AN INTRODUCTION TO BOATING

BOB MOFFATT

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R. Moffatt

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THIS BOOK BELONGS TO _____

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THE AUTHOR

Bob Moffatt is a Science graduate of the Queensland University majoring in Marine Zoology and has completed a Graduate Diploma in School Administration from the Brisbane College of Advanced Education specialising in Marine Management Systems.

He began teaching marine studies programmes 16 years ago in the Wide Bay Region where he developed a programme for Senior Zoology students. In 1976 he received a grant from the Commonwealth Schools Commission to begin the Gladstone Oceanographic Studies Program in Queensland's Central Region. In 1983 he founded the Brisbane South Region Marine Studies Program on Queensland's Gold Coast from which many curriculum materials have been developed.

Bob has been a pioneer in the design and implementation of curriculum materials. He built a prototype Marine Studies building in 1985 and actively promoted marine education throughout Australia largely from the sales of his earlier books. He has had much to do with the purchase of marine resources in Queensland schools and is presently assisting with the Marine Studies Board of Secondary School Studies Syllabus. He was a foundation member of the Marine Studies Education Society of Australasia of which he is now immediate past president.

In 1986 he undertook, at his own expense, a world tour to 14 overseas countries to gather ideas to further marine studies school based curriculum development in Queensland schools. In addition, he represented the Queensland Education Department at the Pacific Area Conference of Marine Technology in Hawaii on an honorary basis.

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by

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Additional illustrations

S. Byers, R. Bedford, S. Oats, J. Green, R. Unsworth and Brady Moffatt

Resources required

A small aluminium dinghy
5 hp motor
Safety gear
Sheltered waterway
Rope for throwing and knots

Syllabus orientation

This booklet has been written with the Qld Marine Studies Board of Secondary School Studies Syllabus. It is also applicable to the AYF federation TL3 course and DEVET Course CN 738, subject TEG 120, Safe Operation of small craft.

SYLLABUS MATCH

Division of Employment, Vocational Education and Training (DEVET)

Course CN 738 Mariners Course IV

Subject TEG 120 Safe Operation of Small Craft

DEVET	Introduction to Boating Chapter					
Topic	Ch 1	Ch 2	Ch 3	Ch 4	Ch 5	Ch 6
Boat Handling	▨				▨	
Emergency and safety					▨	
Safety equipment					▨	
Weather reports	▨				▨	
Engineering	▨	▨	▨	▨		
Collisions and port regulations					▨	
Mathematics	▨			▨		

CONTENTS

List of Student Activities

List of Activities

Chapter 1 Learning the Basics

Chapter 2 Your First Lessons

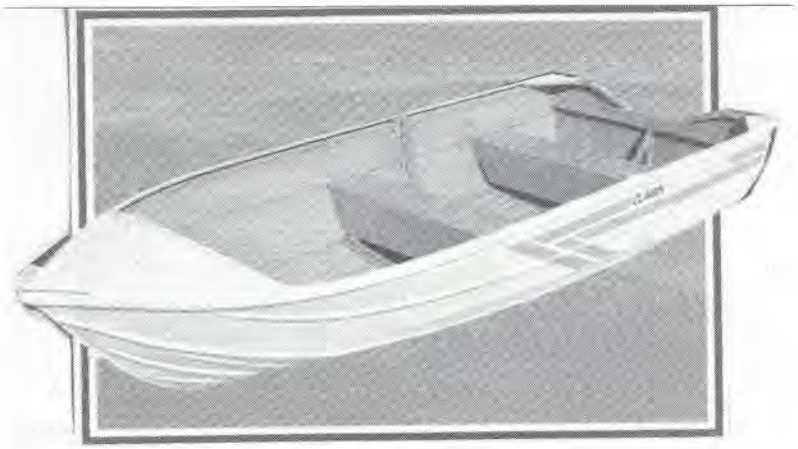
Chapter 3 Acquiring New Skills

Chapter 4 Getting your Licence

Chapter 5 Minor Repairs and maintenance

Chapter 6 How Your Engine Works

Student Assignment Work and Copyright Free Sheets



COURSE TOPICS

1. Ropework:- including at least uses and applications of a clove hitch, round turn and a two half hitch, bowline, figure of eight, sheetbend
2. Rowing and anchoring of boats
3. Starting an outboard motor and driving it round a set course, bringing it back safely to shore
4. Mixing two stroke fuels in a given ratio
5. The shapes, differences, advantages and disadvantages of planing, semi-displacement, displacement hulls and multihulls
6. Different sailing craft rigs, ie; multihull, sloop, cutter, cat, gunter, schooner, ketch and yawl
7. Terminologies applicable to most boat types:- hull, bow, stern, gunwale, chine, transom, deck, cleat, bollard, propeller, tiller, rudder, keel, oars, rowlocks, stoppers, port, starboard, bilge, navigation lights
8. Correct methods of anchoring using a danforth anchor.
9. Correct methods for coilage and stowage of rope
10. Planing a boat
11. Making a figure of eight at speed while crossing the wash
12. Recover an object from the water
13. Mooring at a jetty
14. Demonstration of the difference between 4 and 6 knots
15. Demonstration of the boating rules as set out by the Department of Harbours & Marine
16. The components of an outboard motor
17. The more important controls of a powerboat
18. Fuel storage and supply systems for outboard motors
19. The areas designated for boating and skiing in their local area
20. Diagnosis of simple mechanical problems associated with marine engines
21. Navigation lights

The course also seeks to develop the following attitudes:-

1. The importance of obeying consistently the boating rules both inside and outside of school hours
2. Caring uses of the local waterways by not creating excess wash or littering the forehore
3. Tolerance of others by being patient at boat ramps and helping each other load and unload boats and equipment
4. Willingness to help clean up and maintain equipment

CHAPTER 1

BEFORE

SETTING OUT

Before setting out you must consult the safety brochures produced by your local state authority. Is a licence required, does the boat have to be registered and am I insured against legal action if I cause an accident?

WHY STUDY THIS UNIT?

Ever since our early colonial days, people in Australia have depended on the sea for their livelihood. Today, the sea is still used for many purposes.

Australia has a high involvement in maritime activities at Recreational, Tourist, Fishing Research and Constructional levels. Over 90,000 power boats are currently registered and over 2,500 charter and fishing vessels operate out of Queensland ports alone. With such a large number of craft there is a need for all people using the sea to have a working knowledge of the vessels that operate in its waters.

It is important for all those who use our waterways and seas, to use them safely and wisely. This chapter looks at all the things you need to do before you go out.

EQUIPMENT AND SAFETY

Objectives: You should be able to:-

1 C Define the term: pleasure yacht
2 C Define the terms: smooth water, open water
3 C Describe the responsibilities of the owners of a pleasure yacht regarding safety
4 C Describe how you would obtain further information about safety regulations
5 CP Recognize different types of life jackets
6 P Distinguish between jackets, buoys and rafts
7 PA Recognize the need for jackets, buoys and rafts
8 P Use a table to detail the requirements for life jackets for any boat in Qld waters
9 C Recall the meaning of the letters A.S.A.
10 CP Draw a V sheet and describe what it is used for
11 CP Recognize a set of flares and describe their use and misuse
12 CP Describe the paperwork involved in conducting a programme in boating
13 P Describe 2 types of bailing equipment necessary for pleasure yachts
14 C Define the terms: lanyard, bilge, tender boat
15 C Describe how to obtain a chart
16 CP Define the terms duty of care, liability, negligence
17 C Recall the amount of drinking water required to be carried
18 C Relate the routine safety steps before setting out from home
19 C Recall the routine safety steps before leaving land
20 CP Recall the important suggested code of general safety rules, behaviour expectations and emergency procedures and give reasons for their existence
21 CP List the equipment used in the programme and some of the methods used in its care
22 C Be able to spell and use correctly the following words:

liability	regulation	licence	yacht	forecast
pleasure	extinguisher	lanyard	flare	anchor
stocktaking	bung chart	compass	knots	

SAFETY SKILLS

1 S Put on a life jacket
2 S Rig an anchor for a small boat
3 S Tow another boat using a bowline, round turn or clove hitch
4 S Tie a round turn and two half hitches
5 S Row a boat
6 S Raft up and move from boat to boat
7 S Demonstrate the safety signals

ROPE

Before setting out, a few basic knots need to be mastered.

You need to know how to tie the boats to the trailer, throw a line to and from a disabled boat and tie up a disabled boat for towing.

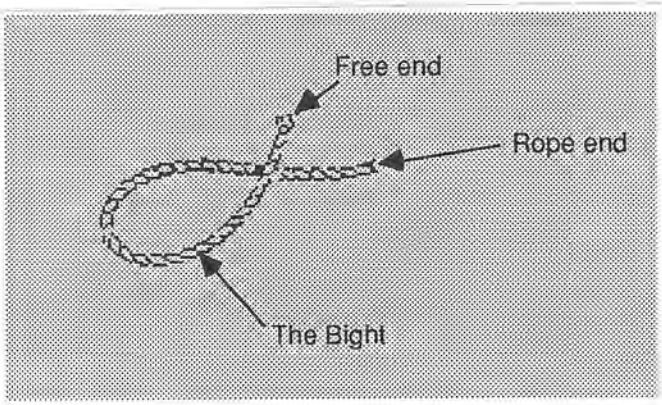
Three basic knots are the round turn and two half hitches, clove hitch and bowline. Others which you need to know are the larks head, sheet bend and figure of eight.

KNOTS

An efficient knot must be easily and quickly tied, become more secure as the strain on it increases and be quickly and easily untied.

Parts of the knot and rope

The main length of a rope is called the standing part; a loop is called a bight; and the long part of the rope is the rope end and the short part is the free end.



There are 6 basic knots:

(1) the figure of 8
(2) the clove hitch
(3) the bowline
(4) reef knot
(5) sheet bend
(6) round turn and two halves

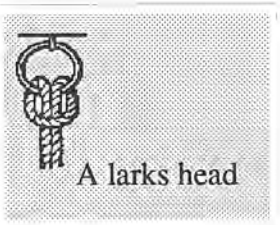
ACTIVITY 1.1 KNOTS

You will need

A piece of rope about 1.5 metres long

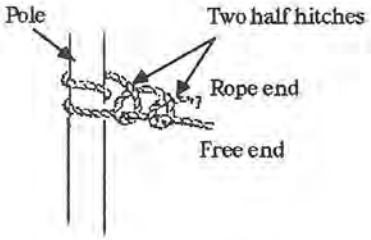
What to do

Look at the photos over and tie the knots indicated.


A larks head

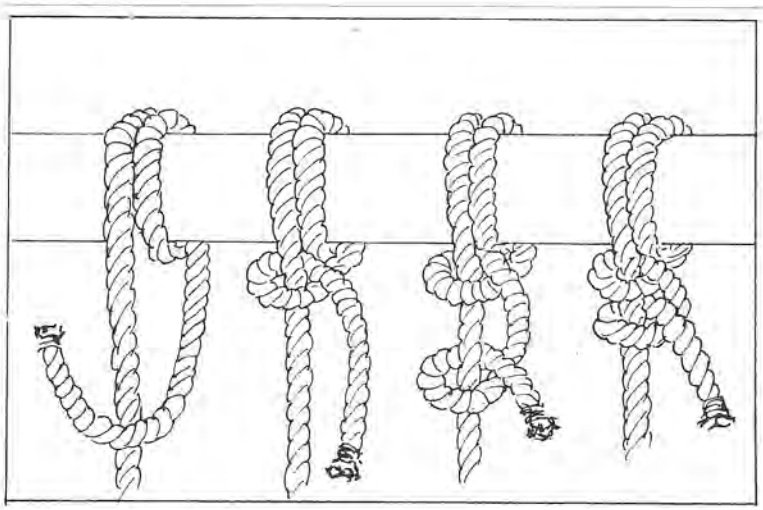
THE ROUND TURN AND TWO HALVES

One use:- For making fast, boat's painter to a post or ring.



How to tie it:

Take the free end and wrap it around a post twice. Now make two half hitches on the rope end.

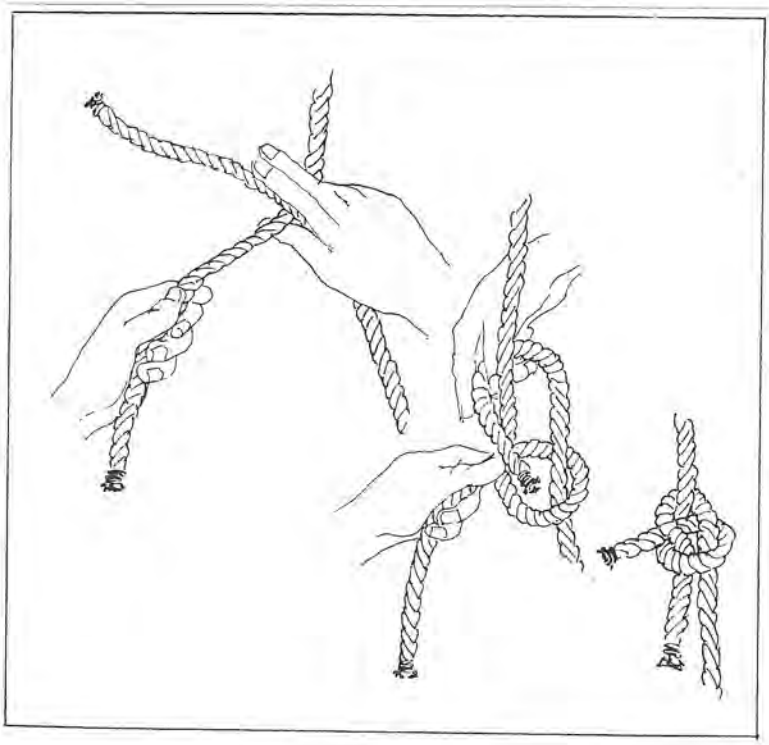


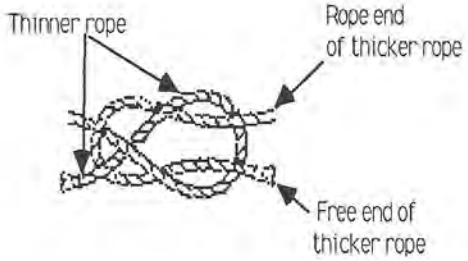
THE SHEET BEND

One use:- For tying two ropes of the same size together or attaching a rope to a loop.

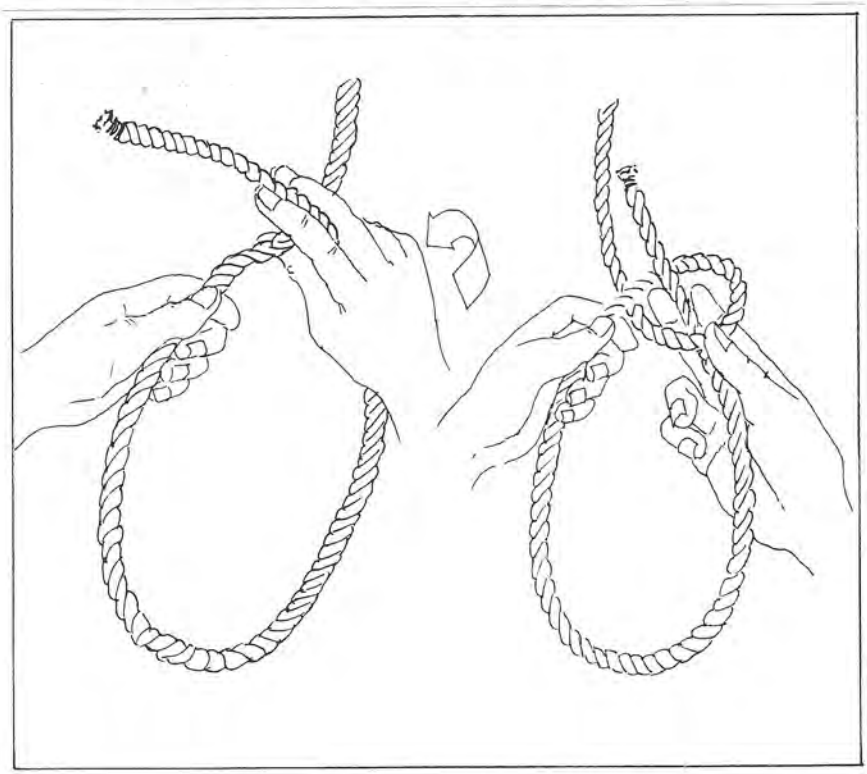
The best method of joining two ropes of un-equal thickness.

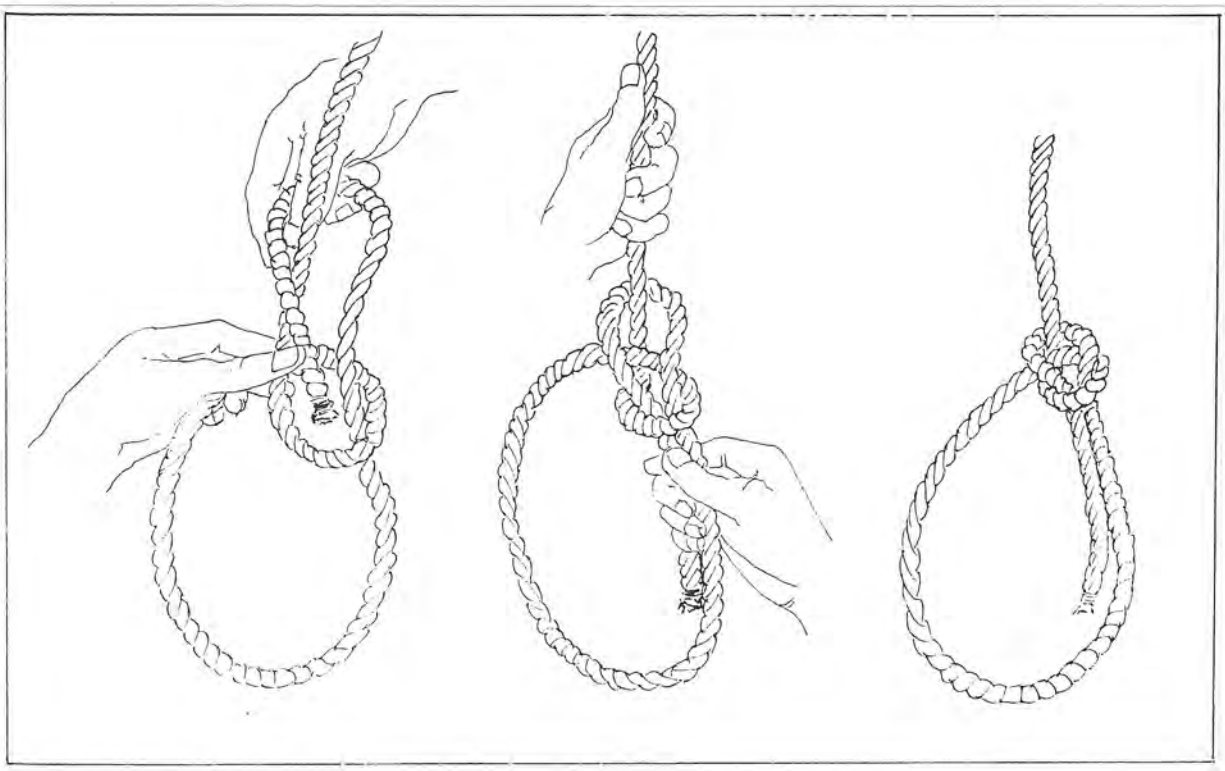
Can also be used for attaching rope to an eye splice or ring.





THE BOWLINE or king of knots. Used for making a loop for a mooring, attaching warps to boats, tying equipment in a boat, or just for making a loop at the end of a rope that will not slip.

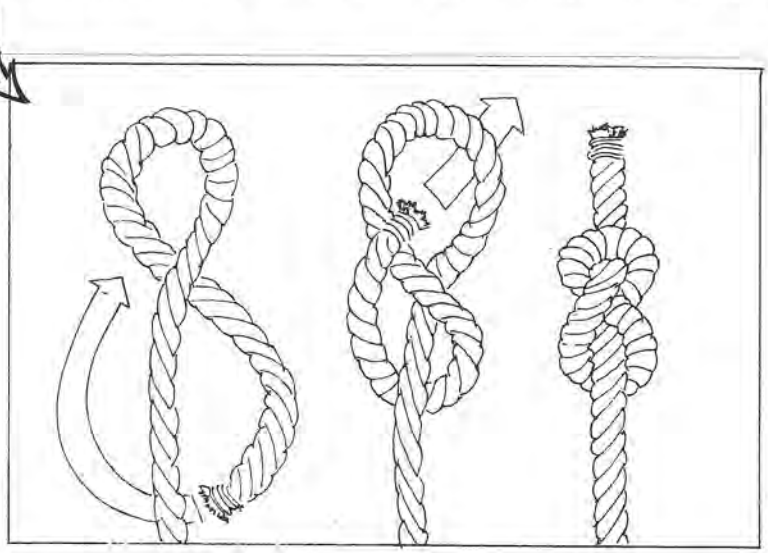




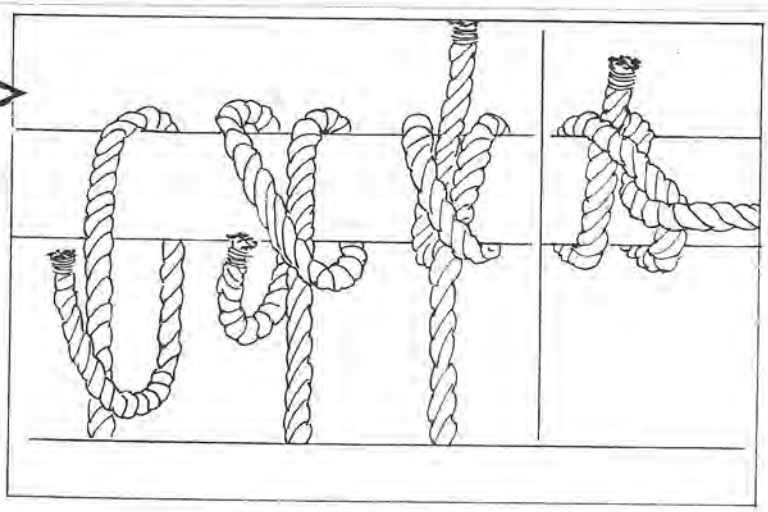
How to tie:

Make a loop in the rope end(sometimes called a rabbit hole). Pass the free end up through the loop (sometimes called up the rabbit hole). Then pass the free end around the rope end (or around the tree) and then back through the loop (back through the rabbit hole)

THE FIGURE OF EIGHT
Used to make a knot that can act as a stopper when passed through a ring



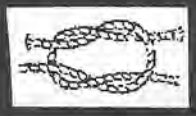
THE CLOVE HITCH
Used to secure small items in a boat



THE REEF KNOT

Used to tie two ropes of equal thickness together

Right over left and under.... left over right and under.....



Activities:

1. Learn how to tie a sheepshank. What is the difference between this and a truckies' hitch?
2. Tie a Lark's head. When would you use this knot?
3. Tie a slippery Clove Hitch.
4. Make a table of common knots and describe how each is used
5. Learn to splice a rope.
6. Obtain some nylon rope and carefully heat the end in the flame of a candle. Does nylon rope have to be whipped?

Teachers Note: Demonstrate to the class a variety of boating situations where these knots could be used. Use an in-class simulation to do this.

A sheepshank is a knot used to shorten a rope. A quick modification of one end becomes a thumb knot.

Whipping rope is a good exercise

ACTIVITY 1.2 LOADING AND UNLOADING THE BOAT TRAILER

You will need

A trailer full of boats

What to do

Go over the procedure required to load and unload the trailer taking special note of knots and safety precautions.

Discuss the following points:

1. How to spring tie the boats.
2. Correct mounting of motors
3. How life jackets are to be packed
4. How petrol tanks are to be carried
5. How to carry motors
6. Where to put gear when the trailer is unloaded
7. Fitting of life jackets
8. How to balance the trailer and towing vehicle
9. How to check indicator lights, safety chain and trailer connections
10. First aid kit, and emergency communications back to school. Nearest phone/radio.
11. What knots are to be tied when and where
12. How to talk to each other for safety

SPECIAL NOTE

Not discussed here is a normal care trailer. *This is mentioned later on* ***page 40.***

For single trailer launchings discuss also

* what to expect at the slipway or boat ramp.
* what type of car can pull the boat and trailer
* state of the tide and sea conditions

ACTIVITY 1.3 COILING AND THROWING A ROPE

You will need:

Some rope about 5 metres long

What to do

Ask your teacher how to coil the rope and throw it at least 3 metres. Check also to see that ropes are correctly whipped.

PREPARING FOR SEA

Boating Safety

Fundamental to all activities associated with working in the sea is basic seamanship. Whether you are endeavouring to pursue a career in the merchant navy, any of the associated industries or further studies relating to tertiary institutions, you will benefit from becoming competent in this area.

During this course you should develop a safe and caring approach towards equipment used to learn the skills, a concern for the safety of others, a caring approach to the environment whilst engaging in the above activities, and value the need to be cooperative and helpful to others and willing to admit to error whilst helping others learn.

One of the major aspects of basic seamanship is the ability to perform to a sound level in the skill objectives. The standards set by the school as well as your behaviour outside will be judged by the local community.
Of all the topics students seem to like most, boating stands alone. Few pastimes offer the relaxation and enjoyment as simply messing around in boats.

A study of the skills of using a boat is fundamental to any course associated with the sea.

SHOW THE VIDEO ON SEA SAFETY

You can obtain a video on Sea Safety available from the Department of Communications Canberra.

Federal Sea Safety and Surveillance Centre

Safety

'. . . SeaSafety, Canberra, is co-ordinating the search.'

SeaSafety Centre, Canberra

The Federal SeaSafety and Surveillance Centre co-ordinates the search and rescue of mariners in distress in Australia's waters. Its area of responsibility — stretching from Indonesia and Papua New Guinea in the north to Antarctica in the south, from halfway to Africa in the west to the middle of the Tasman Sea in the east — covers one ninth of the world's surface and 30 000 kilometres of coastline.

Operational 24 hours a day 365 days a year, the SeaSafety Centre is involved in a variety of incidents which include conducting searches, answering requests for medical evacuations, tracing overdue yachts and other less dramatic incidents such as investigating flare sightings and issuing safety and navigation warnings.

The SeaSafety Centre is also responsible for the operation of the Australian Ship Reporting System (AUSREP) which enables the position of all participating vessels, from the largest bulk carrier to the smallest pleasure craft, to be plotted and stored on the system's computer.

There is a computer sub-section for each of the SeaSafety Centre's functions — AUSREP, surveillance, Australian fishing zone, navigation aids and weapons practice warning area plus search and rescue planning. A colour graphics capability allows search co-ordinators to call up a map down to a scale of half a kilometre of coast line or to superimpose drift diagrams on to charts of any scale or projection.

Despite these technological innovations, bringing together all the information into a workable plan to locate vessels and save lives still depends on the skill and expertise of the search co-ordinators, all of whom are former naval officers or master mariners.

Transport and Communications

PERSONAL FLOATATION DEVICES (LIFE JACKETS)

Life jackets have a part that supports the head. Buoyancy vests don't. But just how safe are life jackets and what is a P.F.D?

