Building
A Liftable Propulsion System
for Small Fishing Craft
THE BOB DRIVE
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for Small Fishing Craft
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by

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Bay of Bengal Programme
Madras, India
1993
INTRODUCTION

Motorization of small fishing craft has contributed considerably to fisheries development in the Bay of Bengal region over the last few decades. In Indonesia, Thailand and Bangladesh the most common engines by far for small fishing craft, are the 5 - 15 hp range of multipurpose diesel engines used for water pumps, generators, power tillers and small tractors. The advantages of this type of engine, compared with the specially marinized diesel engine, is the low cost and easy availability of both engines and spare parts.

Two methods for the installation of these engines have been developed and widely introduced.

The conventional inboard installation, where the propeller shall is fitted through the keel structure, is used in boats operating from harbours or sheltered beaches.

In the ‘longtail’ installation, the engine sits on top of the transom and the propeller shaft goes through a long tube to the propeller.

These two methods of installations are, however, not suitable for boats that have to land on surf-beaten beaches.

The Bay of Bengal Programme (BOBP) undertook a project for development of beachlanding craft and their propulsion systems in India and Shri Lanka in 1979. The main challenge was to develop a propulsion system that could be fitted to a variety of air-cooled and water-cooled diesel engines that were available locally, provide good manoeuvrability when crossing the surf, permit rapid retraction of the propeller and the rudder and be strong enough to withstand both the impact when landing on the beach and the rough handling by users.

Only outboard motors had previously proved satisfactory for surf crossing, but, except in the case of small craft, this solution had economic limitations due to its high operating cost and the short service life of the motor. Further, outboard motors have to be imported from Japan, Australia, Europe or the USA, while the multipurpose kerosene or diesel engines are now manufactured, or assembled, in many developing countries.

This manual describes the final version of the liftable propulsion system developed by BOBP and called the BOB DRIVE. The BOB Drive has undergone long-term trials in India and Shri Lanka and been found to be acceptable to fishermen operating from open surf beaches and from shallow water outlets. A variety of fishing craft, from FRP beachlanding craft and plywood canoes in India to narrow outrigger canoes in Shri Lanka, have been fitted with the BOB Drive and it has worked satisfactorily in all of them.

This manual is intended to be used by skilled mechanics in small workshops having a lathe and welding equipment. It should also be of interest to engine manufacturers, boat builders, teachers in fisheries training institutes and extension workers in small-scale fisheries.

The projects for development of fishing craft, including liftable propulsion systems for beachlanding and negotiating shallow water outlets, were sponsored by the Bay of Bengal Programme’s project “Small-Scale Fisherfolk Communities in the Bay of Bengal” (GCP/RAS118/MUL). They were executed by national fisheries institutions and BOBP in cooperation with engine manufacturers and dealers, boatyards, engineering workshops and fisherfolk.

The Bay of Bengal Programme (BOBP) is a multiagency regional fisheries programme which covers seven countries around the Bay of Bengal - Bangladesh, India, Indonesia, Malaysia, Maldives, Shri Lanka and Thailand. The Programme plays a catalytic and consultative role: it develops, demonstrates and promotes new technologies, methodologies and ideas to help improve the conditions of small-scale fisherfolk communities in member countries. The BOBP is sponsored by the governments of Denmark, Sweden and the United Kingdom, and also by UNDP (United Nations Development Programme) and AGFUND (Arab Gulf Fund for United Nations Development Organizations). The main executing agency is the FAO (Food and Agriculture Organization of the United Nations).

This manual, prepared by O. Gulbrandsen, Naval Architect Consultant, and Mr. M.R. Andersen, Small Craft Specialist, BOBP, is the result of the work done by BOBP staff, Varuna Construction & Design, Madras, fisheries officers and all those who were involved in the development and trials of the BOB Drive. It has not been cleared by the Governments concerned or the FAO.
LIST OF MATERIALS
FOR SIDE OR TOP MOUNTED ENGINE

Does not include:
(a) Alternative large rudder, page 22
(b) Freshwater cooling system and cooling oil in tunnel, pages 29, 30
(c) Seawater cooling system, page 31
(d) Forward mounted engine, chassis, flexible stuffing box and tunnel, pages 34, 35, 36
(e) Tunnel, watertight bulkhead and rudder platform, pages 23, 24, 25, 26

NOTE: Unless otherwise stated, all dimensions are in mm. If metric sizes are not available, use nearest equivalent in inches.

