Chapter 2 Part B:
Liquid-cooled two-stroke engines (NRG MC^2, NRG MC^3 DD, NRG Power DD, Zip SP/RS, Hexagon)

Refer to the beginning of Chapter 1 for model identification details

Contents

Degrees of difficulty

Easy, suitable for novice with little experience 

Fairly easy, suitable for beginner with some experience 

Fairly difficult, suitable for competent DIY mechanic 

Difficult, suitable for experienced DIY mechanic 

Very difficult, suitable for expert DIY or professional 

Specifications

NRG MC^2, NRG MC^3 DD, Zip SP/RS

General

Type	Single cylinder two-stroke
Capacity	49.4 cc
Bore	40.0 mm
Stroke	39.3 mm
Compression ratio	10.9 to 1

Cylinder

Bore	
Standard	39.99 to 40.01 mm
1st oversize	40.19 to 40.21 mm
2nd oversize	40.39 to 40.41 mm

Connecting rod

Small-end internal diameter	
Size I	17.007 to 17.011 mm
Size II	17.003 to 17.007 mm
Size III	17.001 to 17.003 mm

Piston

Piston diameter (measured 25 mm down from lower ring groove, at 90° to piston pin axis)	
Standard	39.94 to 39.96 mm
1st oversize	40.14 to 40.16 mm
2nd oversize	40.34 to 40.36 mm
Piston-to-bore clearance	0.045 to 0.055 mm
Piston pin diameter	11.999 to 12.005 mm

Piston rings

Ring end gap (installed)	0.10 to 0.25 mm

Crankshaft

Runout (max)	
At middle and right-hand end	0.03 mm
At left-hand end	0.02 mm
Endfloat	0.03 to 0.09 mm

Cylinder base gasket selection

Cylinder top gasket surface-to-piston crown measurement	**Gasket thickness**
3.26 mm to 3.45 mm	0.75 mm
3.10 mm to 3.25 mm	0.5 mm
2.85 mm to 3.09 mm	0.4 mm

Torque settings

Engine front mounting bolt	33 to 41 Nm
Shock absorber lower mounting bolt	33 to 41 Nm
Cylinder head nuts	10 to 11 Nm
Crankcase bolts	12 to 13 Nm
Alternator rotor nut	40 to 44 Nm

NRG Power DD

General

Type	Single cylinder two-stroke
Capacity	49.4 cc
Bore	40.0 mm
Stroke	39.3 mm
Compression ratio	11.3 to 1

Cylinder bore

Standard	
Size code M	39.997 to 40.004 mm
Size code N	40.004 to 40.011 mm
Size code O	40.011 to 40.018 mm
Size code P	40.018 to 40.025 mm
1st oversize	40.197 to 40.225 mm
2nd oversize	40.397 to 40.425 mm

Connecting rod

Small-end internal diameter	
Standard	17.001 to 17.011 mm
Service limit	17.060 mm

Piston

Piston diameter (measured 25 mm down from lower ring groove, at 90° to piston pin axis)	
Standard	
Size code M	39.943 to 39.950 mm
Size code N	39.950 to 39.957 mm
Size code O	39.957 to 39.964 mm
Size code P	39.964 to 39.971 mm
1st oversize	40.143 to 40.171 mm
2nd oversize	40.343 to 40.371 mm
Piston-to-bore clearance	0.047 to 0.061 mm
Piston pin diameter	12.001 to 12.005 mm
Piston pin bore diameter in piston	12.007 to 12.012 mm

Piston rings

Ring end gap (installed)	0.10 to 0.25 mm

Crankshaft

Runout (max)	
At middle and left-hand end	0.03 mm
At right-hand end	0.02 mm
Endfloat	0.03 to 0.09 mm

Cylinder base gasket selection

Cylinder top gasket surface-to-piston crown measurement	**Gasket thickness**
3.24 mm to 3.48 mm	0.8 mm
3.04 mm to 3.24 mm	0.6 mm
2.80 mm to 3.04 mm	0.4 mm

