

2 & 4 CYCLE ENGINE I

2 & 4 CYCLE ENGINE I is a course that prepares students for entry-level positions or advanced training in 2 & 4 cycle engines. Course content focuses on 2 & 4 cycle engines used on motorcycles, all-terrain vehicles (ATV), jet skis, outboard motors, garden equipment, and outdoor power equipment and vehicles. Students will perform inspections, tests, and measurements for diagnosis and perform needed repairs. Education and experience simulate small engine industry operations through the use of training aids and modules and offer school-based and work-based learning opportunities. Provides training for a 2 & 4 cycle engine certification from Equipment and Engine Training Council (EETC).

It is strongly recommended that administration and guidance follow the scope and sequence and course recommendations as listed.

Recommended:	Transportation Core
Recommended Credit:	1
Recommended Grade Level(s):	10th
Number of Competencies:	45

2 & 4 CYCLE ENGINE I

STANDARDS

- 1.0** Students will perform safety examinations and maintain safety records.
- 2.0** Students will demonstrate leadership, citizenship, and teamwork skills required for success in the school, community, and workplace.
- 3.0** Students will integrate reading, writing, math, and science skills and understand the impact of academic achievement in the workplace.
- 4.0** Students will identify and properly use, maintain, and store basic 2 & 4 cycle engine service hand tools, power tools, measuring tools, and lab/shop equipment.
- 5.0** Students will access service manuals, identify systems, components and explain the theory of 2 & 4 cycle engines.
- 6.0** Students will identify and explain lubrication, cooling, and fuel systems of 2 and 4 cycle engines.
- 7.0** Students will troubleshoot and describe engine failures.

2 & 4 CYCLE ENGINE I

STANDARD 1.0

Students will perform safety examinations and maintain safety records.

LEARNING EXPECTATIONS

The student will:

- 1.1 Demonstrate a positive attitude regarding safety practices and issues.
- 1.2 Use and inspect personal protective equipment.
- 1.3 Inspect, maintain, and employ safe operating procedures with tools and equipment, such as hand and power tools, ladders, scaffolding, and lifting equipment.
- 1.4 Demonstrate continuous awareness of potential hazards to self and others and respond appropriately.
- 1.5 Assume responsibilities under HazCom (Hazard Communication) regulations.
- 1.6 Adhere to responsibilities, regulations, and Occupational Safety & Health Administration (OSHA) policies to protect coworkers and bystanders from hazards.
- 1.7 Adhere to responsibilities, regulations, and Occupational Safety & Health Administration (OSHA) policies regarding reporting of accidents and observed hazards, and regarding emergency response procedures.
- 1.8 Demonstrate appropriate related safety procedures.
- 1.9 Pass with 100 % accuracy a written examination relating to safety issues
- 1.10 Pass with 100% accuracy a performance examination relating to safety.
- 1.11 Maintain a portfolio record of written safety examinations and equipment examinations for which the student has passed an operational checkout by the instructor.

PERFORMANCE INDICATORS: EVIDENCE STANDARD IS MET

The student:

- 1.1A Is attentive during safety discussions.
- 1.1B Actively seeks information about safe procedures.
- 1.1C Responds positively to instruction, advice, and correction regarding safety issues.
- 1.1D Does not deliberately create or increase hazards, such as by horseplay, practical jokes, or creating distractions.
- 1.1E Reports to school or work physically ready to perform to professional standards, such as rested, or not impaired by medications, drugs, alcohol, etc.
- 1.2 Selects, inspects, and uses the correct personal protective equipment for the assigned task.
- 1.3A Inspects power tools for intact guards, shields, insulation, and other protective devices.
- 1.3B Inspects extension cords for the presence of a functional ground connection, prior to use.
- 1.3C Operates and maintains tools in accordance with manufacturer's instructions and as required by regulation or company policy.
- 1.4A Is observant of personnel and activities in the vicinity of the work area.
- 1.4B Warns nearby personnel, prior to starting potentially hazardous actions.
- 1.5A When asked to use a new hazardous material, retrieves MSDSs (material safety data sheets), and identifies the health hazards associated with the new material.

