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| **Information about overhauling** |
| **KDI-TCP 3404E5 Workshop Manual (Rev. 01.1)** |



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

Sommario

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# Information about overhauling

## Recommendations for overhauls and tuning

* The information is laid out in sequence, according to operational requirements, and the intervention methods have been selected, tested and approved by the manufacturer's  
  technicians.
* This chapter describes procedures for checking, overhauling and tuning units and/or individual components.

**NOT** **E** : To easily locate specific topics, the reader should refer to the analytical index or chapter index.

* Before any intervention, the operator should lay out all equipment and tools in such a way as to enable him to carry out operations correctly and safely.
* The operator must comply with the specific measures described in order to avoid errors that might cause damage to the engine.
* Before carrying out any operation, clean the units and/or components thoroughly and eliminate any deposits.
* Do not wash the components with steam or hot water. Use suitable products only.
* Do not use flammable products (petrol, diesel, etc.) to degrease or wash components. Use suitable products only.
* Dry all washed surfaces and components thoroughly with a jet of air or special cloths before reassembling them.
* Apply a layer of lubricant over all surfaces of all disassembled components to protect them against oxidation.
* Check the integrity and state of wear of all disassembled components in order to ensure good working condition of the engine.
* When indicated, some components are to be replaced in pairs or together with other parts (e.g. crankshaft half-bearings/connecting rod, piston complete with rings and gudgeon pin, etc.).
* When indicated, some grinding operations are to be carried out in series (e.g. grinding of cylinders, crankpins, journals, etc.).

## Crankcase

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| **8.2.1 Oil line check**    Z_importante.jpg **Important**       * Replace and assemble the conical cap **A3** in hole **B** , **B1** (tightening torque at **30 Nm** ), after having performed cleaning operations. * Use a pipe cleaner in access points **A** , **B** , **B1** , **C** , **D** to clean the oil ducts of crankcase **G** . * Use compressed air to eliminate any residues.  1. Remove capscrews **A1** and remove plate **A2** with its gasket.   8.1.jpg **Fig 8.1**    **8.2.2** **Cylinder check**  Position crankcase **G** onto a workbench. With a dial gauge, measure the diameter in correspondence to points **J-M-N (Fig. 8.2)** lengthwise and diagonally with regard to axis **H** of the crankshaft. If ovalisation or wear detected in a single point in **J-M-N** is greater than +0.05 mm with regard to the value in **Tab. 8.1** , crankcase **G**    must be replaced.  Z_importante.jpg **Important**       * Cylinder grinding is forbidden. * **Tab. 8.1** details the dimensional values of new components only.   **Tab 8.1 *Grinding values***   |  |  |  |  | | --- | --- | --- | --- | | **PISTON** | **Ø CILINDER (± 0.007 mm)** | **Ø PISTON (± 0.007 mm)** | **CLEARANCE VALUE (mm)** | | STD | 96.010 | 96.950 | 0.046 - 0.074 |   8.2.jpg **Fig 8.2** |

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| **8.2.3 Block Surface Flatness**    Use a dial gauge to check if the cylinder head surface **A1** is level.  The **MAX** value of allowable irregularity of surface **A1** is:   * 0.10 mm on the entire area; * 0.03 mm on an area of 100x100 mm.   Grinding of surface **A1** is not permitted | 8.2.jpg  **Fig 8.3** |
| **8.2.4 Camshaft housing check**    Use an internal dial gauge to measure the diameters of housings **W - K - Y - Z** . With a micrometer, measure the diameters of gudgeon pins **W1 - K1 - Y1 - Z1 (Fig. 8.5)** . According to the values measured, calculate the clearance between the housing and gudgeon, which is to observe the    values in **Tab. 8.2** . The **MAX** value of wear allowed is **0.120 mm**    Z_importante.jpg **Important**       * **Tab. 8.2** details the dimensional values of new components only. | **Tab 8.2 *Housing and camshaft gudgeon dimensions.***   |  |  |  | | --- | --- | --- | | **REF.** | **DIMENSIONS (mm)** | **CLEARANCE VALUE (mm)** | | **W** | 47.500 - 47.525 | 0.060 - 0.105 | | **W1** | 47.420 - 47.440 | | **K** | 47.000 - 47.025 | 0.060 - 0.105 | | **K1** | 46.920 - 46.940 | | **Y** | 46.500 - 46.525 | 0.060 - 0.105 | | **Y1** | 46.420 - 46.440 | | **Z** | 35.000 - 36.025 | 0.060 - 0.105 | | **Z1** | 34.920 - 35.940 | |
| 8.3.jpg **Fig 8.4** | |