Torque settings

Engine front mounting bolt	33 to 41 Nm
Shock absorber lower mounting bolt	33 to 41 Nm
Cylinder head nuts	10 to 11 Nm
Crankcase bolts	12 to 13 Nm
Alternator rotor nut	40 to 44 Nm

Hexagon

General

Type	Single cylinder two-stroke
Capacity	124 cc
Bore	55.0 mm
Stroke	52.0 mm
Compression ratio	10.2 to 1

Cylinder bore

Standard	
Size-code A	54.990 to 54.995 mm
Size-code B	54.995 to 55.000 mm
Size-code C	55.000 to 55.005 mm
Size-code D	55.005 to 55.010 mm
Size-code E	55.010 to 55.015 mm
Size-code F	55.015 to 55.020 mm
Size-code G	55.020 to 55.025 mm
Size-code H	55.025 to 55.030 mm
Size-code I	55.030 to 55.035 mm
1st oversize	55.190 to 55.235 mm
2nd oversize	55.390 to 55.435 mm
3rd oversize	55.590 to 55.610 mm

Connecting rod

Small-end internal diameter	
Size I	20.009 to 20.013 mm
Size II	20.005 to 20.010 mm
Size III	19.999 to 20.006 mm
Size IIII	19.997 to 20.002 mm

Piston

Piston diameter (measured 35 mm down from lower ring groove, at 90° to piston pin axis)	
Standard	
Size-code A	54.935 to 54.940 mm
Size-code B	54.940 to 54.945 mm
Size-code C	54.945 to 54.950 mm
Size-code D	54.950 to 54.955 mm
Size-code E	54.955 to 54.960 mm
Size-code F	54.960 to 54.965 mm
Size-code G	54.965 to 55.970 mm
Size-code H	54.970 to 54.975 mm
Size-code I	54.975 to 54.980 mm
1st oversize	55.135 to 55.180 mm
2nd oversize	55.335 to 55.380 mm
3rd oversize	55.535 to 55.555 mm
Piston-to-bore clearance	0.050 to 0.060 mm
Piston pin diameter	15.999 to 16.006 mm

Piston rings

Ring end gap (installed)	0.20 to 0.35 mm

Crankshaft

Runout (max)	0.03 mm
Endfloat	0.03 to 0.09 mm

Torque settings

Engine front mounting bolt	33 to 41 Nm
Rear shock absorber lower mounting	33 to 41 Nm
Cylinder head nuts	20 to 22 Nm
Crankcase bolts	13 Nm
Alternator rotor nut	52 to 56 Nm

1 General information

The engine unit is a single cylinder two-stroke, with liquid-cooling. The alternator rotor is on the right-hand end of the crankshaft. The crankshaft assembly is pressed, incorporating the connecting rod, with the big-end running on the crankpin on a needle roller bearing. The piston also runs on a needle roller bearing fitted in the small-end of the connecting rod. The crankshaft runs in caged ball main bearings. The crankcase divides vertically.

2 Operations possible with the engine in the frame

All components and assemblies, with the exception of the crankshaft/connecting rod assembly and its bearings, and the water pump impeller, can be worked on without having to remove the engine/transmission assembly from the frame. If however, a number of areas require attention at the same time, removal of the engine is recommended, as it is easy to do so.

3 Operations requiring engine removal

To access the crankshaft and connecting rod assembly and its bearings, and the water pump impeller, the engine must be removed from the frame and the crankcase halves must be separated.

4 Major engine repair – general note

1 It is not always easy to determine when or if an engine should be completely overhauled, as a number of factors must be considered.

2 High mileage is not necessarily an indication that an overhaul is needed, while low mileage, on the other hand, does not preclude the need for an overhaul. Frequency of servicing is probably the single most important consideration. An engine that has regular and frequent maintenance will most likely give many miles of reliable service. Conversely, a neglected engine, or one which has not been run-in properly, may require an overhaul very early in its life.

