EPA-AA-SDSB-87-3

Technical Report

Heavy-Duty Engine Testing Report

Correlation Testing of Caterpillar 3208 DIT

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 Caterpillar 3208 DIT engine with the intent of providing correlation data for comparison with similar data developed by Caterpillar. 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 Caterpillar, Inc. specifically for this correlation testing. It was a 240 horsepower, turbocharged, eight cylinder ("V" configuration) HD diesel. The rated speed of the engine was 2200 RPM and the peak torque occurred at 1500 RPM.

The fuel used was a Phillips Reference DF2 known as lot G-075. 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 by deenergizing the fuel solenoid and simultaneous dynamometer dial-down. The restrictions were set at an inlet depression of 20.0 inches water and an exhaust backpressure of 3.0 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) one cold start and three hot starts, b) check restrictions and c) natural cool down. Emissions during four steady state modes were also taken.

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 highlights 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 Caterpillar mapping

resulted in more torque, which made the Caterpillar integrated horsepower results about 4 percent higher than those of EPA.

Table 2 presents the EPA lab's composite cold start/hot start data which are the "certification" type results for this engine. In comparing the EPA data with that from Caterpillar Cell 224, good correlation is seen for CO, NOx and BSFC. Caterpillar's HC is somewhat high, but this may represent normal engine variability. Caterpillar's particulate value seems to be somewhat lower than that of EPA. In reviewing the comparison between EPA and Caterpillar's Cell 218, there is good correlation for HC, CO and NOx but poor correlation on particulate and BSFC.

Table 3 presents the cold start results. In comparing the results from EPA with those from Cell 224 for CO, and NOx, there is good correlation. The Cell 224 data trends towards higher HC and BSFC while particulate trends lower. In Cell 218, the HC is lower as well as BSFC. Particulate is significantly lower.

Table 4 presents the hot start data. Again, in Cell 224 there is generally good agreement between the Caterpillar and EPA data with the exception of the particulate results, where Caterpillar's data are about 14 percent lower than that of EPA. In looking at the results from Caterpillar's Cell 218, there is good correlation with HC, CO and NOx but poor correlation with particulate and BSFC. Table 5 presents steady state data taken at EPA. Caterpillar did not supply comparable steady state data for comparison.

IV. Conclusions

The following conclusions can be drawn from this work:

- There was a lack of agreement between the two labs with regards to their lug map and associated reference brake horsepower integration, the source of which is unknown. However, such differences can lead to emissions differences.

- There is generally good agreement between the labs on CO and NOx. Hydrocarbon agreement is marginal but may be within engine variability.

- There is an unexplained difference in particulate results between the two labs, with Caterpillar results being lower than EPA's. Caterpillar Cell 218 particulate results are 20 to 26 percent lower than those of EPA.

- BSFC correlation is quite close between EPA and Caterpillar for Cell 224 but is quite poor for Cell 218. Within the two Caterpillar test cells there is a significant lack of correlation on this important engine performance indicator.

Table 1

Table of Engine Performance Data
From Testing of the
Caterpillar 3208DIT Correlation Engine

Lab	Curb Idle, RPM	Max HP, BHP	Measured Rated Spd. RPM	Max. Torque Pt. Speed, RPM	Max. Torque Pt. Torque, ft.-lb.	Integrated Reference Horsepower, BHP
EPA	650	240	2157	1468	695.6	15.920
CAT Cell 218	580	248	2188	1445	717.4	16.555
CAT Cell 224	575	244	2181	1275	721.0	16.56

Table 2

Table of Composite Transient Test Results
from the Caterpillar 3208DIT Correlation Engine

Lab	Composite Transient Emissions, g/BHP-hr.** HC	CO	NOx	Part.	**BSFC, lb./BHP-hr.
EPA	0.51	1.67	5.13	0.41	0.396
	0.49	1.75	5.36	0.47	0.418
mean	0.50	1.71	5.25	0.44	0.407
Caterpillar Cell 224					
mean	0.56	1.72	5.53	0.39	0.411
% diff.*	12.0	0.6	5.3	-11.4	1.0
Cell 218					
mean	0.51	1.63	5.36	0.35	0.387
% diff.*	2.0	-4.7	2.1	-20.4	-4.91

* relative to EPA
** The EPA tests numbers were 3020 plus 3021 and 3024 plus 3025, respectively

Table 3

Table of Cold Start Emission Results
from the Caterpillar 3208DIT
Correlation Engine

Test Facility	Test No.	Transient Emission, g/BHP-hr HC	CO	NOx	Part.	BSFC, lb/BHP-hr
EPA	3019	0.84	2.47	5.24	0.51	0.403
	3020	0.77	2.42	5.25	0.48	0.407
	3024	0.71	2.33	5.50	0.52	0.426
mean		0.77	2.41	5.33	0.50	0.412
cov %		8.45	2.94	2.76	4.16	2.983
Caterpillar						
Cell 224						
mean		0.84	2.49	5.62	0.47	0.430
% diff.*		9.1	3.3	5.4	-6.0	4.4
Cell 218						
mean		0.67	2.28	5.49	0.37	0.399
% diff.*		-13.0	-5.4	3.0	-26.0	-3.2

* relative to EPA

Table 4

Table of Hot Start Emission
Results from the Caterpillar
3208DIT Correlation Engine

Test Facility	Test No.	Transient Emissions, g/BHP-hr HC	CO	NOx	Part.	BSFC, lb/BHP-hr
EPA	3021	0.47	1.55	5.11	0.40	0.394
	3022	0.49	1.59	5.02	0.42	0.398
	3023	0.49	1.56	4.99	0.42	0.394
	3025	0.45	1.65	5.34	0.46	0.417
	3026	0.46	1.63	5.38	0.46	0.418
	3027	0.47	1.66	5.38	0.45	0.416
mean		0.47	1.61	5.20	0.44	0.406
cov %		3.41	2.90	3.54	5.71	2.949
Caterpillar						
Cell 224						
mean		0.51	1.56	5.49	0.38	0.409
% diff*		8.5	-3.1	5.6	-13.6	0.7
Cell 218						
mean		0.48	1.50	5.32	0.35	0.384
% diff.*		2.1	-6.8	2.3	-20.4	-5.4

* relative to EPA

Table 5

Table of Steady State Values from
Caterpillar 3208DIT Correlation Engine

Engine Speed, RPM	Engine Torque, ft-lb	Fuel Rate, lb/hr		Emissions, g/BHP-hr **			
		Measured	C. Bal.*	HC	CO	NOx	CO_2
2000	502.5	67.17	57.63	0.166	0.392	5.089	434.17
1501	653.0	65.77	64.02	0.099	1.287	4.742	493.49
1500	197.0	20.94	20.98	0.384	1.430	4.729	535.46
652	0.0	2.09	1.95	(19.92)	(46.63)	(44.84)	(2685.66)

* Carbon Balance

** The 600 RPM, 0 ft-lb (idle) mode emissions data are enclosed in parenthesis and are in g/hr.

Appendix

Table of Contents

EPA Torque Map - Table
Diesel Fuel Analysis Results (G-075)
Caterpillar Torque Map Cell 218 - Table
Caterpillar Torque Map Cell 224 - Table
Caterpillar Emissions Results
EPA Individual Emissions Test
  Summary Sheets
Caterpillar Communications
Engine Testing Plan

```
ENTER MANUFACTURES CODE (AAAA)
730

ENTER ENGINE NUMBER
CT3208TURBOCORR2

ENTER VERSION NUMBER (NN)
00

ENTER DATE AND TIME (MMDDYY HHMM)
0421186
    86 1513


No. OF ITEMS IN QUERY RESPONSE: 1
No. OF ITEMS IN DATA BANK: 3928
PERCENTAGE OF RESPONSE/TOTAL DATA BANK: 0.03%
TOTAL CPU TIME: 0.191 SEC.
TYPE "Y" IF YOU WANT INPUT TERMS INFORMATIONS: ? N


 ++++ INPUT CODES UNDER ALL QUESTION MARKS !
  TYPE FUEL GVRNR TRANS CHOKE
   S?R  D?G  Y?N   A?M   A?M
    R    D    Y     M     M

    R    D    Y     M     M

INPUT  SPECIFIED  RATED RPM   (XXXX.)  2200.

                                       2200.00

INPUT (CURB/LOW)  IDLE  RPM   (XXXX.)  650.

                                        650.00
DID YOU TYPE ALL VALUES CORRECTLY? (Y/N) (DEFLT=N): Y
```

