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AN INVESTIGATION OF FUEL ECONOMY POTENTIAL OF SIX 1976-MODEL VEHICLES

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R. D. Fleming and A. D. Campbell

Date Published—July 1977

Bartlesville Energy Research Center
Energy Research and Development Administration
Bartlesville, Oklahoma

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by

R. D. Fleming[1] and A. D. Campbell[2]

ABSTRACT

Experimental work was performed to determine the fuel-economy potential of eighteen 1976 model automobiles representing six different models ranging in weight from 3,000 to 5,000 lb. The fuel-economy potential was determined by adjusting the engines to best fuel economy achievable with acceptable driveability but without constraints on emissions. Comparable data obtained on the vehicles adjusted per manufacturers' specifications provided baseline data from which to quantify fuel-economy differential brought about by imposing emission controls to meet 1976 Federal emission standards.

In results of tests with six different 1976 model automobiles, combined city/highway fuel economy improved within the range 4.3 to 14.1 pct when constraints upon engine parametric adjustments were removed. The average fuel-economy improvement for all six car models was 8.6 pct. Results on fuel economy and emissions for urban, highway, and steady-state driving cycles are discussed.

INTRODUCTION

Automobile fuel economy has been a factor in engine design for many years; with today's energy shortage and with the mandated fuel-economy standards for the 1978-85 period (12)[3] it has become one of the most significant factors to be considered in design of engines and/or vehicle systems. Numerous studies (1-4, 8-10) have shown that fuel economy of automobiles decreased for model years 1967 to 1974--a period during which emission constraints were progressively tightened. Beginning with the 1975 models, the trend has been toward improving fuel economy while meeting requisite emission-control levels.

The Bartlesville (Okla.) Energy Research Center of the U.S. Energy Research and Development Administration has experimentally investigated 1976 model automobiles to provide an estimate of the fuel-economy potential of engines used in current-model vehicles. The report updates information previously reported on 1975 model vehicles (7).

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[1]Mechanical engineer.
[2]Continental Engine Corp., formerly a mechanical engineer with ERDA.
[3]Underlined numbers in parentheses refer to items in the list of references at the end of this report.

The precise value of fuel economy for a given vehicle depends upon the type of emission control system and/or driving cycle. An estimate of the fuel-economy potential of a given vehicle engine can be determined by removing the emission controls and optimizing the engine parameters for best fuel economy. Comparing this potential fuel economy with the fuel economy of the same vehicle equipped with emission controls gives a measure of the potential improvement in fuel-economy with improved emission control techniques. Knowledge of the potential fuel-economy improvement is useful because, given an emission requirement and a control system fully compatible with best economy, it represents the maximum possible gain in fuel economy for that engine technology.

This report presents results obtained from experimental work with vehicles from six 1976 models. The report includes data both from engines adjusted to best economy without emission constraints and from the same engines with standard adjustments and equipped with emission control.

DISCUSSION OF EXPERIMENTAL PROGRAM

Description of Test Vehicles

Six 1976 model vehicles were selected to represent high-volume production vehicles in weight classes ranging from 3,000 to 5,000 lb (1,351 to 2,268 kg). The six different models were represented with three identical vehicles of each model for a total of 18 vehicles to provide a good representation of data. The six models selected for the study are described in table 1. All 18 vehicles were equipped with automatic transmissions and radial-ply tires.

TABLE 1. - Description of test vehicles

Year and make of automobile	Engine displacement, cu in (liter)	Number carburetor barrels	Emission control system	Rear axle ratio	Engine speed/ vehicle speed ratio (N/V) rpm/mph[1]	Curb weight, lb, (kg)	Inertia setting used in tests, lb (kg)
1976 Chevrolet Vega	140 (2.29)	2	Oxidation catalyst, exhaust gas recirculation, (EGR)/evaporative canister	2.92	47.0	2,660 (1,206)	3,000 (1,361)
1976 Dodge Dart	225 (3.69)	1	Oxidation catalyst and exhaust gas recirculation	2.76	41.0	3,320 (1,506)	3,500 (1,588)
1976 Chevrolet Nova	250 (4.10)	1	Oxidation catalyst and exhaust gas recirculation	2.73	38.8	3,440 (1,560)	3,500 (1,588)
1976 Ford Granada	250 (4.10)	1	Oxidation catalyst, air pump, and exhaust gas recirculation	2.79	41.8	3,440 (1,560)	4,000 (1,814)
1976 Ford Torino	351 (5.75)	2	Oxidation catalyst, air pump, and exhaust gas recirculation	2.79	37.6	4,230 (1,919)	4,500 (2,041)
1976 Chevrolet Impala	350 (5.75)	2	Oxidation catalyst and exhaust gas recirculation	3.08	41.1	4,240 (1,923)	5,000 (2,268)

[1]Engine speed/vehicle speed ratio was determined on chassis dynamometer with vehicle operating at 50 mph cruise.

The inertia weight settings used in dynamometer tests were selected to match the settings used by the Environmental Protection Agency (EPA) in certification tests for similar vehicles.

Fuel Used

A single batch of unleaded gasoline (Indolene procured from American Oil Co.) was used throughout the test program. Inspection data for the fuel are given in table 2.

TABLE 2. - Fuel inspection data

Gravity, °API	61.1
Reid vapor pressure, psi	10.0
Octane number:	
Research	92.0
Motor	84.3
Hydrogen/carbon atom ratio	1.88
Lead, g/gal	0.03
Sulfur content, wt-pct	0.05
Distillation, ASTM D-86, °F:	
IBP	88
Pct evaporated:	
10	126
20	154
30	181
50	225
70	264
90	340
End point	415
Composition, vol-pct, GLC:	
Paraffins	65
Olefins	10
Aromatics	25

Dynamometer Equipment and Test Conditions

All vehicle tests were conducted with vehicles operated on a chassis dynamometer with ambient temperature controlled at 75° F. The vehicles were operated on three different test cycles: the 1975 Federal test procedure (1975 FTP) (6); the EPA highway fuel economy test cycle (HWFET) (5); and steady-state operation at idle, 20, 30, 40, 50, and 60 mph cruise with dynamometer load adjusted as specified for the cycle test procedure.

Measurement of Fuel Economy and Emissions

During tests involving the determination of emissions, exhaust was sampled in accordance with the 1975 FTP while the vehicle was driven through the EPA urban driving cycle (6). Exhaust gas was sampled using a constant volume sampler and was analyzed for carbon monoxide (CO), carbon dioxide (CO_2), hydrocarbon (HC), and oxides of nitrogen (NO_x). Analytical methods as specified for the FTP procedure were used (i.e., CO and CO_2 by nondispersive infrared, HC by flame ionization detection, and NO_x by a chemiluminescence analyzer).

Fuel economy values for the urban, highway, and steady-state driving cycles were calculated on the basis of the carbon balance method utilizing the measured mass emissions of CO, CO_2, and HC and using the known hydrogen-to-carbon ratio of the fuel (table 2).

During steady-state tests, the raw exhaust was sampled and analyzed for oxygen (O_2) for the purpose of calculation of air-fuel ratio (A/F). (The method for calculating A/F is given in appendix A.) Oxygen content was determined using a polarographic instrument.

Experimental Test Procedures

Each of the vehicles was tested using two different test configurations to obtain data to determine the fuel-economy potential of the vehicles and to quantify the fuel-economy differential brought about by imposing emission controls to meet the current emission standards. The two configurations were:

1) As configured for a standard production vehicle with emission-control devices operative and engine parameters adjusted to manufacturer's specifications. This configuration was used in the baseline tests.

2) As equipped for a standard production vehicle except with emission-control devices removed and/or made inoperative. This version was used in work to determine best fuel economy.

To determine the best economy adjustments for each vehicle model, one vehicle from each set of three was extensively tested using special hot-start and steady-state tests to determine optimum A/F and spark-timing schedules. A detailed description of procedures for the optimization work is provided in appendix B. Once the set of best-economy adjustments was known for a given vehicle model, these specified adjustments were applied to the other two vehicles that represented that given model. In summary, best economy adjustments were determined from results of experimentation with only six vehicles (that is, one of each of the models in the test program). The 1975 FTP, HWFET, and steady-state tests were run for all 18 vehicles representing six models with triplicate vehicles of each model. Two replicate tests were made for each combination of test procedure, test vehicle, and vehicle configuration, i.e., standard and best economy. All vehicles were operated on the road using a mixture of city and highway driving for at least 4,000 miles before starting tests of fuel economy and emissions.

EXPERIMENTAL RESULTS AND DISCUSSION

Comparison of Baseline Fuel Economy With EPA Certification Results

Fuel economy determined using a dynamometer test procedure for any given vehicle model may vary depending on vehicle-to-vehicle variations and includes also dynamometer-to-dynamometer variations. Recognizing the existence of such variation, fuel economy for baseline tests are compared with values determined by EPA during certification tests on similar vehicle models (table 3). Combined city/highway[4] fuel economy for the six vehicle models tested by EPA for certification ranged from 3.8 pct lower to 9.2 pct higher than that determined by the Bartlesville Energy Research Center (BERC) on similar vehicles; the average difference for the six vehicle models was 2.6 pct higher (EPA showing the better fuel economy). The primary cause of these differences could be (1) vehicle-to-vehicle variability, (2) different instrument calibrations between laboratories, or (3) differences in dynamometer load characteristics. Vehicle-to-vehicle variability is probably not the primary cause of differences in fuel economy because BERC results from most of the individual

[4]The combined city/highway fuel economy is a weighted harmonic mean using weighting factors of 55 pct for city driving (1975 FTP) and 45 pct for highway driving (EPA highway cycle). The 55/45 ratio of city-to-highway driving was determined by the U.S. Department of Transportation as typical for passenger car operation in the United States (13).

vehicles, as well as averages, appear to give lower fuel economy than similar models tested by EPA. Experience in the BERC laboratory comparing fuel economy determined by carbon balance, and fuel economy determined by direct measurement (gravimetric methods) shows that at BERC direct-measured fuel economy is generally lower than carbon balance fuel economy by about 3.9 pct. These factors considered, BERC investigators believe that the difference between EPA and BERC-generated fuel economy values does not result from analytical instrument differences affecting carbon balance calculations but instead probably is due to differences in loading characteristics of the different dynamometers. There are two major differences between dynamometers at EPA and BERC:

	Roll spacing, inches	Inertia drive, type
EPA.....	17.25	Direct
BERC.....	20.00	Belt

Both the roll-spacing and inertia drive differences will influence fuel economy for a given vehicle in the directions that agree with the observations of table 3. According to a 1975 EPA-MVMA (Motor Vehicle Manufacturers Association) correlation study (11), dynamometers with belt-drive inertia systems average about 6 pct higher positive torque during the urban driving cycle than similar dynamometers with direct-drive inertia systems.

TABLE 3. - Fuel economy for 1976 model cars compared to EPA certification results

Vehicle	Fuel economy, mpg						Difference between EPA and BERC results,[1] pct		
	Combined city/highway		City		Highway		Combined city/highway	City	Highway
	EPA	BERC[2]	EPA	BERC[2]	EPA	BERC[2]			
Chevrolet Vega....	23.3	22.7	20.1	19.5	28.9	28.5	2.6	3.1	1.4
Dodge Dart.....	20.3	21.1	18.2	18.8	23.7	24.8	-3.8	3.2	-4.4
Chevrolet Nova....	20.2	18.5	18.0	16.0	23.9	22.6	9.2	12.5	5.8
Ford Granada.....	18.0	17.2	16.2	15.5	20.7	19.9	4.7	4.5	4.0
Ford Torino.....	15.3	15.2	13.4	13.1	18.5	18.9	.7	2.3	-2.1
Chevrolet Impala..	14.5	14.2	12.8	12.3	17.3	17.6	2.1	4.1	-1.7

[1]Pct difference = $\frac{\text{(fuel economy) EPA - (fuel economy) BERC}}{\text{(fuel economy) EPA}} \times 100$

[2]Each value represents the harmonic average of six test results (3 vehicles for each model and 2 replicate tests for each car).

Thus, as suggested above it appears that dynamometer loading probably accounts for the small difference in fuel economy between EPA's certification results and BERC's baseline results as shown in table 3. With this difference existing, it is important to recognize that for purposes of estimating the potential improvement in fuel economy from results of this study, the best

economy results should be compared with BERC baseline values rather than with fuel economy values published by EPA. It is also important to note that, per se, lack of agreement between EPA certification fuel economy values and the BERC values does in no sense put in question the estimate of differential between baseline and best-economy values as generated in this BERC work.

Results From Urban and Highway Driving Cycles

For each of the 18 vehicles tested, results were obtained for urban (1975 FTP) and EPA highway driving cycles for both baseline and best economy configurations. (Procedures for determining best economy adjustments are described in appendix B.) Fuel economy values for combined city/highway driving of the six vehicle models are summarized in table 4. Results show that the fuel-economy gain when comparing the best economy configuration with the baseline, ranged from 4.3 pct for the Dodge Darts to 14.1 pct for the Chevrolet Novas with the average gain being 8.6 pct for all six vehicle models. This suggests that for engine technology at the 1976 stage of development, about 8 pct improvement in fuel economy might be possible given an emission control system that is fully compatible with best fuel economy.

