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| **Assembly information** |
| **KDI 1903TCR / KDI 1903TCRE5 Workshop manual (Rev. 17.8)** |



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**Translated from the original manual in Italian language**

Data reported in this issue can be modified at any time by KOHLER.

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=96&parent=1000) **-** [**Par.**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=97&parent=1000) [**1.5**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=97&parent=1000) ).
* For the assembly of components not described in this chapter refer to [**Chap. 11**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=176&parent=1000) .
* The following are the components described in [**Chap. 11**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=176&parent=1000) .

**11.1** [**Oil dipstick in cylinder head**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=176&parent=1000) **11.2** [**Heater (replacement)**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=177&parent=1000) **11.3** [**Poly-V alternator belt (replacement and adjustment)**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=178&parent=1000) **11.4** [**Tightening pulley and alternator for Poly-V belt**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=179&parent=1000) **11.5** [**Idler gear (for 3 rd / 4 th PTO)**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=180&parent=1000) **11.6** [**3 rd PTO (replacement)**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=181&parent=1000) **11.7** [**4 th PTO (replacement)**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=182&parent=1000) **11.8** [**3 rd + 4 th PTO (configurations)**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=364&parent=1000) **11.9** [**Balancer shafts (replacement)**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=183&parent=1000) **11.10** [**Air filter (cartridge replacement)**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=184&parent=1000) **11.11** [**Remote oil filter (disassembly and assembly)**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=185&parent=1000) **11.12** [**Oil sump with supporting structure**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=821&parent=1000)

**11.13** [**ETB (REPLACEMENT)**](https://iservice.lombardini.it/jsp/Template4/manuale.jsp?id=2663&parent=1088)

**11.14** [**ACACT (REPLACEMENT)**](https://iservice.lombardini.it/jsp/Template4/manuale.jsp?id=2665&parent=1088)

**11.15** [**EGTS (REPLACEMENT)**](https://iservice.lombardini.it/jsp/Template4/manuale.jsp?id=2666&parent=1088)

**11.16** [**DPF & DOC filter (REPLACEMENT)**](https://iservice.lombardini.it/jsp/Template4/manuale.jsp?id=2667&parent=1088)

**11.17** [**Oil dipstick on timing gear side**](https://iservice.lombardini.it/jsp/Template4/manuale.jsp?id=2675&parent=1088)

## 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=822&parent=1000) , [**Tab. 13.2**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000) and [**Tab. 13.3**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000) hereinafter in **Tab. 9.1** an example of a special tool ( [**ST\_05**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000) ).

**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=198&parent=1000) .
* 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=152&parent=1000) , 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 **B** onto the crankcase upper half **E** adhering to the reference notches **C** .         Z_importante.jpg **Important**       * After the half-bearings are fitted, check that the lubrication holes **D** correspond with the crankcase grooves **E** . * The lower and upper half bearings **CANNOT** be singularly replaced, and both halves must be replaced together.  1. Fit the new half-bearings **S** onto the lower crankcase **F** using the reference notches **C** . 2. Lubricate the half-bearings **A and B** with oil. | imm9.1.jpg **Fig 9.1**imm9.2.jpg **Fig 9.2** |
| **9.3.2 Tappets**   1. Lubricate the tappets **G** with oil. 2. Insert the tappets **G** into the housings **H** of the upper crankcase. | imm9.3.jpg **Fig 9.3** |
| **9.3.3 Camshaft**   1. Check that the bushing **Q** is correctly fitted. 2. Lubricate the pins **L** , the cams **M** of the camshaft **N** , all the housing **P** and the bushing **Q** with oil. 3. Insert the camshaft **N** all the way into its housing **P** . 4. Fit the lock ring **R** on to the crankcase **E** to hold the position of the camshaft **N** . 5. Manually rotate the camshaft **N** ensuring that it is free. | imm9.4.jpg **Fig 9.4** |
| **9.3.4 Oil spray nozzles**   1. Insert the sprayers **V** onto the upper crankcase **E** manually screwing the screw fittings **U** . 2. Direct the sprayers **V** as shown **Z** and tighten the connecting screws **U** (tightening torque of **10 Nm** ). | imm9.5.jpg **Fig 9.5** |
| **9.3.5 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=154&parent=1000) .  1. Check that the crankshaft half-bearings are mounted correctly on the upper crankcase **E** . 2. Lubricate the main journal and crankpin **J** , with oil. 3. Insert the crankshaft **W** into its seat on the upper crankcase **E** . 4. Insert the 2 shoulder half-rings **K** , between the crankshaft **W** and the upper crankcase **E** ( **AB** detail). | imm9.6.jpg **Fig 9.6** |
| **9.3.6 Lower crankcase**   1. Check that the crankshaft half-bearings are mounted correctly on the lower crankcase **F** ( **AC** detail). 2. Assemble the 2 shoulder half-rings **AD** onto the lower crankcase **F** applying two drops of grease to keep them in their seat. 3. Check that the coupling surfaces **AE** are free from dirt and grit. | imm9.7.jpg **Fig 9.7** |
| 1. Spread a bead of **Loctite 5660 (rif. AL)** of approx **1 mm** thickness on the surface **AM** of the upper crankshaft half **C** being careful not to block the oil feed grooves **AG** and the return oil sump **AH** . 2. Join the two crankshaft halves **E and F** observing the guide pins **AN** . | imm9.8.jpg **Fig 9.8** |
| Z_importante.jpg **Important**       * Failure to adhere to the bolt fixing procedures may compromise the functionality of the engine, and may also cause damage to persons and property.  1. Tighten the fastening screws strictly following the sequence and the tightening torque indicated. **Tightening sequence for 3 cylinders** Tightening Screws **Torx M12x1.25** (from the **n° 1** to the **n° 8** ): CYCLE 1 - with a torque of **40 Nm** ; CYCLE 2 - with a torque of **70 Nm** ; CYCLE 3 - with a torque of **120 Nm** .     Tightening Screws **M8x1.25** (from the **n° 9** to the **n° 21** ): CYCLE 4 - with a torque of **20Nm** ; CYCLE 5 - with a torque of **35** **Nm** ;   1. Perform the operations described in [**Par. 8.4.2**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=154&parent=1000) . 2. Check that crankshaft **W** rotates smoothly.     **NOTE:** In the next illustrations of **Par. 9.1** the coupled crankcase half will be indicated with the letter **E** . | ***3******Cylinders***  Fig._9.9.jpg   **Fig 9.9** |
| 1. **Tightening sequence for 3 cylinders** Tightening Screws **Torx M12x1,25** (from the **n° 1** to the **n° 10** ): CYCLE 1 - with a torque of **40 Nm** ; CYCLE 2 - with a torque of **70 Nm** ; CYCLE 3 - with a torque of **120 Nm** .     Tightening Screws **M8x1.25** (from the **n° 11** to the **n° 27** ): CYCLE 4 - with a torque of **20Nm** ; CYCLE 5 - with a torque of **35** **Nm** ;   1. Perform the operations described in  [**Par. 8.4.2**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=154&parent=1000) . 2. Check that crankshaft **W** rotates smoothly. | ***4******Cylinders***  Fig._9.10.jpg **Fig 9.10** |
| **9.3.7 Piston rings**   1. Perform the operations described in [**Par. 8.5.3**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=155&parent=1000) . 2. Put the scraper ring **AP** onto the piston **AQ** . 3. Put the 2° seal ring **AR** on the piston **AQ** . 4. Put the 1° seal ring **AS** onto the piston **AQ** . | imm9.11.jpg **Fig 9.11** |
| 1. Perform the operations described in [**Par. 8.5.4**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=155&parent=1000) . 2. 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_3_7.png **Fig 9.12** |
| **9.3.8 Piston**    Z_importante.jpg **Important**       * 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=155&parent=1000) . * Always replace the bearings **CE** after each assembly. * Mate components respecting references at [**Par. 7.15.5**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=160&parent=1000) .  1. Loosen the screws **AU** and remove the connecting rod cap **AV** . 2. Fit the new bearings **CE** . 3. Insert the connecting rod **AZ** into the piston **AQ** and align the seats **BA** . 4. Insert the gudgeon pin **BB** into the seat **BA** for the assembly of the connecting rod and piston unit. 5. Insert the lock rings **BD** inside the seat **BE** of the piston **AQ** to lock the gudgeon pin **BB** . | imm9.13_9.14.jpg **Fig 9.13**imm9.14_9.15.jpg **Fig 9.14 - Fig 9.15** |

