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Chrysler - EPA Correlation Program To Assess 1980 Model Year Fuel Economy Offsets

By

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I. Introduction

On October 19, 1979, Chrysler submitted a letter to EPA proposing a correlation program to resolve an apparent fuel economy offset between the two facilities. Chrysler stated that paired test results from May through September, 1979 showed Chrysler's test results were 3.3% lower on FTP fuel economy and 2.0% lower on Highway Fuel Economy. They also indicated that this offset increased to 4.8% for FTP and 4.0% for HWFET on their smaller 1.7 Litre "L" body front wheel drive vehicles. Chrysler indicated that correlation of CVS flow calibrations was confirmed in April, 1979. This program was requested to study dynamometer performance and possible differences in CO_2 readings.

II. Summary

1. Specific vehicle emission tests showed an offset of 2% on the average, but due to vehicle variability the offset is not significant.

2. Dynamometer coastdowns and torque measurements indicate that Chrysler has more internal dynamometer friction. The impact on FE would be only partially affected.

3. X-Y plots of PAU torque vs. front roll speed show that the PAU's at Chrysler display an increase in hysteresis over a given time period similar to EPA.

4. Monitoring of vehicle temperatures revealed no unusual temperature fluctuations or differences in cooling.

5. Tailpipe backpressure measurements were made and Chrysler exceeded -1.0" H_2O on four occasions. The affect on fuel economy by these minor fluctuations is not known.

6. CFO Comparisons indicated a 1.8% discrepancy existed between Chrysler and EPA propane kits. After recalibration of the Chrysler kit, using EPA Draft Procedure #210, the discrepancy was alleviated. Since Chrysler's original CFO calibration agreed with their LFE CVS calibration, the LFE may be out of calibration. Chrysler's LFE recently returned from recalibration at CEESI and results will follow this report as an addendum.

7. Analysis of Chrysler CO_2 bottles indicated that Chrysler CO_2 names are 0 to .7% lower than the names determined at EPA. This would produce an affect on fuel economy opposite to what was originally hypothesized.

   Finally, a reduction of the Chrysler vehicle emission variability needs to be achieved before an offset can be determined. The exact affects of a given dynamometer friction on FE might need to be examined. Chrysler should examine turbulance affects

due to the location of the static backpressure tap. Discrepancies of CFO and LFE calibrations should be resolved as soon as possible. Even though there were differences in naming the CO_2 bottles, no further investigation is warranted.

III. Test Program Description

The program was designed so as to focus on test parameters that can effect fuel economy results. The following is a description of the program design.

A. Vehicles Used and Tests Performed

1. Vehicle #C121 (4500 #IW, 12.3 AHP), was equipped with fuel and body temperature recording equipment. This vehicle was used to confirm the overall fuel economy offset and to record any difference in temperatures between the labs. The tests performed each day consisted of one FTP, two hot 505's, two highway tests, and quick check coastdowns.

2. Vehicle #197 (2500 #IW, 7.3 AHP), front wheel drive "L" body. This is a repeatable emission vehicle equipped with wheel torque meters and a microprocessor data acquisition system. This enabled us to integrate vehicle PAU torque and speed to assess dyno loading. The tests performed each day consisted of three hot 505's, two highway tests, and three steady states. The steady states were two minutes each and were at 50, 40, 20, and 10 mph. During the steady states no exhaust samples were taken, but torque at the various speeds was recorded.

3. Vehicle #883 (2500 #IW, 7.3 AHP), was another "L" body, but with cold start capabilities. Since the previously mentioned "L" body could only perform hot start tests, this vehicle enabled us to look at bag by bag variability from FTP cold start results. One cold start FTP test was performed each day.

B. Test Sequences

All vehicle tests were performed on four consecutive days at Chrysler, four consecutive days at EPA, and a final four consecutive days at Chrysler. These sequences were chosen to quantify any shift in test vehicle emissions between "Chrysler Before" and "Chrysler After" data. Also, to reduce variability, the same drivers were used on all vehicles tested.

C. Checks Performed

1. CVS back pressure checks during vehicle emissions testing.

2. X-Y plots of PAU torque vs. front roll speed.

3. Propane injections using Chrysler CFO kits and propane vs. EPA CFO kits and propane.

4. Wet and dry bulb temperatures recorded with Chrysler's hygrometer.

5. Analysis of six Chrysler CO_2 working standards. (2.1%, 1.77%, 1.31%, .935%, .644%, .2966%, and a 1.5% CO/CO_2 interference bottle.)

6. Dynamometer coastdown checks from 55 to 15 mph, 55 to 45 mph, 40 to 30 mph, and 25 to 15 mph, while monitoring speed vs. time. These were performed using diagnostic coastdown vehicles.

7. Torque wheel measurements on Vehicle 197.

IV. Discussion of Results

Vehicle C121 FTP test results (refer to Appendix) indicated a percent difference of the means of 2% in CO_2 and FE, resulting in Chrysler measuring 2% higher CO_2 (2% lower mpg) when compared with EPA. The percent Coefficient of Variation indicated the FTP CO_2 and FE results varied 1 to 1.5%. Although a 2% offset exists, how large can it actually be when vehicle FTP emissions vary 1 to 1.5%, almost the same magnitude as the offsets.

Vehicle C121 hot 505's and Highway Fuel Economy test results (refer to Appendix) shifted by 2 to 3% when comparing "Chrysler Before" to "Chrysler After". This shift virtually eliminated any significant offset that occurred between Chrysler and EPA. Again, there existed a 1 to 2% variation in the mean data, indicating the vehicle variation is almost as large as the offset.

Vehicle 197 hot 505's and Highway Fuel Economy test results (refer to Appendix) were similar to those generated from vehicle C121. The data shifted 1 to 2% in CO_2 and FE when comparing "Chrysler Before" to Chrysler After", resulting in an insignificant offset between Chrysler and EPA. Also, there appears to be a .5 to 1.5% variation in these tests performed at EPA and Chrysler.

Vehicle 883 FTP test results (refer to Appendix) indicated a consistent 3% offset, where Chrysler read higher CO_2 resulting in lower FE, as compared with EPA. The Coefficient of Variation again indicated the data varied, but in this case it varied .5 to 3% when comparing EPA and Chrysler test results.

Dynamometer coastdowns (refer to Appendix) indicated that Chrysler has more internal dyno friction than that at EPA. This was evidenced by the 3% longer coastdown times obtained at EPA, as compared with Chrysler.

Steady state torque wheel data (refer to Appendix) indicated that Chrysler has about a 3% higher total wheel torque. This would indicate that a vehicle works harder at Chrysler because of more internal dynamometer friction than that found at EPA. This can be caused from the split roll dynamometer at Chrysler, which has four more bearings than EPA's one piece roll dynamometer.

X-Y plots of torque vs. front roll speed, taken at Chrysler, indicated a smooth transition between high rate and low rate loading. At EPA, dynamometer 2 displayed a slight hysteresis, while dynamometer 1 appeared to be normal. At the end of the program on December 12, 1979, post torque traces were made at Chrysler. There appeared to be a slight hysteresis forming as seen earlier at EPA. The cause for hysteresis is suspected to be from mineral deposit buildup in the power absorption unit load ports.

Recorded vehicle temperatures (refer to Appendix) indicate no significant temperature influences at Chrysler and EPA, on Vehicles 197 and C121.

Tail pipe backpressure measurements (refer to Appendix) at EPA appeared to have normal backpressure fluctuations, while Chrysler during high accels on 505's and HWFET's Cell 6, slightly exceeded a -1.0" H_2O backpressure.

The Critical Flow Orifice Comparisons (refer to Appendix) revealed discrepancies which were in the direction of the offset between Chrysler and EPA. The Chrysler CFO kits indicated percent errors, generated from the difference between calculated injection concentration and actual concentration, that were 1 to 2% lower than EPA. These discrepancies fluctuated at the beginning of the program, but in the last comparison at Chrysler they remained stable. These last comparisons helped determine what caused the offset in CFO's. As indicated, after comparing and ruling out differences in EPA and Chrysler propane bottles, a consistent 1.8% offset was established between the kits. The differences would likely be linked to calibrations of the CFO kits.

Recalibrations were performed using the draft EPA Procedure #210, "Critical Flow Orifice Calibration". The results of this recalibration shifted the SCFM calculated from the EPA kit .04%, while Chrysler's kit shifted 1.8%. These results led us to believe that the calibration on the Chrysler kit #34 was incorrect. This change in SCFM in the Chrysler kit brought up another issue of CVS calibrations at the Chrysler Proving Grounds. Chrysler stated that the CFO kit #34 SCFM agreed with the SCFM generated by the LFE calibrations on their CVS systems. Chrysler's LFE calibration was therefore also suspect and would have to be checked.