TABLE 4. - Summary of fuel economy of six 1976 model automobiles

(Economy of standard production cars compared to economy achievable via readjustment for best fuel economy without emission constraints)

Vehicle	Combined city/highway fuel economy, mpg[1]				Fuel economy gain relative to production vehicle, pct
	Engine size, CID	Inertia weight setting, lb	Production vehicle (baseline)	Adjusted to best economy	
Chevrolet Vega	140	3,000	22.7	24.7	8.8
Dodge Dart	225	3,500	21.1	22.0	4.3
Chevrolet Nova	250	3,500	18.5	21.1	14.1
Ford Granada	250	4,000	17.2	18.8	9.3
Ford Torino	351	4,500	15.2	16.4	7.9
Chevrolet Impala	350	5,000	14.2	15.2	7.0
Average fuel economy gain.....					8.6

[1]Each fuel economy value represents the average of six determinations (i.e. three vehicles and two replicate tests for each vehicle).

Carbon monoxide emissions (table 5) for the six vehicle models adjusted to best economy ranged from 5.07 g/mile (3.15 g/km) for the Dodge Darts to 20.2 g/mile (12.6 g/km) for the Chevrolet Impalas. The average CO emission from the six vehicle models was 8.37 g/mile (5.70 g/km). Carbon monoxide emissions for the baseline vehicles were in the range of 1.66 g/mile (1.03 g/km) for the Ford Granadas to 13.5 g/mile (8.39 g/km) for the Chevrolet Impalas. Note that both the Chevrolet Vegas and Dodge Darts are shown to have lower CO emissions in the best economy configuration (without emission control) than is the case for the same cars with emission controls. This was because carburetor calibration for best economy was leaner than that for the baseline calibration for the same vehicles.

TABLE 5. - Summary of emissions from six 1976 model automobiles

(Economy of standard production cars compared to economy achievable via readjustment for best fuel economy without emission constraints)

Exhaust component	Vehicle	Engine size, CID	Inertia weight setting, lb	Emissions, g/mile (g/km)[1]	
				Production vehicle (baseline)	Adjusted to best economy
Carbon monoxide	Chevrolet Vega	140	3,000	12.7 (7.89)	5.39 (3.35)
	Dodge Dart	225	3,500	5.52 (3.43)	5.07 (3.15)
	Chevrolet Nova	250	3,500	5.89 (3.66)	7.35 (4.57)
	Ford Granada	250	4,000	1.66 (1.03)	5.50 (3.42)
	Ford Torino	351	4,500	6.01 (3.73)	6.73 (4.18)
	Chevrolet Impala	350	5,000	13.5 (8.39)	20.2 (12.6)
Hydrocarbon	Chevrolet Vega	140	3,000	0.89 (0.55)	1.45 (0.99)
	Dodge Dart	225	3,500	.92 (.57)	1.96 (1.22)
	Chevrolet Nova	250	3,500	.61 (.38)	2.02 (1.26)
	Ford Granada	250	4,000	.76 (.47)	1.97 (1.22)
	Ford Torino	351	4,500	.64 (.40)	2.51 (1.56)
	Chevrolet Impala	350	5,000	.82 (.51)	2.55 (1.58)
Oxides of nitrogen	Chevrolet Vega	140	3,000	1.48 (0.92)	4.13 (2.57)
	Dodge Dart	225	3,500	2.65 (1.65)	8.53 (5.30)
	Chevrolet Nova	250	3,500	2.22 (1.38)	3.77 (2.34)
	Ford Granada	250	4,000	2.45 (1.52)	11.3 (7.02)
	Ford Torino	351	4,500	2.46 (1.53)	5.71 (3.55)
	Chevrolet Impala	350	5,000	2.11 (1.31)	7.60 (4.72)

[1]Each emission value represents the average of six determinations (i.e. three vehicles and two replicate tests for each vehicle).

Hydrocarbon emissions (table 5) for the best economy configuration ranged from 1.45 g/mile (0.90 g/km) for the Chevrolet Vegas to 2.55 g/mile (1.58 g/km) for the Chevrolet Impalas. Average HC emissions from the six vehicle models adjusted to best economy was 2.08 g/mile (1.29 g/km). Hydrocarbon emissions from all of the baseline vehicles were well below the 1.5 g/mile standard for 1976.

Oxides of nitrogen emission (table 5) varied from 3.77 g/mile (2.34 g/km) for the Chevrolet Novas to 11.3 g/mile (7.02 g/km) for the Ford Granadas when the vehicles were adjusted to best economy. The average NO_x emission for all six vehicle models was 6.84 g/mile (4.25 g/km) for the best economy calibration. All the baseline vehicles were within 3.1 g/mile NO_x standard for 1976.

Additional data on fuel economy and emissions are given in tables 6 through 11; included in these tables are results from individual vehicles. Also given in the tables are fuel economy from both the city (1975 FTP) and highway driving cycles. More detailed data including results from replicate tests are given in appendix C.

To determine how effective catalytic converters would be in reducing emissions from the vehicles adjusted to best economy, one vehicle from each of the six models was used, and two replicate tests were run with the catalytic converters installed while the vehicles were still adjusted for best economy.

Results (table 12) from these tests show that CO from the six vehicles ranged from 1.65 g/mile (1.03 g/km) to 4.23 g/mile (2.63 g/km) with best economy adjustments and catalytic conversion. The six vehicle average indicates a reduction (due to catalytic converters) in CO from 6.23 g/mile (3.87 g/km) to 2.74 g/mile (1.70 g/km) or about a 56 pct reduction. Hydrocarbon emissions with the catalytic converters ranged from 0.31 g/mile (0.19 g/km) to 1.12 g/mile (0.70 g/km). Hydrocarbon emissions (six vehicle average) were reduced from 2.09 g/mile (1.30 g/km) to 0.68 g/mile (0.42 g/km) or about 67 pct reduction due to the addition of catalytic converters. Oxides of nitrogen were not significantly affected by the catalytic converter as is indicated by the six vehicle averages (table 12).

Oxides of nitrogen emissions for the best economy configuration can be greatly affected by small changes in spark advance, whereas fuel economy is affected to a much lesser degree for the same changes in spark advance. For this reason, one could postulate that with a higher degree of sophistication in spark-advance control (such as computerized spark control), NO_x levels with a best-economy calibration could be reduced to values lower than those reported in this report. Similarily, with proper tailoring of exhaust gas recirculation (EGR) rates, NO_x levels substantially lower than those reported in tables 5 through 11 for a best economy calibration might be achieved with no penalty in fuel economy. However, to reduce NO_x to a level required by the 1976 standards, fuel-economy penalties on the order of those reported are incurred. Note that it was beyond the scope of this experimental work to use other than conventional hardware for spark-advance control in the best-economy configurations.

TABLE 6. - Fuel economy and emissions of 1976 Chevrolet Vegas with 140-CID engines

(Economy of standard production cars compared to economy achievable via readjustment for best fuel economy without emission constraints)

Test cycle	Vehicle No.	Fuel economy, mpg Fuel consumption (liter/100 km) Production vehicle (baseline)	Adjusted for best economy	Fuel economy gain relative to production vehicle, pct
1975 FTP	138	19.4 (12.1)	21.6 (10.9)	11.3
	139	19.2 (12.2)	21.8 (10.8)	13.5
	[1]140	19.8 (11.9)	22.0 (10.7)	11.1
	Average....	19.5 (12.1)	21.8 (10.8)	11.8
EPA Highway cycle	138	27.7 (8.49)	27.7 (8.49)	0.0
	139	28.6 (8.22)	30.6 (7.69)	7.0
	[1]140	29.1 (8.08)	30.6 (7.69)	5.2
	Average....	28.5 (8.26)	29.6 (7.95)	3.9
Combined city/highway	138	22.4 (10.5)	24.0 (9.80)	7.1
	139	22.6 (10.4)	25.0 (9.41)	10.6
	[1]140	23.1 (10.2)	25.2 (9.33)	9.1
	Average....	22.7 (10.4)	24.7 (9.52)	8.8
Exhaust component		Emissions, g/mile (g/km)		
Carbon monoxide	138	14.3 (8.89)	4.86 (3.02)	
	139	8.81 (5.47)	4.90 (3.04)	
	[1]140	15.0 (9.32)	6.40 (3.98)	
	Average....	12.7 (7.89)	5.39 (3.35)	
Hydrocarbon	138	1.14 (0.71)	1.33 (0.83)	
	139	.84 (.52)	1.62 (1.01)	
	[1]140	.69 (.43)	1.41 (.88)	
	Average....	.89 (.55)	1.45 (.90)	
Oxides of nitrogen	138	1.28 (0.80)	4.38 (2.72)	
	139	1.70 (1.06)	4.32 (2.68)	
	[1]140	1.46 (.91)	3.70 (2.30)	
	Average....	1.48 (.92)	4.13 (2.57)	

[1] Vehicle 140 was used to determine best-economy adjustments.

TABLE 7. - Fuel economy and emissions of 1976 Dodge Darts with 225-CID engines

(Economy of standard production cars compared to economy achievable via readjustment for best fuel economy without emission constraints)

Test cycle	Vehicle No.	Fuel economy, mpg Fuel consumption (liter/100 km) Production vehicle (baseline)	Adjusted for best economy	Fuel economy gain relative to production vehicle, pct
1975 FTP	[1]130	18.6 (12.6)	18.9 (12.4)	1.6
	131	19.0 (12.4)	19.4 (12.1)	2.1
	137	18.8 (12.5)	19.5 (12.0)	3.7
	Average...	18.8 (12.5)	19.3 (12.2)	2.7
EPA Highway cycle	[1]130	24.0 (9.80)	25.7 (9.15)	7.1
	131	25.3 (9.30)	27.5 (8.55)	8.7
	137	25.1 (9.37)	26.2 (8.98)	4.4
	Average...	24.8 (9.48)	26.5 (8.88)	5.6
Combined city/highway	[1]130	20.7 (11.3)	21.5 (10.9)	3.9
	131	21.4 (11.0)	22.4 (10.5)	4.7
	137	21.2 (11.1)	22.0 (10.7)	3.8
	Average...	21.1 (11.1)	22.0 (10.7)	4.3
Exhaust component		Emissions, g/mile (g/km)		
Carbon monoxide	[1]130	8.31 (5.16)	4.77 (2.96)	
	131	3.55 (2.21)	4.41 (2.74)	
	137	4.71 (2.93)	6.04 (3.75)	
	Average...	5.52 (3.43)	5.07 (3.15)	
Hydrocarbon	[1]130	1.09 (0.68)	1.67 (1.04)	
	131	.85 (.53)	2.69 (1.67)	
	137	.82 (.51)	1.53 (.95)	
	Average...	.92 (.57)	1.96 (1.22)	
Oxides of nitrogen	[1]130	2.84 (1.76)	9.49 (5.90)	
	131	2.39 (1.49)	8.04 (5.00)	
	137	2.72 (1.69)	8.06 (5.01)	
	Average...	2.65 (1.65)	8.53 (5.30)	

[1] Vehicle 130 was used to determine best-economy adjustments.

TABLE 8. - Fuel economy and emissions of 1976 Chevrolet Novas with 250-CID engines

(Economy of standard production cars compared to economy achievable via readjustment for best fuel economy without emission constraints)

Test cycle	Vehicle No.	Fuel economy, mpg Fuel consumption (liter/100 km) Production vehicle (baseline)	Adjusted for best economy	Fuel economy gain relative to production vehicle, pct
1975 FTP	132	15.4 (15.3)	17.6 (13.4)	14.3
	[1]133	15.6 (15.1)	19.0 (12.4)	21.8
	134	17.0 (13.8)	18.4 (12.8)	8.2
	Average...	16.0 (14.7)	18.3 (12.9)	14.4
EPA Highway cycle	132	21.3 (11.0)	25.3 (9.30)	18.8
	[1]133	24.6 (9.56)	25.9 (9.08)	5.3
	134	22.6 (10.4)	26.0 (9.06)	15.0
	Average...	22.8 (10.3)	25.7 (9.15)	13.7
Combined city/highway	132	17.6 (13.4)	20.4 (11.5)	15.9
	[1]133	18.7 (12.6)	21.6 (10.9)	15.5
	134	19.2 (12.3)	21.2 (11.1)	10.4
	Average...	18.5 (12.7)	21.1 (11.2)	14.1
Exhaust component		Emissions, g/mile (g/km)		
Carbon monoxide	132	10.8 (6.71)	12.1 (7.52)	
	[1]133	3.12 (1.94)	5.71 (3.55)	
	134	3.78 (2.35)	4.25 (2.64)	
	Average...	5.89 (3.66)	7.35 (4.57)	
Hydrocarbon	132	0.83 (0.52)	1.92 (1.19)	
	[1]133	.40 (.25)	2.49 (1.55)	
	134	.61 (.38)	1.66 (1.03)	
	Average...	.61 (.38)	2.02 (1.26)	
Oxides of nitrogen	132	2.04 (1.27)	3.75 (2.33)	
	[1]133	2.63 (1.63)	3.79 (2.35)	
	134	1.98 (1.23)	3.28 (2.04)	
	Average...	2.22 (1.38)	3.77 (2.34)	

[1] Vehicle 133 was used to determine best-economy adjustments.

