EPA-AA-TEB-81-19

Evaluation of the Impact on Emissions and Fuel Economy of Converting Two Vehicles to Compressed Natural Gas Fuel

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Office of Mobile Source Air Pollution Control
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Background

The EPA was requested by the Department of Energy to perform testing on two late model vehicles which had been converted with on-the-market systems to run on compressed natural gas (CNG). The EPA was requested to measure vehicle emissions, fuel econony, and acceleration characteristics of the vehicles in stock configuration, modified running on gasoline, and modified-running on natural gas. The testing was run over a three week period with triplicate tests run in each condition. This report presents the results of the testing; but does not attempt to analyze the feasibility of CNG powered vehicles in the market place.

Test Procedure

Two vehicles were supplied by the Department of Energy. These vehicles (a 1980 Dodge Diplomat and a 1979 Chevrolet Impala) are more completely described in the attached Vehicle Description. The vehicles were checked against manufacturer's specifications upon arrival at the EPA Motor Vehicle Emission Laboratory (MVEL). Both vehicles met all specification tolerances. Prior to delivery, the vehicle exhaust systems were leak checked and new catalysts installed. All filters, spark plugs, PCV valves, and the normal tune-up items were replaced. The rear brakes were closely checked and worn components were replaced. Choke operation was specifically checked for correct operation prior to delivery.

The basic test procedures used were the Federal Test Procedure (FTP) and Highway Fuel Economy Test (HFET). The test plan called for three FTP/HFET sequences for each configuration. Methane, total hydrocarbons (HC), CO, CO2, and NOx emissions were measured. Fuel economy calculations based on the HC, CO, and CO2 emissions were calculated using the standard FTP procedure except for the actual CNG tests where carbon balance calculations based on the vehicle emissions and the chemical analysis of the CNG were used. There were several problems noted in the testing which required additional testing and are detailed below. Acceleration times from 5 to 60 mph at WOT and 30 to 60 mph at WOT were taken using a coupled roll Clayton dynamometer. No evaporative emissions were measured.

Test Results

The results of the testing are given in Tables I through VII. These results show several changes in emission levels for both the changes in fuel and the changes made in equipment.

First of all, these results show that the modifying of the engine to run on CNG has a detrimental effect on the gasoline-fueled emissions of the vehicle. For both vehicles, the modifications showed increases in HC, HC-NM, CO and NOx ranging from 12% to 40%. The HFET results showed both reductions and increases. The optimization of the added equipment showed varied results in HC, but significantly increased CO and NOx on the FTP. The HFET data again varied. The CNG test data showed reductions in HC-NM, NOx, and almost total elimination of CO emissions. However, methane emissions increased.

Acceleration test data is presented in Table VII.

Conclusions

The conclusions to be drawn from the testing performed are as follows:

1. The modifications required to convert the vehicles to dual-fuel capability have a detrimental effect on HC, CO, and NOx emissions during the FTP cycle.

2. The optimization of the conversion equipment did not return the test vehicle's emissions to baseline values. Both vehicles would run at higher emission levels on gasoline fuel when converted and optimized than they would run in stock configuration.

3. The emission data taken on compressed natural gas showed greatly reduced CO emissions and significant reductions in NOx and non-methane hydrocarbons.

4. The methane emissions of the vehicles running on compressed natural gas were significantly increased.

5. The acceleration data indicates a 50-60% decrease in acceleration performance. On vehicles with marginal performance, such a conversion might result in unsafe vehicle acceleration capabilities.

6. Both CNG systems appeared to be of good quality, were easy to use, and were designed to allow fuel switching with a minimum of problems.

