

Technical Report

Heavy-Duty Engine Testing Report

Correlation Testing of Mack EM G-285

By

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NOTICE

Technical Reports do not necessarily represent final EPA decisions or positions. They are intended to present technical analysis of issues using data which are currently available. The purpose in the release of such reports is to facilitate the exchange of technical information and to inform the public of technical developments which may form the basis for a final EPA decision, position or regulatory action.

Standards Development and Support Branch  
Emission Control Technology Division  
Office of Mobile Sources  
Office of Air and Radiation  
U. S. Environmental Protection Agency

## I. Background

The correlation between the heavy-duty test facilities of a manufacturer and EPA's test facilities is of significant interest to both the manufacturer and EPA. It is especially important to establish correlation in this timeframe in that relatively new transient heavy-duty engine testing procedures have been implemented. Thus, EPA/MVEL conducted testing on a Mack engine with the intent of providing correlation data for comparison with similar data developed by Mack. The intent of this report is to summarize this testing program.

## II. Engine, Fuels, Test Procedures and Test Plan

The engine that was used in this program was supplied by Mack Trucks, Inc. specifically for this correlation testing. It was a 285 horsepower, in-line six cylinder HD diesel which displaces 672 cubic inches. For charge cooling, it uses a tip turbine-powered air to air intercooler. This tip turbine uses a portion of the turbocharger boost to operate it. The rated speed of the engine is 2100 RPM and the peak torque occurs at 1200 RPM.

The fuel used was a Phillips Reference DF2 known as lot G-463. A copy of the fuel analysis is included in the Appendix. The fuel was presented to the engine at 0 to 0.5 psi and at a temperature less than 100°F. All Federal Test Procedure regulations were used in this testing. The engine was shutdown using the fuel shut off lever and simultaneous dynamometer dial-down. The restrictions were set at an inlet depression of 27.3 inches water and an exhaust backpressure of 2.5 inches mercury. The restrictions were checked after testing was completed and found to be very close to the initial settings.

The test plan for this engine (a copy of which is included in the appendix) called for setting up the engine using the normal engine set-up procedures. This was followed by three sets of a) 1 cold start and three hot starts, b) check restrictions and c) natural cool down. However, Mack reported that when they switched from Phillips lot G-463 to Phillips lot G-580, that they may have experienced a particulate emissions increase. To check this possibility, they sent two barrels of G-580 and requested that EPA perform several tests with this different fuel, which was done. The fuel was introduced to the engine by transferring it from the barrel to the normal fuel delivery system by an auxiliary lift pump.

### III. Results

The results from this work are presented in Tables 1 through 5. The reader is encouraged to review these tables, using the following narrative to assist in interpreting the data highlites contained therein.

Table 1 presents the key torque lug map data and resultant integrated reference brake horsepower from both labs. A review of this data shows that both labs had nearly identical map and integrated horsepower results.

Table 2 presents the EPA lab's composite cold start/hot start data which are the "certification" type results for this engine. Mack submitted data on 5 cold starts and 14 hot starts but none of these data were cold start/hot start combinations. Thus, a data comparison between laboratories cannot be made.

Table 3 presents the cold start results. In comparing the results for HC, NOx, BSFC and actual work, the data are quite similar. However, the Mack particulate results were about 23 percent higher.

Table 4 presents the hot start data. Again, there is generally good agreement between the Mack and EPA data with the exception of the particulate results where Mack's data are about 20 percent higher than that of EPA. In response to this observed difference, EPA personnel thoroughly checked the particulate measurement system to see if its operation was contributing to the differences and concluded that it was not.

Table 5 presents the results from EPA's testing of this engine on the fuel supplied by Mack (lot G-580). This was done because when Mack changed to this fuel, particulate levels from this engine appeared to have increased. However, at the same time the fuel lot was changed, Mack changed a number of other test cell parameters and so there was uncertainty as to the influencing factors. Nevertheless, Mack requested that EPA test the engine using G-580 fuel. The results indicate about a 3.5 to 4.7 percent increase in HC, NOx, particulate and BSFC. However, almost all of this could be accounted for by the 3.2 percent drop in work which may have happened independently of the fuel change. Thus, one can conclude that there was almost no change in emissions due to the fuel change.

### IV. Conclusions

The following conclusions can be drawn from this work:

There was good agreement between the two labs with regards to their lug map and associated reference brake horsepower integration.

- There is generally good agreement between the labs on HC, NOx and BSFC.
- There is an unexplained difference in particulate results between the two labs, with Mack results being about 20 higher than EPA's.
- Differences in fuel lots does not explain the particulate result differences.

Table 1

Table of Engine Performance Data  
From Testing of the  
Mack EM6-285 Correlation Engine

<u>Lab</u>	<u>Curb Idle, RPM</u>	<u>Max HP, BHP</u>	<u>Measured Rated Spd. RPM</u>	<u>Max. Torque Pt.</u>		<u>Integrated Reference Horsepower, BHP-hr</u>
				<u>Speed, RPM</u>	<u>Torque, ft-lb</u>	
EPA	605	300	1889	1325	1100	20.327
Mack	610	300	1828	1349	1108	20.323

Table 2

Table of Composite Transient  
Test Results From  
Mack EM6-285  
Correlation Engine  
EPA Fuel (G-463)

<u>Test No</u>	<u>Emissions, q/BHP-hr.</u>			<u>BSFC, Part.</u>	<u>lb/BHP-hr</u>
	<u>HC</u>	<u>CO</u>	<u>NOx</u>		
3327	0.75	1.60	7.67	0.49	0.426
3330	0.81	1.71	7.87	0.58	0.420
$\bar{X}$	0.78	1.66	7.77	0.54	0.423

Table 3

Table of Cold Start  
Transient Test Results From  
Mack EM6-285  
Correlation Engine  
EPA Fuel (G-463)

Test No.	Emission, g/BHP-hr.				BSFC, lb/BHP-hr	Actual Work, BHP-hr
	HC	CO	NOx	Part.		
3327	0.83	1.92	7.52	0.52	0.438	19.529
3330	0.88	2.00	7.89	0.59	0.430	19.655
$\bar{X}$	0.86	1.96	7.71	0.56	0.434	19.592
Mack Results, $\bar{X}$	0.88	2.19	7.23	0.69	0.455	19.48
% Diff.*	2.3	11.7	-6.2	23.2	4.8	-0.6

\* Percent difference relative to EPA

Table 4

Table of Hot Start  
Transient Test Results From  
Mack EM6-285  
Correlation Engine  
EPA Fuel (G-463)

Test No.	Emission, g/BHP-hr.				BSFC, lb/BHP-hr	Actual Work, BHP-hr
	HC	CO	NOx	Part.		
3327	0.74	1.54	7.70	0.49	0.424	19.601
3328	0.76	1.58	7.41	0.51	0.392	19.708
3329	0.81	1.56	7.37	0.52	0.418	19.745
3330	0.80	1.67	7.86	0.58	0.418	19.839
3331	0.74	1.65	7.63	0.57	0.415	19.836
3332	0.79	1.67	7.69	0.57	0.415	19.842
3333	0.88	1.73	7.52	0.59	0.427	19.072
3334	0.83	1.73	7.58	0.57	0.429	19.059
3345	0.71	1.58	7.21	0.52	0.406	19.947
3346	0.76	1.58	7.18	0.51	0.410	19.891
3347	0.77	1.54	7.24	0.53	0.408	19.918
$\bar{X}$	0.78	1.62	7.49	0.54	0.415	19.678
$(\sigma/\bar{X})(100)$	6.1	4.4	3.0	6.4	2.6	1.62
Mack Results, $\bar{X}$	0.74	1.66	7.46	0.64	0.434	19.54
% Diff.*	-5.1	2.5	-0.4	20.4	4.6	-0.7

\* Percent difference relative to EPA.

Table 5

Table of Hot Start  
Transient Test Results From  
Mack EM6-285  
Correlation Engine  
Mack Fuel (G-580)

Test No.	Emission, q/BHP-hr.				BSFC, lb/BHP-hr	Actual Work, BHP-hr
	HC	CO	NOx	Part.		
3335	0.81	1.86	7.51	0.57	0.429	19.013
3336	0.81	1.67	8.16	0.56	0.432	19.097
$\bar{X}$	0.81	1.66	7.84	0.56	0.430	19.055
Average of Tests using EPA fuel (G-463)	0.78	1.62	7.49	0.54	0.415	19.678
% Diff.*	3.8	2.5	4.7	3.7	3.6	-3.2

\* Percent difference relative to the tests using G-463 fuel.

## Appendix

### Table of Contents

EPA Torque Map - Table  
EPA Torque Map - Graph  
Engine Set-Up Sheet  
Diesel Fuel Analysis Results (G-463)  
Mack Torque Map - Graph  
Mack Emissions Results  
EPA Individual Emissions Test  
    Summary Sheets  
Mack Letter  
Engine Testing Plan

Table of Mapping Data from  
Mack EM6-285  
Correlation Engine

THERE ARE ( 248 ) MAPPING DATA POINTS:

396.	388.0	716.	473.3	1045.	602.5	1379.	1077.2	1703.	905.3	2031.	764.5
397.	367.3	723.	478.1	1055.	628.1	1386.	1072.5	1713.	900.5	2040.	758.9
403.	378.5	732.	476.1	1063.	667.3	1393.	1064.5	1720.	900.1	2048.	757.7
412.	391.7	740.	478.1	1073.	722.5	1401.	1058.1	1726.	896.1	2055.	756.9
418.	388.0	747.	484.9	1086.	812.1	1410.	1051.3	1737.	893.7	2063.	753.3
427.	388.0	755.	481.6	1095.	922.1	1418.	1046.9	1745.	890.9	2071.	748.9
435.	397.7	765.	482.9	1105.	1002.1	1425.	1041.3	1752.	888.5	2079.	749.3
442.	390.1	772.	488.9	1111.	1050.1	1432.	1036.5	1760.	883.7	2087.	738.5
451.	376.5	779.	486.8	1119.	1078.1	1442.	1026.9	1767.	881.7	2095.	736.1
458.	403.7	788.	490.9	1123.	1086.5	1448.	1017.3	1775.	879.3	2104.	732.1
468.	404.9	796.	497.7	1131.	1092.5	1457.	1008.9	1784.	874.5	2111.	722.1
475.	386.1	804.	497.7	1138.	1100.9	1464.	998.5	1791.	871.3	2117.	696.5
484.	384.1	812.	502.4	1145.	1106.5	1471.	991.3	1799.	869.3	2123.	687.3
490.	386.5	819.	501.3	1153.	1107.7	1481.	983.7	1807.	862.9	2133.	676.8
499.	391.3	828.	502.9	1160.	1113.7	1488.	983.6	1816.	860.9	2140.	651.3
508.	390.9	835.	502.5	1167.	1116.0	1496.	980.5	1823.	856.8	2148.	623.7
515.	386.0	844.	508.5	1176.	1118.1	1503.	977.3	1833.	853.6	2154.	609.7
524.	394.9	851.	508.5	1183.	1118.9	1513.	974.5	1840.	852.9	2161.	579.7
531.	391.3	860.	509.7	1192.	1118.1	1520.	969.3	1847.	848.1	2170.	552.0
540.	390.8	867.	507.7	1199.	1120.9	1529.	967.7	1856.	848.1	2177.	513.7
547.	400.5	876.	513.3	1206.	1120.9	1537.	967.3	1863.	842.5	2185.	482.5
555.	392.9	883.	512.1	1214.	1124.1	1545.	962.5	1872.	838.4	2194.	460.9
564.	404.5	892.	513.7	1222.	1127.3	1553.	958.9	1880.	833.3	2200.	427.7
572.	409.3	901.	515.3	1231.	1130.1	1562.	956.9	1886.	832.1	2209.	388.9
579.	407.3	907.	518.5	1238.	1128.1	1569.	953.7	1895.	828.0	2216.	375.7
586.	412.0	915.	525.3	1246.	1134.9	1578.	951.3	1903.	823.7	2225.	344.9
595.	419.2	923.	522.1	1254.	1131.6	1586.	946.5	1912.	820.9	2233.	317.3
603.	424.9	932.	524.5	1261.	1128.9	1592.	946.5	1919.	818.9	2239.	288.9
613.	427.3	939.	530.9	1270.	1127.7	1601.	942.9	1928.	813.7	2247.	248.5
619.	436.5	948.	535.3	1277.	1125.3	1608.	941.3	1935.	809.3	2255.	207.7
629.	440.5	956.	534.5	1286.	1121.3	1615.	937.3	1944.	806.1	2262.	170.9
637.	446.1	965.	540.1	1293.	1117.7	1624.	931.3	1951.	802.5	2270.	138.9
645.	447.3	973.	545.7	1302.	1112.5	1631.	931.6	1960.	799.7	2277.	106.1
653.	449.7	979.	546.1	1309.	1108.5	1641.	931.3	1967.	795.3	2284.	62.9
662.	458.5	987.	547.3	1318.	1104.1	1648.	925.3	1976.	790.9	2294.	26.1
669.	456.9	995.	550.9	1325.	1099.7	1657.	921.7	1984.	786.5	2301.	8.5
677.	462.9	1004.	553.3	1334.	1090.5	1664.	920.5	1991.	784.1	2311.	-6.2
684.	466.1	1011.	560.9	1353.	1089.7	1672.	916.1	1999.	778.9	2319.	-29.0
692.	466.1	1020.	566.5	1354.	1090.9	1681.	912.1	2009.	775.3	2323.	-58.2
701.	473.3	1028.	573.7	1362.	1088.5	1689.	910.5	2016.	771.3	2326.	-72.5
708.	473.7	1037.	584.5	1369.	1084.1	1696.	910.1	2023.	768.9	2328.	-100.6
								-	2330.	-93.4	
								-	2331.	-92.2	

<COMMENT> MAX POWER: 299.7 HP @ 1856. RPM.

<COMMENT> RATED SPEED: 1889. RPM.

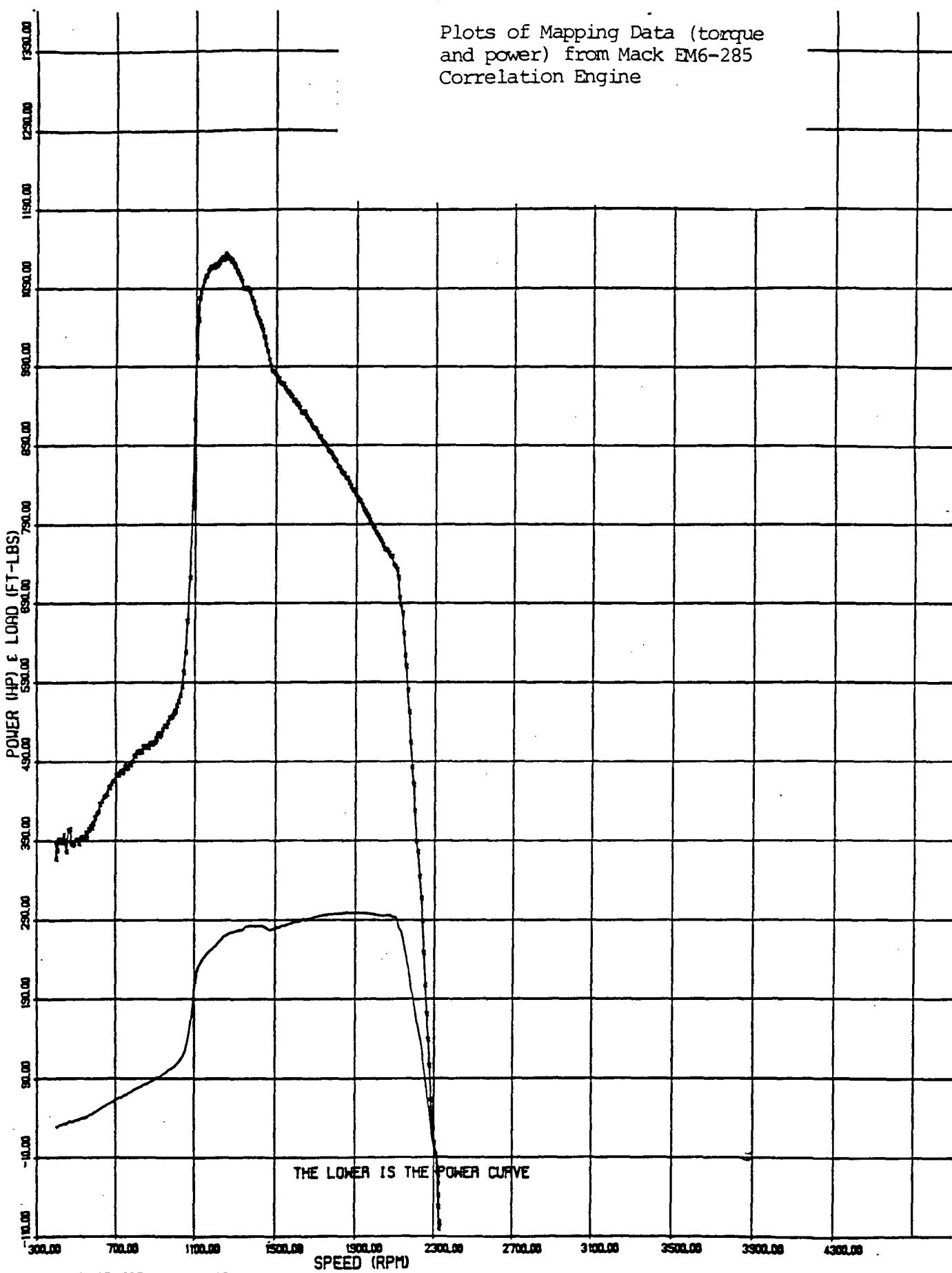
WANT A CALCOMP PLOT OF THE MAPPING CURVE? (Y/N) : Y

MAPPING DATE = 10/ 07/ 86

ENTER PLOT COMMENT LINE (INCLUDE ENGINE MANUFACTURER AND MODEL):  
PLOT OF MACK CORR ENGINE FOR T BAINES #672 MACK

Plots of Mapping Data (torque and power) from Mack EM6-285 Correlation Engine

3 min 55 sec.



MACK CORR FOR T. BAINES

MAX TORQ = 1135 FT-LBS MAX POWER = 299.70 HP MEASURED RATED RPM = 1889.50 MAPPING DATE = 10/07/88

D-2 Diesel Control Fuel  
Lot G-463

<u>Property</u>	<u>Results</u>	<u>Specification</u>	<u>Test Method</u>
Cetane Number	44.8	43-47	D 613
Cetane Index	46.7	43-47	D 976
Distillation Range			D 86
IBP, °F	374	345-375	
10%, °F	429	400-440	
50%, °F	506	495-525	
90%, °F	591	580-610	
EP, °F	634	630-660	
Sulfur, wt. %	0.31	0.2-0.4	D 2622
Aromatics, minimum	32.3	29	D 1319
Flashpoint, °F minimum	155	130	D 93
Viscosity, centistokes @ 40°C	2.43	2.2-3.2	D 445
Gravity, °API, 60°F	35.1	33-36	D 1298
Copper Strip Corrosion, maximum	No. 1	No. 3	D 130
Oxidation Stability, mg/100 ml, max.	0.4	1.5	D 2274
Cloud Point, Maximum, °F	8	15	D 2500
Particulate matter, maximum, mg/l	1.7	15	D 2276
Carbon Density, grams carbon/gal.	2782	2750-2806(a)	
Net Heat of Combustion, BTU/lb.	19435	Report	D 240

(a) The formula for this calculation is:

$$\text{Carbon Density} = \frac{141.5}{131.5 + \text{API gravity}} \times (\text{Weight Fraction Carbon}) \times 3778$$

Where: Weight fraction carbon is the percent carbon by weight found in the fuel by mass spectroscopy (ASTM D 2789), products of combustion analysis (Pregle analysis ASTM E 191), or equivalent means. 3778 is the weight of 1 gallon of water in grams at 60°F in dry air.

TRANSIENT CYCLE POWER SWEEP  
For Mack EM6-285 Correlation Engine  
(Submitted by Mack Trucks; Inc.)

