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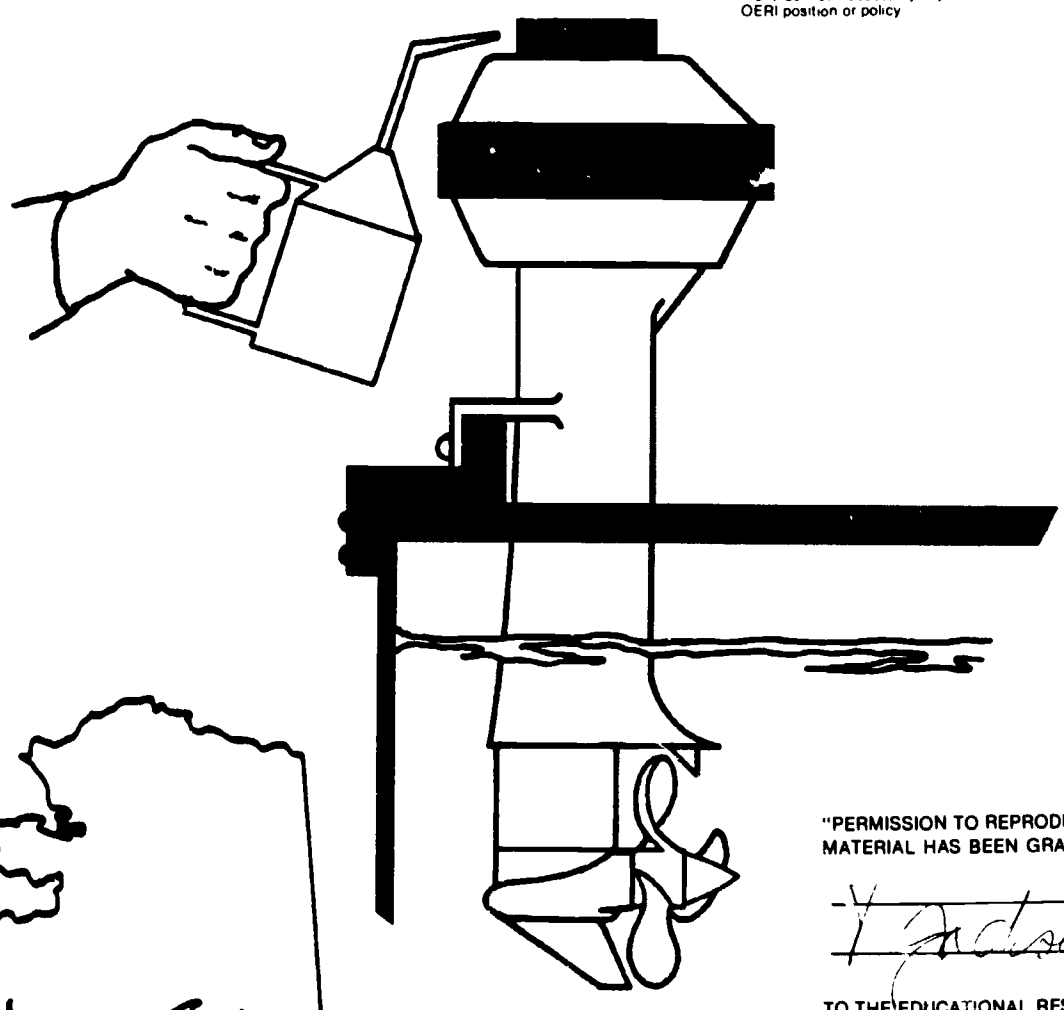
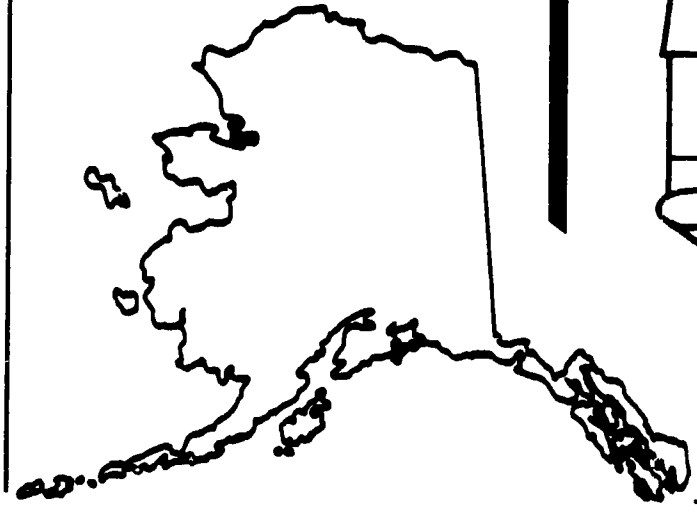
ABSTRACT

This competency-based curriculum guide is a handbook for the development of small engine and outboard marine mechanics programs. Based on a survey of Alaskan small engines and marine mechanics employers, it includes all competencies a student should acquire in such a mechanics program. The handbook stresses the importance of understanding the principles associated with the various components of small engines and outboard marine mechanics. Units begin with definitions of terms and principles so that students will have conceptual frameworks upon which they may develop a complete perspective for working in the field. The handbook is organized in these seven sections: (1) the concept of competency-based curriculum and the role of vocational educators in curriculum planning, implementation, and evaluation; (2) the hierarchy of small engines and outboard marine mechanics competencies; (3) competencies and tasks for the following subjects--employability skills, laboratory safety and shop procedures, tools and equipment, internal combustion engines, engine design and structure, cooling and lubrication systems, fuel systems, electrical systems, exhaust and emissions, engine overhaul/repair, troubleshooting and maintenance, power transmissions, brakes and safety, and marine engines and boat rigging; (4) course descriptions to assist school districts in developing their vocational programs; (5) curriculum analysis matrices to be used to determine competencies for specific small engines and outboard marine mechanics courses; (6) a sample skills card for evaluating and recording student progress; and (7) information on resources and specific materials available in Alaska and the rest of the nation. (KC)

# Small Engines and Outboard Marine Mechanics Curriculum









Alaska Department of Education 1988

# Small Engines and Outboard Marine Mechanics Curriculum

**State of Alaska**
Steve Cowper, Governor

Developed by the:
**Alaska Department of Education**
Office of Adult and Vocational Education

William G. Demmert, Commissioner

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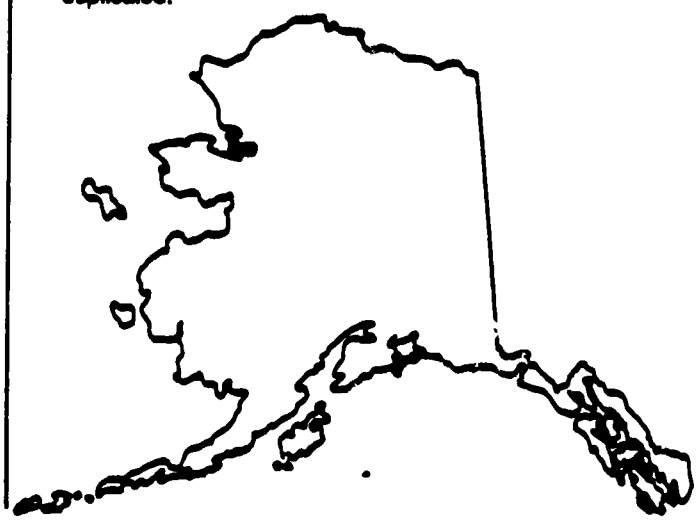

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# Table of Contents

# Foreword

This competency-based curriculum is designed to be a handbook for the development of small engine and outboard marine mechanic programs. It includes all competencies a student will acquire in such a mechanics program. Development of this handbook began with a survey of Alaskan small engines and marine mechanics employers. Their priorities regarding the skills and knowledge students need to acquire to survive and thrive in the industry form the basis of this handbook.

The handbook stresses the importance of understanding the principles associated with the various components of small engines and outboard marine mechanics. Units begin with definition of terms and principles so that students will have conceptual frameworks to which they may develop a complete perspective for working in the field. The fourteen units, basic and engine service competencies, are fundamental to understanding the small engines and outboard marine mechanics industry. The competencies and tasks are presented so that instructors have the prerogative to determine which aspects they want to teach in basic and advanced level courses.

The handbook is organized into seven sections:

Section I introduces the concept of competency-based curriculum. The role of vocational educators in curriculum planning, implementation, and evaluation is also included.

Section II provides the hierarchy of small engines and outboard marine mechanics competencies.

Section III presents the curriculum including the competencies and tasks for small engines and outboard marine mechanics.

Section IV contains course descriptions to assist school districts in developing their vocational programs.

Section V provides curriculum analysis matrices to be used to determine competencies to be included in specific small engines and outboard marine mechanics courses.

Section VI contains a sample skills card for evaluating and recording student progress.

Section VII lists information on resources and specific materials available in Alaska and the rest of nation.

It is recommended that all students participate in career awareness and exploration experiences to help them understand the connection between school and work and make career plans.

# Acknowledgements

This handbook reflects the competencies needed for entry-level employment due to the input of Alaskan small engines and marine mechanics professionals. Thanks and recognition go to the following technical committee members for their assistance and cooperation:

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R & P Small Engine Repair, Fairbanks
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Valley Small Engine Clinic, Juneau

A task force of Alaskan educators in small engines and marine mechanics helped to define the units, competencies, and tasks. The task force which met to finalize this handbook deserve a great deal of credit for their hard work and valuable input:

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Karen Ryals
Administrator
Office of Adult and Vocational Education
Alaska Department of Education
November 1988

# I

# Introduction to Competency-Based Curriculum

# Competency-Based Curriculum

Vocational education should be directed toward the skills, knowledge, and attitudes needed for successful employment. Mechanics educators need to continually update their curriculum in order to prepare students for competition in the job market.

An effective method for delivering vocational education is through a competency-based curriculum. This curriculum is based on a task analysis of the key occupations in small engines and outboard marine mechanics. Once a competency-based curriculum is set in place, student performance must be measured on levels of proficiency in those competencies. Thus, the critical features of competency-based education are:

1) validating competencies to be included in the curriculum; and
2) evaluation of student competency levels.

This curriculum handbook sets direction for local curriculum developers. It provides a framework for developing courses of study and lesson plans in local schools.

## Curriculum Based On Competencies

Competence refers to the adequate performance of a task. The task may be evaluated according to the performance or process, the service, or both.

Competency-Based Vocational Education consists of programs that derive their content from the tasks performed in each occupation/job and assess student performance on the basis of preset performance standards.

Learning materials define the competencies the student is to master, the criteria by which the student will be evaluated, and the conditions under which the evaluation will occur.

Competency-based instruction places emphasis on the ability to do, as well as on learning how and why. Student performance and knowledge are individually evaluated against the stated criteria, rather than against group norms.

The competency process utilizes a checklist of attitudes, knowledge, and skills that are commonly needed by entry-level employees in small engines and marine mechanics occupations. In developing this curriculum handbook, a cross-section of mechanics professionals were asked to respond to a survey on the basis of needs within their own establishments. The survey results were summarized to determine which attitudes, knowledge, and skills were important to firms in Alaska.

## Student Performance Assessment

A curriculum becomes competency-based when students are assessed on the basis of their competence. Sample skill cards are provided in this guide for teachers who wish to use them in assessing the competency levels of their students. The card has four levels of proficiency which allow continued development of skills. The card can be used to monitor students' progress as they move between tourism classes, between teachers and ..Je levels, and between school and work. The completed skills card is an important part of a placement portfolio when students begin their job searches.

# Curriculum Delivery Systems

## Vocational Student Leadership Organizations

Some of the competencies in this curriculum guide cannot be fully met in traditional classroom and lab settings. The Vocational Industrial Clubs of America (VICA) is a delivery system which can be integrated into the regular school program. Human relations skills as well as job skills will be enhanced by student participation in VICA. VICA activities should complement instruction in the small engines and outboard marine mechanics classroom and lab. They should be integrated as a curriculum delivery system and not allowed to become an extracurricular activity.

## Cooperative Work Experience

Some of the competencies identified in this guide cannot be fully developed at a school site. A work station in the community offers realistic experiences in fulfilling the program goals in career development and human relations. Cooperative Work Experience offers an excellent vehicle for the delivery of instruction. With well developed training plans, teachers and employers can cooperate to prepare students for employment. Cooperative Work Experience extends the instructional program beyond the availability of equipment and instructor time at the local school. Teachers and employers must maintain regular communications to assure that students are receiving a high quality experience.

The Rural Student Vocational Program (RSVP) provides a two week full-time work experience for students from rural areas where job stations are limited or non-existent.

The Job Training Partnership Act (JTPA) provides on-the-job experience to disadvantaged youth in both urban and rural areas.

# Role of Instructor in Curriculum Planning, Implementation, and Evaluation

The vocational instructor fulfills many roles which include the following responsibilities:

- Prepares a written vocational program plan.
- Develops and maintains a written program philosophy with objectives that support the philosophy.
- Maintains a written list of competencies identified as needed for the program area.
- Devises and maintains a classroom management system for implementing the curriculum materials provided for the program area.
- Evaluates the curriculum content periodically to determine curriculum changes and updates. This includes the involvement of the students (present and former), advisory committee members, and other personnel.
- Selects units of instruction and plans lesson plans based on the competencies of the occupation.
- Provides appropriate instructional materials, supplies, and equipment for the students to use.