P2-11 20% Bat. 3208T 3rd Eng
4/21/86 1513

```
 THERE  ARE ( 254 ) MAPPING DATA POINTS:
 554.  58.8  876. 473.6 1214. 681.6 1548. 687.2 1885. 637.2 2220. 563.6
 566. 260.4  885. 476.8 1222. 683.6 1556. 687.6 1893. 636.4 2226. 556.4
 569. 345.6  892. 479.6 1228. 684.8 1564. 685.6 1902. 634.4 2235. 550.4
 574. 363.2  902. 482.8 1236. 686.4 1572. 683.6 1909. 632.8 2243. 540.4
 580. 370.0  908. 485.6 1245. 687.6 1581. 681.6 1918. 630.8 2250. 534.0
 586. 374.4  916. 487.6 1253. 688.4 1588. 679.2 1924. 628.8 2258. 522.4
 594. 378.4  925. 490.4 1262. 689.2 1597. 678.0 1931. 628.0 2266. 502.8
 600. 381.6  932. 492.4 1268. 688.8 1604. 674.4 1939. 626.0 2274. 484.4
 606. 384.8  941. 494.0 1277. 689.2 1612. 668.0 1948. 624.8 2280. 462.8
 614. 388.8  949. 497.6 1285. 690.0 1620. 664.4 1957. 623.2 2286. 428.4
 622. 394.0  958. 500.0 1293. 690.4 1628. 660.4 1964. 622.4 2295. 391.2
 630. 397.2  965. 500.0 1301. 690.8 1637. 659.2 1971. 620.4 2302. 370.4
 638. 400.0  973. 498.8 1308. 691.6 1645. 655.6 1980. 618.4 2311. 354.4
 646. 401.2  981. 501.2 1317. 689.2 1653. 653.6 1988. 617.6 2318. 339.6
 654. 403.6  988. 503.6 1324. 689.2 1660. 651.2 1997. 616.8 2326. 314.0
 663. 407.2  996. 506.4 1332. 688.0 1667. 648.0 2005. 615.2 2334. 285.6
 669. 406.8 1004. 509.2 1341. 690.0 1677. 648.4 2011. 614.4 2341. 261.2
 677. 410.0 1013. 512.4 1349. 691.2 1684. 647.6 2020. 612.0 2350. 231.2
 686. 412.8 1021. 517.2 1356. 691.2 1692. 646.8 2027. 610.0 2358. 200.0
 694. 415.6 1029. 521.2 1365. 691.6 1699. 646.8 2036. 608.4 2365. 169.2
 702. 419.2 1037. 526.0 1372. 692.4 1709. 646.8 2044. 606.4 2372. 140.8
 709. 422.4 1046. 532.0 1380. 692.8 1716. 647.2 2052. 604.0 2380. 110.8
 718. 423.6 1053. 535.6 1388. 692.0 1725. 647.2 2060. 601.2 2388.  75.6
 726. 428.8 1062. 543.2 1396. 691.6 1733. 647.2 2068. 599.6 2396.  36.0
 733. 430.0 1069. 547.6 1404. 692.0 1742. 648.0 2076. 595.6 2402.   2.8
 741. 430.4 1078. 552.0 1412. 691.2 1748. 648.0 2083. 595.6 2410. -32.4
 749. 433.2 1085. 556.8 1421. 692.4 1756. 647.2 2092. 595.2 2417. -82.0
 758. 436.4 1092. 562.8 1429. 692.8 1765. 647.2 2099. 593.6 2425.-124.4
 765. 438.4 1102. 569.6 1435. 695.2 1772. 646.8 2108. 592.0 2435.-134.0
 774. 442.8 1111. 574.4 1444. 695.6 1781. 647.2 2115. 590.8 2444.-136.8
 781. 445.2 1118. 581.2 1454. 696.0 1788. 646.8 2124. 589.2 2453.-137.6
 790. 447.2 1126. 587.2 1460. 695.2 1795. 647.2 2132. 588.4 2463.-139.2
 797. 450.8 1134. 593.6 1468. 695.6 1804. 646.0 2140. 586.8 2473.-140.0
 805. 453.2 1141. 598.4 1477. 695.2 1813. 644.8 2147. 585.6 2480.-140.4
 813. 455.6 1150. 605.2 1484. 694.8 1820. 645.6 2156. 584.4 2489.-141.2
 821. 458.0 1157. 611.6 1493. 695.2 1827. 643.6 2163. 582.0 2497.-141.6
 829. 460.0 1165. 620.0 1500. 694.4 1836. 642.0 2171. 578.8 2507.-142.4
 837. 463.6 1174. 631.2 1509. 693.6 1844. 641.6 2180. 576.4 2515.-142.8
 844. 467.2 1181. 645.6 1517. 693.6 1853. 640.4 2187. 574.0 2523.-144.0
 853. 468.4 1190. 661.6 1524. 692.0 1860. 640.4 2196. 570.8 2532.-144.4
 860. 469.2 1200. 673.2 1532. 690.8 1869. 639.6 2204. 568.0 2540.-144.8
 868. 472.8 1206. 678.0 1540. 689.6 1877. 638.4 2211. 566.0 2546.-145.6
                                                            2551.-145.2
                                                            2552.-145.2
 <COMMENT>  MAX POWER: 239.9 HP   @ 2156. RPM.
 <COMMENT>  RATED SPEED: 2119. RPM.
 WANT A CALCOMP PLOT OF THE MAPPING CURVE? (Y/N), (DEFLT = N): N
```

ENGINEERING OPERATIONS DIVISION

Fuel Analysis Report

Type of Fuel: Diesel #2

Proposed Use('s): Diesel Testing - Certification, MOD, EF

Supplier: Phillips Chemical Co. Batch Number: DOT Reference Fuel, G-075

Quantity: 3,500 gallons Date of Delivery: 4-02-84

Sample Analyses

Date Sampled:	N/A	4-2-84	4-2-84
Source of Sample:	N/A	Tank 5	Tank 5
Date Tested:	3-23-84	4-3-84	4-17-84
Tested By:	Phillips	EOD	Chromaspec

Item	Method	Target	Measured Values			Comments
Distillation	ASTM D-86					
Init. Boiling Pt. (°F)		340-400	375	370	374	
5% Point (°F)				401	402	
10% " "		400-460	431	418	420	
20% " "		—		443	443	
30% " "		—		463	462	
40% " "		—		482	480	
50% " "		470-540	505	508	496	
60% " "		—		517	516	
70% " "		—		539	536	
80% " "		—		564	560	
90% " "		550-610	598	596	594	
95% " "		—		629	627	
End Point (°F)		580-660	653	648	650	
Sulfur (wt%)	ASTM D-1266	0.2-0.5	0.35	—	0.36	
Viscosity (CS)	ASTM D-445	2.0-3.2	2.52	—	2.09	
Flash Point °F	ASTM D-93	130 Min	162	—	164	
Aromatics, %	ASTM D-1319	27 Min	32.1	29.6	33.9	

Cetane Number	ASTM D-613	42 - 50	46.2	—	45.2	
Oxidation Stability(mg/100ml)	ASTM D-2274	1.5 Max	—	—	0.34	See Note
H_2O (Wt %)						
C/H Ratio			—	—		
API Gravity (API Units)	ASTM D-287	33 - 37	35.2	35.3	35.1	

FUEL HANDLING HISTORY

	Identification	Tank	Mixed Gal	Delivery Date	Batch #
Majority Batch	#2 Diesel Fuel	5	3500	4-02-84	G-075
Minority Batch	#2 Diesel Fuel		469	1-19-84	C-747

STATUS OF SUPPLY

Date	Location	Amount	Date	Location	Amount
4-02-84	Tank #5	3969			
4-16-84	Tank #5	3752			

NOTE: This is a DOD Standard for Diesel #2 (EPA has no specification).
Fuel contains 30 ptb of Dupont FOA # 11 antitoxidant to enhance stability.

```
DO YOU WANT TO RECALIBRATE TORQUE? (Y,N)          N
DO YOU WANT TO CALIBRATE THROTTLE POSITION? (Y,N)          Y
MOVE THROTTLE TO MIN. POSITION AND PRESS <RETURN>.
MOVE THROTTLE TO MAX. POSITION AND PRESS <RETURN>.

                          ----- MAX ----     ----- MIN ----
                          AVERAGE  NOISE     AVERAGE  NOISE
     THROTTLE POSITION     1036      1         46       1

DO YOU WANT TO RECALIBRATE THROTTLE POSITION? (Y,N)          N
DO YOU WANT TO CALIBRATE HYDRO-CARBONS? (Y,N)          N
DO YOU WANT TO CALIBRATE NOX? (Y,N)          N
DO YOU WANT TO CALIBRATE CO? (Y,N)          N
DO YOU WANT TO CALIBRATE CO2? (Y,N)          N
DO YOU WANT TO CALIBRATE SMOKE? (Y,N)          N
DO YOU WANT TO CALIBRATE FUEL FLOW? (Y,N)          N

                                   SLOPE          INTERCEPT
     SPEED (RPM)                  1.5408          6.1633
     TORQUE (N*M)                0.58371          3.8282
     THROTTLE POSITION (%)       0.10081         -4.6371
     HYDRO-CARBONS (PPM)         0.29304         0.87912
     NOX GAS (PPM)               0.57573          3.9029
     CO GAS (%)                  0.49734E-02     0.19494E-01
     CO2 GAS (%)                 0.48132E-02     0.98262E-02
     SMOKE (%OPACITY)           -0.48434E-01    -0.19374
     FUEL FLOW (LBS/HR)          0.48900E-01     0.19550

ENTER A COMMAND (LC TO LIST COMMANDS).          M

'MAP' DELETES PREVIOUS CYCLE DATA TO GET READY FOR A NEW TEST.
DO YOU WANT TO CHANGE YOUR COMMAND? (Y,N)          N

ENTER TEST DATE (DAY-MO-YR)          14-JAN-88
ENTER ENGINE TYPE                    3208T/240HP
ENTER ENGINE SERIAL NUMBER           2Z10423
ENTER CELL NUMBER                    218

PRESS <RETURN> WHEN THE ENGINE IS AT FREE IDLE SPEED.
MEASURED FREE IDLE SPEED IS    848.     RPM. IS IT OK? (Y,N)          Y
ENTER MINIMUM SPEED. (RPM)          550
ENTER MAXIMUM SPEED. (RPM)          2460
PRESS <RETURN> TO START RUNNING THE LUG MAP.

IF YOU WANT TO STOP THE RUN, ENTER 'S'.
DO YOU WANT A LISTING OF THE LUG MAP? (Y,N)          Y

     MINIMUM SPEED =    550.0       MAXIMUM SPEED =    2460.

     SPEED (RPM)  TORQUE (N*M)  POWER (BHP)
     -----------  -------------  -----------

        576.3        575.2         46.8
        576.3        577.5         46.7
        585.5        587.0         48.3
        591.7        585.2         48.6
        589.4        580.5         48.7
        607.1        593.4         50.6
        616.3        556.3         51.7
        624.0        607.4         53.2
        631.7        610.3         54.1
```

