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| **Assembly information** |
| **KDI 3404 TM Workshop Manual (Rev. 08.3)** |



Sommario

[1. TITOLO 1 2](#_Toc495648770)

[1.1. Asdfsdfsdf 2](#_Toc495648771)

[1.2. Asdfsdfsdfggg 2](#_Toc495648772)

# Assembly information

## Information on engine configuration

* In this chapter, the engine is represented as **"BASE CONFIGURATION"** (refer to [**Par. 1.4**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=725&parent=1545) **-** [**1.5**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=727&parent=1545) ).
* For the assembly of components not described in this chapter refer to [**Chap. 11**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=803&parent=1545) .
* The following are the components described in [**Chap. 11**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=803&parent=1545) .

**11.1** [**Heater (reaplacement)**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=803&parent=1545) **11.2** [**Air filter (cartridge replacement)**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=804&parent=1545) **11.3** [**Cooling circuit (replacement)**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=805&parent=1545)

## Assembly recommendations

* The information is laid out in sequence, the intervention methods have been selected, tested and approved by the manufacturer's technicians.
* This chapter describes the installation procedures for the assemblies and/ or individual components which have already been checked, overhauled or possibly replaced with original spare parts.
* Where necessary, reference to special tools during assembly operations is indicated and identified in [**Tab 13.1**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=812&parent=1545) , hereinafter in **Tab. 9.1** an example of a special tool ( [**ST\_05**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=812&parent=1545) ).

**Tab. 9.1**

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| **SPECIAL TOOLS** | | | |
| **"ST" Code** | **Picture /draw** | **DESCRIPTION** | **PART NUMBER** |
| **ST\_05** | ST_05.jpg | Six nicks Key SN 8 | ED0014603650-S |

Z_importante.jpg **Important**

* Before proceeding with operations, read [**Par. 3.3.2**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=814&parent=1545) .
* To easily locate specific topics, the reader should refer to the **analytical index** or **chapter index** .
* The operator must check that:
  + the components, the assemblies, the coupling surfaces of the parts are washed, clean and thoroughly dried;
  + the coupling surfaces are undamaged;
  + the equipment and tools are ready so that all work can be carried out correctly and safely;
  + ensure that the working environment is safe.
* The operator must:
  + carry out the procedures smoothly and safely. It is thus recommended to install the engine on a special rotating stand used when servicing engines to ensure the safety of the operator and the other individuals involved;
  + tighten the assemblies and / or components in a criss-cross or alternating pattern, initially with a value lower than that preset, and then subsequently, with the tightening torque specified in the procedure;
  + replace all seal gaskets after each assembly for all components on which they are provided.

## Engine block assembly

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| **9.3.1 Crankshaft bushings**    Z_importante.jpg **Important**       * Execute the procedure in [**Par. 8.2.1 and 8.2.2**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=763&parent=1545) , before proceeding with assembly. * The crankshaft  half-bearings are made of special material. Therefore, they must be replaced every time they are assembled to prevent seizures.        1. Fit the new half-bearings **A1** onto the crankcase upper half **B1** adhering to the reference notches **C** .       Z_importante.jpg **Importante**       * After the half-bearings are fitted, check that the lubrication holes **D** correspond with the crankcase grooves **B1** . * The lower and upper half bearings **CANNOT** be singularly replaced, and both halves must be replaced together.  1. Fit the new half-bearings **A2** onto the lower crankcase **B2** using the reference notches **C** . 2. Lubricate the half-bearings **A1** and **A2** with oil. | 9.1.jpg **Fig 9.1**9.2.jpg **Fig 9.2** |
| **9.3.2 Tappets**   1. Lubricate the tappets **E** with oil. 2. Insert the tappets **E** into the housings **F** of the upper crankcase **B1** . | 9.3.jpg **Fig 9.3** |
| **9.3.3 Oil spray nozzles**   1. Insert the sprayers **G** onto the upper crankcase **B1** manually screwing the screw fittings **H** . 2. Ensure that the spray nozzles **G** are inserted correctly in their seat, as shown in detail  **L** and tighten the connecting screws **H** (tightening torque of **10 Nm** ). | 9.4.jpg **Fig 9.4** |
| **9.3.4 Crankshaft**    Z_importante.jpg **Important**       * Carry out the checks described in [**Par. 8.4.1 and Par. 8.4.2**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=765&parent=1545) .  1. Check that the crankshaft half-bearings **A1** are mounted correctly on the upper crankcase **B1** . 2. Lubricate the main journal and crankpin **J** , with oil. 3. Insert the crankshaft **M** into its seat on the upper crankcase  **B1** . 4. Insert the 2 shoulder half-rings **N1** , between the crankshaft **M** and the upper crankcase **B1** ( **Q** detail). | 9.5.jpg **Fig 9.5** |
| **9.3.5 Lower semi-crankcase**   1. Check that the coupling surfaces **P** are free from dirt and grit. 2. Spread a bead of **Loctite 5660** of approx **1,5 mm** thickness on the surface **P** of the upper crankshaft half **B1** being careful not to block the oil feed grooves **X** and the return oil sump **Y** . 3. Insert gasket **S** into the seat of crankcase **B1** .     **Note: alternatively apply Loctite 5699.** | 9.6.jpg **Fig 9.6** |