Abbreviations: L = Length, D = Diameter, ID = Inner diameter, T = Thickness

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<th>PAGE NOS.</th>
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<td>21,22</td>
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<td>16</td>
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<tr>
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<td>20,21</td>
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<td>Rod D = 35, L = 45 — Alternative tube ID = 24</td>
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<td>10</td>
</tr>
<tr>
<td>Propeller Shaft D = 25.4 or D = 28, L = 1470</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Tube 1/2&quot; ASTM SCH 5S, OD = 48.3, ID = 45, L = 70</td>
<td>1</td>
<td>10</td>
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<td>9</td>
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<td>25, 26</td>
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<td>4</td>
<td>18</td>
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<td>Hex Bolt M 12 x 120 — Alternative 12 x 200 for top mounted</td>
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<td>17, 33</td>
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<td>Hex Nut M6</td>
<td>2</td>
<td></td>
</tr>
<tr>
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<td>14</td>
<td></td>
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<tr>
<td>Hex Nut M 12</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Washer M 6</td>
<td>2</td>
<td></td>
</tr>
<tr>
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<td>14</td>
<td>12, 13</td>
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<td>20</td>
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<td>10, 19</td>
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<td>Spherical roller bearing SKF 22205 CC or equivalent</td>
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<td>9, 12</td>
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<td>Oil Seal OD = 47, ID = 32, B = 7</td>
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<td></td>
</tr>
<tr>
<td>Key, Stainless steel 316, 6 x 6 x 35</td>
<td>12, 13</td>
<td></td>
</tr>
<tr>
<td>Key, Stainless steel 316, 6 x 6 x 40</td>
<td>10, 12</td>
<td></td>
</tr>
<tr>
<td>Washer, Stainless steel 316, T 3, OD 32, ID 17</td>
<td>12, 13</td>
<td></td>
</tr>
<tr>
<td>Quick coupling, hydraulic 1/4'</td>
<td></td>
<td></td>
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<td>Grease gun with flexible hose and quick coupling</td>
<td>38</td>
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<td>Grease cup No. 4, 1/4' BSP</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Grease 2kg</td>
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<td>5, 11</td>
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<td>V-belt pulley for propeller shaft, cast iron</td>
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<td>5, 11</td>
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<tr>
<td>V-belts</td>
<td>1 set</td>
<td>5, 18</td>
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<td>28</td>
</tr>
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<td>Hoseclip, Stainless steel, D 190</td>
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<td>28</td>
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<tr>
<td>Rod, Copper 5x t60</td>
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<td>21</td>
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<td>Timber, heavy, sawn, 65 x 1400 (for 2)</td>
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<td>21</td>
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<tr>
<td>Timber, heavy, sawn, 40 x 200 x 1400 (for 2)</td>
<td></td>
<td>21</td>
</tr>
<tr>
<td>Timber, heavy, sawn, 32 x 200 x 450 (for 2)</td>
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<td>21</td>
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</table>
LIFTABLE PROPULSION SYSTEM - BOB DRIVE

IN NORMAL OPERATION
Advantages:
- Rapid rudder response for surf-crossing
- Variable propeller immersion in shallow areas.

IN RETRACTED POSITION
Advantages:
- Beachlanding and shallow water operation
- Propulsion in neutral without engine clutch
- Rope and fishing net entangled in propeller can be easily removed.

BEACHLANDING

RIVER OUTLET WITH SHALLOW WATER

CONVENTIONAL ENGINE INSTALLATION
Engine takes useful space midship

Deep draft and slow rudder response because of keel
BOB DRIVE

REMOVAL OF BOB DRIVE

1. Unbolt skeg and remove propeller
2. Remove engine
3. Remove pivot bolts
4. Loosen bellows hose clips
5. Slide BOB Drive forward and up

Forward

Skeg and rudder assembly

Chassis

Pivot bearer

V-belt transmission 2:1 Reduction

Bellows flange Rubber bellows

Propeller Tunnel

Horizontal cylinder water-cooled diesel engine

Rudder Skeg
DIESEL ENGINES FOR THE BOB DRIVE

WATER-COOLED

Hopper cooling: Preferred for installation in boats, because of low cost.
Radiator cooling: Can be used after modifications

AIR-COOLED

Multipurpose engines used for pumps, generators, power tillers, and tractors have the advantage of low price and availability of spare parts. The engines are single cylinder and available in the range of 4 hp to 15 hp. Kerosene engines can also be used. They are cheaper to buy, but have more operating problems because of electric ignition.