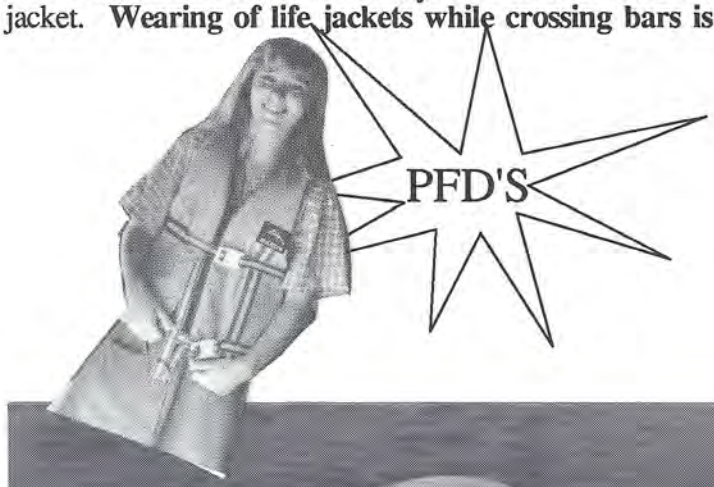
PFD's are now numbered according to the type of situation for which they are designed.

Type 3 are for when immediate rescue is close by. The buoyancy vest would fit into this situation.

Type 2 are for sheltered water where help is close by and Type 1 are for beyond sheltered waters where early rescue is necessary. What is early rescue? It takes 3 minutes to drown and it must be stressed that a PFD of any type does not guarantee safety in all situations. Waves from the back can actually make swimming very difficult.

Each ASA PFD has a label which clearly sets out the conditions for which the vest is designed. You can still buy a life jacket and you should seek expert advice if you are in doubt.

A life jacket is also useless if it is not worn. If a situation arises in which your level of confidence decreases, you should put on your life jacket. **Wearing of life jackets while crossing bars is mandatory.**



1.4 CHECKING SAFETY GEAR

All of this should be stowed in a safety bucket which can easily be removed and checked regularly. A bucket which fits inside another bucket will solve the two bucket regulation. Other safety gear can then be stowed inside:-

* anchor, 2m chain, 27metres rope
* signal mirror (Try glueing it to the lid so it won't get lost)
* torch
* spare bung
* water (if applicable)
* each fixed with 2 metres of lanyard(rope)

Safety gear includes torch, signal mirror, buckets with lanyards, anchor, rope and chain of specified length, safety pamphlet, water.

Trailers and towing vehicles

A trailer suitable for transporting a number of these boats to the venue is needed and a towing vehicle. Ideally the rig should be self contained and carry crates, and add on frames are useful in organisation of the class to perform routine duties in loading and unloading.

ACTIVITY 1.5 SAFETY RULES

What you need

A list of general code of safety rules and behaviour expectations. See appendix.
Boating safety pamphlet

What to do

(a) Make a list of the equipment necessary for the boats involved in your boating programme

(b) Discuss the following as a class

1. A code of general safety rules and signals
2. Discipline
3. The role of the safety boat
4. First aid
5. Engine failure
6. Man overboard
7. Capsized boat and motor
8. Rafting up

BOATS AND MOTORS

The ideal training boat is aluminium, about 3 - 4 metres long and fitted with a small 5-8hp motor depending on the state regulations regarding driving a power boat.

A small metal fuel tank, a pair of oars, and safety gear stowed in a safety bucket, complete the training rig.

The photograph opposite is reproduced courtesy of the Australian Volunteer Coast Guard and Air Sea Rescue Associations.

Excellent training is offered by these associations so, why not enquire about joining and extending your skills into this important area.

Many young people get jobs as a result of the contacts they make in these groups and various certificates and awards are issued which are useful additions to your job resume.

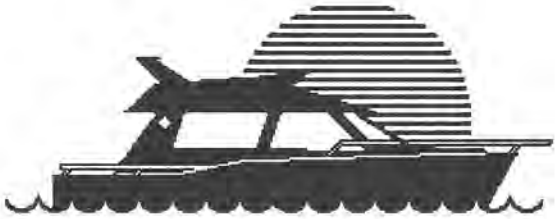
CHAPTER 2

YOUR FIRST LESSONS

OBJECTIVES

You should be able to:

1C Correctly identify the following boating terms
- * Rowlocks
- * Chain securing outboard to boat
- * Gunwales
- * Painter bollard
- * Ribs
- * Hull
- * Painter
- * Ocki strap
- * Registration sticker
- * Seat
- * Fuel tank
- * Outboard motor
- * Transom
- * Oars



2 CP Recall and explain the difference between a planing, displacement and semi displacement hull

3 CP Recall and explain the difference between a clinker built, carvel hull, moulded construction and hard chine hull.

4 CP Identify and draw the following types of sailing boat
Masthead sloop, masthead cutter, three quarter cutter, lug, sliding gunter, cat, schnooner, ketch and yawl

5 CP Recall and debate the types and uses of engines fitted to boats

6 CP Correctly identify the following parts of an outboard motor
- * cowling release
- * foreward
- * reverse
- * prop
- * split pin
- * cold water intake
- * pull start
- * throttle
- * exhaust housing
- * prop
- * water pump
- * fin
- * tell tail opening
- * neutral
- * propeller shaft
- * nylon nut
- * sheer pin
- * powerhead
- * cowling
- * shift handle
- * attachment to transom
- * trim and tilt mechanism
- * gear case
- * leg of motor

7 CP Describe the action of the rudder and predict movements

8 P Calculate the petrol mix required for an outboard engine

9 P Discuss a motor starting checklist

10 P Identify the local water ski areas

11 P Use a pamphlet to determine the requirements for navigation lights on a boat

12 C Recall the equipment necessary for safety on a boat

13 C Recall the parts of an anchor

14 C Recall and describe the various uses for the following anchor types
- * yachtmans
- * danforth
- * sea anchor
- * C.Q.R.
- * reef
- * makeshift
- * dreadnaught

15 P Describe the function and parts of the cooling system of the outboard motor

16 P Define the terms: chain pendant, anchor, rope, kedge anchor, plough anchor, bung

17 P From a table of fire extinguishers, indicate the correct use for common fires at sea

18 C Recall the safety steps in the following cases of emergency:
(a) boat stops (b) engine stops
(c) man overboard (d) boat sinking
(e) boat overturns

ACTIVITY 2.1 GETTING INTO AND OUT OF A BOAT

A knowledge of the training boat and its equipment helps all who use the boat to communicate well. A knowledge of boat parts is necesary before starting out. Each has its own purpose and function. Incorrect use can be a danger to the parts life and the user.

Always face the stern when you get into a boat and step into the middle so that the centre of gravity is as low as possible. Take a hold of the gunwales to steady yourself.

If you move from side to side you, your centre of gravity changes and the boat will move accordingly. If you have a passenger, any sideways movement will move the boat also so the weight of a boat should be distributed equally.

Next there are the parts of a boat.

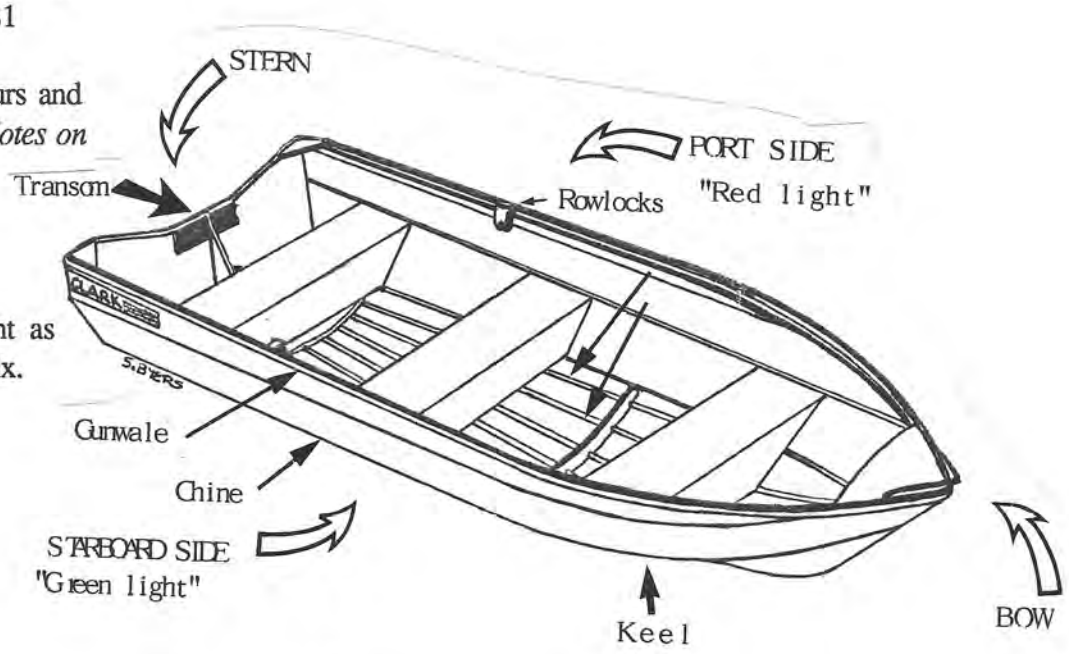
ACTIVITY 2.2 LEARNING THE NAMES OF THE PARTS OF A BOAT

You will need

* A copy of the worksheet in the Appendix, page 81
* A training boat
* A copy of the Harbours and Marine Pamphlet: *Notes on small craft*

What to do

Complete the assignment as outlined in the Appendix.



Now that you know something about boat hulls its time for your first real lesson in a boat.

Before you get in however, make sure you can

* swim with a life jacket
* throw a rope 3 metres
* tie a clove hitch
* balance yourself in a boat

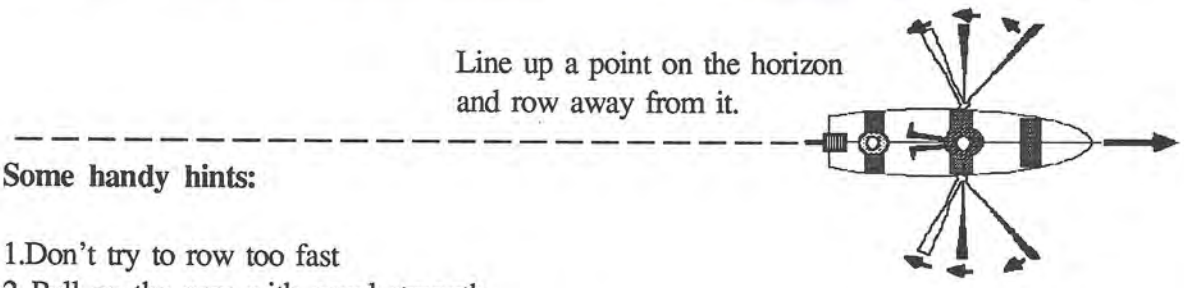
ACTIVITY 2.3 ROWING A SMALL BOAT

You will need

A boat, oars and observer

What to do

When rowing, sit comfortably in the middle of the boat and face the stern.
Grasp the oars and push forward so that the oar blade moves towards the bow of the boat. Don't go too far and dip the blade in the water. Pull back until the oar blade just passes you and then manoeuvre the blade out of the water so as to repeat the cycle.

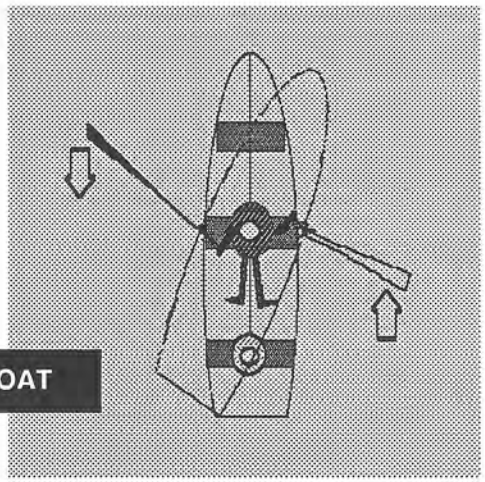


Some handy hints:

1.Don't try to row too fast
2. Pull on the oars with equal strength
3. You don't have to dip the oars in too deep, they just have to dip right in under the water
4. Line up a point that you are rowing from and keep it in line in order to row straight.
5. If the boat has an observer, seat this person in front of you so they can see where you are going
6. If the boat is fitted with a motor make sure it is in the up position

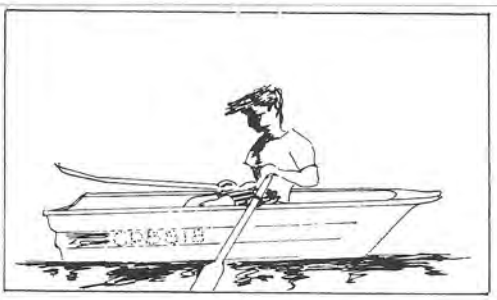
The oars also control the direction in which the boat travels.

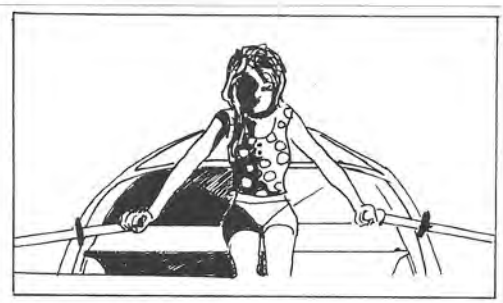
If you want to go to port, then pull on the oar that is in your left hand, while moving the oar in your right hand in the opposite direction.

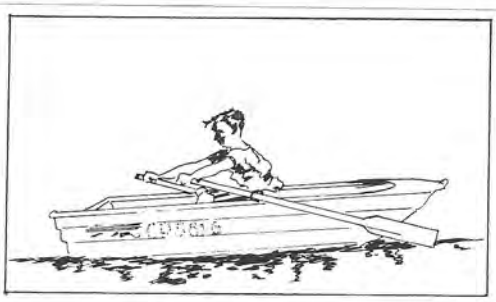


HOW TO TURN YOUR BOAT

THE STAGES IN ROWING A BOAT







ENGINES

The choice of engines is practically unlimited. There are four broad categories: outboard, inboard, outboard/inboard and 'specials', i.e. jet and electric. We will consider the first three types. The outboard engine, so called because the complete unit is hung over the stern of the boat, has certain advantages.

(a) It is easily removable for maintenance, storage, etc.
(b) Most outboards automatically tilt if they hit an underwater obstruction and so are not easily damaged.
(c) Mounted at the stern of the boat, they occupy very little space in the boat.
(d) The cost is less than for an equivalent inboard unit.

However the following are disadvantages:-

(a) Running costs are greater than with an inboard.
(b) It is possible for the engine to fall off while running or be stolen
(c) An outboard is less protected from the elements and from damage by collision.

With one exception, outboards are of the two-stroke design i.e. fuel and lubricant are mixed and transferred together to the engine. In the normal car engine, the oil added independently, may recirculate around the engine for several thousand kilometres before requiring replacement.

Inboard engines offer many variations in speed and power but require three holes in the boat hull for (a) cooling water intake (b) exhaust and cooling water outlet and (c) propeller. The prop must be aligned carefully to prevent wear and tear on the engine bearings.

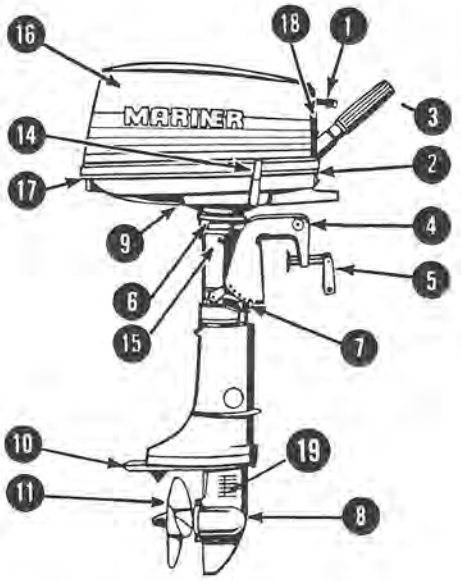
The outboard/inboard engine employs a standard inboard engine, mounted on the inboard side of the transom.

ACTIVITY 2.4 PARTS OF THE OUTBOARD MOTOR

You will need

* A copy of the worksheet in the Appendix
* An outboard motor on a stand

The outboard motor



1 - Starter Handle
2 - Engine Controls
3 - Steering Handle
4 - Clamp Brackets
5 - Clamp Handles
6 - Steering Adjustment Wing Nut (Port Side)
7 - Tilt Pin
8 - Lower Unit
9 - Water Outlet
10 - Anti-Cavitation
11 - Propeller
12 - Fuel Tank Cap
13 - Air Screw
14 - Shift Lever
15 - Tilt Stop Lever
16 - Top Cowl
17 - Cowl Clamp Lever (Port Side)
18 - Throttle Friction Screw
19 - Water Intake

Read and learn section from worksheet 3

The cowling is the external cover of the top part of the outboard motor and has the pull start coming out from the end near the steering handle. The throttle is located on the steering handle which is found just under the cowling.

The cowling is sealed by rubber to stop water entering the engine area. The shift handle is located on one side of the cowling and is used to change gears fron neutral, reverse and forward. The exhaust hosing is located under the cowling and is to the left of the diagram. At the bottom of the leg of the motor is the prop which turns by means of the motor and gear box system so as to propel the boat forward.

To the right of the diagram and just under the steering handle can be seen the attachment mechanism to the transom. This mechanism has two wing screws which break off if they are tightened too much. If you break these the owner of the boat will rip your arms off.

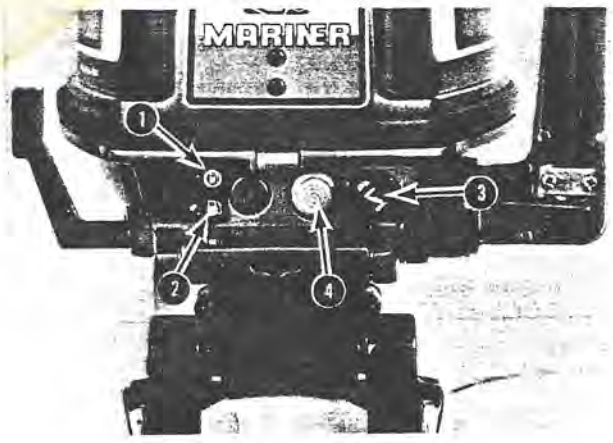
Under this is the trim and tilt mechanism which has a shift pin which can be moved so as to help the boat plane properly when under power. The water pump housing and the gear case housing are indicated by the two arrows just above the arrow pointing to the fin on the right hand lower side of diagram 1. The scarificial anode is located just above the prop and you will get an extra mark if you put it in.

2. Label the parts of the external features on diagram 2

* Cowling release (Arrowed)
* foreward (3)
* reverse (1)
* prop (5)
* split pin (6)
* cold water intake (9)
* tell tail opening (Arrow)
* neutral (2)
* propeller shaft (8)
* nylon nut (4)
* sheer pin (7)
* powerhead (Under cowl)

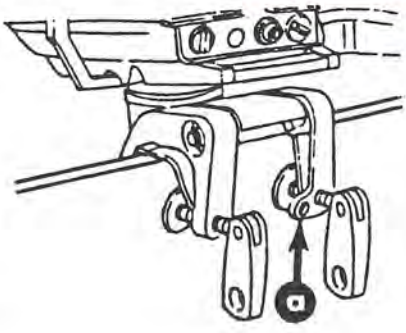
THE MORE IMPORTANT CONTROLS OF AN OUTBOARD MOTOR

In dinghies fitted with an outboard motor, all the controls are at the stern of the vessel. The outboard motor has a steering arm acting as a rudder, which enables the boat to be steered to port or starboard. At the end of the steering arm is the throttle which accelerates or decelerates the motor.



1 - Fuel Cock Closed
2 - Fuel Cock Open
3 - Choke Knob (Run Position)
4 - Stop Button

Security Line



a - Security Line Attachment Ring

ACTIVITY 2.5 HOW TO CARRY AND STORE An OUTBOARD MOTOR

You will need

An outboard motor and motor trolley

What to do

Practice loading and unloading the motor getting used to its weight. Practice lifting it to and from the trolley. Remember to lift with your feet and not with your back. Lay the motor down on the front end of the cowling. Position it so that it cannot fall over.

Ideally a motor should be stored on a trolley so that it can be wheeled from place to place inside your workshop or garage.

Carry a motor so that you are balanced properly

An easy way to store and move a motor is on a trolley

Never carry a motor so that it points downwards towards the powerhead because water left over from the last use will run down into the powerhead.

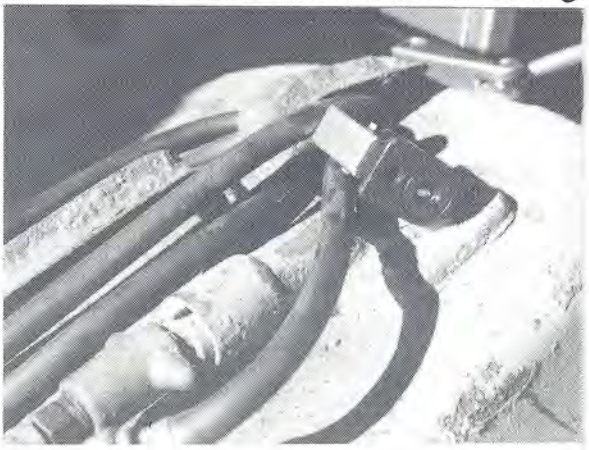
FUEL STORAGE AND SUPPLY SYSTEMS FOR OUTBOARD MOTORS

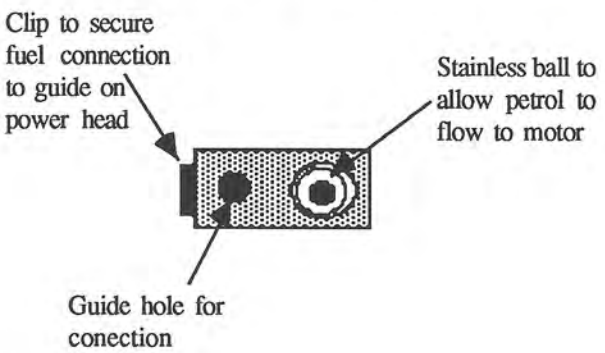
The outboard motor is fuelled usually by two stroke fuel supplied from a fuel tank. Two stroke fuel is a mixture of pertol and oil usually in the ratio of 1 litre of oil for every 50 litres of petrol.

The fuel tank has a storage area, a gauze filter, and is attached to the motor by a fuel line. When the fuel tank is transported the cap is closed to prevent leakage. However pressure will build up and should be released before connecting the fuel hose.

Fuel is pumped throught the line by the rubber squeeze pump located at the end of the hose near the tank.

The flow of fuel mix is controlled by a stainless steel ball at the end of the hose. Before connecting the hose to the motor make sure there is no gunk (see definition page 26.) around the ball.





ACTIVITY 2.6 MIXING OUTBOARD FUEL

For a small five litre can of fuel, 100 mls would be required.

To calculate the fuel mix use the cross multiplication table shown below:

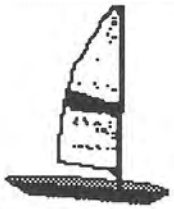
If 1 litre is required for 50 litres

then x litres are required for 20 litres

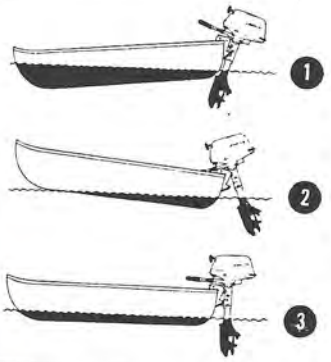
X times 50 = 1 times 20

$X = \frac{1 \times 20}{50} = \frac{2}{5}$ litre = 400ML

Gunk. (After Failes 1988) **Defined as small pieces of sand, dirt, grease, cloth etc, which can get into a fuel line if care is not taken.**



ACTIVITY 2.7 MOUNTING THE MOTOR ONTO THE BOAT



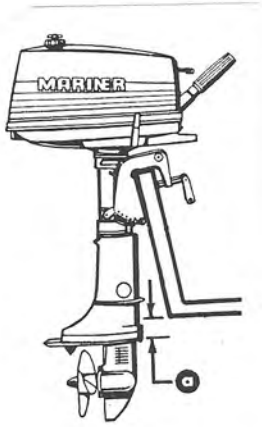
Points to note:

1. If you can't lift the motor, get someone to help. It's no good damaging a motor just to prove you are strong.

2. Make sure the trim and tilt mechanism is adjusted so that when you mount the motor, it sits at an angle.

3. Screw the wing nuts on firmly but not to a point where you break them. You can adjust them when you have the motor in the water.

4. Connect the safety chain to an appropiate point on the motor.



Always make sure your motor is centred and the height is adjusted. (a) opposite should be 25 mm on flat bottom boats and 51 mm on round bottom boats. Consult the manufactures handbook also if unsure.

ACTIVITY 2.8 STARTING THE OUTBOARD MOTOR

Always start a motor when you are inside the boat and never start a motor when people are in the water close to you.

You will need

An outboard motor
Fuel tank and lead
Petrol
Boat

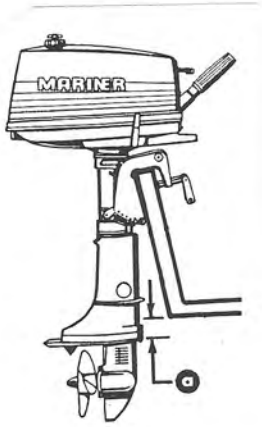
What to do

Check to see that everything is stowed correctly.

Make sure oars and safety gear are secured.

Push the boat into the water with the motor up and make sure the motor is out of the mud when lowering.

Have your partner hold the boat at the bow while you start the motor and steady the boat for you.



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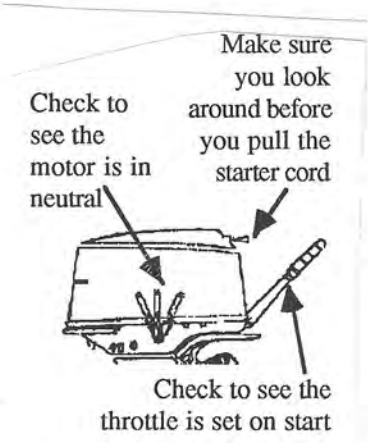
THE STARTING CHECKLIST

(Based on an original idea by Tony Failes)

Motor Starting Checklist (cold)

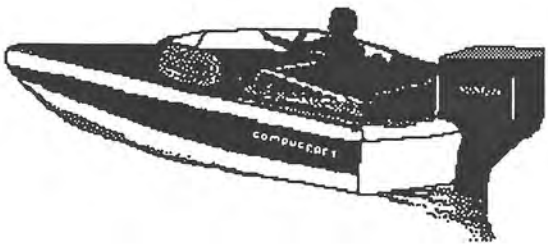
1. Check motor mounted correctly
2. Check safety chain attached
3. Connect fuel line (check for sand or gunk on end) and make sure the screw on the cap is loose so the tank can breathe
4. Pump bulb until reasonably firm
5. Check wire at bottom of control arm, is it in correct position?
6. Is the gear lever in neutral?
7. Is the choke on?
8. Is the throttle on "start"?
9. Gently pull starter cord until it catches
10. Look behind you (so no-one gets belted in the mouth when you pull cord!)
11. Pull starter cord hard three times or until motor starts. If motor does not start after three pulls, turn the choke off.
12. As soon as motor "kicks" turn off choke and drop the revs
13. Check to see if water is coming out from the tell tail (shows water pump is operating)
14. Never change gears when the motor is reving

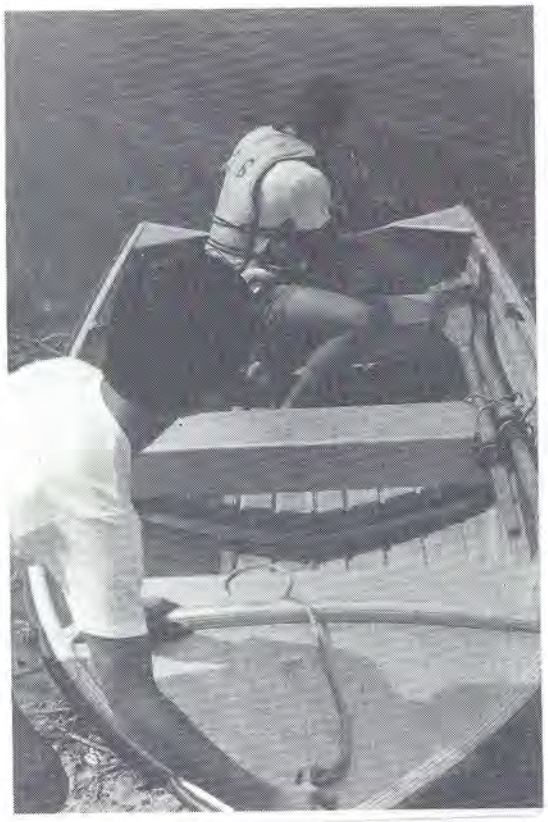


Starting Motor (when already hot)

1. Gear lever should be in neutral
2. Throttle on start
3. Same as 9, 10, 11

*N.B. When motor is hot do not use choke.