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| 1. Check that the crankshaft half-bearings **A2** are mounted correctly on the lower crankcase **B2** . 2. Assemble the 2 shoulder half-rings **N2** onto the lower crankcase **B2** applying two drops of grease to keep them in their seat. 3. Join the two crankshaft halves **B1** and **B2** observing the guide pins  **T** . | |
| 9.7_9.8.jpg  **Fig 9.7 - F** **ig 9.8** | |

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| 9.9.jpg  **Fig 9.9** | 9.10.jpg  **Fig 9.10** |
| **Tab 9.2**   |  |  |  | | --- | --- | --- | | **CYCLE** | **SCREWS** | **TORQUE** | | **1** | **J - Torx M14x1,5** | **60 Nm** | | **2** | **K - Torx M10x1.25** | **30 Nm** | | **3** | **J - Torx M14x1,5** | **45°** | | **4** | **J - Torx M14x1,5** | **45°** |     Z_importante.jpg **Important**       * The fastening bolts **J** , **K** must be replaced every time they are assembled. * Failure to adhere to the bolt fixing procedures may compromise the functionality of the engine, and also may cause damage to persons and property. * Tighten capscrews **J** , **K** observing the cycles, tightening, and subsequent rotation as indicated in **Tab. 9.2** .   + 1. Apply " **Molyslip AS COMPOUND 40** " on the threads and under the head of capscrews **J** and **K** and manually tighten them until their stop.     2. Tightening the screws **J** , **K** strictly following the sequence indicated in the **Fig. 9.9** or **Fig.** **9.10** and the tightening torque indicated in the **Tab. 9.2** .     3. Check that crankshaft **M** rotates smoothly.     4. Insert gasket **W** into the seat of crankcase **B** **(** [**ST\_47**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=812&parent=1545) **)** . | 9.11.jpg  **Fig 9.11** |
| **9.3.6 Camshaft**   1. Lubricate the pins **S2** the cams **S3** of the camshaft **S1** all the housing **Q1** with oil. 2. Insert the camshaft **S1** all the way into its housing **Q1** . 3. Fit the lock ring **S4** on to the crankcase B to hold the position of the camshaft **S1.** | 9.12.jpg  **Fig 9.12** |
| **9.3.7 Timing system gear**   1. Check that the pin **P1** is correctly fitted on the crankshaft M. 2. Position the gear **M1** on the crankshaft M respecting the reference with pin **P1** . 3. Fully tighten the screw **N1** interposing tool [**ST\_41**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=812&parent=1545) between **N1** and **M1** . 4. Position the gear **R1** on the camshaft S1 observing the marks **T1** of the gear **M1** .     Z_importante.jpg **Important**       * Failure to comply with the marks **T1** on the gears **M1** and **R1** causes engine malfunction and serious damage. * Fastening capscrew **R2** must be replaced every time it is assembled.  1. Assemble gear **R1** by means of capscrew **R2** (tightening torque **100** **Nm** ). 2. Check that crankshaft **M** rotates smoothly. | 9.12.jpg  **Fig 9.13**  9.14.jpg  **Fig 9.14** |
| **9.3.8 Piston rings**   1. Perform the operations described in [**Par. 8.5.3**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=766&parent=1545) . 2. Put the scraper ring **Z3** onto the piston **Z** . 3. Put the 2° seal ring **Z2** on the piston **Z** . 4. Put the 1° seal ring **Z1** onto the piston **Z** . 5. Perform the operations described in [**Par. 8.5.4**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=766&parent=1545) . 6. Position the segment openings with a 120° angle between them ( **Y** ).   **NOTE:**  do not use the segment opening with the pin hole ( **N** )   1. Lubricate the piston skirt and piston rings with oil. | 9.14.jpg  **Fig 9.15**  9_3_7.png  **Fig 9.16** |
| **9.3.9 Piston**    Z_importante.jpg **Importante**     * The fastening bolts **E1** must be replaced every time they are assembled. * Before proceeding to the assembly of the piston and connecting rod, carry out the checks described in [**Par. 8.5.1**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=766&parent=1545) . * Always replace the bearings **D1** after each assembly. * Mate components respecting references at [**Par. 7.12.5**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=762&parent=1545) .      1. Loosen the screws **E1** and remove the connecting rod cap  **F1** . 2. Insert the connecting rod **F2** into the piston **Z** and align the seats **G1** . 3. Insert the gudgeon pin **H1** into the seat **G1** for the assembly of the connecting rod and piston unit. 4. Insert the lock rings **L1** inside the seat **G2** of the piston **Z** to lock the gudgeon pin **H1** . | 9.16.jpg  **Fig 9.17**  9.17.jpg  **Fig 9.18** |