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| **9.3.9 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=155&parent=1000) .  1. Rotate the crankshaft **W** by moving the crankpin **BG** to a TDC position of the affected cylinder. | imm9.16.jpg **Fig 9.16** |
| 1. Lubricate the piston skirt and rings **AQ** . 2. Check that the half-bearing **AS** is mounted correctly and lubricate it thoroughly. 3. Using the piston ring compression pliers, insert the piston inside the cylinder **BQ** by around 10mm (height **BM** ).       Z_importante.jpg **Important**       * Make sure you are at the stage described in **Point 1** . * The piston **AQ** must be mounted with the arrow **BN** (stamped on the piston crown) facing the timing system side.  1. Rotate the piston **AQ** by **10°** counter-clockwise with respect to its correct assembly position ( **Fig. 9.18** - height **BP** ).   **NOTE:** Doing this prevents the impact between the connecting rod **AZ** and the sprayer **V** . | imm9.17.jpg **Fig 9.17**imm9.18.jpg **Fig 9.18**imm9.19.jpg **Fig 9.19** |
| Z_importante.jpg **Important**         * Leave the ring compressor assembled on the piston  1. Push piston **AQ** downwards without introducing the segments in the cylinder, rotate piston **AQ** by **10°** in a clockwise direction (value **BR** – correct assembly position). | imm9.20.jpg **Fig 9.20** |

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| 1. Push the piston **AQ** downwards by centering the crankpin **BG** with the connecting rod **AZ** . 2. Turn the crankcase on support to assemble the con rod capp on cylinder 1 and 4. 3. Check that the half-bearing **AS** is mounted correctly on the connecting rod cap **AV** .       Z_importante.jpg **Important**       * Check that the break levels of connecting rod cap AV coincide perfectly onto connecting rod AZ before screwing on and tightening capscrews AU.  1. Couple the connecting rod cap **AV** to the connecting rod **AZ** using the marks made at disassembly ( [**Par. 7.15.2 and 7.15.5**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=148&parent=1000) ). 2. Screw in the screws **AU** . 3. Repeat the operations from 1 to 10 for each cylinder.         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 **AU** , alternately, strictly following the tightening torques indicated.     Tightening sequence of screws **Torx M10x1** : **1° CYCLE -** with a torque of **40 Nm; 2° CYCLE** - with a torque of **85 Nm** ;     1. Check that the connecting rods have axial play and the crankshaft **W** rotates smoothly.     **NOTE:** After the check carried out at point **14** , position the shaft **W** with the first cylinder to TDC. | imm9.21.jpg **Fig 9.21**imm9.22.jpg **Fig 9.22**imm9.23.jpg **Fig 9.23** |
| **NOTE:** Click by side to play the procedure. | <https://www.youtube.com/embed/Ba8qqxTx6wA?rel=0> |
| **9.3.10 Crankshaft gasket flange**      Z_importante.jpg **Important**       * Check that the contact surface between the flange and the crankcase is free of grit and dirt. * Always replace the gasket **BS** at each assembly.      1. Check that there are bushings **BT** on the crankcase **E** . 2. Lubricate the oil seal lip **BU** . 3. Position the gasket **BS** and flange **BV** on the crankcase **E** in correspondence with the bushings **BT** . 4. Put **Loctite 243** on the **2** screws **BW** matching the bushings **BT** . 5. Screw the fastening screws all the way in **BW** without tightening them. 6. Tighten all the screws **BW** strictly following the tightening sequence indicated (tightening torque to **10 Nm** ). | imm9.24.jpg **Fig 9.24**imm9.25.jpg **Fig 9.25** |
| **9.3.11 Cover 3 rd PTO**    Z_importante.jpg **Important**       * Replace capscrews **CA** with each assembly or alternatively apply **Loctite 2701** on the thread.  1. Secure the cover **CB** with the screws **CA** and **CC** inserting the gasket **CD** (tightening torque **25 Nm** ). | imm9.26.jpg **Fig 9.26** |

## Oil sump unit assembly

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| **9.4.1 Oil vapour pipes**   1. Apply **Loctite 648** on the pipe threads **A** . 2. Screw and tighten the pipes **A** (tightening torque of **15 Nm** ). | imm9.27.jpg **Fig 9.27** |
| **9.4.2 Oil suction pipe**  Z_importante.jpg **Important**       * It is mandatory to replace the gasket **B** after each assembly. * Always replace capscrews **D** with new ones or alternatively apply **Loctite 2701** .      1. Insert the new gasket **B** in the seat of the oil suction hose flange **D** . 2. Secure the hose **C** on the crankcase **E** with the screws **D** (tightening torque **10 Nm** ). | imm9.28.jpg **Fig 9.28** |
| **9.4.3 Oil Sump**   1. Ensure that the contact surfaces **F** of the oil sump **G** and the crankcase **E** are completely clean. 2. Apply a bead of approx. **2.5 mm** of sealant **(Loctite 5660)** on the surface **F** of the oil sump **G** . 3. **Note** : alternatively apply **Loctite 5699** . | imm9.29.jpg **Fig 9.29** |
| Z_importante.jpg **Important**       * Tighten the screws **L** , strictly following the sequence and tightening torque indicated.      1. Tighten the screws **L** following the sequence indicated (tightening torque **25 Nm** ). 2. After tightening all of the screws, loosen screw **n°1** and retighten it to the torque value specified in step **4** . 3. Check that the oil drain plugs **M** are tight (tightening torque **35 Nm** ). | imm9.30.jpg **Fig 9.30** |

## Flange unit assembly

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| **9.5.1 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. Install the bell housing **A** in accordance with the reference pins **B** on the base **C** . | imm9.31.jpg **Fig 9.31** |
| 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 fastening screws strictly following the tightening sequence indicated (tightening torque **50 Nm** ). | imm9.32.jpg **Fig 9.32** |
| **9.5.2 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. Screw the special tool [**ST\_09**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000) on the crankshaft **E** instead of the screws **G** positioned higherup ( **Fig. 9.33** ). 2. Insert the flywheel F on the crankshaft **E** using the tool as a guide [**ST\_09**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000) and manually tighten all the screws **G** , remove the tool [**ST\_09**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000) and install the last screw **G.** 3. Mount the tool [**ST\_34**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000) in the seat of the starter motor **H** and fit it with the two starter motor fixing screws. 4. Tighten the screws **G** (tightening torque at **140 Nm** ). | imm9.33.jpg **Fig 9.33** |

