|  |
| --- |
| **Assembly information** |
| **KDI-TCP 3404E5 Workshop Manual (Rev. 01.1)** |



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=547&parent=1273) **-** [**1.5**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=548&parent=1273) ).
* For the assembly of components not described in this chapter refer to [**Chap. 11**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=624&parent=1273) .
* The following are the components described in [**Chap. 11**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=624&parent=1273) .

**11.1** [**Heater (reaplacement)**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=624&parent=1273) **11.2** [**Idler gear (for III/IV PTO)**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=640&parent=1273) **11.3** [**III PTO (replacement)**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=639&parent=1273) **11.4** [**IV PTO (replacement)**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=631&parent=1273) **11.5** [**Balancer shafts (replacement)**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=629&parent=1273)

**11.** **6** [**ETB (replacement)**](https://iservice.lombardini.it/jsp/Template4/manuale.jsp?id=2681&parent=1273)

## 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=573&parent=1273) , hereinafter in **Tab. 9.1** an example of a special tool ( [**ST\_05**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=573&parent=1273) ).

**Tab. 9.1**

|  |  |  |  |
| --- | --- | --- | --- |
| **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=642&parent=1273&txts=3.3.2) .
* 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

|  |  |
| --- | --- |
| **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=574&parent=1273) , 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 capscrews of union **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=576&parent=1273) .  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** |

|  |  |
| --- | --- |
| 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** | |

|  |  |
| --- | --- |
| 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=573&parent=1273) **)** . | 9.11.jpg  **Fig 9.11** |
| **9.3.6 Camshaft**   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** . 4. Lubricate the pins **S2** , the cams **S3** of the camshaft **S1** , all the housing **Q1** with oil. 5. Insert the camshaft **S1** all the way into its housing **Q1** . 6. Position the gear **R1** observing all the marks **T1** of the gears **M1** .     Z_importante.jpg **Important**       * Failure to comply with the marks **T1** on the gears **M1** and **R1** causes engine malfunction and serious damage.        7. Check that crankshaft **M** rotates smoothly. | 9.12.jpg  **Fig 9.12**  9.13.jpg  **Fig 9.13** |
| **9.3.7 Piston rings**   1. Perform the operations described in [**Par. 8.5.3**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=577&parent=1273) . 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=577&parent=1273) . 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 9.14**  9_3_7.png  **Fig 9.15** |
| **9.3.8 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=577&parent=1273) . * Always replace the bearings **D1** after each assembly. * Mate components respecting references at [**Par. 7.15.5**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=605&parent=1273) .      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 9.16**  9.17.jpg  **Fig 9.17** |

|  |  |
| --- | --- |
| **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=577&parent=1273) .  1. Rotate the crankshaft **M** by moving the crankpin **J1** to a TDC position of the affected cylinder. | 9.18.jpg **Fig 9.18** |
| 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 9.19**    9.20.jpg **Fig 9.20**    9.21.jpg **Fig 9.21**  9.22.jpg  **Fig 9.22** |
| 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 9.23** |

|  |  |
| --- | --- |
| 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. 7.15.2** and **7.15.5**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=605&parent=1273) ). 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 9.24**9.25.jpg **Fig 9.25**9.26.jpg **Fig 9.26** |
| **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/V4aXYc_0x8U?showinfo=0&rel=0> |

## Oil sump unit assembly

|  |  |
| --- | --- |
| **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 9.27** |
| **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 9.28** |
| **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 9.29** |
| * 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=573&parent=1273) ). | 9.30.jpg **Fig 9.30** |
| 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 9.31** |