Analysis of six Chrysler CO_2 bottles and a CO/CO_2 interference bottle (refer to Appendix) gave indications of some minor differences. Comparing Chrysler "Master Concentration" to "EPA Average

Concentration" indicated EPA named all bottles higher than Chrysler's master name. This was opposite of the supposed CO_2-FE offsets between EPA and Chrysler. When comparing Chrysler analysis on all of their analyzers, there is a greater percent of difference in the critical concentrations of .2966% to 1.77% than exists between EPA and Chrysler. EPA also indicated a larger percent of difference between Site A001 and A003 than what existed between Chrysler and EPA.

V. Conclusions and Areas for Follow-up

The following conclusions were derived from the program:

Shifts in vehicle emissions from "Chrysler Before" to Chrysler After" results erases any clear and definable offsets. But a reduction of Chrysler vehicle emission shifts and variability within each facility can lead to a more exact estimate of the magnitude of the offset.

Torque wheel and coastdown measurements indicate Chrysler has more internal dyno friction than EPA, but there is no proven effects on relating given amounts of dyno friction to an actual mpg effect on fuel economy.

PAU hysteresis indicates that measures may need to be taken to reduce mineral content of water used in dynamometer PAU's.

Chrysler should examine the placement of the static backpressure tap. The location used appears to be in an area where turbulances occur, possibly causing false measurements.

Critical Flow Orifice comparisons indicate a large discrepancy in calibration of CFO's and LFE's between Chrysler and EPA. Correcting these discrepancies can lead to closer correlation between Chrysler and EPA and must be resolved as soon as possible.

Analysis of CO_2 bottles indicates a small opposite effect of 0 to .7% in measuring CO_2 than what was originally hypothesized. This difference appears too small to warrant any further investigation at this time.

Finally, at the writing of this report, Chrysler had received a recalibration of their LFE from the Colorado Engineering Experiment Station, Inc. The effects of this recalibration will be forthcoming in an addendum to this report.

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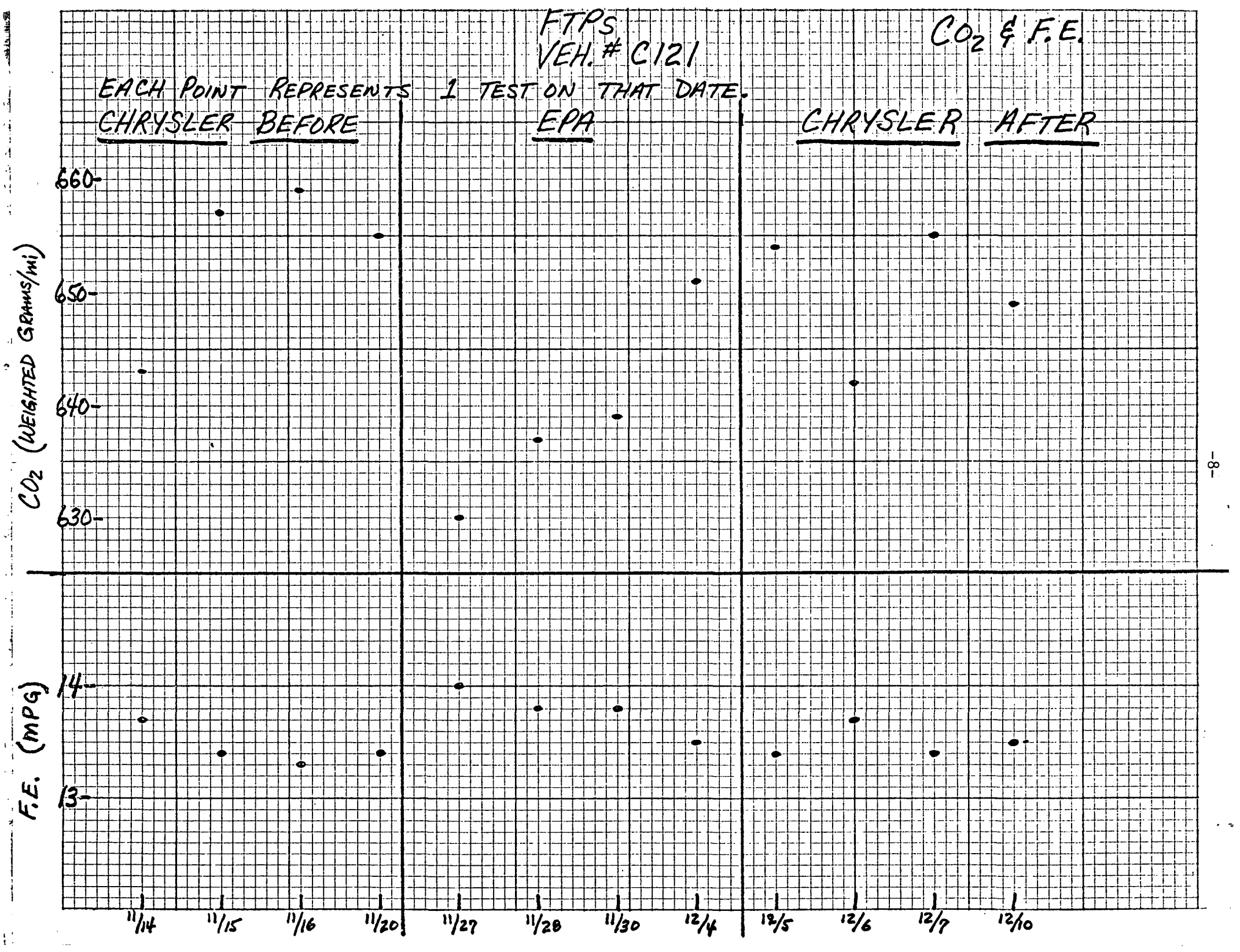
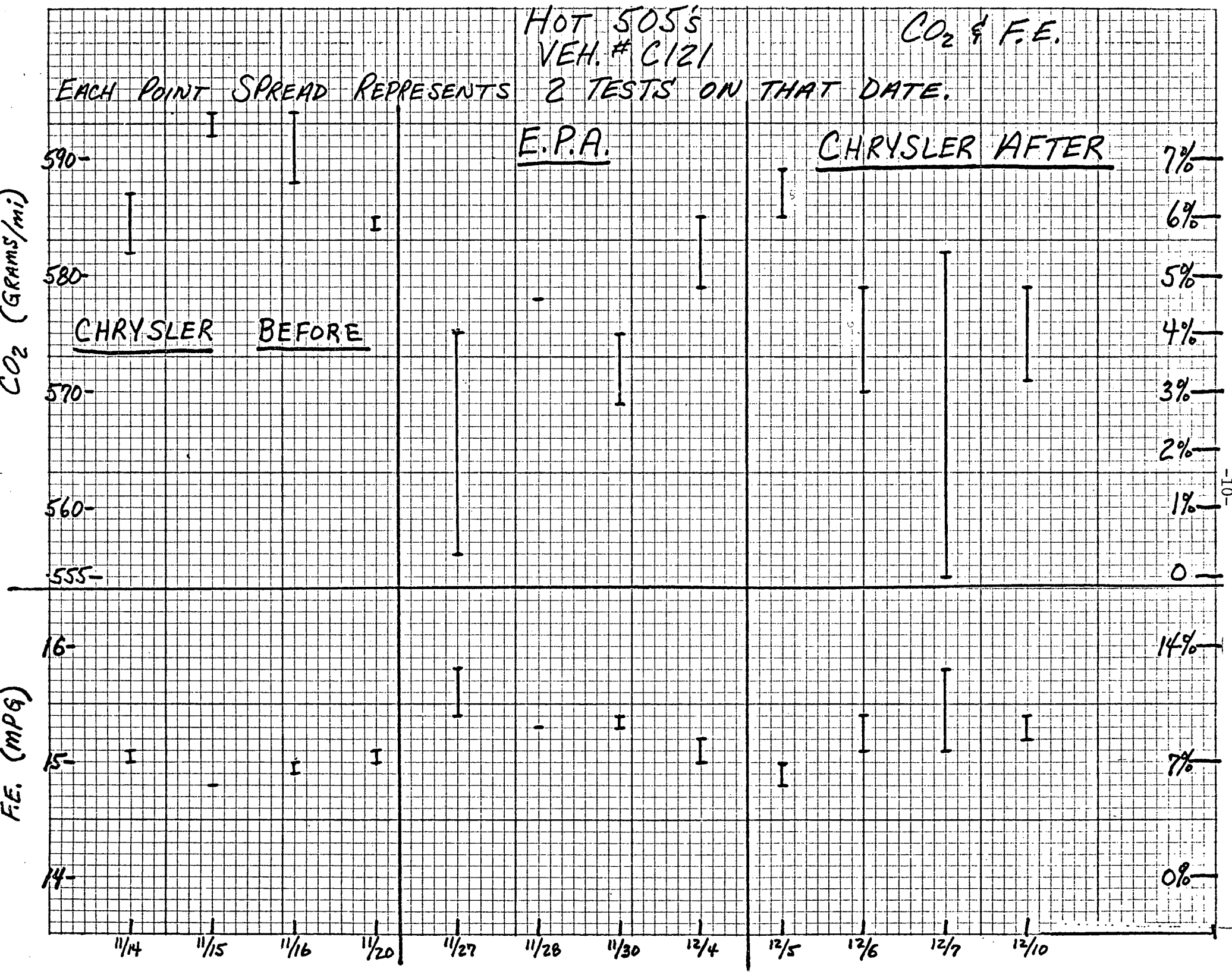