## Timing system gear assembly and injection pump

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| **9.6.1 Timing system gear assembly**   1. Check that the key **A** is correctly fitted on the camshaft **B** . 2. Position the gear **C** on the camshaft B adhering to the key reference **A** . 3. Screw capscrew **D** until the end. 4. Insert the reference pin **E** on the gear **C** . 5. Screw the encoder **F** with the screws **G** on the gear **C** observing the plug **E** . 6. Tighten the middle gear pin **H** , in the housing **J** of the crankcase, with the screws **K** (tightening torque **25 Nm** ).       Z_importante.jpg **Important**       * The fitting of the middle gear pin **H** has only one position, the 4 screw holes **K** are not equally spaced. * Always replace the gasket **L** after each assembly.  1. Insert the shoulder ring **M** . 2. Check the integrity of the bushing **N** on the middle gear **P** , and ensure that it is free from impurities. 3. Thoroughly lubricate the pin **H** and the bushing **N** . 4. Position the gear **P** on the pin **H** observing all the marks **W** of the gears **C and S** , **(Fig. 9.37).**       Z_importante.jpg **Important**       * Failure to comply with the marks **W** on the gears **C, P and S** , causes engine malfunction and serious damage.  1. Insert the shoulder ring **Q** and the lock ring **R** . 2. Tighten the gear **C** with the screw **D** ( **Fig. 9.34** - tightening torque at **100 Nm** ). 3. Tighten the screws **G** on the gear **C** (tightening torque at **5 Nm** ). | imm9.34.jpg **Fig 9.34**imm9.35.jpg **Fig 9.35**imm9.36.jpg **Fig 9.36**imm9.37.jpg **Fig 9.37** |
| **9.6.2 High-pressure injection pump**   1. Check that the surface **V** is free from impurities ( **Fig. 9.38** ).       Z_importante.jpg **Important**       * Always replace gasket **U** with every assembly. * The seal gasket **U** can only be fitted in one direction( **Fig. 9.38** ). * Always replace capscrews **T** with new ones or alternatively apply **Loctite 2701 (Fig. 9.38)** .  1. Fit the new gasket **U** on the injection pump **Z** **(Fig. 9.38)** . 2. Fix the pump **Z** into the housing **V** together with the gasket **U** by the screws **T** ( **Fig. 9. 38** - tightening torque at **25 Nm** ). 3. Check the correct fitting of the key **AA** on the shaft **AB** of the injection pump ( **Fig. 9.39** ). 4. Place the gear **AC** on the shaft **AB** of the pump respecting the reference to the key **AA** and the reference **Q** of the gear **A** **E (Fig. 9.39)** . Serrare il dado **AD** (coppia di serraggio a **65 Nm** ). 5. Remove special tool [**ST\_34**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000) ). | imm9.38.jpg **Fig 9.38**imm9.39.jpg **Fig 9.39**imm9.40.jpg **Fig 9.40** |

## Cylinder head unit assembly

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| **9.7.1 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=680&parent=1000) before proceeding with the following operations. * 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=822&parent=1000) . | imm9.41.jpg **Fig 9.41** |
| **9.7.2 Electronic 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 **BF** .     1. Clamp the sleeve **D** (tightening torque at **30 Nm** ). | imm9.42.jpg **Fig 9.42** |
| **9.7.3 Electronic injectors projection**   1. Insert the electronic injector **G** inside the sleeve **H** . 2. Mount the rocker arm pin fixing screw **L** up to the stop. 3. Mount the electronic injector fixing bracket **M** and secure it with the screw **N** , without performing the calibration. 4. Check using [**ST\_03**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000) tool **(Fig. 9.44)** , 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. | imm9.43.jpg **Fig 9.43**imm9.44.jpg **Fig 9.44** |
| **9.7.4 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. 7.13.4.1**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=146&parent=1000) . 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=822&parent=1000) 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=822&parent=1000) on the valve as shown in the figure. 2. Push the lever of the tool [**ST\_07**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000) 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=822&parent=1000) .     **NOTE:** repeat all the steps for the relevant valves and remove the tool [**ST\_07**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000) . | imm9.45.jpg **Fig 9.45** |
| imm9.46.jpg **Fig 9.46** |
| imm9.47.jpg **Fig 9.47** |
| **9.7.5 Cylinder head**   1. Fix the eyebolts **AW** with the screws **AX** onto the head **F** (tightening torque of **25 Nm** ). 2. Position the piston **P** at the TDC. 3. Position the tool [**ST\_03**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000) 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. 9.2)** .     **Tab. 9.2**   |  |  | | --- | --- | | **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. 9.2 (Fig. 9.50** 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** . | imm9.48.jpg **Fig 9.48**imm9.49.jpg **Fig 9.49**imm9.50.jpg **Fig 9.50** |
| 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.  1. Secure the head **F** by tightening the screws **V** strictly following the sequence indicated in the **Fig. 9.52** or **Fig. 9.53** and the tightening torque indicated in the **Tab. 9.3** . | imm9.51.jpg **Fig 9.51** |
| Z_importante.jpg **Important**       * 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. 9.3** . * For engine **KDI 1903 TCR** : 8 screws **Torx M12x1,25 (Fig. 9.52)** . * For engine **KDI 2504 TCR** : 10 screws **Torx M12x1,25 (Fig. 9.53)** . | **3 CYLINDERS**  Fig._9.49.jpg **Fig 9.52** |
| **Tab. 9.3**   |  |  | | --- | --- | | **CYCLE** | **TORQUE** | | 1 | 40 Nm | | 2 | 70 Nm | | 3 | 100 Nm | | 4 | 90° | | 5 | 90° | | 6 | 90° | | **4 CYLINDERS**  Fig._9.50.jpg **Fig 9.53** |
| **9.7.6 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. | imm9.54.jpg **Fig 9.54** |
| imm9.55.jpg **Fig 9.55** |
| **9.7.7 Rocker arms**    Z_importante.jpg **Important**       * To correctly position the rocker arms, turn the rocker arm pin **AH** with the lower height **AL** towards the timing system side as in **Fig.9.57** . * 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:** The holder **AV** must be fitted with the last pair of rocker arms towards the flywheel. 6. 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. | imm9.57.jpg **Fig 9.57**imm9.58.jpg **Fig 9.58** |
| **9.7.8 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. Rotate the crankshaft 90° counterclockwise with regard to the 1st cylinder TDC, positioning the crankshaft pin **BP** as shown in Fig **9.60a** . If the crankshaft pulley and the timing gear cover have not been removed, rotate the crankshaft positioning the reference **BQ** located on the target wheel in correspondence of the speed sensor, as shown in **Fig. 9.60b** . * If the engine is painted or protected with clear paint, replace the fastening screws  **BE** .  1. Position the rocker arm pin assembly **BB** on the head **F** , respecting the plug **BC** on the head using the holder indicated **AV** . 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 **25 Nm** ). Adhere to the screw tightening sequence **BE** as shown in **Fig. 9.60** . | imm9.59.jpg **Fig 9.59**imm9.60.jpg **Fig 9.60** |
| imm9.60A.jpg **Fig 9.60a** | imm9.60B.jpg **Fig 9.60b** |
| **9.7.9 Assembly Rocker arm cover**    Z_importante.jpg **Important**       * Replace gasket **BF, BL and BM** with each assembly **(** [**ST\_11**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000) **-** [**ST\_12**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000) **)** . **Modified component, see service letter 700027.** * Observe the order of tightening illustrated in **Fig. 9.62 - 9.63** .      1. Position tool [**ST\_17**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000) onto the head in correspondence with the two fastening holes **5 and 6** . 2. Position gasket **BF** on cylinder head **F** using tool [**ST\_17**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000) as a guide. 3. With vaseline lubricate the gaskets **BL** in the upper part, and the gaskets **BM** in the lower part. 4. Attach the rocker arm cover **BN** on the head **F** with the screw **BG** (tightening torque to **10 Nm** ). | imm9.61.jpg **Fig 9.61** |
| imm9.62.jpg **Fig 9.62** | imm9.63.jpg **Fig 9.63** |