Table I
Chevrolet Impala - 1979
Federal Test Procedure Results in gms/mi

Test No.	Date	HC	Non-methane HC	CO	NOx	MPG Gasoline Equilavent	Miles Per 100 SCF	Comments
80-8557	4/7/81	.3948	- -	9.347	1.0056	14.9584	N/A	Baseline
80-8559	4/8/81	.3807	.3207	10.007	1.0164	14.5398	N/A	Baseline
80-8561	4/9/81	.3703	.3133	9.605	1.0715	14.7984	N/A	Baseline
At this point the vehicle was modified from stock configuration to modified with compressed natural gas equipment installed but running on gasoline.								
80-8563	4/10/81	.4377	- -	11.091	1.3173	15.5081	N/A	Modified
Vehicle driveability was very poor. The EGR valve was replaced and the carburetor was cleaned. A missing fuel filter spring was added. Further baseline tests in the stock configuration were then run.								
80-8565	4/14/81	.3947	.3438	9.065	1.8379	14.7670	N/A	Baseline
80-8567	4/15/81	.3974	.3427	9.408	1.7412	14.5369	N/A	Baseline
The vehicle was again modified to install the compressed natural gas equipment but still running on gasoline.								
80-8569	4/16/81	.4597	.4032	10.991	2.1052	14.6642	N/A	Modified
80-8571	4/17/81	.4262	.3692	10.889	2.0473	14.7190	N/A	Modified
The vehicle was optimized by the CNG system representative to run on natural gas. A final modified-gasoline test was then run.								
80-8573	4/21/81	.5061	.4405	11.584	2.1141	14.5894	N/A	Modified
The vehicle was then switched to run on natural gas:								
80-8762	4/22/81	.8313	.1487	.037	.9972	14.3	10.0	CNG
80-8764	4/23/81	.8020	- -	.115	1.1439	14.5	11.2	CNG
80-8166	4/24/81	.8124	.1514	.041	1.0764	14.6	11.3	CNG

Table II
Chevrolet Impala - 1979
Highway Fuel Economy Tests

Test No.	Date	HC	Non-methane HC	CO	NOx	MPG Gasoline Equilavent	Miles Per 100 SCF	Comments
80-8558	4/7/81	.0571	- -	1.774	1.0654	19.794	N/A	Baseline
80-8560	4/8/81	.0570	.0374	1.694	1.0791	19.757	N/A	Baseline
80-8562	4/9/81	.0666	.0448	2.464	1.0864	19.570	N/A	Baseline
At this point the vehicle was modified from stock configuration to modified with compressed natural gas equipment installed but running on gasoline.								
80-8564	4/10/81	.0989	- -	5.475	1.930	21.1166	N/A	Modified
Vehicle driveability was very poor. The EGR valve was replaced and the carburetor was cleaned. A missing fuel filter spring was added. Further baseline tests in the stock configuration were then run.								
80-8566	4/14/81	.0375	.0215	.8170	1.7629	20.6051	N/A	Baseline
80-8568	4/15/81	.0338	.0189	.6650	1.6625	21.0546	N/A	Baseline
The vehicle was again modified to install the compressed natural gas equipment but still running on gasoline.								
80-8570	4/16/81	.0462	.0260	1.262	2.7075	21.0543	N/A	Modified
80-8572	4/17/81	.0510	.0304	1.593	2.6639	20.981	N/A	Modified
The vehicle was optimized by the CNG system representative to run on natural gas. A final modified-gasoline test was then run.								
80-8574	4/21/81	.0370	.0200	.778	2.7374	20.995	N/A	Modified
The vehicle was then switched to run on natural gas:								
80-8763	4/22/81	.2876	.0459	0.0	1.3809	19.9	15.4	CNG
80-8765	4/23/81	.2696	.043	0.0	1.3313	19.4	14.8	CNG
80-8175	4/24/81	.2994	.000	0.0	1.4703	20.0	15.5	CNG
The vehicle was returned to modified-running on gasoline and a final HFET test was run.								
80-8843		.0470	.0271	1.532	2.7398	21.0886	N/A	Modified

Table III
Dodge Diplomat - 1980
Federal Test Procedure in gms/mi

Test No.	Date	HC	Non-methane HC	CO	NOx	MPG Gasoline Equilavent	Miles Per 100 SCF	Comments
80-8538	4/7/81	.4023	- -	7.3245	1.2538	16.6138	N/A	Baseline
80-8540	4/8/81	.3437	- -	6.2005	1.1000	16.7375	N/A	Baseline
80-8542	4/9/81	.4856	.3793	8.0323	1.1766	16.2075	N/A	Baseline
80-8544	4/10/81	.36901	- -	7.5846	1.1228	16.6668	N/A	Baseline
At this point the vehicle was modified from stock configuration to modified with compressed natural gas equipment installed but running on gasoline.								
80-8546	4/14/81	.47592	.3710	11.2888	2.3572	16.3241	N/A	Modified
The OSAC valve was found to have been left off during modification. The valve was re-installed.								
80-8548	4/15/81	.52962	.4201	10.2828	1.5106	15.9259	N/A	Modified
80-8550	4/16/81	.46293	.3748	8.2372	1.7140	16.2295	N/A	Modified
The vehicle was then optimized by the CNG system representative to run on CNG but remainined running on gasoline.								
0-8552	4/17/81	.25672	- -	8.9045	1.6195	16.6131	N/A	Modified
The vehicle was then switched to compressed natural gas.								
80-8554	4/21/81	1.10171	- -	.0053	1.2225	16.7	12.8	CNG
80-8556	4/22/81	1.52284	.2513	(-).0012	1.0456	17.1	13.0	CNG
80-8768	4/23/81	1.31240	.2195	.0039	1.2264	17.2	13.3	CNG
A final modified test running on gasoline was then run.								
80-8841	4/24/81	.42039	.3277	10.2605	1.4196	15.6279	N/A	Modified