FTPS
VEH. # C121
CO_2 & F.E.
EACH POINT REPRESENTS 1 TEST ON THAT DATE.
CHRYSLER BEFORE
EPA
CHRYSLER AFTER
660
650
640
630
CO_2 (WEIGHTED GRAMS/MI)
14
13
F.E. (MPG)
11/14
11/15
11/16
11/20
11/27
11/28
11/30
12/4
12/5
12/6
12/7
12/10

CO_2 & F.E. COMPARISONS — FTP'S VEH. #C121

DATE	CHRYSLER BEFORE CO_2 (G/MI)	CHRYSLER BEFORE F.E. (MPG)	EPA CO_2 (G/MI)	EPA F.E. (MPG)	CHRYSLER AFTER CO_2 (G/MI)	CHRYSLER AFTER F.E. (MPG)	ALL CHRYSLER CO_2 (G/MI)	ALL CHRYSLER F.E. (MPG)
11-14-79	643	13.7						
11-15	657	13.4						
11-16	659	13.3						
11-20	655	13.4						
11-27-79			630	14.0				
11-28			637	13.8				
11-30			639	13.8				
12-4			651	13.5				
12-5-79					654	13.4		
12-6					642	13.7		
12-7					655	13.4		
12-10					649	13.5		
$\bar{X}$	654	13.4	639	13.8	650	13.5	652	13.5
σ	7	.2	9.0	.2	6	.1	6	.1
% DIFF. OF MEANS *	2	-2			2	-2	2	-2
% C.V. **	1.1	1.5	1.4	1.4	.92	.74	.92	.74
% OF CERTAINTY THERE IS A DIFF.	88	89			82	88	91	93
MEAN INTERVAL @ 95% CONFIDENCE	4.4 TO .3	-.5 TO -5.2			3.7 TO -.2	-.4 TO -3.9	3.4 TO .7	-.9 TO -3.4

**%C.V. = $\frac{\sigma}{\bar{X}} \times 100$

* $\left(\frac{MFR - EPA}{EPA}\right) \times 100$


HOT 505's
VEH. # C121
CO_2 & F.E.
EACH POINT SPREAD REPRESENTS 2 TESTS ON THAT DATE.
E.P.A.
CHRYSLER AFTER
CHRYSLER BEFORE
CO_2 (GRAMS/mi)
590
580
570
560
555
7%
6%
5%
4%
3%
2%
1%
0
F.E. (MPG)
16
15
14
14%
7%
0%
11/14
11/15
11/16
11/20
11/27
11/28
11/30
12/4
12/5
12/6
12/7
12/10

AMC EFFICIENCY LINE [illegible]

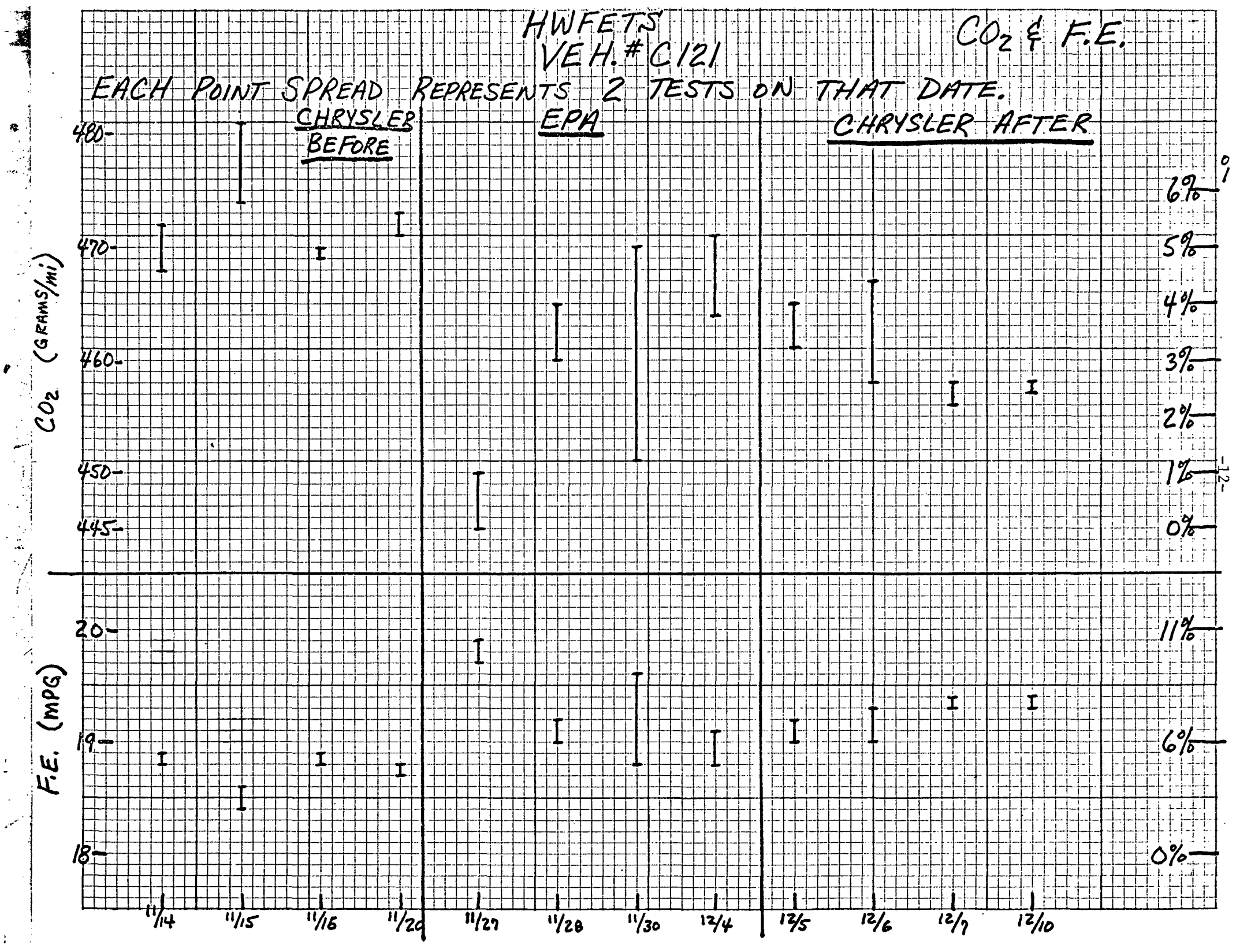
HOT 505's
VEH. # C121

CO_2 & F.E. COMPARISONS

	CHRYSLER BEFORE EPA			CHRYSLER BEFORE EPA			CHRYSLER AFTER EPA			ALL CHRYSLER			
DATE	CO_2 (G/mi)	F.E. (MPG)		CO_2 (G/mi)	F.E. (MPG)		CO_2 (G/mi)	F.E. (MPG)		CO_2 (G/mi)	F.E. (MPG)		
	1	2	3	4	5	6	7	8	9	10	11	12	13
11-14-79	587	15.0											
11-14-79	582	15.1											
11-15	592	14.8											
11-15	594	14.8											
11-16	594	14.8											
11-16	588	14.9											
11-20	585	15.0											
11-20	584	15.1											
11-27-79				575	15.4								
11-27-79				557	15.8								
11-28				578	15.3								
11-28				578	15.3								
11-30				575	15.3								
11-30				569	15.4								
12-4				579	15.2								
12-4				585	15.0								
12-5-79							589	14.8					
12-5-79							585	15.0					
12-6							570	15.4					
12-6							579	15.1					
12-7							582	15.1					
12-7							555	15.8					
12-10							579	15.2					
12-10							571	15.4					
$\bar{X}$	588	14.9		575	15.3		576	15.2		582	15.1		
σ	5	.1		8	.2		11	.3		10	.3		
% DIFF. OF MEANS *	2	-3					0	-1		1	-2		
% C.V.	.85	.67		1.4	1.3		1.9	2.0		1.7	2.0		
% CERTAINTY IS DIFF. **	99	99.7					16	54		86	86		
MEAN INTERVAL @ 95% CONFIDENCE	3.0 TO 1.6	-2 TO -3.2					1.19 TO -.84	.35 TO -1.65		1.47 TO .97	-.65 TO -1.96		

