

Workshop Manual

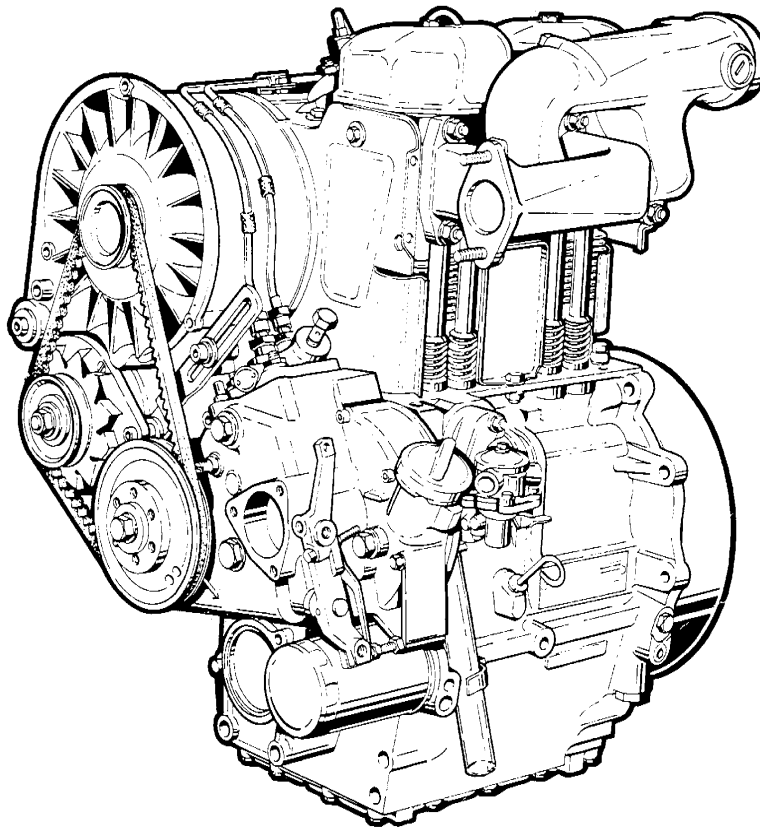


DEUTZ

291 1921

01/1987

FL 511/W



WORKSHOP MANUAL
for
Air-cooled DEUTZ DIESEL Engines

FL 511/W

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FOREWORD

This Workshop Manual informs our customers and Service partners about repair and adjustment work on the DEUTZ diesel engine. It is presumed that this work will be carried out by qualified personnel.

This Manual has been made up in a manner which ensures quick visual comprehension of the contents. This is achieved by illustrations and graphic symbols as substitute for the respective text. This layout permits universal use, because the illustrations and symbols are also largely understood by those being unable to read and write.

Aspects of operation and maintenance are not dealt with in this Manual; they are contained in the Engine Operation Manual.

This Workshop Manual is not regularly updated. Any engineering changes having been introduced in the meantime will be considered in the next issue. Therefore, please refer to the Technical Circulars where engineering changes are announced when appropriate.

General:

- This Workshop Manual has been prepared using our best knowledge and experience, taking into account safety and environmental aspects.
- It has to be ensured that everyone concerned with repair or adjustment work on the engine has this Workshop Manual available, reads it and understands it.
- It has to be ensured that all equipment, hand and special tools required for proper execution of repair work are in good condition.
- Failure to comply with this Workshop Manual may result in malfunction of the engine, short lifetime of components, personal injury or damage to property and environment for which we take no responsibility.
- Engine components such as springs, clips, flexible retaining rings, electric equipment, pipes, etc. involve a risk of damage or personal injury if handled in an improper way. It is therefore essential that no one attempts to do any work on the engine unless he has the necessary experience of the various tools, materials and methods.
- To ensure best efficiency, reliability and lifetime of the engine and its components, only original spare parts may be used for the repair.