## Fuel system assembly

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| Z_importante.jpg **Important**       * Do NOT mount new or different injectors without the required tool ( [**Chap. 13**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000) ). * Remove the protective caps from all the components of the fuel circuit just before assembly just before assembly.   **9.8.1** **Fuel filter**   1. Secure the fuel filter holder **R** with the screws **S** on the crankcase **T** (tightening torque of **25 Nm** ).     **NOTE:** For the assembly of the fuel cartridge, refer to operations **4** and **5** of [**Par. 6.11.2**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=133&parent=1000) . | imm9.64.jpg **Fig 9.64** |
| 1. Insert the tube **K** on the fitting coming out of the filter holder **R** and on the fuel inlet fitting of the injection pump **M** and secure it with the clamps **N** . | imm9.65.jpg **Fig 9.65** |
| **9.8.2 Common Rail**   1. Secure the rail **AA** on the head **AB** with the screws **AC** (tightening torque at **25 Nm** ). | imm9.66.jpg **Fig 9.66** |
| 1. Fit the gaskets **AD** and the fitting **AE** on the screw **AF** . 2. Tighten the parts so assembled on the Common Rail **AG** (tightening torque at **15 Nm** ) with the entrance of union **AE** facing upward. | imm9.67.jpg **Fig 9.67** |
| **9.8.3 Electronic injectors**    Z_importante.jpg **Important**       * Always replace and lubricate the gaskets **AH and** **AL** of the electronic injectors **AM** with fuel, every time they are assembled. * Pay attention when repositioning the electronic injectors, using the marks as described inl [**Par. 7.10.5**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=143&parent=1000) . * If a new (or different) electronic injector is fitted on the engine, you are required to prepare tool [**ST\_01**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000) . * If the engine is painted or protected with clear paint, clean the paint off the diesel injector  **AM  near to the part in contact with the gasket ( BL  >  Fig. 9.61 ) .**  1. Insert the gasket **AL** inside the injector sleeve **BQ** . 2. Insert the electronic injectors **AM** inside the rocker arm cover **AN** and orientate them as per **Fig. 9.68** . | imm9.68.jpg **Fig 9.68** |
| **9.8.4 High pressure fuel pipes**    Z_importante.jpg **Important**       * Always replace the pipes **AQ** and tube **E** after each assembly.      1. Position the pipes **AQ** on the Common Rail **AA** and on the electronic injectors **AM** , adjust the position of electronic injectors **AM** via the fitting inlets with the pipes **AQ.**       Z_importante.jpg **Important**       * Tighten the nuts **AS** and **AT** manually, without clamping them. * If the engine is painted or protected with clear paint, replace the fastening screws  **AU** to ensure the gaskets **BQ** are sealed properly.  1. Position the injector fastening brackets **AV** and the screws **AU** , inserting the washer **AJ** .       Z_importante.jpg **Important**       * Replace the pipes **AQ (Fig. 9.69)** if the screws **AU** do not rotate freely.  1. Tighten all the nuts **AS** (tightening torque at **30 Nm** ). 2. Tighten the nuts **AT** (tightening torque at **25 Nm** ). 3. Make sure that the mounting brackets **AV** are positioned correctly on electroinjectors **BR** and on fixing screws of the rocker arm assembly **AM.** 4. Tighten the fixing screws of the injector mounting bracket (tightening torque of **20 Nm** ). 5. Position the pipe E screwing the screws **BA and BB** .       Z_importante.jpg **Important**       * Screw the nuts **BA** and **BB** manually without tightening them.  1. Tighten the nut **BA** (tightening torque of **30 Nm** ). 2. Tighten the nut **BB** (tightening torque of **25 Nm** ). 3. Tighten the Common Rail fastening screws **BC** (tightening torque of **25 Nm** ). | imm9.69.jpg **Fig 9.69**imm9.70.jpg **Fig 9.70**imm9.71.jpg **Fig 9.71** |
| **9.8.5 Fuel return pipes**   1. Check the gaskets **BD** on the fittings **BG** .     **NOTE:** Do not disconnect the pipes from the distributor. | imm9.72.jpg **Fig 9.72** |
| 1. Position the return pipes and fitting the distributor **BE** with the screw **BC** on the head **BF** ( **Fig. 9.72** - tightening torque of **10 Nm** ). 2. Mount the fittings **BG** ( **Fig. 9.74** ) on the injectors **AM** and lock them with the clips **BH** . 3. Insert the pipe **BL** on the fitting **BN** . 4. Insert the pipe **BM** on the fitting **BP** . | imm9.73.jpg **Fig 9.73** |
| Z_importante.jpg **Important**       * Pipes of a **"BASE CONFIGURATION"** (refer to [**Par. 1.5**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=97&parent=1000) ) engine are shown. Other return pipes can be missing or different. * The pipes can vary in quantity, size and dimensions depending on the engine version. | imm9.74.jpg **Fig 9.74** |

## Intake manifold assembly

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| **9.9.1 Semi-collettor external**    Z_importante.jpg **Important**       * Check that the contact surfaces between the semi-collector **C** and the head **D** are free from impurities.      1. Insert the special tool [**ST\_18**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000) into indicated point. 2. Insert the screws **A** and the gasket **B** on the semi-collector **C** . 3. Secure the semi-collector **C** with the screws **A** on the head **D** (tightening torque of **25 Nm** ). 4. Tighten the clamp **E** with the screw **F** on the semi-collector **C** (tightening torque of **10 Nm -** [**ST\_06**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000) ). 5. Tighten the screw **G** and the holder **H** on the semi-collector **C** (tightening torque of **10 Nm -** [**ST\_06**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000) ). | imm9.75.jpg **Fig 9.75**imm9.76.jpg **Fig 9.76** |
| **9.9.2 External half-manifold**    Z_importante.jpg **Important**       * Check that the contact surfaces between the two semi collectors **C** and **M** are free from impurities.      1. Fit the screws **L** on the semi-collector **M** freeing the holes **Q** indicated in **Fig. 9.78** . 2. Mount the gaskets **N** on the semi-collector by interposing the separation sheet **P** . 3. Fit the semi-collector **M** on the semi-collector **C** with the screws **L** (tightening torque of **22 Nm -** [**ST\_05**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000) ). | imm9.77.jpg **Fig 9.77**imm9.78.jpg **Fig 9.78** |

