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IDENTIFICATION MARKS — Page 3

1. Engine unit - 2. Borg-Warner reducing gear - 3. Injection pump. When entering into correspondence : requesting information ; ordering spare parts.

The references shown on plates 1-2-3 in the illustration must be stated.

GENERAL SPECIFICATIONS — Page 4

Engine	RC 90 DS
Basic engine	SAVIEM
Type	720
Cycle	4-stroke
Number of cylinders	4
Injection system	Direct type M
Injection advance	23° before TDC
Power output (SAE)	80 HP
Bore	102 mm
Stroke	110 mm
Total cubic capacity	3 600 cm^3
Compression ratio	17.5 to 1
Injection order	1 - 3 - 4 - 2
Injection pressure	175 bars
Tickover speed	700 rpm
Maximum speed :	
No load	3 300 rpm
Under load	3 000 rpm
Cruising speed	2 800 rpm
Lubrication	Under pressure
Cooling	Double circuit with heat exchanger
Overloading	Automatic
Maximum slope angle	15°
Direction of rotation	

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Make	Borg-Warner.
Type	Hydraulic 71 C.
Reduction ratios :	
Anti-clockwise direction (1)	1/1 - 1/1.5 - 1/2 - 1/2.5 - 1/2.9.
Clockwise direction (1)	V/drive 1/1.9.

(1) Propeller rotation is considered seen from the REAR of the boat.

OPERATING

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• **INSTRUMENT PANELS**

— **Basic module**

M. I 12 V : 674 125.
24 V : 674 114.

1. *Voltmeter.*
2. *Hour counter.*
3. *Oil pressure.*
4. *Ignition switch.*
5. *Starter.*
6. *Pre-heating (if any).*
7. *Instrument panel lighting.*
8. *« Stop » switch.*
9. *Oil pressure warning light.*
10. *Water temperature warning light.*
11. *« On » warning light.*

— **Tachometer**

M. II 12 V : 674 112.
24 V : 674 120.

1. *Tachometer.*
2. *Navigation lights.*
3. *Navigation lights.*

— **Water temperature gauge**

M. III 12 V : 674 113.
24 V : 674 121.

1. *Water temperature.*
2. *Navigation lights.*
3. *Navigation lights.*

Note : *M. I : Module I.*
M. II : Module II.
M. III : Module III.

Using the different modules here shown on the left, the following combinations may be obtained :

ON 12 VOLTS :
N° 1 (utility) : 674 125.
N° 2 : 674 125 + 674 113.
N° 3 (de luxe) : 674 125 + 674 112.
N° 4 : 674 125 + 674 112.

ON 24 VOLTS :

N° 1 (utility) : 674 114.
N° 2 : 674 114 + 674 121.
N° 3 (de luxe) : 674 114 + 674 120 + 674 121.
N° 4 : 674 114 + 674 120.

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• **RUNNING IN**

Prior to being delivered, the engines are partly run in on RENAULT marine COUACH test benches. During the first 20 hours they are run at the following speed : 2 300 rpm whilst accelerating from time to time for 5 minutes at 2 500 rpm.

For the next 30 hours, the engines can be used at : 2 500 rpm with a few accelerations at 3 000 rpm.

Over and above 50 hours, the engines may be used at any speed.

As a general rule, and for safety reasons, maximum speed should not be maintained for more than one hour.

• **PRELIMINARY STARTING INSTRUCTIONS**

— *Open the sea water inlet valve.*
— *Switch battery on.*
— *Check fuel level.*
— *Using dip gauge, check engine oil level* [fig.1].
— *Using plug dip gauge, check oil level in reversing-reducing gear* [fig. 2]
— *Check the fresh water level through plug* [fig. 3].
— *Purge the fresh water system (see para. purge and fig.).*
— *Purge the fuel system (see purge chapter).*
— *Place reversing gear in neutral.*

Note. — *It is recommended that the fuel tap should only be closed in case of extreme necessity.*
Careful : *If the boat has run aground make sure that the strainer is immersed and not clogged.*