- 1.5B** Reports hazards found on the job site to the supervisor.
- 1.6A** Erects shields, barriers, and signage to protect coworkers and bystanders prior to starting potentially hazardous tasks.
- 1.6B** Provides and activates adequate ventilation equipment as required by the task.
- 1.7A** Reports all injuries to self to the immediate supervisor.
- 1.7B** Reports observed unguarded hazards to their immediate supervisor.
- 1.8A** Complies with personal assignments regarding emergency assignments.
- 1.9A** Passes with 100% accuracy a written examination relating specifically to content area.
- 1.10A** Passes with 100% accuracy a performance examination relating specifically to welding tools, equipment and supplies.
- 1.11A** Maintains a portfolio record of written safety examinations and equipment examinations for which the student has passed an operational checkout by the instructor.

SAMPLE PERFORMANCE TASKS

These are sample projects of the type and scale recommended to address one or more of the learning expectations for this standard. Other projects can be used at the instructor's discretion.

- Conduct a practice drill simulating a hazardous solvent spill in which an emergency action plan is to be implemented.
- Instruct a visitor to obviously approach the vicinity of a student conducting a hazardous activity and note the level of awareness demonstrated by the student.
- For a project requiring the use of ladders and/or scaffolding, note the proper placement and securing procedures followed by students.

INTEGRATION LINKAGES

Language Arts, Mathematics, Technical Algebra, Technical Geometry, Algebra, Geometry English IV: Communication for Life, SkillsUSA Technical Championships, American Welding Society (AWS), Guide for Training and Qualification of Entry Level Welder, National Center for Construction Education Research (NCCER), Secretary's Commission on Achieving Necessary Skills (SCANS), Professional Development Program, SkillsUSA

2 & 4 CYCLE ENGINE I

STANDARD 2.0

Students will demonstrate leadership, citizenship, and teamwork skills required for success in the school, community, and workplace.

LEARNING EXPECTATIONS

The student will:

- 2.1 Cultivate positive leadership skills.
- 2.2 Participate in the student organization directly related to their program of study as an integral part of classroom instruction.
- 2.3 Assess situations, apply problem-solving techniques and decision-making skills within the school, community, and workplace.
- 2.4 Participate as a team member in a learning environment.
- 2.5 Respect the opinions, customs, and individual differences of others.
- 2.6 Build personal career development by identifying career interests, strengths, and opportunities.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 2.1A Demonstrates character and leadership using creative-and critical-thinking skills.
- 2.1B Uses creative thought process by “thinking outside the box.”
- 2.2A Relates the creed, purposes, motto, and emblem of their student organization, directly related to personal and professional development.
- 2.2B Plans and conducts meetings and other business according to accepted rules of parliamentary procedure.
- 2.3A Makes decisions and assumes responsibilities.
- 2.3B Analyzes a situation and uses the Professional Development Program or career technical student organization materials directly related to the student’s program of study to resolve it.
- 2.3C Understands the importance of learning new information for both current and future problem solving and decision making.
- 2.4A Organizes committees and participates in functions.
- 2.4B Cooperates with peers to select and organize a community service project.
- 2.5A Researches different customs and individual differences of others.
- 2.5B Interacts respectfully with individuals of different cultures, gender, and backgrounds.
- 2.5C Resolves conflicts and differences to maintain a smooth workflow and classroom environment.
- 2.6A Creates personal career development by identifying career interests, strengths, and opportunities.
- 2.6B Identifies opportunities for career development and certification requirements.
- 2.6C Plans personal educational paths based on available courses and current career goals.
- 2.6D Creates a resumé that reflects student’s skills, abilities, and interests.

SAMPLE PERFORMANCE TASKS

- Create a leadership inventory and use it to conduct a personal assessment.
- Participate in various career technical student organizations' programs and/or competitive events.
- Implement an annual program of work.
- Prepare a meeting agenda for a specific career technical student organization monthly meeting.
- Attend a professional organization meeting.
- Develop a program of study within their career opportunities.
- Participate in the American Spirit Award competition with SkillsUSA.
- Complete *Professional Development Program Level I and Level II*, SkillsUSA.