- Provides school guidance counselor with information and updates regarding implementation of the specific curriculum.
- Reviews the instructional materials to assure that they are free from sex bias and sex role stereotyping.
- Works with an advisory committee.
- Assists and/or serves as an advisor to the appropriate student organization related to the vocational program area.
- Plans and arranges an appropriate classroom learning environment. This involves assisting students of different abilities to work at their own pace and in cases where remedial instruction is needed, securing additional help for those students.
- Reinforces basic skills of reading, communication (written & oral), and computation through vocational education experiences.
- Helps determine what objective(s) should be established for handicapped students as a part of the individual educational plan (IEP) development
- Uses a grading procedure that is made available to all students at the beginning of their training.
- Sets an example for grooming and dress that is generally found in the occupational area in business or industry to enable students to establish appropriate standards.

## Benefits of the Competency-Based Curriculum

Competency-based vocational education offers several benefits to students:

1. The competencies/tasks are directed to the student and provide measurable criteria for determining when the student has acquired the necessary knowledge and skills.
2. Students receive realistic training for the job. They become competent in tasks that are relevant to the occupation.
3. Students know what is expected of them throughout the course. The competencies are made available to them at the onset. They know what they will be doing and how well it must be done.
4. Each student is individually responsible for completing each competency attempted in the curriculum.
5. The basic thrust of the competency-based program is to evaluate students according to their accomplishments of tasks as they work up to individual capability. Students are not compared with other students in their accomplishments because each is expected to work according to employment standards. Because of the various evaluation policies of different school systems, the ideal of not comparing students in determining grades is not always possible.

# II
# Program Development

# Program Development

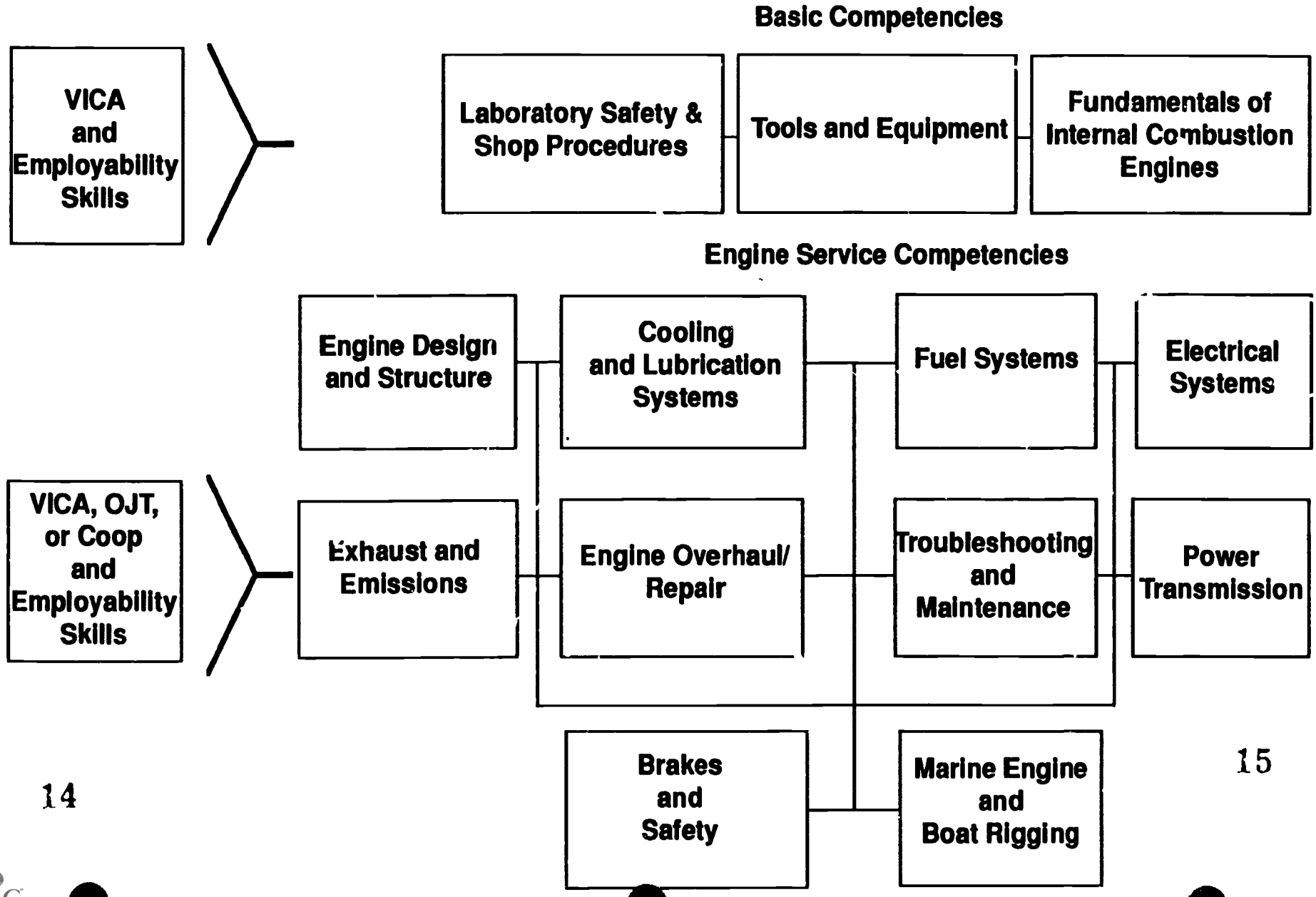
The format of this handbook was selected to aid administrators and teachers in concentrating on the skills needed for vocational training. It will assist in selecting the array of units and the delivery system which fit the school. This provides the flexibility of varying the course content to include the most valuable skills as appropriate for the scope and sequence. The primary importance is that students are able to secure foundation skills. Schools can vary their delivery systems to maximize student opportunities by:

1. Offering courses on alternate years or other planned sequences
2. Offering two or more courses in the same class
3. Providing individualized materials and instruction

A matrix is included in this guide for use in planning the courses to be offered and the content of each course.

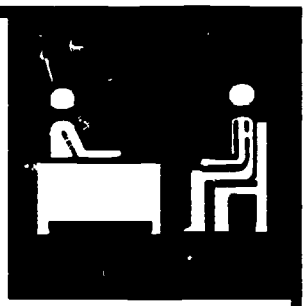
The following chart shows the hierarchy of small engines and outboard marine mechanics competencies.

# Hierarchy of Small Engines and Outboard Marine Mechanics



# III
# Competencies and Tasks

# Employability Skills



**Competency:** **Make career choices**

**Tasks:**

Conduct a self-assessment:
- a. assess values in relation to work
- b. recognize skills and aptitudes
- c. assess employment history and experience
- d. describe obstacles to employment
- e. use Alaska Career Information System and other career counseling systems and publications

Identify career clusters:
- a. list specific jobs and duties within clusters
- b. describe apprenticeship/training programs
- c. describe advanced training opportunities

Use labor market information:
- a. describe the current local labor market
- b. identify growth/demand occupations
- c. relate career choices to local labor market

Select a career goal:
- a. list how skills could be used in other jobs
- b. develop specific steps to reach goals

**Competency:** **Evaluate jobs in the small engine and outboard marine mechanics industry**

**Tasks:**

Identify educational and occupational opportunities such as:
- a. adult, postsecondary vocational training
- b. special grants from industry
- c. federal, state and local funding

Locate resources for finding employment

Confer with prospective employers

Explain the work of a(an):
- a. small engine technician
- b. marine technician
- c. parts shop salesperson
- d. manufacturers technical representative
- e. computer parts inventory technician

**Competency:** **Prepare a resume and job application**

**Tasks:**

Obtain a social security number

List :
- a. past and present work experience
- b. hobbies and interests
- c. community activities or memberships
- d. in-school activities or memberships
- e. awards, positions, or club offices
- f. adult references, including addresses and phone numbers

Obtain extra copies

Read job applications carefully

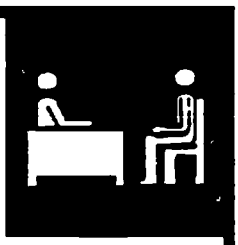
Follow instructions

Complete all items accurately

Write legibly

Verify references before listing them

| | |
|---|---|
| **Competency:** | **Write a cover letter** |
| **Tasks:** | Explain when and how to write a cover letter<br>Explain what a writing sample tells a potential employer<br>List the things the cover letter must include |
| **Competency:** | **Prepare for an interview** |
| **Tasks:** | Contact an employer to schedule an interview<br>Describe questions and responses asked in an interview<br>Use proper etiquette for an interview<br>Dress appropriately for an interview |
| **Competency:** | **Follow up the interview** |
| **Tasks:** | Analyze the interview<br>Determine whether a follow-up letter or call is required<br>Write a thank-you note or make a follow-up call |
| **Competency:** | **Dress appropriately on the job** |
| **Tasks:** | Identify proper attire for small and marine engine technician jobs<br>Be neat and clean |
| **Competency:** | **Manage personal responsibilities related to employment** |
| **Tasks:** | Secure adequate transportation<br>Identify adequate child care alternatives<br>Secure appropriate child care<br>Use independent living skills<br>Develop a personal finance plan |
| **Competency:** | **Maintain good health for effective job performance** |
| **Tasks:** | Exercise regularly<br>Eat properly<br>Get adequate rest<br>Explain the issue of smoking on the job<br>Refrain from drug abuse<br>Identify the hazards of job-related infectious diseases and how to avoid them |
| **Competency:** | **Understand employee rights and responsibilities** |
| **Tasks:** | Explain state labor laws relating to compensation<br>Complete tax forms<br>Describe:<br>a. minimum wage and types of exempt businesses<br>b. employee benefits, rights and responsibilities<br>c. labor contracts, grievance procedures and the role of unions<br>Describe a sample personnel policy |
| **Competency:** | **Deal effectively with customers** |
| **Tasks:** | Greet the customer<br>Talk politely to customer<br>Obtain all necessary information from customer in writing<br>Identify the business on the telephone<br>Relay customer complaints to employer |



**Competency:** **Attain work maturity**

**Tasks:**
Describe the importance of openness to new situations
Demonstrate characteristics of the mature person:
a. self-acceptance
b. consideration and respect for others
c. self-control
d. positive thinking and attitudes
e. flexibility
f. initiative
Maintain good work relationships
Differentiate between personal and job-related problems
Follow orderly and systematic work behavior

**Competency:** **Solve problems**

**Tasks:**
Explain the importance of having a method for analyzing and solving problems
Use the problem-solving process:
a. identify problems
b. obtain information
c. analyze problems
d. develop and analyze alternative solutions
e. choose a course of action
f. persevere through hardships
g. recognize and change otherwise unworkable solutions

**Competency:** **Demonstrate initiative and productivity**

**Tasks:**
Organize time effectively
Be responsible
Care about the quality of work
Complete assignments in accurate and timely manner
Handle pressures and tensions
Set priorities

**Competency:** **Be assertive**

**Tasks:**
Differentiate between assertive, aggressive, and passive behavior
Identify whom to go to for employee problems

**Competency:** **Be honest**

**Tasks:**
Define honesty and integrity
Explain how to deal with theft and dishonesty
Relate employee integrity to overall company performance
Recognize consequences of dishonesty

**Competency:** **Be reliable and dependable**

**Tasks:**
Maintain acceptable attendance records
Be on time
Give timely notice of interruptions to work schedule
Follow rules and regulations of workor training site

**Competency:** **Maintain good personal relations**

**Tasks:**
Use positive attitudes with others
Accept supervision and criticism
Cooperate with others
Accept chain of command
Follow the course of action to bring problems to the attention to management
Identify common on-the-job co-worker problems
Control emotions
Assume responsibility for own decisions and actions
Exhibit pride and loyalty

**Competency:** **Apply reading and writing skills**

**Tasks:**
Read technical journals
Use technical vocabulary
Locate information in trade and consumer magazines and supply catalogs
Write work orders, parts orders, and warranty reports
Locate and correct errors in spelling, grammar, and punctuation
Compose business letters
Transfer written messages to others verbally and in written form
Use good penmanship
Use proper telephone etiquette

**Competency:** **Follow verbal and written directions**

**Tasks:**
Ask for clarification
Use listening skills
Review situations of poor communications
Read directions when assembling and repairing equipment

**Competency:** **Demonstrate on-the-job growth**

**Tasks:**
Be aware of current products and service technology
Be aware of job progression and opportunities
Identify performance evaluation content
Evaluate further education options through the company

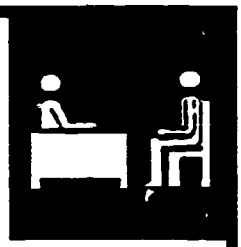
**Competency:** **Use proper job resignation procedures**

**Tasks:**
Write a letter of resignation
Make final settlements (in regards to retirement, physical injury, social security, severance pay, etc.)

