# Power Equipment Technology Standards and Skills

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## Health & Safety Standards

### Standard 1: Safety and Health in a Power Equipment Technology Environment

Students will be able to apply health and safety protocols in a power equipment technology workspace by effectively managing tools and equipment, utilizing personal protective equipment (PPE), and implementing ergonomic practices to ensure a safe and efficient work environment.

OSHA10 – General Industry

Skills:

1. Identify, describe, and demonstrate the effective use of Safety Data Sheets (SDS) to meet documentation requirements, including identifying hazards related to chemicals and materials used in the power equipment technology work environment.
2. Locate emergency response equipment, e.g., first aid kit, fire extinguisher, and review the emergency action and response plan, including labels and signage, following OSHA’s Hazard Communication Standard (HAZCOM).
3. Describe and demonstrate the appropriate use of Personal Protective Equipment (PPE) in power equipment technology, including safety glasses, ear protection, gloves, steel-toed boots, and respiratory protection.
4. Demonstrate safety precautions in the operation and service of power equipment according to current industry and OSHA standards.
5. Identify safety checklists and procedures used while servicing and operating equipment.
6. Identify and demonstrate the safety procedures applicable to lift equipment, such as hydraulic floor jacks and safety stands.
7. Apply safety rules for hand and power-based tool usage according to industry and OSHA standards.
8. Explain hazards associated with the handling of batteries and follow electrical precautions.
9. Identify airborne hazards in the power equipment environment and explain the importance of proper ventilation and respiratory protection to ensure worker health and safety.
10. Identify and demonstrate proper handling and disposal of chemicals and fuels that are used in the servicing of power equipment.
11. Identify and describe the steps involved in lockout/tagout (LOTO) procedures to ensure the safe servicing of equipment.
12. Identify and comply with fire protection regulations, local permit requirements, and state/federal regulations (i.e., OSHA, Hot Work, National Fire Protection Association (NFPA), 527CMR.100).

## Technical & Integrated Academic Standards

### Standard 2: Role of Power Equipment Technology Professionals in Society

Students will explain the historical evolution of power equipment technology, its impact on society and the environment, and the role of professionals in the field.

Skills:

1. Analyze the historical development of power equipment technology, identifying key innovations that have impacted the efficiency, safety, and environmental footprint of power equipment operations, e.g., compare early power equipment tools, e.g., manual, steam-powered, with modern-day machines.
2. Evaluate how power equipment technology contributes to various industries, such as agriculture, construction, landscaping, and transportation, and its broader impact on society’s growth and development.
3. Examine the evolving role of power equipment technicians in the workplace, considering factors, such as the rise of automation, electric vehicles, smart equipment, training, certification, and workplace safety.
4. Analyze the environmental impact of power equipment operations, and identify sustainable practices and technologies that reduce emissions, energy consumption, and environmental damage.
5. Explain how AI and automation are affecting power equipment diagnostics and repair work and suggest how technicians can adapt to these advancements.

### Standard 3: Fundamentals of Tools and Special Equipment

Students will be able to identify, use, and maintain various tools and equipment, including hand tools, power tools, precision instruments, and diagnostic tools, to perform power equipment procedures efficiently, accurately, and safely.

Skills:

1. Identify and categorize basic hand tools based on their functions and applications in power equipment technology, enabling proper selection and use in maintenance and repair tasks.
2. Apply correct procedures for setting up, adjusting, maintaining, and storing basic hand tools, ensuring their functionality and longevity.
3. Identify and describe basic power tools, such as drills and saws, and explain their use in specific procedures related to power equipment maintenance and repair.
4. Apply proper procedures to set up, adjust, maintain, and store basic power tools, ensuring optimal performance and safety in the workplace.
5. Demonstrate the safe and efficient use and maintenance of grinding equipment, applying techniques to ensure optimal performance and safety during operation.
6. Demonstrate the appropriate use and maintenance of soldering tools and their applications in both electrical and mechanical contexts.
7. Demonstrate proficient use and maintenance of air impact tools, ensuring they are optimized for high-torque applications in power equipment servicing.
8. Apply techniques for the operation, maintenance, and safety protocols associated with tire-changing equipment.
9. Demonstrate proper setup, use, and maintenance procedures for hydraulic presses or pullers, ensuring accurate and safe operations.
10. Demonstrate calibrating, using, and maintaining a torque wrench, ensuring precise torque application to fasteners in power equipment technology.
11. Identify, select, and use measuring tools, such as calipers, micrometers, feeler gauges, and levels, evaluating their application in power equipment tasks for precision, alignment, and ensuring proper fastener tightness.
12. Identify and describe the use of precision measurement tools, e.g., dial indicators and bore gauges, understanding their application in achieving high-accuracy results in power equipment diagnostics and repairs.
13. Demonstrate the use of precision measurement tools, ensuring that measurements meet exact specifications and current industry standards.
14. Select and use appropriate specialty tools and diagnostic/testing equipment according to current industry and OSHA standards.
15. Identify specialty tools to service and repair of Outdoor Power Equipment (OPE), understanding their unique functions and applications.
16. Demonstrate proper usage and maintenance procedures for specialty tools, ensuring they are well-maintained and ready for precise applications in OPE repairs.
17. Identify diagnostic and testing equipment, such as multimeters and compression testers, explaining their relevance to troubleshooting and maintaining power equipment technology with high precision.
18. Demonstrate the efficient use and routine maintenance of diagnostic and testing equipment, ensuring the tools remain accurate and reliable for troubleshooting and repairs.