## Cylinder head unit assembly

|  |  |
| --- | --- |
| **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=578&parent=1273) 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=573&parent=1273) . | 9.32.jpg **Fig 9.32** |
| **9.5.2 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 **G** .     1. Clamp the sleeve **D** (tightening torque at **30 Nm** ). | 9.33.jpg **Fig 9.33** |
| **9.5.3 Electronic injectors projection**   1. Perform the operations of **point 1** and **2** [**Par. 6.1.4.**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=580&parent=1273) 2. Perform the operations of **point 3** and **4** [**Par. 6.1.5.**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=580&parent=1273) 3. Check using [**ST\_03**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=573&parent=1273) 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. | 9.34_9.35.jpg **Fig 9.34 - Fig. 9.35** |
| **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=603&parent=1273) . 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=573&parent=1273) 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=573&parent=1273) 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=573&parent=1273) 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=573&parent=1273) .     **NOTE:** repeat all the steps for the relevant valves and remove the tool [**ST\_07**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=573&parent=1273) . | 9.36.jpg **Fig 9.36** |
| 9.37.jpg **Fig 9.37** |
| 9.38.jpg **Fig 9.38** |
| **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=573&parent=1273) 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** . | 9.40.jpg **Fig 9.40**9.41.jpg **Fig 9.41** |
| 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 9.42** |
| **Tab. 9.5**   |  |  |  | | --- | --- | --- | | **CYCLE** | **TORQUE** | **PAUSE** | | 1 | 75 Nm | 3min | | 2 | 90° | 3min | | 3 | 90° | 3min | | 4 | 90° | --- | | 9.43.jpg **Fig 9.43** |
| 1. Remove tool **ST\_60** from cylinder head **F** . | Cap_9_IMO_286_TCP_E5.png |
| **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. | 9.44.jpg  **Fig 9.44**  9.45.jpg **Fig 9.45** |
| **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. | 9.46.jpg **Fig 9.46**  9.47.jpg  **Fig 9.47** |
| **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** ) 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** . * If the engine is painted or protected with clear paint, replace the fastening screws  **BE** .  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 9.48**9.49.jpg **Fig 9.49** |
|  | 9.50.jpg **Fig 9.50** |
| **9.5.9 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=573&parent=1273) **-** [**ST\_12**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=573&parent=1273)  apply Loctite 480 to the seats of cap **BN** before assembling the gaskets). **Modified component, see service letter 710017.** * Observe the order of tightening illustrated in **Fig. 9.52** .  1. Position tool [**ST\_17**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=573&parent=1273) onto the head in correspondence with the two fastening holes **9** and **10** . 2. With vaseline lubricate the gaskets **BL** in the upper part, and the gaskets **BM** in the lower part. 3. Position gasket **BF** and the rocker arm cover **BN** on cylinder head **F** using tool [**ST\_17**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=573&parent=1273) as a guide. 4. Attach the rocker arm cover **BN** on the head **F** with the screw **BG** (tightening torque to **10 Nm** ). | 9.51.jpg **Fig 9.51** |
| 9.52.jpg **Fig 9.52** |

## Intake manifold assembly

|  |  |
| --- | --- |
| **9.6.1 Internal  half-manifold**    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=573&parent=1273) into indicated point. 2. Position gasket **B** and manifold **C** on cylinder head **D** . 3. Secure the semi-collector **C** with the screws **A** on the head **D** (tightening torque of **25** **Nm** ). | 9.53.jpg **Fig 9.53** |
| **9.6.2 External half-manifold**    Z_importante.jpg **Important**       * Check that the contact surfaces between the two semi collectors **C** and **D** are free from impurities.      1. Insert the special tool [**ST\_18**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=573&parent=1273) into indicated point. 2. Position gasket **N** , panel **P** and semi-manifold **M** onto semi-manifold **C** . 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=573&parent=1273) ). | 9.54.jpg **Fig 9.54** |

