



# Operating Systems, Maintenance and Inspection





# Learning Objectives

By the end of this chapter, the participant will be able to:

1. List operating systems, their major components and function.
2. Describe the safety aspects of a kill switch and Carbon Monoxide (CO).
3. List components that need to be routinely maintained and inspected.

*Information to meet these objectives are presented in this lecture, plus field demos and the MOCC Manual*



# Learning Objectives (cont.)

By the end of this chapter, the participant will be able to:

4. List information that should be recorded in a log book.
5. Demonstrate startup and shutdown procedures.
6. List common causes of system failures.
7. List the priority for troubleshooting common system failures.

*Information to meet these objectives are presented in this lecture, plus field demos and the MOCC Manual*



# Operating Systems

## What's important to know?

- Major components and function
- The things that can kill you
- Routine maintenance & inspection needs
- Motor startup, shutdown, and fueling procedures
- How to troubleshoot common causes of system failure.



# Operating Systems

## On a basic motorboat:

- Motor/Propulsion (Outboard, Inboard/Outdrive, Inboard; Propeller or Jet)
- Lubrication
- Fuel
- Cooling
- Electrical
- Throttle control
- Steering
- Bilge dewatering
- Anti-corrosion

# Boat Motor Types

Boat motors are either:



Outboard

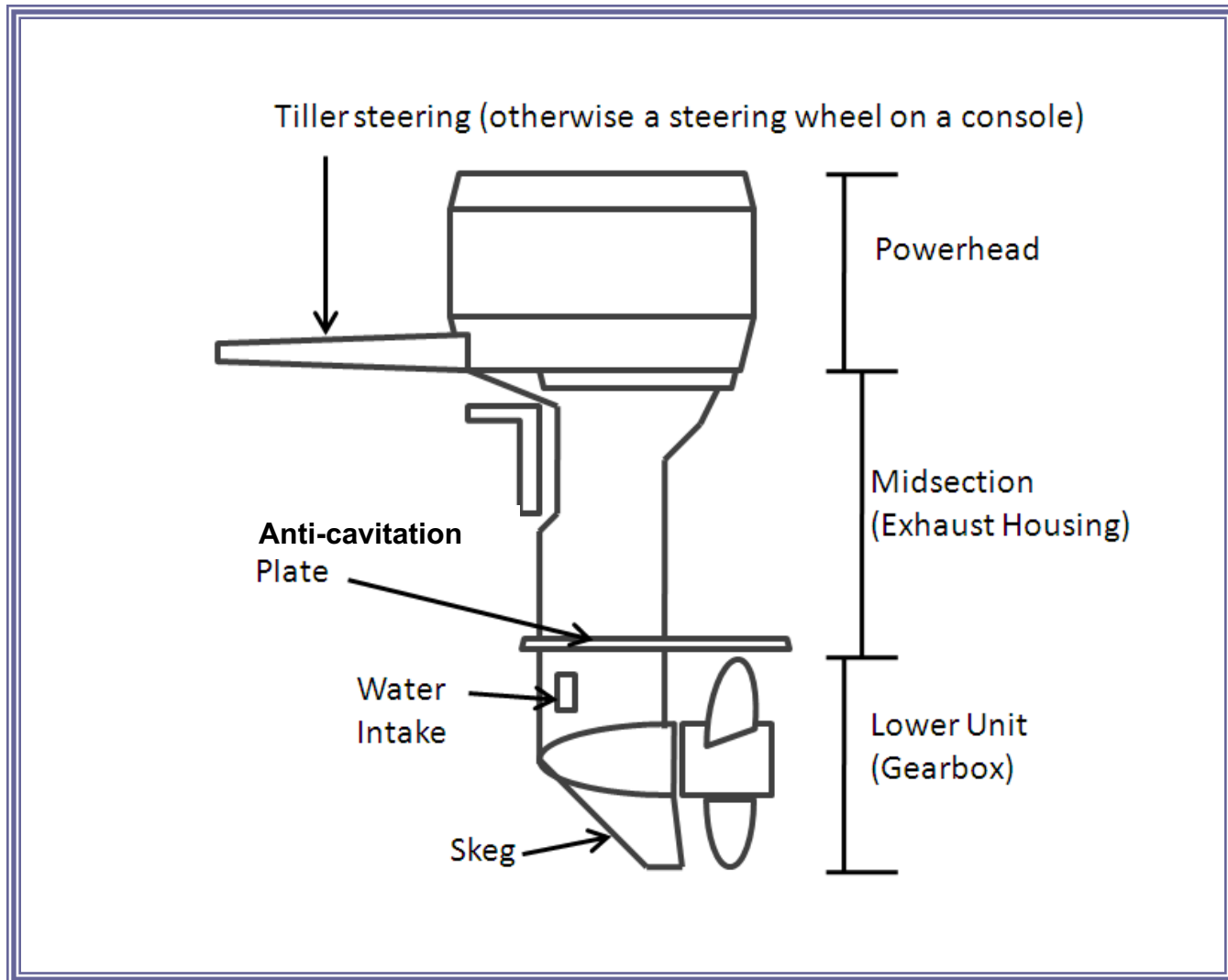


Inboard/Outdrive



Inboard

# Outboard Motor





# Outboard Motor

- + Self contained
- + Wide variety
- + Easy to access
- + Can trim up/down
- + Quiet

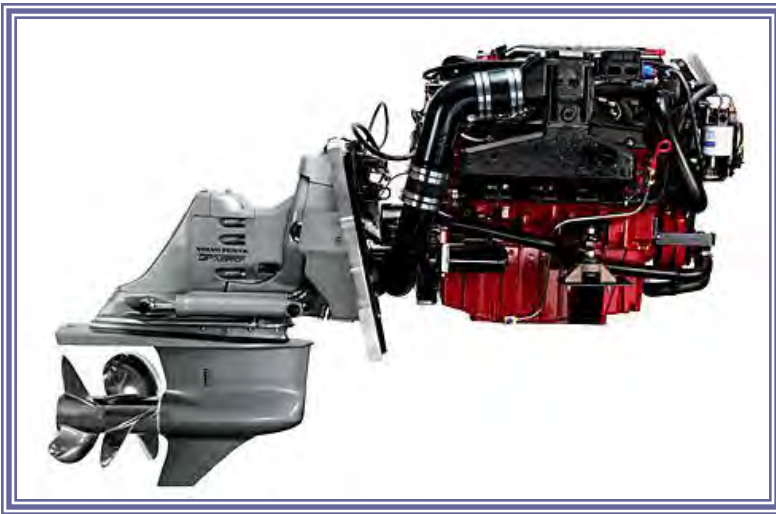




# Inboard/Outdrive Motor

## Features (prop only):

- + Quiet
- + Can trim up/down
- Thru-hull leaks



# Inboard Motor

## Features:

- + Greater power
- + Low center of gravity
- + Quiet (can be)
- Can't trim up/down
- Take up space in boat
- Poor access
- Tend to be heavy



# Propellers

- + Efficient
- + Easy to access
- + Easy to replace
- + Not prone to cavitate
- Exposed to submerged objects
- Inboard - prone to thru-hull leaks

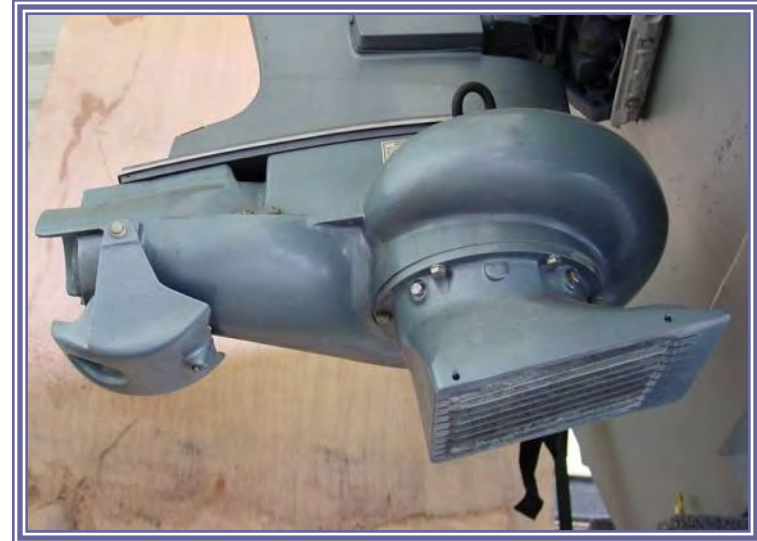




# Jet

## Outboard:

- Inefficient
- Impeller access
- Noisy
- Pump blockage
- Poor reverse
- Prone to cavitation