* % C.V. = $\frac{\sigma}{\bar{X}} \times 100$

** $\left(\frac{MFR - EPA}{EPA}\right) \times 100$


HWFETS
VEH.# C121
CO2 & F.E.
EACH POINT SPREAD REPRESENTS 2 TESTS ON THAT DATE.
CHRYSLER BEFORE
EPA
CHRYSLER AFTER
CO2 (GRAMS/MI)
480
470
460
450
445
6%
5%
4%
3%
2%
1%
0%
F.E. (MPG)
20
19
18
11%
6%
0%
11/14
11/15
11/16
11/20
11/27
11/28
11/30
12/4
12/5
12/6
12/7
12/10

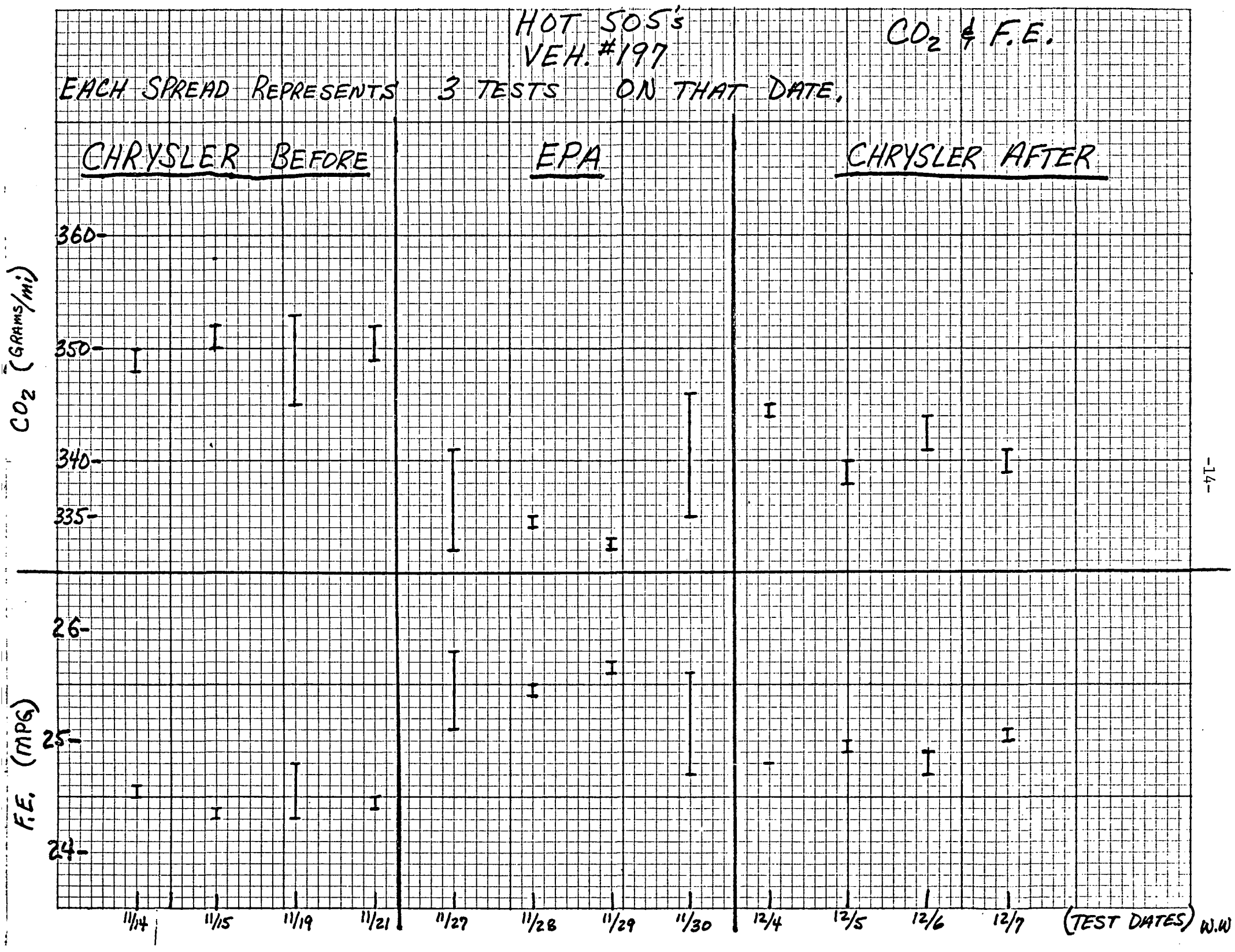
CO_2 & F.E. COMPARISONS

HWFETS
VEH. # C121

DATE		CHRYSLER BEFORE CO_2 (G/mi)	CHRYSLER BEFORE F.E. (MPG)		EPA CO_2 (G/mi)	EPA F.E. (MPG)		CHRYSLER AFTER CO_2 (G/mi)	CHRYSLER AFTER F.E. (MPG)		ALL CHRYSLER CO_2 (G/mi)	ALL CHRYSLER F.E. (MPG)	
11-14-79	1	472	18.8										
11-14-79	2	468	18.9										
11-15	3	474	18.6										
11-15	4	481	18.4										
11-16	5	469	18.9										
11-16	6	470	18.8										
11-20	7	471	18.8										
11-20	8	473	18.7										
11-27-79	9				450	19.7							
11-27-79	10				445	19.9							
11-28	11				465	19.0							
11-28	12				460	19.2							
11-30	13				451	19.6							
11-30	14				470	18.8							
12-4	15				471	18.8							
12-4	16				464	19.1							
12-5-79	17							465	19.0				
12-5-79	18							461	19.2				
12-6	19							467	19.0				
12-6	20							458	19.3				
12-7	21							458	19.3				
12-7	22							456	19.4				
12-10	23							457	19.4				
12-10	24							458	19.3				
$\bar{X}$	25	472	18.7		460	19.3		460	19.2		466	19.0	
σ	26	4	.2		10	.4		4	.2		7	.3	
% DIFF. OF MEANS *	27	3	-3					0	-0		1	-1	
% C.V. **	28	.85	1.1		2.2	2.1		.87	1.0		1.5	1.6	
% OF CERTAINTY THERE IS A DIFF.	29	98	99					0	45		86	92	
	31												
MEAN INTERVAL @ 95% CONFIDENCE		3.6 TO 1.7	-2.2 TO -4.0					.94 TO -.93	.44 TO -1.5		2.17 TO .45	-.7 TO -2.4	

* $\left(\frac{MFR-EPA}{EPA}\right) \times 100$

** % C.V. $= \frac{\sigma}{\bar{x}} \times 100$


HOT SOS's
VEH. #197
CO_2 & F.E.
EACH SPREAD REPRESENTS 3 TESTS ON THAT DATE.
CHRYSLER BEFORE
EPA
CHRYSLER AFTER
360
350
340
335
CO_2 (GRAMS/mi)
26
25
24
F.E. (MPG)
11/14
11/15
11/19
11/21
11/27
11/28
11/29
11/30
12/4
12/5
12/6
12/7
(TEST DATES)
W.W