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• **STARTING UP**

When the checks have been done :
— *Place the gas control to MAXI.*
— *Switch on (instrument panel).*
— *Make sure « STOP » control is not pulled out.*
— *Press starter button.*
— *As soon as engine starts, release the button.*

Warning : *Never press button for more than 4 to 5 seconds when starting. To help starting in cold weather, use a starting agent sprayed into the inlet tube whilst turning the engine over with the starter motor.*

• **STOPPING ENGINE**

— *Put reversing lever into neutral.*
— *Bring engine to tickover and then let it run for a few moments so as to stabilize the temperature.*
— *Pull the stop control.*
— *Turn ignition switch off.*
— *Switch off battery.*

TECHNICAL ENGINE DETAILS

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• LUBRICATION SYSTEM

Engine :

Pressure feed using rotary pump.
Minimum pressure at tickover :
0.5 kg/cm²
Pressure at maximum speed :
3.5 to 4.6 kg/cm² ± 1
System capacity : 9 L.
Sump capacity : 7.5 L.
Filter capacity : 0.5 L.
Cooler capacity : 1 L.

Grade of oil :

Summer : ELF performance 30.
Winter : ELF performance 20.

Filling with oil :

This is done through the filling hole in the rocker cover.
Remove the plug [fig. 4].
Pour in the required quantity of oil.
— Wait a few moments for the oil to run down into the sump.
— Check level with dipstick fig.
— Put plug back.

Careful : *Do not go beyond maximum level of dip-stick. Too much oil may lead to a loss of power and too much smoke in the exhaust fumes.*

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Draining :

Draining must always be carried out when oil is hot using the drain pump [fig. 6].

Oil dip-stick :

This is marked according to the different possible slants of engine. The oil level can be marked as a function of the slant of the chosen engine.

• OIL FILTER [fig.7]

Every 100 hours change the filter element for a new one.
— Slacken off the screw (1).
— Clean the bowl using fuel-oil.
— Check condition of gasket (2) and if necessary, change it.
— Check sleeve tightness.
— Fit parts together making sure gasket is correctly positioned.

• FUEL SYSTEM

The system comprises :
— One or more tanks.
— A dash tank (for twin engines).
— A decanting filter.
— An engine mounted filter and pre-filter.
— A feed pump.
— An injection pump.
— 6 injectors.
— An injector leak return system.
Injector rating 190 bars.

Filling up :

Careful : *To avoid draining of the fuel system and condensation in the tank, it is strongly recommended to fill up after the last trip of the day.*

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• PURGING SYSTEM

— Open tank and dash tank cocks :
— Remove the air purge plug from the dash-tank and evacuate air.
— Replace purge plug as soon as fuel flows.
— Slacken off the decanter-pre-filter purge screw.
— Wait until fuel flows and tighten purge screw.

• PURGING FUEL FILTER (fig.8-10-)

— Open purge screw (1).
— Actuate the primer lever (2) on feed pump until fuel runs clear and free of bubbles.
— Close purge screw.
— Slacken filter outlet union (3).
— Actuate feed pump lever until fuel flows bubble-free.
— Retighten the union at the same time actuating the lever.

• PURGING INJECTION PUMP

— Slacken off inlet union [fig. 9].
— Actuate feed pump lever.
— When fuel flows bubble-free, tighten union.
— Same procedure as for return union [fig. 9].
Slacken off injector inlet unions [fig. 11].
Turn engine over until fuel flows bubble-free. Tighten unions.

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• ADJUSTING VALVES

Clearances :

— Inlet : 0.20 to 0.25 } *Cold.*
— Exhaust : 0.35 to 0.40 }
— Remove rocker cover.
— Adjust rocker clearances in the following manner :

Make valves lap on cylinders	Adjust clearance on cylinders
4	1
2	3
1	4
3	2

Note : *Cylinder n° 1 is on Clywheel end of engine.*

• **RE-TIGHTENING CYLINDER HEAD**

This must be done at guarantee service by an R m C agent, when engine is still hot, at 50 hr. of working.
A torque spanner must be used for this operation and after tightening the rockers must be systematically adjusted.