**Competency:** **Use leadership skills**

**Tasks:**
Describe the Vocational Industrial Clubs of America (VICA) and how it teaches leadership skills:

a. participate in meetings according to rules of parliamentary procedure
b. function effectively on committees by accepting assigned responsibilities
c. plan and conduct effective group leadership activities
d. participate in society in a democratic way
e. be punctual and dependable
f. follow rules, standards and policies
g. work cooperatively with others



Explain importance of self-esteem
Practice eye contact
Use a firm handshake
Use presentation skills
Use communication skills
Participate in leadership activities

**Competency:** **Evaluate personal traits in relationship to self-employment**

**Tasks:**

Explain terms and principles associated with entrepreneurship
Describe the role of self-employment in the free enterprise system
Identify types of business organizations including:
- a. sole proprietorship
- b. limited partnership
- c. partnership
- d. corporation

Identify personal traits necessary for self-employment
Identify risks and rewards of starting a new business
Identify the role small businesses have played in job creation and new products and services
Identify the steps for establishing a business
Explain the importance of developing a business plan
Locate information and assistance on starting a small business

# Laboratory Safety & Shop Procedures

(A) Indicates advanced competency or task

**Competency:** **Understand need for safety**

**Tasks:**
Explain the need for safety
Identify components of a fire triangle and the effects of water, oil, and other flammable liquids
Locate and operate a fire extinguisher
Specify what to do in case of an emergency or accident
Practice safety habits and pass a written safety test
Secure small engines before test running them in the shop
Replace protective guards on chains, gears, shafts, or flywheels before operating engines
Use repair and service manuals

**Competency:** **Understand the organization of the laboratory**

**Tasks:**
Identify:
a. laboratory operation policies
b. location of laboratory equipment and materials
c. safety hazards
d. traffic patterns
e. work storage areas/work stations
f. location of emergency assistance and first-aid stations and exits

**Competency:** **Use general safety procedures**

**Tasks:**
Follow safety rules for:
a. maintaining a safe orderly shop
b. preventing accidents and injuries
c. applying first-aid
d. handling flammable metals
Use safety equipment in the laboratory
Demonstrate general shop and personal safety
Keep a clean, orderly, and safe working area

**Competency:** **Use chemicals safely**

**Tasks:**
Identify the use of hazardous, caustic, and toxic chemicals such as:
a. flammable liquids and solids
b. asbestos
c. acid
d. caustics - lyes, sodium hydroxide, steam cleaning fluids, floor cleaners
e. poisonous liquids
f. hazardous wastes and carcinogens
g. hazardous fumes

**Competency:** **Use laboratory equipment safely**

**Tasks:**
Explain proper use and operation of stationary and portable equipment
Identify faulty equipment
Explain reporting procedures for faulty equipment

**Competency:** **Use tools safely**

**Tasks:**
Explain importance of using tools safely
Identify safety measures such as keeping hands, clothing, tools, and other objects away from moving parts while running small engines.
Select tools appropriate to each project
Follow directions and procedures for specific work activities as given by the instructor, textbook, manual specifications or plans
Utilize tools in prescribed manners including:
a. using the proper tool for the task at hand
b. clamping projects securely before drilling or power grinding
c. using the correct speed for power tools and drill bits when working with metal
d. using properly sharpened tools and drill bits
e. using extension cords
f. using air hoses

**Competency:** **Maintain a clean shop**

**Tasks:**
Perform assigned shop cleanup duties
Keep floors and workbenches clean and neat
Wipe oil and grease spots immediately
Keep rags in self-closing metal container
Place scrap materials in proper containers or locations
Clean and replace all tools to cabinets, racks and other storage locations
Keep aisles, traffic areas, and exits free of materials and other debris

**Competency:** **Follow OSHA guidelines**

**Tasks:**
Explain the purpose of the Occupational Safety and Health Act (OSHA)
Identify material safety sheets and their location in shop
Identify worker rights under OSHA
Explain how to resolve hazardous and OSHA violation situations

**Competency:** **Prevent work-related injuries**

**Tasks:**
Describe the importance of safe working attitudes
Report injuries and accidents no matter how slight
Wear protective gear including:
a. hat or net to restrain long hair
b. eye and ear protection
c. respirators or filter masks
d. gloves
e. chaps
f. long sleeves
g. boots and steel-toed boots
h. shop garments

Follow safety procedures for:

a. lifting
b. working on fuel supply tanks
c. inflating tires
d. noise abatement
e. driving
f. working in enclosed areas

**Competency:** **Perform general shop duties**

**Tasks:**

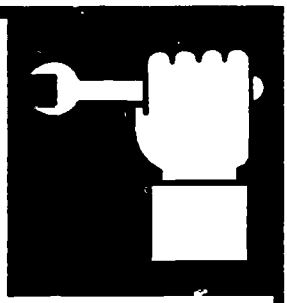
Take in and check out repair work
Maintain tool and equipment inventory
Maintain inventory cards
Read mechanics publications

**Competency:** **Perform service and business procedures**

**Tasks:**

Fill out a work order
Identify engine model, type and serial number
Identify parts needed from a parts manual
Use parts interchange manual
Obtain parts
Complete a parts sales slip
Write service reports
(A) Perform sales and service selling techniques
(A) Evaluate personnel time management
(A) Determine employee productivity
(A) Estimate repair costs

# Tools and Equipment



(A) Indicates advanced competency or task

**Competency:** **Use hand tools**

**Tasks:** Identify and demonstrate the proper use of tools such as:

- a. hammers
- b. chisels and punches
- c. drivers
- d. pliers
- e. drill bits
- f. grinders
- g. files
- h. clamps
- i. screwdrivers
- j. pullers
- k. reamers
- l. socket sets
- m. locking devices
- n. stud extraction tools
- o. taps and dies
- p. torque wrenches
- q. wrenches

Maintain tools by:

- a. sharpening drill bits
- b. sharpening chisels, punches, and screwdrivers
- c. tightening or replacing handles
- d. checking torque wrench for accuracy
- e. cleaning tools
- f. dressing a grinding wheel

**Competency:** **Use power tools**

**Tasks:** Identify and demonstrate the safe operation of:

- a. electric tools and equipment
- b. pneumatic tools and equipment
- c. electric stationary equipment such as:
  1. drill press
  2. grinders

(A) Demonstrate the safe operation of boring machines

**Competency:** **Operate oxy-acetylene equipment**

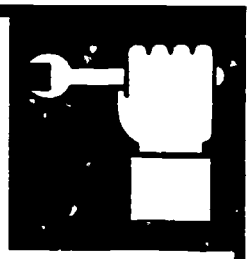
**Tasks:** Explain terms and principles associated with oxy-acetylene equipment including:

- a. types of gases
- b. flames
- c. tip types and sizes
- d. safety equipment
- e. torch adjustments
- f. pressure settings

Safely set up and secure oxy-acetylene torches

Use oxy-acetylene equipment for:

- a. heating
- b. cutting



**Competency:** **Use fasteners, gaskets, sealants, and adhesives**

**Tasks:**
Explain the use, classification, and sizes of fasteners
Explain the proper application of gaskets, sealants, and adhesives
Explain the proper procedure for the removal and tightening of fasteners
Identify the function of types of nuts used in small engines

**Competency:** **Perform thread repair**

**Tasks:**
Chase threads
Extract broken fasteners
Drill and tap holes
(A) Repair damaged threads using a thread repair procedure

**Competency:** **Use measuring devices**

**Tasks:**
Identify terms associated with measuring including:
a. scale
b. graduation
c. tolerance
d. fits
e. reference point

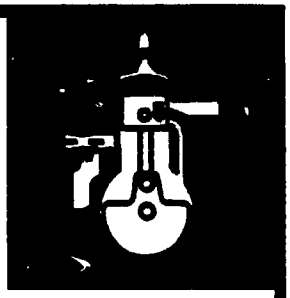
Identify the use of:

| | |
|---|---|
| a. bore gauges | j. pressure gauge |
| b. caliper | k. small hole gauge |
| c. coil tester | l. steel rule |
| d. dial indicator | m. tachometer |
| e. drill gauges | n. telescoping gauges |
| f. electrical test equip. | o. thread pitch gauge |
| g. feeler gauges | p. timing light |
| h. micrometer | q. vernier instruments |
| i. multimeter | r. vacuum gauges |

**Competency:** **Apply mathematic and measurement fundamentals**

**Tasks:**
Explain the importance of math and measurement
Use measurements related to work on small engines

# Fundamentals of Internal Combustion Engines



**Competency:** Identify parts of the small engine

**Tasks:**
- Disassemble a small engine
- Recognize the parts of a small engine
- Reassemble the small engine
- Start the engine

**Competency:** Understand engine classification and applications

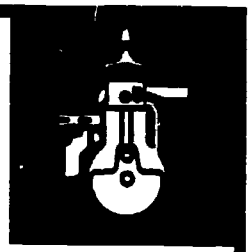
**Tasks:**
- Explain the different types of small engines
- Explain how engines are classified by type, size, and manufacturer
- Explain the different ways engines are classified such as:
  a. internal/external combustion engines
  b. fuels: gasoline, diesel, propane
  c. two-cycle, four-cycle, rotary
  d. displacement
- Explain the application of engines such as:
  a. outboards
  b. generators
  c. ATV's

**Competency:** Understand the operation of the internal combustion engine

**Tasks:**
- Explain terms and principles associated with internal combustion engines including:
  a. expansion of solids, liquids, and gases as they are heated
  b. the triangle of combustion
  c. how a controlled explosion obtains useful power
  d. atmospheric pressure and vacuum
- Explain how high pressure in the engine cylinder causes a piston to move
- Explain how motion is changed to rotary motion
- Explain the sequences, activities, and events taking place in an internal combustion engine
- Contrast the operating cycles of two- and four-cycle engines
- Explain the need for cooling, lubrication, fuel, ignition, and exhaust systems

**Competency:** Understand the operation of small diesel engines

**Tasks:**
- Explain terms and principles associated with small diesel engines including:
  a. governor
  b. fuel pumps
  c. injectors/injector pumps
  d. glow plugs
  e. pre-combustion chamber
- Compare and contrast the differences between compression and spark ignition systems
- Describe the operation of the fuel injection system in diesel engines
- Explain the operation of the four-cycle diesel engine



**Competency:** **Understand engine operating systems**

**Tasks:**

Explain fuel systems such as:
- a. fuel tanks
- b. venting
- c. fuel lines
- d. fuel pumps
- e. carburetion/fuel injection

Identify lubrication systems for small engines including:
- a. oil supply container
- b. oil pumps/splashers
- c. grease fittings

Explain ignition systems including:
- a. points and condensor
- b. electronic systems
- c. computerized systems

Explain cooling systems such as:
- a. liquid
- b. air
- c. combinations of liquid and air

**(A) Competency:** **Understand engine measurement and performance**

**Tasks:**

Explain terms and fundamental principles associated with mechanical power and its production including:
- a. efficiency/work/energy
- b. horsepower
- c. PSI (Pounds per square inch)
- d. compression ratio
- e. torque

# Engine Design and Structure

**Competency:** **Understand the operation of the piston, connecting rod, and crankshaft assembly**

**Tasks:**

Explain terms and principles associated with the piston, connecting rod, and crankshaft assembly including:

a. piston head
b. piston pin
c. skirt
d. pin hole
e. ring grooves
f. ring side clearance
g. skirt clearance
h. retaining ring
i. connecting rod
j. flywheels
k. bearings and retainers
l. piston composition
m. match marks
n. main bearing journals
o. connecting rod journals
p. counterweights/balance
q. keys and keyways
r. lock plate
s. snout

Explain differences in piston and crankshaft designs between two and four stroke engines

Explain the transfer of energy from a chemical reaction to mechanical energy

Explain the transition from reciprocating motion to rotary motion

**Competency:** **Understand the operation of the valve train**

**Tasks:**

Explain terms and principles associated with valves including:

a. margin
b. seat
c. stem
d. face
e. retainer
f. head
g. stem

Explain terms and principles associated with valve trains including:

a. adjusting nut
b. tappet guide
c. camshaft
d. cam lobes/eccentrics
e. head
f. valve guide
g. valve spring
h. clearance
i. lock nut
j. tappet
k. push rods
l. rocker arms
m. timing gears and chains

Explain the relationship between the valve train and operation of the engine

**Competency:** **Understand the operation of the two-stroke induction system**

**Tasks:**

Explain terms and principles associated with two-stroke induction systems including:

a. rotary value
b. reed value
c. piston port (transfer channel)
d. loop scaveging versus cross scaveging

Explain intake, power, and exhaust cycles of the two-stroke system

Explain the difference in efficiency between two and four-stroke engines

**Competency:** **Understand the function of the cylinder block assembly**

**Tasks:**

Explain terms and principles associated with the cylinder block and head including:

a. block
b. block material
c. cooling systems
d. cylinder and sleeves
e. head bolts
f. head gasket
g. head types and construction
h. induction system passages
i. main bearing and capstan supports
j. lubrication systems
k. ports
l. engine mounting systems
m. expansion plugs

Explain the difference in block and head design between two and four stroke engines