# Jet

## Inboard:

- + Variety of designs
- + Shallow running
- +/- Reverse
- Can cavitate
- Expensive



# Advantage of all Jets





# Lubrication (gasoline motors)

## 2-cycle motors:

- Lubricated by oil mixed with fuel (auto lube or mix 50:1)
- Traditionally outboards, but now some inboards
- Carbureted - high emissions
- Computerized - low emissions
- Consider EPA standards and local laws for carbureted
- 2-cycle motors are lighter than 4-cycle motors

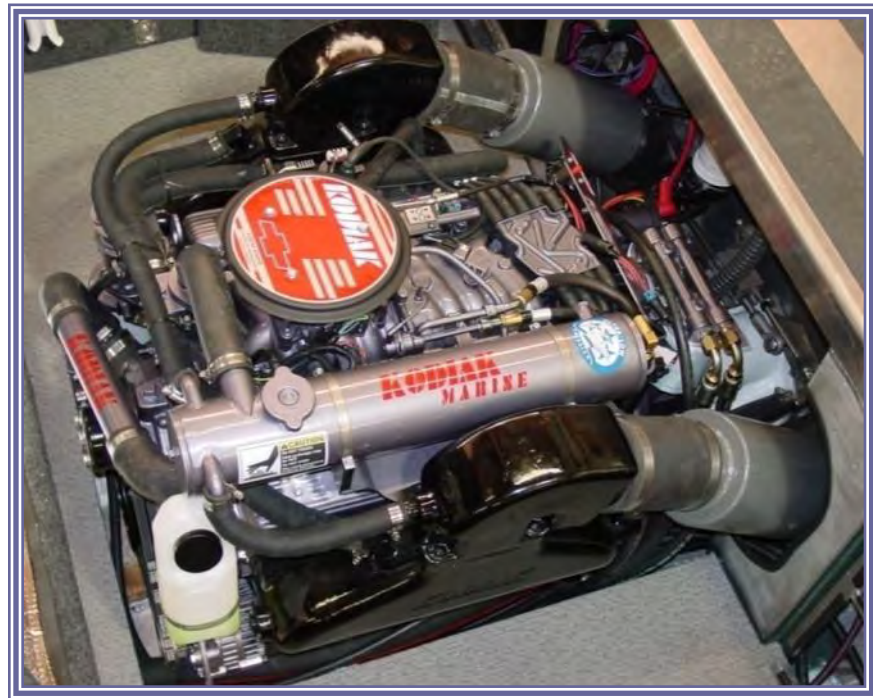


**Carbureted 2-cycle inboard**

# Lubrication (gasoline motors)

## 4-cycle motors:

- Lubrication by oil separated from fuel
- Traditionally inboards but now also outboards
- Clean and quiet



# Lubrication (Outboards)

## Lower Unit/Gear Box:

- Where the "transmission" is
- Contains gear oil





# Fuel System

## Portable or installed:

- Comprised of one or more tanks (portable or installed), valves, lines, pumps and filters
- **The greatest cause of a boat fire or explosion is gasoline fumes in the low part of the boat**
- Installed/enclosed fuel tanks require a blower
- The "Sniff test" is your best tool



# Fueling Procedures

- Secure boat to dock
- Switch engine off
- Extinguish all open flames
- Do not use electrical switches
- No smoking
- Close doors, ports, hatches
- All passengers ashore
- Portable tanks should be filled ashore



# Fueling Procedures (cont.)

- Contact fuel nozzle with boat before pumping & maintain contact.
- Do not overfill
- Wipe up any spillage
- Open doors, ports, hatches to ventilate after fueling





# Fueling Procedures (cont.)

- Turn blower on for 4 minutes minimum
- Do the "sniff test"
- Start engine
- Re-board passengers
- Untie from dock and cast off