INTEGRATION LINKAGES

SkillsUSA, *Professional Development Program*; SkillsUSA; Communications and Writing Skills; Teambuilding Skills; Research; Language Arts; Sociology; Psychology; Math; Technical Math; English IV: Communication for Life; Social Studies; Problem Solving; Interpersonal Skills; Employability Skills; Critical-Thinking Skills; Secretary's Commission on Achieving Necessary Skills (SCANS); Chamber of Commerce; Colleges; Universities; Technology Centers; Secretary's Commission on Achieving Necessary Skills (SCANS)

2 & 4 CYCLE ENGINE I

STANDARD 3.0

Students will integrate reading, writing, math, and science skills and understand the impact of academic achievement in the work place.

LEARNING EXPECTATIONS

The student will:

- 3.1 Assume responsibility for accomplishing classroom assignments and workplace goals within accepted time frames.
- 3.2 Develop advanced study skills.
- 3.3 Demonstrate and use written and verbal communication skills.
- 3.4 Read and understand technical documents such as regulations, manuals, reports, forms, graphs, charts, and tables.
- 3.5 Apply the foundations of mathematical principles such as algebra, geometry, and advanced math to solve problems.
- 3.6 Apply basic scientific principles and methods to solve problems and complete tasks.
- 3.7 Understand computer operations and related applications to input, store, retrieve, and output information as it relates to the course.
- 3.8 Research, recognize, and understand the interactions of the environment and *green* issues as they relate to the course work and to a global economy.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 3.1A Uses appropriate time management to achieve goals.
- 3.1B Arrives at school on time each day.
- 3.1C Completes assignments and meets deadlines.
- 3.2A Assesses current personal study skills.
- 3.2B Demonstrates advanced note-taking ability.
- 3.2C Formulates appropriate study strategies for given tasks.
- 3.3A Communicates ideas, information, and messages in a logical manner.
- 3.3B Fills out forms, reports, logs, and documents to comply with class and project requirements.
- 3.4A Reads and understands technical documents and uses industry jargon, acronyms, and terminology appropriately.
- 3.4B Recognizes the meaning of specialized words or phrases unique to the career and industry.
- 3.5A Utilizes computation in adding, subtracting, multiplying, and dividing of whole numbers, fractions, decimals, and percents.
- 3.5B Chooses the right mathematical method or formula to solve a problem.
- 3.5C Performs math operations accurately to complete classroom and lab tasks.
- 3.6A Understands scientific principles critical to the course.
- 3.6B Applies scientific principles and technology to solve problems and complete tasks.
- 3.6C Has knowledge of the scientific method (e.g., identifies the problem, collects information, forms opinions, and draws conclusions).
- 3.7A Uses basic computer hardware (e.g., PCs, printers) and software to perform tasks

as required for the course work.

- 3.7B** Understands capabilities of computers and common computer terminology (e.g., program, operating system).
- 3.7C** Applies the appropriate technical solution to complete tasks.
- 3.7D** Inputs data and information accurately for the course requirements.
- 3.8A** Researches and recognizes *green* trends in career area and industry.
- 3.8B** Examines current environmentally friendly trends.
- 3.8C** Applies sustainability practices by understanding processes that are non-polluting, conserving of energy and natural resources, and economically efficient.

SAMPLE PERFORMANCE TASKS

- Examine and compile different learning styles for portfolios.
- Create calendars containing all activities and obligations for one month. Discusses how to handle conflicting or competing obligations then complete daily and weekly plans showing tasks, priorities, and scheduling.
- Complete self-assessments of study habits.
- Compute precise and exact measurements.
- Explore study strategies for different subjects and tasks then analyze two homework assignments and select the best strategies for completing them.
- Create “life maps” showing necessary steps or “landmarks” along the path to personal, financial, educational, and career goals.
- Take notes during counselor classroom visits and work in small groups to create flow charts of the path options.
- List attitudes that lead to success then rate individually in these areas. Work together to suggest strategies for overcoming the weaknesses identified own and partners’ self-assessments then share with the class the strategies developed.
- Research the Internet and other technology to collect and analyze data concerning climate change.
- Keep a data file of alternative energy sources and the sources’ impact on the environment.
- Develop a recycling project at home or for the school environment.