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| **8.2.5 Camshaft control**    With a micrometer, measure the maximum dimensions of intake camshaft **R** and exhaust camshaft **S (Tab. 8.3)** . The **MAX** value of wear allowed is **0.1 mm** .    Z_importante.jpg **Important**         * **Tab. 8.3** details the dimensional values of new components only. | **Tab 8. *3 Camshaft dimensions.***   |  |  | | --- | --- | | **REF.** | **DIMENSIONS (mm)** | | **R** | 40.495 - 40.433 | | **S** | 39.175 - 39.113 | |
| 8.4.jpg **Fig 8.5** | |

## Tappets and tappet housings

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| **8.3.1 Tappets check**  Use a surface plate and a dial gauge as shown in **Fig. 8.5** . Check the perpendicularity of the plate **C** , making the tappet **D** rotate in the direction of the arrow. The **MAX** value of wear allowed is **0.02 mm** .  With a gauge, check the length of value **A and B (Tab. 8.4)** . The **MAX** value of wear allowed is **0.08 mm** . | 8.5.jpg  **Fig 8.5** |
| **8.3.2 Tappet housing check**  Use an internal dial gauge to measure the diameter of the tappet housings **X** . Use value of **A** detected **(Par. 8.3.1)** to calculate the clearance value ( **Tab. 8.4** ). If the clearance values are not observed, replace the worn component.    Z_importante.jpg **Important**          **Tab. 8.4 *T*** ***appets and t*** ***appet housing size.***   |  |  |  | | --- | --- | --- | | **REF.** | **DIMENSIONS (mm)** | **CLEARANCE VALUE (mm)** | | A | 14.984 - 14.966 | 0.016 - 0.052 | | X | 15.000 - 15.018 | | B | 47.5 | --- | | 8.6.jpg **Fig 8.6** |

## Crankshaft

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| **8.4.1 Dimensional check and overhauling**    Wash the crankshaft thoroughly using suitable detergent.  Insert the pipe cleaner into all lubrication ducts **B** and blow compressed air to free them completely from any dirt residues. Check the state of wear and integrity of journals **C** and connecting rod **D** .  Perform the operations described in [**Par. 9.3.1**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=608&parent=1273) and [**Par. 9.3.5**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=608&parent=1273) - except points **2, 3, 5, 9** and **10** .  Tighten capscrews **J** ( [**Fig. 9.9**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=608&parent=1273) ) and **K** ( [**Fig. 9.10**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=608&parent=1273) ) observing the cycles, tightening, and subsequent rotation. **Cycle 1 - Screw J - Torx M14x1,5 - Torque 60 Nm.** ( [**Fig. 9.9**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=608&parent=1273) ); **Cycle 2 - Screw K - Torx M10x1.25 - Torque 30 Nm.** ( [**Fig. 9.10**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=608&parent=1273) ).  Measure the crank pins **A1** with a micrometer, and using a dial gauge measure the internal diameter of the connecting rod half-bearings **A2** . Measure the main journals **B1** , with a micrometer, and using a dial gauge measure the internal diameter of the crankshaft half-bearings **B2** . If the values described in **Tab. 8.5** do not correspond, proceed with grinding all gudgeon pins **A1 and B1** .  8.8.jpg **Fig 8.7** | |
| Z_importante.jpg **Important**         * The crankshaft and connecting rod must be replaced every time they are assembled to prevent seizure, as they are made of special lead-free material. * The **MAX** allowed value of wear for **A1 and A2** is 0.120 mm. * The **MAX** allowed value of wear for **B1 and B2** is 0.120 mm. * To grind the crankshaft, a decrease in diameter of the halfbearings and connecting rod is provided for at 0.25 mm and 0.50 mm, to grind gudgeon pins **A1 and B1** , measure the values of diameters **A2 and B2** by assembling the decreased half-bearings, define the diameter to grind of pins **A1 and B1** , observing the clearance indicated in **Tab. 8.5.** * La **Tab. 8.5** riporta i valori dimensionali solo per i componenti nuovi. | **Tab 8.5 *Connecting rod and journal diameter***   |  |  |  | | --- | --- | --- | | **REF.** | **DIMENSIONS**  **(mm)** | **CLEARANCE VALUE (mm)** | | **A1** | 60.980 - 61.000 | 0.034 - 0.090 | | **A2** | 61.034 - 61.069 | | **B1** | 79.978 - 80.000 | 0.036 - 0.104 | | **B2** | 80.036 - 80.082 | |
| **8.4.2 Checking the axial clearance of the crankshaft**  Perform the operations described in [**Par. 9.3.1**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=608&parent=1273) ,  [**Par. 9.3.4**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=608&parent=1273) and. [**Par. 9.3.6**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=608&parent=1273) - except points **2, 3, 5** , and **10** . Tighten capscrew J ( [**Fig. 9.9**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=608&parent=1273) ) observing the cycles, tightening, and subsequent rotation. **Cycle 3 - Screw J - Torx M14x1,5 - Torque 45°.** ( [**Fig. 9.9**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=608&parent=1273) ) **Cycle 4 - Screw J - Torx M14x1,5 - Torque 45°.** ( [**Fig. 9.9**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=608&parent=1273) ).  Using a dial gauge, measure the axial shift of crankshaft **E** . Axial shift must be a **MIN** of 0.18 mm and **MAX** 0.38 mm.. If the values measured do not correspond, replace shoulder rings **D** . | 8.8.jpg **Fig 8.8** |