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| **9.3.10 Piston and connecting rod assembly**    Z_importante.jpg **Important**       * Before assembling the piston and connecting rod assemblies, execute the controls described in [**Par. 8.5.5**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=766&parent=1545) .  1. Rotate the crankshaft **M** by moving the crankpin **J1** to a TDC position of the affected cylinder. | 9.18.jpg **Fig 9.19** |
| 1. Lubricate the piston skirt and rings **Z** . 2. Check that the half-bearing **U1** is mounted correctly and lubricate it thoroughly. 3. Using the piston ring compression pliers, insert the piston inside the cylinder **W1** by around 10mm (height **T2** ).       Z_importante.jpg **Important**       * Make sure you are at the stage described in **Point 1** . * Piston **Z** must be assembled with notch K1 on the side of the skirt facing oil spray nozzles **G** .      1. Rotate the piston **Z** by **10°** counter-clockwise with respect to its correct assembly position (Fig. 9.20 - height **T3** ).     **NOTE:** Doing this prevents the impact between the connecting rod **F2** and the sprayer **G** . | 9.19.jpg **Fig 9.20**    9.20.jpg **Fig 9.21**  9.21.jpg **Fig 9.22**  9.22.jpg  **Fig 9.23** |
| Z_importante.jpg **Important**         * Leave the ring compressor assembled on the piston.  1. Push piston **Z** downwards without introducing the segments in the cylinder, rotate piston **Z** by **10°** in a clockwise direction (value **T3** – correct assembly position). | 9.23.jpg **Fig 9.24** |

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| 1. Push the piston **Z** downwards by centering the crankpin **J1** with the connecting rod  **F2** . 2. Rotate the crankshaft **M** by moving the crankpin **J1** to a BDC position of the affected cylinder. 3. Push the piston **Z** downwards by centering the crankpin **J1** with the connecting rod **F2** . 4. Turn the crankcase on support to assemble the con rod capp **F1** . 5. Check that the half-bearing **U1** is mounted correctly on the connecting rod cap **F1** .       Z_importante.jpg **Important**       * Check that the break levels of connecting rod cap **F1** coincide perfectly onto connecting rod **F2** before screwing on and tightening capscrews **E1** .  1. Couple the connecting rod cap **F1** to the connecting rod **F2** using the marks made at disassembly ( [**Par.** **7.12.2** **and 7.12.5**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=762&parent=1545) ). 2. Apply "Molyslip AS COMPOUND 40" on the threads and under the head of capscrew **E1** and manually tighten them until their stop.     Z_importante.jpg **Important**       * Failure to adhere to the assembly procedures may compromise the functionality of the engine, and also cause damage to persons and property.  1. Tighten the screws **E1** , alternately, strictly following the tightening torques indicated ( **Tab. 9.3** ). 2. Repeat the operations from **1** to **14** for each cylinder. 3. Check that the connecting rods have axial play and the crankshaft **M** rotates smoothly.     **NOTE:** After the check carried out at point 16, position the shaft M with the first cylinder to TDC. | 9.24.jpg **Fig 9.25**9.25.jpg **Fig 9.26**9.26.jpg **Fig 9.27** |
| **Tab 9.3**   |  |  |  | | --- | --- | --- | | **CYCLE** | **SCREWS** | **TORQUE** | | **1** | **E1** | **28 Nm** | | **2** | **E1** | **30°** | | **3** | **E1** | **30°** | | |
| **NOTE** : Click by side to play the procedure. | <https://www.youtube.com/embed/lo6hvF5R6qA?rel=0> |

## Oil sump unit assembly

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| **9.4.1 Oil drain pipe**    Z_importante.jpg **Important**       * It is mandatory to replace the gasket **D** after each assembly. * Always replace capscrews **B** with new ones or alternatively apply **Loctite 2701** .  1. Secure the hose **A** on the crankcase **C** with the screws **B** inserting the gasket **D** (tightening torque **10 Nm** ). | 9.27.jpg **Fig 9.28** |
| **9.4.2 Oil suction pipe**    Z_importante.jpg **Important**       * It is mandatory to replace the gasket **F** after each assembly. * Always replace capscrews **B** with new ones or alternatively apply **Loctite 2701** .      1. Secure the hose **E** on the crankcase **C** with the screws **B** (tightening torque **10 Nm** ) fitting the gasket **F** . | 9.28.jpg **Fig 9.29** |
| **9.4.3 Oil Sump**   1. Ensure that the contact surfaces **G** of the oil sump **H** and the crankcase **C** are completely clean. 2. Apply a bead of approx. **2.5 mm** of sealant ( **Loctite 5660** ) on the surface **G** of the crankcase **C** .   **Note: alternatively apply Loctite 5699.** | 9.29.jpg **Fig 9.30** |
| * 1. Position the oil sump **H** on the crankcase **C** in line with the fastening holes (use the aid of tool  [**ST\_18**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=812&parent=1545) ). | 9.30.jpg **Fig 9.31** |
| Z_importante.jpg **Important**       * Tighten the screws **L** , strictly following the sequence and tightening torque indicated.      1. Secure oil sump **H** by means of capscrews **L** . 2. After tightening of the screw **n° 10** , loosen screw **n°1** and re-tighten it to the torque value specified in **step 4** . | 9.31.jpg  **Fig 9.32** |

