PERFORMANCE DATA [PAG00122]

DECEMBER 07, 2020

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Perf No: EM1453 **Change Level:** 00

General Heat Rejection Sound Emissions Regulatory Altitude Derate Cross Reference Supplementary Data Perf Param Ref

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SALES MODEL:	3516C	**COMBUSTION:**	DIRECT INJECTION
BRAND:	CAT	**ENGINE SPEED (RPM):**	1,800
ENGINE POWER (BKW):	2,188.0	**HERTZ:**	60
COMPRESSION RATIO:	14.7	**ASPIRATION:**	TA
RATING LEVEL:	ELECTRIC PROP - C RATING	**AFTERCOOLER TYPE:**	SCAC
PUMP QUANTITY:	2	**AFTERCOOLER CIRCUIT TYPE:**	JW+OC, AC
FUEL TYPE:	DIESEL	**AFTERCOOLER TEMP (C):**	40
MANIFOLD TYPE:	DRY	**JACKET WATER TEMP (C):**	99
GOVERNOR TYPE:	ADEM3	**TURBO CONFIGURATION:**	PARALLEL
ELECTRONICS TYPE:	ADEM3	**TURBO QUANTITY:**	2
CAMSHAFT TYPE:	STANDARD	**TURBOCHARGER MODEL:**	TPC49-CV33-CT65-TT16-TA70
IGNITION TYPE:	CI	**CERTIFICATION YEAR:**	2005
INJECTOR TYPE:	EUI	**CRANKCASE BLOWBY RATE (M3/HR):**	83.0
FUEL INJECTOR:	2501310	**FUEL RATE (RATED RPM) NO LOAD (L/HR):**	39.6
UNIT INJECTOR TIMING (MM):	64.34	**PISTON SPD @ RATED ENG SPD (M/SEC):**	12.9
REF EXH STACK DIAMETER (MM):	305		
MAX OPERATING ALTITUDE (M):	700		

INDUSTRY	SUB INDUSTRY	APPLICATION
MARINE	PLEASURE CRAFT	MARINE AUXILIARY ENGINE
MARINE	FERRY	MARINE AUXILIARY ENGINE
MARINE	TUG & SALVAGE	MARINE AUXILIARY ENGINE
MARINE	FISHING	MARINE AUXILIARY ENGINE
MARINE	GENERAL CARGO	MARINE AUXILIARY ENGINE
MARINE	INLAND WATERWAY	MARINE AUXILIARY ENGINE
MARINE	OFFSHORE	MARINE AUXILIARY ENGINE
MARINE	CRUISE	MARINE AUXILIARY ENGINE
MARINE	GOVERNMENT	MARINE AUXILIARY ENGINE
MARINE	DREDGE	MARINE AUXILIARY ENGINE

General Performance Data Top

PERCENT LOAD	ENGINE POWER	BRAKE MEAN EFF PRES (BMEP)	BRAKE SPEC FUEL CONSUMPTN (BSFC)	VOL FUEL CONSUMPTN (VFC)	INLET MFLD PRES	INLET MFLD TEMP	EXH MFLD TEMP	EXH MFLD PRES	ENGINE OUTLET TEMP
%	BKW	KPA	G/BKW-HR	L/HR	KPA	DEG C	DEG C	KPA	DEG C
110	2,407	2,055	211.8	599.7	273.0	63.9	607.3	173.6	464.9
100	2,188	1,868	211.0	543.0	255.1	61.6	573.3	163.3	433.3
90	1,969	1,681	209.3	485.0	237.0	59.5	535.5	153.4	397.1
80	1,750	1,495	208.9	430.1	213.5	56.9	506.3	139.3	371.2
75	1,641	1,401	209.2	403.8	200.2	55.6	494.2	131.1	361.7
70	1,532	1,308	209.8	377.9	186.2	54.2	483.0	122.6	353.8
60	1,313	1,121	212.1	327.6	156.6	51.5	463.0	104.3	342.4
50	1,094	934	217.3	279.7	122.8	48.9	453.0	83.4	344.8
40	875	747	225.5	232.2	88.8	46.7	440.6	62.5	346.9
30	656	560	239.1	184.6	57.4	44.7	416.9	43.8	338.0
25	547	467	249.9	160.8	44.6	44.0	394.8	36.6	322.4
20	438	374	266.2	137.0	33.2	43.4	367.5	30.5	301.2
10	219	187	347.5	89.4	14.2	42.7	299.0	21.1	244.5