ACTIVITY 2.9 YOUR FIRST DRIVE

* Make sure you are in the boat when you start the motor.
* Make sure you have an experienced driver with you to hold the boat steady at the shore while you start the motor.
* Lower the motor and check that it is securely mounted. Check that the safety chain is on and that the wing nuts are firmly in place.
* Start the motor as per Activity 2.7. Check to see if water is coming out of the tell tail and that the motor idles.
* When the motor is warmed up ask your instructor to hop in and engage the motor in reverse when the motor is idling.

IF YOU CHANGE GEARS WHEN THE MOTOR IS REVING YOU WILL BREAK A SHEER PIN OR THE MOTOR WILL JUMP UP OUT OF THE WATER.

REVERSING

Now practice your slow water skills. Point the motor in the direction you wish to go and it will go there.

Reverse up to a buoy and around it. Make sure that no water enters the area just in front of the transom.

FORWARD

Now engage forward gear. Sit astride with one hand firmly on the throttle and another on the gunwale. Make sure you are confortable and engage your brain before the throttle. Think to yourself, "if I turn it down, then it will accelerate. Now if I turn it up, it will decelerate.

Do this a few times to convince yourself that you are doing the right thing. Practice increasing and decreasing revs so that you "get the feel " of the motor. Practice steering to port and to starboard so that you get the feel of the rudder. Everything is reversed now. Push the motor one way and the boat goes the other. Learn to engage your brain before using your hand and take your time.

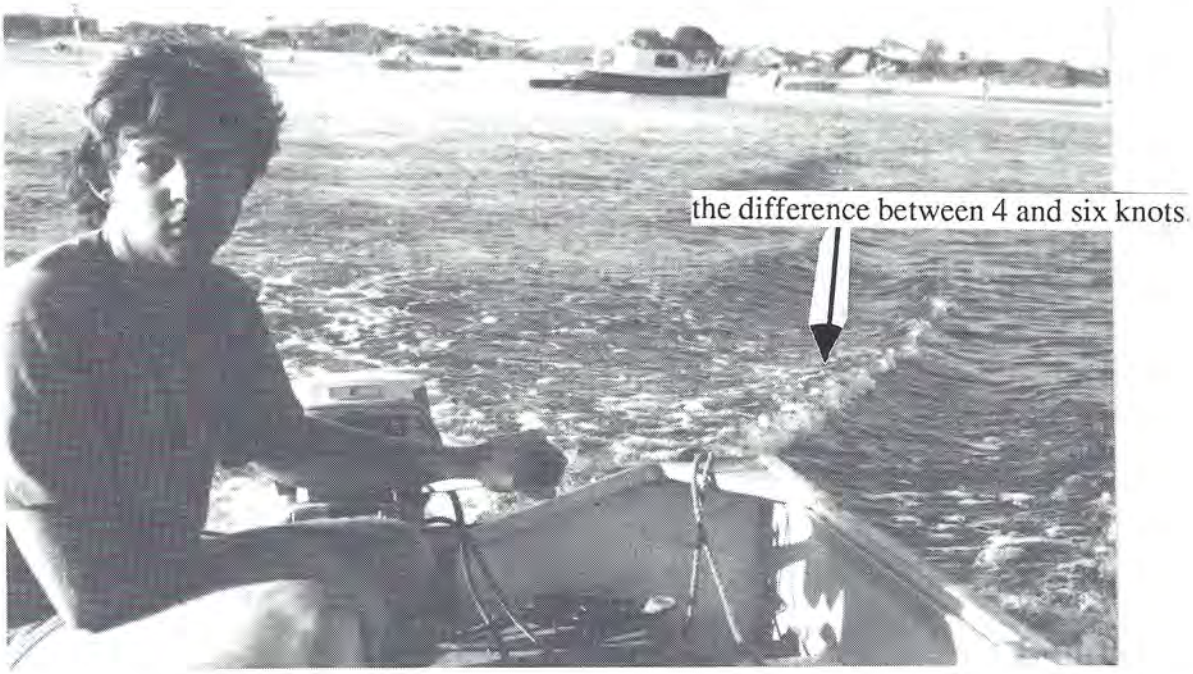
2.10 APPLY THE BOATING RULES

Ask your instructor to explain the following. Use worksheet 3 as a guide.

* Which side of the channel to drive the boat.
* If another boat is approaching you head on, which way to move.
* The right of way rule and the system of buoyage for the area. Are you entering or leaving port

For the first 15 minutes, just be content with becoming confident. Its best to stay close to shore.

Learn to tell the difference between 4 and six knots. Look at your wake. When the waves just start to break, thats when you are doing six knots.



The leg and fin of an outboard motor act as a rudder.

The direction in which the boat travels depends on the direction of the rudder.

Turn the rudder to starboard and the boat will move to port. Move the rudder to port and the boat will move to starboard.

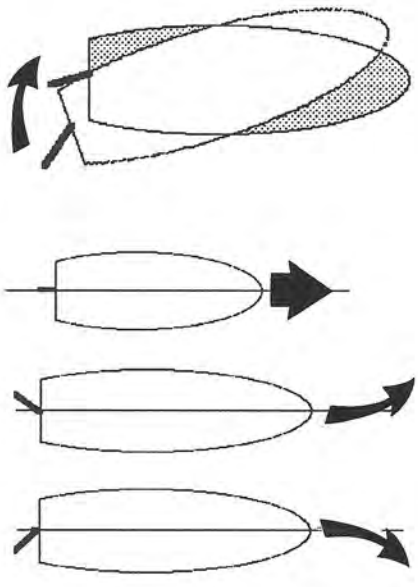
Steer straight ahead and the boat will move straight ahead.

Move the rudder one way and the boat will turn the other.

For boats with a steering wheel the controls are arranged so that they are like a car.

Turn the wheel to port and the boat will move to port. This is achieved by a control arm attached to the outboard motor.

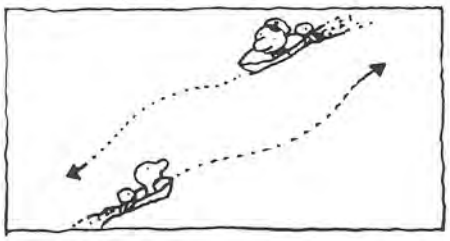
The action of the rudder



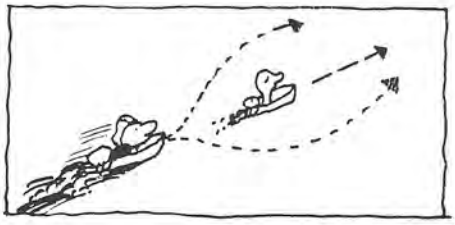
2.11 SAFETY AFLOAT

The following diagrams have been supplied by the Department of Harbours and Marine and are available in pamphlet form should you require any further information.

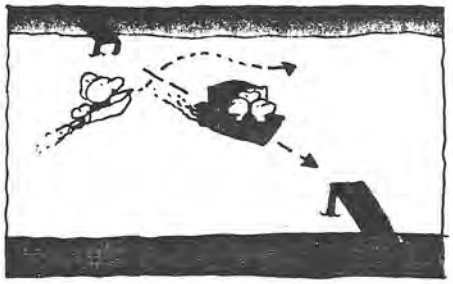
1. When two power boats are approaching head on, or nearly head on, each must alter course to starboard and pass on each other's port side.



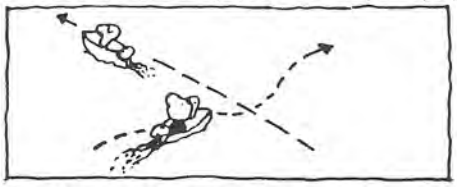
2. When overtaking another vessel, the vessel being passed has right of way and you must always keep clear of that vessel.



3. All vessels under 40 metres in length (except when they are towing or assisting another vessel) must give way to cross-river ferries.

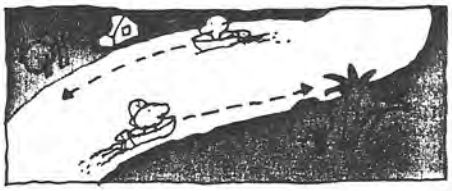


4. When a vessel is crossing your bow from starboard to port that vessel has right of way and you should keep clear. Stop or reduce speed and pass under his stern. (Give way to the vessel on your right.)



5. When a vessel is crossing your bow from port to starboard, you should maintain course and speed as you have the right of way. If the other vessel does not give way, you should take all action to avoid a collision.

6. When in a narrow channel keep to starboard.



7. A power boat must give way to sailing boats, rowboats, ferries and craft under tow.
This rule does not give a sailing vessel the right to hamper the safe passage of a power driven craft in a channel where the power craft can only navigate inside such channel.

8. Do not moor or anchor in any recognised channel used by large of deep draughted vessels. Large and deep draughted vessels have restricted manoeuvrability. Small craft must keep well clear of these vessels at all times and must not hamper the larger vessel's progress.

Some Safety Points when learning

1. Don't go too fast.
2. Look around you all the time
3. Keep to the right of channels
4. Get the feel of the throttle
5. Always have an observer
6. If the boat is over 5hp you must have a licenced driver beside you
7. Never exceed the limit of your confidence

The sailing boat under power in this photo has right of way. You should slow down and pass astern.

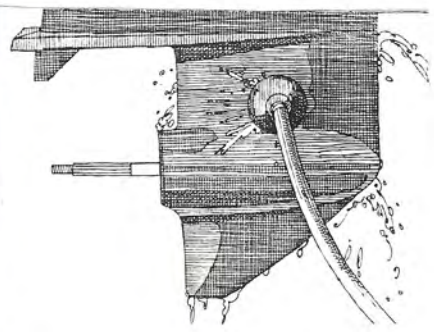
2.12 RETURNING TO SHORE

This is a skill requiring considerable practice. The idea is that you judge your speed so that you can put your motor in neutral, turn off the engine and pull it up just as you glide into the beach. The only way is to practice and you have to take into account factors such as tide and wind as well as the type of ocean bottom.

* Never leave a boat until it has stopped.
* Never jump out of a boat while it in motion.
* Always turn your motor off before you pull it from the water.

2.9 FLUSHING THE MOTOR AND RETURNING TO SHORE

* Always flush the motor with clean water if you have been in salt water. This prevents corrosion.
* Wash the outside of the motor down to remove excess salt.
* Take the cowling off and spray a water repellent around the spark plug and carburetter.
* Remove the prop and check for pieces of fishing line which may have become entangled around the spline.
* Check the lubrication points and add grease if necessary
* Check the sheer pin and split pins for wear.
* Clean the life jackets or buoyancy vests
* Clean the fuel tank and check for gunk



CHAPTER 3

ACQUIRING NEW SKILLS

Now that you have mastered the basics it's time to learn the skills necessary to get your boat licence.

You will need about an hour to get through these and a further two hours to practise the skills.

3.1 PLANING THE BOAT

This is an important part of boating because it makes best use of your hull design. The idea is to accelerate the boat so that the bow rises and then falls so the boat is travelling on an even keel.

Notes:

1. If you are in a small boat you may have to lean forward to get the boat to plane.
2. Don't plane the boat in rough weather or sea. Be careful of wind because small boats are liable to be blown over.
3. You don't have to go flat out to plane a boat. All you have to do is accelerate enough to get the boat to rise and then fall onto its keel.

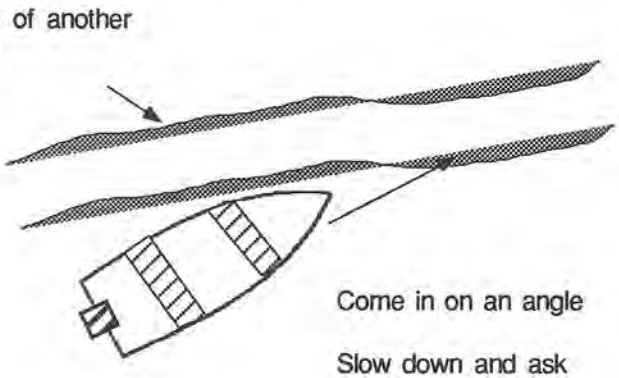
CUT BACK ON THE THROTTLE TO ECONOMISE ON FUEL

4. Always have a firm grip of the gunwale and throttle. Use your brain to control your hand movements and think about what you are doing. If you see a wave coming, slow down and ease the boat through the wash.
5. Make sure everyone and everything are secure before you start planing. Get the seating right so that the boat is balanced and planes properly. Even out the load.

3.2 CROSSING THE WASH

There is an art to this. A small wash will be easily crossed straight ahead but hang on, and keep an eye on your passengers. A larger wash demands some skill.

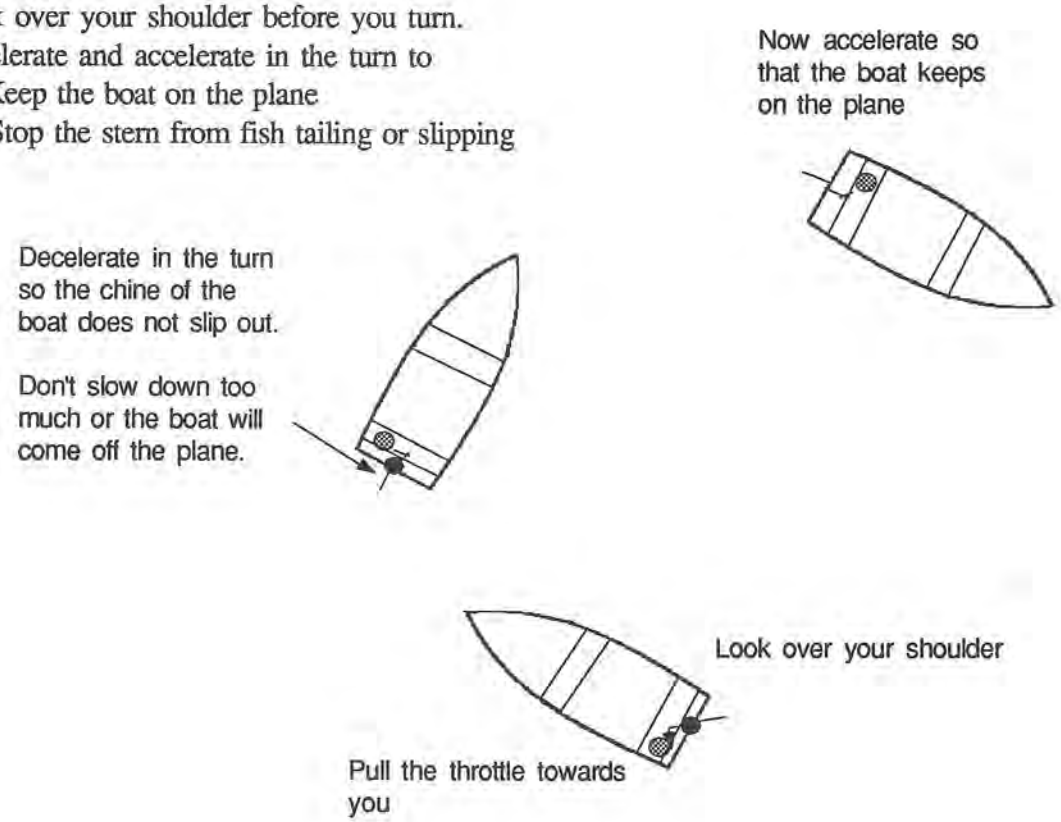
1. Slow down to a speed that you can safely accelerate and decelerate.
2. Approach the wash at an angle so that the sides of the boat just rock through it.
3. Accelerate and decelerate so that you go up and over the waves in the wash.
4. Don't go too fast.



3.3 MAKING U TURNS

Practice making a U turn while on the plane.

* Look over your shoulder before you turn.
* Decelerate and accelerate in the turn to
  (a) Keep the boat on the plane
  (b) Stop the stern from fish tailing or slipping



3. 4 ROUGH WEATHER HANDLING

This is very similar to crossing a wash. A planing boat does not handle well in rough weather and is in danger of swamping. If caught in rough weather head for the nearest land and hug it to safety.

You will have to handle each wave as it comes as best you can and if you capsize, stay with the boat at all times.

3.5 MOORING

This is part of the licence test. You will be required to come up to a rock, buoy, jetty or marker and stop the boat about half a metre away.

You must note the following:-

1. Come up very slowely so that you have complete control of the boat and its direction.
2. Judge when to stop and reverse off slowly.
3. This skill needs practice.
4. It is easier to manoeuvre and much safer if you bring your vessel in *AGAINST THE TIDE and AGAINST THE WIND*.

MOORING AT ROCKS

This is the easiest because you can see where you are going.

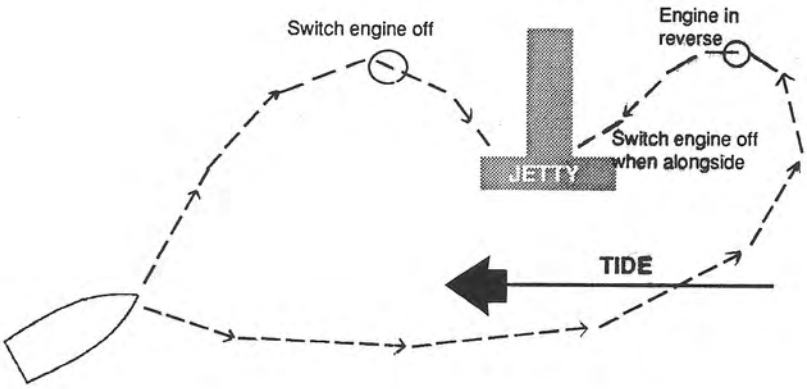
Come in very slowly.

* Reach back and feel the gear shift lever
* When you are a metre off, ease it into neutral and then reverse.
* Allow the momentum of the boat to moor but if need be reverse off to accurately touch the rock.
* Don't be alarmed if you fail a few times.
* Practice makes perfect.

MOORING AT A JETTY

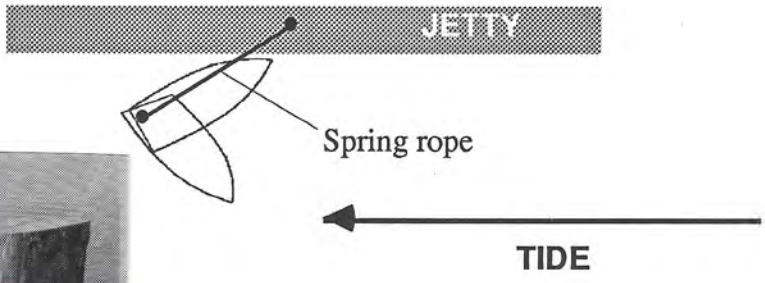
COMING ALONGSIDE

Once again come in very slowly.



CASTING OFF

This is most easily achieved by taking off your footware and giving a good push off, starting off slowly and looking all around for other boats. For larger boats a "Spring" can be used.



3.6 THE BEACH LANDING

1. Sight where you want to make landfall.
2. Remember that your boat does not have brakes.
   (It does, however, have reverse but it is unwise to use it coming into shore)
3. Remember that the propeller will hit the bottom if you don't pull the motor up.
4. Come in very slowly. About 10m from shore switch off the motor. The boat will tend to move towards land.
5. Now quickly pull the motor up - you will hear a click.
6. When the boat has completly stopped, advise your observer to disembark.

3.6a TOWING

Practice this simple exercise to sharpen your water skills and tying knots while in a boat.

3.7 MAN OVERBOARD (See also Page 55)

This is a drill where a life jacket is thrown out of the boat at speed and you are asked to recover it. Many testing officers have their own variation and it may be wise to check with them first.

Notes:

1. The observer throws out the jacket, calls "MAN OVERBOARD", and then stretches his or her arm out to point in the direction of the life jacket. This guides the driver of the boat towards the 'MAN OVERBOARD"

2. Approach the life jacket so that the boat will be blown or drift onto the jacket. Check out which direction the wind is blowing, current or tide flowing.

3. Manoeuvre the boat so that the bow points at the jacket and guide it so that you can reach over and grab the jacket.

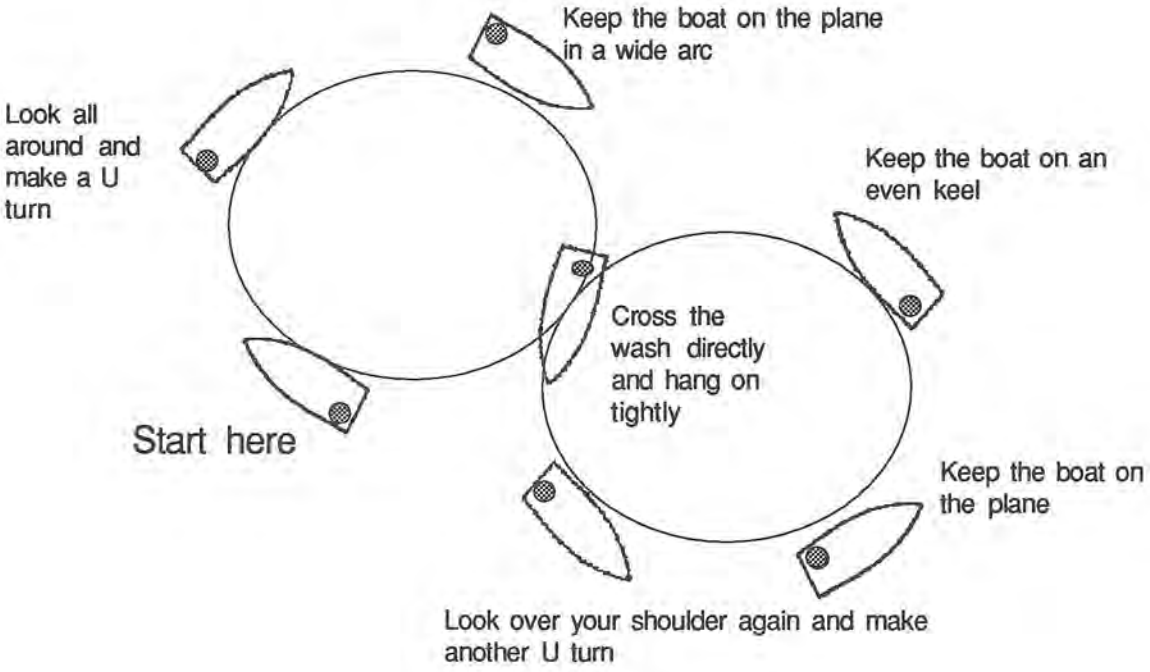
4. Put the motor in neutral or turn it off and bring the jacket to the stern. Simulate pulling in the MAN OVERBOARD over the transom.

It is important to have complete control over the throttle. You should be able to stop, start in a second because you never know what is going to happen.

Some things that can happen are that a log suddenly appears dead ahead, someone falls out of the boat, a large boat races by or something in the boat falls over. All these things call for a quick reaction, so practice this.

3.8 THE FIGURE OF EIGHT

This is performed on the plane. Make sure you have plenty of room, there are no other boats in the vicinity and you have good control of the throttle.



3.9 DRIVING A BOAT WITH A STEERING WHEEL

If you get the chance, this makes boating a real pleasure. Its just like driving a car but you still need to keep you eyes and ears open.

3.10 WATER SKIING AND SCURFING

Make sure you know all the rules.

Make sure you have a competent and alert observer, the right age. You will have to judge the competence of the skiier and be prepared for many spills.

Scurfing is one of the easiest forms of skiing because there is a larger area under the skiier. If the skiier first lies, then kneels and then stands up, the skill can be mastered in an afternoon.

The areas designated for boating and skiing in their local area

These are defined by the local harbours and marine authorities. A typical set of local rules is reprinted below from the South Coast region.

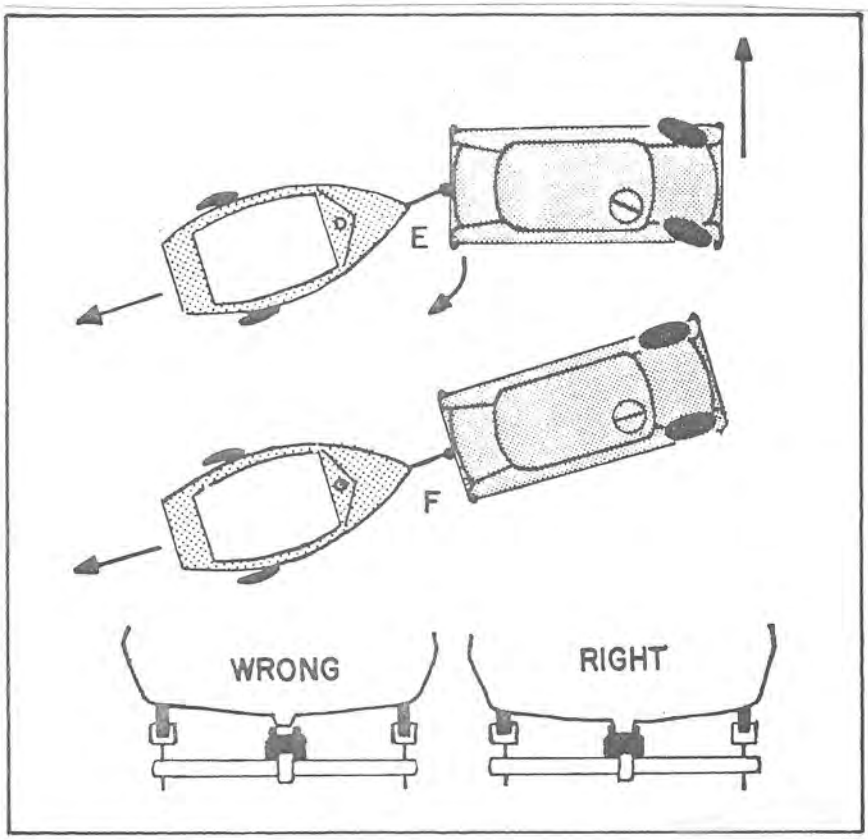
E.g: Tallebudgera Creek (Burleigh Heads)

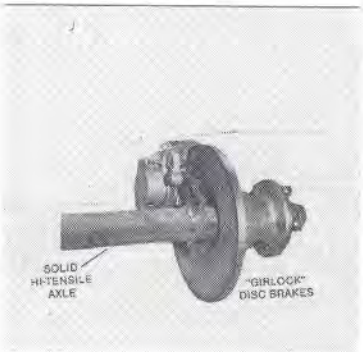
(a) Private water skiing only.
(b) Not more than 4 boats to operate at any one time
(c) Not more than 1 skier to be towed by each boat
(d) Boats having a centre line length in excess of 5.2 metres are not permitted to engage in water skiing.
(e) Water skiing restricted to the hours 9am to 3pm.