The selection of air-cooled or water-cooled engine will depend on what is available locally. Air-cooled engines are simpler, but the installation must permit a free flow of air. Single cylinder engines have strong vibration. In some engines this is compensated for by a counter rotating balancer.

SELECTION OF ENGINE POWER

Engine power is mainly dependent on the displacement (weight of boat including the normal load.)

If the displacement is not known it can be estimated by using the CUBIC NUMBER = L X B X D
Measurements are in metres

Table 1. Engine power

<table>
<thead>
<tr>
<th>Cubic number L X B X D (m³)</th>
<th>Displacement kg</th>
<th>Installed continuous hp</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>500</td>
<td>3</td>
</tr>
<tr>
<td>10</td>
<td>1000</td>
<td>6</td>
</tr>
<tr>
<td>15</td>
<td>1500</td>
<td>9</td>
</tr>
<tr>
<td>20</td>
<td>2000</td>
<td>12</td>
</tr>
<tr>
<td>25</td>
<td>2500</td>
<td>15</td>
</tr>
</tbody>
</table>

Note: Engine power (hp) is for continuous output.

The speed obtained under normal wave conditions with the installed engine power shown to the left and assuming that the engine is operated at 3/4 power, will mainly depend on the length of the boat (L)

<table>
<thead>
<tr>
<th>Length (L) metre</th>
<th>Speed in knots</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>5.2</td>
</tr>
<tr>
<td>7</td>
<td>5.6</td>
</tr>
<tr>
<td>8</td>
<td>6.0</td>
</tr>
<tr>
<td>9</td>
<td>6.3</td>
</tr>
<tr>
<td>10</td>
<td>6.7</td>
</tr>
</tbody>
</table>
THREE WAYS OF MOUNTING
THE ENGINE

Side mounted engine is the best method. It gives more space for passage on one side and easy belt tensioning.

Side mounted engine

Top mounted engine is mainly used in narrow canoes.

Top mounted engine

Forward mounted engine can be used when the engine has a reduction gear or a camshaft drive (2:1 reduction). This installation requires more space in the boat and a bigger rubber bellows.

Forward mounted engine
SELECTION OF V-BELT TRANSMISSION.

The diameter of the V-belt pulley fixed to the propeller shaft is the same for all engines: D = 200 mm (8"").

The diameter of the V-belt pulley fixed to the engine: A section belt D = 100 mm (4") Reduction ratio = 2 : 1
B section belt D = 125 mm (5") Reduction ratio = 1.6 : 1

Table 2. V-belt transmission

<table>
<thead>
<tr>
<th>V-belt section mm</th>
<th>Engine pulley Pitch diameter mm</th>
<th>ENGINE POWER Continuous hp</th>
<th>NUMBER OF BELTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Engine RPM</td>
<td>2200</td>
</tr>
<tr>
<td>A</td>
<td>100 (4&quot;)</td>
<td>4</td>
<td>2 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>2 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
<td>3 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7</td>
<td>3 A</td>
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<td></td>
<td></td>
<td>8</td>
<td>4 A</td>
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<tr>
<td></td>
<td></td>
<td>9</td>
<td>4 A</td>
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<tr>
<td></td>
<td></td>
<td>10</td>
<td>4 A</td>
</tr>
<tr>
<td>B</td>
<td>125 (5&quot;)</td>
<td>11</td>
<td>3 B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12</td>
<td>4 B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>13</td>
<td>4 B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14</td>
<td>4 B</td>
</tr>
</tbody>
</table>

SELECTION OF PROPELLER

Engine turns to the left when seen from forward ( anti-clockwise )
Reduction ratio = \( \frac{d_1}{d_2} \)

CHECK PROPELLER ROTATION:
In this case the propeller turns to the right when seen from aft
The propeller is RIGHT HANDED ( Turning clockwise )

EXAMPLE
ENGINE: Horizontal cylinder engine turning left when seen from the flywheel end ( power take off ).
ENGINE CONTINUOUS POWER: 90 hp at 2200 rpm
V-BELT TYPE: A section V-belt. Number of belts, 4. Pulley diameter = 100 mm. ( from Table 2 ) Reduction ratio = 2 : 1
PROPELLER RPM: Engine rpm / 2 = 2200 / 2 = 1100 rpm.
PROPELLER ROTATION: Right handed.
PROPELLER: Diameter = 15 inch. Pitch = 10 inch. Three-bladed. Blade area ratio = 0.35 - 0.50. ( From Table 3 )