**Thanks very much for your reading,
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manual**




























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Key to Symbols

	Disassembly of assembly groups		Guard against personal injury Indication of hazard
	Reassemble to form assembly group		Guard against material damage Damage to parts
	Remove obstructing parts		Prop up – Support – Hold
	Reinstall – Remount parts which had obstructed disassembly		Oil
	Attention! Important notice!		Grease
	Check – Adjust e. g. torque, dimensions, pressures, etc.		Mark before disassembly, observe marks when reassembling
	Special tool		Balance Eliminate any imbalance
	Note direction of installation		Filling – Topping up – Refilling e. g. oil, cooling water, etc.
	Visual inspection		Drain off e. g. oil, cooling water, etc.
	Possibly still serviceable Renew if necessary		Loosen – Release e. g. loosening a clamping device
	Renew at each reassembly		Tighten – Clamp e. g. tightening a clamping device
	Unlock – Lock e. g. split pin, locking plate, etc.		Vent
	Lock – Adhere e. g. with liquid sealant		Machining process
			See Technical Data (For inst. 67 as indication of the line)

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1. SPECIFICATION DATA

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General engine data

		F1L 511	F1L 511 W	F2L 511	F2L 511 W
	Designation of type				
1	Total piston displacement cm ³	825		1650	
2	Working cycle	Four-stroke diesel			
3	Combustion system	Direct injection W = 2-stage combustion system			
4	Bore mm	100			
5	Stroke mm	105			
6	Weight of engine according to VDMA kg	116		155	
7	Direction of rotation	When facing flywheel left counterclockwise			
8	Rated speed max. 1/min	3000			
9	Minimum idle speed 1/min	950 ⁺⁵⁰			
10	Compression ratio	17 : 1 FL 511 W = 19 : 1			
11	Compression pressure bar	29 - 31			
12	Firing order	—————		2 - 1	
13	Dimensions of engine with oil bath air cleaner and fuel filter				
14	Overall length mm	459,5		571	
15	Overall width mm	525		525	
16	Overall height mm	694		731	

Fuel injection system

	Designation of type	FIL 511	FIL 511 W	F2L 511	F2L 511 W
17	<u>Fuel injection pump</u> Make	Bosch			
18	Pressure for testing tightness of relief valve (drop to 140 bar in a minute permiss) bar	150			
19	Minimum pressure that must be attained with the injection pump element (with about 5 rotations of crankshaft) bar	300			
20	<u>Governor</u> Make	Deutz			
21	<u>Injection nozzle</u> Bosch	DLLA 149 S 774 FL 511 W = DNOSD 165			
22	Opening pressure (checking injector for re-use) bar	175^{+8} FL 511 W = 115^{+8}			
23	Opening pressure (new condition) bar	180^{+8} FL 511 W = 120^{+8}			
24	<u>Commencement of del. before TDC in °crankshaft rota.</u>				
25	Engines without advance unit degree /1/min	24° FL 511 W = 20°			
26	Engines with advance unit degree/1/min	_____			


Fuel injection system

	Designation of type	F1L 511	F1L 511 W	F2L 511	F2L 511 W
27	Advance unit degree	_____			
28	Dimension of Injection Pump mm	82,6 ^{±0,1}			
29	Distance between the governor head and the crankcase mm	84,7 - 85,7			
30	Diameter of balls for the governor's thrust bearing mm	8			
31	No. of balls	19			
32	Speed adjusting shaft Axial clearance mm	0,2 - 1,1			


The commencement of injection expressed in degrees of crank angle ($^{\circ}Kw$) can be translated into a length "L" in mm marked on the V-belt pulley (flywheel) as follows

$$L = \frac{d \cdot 3,14 \cdot ^{\circ}Kw}{360^{\circ}}$$


Cylinder unit

	Designation of type	FIL 511	FIL 511 W	F2L 511	F2L 511 W
		33	<u>Cylinder head</u>		
34	Valve guide Outside diameter mm			+ 0,056 15,0 + 0,045	
35	Number of oversizes			2	
36	Each oversize mm			+ 0,056 0,25 + 0,045	
37	Bore in cylinder head mm			+ 0,011 15,0 0	
38	Number of oversizes			2	
39	Each oversize mm			+ 0,011 0,25 0	
40	Valve guide (pressed in) Inside diameter mm			+ 0,015 8,0 0	
41	Valve stem Diameter Inlet mm			0 7,96 - 0,015	
42	Valve stem Diameter Exhaust mm			0 7,94 - 0,02	
43	Valve stem clearance Inlet normal mm			0,04 - 0,07	
44	Inlet Limit value mm			0,15	
45	Exhaust normal mm			0,06 - 0,095	
46	Exhaust Limit value mm			0,2	
47	<u>Valve seating ring</u> Inlet outside diameter, nominal mm			0 45,66 - 0,02	
48	Number of oversizes			3	
49	Each oversize mm			0 0,1 - 0,02	
50	Exhaust outside diameter, nominal mm			0 40,16 - 0,02	
51	Number of oversizes			3	
52	Each oversize mm			0 0,1 - 0,02	