AMPAD EFFICIENCY LINE NO. 6526

CO_2 & F.E. Comparisons

HOT 505's VEH. #197

DATE	CHRYSLER BEFORE CO_2 (G/mi)	CHRYSLER BEFORE F.E. (MPG)	EPA CO_2 (G/mi)	EPA F.E. (MPG)	CHRYSLER AFTER CO_2 (G/mi)	CHRYSLER AFTER F.E. (MPG)	ALL CHRYSLER CO_2 (G/mi)	ALL CHRYSLER F.E. (MPG)
11-14-79	349	24.6						
11-14-79	348	24.6						
11-14-79	350	24.5						
11-15	350	24.4						
11-15	352	24.3						
11-15	350	24.4						
11-19	353	24.3						
11-19	347	24.7						
11-19	345	24.8						
11-21	349	24.5						
11-21	351	24.5						
11-21	352	24.4						
11-27-79			333	25.6				
11-27-79			332	25.8				
11-27-79			341	25.1				
11-28			334	25.5				
11-28			335	25.4				
11-28			334	25.5				
11-28			333	25.6				
11-29			333	25.6				
11-29			332	25.7				
11-29			333	25.7				
11-30			335	25.6				
11-30			340	25.2				
11-30			346	24.7				
12-4-79					345	24.8		
12-4-79					345	24.8		
12-4-79					344	24.8		
12-5					340	24.9		
12-5					340	25.0		
12-5					338	25.0		
12-6					342	24.9		
12-6					344	24.7		
12-6					341	24.9		
12-7					341	25.0		
12-7					339	25.0		
12-7					339	25.1		
$\bar{X}$	349.5	24.5	335.5	25.5	342	24.9	346	24.7
σ	2.4	.2	4.3	.3	2	.10	5	.3
% DIFF. OF MEANS*	4	-4			2	-2.4	3	-3
% C.V.	.69	.82	1.3	1.2	.58	.40	1.45	1.2
% OF CERTAINTY THERE IS A DIFF.	100	100			100	100	100	100
MEAN INTERVAL @ 95% CONFIDENCE	4.6 TO 3.8	-3.6 TO -4.3			2.4 TO 1.8	-2.1 TO -2.6	3.6 TO 2.96	-2.9 TO -3.4

** % C.V. $= \frac{\sigma}{\bar{X}} \times 100$

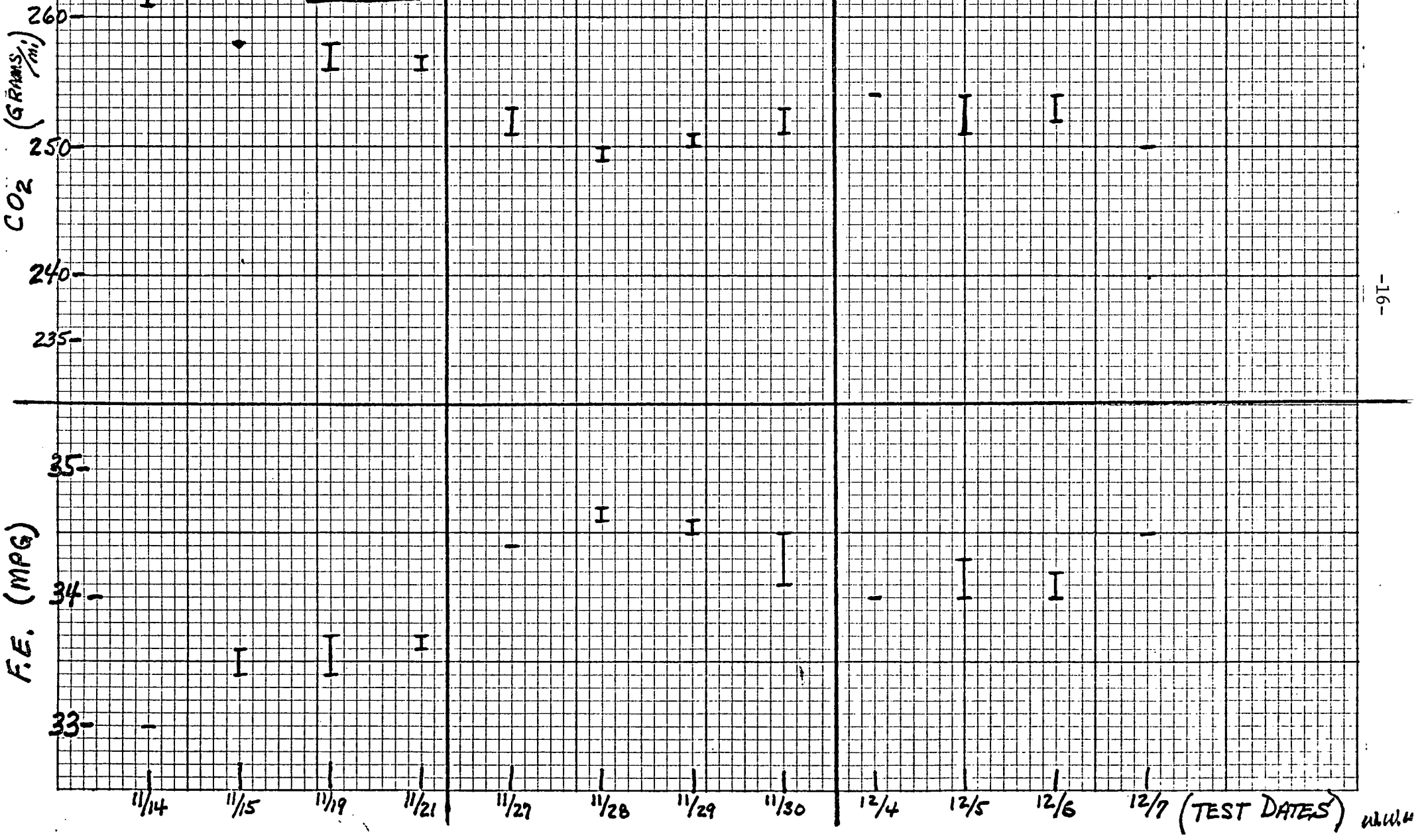
* $\left(\frac{\text{MFR-EPA}}{\text{EPA}} \times 100\right)$

HWFETS VEH. #197

CO_2 & F.E.

EACH POINT IS A SPREAD REPRESENTING TWO TESTS ON THAT DATE.