Table IV
Dodge Diplomat
Highway Fuel Economy Test in gms/mi

Test No.	Date	HC	Non-methane HC	CO	NOx	MPG Gasoline Equilavent	Miles Per 100 SCF	Comments
80-8539	4/7/81	.2195	- -	1.3066	.7830	22.9667	N/A	Baseline
80-8541	4/8/81	.02082	- -	1.2292	.7817	22.7972	N/A	Baseline
80-8543	4/9/81	.02082	.0117	.9740	.8196	22.3609	N/A	Baseline
80-8545	4/10/81	.0394	- -	1.1867	.8413	22.8591	N/A	Baseline
At this point the vehicle was modified from stock configuration to modified with compressed natural gas equipment installed but running on gasoline.								
80-8547	4/14/81	.02625	.0122	1.5439	.9416	22.5938	N/A	Modified
The OSAC Valve was found to have been left off during the modification. The valve was re-installed.								
80-8549	4/15/81	.02291	.0112	.8694	.9349	22.9482	N/A	Modified
80-8551	4/16/81	.02000	.0118	.7652	.8086	22.4354	N/A	Modified
The vehicle was then optimized by the CNG System Representative to run on CNG.The vehicle was then tested on gasoline.								
80-8553	4/17/81	.01518	.0087	2.3559	.5448	21.7486	N/A	Modified
The vehicle was then switched to run on compressed natural gas.								
80-8555	4/21/81	.39475	.000	0.0	1.28353	22.5	17.2	CNG
80-8567	4/22/81	.29640	.000	0.0	.9770	23.5	18.0	CNG
80-8769	4/23/81	.51131	.0678	0.0	1.2099	23.3	18.0	CNG
A final modified test running on gasoline was then run.								
80-8769	4/24/81	.02813	.0195	1.64	.6403	22.2445	N/A	Modified

Table V
Summary of HFET Results

A. Diplomat

# of Tests	HC	HC-NM	CO	NOx	MPG Gasoline Equilavant	Miles per 1000 SCF	Comments
4	.0258	.117*	1.1741	.8064	22.746	N/A	Baseline
2	.0215	.0115	.8173	.8716	22.707	N/A	Modified
2	.0217	.0141	1.998	.5926	21.997	N/A	Modified and Optimized
3	.4008	.0226	0.0	1.1568	23.1	17.73	CNG
	-16.7%	-90.17%*	-30.39%	+8.09%	-.17%		Modified compared to Baseline
	-15.9%	-87.95%*	+70.17%	-26.51%	-3.29%		Optimized compared to Baseline
	+1453.5%	-80.68%		+43.45%	+1.56%		CNG compared to Baseline
	+1747.0%	+60.28%		+95.21%	+5.01%		CNG compared to Optimized

B. Impala

3	.0602	.0411	1.9773	1.0770	19.707	N/A	Baseline
2	.0357	.0202	.7410	1.7127	20.8299	N/A	2nd Baseline
2	.0486	.0282	1.4275	2.6857	21.010	N/A	Modified
2	.0420	.0236	1.1550	2.7386	21.0148	N/A	Modified and Optimized
3	.2855	.0296	0.0	1.3942	19.767	15.23	CNG
+ 36.13%		+39.60%	+92.65%	+55.98%	+ .86%		Modified compared to Baseline
+ 17.65%		+16.83%	+55.87%	+87.48%	+1.02%		Optimized compared to Baseline
+699.72%		+46.53%	00	-18.60%	+5.10%		CNG Compared to Baseline
+579.76%		+25.42%	00	-49.09%	-6.06%		CNG Compared to Optimized

* Only one Methane Result.