TABLE 9. - Fuel economy and emissions of 1976 Ford Granadas with 250-CID engines

(Economy of standard production cars compared to economy achievable via readjustment for best fuel economy without emission constraints)

Test cycle	Vehicle No.	Fuel economy, mpg Fuel consumption (liter/100 km) Production vehicle (baseline)	Adjusted for best economy	Fuel economy gain relative to production vehicle, pct
1975 FTP	[1]117	16.1 (14.6)	16.2 (14.5)	0.6
	118	15.6 (15.1)	17.2 (13.7)	10.3
	119	14.8 (15.9)	16.6 (14.2)	12.2
	Average...	15.5 (15.2)	16.7 (14.1)	7.7
EPA Highway cycle	[1]117	20.5 (11.5)	22.0 (10.7)	7.3
	118	20.4 (11.5)	23.0 (10.2)	12.7
	119	18.8 (12.5)	22.3 (10.5)	18.6
	Average...	19.9 (11.8)	22.5 (10.5)	13.6
Combined city/highway	[1]117	17.8 (13.2)	18.3 (12.8)	2.8
	118	17.4 (13.5)	19.4 (12.1)	11.5
	119	16.4 (14.3)	18.7 (12.5)	14.0
	Average...	17.2 (13.7)	18.8 (12.4)	9.3
Exhaust component		Emissions, g/mile (g/km)		
Carbon monoxide	[1]117	3.14 (1.95)	3.99 (2.48)	
	118	1.10 (.68)	5.06 (3.14)	
	119	.74 (.46)	7.45 (4.63)	
	Average...	1.66 (1.03)	5.50 (3.42)	
Hydrocarbon	[1]117	1.04 (0.65)	1.86 (1.16)	
	118	.68 (.42)	2.11 (1.31)	
	119	.56 (.35)	1.94 (1.21)	
	Average...	.76 (.47)	1.97 (1.22)	
Oxides of nitrogen	[1]117	2.17 (1.35)	11.2 (6.96)	
	118	2.84 (1.76)	12.3 (7.64)	
	119	2.35 (1.46)	10.3 (6.40)	
	Average...	2.45 (1.52)	11.3 (7.02)	

[1] Vehicle 117 was used to determine best-economy adjustments.

TABLE 10. - Fuel economy and emissions of 1976 Ford Torinos with 351-CID engines

(Economy of standard production cars compared to economy achievable via readjustment for best fuel economy without emission constraints)

Test cycle	Vehicle No.	Fuel economy, mpg Fuel consumption (liter/100 km) Production vehicle (baseline)	Adjusted for best economy	Fuel economy gain relative to production vehicle, pct
1975 FTP	[1]126	13.9 (16.9)	14.6 (16.1)	5.0
	128	12.0 (19.6)	13.4 (17.6)	11.7
	136	13.5 (17.4)	13.8 (17.0)	2.2
	Average..	13.1 (17.8)	13.9 (16.9)	6.1
EPA Highway cycle	[1]126	20.0 (11.8)	21.5 (10.9)	7.5
	128	17.2 (13.7)	21.2 (11.1)	20.6
	136	19.2 (12.3)	20.5 (11.5)	6.8
	Average..	18.9 (12.4)	21.0 (11.1)	11.1
Combined city/highway	[1]126	16.1 (14.6)	17.0 (13.8)	5.6
	128	14.0 (16.8)	16.0 (14.7)	14.3
	136	15.6 (15.1)	16.2 (14.5)	3.8
	Average..	15.2 (15.4)	16.4 (14.3)	7.9
Exhaust component		Emissions, g/mile (g/km)		
Carbon monoxide	[1]126	5.97 (3.71)	7.00 (4.35)	
	128	4.55 (2.83)	5.28 (3.28)	
	136	7.52 (4.67)	7.93 (4.93)	
	Average..	6.01 (3.73)	6.73 (4.18)	
Hydrocarbon	[1]126	0.65 (0.40)	2.11 (1.31)	
	128	.45 (.28)	2.51 (1.56)	
	136	.87 (.51)	2.91 (1.81)	
	Average..	.64 (.40)	2.51 (1.56)	
Oxides of nitrogen	[1]126	2.77 (1.72)	5.59 (3.47)	
	128	2.13 (1.32)	5.20 (3.23)	
	136	2.63 (1.63)	6.33 (3.93)	
	Average..	2.46 (1.53)	5.71 (3.55)	

[1] Vehicle 126 was used to determine best-economy adjustments.

TABLE 11. - Fuel economy and emissions of 1976 Chevrolet Impalas with 350-CID engines

(Economy of standard production cars compared to economy achievable via readjustment for best fuel economy without emission constraints)

Test cycle	Vehicle No.	Fuel economy, mpg Fuel consumption (liter/100 km) Production vehicle (baseline)	Adjusted for best economy	Fuel economy gain relative to production vehicle, pct
1975 FTP	[1]114	11.9 (19.8)	13.0 (18.1)	9.2
	121	12.3 (19.1)	13.2 (17.8)	7.3
	122	12.7 (18.5)	13.5 (17.4)	6.3
	Average...	12.3 (19.1)	13.2 (17.8)	7.3
EPA highway cycle	[1]114	17.2 (13.7)	18.5 (12.7)	7.6
	121	17.4 (13.5)	17.9 (13.1)	2.9
	122	18.1 (13.0)	19.0 (12.4)	5.0
	Average...	17.6 (13.4)	18.5 (12.7)	5.1
Combined city/highway	[1]114	13.8 (17.0)	15.0 (15.7)	8.7
	121	14.2 (16.6)	15.0 (15.7)	5.6
	122	14.6 (16.0)	15.5 (15.1)	6.2
	Average...	14.2 (16.6)	15.2 (15.5)	7.0
Exhaust component		Emissions, g/mile (g/km)		
Carbon monoxide	[1]114	6.86 (4.26)	14.6 (9.07)	
	121	13.0 (8.08)	25.8 (16.0)	
	122	20.6 (12.8)	20.1 (12.5)	
	Average...	13.5 (8.39)	20.2 (12.6)	
Hydrocarbon	[1]114	0.80 (0.50)	2.22 (1.38)	
	121	.70 (.43)	2.87 (1.78)	
	122	.95 (.59)	2.56 (1.59)	
	Average...	.82 (.51)	2.55 (1.58)	
Oxides of nitrogen	[1]114	2.17 (1.35)	6.88 (4.28)	
	121	2.08 (1.29)	8.20 (5.10)	
	122	2.09 (1.30)	7.71 (4.79)	
	Average...	2.11 (1.31)	7.60 (4.72)	

[1] Vehicle 114 was used to determine best-economy adjustments.

Fuel economy for the best-economy calibration with and without catalytic converters is compared in table 13 for six cars. Results indicate that the catalytic converter may have penalized fuel economy slightly for some of the vehicles, but the two replicate runs for each vehicle was insufficient to show a statistically significant difference in fuel economy.

TABLE 12. - Emissions of six 1976 model vehicles adjusted to best economy--with and without catalytic converter

Exhaust component	Vehicle No.	Emissions, g/mile (g/km) Without catalytic convertor	With catalytic convertor
Carbon monoxide	139	4.90 (3.04)	3.46 (2.15)
	131	4.41 (2.74)	3.27 (2.03)
	134	4.25 (2.64)	2.18 (1.35)
	117	3.99 (2.48)	1.66 (1.03)
	128	5.28 (3.28)	4.23 (2.63)
	114	14.6 (9.07)	1.65 (1.03)
	Six car average.....	6.23 (3.87)	2.74 (1.70)
Hydrocarbon	139	1.62 (1.01)	0.58 (0.36)
	131	2.69 (1.67)	1.12 (0.70)
	134	1.66 (1.03)	0.64 (0.40)
	117	1.86 (1.16)	0.78 (0.48)
	128	2.51 (1.56)	0.64 (0.40)
	114	2.22 (1.38)	0.31 (0.19)
	Six car average.....	2.09 (1.30)	0.68 (0.42)
Oxides of nitrogen	139	4.32 (2.68)	4.16 (2.58)
	131	8.04 (5.00)	8.50 (5.28)
	134	3.79 (2.35)	3.71 (2.31)
	117	11.2 (6.96)	11.1 (6.90)
	128	5.20 (3.23)	5.28 (3.28)
	114	6.88 (4.28)	7.04 (4.37)
	Six car average.....	6.57 (4.08)	6.63 (4.12)

Results from Steady-State Tests

Following the chassis dynamometer tests involving the 1975 FTP and EPA highway driving schedules, each vehicle was operated on the dynamometer at idle, 20, 30, 40, 50, and 60 mph cruise for purposes of recording engine parametric adjustment in terms of engine speed, spark timing, manifold vacuum, A/F, fuel economy, and emissions.

Data from each of the steady-state test runs including replicate tests (for both baseline and best economy adjustments) are given in tables D-1 through D-18.

Results from each of the six vehicle models are presented in figures 1 through 6. Each point in the figure represents the average of six data points--that is, data from three vehicles for each model and two replicate tests for each vehicle.

TABLE 13. - Fuel economy of six 1976 model vehicles adjusted to best economy--with and without catalytic converter

Vehicle No.	Fuel economy (1975-FTP), mpg (fuel consumption, l/100 km)	
	Without catalytic converter	With catalytic converter
139.....	21.8 (10.8)	19.7 (11.9)
131.....	19.4 (12.1)	19.1 (12.3)
134.....	18.4 (12.8)	18.4 (12.8)
117.....	16.2 (14.5)	16.5 (14.3)
128.....	13.4 (17.6)	13.4 (17.6)
114.....	13.0 (18.1)	12.9 (18.2)

Results (tables 1 through 6) from steady-state tests show that for the best economy configuration, spark timing was advanced at all speeds as compared to the baseline cars. For most cases A/F for the best economy was leaner as compared to the baseline adjustment. Two exceptions were: (1) the Chevrolet Novas (figure 3) that showed slightly richer A/F at low speeds for best economy than that for the baseline, and (2) the Chevrolet Impalas (figure 6) which showed the same A/F for both best economy and baseline cases at lower speeds, but the best economy case went leaner at the higher speeds. The two Ford vehicles (figures 4 and 5) used manifold air injection (for baseline tests); thus, the A/F's shown in the figures are not directly comparable between best economy and baseline configurations.

Fuel economy (figures 1 through 6) for the steady-state conditions was higher for the best economy configuration than that for the baseline tests at nearly all speeds with the difference being dependent on speed. These differences (best economy compared with baseline) ranged from -3 pct (20 mph cruise) for the Chevrolet Novas (figure 3) to 18.4 pct (40 mph cruise) for the Ford Granadas (figure 4). The average improvement at best economy, considering all vehicles and all steady-state points, was about 7.9 pct. This result appears reasonably consistent with the city/highway driving cycle results which showed an average improvement of 8.6 pct.

Carbon monoxide emissions for five of the six vehicle models in best economy configuration were in the range of 1 to 2 g/mile for all speeds (figures 1 through 5). Carbon monoxide for the sixth vehicle (the Chevrolet Impala, figure 6) peaked at about 12 g/mile at 30 mph and decreased with increasing speed and reached about 2 g/mile at 50 mph. Although the overall A/F is not shown to be rich at any speed (figure 6) it is shown to approach stoichiometric; it is therefore probable that the relatively high CO is accounted for by CO produced from the richer cylinders assuming that some degree of mixture maldistribution did exist.

Hydrocarbon emissions for all six vehicle models (figures 1 through 6) for the best economy configuration at steady-state speeds were in the range of 0.5 to 1.8 g/mile depending on speed and/or vehicle model. Hydrocarbon emissions from the baseline vehicles were substantially lower than those of the best economy adjustments primarily due to the catalytic converters. The catalytic converters were highly effective in removing both CO and HC at steady-state conditions as is evidenced by figures 1 through 6.