3.11 TRAILERS AND THEIR USE

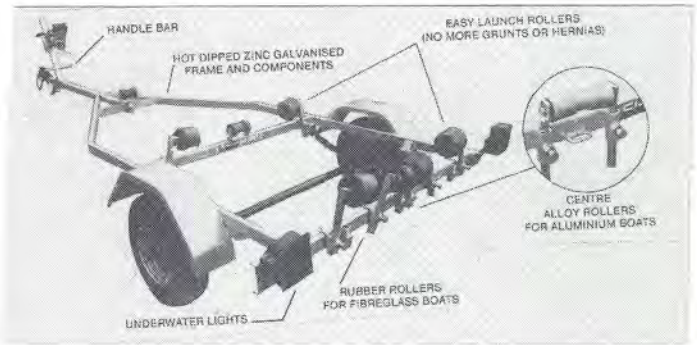
If you have your licence you can learn how to back a trailer. This requires time and skill.

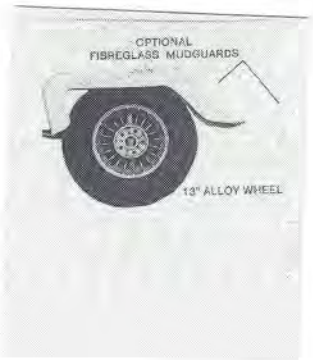
It's best to practice in an empty shopping centre carpark. Once again everything is in reverse. Turn the car one way and the boat will go the other.





Also check how the boat is mounted on the trailer. The keel should touch the rubber rollers. Actually, aluminium rollers make an aluminium boat slide off very easily.





3.12 CARE AND USE OF ANCHORS

Traditional

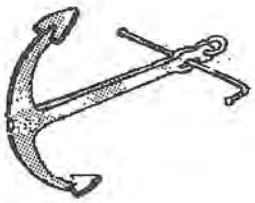
Anchors are part of a boat's safety equipment.

Use the diagram in the appendix to label the following parts

* storage bucket with 2m lanyard
* safety bucket with 2m lanyard
* anchor , 2 m chain and 27 m of rope
* signal mirror
* torch
* spare bung

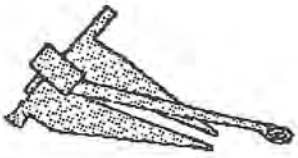
Use the diagram also to label the following parts. Use the read and learn section to help.

* ring
* stock
* shank
* fluke
* arm
* crown



Fishermans anchor

The principal parts of an anchor are shank, crown, arms, flukes or palms, bills or peas, stock, ring or shackle, forelocks.



Danforth anchor

Types of Anchors

Anchors vary in design and performance as well as in size.

The holding power of a modern anchor is strictly dependent upon its design, and is proportional to the area of the flukes and the depth to which they are buried in the bottom. The weight of the anchor is only one factor.

Reef pick or grapnel

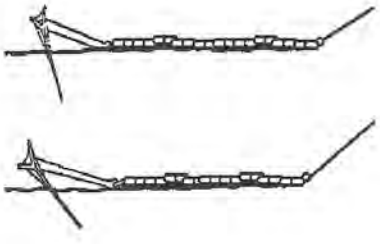
All anchors, rigid or pivoted, rely on the principle of the plough-share. A flat or curved piece of metal (the fluke) catches obliquely in the bottom. When anchors reach the bottom they may slip or slide for a period of time dependent on the type of anchor, its weight, its angle of incidence, its proportions, etc

Use of anchors

There are two principal forces which affect the anchor after it reaches the bottom, viz.

(a) A horizontal pull against the drift of the vessel, which is called a retentive force.

(b) A vertical, downward force, which is called a penetrative force.



There are a variety of anchors each with a specific purpose. Make a table of various anchor types and discuss each with its use.

Read and learn section

The fluke is the pointy part which makes contact with the ocean bed and sticks into it. It is attached to an arm which then connects to the crown at the bottom of the anchor. The crown is connected to the ring by means of the shank. At the top of the shank is the stock. An anchor chain is connected to the ring which helps weigh down the anchor.

3.13 THE CRASH STOP

This is the means by which a boat is stopped in less than its length due to an emergency. The sudden sighting of a log or something falling from the boat may cause you to want to stop suddenly.

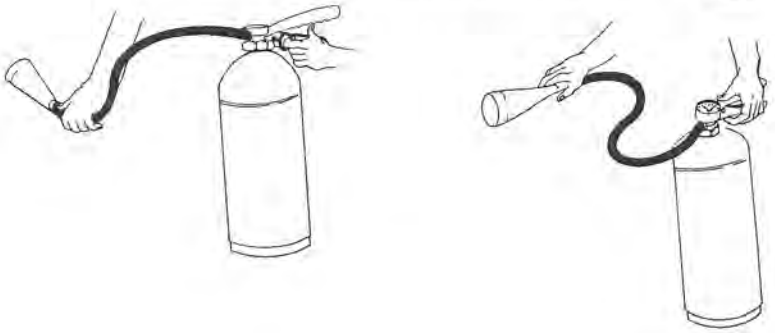
To effect this, drop the throttle to zero while simultaneously making a 90° turn.

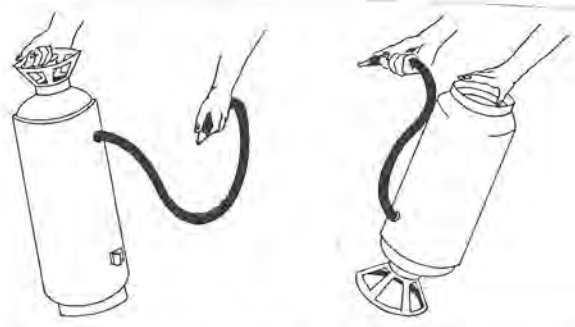
The boat will stop broadside with the stern wash passing the transom and the motor is then put into neutral.

3.14 FIRE FIGHTING

Dry Chemical

Pull the pin and direct at fire





Carry to fire scene, invert and then direct at fire.

STUDY ASSIGNMENTS

1. Cost of fitting out boat
2. Types of materials in trailers
3. Timber hulls - are they still around and where do they come from
4. Tides in secondary places
5. Boat accessories
6. Buying a new boat
7. What does a boat retailer sell
8. Visit a boat builder
9. Rigging a catamaran
10. Visit to Boating & Fisheries Patrol officers.

Notes on Licences & Registrations

CHAPTER 4

GETTING YOUR LICENCE

HARBOURS MARINE
BOATING and FISHERIES PATROL

QUEENSLAND GOVERNMENT BOATING SAFETY CAMPAIGN GUIDE No 6

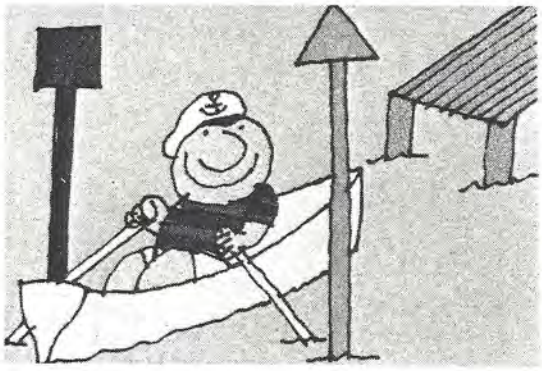
4.1 PILOTAGE

In an estuary there are rules of the road to be followed.

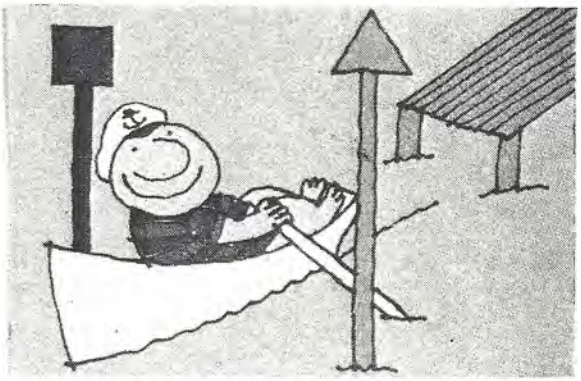
When entering a port the port hand marker (Red) is always kept to the vessels PORT or left side and when leaving a port, it is always kept to the right.(Starboard)

When another vessel is approaching you, vessels pass on their left, i.e port to port. Overtaking vessels must keep clear of the vessel being overtaken.

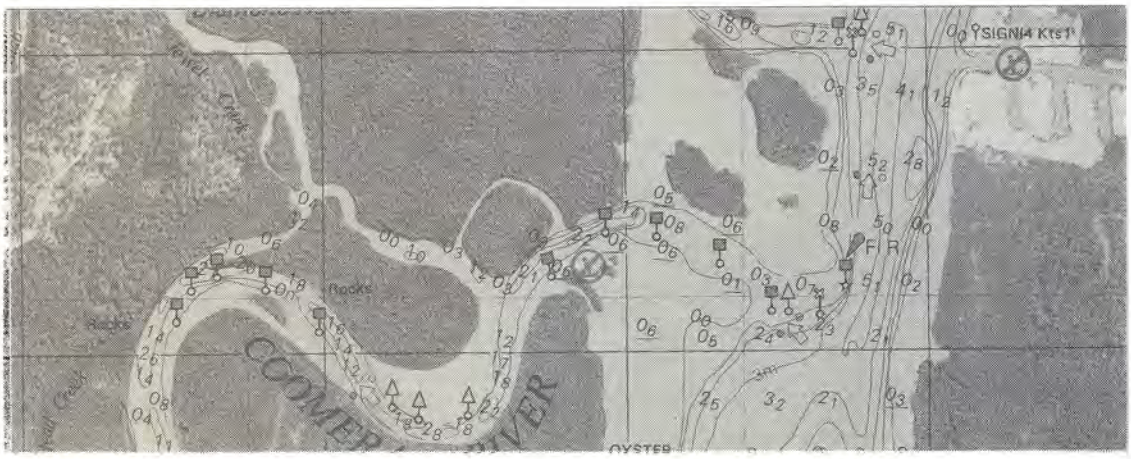
Finally, when a vessel approaches you from the right or starboard side, then it has right of way. Look at the chart below and follow the directions.



When entering port
Red square marks
are kept to the left



When leaving port Red square marks are kept to the right



Part of chart of The Broadwater showing marks (Reproduced with permission Department of Harbours and Marine)

4.2 NAVIGATION LIGHTS

You will need

* A copy of the worksheet in Appendix
* Copy of Harbours and Marine Navigation Lights Brochure
* Red and Green colouring pencil

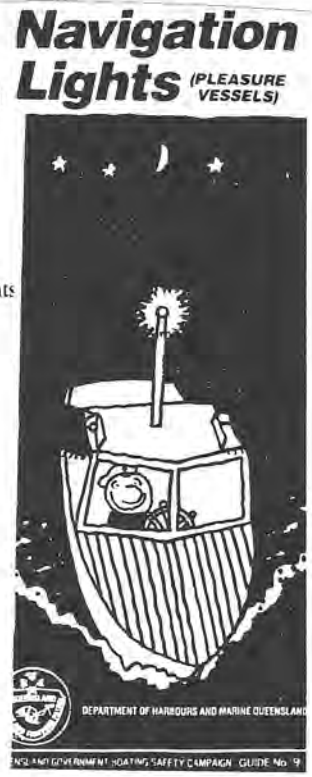
What to do

Use the worksheet to complete the following diagrams

1. Definition of lights
2. Power driven vessels of less than 7 metres in length and whose maximum speed does not exceed 7 knots

ASK FOR THIS PAMPHLET →

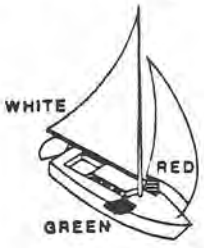
(Available from your local harbours and marine office)



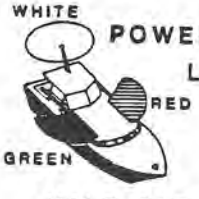
Navigation Lights

Any vessel used at night must display the following navigation lights

SAILING VESSEL UNDERWAY
(Not using motor)

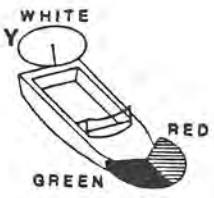


POWER BOAT UNDERWAY
More than 7 metres in length.



POWER BOAT UNDERWAY
Less than 7 metres in length.

HALF-CABIN



RUNABOUT

Standard navigation lights on a small vessels at sea

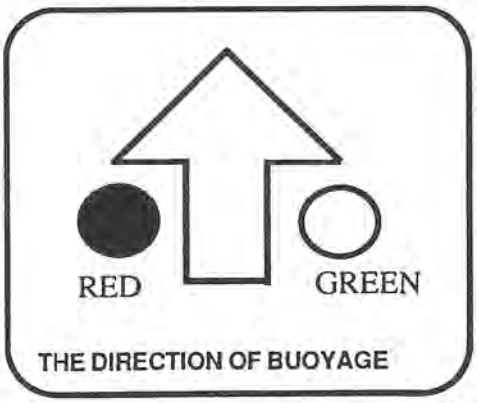
Boats without navigation lights at night are highly dangerous and have caused deaths.

Don't get into a boat at night that does not have fully operational navigation lights.

4.3 BUOYS BEACONS AND MARKS

Just like a highway has road signs, so does an estuary, especially if it is a major port. Buoys, floats, beacons and marks are driven into the ocean bed or positioned on rocks. On sighting a navigational mark, the mariner's reaction must be *instinctive, positive,* and *correct.* Lack of this knowledge usually ends up in disaster.

There are two systems operating in Australia.



THE LATERAL SYSTEM

This relies on the mariners knowledge of the direction the nearest port is. On charts this is marked by a direction of buoyage symbol shown above.

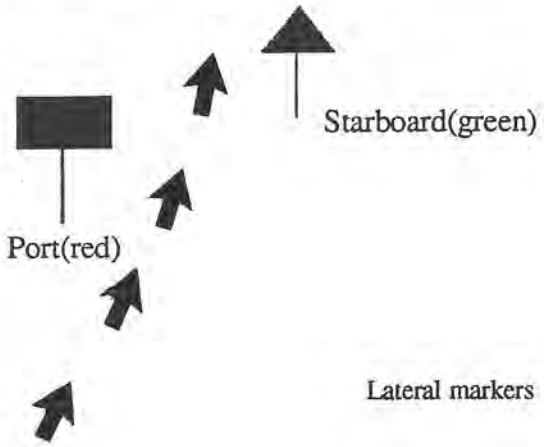
The lateral system is the old system and is characterised by two markers, *Port and Starboard.* These marks indicate the sides of the channel and are used by navigators to get into and out of estuaries.

Other marks include, **Special** marks which indicate special features, **Safe** water marks which indicate there is navigable water all around sides and **Isolated** danger marks which indicate isolated dangers of limited extent.

CHECK ON THE COLOURS

CLASS ACTIVITY

Obtain copies of the harbours and marine pamphlet:
Buoys, beacons and marks and
identify the special marks

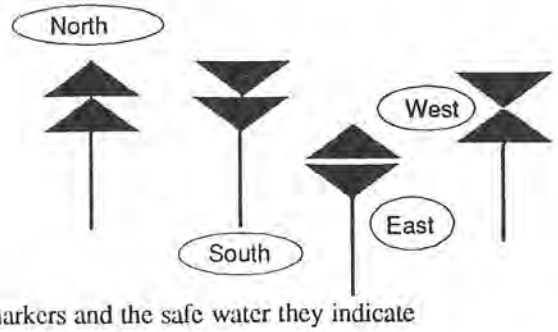


Lateral markers

THE CARDINAL SYSTEM

The second system of buoyage is called the *Cardinal System of Buoyage.* There are four main marks in this system called cardinal marks which indicate on which side of the marker, safe water lie. The mariner is safe if he uses his compass to pass the mark as follows:

(a) North of the North Mark
(b) East of the East Mark
(c) South of the South Mark
(d) West of the West Mark



Cardinal markers and the safe water they indicate

4.4 TIDES AND CURRENTS CLASS ACTIVITY

Obtain a copy of the Tide book, produced by the Department of Harbours and Marine. Perhaps you can obtain a class set, second hand, of the previous year's tide book.

PART A

Find the table of contents and the section in the tidal predictions for your local area. Answer the following questions:

1. What are the times for high tides today and low tides today, for the port nearest to you?
2. What do you notice about the heights of the high tides?
3. Does the highest one occur during the day or night?
4. If it is summer now, look up a month for winter and see when the highest tide is. What difference do you note? (If it is winter, then look up the summer high)
5. Plot the tides over a month and notice what happens to the high tides and neap tides.

PART B

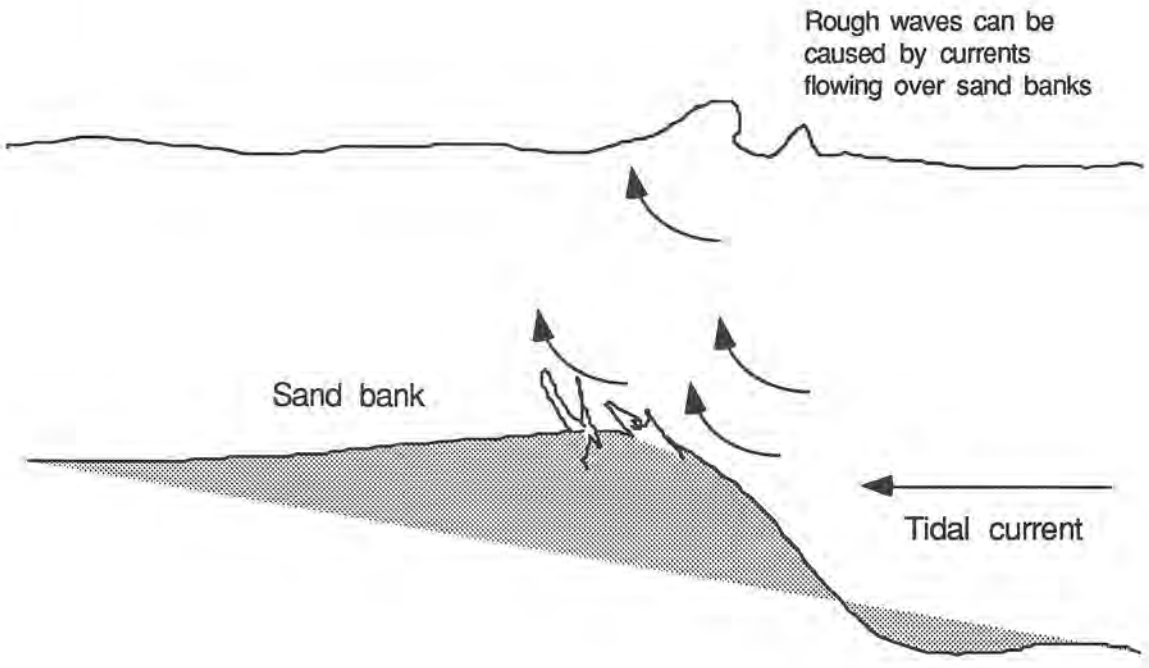
Now find the section dealing with Secondary Ports. Use this particular section if you are near a Secondary Port.

1. Calculate the time for high and low tides today at your port or beach.
2. What is the time difference? Express your answer as either "+" or "-".

Do question 3, only if you live near Bundaberg or Brisbane.

3. *Find the time differences for Secondary Places table. Calculate the high tide say for Caloundra Headland or Russell Island. Your teacher will direct you here.*

OVERFLOWS



FINDING THE HEIGHT BETWEEN THE TIDES

How can you find out the amount of water under a vessel at any one time? Mariners use the ***RULE OF TWELFTHS.***

Using the tide tables listed, consider May 1st. *WHAT IS THE TIDE HEIGHT AT 9am ?*

How much water will be under my boat at 9am on Sunday May 1st?

1	0502	5.2 (High tide first thing in the morning)
	0900	???
Sun	1137	0.8 (Low tide about 6 hours later)
	1752	4.9 (Second high tide for the day, again about six hours later but lower than the morning tide)
	2349	1.2 (Second low tide late in the night)

The Rule of Twelfths states that:-

at nearly all places, the tide rises or falls by the following approximate amounts each hour:

First hour	-	1/12th of range
Second hour	-	2/12ths of range
Third hour	-	3/12ths of range
Fourth hour	-	3/12ths of range
Fifth hour	-	2/12ths of range
Sixth hour	-	1/12th of range

WORKING

First calculate the tidal range for the day.

In our case we see that the tide ranges from 5.2 to 0.8, so by subtracting, that gives a 4.4m tidal range.

TIDAL RANGE

5.2 m
- 0.8 m
4.4 metres

Second, use the rule of twelfths:

So to find the tide height at 0900 hrs we calculate as follows:

* The tidal range is 4.4 metres
* 0900 hrs is 4 hours after high tide
* From the rule above, the total drop in the tide will be as follows:

First hour -	1/12 th of 4.4 is	0.37 m
Second hour -	2/12ths of 4.4 is	0.74 m
Third hour -	3/12ths of 4.4 is	1.11 m
Fourth hour -	3/12ths of 4.4 is	+ 1.11 m
Total drop in tide over 4 hours is		3.3 metres

*So the tide height at 9 am will be 5.2 m
- 3.3 m
Answer 1.9 metres

Now what exactly have we worked out?

We have worked out that at 9am on the 1st May, the water will be 1.9 metres deeper than stated on the chart for that area, e.g: if the chart says the water depth in a certain channel is 2.0 metres, then the depth will actually be 2.0 + 1.9 metres = 3.9 metres deep in that channel at 9.00am May 1st.

4.5 READING THE WEATHER

More people than ever before are taking to the water - in boats of all shapes and sizes: rowboats, canoes, sail and power boats.

There are more than 150,000 small power craft in Australia and, in addition, a growing number of sail boats. They operate on inland lakes and waterways, and in bays and harbours around the coast from Cairns to Ceduna, from Darwin to Esperance. And they all have one thing in common: every time they put out from shore they are affected in one way or another by the weather.

Even with the most up to date equipment and a skilled and experienced skipper, it is the weather which determines whether the day's outing will be safe and pleasant or unpleasantly dangerous. Yet the weather and its effects on a boat in the water are often poorly understood by the amateur boatsman.

The elements which affect a boat in the water more than anything else are wind, wave and sea swell. These separately or together can blow a vessel off course, swamp it, capsize it or at the best give the occupants some anxious moments.

WIND

An indication of the general wind pattern at surface level may be gained from the isobars - lines joining places of equal air pressure on the weather map. The closer the isobars are together, the stronger the wind over that area; the farther apart the lines are, the lighter the wind.

Wind flows in a clockwise direction around centres of low pressure (cyclones) and anticlockwise around high pressure cells (anticyclones). However, wind is deflected slightly inwards towards "lows" and slightly outwards from "high" centres.

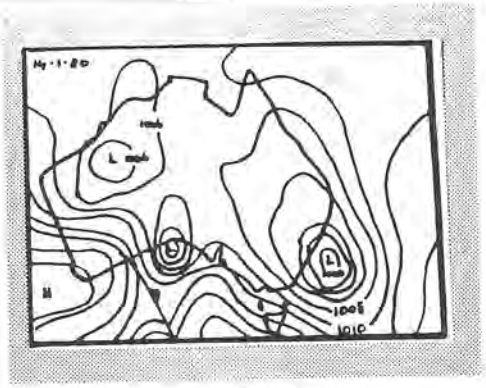
For more about this subject consult the Bureau's brochure "How to Read the Weather Map".

LAND AND SEA BREEZES

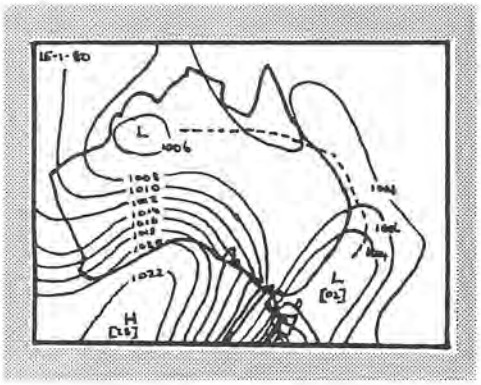
These occur in coastal areas. During cloudless nights the land cools rapidly while the water surface remains at almost the same temperature as during the day. Thus the land becomes colder than the water surface and the air over the land becomes colder than the air over the water. This tends to produce a flow of air from the land over the water. This is a land breeze which generally blows from late evening to just after sunrise and usually does not exceed 15 knots.

During the day, if the land heats rapidly, the water surface will be the colder of the two and the air over the water will be colder than the air over the land. This causes the wind to blow from the water to the land as a sea breeze, generally beginning in the morning and ceasing about sunset. The sea breeze may reach 15-20 knots and its arrival may be accompanied by squally conditions.

Land and sea breezes affect only a narrow area along the coast.



Monday



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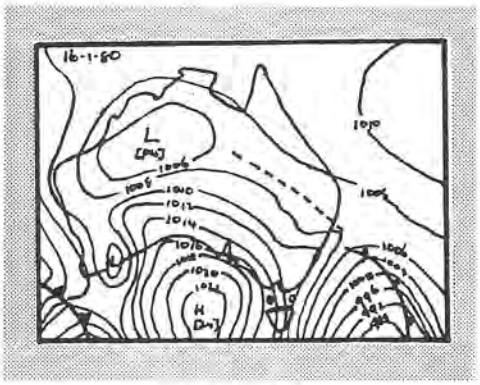

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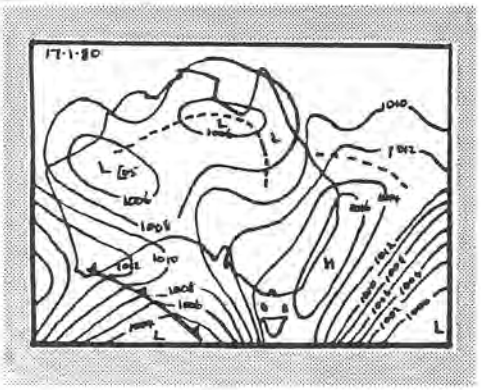

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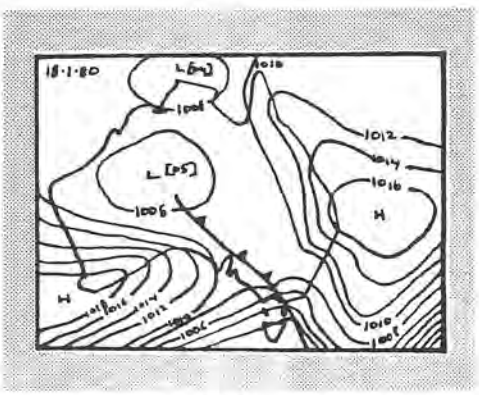


Friday

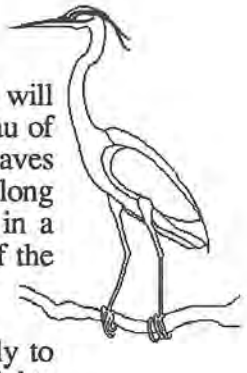
SQUALLS

A wind squall is a strong gust of wind, sometimes exceeding 80 knots, usually accompanied by a sharp change in direction which may or may not be accompanied by rain. A thunder squall is a strong gust of wind associated with thunder and may or may not be accompanied by rain. A thunder squall often accompanies a frontal system, or weather change. Wind squalls, including thunder squalls, are violent and hazardous, particularly for a small boat in open water.

DIURNAL EFFECTS

The surface wind may be strong and gusty during the day, especially during clear summer weather, yet it becomes almost calm at night. A light wind in the early morning can often give a false sense of security, as frequently wind increases during the day.

STATE OF THE SEA



It is important that the person in charge of a boat should know how his craft will behave in various types of sea. Forecasts and weather maps issued by the Bureau of Meteorology make reference to the state of the sea - that is, the height of the waves measured from their peaks to their troughs. With sea swell the waves are of long wave length (crest to crest) and depend on the strength of the wind blowing in a distant area and how long it has blown. Local conditions also affect the state of the sea. Shallow water increases the steepness of the sea and sea swell.