Table VI
Summary of FTP Results

A. Diplomat

# of Tests	HC	HC-HM	CO	NOx	MPG Gasoline Equilavant	Miles per 100 SCF	Comments
4	.4002	.3793*	7.2855	1.1633	15.5564	N/A	Baseline
2	.4963	.3975	9.2600	1.6123	16.0777	N/A	Modified
2	.3386	.3277	9.5825	1.5196	16.1205	N/A	Modified and Optimized
3	1.3123	.2354	.0027	1.1648	17.000	13.03	CNG
	+24.01%	+4.8%	+27.01%	+39.36%	-2.89%		Modified Compared Baseline
	- 15.4%	-13.6%*	+31.53%	+30.63%	-2.63%		Optimized Compared to Baseline
	+ 227.91%	-37.94%	-99.96%	+ .13%	+2.68%		CNG Compared to Baseline
	+ 287.57%	-28.17%	-99.97%	-30.46%	+5.46%		CNG Compared to Optimized

B. Impala

3	.3819	.3170	9.653	1.0312	14.7655	N/A	Baseline
2	.3961	.3433	9.2365	1.7412	11.652	N/A	Baseline
2	.4430	.3862	10.940	2.0763	14.6916	N/A	Modified
1	.5061	.4405	11.584	2.1141	14.5894	N/A	Modified and Optimized
1	.8152	1501	.0643	1.0725	14.4667	10.83	CNG
	+11.84%	+12.50%	+18.44%	+19.25%	+ .27%		Modified Compared to Baseline
	+27.77%	+28.31%	+25.42%	+21.42%	- .43%		Optimized Compared to Baseline
	+105.81%	-56.28%	-99.30%	-38.40%	-1.26%		CNG Compared to Baseline
	+ 61.07%	-65.93%	-99.44%	-49.27%	- .84%		CNG Compared to Optimized

*Only one Methane Result

Table VII
Acceleration Test Data

Run #	Vehicle	Time (seconds) 5 mph - 60 mph WOT		Time (seconds) 30 mph - 60 mph WOT	
		Gasoline	CNG	Gasoline	CNG
1	Diplomat	20.0	30.4	16.0	25.2
2	Diplomat	20.2	29.6	16.0	25.3
1	Impala	13.7	20.2	9.7	15.5
2	Impala	13.5	20.6	9.9	16.1

Method for Calculations of Fuel Economy of Compressed Natural Gas

1. An accurate CNG analysis based on a mole function basis is required. Attached are the two analysis of the CNG used during the test project.

2. Carbon weight fraction, carbon weight fraction not counting CO2, and hydrogen weight fraction of the CNG must then be calculated. An example is given below:

Component	Mole Fraction	Weight Carbon	Molecular Weight	Weight Hydrogen
N2	0.0450	0	1.26060	0
CO2	0.0043	0.05165	0.18924	0
Hc	0.0012	0	0.00480	0
CH4	0.9076	10.90132	14.56065	3.65933
C2H6	0.0362	0.86961	1.08854	0.21893
C3H8	0.0039	0.14053	0.17198	0.03145
i-C4H10	0.0005	0.02402	0.02906	0.00504
n-C4H10	0.0006	0.02883	0.03487	0.00605
i-C5H12	0.0002	0.01201	0.01443	0.00242
n-C5H12	0.0001	0.00601	0.00722	0.00121
C6H14	0.0002	0.01441	0.01724	0.00282
C7H16	0.0001	0.00841	0.01002	0.00161
C8H18	0.0001	0.00961	0.01142	0.00181
Totals	1.000	12.06641	17.40007	3.93068

$$\text{Carbon weight Fraction for Fuel} = \frac{\text{weight carbon}}{\text{molecular weight}} = 0.693 = X$$

$$\text{Carbon weight Fraction for exhaust hydrocarbon (not containing fuel CO2)} = \frac{\text{weight carbon not containing CO2}}{\text{molecular weight}} = 0.691 = Y$$

$$\text{Hydrogen weight Fraction of Fuel} = \frac{\text{total weight of hydrogen}}{\text{molecular weight}} = 0.226 = Z$$

3. Carbon Balance

$$\frac{\text{grams of fuel}}{\text{mile}} (X) = .429\ CO + .273\ CO2 + [Y]\ (HC)$$

HC, CO, CO2 are in grams/mile from FTP analysis.