# Cooling and Lubrication Systems

(A) Indicates advanced competency or task

**Competency:** **Understand engine cooling systems**

**Tasks:**

Explain the components and functions of air-cooled systems including:
- a. flywheel
- b. filter screen
- c. blower shroud
- d. cylinder head baffle
- e. cylinder baffle
- f. air deflector
- g. thermostat

Explain the components of liquid-cooled systems including:
- a. radiator
- b. water pump
- c. water jacket
- d. fan
- e. thermostat
- f. pressure cap
- g. radiator hose
- h. fan belt

Describe the purpose of engine cooling systems
Describe types of cooling systems:
- a. air
- b. liquid

Explain the purpose of pressurizing the liquid cooling system
Explain the purpose of oil and fuel in cooling

**Competency:** **Service air cooling systems**

**Tasks:**

Inspect cooling system components
Adjust/replace belts
Clean air fins
Check for obstructions

**Competency:** **Service liquid cooling systems**

**Tasks:**

Inspect cooling system components
Test pressure cap
Pressure test cooling system for leaks
Perform combustion leakage test
Test and add coolant
Replace hoses
Adjust/replace belts
Check thermostat and by-pass housing
Clean exterior components
Inspect engine oil and transmission fluid coolers
Inspect cooling warning light system and gauges
(A) Inspect water pump for bearing condition and water leaks
(A) Use pressure test, fluid gas detector, and infra-red testers

**Competency:** **Inspect outboard water pumps**

**Tasks:**
Explain how the water pump circulates water
Start the engine
Check for water circulation
Check for system obstructions, both inlet and outlet
Repair/replace pump

**Competency:** **Understand engine lubrication**

**Tasks:**
Identify terms and principles associated with engine lubrication such as:
- a. friction
- b. heat
- c. oil viscosity
- d. oil classification/ratings

Identify uses of lubricants such as:
- a. dry
- b. liquid
- c. paste

Describe the effects of lubrication system failures
Contrast the properties of common small engine lubricating oils

**Competency:** **Service lubricating systems**

**Tasks:**
Remove/replace lubrication system components including:
- a. filters
- b. screens
- c. check valves
- d. PCV valve
- e. oil

Troubleshoot lubrication component failure

**(A) Competency:** **Understand chassis lubrication and service**

**Tasks:**
Explain different types and ratings of lubricants used for chassis lubrication
Service a variety of bearing types including:
- a. ball bearings
- b. roller bearings
- c. needle bearings
- d. babbit or bushing bearings
- e. thrust washers or bearings

Troubleshoot bearing component failure in chassis

**(A) Competency:** **Service oil injection systems**

**Tasks:**
Identify the different types of oil injection:
- a. mechanical type
- b. vacuum type

Repair and replace oil pump and time to engine operation

# Fuel Systems

(A) Indicates advanced competency or task.

**Competency:** **Understand fuel systems**

**Tasks:**

Explain terms and principles associated with fuel systems including:
- a. fuel types
- b. fuel/oil mixtures
- c. fuel storage/venting
- d. fuel distribution and filtration
- e. oil injection system

Describe the principles involved in:
- a. fuel injection
- b. carburetion

Explain the operation of gas (vapor) fuel systems including:
- a. storage tanks, lines and fittings
- b. regulators
- c. carburetors

**Competency:** **Understand carburetor systems**

**Tasks:**

Explain terms and principles associated with carburetor systems including:
- a. butterfly float
- b. slide float
- c. butterfly diaphragm
- d. constant velocity
- e. classifications

Identify carburetor theory and circuitry

Identify the parts and functions of small engine carburetors including:
- a. choke
- b. throttle butterfly
- c. venturi assembly
- d. hi speed needle/orifice
- e. slow speed needle
- f. float or diaphragm metering
- g. inlet needle valve
- h. slide

Disassemble/reassemble and adjust small engine carburetors

**Competency:** **Service fuel systems**

**Tasks:**

Inspect, repair/replace:
- a. fuel delivery system components
- b. carburetion system components

(A) Inspect, repair/replace fuel injection system components

**Competency:** **Service speed control devices**

**Tasks:**

Identify and adjust:
- a. governors
- b. remote controls

Adjust/repair throttle and/or shift controls

# Electrical Systems

(A) Indicates advanced competency or task

**Competency:** Understand electricity and magnetism

**Tasks:**

Explain terms and principles associated with electricity and magnetism including:

a. current flow
b. electrons
c. conductor
d. electromagnet
e. magnetism
f. amperes
g. ampmeter
h. voltage
i. resistance
j. fuse
k. circuitry
l. induction/coils
m. integrated circuits
n. insulator
o. condenser/capacitor

Explain the function and operation of electrical component systems of small gasoline engines

**Competency:** Understand batteries

**Tasks:**

Explain purpose, construction, and operation of batteries including:

a. types
b. voltage
c. safety

**Competency:** Service batteries

**Tasks:**

Explain terms and principles associated with battery service including:

a. safety practices
b. checking the battery and hold downs
c. checking the electrolyte level (specific gravity) in all cells
d. cleaning corrosion from battery terminals and top
e. testing and diagnosing the condition of battery with tester
f. recharging battery

Connect battery charger for charging and jump starting
Remove and replace battery/cables
Prepare battery for installation for:

a. wet/dry
b. maintenance free

**Competency:** Understand charging systems

**Tasks:**

Explain the components of the charging system
Explain how the following relate to small engine charging systems:

a. alternators
b. generators
c. voltage regulators
d. rectifiers
e. transistors
f. diodes
g. relays
h. volt/ampmeters

**Competency:** **Service charging systems**

**Tasks:**
Repair and replace components
Use flywheel pullers and multimeters
(A) Troubleshoot charging system components

**Competency:** **Understand breaker ignition systems**

**Tasks:**
Explain the function of the breaker ignition system
Explain the difference between a magneto-ignition system with breaker points and breakerless magneto-ignition system
Explain the function of the following ignition components:
a. spark plug
b. coil/transformer
c. points or sensor coil
d. condenser/capacitor
e. flywheel magnet
f. cam
g. flywheel key

**Competency:** **Service breaker ignition systems**

**Tasks:**
Inspect primary and secondary ignition wiring
Inspect ignition mechanical advance controls
(A) Remove, test, and replace ignition circuit components

**Competency:** **Understand the solid state ignition system**

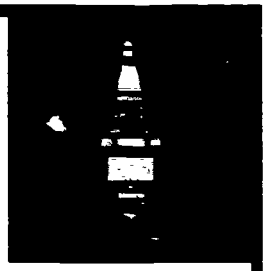
**Tasks:**
Explain terms and principles associated with the solid state ignition system
Explain the operation and advantages of the solid state ignition system:
a. CDI ignition system
b. TCI ignition system
Explain the basic components of the solid state ignition system including:
a. trigger coils
b. CD module
c. rectifier
d. capacitor
e. secondary coil
f. SCR

**Competency:** **Service solid state ignition systems**

**Tasks:**
Demonstrate:
a. ignition timing both statically and dynamically
b. troubleshooting sequence
c. the use of troubleshooting equipment

**Competency:** **Understand starting systems**

**Tasks:**
Identify types of starters used on small engines
Explain operation of different types of mechanical and electrical starters
Explain purpose of starter drives and safety interlocks



**Competency:** **Service starting systems**

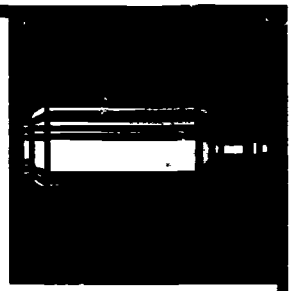
**Tasks:**
Adjust/maintain manual, mechanical, and electrical starters
Inspect starter systems
Remove and replace starter components
(A) Rebuild starter components

**Competency:** **Service engine timing**

**Tasks:**
Explain terms and principles associated with engine timing such as:
a. timing marks
b. timing gears
c. timing chains

Explain the role of timing to the operation of small engines
Determine firing orders/cylinder numbering
Replace points and set gap

# Exhaust and Emissions



**Competency:** **Understand exhaust systems**

**Tasks:**
Identify the purposes of the exhaust system
Identify the terms and principles associated with the exhaust system for both 2 and 4-cycle engines including:
a. pipes
b. mufflers
c. valves
d. ports
e. manifold
f. header
g. spark arrester
Identify applications of different types of mufflers and tuned exhaust systems

**Competency:** **Understand safety and environmental concerns**

**Tasks:**
State the safety concerns of operating an engine in an enclosed area
Explain the potential hazards of flammable material in proximity of exhaust systems
Explain environmental concerns regarding engine emissions and operation

**Competency:** **Service exhaust systems**

**Tasks:**
Follow safety procedures
Diagnose exhaust system problems
Use service and repair manuals
Use special tools for servicing exhaust systems
Remove and replace exhaust system components
Inspect and clean exhaust ports and pipes

# Engine Overhaul/Repair

(A) Indicates advanced competency or task

**Competency:** **Understand engine overhaul**

**Tasks:**

Identify engine noises
Explain:
- a. conditions which cause engine oil consumption
- b. cooling system problems

Explain causes of engine failure such as:
- a. allowing dirt to get into engine
- b. failing to check crankcase oil level often enough and letting engine run low on oil
- c. overloading engine so it works too hard
- d. running the engine too fast
- e. failing to properly store engine during off season
- f. timing
- g. fuel mixture
- h. air leaks

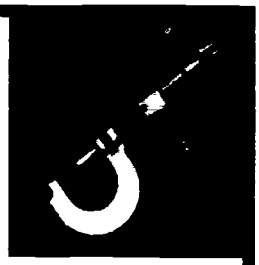
**Competency:** **Disassemble engine**

**Tasks:**

Use tools appropriate for engine disassembly including:
- a. flywheel wrench
- b. flywheel holder
- c. flywheel puller
- d. valve spring compressor
- e. engine stand
- f. ring expander

Disconnect battery
Remove engine from vehicle
Mount engine on suitable stand
Drain all fluids from engine
Remove exterior components including:
- a. starter unit
- b. air cleaner and its mounting bracket
- c. exhaust pipe and muffler
- d. carburetor and intake manifold
- e. air shroud, blower housing baffles, and fuel tank
- f. flywheel
- g. magneto components
- h. valve cover

Disassemble engine and remove internal components including:
- a. head
- b. valves and springs
- c. reed valve assembly
- d. piston assembly
- e. rings from piston
- f. piston pin locks and pin
- g. crankshaft
- h. camshaft
- i. oil pump and governor assembly
- j. main and rod bearings



Clean all parts and dry for inspection and measurement
Inspect for surface damage to machine areas

**Competency:** **Service a cylinder**

**Tasks:**

Use cylinder rebuilding tools including:
- a. measuring instruments
- b. deglazing tool
- c. cylinder vise support
- d. hone
- e. boring bar
- f. ridge reamer

Inspect cylinder examining for:
- a. cracks
- b. stripped threads
- c. broken fins
- d. scored and damaged cylinder walls
- e. sleeve separation
- f. taper and out of roundness

**Competency:** **Service the piston, rings, and connecting rod**

**Tasks:**

Use tools including:
- a. outside micrometer
- b. telescoping gauge
- c. ring groove cleaner
- d. feeler gauges
- e. ring expander

Check piston connecting rod assembly visually for scoring wear spots and deformities
Disassemble piston/connecting rod assembly
Clean and compare measurements to manufacturers specifications
Check for ring groove wear and ring end gap
Inspect pin and connecting rod

**Competency:** **Service a crankshaft assembly**

**Tasks:**

Use tools including:
- a. outside micrometer
- b. seal removal tools
- c. seal installation tools
- d. bearing pullers
- e. bearing installation tools

Measure crankshaft to manufacturer's specifications including:
- a. bearing journals and crank pin
- b. bearings and main seals

**Competency:** **Service a multi-piece crankshaft assembly**

**Tasks:**

Use tools including:

a. dial indicators
b. inside micrometers
c. outside micrometer
d. bearing puller
e. centering device
f. vise
g. soft hammer
h. thickness gauge
i. arbor press

Dissassemble/reassemble crankshaft according to manufacturer's procedures and specifications

**Competency:** **Service a valve assembly**

**Tasks:**

Use tools including:

a. valve seat grinding equipment
b. valve face grinding equipment
c. outside micrometer
d. telescoping gauge/small hole gauges
e. valve spring tension tester
f. valve seat removal tools
g. valve seat driver
h. valve guide removal tools
i. valve guide reamers

Recondition valve face, seats, stems and guides
Disassemble/reassemble valve assembly according to manufacturer's procedures and specifications

**Competency:** **Reassemble the small engine**

**Tasks:**

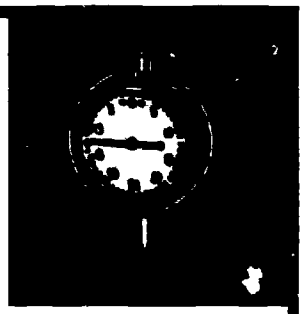
Use tools including:

a. torque wrench
b. gasket sets and sealants
c. valve spring compressor
d. ring compressor
e. assembly lube
f. ring expander
g. engine manual
h. plastigauge