In the table below giving the state of the sea, the wave heights given apply only to the open sea. It is not possible to apply them to inshore waters where wave heights are affected by the sloping sea bed as well as by offshore and onshore winds.

STATES OF THE SEA

These can be summarised in the table below:

Forecast as heard over radio	Height of Waves (m)	Approximate condition of the sea and approximate beaufort scale of wind force
5 to 10 knots wind felt on the face	0 - .5 m	Small waves, direction of smoke shown, **Force 3**
10 -15 knots	.5 - 1.5 m	Fresh breeze, moderate waves, taking a long form, many white horses, chance of spray **Force 4**
15 -20 knots	1.5 - 2 m	Strong breeze, many white horses, spray uncomfortable ride in small boat **Force 5**
20 - 25 knots	2 - 3 m	Very strong winds, large waves begin to form, very uncomfortable and possibly unsafe in small boat. Indication of a front moving through or low pressure system **Force 6**
25 - 30 knots	3 - 3,5 m	Near gale, sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind. Very unsafe sea for inexperienced. **Force 7**
30 - 35 knots	3.5 - 4 m	Gale warning. Moderately high waves of greater length, low pressure system or cyclonic seas **Force 8**
over 35 knots	Over 4 m	Not the type of sea to be caught in, in fact tragedies occur in seas of this magnitude. **Force 9**

FORECASTS AND WARNINGS

Because of the dependence of small boats on the weather, the Bureau of Meteorology issues special forecasts for pleasure boating. The forecasts provide details of expected wind and state of sea, and the Bureau implements these with special warnings of strong winds as necessary.

The Bureau issues warnings for likely strong winds whenever average winds exceeding 25 knots (Force 6 range on the Beaufort Scale or 50 k.p.hr.) are expected. These warnings contain details of the expected direction and speed of the wind and an indication of future developments.

When the average wind force is expected to exceed 34 knots (Force 8 or 65k.p.hr) or to reach or exceed 48 knots (Force 10 or 100 k.p.hr), gale or storm warnings are issued.

Forecasts and warnings are prepared in the Regional Office of the Bureau in each capital city from information collected at the Bureau's 60 field offices and by some 700 part-time observers throughout Australia and adjacent territories. These observations include measurement of wind, temperature, air pressure and humidity at the earth's surface and similar measurements in the upper air to heights up to and sometimes exceeding 100,000 feet.

On receipt of these reports the information is plotted and analysed, synoptic charts drawn up showing the current weather picture, and forecasts compiled of expected conditions. Forecasts are issued to the press, radio and television for publication and broadcasting and are also available over the telephone diall-in service.

Forecasts tend to get "stale" and out of date and for this reason the Regional Offices revise their forecasts throughout the day and pass this latest information to radio and television stations for speedy dissemination to the public.

As most people these days have transistor radios, there is no reason for mariners/boat drivers, or their passengers not to hear radio broadcasts of the news and weather. The set should be kept tuned to the one station: this minimises the risk of missing an important weather announcement through "dial twiddling".

Most commercial and national radio stations broadcast weather forecasts during or near news sessions during the morning, afternoon and night. Some stations broadcast weather information every half hour.

Additional information about the Bureau's services and schedules of broadcasts of news sessions over national and commercial radio and television stations may be obtained from the Regional Office of the Bureau of Meteorology.

Other Bureau publications which will be of value to the mariners/boat drivers are:

"The Weather Map and How to Read It";
"The Aneroid Barometer and How to Use It".

4.6 GETTING YOUR LICENCE

Each town on the coast will have a licence testing officer. The Department of Harbours and Marine will be able to advise you of this. The boat must have a motor greater than 6hp and must plane with you and the testing officer.

Go through the checklist in the appendix and when you have mastered the practical skills, pick up a pamphlet that lists the boating rules and learn them. Have all the paperwork completed before hand.

Have all the required safety gear as per safety schedules.

1. Be prepared. Have your money and licence application filled out. Know your height in cm.
2. Know all the rules, especially those dealing with cross river ferries, lights, sound signals and skiing.
3. Have your boat in good working order. Put in a new set of plugs, mix your fuel correctly and have the motor warm so you can get away to a good start.
4. Remember the applicant supplies the boat. Don't turn up expecting the officer to have a boat.

Test and Licence Fees

A fee is payable to the testing officer for a speed boat driver's test. The test certficate, licence fee and application for a speed boat driver's licence must be supplied to Harbours Marine when applying for a licence. However, please remember a test certificate is not a licence.

You can undertake your test with the Harbours Marine Boating and Fisheries Patrol or civilian testing officers. For further information, please contact Harbours Marine.

Boat Identification

A motor boat must have the registered number displayed in plain characters (light on a dark background or dark on a light background) at least 75mm high on both sides of the vessel or on the stern where they can be clearly seen. A speed boat must have the registered number at least 200mm high on both sides of the boat so as to be clearly visible. The registration label must be attached in a clearly visible position near the steering.

NOTES FROM THE HARBOURS MARINE

Unlicensed persons over the age of 12 years are allowed to drive a speed boat not engaged in water-skiing when –

- They are under the direct supervision of a licensed driver who is on board the boat.
- The person supervising must be in a position on board the speed boat from which he/she is able to take immediate charge.

Your Speed Boat Licence

A Speed Boat Drivers Licence is required if you are in charge of a speed boat. "Speed boat" means any vessel powered by a motor exceeding 4.5kw brake power or 6 Horse Power and capable of a speed in excess of 10 knots and with a planing or non-displacement hull. To obtain a speed boat licence, you must be:

- Aged 16 years or older.
- Satisfy a testing officer by practical demonstration that you are competent to navigate and manage a speed boat.
- Have a good working knowledge of the Rules for the Prevention of Collisions at Sea.
- Be familiar with the regulation speed limits.
- Be familiar with the requirements for the Navigation (Equipment of Pleasure Yachts) Regulations.
- Be able to pass an eyesight test or be the lawful holder of a current driver's licence (Traffic Acts, 1949-1985).

Please note - the vessel used for the test must be provided by the applicant.

Annual Registration and Facility Fee

All motor boats which are powered by an engine of 4 B.H.P. (2.984kw) and over must be registered before they can be legally used. However, vessels with smaller powered motors, which are launched or retrieved by vehicle at a public boat ramp must be registered.

THE SLOW WATER SKILLS TEST

The testing officer will want to see you operate the boat very accurately at slow speeds.

Reverse

1. Make sure you can use the throttle well at slow speeds. Get to know your idling and how to stop the motor from "konking out".

2. Rememeber that in reverse if you want the boat to go one way point the motor in that direction.

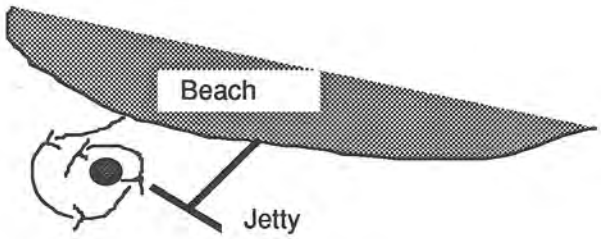
3. Get the feel of changing gears without looking at the gear change or throttle. Get used to looking where you are going and concentrating on that.

4. You will be asked to reverse around an object.

Foreward

1. Next comes the forward gear use. You will be asked to moor at a buoy or jetty. Listen carefully to what your testing officer wants. Ask him to demonstrate if necessary.

2. You will be asked to moor at a buoy or jetty.



4.9 AT THE JETTY

1. Make sure you line up the jetty carefully and come in really slowly *against wind or tide if possible.*

2. With your hand on the gear change and the other on the throttle, come in really slowly and when the officer says reverse, quickly slip the gear and accelerate away keeping the motor pointing in the direction you want the boat to go.

3. Use wind and tide to your advantage.

4.10 MOORING AT ROCKS OR A BUOY

Make sure you follow the officer's instructions. Get him to demonstrate if necessary.

4.11 ON THE PLANE

Follow the instructions and accelerate to get the boat on the plane. You don't have to go flat out, just enough speed to get the bow down so that you are on an even keel.

Accelerate and decelerate so as to get the feel of the motor.

You will be asked to make a few turns:-

1. Always look over your shoulder to see what is coming.
2. Slow down in the turn so as to keep the stern locked into the turn. You will possibly fail if the back slips out. Keep the chine of the hull dug in to assist the turn.

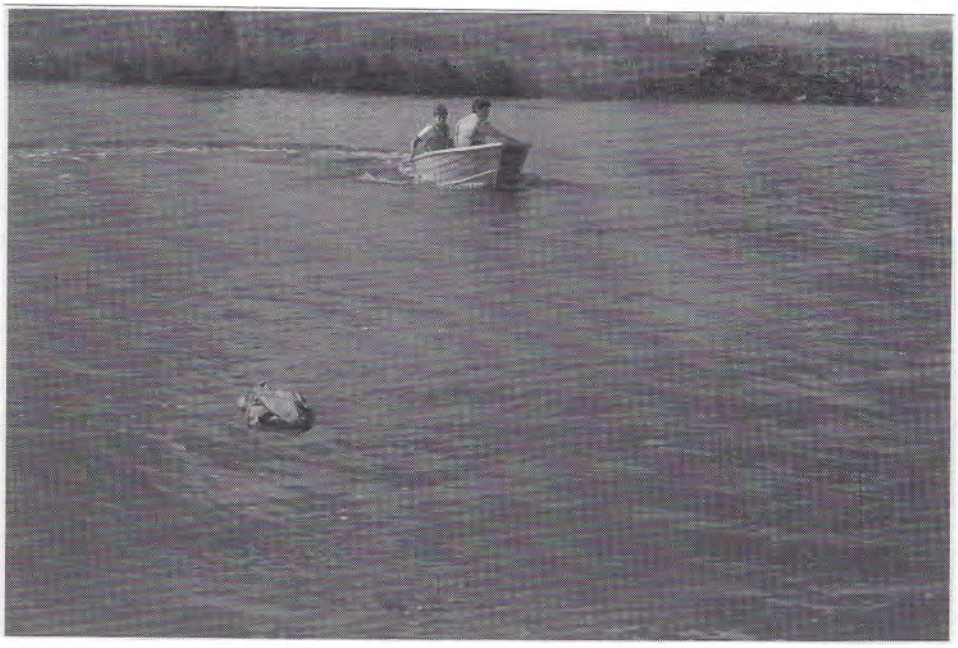
4.12 FIGURE OF EIGHT

1. Make a decent figure of eight. Take your time and decelerate to keep the back of the boat in.
2. Cross the wash directly.
3. Wakes should be crossed at an angle but in some cases you will be required to cross direct.

4.13 MAN OVERBOARD

1. The officer will throw a life jacket overboad and call "Man Overboard" and point in the general direction.

2. Make sure you know which way the current is flowing and which way the wind is blowing.



3. You approach the Man Overboard so that the wind or the tide or both take the boat to the life jacket.

4. As you approach the jacket, allow the tide or wind to move you in, **put the motor in neutral and cut the motor.** *In surf conditions this is different and instructors should consult with their local surf life saving association.*

5. Reach out and grab the life jacket, pull it to the stern and lift it over the transom. Then start the motor and proceed to shore demonstrating knowledge of the boating rules.

4.14 DEMONSTRATE THE BOATING RULES

1. Keep to the right of the channel.
2. Know which direction the main port is and to which side you are to pass markers.
3. Check this out first so you are in no doubt.

ANSWERS TO QUESTIONS

1. The officer will ask you a minimum of 20 questions from the pamphlet.

2. If you pass this, congratulations you have your test certificate.

3. The testing officer will give you an examination certificate and you have to then take it to the Harbours Marine Office to collect your licence. It costs to get this so ring before hand to find out the current rate.

4. Finally thank the testing officer and pay him his test fee.

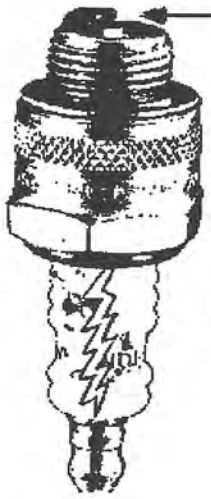
CHAPTER 5

MINOR REPAIRS AND MAINTENANCE

The author greatefully acknowledges materials from the Mariner Operation and Service Manual in this chapter. Students are encouraged to obtain the service manual for their particular engine for this section.

5.1 WHAT TO DO WHEN THE MOTOR DOES NOT START

This can be caused by no fuel in the tank, the spark plug is dirty, the engine is flooded or major damage to the electrical or fuel systems.



Clean the gap between the electrodes and in and around seat.

Use a wire brush and when replacing, make the plug firm but not tight.

Make sure you use the correct tools ad don't force the sockets.

Check the spark plug by removing and cleaning it.

TROUBLE CHART

A	Does Not Start
B	Runs Irregularly or Misses
C	Starts Momentarily and Cuts Out
D	Does Not Idle Properly
E	Motor Speed Faster Than Normal
F	Motor Speed Slower Than Normal
G	Does Not Develop Normal Boat Speed
H	Motor Overheats

A	B	C	D	E	F	G	H	POSSIBLE CAUSE	
•		•						Fuel Tank Empty or Vent Screw Closed	
•			•					Motor Is Cold	
•		•						Fuel Line Not Connected	
•	•	•	•		•	•	•	Fuel Line Pinched or Kinked	
•	•	•	•		•	•	•	Fuel Filter(s) in Need of Cleaning	*
•	•	•	•		•	•	•	Air Leak in Fuel System	*
•		•	•					Low Speed Mixture Screws Mal-Adjusted	
			•		•	•	•	Wrong Oil in Fuel Mixture	
	•		•		•	•	•	Wrong Gasoline in Fuel Mixture	
			•		•	•	•	Not Enough Oil in Fuel Mixture	
	•		•		•	•	•	Too Much Oil in Fuel Mixture	
•								Motor Flooded	
•	•		•		•	•	•	Spark Plugs Fouled or Defective	
	•		•		•	•	•	Wrong Type Spark Plugs	
•								No Spark	*
•	•	•	•		•	•	•	Weak Spark or Intermittent Spark	*
					•	•	•	Water Pump Failure	*
					•	•	•	Cooling System Clogged	*
				•		•		Propeller Damaged	
				•	•	•		Tilt Angle Not Correctly Adjusted	
				•	•	•		Boat Improperly Loaded	
					•	•		Transom Too Low	
				•		•		Transom Too High	
	•				•	•	•	Excessive Spark Advance	*
					•	•		Insufficient Spark Advance	*
				•	•	•		Propeller of Wrong Pitch or Diameter	

*Inspection should be performed by an Authorized Dealer.

From Mariner Service Manual 5hp.

5.2 THE ENGINE STARTS BUT THE BOAT GOES NO WHERE

There is no prop, the sheer pin is broken, you are still tied up to the bank.

a. Use the tool kit to replace the sheer pin. First remove the cotter or split pin.

b. Then unscrew the nut at the end of the shaft and remove the propeller.

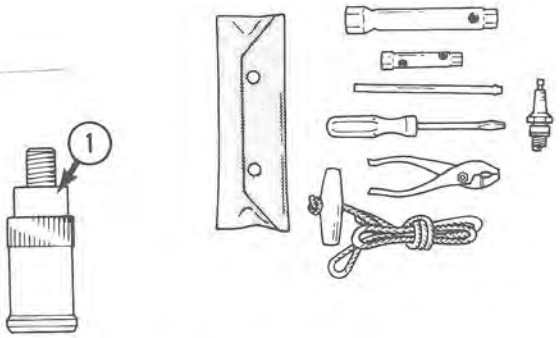
c. Now determine if the sheer pin is broken and if so replace. Now position the prop over the pin and push tight.

d. Check to see if there is no gunk or fishing line and screw in the nut. Push a new cotter pin in and jiggle the prop till the pin goes right through.

e. Bend over one side of the split pin.

TOOL KIT

Your outboard motor comes equipped with a special tool kit This kit includes the necessary tools to perform normal adjustments and maintenance on your outboard motor.



1. Water Flush Device (Models 4 and 5)

CAUTION: Operating the engine with a loose propeller nut will cause the drive pin groove in the propeller and/or drive pin hole in propeller shaft to wear excessively. Check propeller for looseness by trying to move it forward and backward on propeller shaft. If movement is detected, remove cotter pin and tighten propeller nut until no movement is detected. Continue to tighten (not loosen) propeller nut until the cotter pin hole aligns with hole in propeller shaft. Install cotter pin and spread ends to secure.

1 - Propeller Shaft
2 - Drive Pin

Illustrations and photographs, Mariner Outboard Service Manual

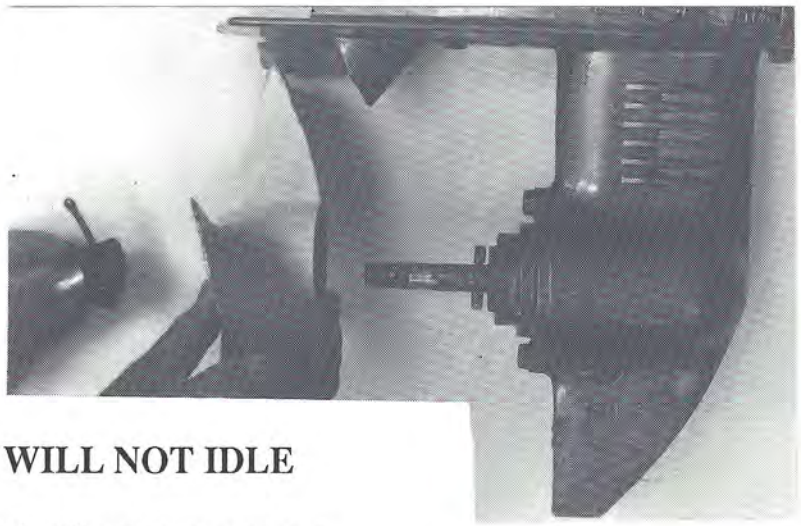
Can you identify on the diagram opposite the following:-

Sheer pin

Prop

Nut

Split (Cotter) pin



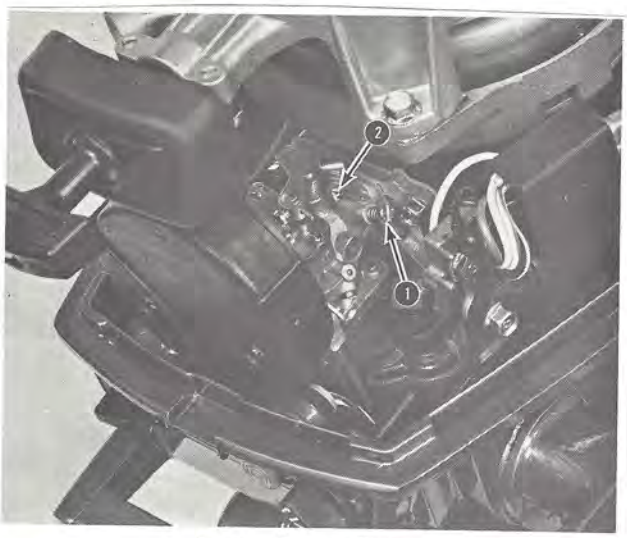
THE MOTOR WILL NOT IDLE

You need to check the idle mixture screw as indicated in the diagram opposite. Note the following:

a. The engine should be warm before adjusting the mixture screws. Move the throttle handle to the lowest position and remove the cowling.

b. Turn the idle screw in until tightly seated and then back out one or one and a half turns. With outboard in gear slowely turn idle screw in and out and then leave where engine runs the best.

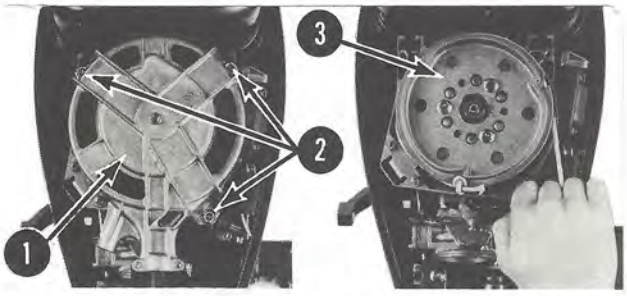
Note: Each service manual is different so check with the one you are using.



1 - Idle Mixture Screw
2 - Idle Speed Screw

THE PULL CORD BREAKS

a. Remove cowling.
b. Unscrew fly wheel nuts and remove.
c. Take spare cord and wrap around pulley as shown in diagram.
d. Pull start and replace cowling.
e. Take pull start to service.



1 - Starter Case Cover
2 - Bolts
3 - Pulley

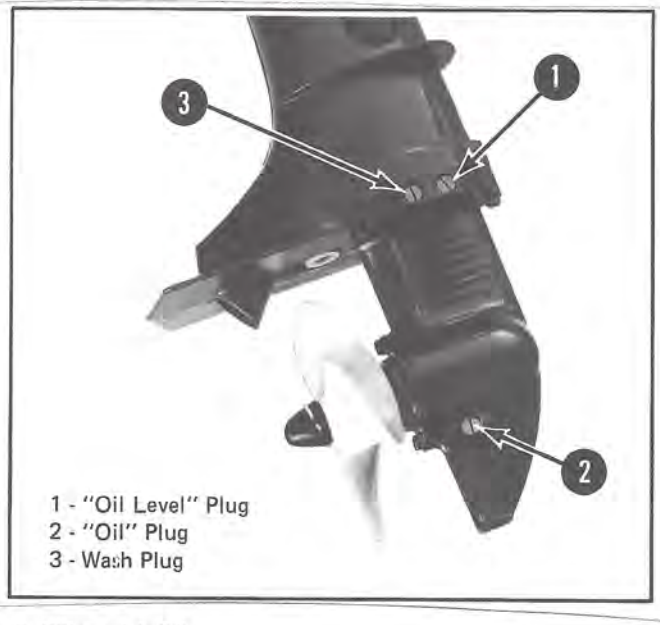
SERVICING MOTORS AND MAINTENANCE

You should have the service manual for this section. A sample manual is described below.

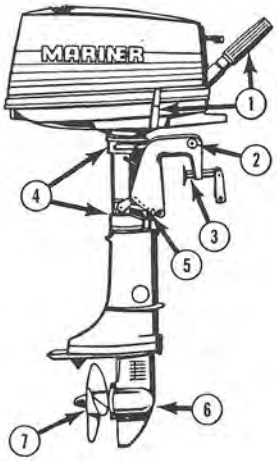
LUBRICATION-

Gearcase

Check the lubricant level in the gearcase every 50 hours of operation. Add lubricant as necessary. Completely drain and refill the gearcase once each season or every 100 hours.



1 - "Oil Level" Plug
2 - "Oil" Plug
3 - Wash Plug



Refilling with Oil

Feed a Quicksilver Gear Lube into the "OIL" hole.

When oil begins to flow out of the "OIL LEVEL" hole, install upper plug with gasket and tighten. Install lower plug with gasket and tighten.

ITEM	DESCRIPTION	TYPE OF LUBRICANT	FRESH WATER FREQUENCY	SALT WATER FREQUENCY
1	Throttle/Shift Linkage (All Pivot Points)	A	Every 60 days	Every 30 days
2	Tilt Tube	A	Every 60 days	Every 30 days
3	Clamp Screws	A	Every 60 days	Every 30 days
4	Swivel Bracket/ Swivel Pin	A	Every 60 days	Every 30 days
5	Reverse Lock Lever	A	Every 60 days	Every 30 days
6	Gear Housing	B	After 1st 10 days, then every 30 days	After 1st 10 days, then every 30 days
7	Propeller Shaft	A	Once a season	Every 60 days

Type of Lubricants
A = Quicksilver 2-4-C Marine Lubricant
B = Quicksilver Gear Lube

REPLACING THE SACRIFICIAL ANODE

1 - Anode

ANODE (Models 4 and 5)

An anode is attached under the anti-cavitation plate

This sacrificial metal anode helps protect the lower unit against galvanic corrosion, which takes place more actively in salt or polluted water. The anode corrodes instead of the lower unit, and must be inspected periodically. When it becomes excessively corroded, replace it.

Illustrations from Mariner Service Manual

BATTERIES

Battery Requirements and Maintenance

BATTERY REQUIREMENTS - ELECTRIC START MODELS

Models 30 and Below

Minimum reserve capacity rating of 35 minutes and cold cranking amperage of 180 amperes.

Models 35 and Above

Minimum reserve capacity rating of 100 minutes and cold cranking amperage of 350 amperes.

All lead/acid batteries have an inherent self-discharge characteristic when not in use. Recharge every 30 to 45 days, or when specific gravity drops below battery manufacturer's specifications.

Refer to specific instructions and warnings which accompany your battery. If this information is not available, following are some precautions you should take when handling a battery.

⚠WARNING

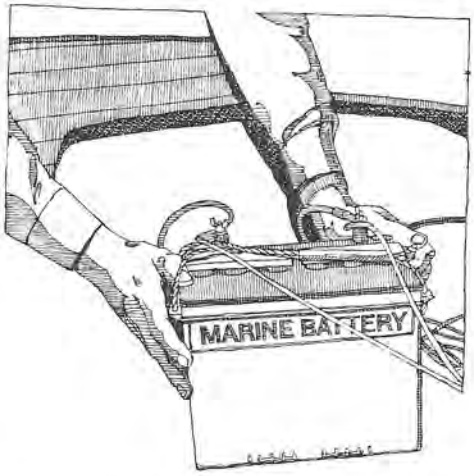
Batteries contain acid which can cause severe burns-- Avoid contact with skin, eyes and clothing. The battery also produces hydrogen and oxygen gases when being charged. This explosive gas escapes the fill/vent cell caps and may form an explosive atmosphere around the battery for several hours after it has been charged, and sparks or flames can ignite the gas and cause an explosion which may shatter the battery and could cause blindness or other serious injury.

Safety glasses and rubber gloves are recommended when handling batteries or filling with electrolyte. Hydrogen gases, that escape from the battery during charging, are explosive. When charging batteries, be sure that the battery compartment or area where batteries are located, is well-vented. Battery electrolyte is a corrosive acid and should be handled with care. If electrolyte is spilled or splashed on any part of the body, immediately flush the exposed area with liberal amounts of water and obtain medical aid as soon as possible.

If a "sealed" or "maintenance-free" battery is used, the outboard must be equipped with an accessory voltage regulator.

ELECTRICAL ACCESSORY CONNECTIONS

Any accessories, such as horns, running lights, etc., should be installed with electrical connections attached directly to the battery terminal via the screws on battery lugs or connected to an approved accessory switch panel.



BATTERY WINTER STORAGE

Follow battery manufacturer's instructions for storage. If not available, the following instructions may be used:

1. Remove battery.
2. Remove grease and dirt from top surface.
3. Cover plates with distilled water to manufacturer's specifications.
4. Grease terminal bolts.
5. Store battery in a cool, dry place. Do not store on a concrete surface. Place on a dry wood board or thick plastic base.
6. Every 30 to 45 days, check water level and recharge battery according to manufacturer's specifications. Do not fast charge.

   IMPORTANT: A discharged battery can be damaged by freezing.

7. When replacing battery in service, remove excess grease from terminals, recharge as necessary and reinstall in boat.

Contact your authorized dealer or local automotive garage for this service if you cannot perform it.

WHEN THE WORST HAPPENS

SUBMERGED ENGINE

If your engine was accidentally submerged it must be recovered as soon as possible. If it is not, severe rust and corrosion will develop throughout the engine. If your engine has been submerged, take the following preventive measures. Remove engine from water as quickly as possible. Wash thoroughly with fresh water to remove all salt, mud, and seaweed. Remove spark plugs and drain all water from cylinders. Feed engine oil into each cylinder through the spark plug hole and crank engine several times to spread oil to cylinder walls. Turn engine over and pour several ounces of engine oil thru carburetor while cranking engine. Have the engine overhauled by your Authorized Dealer as soon as possible.