### Standard 4: Diagnostic and Troubleshooting Techniques

Students will apply diagnostic and troubleshooting techniques for power equipment systems, including engines, ignition, fuel systems, and exhaust systems, using industry-standard practices and adhering to OSHA safety standards.

Skills:

1. Describe the key principles of diagnostics and troubleshooting, explaining how these principles are applied in power equipment technology to identify and resolve system failures effectively.
2. Identify the main systems in power equipment, e.g., ignition, fuel, exhaust, their components, and explain the sequence of events in each system to understand how they function and interrelate during operation.
3. Demonstrate the proper removal, testing, and replacement of the ignition armature module, ensuring it meets operational standards.
4. Apply the correct procedures to test a capacitive discharge ignition (CDI) system, evaluating its functionality and identifying potential faults in the ignition process.
5. Inspect the ignition system for wear or damage and perform a three-point spark test to evaluate spark quality and system integrity.
6. Demonstrate the timing procedure for ignition systems, ensuring proper synchronization of the engine's spark with the engine cycle for optimal performance.
7. Measure the primary and secondary resistance in the ignition system components using a multimeter, assessing whether the readings are within manufacturer specifications.
8. Inspect the safety interlock devices for correct functionality, troubleshoot any issues, and provide written documentation of repairs made to ensure safety compliance and equipment reliability.
9. Analyze engine failures, identify the root cause(s), and document the results and actions taken to resolve the issues, ensuring accurate records for future reference.
10. Inspect the fuel system for leaks or damage and perform a pressure test to evaluate the integrity and functionality of fuel lines, pumps, and injectors.
11. Inspect the carburetor for wear or blockages, test it for functionality, and conduct a pressure test to assess its operational performance and fuel delivery efficiency.
12. Inspect the fuel pump for defects and perform a pressure test to verify fuel pump operation and confirm the fuel system is supplying the correct pressure to the engine.
13. Inspect and test the exhaust system for any restrictions or leaks, identifying areas where exhaust flow may be compromised and performing repairs, as necessary.
14. Perform a cylinder balance test to assess the performance of each cylinder in the engine, recording results and identifying any discrepancies that may indicate an underlying issue.
15. Perform a cylinder compression test to evaluate the health of the engine's cylinders, documenting the results and analyzing them for any signs of wear or malfunction.
16. Conduct a cylinder leak-down test to assess the condition of the engine’s internal components, such as pistons and valves, recording results to help diagnose any potential issues.
17. Inspect the crankcase for leaks or damage by using a pressure/vacuum pump, ensuring the crankcase maintains proper pressure for engine operation.
18. Operate the engine to evaluate starting, acceleration, and power output under load conditions, analyzing performance to detect any issues related to fuel, ignition, or mechanical components.

### Standard 5: Fundamentals of Lifting, Hoisting, and Cleaning Equipment

Students will be able to identify, operate, and maintain various lifting, hoisting, and cleaning equipment, ensuring compliance with industry, OSHA, and environmental standards for safe and efficient use.

Skills:

1. Identify and describe various types of lifting and hoisting equipment, such as cranes, jacks, winches, and forklifts, understanding their specific applications and functions in power equipment technology.
2. Demonstrate the correct procedures for operating lifting and hoisting equipment, following current industry practices, OSHA standards, and relevant state laws and regulations to ensure safety and efficiency during equipment use.
3. Identify basic cleaning equipment, such as brooms, vacuums, and industrial-grade cleaning tools, and explain their role in maintaining a safe and clean work environment in power equipment technology settings.
4. Demonstrate proper operation and maintenance of cleaning equipment, including solvent tanks, pressure washers, and steam cleaners, ensuring effective cleaning and safety during use.
5. Demonstrate the correct disposal procedures for cleaning materials and waste, adhering to Environmental Protection Agency (EPA) guidelines and local regulations to ensure environmental compliance and safety.