## Cylinder head unit assembly

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| **9.5.1 Valve stem gasket**    Z_importante.jpg **Important**       * Carry out the checks described in [**Par. 8.6.4**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=1118&parent=1545) before proceeding with the following operations. * Always replace gasket **A** with every assembly. * Lubricate the oil seals **A** on the inside.      1. Fit the oil seals **A** on the valve guides **B** using the tool [**ST\_08**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=812&parent=1545) . | 9.32.jpg **Fig 9.33** |
| **9.5.2 Injector sleeves** ( operazione_utile.gif **)**   1. Insert the seals **C** in the seats of the sleeve **D** . 2. Insert the seal **E** with the convex side facing upward at the base of the sleeve **D** . 3. Lubricate the gaskets **C** . 4. Insert and carefully screw the sleeve **D** into the seat of the head **F** .     **NOTE:** The sleeve **D** must not protrude above the surface of the head **G** .     1. Clamp the sleeve **D** (tightening torque at **30 Nm** ). | 9.33.jpg **Fig 9.34** |
| **9.5.3 Injectors projection**   1. Perform the operations of  [**Par. 6.1.7.**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=746&parent=1545) 2. Check using [**ST\_03**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=812&parent=1545) tool **(Fig. 9.35)** , the projection of the injector, which must range between 1.68 ÷ 2.42 mm.     **NOTE** : if the value detected does not correspond, replace gasket **Q** with a different thickness. | 9.35.jpg **Fig 9.35 - Fig. 9.36** |
| **9.5.4 Valves**   1. Pre-lubricate and insert the valves **X** into the head **F** taking care to fit them in the original positions as per the reference marks made in [**Par. 7.12.4.1**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=762&parent=1545) . 2. Position the spring **Y** on the seat of the head **F** . 3. Position the disk **S** on the spring **Y** centering the valve **X** . 4. Mount the tool [**ST\_07**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=812&parent=1545) on the head **F** fixing it on one of the holes for securing the rocker arm cover.     **NOTE:** Change the fixing hole according to the position of the valves to be fitted.     1. Position the tool [**ST\_07**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=812&parent=1545) on the valve as shown in the **Fig. 9.37** . 2. Push the lever of the tool [**ST\_07**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=812&parent=1545) downwards, in order to lower the valve disks **S** in the direction of the arrow **AK** , and insert the valve cotters **AJ** inside the disk **S** . 3. Check that the valve cotters **AJ** are properly mounted on the valve seats **X** and release the tool [**ST\_07**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=812&parent=1545) .     **NOTE:** repeat all the steps for the relevant valves and remove the tool [**ST\_07**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=812&parent=1545) . | 9.36.jpg **Fig 9.37** |
| 9.37.jpg **Fig 9.38** |
| 9.38.jpg **Fig 9.39** |
| **9.5.5 Cylinder head**   1. Fix the eyebolts **AW** with the screws **AX** onto the head **F** (tightening torque of **80 Nm** ). 2. Position the piston **P** at the TDC. 3. Position the tool [**ST\_03**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=812&parent=1545) on the crankcase surface of the head and measure the piston protrusion **P** from head level **K** in 4 diametrically opposed points **R.** Repeat the operation for all pistons **P** and take note of the highest average value, determining valu **e S (Tab. 9.4)** .     **Tab. 9.42**   |  |  | | --- | --- | | **S (mm)** | **Hole number** | | 0.030 - 0.126 | 1 1foro.jpg | | 0.127 - 0.250 | 2 2fori.jpg | | 0.251 - 0.375 | 3 3fori.jpg |  1. Based on the value detected at point **3** , select the relevant gasket **T** as shown in the **Tab. 9.4 (Fig. 9.41** detail **U** ). 2. Check that the crankcase surface **K** and the gasket **T** are completely free of dirt and grit.       Z_importante.jpg **Important**       * The head gasket must be replaced for each assembly.  1. Position the gasket **T** on the surface **K** with reference to the centering bushings **J** . | 9.39.jpg **Fig 9.40**9.40.jpg **Fig 9.41**9.41.jpg **Fig 9.42** |
| 1. Check that the surface head **W** is free from impurities. 2. Position the head **F** on the crankcase **Z** with reference to the centering bushings **J** .       Z_importante.jpg **Important**       * The fastening bolts **V** must be replaced every time they are assembled. **Modified component, see service letter 710009.** * Failure to adhere to the bolt fixing procedures may compromise the functionality of the engine, and also may cause damage to persons and property. * Tighten capscrews **V** observing the cycles, tightening, and subsequent rotation as indicated in **Tab. 9.5** .  1. Secure the head **F** by tightening the screws **V** strictly following the sequence indicated in the **Fig. 9.43** and the tightening torque and pauses between cycles indicated in the **Tab. 9.5** . | 9.42.jpg **Fig 9.43** |
| **Tab. 9.5**   |  |  |  | | --- | --- | --- | | **CYCLE** | **TORQUE** | **PAUSE** | | 1 | 75 Nm | 3min | | 2 | 90° | 3min | | 3 | 90° | 3min | | 4 | 90° | --- | | 9.44.jpg **Fig 9.44** |
| **9.5.6 Rods and valve bridges**   1. Insert the rocker control rods **AA** into the niches of the head **F** .     Z_importante.jpg **Important**       * Properly centre the rods **AA** into the spherical housing of the camshaft tappets **AB** .  1. Mount the valve bridge **AC** on to the pairs of discharge and suction valves. | 9.45.jpg **Fig 9.45** |
| 9.46.jpg **Fig 9.46** |
| **9.5.7 Rocker arms**    Z_importante.jpg **Important**       * The discharge rocker arm **AT** is shorter than the suction arm **AR** .      1. Fit the lock ring **AM** into the seat **AN** of the rocker arm pin **AH** . 2. Position the pin **AH** with the screw support surface **AP** facing upwards and insert the 2 shoulder rings **AQ** . 3. Insert in sequence the suction rocker arm **AR** , the holder **AS** and the discharge rocker arm **AT** in the pin **AH .** 4. Insert the spring **AU** in the pin **AH** . 5. Repeat points **3, 4** for all the rocker arms.     **NOTE:** Support **AV** , which contains taper pin **BV** , must be assembled in correspondence with **cylinder n° 3** .     1. Insert 2 shoulder rings **AQ** and the lock ring **AN** to lock all the components inserted in the pin **AH** .     **NOTE** : The spring **AU** ensures that the supports **AS** and **AV** are kept in place. | 9.47.jpg **Fig 9.47**imm9.58.jpg **Fig 9.48** |
| **9.5.8 Rocker arm pin assembly**    Z_importante.jpg **Important**       * Position the rocker arm pin assembly **BB** on a level to align all the support surfaces. * Check that the pistons are positioned half way between the TDC and BDC. As seen from **A** ⇒ ( [**Par. 1.4**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=725&parent=1545) ) turn the crankshaft anticlockwise by 90°, complying with TDC of the **1st cylinder** , positioning taper pin **BP** of the crankshaft as shown in **Fig. 9.48** .      1. Position rocker arm shaft unit **BB** on cylinder head **F** , complying with the taper pin **BC** reference with hole **BF** of cylinder head **F** . 2. Check the correct positioning of all the rocker arms and the u-bolt control valves (detail **BD** ). House the tappet in the seat of the rocker arms control rod. 3. Secure the rocker arm pin **BB** tightening the screws **BE** (tightening torque to **40 Nm** ). Adhere to the screw tightening sequence **BE** as shown in **Fig. 9.50** . | 9.48.jpg **Fig 9.49**9.49.jpg **Fig 9.50** |
| 9.50.jpg **Fig 9.51** |