CHAPTER 6

HOW YOUR ENGINE WORKS

For the beginner, just getting the engine going can be enough drama without having to worry about how the motor actually works.

This chapter is not designed to turn you into an outboard mechanic, rather to give you some basic information so that you can recognise problems as they occur and know what is happening when the engine is going. If you want to learn how to be an outboard mechanic then there are plenty of courses run by TAFE colleges.

The chapter is divided into the following sections:-

* Engine cycles
* The two stroke cycle
* Fuel system
* Fuel pump
* Ignition system
* Spark plugs

An engine is a machine that converts some type of energy into the motion of a propeller to move the boat forward. An engine in which the combustion of fuel is carried out in a closed cylinder is called an internal combustion engine. There are two types of internal combustion engine named after the type of fuel they use, viz, petrol and diesel. This chapter focuses on two stroke petrol engines since they are almost exclusively used in outboard motors.

The principal driving force is generated by the propeller which spins in the desired direction to move the boat forward or backwards.

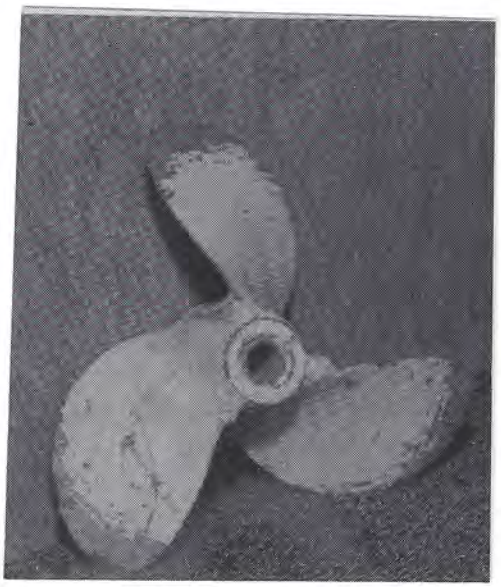


Fig Propellers are rated by diameter, pitch or number of blades

The propeller is connected to the engine through a drive shaft unit which in turn is connected to the main part of the motor through a gearing system.

ENGINE CYCLES

When the motor is started it revolves free of the propeller and is said to be in the neutral position. The propeller is not spinning because the gears are not connected. Engage the gear and the prop turns moving the boat in the desired direction.

You have already had your first drive of the engine and are aware that you have to pump the fuel up to the motor and open the choke when the motor is cold. Also you had to give the cord a good pull to get the motor turning over. The motor started with a loud roar and you probably thought that you had done something wrong, but as soon as you adjusted the throttle, the revs dropped and you were able to engage the gear and drive the boat with confidence.

Why did you have to pump the bulb and why was it necessary to turn on the choke? Why did you have to pull the motor so hard, and what happened when your instructor said to you that you had flooded the motor? Why did the motor roar and how did the throttle work? What is happening under that cowling to drive the boat?

Lets take a closer look at the principles involved in the motor under the cowling of a two stroke engine. The parts of this engine are summarised in the Figs over. See if you can get your instructor to show you a piston from a two stroke engine and compare it with that of a piston from a four stroke engine.

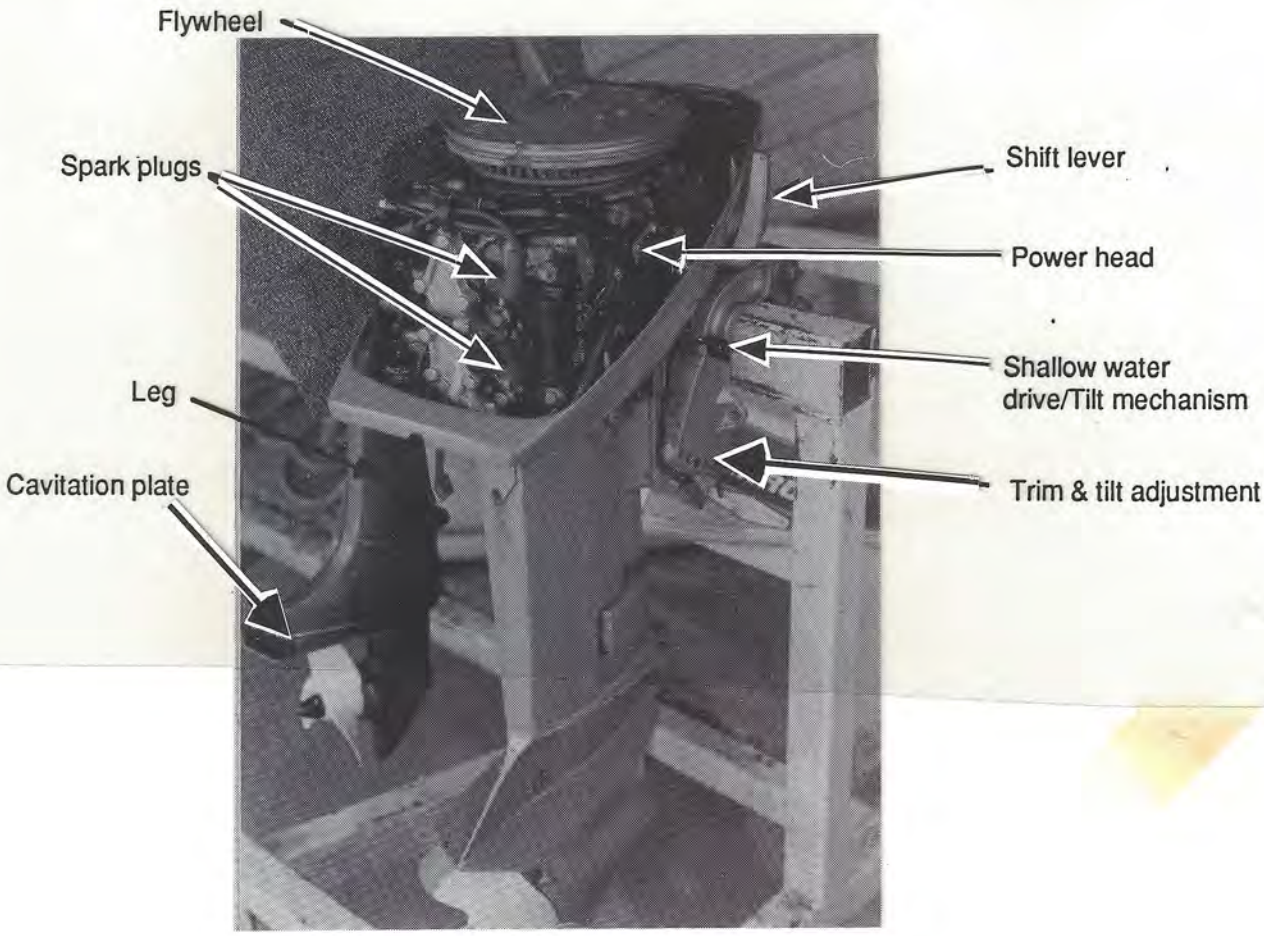
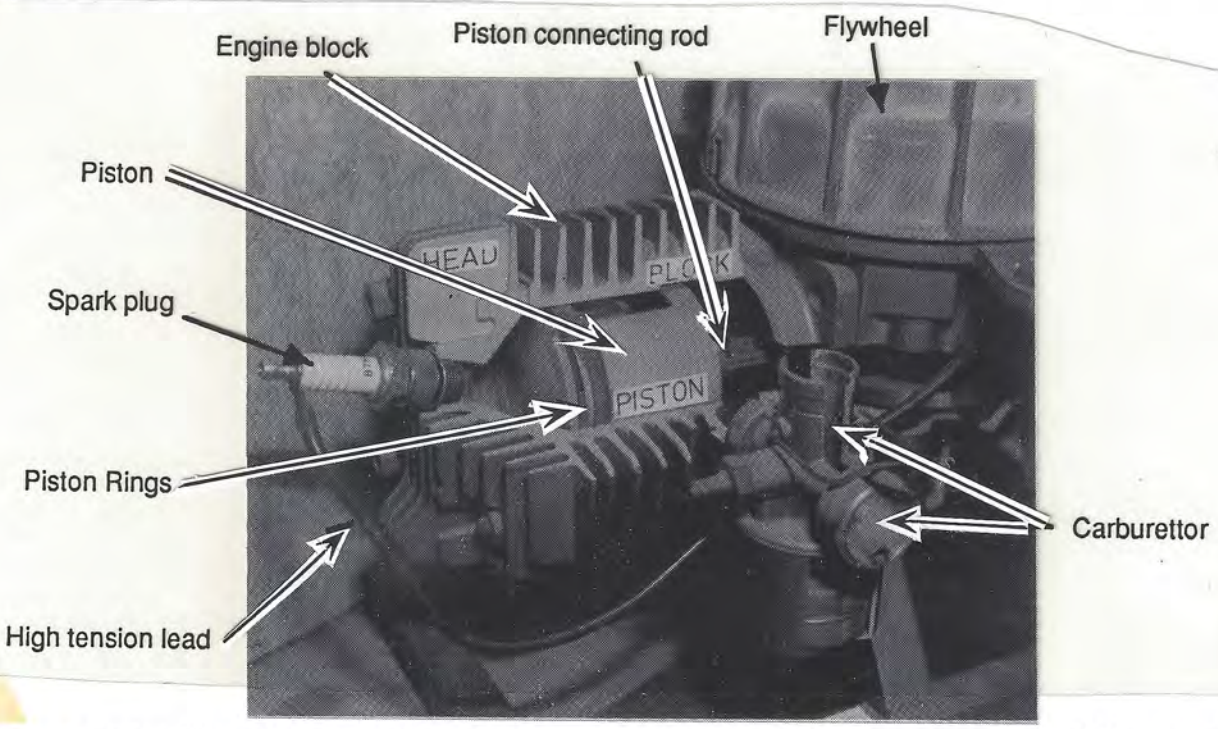


Fig What is under the cowling

INSIDE THE ENGINE BLOCK

Cut a slice through the engine block and you can start to see the parts that control the movement of the motor. Some of these are shown in the photograph below.



To understand how these parts function we need to look firstly at the engine cycle. When starting the motor, and once it is in operation, five events take place in sequence that allow the motor to run.

These are:-

* Intake of fuel
* Compression of fuel
* Ignition of fuel
* Power given to the piston inside the engine cylinder
* Exhaust of burnt fuel

These are shown in the Figures opposite which involve two strokes. Hence the word two stroke engine.

THE POWER STROKE

In the two stroke cycle the piston is forced down by an explosion of fuel in the crankcase when the piston reaches the top of its cycle.

The downstroke is called the power stroke. Burnt fuel is called exhaust and must be removed as the piston reaches the bottom of the first stroke. This happens at the exhaust port.

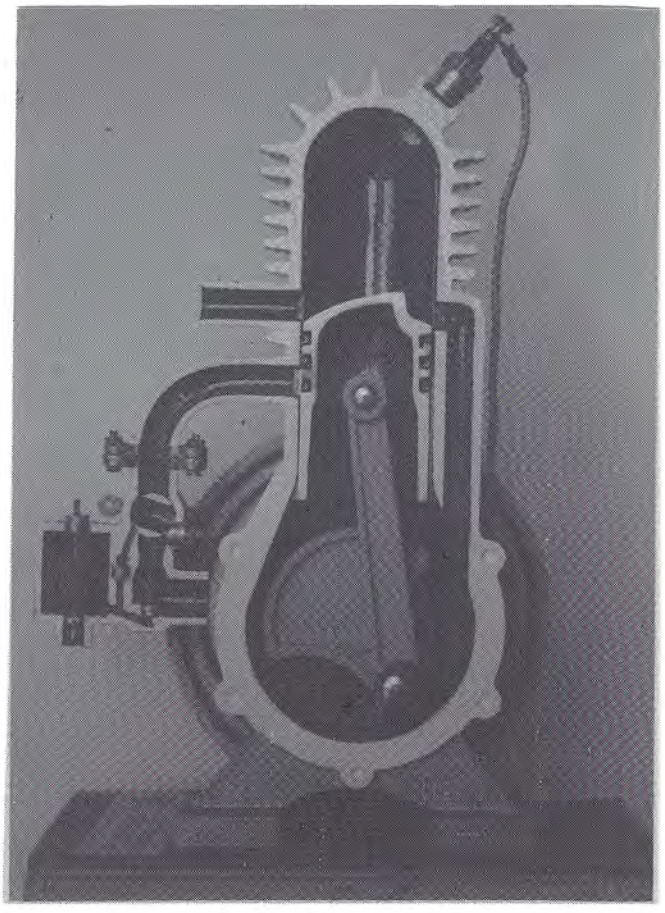


DIAGRAM A

THE COMPRESSION STROKE

The second stroke is called the compression stroke when fuel from the transfer port is sucked in by a drop in pressure inside the cylinder caused by the piston moving down in the first stroke.

A counter weight is needed to keep the motion of the piston and this is why a good pull is necessary to start the motor.

Fuel is now compressed and a timed spark from the spark plug ignites the fuel at the top of the compression stroke causing the cycle to continue.

DIAGRAM B

SUMMARY

In diagram A the piston is at the bottom of the power stroke, fuel and air from the carburettor are sucked in because the pressure in the cylinder is lower than that of the fuel tank. Burnt fuel is exhausted and the flywheel (counter weight) is moving in an anticlockwise direction.

In diagram B the piston moves towards the spark plug compressing the fuel. When it is at the top of the cycle, a timed spark ignites the compressed air/fuel mixture and the resulting expansion moves the piston down on the power stroke.

The reed valve closes and the downward movement of the piston compresses the next air/fuel mixture in the cylinder. As the piston reaches the bottom of the power stroke, it uncovers the exhaust port in the cylinder wall and allows the combusted products and remaining pressure to escape.

When the piston is at the bottom of the power stroke, it opens the transfer port leading from the crank case to the cylinder and then the higher crankcase pressure forces the compressed air/fuel mixture through the transfer port into the engine cylinder.

Research questions.

1. The fuel added is a mixture of what two petrochemical substances?
2. What is the ratio of these two substances?
3. Can an outboard motor use unleaded petrol?
4. What is a hydrocarbon and where is it found?
5. How is petroleum refined and how many carbon atoms to the molecule on average, have the following got:- Petrol, natural gas or oil?
6. What is the chemical composition of the exhaust gases?
7. What happens to the exhaust gasses if the fuel is incorrectly mixed?
8. How is the piston lubricated?
9. What are piston rings and what function do they serve?
10. How does the engine get hot and how is it cooled?

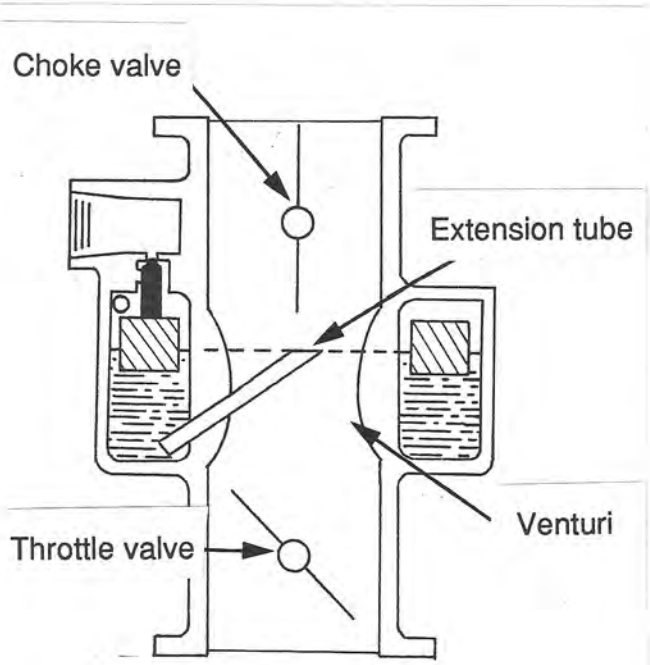
THE FUEL SYSTEM

The supply of fuel is regulated by the carburettor. Air and fuel are mixed here into a fine spray in a definite ratio depending on the power of the engine.

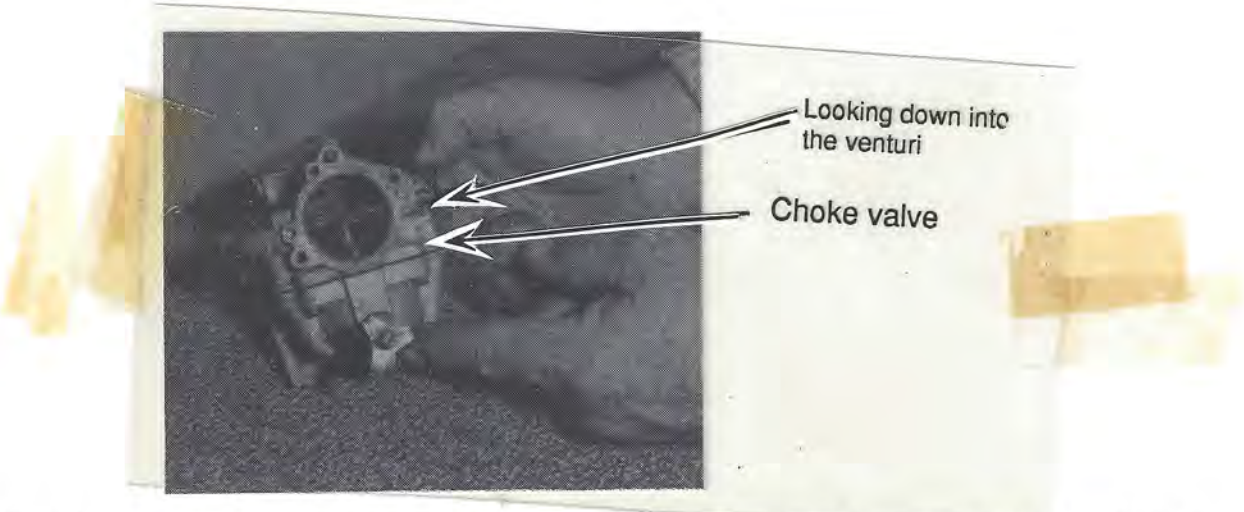
Fuel moves through the carburettor by a venturi. The principle is based on the fact that as air passes through a jet, it increases in speed and causes a vacuum in the constriction called the venturi.

If a tube is inserted in the venturi where the vacuum is greatest, then fuel will be sucked into the tube. If you regulate the speed of the air, you can regulate the amount of vacuum and hence the amount of fuel and air mixture. This is done by the throttle in the figure below.

The fuel must come from a reservoir and this is achieved by a float in a chamber as shown in the figure below:-



The principle of carbur ation is in the venturi system



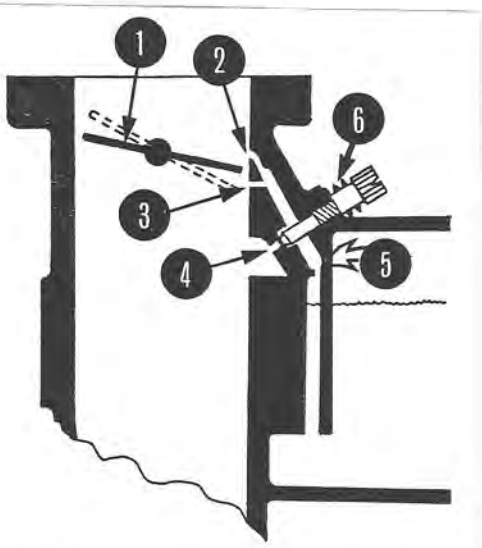
Cut view of a carburettor showing how the fuel jet is inserted into the venturi and the storage of fuel in the reservoir

A petrol and air mixture will ignite at air to petrol ratios ranging from 25:1 to 8:1. The petrol must vaporize to a gas so that the explosion can be effective in forcing the piston down and when the engine is cold, a richer mixture is required.

This is achieved by closing off the air intake and choking throat of the carburettor. That's what you do when you turn on the choke. Now if you allow too rich a mixture to enter the cylinder, the mixture will be too rich and the cylinder will become flooded with fuel and the spark will not ignite the mixture. This is shown in figure 6.7.

When the engine is warm, the choke is open and fuel and air mix freely. When the throttle is opened, more petrol enters accelerating the number of ignitions per second. The revolutions of the crankshaft increase, the propeller spins faster and the boat accelerates.

Ease off the throttle and the motor slows. But how can the motor be made to idle? If a separate passage is drilled from the float chamber to the area below the venturi, fuel and air can still be supplied. The moisture can be controlled by an idle screw as shown in the figure below:-



Legend
1. Throttle valve
2. Orifice in idle passage
3. Orifice in idle passage
4. Metering orifice
5. Idle jet
6. Idle mixture adjustment screw

Fig How the motor can be made to idle without use of the throttle

1 - Idle Mixture Screw
2 - Idle Speed Screw

FUEL PUMPS

Fuel must be pumped to the carburettor. Once the motor is going there exists the mechanism by which a pump can operate. Most two stroke motors use a pulsating pressure and vacuum impulse to operate the fuel pump as shown in figure below.

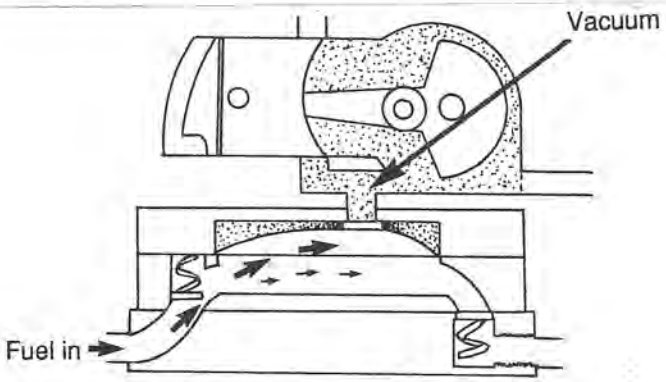


DIAGRAM A

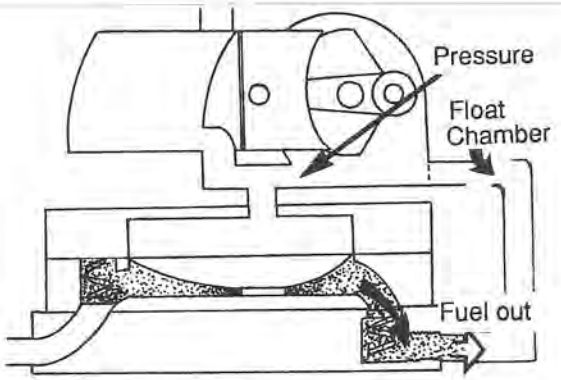


DIAGRAM B

In diagram A As the piston completes its compression stroke the diaphram in the pump moves down caused by a vacuum created in the crankcase. This is called the vacuum impulse. Petrol is sucked in to the fuel chamber through the inlet valve which opens as the spring under it contracts.

In diagram A When the piston moves back in the power stroke as shown in figure B, pressure created in the crankcase pushes the diaphragm back into the fuel chamber forcing the fuel out. This is the pulsating part of the definition.

The spring moves down and the outlet valve opens letting fuel pass into the carburettor. When the piston moves up in the compression stroke the diaphragm moves down and the cycle starts again.

IGNITION SYSTEMS

The purpose of the ignition system is to ignite the petrol and air mixture in the combustion chamber at the exact moment which will provide the greatest power from the combustion. An electrical spark is used to ignite the mixture which occurs at the base of the spark plug.

The spark plug

The spark plug consists of a body supporting two electrodes between which a spark occurs. The inside electrode is insulated by a porcelain insulator as shown in figure opposite:-

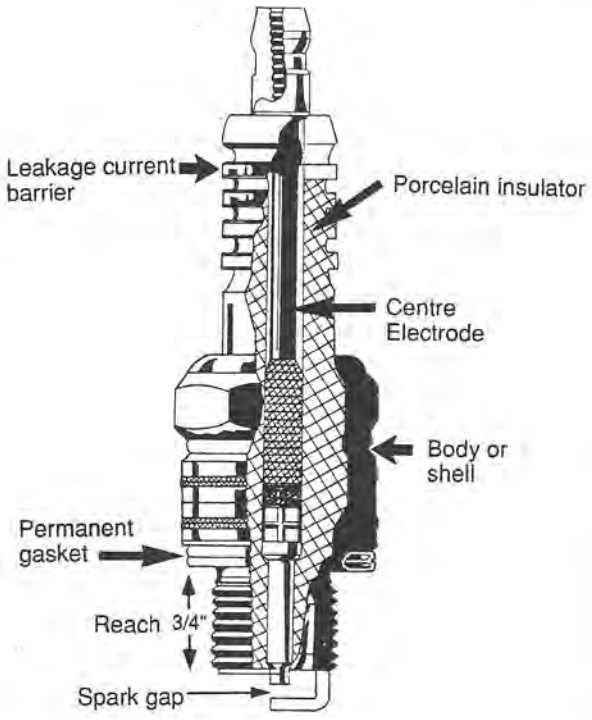


Fig Generalised drawing of a spark plug.

When an electric current passes down the centre of the electrode it leaps across the gap to the second electrode thus igniting the mixture or charge of petrol and air.

But how is this spark created and how dangerous is it? How does the motor generate its own electricity without a battery? What is electricity anyway? The discussion below is a simple explanation of electromagnetism. If you are interested further, you can consult any standard Physics textbook under the headings of electromagnetism, electricity, Ohm's Law, magnets, batteries or conductors.

Batteries

Batteries are also not discussed but are an essential part of the wiring system of a larger boat with a starter motor used to crank the engine. If you use a battery here are some general rules to follow:

1. No smoking or naked lights as hydrogen and oxygen are liberated which are explosive gases.
2. When charging connect positive to positive and negative to negative.
3. Keep all connections clean and tight. A thin smear of vaseline helps prevent corrosion.
4. Keep tops clean and dry.
5. Keep electrolytes topped up to the correct level.
6. Never allow batteries to stand for long periods of time as sulphation will take place.
7. When tightening connections keep the other terminals covered to prevent accidental shorting out.
8. Always keep the battery well charged.

The symbol for a cell is a battery as shown in figure below, as is the symbol for a cell which makes up the battery. Normally cells produce two volts, so a three cell battery becomes a six volt battery.

Fig Cell and battery symbols

Brief electrical theory
(of DC currents as they relate to outboard engines)

Electricity always flows from negative to positive and will only flow if the circuit is complete. Connecting wires are called conductors and switches are fitted in the circuit to interrupt current flow. When the switch is open (i.e. off) a potential difference in electrical pressure still exists, but no current will flow until the switch is closed and the circuit is completed. The electrical pressure is supplied by the battery in the form of electrons that are released from atoms. (But that is a separate story and if you think of the electricity being like water in a pipe then you should get the general idea)

The flow of this water in the pipe depends on how much resistance is in the pipe. If the pipe is long the pressure will drop, or if the pipe is thin the pressure will rise. Factors such as length of material, cross-sectional size and temperature all affect the electrical resistance of the conductor.

The Electric Current

Materials which allow the flow of electricity are called conductors. Good conductors are copper, silver and most metals.

Materials which resist the flow of current are called insulators. Poor conductors are wood, air, glass, porcelain, oil, rubber.

Electrical current implies that a series of conductors have been connected so that the current can flow through it.

The rate of movement will affect anything in the circuit and is measured in terms of the quantity of electricity passing any point at a given time.

This rate of flow of electricity is called the current and is measured in amperes or amps.

The force of pressure that moves the current is called the electromotive force or EMF and is measured in volts. The term potential difference is used to measure the difference in pressure between any two points in the circuit. It too is measured in volts because its a measure of the difference in pressure.