## Exhaust manifold assembly

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| Z_importante.jpg **Important**       * Replace the self-locking nuts **B** and the metal gaskets **D** between the manifold and the cylinder head every time they are disassembled. * In the event of mounting the studs **C** , fix ( **25 Nm** tightening torque) with **Loctite 2701** on the thread.  1. Check that the contact surfaces **F** are free from impurities. 2. Insert the gaskets **D** and **E** on the studs **C** . 3. Position the manifold **A** on the studs **C** . 4. Fix the manifold **A** on the cylinder head by tightening the self-locking nuts **B** (tightening torque of **25 Nm** ). | imm9.79.jpg **Fig 9.79** |

## Assembly lubrication circuit

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| **9.11.1 Assembly oil mist separator unit**    Z_importante.jpg **Important**       * Always replace the gasket **B** after each assembly. * Always carefully inspect the condition of the pipes, and replace them if there is any doubt regarding the integrity of their seal.  1. Check that the contact surfaces **A** are free from impurities. 2. Mount the gasket **B** on the holder **C** . 3. Fix the separator body holder **C** on the crankcase **E** with the screws **D** (tightening torque of **12 Nm** ) fitting the gasket **B** . | imm9.80.jpg **Fig 9.80** |
| 1. Fit the pipes **F and G** on the holder **C** . 2. Insert the bleeder **H** attaching it to the pipes **F and G.** Secure the pipe **F** with the clamps **J** . 3. Secure the bleeder **H** onto the holder **C** with the clamp **K** . | imm9.81.jpg **Fig 9.81** |
| **9.** **11 .2 Oil Cooler and oil filter Unit Assembly**   1. Check that the surface **L** on the holder **V** and on the crankcase **E** are free from impurities. 2. Lubricate and insert the gasket **N** on the fitting **P** .       Z_importante.jpg **Important**       * Always replace the gaskets **Q and S** every time they are disassembled.  1. Lubricate and insert the gaskets **Q and S** respectively in the seats **R and T** of the holder **V** . 2. Secure the holder V with the screws AA and AB (tightening torque of **10 Nm** ).       Z_importante.jpg **Important**       * In the event of mounting the fitting **P** on the crankcase **E** (tightening torque of **15 Nm** with **Loctite 2701** on the thread). | imm9.82_9.83.jpg **Fig 9.83 e Fig 9.83** |
| **NOTE:** To assemble the oil cartridge refer to operations **5 and 6** of [**Par. 6.10.2**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=132&parent=1000) .    Z_importante.jpg **Important**       * Always replace the gaskets **BM and BN** every time they are assembled.  1. Insert and tighten the cartridge-holder cover **AC** on the filter holder **V** (tightening torque of **25 Nm** ). | imm9.84.jpg **Fig 9.84** |
| **9.** **11 .3 Oil pump**  **NOTE:** Carry out the checks described in [**Par. 8.7**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=157&parent=1000) before proceeding with the following operations.     1. Check that all contact surfaces between **AL, AH, AF, AG and AN** are free of impurities – scratches - dents. 2. When assembling, do not use any type of gasket between **AG and AN** . 3. Thoroughly lubricate the seat of the rotors **AF** on the oil pump crankcase **AG** and the two rotors **AH and AL** . 4. Insert, inside the seat **AF** , the 2 rotors (in sequence) **AH and AL** , respecting the reference **BP** as the picture (or refer to [**Par. 2.10.2**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=104&parent=1000) ). 5. Check that the 2 pins **AM** are inserted properly in the crankcase timing system **AN** . 6. Position the oil pump assembly **AG** using the pin marks **AM.** 7. Fasten the oil pump cover **AG** with the screws **AH** (tightening torque **10 Nm** ). | imm9.85.jpg **Fig 9.85**imm9.86.jpg **Fig 9.86** |
| **9.** **11 .4 Timing system carter**    Z_importante.jpg **Important**       * Always replace the the gasket **AP** after each assembly ( [**ST\_14**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000) ). * Always replace the gasket **AU** after each assembly. * To prepare the surface of the **K** plane for the new application of the sealant, it must be cleaned through the use of: - initially **Loctite SF 7200** - subsequently **Loctite SF 7063** Avoid any contact with the **K** plane and be careful not to compromise the cleaning performed.  1. Distribute a bead of **Loctite 5188** , of about **1mm** thickness, on the surfaces **AQ** of the crankcase **AN.** 2. Make sure that the key **AS (Fig. 9.88)** is inserted properly on the crankshaft and that it is facing upwards. 3. Lubricate and insert the gasket **AU** in the seat of oil pump **AV** . 4. Apply the tool **ST\_10** onto the crankshaft. 5. Check that the 2 pins **AT** ( **Fig. 9.88** ) are properly insertedin the timing system crankcase **AN** . 6. Lubricate oil seal **AP** with oil and position the carter **AN** on the crankcase **E** , using the pins **AT** , inserting the oil pump **AV** on the crankshaft. 7. Fasten capscrews **AW** observing the indicated clamping sequence (tightening torque of **25 Nm** ). | imm9.87.jpg **Fig 9.87**imm9.88.jpg **Fig 9.88**imm9.89.jpg **Fig 9.89** |
| **9.** **11 .5 Crankcase oil filler flange Timing System**    Z_importante.jpg **Important**       * Always replace the gasket **BA** after each assembly.  1. Position the gasket **BA** in the seat on the flange **BB** . 2. Fasten the flange **BB** on the crankcase **BC** with the screws **BD** (tightening torque of **10 Nm -** [**ST\_06**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000) ). | imm9.90.jpg **Fig 9.90** |
| **9.** **11 .6 Oil pressure relief valve**   1. Lubricate the piston **BE** and fully insert it in the seat **BF** . 2. Insert the spring **BG** in the piston.       Z_importante.jpg **Important**       * Always replace the gasket **BH** after each assembly.  1. Mount the gasket **BH** on cap **BL** . 2. Tighten the cap **BL** on the crankcase **AN** (tightening torque of **50 Nm** ). | imm9.91.jpg **Fig 9.91** |

## Crankshaft and phonic wheel pulley unit assembly

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| **NOTE:** To fit the target wheel refer to the operations in [**Par. 6.6.2**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=128&parent=1000) .   1. Check that the pin **F** is mounted properly on the crankshaft **G** . 2. Position the pulley unit **H** on the crankshaft **G** using the pin mark **F** (detail **M** ). 3. Apply **Molyslip** grease on the screw thread **N** . 4. Fix the pulley **T** with the screw **Z** (tightening torque of **360 Nm** ) and remove special tool [**ST\_34**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000)  ( **Fig. 9.33** ). | imm9.92.jpg **Fig 9.92** |