## Fuel system assembly

|  |  |
| --- | --- |
| 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=573&parent=1273) ). * 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=560&parent=1273) ). | |
| **9.7.1 High-pressure injection pump**     1. Check that the surface **A** is free from impurities ( **Fig. 9.56** ).     Z_importante.jpg      Important   * Always replace gasket **B** with every assembly. * The seal gasket **B** can only be fitted in one direction ( **Fig. 9.55** ). * Always replace capscrews **C** with new ones or alternatively apply **Loctite** **2701** ( **Fig. 9.55** ).        1. Fit the new gasket **B** on the injection pump **D** ( **Fig. 9.56** ). 2. Fix the pump **D** into the housing **A1** together with the gasket **B** by the screws **C** ( **Fig. 9. 56** - tightening torque at **25** **Nm** ). 3. Check the correct fitting of the key **E** on the shaft **F** of the injection pump **D** ( **Fig. 9.57** ). 4. Place the gear **G** on the shaft **F** of the pump **D** respecting the reference to the key **E** and the reference H of the gear **L** ( **Fig. 9.57** ). 5. Tighten the nut **M** (tightening torque at **140** **Nm** ). | 9.55.jpg **Fig 9.55** |
| 9.56.jpg **Fig 9.56** |
| 9.57.jpg **Fig 9.57** |
| **9.7.2 Fuel filter**     1. Secure the fuel filter holder **N** with the screws **P** on the crankcase **Q** (tightening torque of **25** **Nm** ).   **NOTE** : For the assembly of the fuel cartridge, refer to operations **4 and 5 of** [**Par. 6.9.2**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=590&parent=1273) **.** | 9.58.jpg **Fig 9.58** |
| **9.7.3 Electronic injectors**    Z_importante.jpg **Importante**       * Always replace and lubricate the gaskets **R** of the electronic injectors **S** with fuel, every time they are assembled. * Pay attention when repositioning the electronic injectors, using the marks as described in [**Par. 7.10.5**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=600&parent=1273) **.** * 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=573&parent=1273) . * If the engine is painted or protected with clear paint, clean the paint off the diesel injector  **S  near to the part in contact with the gasket  AB .**  1. Assemble gasket **T** onto electronic injector **S** . 2. Insert the electronic injectors **S** inside the rocker arm cover **U** being extra careful not to damage gasket **AB** and direct it as indicated in **Fig. 9.59.** | 9.59.jpg **Fig 9.59** |
| 9.60.jpg  **Fig 9.60** |
| **9.7.4 Common Rail**   1. Secure the rail **W** on the intake manifold **X** with the screws **V** (tightening torque at **25** **Nm** ). | 9.61.jpg **Fig 9.61** |
| **9.7.5 High pressure fuel pipes**    Z_importante.jpg **Important**       * Always replace the pipes **Y** and tube **Z** after each assembly.  1. Position the pipes **Y** on the Common Rail W and on the electronic injectors **S** , adjust the position of electronic injectors **S** via the fitting inlets with the pipes **Y** .     Z_importante.jpg **Important**       * Tighten the nuts **J and K** manually, without clamping them. * If the engine is painted or protected with clear paint, replace the fastening screws  **B1** .  1. Position the injector fastening brackets **A1** and the screws **B1** , inserting the washer **C1** .     Z_importante.jpg **Important**       * Replace the pipes **Y** ( **Fig. 9.62** ) if the screws **B1** do not rotate freely.  1. Tighten all the nuts **K** (tightening torque at **30** **Nm** ). 2. Tighten the nuts **J** (tightening torque at **25** **Nm** ). 3. Make sure that the mounting brackets **A1** are positioned correctly on electroinjectors **S** and on fixing screws of the  rocker arm assembly **D1** . 4. Tighten the fixing screws **B1** of the injector mounting bracket (tightening torque of **20 Nm** ). 5. Position the pipe **Z** screwing the nuts **J** and **K** .       Z_importante.jpg **Important**       * Screw the nuts **J** and **K** manually without tightening them.        1. Tighten the nut **K** (tightening torque of **30** **Nm** ). 2. Tighten the nut **J** (tightening torque of **25** **Nm** ). 3. Fasten the clamp **E1** with the screw **F1** (tightening torque of **10** **Nm** ). | 9.62.jpg  **Fig 9.62** |
| 9.63.jpg **Fig 9.63** |
| 9.64.jpg  **Fig 9.64** |
| **9.7.6 Fuel flow pipes**   1. Insert the pipes **G1** on the fitting coming out of the filter holder **N** and on the fuel inlet fitting of the injection pump **D** . | 9.65.jpg  **Fig 9.65** |
| **9.7.7  Fuel return pipes**   1. Check the gaskets **H1** on the fittings **J1** .   **NOTE** :    Do not disconnect the pipes from the distributor **K1** .     1. Position the return pipes and fitting the distributor **K1** with the screw **L1** on the intake manifold **X** ( **Fig. 9.67** - tightening torque of **10** **Nm** ). 2. Mount the fittings **J1** ( **Fig. 9.67** ) on the injectors **S** and lock them with the clips **M1** . 3. Insert the pipe **N1** on the fitting **P1** . 4. Fit the gaskets **Q1** and the fitting **R1** on the screw **S1** . 5. Tighten capscrews **S1** on Common Rail **W** (tightening torque **15** **Nm** ) with the opening of union **R1** facing upwards. | 9.66.jpg  **Fig 9.66** |
| 9.67.jpg  **Fig 9.67** |
| 9.68.jpg  **Fig 9.68** |