Method :

— *Work screw by screw in the order shown fig.*
— *Slacken screw off 1/4 turn, then :*
— *Tighten screw to required torque (12 mkg).*

• **TIGHTENING CYLINDER HEAD**

When refitting a cylinder head, tighten the screws in the order shown in fig.
— *Three successive tightenings :*
1 st. tightening : 4 mkg.
2 nd. tightening : 8 mkg.
3 rd. tightening : 12 mkg.
— *Adjust rocker clearances.*

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• **CHECKING INJECTORS**

Removing :

— *Disconnect the injector inlet piping and leak return piping making sure not to bend them.*
— *Remove injector fixing flanges.*
— *Extract injectors.*
— *Have them checked by a R m C dealer.*

When refitting :

— *Fit a new (annealed) copper gasket.*
— *Centre and line up the jet in its housing.*
— *Progressively tighten the lug locking screw with a torque spanner to 3 mkg.*

Rinsing oil cooler :

Every 400 hours (or every year) dismantle the cooler.
— *Soak the tube-bank for 50 minutes in a detergent solution at a temperature of 90°.*
— *Rinse with water.*
— *Dry the tube-bank well.*
— *Fit the cooler changing the gaskets if necessary.*

• **BELT TIGHTNESS**

This should be checked after 20 hours of working and there-after every 100 hours.

Alternator belt :

To be checked after 20 hours of working and then every 100 hours.

Alternator belt :

— *Slacken off fixing screws (1) (2) [fig. 13].*
— *Tighten belt by acting on the tightening screw (3).*
— *Re-tighten the screws in order (1) (2) [fig. 13].*

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Sea-water pump belt :

— *Slacken off nuts (4) (5) and (6) fig. 13*
— *Tighten belt by pivoting pump in direction of arrow fig. 13*
— *Retighten screw (4) at the same time keeping belt taut.*
— *Retighten screws (5) and (6).*

Careful : *The belts must not be too tight so as not to put too much strain on the bearings.*

• **PROPELLER SHAFT STUFFING BOX**

— *After tightening stuffing box you must always check that shaft turns freely in neutral position. Slight seepage is advisable to ensure proper stuffing lubrication.*

• **TIGHTENING TORQUES**

Crankshaft bearing cap screws	*17 to 18 mkg*
Connecting rod nuts	*9.5 to 10 mkg*
Cylinder head bolts	*12 mkg × 3 off*
Engine flywheel screws	*20 to 22 mkg*
Rocker assembly nuts	*8 mkg*
Oil sump/cylinder block	*2.5 mkg*
Oil sump drain plug	*3 mkg*
Inlet manifold fixing bolts	*1.5 mkg*
Exhaust fixing bolts	*5.1 mkg*
Cylinder head cover nuts	*0.45 mkg*
Injector holder clamp	*3 mkg*
Injector	*6 to 8 mkg*
Crankshaft counter-balance screws	*11 mkg*
Crankshaft nuts	*41 to 43 mkg*
Feed union	*1 to 1.5 mkg*

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• **COOLING SYSTEM**

Dual system with heat exchanger.

Fresh water system :

Capacity : 15 litres.

Filling :

Through heat exchanger filling cap [fig. 14].

— *Retighten purge plug.*
— *Start engine and top up level in heat exchanger.*

Note : *We advise you to use the water-anti-freeze mixture all the time.*
However, if no anti-freeze is used, 1/2 litre of anti-rust oil must be added to protect the cooling system (eg. SARROL type 0 soluble oil).

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Draining :

— *Open engine block drain valve* [*fig.*15].
— *Remove exchanger drain plug* [*fig.*16] *or remove exchanger caps, as needs exchanger filler cap.*
may be. To make draining easier, open easier, open exchanger filler cap.
— *Remove engine oil cooler drain plug* [*fig.* 17].
— *Unscrew exhaust pipe drain plug* [*fig.* 18].