### Standard 6: Customer Service, Technical Data Management, and Quality Workmanship

Students will apply effective customer service practices, use technical data, maintain accurate records, and uphold industry standards of workmanship in power equipment technology, ensuring high-quality service and compliance with OSHA standards.

Skills:

1. Conduct an interview with the customer/operator, recording relevant comments and information on the work-order for analysis and further action.
2. Perform a thorough visual and physical inspection of the equipment, identifying and classifying all symptoms related to the problem, ensuring a complete understanding before proceeding with repairs.
3. Conduct necessary tests on the equipment, documenting all findings accurately on the work order to ensure clear communication and future reference for repair verification.
4. Complete all required repairs to the equipment, retesting to verify that the issues have been resolved and ensuring the equipment functions properly.
5. Apply customer service practices to communicate effectively with the customer, explaining the cause of the repair and providing recommendations to prevent future issues.
6. Complete and interpret pre-delivery and delivery instructions for equipment, ensuring proper setup, configuration, and readiness for customer use or installation.
7. Identify the manufacturer, model, and serial number of the engine, ensuring accurate record-keeping for service and warranty documentation.
8. Identify the manufacturer, model, and serial number of the equipment (excluding the engine), ensuring proper identification for service requirements and parts compatibility.
9. Demonstrate the use of service and parts manual formats, such as paper, CD, DVD, web-based, and microfiche, to locate service procedures, torque specifications, and other technical data necessary for repairs.
10. Document all service and repair activities accurately on a work order, ensuring a comprehensive and organized record of work for future reference and compliance.
11. Document all parts and shop supplies used during the repair process on both the work order and shop inventory list, ensuring accurate tracking of inventory and proper billing.
12. Complete and submit OEM warranty forms, ensuring accurate information is provided for warranty claims and compliance with manufacturer requirements and standards.
13. Identify and interpret recommended service operations and maintenance schedules from the operator’s manual, ensuring tasks are performed in accordance with manufacturer guidelines and industry standards.
14. Maintain a neat and organized workspace, following best practices for safety, organization, and efficiency during the repair process.
15. Demonstrate the use of bins, paperwork, and digital recordings of parts for projects, ensuring easy access, proper inventory management, and accountability during tasks.
16. Complete assigned tasks within a set timeframe while maintaining high-quality workmanship and attention to detail, ensuring efficient and reliable results.

### Standard 7: Outdoor Power Equipment (OPE) Maintenance and Repair

Students will apply industry standards to operate, service, and repair outdoor power equipment (OPE), including the use of standard fasteners, equipment maintenance, troubleshooting, and adherence to OSHA guidelines to ensure the safe and efficient operation of machinery.

Skills:

1. Identify various fasteners used on small gas engines and OPE implements, including bolts, nuts, screws, and washers, understanding their specific functions and applications in OPE repair and maintenance.
2. Demonstrate the proper techniques for removing and installing various fasteners and gaskets, ensuring that equipment is assembled securely and properly sealed to avoid leaks and malfunctions.
3. Repair or produce internal and external threads on fasteners, ensuring correct thread alignment for secure connections and preventing damage to the equipment.
4. Identify safe operating practices for tractors, machinery, and equipment used in both consumer and commercial applications, ensuring compliance with safety regulations.
5. Recognize unsafe and dangerous conditions of equipment, such as cracked decks, split belts, or worn-out parts, and apply corrective actions to mitigate risks and prevent accidents.
6. Demonstrate proper methods for starting, stopping, and operating OPE, ensuring safe operation and efficient use of the equipment.
7. Select appropriate fuels, coolants, lubricants, and hydraulic fluids for various types of OPE, considering manufacturer recommendations and environmental impact.
8. Identify the parts and functions of key systems in OPE, including electrical, hydraulic, lubrication, cooling, exhaust, fuel, governor, induction, and drive systems.
9. Perform a pre-operation inspection of tractors and/or equipment, checking for safety, maintenance needs, and proper functionality before use.
10. Establish proper ballast and tire pressure for tractors and equipment, ensuring stability and safety during operation.
11. Demonstrate mower deck service and blade sharpening techniques to ensure efficient cutting performance and extend equipment life.
12. Demonstrate saw sharpening techniques, ensuring sharpness and precision for efficient cutting operations.
13. Demonstrate proper service and maintenance of chainsaws and handheld equipment, including inspecting, cleaning, and maintaining key components.
14. Explain ANSI standards for OPE, such as kickback protection and operator presence systems, ensuring safety features are understood and applied during operation.
15. Adjust steering linkage, including tow-in, ensuring accurate and responsive steering of OPE equipment.
16. Inspect and adjust drive line components, ensuring proper alignment and function for efficient power transfer.
17. Install, adjust, and service belt and chain drives, ensuring they operate smoothly without slippage or excessive wear.
18. Prepare tractors, machinery, or equipment for storage, including proper cleaning, fluid draining, and other maintenance tasks to ensure equipment longevity.
19. Demonstrate service and/or repair of various drive systems, including both mechanical and hydraulic drive systems, ensuring optimal function and performance.
20. Demonstrate service and/or repair of various clutches, understanding the specific requirements of each type and ensuring proper engagement and disengagement for smooth operation.
21. Demonstrate the service of manual and hydrostatic transmissions, ensuring fluid levels, seals, and operational integrity are maintained for reliable transmission performance.
22. Identify the components of generators used in OPE, understanding their role in energy production and system functionality.
23. Explain and demonstrate the repair of common generator malfunctions, including component replacement, troubleshooting, and performance restoration.
24. Compare and contrast the operation of brush/slip-ring vs. brushless (induction) type generators, explaining their differences, benefits, and application in OPE.
25. Diagnose and repair generator output problems, ensuring that generators provide consistent and reliable power for OPE functionality.