## Assembly lubrication circuit

|  |  |
| --- | --- |
| **9.8.1 Assembly oil mist separator unit**    Z_importante.jpg **Important**       * Always carefully inspect the condition of the pipes, and replace them if there is any doubt regarding the integrity of their seal.      1. Secure the plate **A** using the screws **B** (tightening torque of **10 Nm -** [**ST\_05**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=573&parent=1273) ). 2. Assemble clamps **C** onto tube **D** . 3. Secure tube **D** by means of fastening clamp **C** with capscrews **E** , inserting clamp **F.** 4. Fit hose **G** onto union **H** . 5. Secure tube **J** by means of capscrew **K** , inserting gasket **L** . 6. Secure the clamp **M** . 7. Perform the operations of  [**Par. 6.7.2**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=588&parent=1273) **.** | 9.69.jpg **Fig 9.69** |
| 9.70.jpg **Fig 9.70** |
| 9.71.jpg **Fig 9.71** |
| **9.** **8 .2 Oil Cooler and oil filter Unit Assembly**   1. Perform the operations of  [**Par. 6.8.3**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=589&parent=1273) **.**   **NOTE** :To replace the oil cartridge, refer to operations of [**Par. 6.8.2**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=589&parent=1273) **.** | |
| **9.** **8 .3 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 9.72** |
| **9.** **8 .4 Oil pump**  **NOTE:** Carry out the checks described in **Par. 8.7** 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=561&parent=1273) ). 5. Fasten the oil pump cover **T** on the crankcase V with the screws **X** (tightening torque **10** **Nm** ). | 9.73.jpg **Fig 9.73** |
| 9.74.jpg **Fig 9.74** |

## Flange unit assembly

|  |  |
| --- | --- |
| **9.9.1 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.     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 gasket **C** with oil with each assembly (gasket **C** is to be mounted after the operation in **point 5** **(** [**ST\_47**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=573&parent=1273) **)** ). * To assemble components **P, Q, R, S** , and **T** , proceed with the operations described in [**Par. 11.2.2**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=640&parent=1273) **-** [**11.3.2**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=639&parent=1273) **-** [**11.4.2**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=631&parent=1273) **-** [**11.5.2**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=629&parent=1273) .  1. Apply a bead of approx. 2.5 mm of sealant ( **Loctite** **5188** ) on the surface **B** of the bell **A** . 2. Ensure that bearing **J** is correctly assembled on camshaft **K** . 3. Assemble bell **A** onto crankcase **D** , complying with reference taper pins **E** **(** [**ST\_45**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=573&parent=1273) **)** . 4. Apply the screws **F** by hand without tightening them. 5. Tighten the screws **F** following the tightening sequence indicated (tightening torque **75** **Nm** ). | 9.75.jpg   **Fig 9.75**  9.76.jpg **Fig 9.76A**  120.jpg **Fig 9.76B** |

|  |  |
| --- | --- |
| **9.9.2 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=573&parent=1273) . 2. Position flywheel **H** onto crankshaft L by means of tool [**ST\_43 - ST\_46**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=573&parent=1273) **.** 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** ). | 9.77.jpg **Fig 9.77** |

## Exhaust manifold assembly

|  |  |
| --- | --- |
| Z_importante.jpg **Important**     * Replace the metal gaskets **A, B** every time they are assembled. * In the event of mounting the studs **C** , fix ( **25** **Nm** tightening torque) with **Loctite** **2701** on the thread. * Gasket **B** must be assembled with the wording " **TOP** " visible and facing upwards.      1. Check that the contact surfaces **D** are free from impurities. 2. Insert the gasket **B** on the studs **C** . 3. 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** . 4. Secure manifold **E** onto cylinder head **G** by means of capscrews **F** (tightening torque **25** **Nm** ). 5. Clamp the nuts **L** ( **25** **Nm** tightening torque). | 9.78.jpg **Fig 9.78** |