3 If the engine is making obvious knocking or rumbling noises, the connecting rod and/or main bearings are probably at fault.

4 Loss of power, rough running, excessive noise and high fuel consumption rates may also point to the need for an overhaul, especially if they are all present at the same time. If a complete tune-up does not remedy the situation, major mechanical work is the only solution.

5 An engine overhaul generally involves restoring the internal parts to the specifications of a new engine. The piston rings and main and connecting rod bearings are usually renewed and, if necessary, the cylinder is rebored. The end result should be a like-new engine that will give as many trouble-free miles as the original.

6 Before beginning the engine overhaul, read through the related procedures to familiarise yourself with the scope and requirements of the job. Overhauling an engine is not all that difficult, but it is time consuming. Check on the availability of parts and make sure that any necessary special tools, equipment and supplies are obtained in advance.

7 Most work can be done with typical workshop hand tools, although a number of precision measuring tools are required for inspecting parts to determine if they must be renewed. Often a dealer will handle the inspection of parts and offer advice concerning reconditioning and renewal. As a general rule, time is the primary cost of an overhaul so it does not pay to install worn or substandard parts.

8 As a final note, to ensure maximum life and minimum trouble from a rebuilt engine, everything must be assembled with care in a spotlessly-clean environment.

5 Engine/transmission unit – removal and installation

Caution: The engine is not heavy, although engine removal and installation should be carried out with the aid of an assistant; personal injury or damage could occur if the engine falls or is dropped.

Removal

1 The procedure for removing the engine is the same as for air-cooled models, with the following addition: drain the cooling system (see Chapter 1). Release the clamps securing the cooling system hoses to the cylinder head and to the water pipe just ahead and below the alternator on the right-hand side of the engine, and detach the hoses from their unions, noting which fits where **(see illustrations)**. Also pull back the rubber cover on the coolant temperature sensor wiring terminal and pull off the connector.

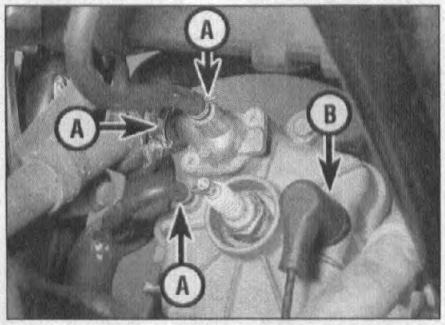
2 Refer to Chapter 2A, Section 5, for the rest of the procedure.

Installation

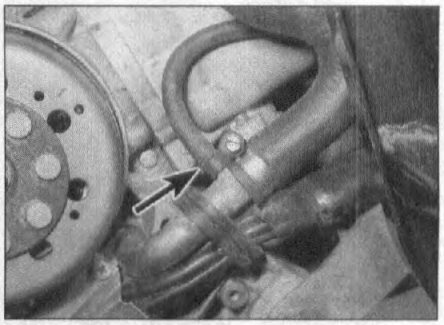
3 Installation is the reverse of the procedure in Chapter 2A, noting the additional points:

*a) Make sure the cooling system hoses are properly connected and secured by their clamps **(see illustrations 5.1a and 5.1b)**. Do not forget to connect the temperature sensor wiring cover.*

b) Fill the cooling system (see Chapter 1).



5.1a Detach the hoses (A) from their unions and disconnect the wiring connector (B)



5.1b Detach the hose (arrowed) from its union

6 Disassembly and reassembly – general information

Disassembly

1 Before disassembling the engine, the external surfaces of the unit should be thoroughly cleaned and degreased. This will prevent contamination of the engine internals, and will also make working a lot easier and cleaner. A high flash-point solvent, such as paraffin can be used, or better still, a proprietary engine degreaser such as Gunk. Use old paintbrushes and toothbrushes to work the solvent into the various recesses of the engine casings. Take care to exclude solvent or water from the electrical components and inlet and exhaust ports.

Warning: The use of petrol (gasoline) as a cleaning agent should be avoided because of the risk of fire.

