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| **Information about overhauling** |
| **KDI 1903TCR / KDI 1903TCRE5 Workshop manual (Rev. 17.8)** |



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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**  Use a pipe cleaner in access points **A, B, C, D, E** to clean the oil ducts of crankcase **G** . Use compressed air to eliminate any residues.    Replace and assemble the conical cap in hole **B** ( **B1** if present - tightening torque at **30 Nm** ) and caps in holes **D** , after having performed cleaning operations.    imm8_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. 8.1a** , the crankcase **G** must be replaced. Refer to **Tab. 8.1a**    to establish the clearance value of cylinders subjected to grinding operations.  Z_importante.jpg **Important**       * Cylinder rehoning is forbidden. * **Tab. 8.1a** details the dimensional values of new components only. * (1) The increase of **+0.20 mm** , may already be present on the engine.   **Tab 8.1a *Grinding values***   |  |  |  |  | | --- | --- | --- | --- | | **PISTON** | **Ø CILINDER (± 0.007 mm)** | **Ø PISTON (± 0.007 mm)** | **CLEARANCE VALUE (mm)** | | STD | 88.010 | 87.950 | 0.046 - 0.074 | | +0.20 (1) | 88.210 | 88.150 |     imm8_2.jpg **Fig 8.2**  **N.B.: if removing the Z2 hole closing cap, the new cap must comply with the MAX measurement of 1.5 mm from the surface G1.**  tappo_albero_camme_su_basamento.png    quota_piantaggio_tappo.png  **Fig 8.2a** |

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| **8.2.3 4-cylinder camshaft housing check**    The camshaft housings only contain the timing system side bushing **Q** . Use an internal dial gauge to measure the diameters of housings **X - W - K - Y - Z** . With a micrometer, measure the diameters of gudgeon pins **X1 - W1 - K1 - Y1 - Z1 (Fig. 8.4)** . According to the values measured, calculate the clearance between the housing and gudgeon, which is to observe the    values in **Tab. 8.2a** . The **MAX** value of wear allowed is **0.120 mm**    Z_importante.jpg **Important**       * **Tab. 8.2a** details the dimensional values of new components only. | **Tab 8.2a *Housing and camshaft gudgeon dimensions.***   |  |  |  | | --- | --- | --- | | **REF.** | **DIMENSIONS (mm)** | **CLEARANCE VALUE (mm)** | | **X** | 44.000 - 44.025 | 0.040 - 0.085 | | **X1** | 43.940 - 43.960 | | **W** | 43.000 - 43.025 | 0.060 - 0.105 | | **W1** | 42.920 - 42.940 | | **K** | 42.000 - 42.025 | 0.060 - 0.105 | | **K1** | 41.920 - 41.940 | | **Y** | 41.000 - 41.025 | 0.060 - 0.105 | | **Y1** | 40.920 - 40.940 | | **Z** | 36.000 - 36.025 | 0.060 - 0.105 | | **Z1** | 35.920 - 35.940 | |
| imm8_3.jpg **Fig 8.3** | |
| **8.2.3.1** **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 8.3b** |

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| **8.2.4 Camshaft control for 4 cylinder engine**  With a micrometer, measure the maximum dimensions of intake camshaft **R** and exhaust camshaft **S (Tab. 8.2b)** . The **MAX** value of wear allowed is **0.1 mm** .    Z_importante.jpg **Important**         * **Tab. 8.2b** details the dimensional values of new components only. | **Tab 8.2b *Camshaft dimensions.***   |  |  | | --- | --- | | **REF.** | **DIMENSIONS (mm)** | | **R** | 32.638 - 32.700 | | **S** | 32.998 - 32.060 | |
| imm8_4.jpg **Fig 8.4** | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **8.2.5 3** **-cylinder camshaft housing check**  The camshaft housings only contain the timing system side bushing **Q** . Use an internal dial gauge to measure the diameters of housings **X - W - K - Z** . Use an internal dial gauge to measure the diameters of housings **X1 - W1 - K1 - 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. 8.2a** . The **MAX** value of wear allowed is **0.120 mm**    Z_importante.jpg **Important**       * **Tab. 8.3a** details the dimensional values of new components only. | **Tab 8.3a *Housing and camshaft gudgeon dimensions.***   |  |  |  | | --- | --- | --- | | **REF.** | **DIMENSIONS (mm)** | **CLEARANCE VALUE (mm)** | | **X** | 44.000 - 44.025 | 0.040 - 0.085 | | **X1** | 43.940 - 43.960 | | **W** | 43.000 - 43.025 | 0.060 - 0.105 | | **W1** | 42.920 - 42.940 | | **K** | 42.000 - 42.025 | 0.060 - 0.105 | | **K1** | 41.920 - 41.940 | | **Z** | 36.000 - 36.025 | 0.060 - 0.105 | | **Z1** | 35.920 - 35.940 | |
| imm8_5.jpg **Fig 8.5** | |