## Coolant circuit assembly

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| **9.3.1 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** ). | imm9.93.jpg **Fig 9.93** |
| **9.13.2 Coolant pump assembly**    Z_importante.jpg **Important**       * Always replace the gasket **L** every time it is assembled.      1. Fit the pump **G** with the screws **H** interposing the gasket **L** (tightening torque of **25 Nm** ). | imm9.94.jpg **Fig 9.94** |
| **9.13.3    Oil Cooler hoses**   1. Assemble the Oil Cooler hose behind the injection pump and connect to oil heat exchanger. 2. Insert hose **L** into clamp **N** . 3. Fasten hose **L** by means of clamp **P** on Oil Cooler **M** . | imm9.95.jpg  **Fig 9.95** |
| 4 **.** Secure the sleeve **Q** on Oil Cooler **M** and to the coolant pump **T** with the clamps **K** . 5. Fasten the clamp **Y** with the screw **S** (tightening torque of **22 Nm** - [**ST\_05**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000) ). | imm9.96.jpg  **Fig 9.96** |

## Turbocharger Assembly

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| Z_importante.jpg **Important**       * Before proceeding, perform the operation described in [**Par. 2.18**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=113&parent=1000) . * Ensure that tube **B** is not clogged.  1. Fasten the connecting sleeve **A** to the pipe **B** with the clamp **C** onto the flange fitting **D** .       Z_importante.jpg **Important**       * Always replace the gasket **F** after each assembly.  1. Lubricate and insert the gasket **F** into the seat of the pipe **G** .       Z_importante.jpg **Important**       * Remove the plastic or foam caps from the turbo compressor before assembling. * Replace nuts **M** with each assembly.  1. Check that the contact surfaces **E** are free from impurities deformations or cracks, otherwise replace exhaust manifold **L** . 2. Position the turbo-compressor **H** on the bolts on the manifold **L** . 3. Fasten the turbo-compressor **H** with the nuts **M** (tightening torque of **25 Nm** ). 4. Fasten the pipe **G** with the screws **N** to the turbo-compressor **H** .         Z_importante.jpg **Important**       * Always replace the gasket **P** after each assembly. * Before assembly of the tube **Q** , perform the operation described in [**Par. 2.19.2 - point 2**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=113&parent=1000) . * Ensure that tube **Q** is not clogged.  1. Fasten the fuel outlet pipe **Q** with the fittings **R** on the turbocompressor **H** and on the crankcase **S** (tightening torque of **15 Nm** ).     Insert the gaskets **P** between: - **Q** and **R** ; - **Q** and **S** ; - **Q** and **H** .     1. Insert the sleeve **T** on the turbo-compressor **H** and secure it with the clamp **U** . 2. Insert the pipe **V** onto the sleeve **T** and onto the relief valve **Z** . Secure tube **V** with the clamps **W** . | imm9.97.jpg **Fig 9.97**imm9.98.jpg **Fig 9.98**imm9.99.jpg **Fig 9.99**imm9.100.jpg **Fig 9.100** |

## Electric component assembly

**9.15.1 Sensors and switches**

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| **9.15.1.1 T-MAP Sensor**   1. Fasten the sensor **A** with the screws **B** on the manifold **C** (tightening torque of **10 Nm -** [**ST\_06**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000) ). | imm9.101.jpg **Fig 9.101** |
| **9.15.1.2 Coolant temperature sensor**   1. Secure the sensor **D** onto the head **E** (tightening torque of **20 Nm** ). | imm9.102.jpg **Fig 9.102** |
| **9.15.1.3 Oil Pressure Switch**   1. Clamp the oil pressure switch **F** on the crankcase **G** (tightening torque at **35 Nm** ). | imm9.103.jpg **Fig 9.103** |
| **9.15.1.4 Camshaft phase sensor disassembly**   1. Rotate the crankshaft **H** posizioning a tooth **L** of the target wheel which is mounted on the camshaft at the center of hole **M** . 2. Carry out the steps described in points **5, 6 and 7** to insert the correct number of spacers **N** . 3. Fit the spacer **N** on the sensor **P** . 4. Fasten the phase sensor **P** on distribution guard **L** with the screw **Q** (tightening torque of **10 Nm -** [**ST\_06**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000) ). | imm9.104.jpg **Fig 9.104** |
| 1. Measure the distance from the coupling surface **AD** to the tooth surface on the target wheel **(X1)** . 2. Measure the distance between the coupling surface **AD** and the sensor surface **R (Y1)** . 3. The difference between the 2 measurements determines the air gap value **(Z1)** . The value **(Z1)** permitted must be a minimum of **0.2 mm** and a maximum of **1.2 mm** . Insert one or two spacers **N (Fig. 9.104)** based on the value **(Z1)** detected.   **NOTE:** The calibrated spacers N have a thickness of **0.2 mm** . | imm9.105.jpg **Fig 9.105** |
| **9.15.1.5 Speed sensor**   1. Measure the distance from the coupling surface **AE** to the external diameter of the target wheel **(X2)** . 2. Measure the distance between the coupling surface **AE** and the sensor surface **V (Y2)** . 3. The difference between the 2 measurements determines the air gap value **(Z2)** . The value **(Z2)** permitted must be a minimum of **0.2 mm** and a maximum of **1.2 mm** . Insert one or two spacers **N (Fig. 9.104)** based on the value **(Z2)** detected.   **NOTE:** The calibrated spacers U have a thickness of **0.2 mm** .  Mount the bracket **S** with the screws **T** (tightening torque at **10 Nm -** [**ST\_06**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000) ).   1. Insert the shim **U** on the sensor **V** .   Clamp the sensor **V** on the bracket **S** with the screw **Z** (tightening torque at **10 Nm -** [**ST\_06**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000) ). | imm9.106.jpg **Fig 9.106**imm9.107.jpg **Fig 9.107** |
| **9.15.1.6 Fuel filter water detection sensor**   1. Lubricate and insert the gasket **AA** on the fitting **AB** . 2. Tighten the sensor **AB** onto the cartridge **AC** (tightening torque of **5 Nm** ). | imm9.108.jpg **Fig 9.108** |