Table 3. Propeller

<table>
<thead>
<tr>
<th>ENGINE CONTINUOUS POWER HP</th>
<th>DIAMETER x PITCH ( inches ) versus PROPELLER RPM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1000</td>
</tr>
<tr>
<td>4</td>
<td>13 x 10½</td>
</tr>
<tr>
<td>10</td>
<td>14 x 10½</td>
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<tr>
<td>16</td>
<td>15 x 10</td>
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<tr>
<td>20</td>
<td>16 x 10</td>
</tr>
<tr>
<td>25</td>
<td>17 x 10</td>
</tr>
<tr>
<td>30</td>
<td>18 x 10</td>
</tr>
</tbody>
</table>
MEASURING PROPELLER DIAMETER AND PITCH

Propeller diameter and pitch are usually given in inches.

The propeller diameter and pitch are often stamped on the propeller boss. In this case, 13x9 means:
- Propeller diameter = 13 inches
- Propeller pitch = 9 inches

Propeller diameter is calculated by first measuring the radius in this case, the radius = 165 mm.

\[
\frac{330\text{ mm}}{25.4} = 13\text{ inches}
\]

The propeller pitch is a measure for how far forward the propeller advances when making one turn. The propeller pitch is measured as follows:

1) Measure the distance from the propeller centre to the widest part of the blade. Choose a round figure. In this case, A = 110 mm.

2) Make a mark at the edge of the propeller blade as shown. Use a square to get accurate marks on the lowest part of the blade as shown in the top figure.

3) Place the propeller on a flat table or a piece of plywood with the propeller boss touching the table, not the blades.

4) Use a ruler or a straight edge minimum 30 cm long. Place it on top of the propeller blade alongside the two marks and with the corner of the ruler touching the table.

5) Measure distances B and C at any convenient point along the ruler. In this case, B = 90 mm, C = 275 mm. Calculate the pitch:

\[
PITCH = \frac{A \times B}{4 \times C} = \frac{110 \times 90}{4 \times 275} = 9\text{ inch}
\]

Note: A, B and C must be in mm.
BOB DRIVE COMPONENTS

These components are common for all engine mountings

- Tiller
- Rudder wood block
- Lock pin
- Rudder
- Propeller
- Stern tube with propeller shaft
- V-belt pulley
- Bellows flange
- Rubber bellows
- Bellows ring
- Forward mounted engine needs bigger bellows and bellows flange
- Pivot
- Pivot bearer
- Pivot fittings
- Speg

FORWARD MOUNTED ENGINE
SIDE MOUNTED ENGINE
TOP MOUNTED ENGINE

The chassis are different
MANUFACTURE OF BOB DRIVE COMPONENTS

Cut from a mm MS plate

FLANGE

BEARING RETAINER

Machine from MS 15x100x120

Drill holes Ø10 in flange and bearing retainer at the same time. Then increase holes in flange to Ø12.

Stern tube and skeg tube are made from the same tube: OD = 60.3, ID = 47.7, Wall thickness = 6.3. Other tubes can be cut from stainless steel. Inside diameter ID = maximum 48.

CUTTING STERN TUBE

* Including 5mm for machining of the ends

WELDING ON FLANGE

The flange must be welded on the tube before machining the tube because of welding distortions.
**Stern Tube Forward End**

- OD = 13.5
- ID = 7.7
- L = 20

For easy access to grease coupling, length of pipe should be increased for top mounted engine.

**Oil Seals**
- OD = 4.7
- ID = 32
- B = 7

**Oil Seal Housing**
- Mild steel

**Spherical Roller Bearing**
- SKF 22205 CC or equivalent

---

**Stern Tube Aft End**

A - Medium drive fit for stainless steel liner

Stainless steel liner is ASTM 1/4” SCH 5S
Other dimensions that will fit inside the stern tube can also be used.

Bearing locking bolt fixed later (page 19)

Grease groove 2 mm

**Bronze Stern Bush**

- B = Locational clearance fit inside stainless steel liner
- C = Dependent on propeller shaft diameter = D
- For free running fit: C = D + 0.10–0.20
**PROPELLER SHAFT**

Material: Stainless steel 316

The diameter $D$ of the propeller shaft is dependent on what is available. If 25mm diameter shafts are slightly undersize, the roller bearing will not fit. Shafts of $D = 25.4$ mm (1") or 28 mm are acceptable.