## Connecting rod - piston assembly

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| Z_importante.jpg **Important**       * In case of replacement, the connecting rods and pistons must always be replaced for all cylinders. | | | |
| **8.5.1 Connecting rod dimensions check**    Z_importante.jpg **Important**         * Before assembling the connecting rod and pistons ( [**Par. 9.3.7 e 9.3.8**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=608&parent=1273) ), check that the difference in weight between the complete connecting rod and piston units do not exceed **15 gr** to prevent weight imbalances during rotation of the crankshaft and consequent damage. * Mark some references on the connecting rods, caps **Q** , pistons and gudgeon pins to prevent unintentionally confusing the components during assembly. Failure to do this may result in engine malfunctions. * Connecting rod half-bearings **S** must be there with each assembly.   Check that the contact surfaces are perfectly clean and intact.  Assemble the connecting rod cap **Q** to the connecting rod with the half-bearings **S** and tighten capscrews **P** (tightening torque at **28** **Nm** ). With a dial gauge, measure diameters **B and D** . The **MAX** allowed value of wear for **B and D** is **0.06 mm.  Tab 8.6**   |  |  |  | | --- | --- | --- | | **REF.** | **DIMENSIONS (mm)** | **CLEARANCE VALUE (mm)** | | **A** | 192.980 - 193.020 |  | | **B** | 37.025 - 37.015 | 0.015 - 0.030 | | **C** | 36.995 - 37.000 | | **D** | 61.034 - 61.069 |  | | **E** | 74.000 - 74.300 |  | | **F** | 33.950 - 33.990 |  |     Z_importante.jpg **Important**       * **Tab. 8.6** details the dimensional values of new components only. * Check that the connecting rod and crankshaft half-bearings are coupled properly. * Refer to the warnings in [**Par. 8.4.1**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=576&parent=1273) for value **D** decreased. * If the clearance value between **B and C** is not observed, you are required to replace bearing **R (Fig. 8.10)** .     Measure value **A, C, D, E and F** and confront them with those described in **Tab.8.6** . If the measured values do not follow those described in **Tab.8.6** , replace connecting rod **T** . | 8.9.jpg **Fig 8.9**8.10.jpg **Fig 8.10**8.11.jpg **Fig 8.11** |
| **8.5.2 Checking the gudgeon pin-pin axes are parallel**    Lubricate gudgeon pin **A** and bearing **R (Fig. 8.10)** . Insert the gudgeon pin into bearing **R** . Use a dial gauge to check the axis parallelism of the connecting rod big end and small end.    Parallel deviation (value **V** ) measured at the tip of the gudgeonpin, must be a **MIN** of 0,015 and **MAX** of 0,030 mm. If the parallelism values do not comply with the specified ones,replace the connecting rod with a new one.  **8.5.3** **Piston rings check**  Insert ring **U** into the cylinder, measure value H (distance between the points of ring **U** ). Repeat for all the seal rings.    If the measured value **H** does not correspond to the values indicated in the table **(Tab. 8.7)** , replace the seal rings **U** .  Z_importante.jpg **Important**       * Seal rings cannot be replaced separately.     **NOTE:** refer to **Fig. 8.17** to locate the rings.  **Tab. 8.7**   |  |  | | --- | --- | | **RINGS** | **H (mm)** | | U1 | 0.30 - 0.15 | | U2 | 0.50 - 0.70 | | U3 | 0.20 - 0.40 | | 8.12.jpg **Fig 8.12**8.13.jpg **Fig 8.13** |
| **8.5.4 Piston dimension check**  Clean the piston thoroughly. Measure the diameter of the piston at 12 mm (quota **L** ) from the base of the skirt in correspondence with the graphite lubrication windows **M** .  Refer to **Tab. 8.8** to establish the clearance value of the pistons with a decreased diameter. In correspondence with point **W** , there are: 3 digits for the STD piston;    3 digits followed by **R** for a piston with an increased diameter of 0.20 mm; +0.5 for a piston with an increased diameter of 0.50 mm;    +1 for a piston with an increased diameter of 1.00 mm;  If clearance between cylinder and piston is greater than 0,074 mm, the piston and seal rings must be replaced.  Z_importante.jpg **Important**       * **Tab. 8.8** details the dimensional values of new components only.   **Tab. 8.8**   |  |  |  |  | | --- | --- | --- | --- | | **PISTON** | **Ø CYLINDERS**  **(± 0.007 mm)** | **Ø PISTON (± 0.007 mm)** | **CLEARANCE VALUE**  **(mm)** | | STD | 96.010 | 95.950 | 0.046 + 0.074 | | +0.20 | 96.210 | 96.150 | | +0.50 | 96.510 | 96.450 | | +1.00 | 97.010 | 96.950 | | 8.14.jpg **Fig 8.14**8.15.jpg **Fig 8.15** |
| Z_importante.jpg **Important**       * With a feeler gauge, measure the clearance of the seal ring in the respective seat (value **L1, L2 e L3** ). * If the clearance does not comply with the values shown in the **Tab. 8.9** , replace the seal rings and the piston.   **Tab 8.9**   |  |  | | --- | --- | | **SEAL RINGS** | **CLEARANCE VALUE (mm)** | | **U1 (L1)** | 0.110 - 0.150 | | **U2 (L2)** | 0.070 - 0.115 | | **U3 (L3)** | 0.030 - 0.070 | | 8.16_8.17.jpg **Fig 8.16 / 8.17** |