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Sea water system :

When working, the sea water is constantly renewed. It is drawn in by the circulating pump and then goes through the heat exchanger, the (BORG-WARNER) reversing gear oil cooler and is then pumped out through the water injection elbow.

Draining :

— *Open drain plugs :*
- *On heat exchanger fig.*[19]*(or if needs be, remove exchanger cap).*
- *On reversing gear oil cooler* [*fig.*20].
- *On water injector elbow* [*fig.* 21].
- *On splash exhaust box.*

— *Close sea water inlet valve.*
— *Disconnect sea water pump piping* [*fig.* 22].
— *Actuate the starter once or twice (with « STOP » control pulled out) to clear the pump of water.*

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• ELECTRICAL SYSTEM

Checking battery :

— *Unscrew filler caps of each element ;*
— *Check that level of electrolyte is between 15 and 20 mm above plates ;*
— *If necessary, top up with distilled water.*

Warning : *Never add acid.*

Checking alternator :

The alternator must never be lubricated. Any checks or overhauling must be carried out by an authorized agent.

Checking starter :

— *Periodically check tightness of fixing bolts to block and electrical connexions.*

Warning : *To avoid any serious deterioration of electrical equiment, the following instructions must be followed :*
— *Switch off engine before disconnecting battery ;*
— *Insulate battery before charging ;*
— *Check connexions to regulator ;*
— *Never disconnect regulator when generator is working ;*
— *Check that regulator is earthed ;*
— *Check that generator is connected to battery ;*
— *Never earth the « EXC » terminal on regulator, nor the lead connecting it to the « EXC » generator terminal.*

TECHNICAL DETAILS Page 20

• BORG-WARNER REVERSING GEAR

Model : hydraulic.
Type : 71 C.
Reduction ratio : 2.1 to 1, 1.5 to 1, etc.
Transmission is with a quick-acting disc clutch.
The clutch is worked by moving the gear-change lever either forwards or backwards which actuates a hydraulic distributor. The assisted pressure is supplied by an oil gear pump.

Hydraulic System :

Grade of oil : ELFMATIC G.
Capacity : 2.6 l approx.

Note. — *It is possible to adapt, as an option, reverse gears of same make but having different ratios, or a V DRIVE type reducing-reversing gear. Depending on the type of V DRIVE, the oil capacity may be 3.8 l or 4.8 l approx. (instead of 2.6 l for current models).*

Checking oil level [fig. 23].

— *Completely unscrew rod 1, remove dip-stick 2 and wipe ;*
— *Take reading by pushing dip-stick home ;*
— *Check that oil level is situated between the mini. and maxi. marks ;*
— *Top up if necessary and screw back dip-stick.*

Entering into service for first time :

When entering into service for first time (or when completely dismantling unit), proceed in the following manner :
— *Fill the reversing gear to maxi. level ;*
— *Start engine to fill the oil system ;*

— *Switch off after a few moments ;*
— *Top up oil level.*

Warning : *Too much oil could have an influence on the neutral position of unit. The maximum level on the dip stick must not be gone beyond in any cicumstances.*

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Draining :

— *Remove filling plug and unscrew drain plug (1)* [*fig.* 24].
— *Replace drain plug and filter ;*
— *Carefully clean filter ;*
— *Fill up ;*
— *Screw filling plug back in ;*
— *Turn engine over a few minutes to ensure system is filled ;*
— *Switch off engine ;*
— *Check level and top up if needs be.*

Note. — *If drain plug is not accessible, use a syringe for draining.*

Checking Borg-Warner Reversing Gear control lever [fig. 25].

Bilge water splashing between the control lever and bearing face can sometimes make the lever difficult to move.