Coat all metal surfaces with light weight oil before assembly
Install crankshaft in block
Assemble rod to piston with wrist pin
Check ring gap in cyclinder
Install rings or piston in correct position
Install ring compressor on piston
Push piston intor cylinder
Line rod in correct position on crankshaft
Install rod cap, oil slinger, and lock tabs
Torque rod bolts to correct specifications
Install tappets
Install camshaft and cam gear
Install oil slinger or oil pump

Install gasket on block assembly
Install sump bolts
Check end play of crankshaft
Install valves
Check valves for correct clearance
Install valve springs, valve cover, and valve cover gasket
Install air deflector shields
Install cam plunger, ignition points, and condensor
Gap points to correct setting when points fully open
Install point dust cover
Install flywheel and flywheel key, washer, and starter recoil mechanism
Install coil assembly and air vane governor assembly
Check cylinder head for warping
Install cylinder head gasket, cylinder head, and air deflector
Install shroud and flywheel cover and fuel tank
Install carburetor gasket, carburetor, governor linkage, and springs
Connect fuel lines and valve cover breather tube
Install muffler and lock nut
Install engine on equipment or implement
Connect remote throttle, belts, and other equipment
Fill crankcase with new oil
Install serviced air filter on carburetor
Fill fuel tank with fresh fuel
Install spark plug
Turn on fuel to carburetor
Make final adjustments
Start the engine

# Troubleshooting and Maintenance



**Competency:** **Diagnose engine malfunctions**

**Tasks:**

Troubleshoot mechanical conditions of the following:
- a. cylinder head and valve train problems
- b. block problems
- c. intake manifold and carburetor pre-heat system
- d. exhaust system

Troubleshoot electrical circuit conditions of the following:
- a. cranking circuit
- b. charging circuit
- c. conventional and electronic ignition systems

Diagnose fuel system conditions including:
- a. fuel storage, pumps, lines and filters
- b. carburetor adjustments

Perform running test including:
- a. low speed operation
- b. high speed operation
- c. acceleration
- d. ignition patterns
- e. carburetor adjustment and power circuit
- f. horsepower/rpm
- g. vibrations

**Competency:** **Service engines that have been submerged**

**Tasks:**

Explain terms and principles associated with engines that have been submerged such as:
- a. chemical reaction with salt water
- b. chemical reaction with fresh water
- c. oxidation

Leave the engine submerged until ready for immediate service
Flush with fresh water
Inspect engine
Drain all fluids
Blow dry
Determine whether or not engine is operational
Refer to manufacturer's specifications for running and/or for repair

**Competency:** **Tune-up small engines**

**Tasks:**

Explain terms and principles associated with small engine tune-up such as:
- a. point gap
- b. proper air/fuel mixture

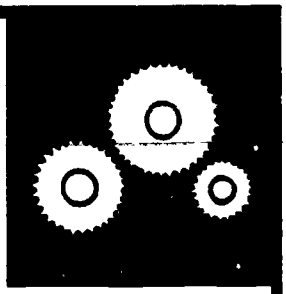
Service and/or replace spark plugs
Service and/or replace ignition points and condenser
Check engine compression and/or cylinder leakage
Service/replace distributor
Adjust dwell and ignition timing
Test and service battery and cables
Set carburetor idle mixture and speed

Adjust linkages
Service spark arrestors and/or filter
Service and/or replace fuel filter
Inspect hoses and tighten all connections
Check and service lower unit oil
Test charging system circuit
Test cranking system circuit
Check and adjust ignition system
Use basic meters, including:
a. ohmmeter
b. ammeter
c. voltmeter
d. timing light/advance meter
e. R.P.M. and dwell meter
Lube mechanical parts (steering, throttle, tilt)

**Competency:** **Install and break-in engine assembly**

**Tasks:**
Explain terms and principles associated with break-in of engine assemblies such as:
a. friction and wear
b. seating of mechanical parts
Install as per manufacturer's instruction
Inspect engine fluid leaks and check oil pressure
Install muffler assemblies
Perform final adjustments on:
a. carburetor
b. belts
c. linkage
d. dwell and timing
e. fluid levels
f. test cooling system
Replace protective guards on chains, gears, shafts, or flywheels before operating

# Power Transmissions



(A) Indicates advanced competency or task

**Competency:** Understand transmissions

**Tasks:**

Explain terms and principles associated with power transmissions such as:
- a. gear ratios
- b. fluid pressures and hydraulic systems

Explain the need for a transmission to keep an engine in its optimum power curve

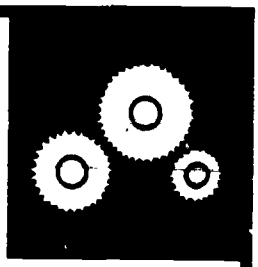
Identify type and operation of the following transmissions:
- a. belt drives
- b. chain drives and sprockets
- c. centrifugal clutches, flex couplings
- d. variable torque converter
- e. outboard lower units and sets
- f. outboard propeller design
- g. gear transmissions
- h. hydraulic systems

(A) Calculate power requirements for a specific engine, including:
- a. force
- b. work
- c. friction
- d. torque
- e. energy
- f. kinetic energy
- g. potential energy
- h. power
- i. horsepower
  1. brake horsepower
  2. indicated horsepower
  3. frictional horsepower
  4. rated horsepower
  5. corrected horsepower
- j. electrical power (kilowatts)

**Competency:** Service transmissions

**Tasks:**

Use service and repair manuals
Check alignment of pulleys and shafts
Remove/repair clutches and flex couplings
Inspect/repair chain drive system
Check belt tension and condition
Disassemble primary and secondary converter
Inspect/repair hydraulic systems fluid levels and leaks
Measure and/or adjust fluid level
Service hydraulic pumps and valve assemblies, hoses and filters
Rebuild drive
(A) Rebuild valve assembly



**Competency:** **Overhaul outboard lower units, propeller, and trim tabs**

**Tasks:**

Explain terms and principles associated with outboard lower units, propellers, and trim tabs including:
- a. pinion gears
- b. gear ratios
- c. pitch of propeller
- d. energy conversion
- e. high volume hydraulic pumps

Use service and repair manuals
Service/repair:
- a. jet units
- b. lower units
- c. propeller
- d. trim tabs

**Competency:** **Service gear housing assembly components**

**Tasks:**

Inspect fluid levels and leaks
Inspect and adjust linkages
Inspect and torque mounting bolts
Inspect vacuum shift controls
Use special tools and equipment
Use service and repair manuals
Service and adjust/replace:
- a. clutch assembly
- b. linkage
- c. transmission
- d. differential
- e. lubricant levels and condition

(A) Overhaul/rebuild
- a. manual transmissions
- b. differentials

**Competency:** **Service drive shaft components**

**Tasks:**

Explain terms and principles associated with servicing drive shaft components such as:
- a. energy conversion
- b. balance
- c. flexible couplings
- d. torque
- e. horsepower

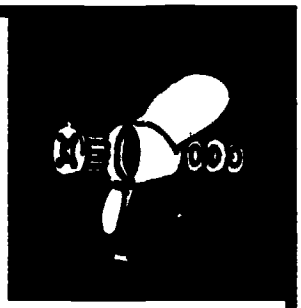
Inspect and lubricate universal joints
Repair/replace constant velocity joint
Measure drive shaft angle and runout

# Brakes and Safety

(A) indicates advanced competency or task

| | |
|---|---|
| **(A) Competency:** | **Service hydraulic brakes** |
| **Tasks:** | Explain terms and principles associated with hydraulic brakes<br>Replace discs and/or drums<br>Bleed brakes<br>Replace pads and/or shoes<br>Adjust shoes and peddle lever for proper free play<br>Rebuild master and slave cylinders |
| **(A) Competency:** | **Service mechanical brakes** |
| **Tasks:** | Explain terms and principles associated with mechanical brakes<br>Change cables and brake shoes<br>Adjust shoes<br>Adjust linkage for proper free play |
| **(A) Competency:** | **Service safety interlocks** |
| **Tasks:** | Explain terms and principles associated with safety interlocks<br>Troubleshoot with multimeter interlock switches<br>Replace switch<br>Adjust switch engagement |
| **(A) Competency:** | **Service chain saw brakes** |
| **Tasks:** | Explain terms and principles associated with chain saw brakes<br>Replace brake parts<br>Adjust brake for proper free play |
| **(A) Competency:** | **Service blade brakes** |
| **Tasks:** | Explain terms and principles associated with blade brakes<br>Troubleshoot and repair blade brake systems<br>Replace parts<br>Adjust brake for proper free play |

# Marine Engine and Boat Rigging



(A) Indicates advanced competency or task

**(A) Competency:** **Understand motor installation**

**Tasks:**
Explain terms and principles associated with motor installation
Calculate:
- a. center of boat
- b. engine height

Install:
- a. steering system
  - 1. hydraulic
  - 2. mechanical
- b. remote control systems

**(A) Competency:** **Service accessories**

**Tasks:**
Inspect steering mechanism, bushings or bearings, lowering mechanism:
- a. cables
- b. gears
- c. shafts

Refit and replace steering mechanism, bushings and bearings, steering, cables, gears, shafts
Remove and replace raising and lowering mechanism
Diagnose and repair deck mounting or transom mounting mechanism

**(A) Competency:** **Understand corrosion protection and engine storage**

**Tasks:**
Explain terms and principles associated with corrosion protection and engine storage such as:
- a. oxidation
- b. electron flow
- c. electrolysis and protection devices
- d. surface protection

Remove, inspect and replace sacrificial anodes
Winterize engine

**(A) Competency:** **Service propellers**

**Tasks:**
Select appropriate prop for a given marine package, including:
- a. selecting a prop from a manufacturer's prop chart
- b. testing prop
- c. changing tilt pin hole
- d. adjusting trim tab
- e. adjusting engine height

Test vessel on the water including:
- a. drivability of vessel
- b. engine operation
- c. safety features of vessel

**(A) Competency:** **Perform finish repair**

**Tasks:**

Explain terms and principles associated with finish repair such as:
- a. adhesion
- b. solvents
- c. catalytic reactions

Perform fiberglass/painting operations including:
- a. selecting repair materials
- b. repairing surface area
- c. preparing surface area
- d. preparing paint mixture
- e. spraying paint surface

**(A) Competency:** **Rig trailers**

**Tasks:**

Explain terms and principles associated with rigging of trailers including:
- a. electrical current
- b. resistence
- c. grounding
- d. insulation
- e. corrosion

Perform trailer set-up including the inspection, assembly and maintenance of:
- a. safety chains and couples
- b. trailer winch
- c. bow eye hook
- d. cable or rope
- e. ratchet lock
- f. winch gears
- g. mounting bolts
- h. electrical lighting system

Inspect and adjust bunks and rollers including:
- a. checking boat hull to trailer clearance
- b. tightening all bunk fasteners

Inspect drum brake and wheel system including:
- a. brakes
- b. drums
- c. linings
- d. wheel cylinders/calipers
- e. master cylinder
- f. lines/hoses
- g. control valves
- h. surge brakes

**(A) Competency:** **Service wheel bearings and seals**

**Tasks:**

Explain terms and principles associated with wheel bearings and seals including:
- a. corrosion
- b. friction
- c. lubrication

Remove, inspect, pack/replace wheel bearings and seals

**(A) Competency:** **Install dash and bow accessories and components**

**Tasks:**

Explain terms and principles associated with installing dash and bow accessories and components such as:

a. arrangement of components
b. electrical/electronic concerns
c. mechanics
d. economics

Install accessories such as:

a. circuit breaker and ground bar system
b. speedometer
c. tachometer
d. horn and horn button
e. depth indicator
f. windshield wiper
g. running lights
h. spot light
i. anchor
j. voltmeter
k. water pressure gauge
l. trim gauge

# IV
# Course Descriptions

# Course Descriptions

These brief course descriptions provide a conceptual framework for the design and implementation of a balanced program in small engines and outboard marine mechanics. Teachers can use these descriptions to organize course offerings in small engines and outboard marine mechanics education. These descriptions are examples of content organization and are too brief for purposes of program approval. Local schools will need to provide more definition regarding the content of their courses than is reflected in these course descriptions.

Course: Small Engines and Outboard Marine Mechanics I
Length: One Year
Grades: 9-12

Small Engines and Outboard Marine Mechanics I is a course which provides students with introductory experience and basic skills in small engine and marine technology. This first course includes an introduction to: laboratory safety and shop procedures, tools and equipment, fundamentals of internal combustion engines, employability skills, engine design and structure, cooling and lubrication systems, fuel systems, electrical systems, exhaust and emissions, engine overhaul/repair, troubleshooting and maintenance, power transmissions, brakes and safety, marine engine and boat rigging.

Course: Small Engines and Outboard Marine Mechanics II
Length: One Year
Grades: 10-12

Small Engines and Outboard Marine Mechanics II is a course which provides students with intermediate level skills in all units taught in the introductory course. These units cover: laboratory safety and shop procedures, tools and equipment, fundamentals of internal combustion engines, employability skills, engine design and structure, cooling and lubrication systems, fuel systems, electrical systems, exhaust and emissions, engine overhaul/repair, troubleshooting and maintenance, power transmissions, brakes and safety, marine engine and boat rigging. Only those students who have successfully completed Small Engines and Outboard Marine Mechanics I should be enrolled.