RPM	TORQ	HP	RPM	TORQ	HP	RPM	TORQ	HP
594+	397+	44	492+	440+	44	732+	443+	44
603+	399+	45	495+	442+	45	734+	445+	45
613+	398+	46	496+	443+	46	734+	446+	46
625+	410+	48	497+	444+	48	735+	447+	48
636+	415+	50	498+	445+	50	736+	448+	50
648+	423+	51	499+	446+	51	737+	449+	51
651+	418+	51	500+	447+	51	738+	450+	51
656+	422+	51	501+	448+	51	739+	451+	51
664+	425+	51	502+	449+	51	740+	452+	51
674+	429+	51	503+	450+	51	741+	453+	51
686+	435+	51	504+	451+	51	742+	454+	51
696+	439+	51	505+	452+	51	743+	455+	51
708+	445+	51	506+	453+	51	744+	456+	51
720+	451+	51	507+	454+	51	745+	457+	51
733+	456+	51	508+	455+	51	746+	458+	51
747+	460+	51	509+	456+	51	747+	459+	51
757+	462+	51	510+	457+	51	748+	460+	51
772+	465+	51	511+	458+	51	749+	461+	51
780+	467+	51	512+	459+	51	750+	462+	51
786+	470+	51	513+	460+	51	751+	463+	51
794+	472+	51	514+	461+	51	752+	464+	51
804+	475+	51	515+	462+	51	753+	465+	51
817+	478+	51	516+	463+	51	754+	466+	51
825+	480+	51	517+	464+	51	755+	467+	51
831+	483+	51	518+	465+	51	756+	468+	51
837+	485+	51	519+	466+	51	757+	469+	51
845+	487+	51	520+	467+	51	758+	470+	51
854+	490+	51	521+	468+	51	759+	471+	51
864+	492+	51	522+	469+	51	760+	472+	51
872+	495+	51	523+	470+	51	761+	473+	51
885+	497+	51	524+	471+	51	762+	474+	51
897+	499+	51	525+	472+	51	763+	475+	51
911+	500+	51	526+	473+	51	764+	476+	51
919+	500+	51	527+	474+	51	765+	477+	51
925+	500+	51	528+	475+	51	766+	478+	51
931+	500+	51	529+	476+	51	767+	479+	51
937+	500+	51	530+	477+	51	768+	480+	51
945+	500+	51	531+	478+	51	769+	481+	51
954+	500+	51	532+	479+	51	770+	482+	51
964+	500+	51	533+	480+	51	771+	483+	51
974+	500+	51	534+	481+	51	772+	484+	51
984+	500+	51	535+	482+	51	773+	485+	51
994+	500+	51	536+	483+	51	774+	486+	51
1004+	500+	51	537+	484+	51	775+	487+	51
1014+	500+	51	538+	485+	51	776+	488+	51
1024+	500+	51	539+	486+	51	777+	489+	51
1034+	500+	51	540+	487+	51	778+	490+	51
1044+	500+	51	541+	488+	51	779+	491+	51
1054+	500+	51	542+	489+	51	780+	492+	51
1064+	500+	51	543+	490+	51	781+	493+	51
1074+	500+	51	544+	491+	51	782+	494+	51
1084+	500+	51	545+	492+	51	783+	495+	51
1094+	500+	51	546+	493+	51	784+	496+	51
1104+	500+	51	547+	494+	51	785+	497+	51
1114+	500+	51	548+	495+	51	786+	498+	51
1124+	500+	51	549+	496+	51	787+	499+	51
1134+	500+	51	550+	497+	51	788+	500+	51
1144+	500+	51	551+	498+	51	789+	501+	51
1154+	500+	51	552+	499+	51	790+	502+	51
1164+	500+	51	553+	500+	51	791+	503+	51
1174+	500+	51	554+	501+	51	792+	504+	51
1184+	500+	51	555+	502+	51	793+	505+	51
1194+	500+	51	556+	503+	51	794+	506+	51
1204+	500+	51	557+	504+	51	795+	507+	51
1214+	500+	51	558+	505+	51	796+	508+	51
1224+	500+	51	559+	506+	51	797+	509+	51
1234+	500+	51	560+	507+	51	798+	510+	51
1244+	500+	51	561+	508+	51	799+	511+	51
1254+	500+	51	562+	509+	51	800+	512+	51
1264+	500+	51	563+	510+	51	801+	513+	51
1274+	500+	51	564+	511+	51	802+	514+	51
1284+	500+	51	565+	512+	51	803+	515+	51
1294+	500+	51	566+	513+	51	804+	516+	51
1304+	500+	51	567+	514+	51	805+	517+	51
1314+	500+	51	568+	515+	51	806+	518+	51
1324+	500+	51	569+	516+	51	807+	519+	51
1334+	500+	51	570+	517+	51	808+	520+	51
1344+	500+	51	571+	518+	51	809+	521+	51
1354+	500+	51	572+	519+	51	810+	522+	51
1364+	500+	51	573+	520+	51	811+	523+	51
1374+	500+	51	574+	521+	51	812+	524+	51
1384+	500+	51	575+	522+	51	813+	525+	51
1394+	500+	51	576+	523+	51	814+	526+	51
1404+	500+	51	577+	524+	51	815+	527+	51
1414+	500+	51	578+	525+	51	816+	528+	51
1424+	500+	51	579+	526+	51	817+	529+	51
1434+	500+	51	580+	527+	51	818+	530+	51
1444+	500+	51	581+	528+	51	819+	531+	51
1454+	500+	51	582+	529+	51	820+	532+	51
1464+	500+	51	583+	530+	51	821+	533+	51
1474+	500+	51	584+	531+	51	822+	534+	51
1484+	500+	51	585+	532+	51	823+	535+	51
1494+	500+	51	586+	533+	51	824+	536+	51
1504+	500+	51	587+	534+	51	825+	537+	51
1514+	500+	51	588+	535+	51	826+	538+	51
1524+	500+	51	589+	536+	51	827+	539+	51
1534+	500+	51	590+	537+	51	828+	540+	51
1544+	500+	51	591+	538+	51	829+	541+	51
1554+	500+	51	592+	539+	51	830+	542+	51
1564+	500+	51	593+	540+	51	831+	543+	51
1574+	500+	51	594+	541+	51	832+	544+	51
1584+	500+	51	595+	542+	51	833+	545+	51
1594+	500+	51	596+	543+	51	834+	546+	51
1604+	500+	51	597+	544+	51	835+	547+	51
1614+	500+	51	598+	545+	51	836+	548+	51
1624+	500+	51	599+	546+	51	837+	549+	51
1634+	500+	51	600+	547+	51	838+	550+	51
1644+	500+	51	601+	548+	51	839+	551+	51
1654+	500+	51	602+	549+	51	840+	552+	51
1664+	500+	51	603+	550+	51	841+	553+	51
1674+	500+	51	604+	551+	51	842+	554+	51
1684+	500+	51	605+	552+	51	843+	555+	51
1694+	500+	51	606+	553+	51	844+	556+	51
1704+	500+	51	607+	554+	51	845+	557+	51
1714+	500+	51	608+	555+	51	846+	558+	51
1724+	500+	51	609+	556+	51	847+	559+	51
1734+	500+	51	610+	557+	51	848+	560+	51
1744+	500+	51	611+	558+	51	849+	561+	51
1754+	500+	51	612+	559+	51	850+	562+	51
1764+	500+	51	613+	560+	51	851+	563+	51
1774+	500+	51	614+	561+	51	852+	564+	51
1784+	500+	51	615+	562+	51	853+	565+	51
1794+	500+	51	616+	563+	51	854+	566+	51
1804+	500+	51	617+	564+	51	855+	567+	51
1814+	500+	51	618+	565+	51	856+	568+	51
1824+	500+	51	619+	566+	51	857+	569+	51
1834+	500+	51	620+	567+	51	858+	570+	51
1844+	500+	51	621+	568+	51	859+	571+	51
1854+	500+	51	622+	569+	51	860+	572+	51
1864+	500+	51	623+	570+	51	861+	573+	51
1874+	500+	51	624+	571+	51	862+	574+	51
1884+	500+	51	625+	572+	51	863+	575+	51
1894+	500+	51	626+	573+	51	864+	576+	51
1904+	500+	51	627+	574+	51	865+	577+	51
1914+	500+	51	628+	575+	51	866+	578+	51
1924+	500+	51	629+	576+	51	867+	579+	51
1934+	500+	51	630+	577+	51	868+	580+	51
1944+	500+	51	631+	578+	51	869+	581+	51
1954+	500+	51	632+	579+	51	870+	582+	51
1964+	500+	51	633+	580+	51	871+	583+	51
1974+	500+	51	634+	581+	51	872+	584+	51
1984+	500+	51	635+	582+	51	873+	585+	51
1994+	500+	51	636+	583+	51	874+	586+	51
2004+	500+	51	637+	584+	51	875+	587+	51
2014+	500+	51	638+	585+	51	876+	588+	51
2024+	500+	51	639+	586+	51	877+	589+	51
2034+	500+	51	640+	587+	51	878+	590+	51
2044+	500+	51	641+	588+	51	879+		

## TRANSIENT EMISSIONS DATA SUMMARY

Submitted by Mack Trucks, Inc.

**HOT RUNS (14)**

**COLD RUNS (5)**

#### + Combustion Air Humidity

\* C.O.V. = STD/MEAN x 100%

HD-863327  
760 EM6-28580CORR672 0  
88

HEAVY DUTY DIESEL TRANSIENT ENGINE TEST  
DIESEL SUMMARY REPORT

DATE: 12-12-86 TIME: 09:40:02 HD-863327

TEST NUMBER: HD-863327  
TEST DATE/TIME: 10-9-86 9:12  
MANUFACTURER: MACK  
ENGINE ID: 760 EM6-28580CORR672 0

AMBIENT DATA

BAROMETER (DRY): 29.20 "HG  
DRY BULB TEMPERATURE: 77.70 F  
ABSOLUTE HUMIDITY: 76.13 GRAINS H2O / LB. DRY AIR

EMISSION RESULTS	CS	HS	WTD TEST	CYCLE STATISTICS	CS	HS
HC (INTEGRATED)				SPEED		
BACKGROUND, PPM	3.47	4.38		NUMBER	1176	1176
EXHAUST+BKG, GM	19.19	18.33		SLOPE	0.99457	0.99480
NET, GM/BHP-HR	0.827	0.740	0.752	(LIMIT: 0.97-1.03)		
CO (BAG)				Y-INTERCEPT	3.755	1.635
BACKGROUND, PPM	0.00	0.00		(LIMIT: +/-50 RPM)		
EXHAUST+BKG, GM	37.42	30.29		STD ERROR	16.024	15.979
NET, GM/BHP-HR	1.92	1.54	1.60	(LIMIT: 100 RPM)		
NOX (INTEGRATED)				R-SQUARE	0.99931	0.99932
BACKGROUND, PPM	0.00	0.49		(LIMIT: 0.97)		
EXHAUST+BKG, GM	146.36	151.84		TORQUE		
NET, GM/BHP-HR	7.517	7.696	7.670	NUMBER	984	980
CO2 (BAG)				SLOPE	0.94466	0.94684
BACKGROUND, PPM	0.034	0.034		(LIMIT: 0.77/0.83-1.03)		
EXHAUST+BKG, GM	13160.30	12843.44		Y-INTERCEPT	-0.575	-0.375
NET, GM/BHP-HR	626.8	608.2	610.9	(LIMIT: +/-15 FT-LBS)		
PARTICULATE				STD ERROR	6.237%	6.191%
SECONDARY TARE, GM	0.167306	0.161744		(LIMIT: 13% MAX ENG TQ)		
SECONDARY PART, GM	0.167535	0.161887		R-SQUARE	0.93114	0.93147
PRIMARY TARE, GM	0.170273	0.162474		(LIMIT: 0.85/0.88)		
PRIMARY PART, GM	0.177630	0.169458		POWER		
TOTAL, GM/BHP-HR	0.52	0.49	0.49	NUMBER	983	980
FUEL CONSUMPTION				SLOPE	0.98076	0.98158
LBS	8.54	8.31	8.35	(LIMIT: 0.87/0.89-1.03)		
LBS/BHP-HR	0.438	0.424	0.426	Y-INTERCEPT	-1.959	-1.940
BRAKE HORSEPOWER-HOUR	19.529	19.601		STD ERROR	6.868%	6.718%
				R-SQUARE	0.95309	0.95438
				(LIMIT: 8%)		
				WORK		
				ACTUAL	19.529	19.601
				(LIMIT: +/-5% REF BHP-HR)		
				REFERENCE	20.327	20.327
				% DIFFERENCE	-3.93%	-3.57%