INTEGRATION LINKAGES

SkillsUSA, *Professional Development Program*; SkillsUSA; Communications and Writing Skills; Teambuilding Skills; Research; Language Arts; Sociology; Psychology; Math; Technical Math; English IV: Communication for Life; Social Studies; Problem Solving; Interpersonal Skills; Employability Skills; Critical-Thinking Skills; Secretary’s Commission on Achieving Necessary Skills (SCANS); Chamber of Commerce; Colleges; Universities; Technology Centers; Secretary’s Commission on Achieving Necessary Skills (SCANS)

2 & 4 CYCLE ENGINE I

STANDARD 4.0

Students will identify and properly use, maintain, and store basic 2 & 4 cycle engine service hand tools, power tools, measuring tools, and lab/shop equipment.

LEARNING EXPECTATIONS

The student will:

- 4.1** Properly identify and describe the use of a basic set of hand tools, including metric and SAE sizes.
- 4.2** Properly identify and describe power tools and shop equipment, including maintenance and storage.
- 4.3** Demonstrate safe practices using hydraulic jacks, safety stands, and lifts.
- 4.4** Identify and demonstrate the proper use of measuring tools such as calipers, micrometers, tape measures, and dial indicators.
- 4.5** Properly use and dispose of lab/shop cleaning tools and supplies.

PERFORMANCE INDICATORS: EVIDENCE STANDARD IS MET

The student:

- 4.1A** Identifies, describes, and lists the sizes of metric and SAE wrenches, sockets, screwdrivers, ratchet drives and hammers.
- 4.1B** Properly cleans and stores tools in a toolbox or storage area/wall according to correct size and nomenclature.
- 4.2A** Identifies, describes, and demonstrates the safe use of air and electric powered tools.
- 4.2B** Cleans, lubricates, and properly stores shop equipment and power tools.
- 4.3** Demonstrates safe use of hydraulic jacks, safety stands, and power lifts.
- 4.4** Makes correct measurements using mechanical and digital calipers, micrometers, tape measures, dial indicators.
- 4.5** Demonstrates proper use and disposal of cleaning supplies, mops, brooms, and trash bins according to EPA and state laws.

SAMPLE PERFORMANCE TASKS

- Uses math skills to list sizes of wrenches and sockets.
- Creates lists of types and sizes of tools.
- Maintains and organizes a toolbox or a tool room.
- Creates an inventory list of shop equipment.
- Reads the instruction manual for air and power tools used in the shop.
- Reads the instruction manuals for hydraulic and power lifts.
- Creates a chart of measurements made of various shop items using various types of measuring tools.
- Read and explain the MSDS sheet concerning shop chemicals.
- Read and explain the EPA and state laws concerning disposal of shop chemicals and waste.

INTEGRATION LINKAGES

Math, Science, Communication Skills, Teamwork Skills, Reading Skills, Leadership Skills, Secretary's Commission on Achieving Necessary Skills (SCANS), National Institute for Automotive Service Excellence, National Automotive Technician Education Foundation (NATEF), Occupational Safety and Health Administration (OSHA), Environmental Protection Agency (EPA), SkillsUSA, CDX eTextbook, Equipment and Engine Training Council, Outdoor Power Equipment.

2 & 4 CYCLE ENGINE I

STANDARD 5.0

Students will access service manuals, identify systems, components and explain the theory of 2 & 4 cycle engines.

LEARNING EXPECTATIONS

The student will:

- 5.1** Access service manuals to find information and specifications.
- 5.2** Interview customers and legibly record information on work orders.
- 5.3** Properly identify manufacturer model number, serial number, and whether 2 or 4 cycle engine.
- 5.4** Communicate with customers regarding cause, repair solutions, and preventive maintenance.
- 5.5** Explain the theory and power stroke cycles of the 2 & 4 cycle engines.