**FORWARD END**

- Keyway $3 \times 6 \times 35$
- $M_{16}$ (5/8"

**THRUPT COLLAR**

Stainless steel

**AFT END**

- Keyway $3 \times 6 \times 40$
- $M_{16}$ (5/8"

**SPACER**

Stainless steel

**PROPELLER**

Propeller boss

Note gap 3-5mm

Some propeller bosses are longer than standard

60 (ISO standard)

**TAPER ON PROPELLER SHAFT**

ISO STANDARD $= 1:10$

**GREASE RETAINER**

Material: Bronze

- Propeller boss
- Stern bush
- The grease retainer is brazed to the propeller

To obtain the correct length of the grease retainer the stern gear must be assembled as shown on pages 12 and 13. The gap between the propeller and the stern bush is measured $G$. 

$D = 25.4$ mm (1")
V-BELT PULLEYS

Chapter 5: Belts and Pulleys

For selection of belt type and pulleys, see page 5.

Minimum clearance between flywheel and first belt.

4-A-BELT SMALL PULLEY
FOR BOLTING TO FLYWHEEL

3-A BELT SMALL PULLEY
FOR MOUNTING ON STUB SHAFT

3-BELT SMALL PULLEY WITH ONE A-BELT
FOR DRIVING WATERPUMP
Boss = 50 for all pulleys

3-A BELT LARGE PULLEY
FOR MOUNTING ON PROPELLER SHAFT

B-SECTION, SMALL PULLEY

A-SECTION
SMALL PULLEY

B-SECTION, LARGE PULLEY

A-SECTION
LARGE PULLEY

B-SECTION, SMALL PULLEY

A-SECTION
SMALL PULLEY

B-SECTION, LARGE PULLEY

A-SECTION
LARGE PULLEY

Dimensions and design details are shown in the diagrams.
STERN GEAR ASSEMBLY

1. Shaft assembly - Items 1-10. Apply a lot of grease to the bearing.
3. Insert shaft assembly into stern tube assembly. Do not use force when pushing Items 10 and 3 into stern tube. Tighten evenly on flange bolts.
4. Fix items 14-17.

1. Propeller shaft
2. Thrust Collar. If no step in shaft, fix collar with spot weld.
3. Bearing
4. Spacer
5. Bearing retainer
6. Key
7. Pulley
8. Washer t=3
9. Nuts
10. Oil seal housing
11. Stern tube
12. Stainless steel liner
13. Bronze bush
14. Grease retainer brazed to propeller after complete assembly
15. Propeller
16. Key
17. Nuts

Grease quick coupling 1/4". Fill stern tube with grease after completion of BOB Drive.

Studs 10x50 welded to 5.
CHASSIS - SIDE MOUNTED ENGINE

Steel plate 6 mm

FRONT PLATE

BRACKETS

BELLOWS PLATE

Without keel cooling coil in the tunnel, the bellows plate can be 220 wide.

MAKE PATTERNS FOR ALL PARTS FOR BETTER STEEL UTILIZATION

Flat iron 6 x 50

Distance between engine bolts = A + 4.20

KNEE PLATES
PIVOTS WELDED TO BRACKETS
Weld on both sides

FLAT IRON 6 x 50
WELDED TO FRONT PLATE
AND BRACKETS

SMALL KNEE
**Bellows Flanges**

**Alternative 1**
- Stainless steel Ø 6
- Tack weld
- Stainless steel 3x40
- Ø 180

**Alternative 2**
- Outside diameter = 180
- Note widest part of flange on this side
- Drill holes Ø 11.

**Bellows Plate**

**Front Plate**

Bellows ring positioned about 5 mm from top and bottom edge of front plate.
ENGINE MOUNTS

1. Bolt the engine to the two engine mounts.

2. Place the engine with mounts on the chassis.

3. Keep distance 45 mm from end of flat iron and align it along the flat iron.

4. Shim up under engine mounts where required.

5. Tack weld the engine mounts to the chassis.

6. Remove engine and weld.

7. Weld nuts M12 (1/2") on top of piece 20x20x40 to permit shifting the engine for belt tensioning. Bolts M12x120
1. Assemble the stern tube with propeller shaft, bearings and pulley.
2. Insert the stern tube through the hole in the front plate.
3. Bolt the engine to the chassis.
4. Align the pulleys carefully.
5. Support the stern tube and weld.

Check that there is no gap here.

Steel ruler

6. Weld brackets.

Brackets See page 14

Brackets
SKEG

For 15" propeller diameter.
See plywood pattern for propellers of other diameters.

100 106 260

To suit Nose cone.

106 290

CUTTING OF FLAT IRON 15x100

The pattern shown is for a propeller diameter of 15". For different propellers, raise or lower the bottom line 12 mm for each 1" difference in diameter.