HD-863328  
760 EM6-28580CORR672 0  
HS

HEAVY DUTY DIESEL TRANSIENT ENGINE TEST  
DIESEL SUMMARY REPORT

DATE: 12-12-86 TIME: 09:49:27 HD-863328

TEST NUMBER: HD-863328  
TEST DATE/TIME: 10- 9-86 12:59

MANUFACTURER: MACK  
ENGINE ID: 760 EM6-28580CORR672 0

AMBIENT DATA

BAROMETER (DRY): 29.30 "HG

DRY BULB TEMPERATURE: 76.70 F

ABSOLUTE HUMIDITY: 72.47 GRAINS H2O / LB. DRY AIR

EMISSION RESULTS	CS	HS	WTD TEST	CYCLE STATISTICS	CS	HS
HC (INTEGRATED)				SPEED		
BACKGROUND, PPM	0.00	0.00		NUMBER	0	1176
EXHAUST+BKG, GM	0.00	17.72		SLOPE	0.00000	0.99344
NET, GM/BHP-HR	0.000	0.758	0.758	(LIMIT: 0.97-1.03)		
CO (BAG)				Y-INTERCEPT	0.000	3.800
BACKGROUND, PPM	0.00	0.00		(LIMIT: +-50 RPM)		
EXHAUST+BKG, GM	0.00	31.24		STD ERROR	0.000	15.753
NET, GM/BHP-HR	0.00	1.58	1.58	(LIMIT: 100 RPM)		
NOX (INTEGRATED)				R-SQUARE	0.00000	0.99933
BACKGROUND, PPM	0.00	0.00		(LIMIT: 0.97)		
EXHAUST+BKG, GM	0.00	146.92		FORQUE		
NET, GM/BHP-HR	0.000	7.406	7.406	NUMBER	0	990
CO2 (BAG)				SLOPE	0.00000	0.92991
BACKGROUND, PPM	0.000	0.000		(LIMIT: 0.77/0.83-1.03)		
EXHAUST+BKG, GM	0.00	11987.13		Y-INTERCEPT	0.000	5.193
NET, GM/BHP-HR	0.0	561.3	561.3	(LIMIT: +-15 FT-LBS)		
PARTICULATE				STD ERROR	0.000%	6.404%
SECONDARY TARE, GM	0.000000	0.170662		(LIMIT: 13% MAX ENG TQ)		
SECONDARY PART, GM	0.000000	0.170832		R-SQUARE	0.00000	0.92784
PRIMARY TARE, GM	0.000000	0.166215		(LIMIT: 0.85/0.88)		
PRIMARY PART, GM	0.000000	0.173454		POWER		
TOTAL, GM/BHP-HR	0.00	0.51	0.51	NUMBER	0	989
FUEL CONSUMPTION				SLOPE	0.00000	0.97605
LBS	0.00	7.72	7.72	(LIMIT: 0.87/0.89-1.03)		
LBS/BHP-HR	0.000	0.392	0.392	Y-INTERCEPT	0.000	-1.462
BRAKE HORSEPOWER-HOUR	0.000	19.708		(LIMIT: +-5 BHP)		
				STD ERROR	0.000%	6.886%
				(LIMIT: 8%)		
				R-SQUARE	0.00000	0.95301
				(LIMIT: 0.91)		
				WORK		
				ACTUAL	0.000	19.708
				(LIMIT: -15%-5% REF BHP-HR)		
				REFERENCE	0.000	20.327
				% DIFFERENCE	0.00%	-3.05%

HD-863329  
760 EM6-28580CORR672 0  
HS

HEAVY DUTY DIESEL TRANSIENT ENGINE TEST  
DIESEL SUMMARY REPORT

DATE: 12-12-86 TIME: 09:49:58 HD-863329

TEST NUMBER: HD-863329  
TEST DATE/TIME: 10- 9-86 13:35  
MANUFACTURER: MACK  
ENGINE ID: 760 EM6-28580CORR672 0

AMBIENT DATA

BAROMETER (DRY): 29.20 "HG  
DRY BULB TEMPERATURE: 77.80 F  
ABSOLUTE HUMIDITY: 67.50 GRAINS H2O / LB. DRY AIR

<u>EMISSION RESULTS</u>	<u>CS</u>	<u>HS</u>	<u>WTD TEST</u>	<u>CYCLE STATISTICS</u>	<u>CS</u>	<u>HS</u>
HC (INTEGRATED)				SPEED		
BACKGROUND, PPM	0.00	3.47		NUMBER	0	1176
EXHAUST+BKG, GM	0.00	19.05		SLOPE	0.00000	0.99476
NET, GM/BHP-HR	0.000	0.811	0.811	(LIMIT: 0.97-1.03)		
CO (BAG)				Y-INTERCEPT	0.000	2.035
BACKGROUND, PPM	0.00	0.00		(LIMIT: +-50 RPM)		
EXHAUST+BKG, GM	0.00	30.76		STD ERROR	0.000	15.905
NET, GM/BHP-HR	0.00	1.56	1.56	(LIMIT: 100 RPM)		
R-SQUARE				R-SQUARE	0.00000	0.99932
(LIMIT: 0.97)				(LIMIT: 0.97)		
NOX (INTEGRATED)				TORQUE		
BACKGROUND, PPM	0.00	0.00		NUMBER	0	978
EXHAUST+BKG, GM	0.00	148.45		SLOPE	0.00000	0.95386
NET, GM/BHP-HR	0.000	7.374	7.374	(LIMIT: 0.77/0.83-1.03)		
CO2 (BAG)				Y-INTERCEPT	0.000	3.274
BACKGROUND, PPM	0.000	0.031		(LIMIT: +-15 FT-LBS)		
EXHAUST+BKG, GM	0.00	12690.09		STD ERROR	0.000%	5.899%
NET, GM/BHP-HR	0.0	599.5	599.5	(LIMIT: 13% MAX ENG TQ)		
R-SQUARE				R-SQUARE	0.00000	0.93778
(LIMIT: 0.85/0.88)				(LIMIT: 0.85/0.88)		
PARTICULATE				POWER		
SECONDARY TARE, GM	0.000000	0.164381		NUMBER	0	977
SECONDARY PART, GM	0.000000	0.164536		SLOPE	0.00000	0.98861
PRIMARY TARE, GM	0.000000	0.164637		(LIMIT: 0.87/0.89-1.03)		
PRIMARY PART, GM	0.000000	0.171991		Y-INTERCEPT	0.000	-1.503
TOTAL, GM/BHP-HR	0.00	0.52	0.52	(LIMIT: +-5 BHP)		
FUEL CONSUMPTION				STD ERROR	0.000%	6.444%
LBS	0.00	8.26	8.26	(LIMIT: 8%)		
LBS/BHP-HR	0.000	0.418	0.418	R-SQUARE	0.00000	0.95871
BRAKE HORSEPOWER-HOUR	0.000	19.745		(LIMIT: 0.91)		
WORK				ACTUAL	0.000	19.745
				(LIMIT: -15%-5% REF BHP-HR)		
				REFERENCE	0.000	20.327
				% DIFFERENCE	0.00%	-2.86%

HD-863330  
760 EM6-28580CORR672 0  
88

## HEAVY DUTY DIESEL TRANSIENT ENGINE TEST

DATE: 12-12-86 TIME: 09:50:29 HD-863330

## DIESEL SUMMARY REPORT

TEST NUMBER: HD-863330  
TEST DATE/TIME: 10-10-86 7:50

MANUFACTURER: MACK  
ENGINE ID: 760 EM6-28580CORR672 0

AMBIENT DATA

BAROMETER (DRY): 29.40 "HG

DRY BULB TEMPERATURE: 74.70 F

ABSOLUTE HUMIDITY: 77.01 GRAINS H2O / LB. DRY AIR

<u>EMISSION RESULTS</u>	<u>CS</u>	<u>HS</u>	<u>WTD TEST</u>	<u>CYCLE STATISTICS</u>	<u>CS</u>	<u>HS</u>
HC (INTEGRATED)				SPEED		
BACKGROUND, PPM	3.47	3.47		NUMBER	1176	1176
EXHAUST+BKG, GM	20.33	18.84		SLOPE	0.99390	0.99343
NET, GM/BHP-HR	0.879	0.796	0.808	(LIMIT: 0.97-1.03)		
CO (BAG)				Y-INTERCEPT	3.270	2.993
BACKGROUND, PPM	0.72	0.96		(LIMIT: +-50 RPM)		
EXHAUST+BKG, GM	40.49	34.76		STD ERROR	16.176	15.942
NET, GM/BHP-HR	2.00	1.67	1.71	(LIMIT: 100 RPM)		
NOX (INTEGRATED)				R-SQUARE	0.99930	0.99932
BACKGROUND, PPM	0.49	0.00		(LIMIT: 0.97)		
EXHAUST+BKG, GM	155.65	155.18		TORQUE		
NET, GM/BHP-HR	7.887	7.863	7.866	NUMBER	987	995
CO2 (BAG)				SLOPE	0.93489	0.92270
BACKGROUND, PPM	0.035	0.038		(LIMIT: 0.77/0.83-1.03)		
EXHAUST+BKG, GM	13067.18	12943.61		Y-INTERCEPT	3.426	7.734
NET, GM/BHP-HR	615.3	599.7	601.9	STD ERROR	6.488%	6.590%
PARTICULATE				(LIMIT: 13% MAX ENG TQ)		
SECONDARY TARE, GM	0.168188	0.168551		R-SQUARE	0.92571	0.92450
SECONDARY PART, GM	0.168393	0.168742		(LIMIT: 0.85/0.88)		
PRIMARY TARE, GM	0.168138	0.169864		POWER		
PRIMARY PART, GM	0.175139	0.176860		NUMBER	986	995
TOTAL, GM/BHP-HR	0.59	0.58	0.58	SLOPE	0.97627	0.97453
FUEL CONSUMPTION				(LIMIT: 0.87/0.89-1.03)		
LBS	8.45	8.30	8.32	Y-INTERCEPT	-1.523	-1.281
LBS/BHP-HR	0.430	0.418	0.420	STD ERROR	7.046%	7.018%
BRAKE HORSEPOWER-HOUR	19.655	19.839		R-SQUARE	0.95091	0.95141
				(LIMIT: 8%)		
				WORK		
				ACTUAL	19.655	19.839
				(LIMIT: -15%-5% REF BHP-HR)		
				REFERENCE	20.327	20.327
				% DIFFERENCE	-3.31%	-2.40%

HD-863331  
760 EM6-28580CORR672 0  
HS

HEAVY DUTY DIESEL TRANSIENT ENGINE TEST  
DIESEL SUMMARY REPORT

DATE: 12-12-86 TIME: 09:50:59 HD-863331

TEST NUMBER: HD-863331  
TEST DATE/TIME: 10-10-86 9:39

MANUFACTURER: MACK  
ENGINE ID: 760 EM6-28580CORR672 0

AMBIENT DATA

BAROMETER (DRY): 29.40 "HG

DRY BULB TEMPERATURE: 75.70 F

ABSOLUTE HUMIDITY: 73.34 GRAINS H2O / LB. DRY AIR

EMISSION RESULTS	CS	HS	WTD TEST	CYCLE STATISTICS	CS	HS
HC (INTEGRATED)				SPEED		
BACKGROUND, PPM	0.00	3.92		NUMBER	0	1176
EXHAUST+BKG, GM	0.00	18.12		SLOPE	0.00000	0.99371
NET, GM/BHP-HR	0.000	0.740	0.740	(LIMIT: 0.97-1.03)		
CO (BAG)				Y-INTERCEPT	0.000	1.971
BACKGROUND, PPM	0.00	0.72		(LIMIT: +-50 RPM)		
EXHAUST+BKG, GM	0.00	34.00		STD ERROR	0.000	16.083
NET, GM/BHP-HR	0.00	1.65	1.65	(LIMIT: 100 RPM)		
R-SQUARE				R-SQUARE	0.00000	0.99931
(LIMIT: 0.97)				(LIMIT: 0.97)		
NOX (INTEGRATED)				TORQUE		
BACKGROUND, PPM	0.00	0.00		NUMBER	0	987
EXHAUST+BKG, GM	0.00	152.01		SLOPE	0.00000	0.94777
NET, GM/BHP-HR	0.000	7.631	7.631	(LIMIT: 0.77/0.83-1.03)		
CO2 (BAG)				Y-INTERCEPT	0.000	4.506
BACKGROUND, PPM	0.000	0.038		STD ERROR	0.000%	5.938%
EXHAUST+BKG, GM	0.00	12828.28		(LIMIT: 13% MAX ENG TQ)		
NET, GM/BHP-HR	0.0	594.2	594.2	R-SQUARE	0.00000	0.93835
PARTICULATE				(LIMIT: 0.85/0.88)		
SECONDARY TARE, GM	0.000000	0.169644		POWER		
SECONDARY PART, GM	0.000000	0.169778		NUMBER	0	986
PRIMARY TARE, GM	0.000000	0.164907		SLOPE	0.00000	0.98837
PRIMARY PART, GM	0.000000	0.171939		(LIMIT: 0.87/0.89-1.03)		
TOTAL, GM/BHP-HR	0.00	0.57	0.57	Y-INTERCEPT	0.000	-1.621
FUEL CONSUMPTION				(LIMIT: +-5 BHP)		
LBS	0.00	8.22	8.22	STD ERROR	0.000%	6.391%
LBS/BHP-HR	0.000	0.415	0.415	(LIMIT: 8%)		
BRAKE HORSEPOWER-HOUR	0.000	19.836		R-SQUARE	0.00000	0.95974
				(LIMIT: 0.91)		
WORK				WORK		
ACTUAL				ACTUAL	0.000	19.836
(LIMIT: -15%-5% REF BHP-HR)				REFERENCE	0.000	20.327
%				% DIFFERENCE	0.00%	-2.42%