664.1	616.7	57.5
671.8	623.7	58.8
681.0	629.6	60.2
687.2	634.8	61.3
694.9	633.1	61.8
702.6	636.0	62.8
710.3	640.1	63.8
718.0	637.7	64.3
725.7	640.1	65.2
735.0	640.7	66.1
742.7	643.6	67.1
750.4	642.4	67.7
758.1	653.5	69.6
767.3	651.7	70.2
775.0	648.8	70.6
782.7	649.4	71.4
790.4	650.0	72.2
798.2	651.2	73.0
807.4	658.2	74.3
813.6	652.9	74.6
822.8	656.7	76.1
830.5	658.2	76.8
838.2	656.4	77.3
845.9	663.2	79.0
853.6	666.9	79.9
861.3	665.8	80.5
869.0	666.9	81.4
878.7	668.7	82.3
884.4	675.7	83.9
893.7	670.4	84.1
901.4	678.3	85.6
909.1	679.6	86.3
918.8	683.3	86.0
924.5	679.8	86.3
933.7	683.8	90.1
939.9	680.9	91.2
948.2	688.2	91.5
955.3	688.5	92.4
963.0	682.1	92.2
972.3	691.4	94.4
980.0	689.6	96.3
987.7	695.5	96.5
995.4	699.7	97.4
1003.1	700.8	99.7
1010.8	699.0	99.2
1020.0	701.9	100.5
1027.7	707.3	102.2
1035.4	718.3	104.4
1044.7	713.6	104.7
1050.9	720.3	106.3
1058.8	721.8	107.3
1066.3	724.7	109.5
1075.5	731.7	110.5
1083.2	735.2	111.8
1090.9	738.3	113.3
1097.1	743.7	114.9
1106.3	753.3	117.0
1112.5	752.7	117.6
1121.7	753.0	119.4
1127.9	772.0	122.3
1137.1	776.7	124.0
1146.4	783.3	127.0
1154.1	786.5	129.1
1161.8	808.2	131.9

1177.2	830.4	137.3
1186.4	842.0	140.3
1192.6	856.0	143.4
1200.3	868.9	146.5
1209.6	880.6	149.6
1217.3	888.7	151.9
1225.0	902.7	155.3
1232.7	911.5	157.8
1240.4	928.4	161.7
1248.1	945.9	165.8
1255.8	959.9	169.3
1263.5	961.7	170.6
1272.7	957.6	171.2
1280.4	961.1	172.8
1288.1	959.9	173.6
1295.8	962.9	175.2
1303.5	963.4	176.4
1312.8	969.3	178.7
1319.0	961.1	178.0
1328.2	965.2	180.0
1334.4	961.1	180.1
1343.6	961.1	181.3
1349.8	962.3	182.4
1359.0	934.6	184.1
1366.7	963.2	185.3
1374.4	964.6	186.2
1382.1	989.3	188.1
1388.8	964.0	188.2
1399.1	986.9	190.0
1406.8	993.4	190.3
1414.5	965.8	191.8
1422.2	989.9	193.7
1429.9	961.7	193.1
1439.1	969.3	195.9
1445.3	972.8	197.4
1456.1	965.8	197.5
1462.3	968.7	198.9
1470.0	966.3	199.6
1476.1	963.8	200.2
1483.8	962.9	200.6
1491.5	961.7	201.4
1500.8	986.9	203.8
1508.5	962.9	204.0
1519.2	963.4	205.1
1525.4	961.7	206.0
1533.1	954.1	205.4
1540.8	957.0	207.1
1550.1	955.3	207.9
1556.2	954.7	208.3
1563.9	955.3	209.8
1573.2	945.3	209.9
1580.9	945.9	210.0
1587.1	940.7	209.7
1596.3	933.1	209.2
1604.0	920.9	207.4
1611.7	919.1	208.0
1619.4	920.2	209.3
1627.1	920.2	210.3
1634.8	903.9	207.5
1642.5	906.3	209.2
1651.8	902.2	209.3
1661.0	901.6	210.3
1667.2	897.5	210.1
1674.9	896.9	211.0

[illegible]	[illegible]	[illegible]
1705.7	896.9	214.8
1715.0	896.9	216.0
1722.7	892.2	215.8
1728.8	896.3	217.6
1736.1	896.3	218.8
1745.8	890.5	218.3
1753.5	897.5	221.0
1761.2	896.3	221.7
1768.9	888.7	220.8
1778.1	894.0	223.2
1785.8	895.2	224.5
1793.5	883.4	225.0
1801.2	894.6	226.3
1810.5	885.2	227.6
1818.2	889.9	227.2
1825.9	889.3	228.0
1833.6	895.2	230.5
1838.8	884.1	228.4
1847.5	880.6	228.5
1856.7	884.6	230.7
1864.4	884.1	231.5
1872.1	[illegible]	[illegible]
1879.8	885.2	233.7
1887.5	882.9	234.0
1895.2	878.2	233.7
1904.5	875.3	234.1
1912.2	878.8	236.0
1919.8	870.1	234.6
1929.1	872.4	236.3
1935.3	869.5	236.3
1944.5	873.6	238.5
1950.7	868.8	238.0
1958.4	871.2	239.3
1967.8	862.5	238.3
1975.4	861.8	238.1
1983.1	862.5	240.2
1990.8	861.9	241.0
1998.9	860.1	241.2
2006.2	854.5	240.6
2013.9	856.6	242.3
2021.9	853.1	242.2
2030.8	849.6	242.3
2038.5	844.4	241.7
2046.2	838.5	241.0
2055.5	837.9	241.9
2061.3	829.2	240.1
2068.3	827.4	243.3
2077.0	823.9	243.2
2086.3	823.9	244.3
2092.5	823.8	245.0
2101.7	832.1	245.6
2107.9	830.4	245.8
2117.1	825.7	245.5
2123.3	818.7	244.1
2132.5	815.7	245.2
2140.2	816.1	245.9
2147.9	815.2	245.9
2157.2	810.5	245.5
2164.8	812.3	246.9
2172.6	804.7	245.5
2178.7	798.8	244.4
2188.0	805.8	247.3
2195.7	797.7	246.0

2226.5	779.6	243.8
2234.2	770.2	241.7
2241.9	755.6	237.9
2249.6	742.8	234.7
2257.3	725.3	229.9
2265.0	699.6	222.5
2272.7	678.6	216.6
2280.4	633.1	202.7
2289.7	591.6	190.2
2297.4	536.2	173.0
2305.1	508.7	164.7
2312.8	487.1	158.2
2320.5	459.1	149.6
2326.7	427.0	139.5
2335.9	394.3	129.4
2342.1	361.1	118.8
2351.3	326.6	107.8
2357.5	268.8	88.0
2366.7	225.1	74.8
2372.9	189.4	63.1
2382.1	141.5	47.4
2388.3	92.6	31.0
2396.0	40.6	13.7
2406.8	-23.0	-7.8
2414.5	-89.6	-30.4
2419.1	-169.5	-57.6
2429.9	-173.6	-59.2
2431.4	-177.7	-60.7
2429.9	-168.4	-57.5
2428.4	-172.5	-58.8
2431.4	-166.0	-56.7
2429.9	-177.1	-60.4

```
IS THE LUG MAP VALID ACCORDING TO EPA SPECIFICATIONS? (Y,N)        Y
ENTER THE MEASURED RATED SPEED. (RPM)        2200

ENTER A COMMAND (LC TO LIST COMMANDS).        T

AUTOMATED OR MANUAL EMISSIONS (A,M)?          M


ENTER TEST DATE (DAY-MO-YR)          14-JAN-86
ENTER ENGINE TYPE                    320ST/240HP
ENTER ENGINE SERIAL NUMBER           2Z10423
ENTER RUN NUMBER                     PRAT@218
ENTER CELL NUMBER                    218

CLOSED RACK ADJUSTMENT OPTIONS:
1 = NO MODIFICATION OF LAST CLOSED RACK VALUE
2 = SET TO "NEXT POINT"
3 = SET TO "ZERO"
4 = SET TO "NEXT POINT/2"
ENTER CLOSED RACK ADJUSTMENT OPTION (1,2,3,4): 2
USE FREE IDLE INSTEAD OF LOW IDLE? (Y,N)        Y
ENTER THE SPEED CONTROL TIME LAG. (SECONDS)        .2
ENTER THE TORQUE CONTROL TIME LAG. (SECONDS)        .1
PRESS <RETURN> TO START SAMPLING HYDRO-CARBONS
PRESS <RETURN> TO START CYCLE

IF YOU WANT TO STOP THE RUN, ENTER 'S'.
```

'MAP' DELETES PREVIOUS CYCLE DATA TO GET READY FOR A NEW TEST.
DO YOU WANT TO CHANGE YOUR COMMAND? (Y,N) N

ENTER TEST DATE (DAY-MO-YR) 03-DEC-85
ENTER ENGINE TYPE 3208T/240HP
ENTER ENGINE SERIAL NUMBER 2Z10423/1A7309
ENTER CELL NUMBER 224

PRESS <RETURN> WHEN THE ENGINE IS AT FREE IDLE SPEED.
MEASURED FREE IDLE SPEED IS 635. RPM. IS IT OK? (Y,N) Y
ENTER MINIMUM SPEED. (RPM) 575
ENTER MAXIMUM SPEED. (RPM) 2475
PRESS <RETURN> TO START RUNNING THE LUG MAP.

IF YOU WANT TO STOP THE RUN, ENTER 'S'.
DO YOU WANT A LISTING OF THE LUG MAP? (Y,N) Y

MINIMUM SPEED = 575.0 MAXIMUM SPEED = 2475.