4. Fuel Density

$$\frac{PM}{RT_{Air}} (S.G.) = \frac{14.696 \times 144 \times 28.967 \times 453.592}{1545.33 \times 520} (S.G.)\ (100)$$

= grams of fuel/100 SCF

5. Fuel Economy in Miles/100 SCF $= \dfrac{(\text{gms}/100\ SCF)(X)}{.429\ CO + .273\ CO2 + (Y)\ HC}$

6. Equivalent gasoline MPG Calculations.
Using higher heating valve from CNG Analysis for 100 SCF.

$$\text{Grams of fuel}/100\ SCF = \left(\frac{PM}{RT}\right)_{Air} S.G.$$

Grams of Hydrogen = (grams of fuel/100 SCF) (Z) = A

$$H_2O \text{ produced per } 100\ SCF = A\ \frac{((Z)\ 1.00797 + 15.9994)}{(2)\ 1.00797} = B$$

$$\text{Heating Value of } H_2O \text{ at } 60°F = \frac{(B)}{453.592}\ 1059.9\ \frac{BTU}{lb.} = C$$

Lower Heating Value = Higher Heating Value - C in BTU/100 SCF = D.

Calculate equivalent volume on a BTU basis of 1 gallon of gasoline $= \dfrac{\text{BTU of one gallon of gasoline}}{D} (100) = E$

$$\text{MPG gasoline equivalent} = \frac{\text{miles}}{100\ SCF} (E)$$

GAS ANALYSIS REPORT

OMPANY
CHIGAN CONSOLIDATED GAS COMPANY

DATE ANALYZED
4-16-81

RUN NO. 81-477

GAS ANALYSIS MOLE %		
NSUFFICIENT SAMPLE		NO
TROGEN		4.24
RBON DIOXIDE		1.23
LIUM		0.12
THANE		90.52
HANE		3.22
OPANE		0.45
BUTANE		0.06
UTANE		0.07
ENTANE		0.02
ENTANE		0.02
ANES	(C6)	0.02
TANES	(C7)	0.01
ANES	(C8)	0.01
ANES	(C9)	0.01
ANES	(C10)	
ECANES	(C11)	
ECANES	(C12)	
DECANES	(C13)	
RADECANES	(C14)	
ROGEN		
AL		100.00

GROSS HEATING VALUE (BTU/SCF)	LOCATION/14.734 SAT/14.65 DRY
CALCULATED	976 987
DETERMINED	
DETERMINED	

SPECIFIC GRAVITY	LOCATION
CALCULATED	.607
DETERMINED	
DETERMINED	

SULFUR (EXPRESSED AS H2S) GR/CCF
HYDROGEN SULFIDE
MERCAPTAN
SULFIDES
RESIDUAL
TOTAL SULFUR

OTHER	
HYDROCARBON LIQUID GAL/MCF	0.20
HYDROCARBON DEW POINT (F @ PSIG)	@
WATER DEW POINT (F @ PSIG)	@

SAMPLE INFORMATION

JECT CODE
ARTMENT TRANSPORTATION
ATION NOBLE GARAGE FOR E.P.A.
LD CITY DETROIT
E MICHIGAN
TALLATION NO.
MIT NO.
MATION
TEM
ER
CHASER
RCE
JECT GAS FUEL FOR GAS POWERED CAR
ATED TESTS

CYLINDER I.D. E.P.A.
SAMPLE NO 1
SAMPLE POINT Auto Natural Gas Tank
SAMPLING TIME
SAMPLE RECEIVED 4-16-81
ATMOSPHERIC TEMP. F.
GAS PRESSURE (PSIG)
GAS TEMP. F.
WELL HEAD PRESS. (PSIG)
FLOW MMCF/DA
SAMPLED BY D. EILERS
SAMPLING PROCEDURE
% AIR
% AIR NORMALIZED 0.00