## Crankshaft pulley assembly

|  |  |
| --- | --- |
| * Perform the operations from point **1** to **7** of [**Par. 6.6.2**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=585&parent=1273) **.** | |

## Turbocharger Assembly

|  |  |
| --- | --- |
| Z_importante.jpg **Importante**       * Before proceeding, perform the operation described in [**Par. 2.18**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=637&parent=1273) **.** * 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=637&parent=1273) **.** * 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.** | 9.79.jpg **Fig 9.79**9.80.jpg **Fig 9.80**9.81.jpg **Fig 9.81** |

## Electric component assembly

|  |  |
| --- | --- |
| **9.13.1 Sensors and switches** | |
| **9.13.1.1 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=573&parent=1273) ). | 9.82.jpg **Fig 9.82** |
| **9.13.1.2 Coolant temperature sensor**   1. Secure the sensor **D** onto the head **E** (tightening torque of **20** **Nm** ). | 9.83.jpg **Fig 9.83** |
| **9.13.1.3 Oil Pressure Switch**   1. Clamp the oil pressure switch **F** on the crankcase **G** (tightening torque at **35 Nm** ). | 9.84.jpg **Fig 9.84** |
| **9.13.1.4 Camshaft phase sensor disassembly**   1. Measure the distance between the coupling surface P1 to gear teeth G1 (X1). 2. Measure the distance between the coupling surface P1 and the sensor surface S7 (Y1). 3. The difference between the 2 measurements determines the air gap value (Z1). The value (Z1) permitted must be a MIN of 0.2 mm and a MAX of 1.2 mm. Insert one spacers K2 based on the value (Z1) detected.     **NOTE** : The calibrated spacers K1 have a thickness of 0.2mm.     1. Insert the shim K1 on the sensor S10. 2. Secure phase sensor S10 onto crankcase L using capscrew R2 (tightening torque 10 Nm). | 9.86.jpg   **Fig 9.85** |
| 9.86A.jpg  **Fig 9.85A** | |
| **9.13.1.5 Speed sensor**   1. Measure the distance from the coupling surface **J** to the external diameter of the phonic wheel ( **X2** ). 2. Measure the distance between the coupling surface **J** and the sensor surface **H** ( **Y2** ).      1. The difference between the 2 measurements determines the air gap value ( **Z2** ). The value ( **Z2** ) permitted must be a **MIN** of **0.2 mm** and a **MAX** of **1.2 mm** . Insert one or two spacers K based on the value ( **Z2** ) detected.     **NOTE** : The calibrated spacers **K** have a thickness of **0.2mm.**       1. Secure the bracket **M** with the screws **N** inserting the washer **S** (tightening torque at **10** **Nm** ). 2. Insert the shim **K** on the sensor **H** . 3. Clamp the sensor **H** on the bracket **M** with the screw **R** (tightening torque at **10 Nm -** [**ST\_06**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=573&parent=1273) ). | 9.86.jpg **Fig 9.86**9.87.jpg **Fig 9.87** |
| **9.13.1.6 Fuel filter water detection sensor**   1. Lubricate and insert the gasket **V** on the fitting **W** . 2. Tighten the sensor **W** onto the cartridge **Z** (tightening torque of **5** **Nm** ). | 9.88.jpg **Fig 9.88** |
| **9.13.3 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 **L1, F** onto the crankcase **L** .   **9.13.4 Starter Motor**   1. Perform the operations to point **10** of [**Par. 6.6.2**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=585&parent=1273) . | 9.92.jpg **Fig 9.90** |
| **9.13.5 Electric cabling**     1. Position the cable holder **N** together with the cabling **P** on the rocker cap **Q** . 2. Screw the wiring holder **N** on the rocker cap **Q** with the screws **R** (tightening torque of **10 Nm -** [**ST\_06**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=573&parent=1273) ). 3. Mount the connectors **C1** on the electronic injectors **S1** .     Z_Avvertenza.jpg **Warning**       * Slightly move wiring support **N** to check that there is no voltage in the electrical wire of connector **C1** in correspondence with the outlet hole **N1** . | 9.91.jpg **Fig 9.91** |
| 1. Fit the connector **C2** on the sensor **S2** . | 9.92.jpg **Fig 9.92** |
| 1. Fit the connector **C3** on the sensor **S3** . | 9.93.jpg **Fig 9.93** |
| 1. Insert the connector **C4** on the fuel intake valve **S4** . 2. Insert the connector **C5** on fuel temperature sensor **S5** . | 9.94.jpg **Fig 9.94** |
| 1. Fit the connector **C6** on the sensor **S6** . | 9.95.jpg  **Fig 9.95** |
| 1. Fit the connector **C7** on the sensor **S7** . 2. Insert the clamp **P1** onto the crankcase **M** . 3. Fasten the clamp **P2** with the screw **T** onto the crankcase **M** (tightening torque of **10** **Nm** ). | 9.96.jpg  **Fig 9.96** |
| 1. Fit the connector **C9** on the sensor **S9** . | 9.97.jpg  **Fig 9.97** |
| 1. Secure cable **X** on motor **V** by means of nut **J** . 2. Secure cable **Y** on alternator **W** by means of nut **K** . | 9.98.jpg  **Fig 9.98** |