The resistance to the flow of electricity (water flow if you like) is called resistance and is measured in ohms.

A volt is the pressure difference required to cause one amp of electricity to flow through one ohm of resistance.

The relationship between volts, amps and resistance can be summarised by the simple relationship outlined below where volts have the symbol V, amperes the symbol I and resistance the symbol R. It's called Ohms law named after the person who discovered it.

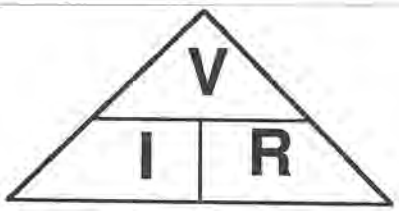


Fig Ohms law. Cover up one side and you have the formula for the other.

Power

Power is a measure of how powerful your motor is. Under the old scale power was measured by how much work a team of horses could do, thus the term horsepower arose. Small outboard motors are rated as either 5hp, 6hp, 8hp or so on. The bigger the motor the more powerful.

So power is the rate of doing work. The current (water in the pipe) is also capable of doing work. A water turbine can generate power in an hydroelectric powerstation for example. The unit of electrical power is the watt and 1000 watts is equal to a kilowatt.

Power = EMF x current

Watts = Volts x amps

The relationship between electrical power and mechanical power is 746 watts = 1 horse power so a 5 hp motor is rated at 4.73 kilowatts. This new rating is stamped on all motors and is used as the basis for licencing testing in Queensland. All motors over 4kw and capable of speeds in excess of 10 knots have to have a licenced driver.

Revision questions

Your teacher will set you some questions on

Volts, Amps and Ohms

Also some questions on Power would not go astray to highlight the different ratings

Electromagnets

If an electric current is passed through a piece of soft iron an electro magnet occurs. Cut the electricity and the electromagnet stops. The strength of the magnet depends on the turns of wire around the soft iron core.

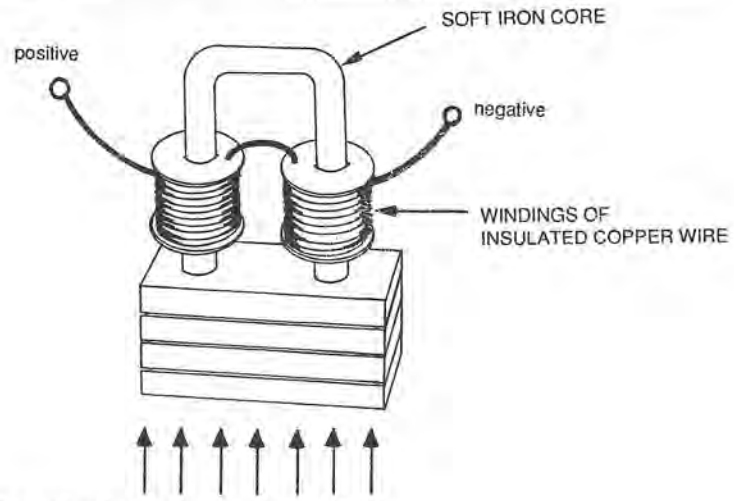


Fig A simple electromagnet

Induced current

By moving a magnetic field across a conducting circuit an induced current can be created in that circuit. Placing a magnet in a coil of wire and moving it back and forth will induce a current to form in the wire. When the movement stops so does the induced current.

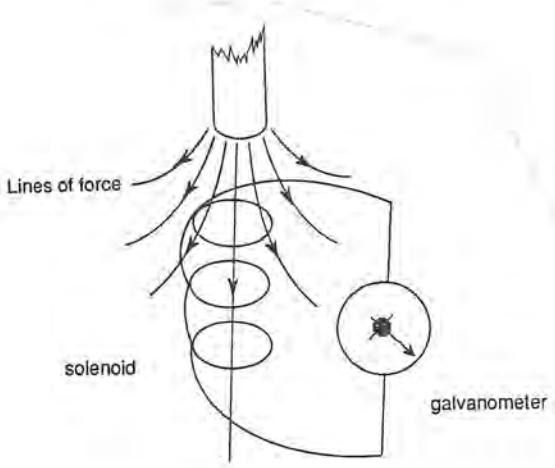


Fig An induced current can be formed by moving a magnet around a coil of wire

The induced current is proportional to the number of turns and the speed of the magnet's movement. The same effect can be obtained by using an electrical magnet in the form of a coil in place of the permanent magnet.

THE IGNITION PROCESS

Now that some of the basics have been discussed, the process of making the spark can be delt with.

A source of electricity is needed, and the magneto supplies this. A revolving permanent magnet around a coil induces the electricity for the circuit.

If a spark plug were inserted in the circuit and the switch closed nothing would happen. The gap between the electrodes in the plug would act like an open switch.

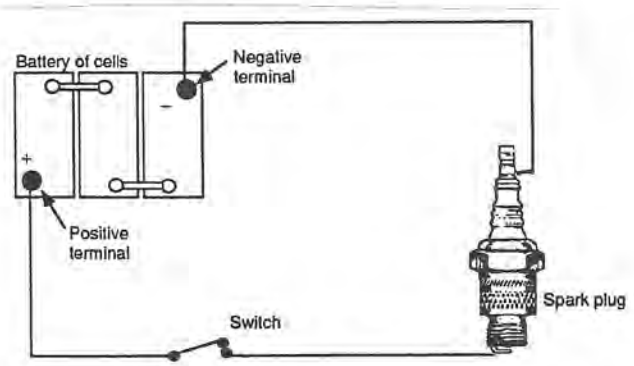


Fig A spark plug placed in a circuit would simply act as an open switch

Clearly then there must be some way to increase the voltage. This is done by the principle of electromagnetic induction. If an insulated wire is wound around the core of a piece of soft iron a magnetic field can be created.

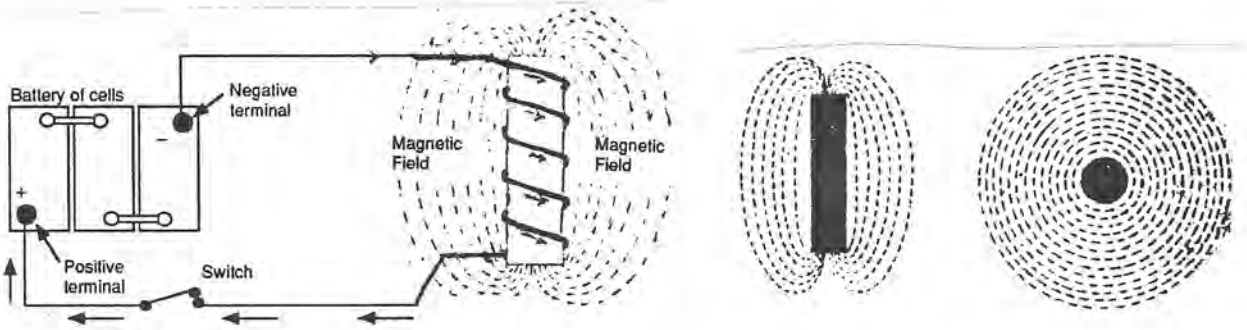


Fig A magnetic field created by electricity passing around a soft iron core

The magnetic field is composed of a set of magnetic lines of force that are in place when current flows and cease when the current stops. An important property of these lines is that as they collapse or move they can induce an electric current in any other wire circuit that is placed in the collapsing field. If a second winding is wrapped around the coil then as the magnetic field collapses, a second current is generated as a result of the first. This is shown in figure

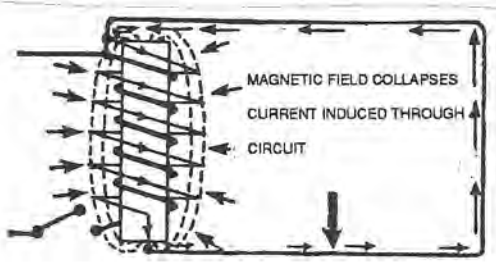


Fig A magnetic field collapsing caused by the opening of the switch causes a current in the second circuit

The first winding is called the primary winding and the second the secondary winding. The new current is called the induced current. When the magnetic field collapses, the moving lines of force travel past the turns of the secondary winding and induce a flow of current through the secondary circuit. It must be remembered that the induced secondary current occurs during the collapsing of the field and that this collapse in turn is caused by the opening of the switch. Therefore the opening of the switch governs the instant at which the induced current flows. Each turn of the secondary circuit picks up a definite amount of induced current. The voltage in the secondary wiring depends on the number of turns in the secondary wiring so that more turns, the higher the voltage. This is exactly what we want to cause a spark

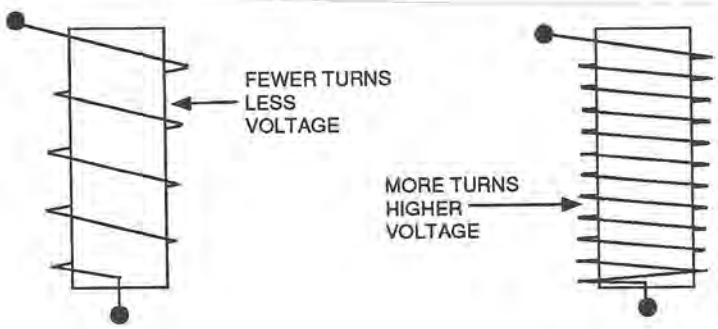


Fig Fewer turns less voltage, more turns higher voltage

Having obtained the means to get a high voltage, the spark plug can be inserted into the secondary circuit. In this ignition system this induction devise is known as a coil. To obtain a strong magnetic field in this coil about 150 to 200 turns of wire are used in the primary wiring. This is shown in figure below compared to the secondary wiring of some 20,000 turns.

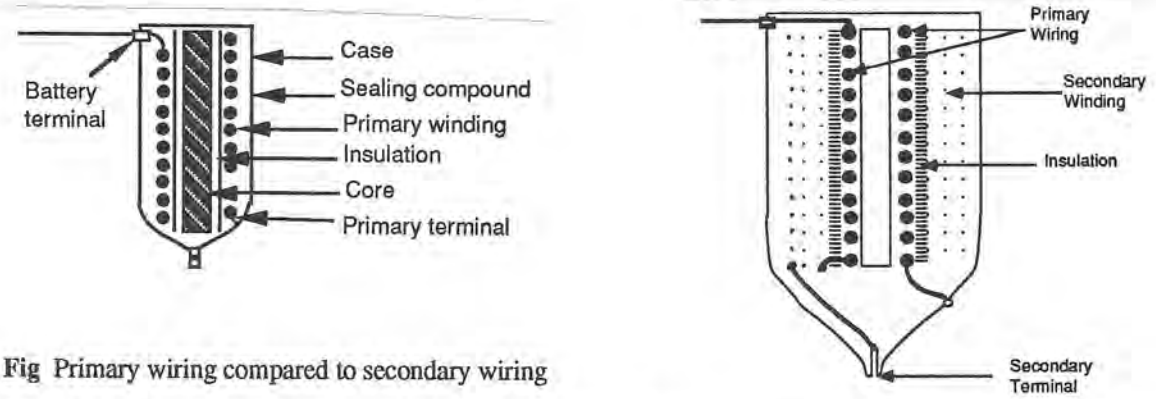


Fig Primary wiring compared to secondary wiring

This high voltage current from the coil will provide the spark across the spark plug gap. It is necessary to have a complete circuit in the secondary wiring circuit. To accomplish this the primary and secondary circuits are connected as shown in figure below

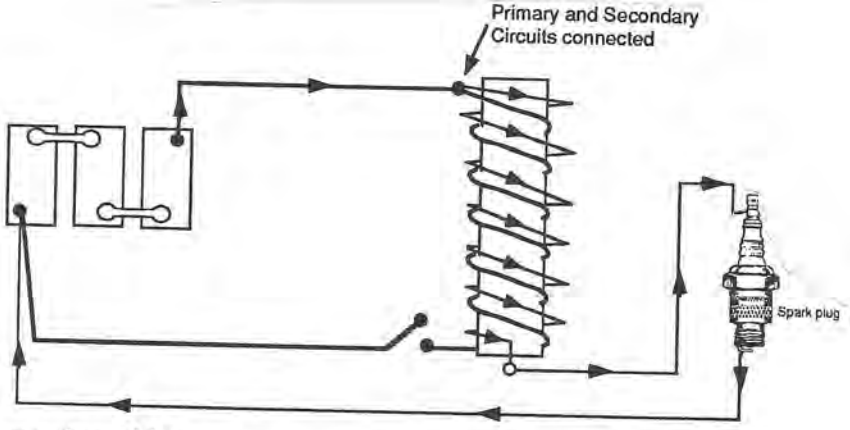


Fig Primary wiring compared to secondary wiring

Unfortunately due to this connection some current will be induced in the primary circuit and will have sufficient voltage to arc across the switch as shown in figure below:-

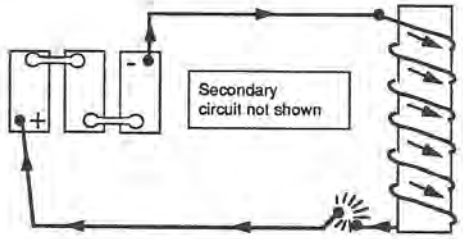


Fig Induction of current in the primary circuit. Note secondary circuit not shown

This would result in serious damage to the primary circuit and some means must be found to absorb this electricity. This is achieved by the insertion of a condenser in the primary circuit. A condenser is made up of light metals which absorb the electric charge.

It is made of two strips of tin foil, separated from each other by an insultating strip of wax or paraffin paper. The tin foil and insulation sandwich is wrapped in a tight roll and placed in a small can. The condenser is able to trap and store up a temporary charge of electricity in the strip of foil. The condenser is connected in the primary circuit so that it will store up the induced charge from the primary winding.

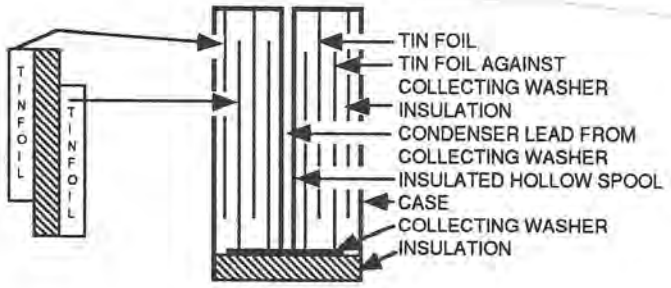


Fig Cross-section through a simple condenser

The charge builds up to a certain point and then forces the current in the reverse direction through the primary circuit so it cannot pass through the switch and damage it. In practice the condenser discharge occurs just before the induced secondary current leaps the spark gap.

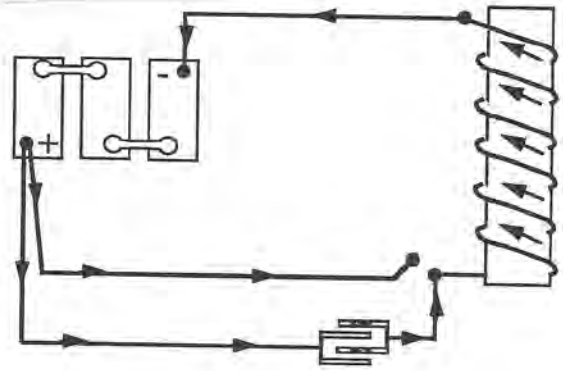


Fig The condenser protects the switch from damage and discharges sending the current backwards through the circuit

Summary

1. The primary circuit builds up the magnetic field around the coil.
2. The condenser absorbs and then discharges the induced current back into the primary circuit protecting the switch in the circuit.
4. The secondary circuit induces a very hot spark which is used to ignite the petrol and air mixture.

The three circuits give wires back to the terminals of the power supply and can be eliminated by grounding the wires to the metal casing of the outboard engine and regrounding the terminal of the power source as shown in figure below:-

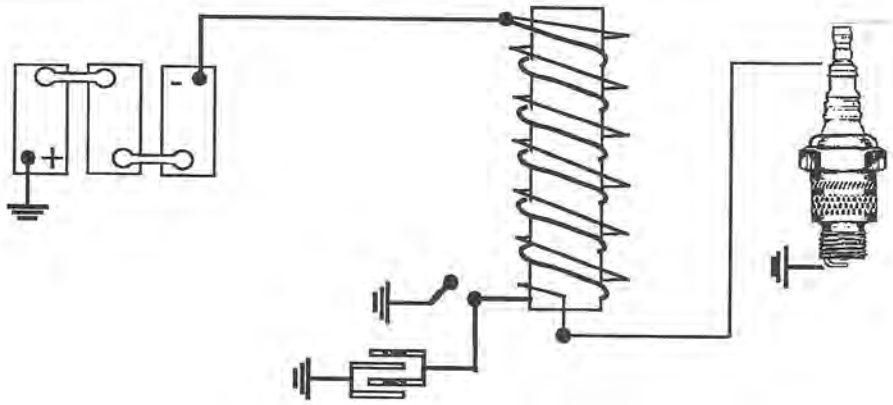


Fig Grounding of the primary and secondary circuits

The primary circuit and condenser are grounded to the cylinder block while the secondary circuit is grounded to the grounded electrode of the spark plug directly to the cylinder head. The power source terminal is grounded to some metal directly connected with the metal used to ground the circuits.

So far the spark has been timed by operating the switch by hand. By reorganising the switch it can be opened and closed by the motor's movement by the construction of a small cam. The cam is placed so that as the lobe comes around and hits the switch arm, the switch contacts are pushed away from each other. This type of switch is called a breaker and the points of contact are called breaker points. The cam is driven by a shaft directly connected to the engine and is timed to open at the exact time the piston is at the top of it's compression stroke. This is known as ignition timing.

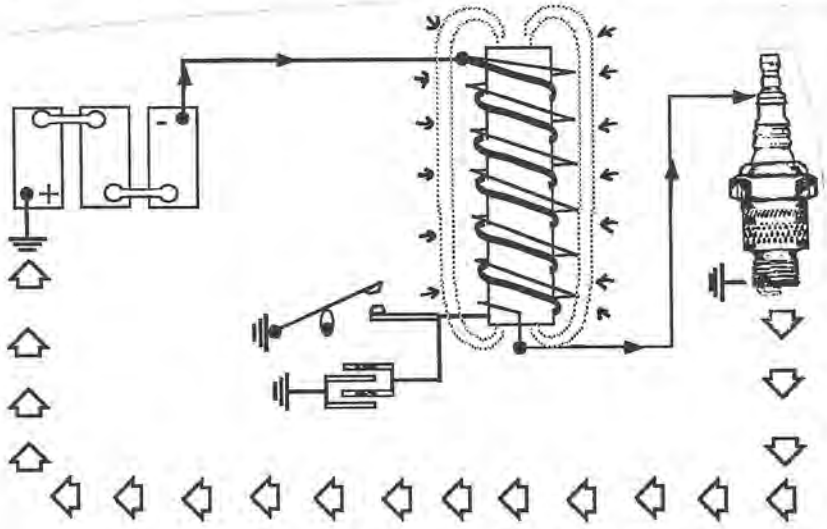


Fig The addition of contact points allows the spark to be timed with the movement of the piston in the engine

The magneto

The magneto is actually a very small dynamo which operates much the same way as that on your bike except that a very high voltage is required. To achieve this voltage the principles of magnetic induction are applied.

The magneto is connected to the spark plug by a high tension lead and at appropiate times, controlled by the operation of the cam and breaker points, a spark producing high voltage appears across the spark plug's electrodes.

The ignition coil builds up the high voltage current and consists of two separate coils. The coil closest to the core consists of a small number of turns of thick copper wire and is known as the primary coil.

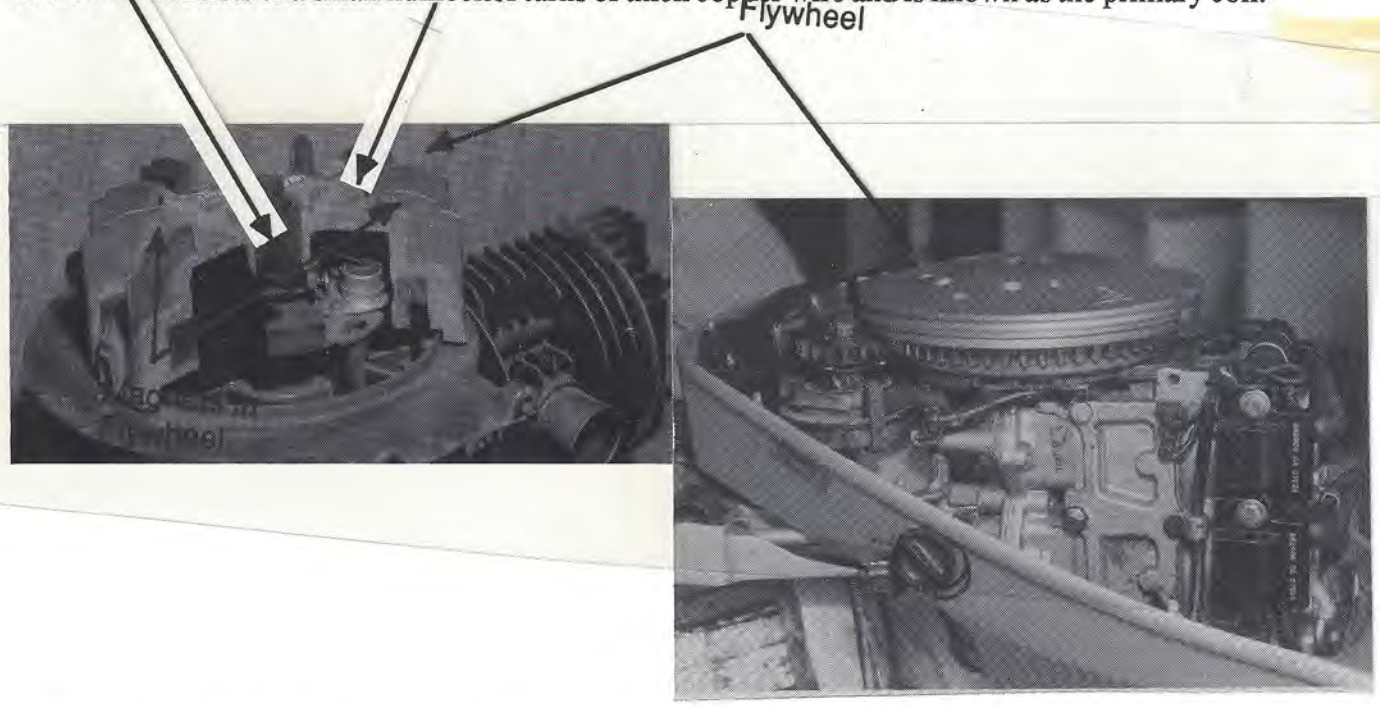


Fig Exploded view of a fly wheel magneto for a small outboard engine

One end of this coil is connected to the frame of the magneto and the other end is connected to the breaker points. Wound over the primary coil and insulated from it are many turns of a thinner copper wire making up the secondary circuit. One end of the coil goes to the frame and the other to the high tension lead and spark plug. The other side of the points goes to the frame as shown in figure below:-

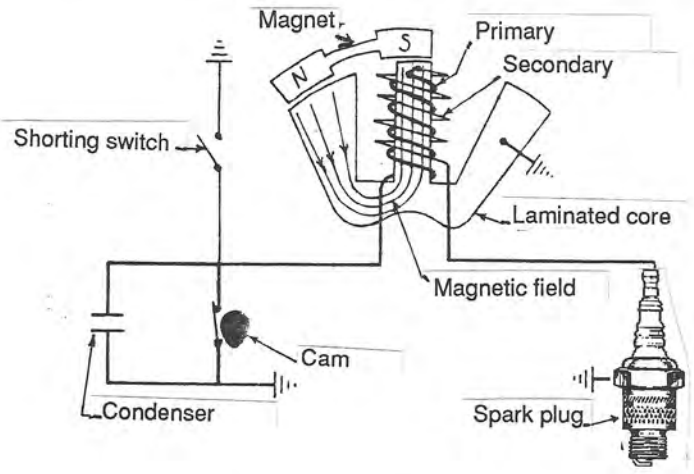


Fig When the breaker points are closed the magnet passing over the coil induces current into the primary circuit.

The breaker points have to be closed when the magnet in the flywheel passes the coil. When this happens current is induced in the primary winding. When this current is interrupted by the opening of the breaker points, a very high voltage is induced in the secondary winding and this is the current which, connected to the spark plug, causes a spark to jump across the points of the plug.

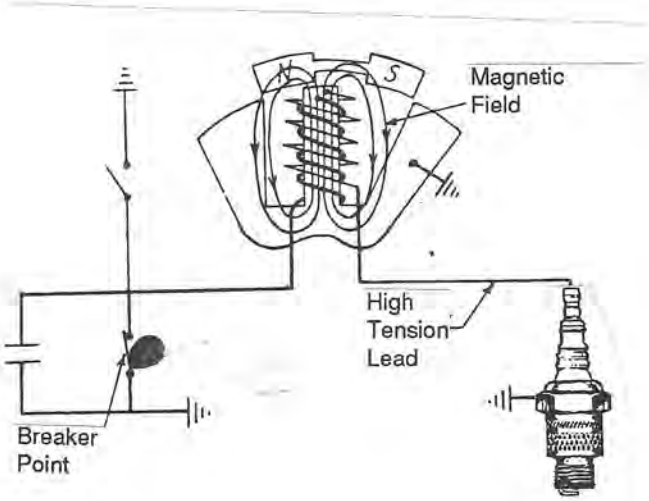


Fig Current flowing in the primary circuit sets up a magnetic field surrounding primary and secondary coils.

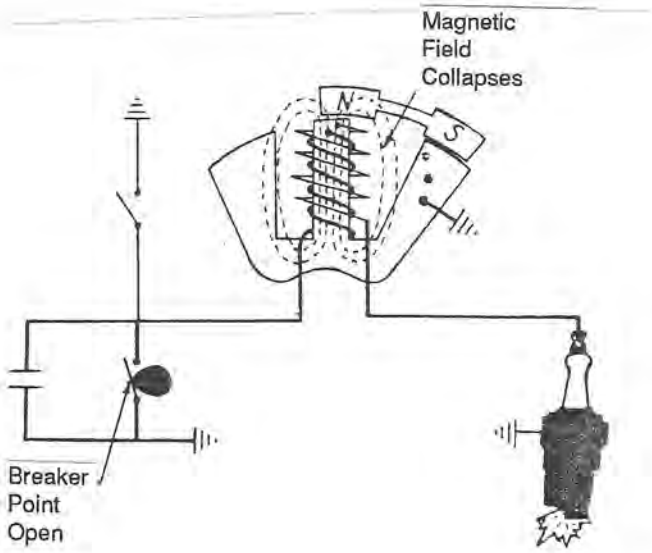


Fig Primary current is interrupted as cam opens breaker points, inducing high voltage in the secondary winding and causing a spark to jump the electrode gap to ground. The condenser absorbs the current which would otherwise arc across the breaker points.

APPENDIX

COPYRIGHT FREE WORKSHEETS

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Worksheet 1: Parts of a Boat:

Use the read and learn section below to answer the following questions

1. Name the parts of the boat labelled below

   A .....

   B .....

   C .....

   D .....

2. Why must the correct motor be placed on the boat?

   .....

3. Where should the fuel tank be kept in the boat?

   .....