DISTRIBUTION
DAVID EILERS & E. A. MORAN

ANALYZED BY
N. R. MCEACHERN
APPROVED BY
Edward A Moran

REMARKS

CNG SAMPLE #2
RECEIVED 24 APRIL 1981

GAS ANALYSIS REPORT

OMPANY
ICHIGAN CONSOLIDATED GAS COMPANY

DATE ANALYZED
4-23-81

RUN NO. 81-508

GAS ANALYSIS MOLE %		
SUFFICIENT SAMPLE		NO
TROGEN		3.89
RBON DIOXIDE		0.62
LIUM		0.11
THANE		91.41
HANE		3.26
OPANE		0.46
BUTANE		0.07
BUTANE		0.08
PENTANE		0.02
PENTANE		0.02
XANES	(C6)	0.02
PTANES	(C7)	0.02
TANES	(C8)	0.01
NANES	(C9)	0.01
CANES	(C10)	
DECANES	(C11)	
DECANES	(C12)	
DECANES	(C13)	
TRADECANES	(C14)	
ROGEN		
TAL		100.00

GROSS HEATING VALUE (BTU/SCF)		
	LOCATION/14.734	SAT/14.65 DRY
CALCULATED	987	998
DETERMINED		
DETERMINED		

SPECIFIC GRAVITY	
	LOCATION
CALCULATED	.600
DETERMINED	
DETERMINED	

SULFUR (EXPRESSED AS H2S) GR/CCF
HYDROGEN SULFIDE
MERCAPTAN
SULFIDES
RESIDUAL
TOTAL SULFUR

OTHER	
HYDROCARBON LIQUID GAL/MCF	0.21
HYDROCARBON DEW POINT (F @ PSIG)	@
WATER DEW POINT (F @ PSIG)	@

SAMPLE INFORMATION

JECT CODE	CYLINDER I.D. E.P.A.
ARTMENT NOBLE TRANSPORTATION	SAMPLE NO 2
ATION ANN ARBOR STATION	SAMPLE POINT E.P.A. STAND
LD CITY DETROIT	SAMPLING TIME 4-23-81 BOTTLE
TE MICHIGAN	SAMPLE RECEIVED
STALLATION NO.	ATMOSPHERIC TEMP. F.
MIT NO.	GAS PRESSURE (PSIG)
MATION	GAS TEMP. F.
STEM	WELL HEAD PRESS. (PSIG)
ER	FLOW MMCF/DA
CHASER	SAMPLED BY E.P.A.
RCE	SAMPLING PROCEDURE
JECT GAS QUALITY	% AIR
ATED TESTS E.P.A. TEST	% AIR NORMALIZED 0.00

DISTRIBUTION

E. A. MORAN & DAVE EILERS

REMARKS

ANALYZED BY
N. R. MCEACHERN

APPROVED BY
E A Moran

VEHICLE SPECIFICATION REPORT - - DATE OF ENTRY : 4/ 6/81

VEHICLE SPECIFICATIONS

MANUFACTURER	VEHICLE ID / VER	REPRESENTED CARLINE	MODEL CODE	DRIVE CODE	SOURCE
GENERAL MOTORS	1L69695255295 0		SEDAN	REAR DRIVE STR. LEFT	OTHER

VEHICLE TYPE	ACTUAL VEHICLE MODEL	MODEL YEAR	ACTIVE YEAR	DRIVE AXL WTS FULL TANK	DRIVE AXL WTS EMPTY TANK	CURB WEIGHT	INRTIA CLASS	EQUIV. TEST WEIGHT	O/D CODE	ACTUAL DYNO HP	RUNNING CHG NUMBER
NON-CER	CHEVROLET IMPALA	79	79						1	.	FULL LOAD

PRIMARY DURABILITY VEHICLE ID OR ASSIGNED DF	ALT. MANUFACTURER	TIRE - SPECIFICATIONS TIRE & RIM SIZES	MFR	CONSTR	SWL N	SWL M	BLT N	BLT M	PSI FT	PSI RR
		GR78X15B	KORDHANDLER	RADIAL						42

ENGINE SPECIFICATIONS

DISPLACEMENT	BORE	STROKE	RATED HP	ENGINE TYPE	ENGINE CONFIGURATION	NO. CYL.	NO. CARBS	TOTAL # BBLS	FUEL SYSTEM MFR/MODEL	FUEL INJCT?	TURBO?	COMP. RATIO	COAST-DOWN TM
5.0L	3.78	3.48		OTTO SPARK	V-BLOCK	8	1	2			NO	84.1	

IGNITION TIMING 1	IGNITION TIMING 2	TIM. TOL.	TIMING RPM	RPM TOL.	TIM. GEAR	% CO LEFT	% CO RIGHT	% CO COMB.	CO TOL.	IDLE RPM	IDLE TOL.	IDLE GEAR	ENGINE FAMILY		ENGINE CODE
4A		4	500	500	PARK							PARK	910624	983-1	G