PLYWOOD PATTERN

156

15.5

9" prop 2

30

15" prop

17" prop 263

Plate 6 welded to end

End of stern tube with bearing

SEEN FROM AFT FLANGE OFFSET 7 MM

Bearing locking bolt Stainless M10x30
Weld one nut to stern tube

Locknut Ø16.5

Grind forward edge

Bracket

Skeg

1. Tack weld temporarily the skeg and the bracket together
2. Drill holes Ø 16.5
3. Bolt skeg and bracket together
4. Align stern tube with skeg and bracket
   Note that bracket is off centre on stern tube
5. Weld bracket to stern tube. Weld in steps and keep stern tube cool to avoid welding distortions
**ALTERNATIVE LARGE RUDDER**

**FOR USE IN SURF LANDING WHEN HIGH MANOEUVRABILITY IS REQUIRED.**

**STAINLESS STEEL FLAT IRON 4 x 30**

Stainless steel tube
ASTM 1/4", SCH 10S, TP 316 L
OD = 42.2 t = 2.77
or nearest available

**HEAVY STRONG WOOD**

**THICKNESS = 45**

**THICKNESS = 38**

**THICKNESS = 35**

**PATTERN FOR RUDDER BLADE**

Stainless steel pipe
OD = 19, ID = 13
weld to tube

M6x70

Stainless steel rod
Φ12x200.

Washer welded on

Wood pieces 35 thick to maintain distance while welding

Bolt 10x52
Rivet over nut after fixing rudder blade

Stop wood block
(see page 27)

Drill hole for locking pin with rudder in upper position on the boat

STOP 105
From centre of tube

105

75
Inclined transom

The propeller must not touch the transom in upper position

900

500

Watertight bulkhead

Bellows frame

The skeg must be above the bottom

BELLOWS FRAME

Cutout in frame = 100 for all installations

Add piece if required

* The width of the tunnel measured on the inside will depend on whether cooling coil for the water cooling system is placed inside the tunnel.
The inside width of the tunnel:
With cooling coil = 130 mm
Without cooling coil = 100 mm

In wooden boats place the tunnel on the side to avoid weakening the keel
TUNNEL

Top 20mm Thickness
Screwed off

35x35

Plywood 9 mm
or planks 15 mm

45x45

Without cooling coil = 100

Intermediate frame if required

Use bitumastic compound and strips of nylon flyscreen in all joints

Bolt on the rubber bellows flange M12x100

Water drain

Pretabricate the sides
WATERTIGHT BULKHEAD

The dimensions must be respected to permit removal of the BOB Drive.
RUDDER PLATFORM

Rudder bearing 35x140

Inclined transom

Adjust hole in rudder bearing

Bolt M10

Jam cleat, long end towards rudder

JAM CLEAT

Bolt M8 x 75

Lifting rope Ø 10

Rounded hole

1. Take rope around short end
2. Jam rope under long end

Removable lid

With a plate put up against the bottom there must be a clearance of 50 mm to the tip of the propeller
ALIGNMENT OF BOB DRIVE

PROCEDURE
1. Insert stern tube through bellows flange as shown on page 25
2. Fix propeller, skeg and rudder
3. Place pivot bearings on top of pivot bearings
4. Block up the pivot bearings and support the skeg so that the following measures are respected:
   A. A gap of 10 mm between the stern tube and the bottom of the bellows flange hole
   B. A distance of 60 mm between the bellows ring on top
   C. A distance of 50 mm between the tip of the propeller and an extension of the bottom of the boat (see page 26)
5. Raise the rudder and check that the stern tube has correct clearance to the tunnel sides in upper position
6. Drill for the fixation bolts of the pivot bearings and pivots
7. Drill the hole for the stop block pin in the rudder stock.

LUGS FOR PIVOT BEARERS

Thickness = 8

Bolt M10x75 with washer T=4 against wood

Pivot bolts stainless steel M10x40 with double nuts
**MATERIAL : NEOPRENE**

The bellows should be protected against direct contact with grease, oil, and diesel by tying a sheet of plastic over the top half. This is especially important where the engine is mounted above the bellows.

**ANTI-CORROSION TREATMENT**

**BEST PROTECTION RECOMMENDED WHEREVER POSSIBLE**

1. Sand blasting
2. Zinc spraying
3. Two coats of enamel paint

For sand blasting and zinc spraying, plug ends of stern tube and pivot bearings.