PERCENT LOAD	ENGINE POWER	COMPRESSOR OUTLET PRES	COMPRESSOR OUTLET TEMP	WET INLET AIR VOL FLOW RATE	ENGINE OUTLET WET EXH GAS VOL FLOW RATE	WET INLET AIR MASS FLOW RATE	WET EXH GAS MASS FLOW RATE	ENGINE OUTLET WET EXH VOL FLOW RATE (0 DEG C AND 101 KPA)	ENGINE OUTLET DRY EXH VOL FLOW RATE (0 DEG C AND 101 KPA)
%	BKW	KPA	DEG C	M3/MIN	M3/MIN	KG/HR	KG/HR	M3/MIN	M3/MIN
110	2,407	284	201.1	220.8	565.3	15,422.4	15,933.0	209.2	195.0
100	2,188	265	191.8	212.2	517.9	14,769.2	15,201.2	200.2	187.3
90	1,969	246	182.6	203.4	468.0	14,097.6	14,487.4	190.7	179.1
80	1,750	222	171.6	190.4	420.2	13,167.3	13,533.1	178.1	167.7
75	1,641	208	165.3	182.7	397.0	12,629.3	12,972.8	170.8	161.0
70	1,532	194	158.4	174.5	374.1	12,060.9	12,382.6	163.0	153.8
60	1,313	163	143.3	156.8	329.1	10,833.0	11,112.1	146.1	138.1
50	1,094	128	123.8	136.3	284.8	9,413.3	9,651.0	125.9	119.2
40	875	93	102.9	115.4	241.7	7,976.1	8,173.2	106.5	101.0
30	656	61	82.5	96.2	200.0	6,651.1	6,808.0	89.4	84.9
25	547	48	73.7	88.5	180.3	6,119.2	6,255.9	82.7	78.7
20	438	36	65.5	81.7	161.3	5,651.4	5,767.8	76.7	73.3
10	219	16	50.6	70.6	124.9	4,877.5	4,953.5	65.9	63.6

Heat Rejection Data Top

PERCENT LOAD	ENGINE POWER	REJECTION TO JACKET WATER	REJECTION TO ATMOSPHERE	REJECTION TO EXH	EXH RECOVERY TO 177C	FROM OIL COOLER	FROM AFTERCOOLER	WORK ENERGY	LOW HEAT VALUE ENERGY	HIGH HEAT VALUE ENERGY
%	BKW	KW	KW	KW	KW	KW	KW	KW	KW	KW
110	2,407	861	138	2,450	1,351	323	598	2,407	6,058	6,454
100	2,188	812	128	2,172	1,141	292	542	2,188	5,486	5,843
90	1,969	761	118	1,881	928	261	490	1,969	4,899	5,218
80	1,750	710	111	1,633	761	231	426	1,750	4,345	4,629
75	1,641	685	108	1,522	693	217	391	1,641	4,079	4,345
70	1,532	659	106	1,417	632	203	355	1,532	3,818	4,067
60	1,313	608	102	1,222	529	176	280	1,313	3,309	3,525
50	1,094	554	100.0	1,049	466	151	210	1,094	2,826	3,010
40	875	497	97.8	887	400	125	141	875	2,345	2,498
30	656	437	94.7	726	315	99.3	72.5	656	1,865	1,987
25	547	402	92.1	640	260	86.5	49.2	547	1,625	1,731
20	438	365	89.1	552	204	73.7	31.3	438	1,384	1,475
10	219	284	81.8	371	94.3	48.1	7.3	219	903	962

Sound Data Top

Note(s)
SOUND PRESSURE DATA FOR THIS RATING CAN BE FOUND IN PERFORMANCE NUMBER - DM8779.