DRIVE TRAIN AND CONTROL SYSTEM SPECIFICATIONS

AXLE RATIO	N/V RATIO	ODOMETER	A/C INSTALLED	EXHAUST TYPE	CRANKCASE SYSTEM	TRANSMISSION CONFIGURATION	TRANSMISSION CODE	EVAPORATION SYSTEM	FUEL TYPE
.	.	MILES	YES	SINGLE RIGHT REAR		AUTO	AUTO	CANISTER	INDOLENE 30

MAIN-TANK CAPACITY	MAIN-TANK VOLUME	AUX.-TANK CAPACITY	AUX.-TANK VOLUME	SHIFT SPEED	EVAPORATIVE EMISSION FAMILY	EVAPORATIVE EMISSION CODE	SALES CLASS
20.76	8.36						

CONTROL SYSTEM TYPES

EXHAUST RECYCLE
AIR PUMP
OXIDATION CATALYST

VEHICLE SPECIFICATION COMMENTS

DEPARTMENT ENERGY. DUEL FUEL CONVERSION VEHICLE

VEHICLE SPECIFICATION REPORT - - DATE OF ENTRY : 4/ 6/81

VEHICLE SPECIFICATIONS

MANUFACTURER	VEHICLE ID / VER	REPRESENTED CARLINE	MODEL CODE	DRIVE CODE	SOURCE
ERAL MOTORS	1L69695255295 0		SEDAN	REAR DRIVE STR. LEFT	OTHER

TICLE PE	ACTUAL VEHICLE MODEL	MODEL YEAR	ACTIVE YEAR	DRIVE AXL WTS FULL TANK	DRIVE AXL WTS EMPTY TANK	CURB WEIGHT	INRTIA CLASS	EQUIV. TEST WEIGHT	O/D CODE	ACTUAL DYNO HP	RUNNING CHG NUMBER
V-CER	CHEVROLET IMPALA	79	79						1	.	FULL LOAD

TIRE - SPECIFICATIONS

IMARY DURABILITY VEHICLE ID OR ASSIGNED DF	ALT. MANUFACTURER	TIRE & RIM SIZES	MFR	CONSTR	SWL N	SWL M	BLT N	BLT M	PSI FT	PSI RR
		GR78X15B	RORDHANDLER	RADIAL						42

ENGINE SPECIFICATIONS

SPLACEMENT	BORE	STROKE	HP	ENGINE TYPE	ENGINE CONFIGURATION	NO. CYL.	NO. CARBS	TOTAL # BBLS	FUEL SYSTEM MFR/MODEL	FUEL INJCT?	TURBO?	COMP. RATIO	COAST-DOWN TM
5.0E	3.73E	3.48E		OTTO SPARK	V-BLOCK	8	1	2			NO	84.1	

NITION MING 1	IGNITION TIMING 2	TIM. TOL.	TIMING RPM	RPM TOL.	TIM. GEAR	% CO LEFT	% CO RIGHT	% CO COMB.	CO TOL.	IDLE RPM	IDLE TOL.	IDLE GEAR	ENGINE FAMILY	ENGINE CODE
4A		4	500	500	PARK							PARK	910624 983-1	G

DRIVE TRAIN AND CONTROL SYSTEM SPECIFICATIONS

LE TIO	N/V RATIO	ODOMETER	A/C INSTALLED	EXHAUST TYPE	CRANKCASE SYSTEM	TRANSMISSION CONFIGURATION	TRANSMISSION CODE	EVAPORATION SYSTEM	FUEL TYPE
.	.	MILES	YES	SINGLE RIGHT REAR		AUTO	AUTO	CANISTER	INDOLENE 30

MAIN-TANK PACITY	MAIN-TANK VOLUME	AUX.-TANK CAPACITY	AUX.-TANK VOLUME	SHIFT SPEED	EVAPORATIVE EMISSION FAMILY	EVAPORATIVE EMISSION CODE	SALES CLASS
20.76	8.36						

CONTROL SYSTEM TYPES

EXHAUST RECYCLE	AIR PUMP	OXIDATION CATALYST		

VEHICLE SPECIFICATION COMMENTS

DEPARTMENT ENERGY, DUEL FUEL CONVERSION VEHICLE