### Standard 8: Fundamentals of Engine Service and Repair

Students will apply the principles of engine operation, including two-stroke and four-stroke engines, diesel engine components, lubrication theory, and maintenance procedures.

Skills:

1. Explain the operation and theory of two-stroke cycle engines, analyzing the intake, compression, power, and exhaust strokes to identify key operational differences between two-stroke and four-stroke engines.
2. Explain the differences between piston ported, reed valve, and rotary valve operations in two-stroke cycle engines, emphasizing the advantages and limitations of each system for specific applications.
3. Explain the operation and theory of four-stroke cycle engines, demonstrating how each of the four strokes (intake, compression, power, exhaust) function in a complete cycle, and how these contribute to the engine's power output and efficiency.
4. Identify and describe the components and parts of four-stroke cycle engines, including the camshaft, piston, crankshaft, and valve systems, and explain the role each part plays in engine operation.
5. Explain the operation and theory of diesel two-stroke and four-stroke engines, emphasizing differences in combustion methods, fuel delivery, and power generation compared to gasoline engines.
6. Describe the differences between turbocharging and normal aspiration, explaining how turbocharging increases engine efficiency and power by forcing more air into the combustion chamber.
7. Describe the differences between supercharging and normal aspiration, explaining how supercharging boosts engine performance by forcing air into the engine using a mechanically driven compressor.
8. Identify and select lubricants specified for diesel engine use, emphasizing the importance of choosing the correct diesel oil to ensure engine longevity and optimal performance.
9. Diagnose common diesel engine operating issues, including rough idling, excessive exhaust smoke, and loss of power, and develop a systematic approach to identify and resolve these issues.
10. Apply the theory of lubrication, explaining how oil reduces friction, prevents wear, and cools engine components by creating a protective film between moving parts.
11. Describe American Petroleum Institute (API) oil ratings and Society of Automotive Engineers (SAE) viscosity ratings, explaining how these classifications help determine the appropriate oil for different engine types and operating conditions.
12. Describe the classification of two-stroke engines and demonstrate how to mix a given oil ratio for a two-cycle engine, ensuring correct fuel-to-oil mixtures for proper engine performance and longevity.
13. Describe the functions of engine oil, including its role in cooling, cleaning, sealing, and lubricating engine components, as well as how it prevents corrosion and reduces friction.
14. Describe the differences between splash and pressure lubrication systems, including how each system delivers oil to engine components, and which is best suited for certain engine types.
15. Describe the two types of oil filtration systems (full-flow and bypass), explaining their role in maintaining clean oil and preventing contamination of engine components.
16. Demonstrate methods of checking oil levels in an engine, ensuring students can properly use dipsticks or electronic sensors to assess oil levels and determine if maintenance is required.
17. Demonstrate changing engine oil and filter on a variety of equipment, including small engines, tractors, and other power equipment, ensuring that oil is replaced safely and properly disposed of according to environmental regulations.

### Standard 9: Cooling Systems Maintenance and Repair

Students will be able to maintain, troubleshoot, and repair cooling systems in power equipment, including air-cooled and liquid-cooled engines, ensuring the equipment operates efficiently and within safety standards according to current industry practices and OSHA regulations.

