocity (CV) and universal joint noise and vibration concerns, determining needed action.
- 8.1.19 Check and adjust differential case fluid level, checking for leaks, inspecting housing vent, and using proper fluid type, per manufacturer specification.
- 8.1.20 Drain and refill differential case, using proper fluid type, per manufacturer specification.
- 8.1.21 Inspect and replace drive axle wheel studs.

8.1.22 Remove and replace drive axle shafts.

CONTENT STANDARD 9.0: WHEELS, TIRES, AND BRAKE SYSTEMS

Performance Standard 9.1: Wheels and Tires

- 9.1.1 Describe the operating principles of mechanical, electrical, and hydraulic brake systems.
- 9.1.2 Identify the brake system components used on powersports vehicles.
- 9.1.3 Describe ABS and linked systems.
- 9.1.4 Describe the types of wheels used on modern powersports vehicles.
- 9.1.5 Identify the types of tire construction used on powersports and outdoor power equipment.
- 9.1.6 Inspect tire condition; identify tire wear patterns; check for the correct tire size, application (e.g., load ratings, speed ratings), and air pressure, as listed on the tire information placard/label.
- 9.1.7 Diagnose wheel/tire vibration, shimmy, air loss, pull, and noise, determining needed action.
- 9.1.8 Rotate tires according to the manufacturer's recommendation.
- 9.1.9 Measure wheel, tire, axle flange, and hub runout, determining needed action.
- 9.1.10 Dismount, inspect, and remount the tire on the wheel, balancing wheel, and tire assembly.
- 9.1.11 Install wheel and torque lug nuts.

Performance Standard 9.2: Brake Systems

- 9.2.1 Describe the operating principles of mechanical, electrical, and hydraulic brake systems.
- 9.2.2 Identify the brake system components used on powersports vehicles.
- 9.2.3 Describe ABS and linked systems.
- 9.2.4 Describe the types of wheels used on modern powersports vehicles.
- 9.2.5 Identify the types of tire construction used on powersports and outdoor power equipment.
- 9.2.6 Inspect tire condition; identify tire wear patterns; check for the correct tire size, application (e.g., load ratings, speed ratings), and air pressure, as listed on the tire information placard/label.
- 9.2.7 Diagnose wheel/tire vibration, shimmy, air loss, pull, and noise, determining needed action.
- 9.2.8 Rotate tires according to the manufacturer's recommendation.
- 9.2.9 Measure wheel, tire, axle flange, and hub runout, determining needed action.
- 9.2.10 Dismount, inspect, and remount the tire on the wheel, balancing wheel, and tire assembly.
- 9.2.11 Install wheel and torque lug nuts.
- 9.2.12 Clean and inspect the rotor and mounting surface, measuring the rotor thickness, thickness variation, and lateral runout and determining the needed action.
- 9.2.13 Remove and reinstall/replace the rotor.
- 9.2.14 Describe the importance of operating the vehicle to burnish/break-in replacement brake pads, per the manufacturer's recommendations.

CONTENT STANDARD 10.0: CHASSIS, SUSPENSION, AND STEERING SYSTEMS

Performance Standard 10.1: Chassis, Suspension, and Steering Components and Repair

- 10.1.1 Describe the types, functions, and components of front and rear suspension systems.
- 10.1.2 Inspect suspension components for leaks, determining needed action.
- 10.1.3 Inspect chassis bearings (e.g., steering head, swing arm, wheel) for wear and play.
- 10.1.4 Describe the procedures for rebuilding a front fork assembly and shock absorber.
- 10.1.5 Interpret suspension and steering system concerns (e.g., ride height, sway, noises) to determine the needed action.

- 10.1.6 Inspect upper and lower control arms, bushings, shafts, and rebound bumpers.
- 10.1.7 Inspect upper and/or lower ball joints with or without wear indicators.
- 10.1.8 Inspect steering knuckle assemblies.
- 10.1.9 Inspect, remove, and/or replace shock absorbers, inspecting mounts and bushings.
- 10.1.10 Remove, inspect, service, and/or replace front and rear wheel bearings.
- 10.1.11 Inspect steering alignment per manufacturer's specification.
- 10.1.12 Describe the effects of camber, caster, and toe on handling, performance, and ride quality.
- 10.1.13 Inspect steering systems and components (e.g., electric assist, hydraulic assist, hydrostatic, cable, rack, and pinion).

CONTENT STANDARD 11.0: HYDRAULIC SYSTEMS

Performance Standard 11.1: Hydraulics Components and Repair

- 11.1.1 Describe fundamental features and principles of hydraulics using hydraulics terminology.
- 11.1.2 Identify safety concerns and procedures specific to hydraulic systems.
- 11.1.3 Describe the function of the primary hydraulic system components.
- 11.1.4 Describe open-center and closed-center hydraulic systems and their operating principles.
- 11.1.5 Describe the types and functions of hydraulic fluid.
- 11.1.6 Describe the types and functions of hydraulic reservoirs and cooling systems.
- 11.1.7 Describe the types of hydraulic pumps and their principles of operation.
- 11.1.8 Describe the types and functions of hydraulic control valves and valve actuating systems.
- 11.1.9 Describe the types and functions of hydraulic actuators.
- 11.1.10 Describe the types and applications of hydraulic fittings, hoses, and lines.
- 11.1.11 Interpret hydraulic symbols from a hydraulic schematic.
- 11.1.12 Compare a hydraulic drive system and a hydrostatic drive system.
- 11.1.13 Calculate hydraulic cylinder force and cycle times based on pump pressure and flow using Pascal's law.
- 11.1.14 Disassemble, inspect and repair hydraulic control valves.
- 11.1.15 Disassemble, inspect and repair hydraulic pumps.
- 11.1.16 Disassemble, inspect and repair hydraulic actuators.
- 11.1.17 Describe the operation of a hydrostatic transmission.
- 11.1.18 Replace hydraulic hose, line, and seal.
- 11.1.19 Perform hydraulic system pressure and flow tests.
- 11.1.20 Diagnose and suggest solutions for hydraulic system problems.