## Assembly lubrication circuit

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| **9.** **6 .1 Oil pressure relief valve**     1. Lubricate the piston **N** and fully insert it in the seat **P** . 2. Insert the spring **Q** in the piston **N** . 3. Insert disk **R** onto spring **Q** . 4. Insert cotter pin **S** in the provided seat of oil pump **T** to lock components **N, Q** and **R** . | 9.72.jpg **Fig 9.52** |
| **9.6** **.2 Oil pump**  **NOTE:** Carry out the checks described in [**Par. 8.7**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=579&parent=1545) before proceeding with the following operations.     1. Check that all contact surfaces between **T, V** are free of impurities – scratches - dents. 2. When assembling, do not use any type of gasket between  **T** and **V** . 3. Thoroughly lubricate the seat of the rotors on oil pump **T** . 4. Make sure the external rotor is assembled correctly with Ref. **U** visible, as shown in the picture (or refer to [**Par. 2.10.2**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=735&parent=1545) ). 5. Fasten the oil pump cover **T** on the crankcase V with the screws **X** (tightening torque **10** **Nm** ). | 9.73.jpg **Fig 9.53** |
| 9.74.jpg **Fig 9.54** |

## Flange unit assembly

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| **9.7.1 Bell housing**    Z_Pericolo.jpg **Danger**       * Bell **A** is very heavy; pay special attention during assembly operations to avoid dropping and causing serious risks to the operator.  1. Apply a bead of approx. 2.5 mm of sealant ( **Loctite** **5188** ) on the surface **B** of the bell **A** . 2. Assemble bell **A** onto crankcase **D** , complying with reference taper pins **E** **(** [**ST\_45**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=812&parent=1545) **)** . | 9.55.jpg   **Fig 9.55** |

