

OFF-ROAD ENGINES

IT'S THE CLASS NINE



This engine range still shines, although 2019 has not seen new entries. MAN is spreading the word of its D1556 among on-road applications as widely expected (and predictable, given the connotations of the German manufacturer under the Volkswagen umbrella). The six cylinder was for the second time at Agritechnica after its debut in 2017. In the off-road segment the D1556 will replace the D2066, following the downsizing trend (see box at page 22). The engine block gives up EGR in favor of SCR only with after-treatment management integrated in the control unit (AGN). Common rail is probably the same for all applications, 2,500 bars an variable geometry turbine delivering from 205 to 324 kW and torque reaching its peak at 1,970 Nm at 1,150 to 1,300 rpm. MAN

Among these engines, four out of nine are German native speakers, with MAN Engines to open the way. Yet, on the podium, there are Perkins, arm in arm with the lion of Nuremberg, and Cummins. Deutz has brought in this range of engines the Diesel of the year 2018, the TCD9.0. Above, the Doosan Construction Equipment D30, a dumper truck powered by a Scania DC9

BRAND MODEL	CATERPILLAR C9.3 ACERT
I. D.	
B x S mm - S/B	115 x 149 - 1,30
N. cil. - dm ³	6 - 9,28
Maximum power kW - rpm	298 - 2.200
Mep at max power bar	17,9
Piston speed m/s	10,9
Maximum torque Nm - rpm	1.715 - 1.400
Mep at max torque bar	23,7
% power at max torque (kW)	47,6
Torque at max power Nm	1.294
% power at max torque (kW)	84,4 (252)
DETAILS	
Specific power kW/dm ³	32,0
Specific torque Nm/dm ³	184,6
Areal spec. power kW/dm ²	47,83
RULES AND BALANCE	
Dry weight kg	885
L x W x H mm	1.119x827x1.066
Volume m ³	0,99
Weight/power kg/kW	3
Weight/displacement kg/dm ³	95,3
Power density kW/m ³	301
Total density t/m ³	0,89
Displacement/volume dm ³ /m ³	9,38

boasts a plastic oil sump and introduced electronic immobilizers and modular auxiliary units so to fit alternator, air conditioning and compressor to different engine compartment configuration. What has changed in this displacement range? The 1.5 liter cylinder (with due approximations and the exception of the only 'odd' cylinders engine, the Scania 5-cylinder) was introduced in the engine hall of fame by Deutz, Cummins and the same MAN. Deutz even won the Diesel of the year 2018 with its TCD 9.0.

Speaking of 1.5 liter cylinder, the Cologne anomaly is evident and here lies its competitiveness. It is in fact a 4-cylinder whose compactness guarantees a competitive advantage compared to its natural competitors, all featuring 6 cylinders apart from the odd Scania. TCD9.0 was introduced at Bauma China and comes

Reiner Rössner, Head of Sales at MAN Engines: «With the D4276, we are offering OEM manufacturers an engine that is easy to integrate and will help set them and their machines apart from the competition»

from the collaboration with Liebherr which also brings in a 12 and a 13.5 liters, sharing with them about 65 percent of the spare parts. At the top of this common platform we find the 18-liter, a brand new displacement for Deutz. Let's go back to our engine, which does not push to hard when it comes to absolute power entirely focusing instead on density. It shares the top position with Cummins when it comes to kW/displacement ratio and dimension is of the essence (see power density and relative density).

Deutz's TCD 9.0 has a white-painted twin, the D964 by Liebherr, a recent partner in Cologne in the restructuring of the upper range of Deutz portfolio which re-proposes the quartet among captive applications and free market.

But let's go to the other player, Cummins. From QSL9 to L9, the red-painted 8.88-liter lost two letters while gaining the plus symbol. The evolution of the full line from Columbus for Stage V upgrade excluded exhaust gas recirculation while heavily betting on efficiency. This approach granted an

8 percent gain on power curve and 13 percent on torque curve. Cummins improves its performance sharing the same Diesel index with Perkins, which relying on the properly adapted Caterpillar monoblock (as evidenced by the gap with its yellow elder brother) won the first place. The 1706J-E93TA made a sweep in specific values: specific power, specific torque, areal power. The yellow from Peoria features the same monoblock while showing different figures, being more conservative and captive-leaning. Reasoning in absolute values, the two engines are separated by 42 kW and 366 Nm. 95 percent of Cursor 9 are assembled in the SFH Saic Fiat powertrain Hongyan plant, the Chinese joint venture with Saic, which boasts 65 thousand sqm in Chongqing, 23 thousand of which are dedicated to 9 liters. This is not the most performing model of the Cursor family but is able to keep a balanced profile in dimension/performance ratio while standing out in terms of elasticity. John Deere revisited its top of the range introduced in Las Vegas at