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| **8.2.6 Camshaft control for 3 cylinder engine**  With a micrometer, measure the maximum dimensions of intake camshaft **R** and exhaust camshaft **S (Tab. 8.3b)** . The **MAX** value of wear allowed is **0.1 mm** .    Z_importante.jpg **Important**         * **Tab. 8.3b** details the dimensional values of new components only. | **Tab 8.3b *Camshaft dimensions***   |  |  | | --- | --- | | **REF.** | **DIMENSIONS (mm)** | | **R** | 32.834 - 32.896 | | **S** | 33.335 - 33.397 | |
| imm8_6.jpg **Fig 8.6** | |

## 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. 8.7** . 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** . | imm8_7.jpg **Fig 8.7** |
| **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 | 11.966 - 11.984 | 0.060 - 0.105 | | X | 12.000 - 12.018 | | B | 46.5 ± 0.2 | --- | | imm8_8.jpg **Fig 8.8** |

## Crankshaft

**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=160&parent=1000) , perform the operations described in [**Par. 9.3.6**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=160&parent=1000) - except Points **2, 4, 9 and 10** .  
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** .

Gear **A** on the crankshaft is timed by a key, assembly of gear **A** on the shaft occurs after heating at a stabilized temperature of +180° C for 5 mins.

 **Fig 8.9**

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| 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** | 53.981 - 54.000 | 0.035 - 0.085 | | **A2** | 54.035 - 54.066 | | **B1** | 63.981 - 64.000 | 0.035 - 0.102 | | **B2** | 64.035 - 64.083 | |
| **8.4.2 Checking the axial clearance of the crankshaft**  Perform the operations described in [**Par. 9.3.5 and 9.3.6**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=160&parent=1000) .    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** . | imm8_10.jpg **Fig 8.10** |

## 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=160&parent=1000) ), check that the difference in weight between the complete connecting rod and piston units do not exceed 8 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 **25 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** | 169.980 - 170.020 |  | | **B** | 30.020 - 30.030 | 0.025 - 0.030 | | **C** | 29.995 - 30.000 | | **D** | 54.035 - 54.066 |  | | **E** | 67.700 - 68.000 |  | | **F** | 29.750 - 29.790 |  |     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=154&parent=1000) for value **D** decreased. * If the clearance value between **B and C** is not observed, you are required to replace bearing **R (Fig. 8.12)** .     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** . | imm8_11.jpg **Fig 8.11**imm8_12.jpg **Fig 8.12**imm8_13.jpg **Fig 8.13** |
| **8.5.2 Checking the gudgeon pin-pin axes are parallel**    Lubricate gudgeon pin **A** and bearing **R (Fig. 8.12)** . 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. 8.19** to locate the rings.  **Tab. 8.7**   |  |  | | --- | --- | | **RINGS** | **H (mm)** | | U1 | 0.100 - 0.300 | | U2 | 0.250 - 0.500 | | U3 | 0.250 - 0.400 | | imm8_14.jpg **Fig 8.14**imm8_15.jpg **Fig 8.15** |
| **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. 8.1b** 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. 8.1b** details the dimensional values of new components only.   **Tab. 8.1b**   |  |  |  |  | | --- | --- | --- | --- | | **PISTON** | **Ø CYLINDERS**  **(± 0.007 mm)** | **Ø PISTON (± 0.007 mm)** | **CLEARANCE VALUE**  **(mm)** | | STD | 88.010 | 87.950 | 0.046 + 0.074 | | +0.20 | 88.210 | 88.150 | | +0.50 | 88.510 | 88.450 | | +1.00 | 89.010 | 88.950 | | imm8_16.jpg **Fig 8.16**imm8_17.jpg **Fig 8.17** |
| 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. 8.8** , replace the seal rings and the piston.   **Tab 8.8**   |  |  | | --- | --- | | **SEAL RINGS** | **CLEARANCE VALUE (mm)** | | **U1 (L1)** | 0.110 - 0.150 | | **U2 (L2)** | 0.070 - 0.115 | | **U3 (L3)** | 0.030 - 0.065 | | imm8_18_8_19.jpg **Fig 8.18 e 8.19** |