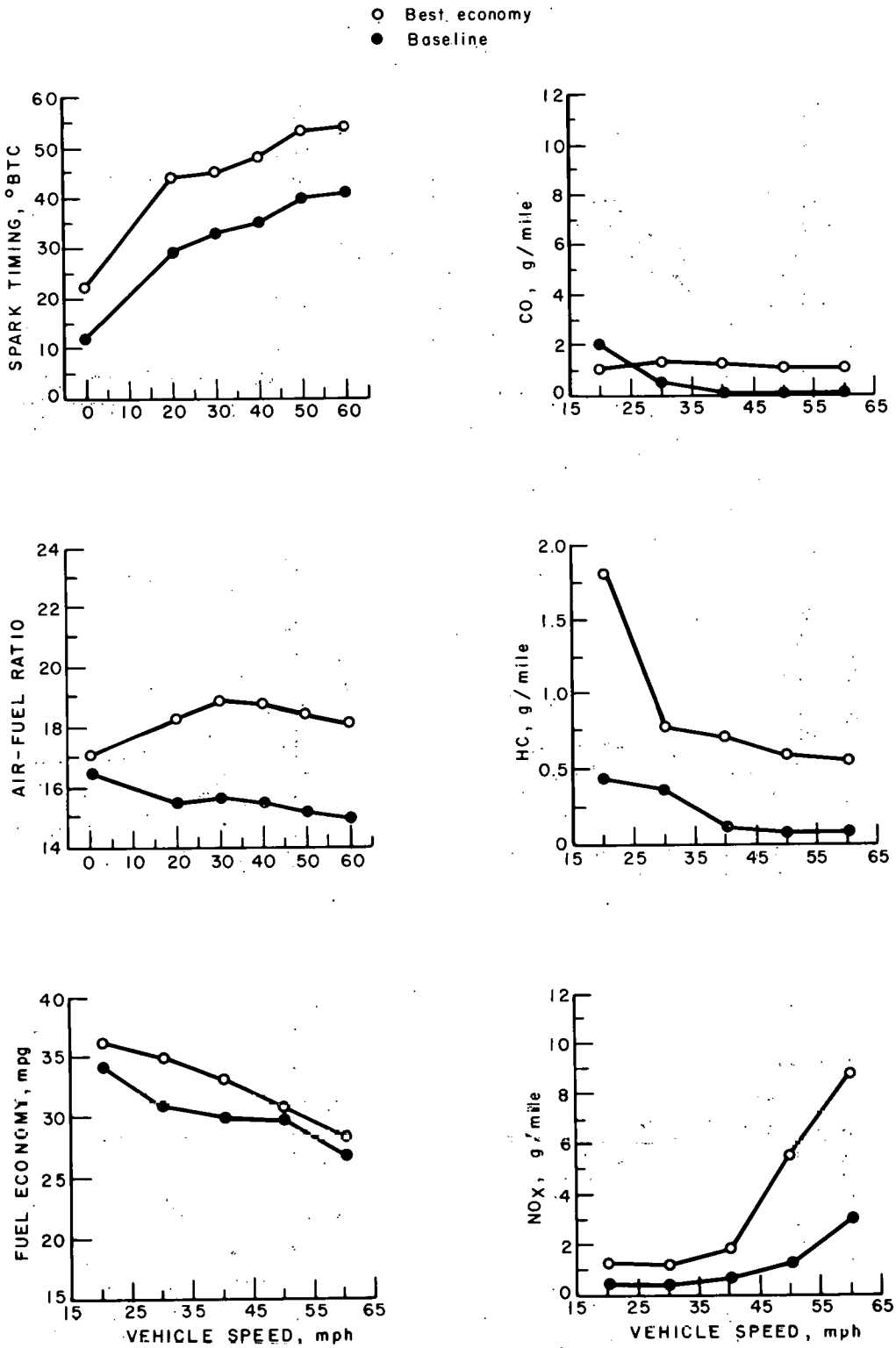

FIGURE 1. - Fuel Economy, Emissions, and Engine Adjustments for Three 1976 Chevrolet Vegas (140-CID Engines) Operated at Steady-State

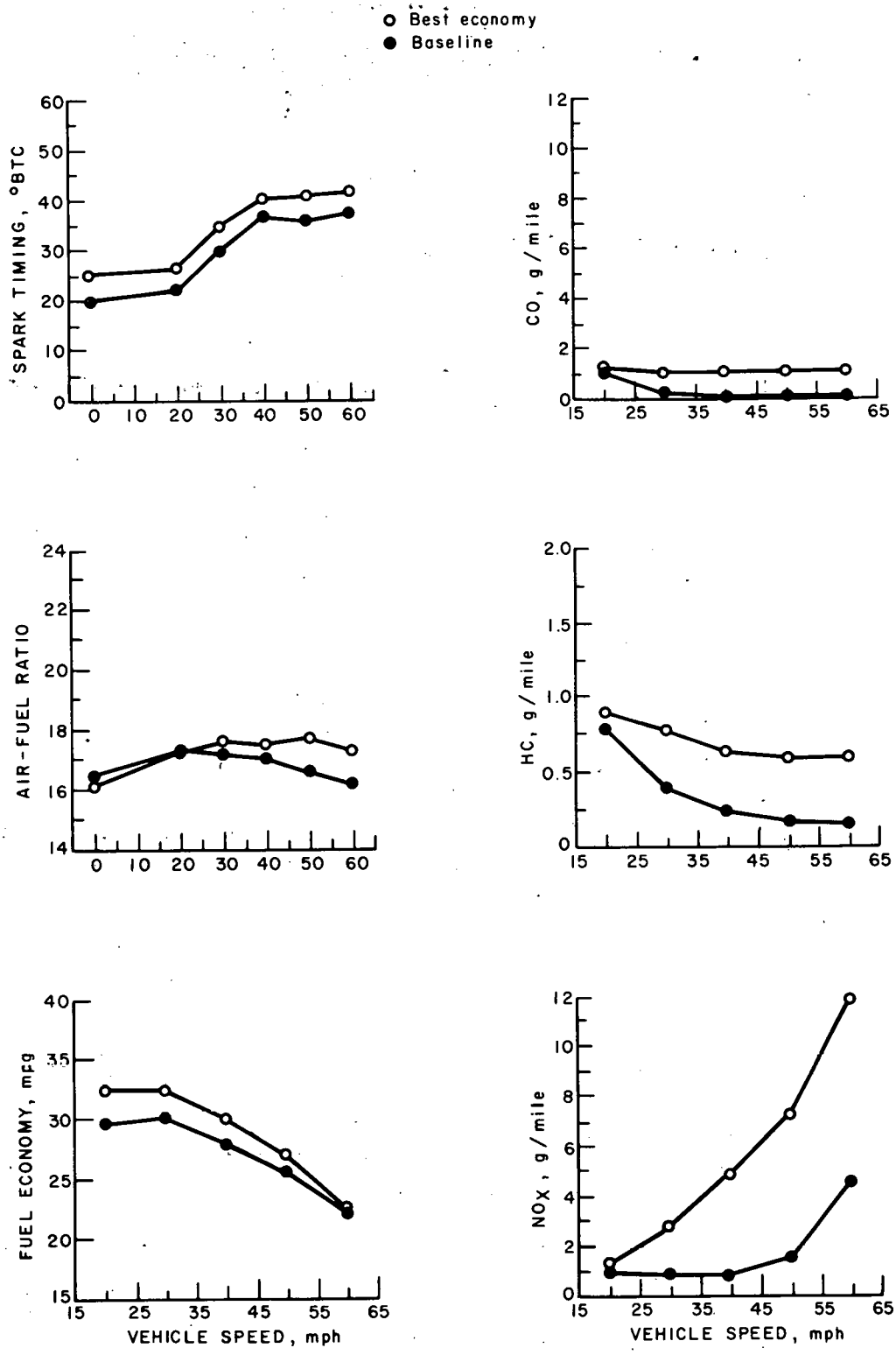

FIGURE 2 - Fuel Economy, Emissions, and Engine Adjustments for Three 1976 Dodge Darts (225-CID Engines) Operated at Steady-State

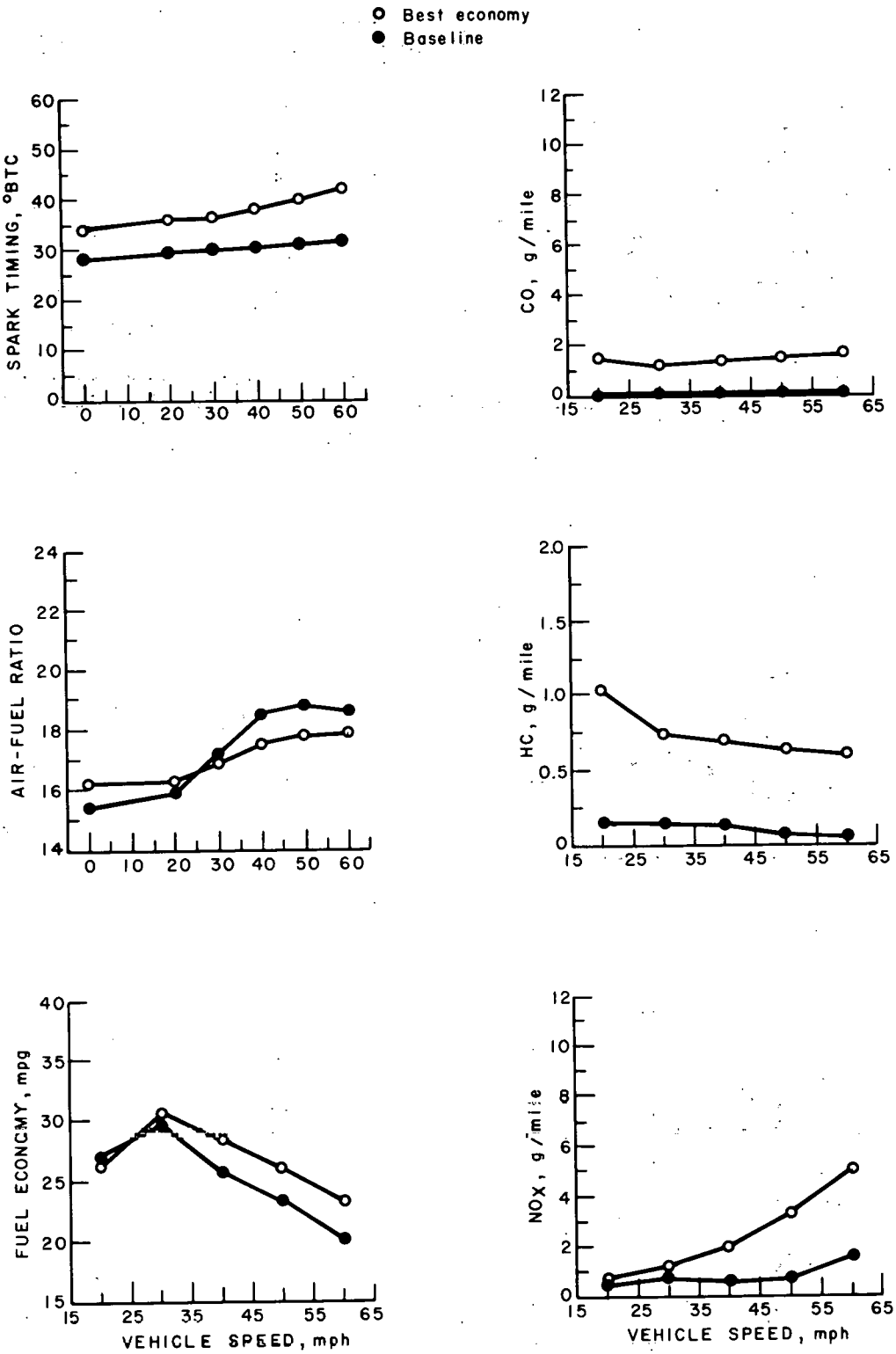

FIGURE 3. - Fuel Economy, Emissions, and Engine Adjustments for Three 1976 Chevrolet Novas (250- CID Engines) Operated at Steady-State

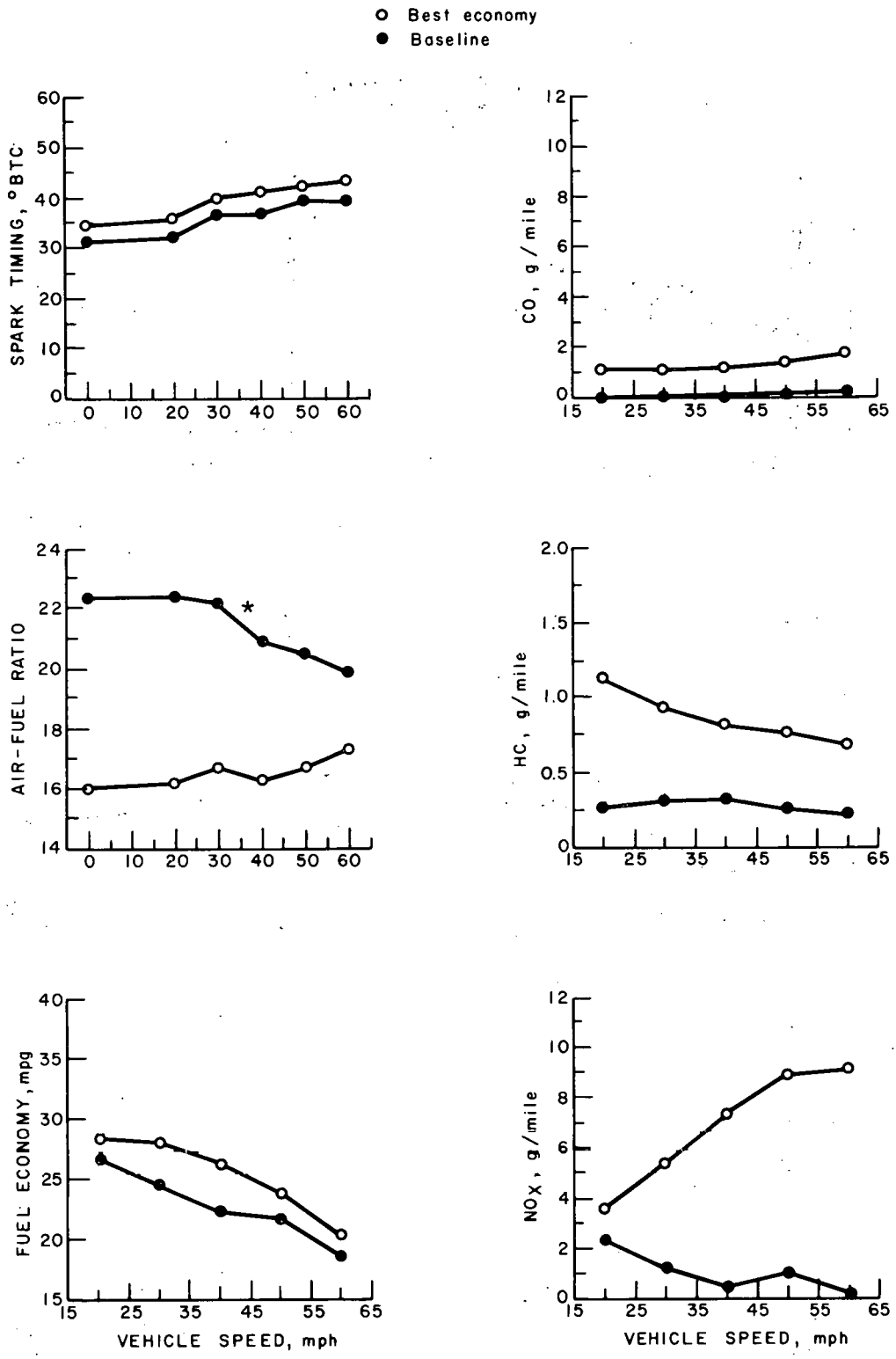

FIGURE 4. - Fuel Economy, Emissions, and Engine Adjustments for Three 1976 Ford Granadas (250-CID Engines) Operated at Steady-State