## Cylinder head

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| **8.6.1 Flatness check**  Put the cylinder head on a surface plate and, with a dial gauge, check the flatness of surface **C** .  The **MAX** value of allowable irregularity of surface **C** is 0.10mm. If the value is not observed, you are required to grind surface **C** . The **MAX** removal allowed is 0.20 mm.    Z_importante.jpg **Important**       * Grinding is to be performed with sleeves **A** of the electronic injectors assembled. * Grinding is prohibited on all engines provided with an EPA name plate (refer to [**Par. 1.3**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=546&parent=1273) ). | 8.18_8.19.jpg **Fig 8.18 -** **Fig 8.19** |
| **8.6.2 Valve seats check**  Thoroughly clean the valves and their seats with. Measure indentation **B** of each valve with regard to the cylinder head surface **C** , which is to be a **MIN** of 0.50 mm and **MAX** of 0.53 mm. The **B MAX** indentation allowed on worn components is 0.90 mm.    If the measured value does not correspond with the values indicated, replace the worn component.    Z_importante.jpg **Important**       * The seats must be worked after driving to reach value **B** , go to a rectification workshop for such operations.   **8.6.3 Valve springs**  Use a gauge to measure the free length **Z** .    Using a dynamometer, subject the spring to two different forces and check that the length of the spring corresponds to the values indicated in **Tab. 8.10** .    **Tab 8.10**   |  |  |  | | --- | --- | --- | | **WEIGHT (kg)** | **LENGHT (mm)** | | | 0 | **Z** | 42.50 | | 20,4 | **Z1** | 33.00 | | 42,8 | **Z2** | 23.80 | | 8.20.jpg **Fig 8.20**8.21.jpg **Fig 8.21** |
| **8.6.4 Valve guides check**  Measure the diameters **D** and **E** of the rods and guides valve **(Tab. 8.11)** . If the diameters don't correspond to the values indicated, replace the valves or guides.  The **MAX** allowed value of wear for **D** and **E** is 0.10 mm.    Observe values **G** from surface **F** when assembling guides **H (Tab. 8.11)** .    Z_importante.jpg **Important**       * Carry out the measurements in different points to detect any ovalisation and/or concentrated wear. * **Tab. 8.11** details the dimensional values of new components only.   **Tab 8.11 *Valve stem - valve guide dimensions***   |  |  |  | | --- | --- | --- | | **REF.** | **DIMENSIONS (mm)** | **CLEARANCE VALUE (mm)** | | **D** | 5.978 - 5.990 | 0.040 - 0.064 | | **E** | 6.030 - 6.042 | | **G** | 38.300 - 38.700 |  | | 8.22.jpg **Fig 8.22** |
| **8.6.5 Valve guides replacement**  The intake and exhaust guides are both made out of grey iron with pearlitic phosphoric matrix and they have the same dimensions.    The guides are press-fit assembled; assembly is possible by cooling the guides with the aid of liquid nitrogen.      Before assembling a new guide, measure value **L and M** ,calculate the press-fit value, which must observe the values in **Tab. 8.12** .    Observe values **G** from surface **F** when assembling guides **H (Tab. 8.11 - Fig. 8.22)** .    Z_importante.jpg **Important**       * The guides must be worked for value **E (Tab. 8.11 - Fig.8.22)** after driving. Contact a rectification workshop for such operations.   **Tab 8.12 *valve guides - housing dimensions***   |  |  |  | | --- | --- | --- | | **REF.** | **DIMENSIONS (mm)** | **PRESS-FIT VALUE (mm)** | | **L** | 10.000 - 10.015 | 0.030 - 0.054 | | **M** | 10.045 - 10.054 | | 8.23.jpg **Fig 8.23** |
| **8.6.6 Rocker arm check**  Measure values **W1** in correspondence with holes **M** located on rocker arm gudgeon **L** (seen from  **B** in **Fig. 8.25** ). Measure values **W2 (Fig. 8.26).** Based on the values measured, calculate the clearance between  **W1** and **W2** , which is to observe the values in **Tab. 8.13.** Check that all oil pipes **N** and **M** are free from impurities or obstructions.  **Tab 8.13**   |  |  |  | | --- | --- | --- | | **REF.** | **DIMENSIONS (mm)** | **CLEARANCE VALUE (mm)** | | **W1** | 22.005 - 22.015 | 0.025 - 0.056 | | **W2** | 22.040 - 22.061 |   8.25.jpg  **Fig. 8.25** | 8.24.jpg  **Fig 8.24**  8.26.jpg  **Fig 8.26** |