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| Z_importante.jpg **Important**     * Failure to adhere to the assembly procedures may compromise the functionality of the engine, and also cause damage to persons and property. * Always replace and lubricate the gasket **C** with oil, every time they are assembled (the gasket **C** is to be mounted after the operation at point 4 [**ST\_47**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=812&parent=1545) ).  1. Apply the screws **F** by hand without tightening them. 2. Tighten the screws **F** following the tightening sequence indicated (tightening torque **75** **Nm** ). | 9.56.jpg **Fig 9.56** |

|  |  |
| --- | --- |
| **9.7.2 Flywheel**    Z_Pericolo.jpg **Danger**       * Flywheel **F** is very heavy; pay special attention during assembly operations to avoid dropping and causing serious risks to the operator.      1. Loosen capscrews **G** and remove tool [**ST\_41**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=812&parent=1545) . 2. Position flywheel **H** onto crankshaft L by means of tool [**ST\_43 - ST\_46**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=812&parent=1545) **.** 3. Apply " **Molyslip AS COMPOUND 40** " on the threads and under the head of capscrews **G** and manually tighten them until their stop. 4. Secure flywheel H with capscrews **G** (tightening torque **60 Nm** ). 5. Once again, tighten capscrews **G** (2 cycles with tightening torque **130 Nm** ). | 9.57.jpg **Fig 9.57** |

## Fuel system assembly

|  |  |
| --- | --- |
| Z_importante.jpg **Important**       * Remove the protective caps from all the components of the fuel circuit just before assembly just before assembly ( [**Par. 2.9.8**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=786&parent=1545) ). | |
| **9.8.1 High-pressure injection pump**     1. Follow operations 1, 2, 3, 4, 5, 6, 7 and 8 of [**Par. 6.1.5** .](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=746&parent=1545) 2. Follow operations 1, 2, 3, 4, 5, 6, 7 and 10 of [**Par. 6.1.6**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=746&parent=1545) . | |
| **9.8.2 Injectors**    Z_importante.jpg **Important**       * To prevent damaging the injection system, the protection caps ( [**Par. 2.9.7**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=786&parent=1545) ) must be removed during assembly.      1. Follow operations of [**Par. 6.1.7**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=746&parent=1545) . | |
| **9.8.3 Fuel return pipes**     1. Tighten union **A** onto cylinder head **B** , inserting the relative gasket. 2. Perform the operations of point **8** of [**Par. 6.1.6**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=746&parent=1545) **.** | 9.58_34tm.jpg |
| **9.8.4 Rocker arms cover**     1. Perform the operations of [**Par. 6.1.9**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=746&parent=1545) **.** | |
| **9.8.5 Injection fuel pipes**     1. Perform the operations of [**Par. 6.1.10**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=746&parent=1545) **.** | |
| **9.8.6 Fuel filter**     1. Perform the operations of [**Par. 6.5.2**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=750&parent=1545) **.** | |

## Crankshaft pulley assembly

|  |  |
| --- | --- |
| 1. Check that the pin **A** is mounted properly on the crankshaft **B** . 2. Position the pulley **C** on the crankshaft **B** using the pin mark **A** . 3. Apply " **Molyslip AS COMPOUND 40** " grease onto the thread and under the head of capscrew **D** . 4. Fix the pulley **C** with the screw **D** (tightening torque of **100** **Nm** ) and remove special tool [**ST\_34**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=812&parent=1545) . | 9.61.jpg  **Fig 9.61** |

## Coolant circuit assembly

|  |  |
| --- | --- |
| **9.14.1 Thermostatic valve**    Z_importante.jpg **Important**       * Always replace the gasket **A** after each assembly.      1. Check the condition of the seal gasket **A** and fit it on the thermostatic valve **B** . 2. Position the thermostatic valve **B** in the seat on the head **C** (detail **D** ). 3. Secure the cover **E** with the screws **F** on the head **C** (tightening torque of **10 Nm** ). | 9.62.jpg **Fig 9.62** |
| **9.10.2 Coolant pump**  Z_importante.jpg **Important**       * Always replace the gasket **L** every time it is assembled.      1. Secure the flange **G** with the screws **H** interposing the gasket **L** onto the crankcase **M** (tightening torque of **25 Nm** ). 2. Perform the operations 1 and 2 of **Par. 6.2.2.** | 9.63.jpg **Fig 9.63** |
| **9.10.3 Oil Cooler hoses**     1. Secure hose **N** on Oil Cooler **P** and on crankcase **M** by means of clamps **Q** . 2. Position and secure hose **R** by means of clamp **S** on Oil Cooler **P** and on crankcase **M** . 3. Secure clamps **T** on manifold **U** by means of capscrews **V** in points **X** (tightening torque  **10 Nm -** [**ST\_06**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=812&parent=1545) ). | 9.64.jpg  **Fig 9.64** |
| 9.65.jpg  **Fig 9.65** | |