Course: Small Engines and Outboard Marine Mechanics III
Length: One Year
Grades: 11-12

Small Engines and Outboard Marine Mechanics III provides students with advanced level training in: laboratory safety and shop procedures, tools and equipment, fundamentals of internal combustion engines, employability skills, engine design and structure, cooling and lubrication systems, fuel systems, electrical systems, exhaust and emissions engine overhaul/repair, troubleshooting and maintenance, power transmissions, brakes and safety, marine engine and boat rigging. Only those students who have successfully completed Small Engines and Outboard Marine Mechanics I and II should be enrolled.

Course: Small Engines and Outboard Marine Mechanics IV
Length: One Year
Grades: 12

Small Engines and Outboard Marine Mechanics IV covers all of the skills required for entry-level small engines and marine mechanics occupations. This is a course which provides students with mastery level skills in: laboratory safety and shop procedures, tools and equipment, fundamentals of internal combustion engines, employability skills, engine design and structure, cooling and lubrication systems, fuel systems, electrical systems, exhaust and emissions, engine overhaul/repair, troubleshooting and maintenance, power transmissions, brakes and safety, marine engine and boat rigging. Only those students who have successfully completed Small Engines and Outboard Marine Mechanics I, II, and III should be enrolled in this senior-level.

# V
# Curriculum Analysis Matrices

# Curriculum Analysis Matrices

## Identified Competencies by Course Offerings

This competency checklist should be used by teachers in identifying competencies to be included in specific classes in small engines and outboard marine mechanics education. This checklist is a curriculum analysis tool for use by teachers in assigning responsibilities for the competencies of a total small engines and outboard marine mechanics education program.

All courses taught in the small engines and outboard marine mechanics education program are identified in the columns at the top of the matrix. The individual competencies can be allocated to specific courses. One method for analyzing the competency list is to assign letters where the competency will be introduced (I), taught (T), or mastered (M). Curriculum sequences can be organized through this approach.

To assist mechanics teachers to reinforce basic skills instruction, competencies have been cross-referenced with the following academic areas:

| | |
|---|---|
| Math (M) | Science (S) |
| Social Studies (SS) | Language Arts (LA) |

This will assist local school districts in awarding cross-credit (academic credit) for participation in vocational classes they deem appropriate.

The following checklists are also cross-referenced with the Job Training Partnership Act pre-employment competencies and student leadership competencies. The Job Training Partnership Act provides funds to train economically disadvantaged youth to enter and succeed in employment. Each Private Industry Council responsible for administering these funds adopted youth pre-employment competencies as one of the measures for positive termination for program participants. The other measures are attained through unsubsidized employment, or through another training program.

The following categories of work-related knowledge must be evaluated and measured in the course of a participant's enrollment in a JTPA program:

1. Pre-Employment Competencies, which require the participant to demonstrate the skills and knowledge necessary to identify career objectives, seek and obtain employment and understand job performance.

2. Work Maturity Competencies, which require the participant to demonstrate the ability to apply skills in a training position.

3. Educational Skills Competencies, which require the participant to demonstrate basic computation and communication skills necessary to enter the labor market.

4. Occupational Skills Competencies, which require the participant demonstrate proficiency in those skills necessary to maintain employment in a specific occupation or occupational cluster.

The pre-employment and work maturity competencies have been specifically cross-referenced in this curriculum so that small engines and outboard marine mechanics instructors could specify where these competencies are integrated into the curriculum.

Student leadership programs are designed to be an integral part of the curriculum. The competencies are reinforced by student participation in approved student organizations such as Vocational Industrial Clubs of America. The student leadership competencies have been cross-referenced in this handbook to assist the small engines and outboard marine mechanics instructor in identifying specifically where these competencies will be taught.

### Vocational Industrial Clubs of America (VICA)

Vocational Industrial Clubs of America (VICA) is for students enrolled in secondary and postsecondary vocational courses in trade, industrial, technical and health education.

Through planned club activities, VICA develops the "whole" student, social and leadership abilities as well as vocational skills. The VICA motto is "Preparing for Leadership in the World of Work." VICA goals include:

- Foster an understanding of the functions of labor and management organizations and a recognition of their interdependence.
- Foster respect for the dignity of work.
- Relate school experiences to a young person's search for meaning, identity and achievement.
- Teach young people how to live and work with others...to accept and be accepted.
- Offer activities that complement occupational skill development.


- Create interest in and stimulate favorable community response to trade, industrial, technical and health occupations education.
- Promote high standards in work ethics, craftsmanship, scholarship and safety.
- Help students understand their roles in a technological age.

Alaska VICA, chartered in 1973, serves about 140 members in 10 chapters. The national organization is located in Leesburg, Virginia.

**KEY**

| | |
|---|---|
| M | Math |
| S | Science |
| LA | Language Arts |
| SS | Social Studies |
| * | Pre-Employment Competencies |
| + | Student Leadership Competencies |

# Recommended Competencies by Course Offerings

## Competencies

| | Employability Skills | Small Engines and Outboard Marine Mechanics I | Small Engines and Outboard Marine Mechanics II | Small Engines and Outboard Marine Mechanics III | Small Engines and Outboard Marine Mechanics IV | |
|---|---|---|---|---|---|---|
| • LA + | Make career choices | | | | | |
| LA • SS + | Evaluate jobs in the small engine and outboard marine mechanics industry | | | | | |
| • LA + | Prepare a resume and job application | | | | | |
| • LA + | Write a cover letter | | | | | |
| • LA + | Prepare for an interview | | | | | |
| • LA | Follow up the interview | | | | | |
| • + | Dress appropriately on the job | | | | | |
| • | Manage personal responsibilities related to employment | | | | | |
| • S | Maintain good health for effective job performance | | | | | |
| • | Understand employee rights and responsibilities | | | | | |
| LA | Deal effectively with customers | | | | | |
| • LA + | Attain work maturity | | | | | |
| • LA + | Solve problems | | | | | |
| • + | Demonstrate initiative and productivity | | | | | |
| • + | Be assertive | | | | | |
| • + | Be honest | | | | | |
| • + | Be reliable and dependable | | | | | |
| • + | Maintain good personal relations | | | | | |
| LA | Apply reading and writing skills | | | | | |
| • LA + | Follow verbal and written directions | | | | | |
| LA | Demonstrate on-the-job growth | | | | | |

# Recommended Competencies by Course Offerings

## Competencies

| | Competencies | Small Engines and Outboard Marine Mechanics I | Small Engines and Outboard Marine Mechanics II | Small Engines and Outboard Marine Mechanics III | Small Engines and Outboard Marine Mechanics IV | |
|---|---|---|---|---|---|---|
| • LA | Use proper job resignation procedures | | | | | |
| • + | Use leadership skills | | | | | |
| LA SS | Evaluate personal traits in relationship to entrepreneurship | | | | | |
| | **Laboratory Safety & Shop Procedures** | | | | | |
| LA S | Understand need for safety | | | | | |
| LA SS | Understand the organization of the laboratory | | | | | |
| LA SS | Use general safety procedures | | | | | |
| S | Use chemicals safely | | | | | |
| LA S | Use laboratory equipment safely | | | | | |
| LA S | Use tools safely | | | | | |
| SS | Maintain a clean shop | | | | | |
| LA SS | Follow OSHA guidelines | | | | | |
| LA S | Prevent work-related injuries | | | | | |
| LA S | Perform general shop duties | | | | | |
| M SS | Perform service and business procedures | | | | | |
| | **Tools and Equipment** | | | | | |
| M S | Use hand tools | | | | | |
| M S | Use power tools | | | | | |
| M S | Operate oxy-acetylene equipment | | | | | |
| M S | Use fasteners, gaskets, sealants, and adhesives | | | | | |
| S | Perform thread repair | | | | | |
| M | Use measuring devices | | | | | |

# Recommended Competencies by Course Offerings

## Competencies

| | | Small Engines and Outboard Marine Mechanics I | Small Engines and Outboard Marine Mechanics II | Small Engines and Outboard Marine Mechanics III | Small Engines and Outboard Marine Mechanics IV | |
|---|---|---|---|---|---|---|
| M | Apply mathematics and measurement fundamentals | | | | | |
| | **Fundamentals of internal combustion engines** | | | | | |
| S | Identify parts of small engine | | | | | |
| S | Understand engine classification and applications | | | | | |
| S | Understand the operation of the internal combustion engine | | | | | |
| S | Understand the operation of small diesel engines | | | | | |
| S | Understand engine operating systems | | | | | |
| S | Understand engine measurement and performance | | | | | |
| | **Engine Design and Structure** | | | | | |
| S | Understand the operation of the piston, connecting rod, and crankshaft assembly | | | | | |
| S | Understand the operation of the valve train | | | | | |
| S | Understand the operation of the two-stroke induction system | | | | | |
| S | Understand the function of the cylinder block assembly | | | | | |
| | **Cooling and Lubrication Systems** | | | | | |
| S | Understand engine cooling systems | | | | | |
| S | Service air cooling systems | | | | | |
| S | Service liquid cooling systems | | | | | |
| S | Inspect outboard water pumps | | | | | |
| S | Understand engine lubrication | | | | | |
| S | Service lubricating systems | | | | | |
| S | Service oil injection systems | | | | | |
| | **Fuel Systems** | | | | | |

# Recommended Competencies by Course Offerings

## Competencies

| | | Small Engines and Outboard Marine Mechanics I | Small Engines and Outboard Marine Mechanics II | Small Engines and Outboard Marine Mechanics III | Small Engines and Outboard Marine Mechanics IV | |
|---|---|---|---|---|---|---|
| S | Understand chassis lubrication and service | | | | | |
| S | Understand fuel systems | | | | | |
| S | Understand carburetor systems | | | | | |
| S | Service fuel systems | | | | | |
| S | Service speed control devices | | | | | |
| | **Electrical Systems** | | | | | |
| S | Understand electricity and magnetism | | | | | |
| S | Understand batteries | | | | | |
| S | Service batteries | | | | | |
| S | Understand charging systems | | | | | |
| S | Service charging systems | | | | | |
| S | Understand breaker ignition systems | | | | | |
| S | Service breaker ignition systems | | | | | |
| S | Understand the solid state ignition system | | | | | |
| S | Service solid state ignition systems | | | | | |
| S | Understand starting systems | | | | | |
| S | Service starting systems | | | | | |
| S | Service engine timing | | | | | |
| | **Exhaust and Emissions** | | | | | |
| S | Understand exhaust systems | | | | | |
| S | Understand safety and environmental concerns | | | | | |
| S | Service exhaust systems | | | | | |

# Recommended Competencies by Course Offerings

## Competencies

| | | Small Engines and Outboard Marine Mechanics I | Small Engines and Outboard Marine Mechanics II | Small Engines and Outboard Marine Mechanics III | Small Engines and Outboard Marine Mechanics IV | |
|---|---|---|---|---|---|---|
| | **Engine Overhaul/Repair** | | | | | |
| S | Understand engine overhaul | | | | | |
| S | Disassemble engine | | | | | |
| S | Service a cylinder | | | | | |
| LA M S | Service the piston, rings, and connecting rod | | | | | |
| LA M S | Service a crankshaft assembly | | | | | |
| LA M S | Service a multi-piece crankshaft assembly | | | | | |
| LA M S | Service a valve assembly | | | | | |
| LA M S | Reassemble the small engine | | | | | |
| | **Troubleshooting and Maintenance** | | | | | |
| S | Diagnose engine malfunctions | | | | | |
| S | Service engines that have been submerged | | | | | |
| S | Tune-up small engines | | | | | |
| S | Install and break-in engine assembly | | | | | |
| | **Power Transmissions** | | | | | |
| M S | Understand transmissions | | | | | |
| M S | Service transmissions | | | | | |
| S | Overhaul outboard lower units, propeller, and trim tabs | | | | | |
| LA S | Service gear housing assembly components | | | | | |
| M S | Service drive shaft components | | | | | |
| | **Brakes and Safety** | | | | | |
| S | Service hydraulic brakes | | | | | |

# Recommended Competencies by Course Offerings

## Competencies

| | | Small Engines and Outboard Marine Mechanics I | Small Engines and Outboard Marine Mechanics II | Small Engines and Outboard Marine Mechanics III | Small Engines and Outboard Marine Mechanics IV | |
|---|---|---|---|---|---|---|
| S | Service mechanical brakes | | | | | |
| S | Service safety interlocks | | | | | |
| S | Service chain saw brakes | | | | | |
| S | Service blade brakes | | | | | |
| | **Marine Engine and Boat Rigging** | | | | | |
| M S | Understand motor installation | | | | | |
| S | Service accessories | | | | | |
| S | Understand corrosion protection and engine storage | | | | | |
| S | Service propellers | | | | | |
| S | Perform finish repair | | | | | |
| S | Rig trailers | | | | | |
| S | Service wheel bearings and seals | | | | | |
| S | Install dash and bow accessories and components | | | | | |
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# VI
# Sample
# Skills Card

# Sample Skills Card

This section of the guide provides teachers with an example of an instrument for evaluating the effectiveness of instruction. The skills record allows teachers to assess competency at four levels of proficiency. Teachers are encouraged to construct their own skills performance record using the competency lists in the curriculum section of this guide.