## Balance device check

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| **8.7.1 Dimensional and visual check**    With a micrometre, measure the diameter of the pins **A1 - B1 - C1** . Use an internal dial gauge to measure the diameters of housings **D1 - E1 - F1** .  According to the values measured, calculate the clearance between the housing and pin, which is to observe the values in Tab. 8.14.  The **MAX** value of wear allowed is 0.03 mm.    Z_importante.jpg **Important**    La Tab. 8.14 details the dimensional values of new components only. | 8.28.jpg  **Fig. 8.27** |
| **Tab. 8.14**   |  |  |  | | --- | --- | --- | | **REF .** | **DIMENSIONS (mm)** | **CLEARANCE VALUE (mm)** | | **A1** | 41.405 - 41.425 | 0.075 - 0.135 | | **D2** | 41.500 - 41.540 | | **B1** | 40.905 - 40.925 | 0.075 - 0.135 | | **E1** | 41.000 - 41.040 | | **C1** | 40.405 - 40.425 | 0.075 - 0.135 | | **F1** | 40.500 - 40.540 | | 8.29.jpg  **Fig. 8.28** |
| **8.7.2 Replacement of bearings**  The bearings must be bored after assembly. Refer to the D1, E1, F1 values in Tab. 8.14. Refer to surface P for G1, G2, G3 assembly values in    Z_importante.jpg **Important**    Bearing G2 must be oriented for engine lubrication circuit oil holes.  **Tab. 8.15**   |  |  | | --- | --- | | **REF .** | **DIMENSIONS (mm)** | | **G1** | 49.5 | | **G2** | 285 | | **G3** | 517 | | 8.31.jpg  **Fig. 8.30** |
| 8.30.jpg  **Fig. 8.29** |

## Oil pump check

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| **8.7.1 Dimensional and visual check**  Measure clearance value **B**  between the rotor teeth, the value of allowable wear is **MAX** 0.28 mm.      Z_importante.jpg **Important**         * Should the results from checks carried out not be in accordance with the conditions described, replace the oil pump **A** . | 8.27.jpg **Fig 8.27** |
| **8.7.2 Oil pressure valve check**  Measure the free length **F** of spring **D** , which must be  **47.5** **mm** . If the measured value does not correspond to the value indicated, replace spring **D** .    **Tab 8.16**   |  |  | | --- | --- | | **POS** | **DESCRIPTION** | | **B** | Oil stopper | | **C** | Gasket | | **D** | Spring | | **E** | Piston | | 8.28.jpg **Fig 8.28** |