*Baseline vehicle had manifold air injection--thus air-fuel represents the combined effect of carbureted air and secondary air added to the exhaust

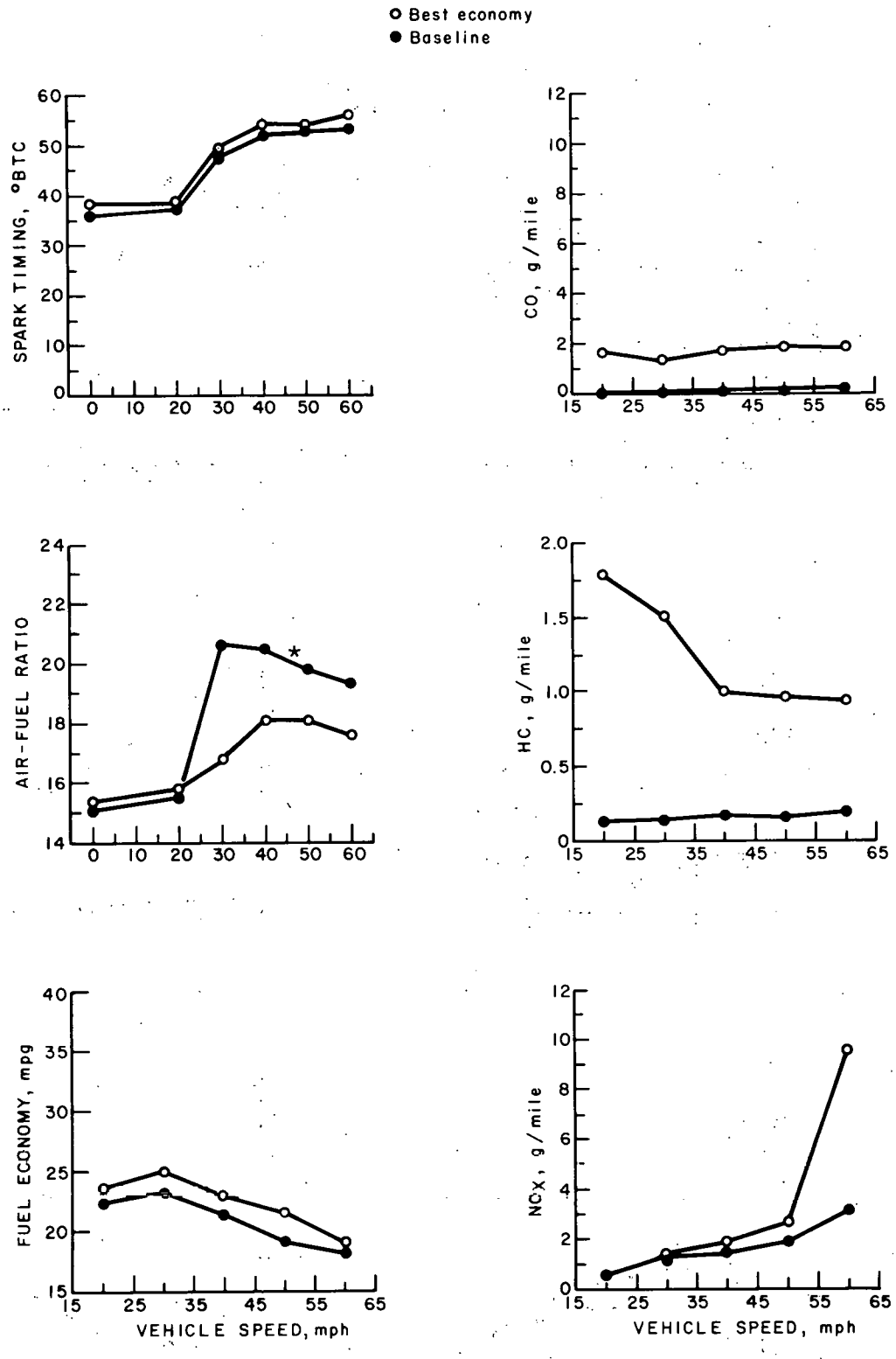

FIGURE 5. - Fuel Economy, Emissions, and Engine Adjustments for Three 1976 Ford Torinos (350-CID Engines) Operated at Steady-State

*Baseline vehicle used manifold air injection--thus air-fuel ratio represents the combined effect of carbureted air and secondary air added to the exhaust.

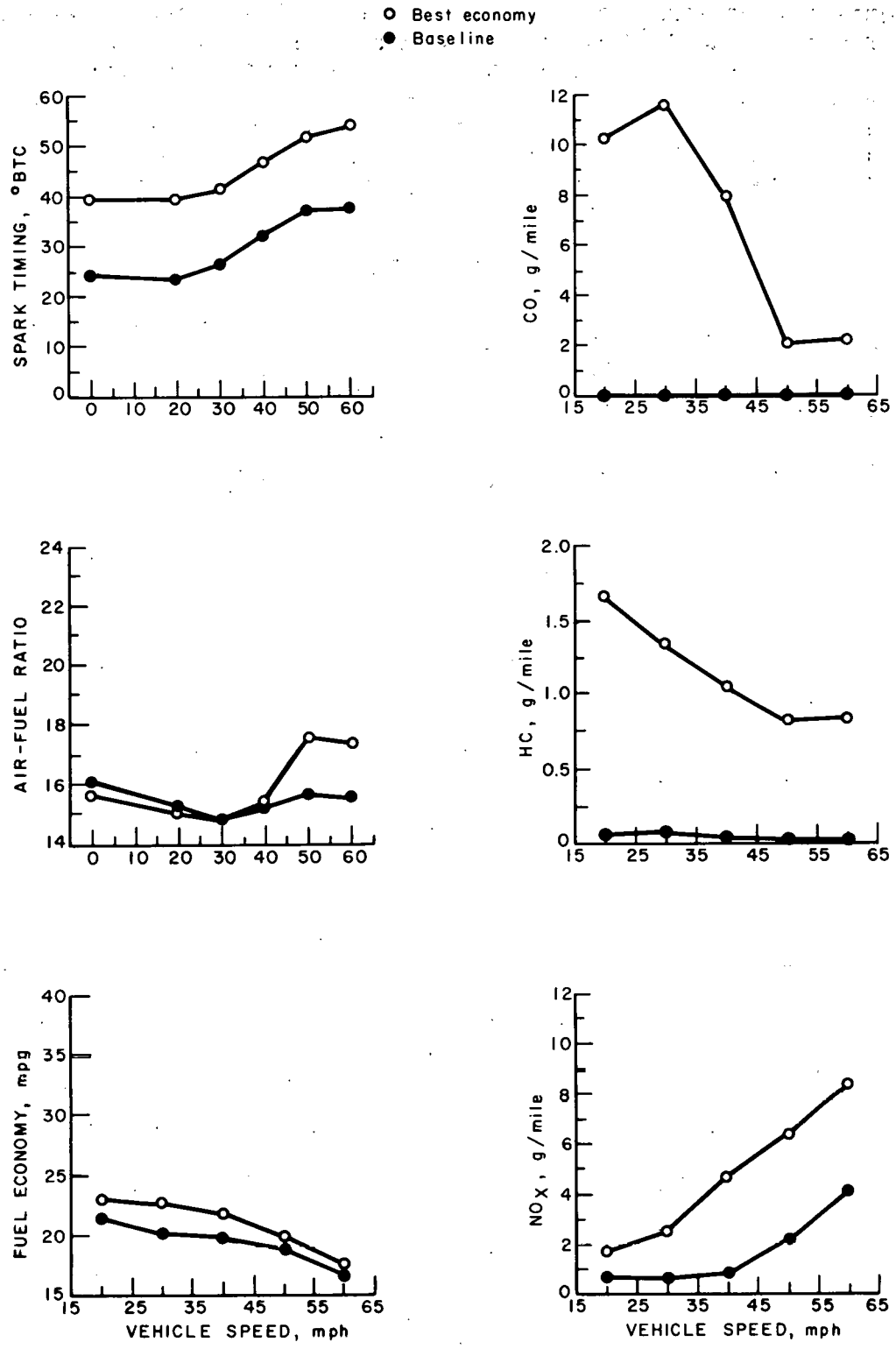

FIGURE 6. - Fuel Economy, Emissions, and Engine Adjustments for Three 1976 Chevrolet Impalas (350-CID Engines) Operated at Steady-State

Oxides of nitrogen for the best economy configurations increased markedly with increasing speed (figures 1 through 6). The maximum NO_x level at 60 mph cruise for the six different vehicles ranged from 5 g/mile for the Chevrolet Novas to 11.9 g/mile for the Dodge Darts. As stated previously in discussion of cycle tests, NO_x could probably be reduced markedly by utilizing carefully tailored EGR rates with virtually no penalty in fuel economy. However, determining the best economy conditions with the lowest NO_x level was beyond the scope of this experimental program.

SUMMARY AND CONCLUSIONS

Six 1976 vehicle models, (three identical vehicles of each model for a total of 18 vehicles) ranging in weight class from 3,000 to 5,000 lb, were used to generate experimental data to estimate the fuel economy potential of late-model vehicles. This was done by obtaining data both (1) for the vehicles as produced for sale (taken as the baseline data), and (2) for the vehicles adjusted for best economy without emission constraints.

The following observations and conclusions were made:

1. Fuel economy (combined city/highway) for the six vehicle models adjusted for best fuel economy without emission constraints averaged 8.6 pct better than that for the same cars with emission controls operative and tuned to manufacturers specified adjustments. For the individual vehicle models, fuel economy improved from 4.3 to 14.1 pct when the engines were configured for best fuel economy without regard to emissions.

2. Hydrocarbon emissions for the six models adjusted for best economy ranged from 1.45 to 2.55 g/mile (0.90 to 1.58 g/km) with the six vehicle average being 2.08 g/mile (1.29 g/km). For the baseline vehicles, HC was below the 1976 Federal emission standard of 1.5 g/mile.

3. Oxides of nitrogen level ranged from 3.77 to 11.3 g/mile (2.34 to 7.02 g/km) for the six vehicle models adjusted to best economy. The average NO_x level for all the vehicle models adjusted to best economy was 6.84 g/mile (4.25 g/km). Oxides of nitrogen for the baseline cars were below the 1976 Federal emission standard of 3.1 g/mile.

4. Carbon monoxide emissions for the six models adjusted to best economy ranged from 3.07 to 20.2 g/mile (3.15 to 12.6 g/km) and the six vehicle average was 8.37 g/mile (5.20 g/km).

5. Hydrocarbon and CO emissions for six vehicle models were reduced to 0.68 g/mile (0.42 g/km) and 2.74 g/mile (1.70 g/km) respectively, when catalytic converters were installed on the cars adjusted to best economy. The catalytic converter had little or no effect on NO_x emission or fuel economy.

6. Fuel economy at steady-state speeds with the best economy adjustments averaged about 7.9 pct better than that for the baseline vehicles with emission control constraints.

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APPENDIX A. - AIR-FUEL RATIO DETERMINATION

Air-fuel ratios are normally determined by calculations using compositional data from analysis of undiluted exhaust gas. Since exhaust analysis for this test program involved the use of samples diluted with air (i.e., CVS samples) the calculation of A/F by the classical methods was precluded.

In order to get a measure of A/F during steady-state modes, an oxygen analyzer was set up to measure oxygen of "raw" undiluted exhaust during steady-state tests while the emissions of CO, HC, and NO_x were determined from analysis of CVS (diluted) samples.