Emissions Data Top

Units Filter All Units

RATED SPEED POTENTIAL SITE VARIATION: 1800 RPM

ENGINE POWER		BKW	2,407	2,188	1,641	1,094	547	219
PERCENT LOAD		%	110	100	75	50	25	10
TOTAL NOX (AS NO2)		G/HR	24,053	21,845	17,579	11,508	5,508	2,926
TOTAL CO		G/HR	2,500	2,566	2,220	1,869	2,432	2,893
TOTAL HC		G/HR	266	300	311	282	286	434
PART MATTER		G/HR	123.1	116.8	121.5	187.6	241.9	189.8
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	3,880.7	3,908.6	4,226.9	3,933.6	3,341.0	3,266.9
TOTAL CO	(CORR 5% O2)	MG/NM3	361.3	410.5	453.5	553.8	1,476.0	3,340.3
TOTAL HC	(CORR 5% O2)	MG/NM3	33.2	41.5	58.6	77.2	163.4	460.9
PART MATTER	(CORR 5% O2)	MG/NM3	15.4	16.2	22.8	52.0	120.0	177.4
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	1,890	1,904	2,059	1,916	1,627	1,591
TOTAL CO	(CORR 5% O2)	PPM	289	328	363	443	1,181	2,672
TOTAL HC	(CORR 5% O2)	PPM	62	78	109	144	305	860
TOTAL NOX (AS NO2)		G/HP-HR	7.50	7.49	8.03	7.88	7.55	10.02
TOTAL CO		G/HP-HR	0.78	0.88	1.01	1.28	3.33	9.91
TOTAL HC		G/HP-HR	0.08	0.10	0.14	0.19	0.39	1.49
PART MATTER		G/HP-HR	0.04	0.04	0.06	0.13	0.33	0.65
TOTAL NOX (AS NO2)		LB/HR	53.03	48.16	38.75	25.37	12.14	6.45

ENGINE POWER		BKW	2,407	2,188	1,641	1,094	547	219
PERCENT LOAD		%	110	100	75	50	25	10
TOTAL CO		LB/HR	5.51	5.66	4.90	4.12	5.36	6.38
TOTAL HC		LB/HR	0.59	0.66	0.69	0.62	0.63	0.96
PART MATTER		LB/HR	0.27	0.26	0.27	0.41	0.53	0.42

RATED SPEED NOMINAL DATA: 1800 RPM

ENGINE POWER		BKW	2,407	2,188	1,641	1,094	547	219
PERCENT LOAD		%	110	100	75	50	25	10
TOTAL NOX (AS NO2)		G/HR	20,044	18,204	14,649	9,590	4,590	2,438
TOTAL CO		G/HR	1,389	1,426	1,234	1,038	1,351	1,607
TOTAL HC		G/HR	200	226	234	212	215	326
TOTAL CO2		KG/HR	1,575	1,426	1,062	733	422	234
PART MATTER		G/HR	87.9	83.4	86.8	134.0	172.8	135.6
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	3,233.9	3,257.2	3,522.4	3,278.0	2,784.2	2,722.4
TOTAL CO	(CORR 5% O2)	MG/NM3	200.7	228.1	252.0	307.7	820.0	1,855.7
TOTAL HC	(CORR 5% O2)	MG/NM3	25.0	31.2	44.0	58.0	122.8	346.6
PART MATTER	(CORR 5% O2)	MG/NM3	11.0	11.5	16.3	37.2	85.7	126.7
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	1,575	1,587	1,716	1,597	1,356	1,326
TOTAL CO	(CORR 5% O2)	PPM	161	182	202	246	656	1,485
TOTAL HC	(CORR 5% O2)	PPM	47	58	82	108	229	647
TOTAL NOX (AS NO2)		G/HP-HR	6.25	6.24	6.69	6.57	6.29	8.35
TOTAL CO		G/HP-HR	0.43	0.49	0.56	0.71	1.85	5.51
TOTAL HC		G/HP-HR	0.06	0.08	0.11	0.15	0.29	1.12
PART MATTER		G/HP-HR	0.03	0.03	0.04	0.09	0.24	0.46
TOTAL NOX (AS NO2)		LB/HR	44.19	40.13	32.30	21.14	10.12	5.38
TOTAL CO		LB/HR	3.06	3.14	2.72	2.29	2.98	3.54
TOTAL HC		LB/HR	0.44	0.50	0.52	0.47	0.47	0.72
TOTAL CO2		LB/HR	3,471	3,144	2,341	1,617	930	516
PART MATTER		LB/HR	0.19	0.18	0.19	0.30	0.38	0.30
OXYGEN IN EXH		%	11.4	11.9	13.1	13.8	14.6	16.6
DRY SMOKE OPACITY		%	1.0	1.0	1.1	2.3	3.6	2.4
BOSCH SMOKE NUMBER			0.37	0.37	0.40	0.82	1.23	0.84

Regulatory Information Top

EPA TIER 1	2004 - 2007

GASEOUS EMISSIONS DATA MEASUREMENTS PROVIDED TO THE EPA ARE CONSISTENT WITH THOSE DESCRIBED IN EPA 40 CFR PART 94.103 AND ISO 8178 FOR MEASURING HC, CO, PM, AND NOX. THIS ENGINE CONFORMS TO US EPA MARINE COMPRESSION-IGNITION EMISSION REGULATIONS.