PERFORMANCE INDICATORS: EVIDENCE STANDARD IS MET

The student:

- 5.1A** Accesses service manuals to find information and specifications.
- 5.1B** Properly identifies a manufacturer ID model number, serial number, and type number for 2 & 4 stroke engines.
- 5.1C** Identifies 2 & 4 cycle engine components and parts and explains their purpose.
- 5.2** Interviews customers and enters information on a repair order.
- 5.3** Properly identifies a manufacturer ID model number, serial number, and type number for 2 & 4 stroke engines.
- 5.4** Explains to customers the cause, repair solutions, and preventive maintenance needs of their equipment.
- 5.5A** Explain 2 stroke engine components and operating theory.
- 5.5B** Explain 4 stroke engine components and operating theory.
- 5.5C** Explain normal combustion, pre-ignition, detonation, and their effects.

SAMPLE PERFORMANCE TASKS

- Use the internet or OEM service manuals to research and find information and specifications for 2 & 4 engines.
- Pick a specific manufacturer and list all of the different size 2 & 4 cycle engines they manufacture.
- Disassemble a single cylinder 2 stroke engine and identify the components.
- Disassemble a single cylinder 4 stroke engine and identify the components.
- Prepare a repair order after examining the engine components and estimating the cost of parts and labor.
- Describe the correct order of combustion in a 2 stroke and a 4 stroke engine.
- Show the effects of pre-ignition and detonation.

INTEGRATION LINKAGES

Mathematics, Math for Technology, Science, Electronics, Chemistry, Physics, Applied Communications, Technical Writing, Problem-Solving and Critical Thinking Skills, Occupational Safety and Health Administration (OSHA), Tennessee Occupational Safety and Health Administration (TOSHA), Environment Protection Agency (EPA), SkillsUSA, Interpersonal Skills, Employability Skills, Secretary's Commission on Achieving Necessary Skills (SCANS), CDX eTextbook, Equipment and Engine Training Council (EETC), Outdoor Power Equipment (OPEESA).

2 & 4 CYCLE ENGINE I

STANDARD 6.0

Students will identify and explain lubrication, cooling, and fuel systems of 2 and 4 cycle engines.

LEARNING EXPECTATIONS

The student will:

- 6.1** Describe lubrication systems nomenclature and functions.
- 6.2** Identify types of oil used in 2 & 4 cycle engines.
- 6.3** Change oil and filter on variety of 2 & 4 cycle engines.
- 6.4** Compare liquid cooled and air cooled 2 & 4 cycle engines and identify their benefits and negatives.
- 6.5** List the different types of fuel, fuel mixtures, and fuel systems used in 2 & 4 cycle engines.
- 6.6** Describe carburetors, fuel injection, mechanical and electric fuel pumps used on 2 & 4 cycle engines.

PERFORMANCE INDICATORS: EVIDENCE STANDARD IS MET

The student:

- 6.1A** Identifies components in the lubrication system and their functions.
- 6.2A** Using manufacturer service manuals; lists the different grades and types of oil used in 2 & 4 cycle engines.
- 6.3A** Changes oil and filter on various 2 & 4 cycle engines.
- 6.3B** Describes splash lubrication and pressure lubrication.
- 6.4A** Lists the positives and negatives of air-cooled verses liquid cooled engines.
- 6.4B** Properly pressure tests a liquid cooling system.
- 6.5A** Correctly mixes fuel for 2 cycle engines.
- 6.5B** Lists and explains fuel octane ratings.
- 6.5C** Inspects and replaces fuel filters and fuel lines.
- 6.6** Describes and explains the function of carburetors, fuel injection, mechanical and electric fuel pumps used on 2 & 4 cycle engines.

SAMPLE PERFORMANCE TASKS

- Select and replace fuel filters.
- Repair a carburetor.
- Adjust and repair a fuel injection system.
- Inspect fuel lines and determine necessary actions.
- Using case scenarios follow strategy based diagnostic procedure to verify the complaint, define the problem, isolate the problem, validate the problem, make the repair, and test the repair.
- Properly mix fuel for 2 cycle engines.
- Understands viscosity rating for engine oil.
- Properly changes oil and filter on variety of engines.
- Cleans and/or replaces air filters.