Skills:

1. Describe the major types of cooling systems used on power equipment, explaining the differences between air-cooled and liquid-cooled systems and their specific functions in preventing engine overheating.
2. Identify and repair the major causes of air-cooled engine overheating, including issues such as clogged cooling fins, insufficient airflow, and faulty fans, and apply corrective actions to restore proper engine temperature regulation.
3. Perform a cooling system flush and cleaning on a liquid-cooled engine, ensuring the removal of contaminants and ensuring proper coolant flow and heat dissipation.
4. Inspect, remove, and replace a water pump in a liquid-cooled engine, ensuring that the pump operates correctly to circulate coolant and maintain optimal engine temperature.
5. Inspect, remove, and replace a thermostat in an engine's cooling system, ensuring it regulates engine temperature within the manufacturer’s specified range for optimal performance.

### Standard 10: Fuel and Exhaust Systems Maintenance

Students will be able to maintain, service, and repair fuel systems and exhaust components in power equipment, including carburetors, fuel tanks, air filters, and exhaust systems to ensure efficient, safe, and environmentally compliant operation of outdoor power equipment.

Skills:

1. Define the types and grades of fuels used in power equipment, including gasoline, diesel, and alternative fuels, and explain their suitability for various engine types and power equipment.
2. Describe the use of a fuel additive for storage, emphasizing the importance of stabilizers to prevent fuel degradation and ensure easy starting after prolonged periods of non-use.
3. Describe and perform the method of carburetor cleaning, removing dirt and debris from the carburetor to maintain proper fuel-air mixture and engine performance.
4. Describe potential problems with oil/fuel mixtures, including the risk of improper fuel-to-oil ratios in two-stroke engines that can lead to engine damage, fouling, or poor performance.
5. Identify common types and nomenclature of fuel pumps, including diaphragm pumps and electric pumps, and explain their role in fuel delivery to the engine.
6. Define accelerator pump nomenclature and function, explaining how the accelerator pump delivers extra fuel to the carburetor during rapid acceleration to prevent engine sputtering.
7. Explain the theory and function of fuel injection, discussing how fuel injectors atomize fuel for more efficient combustion in modern power equipment engines.
8. Inspect, remove, and replace a carburetor on a small gasoline engine, ensuring the carburetor is functioning correctly to provide the engine with the right fuel mixture.
9. Clean and install a repair kit in a carburetor, including replacing seals, gaskets, and jets, to restore proper carburetor function and prevent fuel leaks or engine performance issues.
10. Inspect internal carburetor parts for wear, including checking for corrosion or wear on components, such as the throttle shaft or needle valve, that could affect performance.
11. Inspect, remove, and replace the fuel tank, filters, caps, hoses, and lines, ensuring fuel system components are clean, properly sealed, and free of leaks to prevent fuel contamination or loss.
12. Adjust carburetor linkage, ensuring the throttle and choke operate smoothly to provide correct fuel-air mixtures at all engine speeds.
13. Adjust carburetor mixture screws per OEM specifications, ensuring the proper air-fuel ratio for smooth idle and optimal engine performance.
14. Demonstrate setting and adjusting a carburetor float, ensuring the correct fuel level in the carburetor bowl to avoid flooding or insufficient fuel delivery to the engine.
15. Define and describe an air filter system nomenclature and explain its function, emphasizing the role of air filters in ensuring clean air intake for the engine and preventing contaminants from damaging engine components.
16. Demonstrate normal service procedures performed on each type of air filter system, including cleaning or replacing foam, paper, and other types of air filters based on the manufacturer's recommendations and engine type.
17. Identify exhaust system types, nomenclature, and describe their functions, recognizing different exhaust system components, such as mufflers, pipes, and silencers, and understanding their role in controlling emissions, reducing noise, and promoting engine efficiency.
18. Describe proper service cleaning procedures for exhaust ports and spark arrestor screens, ensuring that exhaust ports are free from blockages and spark arrestor screens are cleaned or replaced to maintain safety and prevent fire hazards in outdoor equipment operation.

### Standard 11: Ignition, Starting, Electrical, and Governor Systems Maintenance

Students will be able to service ignition, starting, electrical, and governor systems in power equipment, including applying diagnostic testing, repair techniques, and adjustments to optimize engine performance, ensure system functionality, and maintain compliance with current industry practices.