2 When clean and dry, arrange the unit on the workbench, leaving a suitable clear area for working. Gather a selection of small containers and plastic bags so that parts can be grouped together in an easily identifiable manner. Some paper and a pen should be on hand to permit notes to be made and labels attached where necessary. A supply of clean rag is also required.

3 Before commencing work, read through the appropriate section so that some idea of the necessary procedure can be gained. When removing components it should be noted that great force is seldom required, unless specified. In many cases, a component's reluctance to be removed is indicative of an incorrect approach or removal method – if in any doubt, recheck with the text.

4 When disassembling the engine, keep 'mated' parts that have been in contact with each other during engine operation together. These 'mated' parts must be reused or renewed as an assembly.

5 A complete engine disassembly should be done in the following general order with reference to the appropriate Sections and Chapters.

Remove the cylinder head.
Remove the cylinder.
Remove the piston.
Remove the alternator.
Remove the variator (see Chapter 2G).
Remove the starter motor (see Chapter 9).
Remove the oil pump and drivebelt.
Remove the reed valve (see Chapter 4).
Remove the water pump (see Chapter 3).
Separate the crankcase halves.
Remove the crankshaft.

Reassembly

6 Reassembly is accomplished by reversing the general disassembly sequence.

7 Cylinder head – removal, inspection and installation

Note: *The cylinder head can be removed with the engine in the frame. If the engine has been removed, ignore the steps which don't apply.*
Caution: The engine must be completely cool before beginning this procedure or the cylinder head may become warped.

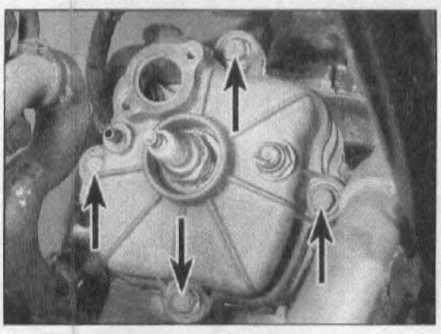
Removal

1 Remove the bodywork as required by your model (see Chapter 7).

2 Drain the cooling system (see Chapter 1). Release the clamps securing the cooling system hoses to the cylinder head, and detach the hoses from their unions, noting which fits where **(see illustration 5.1a)**. Also pull back the rubber cover on the coolant temperature sensor wiring terminal and pull off the connector. If required, remove the thermostat and housing (see Chapter 3).

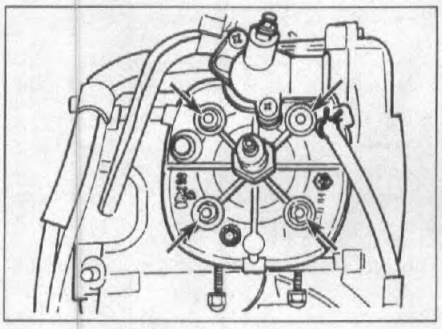
3 On Hexagon models, remove the four bolts securing the cylinder head cover and remove the cover **(see illustration)**. Remove the O-ring from the plug housing and discard it, as a new one must be used **(see illustration)**.

4 Unscrew the four cylinder head nuts evenly and a little at a time in a criss-cross sequence until they are all loose, then draw the head off the cylinder and the studs **(see illustrations)**.

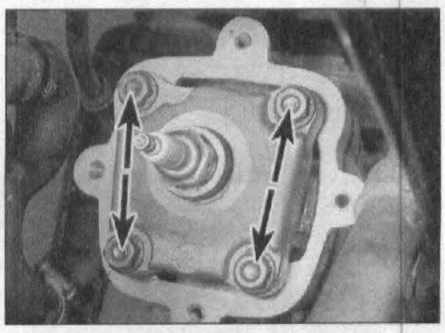


7.3a Unscrew the bolts (arrowed) and remove the cover

7.3b Remove the O-ring and discard it



7.4a Cylinder head nuts (arrowed) – 50 cc engine



7.4b Cylinder head nuts (arrowed) – 125 cc engine

If it is stuck, tap around the joint faces of the cylinder head with a soft-faced mallet to free the head. Do not attempt to free the head by inserting a screwdriver between the head and cylinder – you'll damage the sealing surfaces. Discard the cylinder head O-ring and gasket (where fitted), as new ones must be used.