SPEED (RPM)	TORQUE (N*M)	POWER (BHP)
579.3	587.9	46.2
580.8	573.3	46.8
583.7	563.4	46.7
595.6	583.6	48.9
603.0	591.1	49.2
610.3	599.0	50.2
618.2	592.3	51.3
626.3	597.5	51.7
634.0	601.7	53.9
641.4	602.7	54.3
650.2	614.9	55.2
657.6	618.8	57.2
662.0	623.7	58.3
673.8	630.6	59.7
681.3	630.6	60.6
680.2	639.3	62.0
697.5	637.9	62.5
706.4	638.4	63.4
713.6	642.3	64.4
721.2	652.6	65.1
728.6	651.1	66.6
737.4	661.4	65.5
744.8	658.0	68.6
752.2	659.5	69.7
761.1	660.9	70.8
768.5	663.3	72.1
775.8	667.3	72.8
784.7	673.5	74.2
792.1	657.3	74.2
801.0	668.2	75.3
808.4	674.5	76.6
815.8	672.2	77.0
822.2	673.1	78.4
832.0	676.7	79.1
839.4	680.0	80.2
848.3	682.0	81.2
854.2	682.0	81.8
863.1	681.0	82.5
870.4	680.4	83.9

895.6	689.8	86.8
903.0	689.3	87.4
910.3	686.4	87.7
919.2	688.3	89.9
928.1	687.8	89.6
935.5	691.3	90.8
942.9	698.1	92.4
951.7	694.7	92.8
959.1	699.6	94.1
966.5	707.4	96.0
975.4	707.9	97.0
981.3	719.2	98.0
990.2	725.5	100.9
997.5	728.0	101.7
1006.4	733.9	103.7
1013.8	740.2	105.4
1021.2	746.6	107.1
1028.6	746.6	107.8
1036.0	757.9	110.3
1046.3	765.2	112.4
1053.7	772.9	115.0
1061.1	784.3	118.9
1068.5	793.1	118.0
1072.8	805.3	122.0
1086.2	812.2	123.9
1093.6	820.0	125.9
1101.0	823.9	127.4
1109.9	834.2	130.0
1117.2	845.5	132.7
1124.6	851.4	134.5
1132.0	860.7	136.9
1139.4	873.6	138.6
1148.9	885.6	140.0
1155.7	885.8	145.4
1164.5	908.6	148.6
1170.4	923.3	152.2
1180.9	928.0	155.5
1188.2	851.7	156.9
1195.6	933.4	162.3
1204.4	938.3	164.0
1211.8	970.8	165.2
1218.2	975.7	167.1
1228.1	971.3	167.5
1235.5	972.3	168.7
1241.4	974.7	168.8
1251.7	972.3	170.9
1258.1	977.2	172.8
1268.5	978.7	173.7
1275.4	977.7	175.1
1281.3	972.3	174.9
1290.2	973.2	176.3
1298.0	975.2	177.3
1306.4	979.7	178.2
1315.3	973.2	178.9
1322.7	973.2	180.5
1330.1	974.7	182.1
1337.4	979.2	182.2
1348.8	973.2	184.0
1352.2	971.9	184.5
1361.1	974.2	186.2
1368.5	986.4	185.7
1377.2	972.3	188.2
1384.7	973.7	189.4
1392.1	973.2	190.2

1414.3	972.3	193.1
1426.1	971.3	194.5
1432.0	972.3	195.5
1440.9	973.2	196.9
1448.3	971.8	197.6
1457.1	972.9	199.1
1464.5	970.3	199.6
1471.9	971.8	200.9
1479.3	971.3	201.8
1488.2	969.8	202.7
1495.6	967.4	203.2
1503.0	964.9	203.7
1510.3	967.4	205.2
1519.2	967.9	206.5
1526.6	963.9	206.7
1535.5	963.9	207.9
1542.9	958.1	207.6
1551.7	957.1	208.9
1559.1	946.3	207.2
1566.5	943.9	207.9
1573.9	943.9	208.6
1582.8	943.9	209.9
1590.2	939.5	209.9
1598.0	943.4	211.3
1606.4	934.6	210.9
1613.9	932.6	211.6
1621.2	921.4	206.8
1630.1	925.8	211.8
1637.4	921.4	211.3
1644.8	912.5	210.3
1653.7	910.6	211.5
1661.1	906.7	211.5
1668.5	900.3	210.9
1677.3	959.3	211.9
1685.2	889.3	213.0
1692.1	895.4	212.9
1702.5	892.5	213.4
1709.9	898.9	215.4
1717.2	895.4	215.9
1726.1	896.9	217.4
1733.5	897.4	218.5
1740.8	895.9	219.0
1749.6	893.5	218.5
1755.7	895.9	220.9
1762.1	892.0	221.1
1771.9	899.9	223.2
1780.8	887.8	224.5
1788.2	881.5	223.9
1795.6	884.4	223.5
1804.4	881.5	225.9
1813.3	892.5	227.6
1820.7	889.5	227.4
1828.1	892.0	229.0
1837.0	881.5	230.0
1844.3	880.0	230.0
1850.3	888.5	230.4
1859.1	887.3	231.7
1869.5	887.3	232.6
1875.4	899.6	233.5
1881.3	883.7	233.5
1890.2	884.2	234.7
1898.0	885.1	235.0
1906.4	834.6	236.9
1913.3	878.7	236.4

1938.9	874.4	238.1
1944.8	876.3	239.3
1953.7	874.4	239.9
1961.1	869.5	239.4
1968.5	866.5	239.5
1977.3	867.5	240.9
1984.7	860.7	239.9
1992.1	864.1	241.7
2001.0	855.8	240.5
2009.9	853.3	241.4
2015.8	854.8	242.0
2024.6	853.3	242.6
2032.0	852.3	243.2
2039.4	843.5	241.6
2046.8	839.1	240.9
2055.7	833.7	240.7
2064.5	830.8	240.9
2073.4	830.3	241.8
2080.8	830.3	242.6
2088.2	823.9	241.6
2095.6	822.0	241.8
2103.0	816.1	241.0
2111.8	818.1	242.6
2119.2	817.1	243.2
2126.6	804.4	240.2
2134.0	807.3	241.8
2142.9	802.9	241.6
2151.7	802.4	242.5
2157.6	802.8	243.3
2165.0	798.5	242.9
2173.8	787.0	243.3
2182.8	785.1	243.7
2191.6	791.6	246.6
2197.5	784.3	242.0
2206.4	778.4	241.2
2213.8	773.0	240.3
2222.7	782.3	237.8
2230.1	765.7	238.9
2238.9	751.0	233.1
2244.8	734.4	231.5
2252.7	730.4	231.2
2261.1	711.8	228.0
2268.5	683.9	217.8
2275.9	658.0	209.7
2283.3	618.3	188.3
2280.8	552.2	177.5
2293.5	513.6	165.9
2302.8	484.5	160.4
2317.2	478.8	155.2
2323.2	448.0	148.5
2330.6	407.8	133.5
2338.4	370.1	121.6
2348.8	335.4	110.5
2354.2	291.8	93.5
2361.6	243.8	81.5
2369.0	206.1	69.6
2376.4	172.8	58.0
2383.8	123.2	41.5
2392.6	67.1	22.5
2400.0	18.2	5.5
2407.4	-32.8	-11.1
2414.8	-90.0	-30.5
2422.2	-172.8	-58.8
2434.0	-177.7	-60.7

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        2448.8          -181.1          -62.3
        2448.8          -181.1          -62.3
        2448.8          -182.1          -62.6
        2451.7          -182.6          -62.9
        2448.8          -182.3          -62.8

IS THE LUG MAP VALID ACCORDING TO EPA SPECIFICATIONS? (Y,N)          Y
ENTER THE MEASURED RATED SPEED. (RPM)          2200

ENTER A COMMAND (LC TO LIST COMMANDS).          T

ENTER TEST DATE (DAY-MO-YR)          03-DEC-85
ENTER ENGINE TYPE                    3208T/240
ENTER ENGINE SERIAL NUMBER           147308/2Z10423
ENTER RUN NUMBER                     PRAT#1
ENTER CELL NUMBER                    224

CLOSED RACK ADJUSTMENT OPTIONS:
1 = NO MODIFICATION OF LAST CLOSED RACK VALUE
2 = SET TO "NEXT POINT"
3 = SET TO "ZERO"
4 = SET TO "NEXT POINT/2"
ENTER CLOSED RACK ADJUSTMENT OPTION (1,2,3,4): 2
USE FREE IDLE INSTEAD OF LOW IDLE? (Y,N)          Y
ENTER THE SPEED CONTROL TIME LAG. (SECONDS)          .2
ENTER THE TORQUE CONTROL TIME LAG. (SECONDS)          .1
PRESS <RETURN> TO START SAMPLING HYDRO-CARBONS
PRESS <RETURN> TO START CYCLE

IF YOU WANT TO STOP THE RUN, ENTER 'S'.          S
USER TERMINATED TEST CYCLE RUN

ENTER A COMMAND (LC TO LIST COMMANDS).          T

ENTER TEST DATE (DAY-MO-YR)          03-DEC-85
ENTER ENGINE TYPE                    3208T/240
ENTER ENGINE SERIAL NUMBER           1A2309/2Z10423
ENTER RUN NUMBER                     PRAT#1
ENTER CELL NUMBER                    224