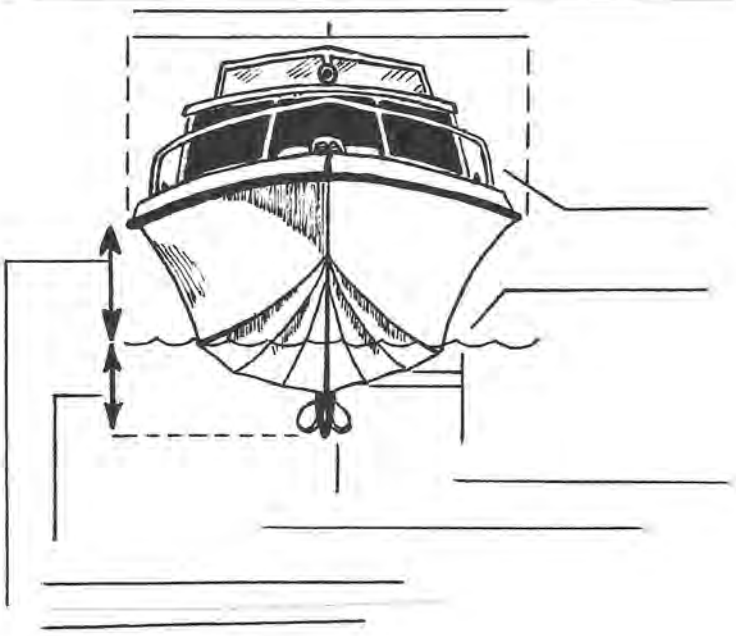
4. Draw in how the oars should be stowed.

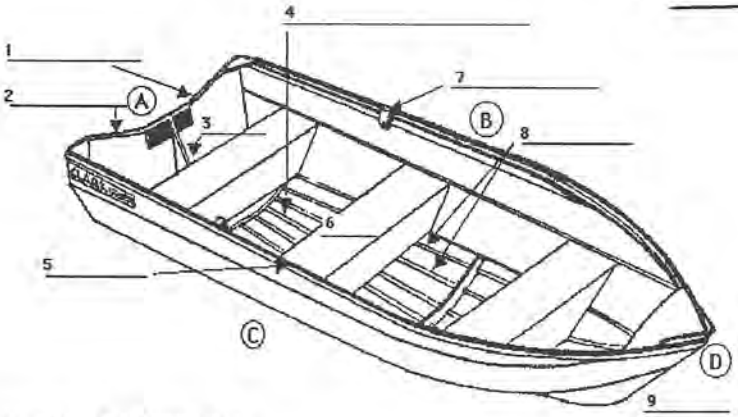
5. Three people are to be seated in the boat. Mark on the diagram their positions.

6. What coloured lights should be placed on the boat and on what side?

7. Copy the following names onto the diagrams

   * Rowlocks
   * Chain securing outboard to boat
   * Gunwales
   * Painter bollard
   * Ribs
   * Hull
   * Painter
   * Ocki strap
   * Registration sticker
   * Seat
   * Fuel tank
   * Outboard motor
   * Transom
   * Oars
   * Some names are not here





READ AND LEARN

Some notes on the parts of a boat and their functions that will help you complete the worksheet.

The left hand side is called port and the right side, starboard. The front is called the bow and the rear the stern. The strengthened section of the stern where the motor goes is called the transom. The bottom of the boat is called the hull and the pointed part which helps cut the boat through the water is called the keel. The rope which ties onto the bow of the boat is called the painter and the knob through which it is tied is called the bollard. Ribs are welded into the inside of the hull so that the hull does not break under power. The number of ribs and the strength of the welds are specific to the manufacture' s design. If a too powerful motor is put onto the boat then the ribs will break or the transom will become weakened. The fuel tank is placed nearest the motor so that it does not get in the way of the persons who are travelling in the boat. The oars are stored on top of the seats and are held by ocki straps so that they do not roll around while the boat is in progress. They contain a rowlock and a stopper which is fitted over the sleeve of the oar. They should be secured into the boat by octopus straps. In dinghies without motors, the oars are used control the boat. The oar has a grip,rowlock, rubber stopper and blade. They are mounted in the rowlock mounting brackets and stored on top of the seats with ocki straps when not in use. The registration sticker tells officers of the Department of Harbours and Marine that the boat is registered and that the fees for the year have been paid. Money from the payment of fees goes to making better boat ramps and providing navigation markers in channels for boaties to use.

WORKSHEET 2: HULL TYPES AND CONSTRUCTION

Read the information below and answer the questions over

HULL CONSTRUCTION

Boats come in a variety of shapes and sizes. Hulls can be constructed in four main ways and separated into three main categories. They can also be made of a variety of materials. This section discusses hulls.

CLINKER-BUILT

This hull is generally made of wood, gently curved, and is usually expensive and is not a normal construction method for a hull longer than about 10 metres. The planks run longitudinally from bow to stern, each overlapping adjacent planks which may be glued or copper rivetted along their sides.

CARVEL HULL

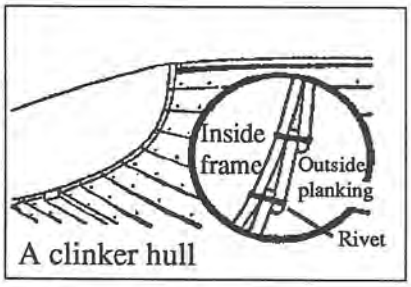
A carvel hull is also made of wood and is used for all types of boats. Because of its weight and expense, it is not usually found on a boat under 6m long intended for high speed use. The planks, running either longitudinally or diagonally from the deck to the keel, butt against each other giving a smooth finish.

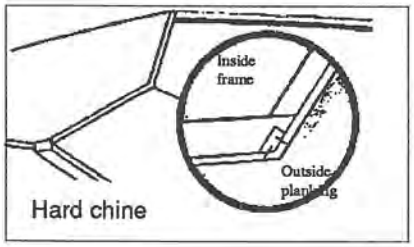
HARD CHINE

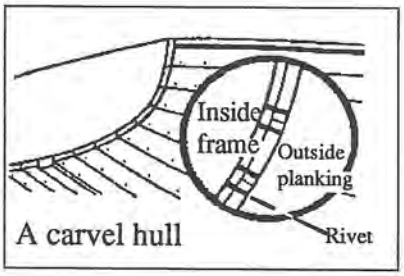
Hard chine is more an 's' shape than a method of building. Practically any material can be used, and as a shape, it is easier to construct than any other. The sides make an angle (the chine) with the bottom.

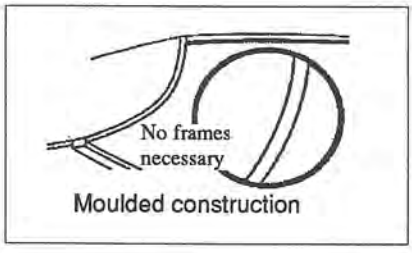
MOULDED CONSTRUCTION

Moulded construction employs metal, wood, plastic or glass fibre and is thus regarded as ideal for many of the cheaper processes of building. It can be light in weight yet strong, so a runabout will probably use this form of construction. Sheets of thin veneer, glass fibre or other plastic material are moulded and bonded together. Light and strong, this gives a smooth finish.









HULL TYPES

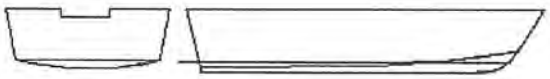
As in aircarft design there is the sound barrier, so with boats there is the 'water barrier', which, for the average runabout, might be about 5 knots

Planing hulls

That is, to attain a speed greater than 5 knots the boat must rise out of the water and plane across the surface of it, thus reducing the area of friction and drag. This makes the hull a planing hull.

Semi displacement hulls

If the design of the boat will not permit it to plane, then it becomes a displacement hull so called because it displaces its own weight of water as it moves forward.



A Planing hull

A Displacement hull

So we have two major categories of design - the displacement hull and the planing hull. Which is the better? That question brings us to the use to which you mean to put the boat.

The full-planing, hard chine hull has the advantages of speed and economy of power - but it is not a particularly sea-kindly design, and becomes hard to handle in rough weather.

The figure opposite shows the compromise known as the semi-chine, where the main advantages of the hard (good speed, power economy) chine have been maintained, together with the steadying roundness of the displacement hull.

This design is favoured by water-skiers as the boat tends to bank more on the turns, thus counter-acting the centrifugal force exerted on the stern by a skier pulled at the end of a 20m rope.

There are, too, the specialised shapes such as the stepped hull of a racing boat, which merely skims the surface of the water on two points of contact; but these, along with hydroplanes, hydrofoils and the like, are beyond the scope of this text.

Hulls can be of wood, steel, aluminium, fibre glass, rubber

The photograph below shows a large rubber boat used as a high speed ferry service between two cities.

In recent years the rubber inflatable or rubber duckie has become popular as a multipurpose boat. The Surf Lifesaving Association uses these exclusively in rescues along our coastline, because persons can be pulled from the water from almost any angle.

Complete worksheet 2. You may like to cut out a series of photographs, illustrations on boat hulls and paste them into a scrap book. You can get plenty of these from boat shows.

TYPES OF BOATS

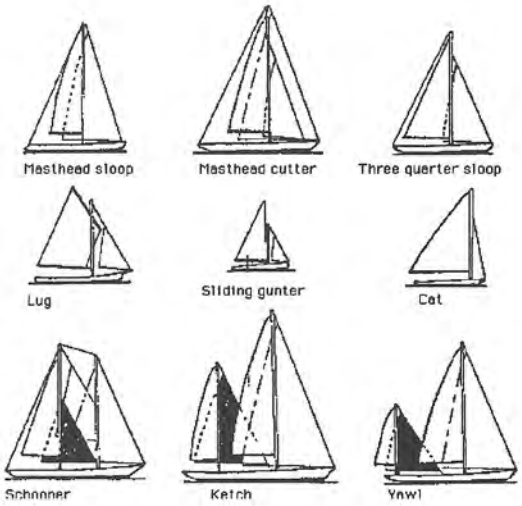
Boats can be divided in to two categories:

(a) Power and Sail

Power boats can be divided into two general categories:

(i) Launches or Runabouts, open vessels fitted with either outboard or inboard engines. Some of these are of the speedboat variety.

(ii) Motor cruisers ranging from 7m to 18m or more in length and designed for the owner who cruises, living and sleeping on board in comfort. These may be powered by either petrol or diesel inboard engines.

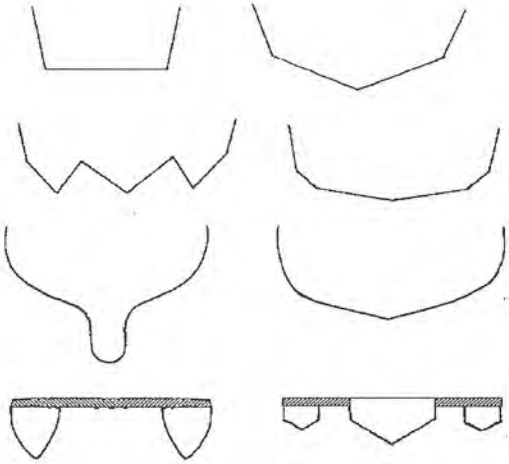


SAIL BOATS

Generally speaking, modern sailing craft can be identified by the type of sail plan they carry. The figure below shows a few different types.

Hull Types Assignment

1. Use the shapes opposite to design a cabin to fit the shape.
2. Draw the boat from a side on perspective
3. Say if the boat is planing, displacement or semi displacement
4. Predict the materials used in the boat



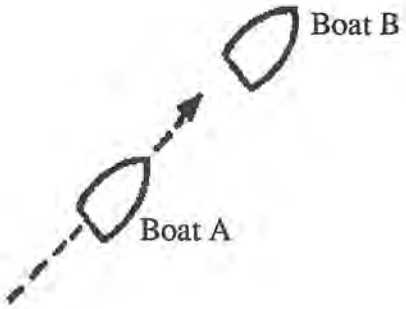
Worksheet 4: Safety rules and regulations

Study the boating safety brochure from the department of Harbours Marine and answer the following questions in the spaces below:

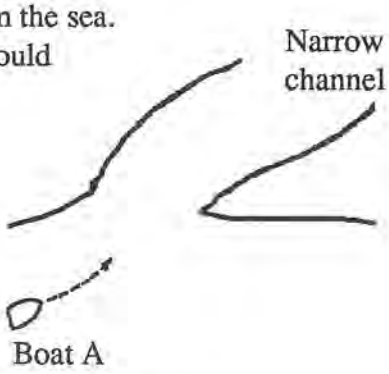
Q1. Two boats are approaching head on, right ahead. Mark what each boat should do.

Q2. Boat A wishes to pass Boat B. Mark on the diagram the possible course.

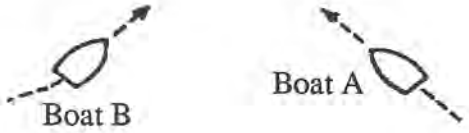
What should boat B do?



Q3. Boat A is entering a narrow channel from the sea. Mark on the diagram which side of the channel it should proceed and write a sentence why.



Q4. Boat A is leaving a channel at speed. What should boat B do?



Q5. Boat A approaches sailing boat B. What should;-

(a) Boat A do?

(b) Boat B do?

Q6. What rights do sailboard riders have?

Worksheet 4 Parts of an outboard motor: External features

Students Name:.....Teacher.....

Name all the parts of the motors below. Use the photograph to help.

DIAGRAM 1

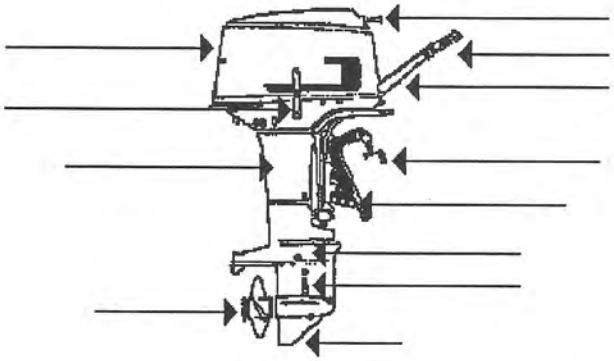
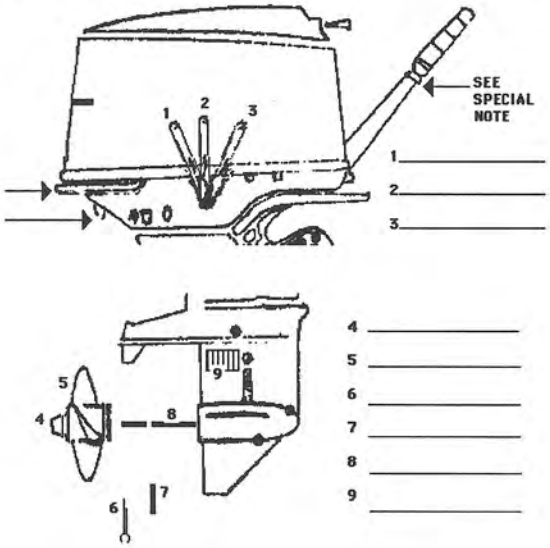


DIAGRAM 2



Calculate how much oil would be required for the following mixes:

(a) 25 Litres of a 20:1 mix
(b) 50 Litres of a 50:1 mix
(c) 100 Litres of a 100:1 mix

Name as many parts as you can on the photograph below

Worksheet 5: Pilotage, navigation lights and anchoring

PILOTAGE

Draw diagrams in the spaces below for the shapes of the lateral markers as specified and state the rule for each.

Port hand marker | Channel crossing | Starboard hand marker

Rule..... Rule..... Rule.....

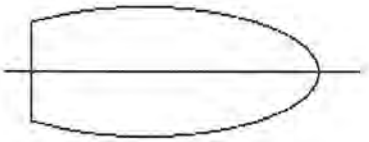
....

NAVIGATION LIGHTS

Draw the lights required for a trawler with nets out at night

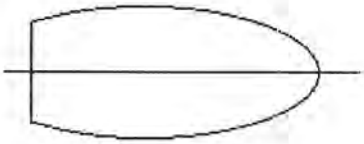
Mark in the navigation lights as per book

Length of vessel.....



Mark in the navigation lights as per book

Length of vessel.....



Worksheet 6: Anchors

Label the parts of the anchor opposite

Draw a diagram of how an anchor secures itself to the substrate

What types of anchors are used on reefs and why?

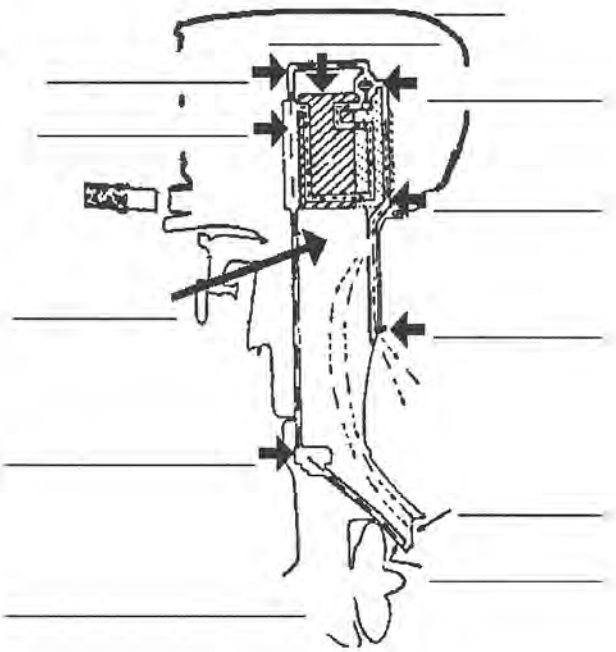
How much anchor should be let out in a storm?

What is a sea anchor and how does it work?

Worksheet 7: Cooling system research

Research the following terms and complete the diagram opposite:-

* Cowl
* Cylinder assembly
* By pass exhaust
* Cooling chamber
* Thermostatic valve that opens at a specific temperature
* Exhaust tube cooling
* Cylinder head
* Water outlet
* Underwater exhaust
* Cold water intake



Worksheet 8: The ignition system

Name the parts arrowed and state their function

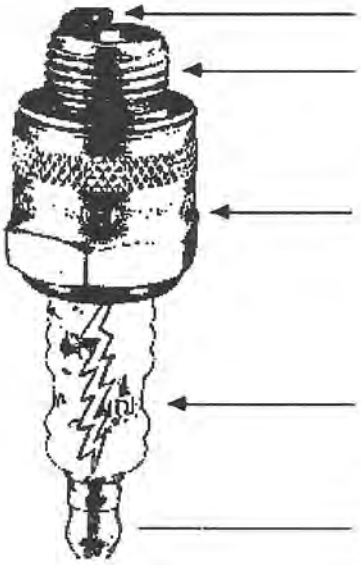
What does a electric current do when it passes through a coiled wire?

What does the term electromagnetic induction mean?

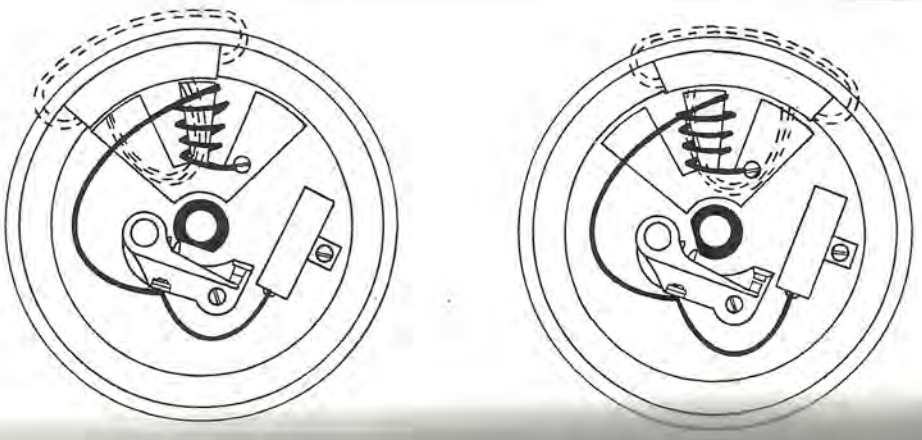
How does the field in a magneto collapse?

Why are magnets necessary in a magneto?

Complete the diagram below to correctly identify the following:



Cam
Laminated core
Magnet
Condenser
Primary winding
Breaker points closed
Breaker points open
Magnetic field



Boating Criteria Sheet

A mark of 30 would be equivalent to the standard required by a boat licence testing officer in a practical situation but you are still required to answer correctly the questions and answers in the boat licence exam. As a guide, however you should be able to

For a Very Limited Achievement

1. Tie a clove hitch and demonstrate it's use (1) .....
2. Tie a round turn and a two half hitches (1) .....
3. Tie a bowline and demonstrate it's use (1) .....
4. Tie a figure of eight and demonstrate it's use (1) .....
5. Tie a sheetbend and demonstrate it's use (1) .....
6. Tie a reef knot and demonstrate it's use (1) .....
7. Mix two stroke fuels in a given ratio (1) .....
8. Coil and use rope correctly on a trailer (1) .....
9. Row a boat in a straight line (1) .....

For a Limited Achievement

Using a boat with a 5 hp motor....

10. Mount a motor correctly and connect a fuel tank (1) .....
11. Start an outboard motor (1) .....
12. Use gears correctly (1) .....
13. Reverse out and around a buoy (1) .....
14. Steer a boat with confidence at slow speed (1) .....
15. Bring a boat back to shore correctly (1) .....

For a Sound Achievement

Using a boat with a 5 hp motor

16. Demonstrate 4 and 6 knots (1) .....
17. Demonstrate knowledge of the boating rules (1) .....
18. Steer a boat with confidence on the plane (1) .....
19. Demonstrate turns while on the plane (1) .....
20. Demonstrate crossing a wash (1) .....
21. Demonstrate increase decrease speed while turning (1) .....
22. Reverse out and perform a figure of eight (1) .....

For a High Achievement

Using a boat with a 5 hp motor

23. Make a figure of eight at speed (1) .....
24. Perform a Man over board drill (1) .....
25. Moor at a jetty, rock or buoy (1) .....

For a Very High Achievement

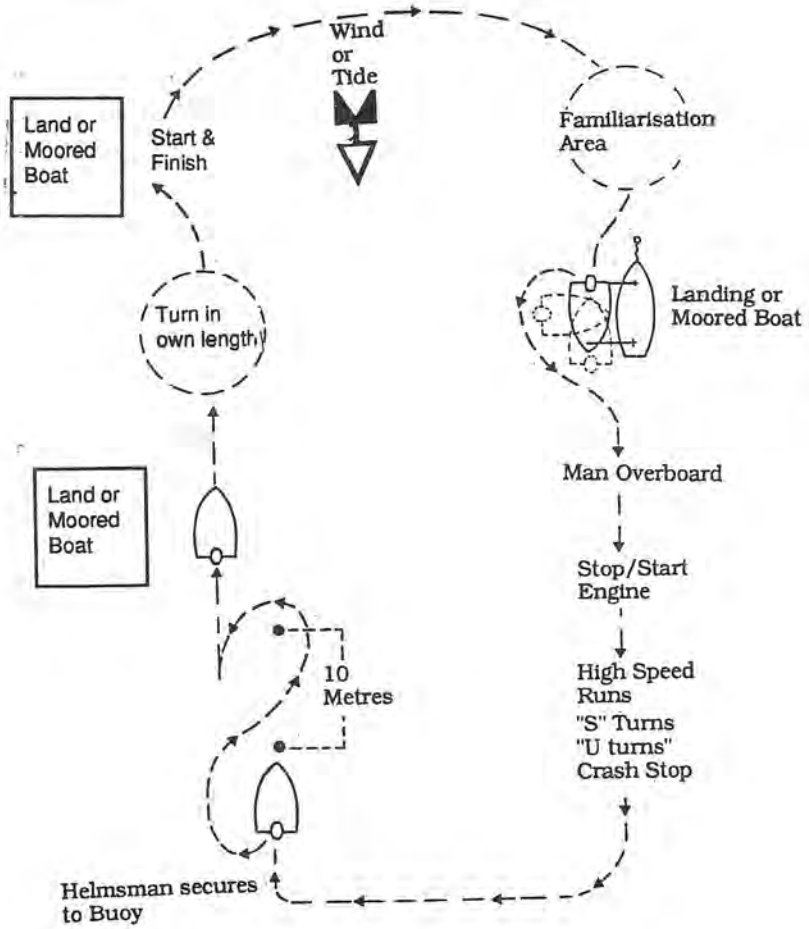
Using a boat with a >6 hp motor

26. Make a figure of eight at speed (1) .....
27. Recover an object from the water (1) .....
28. Demonstrate control in mooring at a jetty or buoy (1) .....
29. Demonstrate a crash stop (1) .....
30. Demonstrate control of keel while turning (1) .....

Marks: 30 Time: 30 minutes individual test

AUSTRALIAN YACHTING FEDERATION

POWERBOAT HANDLING CERTIFICATE - PRACTICAL TEST



BOATING CERTIFICATE

Student's Name:_____

This is to certify that the following Level of Achievement has been gained in this school's eight week boating programme.

_____

CRITERIA

Sound Achievement (Using a boat with a 5 hp motor)

[ ] Ties the following knots successfully:- a clove hitch, a round turn and a two half hitches, bowline, a figure of eight, a sheetbend, a reef knot
[ ] Coils and uses rope correctly on a trailer
[ ] Rows a boat in a straight line
[ ] Mounts a motor correctly and connecting fuel tank and all relevant parts
[ ] Starts an outboard motor
[ ] Uses gears correctly and reverses out in a figure of eight
[ ] Steers a boat with confidence at slow speed
[ ] Brings a boat back to shore correctly
[ ] Demonstrate 4 and 6 knots and all other boating rules
[ ] Steers a boat with confidence on the plane
[ ] Demonstrates crossing a wash
[ ] Answer correctly 25/30 boating fact questions from the test sheet
[ ] Apply boating knowledge to a >45% accuracy level from the licence test sheet

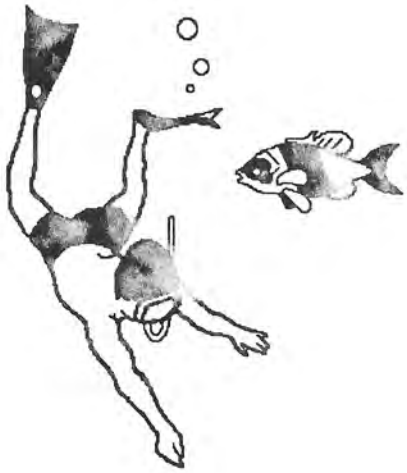
High Achievement (in addition to the above and using a 5hp motor)

[ ] Make a figure of eight on the plane & demonstrates increasing and decreasing speed while turning
[ ] Demonstates Man over board drill correctly
[ ] Moors at a jetty or buoy
[ ] Answer correctly 27/30 boating fact questions from the test sheet
[ ] Apply boating knowledge to a >65% accuracy level from the licence test sheet

Very High Achievement (in addition to the above and using a boat with a 15 hp motor)

[ ] Makes a figure of eight at speed and demonstrates increasing and decreasing speed while turning
[ ] Recover an object from the water
[ ] Demonstrates slow water control in both forward and reverse gears
[ ] Demonstrates a crash stop
[ ] Answer correctly 29 or 30/30 boating fact questions from the test sheet
[ ] Apply boating knowledge to a >75% accuracy level from the licence test sheet

Supervising Teacher: ..... Date:.....



OTHER PUBLICATIONS

CLASSROOM NAVIGATION

SNORKELLING

COASTAL STUDIES

INTRODUCTION TO BOATING

FISHERIES BIOLOGY

MARINE ENGINES

MARINE RADIO

THE BARRIER REEF WORLD

A STUDY OF SEA WATER

CAMPING

TEACHER'S GUIDES

Australian Made

A WET PAPER PUBLICATION

WET PAPER WET PAPER WET PAPER WET PAPER WET PAPER WET PAPER WET PAPER WET PAPER WET PAPER WET PAPER WET PAPER WET PAPER WET PAPER WET PAPER WET PAPER