The formula for calculating A/F from oxygen concentration in undiluted exhaust was derived as follows:

Assumptions

1. The formula is applicable to lean combustion only (i.e., leaner than stoichiometric).

2. Combustion is complete and exhaust products are CO_2, O_2, H_2O, and nitrogen.

3. Oxygen was measured on a "dry" basis (i.e., H_2O was completely removed from the sample before analysis of oxygen).

The Combustion equation is:

$$CH_x + Y(O_2 + 3.76\ N_2)$$

$$CO_2 + \left(\frac{X}{2}\right) H_2O + ZO_2 + Y\ (3.76)N_2 \qquad (1)$$

Oxygen balance:

$$2Y = 2 + \frac{X}{2} + 2Z$$

or,

$$Z = Y - \frac{X}{4} - 1$$

$$(\%O_2)_{Dry} = \frac{\text{Moles of } O_2 \text{ in exhaust}}{\text{Total moles of exhaust - moles } H_2O} \times 100$$

$$(\%O_2)_{Dry} = \frac{Z \times 100}{1 + Z + 3.76Y} = \frac{[Y - X/4 - 1] \times 100}{1 + [Y - \frac{X}{4} - 1] + 3.76Y}$$

$$(\%O_2)_{Dry} = \frac{100\,[Y - \frac{X}{4} - 1]}{4.76Y - \frac{X}{4}} \qquad (2)$$

But, by definition:

$$A/F = \frac{\text{weight of air}}{\text{weight of fuel}} = \frac{Y\,[4.76]\,28.967}{12.011 + 1.008X}$$

$$Y = \frac{(A/F)[12.011 + 1.008X]}{(4.76)\,(28.967)} \qquad (3)$$

Substituting equation (3) into equation (2):

$$(\%O_2)_{Dry} = \left(\frac{100[A/F]\,[12.011 + 1.008]}{[4.76]\,[28.967]}\right) - 100[1 + (X/4)] \Big/$$

$$[1/28.967]\,[A/F\,(12.011 + 1.008X)] - X/4$$

Solving for A/F:

$$A/F = \frac{\frac{X}{4}\,[(\%O_2)_{Dry} - 100] - 100}{(12.011 + 1.008X)[0.0345(\%O_2)_{Dry} - 0.725]} \qquad (4)$$

where,

X = Hydrogen-carbon atom ratio for the fuel

$(\%O_2)_{Dry}$ = Oxygen concentration in the undiluted exhaust measured on a "dry" basis

Equation (4) was used to calculate A/F for tests involving idle and steady-state cruising modes (data in tables of appendix D and figures 1 thru 6 in the text).

Note that since CO and HC were neglected in the equation, A/F's calculated by this method are estimates of the true A/F. The equation applies only for the case of lean combustion, and for those cases where CO and HC are significant, the measure of A/F is less precise than those cases where CO and HC are low. However, since all data reported in this paper are for lean combustion, equation (4) gives an estimate of A/F which is adequate for the purpose of this report.

APPENDIX B. - PROCEDURES FOR ADJUSTING VEHICLES TO BEST ECONOMY

One vehicle was selected from each set of three vehicles representing each of the six models, and experimental work was done to determine the engine parametric adjustments (in terms of A/F and spark timing schedules) that resulted in best fuel economy for the urban driving cycle. Since there were no constraints on emissions, all emission control hardware was removed and/or deactivated.

To establish a starting point for adjusting A/F ratio and spark timing for best fuel economy in the urban driving cycle, steady-state runs at 50-mph cruise were conducted with A/F varied from the standard A/F (that of the production vehicle) to an A/F which resulted in misfire.[1] For each A/F, spark timing was advanced in 5-degree increments from 30° before top center (BTC) to a point where the engine either misfired or fuel economy reached a maximum. The A/F was varied by changing the size of the main metering jets in the conventional carburetors.

Following the steady-state tests, the vehicles were set up for the A/F and spark timing that resulted in best fuel economy based on the 50 mph cruise. The vehicles were operated at this condition over the urban driving cycle corresponding to the transient and stabilized phases of the 75-FTP, except in this case the procedure was started from a hot start. If there was a drivability problem in terms of lean misfire or stumble during the cycle, the carburetor was rejetted toward a richer setting to eliminate stumble during acceleration modes of the cycle. The vehicles were then operated on repetitive hot-start cycles with basic spark timing adjusted until best fuel economy for the urban cycle was achieved.

The idle A/F for the best economy configurations was adjusted as lean as possible and still prevent excessive engine roughness (in all cases leaner than stoichiometric). The idle A/F;s for all the cars were in the range of 14.9:1 to 17.6:1.

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[1]Engine misfire was determined by observing hydrocarbon emissions continuously on a strip-chart recorder. Misfire was detected by the presence of spikes on the continuous hydrocarbon trace.

APPENDIX C

FUEL ECONOMY AND EMISSIONS FOR 1976 MODEL VEHICLES OPERATED ON URBAN AND HIGHWAY DRIVING CYCLES

TABLE C-1. - Fuel economy and emissions for three 1976 Chevrolet Vegas (140-CID engines) including replicate tests

Vehicle configuration	Vehicle No.	Fuel economy, mpg (fuel consumption, l/100 km)			Emissions, g/mile (g/km)		
		Combined city/highway	City	Highway	CO	HC	NO_x
Baseline (adjusted to manufacturers' specifications)	138	23.0 (10.2)	19.8 (11.9)	28.7 (8.20)	15.1 (9.38)	1.33 (0.83)	1.20 (0.75)
	"	21.8 (10.8)	19.0 (12.4)	26.7 (8.81)	13.5 (8.39)	.94 (.58)	1.37 (.85)
	Average	22.4 (10.5)	19.4 (12.1)	27.7 (8.49)	14.3 (8.89)	1.14 (.71)	1.28 (.80)
	139	23.2 (10.1)	20.0 (11.8)	28.7 (8.20)	6.52 (4.05)	0.72 (0.45)	1.64 (1.02)
	"	22.0 (10.7)	18.5 (12.7)	28.6 (8.22)	11.1 (6.90)	.97 (.60)	1.77 (1.10)
	Average	22.6 (10.4)	19.2 (12.2)	28.6 (8.22)	8.81 (5.47)	.84 (.52)	1.70 (1.06)
	140	22.9 (10.3)	19.4 (12.1)	29.2 (8.05)	15.6 (9.69)	0.74 (0.46)	1.52 (0.94)
	"	23.4 (10.1)	20.2 (11.9)	29.0 (8.11)	14.4 (8.95)	.64 (.40)	1.40 (.87)
	Average	23.1 (10.2)	19.8 (11.9)	29.1 (8.08)	15.0 (9.32)	.69 (.43)	1.46 (.91)
	Car average	22.7 (10.4)	19.5 (12.1)	28.5 (8.25)	12.7 (7.89)	0.89 (0.55)	1.48 (0.92)
Best economy adjustments	138	24.3 (9.68)	22.0 (10.7)	28.0 (8.40)	4.96 (3.08)	1.21 (0.75)	4.88 (3.03)
	"	23.7 (9.92)	21.3 (11.0)	27.5 (8.55)	4.77 (2.96)	1.45 (.90)	3.88 (2.41)
	Average	24.0 (9.80)	21.6 (10.9)	27.7 (8.49)	4.86 (3.02)	1.33 (.83)	4.38 (2.72)
	139	25.0 (9.41)	22.0 (10.7)	30.0 (7.84)	5.18 (3.22)	1.59 (0.99)	4.29 (2.67)
	"	25.1 (9.37)	21.6 (10.9)	31.2 (7.54)	4.63 (2.88)	1.65 (1.03)	4.34 (2.70)
	Average	25.0 (9.41)	21.8 (10.8)	30.6 (7.69)	4.90 (3.04)	1.62 (1.01)	4.32 (2.68)
	140	24.6 (9.56)	21.5 (10.9)	30.0 (7.84)	6.72 (4.18)	1.44 (0.89)	3.16 (1.96)
	"	25.8 (9.12)	22.6 (10.4)	31.3 (7.51)	6.09 (3.78)	1.38 (.86)	4.23 (2.63)
	Average	25.2 (9.33)	22.0 (10.7)	30.6 (7.69)	6.40 (3.98)	1.41 (.88)	3.70 (2.30)
	Car average	24.7 (9.52)	21.8 (10.8)	29.6 (7.95)	5.39 (3.35)	1.45 (0.90)	4.13 (2.57)

TABLE C-2. - Fuel economy and emissions for three 1976 Dodge Darts (225-CID engines) including replicate tests

Vehicle configuration	Vehicle No.	Fuel economy, mpg (fuel consumption, l/100 km)			Emissions, g/mile (g/km)		
		Combined city/highway	City	Highway	CO	HC	NO_x
Baseline (adjusted to manufacturers' specifications)	130	20.5 (11.5)	18.5 (12.7)	23.5 (10.0)	9.53 (5.92)	0.89 (0.55)	2.85 (1.77)
	"	21.0 (11.2)	18.8 (12.5)	24.5 (9.60)	7.09 (4.41)	1.28 (.80)	2.83 (1.76)
	Average	20.7 (11.3)	18.6 (12.6)	24.0 (9.80)	8.31 (5.16)	1.09 (.68)	2.84 (1.76)
	131	21.5 (10.9)	19.1 (12.3)	25.3 (9.30)	3.96 (2.46)	0.74 (0.46)	2.25 (1.40)
	"	21.4 (11.0)	19.0 (12.4)	25.3 (9.30)	3.14 (1.95)	.95 (.59)	2.52 (1.57)
	Average	21.4 (11.0)	19.0 (12.4)	25.3 (9.30)	3.55 (2.21)	.85 (.53)	2.39 (1.49)
	137	21.6 (10.9)	19.1 (12.3)	25.8 (9.12)	3.97 (2.47)	0.85 (0.53)	2.61 (1.62)
	"	20.8 (11.3)	18.6 (12.6)	24.4 (9.64)	5.44 (3.38)	.79 (.49)	2.83 (1.76)
	Average	21.2 (11.1)	18.8 (12.5)	25.1 (9.37)	4.71 (2.93)	.82 (.51)	2.72 (1.69)
	Car average	21.1 (11.1)	18.8 (12.5)	24.8 (9.48)	5.52 (3.43)	0.92 (0.57)	2.65 (1.65)
Best economy adjustments	130	21.2 (11.1)	18.9 (12.4)	25.0 (9.41)	3.97 (2.47)	1.74 (1.08)	9.43 (5.86)
	"	21.8 (10.8)	19.0 (12.4)	26.5 (8.88)	5.57 (3.46)	1.60 (.99)	9.55 (5.93)
	Average	21.5 (10.9)	18.9 (12.4)	25.7 (9.15)	4.77 (2.96)	1.67 (1.04)	9.49 (5.90)
	131	21.9 (10.7)	19.2 (12.3)	26.4 (8.91)	4.97 (3.09)	3.16 (1.96)	7.80 (4.85)
	"	23.0 (10.2)	19.7 (11.9)	28.8 (8.17)	3.85 (2.39)	2.22 (1.38)	8.28 (5.14)
	Average	22.4 (10.5)	19.4 (12.1)	27.5 (8.55)	4.41 (2.74)	2.69 (1.67)	8.04 (5.00)
	137	22.5 (10.5)	20.0 (11.8)	26.7 (8.81)	5.69 (3.54)	1.51 (0.94)	8.28 (5.14)
	"	21.6 (10.9)	19.1 (12.3)	25.8 (9.12)	6.38 (3.96)	1.54 (.96)	7.83 (4.87)
	Average	22.0 (10.7)	19.5 (12.0)	26.2 (8.98)	6.04 (3.75)	1.53 (.95)	8.06 (5.01)
	Car average	22.0 (10.7)	19.3 (12.2)	26.5 (8.88)	5.07 (3.15)	1.96 (1.22)	8.53 (5.30)

TABLE C-3. - Fuel economy and emissions for three 1976 Chevrolet Novas (250-CID engines) including replicate tests

Vehicle configuration	Vehicle No.	Fuel economy, mpg (fuel consumption, l/100 km)			Emissions, g/mile (g/km)		
		Combined city/highway	City	Highway	CO	HC	NO_x
Baseline (adjusted to manufacturers' specifications)	132	17.5 (13.4)	15.4 (15.3)	21.1 (11.1)	9.83 (6.11)	0.78 (0.48)	2.13 (1.32)
	"	17.7 (13.3)	15.5 (15.2)	21.5 (10.9)	11.7 (7.27)	.87 (.54)	1.94 (1.21)
	Average	17.6 (13.4)	15.4 (15.3)	21.3 (11.0)	10.8 (6.71)	.83 (.52)	2.04 (1.27)
	133	19.1 (12.3)	15.9 (14.8)	25.2 (9.33)	3.26 (2.03)	0.42 (0.26)	2.91 (1.81)
	"	18.4 (12.8)	15.4 (15.3)	24.1 (9.76)	2.98 (1.85)	.37 (.23)	2.35 (1.46)
	Average	18.7 (12.6)	15.6 (15.1)	24.6 (9.56)	3.12 (1.94)	.40 (.25)	2.63 (1.63)
	134	19.4 (12.1)	17.2 (13.7)	22.9 (10.3)	3.95 (2.45)	0.54 (0.34)	1.97 (1.22)
	"	19.0 (12.4)	16.9 (13.9)	22.3 (10.6)	3.60 (2.24)	.68 (.42)	1.98 (1.23)
	Average	19.2 (12.3)	17.0 (13.8)	22.6 (10.4)	3.78 (2.35)	.61 (.38)	1.98 (1.23)
	Car average	18.5 (12.7)	16.0 (14.7)	22.8 (10.3)	5.89 (3.66)	0.61 (0.38)	2.21 (1.37)
Best economy adjustments	132	20.0 (11.8)	17.2 (13.7)	24.8 (9.48)	12.4 (7.71)	1.76 (1.09)	3.94 (2.45)
	"	20.9 (11.3)	18.1 (13.0)	25.8 (9.12)	11.8 (7.33)	2.08 (1.29)	3.56 (2.21)
	Average	20.4 (11.5)	17.6 (13.4)	25.3 (9.30)	12.1 (7.52)	1.92 (1.19)	3.75 (2.33)
	133	21.5 (10.9)	18.9 (12.4)	25.9 (9.08)	5.76 (3.58)	2.52 (1.57)	4.27 (2.65)
	"	21.7 (10.8)	19.2 (12.2)	25.9 (9.08)	5.66 (3.52)	2.46 (1.53)	3.30 (2.05)
	Average	21.6 (10.9)	19.0 (12.4)	25.9 (9.08)	5.71 (3.55)	2.49 (1.55)	3.79 (2.35)
	134	20.9 (11.3)	18.2 (12.9)	25.4 (9.26)	4.77 (2.96)	1.68 (1.04)	3.77 (2.34)
	"	21.5 (10.9)	18.6 (12.6)	26.7 (8.81)	3.73 (2.32)	1.63 (1.01)	2.79 (2.35)
	Average	21.2 (11.1)	18.4 (12.8)	26.0 (9.05)	4.25 (2.64)	1.66 (1.03)	3.28 (2.04)
	Car average	21.1 (11.2)	18.3 (12.9)	25.7 (9.15)	7.35 (4.57)	2.02 (1.26)	3.77 (2.34)