CLOSED RACK ADJUSTMENT OPTIONS:
1 = NO MODIFICATION OF LAST CLOSED RACK VALUE
2 = SET TO "NEXT POINT"
3 = SET TO "ZERO"
4 = SET TO "NEXT POINT/2"
ENTER CLOSED RACK ADJUSTMENT OPTION (1,2,3,4): 2
USE FREE IDLE INSTEAD OF LOW IDLE? (Y,N)          Y
ENTER THE SPEED CONTROL TIME LAG. (SECONDS)          .2
ENTER THE TORQUE CONTROL TIME LAG. (SECONDS)          .1
PRESS <RETURN> TO START SAMPLING HYDRO-CARBONS
PRESS <RETURN> TO START CYCLE

IF YOU WANT TO STOP THE RUN, ENTER 'S'.
```

Results from Caterpillar Tractor Co. Testing of the 3208T correlation engine

		HC g/bhp hr	NOX g/bhp hr	CO g/bhp hr	CO2 g/bhp hr	PT g/bhp hr	BSFC lb/bhp hr	CYCLE WORK bhp-hr
CELL 212	1 COLD	0.853	5.579	2.456	601.41	0.438	0.408	15.52
	1 HOT	0.592	5.442	1.511	581.85	0.382	0.406	15.51
	2 HOT	0.566	5.432	1.478	576.91	0.364	0.403	15.51
	3 HOT	0.559	5.384	1.456	583.36	0.345	0.407	15.48
	4 HOT	0.553	5.314	1.413	574.16	0.352	0.401	15.42
	5 HOT	0.528	5.314	1.389	573.38	0.319	0.400	15.46
	1 COLD	0.830	5.622	2.381	595.75	0.422	0.417	15.67
	1 HOT	0.544	5.496	1.478	573.57	0.340	0.400	15.63
	2 HOT	0.558	5.424	1.501	573.19	0.360	0.400	15.62
	3 HOT	0.578	5.459	1.518	577.41	0.366	0.403	15.62
	4 HOT	0.556	5.428	1.498	577.41	0.367	0.402	15.63
CELL 223	1 COLD	0.803	5.374	2.485	586.92	0.439	0.411	15.83
	1 HOT	0.591	5.550	1.673	575.19	0.451	0.402	15.82
	2 HOT	0.592	5.621	1.634	570.87	0.419	0.399	15 81
	3 HOT	0.610	5.576	1.659	569.40	0.414	0.398	15.81
	1 COLD	0.832	5.538	2.368	584.66	0.404	0.409	15.81
	1 HOT	0.633	5.584	1.576	572.42	0.385	0.400	15.79
	2 HOT	0.641	5.543	1.584	569.68	0.402	0.398	15.79
	3 HOT	0.651	5.576	1.521	573.81	0.383	0.401	15.80
	1 COLD	0.809	5.501	2.528	578.17	0.413	0.405	15.94
	1 HOT	0.648	5.568	1.707	568.46	0.417	0.397	15.93
	2 HOT	0.649	5.546	1.630	572.22	0.440	0.400	15.94
	3 HOT	0.651	5.547	1.595	567.68	0.421	0.396	15.95
	1 COLD	0.659	5.529	1.750	569.53	0.440	0.406	15.95
	1 HOT	0.630	5.544	1.636	567.86	0.398	0.397	15.94
	2 HOT	0.606	5.596	1.597	566.27	0.393	0.396	15.95
	3 HOT	0.606	5.600	1.594	566.08	0.394	0.395	15.94
CELL 224	1 COLD	0.906	5.556	2.454	601.19	0.453	0.430	16.30
	1 HOT	0.519	5.492	1.616	593.06	0.356	0.412	16.28
	2 HOT	0 523	5.458	1.554	607.03	0.369	0.422	16.28
	3 HOT	0.499	5.450	1.529	580.76	0.357	0.404	16.27
	1 COLD	0.621	5.563	2.562	609.40	0.472	0.425	16.41
	1 HOT	0.510	5.458	1.570	571.09	0.374	0.397	16.35
	2 HOT	0.520	5.446	1.563	583.88	0.381	0.406	16.32
	3 HOT	0.504	5.476	1.553	577.63	0.383	0.402	16.31
	1 COLD	0.798	5.729	2.449	637.45	0.472	0.444	16.15
	1 HOT	0.533	5.589	1.584	590.67	0.384	0.411	16.05
	2 HOT	0.522	5.516	1.531	595.01	0.378	0.414	16.22
	3 HOT	0.498	5.548	1.496	589.66	0.378	0.410	16.17
CELL 218	1 COLD	0.655	5.444	2.267	566.29	0.365	0.394	16.02
	1 HOT	0.463	5.360	1.525	557.95	0.334	0.387	16.02
	2 HOT	0.471	5.323	1.475	555.46	0.342	0.386	16.03
	3 HOT	0.454	5.332	1.470	557.18	0.344	0.387	16.00
	1 COLD	0.648	5.531	2.319	573.19	0.352	0.403	15.97
	1 HOT	0.502	5.305	1.567	555.13	0.345	0.386	15 99
	2 HOT	0.467	5.284	1.485	551.49	0.323	0.383	15.98
	3 HOT	0.484	5.282	1.553	541.21	0.347	0.380	15.98
	1 COLD	0.697	5.503	2.238	573.96	0.398	0.400	16.06
	1 HOT	0.493	5.348	1.470	551.10	0.350	0.383	16.04
	2 HOT	0.506	5.317	1.510	555.06	0.369	0.386	16.03
	3 HOT	0.498	5.291	1.478	548.06	0.355	0.381	16.03

HEAVY DUTY DIESEL TRANSIENT ENGINE TEST DATE: 04-24-86 TIME: 09:31:55 HD-863019

DIESEL SUMMARY REPORT

TEST NUMBER: HD-863019 MANUFACTURER: CATERPILLAR
TEST DATE/TIME: 4-22-86 13:49 ENGINE ID: 730 CT3208TURBOCORR2 0

AMBIENT DATA

BAROMETER (DRY): 29.00 "HG
DRY BULB TEMPERATURE: 71.20 F
ABSOLUTE HUMIDITY: 45.61 GRAINS H20 / LB. DRY AIR

EMISSION RESULTS	CS	HS	WTD TEST
HC (INTEGRATED)			
BACKGROUND, PPM	3.93	0.00	
EXHAUST+BKG, GM	16.31	0.0	
NET, GM/BHP-HR	0.841	0.000	0.841
CO (BAG)			
BACKGROUND, PPM	0.00	0.00	
EXHAUST+BKG, GM	37.47	0.00	
NET, GM/BHP-HR	2.47	0.00	2.47
NOX (INTEGRATED)			
BACKGROUND, PPM	0.00	0.00	
EXHAUST+BKG, GM	85.60	0.0	
NET, GM/BHP-HR	5.238	0.000	5.238
CO2 (BAG)			
BACKGROUND, PPM	0.036	0.000	
EXHAUST+BKG, GM	9751.68	0.00	
NET, GM/BHP-HR	576.5	0.0	576.5
PARTICULATE			
SECONDARY TARE, GM	0.167000	0.000000	
SECONDARY PART, GM	0.167100	0.000000	
PRIMARY TARE, GM	0.165900	0.000000	
PRIMARY PART, GM	0.171500	0.000000	
TOTAL, GM/BHP-HR	0.51	0.00	0.51
FUEL CONSUMPTION			
LBS	6.12	0.00	6.12
LBS/BHP-HR	0.403	0.000	0.403
BRAKE HORSEPOWER-HOUR	15.182	0.000	15.182

CYCLE STATISTICS	CS	HS
SPEED		
NUMBER	1176	0
SLOPE	0.99700	0.00000
(LIMIT: 0.97-1.03)		
Y-INTERCEPT	4.531	0.000
(LIMIT: +-50 RPM)		
STD ERROR	17.968	0.000
(LIMIT: 100 RPM)		
R-SQUARE	0.99920	0.00000
(LIMIT: 0.97)		
TORQUE		
NUMBER	828	0
SLOPE	0.97425	0.00000
(LIMIT: 0.77/0.83-1.03)		
Y-INTERCEPT	-4.020	0.000
(LIMIT: +-15 FT-LBS)		
STD ERROR	6.055%	0.000%
(LIMIT: 13% MAX ENG TQ)		
R-SQUARE	0.94044	0.00000
(LIMIT: 0.85/0.88)		
POWER		
NUMBER	827	0
SLOPE	0.99046	0.00000
(LIMIT: 0.87/0.89-1.03)		
Y-INTERCEPT	-2.089	0.000
(LIMIT: +-5 BHP)		
STD ERROR	5.850%	0.000%
(LIMIT: 8%)		
R-SQUARE	0.94338	0.00000
(LIMIT: 0.91)		
WORK		
ACTUAL	15.182	0.000
(LIMIT: -15%-5% REF BHP-HR)		
REFERENCE	15.920	0.000
% DIFFERENCE	-4.64%	0.00%

DIESEL SUMMARY REPORT

TEST NUMBER: HD-863020 MANUFACTURER: CATERPILLAR
TEST DATE/TIME: 4-23-86 8: 1 ENGINE ID: 730 CT3208TURBOCORR2 0

AMBIENT DATA

BAROMETER (DRY): 29.20 "HG
DRY BULB TEMPERATURE: 73.20 F
ABSOLUTE HUMIDITY: 52.06 GRAINS H20 / LB. DRY AIR

EMISSION RESULTS	CS	HS	WTD TEST
HC (INTEGRATED)			
BACKGROUND, PPM	3.93	0.00	
EXHAUST+BKG, GM	15.17	0.0	
NET, GM/BHP-HR	0.766	0.000	0.766
CO (BAG)			
BACKGROUND, PPM	0.00	0.00	
EXHAUST+BKG, GM	36.66	0.00	
NET, GM/BHP-HR	2.42	0.00	2.42
NOX (INTEGRATED)			
BACKGROUND, PPM	0.99	0.00	
EXHAUST+BKG, GM	87.21	0.0	