## Exhaust manifold assembly

|  |  |
| --- | --- |
| Z_importante.jpg **Important**     * Replace the metal gaskets **A** every time they are assembled.      1. Check that the contact surfaces **D** are free from impurities. 2. Position manifold **E** onto cylinder head **G** by manually tightening capscrews **F** , inserting: - gaskets **A** between cylinder head **G** and manifold **E** ; - spacers **H** between capscrews **F** and manifold **E** . 3. Secure manifold **E** onto cylinder head **G** by means of capscrews **F** (tightening torque **25** **Nm** ). | 9.66.jpg **Fig 9.66** |

## Turbocharger assembly

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| --- | --- |
| Z_importante.jpg **Importante**       * Before proceeding, perform the operation described in [**Par. 2.18**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=815&parent=1545) **.** * Ensure that tube **C** is not clogged. * Always replace the gaskets **A, B, Q** at each assembly. * Remove the plastic or foam caps from the turbo compressor before assembling.  1. Check that the contact surfaces **D** are free from impurities deformations or cracks, otherwise replace the damaged component. 2. Position the turbo-compressor **E** on the bolts **F** on the manifold **G** . 3. Fasten the turbo-compressor **E** with the nuts **H** (tightening torque of **25 Nm** ). 4. Fasten the pipe **L** with the screws **M** to the turbo-compressor **E** . 5. Fasten the pipe **G** with the screws **N** on the crankcase **P** .     Z_importante.jpg **Importante**     * Always replace the gasket **Q** after each assembly. * Before assembly of the tube **R** , perform the operation described in [**Par. 2.18.2 - Point 2**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=815&parent=1545) **.** * Ensure that tube **R** is not clogged.  1. Fasten the pipe **R** with the fittings **S** on the turbo-compressor **E** and on the crankcase **P** (tightening torque of **15 Nm** ).       Insert the gaskets **Q** between: **- S and R;     - E and R;**    **- P and R.** | 9.67.jpg **Fig 9.67**9.80.jpg **Fig 9.68**9.69.jpg **Fig 9.69** |

## Electric component assembly

|  |  |
| --- | --- |
| **9.13.1 Sensors and switches** | |
| **9.13.1.1 Coolant temperature sensor**   1. Secure the sensor **A** onto the head **B** (tightening torque of **20** **Nm** ). | 9.70.jpg **Fig 9.70** |
| **9.13.1.2 Oil Pressure Switch**   1. Clamp the oil pressure switch **C** on the crankcase **D** (tightening torque at **35 Nm** ). | 9.71.jpg **Fig 9.71** |
| **9.13.2 Alternator**   1. Insert the washer **E** onto the screw **F** . 2. Insert the screw **F** onto the alternator **G** . 3. Secure the bracket **H** and the alternator **G** using the screws **L, F** onto the crankcase **M** . 4. Follow operations 3, 4, 5, 6 and 7 of **Par. 6.2.2.** | 9.72.jpg **Fig 9.72** |
| **9.13.3 Starter Motor**   1. Secure motor **N** by means of capscrews **P** (tightening torque at **45** **Nm** ). | 9.73.jpg  **Fig 9.73** |