IMO	2000 - 2010

GASEOUS EMISSIONS DATA MEASUREMENTS ARE CONSISTENT WITH THOSE DESCRIBED IN REGULATION 13 OF ANNEX VI OF MARPOL 73/78 AND ISO 8178 FOR MEASURING HC, CO, PM, AND NOX. THIS ENGINE CONFORMS TO INTERNATIONAL MARINE ORGANIZATION'S (IMO) MARINE COMPRESSION-IGNITION EMISSION REGULATIONS.

Altitude Derate Data Top

ALTITUDE CORRECTED POWER CAPABILITY (BKW)

AMBIENT OPERATING TEMP (C)	0	5	10	15	20	25	30	35	40	45	50	55	60	NORMAL
ALTITUDE (M)														
0	2,188	2,188	2,188	2,188	2,188	2,188	2,188	2,188	2,188	2,188	2,188	2,168	2,136	2,188
250	2,188	2,188	2,188	2,188	2,188	2,188	2,188	2,188	2,188	2,171	2,137	2,105	2,073	2,188
500	2,188	2,188	2,188	2,188	2,188	2,188	2,188	2,175	2,140	2,107	2,074	2,042	2,012	2,188
750	2,175	2,175	2,175	2,175	2,175	2,175	2,145	2,111	2,077	2,044	2,013	1,982	1,952	2,175
1,000	2,112	2,112	2,112	2,112	2,112	2,112	2,081	2,048	2,015	1,983	1,953	1,923	1,894	2,112

Cross Reference Top

Test Spec	Setting	Engine Arrangement	Engineering Model	Engineering Model Version	Start Effective Serial Number	End Effective Serial Number
0K8060	LL8252	2397319	E784	-	PAG00001	

Supplementary Data Top

Type	Classification	Performance Number
SOUND	SOUND PRESSURE	DM8779

Performance Parameter Reference Top

Parameters Reference: DM9600 - 12

PERFORMANCE DEFINITIONS

PERFORMANCE DEFINITIONS DM9600

APPLICATION: Engine performance tolerance values below are representative of a typical production engine tested in a calibrated dynamometer test cell at SAE J1995 standard reference conditions. Caterpillar maintains ISO9001:2000 certified quality management systems for engine test Facilities to assure accurate calibration of test equipment. Engine test data is corrected in accordance with SAE J1995. Additional reference material SAE J1228, J1349, ISO 8665, 3046-1:2002E, 3046-3:1989, 1585, 2534, 2288, and 9249 may apply in part or are similar to SAE J1995. Special engine rating request (SERR) test data shall be noted.

PERFORMANCE PARAMETER TOLERANCE FACTORS: Power +/- 3% Torque +/- 3% Exhaust stack temperature +/- 8% Inlet airflow +/- 5% Intake manifold pressure-gage +/- 10% Exhaust flow +/- 6% Specific fuel consumption +/- 3% Fuel rate +/- 5% Specific DEF consumption +/- 3% DEF rate +/- 5% Heat rejection +/- 5% Heat rejection exhaust only +/- 10% Heat rejection CEM only +/- 10%
Heat Rejection values based on using treated water.
Torque is included for truck and industrial applications, do not use for Gen Set or steady state applications.
On C7 - C18 engines, at speeds of 1100 RPM and under these values are provided for reference only, and may not meet the tolerance listed.
These values do not apply to C280/3600. For these models, see the tolerances listed below.

C280/3600 HEAT REJECTION TOLERANCE FACTORS: Heat rejection +/- 10% Heat rejection to Atmosphere +/- 50% Heat rejection to Lube Oil +/- 20% Heat rejection to Aftercooler +/- 5%

TEST CELL TRANSDUCER TOLERANCE FACTORS: Torque +/- 0.5% Speed +/- 0.2% Fuel flow +/- 1.0% Temperature +/- 2.0 C degrees Intake manifold pressure +/- 0.1 kPa
OBSERVED ENGINE PERFORMANCE IS CORRECTED TO SAE J1995 REFERENCE AIR AND FUEL CONDITIONS.

REFERENCE ATMOSPHERIC INLET AIR FOR 3500 ENGINES AND SMALLER SAE J1228 AUG2002 for marine engines, and J1995 JAN2014 for other engines, reference atmospheric pressure is 100 KPA (29.61 in hg), and standard temperature is 25deg C (77 deg F) at 30% relative humidity at the stated aftercooler water temp, or inlet manifold temp.
FOR 3600 ENGINES Engine rating obtained and presented in accordance with ISO 3046/1 and SAE J1995 JANJAN2014 reference atmospheric pressure is 100 KPA (29.61 in hg), and standard temperature is 25deg C (77 deg F) at 30% relative humidity and 150M altitude at the stated aftercooler water temperature.