## Instructions for Use

The list of vocational skills/traits was developed from a task analysis of a small engines and outboard marine mechanics competency.

| Level | Code Key |
|---|---|
| 1 | Introductory Level: Can do simple parts of task. Needs to be told/shown how to do most of the task. Needs extremely close supervision. |
| 2 | Minimum Level: Can do most parts of the task. Needs help only with most difficult parts. Needs close supervision. |
| 3 | Average Level: Can do all parts of task. Needs only spot-check of completed work. Meets local demands for speed and accuracy. Needs moderate job entry supervision. |
| 4 | Proficiency Level: Can complete task quickly and accurately. Can direct others in how to do the task. Needs little supervision. |

Directions: The instructor/employer may write, date and initial in appropriate square.

### Perform thread repair

| 1 | 2 | 3 | 4 | |
|---|---|---|---|---|
| | | | | Chase threads |
| | | | | Extract broken fasteners |
| | | | | Drill and tap holes |
| | | | | (A) Repair damaged threads using a thread repair procedure |

Comments:

# VII
# Suggested Resources

# Suggested Resources

This section identifies specific resources and sources for finding instructional materials and supplies for small engines and outboard marine mechanics.

The following source lists have been characterized by media type to facilitate teacher use: resource libraries, publishers of texts and instructional materials, state resources, associations, periodicals, special books/ pamphlets, media, and materials suppliers. A comprehensive tools and equipment list is provided at the end of this section.

The Alaska Department of Education has not formally reviewed nor approved all the resources listed in this section. Teachers are encouraged to preview materials before using them in the classroom.

## *Resource Libraries*

Alaska Vocational Materials Library
Office of Adult & Vocational Education
Alaska State Department of Education
Box F
Juneau, AK 99811
(907) 465-2980

- Alaska Energy Education Series
- Appropriate Technology for Alaskans
- Basic Skills For The Trades
- Choices & Challenges: A Young Man's and Teen Woman's Journal for Self-Awareness and Personal Planning
- Cooperative Education and On-The-Job Training Handbook
- Engine and Vehicle Mechanics Curriculum
- Home-Based Business Resources
- Industrial Education Curriculum
- Industrial Education Resources
- Introduction to Marine Technology
- Local Advisory Committee: Handbook for Vocational Administrators
- Pre-Employment Competencies Resource Guide
- Safety and School Shop Planning
- Snowmobile Repair
- STARS: Secondary Training For Alaska
- Vocational Education Administration Handbook

The Library maintains curricula for all vocational areas. Resources are loaned for a 2 month review period. There are also many materials which may be purchased from the Library's special collections. Some materials are available free of charge.

The Library's catalog is computerized and may be operated on an Apple Computer using Appleworks software. The catalog may be obtained by sending five blank disks for duplication or upon request.

Alaska Career Information System
Office of Adult and Vocational Education
Alaska Department of Education
Box F
Juneau, AK 99811
(907) 465-2980

- Comprehensive career guidance system developed by Alaskans and for Alaskans seeking occupational and educational opportunities in and out of Alaska.

Alaska Health Sciences Library
3211 Providence Dr.
Anchorage, AK
(907) 786-1870

- Journals and magazines in the area of job safety and health

Alaska State Film Library
650 W International Airport Road
Anchorage, AK 99518
(907) 561-1132

- Films on small engines and marine mechanics

Curriculum Collection
Alaska Department of Education
Office of Educational Program Support
Box F
Juneau, AK 99811
(907)465-2841

- Village Science: A Resource Handbook for Rural Alaskan Teachers

Northwestern Vocational Curriculum
Coordination Center
St. Martin's College
Lacey, WA 98503
(206)438-4456

- 10-state regional library of vocational materials. Can be accessed through the Alaska Vocational Materials Library.

National Center for Research in
Vocational Education
The Ohio State University
1960 Kenny Road
Columbus, OH 43210

- Vocational Education Curriculum Materials database of all 50 states. Can be accessed through the Alaska Vocational Materials Library.
- Catalog of materials available on new technology in vocational-technical education.

## *Publishers*

American Technical Publishers, Inc.
12235 South Laramie Ave.
Alsip, IL 60658

Bobbs-Merrill Publishing Co.
4300 W 62 St.
P.O. Box 7080
Indianapolis, IN 46206

Briggs and Stratton Engine Corporation
2711 North 13 St.
Milwaukee, WI

Chilton Book Company
Chilton Way
Radnor, PA 19089

Clymer Publications
P.O. Box 4520
Arleta, CA 91333

Dana Corporation
School Assistance
Box 453
Toledo, OH 43692

Deere and Co.
John Deere Road
Moline, IL 61265

Goodheart-Wilcox Co., Inc.
123 W Taft Dr.
South Holland, IL 60473

Gregg Division/McGraw-Hill Book Co.
8171 Redwood Highway
Novato, CA 94947
(415) 897-5298

Intertec Publishing Corp
Box 12901
Overland Park, KS 66212
(913) 888-4664

Mitchell Information Services, Inc.
9889 Willow Creek Rd.
Box 26260
San Diego, CA 92126

National Textbook Company
4255 W. Touhy Ave.
Lincolnwood, IL 60646

Prakken Publications
P.O. Box 8623
Ann Arbor, MI 48107

Prentice-Hall Publishing Co.
Educational Books Division
Englewood Cliffs, NJ 07632

Delmar Publishers
2 Computer Dr. West
Albany, NY 12212

Glencoe Publishing Co.
Bennet and McKnight
17337 Ventura Blvd.
Encino, CA 91316

JIST Works, Inc.
150 East 14th Street
Indianapolis, IN 46202

South-Western Publishing Co.
5101 Madison Rd.
Cincinnati, OH 45227

Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402

TAB Books
PO Box 40
Blue Ridge Summit, PA 17214-9989

## *State Resources*

Alaska Department of Labor
Occupational Safety and Health
3301 Eagle St.
P.O. Box 7-022
Anchorage, AK 99501

- Provides free information, training and inspections

Alaska Vocational Technical Center
Box 889
Seward, AK 99664

- Orientation to Mechanics

Curriculum Development Unit
Office of Vocational Education
2024 Capital Plaza Tower
Frankfort, KY 40601
(502) 564-2890

- Instructional modules on small engines and repair mechanics

Curriculum Publications Clearinghouse
Western Illinois University
Horrabin Hall Y6
Macomb, IL 61455
(309) 298-1917

- Microcomputer Applications in Vocational Education: Trades and Industry
- Vocational-Technical Education Consortium of States (V-TECS) catalogs of performance objectives and curriculum guides for small engines and mechanics

District of Columbia Public Schools
Division of Career Development Programs
Washington, DC

- Competency-Based Curriculum on Small Engine Repair Grades 10-12

Educational Instructional Materials Center
University of Texas at Austin
P.O. Box 7218
Austin, TX 78713-7218
(512) 471-7716

- Maintenance Equipment Mechanic
- Motorboat Mechanic
- Motorcycle Mechanic

Florida Department of Adult and
Vocational Education
College of Education
University of South Florida
Tampa, FL 33620

- Florida Vocational Program Guide to Basic Marine Mechanics

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|---|---|
| Instructional Materials<br>Industrial Education<br>202-B Skyland Blvd.<br>Tuscaloosa, AL 35405<br>(205) 759-5448 | • Curriculum Standards for Small EngineTrade and Repair |
| Instructional Materials Laboratory<br>10 Industrial Education Building<br>University of Missouri-Columbia<br>Columbia, MO 65211<br>(314) 882-2883 | • Diesel Repair<br>• Maintaining Small Engines<br>• Service and Repair of Small Engines<br>• Small Engines Series |
| Instructional Materials Service<br>Trade and Industrial Education<br>Texas A&M University<br>FE Box 2588<br>College Station, TX 77843-2588<br>(409) 845-6601 | • Mechanics Series |
| The Media Center<br>State Fair Community College<br>1906 Clarendon Rd.<br>Sedalia, MO 65301<br>(816) 826-7100 | • Instructional modules including student and teacher guides, slide-tape or video presentations on mechanics |
| Michigan Vocational Education Resource Center<br>133 Erickson Hall<br>Michigan State University<br>East Lansing, MI 48824<br>(517) 353-4397 | • Small Engine Repair and Related Equipment Repair Competencies and Tasks |
| Mid-America Vocational Curriculum Consortium (MAVCC)<br>1500 W Seventh Ave.<br>Stillwater, OK 74074<br>(405) 377-2000 | • Chain Saw Repair<br>• Comprehensive Small Engine Repair<br>• Diesel Mechanics Series<br>• Motorcycle Repair<br>• Outboard Power Equipment Repair<br>• Outboard Repair<br>• Parts Specialist<br>• Small Engine Series<br>• Snowmobile Repair |
| Minnesota Curriculum Services Center<br>3554 White Bear Ave.<br>White Bear Lake, MN 55110<br>(612) 770-3943 | • A Course on Alcohol Fuels<br>• Marine Task List<br>• Small Engines Marine Terminal Performance Objectives<br>• Small Engines Task List<br>• Teaching Aids and Competency-Based Education Modules |
| Occupational Curriculum Laboratory<br>East Texas State University<br>Commerce, TX 75428<br>(214) 886-5624 | • General Mechanical Repair |

Oregon Career Development Consortium
Marion Education Service District
651 High St. NE Suite 4
Salem, OR 97301
(503) 378-7470

- Basic Skills in Vocational Education: Computer Skills, Mathematics, Reading, Speaking/ Listening, Writing

South Carolina Department of Education
Columbia, SC 29201

- Small Engine Repair Course Competencies

Superintendent of Public Instruction
Office of Trade, Industrial, Technical and Health Occupations
Division of Vocational/Technical Education
Old Capitol building, MS FG111
Olympia, WA
(206) 753-5675

- Job Standards for Air Cooled Gasoline Engine Repair

Vocational Curriculum Development and Center
P.O. Box 1159
Natchitoches, LA 71458-1159
(318) 352-5348

- Small Engine Mechanics and Marine Operations

Vocational Instructional Materials Laboratory
1885 Neil Avenue Room 112
The Ohio State University
Columbus, OH 43210

- Task Analysis for Small Engine Mechanic

Vocational Studies Center
University of Wisconsin-Madison
Publications Unit
265 Educational Sciences Building
1025 W. Johnson Street
Madison, WI 53706

- Small Business and Entrepreneurship Series

## *Associations*

American Association for Vocational Instructional Materials (AAVIM)
120 Driftmeir Engineering Center
Athens, GA 30602
(404) 542-2586

- Assisting Students in Improving Their Basic Skills
- ATV Maintenance Manual
- Care and Operation of Small Gasoline Engines
- Diesel Engine Repair
- Developing Shop Safety
- Electric Motors
- Fuels and Lubricants
- Inboard Engines and Drives I, II
- Inboard/Outboard Service
- Outboard Motor Flat Rate Manual
- Outboard Motor Service Manual I, II
- Small Air Cooled Engines Service Manual
- Small Diesel Engines Service Manual
- Small Engine Flat Rate Manual
- Small Gas Engine Part Identification
- Small Engines Maintenance and Repair
- Snowmobile Service Manual
- Snowthrower Service Manual

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| American Gear Manufacturers Association<br>1500 King St., Suite 201<br>Alexandria, VA 22314<br>(703) 684-0211 | • AGMA Standards<br>• Monthly News Digest |
| American National Standards Institute<br>1430 Broadway<br>New York, NY 10018<br>(212) 354-3300 | • Catalog of Standards |
| American Petroleum Institute<br>1220 L St. NW<br>Washington, DC 20005 | • How To Sell Motor Oil<br>• Motor Oil Guide |
| American Society of Lubrication Engineers<br>838 Busse Highway<br>Park Ridge, IL 60068<br>(312) 825-5536 | • Lubrication Engineering<br>• ASLE Transactions |
| American Society for Testing and Materials<br>655 15 St. NW<br>Washington, DC 20005<br>(202) 639-4025 | • Book of ASTM Standards<br>• Standardization News |
| American Technical Society<br>848 E 58th St.<br>Chicago, IL 60637 | • Fuel and Ignition Systems |
| American Vocational Association (AVA)<br>1410 King St.<br>Alexandria, VA 22314 | • Catalog of resources for vocational educators |
| Boating Industry Association<br>333 North Michigan Ave<br>Chicago, IL 60601 | • Marine Service Manual of Recommended Practices |
| Engine Service Association, Inc.<br>710 N Plankinton Ave.<br>Milwaukee, WI 53202<br>(414) 271-2263 | • Provide vocational education services for those involved in sales and service of internal combustion engines and engine powered equipment |
| Instrument Society of America<br>P.O. Box 12277<br>Research Triangle Park, NC 27709<br>(919) 549-8411 | • Publications and Training Aids Catalog |
| National Marine Manufacturers Association<br>Boating Industry Association<br>401 N. Michigan Ave.<br>Chicago, IL 60611<br>(312) 836-4747 | • Publishes booklets on marinas, statistics, boating writer's information guide, boating laws and a film directory |
| National Occupational Testing Institute<br>318 Johnson Hall<br>Ferris State College<br>Big Rapids, MI 49302<br>(616) 796-4695 | • Small Engines Performance Test |