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| **9.15.2 Alternator**   1. Insert the screw **BA** onto the alternator **BB** . 2. Insert the washer **BC** onto the screw **BA** . 3. Manually fit the screw **BA** all of the way onto the crankcase **BD** without tightening. 4. Manually fit the screw **BE** all of the way onto the head **BF** without tightening. | imm9.109.jpg **Fig 9.109** |
| 1. Pull out the dipstick **BB** in the direction of the arrow **BG** .         Z_importante.jpg **Important**       * The belt **BH** must always be replaced every time it is assembled, even if it has not reached the scheduled hours for replacement.  1. Insert the belt **BH** on the pulleys **BJ** . | imm9.110.jpg **Fig 9.110** |
| 1. Pull out the dipstick **BB** in the direction of the arrow **BK** . 2. While tensioning the alternator **BB** , first clamp screw **BE** (tightening torque at **25 Nm** ) and then screw **BA** (tightening torque at **69 Nm [thread M10] - 40 Nm** **[thread M8]** ). | imm9.111.jpg **Fig 9.111** |
| 1. Check the tension of the belt **BH** with a Clavis type instrument, positioning it in point (the tension must be between **350 and 450 Nm** ). 2. If the tension values do not correspond, tighten screws **BA and BE** , then repeat operations **7, 8 and 9** . | imm9.112.jpg **Fig 9.112** |
| **9.15.3 Starter Motor**    Z_importante.jpg **Important**       * Remove the [**ST\_34**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000)  tool if it remains in position on the engine  1. Fit the starter **BQ** with the screws **BR** on to the flange bell **BS** (tightening torque of **45 Nm** ). | imm9.113.jpg **Fig 9.113** |
| **9.15.4 Electric cabling**   1. Position the cable holder **BT** together with the cabling **BU** on the rocker cap **BV** . 2. Mount the connectors **C1** on the electronic injectors **S1** . 3. Screw the wiring holder BT on the rocker cap BV with the screws BW (tightening torque of **10 Nm -** [**ST\_06**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000) ). | imm9.114.jpg **Fig 9.114** |
| 1. Fit the connector **C2** on the sensor **S2** . 2. Fit the connector **C3** on the sensor **S3** . 3. Insert the clamp **H1** on the collector **DA** . | imm9.115.jpg **Fig 9.115** |
| 1. Insert the connector **C4** on the fuel intake valve **S4** . 2. Insert the connector **C5** on fuel temperature sensor **S5** . | imm9.116.jpg **Fig 9.116** |
| 1. Fit the connector **C6** on the sensor **S6** . 2. Fit the connector **C7** on the sensor **S7** . 3. Insert the clamps **H2** on the thermostat cover **DB and H3** on the lateral oil intake flange **DC** . 4. Fit the connector **C8** on the sensor **S8** . | imm9.117.jpg **Fig 9.117** |
| 1. Fit the connector **C9** on switch **S9** . 2. Insert the terminal **C10** on the engine **S10** . 3. Insert the connector **C11** on the alternator cable **S11** . 4. Insert the clamp **H4** on the vent holder **DD** . | imm9.118.jpg **Fig 9.118** |

## EGR Circuit Assembly

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| **9.16.1 EGR valve**    Z_importante.jpg **Important**       * Check that the contact surfaces between flange **B** and the head **D** are free from impurities. * Always replace the gasket **A** after each assembly.      1. Mount the gasket **A** on the flange **B** . 2. Secure the flange **B** with the screws **C** on the head **D** (tightening torque of **10 Nm** ). | imm9.119.jpg **Fig 9.119** |
| 1. Insert the screws **E** into the holder **F** . 2. Position the gasket **G** in correspondence with the screws **E** on the holder **F** . 3. Secure the EGR valve holder **F** with the screws **E** on the flange **B** (tightening torque of **10 Nm** ). | imm9.120.jpg **Fig 9.120** |
| 1. Fit the connector **H** on the valve **L** . 2. Tighten the clamp **J** with the screw **K** on the flange **B** . | imm9.121.jpg **Fig 9.121** |
| **9.16.2 EGR Cooler**   1. Insert the fitting **N** of EGR Cooler **M** in the sleeve **P** of the EGR valve unit. 2. Position EGR Cooler **M** on the intake manifold **Q** with the screws **R** **(** [**ST\_05**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000) **)** . 3. Secure the fitting **N** with the clamp **S** to the sleeve **P** . | imm9.122.jpg **Fig 9.122** |
| 1. Fasten the pipe **T** with the screws **U** on the EGR valve unit **V** inserting the gasket **W** (tightening torque of **10 Nm -** [**ST\_06**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000) ). 2. Fasten the pipe **T** with the screws **AA** on EGR Cooler **M** inserting the gasket **AB** (tightening torque of **25 Nm ).** | imm9.123.jpg **Fig 9.123** |
| 1. Fasten the pipe **AC** on the intake manifold **AD** with the screws **AE** (tightening torque of **25 Nm** - [**ST\_05**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000) ) inserting the gasket **AF** . 2. Fasten the pipe **AC** on the EGR Cooler **M** with the screws **AG** (tightening torque of **25 Nm** ) inserting the gasket **AH** . 3. Fit the EGR Cooler **M** on the intake manifold **Q** with the screws **R** (tightening torque of **25 Nm -** [**ST\_05**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=822&parent=1000) **- Fig. 9.122** ). 4. Connect hose **AL** on EGR Cooler **M** . | imm9.124.jpg **Fig 9.124** |