Skills:

1. Explain industry-specific electrical/electronic terminology to ensure clarity in communication within a technical environment.
2. Explain the purpose of ignition systems in engine performance and safety.
3. Compare different engine starting system components and describe their functions within the system.
4. Identify and explain the key components of a battery ignition system, explaining their functions and relevance in starting an engine.
5. Identify and describe the role of each component in a magneto ignition system and explain how the system operates to initiate engine function.
6. Describe the components in a recoil starting system, explaining their functionality in engine startup.
7. Demonstrate diagnostic testing on starter motors, remove and replace a starter motor, applying appropriate techniques for reinstallation.
8. Demonstrate testing, removing, and replacing a starter relay (solenoid), applying troubleshooting techniques to ensure proper system functionality.
9. Inspect and service different rewind starter models, ensuring operational efficiency and adhering to industry guidelines for each system type.
10. Demonstrate the replacement of a starter drive gear, ensuring proper alignment and functionality.
11. Disassemble and reassemble a starter motor for power equipment, e.g., 12V DC, 120V AC, or other voltage systems.
12. Define key charging system nomenclature, analyzing how they contribute to the system’s ability to maintain power within the electrical system.
13. Demonstrate an AC/DC volt test with accuracy, evaluating the test results for proper system functionality.
14. Explain the roles of diodes and rectifiers in the conversion of electrical current and their impact on system reliability.
15. Apply the use of a DC shunt to measure current drain and charging, analyzing the results for system efficiency and proper operation.
16. Demonstrate the safe removal and replacement of a regulator/rectifier, assessing the impact of its functionality on system performance.
17. Compare the characteristics and uses of series and parallel circuits in electrical systems, describing their practical applications in various systems.
18. Categorize different types of circuit failures, assessing the causes and solutions for each scenario in the context of power equipment systems.
19. Perform continuity checks on circuits and electrical components, evaluating results to confirm proper system function.
20. Examine and test the flow of current in electrical systems, assessing the results to ensure optimal system operation and troubleshooting issues.
21. Inspect, test, and replace fusible links, fuses, and circuit breakers, evaluating their condition and ensuring that they meet safety standards.
22. Identify and install appropriate terminals and connectors, ensuring that connections are secure and meet industry standards for electrical systems.
23. Calculate electrical wire sizes and selection based on anticipated current load.
24. Identify sending units within electrical circuits and explain their role in transmitting data and controlling system functions.
25. Explain the theory behind storage battery operation and analyze how battery systems are integral to power equipment functionality.
26. Demonstrate procedures to clean, test, remove, and replace a battery, demonstrating proper handling techniques for both safety and system integrity.
27. Describe the primary purpose of a governor system and evaluate its impact on engine performance and stability.
28. Explain the nomenclature and functional components of governor systems, identifying their role in regulating engine speed.
29. Demonstrate adjusting the settings of pneumatic and mechanical governor systems to optimize engine performance, identifying each adjustment based on specific system needs.

### Standard 12: Engine Inspection, Rebuilding, and Installation

Students will apply diagnostic testing, measurement techniques, and manufacturer specifications to inspect, disassemble, rebuild, and install engines.

Skills:

1. Inspect valves and seats for wear and damage, analyzing their condition and deciding when to resurface or replace it based on OEM specifications.
2. Demonstrate the valve lapping operation with precision, explaining its purpose in ensuring proper valve seating and optimizing engine performance.
3. Demonstrate the removal of ridge, de-glazing, and cleaning of the cylinder bore using a rigid hone, ensuring that the surface is smooth and ready for reassembly.
4. Describe the OEM cylinder reuse specifications and analyze when a cylinder can be reused based on these guidelines to maintain engine integrity.
5. Inspect and measure camshaft bearings for signs of wear or damage, evaluating their condition to determine the need for repair or replacement.
6. Inspect and evaluate the components of the valve train, including valves, seats, valve guides, rocker arms, lifters, studs, and push rods, identifying any wear or damage requiring attention.
7. Examine the balance system of the engine, identifying any issues with vibration or imbalance that may affect engine performance.
8. Inspect shafts and support bearings for damage, measuring wear to assess their functionality and determine if they need to be replaced.
9. Measure engine bearings to ensure they meet manufacturer specifications, analyzing the results to confirm proper tolerances.
10. Apply plasti-gauge to measure bearing clearances, interpreting the readings to ensure the engine’s tolerances are within the manufacturer's recommended limits.
11. Install engine components, assemblies, and gaskets with precision, torquing to manufacturer specifications to ensure proper sealing and prevent future engine issues.
12. Install the crankshaft and its bearings, ensuring correct positioning and alignment to meet operational standards.
13. Measure crankshaft end play to ensure it meets manufacturer specifications, analyzing results for proper fit and function within the engine.
14. Measure crankshaft run-out, interpreting the results to ensure minimal distortion and ensure proper function during engine operation.
15. Explain the verification process for camshaft timing according to manufacturer’s specifications and procedure.
16. Demonstrate adjusting both mechanical and hydraulic valves, evaluating the necessary clearances for optimal engine performance and operation.
17. Demonstrate assembling the engine following manufacturer specifications, test running it to ensure proper function, and identifying any issues that may need further attention.