TABLE C-4. - Fuel economy and emissions for three 1976 Ford Granadas (250-CID engines) including replicate tests

Vehicle configuration	Vehicle No.	Fuel economy, mpg (fuel consumption, l/100 km)			Emissions, g/mile (g/km)		
		Combined city/highway	City	Highway	CO	HC	NO_x
Baseline (adjusted to manufacturers' specifications)	117	18.0 (13.1)	16.1 (14.6)	20.9 (11.3)	2.40 (1.49)	1.08 (0.67)	2.32 (1.44)
	"	17.7 (13.3)	16.1 (14.6)	20.1 (11.7)	3.87 (2.40)	.99 (.62)	2.02 (1.26)
	Average	17.8 (13.2)	16.1 (14.6)	20.5 (11.5)	3.14 (1.95)	1.04 (.65)	2.17 (1.35)
	118	17.3 (13.6)	15.7 (15.0)	19.8 (11.9)	0.80 (0.50)	0.65 (0.40)	2.63 (1.63)
	"	17.6 (13.4)	15.5 (15.2)	21.1 (11.1)	1.40 (0.87)	.70 (.43)	3.04 (1.89)
	Average	17.4 (13.5)	15.6 (15.1)	20.4 (11.5)	1.10 (0.68)	.68 (.42)	2.84 (1.76)
	119	16.4 (14.3)	14.9 (15.8)	18.7 (12.6)	0.75 (0.47)	0.55 (0.34)	2.22 (1.38)
	"	16.4 (14.3)	14.7 (16.0)	19.0 (12.4)	.73 (0.45)	.56 (.35)	2.48 (1.54)
	Average	16.4 (14.3)	14.8 (15.9)	18.8 (12.5)	.74 (0.46)	.56 (.35)	2.35 (1.46)
	Car average	17.2 (13.7)	15.5 (15.2)	19.9 (11.8)	1.66 (1.03)	0.76 (0.47)	2.45 (1.52)
Best economy adjustments	117	18.5 (12.7)	16.4 (14.3)	22.0 (10.7)	3.58 (2.22)	1.84 (1.14)	11.2 (6.96)
	"	18.2 (12.9)	16.0 (14.7)	22.0 (10.7)	4.40 (2.73)	1.88 (1.17)	11.2 (6.96)
	Average	18.3 (12.8)	16.2 (14.5)	22.0 (10.7)	3.99 (2.48)	1.86 (1.16)	11.2 (6.96)
	118	19.4 (12.1)	17.3 (13.6)	22.7 (10.4)	5.69 (3.54)	2.15 (1.34)	12.1 (7.52)
	"	19.5 (12.1)	17.1 (13.8)	23.4 (10.1)	4.42 (2.75)	2.07 (1.29)	12.5 (7.77)
	Average	19.4 (12.1)	17.2 (13.7)	23.0 (10.2)	5.06 (3.14)	2.11 (1.31)	12.3 (7.64)
	119	18.9 (12.4)	16.8 (14.0)	22.4 (10.5)	8.16 (5.07)	1.89 (1.17)	9.88 (6.14)
	"	18.6 (12.6)	16.4 (14.3)	22.3 (10.5)	6.73 (4.18)	1.99 (1.24)	10.7 (6.65)
	Average	18.7 (12.5)	16.6 (14.2)	22.3 (10.5)	7.45 (4.63)	1.94 (1.21)	10.3 (6.40)
	Car average	18.8 (12.4)	16.7 (14.1)	22.5 (10.5)	5.50 (3.42)	1.97 (1.22)	11.3 (7.02)

TABLE C-5. - Fuel economy and emissions for three 1976 Ford Torinos (351-CID engines) including replicate tests

Vehicle configuration	Vehicle No.	Fuel economy, mpg (fuel consumption, l/100 km)			Emissions, g/mile (g/km)		
		Combined city/highway	City	Highway	CO	HC	NO_x
Baseline (adjusted to manufacturers' specifications)	126	16.0 (14.7)	13.8 (17.0)	20.0 (11.8)	6.34 (3.94)	0.63 (0.39)	2.73 (1.70)
	"	16.2 (14.5)	14.0 (16.8)	20.1 (11.7)	5.60 (3.48)	.67 (.42)	2.82 (1.75)
	Average	16.1 (14.6)	13.9 (16.9)	20.0 (11.8)	5.97 (3.71)	.65 (.40)	2.77 (1.72)
	128	14.3 (16.4)	12.4 (19.0)	17.1 (13.4)	4.62 (2.87)	0.45 (0.28)	1.96 (1.22)
	"	13.7 (17.2)	11.7 (20.1)	17.4 (13.5)	4.48 (2.78)	.44 (.27)	2.29 (1.42)
	Average	14.0 (16.8)	12.0 (19.6)	17.2 (13.7)	4.55 (2.83)	.45 (.28)	2.13 (1.32)
	136	15.8 (14.9)	13.6 (17.3)	19.7 (11.9)	8.53 (5.30)	0.94 (0.58)	2.77 (1.72)
	"	15.4 (15.3)	13.4 (17.6)	18.8 (12.5)	6.51 (4.03)	.80 (.43)	2.48 (1.54)
	Average	15.6 (15.1)	13.5 (17.4)	19.2 (12.3)	7.52 (4.67)	.87 (.51)	2.63 (1.63)
	Car average	15.2 (15.4)	13.1 (17.8)	18.9 (12.4)	6.01 (3.73)	0.64 (0.40)	2.46 (1.53)
Best economy adjustments	126	17.0 (13.8)	14.6 (16.1)	21.4 (11.0)	7.09 (4.41)	2.17 (1.35)	5.09 (3.16)
	"	17.1 (13.8)	14.6 (16.1)	21.6 (10.9)	6.91 (4.29)	2.04 (1.27)	6.09 (3.78)
	Average	17.0 (13.8)	14.6 (16.1)	21.5 (10.9)	7.00 (4.35)	2.11 (1.31)	5.59 (3.47)
	I28	16.0 (14.7)	13.9 (16.9)	19.7 (11.9)	5.50 (3.42)	2.60 (1.62)	4.71 (2.93)
	"	16.1 (14.6)	13.0 (18.1)	22.8 (10.3)	5.05 (3.14)	2.41 (1.50)	5.68 (3.53)
	Average	16.0 (14.7)	13.4 (17.6)	21.2 (11.1)	5.28 (3.28)	2.51 (1.56)	5.20 (3.23)
	136	16.5 (14.3)	14.1 (16.7)	20.8 (11.3)	8.16 (5.07)	2.90 (1.80)	5.88 (3.65)
	"	15.9 (14.8)	13.6 (17.3)	20.2 (11.6)	7.69 (4.78)	2.92 (1.81)	6.78 (4.21)
	Average	16.2 (14.5)	13.8 (17.0)	20.5 (11.5)	7.93 (4.93)	2.91 (1.81)	6.33 (3.93)
	Car average	16.4 (14.3)	13.9 (16.8)	21.0 (11.1)	6.73 (4.18)	2.51 (1.56)	5.71 (3.55)

TABLE C-6. - Fuel economy and emissions for three 1976 Chevrolet Impalas (350-CID engines) including replicate tests

Vehicle configuration	Vehicle No.	Fuel economy, mpg (fuel consumption, l/100 km)			Emissions, g/mile (g/km)		
		Combined city/highway	City	Highway	CO	HC	NO_x
Baseline (adjusted to manufacturers' specifications)	114	13.9 (16.9)	11.9 (19.8)	17.4 (13.5)	5.28 (3.28)	1.18 (0.73)	2.19 (1.36)
	"	13.8 (17.0)	11.9 (19.8)	17.0 (13.8)	8.44 (5.24)	0.42 (.26)	2.14 (1.33)
	Average	13.8 (17.0)	11.9 (19.8)	17.2 (13.7)	6.86 (4.26)	.80 (.50)	2.17 (1.35)
	121	14.5 (16.2)	12.7 (18.5)	17.4 (13.5)	12.1 (7.52)	0.65 (0.40)	1.95 (1.21)
	"	13.9 (16.9)	11.9 (19.8)	17.4 (13.5)	14.0 (8.70)	.74 (.46)	2.20 (1.37)
	Average	14.2 (16.6)	12.3 (19.1)	17.4 (13.5)	13.0 (8.08)	.70 (.43)	2.08 (1.29)
	122	14.4 (16.3)	12.4 (19.0)	18.0 (13.1)	22.1 (13.7)	1.04 (0.65)	2.12 (1.32)
	"	14.9 (15.8)	13.0 (18.1)	18.3 (12.9)	19.1 (11.9)	.86 (.53)	2.06 (1.28)
	Average	14.6 (16.0)	12.7 (18.5)	18.1 (13.0)	20.6 (12.8)	.95 (.59)	2.09 (1.30)
	Car average	14.2 (16.6)	12.3 (19.1)	17.6 (13.4)	13.5 (8.39)	0.82 (0.51)	2.11 (1.31)
Best economy adjustments	114	15.2 (15.5)	13.3 (17.7)	18.3 (12.9)	13.2 (8.20)	2.23 (1.39)	6.49 (4.03)
	"	14.8 (15.9)	12.7 (18.5)	18.7 (12.6)	16.0 (9.94	2.20 (1.37)	7.27 (4.52)
	Average	15.0 (15.7)	13.0 (18.1)	18.5 (12.7)	14.6 (9.07)	2.22 (1.38)	6.88 (4.28)
	121	15.1 (15.6)	13.2 (17.8)	18.2 (12.9)	26.8 (16.6)	2.84 (1.76)	8.40 (5.22)
	"	14.9 (15.8)	13.2 (17.8)	17.6 (13.4)	24.8 (15.4)	2.90 (1.80)	7.99 (4.96)
	Average	15.0 (15.7)	13.2 (17.8)	17.9 (13.1)	25.8 (16.0)	2.87 (1.78)	8.20 (5.10)
	122	15.8 (14.9)	13.9 (16.9)	19.0 (12.4)	20.4 (12.7)	2.52 (1.57)	7.37 (4.58)
	"	15.3 (15.4)	13.2 (17.8)	19.0 (12.4)	19.8 (12.3)	2.59 (1.61)	8.05 (5.00)
	Average	15.5 (15.1)	13.5 (17.4)	19.0 (12.4)	20.1 (12.5)	2.56 (1.59)	7.71 (4.79)
	Car average	15.2 (15.5)	13.2 (17.8)	18.5 (12.7)	20.2 (12.6)	2.55 (1.58)	7.60 (4.72)

APPENDIX D

FUEL ECONOMY AND EMISSIONS FOR 1976 MODEL VEHICLES OPERATED AT STEADY-STATE

TABLE D-1. - Fuel economy, emissions, and engine parametric adjustment for 1976 Chevrolet Vega (Car No. 138)