MEASUREMENT LOCATION FOR INLET AIR TEMPERATURE Location for air temperature measurement air cleaner inlet at stabilized operating conditions.

REFERENCE EXHAUST STACK DIAMETER The Reference Exhaust Stack Diameter published with this dataset is only used for the calculation of Smoke Opacity values displayed in this dataset. This value does not necessarily represent the actual stack diameter of the engine due to the variety of exhaust stack adapter options available. Consult the price list, engine order or general dimension drawings for the actual stack diameter size ordered or options available.

REFERENCE FUEL DIESEL Reference fuel is #2 distillate diesel with a 35API gravity; A lower heating value is 42,780 KJ/KG (18,390 BTU/LB) when used at 15 deg C (59 deg F), where the density is 850 G/Liter (7.0936 Lbs/Gal).
GAS Reference natural gas fuel has a lower heating value of 33.74 KJ/L (905 BTU/CU Ft). Low BTU ratings are based on 18.64 KJ/L (500 BTU/CU FT) lower heating value gas. Propane ratings are based on 87.56 KJ/L (2350 BTU/CU Ft) lower heating value gas.

ENGINE POWER (NET) IS THE CORRECTED FLYWHEEL POWER (GROSS) LESS EXTERNAL AUXILIARY LOAD Engine corrected gross output includes the power required to drive standard equipment; lube oil, scavenge lube oil, fuel transfer, common rail fuel, separate circuit aftercooler and jacket water pumps. Engine net power available for the external (flywheel) load is calculated by subtracting the sum of auxiliary load from the corrected gross flywheel out put power. Typical auxiliary loads are radiator cooling fans, hydraulic pumps, air compressors and battery charging alternators. For Tier 4 ratings additional Parasitic losses would also include Intake, and Exhaust Restrictions.

ALTITUDE CAPABILITY Altitude capability is the maximum altitude above sea level at standard temperature and standard pressure at which the engine could develop full rated output power on the current performance data set.
Standard temperature values versus altitude could be seen on TM2001.
When viewing the altitude capability chart the ambient temperature is the inlet air temp at the compressor inlet.
Engines with ADEM MEUI and HEUI fuel systems operating at conditions above the defined altitude capability derate for atmospheric pressure and temperature conditions outside the values defined, see TM2001.
Mechanical governor controlled unit injector engines require a setting change for operation at conditions above the altitude defined on the engine performance sheet. See your Caterpillar technical representative for non standard ratings.

REGULATIONS AND PRODUCT COMPLIANCE TMI Emissions information is presented at 'nominal' and 'Potential Site Variation' values for standard ratings. No tolerances are applied to the emissions data. These values are subject to change at any time. The controlling federal and local emission requirements need to be verified by your Caterpillar technical representative.
Customer's may have special emission site requirements that need to be verified by the Caterpillar Product Group engineer.

EMISSION CYCLE LIMITS: Cycle emissions Max Limits apply to cycle-weighted averages only. Emissions at individual load points may exceed the cycle-weighted limit.

EMISSIONS DEFINITIONS: Emissions : DM1176

EMISSION CYCLE DEFINITIONS
1. For constant-speed marine engines for ship main propulsion, including,diesel-electric drive, test cycle E2 shall be applied, for controllable-pitch propeller sets test cycle E2 shall be applied.

2. For propeller-law-operated main and propeller-law-operated auxiliary engines the test cycle E3 shall be applied.
3. For constant-speed auxiliary engines test cycle D2 shall be applied.
4. For variable-speed, variable-load auxiliary engines, not included above, test cycle C1 shall be applied.

HEAT REJECTION DEFINITIONS: Diesel Circuit Type and HHV Balance : DM9500

HIGH DISPLACEMENT (HD) DEFINITIONS: 3500: EM1500

RATING DEFINITIONS: Agriculture : TM6008
Fire Pump : TM6009
Generator Set : TM6035
Generator (Gas) : TM6041
Industrial Diesel : TM6010
Industrial (Gas) : TM6040
Irrigation : TM5749
Locomotive : TM6037
Marine Auxiliary : TM6036
Marine Prop (Except 3600) : TM5747
Marine Prop (3600 only) : TM5748
MSHA : TM6042
Oil Field (Petroleum) : TM6011
Off-Highway Truck : TM6039
On-Highway Truck : TM6038

SOUND DEFINITIONS: Sound Power : DM8702
Sound Pressure : TM7080

Date Released : 07/10/19