**MINIMUM PROTECTION**

1. Wire brushing to remove rust
2. Two coats of anti-corrosive primer
3. Two coats of enamel paint.
FRESHWATER COOLING SYSTEM

Freshwater cooling will give a longer life to the engine than seawater cooling, and will prevent problems due to sand getting into the engine when surf crossing and beach landing.

**EXAMPLE 1:** Converted hopper cooled engine with pump driven from pulley bolted on the flywheel.

- Plate cover bolted over the hopper.
- Combined pulley. See page 11.

The pump can be a centrifugal pump or a rubber impeller pump. Choose if possible a pump recommended by the engine manufacturer. The pulley size must give the correct pump speed.

**EXAMPLE 2:** Converted radiator cooled engine with pump driven from radiator fan pulley.

- Freshwater tank 6 litres painted blue. The tanks are separate but tack welded together in the corner.
- Fuel tank 12 litres painted red.

- Shaft ø 32 welded to bracket. The bush can be rotated on the shaft to tighten the V-belt. The V-belt is long enough to go over the flywheel.

- To cooling coil.

- The radiator has a short life in a marine environment. In this example the radiator and fuel tank have been removed and replaced by engine mounted freshwater and fuel tanks made from stainless steel. The fuel tank can also be bolted to the side of the boat.

- To engine.

**Example:**

The centrifugal pump from a small tractor is driven by the radiator fan pulley behind the flywheel. A new pump backplate is welded to the bush.
The cooling coil is fixed on the port side in the tunnel as low down as the inside structure allows.

Copper tube OD=16 Length approximately 100 mm per engine hp (10 Hp=1000 mm) but this also depends on the pump. Temperature of water should be 80°C.

The tunnel must give sufficient clearance between cooling coil and stern tube.

SKIN FITTING FOR COOLING COIL

Material: Bronze

Hose ID=19

SS Hose clip

Braze

Copper tube OD=16

Copper tube OD=20 Length=60

Nut Ø32

Thread M33×1.5

Bitumastic compound and nylon fly screen for water tightness.
SEAWATER COOLING SYSTEM

This system is not suitable where there is sand mixed in the seawater (surf crossing and beach landing).

TUNNEL MODIFICATIONS

The tunnel must be higher to give sufficient clearance. This section must be unbolted to be able to remove the BOB Drive.

Tube 00-20
Placed below top of stern tube and as close as possible.

See detail *

Front plate
Stern tube
WIDTH REQUIREMENTS FOR INSTALLATION

SIDE MOUNTED ENGINE

The side mounted engine gives a low installation with passage on one side.

Note that the tunnel is not on centre.

TOP MOUNTED ENGINE WITH NARROW BASE

This is the only installation possible in a narrow canoe.

TOP MOUNTED ENGINE WITH A WIDE BASE

The wider base gives less force on the pivots and should be used whenever the width of the craft allows.

Note that the tunnel is not on centre.
CHASSIS - TOP MOUNTED ENGINE

1. FRONT PLATE
   - STEEL PLATE - 6mm
   - Maximum: 500
   - Minimum: 320

2. BRACKETS
   - 2 pieces
   - Φ20-
   - 80
   - 100

3. FLAT IRON: 6×50
   - A = Distance between engine bolts
   - A = 250
   - A = 160
   - Maximum: 309
   - Minimum: 129

4. BRACKET (short base only)
   - 125
   - 50 25 50
   - 10

5. ENGINE MOUNT: 20×40
   - 2 pieces

ASSEMBLY
1. Tack weld (5) to (3) and (4)
2. Bolt engine to (6) in extreme right position
3. Place engine on chassis and move until the pulleys are in a vertical line
4. Tack weld (3) and (4) to (1) and (2) and stern tube
5. Remove engine

6. Weld brackets to stern tube and assembly.

If there is insufficient space to use a 12×180 bolt, use a block of wood and a wedge to shift the engine.
CHASSIS - FORWARD MOUNTED ENGINE

FRONT PLATE 6mm

BELLOWS PLATE 6mm

KNEE (2) 6mm

If distance B is greater than 110, engine bed like this.

Pivots will be raised to get sufficient height for the pivot bearing above the bottom.

Stern tube OD=60.3 t=6.3
length=1430

6x40x70

Loose steel shims (4)

12x50 steel plate

ASSEMBLING PROCEDURE

1. Bolt engine to 12x50 flat iron with 4mm steel shims.
2. Tack weld 12x50 flat iron to frame (6x40x70)
3. Align engine to propeller shaft. Tack weld frame to front plate and knees.
4. Remove engine and weld assembly.
TUBE OD=13.5
10=1.7
L=40
To fit 1/4” quick coupling

Hydraulic hose ID=50
length=55

Propeller shaft=Ø25
length=1490

Washer 3 thick

Packing 8 x 8
3 rings

Coupling to fit engine

Steel tube
OD=60.3 t=6.3
length=1150.

