Southern Region, B.S.A.
Yachting Initiative
Program Elements

BOAT ENGINE ESSENTIALS

Learning Objectives:

As a result of this session the participant should be able to:

- Become familiar with the various types of boat engines.
- Be aware of the effect of propeller selection on boat performance.
- Be aware of boat engine induction, ignition, cooling systems.
- Be aware of electrical and battery operations.
- Become familiar with routine maintenance and Winterizing/De-winterizing procedures.

Resources:

Boating Skills & Seamanship, Eleventh Edition, U.S. Coast guard Auxiliary, Chapter 8
Chapman Piloting Seamanship & Small Boat Handling, 62nd Edition, Hearst Marine Books, Chapter 1, 8

Material and Equipment:

Equipment Items
Overhead Projector, as required by instructor

Material Items
Provide one copy for each participant:
Boat Engine/Spring Checklist Handout
Preventing Electrical Hazards/Damage Handout

Instructor Qualification:

U.S. Coast Guard Auxiliary Trainer presence required for USCGAUX Certificate Program
U.S. Power Squadron Instructor, Council Venturing Trainer or equivalent

Time Allocation: 1.5 Hours

Session Plan:

Classroom Session

1. **Module Introduction.**
   a. Introduce yourself and each member of the module staff.

   b. Explain the objectives of this module.

2. **Marine Engines.**
   a. Describe the following engine installation classes:
      1. Inboard Engines
      2. Stern Drive Engines (I/O)
      3. Outboard Motors

   b. Explain the International Congress of Marine Industry Associations (IOCMIA) September 1989 method and units for measuring engine power.

   c. Describe the operating cycles of the Two Stroke and Four Stroke Engines and explain their differences.

   d. Describe briefly the differences between the following fuel types:
      1. Two and Four Stroke Gasoline
      2. Diesel

3. **Propeller Selection.**
   a. Describe briefly the following propeller basics:
      1. Number and style of blades
      2. Direction of blade rotation
      3. Blade Diameter
      4. Blade Pitch

   b. Describe briefly propeller efficiency for the following:
      1. Fixed pitch propellers
      2. Variable pitch propellers
      3. Adjustable pitch propellers

4. **Induction Systems.**
   a. Describe briefly the following methods of fuel induction:
      1. Carburetors
      2. Fuel Injection
      3. Diesel Induction/Ignition

5. **Ignition Systems.**
   a. Describe briefly the following methods of gasoline engine ignition:
      1. Magneto Ignition
      2. Alternator-Battery Ignition
      3. Electronic Ignition

   b. Explain the requirement of inboard and stern drive engines to have flame arresters.

6. **Cooling Systems.**
   a. Explain and describe briefly the following methods of cooling internal combustion marine engines:
      1. Air Cooled Engines

2. Water Cooled - Open Cooling System
3. Water Cooled – Duel Cooling Systems

b. Explain cooling systems precautions operating in either fresh or salt water.

7. **Gasoline Products.**
   a. Describe briefly the effects of using the following gasoline products:
      1. Leaded or Unleaded with lead substitute Gasoline (1973 or earlier engines)
      2. Unleaded Gasoline
      3. Premium Gasoline
      4. Alcohol and Gasoline

8. **Batteries.**
   a. Explain that not all outboard motors require a battery (motor with pull starter).

   b. Explain that marine engines usually use “deep-cycle” batteries and some boats operate with two batteries on a battery switch.

   c. Describe briefly the following battery operations:
      1. Checking and charging the battery
      2. Battery failure and corroded terminals
      3. Battery short circuits
      4. Alternating both batteries (assuming boat has two)
      5. 110 Volt electrical dangers
      6. Direct current problems

   d. Describe the simple steps taken to reduce DC current hazards and damage.

   e. Describe reducing potential AC current hazards and damage.

9. **Routine Maintenance.**
   a. Describe briefly the following maintenance procedures for the following systems:
      1. Lubrication of the engine and its power transmission system
      2. Lubrication of the lower unit (gears)
      3. Check the Bilge Pumps, Stuffing Box, Drive Belts, Stuffing Box (Inboard only)
      4. Check Ignition System
      5. Check Fuel and Cooling Systems
      6. Check Galvanic Action and Propeller

10. **Boat Winterizing.**
    a. Describe briefly the following winterizing guidelines:
       1. Perform storage maintenance on the following:
          (a) Oil, Fuel Systems and Fuel Tank
          (b) Gasoline Engine, Cooling Systems, and Lower Units
          (c) Ignition system, Freshwater System and Holding Tank (if onboard)
       2. Store boat ashore to prevent damage from freezing

3. List the items done to lay the boat up
4. Consult boat owner's manual for lay-up procedures not covered

11. **Spring De-winterizing.**

a. Distribute the handout "Boat Engine/Spring Checklist".

b. Discuss briefly the "Boat Engine/Spring Checklist.

c. Describe the preparation for starting the boat engine.

d. Describe briefly troubleshooting the following conditions:

1, Engine will not turn over
2. Engine will not start
3. Engine runs rough
. 4. Engine idles but does not develop full power

e. Distribute the handout "Preventing Electrical Hazards/Damage".

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BOAT ENGINE/SPRING CHECKLIST HANDOUT

ITEMS TO CHECK. *Inspect the following items. Service or replace them as needed:*

[Be advised that some checklist items may not be applicable to your boat]

☐ Lubricate all seacocks.

☐ Close all seacocks that you opened in the fall.

☐ Inspect hoses and hose clamps.

☐ Inspect the engine water intake strainer to see that it is free of corrosion and properly secured.

☐ Inspect the hull for cracks and blisters.

☐ Inspect zincs.

☐ Inspect the fuel tank for corrosion and leaks.

☐ Inspect the bilge blower hoses for leaks.

☐ For a stern-drive; inspect the bellows for dried, cracked, or deteriorated spots.

☐ Inspect power steering and power trim oil levels.

☐ Inspect and lubricate steering and control cables.

☐ Inspect the fire extinguishers.

☐ Inspect the galley stove or loose fittings or leaking hoses.

☐ Inspect the bilge pump and float switch

☐ Inspect pyrotechnic distress signals. Replace outdated ones. Keep old ones as spares.

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PREVENTING ELECTRICAL HAZARDS/DAMAGE HANDOUT

The following are some simple steps to be taken to reduce hazards and damage from DC and AC current:

DIRECT CURRENT

- Keep electrical wiring out of the bilge.
- Use only watertight connections if there is any possibility of immersion in bilge water.
- Install a battery isolation switch.
- Make certain there is a fuse or circuit breaker in the main distribution line from your battery and as near your batteries as possible.
- Use only recommended size fuses or circuit breakers in the accessories connection panel.
- If new wiring is added to the boat, be certain it is large enough to carry its intended load without overheating.
- Have any worn or frayed wires replaced by a professional marine electrician ASAP.
- Inspect all metal fittings at frequent intervals for electrolytic or galvanic corrosion.

ALTERNATING CURRENT

- Use a “plug-in” tester to screen for potential problems in the on-shore service line.
- Don’t use the on-shore service line unless you know it is correctly wired.
- Use a galvanic isolator that has been tested and approved by the *Underwriters Laboratories* to allow AC current to flow to ground while preventing stray DC current from following the same path.
- Properly fuse all AC circuits or install circuit breakers.
- Install new wire in the boat for any AC circuit. Be certain it is heavy enough to carry the intended load.
- Have worn or frayed wiring replaced immediately.
- Be certain the on-shore power source is properly wired by installing a GFI (ground fault interrupter) between the boat and the power source.