### Standard 13: Fundamentals of Motorcycles and ATV’s

Students will apply technical skills in the maintenance, diagnosis, and repair of motorcycles and all-terrain vehicles (ATVs), including identifying, servicing, and troubleshooting key systems such as the chassis, suspension, braking, electrical, and tire components.

Skills:

1. Identify key components and systems in motorcycles and ATVs, assessing their condition and service needs based on manufacturer specifications and industry standards.
2. Demonstrate basic service procedures for motorcycles and ATVs, utilizing correct tools and observing OSHA safety standards to maintain vehicle functionality and shop safety.
3. Demonstrate routine maintenance and repair tasks on motorcycles and ATVs, including transmissions, suspension, and electrical systems, applying safety standards and manufacturer guidelines, ensuring all systems are properly adjusted and fully operational.
4. Diagnose common chassis and suspension issues in motorcycles and ATVs, applying diagnostic tools and techniques to identify wear, damage, or misalignment.
5. Repair chassis and suspension components, utilizing appropriate parts and procedures to restore proper functionality and performance.
6. Examine tires for wear, damage, and proper inflation, diagnosing issues such as punctures, tread wear, and alignment problems.
7. Perform tire repairs and mount and balance tires on motorcycles and ATVs, ensuring proper fit and balance to ensure safety and performance.
8. Differentiate between mechanical and hydraulic braking systems, identifying the unique components and functions of each system.
9. Apply manufacturer’s recommendations for system type to service both mechanical and hydraulic braking systems and repairing or replacing components, such as brake pads, discs, fluid, and lines.

### Standard 14: Fundamentals of Marine Equipment

Students will be able to diagnose, service, and repair marine equipment, including outboard and stern-drive assemblies, and personal watercraft (PWCs), while adhering to current industry and OSHA standards.

Skills:

1. Diagnose and service marine equipment, identifying common issues and applying repair solutions to outboard, stern-drive assemblies, and PWCs in accordance with industry standards and OSHA guidelines.
2. Perform routine maintenance and repair on marine engines and equipment, ensuring that all systems such as fuel, electrical, and propulsion are operating within manufacturer specifications.
3. Follow OSHA safety standards when servicing marine equipment, adhering to best practices for handling hazardous materials and ensuring equipment safety.
4. Diagnose problems within an outboard drive assembly, applying diagnostic tools and procedures to identify issues with the engine, fuel system, or mechanical components.
5. Service outboard drive assemblies, replacing worn or damaged parts, such as seals, bearings, and impellers, following manufacturer specifications to ensure reliable performance.
6. Diagnose issues in a stern-drive assembly, evaluating components, such as the drive shaft, bearings, and seals for wear or damage.
7. Service stern-drive assemblies, repairing or replacing faulty components to restore proper function, and ensure the system is sealed and operating efficiently.
8. Assess the correct propeller pitch and size for various types of vessels, considering engine specifications, vessel weight, and performance requirements.
9. Demonstrate the process of selecting and installing a suitable propeller, ensuring optimal performance and fuel efficiency for the given vessel.
10. Demonstrate servicing a personal watercraft (PWC), performing maintenance tasks, such as engine checks, fuel system inspection, and cleaning, following the manufacturer's specifications for each system.
11. Inspect and test the PWC systems, including the propulsion system and electrical components, to ensure they meet operational standards and safety guidelines.

### Standard 15: Horsepower and Torque Analysis

Students will be able to measure and calculate horsepower and torque, applying critical performance analysis techniques to evaluate engine efficiency.

Skills:

1. Measure the output of horsepower and torque in an engine, analyzing data to determine engine performance characteristics using appropriate tools and techniques.
2. Calculate horsepower and torque based on provided engine data, ensuring accurate results that reflect the system's capabilities.
3. Explain the concept of horsepower, describing how it is derived from an engine's torque and RPM.
4. Measure the horsepower output of an engine using a dynamometer or other suitable devices, interpreting the readings to evaluate engine performance.
5. Measure torque and RPM using precise instrumentation, accurately documenting the values.
6. Calculate horsepower by applying the formula: Horsepower = Torque × RPM ÷ 5252, demonstrating understanding of the relationship between these variables in engine performance.
7. Perform pre- and post-modification engine tests using a dynamometer, recording and comparing horsepower and torque values to assess the impact of engine alterations.
8. Analyze changes in performance data to determine the effectiveness of modifications and evaluate their influence on engine efficiency.

### Standard 16: Fundamentals of Welding

Students will apply industry-standard techniques in welding and cutting projects, focusing on safety, proper equipment setup for gas and electric welding, and adherence to OSHA safety standards for PPE, while maintaining a safe working environment.