CHRYSLER BEFORE | EPA | CHRYSLER AFTER

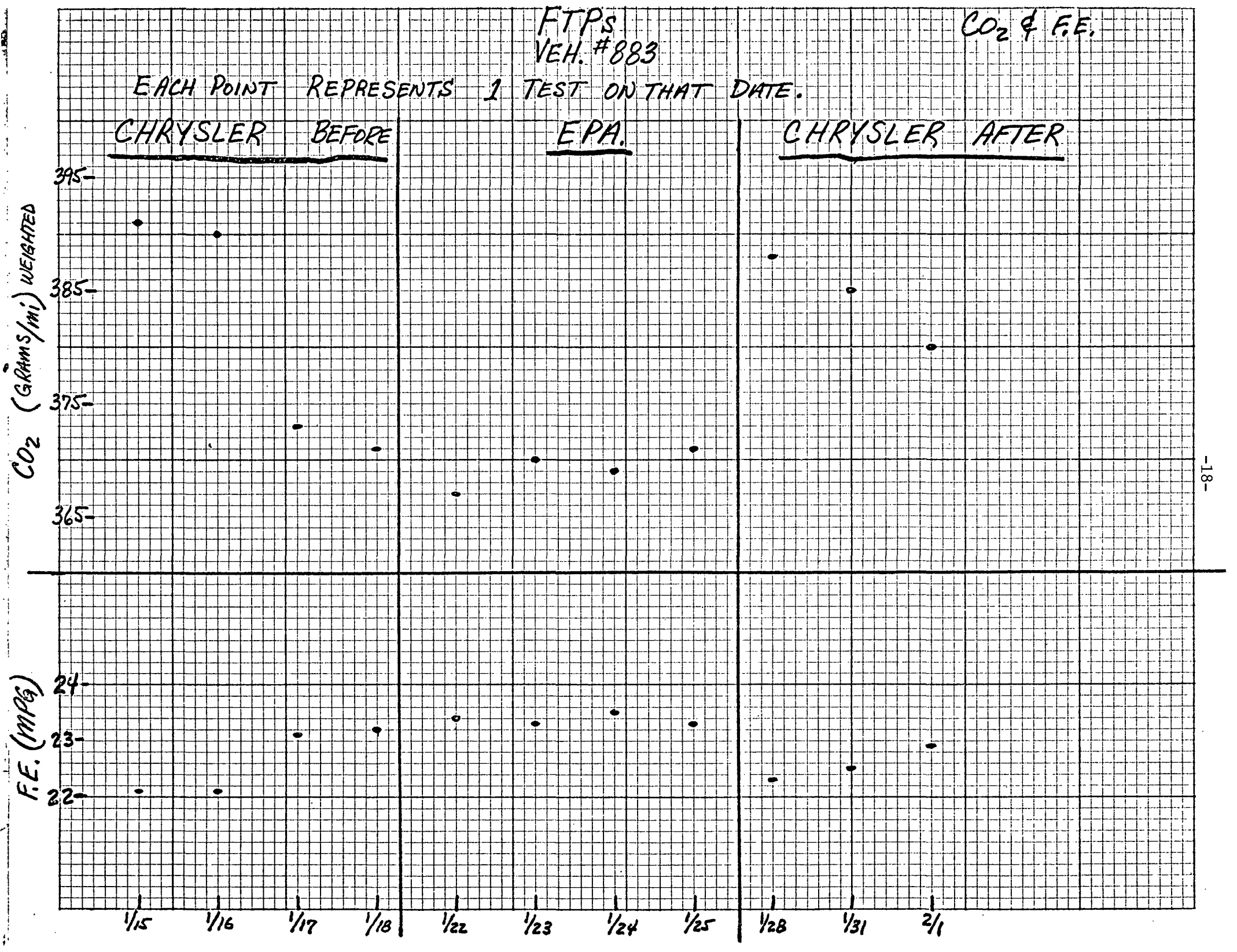


CO_2 & F.E. COMPARISONS

HFET VEH. #197

DATE		CHRYSLER BEFORE CO_2 (G/mi)	CHRYSLER BEFORE F.E. (MPG)		EPA CO_2 (G/mi)	EPA F.E. (MPG)		CHRYSLER AFTER CO_2 (G/mi)	CHRYSLER AFTER F.E. (MPG)		ALL CHRYSLER CO_2 (G/mi)	ALL CHRYSLER F.E. (MPG)	
11-14-79	1	261	33.0										
11-14-79	2	262	33.0										
11-15	3	258	33.6										
11-15	4	258	33.4										
11-19	5	256	33.7										
11-19	6	258	33.4										
11-21	7	257	33.6										
11-21	8	256	33.7										
11-27-79	9				253	34.4							
11-28-79	10				251	34.4							
11-28	11				249	34.7							
11-28	12				250	34.6							
11-29	13				250	34.6							
11-29	14				251	34.5							
11-30	15				251	34.5							
11-30	16				253	34.1							
12-4-79	17							254	34.0				
12-4-79	18							254	34.0				
12-5	19							254	34.0				
12-5	20							251	34.3				
12-6	21							252	34.2				
12-6	22							254	34.0				
12-7	23							250	34.5				
12-7	24							250	34.5				
$\bar{X}$	25	258	33.4		251	34.5		252.38	34.2		255	33.8	
σ	26	2	.3		1	.2		1.84	.2		4	.5	
% DIFF. OF MEANS*		3	-3					.54	-1		2	-2	
% C.V. ($\frac{\sigma}{\bar{X}} \times 100$)		.78	.90		.40	.58		.73	.58		1.6	1.5	
% CERTAINTY THERE IS A DIFFERENCE	31	100	100					74.7	98		97	99	
MEAN INTERVAL @ 95% CONFIDENCE		3.2 TO 2.4	-2.8 TO -3.6					.15 TO .95	-.52 TO -1.2		1.9 TO 1.3	-1.7 TO -2.4	

* $\left(\frac{MFR - EPA}{EPA}\right) \times 100$


FTPs
VEH. #883
CO_2 & F.E.
EACH POINT REPRESENTS 1 TEST ON THAT DATE.
CHRYSLER BEFORE
EPA.
CHRYSLER AFTER
CO_2 (GRAMS/MI) WEIGHTED
395
385
375
365
F.E. (MPG)
24
23
22
1/15
1/16
1/17
1/18
1/22
1/23
1/24
1/25
1/28
1/31
2/1

AMAX EFFICIENCY LINE NO. 6006

CO_2 & F.E. COMPARISONS

FTPs
VEH. #883

DATE	CHRYSLER BEFORE CO_2 (G/mi)	CHRYSLER BEFORE F.E. (MPG)	EPA CO_2 (G/mi)	EPA F.E. (MPG)	CHRYSLER AFTER CO_2 (G/mi)	CHRYSLER AFTER F.E. (MPG)	ALL CHRYSLER CO_2 (G/mi)	ALL CHRYSLER F.E. (MPG)
1-15-80	391	22.1						
1-16	390	22.1						
1-17	373	23.1						
1-18	371	23.2						
1-22-80			369	23.4				
1-23			370	23.3				
1-24			369	23.5				
1-25			371	23.3				
1-28-80					388	22.3		
1-31					385	22.5		
2-1					380	22.9		
$\bar{X}$	381	22.6	369	23.4	384	22.6	383	22.6
σ	11	.6	2	.1	4	.3	8	.5
% DIFF OF MEANS *	3	-3			4	-3	4	-3
% C.V.	2.9	2.7	.54	.43	1.0	1.3	2.1	2.2
% OF CERTAINTY THERE IS A DIFF.	84	88			98	96	92	91
MEAN INTERVAL @ 95% CONFIDENCE	.377 TO 6.2	-5.8 TO -.98			6.0 TO 2.2	-1.4 TO -5.4	5.0 TO 2.6	-2.3 TO -4.5

** % C.V. $= \frac{\sigma}{\bar{X}} \times 100$

* $\left(\frac{MFR - EPA}{EPA}\right) \times 100$

PG/EPA SUMMARY -- ALL COASTDOWNS--

INERTIA / H.P.	SITE	ROLLS	E.T. 55-45	ABS. HP. 55-45	E.T. 40-30	ABS. HP. 40-30	E.T. 25-15	ABS. HP. 25-15	E.T. 55-15	
2500 P 7.3	PG	5+6	20.40	7.45	38.42	2.77	86.07	.71	185.80	
	EPA	1+2	21.00	7.23	39.73	2.68	99.17	.61	203.89	
% DIF ((PG-EPA)/EPA) *100.			-2.86	3.04	-3.30	3.36	-13.21	16.39	-8.87	
4250 P 12.3	PG	5+6	20.92	12.34	40.23	4.49	99.34	1.04	204.01	
	EPA	1+2	21.64	11.93	42.17	4.28	112.48	.92	222.90	
% DIF ((PG-EPA)/EPA) *100.			-3.33	3.44	-4.60	4.91	-11.68	13.04	-8.47	

FOR H.P. CALC -- LINEARITY OF TORQUE CURVE WAS ASSUMED (PIECEWISE)

Z500 @ 7.3 H.P. QUICK CID SUMMARY (E.T.)
(55 TO 45 MPH.)

	ROLLS →	PG 6	PG 5	PG 6	PG 5	EPA-2	EPA-1	EPA-1	EPA-2	PG-5	PG-6	PG-5	PG-6
	DATE →	11-14	11-15	11-19	11-21 *	11-27	11-28	11-29	11-30	12-4	12-5	12-6	12-7
		11.2	11.4	11.0		11.65	11.91	11.89	11.64	11.8	11.6	11.6	11.4
		11.0	11.6	11.2		11.78	12.00	12.01	11.72	11.6	11.8	11.8	11.4
		11.4	11.6	11.4		11.83	12.09	12.08	11.82	11.6	11.8	12.0	11.6
		11.4	11.6	11.4		11.87	12.12	12.08	11.89	11.6	11.8	12.6	11.8
		11.4		11.4			12.22					12.0	12.0
													12.0
MEAN		11.28	11.55	11.28		11.78	12.07	12.02	11.77	11.65	11.75	11.88	11.70
STD DEV.		.179	.1	.179		.096	.118	.090	.110	.1	.1	.179	.276
% C.V.		1.59	.87	1.59		.81	.98	.75	.93	.86	.85	1.51	2.36
MEAN ROLLS *		11.69											
MEAN ROLLS6 *		11.50											
MEAN EPA-1 *		12.05											
MEAN EPA-2 *		11.77											
							* WEIGHTING FACTOR -- 1 PER DAY						
PG-MEAN		11.58					* DATA LOST						
EPA-MEAN		11.91											
% DIF $\left(\frac{PG}{EPA}\right) \times 100$		-2.77					TIRE PRESSURE			45	PSI.		

84-110-7698 PRINTED IN U.S.A.

Z500Ω 7.3 HP
NOV-DEC. 1979

STEADY STATE TEST SUMMARY (127 SEC.)