CUMMINS L9	DEUTZ TCD9.0	FPT INDUSTRIAL CURSOR 9	JOHN DEERE PSS9.0L	LIEBHERR D964A7	MAN D1556	PERKINS 1706J-E93TA	SCANIA DC9
114 x 145 - 1,27	135 x 157 - 1,16	117 x 135 - 1,15	118 x 136 - 1,15	135 x 157 - 1,16	115 x 145 - 1,26	115 x 149 - 1,30	130 x 140 - 1,08
6 - 8,88	4 - 8,98	6 - 8,70	6 - 8,92	4 - 8,98	6 - 9,03	6 - 9,28	5 - 9,29
321 - 2.100	300 - 1.900	330 - 1.900	317 - 2.200	300 - 1.900	324 - 1.900	340 - 2.200	294 - 2.100
21,1	21,5	24,4	19,8	21,5	23,1	20,4	18,4
10,2	9,9	8,6	10	9,9	9,2	10,9	9,8
1847 - 1.500	1695 - 1.200	1850 - 1.400	1686 - 1.600	1739 - 1.400	1970 - 1.150	2.081 - 1.400	1827 - 1.500
26,7	24,2	27,2	24,2	24,8	28,0	28,7	25,2
47,5	46,5	46	43,2	48,0	50,8	51,3	52,1
1.460	1.509	1.656	1.372	1.509	1.627	1.470	1.333
90,40 (290)	71 (213)	82,20 (271)	89,20 (283)	85 (255)	73,30 (237)	89,80 (305)	97,70 (287)
36,1	33,3	37,9	35,5	33,3	35,8	36,5	31,6
208	188,5	212,4	188,9	193,4	217,9	224,1	196,6
52,45	52,36	51,16	48,32	52,36	52,01	54,57	44,28
708	750	870	1.044	750	860	865	970
1.128x704x1.166	1.015x838x1.116	1.216x883x1.007	1.271x856x1.265	1.015x838x1.116	1.414x807x1.103	1.125x791x1.068	1.235x980x1.100
0,93	0,95	1,08	1,38	0,95	1,26	0,95	1,33
2,2	2,5	2,6	3,3	2,5	2,7	2,5	3,3
79,7	83,4	99,9	117,0	83,4	95,2	93,2	104,4
345,2	315,8	305,6	229,7	315,8	257,1	357,9	221,1
0,76	0,79	0,81	0,76	0,79	0,68	0,91	0,73
9,55	9,46	8,06	6,47	9,46	7,17	9,77	6,99

LIONS ON THE ROAD

The D15 will replace the D26, the 10.5-liter that replaced the D28 in 2004 for distribution and construction applications: thanks to its power density, 120 kg less than the D20 are a nice introduction. Coming to bus applications, the D1556 has already a companion. It's the fully updated Lion's City, in whose driveline the engine is vertically mounted to favor the arrangement of components elements and consequently the configuration above the walking surface. The Lion's City features the Efficient Hybrid system featuring a continuous-6 kW electric motor-generator, developed by MAN together with Nidec and mounted between the engine and gearbox, a 48V power line linked to a Csai Ac/Dc inverter, an Ultracap 48V Eberspächer-Maxwell group, a 48V/24V converter powering the on-board network and a mass distributor. The system allows a substantial reduction in fuel consumption.

13.6 liters in Stage V and will bring it in at Intermat together with its Stage V full range. Stresses are contained, following John Deere engineering philosophy. The dimension/weight/performance ratio is certainly penalized by this approach, while specific power is very appreciable. Scania is looking towards 2019 and beyond with its odd that leaves out recirculation while confirming XPI. The 9.3 liter engine has the credentials to do well even in Stage V. Södertälje could focus on rotation speed and mean effective pressure to maximize the performances virtues showed under the Scania bonnets. ■

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INDEX									
Torque	11,1	9,4	10,3	8,4	9,2	8,5	10,9	11,6	9,4
Performance	6,9	7,5	7,1	7,5	7	7,2	7,7	7,9	7,1
Stress	11,5	12,3	11,4	11,9	11,4	11,6	12,4	13,2	11,7
Lightness	12,3	10,1	11,5	12,7	15,1	11,7	11,8	11,7	13,4
Density	11,8	14,1	13,9	12,4	8,8	14,1	10,8	14,8	9,6
DIESEL INDEX	7,6	8,1	7,8	7,7	7,4	7,6	8	8,2	7,5

1 PERKINS



2 MAN



3 CUMMINS