## 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** ). | 9.99.jpg **Fig 9.99** |
| **9.14.2 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 of [**Par. 6.5.2**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=584&parent=1273) **.** | 9.100.jpg  **Fig 9.100** |
| **9.14.3 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=573&parent=1273) ). | 9.101.jpg  **Fig 9.101** |
| 9.102.jpg  **Fig 9.102** | |

## ATS ASSEMBLY

|  |  |
| --- | --- |
| **1 -** Position the support **L3** on the cylinder head and tighten the screws **H2** and **H3** .  **2 -** Fasten screws **H3** (tightening torque of **25 Nm** ).  **3 -** Fasten screws **H2** (tightening torque of **85 Nm** ). | Cap_9_IMO_287_TCP_E5.png  Cap_9_IMO_288_TCP_E5.png |
| **4 -** Position the support **L2** on the cylinder head and tighten the screws **H2** and **H3** .  **5 -** Fasten screws **H2** (tightening torque of **85 Nm** ).  **6 -** Fasten screws **H3** (tightening torque of **25 Nm** ). | Cap_9_IMO_289_TCP_E5.png  Cap_9_IMO_282_TCP_E5.png  Cap_9_IMO_279_TCP_E5.png |
| **7 -** Position the support **L1** on supports **L2** and **L3** and tighten screws **H1** .  **8 -** Fasten screws **H1** (tightening torque of **25 Nm** ). | Cap_9_IMO_290_TCP_E5.png |
| **9 -** Fasten tube **N** with nuts **M** on turbocharger **T** (tightening torque of **50 Nm** ). | Cap_9_IMO_284_TCP_E5.png |
| Z_Avvertenza.jpg **Warning**       * Avoid tensioning the assembly of the ATS **C** on the exhaust line, the **MAX** misalignment allowed on the junction point is of **1°** .     **10 -** Position the ATS **C** on clamps **G** .  **11 -** Fit ATS **C** on exhaust line **D** .  **12 -** Insert clamp **B** on the junction and tighten screw **A** (tightening torque of **12 Nm** ). | Cap_9_IMO_275_TCP_E5.png  Cap_6_I_SOST_282_TCP_E5.png  Cap_6_I_SOST_283_TCP_E5.png |
| **13 -** Fasten clamps **G** with screws **F** for the fastening of the ATS **C** (tightening torque of **15 Nm** ).  **14 -** Fit tubes **E** . | Cap_9_IMO_276_TCP_E5.png  Cap_9_IMO_275_TCP_E5_02.png |