HD-863332  
760 EM6-28580CORR672 0  
HS

HEAVY DUTY DIESEL TRANSIENT ENGINE TEST  
DIESEL SUMMARY REPORT

DATE: 12-12-86 TIME: 09:51:24 HD-863332

TEST NUMBER: HD-863332  
TEST DATE/TIME: 10-10-86 10:19

MANUFACTURER: MACK  
ENGINE ID: 760 EM6-28580CORR672 0

AMBIENT DATA

BAROMETER (DRY): 29.30 "HG

DRY BULB TEMPERATURE: 76.30 F

ABSOLUTE HUMIDITY: 70.19 GRAINS H<sub>2</sub>O / LB. DRY AIR

<u>EMISSION RESULTS</u>	<u>CS</u>	<u>HS</u>	<u>WTD TEST</u>	<u>CYCLE STATISTICS</u>	<u>CS</u>	<u>HS</u>
HC (INTEGRATED)				SPEED		
BACKGROUND, PPM	0.00	0.00		NUMBER	0	1176
EXHAUST+BKG, GM	0.00	18.72		SLOPE	0.00000	0.99288
NET, GM/BHP-HR	0.000	0.790	0.790	(LIMIT: 0.97-1.03)		
CO (BAG)				Y-INTERCEPT	0.000	3.717
BACKGROUND, PPM	0.00	0.00		(LIMIT: +-50 RPM)		
EXHAUST+BKG, GM	0.00	33.88		STD ERROR	0.000	15.889
NET, GM/BHP-HR	0.00	1.67	1.67	(LIMIT: 100 RPM)		
				R-SQUARE	0.00000	0.99932
(LIMIT: 0.97)						
NOX (INTEGRATED)				TORQUE		
BACKGROUND, PPM	0.00	0.00		NUMBER	0	987
EXHAUST+BKG, GM	0.00	154.41		SLOPE	0.00000	0.95089
NET, GM/BHP-HR	0.000	7.686	7.686	(LIMIT: 0.77/0.83-1.03)		
CO2 (BAG)				Y-INTERCEPT	0.000	4.493
BACKGROUND, PPM	0.000	0.000		(LIMIT: +-15 FT-LBS)		
EXHAUST+BKG, GM	0.00	12842.18		STD ERROR	0.000%	5.827%
NET, GM/BHP-HR	0.0	594.8	594.8	(LIMIT: 13% MAX ENG TQ)		
				R-SQUARE	0.00000	0.94083
(LIMIT: 0.85/0.88)						
PARTICULATE				POWER		
SECONDARY TARE, GM	0.000000	0.168437		NUMBER	0	986
SECONDARY PART, GM	0.000000	0.168604		SLOPE	0.00000	0.98876
PRIMARY TARE, GM	0.000000	0.167470		(LIMIT: 0.87/0.89-1.03)		
PRIMARY PART, GM	0.000000	0.174478		Y-INTERCEPT	0.000	-1.566
TOTAL, GM/BHP-HR	0.00	0.57	0.57	(LIMIT: +-5 BHP)		
				STD ERROR	0.000%	6.322%
FUEL CONSUMPTION				(LIMIT: 8%)		
LBS	0.00	8.24	8.24	R-SQUARE	0.00000	0.96072
LBS/BHP-HR	0.000	0.415	0.415	(LIMIT: 0.91)		
BRAKE HORSEPOWER-HOUR	0.000	19.842				
				WORK		
				ACTUAL	0.000	19.842
				(LIMIT: -15%-5% REF BHP-HR)		
				REFERENCE	0.000	20.327
				% DIFFERENCE	0.00%	-2.39%

HD-863333  
760 EM6-28580CORR672 0  
HS

## HEAVY DUTY DIESEL TRANSIENT ENGINE TEST

DATE: 12-12-86 TIME: 09:51:54 HD-863333

## DIESEL SUMMARY REPORT

TEST NUMBER: HD-863333  
TEST DATE/TIME: 10-15-86 9:57  
MANUFACTURER: MACK  
ENGINE ID: 760 EM6-28580CORR672 0

AMBIENT DATA

BAROMETER (DRY): 29.00 "HG  
DRY BULB TEMPERATURE: 75.80 F  
ABSOLUTE HUMIDITY: 57.25 GRAINS H2O / LB. DRY AIR

EMISSION RESULTS	CS	HS	WTD TEST	CYCLE STATISTICS	CS	HS
HC (INTEGRATED)				SPEED		
BACKGROUND, PPM	0.00	0.00		NUMBER	0	1176
EXHAUST+BKG, GM	0.00	18.70		SLOPE	0.00000	0.99463
NET, GM/BHP-HR	0.000	0.884	0.884	(LIMIT: 0.97-1.03)		
CO (BAG)				Y-INTERCEPT	0.000	16.391
BACKGROUND, PPM	0.00	0.00		((LIMIT: +-50 RPM))		
EXHAUST+BKG, GM	0.00	32.96		STD ERROR	0.000	15.942
NET, GM/BHP-HR	0.00	1.73	1.73	(LIMIT: 100 RPM)		
R-SQUARE				(R-SQUARE)	0.00000	0.99932
(LIMIT: 0.97)						
NOX (INTEGRATED)				TORQUE		
BACKGROUND, PPM	0.00	0.00		NUMBER	0	987
EXHAUST+BKG, GM	0.00	150.01		SLOPE	0.00000	0.95458
NET, GM/BHP-HR	0.000	7.519	7.519	(LIMIT: 0.77/0.83-1.03)		
CO2 (BAG)				Y-INTERCEPT	0.000	-15.228
BACKGROUND, PPM	0.000	0.000		((LIMIT: +-15 FT-LBS))		
EXHAUST+BKG, GM	0.00	12615.93		STD ERROR	0.000%	5.851%
NET, GM/BHP-HR	0.0	612.1	612.1	(LIMIT: 13% MAX ENG TQ)		
R-SQUARE				(R-SQUARE)	0.00000	0.94083
(LIMIT: 0.85/0.88)						
PARTICULATE				POWER		
SECONDARY TARE, GM	0.000000	0.168890		NUMBER	0	986
SECONDARY PART, GM	0.000000	0.168994		SLOPE	0.00000	0.98238
PRIMARY TARE, GM	0.000000	0.170203		(LIMIT: 0.87/0.89-1.03)		
PRIMARY PART, GM	0.000000	0.176786		Y-INTERCEPT	0.000	-4.539
TOTAL, GM/BHP-HR	0.00	0.59	0.59	((LIMIT: +-5 BHP))		
FUEL CONSUMPTION				STD ERROR	0.000%	6.445%
LBS	0.00	8.15	8.15	(LIMIT: 8%)		
LBS/BHP-HR	0.000	0.427	0.427	R-SQUARE	0.00000	0.95866
(LIMIT: 0.91)						
BRAKE HORSEPOWER-HOUR	0.000	19.072		WORK		
				ACTUAL	0.000	19.072
				(LIMIT: -15%-5% REF BHP-HR)		
				REFERENCE	0.000	20.327
				% DIFFERENCE	0.00%	-6.17%

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HD-863334  
760 EM6-28580CORR672 0  
HS

HEAVY DUTY DIESEL TRANSIENT ENGINE TEST  
DIESEL SUMMARY REPORT

DATE: 12-12-86 TIME: 09:52:25 HD-863334

TEST NUMBER: HD-863334  
TEST DATE/TIME: 10-15-86 10:39  
MANUFACTURER: MACK  
ENGINE ID: 760 EM6-28580CORR672 0

AMBIENT DATA

BAROMETER (DRY): 29.00 "HG  
DRY BULB TEMPERATURE: 76.20 F  
ABSOLUTE HUMIDITY: 56.58 GRAINS H2O / LB. DRY AIR

EMISSION RESULTS	CS	HS	WTD TEST	CYCLE STATISTICS	CS	HS
HC (INTEGRATED)				SPEED		
BACKGROUND, PPM	0.00	4.07		NUMBER	0	1176
EXHAUST+BKG, GM	0.00	19.28		SLOPE	0.00000	0.99426
NET, GM/BHP-HR	0.000	0.826	0.826	(LIMIT: 0.97-1.03)		
CO (BAG)				Y-INTERCEPT	0.000	17.010
BACKGROUND, PPM	0.00	0.00		(LIMIT: +-50 RPM)		
EXHAUST+BKG, GM	0.00	32.94		STD ERROR	0.000	15.779
NET, GM/BHP-HR	0.00	1.73	1.73	(LIMIT: 100 RPM)		
R-SQUARE				(LIMIT: 0.97)	0.00000	0.99934
NOX (INTEGRATED)				TORQUE		
BACKGROUND, PPM	0.00	0.49		NUMBER	0	989
EXHAUST+BKG, GM	0.00	152.84		SLOPE	0.00000	0.94131
NET, GM/BHP-HR	0.000	7.581	7.581	(LIMIT: 0.77/0.83-1.03)		
CO2 (BAG)				Y-INTERCEPT	0.000	-13.386
BACKGROUND, PPM	0.000	0.035		(LIMIT: +-15 FT-LBS)		
EXHAUST+BKG, GM	0.00	12675.36		STD ERROR	0.000%	6.177%
NET, GM/BHP-HR	0.0	614.4	614.4	(LIMIT: 13% MAX ENG TQ)	0.00000	0.93392
PARTICULATE				R-SQUARE		
SECONDARY TARE, GM	0.000000	0.166443		(LIMIT: 0.85/0.88)		
SECONDARY PART, GM	0.000000	0.166595		POWER		
PRIMARY TARE, GM	0.000000	0.168051		NUMBER	0	988
PRIMARY PART, GM	0.000000	0.174440		SLOPE	0.00000	0.97681
TOTAL, GM/BHP-HR	0.00	0.57	0.57	(LIMIT: 0.87/0.89-1.03)		
FUEL CONSUMPTION				Y-INTERCEPT	0.000	-4.420
LBS	0.00	8.17	8.17	(LIMIT: +-5 BHP)		
LBS/BHP-HR	0.000	0.429	0.429	STD ERROR	0.000%	6.677%
BRAKE HORSEPOWER-HOUR	0.000	19.059		(LIMIT: 8%)		
				R-SQUARE	0.00000	0.95547
				(LIMIT: 0.91)		
				WORK		
				ACTUAL	0.000	19.059
				(LIMIT: -15%-5% REF BHP-HR)		
				REFERENCE	0.000	20.327
				% DIFFERENCE	0.00%	-6.24%