IMPORTANT: When aligning engine. Loosen hose clip and move stuffing box so that a temporary block will center the shaft in the tube.

1 EXTENSION SOCKET
M.S.

2 STUFFING BOX
Brass

3 PACKING CAP
Brass

Grease grooves

PROPELLER SHAFT
Taper=1:10

LOCKING PLATE
M.S.

FORWARD MOUNTED ENGINE-FLEXIBLE STUFFING BOX

35
TUNNEL-FORWARD MOUNTED ENGINE

The minimum height of the tunnel is 340mm but might have to be higher to obtain sufficient clearance between chassis and bottom. See page 23 for width of tunnel. See page 27 for requirement in lower position. Note however that due to the greater bellows the gap between the bellows rings should be B=90 on top.

ALTERNATIVE BELLOWS

Material: NEOPRENE

Thickness: 3.4 mm
ENGINE PROTECTION

WATER-COOLED ENGINE

Below is shown an engine compartment for a side mounted engine.

The whole engine cover is removable for major repairs.

The lid provides access to engine for starting and maintenance. Lid can be kept half open when engine is running.

Watertight bulkhead with screwed on section for removal of BOB Drive.

Box open on one side allows movement of extended exhaust pipe during tilting engine.

AIR-COOLED ENGINE

Cover for crossing heavy surf and protection of engine ashore

Box for exhaust

The engine installation must permit free flow of air in normal operation.

For surf-crossing where some protection is required, a raised coaming with a lid can be used. Lash down with rope.
MAINTENANCE

DAILY
1. Oil dipstick: check oil level and refill.
2. Grease gun with quick coupling.
   Check that grease is emerging at the propeller.
3. Check freshwater level and carry spare can of freshwater for refilling.
4. Fuel level: Check level and carry extra fuel in spare can.
5. Tool kit: Always have it on board.

AT REGULAR INTERVALS
6. Belts: After tensioning if some belts are slack, change all belts at the same time.
   Never run with less belts than specified.
7. Sump in fuel tank: Drain dirty fuel.
8. Fuel filter and water separator: Cleaning and replacement as appropriate.
9. Engine oil: Change every 100 hours.
10. Air filter: Clean or change according to manufacturer's instructions.
11. Filt pump: Clean and spray engine with diesel, using it.

Note: Apply grease on to bolts and nuts and other parts subject to corrosion.

REMOVAL OF PULLEY
Do not use a hammer.
Bolts M10 through holes in pulley (see page 11).
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Top mounted VST air-cooled diesel engine BOB Drive

Top mounted VST air-cooled diesel engine BOB Drive installed in BLC IND-25
6.7 m FRP beachlanding craft, IND-25, fitted with top mounted VST air-cooled diesel engine
BOB Drive

8.5 m timber outrigger canoe, SRL-18A, fitted with top mounted Yanmar air-cooled diesel engine
BOB Drive
Forward mounted Lombardini air-cooled diesel engine
BOB Drive installed in FRP beach nava

9.1 m FRP beach nava fitted with forward mounted Lombardini air-cooled diesel engine
BOB Drive

(42)
Side mounted VST water-cooled diesel engine BOB Drive

Side mounted VST water-cooled diesel engine BOB Drive installed in plywood canoe
8.5 m plywood canoe, IND-28A, fitted with side mounted VST water-cooled diesel engine
BOB Drive

8.5 m FRP beachlanding craft, IND-20, fitted with side mounted VST water-cooled diesel engine
BOB Drive
The Bay of Bengal Programme (BOBP) undertook a project for development of beachlanding craft and their propulsion systems in India and Shri Lanka in 1979. The main challenge was to develop a propulsion system that could be fitted to a variety of air-cooled and water-cooled diesel engines that were available locally, provide good manoeuvrability when crossing the surf, permit rapid retraction of the propeller and the rudder and be strong enough to withstand both the impact when landing on the beach and the rough handling by users.

This manual describes the final version of the lifttable propulsion system developed by BOBP and called the BOB Drive. It is intended to be used by skilled mechanics in small workshops having a lathe and welding equipment. It should also be of interest to engine manufacturers, boat-builders, teachers in fisheries training institutes and extension workers in small-scale fisheries.