		SPEED. F	SPEED R.	PAU TORQUE	LEFT WHEEL TORQUE	RIGHT WHEEL TORQUE		TOTAL WHEEL TORQUE		FUEL * COUNTS
50 MPH	CHRYSLER PG --TOTAL MEAN--	49.31	49.93	12.82	33.12	44.89		78.02		3012
	CHRYSLER PG -- PRE-EPA --	49.32	49.93	12.70	33.47	43.51		76.98		3055
	CHRYSLER P.G. -- POST-EPA --	49.30	49.93	12.95	32.78	46.27		79.05		2968
	EPA -- TOTAL MEAN --	49.30	49.93	14.15	31.97	43.60		75.57		2968
	% DIF (PG TOTAL - EPA TOTAL)/EPA T x 100.	-.02	0.0	-9.40	3.60	2.96		3.24		1.48
40 MPH	CHRYSLER PG TOTAL MEAN	39.60	39.91	8.28	25.48	34.39		59.87		2067
	CHRYSLER PG PRE-EPA	39.60	39.91	8.23	26.36	33.83		60.18		2114
	CHRYSLER PG POST-EPA	39.60	39.91	8.34	24.61	34.94		59.55		2019
	EPA TOTAL MEAN	39.55	39.96	9.28	23.78	34.44		58.22		2038
	% DIF $\left(\frac{\text{PG TOTAL - EPA TOTAL}}{\text{EPA TOTAL}}\right)$ x 100.	.13	-.13	-10.78	7.15	-.15		2.83		1.42
30 MPH	CHRYSLER PG TOTAL MEAN	29.76	29.91	4.66	20.11	27.51		47.62		1409
	CHRYSLER PG. PRE-EPA	29.77	29.93	4.59	20.11	27.02		47.13		1418
	CHRYSLER PG POST EPA	29.75	29.90	4.73	20.11	28.01		48.11		1401
	EPA TOTAL MEAN	29.73	29.96	5.19	19.84	27.32		47.16		1418
	% DIF $\left(\frac{\text{PG TOTAL - EPA TOTAL}}{\text{EPA TOTAL}}\right)$ x 100.	.10	.17	-10.21	1.36	.69		.98		-.63

PG -- Rolls 5+6 EPA -- DYNO 42

* FUEL COUNTS -- 116,600 COUNTS / GALLON

84-110-7698 PRINTED IN U.S.A.

STEADY STATE TEST SUMMARY (127 SEC)

		SPEED F.	SPEED R.	PAU TORQUE	LEFT WHEEL TORQUE	RIGHT WHEEL TORQUE	TOTAL WHEEL TORQUE	FUEL * COUNTS
20 MPH	CHRYSLER PG TOTAL MEAN	19.91	19.92	2.06	16.34	23.10	39.44	931
	CHRYSLER PG PRE EPA	19.93	19.92	1.99	17.11	22.11	39.32	934
	CHRYSLER PG POST EPA	19.89	19.92	2.12	15.58	23.99	39.57	928
	EPA TOTAL MEAN	19.90	19.95	2.61	14.40	23.35	37.75	928
	% DIF $\left(\frac{\text{PG TOTAL} - \text{EPA TOTAL}}{\text{EPA TOTAL}}\right) \times 100.$	.05	-.15	-21.07	13.47	-1.07	4.48	.32
10 MPH	CHRYSER PG TOTAL MEAN	9.93	9.89	.80	14.18	20.58	34.76	971
	CHRYSLER PG PRE-EPA	9.90	9.86	.58	14.38	19.99	34.37	968
	CHRYSLER PG POST EPA	9.96	9.93	1.01	13.97	21.17	35.15	973
	EPA TOTAL MEAN	9.91	9.95	.99	13.14	20.32	33.45	943
	% DIF $\left(\frac{\text{PG TOTAL} - \text{EPA TOTAL}}{\text{EPA TOTAL}}\right) \times 100.$	.20	-.60	-19.19	7.91	1.28	3.92	2.97

PC-110-7828 PRINTED IN U.S.A.

VEH. #197 TEMPERATURE DATA

	CARB AIR			SNORKEL			FRONT OF CAR			MIDDLE OF CAR			REAR OF CAR							
	1 START OF TEST	2 MIN	3 MAX	4 SOT	5 MIN	6 MAX	7 SOT	8 MIN	9 MAX	10 SOT	11 MIN	12 MAX	13 SOT	14 MIN	15 MAX	16	17	18	19	20
CHRYSLER BEFORE																				
AVG. DYNO #5	93	93	100	89	83	97	103	94	116	110	102	152	159	157	192					
AVG. DYNO #6	92	92	101	90	85	98	98	96	125	138	120	150	180	170	200					
EPA																	HOT			
AVG. DYNO #1	94	94	100	86	84	93	124	108	124	139	120	145	158	150	178					
AVG. DYNO #2	92	90	99	84	80	90	108	106	131	119	110	142	164	158	196		505			
CHRYSLER AFTER																				
AVG. DYNO #5	92	92	100	86	82	95	93	92	114	105	104	137	149	146	184					
AVG. DYNO #6	93	93	103	89	84	95	117	117	124	124	123	147	142	142	182					
CHRYSLER BEFORE																				
AVG DYNO #5	106	102	109	90	90	100	115	99	137	109	98	165	200	190	210					
AVG DYNO #6	111	106	111	99	99	111	116	110	124	131	118	158	194	186	204					
EPA																	HIGHWAY			
AVG. DYNO #1	104	102	106	88	88	100	118	112	128	136	122	144	192	186	192					
AVG. DYNO #2	104	102	107	90	90	101	126	114	142	131	116	149	214	206	225		TEST			
CHRYSLER AFTER																				
AVG. DYNO #5	104	103	107	95	95	107	115	109	127	129	115	147	190	184	202					
AVG. DYNO #6	109	105	110	93	93	103	116	105	124	137	121	142	181	168	178					

VEHICLE TEMPERATURE SUMMARY

VEHICLE: C121 (318 CID, M-body)

INERTIA: 4250 # @ 12.3 HP

Thermocouple		Location
#1	-	Underneath vehicle by differential
#2	-	Underneath vehicle by catalyst
#3	-	Underneath vehicle by Y-exhaust pipe
#4	-	20% level of fuel tank
#5	-	Front grille center of vehicle

TYPE TEST	FACILITY	# OF TESTS		#1 Min.	#1 Max.	#2 Min.	#2 Max.	#3 Min.	#3 Max.	#4 Min.	#4 Max.	#5 Min.	#5 Max.
75 CCVS	Chrysler	8	mean	71.1	105.3	71.1	117.4	72.1	138.8	74.6	81.5	70.4	89.0
			std. dev.	1.5	4.8	2.9	11.9	1.6	7.3	3.5	2.9	1.3	9.4
	EPA	4	mean	72.0	112.5	72.3	126.5	71.0	131.8	75.8	84.3	69.5	76.5
			std. dev.	0.8	12.0	1.3	10.3	1.2	19.1	3.3	2.2	1.7	5.3
			% diff.	-1.3	-6.4	-1.7	-7.2	+1.5	+5.3	-1.6	-3.3	+1.3	+16.?
HWFE	Chrysler	7	mean	94.0	102.1	80.7	88.3	96.3	109.7	90.7	93.0	72.1	74.9
			std. dev.	6.7	4.6	7.4	12.9	16.3	24.0	4.9	4.3	1.6	1.5
	EPA	7	mean	98.1	111.6	79.1	87.0	87.0	95.4	91.4	94.3	70.4	73.3
			std. dev.	3.8	4.6	1.7	5.7	3.5	4.6	2.7	2.6	1.7	1.7
			% diff.	-4.2	-8.5	+2.0	+1.5	+10.7	+15.0	-0.8	-1.4	+2.4	+2.2

$$\% \text{ Diff.} = \frac{\text{Chrysler-EPA}}{\text{EPA}} \times 100$$

NOTES: 1) The first two 75 CCVS's at EPA had diurnal heat builds done which could have a slight affect on thermocouple #4 data.

2) The Pre-EPA data on the HWFE tests were not representative of the rest of the testing because a cooling fan was not used by the rear tires; therefore, the data summarized includes only the Post-EPA data.

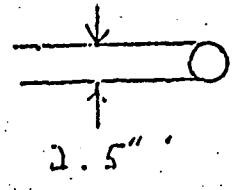
CHRYSLER CORP. A.

TAILPIPE PRESSURE SUMMARY (INCHES OF H_2O)

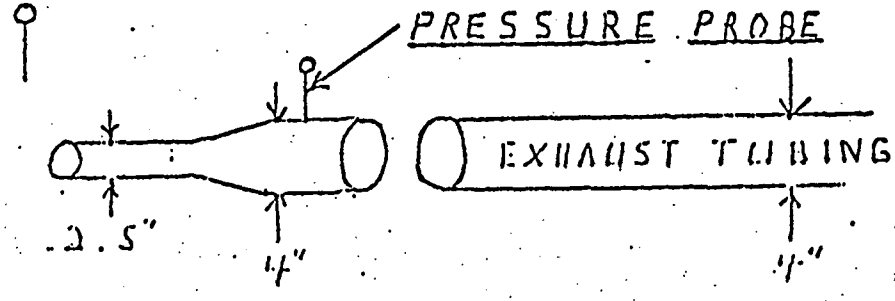
DATE	TEST CELL	TP (VEHICLE OFF)	SS 50 MPH	SS 40 MPH	SS 30 MPH	SS 20 MPH	SS 10 MPH	505 #1 MAX.	505 #1 MIN.	FEC #1 MAX.	FEC #1 MIN.	BLOWER SPEED
*11-14	PC-6	-0.75	-0.55	-0.60	-0.65	-0.65	-0.70	-1.15	-0.35	-1.1	-0.45	2
*11-15	PC-5	-0.45	-0.35	-0.35	-0.45	-0.45	-0.45	-0.80	0.05	-0.75	-0.1	2
**11-27	EPA-D-2	-0.65	-0.15	-0.35	-0.50	-0.65	-0.75	-0.90	0.50	-0.80	0.40	CFV
**11-29	EPA-D-1	-0.80	-0.10	-0.35	-0.58	-0.70	-0.80	-1.0	0.65	-0.80	0.45	CFV
**12-5	PC-6	-0.75	-0.40	-0.55	-0.65	-0.67	-0.70	-1.05	-0.15	-1.05	-0.10	2
**12-6	PC-5	-0.50	-0.10	-0.30	-0.35	-0.40	-0.40	-0.75	0.10	-0.75	0.0	2
**12-11	PC-9	-0.40	-	-	-	-	-	-0.5	0.07	-0.5	0.0	CFV
**12-11	PC-10	-0.40	-	-	-	-	-	-0.5	0.5	-0.5	0.05	CFV