Inspection

5 Refer to Chapter 1 and decarbonise the cylinder head.

6 Inspect the head very carefully for cracks and other damage. If cracks are found, a new head will be required.

7 Check the mating surfaces on the cylinder head and cylinder for signs of leakage, which could indicate warpage.

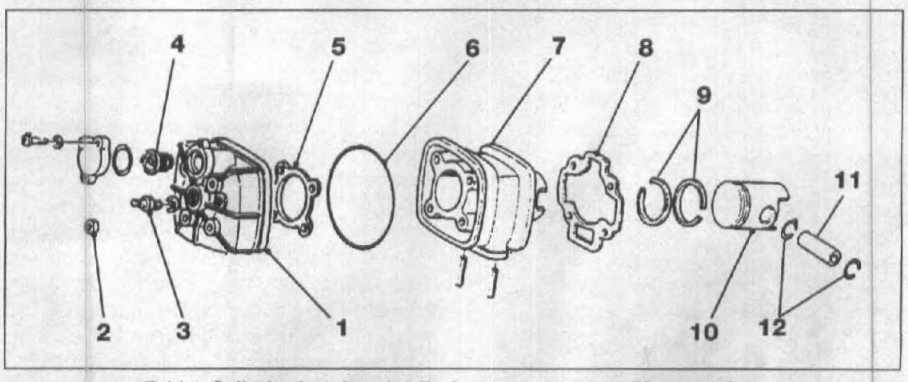
8 Using a precision straight-edge, check the head mating surface for warpage. Check vertically, horizontally and diagonally across the head, making four checks in all.

Installation

9 Lubricate the cylinder bore with two-stroke oil.

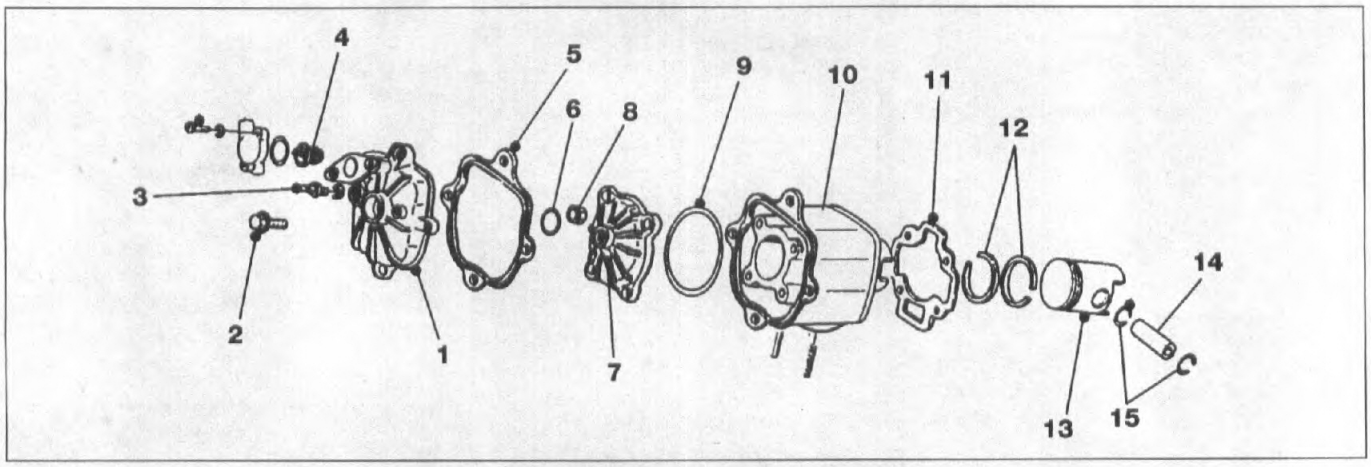
10 Ensure both cylinder head and cylinder mating surfaces are clean.