Cylinder unit

	Designation of type	F1L 511	F1L 511 W	F2L 511	F2L 511 W
		53	Bore in cylinder head Inlet mm		
54	Exhaust mm			$+0,025$ $40,0$ 0	
55	Valve tulip \varnothing Inlet mm			$\pm 0,1$ $43,0$	
56	Valve tulip \varnothing Exhaust mm			$\pm 0,1$ $37,0$	
57	Valve seat width Inlet mm			$+0,6$ $1,5$ 0	
58	Exhaust mm			$+0,6$ $1,5$ 0	
59	Seat angle - degree Inlet			45°	
60	Exhaust degree			45°	
61	Rim thickness Inlet mm			0 $1,0 - 0,2$	
62	Exhaust mm			0 $1,8 - 0,2$	
63	Wear limit Inlet mm			$0,5$	
64	Exhaust mm			$0,7$	
65	Distance valve disc/ Cylinder head sealing surface mm			$5,9$	
66	Limit value mm			$5,2$	
67	Valve clearance when engine is cold Inlet mm			$0,15$	
68	Exhaust mm			$0,15$	
69	After repairs to cylinder unit Inlet mm			$0,15$	
70	Exhaust mm			$0,15$	
71	Clearance between valve rockers and the cams of the decompression gear Coarse adjustment mm			_____	


Cylinder unit

	Designation of type	F1L 511	F1L 511 W	F2L 511	F2L 511 W
	72	Setting dimension for decompression device mm			60,3 ⁰ _{-0,2}
73	Maximum distance between cylinder head bottom and cylinder head joint mm			6,3	
74	Limit value mm			5,8	
75	<u>Valve spring</u>				
76	Windings total			7	
77	Length unloaded, normal mm			59	
78	Length unloaded Fatigue limit mm			56	
79	<u>Cylinder head bolts</u>				
80	Length mm			188 ^{+0,5} ₋	
81	max. length mm			189,5	
82	<u>Cylinder</u>				
83	Bore normal mm			100 ^{+0,22} ₀	
84	Bore wear limit mm			1) 0,15 2) 0,10	
85	Number of over-sizes			2	
86	Each oversize mm			0,5 ^{+0,22} ₀	
87	Nominal distance between cylinder a. engine housing mm			_____	
88	<u>Piston</u>				
89	Diameter normal mm	FL 511 = 99,96 ^{+0,009} ₋		FL 511 W = 99,97 ^{+0,009} ₋	


1) Reversing point, 1st piston ring;

2) Remaining range of stroke;


Cylinder unit

	Designation of type	FIL 511	FIL 511 W	F2L 511	F2L 511 W
90	Number of oversizes	2			
91	Each oversize mm	$0,5 \begin{matrix} +0,009 \\ - \end{matrix}$			
92	Distance between piston and cylinder head mm	1,0 - 1,2			
93	Bore for piston pin mm	$35,0 \begin{matrix} +0,010 \\ +0,004 \end{matrix}$			
94	Piston pin diameter mm	$35,0 \begin{matrix} 0 \\ -0,006 \end{matrix}$			
95	Piston ring grooves width of 1st groove (based on) mm	$2,7 \begin{matrix} +0,002 \\ - \end{matrix}$ ($\varnothing 97 - 0,16$)			
96	Width of 2nd and 3rd grooves mm	$2,5 \begin{matrix} +0,10 \\ +0,08 \end{matrix}$			
97	Width of scraper ring groove mm	$5,0 \begin{matrix} +0,05 \\ +0,03 \end{matrix}$			
98	<u>Piston rings</u>				
99	Side clearance 1st compression ring mm	0,105 - 0,145			
100	Limit value mm	0,5			
101	2nd compression ring mm	0,090 - 0,122			
102	Limit value mm	0,3			
103	3rd compression ring mm	_____			
104	Limit value mm	_____			
105	Slotted oil ring mm	0,040 - 0,072			
106	Limit value mm	0,15			
107	Gap compression rings, normal mm	0,35 - 0,55			
108	Limit value mm	0,8			