Skills:

1. Identify the components and functions of gas welding and cutting equipment, ensuring all parts are in working order before use.
2. Demonstrate the safe set-up of gas welding and cutting equipment, following industry and OSHA guidelines for safety, including securing proper gas mixtures, checking hoses, and ensuring ventilation.
3. Identify key components of electric welding equipment, such as the power source, electrodes, and ground connections, explaining their function and setup requirements.
4. Demonstrate the safe set-up of electric welding equipment, ensuring proper calibration, grounding, and protective measures are in place before beginning any welding activity.
5. Demonstrate welding and cutting techniques on metal parts, applying the appropriate method (gas or electric) based on material type and project needs.
6. Apply safety protocols to all welding and cutting techniques, adhering to industry standards and OSHA safety guidelines, while working efficiently and maintaining both the integrity of the metal and personal safety.
7. Assess the quality of welds and cuts, adjusting technique as needed to achieve a high-quality result.

## Employability Standards

### Standard 17: Employability Skills

Students will apply essential employability skills in the context of the power equipment industry, including professional communication, critical thinking, problem-solving, professionalism, teamwork, and collaboration.

Skills:

1. Apply effective communication techniques (verbal, written, digital) to ensure clarity and professionalism when interacting with customers and colleagues.
2. Analyze a project plan and propose solutions to streamline workflow, remove unnecessary steps, and optimize efforts, while ensuring the project meets safety, quality, and timeline goals.
3. Use critical thinking to identify the root causes of equipment malfunctions and develop effective solutions for complex mechanical or electrical problems.
4. Demonstrate a professional attitude when interacting with clients, coworkers, and supervisors, exemplifying respect for deadlines, quality standards, and workplace regulations.
5. Demonstrate fostering a collaborative environment by respecting the skills and roles of team members, taking responsibility for assigned tasks, and working together to complete repairs or installations to the highest standard.
6. Integrate industry standard practices for quality control and continuous improvement in power equipment projects, evaluating work processes and products to ensure they meet or exceed established industry standards.

## Entrepreneurship Standards

### Standard 18: Entrepreneurship

Students will identify opportunities for entrepreneurship within the power equipment technology field, evaluate the value of business ownership, and understand the critical aspects of starting and growing a successful business focused on power equipment repair, sales, and service.

Skills:

1. Evaluate the licensing, regulatory, and tax requirements for self-employment or business ownership in power equipment technology compared with traditional W-2 employment.
2. Explain the requirements for starting a power equipment service or sales business, including essential equipment, such as diagnostic tools, inventory, and service vehicles.
3. Develop a marketing/business plan to attract clients in sectors like landscaping, agriculture, or construction.
4. Describe professional networking within the power equipment industry and demonstrate how to deliver a compelling 'elevator speech' that effectively introduces your skills, services, and business offerings to potential clients, partners, or employers.
5. Examine market demand for power equipment services, focusing on key sectors, such as lawn and garden equipment, heavy machinery, or agricultural equipment.
6. Apply strategies to gain a competitive edge in the market, such as offering specialized repair services, exceptional customer service, or fast turnaround times.
7. Identify the process of sourcing raw materials, e.g., parts, tools, managing inventory for repair parts and equipment, and negotiating with suppliers for the best deals.
8. Assess the operational challenges specific to running a power equipment repair or service business, including managing workflows, scheduling maintenance jobs, and overseeing technicians.

## Digital Literacy Standards

### Standard 19: Digital Literacy

Students will be able to demonstrate proficiency in using common software and information technology tools essential to the power equipment industry, including digital communication, project management, and equipment diagnostics software, to enhance productivity and ensure effective operations.

Skills:

1. Demonstrate clear and professional digital communication when coordinating repairs, parts orders, scheduling service appointments, and discussing technical issues.
2. Collaborate with team members, customers, and suppliers using tools such as email, instant messaging, video conferencing, e.g., Microsoft Teams, Zoom, and project management platforms, e.g., Trello, Asana.
3. Apply data management software to track maintenance logs, service history, inventory, and customer interactions, ensuring accurate and up-to-date records for all equipment.
4. Identify and use digital libraries, forums, instructional videos, and software updates to troubleshoot and repair power equipment, such as small engines, lawnmowers, or heavy machinery.
5. Apply ethical use practices of online resources, ensuring the integrity of shared and consumed digital content, including manuals, schematics, and technical articles.
6. Utilize diagnostic and repair software to identify issues with power equipment, such as engines, starters, or electrical systems, improving troubleshooting efficiency.
7. Use specialized software, e.g., CAD software for creating custom parts, and digital tools to enhance service processes, ensuring faster repairs and optimized service delivery.
8. Demonstrate awareness of cybersecurity practices, ensuring the protection of sensitive customer and service data through secure digital communications and data management systems.