HD-863335  
760 EM6-28580CORR672 0  
HS

HEAVY DUTY DIESEL TRANSIENT ENGINE TEST  
DIESEL SUMMARY REPORT

DATE: 12-12-86 TIME: 09:52:45 HD-863335

TEST NUMBER: HD-863335  
TEST DATE/TIME: 10-15-86 13:28

MANUFACTURER: MACK  
ENGINE ID: 760 EM6-28580CORR672 0

AMBIENT DATA

BAROMETER (DRY): 29.00 "HG

DRY BULB TEMPERATURE: 75.10 F

ABSOLUTE HUMIDITY: 57.50 GRAINS H2O / LB. DRY AIR

<u>EMISSION RESULTS</u>	<u>CS</u>	<u>HS</u>	<u>WTD TEST</u>	<u>CYCLE STATISTICS</u>	<u>CS</u>	<u>HS</u>
HC (INTEGRATED)				SPEED		
BACKGROUND, PPM	0.00	0.00		NUMBER	0	1176
EXHAUST+BKG, GM	0.00	18.46		SLOPE	0.00000	0.99551
NET, GM/BHP-HR	0.000	0.812	0.812	(LIMIT: 0.97-1.03)		
CO (BAG)				Y-INTERCEPT	0.000	14.526
BACKGROUND, PPM	0.00	0.00		(LIMIT: +50 RPM)		
EXHAUST+BKG, GM	0.00	31.63		STD ERROR	0.000	16.042
NET, GM/BHP-HR	0.00	1.66	1.66	(LIMIT: 100 RPM)		
				R-SQUARE	0.00000	0.99932
NOX (INTEGRATED)				(LIMIT: 0.97)		
BACKGROUND, PPM	0.00	0.00		TORQUE		
EXHAUST+BKG, GM	0.00	149.29		NUMBER	0	994
NET, GM/BHP-HR	0.000	7.510	7.510	SLOPE	0.00000	0.93322
CO2 (BAG)				(LIMIT: 0.77/0.83-1.03)		
BACKGROUND, PPM	0.000	0.000		Y-INTERCEPT	0.000	-13.442
EXHAUST+BKG, GM	0.00	12605.10		(LIMIT: +/-15 FT-LBS)		
NET, GM/BHP-HR	0.0	614.8	614.8	STD ERROR	0.000%	6.324%
PARTICULATE				(LIMIT: 13% MAX ENG TQ)		
SECONDARY TARE, GM	0.000000	0.166593		R-SQUARE	0.00000	0.93107
SECONDARY PART, GM	0.000000	0.166722		(LIMIT: 0.85/0.88)		
PRIMARY TARE, GM	0.000000	0.169722		POWER		
PRIMARY PART, GM	0.000000	0.175965		NUMBER	0	993
TOTAL, GM/BHP-HR	0.00	0.57	0.57	SLOPE	0.00000	0.97014
FUEL CONSUMPTION				(LIMIT: 0.87/0.89-1.03)		
LBS	0.00	8.16	8.16	Y-INTERCEPT	0.000	-4.430
LBS/BHP-HR	0.000	0.429	0.429	(LIMIT: +/-5 BHP)		
BRAKE HORSEPOWER-HOUR	0.000	19.013		STD ERROR	0.000%	6.839%
				R-SQUARE	0.00000	0.95310
				(LIMIT: 0.91)		
				WORK		
				ACTUAL	0.000	19.013
				(LIMIT: -15%-5% REF BHP-HR)		
				REFERENCE	0.000	20.327
				% DIFFERENCE	0.00%	-6.46%

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HD-863336  
760 EM6-28580CORR672 0  
HS

HEAVY DUTY DIESEL TRANSIENT ENGINE TEST  
DIESEL SUMMARY REPORT

DATE: 12-12-86 TIME: 09:53:17 HD-863336

TEST NUMBER: HD-863336  
TEST DATE/TIME: 10-15-86 14: 7

MANUFACTURER: MACK  
ENGINE ID: 760 EM6-28580CORR672 0

AMBIENT DATA

BAROMETER (DRY): 29.00 "HG  
DRY BULB TEMPERATURE: 75.60 F  
ABSOLUTE HUMIDITY: 71.83 GRAINS H2O / LB. DRY AIR

<u>EMISSION RESULTS</u>	<u>CS</u>	<u>HS</u>	<u>WTD TEST</u>	<u>CYCLE STATISTICS</u>	<u>CS</u>	<u>HS</u>
HC (INTEGRATED)				SPEED		
BACKGROUND, PPM	0.00	0.00		NUMBER	0	1176
EXHAUST+BKG, GM	0.00	18.94		SLOPE	0.00000	0.99582
NET, GM/BHP-HR	0.000	0.814	0.814	(LIMIT: 0.97-1.03)		
CO (BAG)				Y-INTERCEPT	0.000	18.952
BACKGROUND, PPM	0.00	0.00		(LIMIT: +-50 RPM)		
EXHAUST+BKG, GM	0.00	31.89		STD ERROR	0.000	16.034
NET, GM/BHP-HR	0.00	1.67	1.67	(LIMIT: 100 RPM)		
R-SQUARE				(LIMIT: 0.97)	0.00000	0.99931
NOX (INTEGRATED)				TORQUE		
BACKGROUND, PPM	0.00	0.00		NUMBER	0	984
EXHAUST+BKG, GM	0.00	158.56		SLOPE	0.00000	0.95895
NET, GM/BHP-HR	0.000	8.161	8.161	(LIMIT: 0.77/0.83-1.03)		
CO2 (BAG)				Y-INTERCEPT	0.000	-15.831
BACKGROUND, PPM	0.000	0.000		(LIMIT: +-15 FT-LBS)		
EXHAUST+BKG, GM	0.00	12745.53		STD ERROR	0.000%	5.774%
NET, GM/BHP-HR	0.0	619.8	619.8	(LIMIT: 13% MAX ENG TQ)	0.00000	0.94197
PARTICULATE				R-SQUARE		
SECONDARY TARE, GM	0.000000	0.163263		(LIMIT: 0.85/0.88)		
SECONDARY PART, GM	0.000000	0.163369		POWER		
PRIMARY TARE, GM	0.000000	0.163705		NUMBER	0	983
PRIMARY PART, GM	0.000000	0.169949		SLOPE	0.00000	0.98764
TOTAL, GM/BHP-HR	0.00	0.56	0.56	(LIMIT: 0.87/0.89-1.03)		
FUEL CONSUMPTION				Y-INTERCEPT	0.000	-4.594
LBS	0.00	8.26	8.26	(LIMIT: +-5 BHP)		
LBS/BHP-HR	0.000	0.432	0.432	STD ERROR	0.000%	6.405%
BRAKE HORSEPOWER-HOUR	0.000	19.097		R-SQUARE	0.00000	0.95934
				(LIMIT: 8%)		
				WORK		
				ACTUAL	0.000	19.097
				(LIMIT: -15%-5% REF BHP-HR)		
				REFERENCE	0.000	20.327
				% DIFFERENCE	0.00%	-6.05%

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HD-863345  
760 EM6-28580CORR672 0  
HS

HEAVY DUTY DIESEL TRANSIENT ENGINE TEST  
DIESEL SUMMARY REPORT

DATE: 12-12-86 TIME: 09:53:54 HD-863345

TEST NUMBER: HD-863345  
TEST DATE/TIME: 11-21-86 14: 8

MANUFACTURER: MACK  
ENGINE ID: 760 EM6-28580CORR672 0

AMBIENT DATA

BAROMETER (DRY): 29.10 "HG  
DRY BULB TEMPERATURE: 73.30 F  
ABSOLUTE HUMIDITY: 61.62 GRAINS H<sub>2</sub>O / LB. DRY AIR

EMISSION RESULTS	CS	HS	WTD TEST	CYCLE STATISTICS	CS	HS
HC (INTEGRATED)				SPEED		
BACKGROUND, PPM	0.00	0.00		NUMBER	0	1176
EXHAUST+BKG, GM	0.00	17.63		SLOPE	0.00000	0.98743
NET, GM/BHP-HR	0.000	0.709	0.709	(LIMIT: 0.97-1.03)		
CO (BAG)				V-INTERCEPT	0.000	8.418
BACKGROUND, PPM	0.00	0.00		(LIMIT: +-50 RPM)		
EXHAUST+BKG, GM	0.00	31.52		STD ERROR	0.000	38.358
NET, GM/BHP-HR	0.00	1.58	1.58	(LIMIT: 100 RPM)		
NOX (INTEGRATED)				R-SQUARE	0.00000	0.99603
BACKGROUND, PPM	0.00	0.00		(LIMIT: 0.97)		
EXHAUST+BKG, GM	0.00	149.48		TORQUE		
NET, GM/BHP-HR	0.000	7.206	7.206	NUMBER	0	992
CO <sub>2</sub> (BAG)				SLOPE	0.00000	0.95614
BACKGROUND, PPM	0.000	0.000		(LIMIT: 0.77/0.83-1.03)		
EXHAUST+BKG, GM	0.00	12650.02		V-INTERCEPT	0.000	1.319
NET, GM/BHP-HR	0.0	582.2	582.2	(LIMIT: +-15 FT-LBS)		
PARTICULATE				STD ERROR	0.000%	6.733%
SECONDARY TARE, GM	0.000000	0.170567		(LIMIT: 13% MAX ENG TQ)		
SECONDARY PART, GM	0.000000	0.170767		R-SQUARE	0.00000	0.92581
PRIMARY TARE, GM	0.000000	0.168075		(LIMIT: 0.85/0.88)		
PRIMARY PART, GM	0.000000	0.175166		POWER		
TOTAL, GM/BHP-HR	0.00	0.52	0.52	NUMBER	0	991
FUEL CONSUMPTION				SLOPE	0.00000	0.99177
LBS	0.00	8.10	8.10	(LIMIT: 0.87/0.89-1.03)		
LBS/BHP-HR	0.000	0.406	0.406	V-INTERCEPT	0.000	-1.777
BRAKE HORSEPOWER-HOUR	0.000	19.947		(LIMIT: +-5 BHP)		
				STD ERROR	0.000%	7.352%
				R-SQUARE	0.00000	0.94848
				(LIMIT: 0.91)		
				WORK		
				ACTUAL	0.000	19.947
				(LIMIT: -15%-5% REF BHP-HR)		
				REFERENCE	0.000	20.327
				% DIFFERENCE	0.00%	-1.87%

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HD-863346  
760 EM6-28580CORR672 0  
HS