NET, GM/BHP-HR	5.248	0.000	5.248
CO2 (BAG)			
BACKGROUND, PPM	0.038	0.000	
EXHAUST+BKG, GM	9870.58	0.00	
NET, GM/BHP-HR	581.9	0.0	581.9
PARTICULATE			
SECONDARY TARE, GM	0.164400	0.000000	
SECONDARY PART, GM	0.164400	0.000000	
PRIMARY TARE, GM	0.171300	0.000000	
PRIMARY PART, GM	0.176450	0.000000	
TOTAL, GM/BHP-HR	0.48	0.00	0.48
FUEL CONSUMPTION			
LBS	6.16	0.00	6.16
LBS/BHP-HR	0.407	0.000	0.407
BRAKE HORSEPOWER-HOUR	15.144	0.000	15.144

CYCLE STATISTICS	CS	HS
SPEED		
NUMBER	1176	0
SLOPE	0.99548	0.00000
(LIMIT: 0.97-1.03)		
Y-INTERCEPT	5.315	0.000
(LIMIT: +-50 RPM)		
STD ERROR	17.858	0.000
(LIMIT: 100 RPM)		
R-SQUARE	0.99921	0.00000
(LIMIT: 0.97)		
TORQUE		
NUMBER	817	0
SLOPE	0.98309	0.00000
(LIMIT: 0.77/0.83-1.03)		
Y-INTERCEPT	-7.235	0.000
(LIMIT: +-15 FT-LBS)		
STD ERROR	6.290%	0.000%
(LIMIT: 13% MAX ENG TQ)		
R-SQUARE	0.93848	0.00000
(LIMIT: 0.85/0.88)		
POWER		
NUMBER	816	0
SLOPE	0.99434	0.00000
(LIMIT: 0.87/0.89-1.03)		
Y-INTERCEPT	-2.543	0.000
(LIMIT: +-5 BHP)		
STD ERROR	6.159%	0.000%
(LIMIT: 8%)		
R-SQUARE	0.93943	0.00000
(LIMIT: 0.91)		
WORK		
ACTUAL	15.144	0.000
(LIMIT: -15%-5% REF BHP-HR)		
REFERENCE	15.920	0.000
% DIFFERENCE	-4.87%	0.00%

HEAVY DUTY DIESEL TRANSIENT ENGINE TEST

DIESEL SUMMARY REPORT

TEST NUMBER: HD-863021
TEST DATE/TIME: 4-23-86 8:52
MANUFACTURER: CATERPILLAR
ENGINE ID: 730 CT3208TURBOCORR2 0

AMBIENT DATA

BAROMETER (DRY): 29.20 "HG
DRY BULB TEMPERATURE: 73.80 F
ABSOLUTE HUMIDITY: 50.63 GRAINS H20 / LB. DRY AIR

EMISSION RESULTS	CS	HS	WTD TEST
HC (INTEGRATED)			
BACKGROUND, PPM	0.00	3.90	
EXHAUST+BKG, GM	0.00	10.70	
NET, GM/BHP-HR	0.000	0.474	0.474
CO (BAG)			
BACKGROUND, PPM	0.00	0.00	
EXHAUST+BKG, GM	0.00	23.40	
NET, GM/BHP-HR	0.00	1.55	1.55
NOX (INTEGRATED)			
BACKGROUND, PPM	0.00	0.49	
EXHAUST+BKG, GM	0.00	83.55	
NET, GM/BHP-HR	0.000	5.108	5.108
CO2 (BAG)			
BACKGROUND, PPM	0.000	0.037	
EXHAUST+BKG, GM	0.00	9582.04	
NET, GM/BHP-HR	0.0	565.8	565.8
PARTICULATE			
SECONDARY TARE, GM	0.000000	0.169600	
SECONDARY PART, GM	0.000000	0.169700	
PRIMARY TARE, GM	0.000000	0.171650	
PRIMARY PART, GM	0.000000	0.175900	
TOTAL, GM/BHP-HR	0.00	0.40	0.40
FUEL CONSUMPTION			
LBS	0.00	5.96	5.96
LBS/BHP-HR	0.000	0.394	0.394
BRAKE HORSEPOWER-HOUR	0.000	15.106	15.106

CYCLE STATISTICS	CS	HS
SPEED		
NUMBER	0	1176
SLOPE	0.00000	0.99553
(LIMIT: 0.97-1.03)		
Y-INTERCEPT	0.000	3.188
(LIMIT: +-50 RPM)		
STD ERROR	0.000	17.868
(LIMIT: 100 RPM)		
R-SQUARE	0.00000	0.99921
(LIMIT: 0.97)		
TORQUE		
NUMBER	0	822
SLOPE	0.00000	0.98404
(LIMIT: 0.77/0.83-1.03)		
Y-INTERCEPT	0.000	-8.431
(LIMIT: +-15 FT-LBS)		
STD ERROR	0.000%	6.037%
(LIMIT: 13% MAX ENG TQ)		
R-SQUARE	0.00000	0.94441
(LIMIT: 0.85/0.88)		
POWER		
NUMBER	0	821
SLOPE	0.00000	0.99143
(LIMIT: 0.87/0.89-1.03)		
Y-INTERCEPT	0.000	-2.688
(LIMIT: +-5 BHP)		
STD ERROR	0.000%	5.972%
(LIMIT: 8%)		
R-SQUARE	0.00000	0.94290
(LIMIT: 0.91)		
WORK		
ACTUAL	0.000	15.106
(LIMIT: -15%-5% REF BHP-HR)		
REFERENCE	0.000	15.920
% DIFFERENCE	0.00%	-5.11%

DIESEL SUMMARY REPORT

TEST NUMBER: HD-863022 MANUFACTURER: CATERPILLAR
TEST DATE/TIME: 4-23-86 10:25 ENGINE ID: 730 CT3208TURBOCORR2 0

AMBIENT DATA

BAROMETER (DRY): 29.30 "HG
DRY BULB TEMPERATURE: 74.40 F
ABSOLUTE HUMIDITY: 49.37 GRAINS H2O / LB. DRY AIR

EMISSION RESULTS	CS	HS	WTD TEST
HC (INTEGRATED)			
BACKGROUND, PPM	0.00	3.60	
EXHAUST+BKG, GM	0.00	10.73	
NET, GM/BHP-HR	0.000	0.492	0.492
CO (BAG)			
BACKGROUND, PPM	0.00	0.24	
EXHAUST+BKG, GM	0.00	24.52	
NET, GM/BHP-HR	0.00	1.59	1.59
NOX (INTEGRATED)			
BACKGROUND, PPM	0.00	0.49	
EXHAUST+BKG, GM	0.00	82.64	
NET, GM/BHP-HR	0.000	5.017	5.017
CO2 (BAG)			
BACKGROUND, PPM	0.000	0.038	
EXHAUST+BKG, GM	0.00	9762.18	
NET, GM/BHP-HR	0.0	571.5	571.5
PARTICULATE			
SECONDARY TARE, GM	0.000000	0.165900	
SECONDARY PART, GM	0.000000	0.165900	
PRIMARY TARE, GM	0.000000	0.160500	
PRIMARY PART, GM	0.000000	0.165050	
TOTAL, GM/BHP-HR	0.00	0.42	0.42
FUEL CONSUMPTION			
LBS	0.00	6.04	6.04
LBS/BHP-HR	0.000	0.398	0.398
BRAKE HORSEPOWER-HOUR	0.000	15.163	15.163

CYCLE STATISTICS	CS	HS
SPEED		
NUMBER	0	1176
SLOPE	0.00000	0.99587
(LIMIT: 0.97-1.03)		
Y-INTERCEPT	0.000	2.257
(LIMIT: +-50 RPM)		
STD ERROR	0.000	17.966
(LIMIT: 100 RPM)		
R-SQUARE	0.00000	0.99920
(LIMIT: 0.97)		
TORQUE		
NUMBER	0	827
SLOPE	0.00000	0.99044
(LIMIT: 0.77/0.83-1.03)		
Y-INTERCEPT	0.000	-7.363
(LIMIT: +-15 FT-LBS)		
STD ERROR	0.000%	5.758%
(LIMIT: 13% MAX ENG TQ)		
R-SQUARE	0.00000	0.95079
(LIMIT: 0.85/0.88)		
POWER		
NUMBER	0	826
SLOPE	0.00000	1.00209
(LIMIT: 0.87/0.89-1.03)		
Y-INTERCEPT	0.000	-2.524
(LIMIT: +-5 BHP)		
STD ERROR	0.000%	5.480%
(LIMIT: 8%)		
R-SQUARE	0.00000	0.95410
(LIMIT: 0.91)		
WORK		
ACTUAL	0.000	15.163
(LIMIT: -15%-5% REF BHP-HR)		
REFERENCE	0.000	15.920
% DIFFERENCE	0.00%	-4.76%

DIESEL SUMMARY REPORT

TEST NUMBER: HD-863023 MANUFACTURER: CATERPILLAR
TEST DATE/TIME: 4-23-86 11: 7 ENGINE ID: 730 CT3208TURBOCORR2 0

AMBIENT DATA

BAROMETER (DRY): 29.20 "HG
DRY BULB TEMPERATURE: 74.70 F
ABSOLUTE HUMIDITY: 51.33 GRAINS H20 / LB. DRY AIR

EMISSION RESULTS	CS	HS	WTD TEST
HC (INTEGRATED)			
BACKGROUND, PPM	0.00	3.45	
EXHAUST+BKG, GM	0.00	10.55	
NET, GM/BHP-HR	0.000	0.492	0.492
CO (BAG)			
BACKGROUND, PPM	0.00	0.48	
EXHAUST+BKG, GM	0.00	24.39	
NET, GM/BHP-HR	0.00	1.56	1.56
NOX (INTEGRATED)			
BACKGROUND, PPM	0.00	0.49	
EXHAUST+BKG, GM	0.00	81.32	
NET, GM/BHP-HR	0.000	4.988	4.988
CO2 (BAG)			
BACKGROUND, PPM	0.000	0.038	
EXHAUST+BKG, GM	0.00	9622.80	
NET, GM/BHP-HR	0.0	566.1	566.1
PARTICULATE			
SECONDARY TARE, GM	0.000000	0.154300	
SECONDARY PART, GM	0.000000	0.154300	
PRIMARY TARE, GM	0.000000	0.164500	
PRIMARY PART, GM	0.000000	0.168950	
TOTAL, GM/BHP-HR	0.00	0.42	0.42
FUEL CONSUMPTION			