11 Carefully fit the cylinder head onto the cylinder using a new gasket (where fitted) and O-ring **(see illustrations)**.



7.11a Cylinder head and cylinder components – 50 cc engine

1 Cylinder head
2 Cylinder head nut – 4 off
3 Temperature sender
4 Thermostat
5 Cylinder head gasket
6 O-ring
7 Cylinder
8 Base gasket
9 Piston rings
10 Piston
11 Piston pin
12 Circlips



7.11b Cylinder head and cylinder components – 125 cc engine

1 Cylinder head cover
2 Cover bolt – 4 off
3 Temperature sender
4 Thermostat
5 Cover seal
6 O-ring
7 Cylinder head
8 Cylinder head nut – 4 off
9 O-ring
10 Cylinder
11 Base gasket
12 Piston rings
13 Piston
14 Piston pin
15 Circlips

12 Install the four nuts and tighten them all finger-tight **(see illustration 7.4a or 7.4b)**. Now tighten them evenly and a little at a time in a criss-cross pattern to the torque setting specified at the beginning of the Chapter.

13 On the Hexagon, check the condition of the head cover gasket and fit a new one if necessary **(see illustration)**. Also fit a new O-ring around the plug housing **(see illustration 7.3b)**.

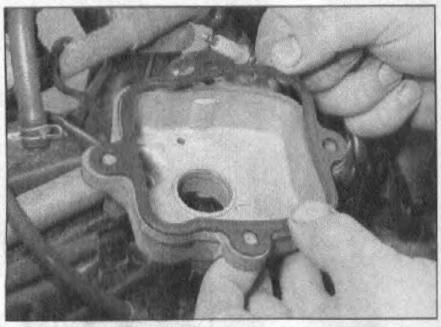
14 Install the remaining components in a reverse of their removal sequence, referring to the relevant Sections or Chapters.

15 Refill the cooling system (see Chapter 1).

8 Cylinder – removal, inspection and installation

Note: *The cylinder can be removed with the engine in the frame.*

1 Remove the exhaust system (see Chapter 4) and the cylinder head (see Section 7).



7.13 Check the cover gasket and renew if necessary

The procedure for removal, inspection and installation of the cylinder is basically the same as for air-cooled models. Refer to Chapter 2A, Section 8, for details.

2 Note that the cylinder base gasket thickness on 50 cc liquid-cooled two-stroke engines has to be calculated in the same way as on 125 cc engines (see Step 4). All cylinders and pistons are size-coded as on air-cooled engines.

3 Note that some 125 cc liquid-cooled two-stroke engines are fitted with iron cylinders which can be rebored, and some are fitted with Nicasil coated aluminium cylinders which cannot. Specifications for oversize cylinders and pistons are listed at the beginning of this Chapter. To assess the amount of wear in a Nicasil coated cylinder, compare the measurements taken with the standard cylinder bore specifications. Likewise, the appropriate piston sizes in the specifications are those for standard pistons.

4 When installing the cylinder, note that different thickness base gaskets are available. For the Zip SP/RS and NRG models, gaskets are available in 0.4 (early models only), 0.5 and 0.75 mm thicknesses, and for the Hexagon they are available in 0.2, 0.3, 0.4, 0.5, 0.6, 0.7 and 0.8 mm thicknesses. To determine which thickness of gasket to use, assemble the cylinder on the crankcase and piston without any base gasket fitted. Mount the dial gauge as described in Chapter 2A and measure the distance between the cylinder top gasket surface and the top of the piston crown. On Zip SP/RS and NRG models, use the specifications at the beginning of this Chapter to determine the gasket thickness. On Hexagon models, subtract 2.79 mm from the reading to obtain the gasket thickness.

9 Piston – removal, inspection and installation

1 The procedure for removal, inspection and installation of the piston is the same as for air-cooled engines. Refer to Chapter 2A, Section 9, for the procedure.