INTEGRATION LINKAGES

Mathematics, Math for Technology, Science, Electronics, Chemistry, Physics, Applied Communications, Technical Writing, Problem-Solving and Critical Thinking Skills, Occupational Safety and Health Administration (OSHA), Tennessee Occupational Safety and Health Administration (TOSHA), Environment Protection Agency (EPA), SkillsUSA, Interpersonal Skills, Employability Skills, Secretary's Commission on Achieving Necessary Skills (SCANS), CDX eTextbook, Equipment and Engine Training Council (EETC), Outdoor Power Equipment (OPEESA).

2 & 4 CYCLE ENGINE I

STANDARD 7.0

Students will troubleshoot and describe 2 & 4 cycle engine failures.

LEARNING EXPECTATIONS

The student will:

- 7.1** Accurately identify damaged cylinder walls, valves, and pistons caused by abrasives.
- 7.2** Accurately define root cause of engine failure due to overheating.
- 7.3** Identify 2 stroke engine failures due to stale fuel and poor lubrication quality.
- 7.4** Perform a cylinder compression test on 2 & 4 cycle engines.

PERFORMANCE INDICATORS: EVIDENCE STANDARD IS MET

The student:

- 7.1A** Disassembles a 2 or 4 cycle engine and inspects for damaged components.
- 7.1B** Uses manufacturer specifications to measure damaged components for wear.
- 7.2A** Performs a cooling system flush and thermostat replacement.
- 7.2B** Properly performs cleaning an air cooled engine
- 7.2C** Identifies and explains a water pump operation.
- 7.3A** Examines 2 cycle engine components and determines engine failure due to stale fuel and poor lubrication.
- 7.3B** Explains the damage done from improperly mixed fuel for 2 cycle engines.
- 7.4A** Correctly performs a cylinder compression test on 2 & 4 cycle engines.
- 7.4B** Correctly performs a cylinder leak down test on 2 & 4 cycle engines.
- 7.4C** Correctly performs an oil pressure test on 2 & 4 cycle engines.

SAMPLE PERFORMANCE TASKS

- Uses proper hand tools and holding devices to disassemble a 2 or 4 cycle engine.
- Looks up engine specifications for the engine student is working on.
- Tests and inspects a liquid cooling system.
- Cleans and inspects an air cooled system.
- Determines damage to 2 cycle engines due to contaminated fuel.
- Explains how compression and leak down tests can validate engine damage.

INTEGRATION LINKAGES

Mathematics, Math for Technology, Science, Electronics, Chemistry, Physics, Applied Communications, Technical Writing, Problem-Solving and Critical Thinking Skills, Occupational Safety and Health Administration (OSHA), Tennessee Occupational Safety and Health Administration (TOSHA), Environment Protection Agency (EPA), SkillsUSA, Interpersonal Skills, Employability Skills, Secretary's Commission on Achieving Necessary Skills (SCANS), CDX eTextbook, Equipment and Engine Training Council (EETC), Outdoor Power Equipment (OPEESA).

SUGGESTED RESOURCES

- Briggs and Stratton Power Equipment
- Harley Davidson Motorcycle Company
- National Automotive Technicians Education Foundation (NATEF) www.natef.org
- A8 Engine Performance, CD-ROM, Interactive Computer Based Training, DVP/CDX, 1-888-873-2239
- Multistate Academic and Vocational Curriculum Consortium, Inc. (MAVCC), *Power Product Equipment Technicians: Outboard-Engine Systems and Service*
- Outboard Engine Accessories Parts Catalogs
- Outboard Marine Corporation (OMC) Service Manuals
- *Boating Magazine*, New York, New York, 10019, 212-767-5585
- *Motor Boating and Sailing* magazine, New York, New York 10019, 212-649-4099
- American Power Boat Association (APBA)
- *Prope*
- Honda Motor Company
- Yamaha
- SkillsUSA, www.skillsusa.org
- Equipment and Engine Training Council
- Outdoor Power Equipment