To overcome this, you must :

— *Slightly unscrew the control lever retaining nut ;*
— *Clear lever from bearing face by approx. 2 mm ;*
— *Using a brush, apply engine oil or grease to the lever and bearing interfaces ;*
— *Retighten retaining screw.*

Pages 22 and 23

• LAYING UP FOR WINTER

Sea water freezes at — 6 °C.
To avoid any risk of freezing, which would damage the engine, it is necessary to complete the following operations before the winter period arrives :

Afloat :

— *Drain the fresh water system (see draining chapter p.* 16 *).*
— *Replace fresh water with a mixture of water and anti-freeze in the following proportions :*
  - *15 % for protection to — 10 °C (approx. 2.5 l of anti-freeze).*
  - *22 % for protection to — 20 °C (approx. 3.5 l of anti-freeze).*
  - *35 % for protection to — 30 °C (approx. 5.5 l of anti-freeze).*
— *Close sea-water inlet valve.*
— *Drain sea-water system.*
— *Tighten the stuffing box to make it water-tight.*
— *Spray oil into the inlet pipe ;*
— *Remove injectors and put in 5 cm³ of storage oil into each cylinder.*
— *Refit injectors.*
— *Plug all openings with either oil paper or greasy rags.*
— *Remove the battery and electrical accessories and give them to a R m C agent who will carry out maintenance work on them.*

Ashore :

When the boat is to be laid up, you should :

— *Remove the sea-water inlet piping* [*fig.* 22].
— *Connect a fresh water pipe.*
— *Drain engine oil.*
— *Fill up with ELF STOCKAGE oil.*
— *Let engine tick over for approx. 30 minutes.*
— *Switch off engine and drain off storage oil.*
— *Drain off the sea-water system (see chapter p.* 18 *).*
— *Drain off fresh water system (see chapter p.* 17 *).*
— *Spray oil into inlet tube.*
— *Take injectors out and put in 5 cm³ of storing oil in each cylinder.*
— *Put injectors back in.*
— *Plug all openings using oil paper or greasy rags.*
— *Remove the battery and electrical accessories and give them to a R m C agent who will carry out maintenance work on them.*

Very Important :

In all circumstances when the engine will not be run for some time (laying up for winter. storage) the following instructions must be followed for the fuel system :

— *Close tank cocks ;*
— *Change fuel filter elements ;*
— *Disconnect feed pipe and plunge it into a container of clean fuel placed under load with relation to the engine ;*
— *If necessary purge the system ;*
— *Let engine run for approx. 10 minutes ;*
— *Reconnect the fuel inlet.*

• PUTTING INTO SERVICE

— *Remove the oil paper (or greasy rags) from all openings ;*
— *Drain storage oil ;*
— *Fill up with engine oil ;*

— *Fill up with fuel ;*

— *Purge fuel system ;*

— *Fill fresh water system, and add half a litre of anti-corrosive oil (eg. SARROL, type : 0) ;*

— *Re-fit the battery and electrical accessories ;*

— *Untighten the shaft stuffing box (the shaft should turn freely by hand).*

— *Inspect engine completely prior to starting.*

Important :

Before starting engine do not forget to open the sea-water inlet cock.

PERIODICAL MAINTENANCE

OPERATIONS	At each time of starting	After first 20 hours	After first 50 hours	Every 100 hours	Every 200 hours	Every 400 hours	Every 1 000 hours
Engine oil level	X						
Reversing gear oil level	X	X					
Fuel level	X						
Fresh water level	X						
Drain decanter, decanter filter		X	X	X			
Drain engine oil		X	X	X			
Drain reversing gear oil						X	
Electrolyte level		X	X	X			
Check tightness of belts		X		X			
Change oil filter element		X			X		
Change fuel filter elements		X				X	
Clean battery terminals						X	
Retighten cylinder head			X				
Adjust valves			X				
Clean decanter filter			X	X			
Injector calibration and jet checking						X	
Cleaning turbo compressor						X	
Retightening oil filter			X				
Retightening fuel filter			X				
Retightening push-rod access cover			X				
Retightening sump			X				
Retightening feed pump			X				
Retightening injection pump			X				
Retightening inlet manifold			X				
Retightening exhaust manifold			X				
Check condition of decanting bowl of fuel filter				X			
Purge reservoir(s)					X		
Rinse oil heat exchanger						X	