10 Piston rings – inspection and installation

1 The procedure for inspection and installation of the piston rings is the same as for air-cooled models. Refer to Chapter 2A, Section 10, for the procedure.

11 Alternator rotor and stator – removal and installation

Note: *The alternator can be removed with the engine in the frame.*

1 Where fitted, unclip the secondary air system from the alternator cover (see Chapter 1, Section 21). Remove the screws securing the alternator cover and remove the cover, noting how it fits.

2 The remainder of the procedure for removal, inspection and installation of the alternator rotor and stator is the same as for air-cooled models, though liquid-cooled models have no cooling fan attached to the rotor. Refer to Chapter 2A, Section 12, for the procedure.

12 Starter pinion assembly – removal, inspection and installation

Note: *The starter pinion assembly can be removed with the engine in the frame.*

1 The procedure for removal, inspection and installation of the starter pinion assembly is the same as for air-cooled models. Refer to Chapter 2A, Section 13, for the procedure.

13 Oil pump and drivebelt – removal, inspection, installation and bleeding

1 The procedure for removal, inspection, installation and bleeding of the oil pump and drivebelt is the same as for air-cooled models. Refer to Chapter 2A, Section 14, for the procedure.

14 Crankcase halves, crankshaft and connecting rod and bearings

Note: *To separate the crankcase halves, the engine must be removed from the frame.*

Separation

1 To access the crankshaft and its bearings, the crankcase must be split into two parts.

2 To enable the crankcases to be separated, the engine must be removed from the frame (see Section 5). Before the crankcases can be separated the following components must be removed:

a) Cylinder head (Section 7).
b) Cylinder (Section 8).
c) Alternator rotor and stator (Section 11).
d) Reed valve (Chapter 4).
e) Starter motor (Chapter 9).
f) Oil pump and drivebelt (Section 13).

3 The remainder of the procedure for separation and joining of the crankcase halves and for removal, inspection and installation of the crankshaft/connecting rod and bearings is the same as for air-cooled models, though liquid-cooled models have the water pump assembly housed within the left-hand side of the crankcase. Refer to Chapter 2A, Section 15, for the procedure. Remove the water pump from the crankcase after the halves have been separated, noting how it fits.

Reassembly

4 Do not forget to install the water pump before joining the crankcase halves (see Chapter 3).

15 Initial start-up after overhaul

1 Make sure the oil tank is at least partly full and the pump is correctly adjusted (see Chapter 1) and bled of air (see Section 13).

2 Fill the coolant reservoir with fresh coolant (see Chapter 1).

3 Make sure there is fuel in the tank.

4 With the ignition OFF, operate the kickstart a couple of times to check that the engine turns over easily.

5 Turn the ignition ON, start the engine and allow it to run at a slow idle until it reaches operating temperature. Do not be alarmed if there is a little smoke from the exhaust – this will be due to the oil used to lubricate the piston and bore during assembly and should subside after a while.

6 If the engine proves reluctant to start, remove the spark plug and check that it has not become wet and oily. If it has, clean it and try again. If the engine refuses to start, go through the fault finding charts at the end of this manual to identify the problem.

7 Check the coolant level after the engine has cooled down and bleed the cooling system of air as described in Chapter 1.

16 Recommended running-in procedure

1 Treat the engine gently for the first few miles to allow any new parts to bed-in.

2 Even greater care is necessary if the engine has been rebored or a new crankshaft has been installed. In the case of a rebore, the bike will have to be run-in as when new. This means a restraining hand on the throttle until at least 600 miles (1000 km) have been covered. There's no point in keeping to any set speed limit – the main idea is to keep from labouring the engine and to gradually increase performance up to the 600 mile (1000 km) mark. Make sure that the throttle position is varied to vary engine speed, and use full throttle for only short bursts, but do not allow the machine to attain more than 80% full speed (70% on Hexagon) or to maintain any one speed for too long. Experience is the best guide, since it's easy to tell when an engine is running freely.