## HEAVY DUTY DIESEL TRANSIENT ENGINE TEST

DATE: 12-12-86 TIME: 09:54:24 HD-863346

## DIESEL SUMMARY REPORT

TEST NUMBER: HD-863346  
TEST DATE/TIME: 11-21-86 14:34

MANUFACTURER: MACK  
ENGINE ID: 760 EM6-28580CORR672 0

AMBIENT DATA

BAROMETER (DRY): 29.10 "HG  
DRY BULB TEMPERATURE: 72.50 F  
ABSOLUTE HUMIDITY: 62.32 GRAINS H2O / LB. DRY AIR

EMISSION RESULTS	CS	HS	WTD TEST	CYCLE STATISTICS	CS	HS
HC (INTEGRATED)				SPEED		
BACKGROUND, PPM	0.00	0.00		NUMBER	0	1176
EXHAUST+BKG, GM	0.00	18.71		SLOPE	0.00000	0.98572
NET, GM/BHP-HR	0.000	0.758	0.758	(LIMIT: 0.97-1.03)		
CO (BAG)				Y-INTERCEPT	0.000	10.130
BACKGROUND, PPM	0.00	0.00		(LIMIT: +-50 RPM)		
EXHAUST+BKG, GM	0.00	31.82		STD ERROR	0.000	38.387
NET, GM/BHP-HR	0.00	1.58	1.58	(LIMIT: 100 RPM)		
				R-SQUARE	0.00000	0.99601
NOX (INTEGRATED)				(LIMIT: 0.97)		
BACKGROUND, PPM	0.00	0.00		TORQUE		
EXHAUST+BKG, GM	0.00	148.18		NUMBER	0	992
NET, GM/BHP-HR	0.000	7.176	7.176	SLOPE	0.00000	0.96091
CO2 (BAG)				(LIMIT: 0.77/0.83-1.03)		
BACKGROUND, PPM	0.000	0.000		Y-INTERCEPT	0.000	0.311
EXHAUST+BKG, GM	0.00	12696.45		(LIMIT: +-15 FT-LBS)		
NET, GM/BHP-HR	0.0	587.4	587.4	STD ERROR	0.000%	6.553%
				(LIMIT: 13% MAX ENG TQ)		
PARTICULATE				R-SQUARE	0.00000	0.92977
SECONDARY TARE, GM	0.000000	0.172011		(LIMIT: 0.85/0.88)		
SECONDARY PART, GM	0.000000	0.172108		POWER		
PRIMARY TARE, GM	0.000000	0.169839		NUMBER	0	991
PRIMARY PART, GM	0.000000	0.176694		SLOPE	0.00000	0.98915
TOTAL, GM/BHP-HR	0.00	0.51	0.51	(LIMIT: 0.87/0.89-1.03)		
FUEL CONSUMPTION				Y-INTERCEPT	0.000	-1.745
LBS	0.00	8.15	8.15	(LIMIT: +-5 BHP)		
LBS/BHP-HR	0.000	0.410	0.410	STD ERROR	0.000%	7.244%
BRAKE HORSEPOWER-HOUR	0.000	19.891		(LIMIT: 8%)		
				R-SQUARE	0.00000	0.94975
				(LIMIT: 0.91)		
				WORK		
				ACTUAL	0.000	19.891
				(LIMIT: -15%-5% REF BHP-HR)		
				REFERENCE	0.000	20.327
				% DIFFERENCE	0.00%	-2.14%

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HD-863347  
760 EM6-28580CORR672 0  
HS

HEAVY DUTY DIESEL TRANSIENT ENGINE TEST  
DIESEL SUMMARY REPORT

DATE: 12-12-86 TIME: 09:54:50 HD-863347

TEST NUMBER: HD-863347  
TEST DATE/TIME: 11-21-86 15:14

MANUFACTURER: MACK  
ENGINE ID: 760 EM6-28580CORR672 0

AMBIENT DATA

BAROMETER (DRY): 29.10 "HG

DRY BULB TEMPERATURE: 75.00 F

ABSOLUTE HUMIDITY: 63.02 GRAINS H2O / LB. DRY AIR

EMISSION RESULTS	CS	HS	WTD TEST	CYCLE STATISTICS	CS	HS
HC (INTEGRATED)				SPEED		
BACKGROUND, PPM	0.00	0.00		NUMBER	0	1176
EXHAUST+BKG, GM	0.00	19.13		SLOPE	0.00000	0.98666
NET, GM/BHP-HR	0.000	0.766	0.766	(LIMIT: 0.97-1.03)		
CO (BAG)				Y-INTERCEPT	0.000	6.986
BACKGROUND, PPM	0.00	0.00		(LIMIT: +-50 RPM)		
EXHAUST+BKG, GM	0.00	30.74		STD ERROR	0.000	38.359
NET, GM/BHP-HR	0.00	1.54	1.54	(LIMIT: 100 RPM)		
R-SQUARE				(LIMIT: 0.97)	0.00000	0.99602
NOX (INTEGRATED)				TORQUE		
BACKGROUND, PPM	0.00	0.00		NUMBER	0	996
EXHAUST+BKG, GM	0.00	148.65		SLOPE	0.00000	0.94998
NET, GM/BHP-HR	0.000	7.237	7.237	(LIMIT: 0.77/0.83-1.03)		
CO2 (BAG)				Y-INTERCEPT	0.000	1.646
BACKGROUND, PPM	0.000	0.000		(LIMIT: +-15 FT-LBS)		
EXHAUST+BKG, GM	0.00	12697.56		STD ERROR	0.000%	6.861%
NET, GM/BHP-HR	0.0	585.4	585.4	(LIMIT: 13% MAX ENG TQ)		
PARTICULATE				R-SQUARE	0.00000	0.92329
SECONDARY TARE, GM	0.000000	0.166141		POWER		
SECONDARY PART, GM	0.000000	0.166301		NUMBER	0	995
PRIMARY TARE, GM	0.000000	0.167027		SLOPE	0.00000	0.98387
PRIMARY PART, GM	0.000000	0.173976		(LIMIT: 0.87/0.89-1.03)		
TOTAL, GM/BHP-HR	0.00	0.53	0.53	Y-INTERCEPT	0.000	-1.680
FUEL CONSUMPTION				(LIMIT: +-5 BHP)		
LBS	0.00	8.13	8.13	STD ERROR	0.000%	7.545%
LBS/BHP-HR	0.000	0.408	0.408	(LIMIT: 8%)		
BRAKE HORSEPOWER-HOUR	0.000	19.918		R-SQUARE	0.00000	0.94555
				(LIMIT: 0.91)		
				WORK		
				ACTUAL	0.000	19.918
				(LIMIT: -15%-5% REF BHP-HR)		
				REFERENCE	0.000	20.327
				% DIFFERENCE	0.00%	-2.01%

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September 18, 1986

U.S. EPA/SDSB  
2565 Plymouth Road  
Ann Arbor, MI 48105

Attention: Mr. Thomas Baines

Dear Tom:

Enclosed is information pertaining to the set-up and operation of the EM6-285 Mack correlation engine. In addition, the compiled data for the transient cycle and steady state testing performed at our facility is attached.

Feel free to contact me at (301) 824-6764 if you require any additional information prior to our visit.

Sincerely,

MACK TRUCKS, INC.

*Steve*

S. S. Trevitz

nk

cc: CKSalter, JWMorris, KEMurphy, GOShetter

SPECIFICATIONS

ENGINE:	MACK EM6-285
SERIAL NUMBER:	ON-4771
DISPLACEMENT:	672 CU.IN.
BORE & STROKE:	4-7/8" X 6"
COMPRESSION RATIO:	15:1
CHARGE COOLING:	SERIES, TIP TURBINE FAN DUCT PROVIDED
RATED POWER:	285 BHP
RATED SPEED:	2100 RPM
PEAK TORQUE SPEED:	1200 RPM
LOW IDLE:	580 RPM
HIGH IDLE:	2300 RPM
GOVERNOR CUT-IN:	2160 RPM
FUEL:	PHILLIPS D-2 CONTROL FUEL LOT G-580, 2 DRUMS SHIPPED
LUBE:	MACK HOUSE LUBE, CRANKCASE FULL AND 5 GALS SHIPPED

### THERMOCOUPLES

The engine was shipped with type "J" thermocouples which monitor fuel, oil, compressor discharge air, and intake manifold air temperatures. Additional temperature measurement will be required for cooling water inlet and outlet as well as tip turbine fan inlet. Furthermore, the post-turbine exhaust temperature should be monitored and not permitted to exceed 1200 F.

### PRESSURE TAPS

The oil pressure is typically 60 psi in the gallery and 45 psi at piston cooling. Gallery pressure should be monitored by a safety system at a threshold of 30 psi. Fuel pressure to the transfer pump is not critical, but 12 psi is a typical value. The following pressures should be recorded for steady state maximum power tests:

Inlet Air Restriction (Piezometer)  
Compressor Discharge  
Intake manifold  
Exhaust Restriction

### ENGINE SPEED

The drive plate on the engine has 60 holes around the circumference to facilitate engine RPM measurement. Maximum overspeed is 2450 RPM.

### ENGINE START-UP

Prior to high load operation, the engine should be run at 1200 RPM and 400 lb-ft until the oil temperature reaches approximately 150

### ENGINE SHUT-DOWN

Always idle the engine a few minutes before normal shut-down to allow proper cooling of the turbocharger. Stop engine by closing fuel shut-off lever on injection pump.

### INJECTION PUMP CONTROLS

Throttle is spring-loaded to idle position. Fuel shut-off is spring-loaded to "run" position.

INSTALLATION OF SHUT-OFF EQUIPMENT

1. Connect the flexible cable sheath to the brass fitting on the air cylinder bracket using the ferrule and nut taped to the sheath.
2. Connect the movable core of the cable to the air cylinder by inserting the core about one inch into the hole in the end of the cylinder attachment and tightening the set screw.
3. Connect house air ( $\approx$  100 psi) to the inlet of the pressure regulator. Regulator is set to 30 psi.
4. Connect a 12 VDC source to the solenoid valve.
5. With the valve energized, the cylinder should extend. With the cylinder in this position, connect the free end of the center core to the shut-off lever on the injection pump. Clamp the cable sheath to the bracket on the pump while holding the shut-off lever on the pump in the "run" (forward position).
6. De-energize the solenoid valve and see that the shut-off lever goes to the stop position (all the way to the rear).

TEST CONDITIONS

	<u>TRANSIENT AND STEADY STATE EMISSIONS</u>	<u>STEADY STATE MAXIMUM POWER</u>
INLET RESTRICTION	27.3" H <sub>2</sub> O	22.9" H <sub>2</sub> O
EXHAUST RESTRICTION	33.8" H <sub>2</sub> O	33.9" H <sub>2</sub> O
FUEL TEMPERATURE	95°F	104°F
TIP TURBINE FAN INLET	60-90°F	60-90°F
INTAKE MANIFOLD AIR TEMP	150°F AVG	AVAILABLE UPON REQUEST
COOLANT*	180°F OUTLET 175°F INLET	180°F OUTLET 175°F INLET

\*Mack controls outlet water temp to 180°F on hot engine.  
Inlet water temp is typically 5°F less. A 180°F termostat  
was installed on the water outlet. Therefore, EPA should  
set their water inlet controller to 175°F.