NOTE : *The service operations intended for 100 hr., 200 hr. and 400 hr. must be systematically carried out every year if the engine does not reach the amount of hours required.*

TROUBLE SHOOTING

TROUBLE	CAUSES	REMEDIES
Black smoke in exhaust.	*Bad combustion.*	*Have the injectors as well as the injector pump checked by a specialist.*
	Air deceleration at inlet.	*Check condition of air filter.*
	Exhaust blocked.	*Check exhaust outlet.*
		Check thermostart plug.
Engine won't start.	*Out of fuel.* *Fuel not coming through properly.* *Fuel filters blocked.* *Air in the fuel system.* *Starter won't work.* *— Faulty contact.* *— Battery discharged.*	*Fill up and purge system.* *Purge system.* *Change filter elements.* *Purge system.* *Check connexions and purge system.* *Have starter checked.* *Check tightness of battery terminals. Recharge batteries.*
Engine difficult to start.	*« STOP » control stays in intermediate position.* *Air in fuel system.* *Lack of compression.* *Insufficient flow from fuel pump.*	*Check and push in the « stop » control.* *Purge system.* *Check compression ratios.* *Check fuel pump.*
Engine runs irregularly.	*Small quantity of air in fuel system.* *Injectors fouled up.* *Water or dirt in system.* *Rocker clearances wrong.* *Pump maladjusted.*	*Check unions and piping. Purge system.* *Remove, clean and adjust injectors.* *Purge decanter and system.* *Adjust rocker clearances.* *Check timing and controls.*
White smoke in exhaust.	*Faulty cylinder head gasket.* *Lack of injection advance.*	*Change gasket.* *Check injection pump timing.*
The oil and water warning light comes on.	*Out of water.* *Out of oil.*	*Switch engine off immediately.*

TROUBLE	CAUSES	REMEDIES
Water and oil warning signal sounds. *Engine becomes abnormally hot.*	*Inlet strainer clogged or dirty.* *Stretched or broken belt.* *Faulty water pump rotor.* *Electrolytic zinc comes out and blocks piping.* *Faulty thermostat.*	*Check oil level.* *Check fresh water level.* *Fill up. Check sea-water flow rate.* *Clean inlet strainer.* *Change or tighten belt.* *Change rotor.* *Remove zinc and fit a new one.* *Momentarily remove and replace.*
Engine won't reach required n° of revs.	*« STOP » control lacks stroke.*	*Adjust « STOP » control stroke.*
Engine runs unevenly.	*Air leak.*	*Check fuel system and purge it.*
Engine is noisy.	*Adjust rocker clearances.* *Check injection pump adjustment.*	*Check injectors.* *Check pump timing.* *Check valve springs.*
Reverse gear control lever difficult to move (BORG-WARNER). *No reverse gear neutral position (BORG-WARNER).*	*Oxidisation between lever and bearing face.* *Too much oil.* *Faulty clutch.*	*Slacken fixing nut.* *Pull lever out slightly (2 mm) and oil.* *Drain off oil to correct level.* *Have reverse gear checked.*

ELECTRICALS

For the wiring diagram, depending on the type of engine, refer to dwgs.

N° 674 134 — Engine wiring 12 V.
N° 674 135 — Engine wiring 24 V.
N° 674 125 — Module I instrument panel wiring 12 V.
N° 674 114 — Module I instrument panel wiring 24 V.
N° 674 112 — Module II instrument panel wiring 12 V.
N° 674 113 — Module III instrument panel wiring 12 V.
N° 674 120 — Module II instrument panel wiring 24 V.
N° 674 121 — Module III instrument panel wiring 24 V.