Society of Automotive Engineers
400 Commonwealth Dr.
Warrendale, PA 15096
(412) 776-4841

- Air Cleaner Test Code
- Combustion Chamber Deposition and Power Loss
- Engine Varnish and Sludge
- Factors Affecting Piston Ring Life
- Handbook of Standards
- SAE Quarterly Transactions
- The Where and Why of Engine Reports

Tune-Up Manufacturers Institute
222 Cedar Lane
Teaneck, NJ 07666
(201) 836-9500

- Tune-Up Manual

Vocational Industrial Clubs of America (VICA)
P.O. Box 3000
Leesburg, VA 22075

- Advisor Guide
- National Leadership Handbook

## *Periodicals*

American Industrial Arts Association
1914 Association Dr.
Reston, VA 22091

- The Technology Teacher

American Vocational Association
1410 King St.
Alexandria, VA 22314

- Vocational Education Journal

Fawcett Publications
1515 Broadway
New York, NY 10036

- Mechanix Illustrated

National Association of Trade and Technical Schools
2251 Wisconsin Avenue NW Suite 200
Washington, DC 20087

- Career Training Journal

Peterson Publishing Co.
8490 Sunset Blvd.
Los Angeles, CA 90069

- Motor Trend

Prakken Publications
P.O. Box 8623
Ann Arbor, MI 48107

- School Shop

## *Special Books/Pamphlets*

American Honda Motor Company, Inc.
PO Box 50
100 W. Alondra Blvd.
Gardena, CA 90247-0805

- Educational materials (audiovisual)
- Periodicals
- Shop Manuals

Champion Spark Plug Co.
900 Upton Ave.
Toledo, OH 43661
(419) 535-2567

- Facts About Spark Plugs and Engines

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|---|---|
| Chrysler Motors Corporation<br>Service Training<br>26001 Lawrence Ave.<br>Center Line, MI 48015 | • Carburetion Facts and Fundamentals<br>• Carburetion Fundamentals<br>• Mechanical Information |
| Clymer Publications<br>12860 Muscatine St.<br>P.O. Box 20<br>Arleta, CA 91331 | • Clymer's Honda ATC Repair Manuals |
| Cooperative Extension Service<br>University of Alaska<br>WWB-6 Bunnell Building<br>303 Tanana Dr.<br>Fairbanks, AK 99701<br>(907) 479-7268 | • Small Engine Storage |
| Ford Motor Co.<br>3000 Schaefer Rd.<br>Dearborn, MI 48121 | • Service Training Aids Catalog |
| General Motors Corporation<br>Public Relations Staff<br>General Motors Bldg.<br>Detroit, MI 48202 | • The ABC of Hand Tools |
| Howard Sams, Inc.<br>4300 W 62nd St.<br>P.O. Box 7080<br>Indianapolis, IN 46206 | • Outboard Motors and Boating<br>• Small Gasoline Engines<br>• Small Gasoline Engine Repairman |
| HP Books<br>PO Box 5367<br>Tucson, AZ 85703<br>(602) 888-2150 | • How to Rebuild Engines books |
| National Institute for Occupational Safety and Health<br>Regional Office<br>321 Second Ave.<br>Seattle, WA<br>(206) 442-0530 | • Research and technical assistance, information and publications for all areas of job safety and health |
| National Safety Council<br>444 North Michigan Ave.<br>Chicago, IL 60611<br>(312) 527-4800 | • Accident Prevention Program for School Shops<br>• Safe Worker |
| Pathfinder Publications, Inc.<br>108 Moss Ave.<br>Boston, MA 02123 | • The Incredible Illustrated Tool Book |
| Quaker State Oil Refining Corp.<br>255 Elm St.<br>Oil City, PA 16301<br>(814) 676-7676 | • Motor Oils and Engine Lubrication |

S-A Design Books
515 West Lambert, Bldg E
Brea, CA 92621

- Bolt-On Performance
- Ford Performance
- Holley Carburetors
- Mopar Performance
- Performance with Economy
- Super Power

Tecumseh Products Co.
Ottawa and Patterson Streets
Tecumseh, MI 49286
(517) 423-8411

- Four Stroke Cycle Engine Mechanic's Handbook
- Mechanics Handbook: Light and Medium Frames

Theodore Audel and Co.
4300 W 62nd St.
Indianapolis, IN 46268

- Audel's Outboard Motors and Boating

## *Media*

Bergwall Productions, Inc.
106 Charles Lindbergh Blvd.
Uniondale, NY 11553

Career Aids, Inc.
20417 Nordhoff St. Dept. D5
Chatsworth, CA 91311
(818) 341-8200

Color Film Corporation
Video Division
770 Connecticut Ave.
Norwalk, CT 06854
(203) 886-2711

Dana Corporation
Educational Assistance
P.O. Box 453
Toledo, OH 43692

DCA Educational Products
4685 Stenton Ave.
Philadelphia, PA 19144

DRW Educational Systems
PO Box 2941
Costa Mesa, CA 92628-2941

Education Associates, Inc.
P.O. Box Y
Frankfort, KY 40602

Ford Service Division
3000 Schaefer Rd.
Dearborn, MI 48121

Meridian Education Corporation
606 E. Locust St.
Bloomington, IL 61701
(309) 827-5455

National Audiovisual Center
8700 Edgeworth Dr.
Capitol Heights, MD 20743
(301) 763-1896

National Innovative Media Co.
Route #2 Box 301 B
Calhoun, KY 42327
(502) 273-5050

Nationwide Computer and Video
P.O. Box 61E
Morrisville, PA 19087
(215) 295-0055

Pictures, Inc.
811 W. 8th Ave.
Anchorage, AK 99501
(907) 279-1515

Teaching Aids, Inc.
P.O. Box 1798
Costa Mesa, CA 92628-0798

Technovate, Inc.
910 SW 12th Ave.
Pompano Beach, FL 33060

TPC Training Systems
P.O. Box 1030
Barrington, IL 60010
(312) 381-7015

Guidance Associates
90 South Bedford Road
Mt Kisco, NY 10549
(914)666-4100

Hobar Publications
1234 Tiller Lane
St. Paul, MN 55112
(612) 633-3170

U.S. Environmental Protection Agency
TSCA Assistance Office TS-799
401 M St. SW
Washington, DC 20460
(202) 554-1404

Vocational Media Associates
Prentice-Hall Media
Box 1050
Mt. Kisco, NY 10549

## *Materials Suppliers*

Allen Test Products Division
2101 N Pitcher St.
Kalamazoo, MI 49007

Ammco Tools, Inc.
Wacker Park
North Chicago, IL 60064

Bacharach, Inc.
625 Alpha Dr.
Pittsburgh, PA 15238

Bob Kerr's Marine Tool Co.
P.O. Box 1135
Winter Garden, FL 32787

Brodhead-Garrett Co.
4560 E 71st St
Cleveland, OH 44105
(800) 321-6730

Clayton Associates, Inc.
P.O. Box 589
Farmingdale, NJ 07727

Deere and Co.
John Deere Road
Moline, IL 61265

Eagle Manufacturing Co.
24th and Charles St.
Wellsburg, WV 26070

FMC Corporation
Auto Service Equipment Division
Industrial Park
Conway, AR 72032

Ken Cook Education Systems
12855 West Silver Spring Dr.
Butler, WI 53007

Mac Tools, Inc.
P.O. Box 370
Washington Court House, OH 43160

Miller Special Tools
32615 Park Lane
Garden City, MI 48135

Nilfisk of America
300 Technology Dr.
Malvern, PA 19355

Paxton/Patterson
5719 W 65th St.
Chicago, IL 60638

Rotary Lift
A Dover Industries Company
P.O. Box 30205, Airport Station
Memphis, TN 38130

Satco, Division of Saterlee
924 S 19th Ave.
Minneapolis, MN 55404

Sears Contract Sales
Sears Roebuck and Co.
19th Floor, Sears Tower
Chicago, IL 60684

Snap On Tools
Industrial Sales
3300 Knik Ave.
Anchorage, AK

S-T Industries, Inc.
301 Armstrong Blvd.
St. James, MN 56081

Sun Electric Corp.
One Sun Parkway
Crystal Lake, IL 60014

Kleer-Flo Co.
15151 Technology Drive
Eden Prairie, MN 55344

Northwest Sales Group
5718 1st Ave. S.
Seattle, WA 98108
(206) 762-5111

Wear Corporation
PO Box 80312
Seattle, WA 98108

ZEP Manufacturing Co.
18417 Cascade Ave. S.
Seattle, WA 98188
(206) 248-1900

Zip-Penn
3633 Seaport Blvd
P.O. Box 15129
Sacramento, CA 95851
(916) 372-7410

## *Tools and Equipment List*

The following details tools and equipment used by small engine and outboard marine mechanics. This list is not inclusive.

Special Tools

1 Piston Groove Cleaner
1 Piston Ring Compressor
1 Ridge Reamer
2 Piston Ring Expanders
1 Valve Spring Compressor
1 Valve Refacing Lathe
1 Cylinder Gauge
1 Valve Seat Grinding Set
2 Cylinder Hones
1 Telescope Gauge Set
Machinists Files
1 Micrometer Set
1 Spark Plug Tap Set
1 Tachometer
1 Ignition Analyzer and CAP Disc. Adapter
2 Strap Wrenches
2 Hex Key Wrench Sets
1 Retaining Ring Plier Set
2 Putty Knives
4 Adjustable Wrenches (2 ea, 6", 10")
2 Torque Wrenches
2 Pipe Wrenches 10"
1 Rod Alignment Tester
1 Neway Valve Set Cutter Set
1 Grease Gun
2 Oilers
1 Ball Pein Hammer 12 oz.
1 Brass Hammer
1 Rubber Mallet
1 Soft Face Hammer 16 oz.
1 Brush (For Parts Cleaning)
2 Wire Brushes

Master Timing Set
Visual Timing Tester
Disc Brake Indicator Set
Scribers
Compression Tester Gauge
Ignition Point Files
Metric Drill Bit Set, 19 pieces
1 Crank Case Vacuum Tester
1 3/8" Sq. Drive Socket Set Std. 20 pieces
1 Comb Box/Open End Wrench Set 12 pieces
1 Open End Wrench Set, 7 pieces
10 Offset Box Wrenches
10 12 pt. Box Wrenches
10 Open End Wrenches
19 Comb. Box & Open End Wrenches
11 1/4" Sq. Drive Sockets
3 Ratchets
2 Hinge Handles for Ratchet
8 Extensions for Ratchet
2 Universal Joints for Ratchet
Safety Glasses
1 Spark Plug Socket
15 3/8" Drive Sockets
7 3/8" Drive Univ. Joint Sockets
1 4 oz. Ball Pein Hammer
1 8 oz. Ball Pein Hammer
1 Universal Gauge
1 Feeler Gauge
1 Comb. Ignition & Spark Plug Gauge
12 Asst. Wrenches and Snips
1 Set Ball Hone
1 Tap and Die Set Metric Standard

1 Soldering Gun
1 Spark Plug Gauge Set
1 Flaring Tool
1 Tubing Cutter
1 Thread Repair Kit
Battery Plyers
32 Assorted Screwdrivers with Key Rings
1 Puller Set with Attachments
1 Battery Hydrometer
Belt Tension Gauge
Brake Spoon
Battery Post Cleaner
Creeper
Files -10" Coarse, 6" Fine
Mechanics Steel Ruler
1/4" and 1/8" pin punch
3" center punch
Screw Pitch Gauge - N.F., N.C., Metric
Spark Plug Wire Remover
Thread Chaser Set
Tool Box

Tubing Wrenches
Vernier Caliper
Hacksaws
Torx Screwdrivers
1 Tube Bender
18 Assorted Pliers
1 Punch and Chisel Set (44 pieces)
1 Complete Socket Set (122 pieces)1/2"
1 Adv. Reamer Set 3/8" to 1 5/16"
Battery Nut Pliers
Battery Terminal Clamp Puller
Blow Gun — Rubber Tip (OSHA approved)
Filter Wrench - Oil and Gas
Magnetic Pickup Tool
Oil Can - Pump Type
3/8" taper punch
Scraper - 1 1/2" wide
Screw Starter - Standard and Phillips
Tape Measure
Tire Pressure Gauge
Wire Brush

Special Equipment

1 Valve Grinder
2 Small Engine Test Stands
2 Outboard Motor Stands
1 Battery Charger
1 Outboard Test Tank
1 ACTY Torch Set
1 Drill Press
1 Machinists Vice
1 Bench Grinder
1 1/2" Variable Speed Drill Motor
1 3/8" Drill Motor
1 1/2" Impact Wrench
1 Hydraulic Press (Arbor Press)
1 Parts Cleaning Tank
1 Steam or Detergent Cleaner