Cylinder unit


Designation of type	FIL 511	FIL 511 W	F2L 511	F2L 511 W
				
109 Gap - slotted oil control rings normal mm	0,25 - 0,40			
110 Limit value mm	0,8			
111 <u>Connecting rod</u>				
112 Hole for gudgeon pin bushing mm	$38,0^{+0,020}_0$			
113 Outside diameter gudgeon pin bushing mm	$38,080^0_{-0,03}$			
114 Inside diameter, pressed in mm	$35^{+0,036}_{+0,080}$			
115 Gudgeon pin clearance in gudgeon pin bush mm	0,036 - 0,086			
116 Limit value mm	0,15			
117 Big-end bearing bore mm	$57,0^{+0,025}_0$			
118 Bearing shell Nominal inside diameter mm	$52,04^{+0,033}_0$			
119 Number of undersizes	3			
120 Each undersize mm	$0,5^{+0,033}_0$			
121 Nominal wall thickness mm	$2,476^{+0,005}$			
122 Number of oversizes	3			

Motion parts

	Designation of type	F1L 511	F1L 511 W	F2L 511	F2L 511 W
		123	Each oversize mm	0,5	
124	Width of bearing mm	25 ⁰ _{-0,3}			
125	Width of connecting rod mm	34,0 ^{-0,170} _{-0,232}			
126	<u>Big-end bearing clearance</u>				
127	Radial clearance normal mm	0,05 - 0,108			
128	Radial clearance limit value mm	0,15			
129	Side clearance normal mm	0,170 - 0,271			
130	Side clearance limit value mm	0,6			
131	<u>Camshaft</u>				
132	Camshaft main bearing bore spur gear cap mm	—————			
	Crankcase mm	52 ^{+0,030} ₀			
133	Camshaft bearing bushing Nominal internal diameter mm	48,01 ^{+0,054} ₀			
134	Journal Camshaft	48 ^{-0,025} _{-0,050}			
135	Side clearance of camshaft mm	0,25 - 0,6			
136	Limit value mm	0,8			
137	Radial clearance of camshaft mm	1) 0,035 - 0,114 2) 0,04 - 0,094			
138	Radial clearance limit value (Replacement is governed by oil pressure) mm	0,2			
139	Valve cams Inlet mm	8,0 ^{+0,1}			
140	Exhaust mm	8,0 ^{+0,1}			
141	<u>Timing data check</u>				
142	with valve clearance mm	0,15			
143	Inlet opens before TDC degree	32° 30'			

1) Blower end, 2) Flywheel end,

Motion parts,

	Designation of type	FIL 511	FIL 511 W	F2L 511	F2L 511 W
		144	Inlet closes after BDC degree	59° 30'	
145	Exhaust opens before BDC degree	71° 30'			
146	Exhaust closes after TDC degree	32° 30'			
147	Main bearing bore <u>Drive shaft</u> Spur gear cover mm	37 - 0,029 - 0,045			
	Crankcase mm	62 - 0,026 - 0,045			
148	<u>Crankshaft</u>				
149	Crankpin Diameter normal mm	- 0,010 52,0 - 0,029			
150	Number of undersizes	3			
151	Each undersize mm	- 0,010 0,5 - 0,029			
152	Pin width mm	+ 0,039 34 0			
153	Out-of-roundness wear limit mm	0,01			
154	Hardness normal HRc	55 - 61			
155	Limit value HRc	50			
156	<u>Shaft journal for crankshaft bearing</u>				
157	Diameter normal mm	- 0,010 64,0 - 0,029			
158	Number of under-sizes	3			
159	Each undersize mm	- 0,010 0,5 - 0,029			
160	Out-of-roundness wear limit mm	0,01			
161	Width of journal mm	0 33,5 - 0,15			
162	Hardness normal HRc	55 - 61			
163	Limit value HRc	50			
164	<u>Locating bearing</u>				
165	Bore for main bearing mm	+ 0,019 69,0 0			