## 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 |  |
| **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 |  |
| 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 |  |
| Fuel cartridge fastening | ... | 17 |  |
| Common rail fastening capscrew | M8x1.25 | 25 |  |
| Electronic injector brace fastening capscrew | M8x1.25 | 20 |  |
| Distributor fastening capscrew | M8x1.25 | 25 |  |
| Waste line fastening drilled capscrew on common rail | M10x1 | 30 |  |
| 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\* |
| Gear fastening nut on high-pressure 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** |
| 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 screw | M10x1.5 | 50 |  |
| Exhaust manifold fastening nut | M10x1.5 | 50 |  |
| **Exhaust manifold fastening stud** | **M10x1.5** | **2 Torque Cycles** |  |
| 1 st  Cycle |  | 40 |  |
| 2 nd  Cycle |  | 80 |  |
| **LUBRICATION CIRCUIT** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Oil vapour separator support plate fastening capscrew | TG8 | 22 |  |
| Oil vapour separator support fastening capscrew (on crankcase) | M6x1 | 12 |  |
| Oil steam separator return tube drilled fastening screw (on cranckase) | M16x1.5 |  |  |
| 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 AND TARGET WHEEL PULLEY ASSEMBLY (2nd PTO)** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Phonic wheel fastening capscrew (on crankshaft pulley) | M6x1 | 10 |  |
| 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 |  |
| **TURBOCHARGER** | | | |
| **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 | 25 |  |
| Exhaust flange fastening stud (on turbine) | M8x1.25 | 25 |  |
| Turbine fastening stud | M10x1.5 | 30 |  |
| Exhaust flange fastening nut (on turbine) | M8x1.25 | 25 |  |
| **ELECTRICAL COMPONENTS** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| MAP sensor fastening capscrew | M6x1 | 10 |  |
| Coolant temperature sensor | M12x1.5 | 20 max. |  |
| Oil pressure switch | M12x1.5 | 35 |  |
| Phase sensor fastening capscrew | M6x1 | 10 |  |
| Speed sensor fastening capscrew | M6x1 | 10 |  |
| Sensor for water presence in fuel |  | 5 |  |
| Alternator fastening capscrew | M10x1.5 | 45 |  |
| Alternator fastening capscrew | M8x1.25 | 25 |  |
| Alternator brace fastening capscrew | M12x1.75 | 75 |  |
| Starter motor fastening capscrew | M10x1.5 | 45 |  |
| Supply cable fastening nut (starter motor) | M10x1.5 | 15 |  |
| ETB fastening screw | M6 | 10 |  |
| **ATS COMPONENTS** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| DCU fastening screw | M6 | 8 |  |
| ETB fastening screw | M6 | 10 |  |
| DEF heating valve fastening screw | M6 | 10 |  |
| DEF injector fastening screw | M6 | 8 |  |
| DEF pump fastening screw | M8 | 19 |  |
| Ambient temperature sensor | M12x1.5 | 20 |  |
| SCR temperature sensor | M14x1.5 | 45 |  |
| DEF draining screw (tank supplied by KOHLER) | .... | 20 |  |
| NOx Sensor | M20x1.5 | 60 | Castrol Optimol Paste MF  o  Bostik Never-Seez Grade |
| NOx control unit | ... | 3 |  |
| EGTS (black | yellow) | M12x1.25 | 30 | Castrol Optimol Paste MF  o  Bostik Never-Seez Grade |
| Union fastening nut for Delta-P tube | M14x1.5 | 55 | Castrol Optimol Paste MF  o  Bostik Never-Seez Grade |
| Delta-P fastening screw | M6x16 | 10 |  |
| ATS support fastening screw | M12x30 | 85 |  |
| M8x25 | 25 |  |
| ATS support plate fastening screw | M8x25 | 25 |  |
| ATS fastening clamp screw (V clamp) | M8x70 | 15 |  |
| ATS component fastening clamp screw (V clamp) | M8 | 15 |  |
| ATS fitting clamp screw (V clamp) on exhaust line | M8 | 12 |  |

\* *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 |  |
| **IDLE GEAR (FOR 3 rd )** | | | |
| **Component** | **Thread (mm)** | **Torque (Nm)** | **Sealer** |
| Gear fastening capscrew | M8x1 | 25 |  |

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