## Tightening torques and the use of sealants

**Tab. 9.4** - *\*Alternatively to the capscrew replacements, with "Dri-loc"*

|  |  |  |  |
| --- | --- | --- | --- |
| **BASE CONFIGURATION** | | | |
| **SHORT BLOCK** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Oil sprays fastening capscrew | M6x1 | 10 |  |
| **Lower crankcase fastening capscrew** | **M14x1.25** | **3 Torque cycles** |  |
| 1st Cycle |  | 60 |  |
| 2nd Cycle |  | +45° |  |
| 3rd Cycle |  | +45° |  |
| **Lower crankcase fastening capscrew** | **M10x1.25** | 30 |  |
| **Connecting rod screw** | **M11x1** | **3 Torque cycles** |  |
| 1st Cycle |  | 28 |  |
| 2nd Cycle |  | +30 |  |
| 3rd Cycle |  | +30 |  |
| Coolant drain hole closing cap | M16x1.5 | 50 |  |
| Main oil delivery line closing plate | M6x1 | 15 |  |
| Intermediate idle gear cap fastening screw | M8x1 | 25 |  |
| Camshaft gear fastening screw | M10x1 | 100 | DRI LOC 2040 |
| **OIL SUMP ASSEMBLY** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Oil suction hose fastening capscrew | M6x1 | 10 | Loctite 2701\* |
| Oil return pipe fastening screw | M6x1 | 10 | Loctite 2701\* |
| Oil sump fastening capscrew | M8x1.25 | 25 |  |
| Oil drain cap | M18x1.5 | 30 |  |
| **FLANGE ASSEMBLY (1st PTO)** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Flange bell fastening capscrew | M12x1,75 | 75 |  |
| **Flywheel fastening capscrew** | M12x1,25 | **3 Torque cycles** |  |
| 1st Cycle |  | 60 |  |
| 2nd Cycle |  | 130 |  |
| 3rd Cycle |  | 130 |  |
| **ENGINE CYLINDER HEAD ASSEMBLY** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Air bleeding cap (Rev. 00) | M6x1 | 6 |  |
| Air bleeding cap (Rev. 01) | M14x1,5 | 50 |  |
| Lifting brace fastening capscrew | M8x1.25 | 80 |  |
| Injector manifold | M12x1 | 30 |  |
| **Cylinder head fastening capscrew** | **M12x1.25** | **4 Torque cycles** |  |
| 1 st Cycle |  | 75 |  |
| 2 nd Cycle |  | +90° |  |
| 3 rd Cycle |  | +90° |  |
| 4 th Cycle |  | +90° |  |
| Rocker arm gudgeon fastening capscrew | M8x1,25 | 40 |  |
| Rocker arm cover fastening capscrew | M6x1 | 10 |  |
| **INJECTION SYSTEM** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Fuel filter fastening capscrew | M8x1.25 | 25 |  |
| Injector brace fastening capscrew | M8x1.25 | 20 |  |
| Injector side injection tube nuts | M12x1.5 | 25 |  |
| Injection pump side injection tubes nuts | M12x1.5 | 25 |  |
| Injection pump fastening capscrew | M8x1.25 | 25 | Loctite 2701\* |
| Gear fastening nut on fuel injection pump | M14x1.5 | 140 |  |
| Screw for cover over injection pump shaft nut (on bell housing) | M6x1 | 10 |  |
| **INTAKE MANIFOLD** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Manifold fastening screw | M8x1.25 | 25 |  |
| Intake flange fastening capscrew | M8x1.25 | 25 |  |
| **EXHAUST MANIFOLD** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Exhaust manifold fastening screw | M10x1.5 | 50 |  |
| **LUBRICATION CIRCUIT** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Oil vapour separator support plate fastening capscrew | TG8 | 22 |  |
| Oil steam separator return tube drilled fastening screw (on crankcase) | M6x1.5 |  |  |
| Oil filter fastening union | M20x1.5 | 15 | Loctite 2701\* |
| Oil cooler fastening capscrew | M6x1 | 10 |  |
| Cartridge-holder cover | ... | 25 |  |
| Oil pump fastening screw | M6x1 | 10 |  |
| **CRANKSHAFT PULLEY ASSEMBLY (2nd PTO)** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Crankshaft pulley fastening capscrew | M12x1.75 | 100 | Molyslip |
| **COOLANT CIRCUIT** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Coolant tube clamp fastening capscrew (Oil Cooler return) | TG8 | 22 |  |
| Thermostatic valve cover fastening capscrew | M6x1 | 10 |  |
| Coolant pump fastening capscrew | M8x1.25 | 25 |  |
| Blower fastening capscrew | M8x1.25 | 25 |  |
| **TURBO COMPRESSOR** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Oil return tube fastening capscrew | M6x1 | 10 |  |
| Oil supply tube fastening capscrew | M10x1 | 15 |  |
| Turbine fastening stud (on manifold) | M10x1.5 | 30 |  |
| Exhaust fastening stud (on turbine) | M8x1.25 | 25 |  |
| Exhaust flange fastening stud (on turbine) | M10x1.5 | 30 |  |
| Exhaust flange fastening nut (on turbine) | M8x1.25 | 25 |  |
| **ELECTRICAL COMPONENTS** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Coolant temperature sensor | M12x1.5 | 20 max. |  |
| Oil pressure switch | M12x1.5 | 35 |  |
| Alternator fastening capscrew | M10x1.5 | 45 |  |
| Alternator fastening capscrew | M8x1.25 | 25 |  |
| Starter motor fastening capscrew | M10x1.5 | 45 |  |
| Supply cable fastening nut (starter motor) | M10x1.5 | 15 |  |

\* *Alternatively to the capscrew replacements, with "Dri-loc"*

|  |  |  |  |
| --- | --- | --- | --- |
| **OPTIONAL COMPONENTS (Chap. 11)** | | | |
| **HEATER** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Flange intake with heater fastening capscrew | M8x1.25 | 25 |  |
| **COOLING CIRCUIT** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Blower fastening capscrew | M6x1 | 10 |  |
| Radiator support fastening capscrew | M12x1.75 |  |  |
| Shroud radiator fastening capscrew | M6x1 | 10 |  |
| Radiator lower brace fastening capscrew | M10x1.5 |  |  |
| Radiator on anti-vibrating | M8x1.25 | 25 |  |
| Vibration-damping nut fixing (on radiator support) | M8x1.25 | 25 |  |
| Anti-vibrating and brace fastening capscrew (upper) | M8x1.25 | 25 |  |
| Upper brace fastening capscrew (on engine cylinder head) | M8x1.25 | 25 |  |
| Side bulkheads fastening capscrew | M6x1 | 10 |  |

*\* Alternatively to the capscrew replacements, with "Dri-loc"*