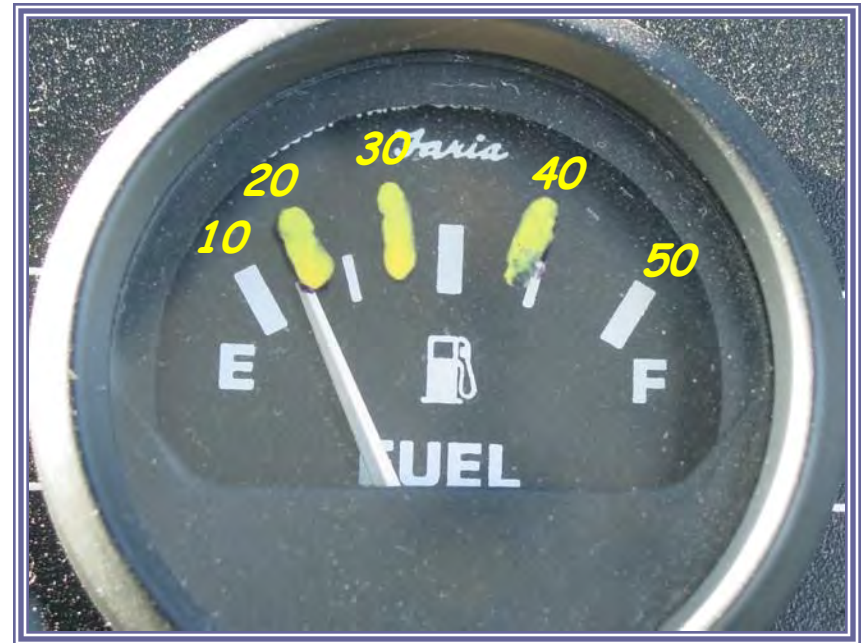


*Remember this: The greatest cause of a boat fire or explosion is gasoline fumes in the low part of the boat*

# Fuel System

## Check fuel level

- Rule of thumb - Plan for using a third of your fuel getting out, a third getting back, and having a third left over.
- Know (and consider custom marking) your fuel gauge.



# Fuel Management System

Fuel management systems (including fuel flow meters) are available that accurately measure fuel consumption, and can be reset when refueling



# Cooling System

## Outboards

- Water enters intake, circulates and is discharge through propeller hub
- Weep hole indicates system is functioning
- Never start without water



# Cooling System

## Outboards

- Never start without water





# Cooling System

## Inboards

- Uses anti-freeze that is cooled by water that passes through a "Heat Exchanger" then out the exhaust.





# Electrical Components

## Electronics - Battery and switches

-Consider a master switch, usually located near the engine/ batteries or on the console



-Consider an onboard battery charger



# Electrical Components

## More about batteries

- Securely mounted in a protected, dry, area.

- Be familiar with the types and purpose of the batteries on the vessel.





# Other Systems

**Throttle Control System** - Typically linked to forward/reverse

**Bilge-Dewatering System** - Not always a "system", but can have multiple bilge pumps including auto-bilge switches.

**Anti-Corrosion System** - At minimum zinc anodes.

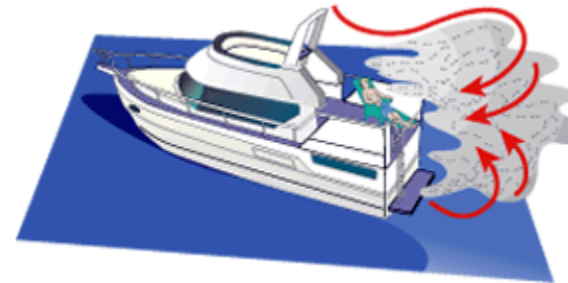
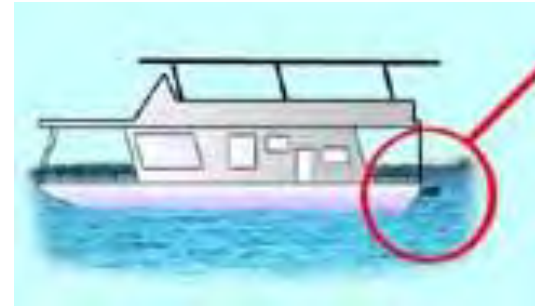
# Kill Switch

Shuts off the engine if the operator is thrown away from the controls



# Carbon Monoxide Poisoning

The "silent killer"







# Operating Systems

## Topics covered in the field:

- Propeller inspection and removal
- Impeller inspection and removal (outboard if present)
- Startup and shutdown procedures
- Inspection, maintenance and troubleshooting

Also...

- Pre-departure checklists
- Emergency procedures