LBS	0.00	5.95	5.95
LBS/BHP-HR	0.000	0.394	0.394
BRAKE HORSEPOWER-HOUR	0.000	15.077	15.077

CYCLE STATISTICS	CS	HS
SPEED		
NUMBER	0	1176
SLOPE	0.00000	0.99580
(LIMIT: 0.97-1.03)		
Y-INTERCEPT	0.000	1.931
(LIMIT: +-50 RPM)		
STD ERROR	0.000	17.852
(LIMIT: 100 RPM)		
R-SQUARE	0.00000	0.99921
(LIMIT: 0.97)		
TORQUE		
NUMBER	0	812
SLOPE	0.00000	0.98433
(LIMIT: 0.77/0.83-1.03)		
Y-INTERCEPT	0.000	-8.893
(LIMIT: +-15 FT-LBS)		
STD ERROR	0.000%	6.058%
(LIMIT: 13% MAX ENG TQ)		
R-SQUARE	0.00000	0.94282
(LIMIT: 0.85/0.88)		
POWER		
NUMBER	0	811
SLOPE	0.00000	0.99075
(LIMIT: 0.87/0.89-1.03)		
Y-INTERCEPT	0.000	-2.711
(LIMIT: +-5 BHP)		
STD ERROR	0.000%	5.999%
(LIMIT: 8%)		
R-SQUARE	0.00000	0.93994
(LIMIT: 0.91)		
WORK		
ACTUAL	0.000	15.077
(LIMIT: -15%-5% REF BHP-HR)		
REFERENCE	0.000	15.920
% DIFFERENCE	0.00%	-5.30%

DIESEL SUMMARY REPORT

TEST NUMBER: HD-863024 MANUFACTURER: CATERPILLAR
TEST DATE/TIME: 4-24-86 8:24 ENGINE ID: 730 CT3208TURBOCORR2 0

AMBIENT DATA

BAROMETER (DRY): 29.20 "HG
DRY BULB TEMPERATURE: 74.20 F
ABSOLUTE HUMIDITY: 49.09 GRAINS H20 / LB. DRY AIR

EMISSION RESULTS	CS	HS	WTD TEST
HC (INTEGRATED)			
BACKGROUND, PPM	4.68	0.00	
EXHAUST+BKG, GM	15.15	0.0	
NET, GM/BHP-HR	0.712	0.000	0.712
CO (BAG)			
BACKGROUND, PPM	0.00	0.00	
EXHAUST+BKG, GM	35.71	0.00	
NET, GM/BHP-HR	2.33	0.00	2.33
NOX (INTEGRATED)			
BACKGROUND, PPM	0.49	0.00	
EXHAUST+BKG, GM	91.39	0.0	
NET, GM/BHP-HR	5.499	0.000	5.499
CO2 (BAG)			
BACKGROUND, PPM	0.035	0.000	
EXHAUST+BKG, GM	10315.84	0.00	
NET, GM/BHP-HR	609.6	0.0	609.6
PARTICULATE			
SECONDARY TARE, GM	0.164900	0.000000	
SECONDARY PART, GM	0.165000	0.000000	
PRIMARY TARE, GM	0.165350	0.000000	
PRIMARY PART, GM	0.170950	0.000000	
TOTAL, GM/BHP-HR	0.52	0.00	0.52
FUEL CONSUMPTION			
LBS	6.52	0.00	6.52
LBS/BHP-HR	0.426	0.000	0.426
BRAKE HORSEPOWER-HOUR	15.316	0.000	15.316

CYCLE STATISTICS	CS	HS
SPEED		
NUMBER	1176	0
SLOPE	0.99624	0.00000
(LIMIT: 0.97-1.03)		
Y-INTERCEPT	3.104	0.000
(LIMIT: +-50 RPM)		
STD ERROR	17.900	0.000
(LIMIT: 100 RPM)		
R-SQUARE	0.99921	0.00000
(LIMIT: 0.97)		
TORQUE		
NUMBER	828	0
SLOPE	0.99442	0.00000
(LIMIT: 0.77/0.83-1.03)		
Y-INTERCEPT	-4.011	0.000
(LIMIT: +-15 FT-LBS)		
STD ERROR	5.676%	0.000%
(LIMIT: 13% MAX ENG TQ)		
R-SQUARE	0.95321	0.00000
(LIMIT: 0.85/0.88)		
POWER		
NUMBER	827	0
SLOPE	1.01022	0.00000
(LIMIT: 0.87/0.89-1.03)		
Y-INTERCEPT	-1.909	0.000
(LIMIT: +-5 BHP)		
STD ERROR	5.243%	0.000%
(LIMIT: 8%)		
R-SQUARE	0.96034	0.00000
(LIMIT: 0.91)		
WORK		
ACTUAL	15.316	0.000
(LIMIT: -15%-5% REF BHP-HR)		
REFERENCE	15.920	0.000
% DIFFERENCE	-3.79%	0.00%

DIESEL SUMMARY REPORT

TEST NUMBER: HD-863025 MANUFACTURER: CATERPILLAR
TEST DATE/TIME: 4-24-86 8:59 ENGINE ID: 730 CT3208TURBOCORR2 0

AMBIENT DATA

BAROMETER (DRY): 29.20 "HG
DRY BULB TEMPERATURE: 72.40 F
ABSOLUTE HUMIDITY: 49.91 GRAINS H20 / LB. DRY AIR

EMISSION RESULTS	CS	HS	WTD TEST
HC (INTEGRATED)			
BACKGROUND, PPM	0.00	3.97	
EXHAUST+BKG, GM	0.00	10.37	
NET, GM/BHP-HR	0.000	0.448	0.448
CO (BAG)			
BACKGROUND, PPM	0.00	0.00	
EXHAUST+BKG, GM	0.00	24.94	
NET, GM/BHP-HR	0.00	1.65	1.65
NOX (INTEGRATED)			
BACKGROUND, PPM	0.00	0.00	
EXHAUST+BKG, GM	0.00	86.02	
NET, GM/BHP-HR	0.000	5.337	5.337
CO2 (BAG)			
BACKGROUND, PPM	0.000	0.035	
EXHAUST+BKG, GM	0.00	10034.50	
NET, GM/BHP-HR	0.0	598.7	598.7
PARTICULATE			
SECONDARY TARE, GM	0.000000	0.166950	
SECONDARY PART, GM	0.000000	0.167000	
PRIMARY TARE, GM	0.000000	0.164300	
PRIMARY PART, GM	0.000000	0.169200	
TOTAL, GM/BHP-HR	0.00	0.46	0.46
FUEL CONSUMPTION			
LBS	0.00	6.31	6.31
LBS/BHP-HR	0.000	0.417	0.417
BRAKE HORSEPOWER-HOUR	0.000	15.131	15.131

CYCLE STATISTICS	CS	HS
SPEED		
NUMBER	0	1176
SLOPE	0.00000	0.99582
(LIMIT: 0.97-1.03)		
Y-INTERCEPT	0.000	-3.197
(LIMIT: +-50 RPM)		
STD ERROR	0.000	17.861
(LIMIT: 100 RPM)		
R-SQUARE	0.00000	0.99921
(LIMIT: 0.97)		
TORQUE		
NUMBER	0	809
SLOPE	0.00000	0.99191
(LIMIT: 0.77/0.83-1.03)		
Y-INTERCEPT	0.000	-6.671
(LIMIT: +-15 FT-LBS)		
STD ERROR	0.000%	5.750%
(LIMIT: 13% MAX ENG TQ)		
R-SQUARE	0.00000	0.95073
(LIMIT: 0.85/0.88)		
POWER		
NUMBER	0	808
SLOPE	0.00000	1.00294
(LIMIT: 0.87/0.89-1.03)		
Y-INTERCEPT	0.000	-2.433
(LIMIT: +-5 BHP)		
STD ERROR	0.000%	5.420%
(LIMIT: 8%)		
R-SQUARE	0.00000	0.95435
(LIMIT: 0.91)		
WORK		
ACTUAL	0.000	15.131
(LIMIT: -15%-5% REF BHP-HR)		
REFERENCE	0.000	15.920
% DIFFERENCE	0.00%	-4.96%

DIESEL SUMMARY REPORT

TEST NUMBER: HD-863026 MANUFACTURER: CATERPILLAR
TEST DATE/TIME: 4-24-86 9:39 ENGINE ID: 730 CT3208TURBOCORR2 0

AMBIENT DATA

BAROMETER (DRY): 29.20 "HG
DRY BULB TEMPERATURE: 73.80 F
ABSOLUTE HUMIDITY: 49.32 GRAINS H20 / LB. DRY AIR

EMISSION RESULTS	CS	HS	WTD TEST
HC (INTEGRATED)			
BACKGROUND, PPM	0.00	3.75	
EXHAUST+BKG, GM	0.00	10.35	
NET, GM/BHP-HR	0.000	0.462	0.462
CO (BAG)			
BACKGROUND, PPM	0.00	0.00	
EXHAUST+BKG, GM	0.00	24.60	
NET, GM/BHP-HR	0.00	1.63	1.63
NOX (INTEGRATED)			
BACKGROUND, PPM	0.00	0.00	
EXHAUST+BKG, GM	0.00	86.44	
NET, GM/BHP-HR	0.000	5.377	5.377
CO2 (BAG)			
BACKGROUND, PPM	0.000	0.036	
EXHAUST+BKG, GM	0.00	10050.74	
NET, GM/BHP-HR	0.0	600.7	600.7
PARTICULATE			
SECONDARY TARE, GM	0.000000	0.154900	
SECONDARY PART, GM	0.000000	0.155000	
PRIMARY TARE, GM	0.000000	0.156000	
PRIMARY PART, GM	0.000000	0.160900	
TOTAL, GM/BHP-HR	0.00	0.46	0.46
FUEL CONSUMPTION			
LBS	0.00	6.30	6.30
LBS/BHP-HR	0.000	0.418	0.418
BRAKE HORSEPOWER-HOUR	0.000	15.069	15.069

CYCLE STATISTICS	CS	HS
SPEED		
NUMBER	0	1176
SLOPE	0.00000	0.99407
(LIMIT: 0.97-1.03)		
Y-INTERCEPT	0.000	-1.460
(LIMIT: +-50 RPM)		
STD ERROR	0.000	17.699
(LIMIT: 100 RPM)		
R-SQUARE	0.00000	0.99922
(LIMIT: 0.97)		
TORQUE		
NUMBER	0	817
SLOPE	0.00000	0.98947
(LIMIT: 0.77/0.83-1.03)		
Y-INTERCEPT	0.000	-7.809
(LIMIT: +-15 FT-LBS)		