STEADY STATE MAXIMUM POWER

ENGINE SPEED <u>(rpm)</u>	OBSERVED TORQUE <u>(lb-ft)</u>	FUEL FLOW <u>(lb/hr)</u>	AIR FLOW (lb/min) <u>WET</u>	<u>DRY</u>
2100	715	112.0	60.29	59.11
2000	761	110.5	58.27	57.12
1800	852	104.7	51.46	50.45
1600	930	97.7	43.86	43.00
1400	1045	95.5	37.02	36.29
1200	1125	91.5	30.25	29.65
1000	1038	76.7	21.99	21.55

ATOMOSPHERIC CONDITIONS

BAROMETER            29.23" Hg  
VAPOR PRESSURE       0.70" Hg  
TEMPERATURE          85 DEG. F

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TRANSIENT CYCLE POWER SWEEP

RPM	TORQ	HP	RPM	TORQ	HP	RPM	TORQ	HP
594+	397+	44	56	46	46	50	51	51
603+	399+	44	56	46	46	50	51	51
611+	400+	44	56	46	46	50	51	51
619+	400+	44	56	46	46	50	51	51
625+	410+	44	56	46	46	50	51	51
636+	415+	44	56	46	46	50	51	51
643+	423+	44	56	46	46	50	51	51
651+	416+	44	56	46	46	50	51	51
660+	422+	44	56	46	46	50	51	51
666+	426+	44	56	46	46	50	51	51
674+	429+	44	56	46	46	50	51	51
684+	430+	44	56	46	46	50	51	51
690+	700+	44	56	46	46	50	51	51
708+	716+	44	56	46	46	50	51	51
720+	723+	44	56	46	46	50	51	51
731+	739+	44	56	46	46	50	51	51
747+	757+	44	56	46	46	50	51	51
763+	771+	44	56	46	46	50	51	51
788+	794+	44	56	46	46	50	51	51
794+	804+	44	56	46	46	50	51	51
800+	802+	44	56	46	46	50	51	51
805+	805+	44	56	46	46	50	51	51
811+	812+	44	56	46	46	50	51	51
817+	827+	44	56	46	46	50	51	51
831+	831+	44	56	46	46	50	51	51
837+	837+	44	56	46	46	50	51	51
843+	843+	44	56	46	46	50	51	51
849+	849+	44	56	46	46	50	51	51
855+	855+	44	56	46	46	50	51	51
861+	861+	44	56	46	46	50	51	51
867+	867+	44	56	46	46	50	51	51
873+	873+	44	56	46	46	50	51	51
879+	879+	44	56	46	46	50	51	51
885+	885+	44	56	46	46	50	51	51
891+	891+	44	56	46	46	50	51	51
897+	897+	44	56	46	46	50	51	51
903+	903+	44	56	46	46	50	51	51
909+	909+	44	56	46	46	50	51	51
915+	915+	44	56	46	46	50	51	51
921+	921+	44	56	46	46	50	51	51
927+	927+	44	56	46	46	50	51	51
933+	933+	44	56	46	46	50	51	51
939+	939+	44	56	46	46	50	51	51
945+	945+	44	56	46	46	50	51	51
951+	951+	44	56	46	46	50	51	51
957+	957+	44	56	46	46	50	51	51
963+	963+	44	56	46	46	50	51	51
969+	969+	44	56	46	46	50	51	51
975+	975+	44	56	46	46	50	51	51
981+	981+	44	56	46	46	50	51	51
987+	987+	44	56	46	46	50	51	51
993+	993+	44	56	46	46	50	51	51
999+	999+	44	56	46	46	50	51	51
1005+	1005+	44	56	46	46	50	51	51
1011+	1011+	44	56	46	46	50	51	51
1017+	1017+	44	56	46	46	50	51	51
1023+	1023+	44	56	46	46	50	51	51
1029+	1029+	44	56	46	46	50	51	51
1035+	1035+	44	56	46	46	50	51	51
1041+	1041+	44	56	46	46	50	51	51
1047+	1047+	44	56	46	46	50	51	51
1053+	1053+	44	56	46	46	50	51	51
1059+	1059+	44	56	46	46	50	51	51
1065+	1065+	44	56	46	46	50	51	51
1071+	1071+	44	56	46	46	50	51	51
1077+	1077+	44	56	46	46	50	51	51
1083+	1083+	44	56	46	46	50	51	51
1089+	1089+	44	56	46	46	50	51	51
1095+	1095+	44	56	46	46	50	51	51
1101+	1101+	44	56	46	46	50	51	51
1107+	1107+	44	56	46	46	50	51	51
1113+	1113+	44	56	46	46	50	51	51
1119+	1119+	44	56	46	46	50	51	51
1125+	1125+	44	56	46	46	50	51	51
1131+	1131+	44	56	46	46	50	51	51
1137+	1137+	44	56	46	46	50	51	51
1143+	1143+	44	56	46	46	50	51	51
1149+	1149+	44	56	46	46	50	51	51
1155+	1155+	44	56	46	46	50	51	51
1161+	1161+	44	56	46	46	50	51	51
1167+	1167+	44	56	46	46	50	51	51
1173+	1173+	44	56	46	46	50	51	51
1179+	1179+	44	56	46	46	50	51	51
1185+	1185+	44	56	46	46	50	51	51
1191+	1191+	44	56	46	46	50	51	51
1197+	1197+	44	56	46	46	50	51	51
1203+	1203+	44	56	46	46	50	51	51
1209+	1209+	44	56	46	46	50	51	51
1215+	1215+	44	56	46	46	50	51	51
1221+	1221+	44	56	46	46	50	51	51
1227+	1227+	44	56	46	46	50	51	51
1233+	1233+	44	56	46	46	50	51	51
1239+	1239+	44	56	46	46	50	51	51
1245+	1245+	44	56	46	46	50	51	51
1251+	1251+	44	56	46	46	50	51	51
1257+	1257+	44	56	46	46	50	51	51
1263+	1263+	44	56	46	46	50	51	51
1269+	1269+	44	56	46	46	50	51	51
1275+	1275+	44	56	46	46	50	51	51
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1287+	1287+	44	56	46	46	50	51	51
1293+	1293+	44	56	46	46	50	51	51
1299+	1299+	44	56	46	46	50	51	51
1305+	1305+	44	56	46	46	50	51	51
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1323+	1323+	44	56	46	46	50	51	51
1329+	1329+	44	56	46	46	50	51	51
1335+	1335+	44	56	46	46	50	51	51
1341+	1341+	44	56	46	46	50	51	51
1347+	1347+	44	56	46	46	50	51	51
1353+	1353+	44	56	46	46	50	51	51
1359+	1359+	44	56	46	46	50	51	51
1365+	1365+	44	56	46	46	50	51	51
1371+	1371+	44	56	46	46	50	51	51
1377+	1377+	44	56	46	46	50	51	51
1383+	1383+	44	56	46	46	50	51	51
1389+	1389+	44	56	46	46	50	51	51
1395+	1395+	44	56	46	46	50	51	51
1401+	1401+	44	56	46	46	50	51	51
1407+	1407+	44	56	46	46	50	51	51
1413+	1413+	44	56	46	46	50	51	51
1419+	1419+	44	56	46	46	50	51	51
1425+	1425+	44	56	46	46	50	51	51
1431+	1431+	44	56	46	46	50	51	51
1437+	1437+	44	56	46	46	50	51	51
1443+	1443+	44	56	46	46	50	51	51
1449+	1449+	44	56	46	46	50	51	51
1455+	1455+	44	56	46	46	50	51	51
1461+	1461+	44	56	46	46	50	51	51
1467+	1467+	44	56	46	46	50	51	51
1473+	1473+	44	56	46	46	50	51	51
1479+	1479+	44	56	46	46	50	51	51
1485+	1485+	44	56	46	46	50	51	51
1491+	1491+	44	56	46	46	50	51	51
1497+	1497+	44	56	46	46	50	51	51
1503+	1503+	44	56	46	46	50	51	51
1509+	1509+	44	56	46	46	50	51	51
1515+	1515+	44	56	46	46	50	51	51
1521+	1521+	44	56	46	46	50	51	51
1527+	1527+	44	56	46	46	50	51	51
1533+	1533+	44	56	46	46	50	51	51
1539+	1539+	44	56	46	46	50	51	51
1545+	1545+	44	56	46	46	50	51	51
1551+	1551+	44	56	46	46	50	51	51
1557+	1557+	44	56	46	46	50	51	51
1563+	1563+	44	56	46	46	50	51	51
1569+	1569+	44	56	46	46	50	51	51
1575+	1575+	44	56	46	46	50	51	51
1581+	1581+	44	56	46	46	50	51	51
1587+	1587+	44	56	46	46	50	51	51
1593+	1593+	44	56	46	46	50	51	51
1599+	1599+	44	56	46	46	50	51	51
1605+	1605+	44	56	46	46	50	51	51
1611+	1611+	44	56	46	46	50	51	51
1617+	1617+	44	56	46				

## STEADY STATE EMISSIONS DATA SUMMARY ( 2 RUNS )

EM6-285

## TRANSIENT EMISSIONS DATA SUMMARY

EM6-285

	HOT RUNS (14)			COLD RUNS (5)			
	MEAN	STD DEV	C.O.V.*		MEAN	STD DEV	C.O.V.*
BSNOx	7.456	.143	1.91%		7.234	.103	1.42%
BSHC	.737	.058	7.98%		.881	.080	9.07%
BSCO	1.657	.082	4.95%		2.194	.066	3.01%
BSCO (CORR) +	1.685	.046	2.73%		2.252	.082	3.63%
BSPT	.644	.022	3.46%		.693	.057	8.16%
BSPT (CORR) +	.655	.026	4.08%		.711	.062	8.69%
BSCO2	622.2	6.7	1.07%		652.1	4.6	.71%
HP-hr	19.54	.08	.42%		19.48	.10	.51%
BSFC	.4336	.0047	1.08%		.4552	.0030	.67%



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
ANN ARBOR, MICHIGAN 48105

SEP 12 1986

OFFICE OF  
AIR AND RADIATION

MEMORANDUM

SUBJECT: Mack Correlation Engine Testing Plan

FROM: Thomas Baines, Heavy-Duty Programs Coordinator  
Standards Development and Support Branch *(Signature)*

TO: Charles L. Gray, Jr., Director  
Emission Control Technology Division

THRU: Chester J. France, Chief  
Standards Development and Support Branch *(Signature)*

1. Introduction: The Selective Enforcement Audit (SEA) group in OMS/MOD places a very high importance on correlation data between a manufacturers' SEA heavy-duty cell and the EPA/MVEL heavy-duty testing cell. Thus, they have requested that EPA test an engine from Mack to correlate the testing facilities at both laboratories. The testing of the Mack engine is of great importance to Mack in that they will use this engine as a calibration engine for their test cells. This test plan is for the testing of this engine.

2. Objective: The objective of this work is to test the Mack engine for correlation purposes and supply the data to MOD/SEA and Mack.

3. Project Scope of Work:

Work Description

Set restrictions

Check power @ WOT, rated & peak torque rpm

Map engine

One Hot Start transient for cycle performance and data  
to compare to engine history

Natural cool

1 C/S, 3 H/S

rated RPM, WOT, check restrictions

Natural Cool  
1 C/S, 3 H/S  
rated RPM, WOT, check restrictions  
Natural Cool  
1 C/S, 3 H/S  
rated RPM, WOT, check restrictions  
Steady states - To be determined

Test data taken: All usual emissions and performance.

4. Output: Report memo transmitting data to MOD.

5. Timing: The engine will arrive at our facility in mid-September. The engine should be tested in the most convenient time slot. It is suggested that it be tested after the JAMA round robin engine has been completed.

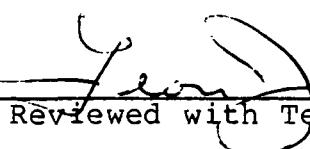
6. Level of Effort: technicians 100 hours, engineering 20 hours.

7. Additional Comments: The project area for this work should be "SEA + HD recall."

8. Review/Approval:

Review:

Lee Jones

  
Reviewed with Technicians?

Date

9-10-86

Approval:

Charles L. Gray, Jr.



Date 9-13

Priority