## 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=51&parent=1000) ). | imm8_20.jpg **Fig 8.20a -** **Fig 8.20b** |
| **8.6.2 Valve seats check**  Measure indentation **B** of each valve with regard to the cylinder head surface **C** , which is to be a **MIN** of 0.60 mm and **MAX** of 0.85 mm. The **B MAX** indentation allowed on worn components is 1.10 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**    Using a dynamometer, subject the spring to two different forces **(in Tab. 8.9)** and check that the length of the spring corresponds to the values indicated in the table.  (\*1) The code **ED0057551850-S** is installed from **S/N 4418801760**    **Tab 8.9**   |  |  |  |  | | --- | --- | --- | --- | | **WEIGHT (kg)** | | **LENGHT (mm)** | | | **ED0057552810-S** | **ED0057551850-S (\*1)** | | 0 | 0 | **Z** | 48.34 | | 13.5 | 20.4 | **Z1** | 30.00 | | 19.5 | 29.8 | **Z2** | 22.00 | | imm8_21.jpg **Fig 8.21**imm8_22.jpg **Fig 8.22** |
| **8.6.4 Valve guides check**  Measure the diameters **D** and **E** of the rods and guides valve **(Tab. 8.10)** . 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. 8.10)** .    Z_importante.jpg **Important**       * Carry out the measurements in different points to detect any ovalisation and/or concentrated wear. * **Tab. 8.10** details the dimensional values of new components only.   **Tab 8.10 *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** | 7.000 - 7.020 |  | | imm8_23.jpg **Fig 8.23** |
| **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. 8.11** .    Observe values **G** from surface **F** when assembling guides **H (Tab. 8.10 - Fig. 8.23)** .    Z_importante.jpg **Important**       * The guides must be worked for value **E (Tab. 8.10 - Fig.8.23)** after driving. Contact a rectification workshop for such operations.   **Tab 8.11 *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 | | imm8_24.jpg **Fig 8.24** |
| **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. 8.27).** Based on the values measured, calculate the clearance between  **W1** and **W2** , which is to observe the values in **Tab. 8.12.** Check that all oil pipes **N** and **M** are free from impurities or obstructions.  **Tab 8. *12***   |  |  |  | | --- | --- | --- | | **REF.** | **DIMENSIONS (mm)** | **CLEARANCE VALUE (mm)** | | **W1** | 19.985 - 20.005 | 0.035 - 0.076 | | **W2** | 20.040 - 20.061 |   8.26.png  **Fig. 8.26** | 8.25.png  **Fig 8.25**  8.27.png  **Fig 8.27** |

## Oil pump check

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| **8.7.1 Dimensional and visual check**  Perform the operations described in [**Par.7.8.1 and Par.7.8.4.**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=141&parent=1000)    Measure clearance value **B**  between the rotor teeth, the value of allowable wear is **MAX** 0.28 mm.    Clean all the components thoroughly, check that the work surfaces **C** of the rotors and pump body are not worn.    Z_importante.jpg **Important**         * Should the results from checks carried out not be in accordance with the conditions described, replace the timing system carter together with the oil pump.   On assembly, references **A** must be visible. | imm8_25.jpg **Fig 8.28**imm8_26.jpg **Fig 8.29** |
| **8.7.2** **R otors clearance check**    Z_importante.jpg **Important**    Replace carter **R** complete with its oil pump, if there are signs of wear in area **P** of surface **Q (Fig. 8.32 - 8.32a)** .  Measure values **G and H (Fig. 8.30)** . Measure values **L, M and N (Fig. 8.31)** . According to the values measured, calculate the clearance between **G and H, L and M and L and N** which are to observe the values in **Tab. 8.** **13** .    For assembly, carry out the operations described from [**Par. 9.11.3 to Par. 9.11.4**](https://iservice.lombardini.it/jsp/Template2/manuale.jsp?id=167&parent=1000) . | imm8_27.jpg **Fig 8.30** |
| **Tab 8.13**   |  |  |  | | --- | --- | --- | | **REF.** | **DIMENSIONS (mm)** | **CLEARANCE VALUE (mm)** | | **G** | 82.820 - 82.855 | 0.395 - 0.320 | | **H** | 82.460 - 82.500 | | **L** | 17.500 - 17.525 | 0.036 - 0.086 | | **M** | 17.464 - 17.439 | | **N** | | imm8_28.jpg **Fig 8.31** |
| 8.32.png **Fig 8.32** - **Fig 8.32a** | |
| **8.7.3 Oil pressure valve check**  Measure the free length **F** of spring **D** , which must be **47.91 mm** . If the measured value does not correspond to the value indicated, replace spring **D** .    **Tab 8.14**   |  |  | | --- | --- | | **POS** | **DESCRIPTION** | | **B** | Oil stopper | | **C** | Gasket | | **D** | Spring | | **E** | Piston | | imm8_30.jpg **Fig 8.33** |