## 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** | **M12x1.25** | **3 Torque cycles** |  |
| 1st Cycle |  | 40 |  |
| 2nd Cycle |  | 70 |  |
| 3rd Cycle |  | 120 |  |
| **Lower crankcase fastening capscrew** | **M8x1.25** | **2 Torque cycles** |  |
| 1st Cycle |  | 20 |  |
| 2nd Cycle |  | 35 |  |
| **Connetting road screw** | **M8x1** | **2 Torque cycles** |  |
| 1st Cycle |  | 40 |  |
| 2nd Cycle |  | 85 |  |
| Flange oil seal fastening capscrew | M6x1 | 10 |  |
| Closing cover fastening capscrew 3rd PTO | M8x1.25 | 25 | Loctite 2701\* |
| Idle gear lubr. hole cap closure | M14x1.5 | 30 | Loctite 2701\* |
| Coolant drain hole closing cap | M16x1.5 | 50 |  |
| **OIL SUMP ASSEMBLY** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Oil fumes tube | M12x1,5 | 15 | Loctite 648 |
| Oil suction hose fastening capscrew | M6x1 | 10 | Loctite 2701\* |
| Oil sump fastening capscrew | M8x1.25 | 25 |  |
| Oil drain cap | M18x1.5 | 35 |  |
| **FLANGE ASSEMBLY (1ST PTO)** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Flange bell fastening capscrew | M10x1,5 | 50 |  |
| Flywheel fastening capscrew | M12x1,25 | 140 |  |
| **GEAR DISTRIBUTION** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Intermediate gear gudgeon fastening screw | M8x1.25 | 25 |  |
| Camshaft gear control fastening capscrew | M10x1 | 100 |  |
| Gear fastening nut on high-pressure fuel injection pump | M14x1.5 | 65 |  |
| **ENGINE CYLINDER HEAD ASSEMBLY** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Air bleeding cap | M6x1 | 8 |  |
| Lifting brace fastening capscrew | M8x1.25 | 25 |  |
| Electronic injector manifold | M12x1 | 30 |  |
| **Cylinder head fastening capscrew** | **M12x1.25** | **6 Torque cycles** |  |
| 1st Cycle |  | 40 |  |
| 2st Cycle |  | 70 |  |
| 3st Cycle |  | 100 |  |
| 4st Cycle |  | 90° |  |
| 5st Cycle |  | 90° |  |
| 6st Cycle |  | 90° |  |
| Rocker arm gudgeon fastening capscrew | M8x1,25 | 25 |  |
| Rocker arm cover fastening capscrew | M6x1 | 10 |  |
| **INJECTION SYSTEM** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Fuel filter fastening capscrew | M8x1.25 | 25 |  |
| Fuel cartridge fastening | ... | 17 |  |
| Common rail fastening capscrew | M8x1.25 | 25 |  |
| Electronic injector brace fastening capscrew | M8x1.25 | 20 |  |
| Distributor fastening capscrew | M8x1.25 | 10 |  |
| Waste line fastening drilled capscrew on common rail | M10x1 | 15 |  |
| Electronic Injector side injection tube nuts | M12x1.5 | 25 |  |
| Injection pump side injection tubes nuts | M12x1.5 | 25 |  |
| Common Rail side injection tubes nuts | M14x1.5 | 30 |  |
| Injection pump fastening capscrew | M8x1.25 | 25 | Loctite 2701\* |
| **INTAKE MANIFOLD** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Internal semi-manifold fastening capscrew (on cylinder head) | M8x1.25 | 25 |  |
| External semi-manifold fastening capscrew | TG8 | 22 |  |
| Intake flange fastening capscrew | TG8 | 22 |  |
| **EXHAUST MANIFOLD** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Exhaust manifold fastening stud | M8x1.25 | 25 |  |
| Exhaust manifold fastening nut | M8x1.25 | 25 |  |
| Exhaust/manifold/muffler flange fastening nut | M8x1.25 | 25 |  |
| **LUBRICATION CIRCUIT** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Oil fumes support fastening capscrew (on crankcase) | M6x1 | 12 |  |
| Oil filter fastening union | M20x1.5 | 15 | Loctite 2701\* |
| Oil cooler fastening capscrew | M6x1 | 10 |  |
| Cartridge-holder cover | ... | 25 |  |
| Oil pump carter fastening capscrew | TG6 | 10 |  |
| Carter distribution fastening capscrew | M8x1.25 | 25 |  |
| Side oil load flange fastening capscrew (onto carter distribution) | TG6 | 10 |  |
| Pressure relief valve cap | M16x1.5 | 50 |  |
| **CRANKSHAFT AND TARGET WHEEL PULLEY ASSEMBLY (2 ND PTO)** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Phonic wheel fastening capscrew (on crankshaft pulley) | M6x1 | 10 |  |
| Crankshaft pulley fastening capscrew | M16x1.5 | 360 | Molyslip |
| **COOLANT CIRCUIT** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Coolant tube clamp fastening capscrew (Oil Cooler return) | TG6 | 10 |  |
| Thermostatic valve cover fastening capscrew | M6x1 | 10 |  |
| Coolant pump 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) | M8x1.25 | 25 |  |
| Exhaust flange fastening stud (on turbine) | M8x1.25 | 25 |  |
| Turbine fastening nut | M8x1.25 | 25 |  |
| Exhaust flange fastening nut (on turbine) | M8x1.25 | 25 |  |
| **ELECTRICAL COMPONENTS** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| MAP sensor fastening capscrew | TG6 | 10 |  |
| Coolant temperature sensor | M12x1.5 | 20 max. |  |
| Oil pressure switch | M12x1.5 | 35 |  |
| Phase sensor fastening capscrew | TG6 | 10 |  |
| Speed sensor fastening capscrew | TG6 | 10 |  |
| Sensor for water presence in fuel |  | 5 |  |
| Alternator bracket fastening capscrew | M8x1.25 | 25 |  |
| Alternator fastening capscrew | M8x1.25 | 40 |  |
| Alternator fastening capscrew | M10x1.5 | 69 |  |
| Starter motor fastening capscrew | M10x1.5 | 45 |  |
| Supply cable fastening nut (starter motor) | M8x1.25 | 10 |  |
| Cabling support fastening capscrew | TG6 | 10 |  |
| **EGR CIRCUIT** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Flange EGR valve fastening capscrew | M6x1 | 10 |  |
| EGR valve fastening capscrew | M6x1 | 10 |  |
| EGR Cooler tube fastening capscrew (on flange EGR valve) | TG6 | 10 |  |
| EGR Cooler fastening capscrew | TG8 | 22 |  |
| Tube fastening capscrew on EGR Cooler | M8x1.25 | 25 |  |
| Tube fastening capscrew on intake manifold | M8x1.25 | 25 |  |

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

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| **OPTIONAL COMPONENTS (CHAP. 11)** | | | |
| **OIL DIPSTICK ON CYLINDER HEAD** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Oil dipstick tube fastening capscrew | M6x1 | 10 |  |
| **HEATER** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Flange intake with heater fastening capscrew | M8x1.25 | 22 |  |
| **ALTERNATOR WITH POLY-V BELT** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Pulley fastening capscrew | M10x1.5 | 48 |  |
| Pulley positioning blocking nut capscrew | M10x1.5 | 45 |  |
| Alternator brace fastening capscrew | M8x1.25 | 25 |  |
| Alternator fastening capscrew (upper) | M8x1.25 | 25 |  |
| Alternator fastening capscrew (lower) | M8x1.25 | 40 |  |
| Pulley sliding plate fastening capscrew | M8x1.25 | 25 |  |
| **IDLE GEAR (FOR 3TH /4TH PTO)** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Gear drilled fastening capscrew | M14x1.5 | Consultare il Par. >> | Molyslip |
| **3 TH PTO** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Pump support fastening capscrew | M8x1.25 | 25 | Loctite 2701\* |
| Pump fastening capscrew | M8x1.25 | 25 |  |
| **4 TH PTO** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Grooved crankshaft support fastening capscrew | M8x1.25 | 25 | Loctite 2701\* |
| Cover fastening capscrew (3 rd PTO side) | M8x1.25 | 25 |  |
| Sump support fastening capscrew | TG6 | 10 |  |
| Pump fastening capscrew | M8x1.25 | 25 |  |
| **BALANCE DEVICE (4 CYLINDERS)** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Housing closing panel fastening capscrew | M6x1 | 8 |  |
| Shafts support fastening capscrew | M10x1.5 | 50 |  |
| **REMOTE OIL FILTER** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Head fastening and Oil Cooler union on crankcase | M20x1.5 | 25 | Loctite 2701\* |
| Crankcase head nipple and oil filter support | M14x1.5 | 40 |  |
| Tube union on crankcase head | G3/8 | 30 |  |
| Tube union on filter support | G3/8 | 35 |  |
| Oil filter | M20x1.5 | 20 |  |
| Filter support head air bleeding cap | M8x1.25 | 25 |  |
| **INTAKE CIRCUIT** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Air filter support plate fastening capscrew (on flange bell) | M8x1.25 | 25 |  |
| Air filter support fastening capscrew | M8x1.25 | 25 |  |
| **EXHAUST CIRCUIT** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Muffler brace support fastening capscrew | M8x1.25 | 25 |  |
| Muffler fastening capscrew on muffler | M8x1.25 | 25 |  |
| Muffler fastening nut | M8x1.25 | 25 |  |
| **COOLING CIRCUIT** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Blower fastening capscrew | M6x1 | 10 |  |
| Radiator support fastening capscrew | M16x1.5 | 150 |  |
| Shroud radiator fastening capscrew | M6x1 | 10 |  |
| Radiator lower brace fastening capscrew | M8x1.25 | 25 |  |
| Radiator on anti-vibrating | M8x1.25 | 25 |  |
| Anti-vibrating radiator fastening nut (on lower brace) | M8x1.25 | 25 |  |
| Anti-vibrating and brace fastening capscrew (upper) | M6x1 | 10 |  |
| Upper brace fastening capscrew (on engine cylinder head) | M8x1.25 | 25 |  |
| Side bulkheads fastening capscrew | M6x1 | 10 |  |
| **ENGINE SUPPORT** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Side feet fastening capscrew (on flange bell or crankcase) | M12x1.75 | 50 |  |
| Rear feet fastening capscrew | M16x1.5 | 200 |  |