-26-

* 11-14/11-15
EXHAUST CONNECTION

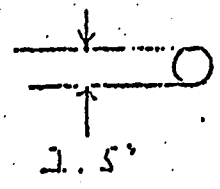


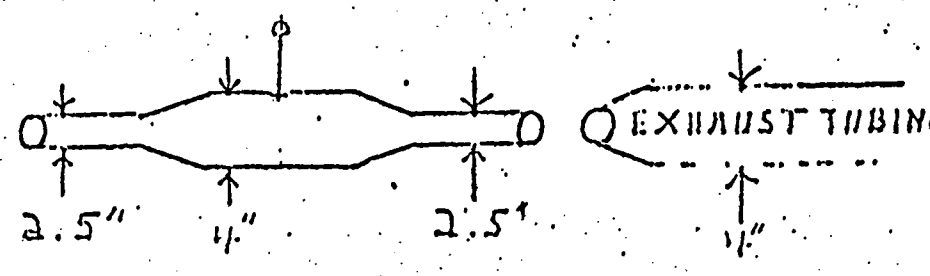
TAIL PIPE



PRESSURE PROBES AND ADAPTOR

** 11-27 to 12-11
EXHAUST CONNECTION





C.F.O. AT EPA

DATE	CVS #	KIT #	% ERROR	% ERROR W/ NEW COEFFICIENTS	% Δ IN ERROR W/ NEW COEFF.	
11-14-79						
11-14						
11-15						
11-15						
11-19						
11-19						
11-21						
11-21						
11-27-79	21c	CHRY 7220	-2.53			
11-28	22c	"	-.71			
11-28	21c	EPA 22	-.39			
11-28	22c	EPA 22	-.52			
11-29	21c	CHRY 7220	-3.3			
11-29	22c	"	-3.71			
12-5	21c	EPA 22	-1.38			
12-5	22c	EPA 22	-1.94			
12-4-79						
12-4						
12-5						
12-5						
12-6						
12-6						
12-7						
12-7						
12-11-79	21c	CHRY 7220	-4.99			
12-11	21c	"	-.66			
12-11	22c	"	-2.42			
12-11	22c	"	-1.16			
12-12	21c	EPA 22	-2.35			
12-12	22c	EPA 22	-1.25			
12-17	21c	EPA 37469	-2.28			
12-17	21c	CHRY 7220	-4.05			
12-17	21c	"	-.18			
12-17	21c	"	-.43			
12-17	22c	"	+.78			
12-17	22c	"	+.42			
12-19	21c	EPA 22	+.02			
12-19	22c	EPA 22	-1.96			
12-27	21c	"	+1.44			
12-27	22c	"	+2.17			
1-3-80	21c	"	+.55			
1-3	22c	"	-2.63			
1-9	21c	"	+1.64			
1-9	22c	"	-1.04			
1-9-80	21c	CHRY 8930	-1.29			
1-9	21c	"	-1.14			
1-9	21c	"	-1.60			
1-9	22c	"	-4.08			
1-9	22c	"	-3.84			
1-9	22c	"	-4.11			
1-15-80	21c	EPA 106380	+.927			
1-15	22c	"	-.638			
1-17-80						
1-17						
1-17						
1-17						
1-17						
1-17						
1-17						
1-17						
1-17						
1-23-80	21c	EPA 106380	+1.28	+1.31	.04	*
1-23	22c	"	+.20	+.239	.04	*

COMPARISONS AT CHRYSLER

	SITE #	KIT #	% ERROR	% ERROR W/ NEW COEFF.	% Δ IN ERROR W/ NEW COEFF.	
	6	CHRY. 9220	-.27			
	6	"	-.57			
	5	"	+1.12			
	5	"	+1.17			
	6	"	0.0			
	6	"	+.43			
	5	"	+1.06			
	5	"	+.98			
	5	CHRY. 7220	+.28			
	5	"	+.26			
	6	"	+.06			
	6	"	+0.0			
	5	"	+.10			
	5	"	+.02			
	6	"	+.18			
	6	"	+.03			
	7	CHRY 8730	+.86	+2.63	1.8	
	7	EPA 106380	+2.54	+2.58	.04	
	7	"	+2.17	+2.21	.04	
	7	"	+2.73	+2.77	.04	
	7	CHRY 8730	+.49	+2.27	1.8	*
WITH EPA PROPANE	7	"	+1.19	-2.99	1.8	
	7	"	+.83	+2.62	1.8	
WITH CHRYSLER PROPANE	7	EPA 106380	+2.55	+2.59	.04	
	7	"	+2.30	+2.34	.04	

* THAT OUTLINED IN RED ARE THOSE KITS WHICH HAD NEW COEFFICENTS GENERATED BY EPA BROOKS PROVER.

CO_2 Bottle Comparisons

Bottle #		CHRY. MASTER CONC. (%)	EPA. MASTER CONC. (%)	* % DIFF. BETWEEN MASTERS	EPA SITE A001 CONC (%)	* % DIFF. FROM CHRY. MASTER	** % DIFF. FROM E.P.A. MASTER	E.P.A. SITE A003 CONC. (%)	* % DIFF. FROM CHRY. MASTER.	** % DIFF FROM E.P.A. MASTER	*** % DIFF. EPA A001 TO A003	AVG. CONC. OF E.P.A. A001 & A003	AVG. CONC. CHRY. ROLLS 1-10	* % DIFF. BETWEEN CHRY. AND EPA.
A-1408	1	2.1	2.102	-.10	2.112	-.57	.47	2.0974	.12	-.22	.70	2.11	2.10	-.47
XA-5072	2	1.77	1.766	.23	1.769	.06	.17	1.7646	.31	-.08	.25	1.77	1.77	0
XA-9341	3	1.31	1.309	.08	1.3137	-.28	.36	1.3128	-.21	.29	.07	1.313	1.311	-.15
CC-23492	4	.935	.930	.54	.9367	-.18	.71	.9313	.40	.14	.58	.934	.9325	-.16
A-12353	5	.644	.645	-.16	.6499	-.91	.77	.6527	-1.33	1.2	-.43	.6513	.6462	-.78
A-10305	6	.2966	.295	.54	.2969	-.10	.64	.2987	-.70	1.2	-.60	.2978	.2961	-.57
CC-7952 (CO_2)		1.5	—	—	1.501	-.07	—	1.4963	.25	—	.31	1.497	1.50	.20
	8													
	9													
	10													
	11													
	12													
	13													
	14													
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	31													

CHRYSLER Comparison (Rolls 1-8)

Named Conc.	Low		High		**** % Diff. Between Chry. Low and High
	Roll #	Conc.	Roll #	Conc.	
	3	2.099	8	2.101	-.095
	8	1.766	3	1.774	-.45
	3	1.306	8	1.316	-.76
	1	.9297	7	.9371	-.79
	7	.6435	4	.6485	-.77
	3	.2943	5	.2977	-1.14
	1-3 & 5-7	1.50	4, 8	1.51	-.66

* % Diff. From CHRYSLER = $\left(\frac{\text{CHRY} - \text{EPA}}{\text{EPA}}\right) \times 100$

** % Diff. From EPA MASTER = $\left(\frac{\text{EPA SITE} - \text{EPA MASTER}}{\text{EPA MASTER}}\right) \times 100$

*** % Diff Sites A001 to A003 = $\left(\frac{\text{A001} - \text{A003}}{\text{A003}}\right) \times 100$

**** % Diff. Between CHRY Low & High = $\left(\frac{\text{CHRY. LOW} - \text{HIGH}}{\text{CHRY HIGH}}\right) \times 100$