STD ERROR	0.000%	5.748%
(LIMIT: 13% MAX ENG TQ)		
R-SQUARE	0.00000	0.95054
(LIMIT: 0.85/0.88)		
POWER		
NUMBER	0	816
SLOPE	0.00000	0.99682
(LIMIT: 0.87/0.89-1.03)		
Y-INTERCEPT	0.000	-2.522
(LIMIT: +-5 BHP)		
STD ERROR	0.000%	5.408%
(LIMIT: 8%)		
R-SQUARE	0.00000	0.95427
(LIMIT: 0.91)		
WORK		
ACTUAL	0.000	15.069
(LIMIT: -15%-5% REF BHP-HR)		
REFERENCE	0.000	15.920
% DIFFERENCE	0.00%	-5.35%

HEAVY DUTY DIESEL TRANSIENT ENGINE TEST DATE: 04-25-86 TIME: 09:59:09 HD-863027

DIESEL SUMMARY REPORT

TEST NUMBER: HD-863027 MANUFACTURER: CATERPILLAR
TEST DATE/TIME: 4-24-86 10:20 ENGINE ID: 730 CT3208TURBOCORR2 0

AMBIENT DATA

BAROMETER (DRY): 29.20 "HG
DRY BULB TEMPERATURE: 75.10 F
ABSOLUTE HUMIDITY: 47.60 GRAINS H20 / LB. DRY AIR

EMISSION RESULTS	CS	HS	WTD TEST
HC (INTEGRATED)			
BACKGROUND, PPM	0.00	3.52	
EXHAUST+BKG, GM	0.00	10.32	
NET, GM/BHP-HR	0.000	0.474	0.474
CO (BAG)			
BACKGROUND, PPM	0.00	0.00	
EXHAUST+BKG, GM	0.00	24.92	
NET, GM/BHP-HR	0.00	1.66	1.66
NOX (INTEGRATED)			
BACKGROUND, PPM	0.00	0.00	
EXHAUST+BKG, GM	0.00	86.68	
NET, GM/BHP-HR	0.000	5.383	5.383
CO2 (BAG)			
BACKGROUND, PPM	0.000	0.036	
EXHAUST+BKG, GM	0.00	9986.92	
NET, GM/BHP-HR	0.0	597.5	597.5
PARTICULATE			
SECONDARY TARE, GM	0.000000	0.156700	
SECONDARY PART, GM	0.000000	0.156800	
PRIMARY TARE, GM	0.000000	0.154500	
PRIMARY PART, GM	0.000000	0.159300	
TOTAL, GM/BHP-HR	0.00	0.45	0.45
FUEL CONSUMPTION			
LBS	0.00	6.26	6.26
LBS/BHP-HR	0.000	0.416	0.416
BRAKE HORSEPOWER-HOUR	0.000	15.032	15.032

CYCLE STATISTICS	CS	HS
SPEED		
NUMBER	0	1176
SLOPE	0.00000	0.99599
(LIMIT: 0.97-1.03)		
Y-INTERCEPT	0.000	-4.731
(LIMIT: +-50 RPM)		
STD ERROR	0.000	17.828
(LIMIT: 100 RPM)		
R-SQUARE	0.00000	0.99921
(LIMIT: 0.97)		
TORQUE		
NUMBER	0	798
SLOPE	0.00000	0.98299
(LIMIT: 0.77/0.83-1.03)		
Y-INTERCEPT	0.000	-8.118
(LIMIT: +-15 FT-LBS)		
STD ERROR	0.000%	5.993%
(LIMIT: 13% MAX ENG TQ)		
R-SQUARE	0.00000	0.94259
(LIMIT: 0.85/0.88)		
POWER		
NUMBER	0	797
SLOPE	0.00000	0.98968
(LIMIT: 0.87/0.89-1.03)		
Y-INTERCEPT	0.000	-2.621
(LIMIT: +-5 BHP)		
STD ERROR	0.000%	5.712%
(LIMIT: 8%)		
R-SQUARE	0.00000	0.94369
(LIMIT: 0.91)		
WORK		
ACTUAL	0.000	15.032
(LIMIT: -15%-5% REF BHP-HR)		
REFERENCE	0.000	15.920
% DIFFERENCE	0.00%	-5.58%

Communication From Cat.

Contacts

Mike Thornton	(309)	578-6611
Doug Young	(309)	578-6889
Bill Strawbridge	(309)	578-8592

Address: Caterpillar
Technical Center
Building L
Mossville, IL 61552

Engine

3208 DIT S/N D2Z 10423

Rating	240 BHP @ 2200 RPM
Peak Torque	700 Ft LB @ 1500 RPM
Hi Idle	2400 RPM
Low Idle	700 RPM

Restrictions

Set at 2200 RPM and full throttle

Lug Map and Transient Emissions

Inlet	-20.0" H_2O (-1.5" Hg)
Exhaust	40.8" H_2O (3.0" Hg)

Transient Smoke

Inlet	-25.0" H_2O (-1.8" Hg)
Exhaust	40.8" H_2O (3.0" Hg)

Lube Oil

SAE 30 wt CD Type

(Engine Shipped Full)

Fuel System

Maximum Allowable Restrictions To Inj Pump 8.0" Hg

Engine Shut Down

De-energize Fuel Solenoid

(Energize To Run - 12v)

Air Inlet Flapper Valve - Back Up

Dyno Not Used Unless Panic Shut Down

Test Plan At CTCo

Check Power @ WDT	2200 + 1500 RPM Minimum Restrictions 30°C Fuel to Engine 25°C Air to Engine
Repeat Above With:	-20.0" H_2O Inlet 40.8" H_2O Exhaust 38°C Fuel to Engine 25°C Air to Engine

Lug Map (Reference Work Within ± 2%)

Practice Cycles To Assure Acceptable:

- Cycle Statistics
- Temperatures
- Pt. Sampler Flows

Run 1 Cold, 3 + Hot Tests

At Completion of Days Testing, Run
At 2200 RPM WOT Thru
Tunnel to Check Restrictions,
Return to Idle, Shut Down

Repeat
3+ Days

Cold Soak Using Appropriate Methods

Average All Hot Test Values For Comparison

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

ANN ARBOR, MICHIGAN 48105

OFFICE OF
AIR, NOISE AND RADIATION

MEMORANDUM

SUBJECT: Caterpillar Correlation Engine Testing Plan

FROM: Thomas M. Baines, Heavy Duty Programs Coordinator
Standards Development and Support Branch

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

THRU: Richard A. Rykowski, Senior Project Manager
Standards Development and Support Branch

Chester J. France, Chief
Standards Development and Support Branch

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 test cell and the EPA/MVEL heavy duty test cell. Thus, they have requested that EPA test an engine from Caterpillar to correlate the testing facilities at both laboratories. The testing of a Caterpillar engine is of great importance to Caterpillar 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 Caterpillar engine for correlation purposes and supply the data to MOD/SEA and Caterpillar.

3. Project Scope of Work

Engine. 3208 Turbocharged. The remaining engine information will be supplied by the manufacturer before testing.

Work Description.

Check power @ WOT, 2200 & 1500 rpm - no restrictions
Set restrictions
Check power @ WOT, 2200 & 1500 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
2200 RPM, WOT, check restrictions
Natural cool
1 C/S, 3 H/S
2200 RPM, WOT, check restrictions
Natural cool
1 C/S, 3 H/S
2200 RPM, WOT, check restrictions

Steady states -

Speed, RPM	Load, ft-lb
2000	500
1500	650
1500	200
700	0

Test data taken.- All usual emissions and performance

4. Output

Report memo transmitting data to MOD. This report will be to the Project Manager within six working days of test completion.

5. Timing

The engine has arrived at our facility. This engine should be tested in the next most convenient time slot. It is suggested that it be tested after the Daimler-Benz 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 _____ Date 4-7-86

Reviewed with Technicians? _____

Approval:

Charles L. Gray, Jr. _____ Date _____

Priority _____