Vehicle speed, mph	Engine speed, rpm	Spark timing, °BTC	Manifold vacuum, in. of Hg	Air fuel ratio	Fuel consumption		Fuel economy, mpg	Emissions, g/hr		
					kg/hr	liters/ 100 km		CO	HC	NO_x
BASELINE (MANUFACTURERS' SPECIFIED ADJUSTMENTS)										
0	680	12	16.8	16.8	0.96	-	-	0.0	0.00	2.9
"	680	12	16.6	17.3	1.06	-	-	.2	1.48	3.9
Average	680	12	16.7	17.1	1.01	-	-	.1	.7	3.4
20	1,110	36	18.4	15.2	1.51	6.36	37.0	10.4	.8	6.0
"	1,110	37	18.4	15.4	1.70	7.13	33.0	42.6	3.8	5.4
Average	1,110	36	18.4	15.3	1.61	6.75	35.0	26.5	2.3	5.7
30	1,500	36	13.1	15.2	2.73	7.78	30.8	40.5	11.4	5.4
"	1,500	37	13.0	15.4	2.96	8.30	28.4	24.9	12.3	7.8
Average	1,500	36	13.0	15.3	2.85	8.04	29.6	32.7	11.9	6.6
40	1,900	39	12.0	15.2	3.72	7.83	30.0	.4	4.0	19.2
"	1,900	39	12.0	15.4	3.99	8.40	28.0	2.0	6.0	19.2
Average	1,900	39	12.0	15.3	3.86	8.12	29.0	1.2	5.0	19.2
50	2,300	45	12.4	14.8	4.66	7.85	30.0	6.0	3.0	46.5
"	2,350	44	12.5	14.9	4.79	8.07	29.2	4.5	4.5	46.0
Average	2,325	44	12.4	14.8	4.73	7.96	29.6	5.3	3.8	46.3
60	2,750	45	11.2	14.9	6.06	8.51	27.6	.6	3.0	182
"	2,800	45	11.0	14.9	6.50	9.12	25.8	1.8	4.8	220
Average	2,775	45	11.1	14.9	6.28	8.82	26.7	1.2	3.9	201
BEST ECONOMY ADJUSTMENTS										
0	720	22	17.3	17.5	0.92	-	-	10.8	9.64	4.34
"	740	23	17.3	17.7	.96	-	-	11.7	11.5	5.62
Average	730	22	17.3	17.6	.94	-	-	11.3	10.6	4.98
20	1,100	47	17.0	17.7	1.55	6.53	36.0	18.2	29.6	27.8
"	1,110	47	17.1	18.2	1.58	6.64	35.4	19.8	33.4	28.2
Average	1,105	47	17.1	18.0	1.57	6.59	35.7	19.0	31.5	28.0
30	1,500	45	15.0	18.0	2.44	6.86	34.3	36.3	17.1	31.8
"	1,500	46	14.6	18.8	2.46	6.90	34.1	40.8	21.9	9.0
Average	1,500	46	14.8	18.4	2.45	6.88	34.2	38.6	19.5	20.4
40	1,900	49	14.5	18.0	3.30	6.95	33.8	47.2	22.0	107
"	1,900	50	15.5	18.9	3.40	7.15	32.9	48.0	26.8	66.0
Average	1,900	50	15.0	18.5	3.35	7.05	33.4	47.6	24.4	86.5
50	2,400	53	14.0	17.4	4.46	7.51	31.3	49.5	24.5	320
"	2,400	54	12.6	18.8	4.63	7.80	30.2	50.5	28.0	239
Average	2,400	54	13.3	18.1	4.55	7.66	30.8	50.0	26.3	280
60	2,750	55	11.7	17.3	5.70	8.00	29.4	56.4	26.4	566
"	2,800	56	10.6	18.8	6.09	8.54	27.5	61.8	31.2	455
Average	2,775	56	11.2	18.1	5.90	8.27	28.5	59.1	28.8	510

TABLE D-2. - Fuel economy, emissions, and engine parametric adjustment for 1976 Chevrolet Vega (Car No. 139)

Vehicle speed, mph	Engine speed, rpm	Spark timing, °BTC	Manifold vacuum, in. of Hg	Air fuel ratio	Fuel consumption		Fuel economy, mpg	Emissions, g/hr		
					kg/hr	liters/ 100 km		CO	HC	NO_x
BASELINE (MANUFACTURERS' SPECIFIED ADJUSTMENTS)										
0	810	12	16.9	16.8	1.12	-	-	0.0	0.0	6.2
"	810	12	17.2	16.0	1.08	-	-	0.2	.2	6.0
Average	810	12	17.1	16.4	1.10	-	-	.1	.1	6.1
20	1,080	28	15.0	15.7	1.69	7.11	33.1	102	25.0	3.8
"	1,120	27	14.8	16.0	1.74	7.45	32.1	73.8	18.6	16.6
Average	1,100	28	14.9	15.8	1.72	7.28	32.6	87.9	21.8	10.2
30	1,550	28	11.5	16.0	2.76	7.74	30.4	9.6	17.4	11.7
"	1,500	27	11.3	16.0	2.78	7.79	30.2	2.1	6.9	11.7
Average	1,525	28	11.4	16.0	2.77	7.77	30.3	5.9	12.2	11.7
40	1,920	31	11.0	15.6	3.85	8.10	29.0	.4	4.8	30.8
"	1,900	29	11.0	15.7	3.71	7.81	30.1	.0	3.6	28.8
Average	1,910	30	11.0	15.6	3.78	7.96	29.6	.2	4.2	29.8
50	2,350	36	11.2	14.9	4.85	8.16	28.8	1.5	4.5	76.5
"	2,400	37	11.1	15.0	4.59	7.74	30.4	.5	4.0	79.5
Average	2,375	36	11.2	15.0	4.72	7.95	29.6	1.0	4.3	78.0
60	2,750	36	9.9	15.0	6.60	9.26	25.4	1.2	5.4	215
"	2,700	35	9.9	14.9	6.16	8.64	27.2	1.8	4.8	212
Average	2,725	36	9.9	15.0	6.38	8.95	26.3	1.5	5.1	214
BEST ECONOMY ADJUSTMENTS										
0	840	22	17.8	17.4	1.00	-	-	12.7	15.6	11.6
"	800	22	17.8	16.8	1.01	-	-	14.4	15.6	13.7
Average	820	22	17.8	17.1	1.00	-	-	13.6	15.6	12.7
20	1,120	42	16.5	18.8	1.61	6.79	34.6	23.6	48.6	28.2
"	1,140	45	16.2	18.8	1.47	6.21	37.9	23.0	49.6	20.2
Average	1,130	44	16.4	18.8	1.54	6.50	36.3	23.3	49.1	24.2
30	1,500	43	15.0	18.9	2.40	6.73	35.0	39.6	28.2	87.9
"	1,500	44	15.2	18.9	2.26	6.35	37.0	39.6	22.5	28.8
Average	1,500	44	15.1	18.9	2.33	6.54	36.0	39.6	25.4	58.4
40	1,900	47	13.5	18.9	3.38	7.11	33.1	49.2	32.4	84.0
"	1,900	47	13.5	18.9	3.23	6.79	34.7	48.4	26.4	60.0
Average	1,900	47	13.5	18.9	3.31	6.95	33.9	48.8	29.4	72.0
50	2,300	52	12.5	18.2	4.65	7.83	30.0	53.0	33.5	346
"	2,350	51	12.6	18.7	4.43	7.46	31.5	52.5	28.5	296
Average	2,325	52	12.6	18.5	4.54	7.65	30.8	52.8	31.0	321
60	2,800	53	10.0	18.0	5.98	8.40	28.0	66.6	38.4	568
"	2,750	51	10.4	17.7	5.91	8.29	28.4	66.6	34.2	567
Average	2,775	52	10.2	17.9	5.95	8.35	28.2	66.6	36.3	568

TABLE D-3. - Fuel economy, emissions, and engine parametric adjustment for 1976 Chevrolet Vega (Car No. 140)

Vehicle speed, mph	Engine speed, rpm	Spark timing, °BTC	Manifold vacuum, in. of Hg	Air fuel ratio	Fuel consumption		Fuel economy, mpg	Emissions, g/hr		
					kg/hr	liters/ 100 km		CO	HC	NO_x
BASELINE (MANUFACTURERS' SPECIFIED ADJUSTMENTS)										
0	700	12	16.4	15.7	0.97	-	-	0.0	0.12	3.6
"	700	11	16.2	16.5	.93	-	-	.0	.02	2.4
Average	700	12	16.3	16.1	.95	-	-		.07	3.0
20	1,100	22	17.4	15.4	1.57	6.61	35.6	13.0	2.8	8.8
"	1,100	24	17.4	15.6	1.57	6.60	35.6	1.0	1.6	12.0
Average	1,100	23	17.4	15.5	1.57	6.61	35.6	7.0	2.2	10.4
30	1,500	34	14.3	15.7	2.53	7.08	33.2	11.7	13.2	18.0
"	1,500	34	14.5	15.6	2.52	7.19	33.3	2.4	5.1	18.0
Average	1,500	34	14.4	15.7	2.53	7.14	33.3	7.0	9.2	18.0
40	1,900	37	11.7	15.7	3.58	7.54	31.2	.0	4.4	25.6
"	1,900	37	12.0	15.7	3.53	7.43	31.6	.4	3.6	21.2
Average	1,900	37	11.9	15.7	3.56	7.49	31.4	.2	4.0	23.4
50	2,300	40	11.2	15.9	4.59	7.73	30.4	.0	3.0	66.0
"	2,300	41	11.8	15.8	4.46	7.51	31.3	.0	3.0	55.0
Average	2,300	41	11.5	15.9	4.53	7.62	30.9	.0	3.0	60.5
60	2,750	40	-	15.2	6.25	8.77	26.8	.0	4.2	229
"	2,700	41	10.6	15.2	5.92	8.31	28.3	.0	4.2	187
Average	2,725	41	10.6	15.2	6.09	8.54	27.6	.0	4.2	208
BEST ECONOMY ADJUSTMENTS										
0	720	22	17.7	16.6	0.95	-	-	18.0	13.0	6.6
"	680	23	16.9	-	.87	-	-	10.6	12.4	4.6
Average	700	23	17.3	16.6	.91	-	-	14.3	12.7	5.6
20	1,080	44	17.0	18.2	1.47	6.16	38.2	20.0	25.8	23.4
"	1,110	42	16.2	-	1.58	6.67	35.3	21.8	28.4	27.6
Average	1,095	43	16.6	18.2	1.53	6.42	36.8	20.9	27.1	25.5
30	1,500	45	14.7	19.4	2.36	6.62	35.5	40.2	25.5	22.5
"	1,500	46	14.7	-	2.44	6.87	34.2	38.4	24.6	34.8
Average	1,500	46	14.7	19.4	2.40	6.75	34.9	39.3	25.1	28.7
40	1,900	47	12.8	20.0	3.40	7.16	32.9	56.0	32.8	21.6
"	1,900	48	13.9	-	3.46	7.28	32.3	50.8	29.6	88.0
Average	1,900	47	13.4	20.0	3.43	7.22	32.6	53.4	31.2	54.8
50	2,400	52	12.2	18.8	4.48	7.54	31.2	56.5	31.5	156
"	2,350	52	12.9	-	4.50	7.57	31.1	53.0	30.5	286
Average	2,375	52	12.6	18.8	4.49	7.56	31.2	54.8	31.0	221
60	2,700	53	10.8	18.7	5.77	8.24	29.0	65.4	34.8	376
"	2,800	54	11.2	-	6.07	8.52	27.6	58.8	31.8	640
Average	2,800	54	11.0	18.7	5.92	8.38	28.3	62.1	33.3	508

TABLE D-4. - Fuel economy, emissions, and engine parametric adjustment for 1976 Dodge Dart (Car No. 130)

Vehicle speed, mph	Engine speed, rpm	Spark timing, °BTC	Manifold vacuum, in. of Hg	Air fuel ratio	Fuel consumption		Fuel economy, mpg	Emissions, g/hr		
					kg/hr	liters/ 100 km		CO	HC	NO_x
BASELINE (MANUFACTURERS' SPECIFIED ADJUSTMENTS)										
0	600	20	18.1	16.8	1.06	-	-	1.2	0.52	5.6
"	600	20	18.0	16.9	1.08	0	0	.7	.39	5.5
Average	600	20	18.1	16.9	1.07	0	0	1.0	.46	5.6
20	1,000	25	17.6	16.8	1.86	7.85	30.0	22.6	15.0	24.8
"	1,020	23	17.6	16.6	2.00	8.43	27.9	33.2	15.6	32.8
Average	1,010	24	17.6	16.7	1.93	8.14	29.0	27.9	15.3	28.8
30	1,350	31	16.0	16.6	2.82	7.91	29.7	6.6	7.8	25.9
"	1,350	29	16.2	16.8	2.81	7.88	29.8	27.6	22.2	26.1
Average	1,350	30	16.1	16.7	2.82	7.90	29.8	17.1	15.0	26.0
40	1,700	37	13.2	16.9	4.08	8.60	27.4	2.8	6.0	41.9
"	1,720	39	14.2	16.8	3.91	8.24	28.6	2.4	6.8	37.2
Average	1,710	38	13.7	16.9	4.00	8.42	28.0	2.6	6.4	39.6
50	2,100	36	12.2	16.7	5.59	9.42	25.0	4.0	6.0	104
"	2,120	37	12.8	16.6	5.41	9.10	25.8	3.5	6.0	78.0
Average	2,110	37	12.5	16.6	5.50	9.26	25.4	3.8	6.0	91
60	2,550	38	10.6	16.4	8.59	12.1	19.5	11.4	8.4	401
"	2,560	38	10.8	16.3	8.10	11.4	20.7	9.0	7.2	363
Average	2,555	38	10.7	16.4	8.35	11.8	20.1	10.2	7.8	382
BEST ECONOMY ADJUSTMENTS										
0	610	25	17.7	16.0	1.05	-	-	15.1	14.4	8.5
"	630	25	18.3	15.6	1.09	-	-	18.7	12.9	9.0
Average	620	25	18.0	15.8	1.07	-	-	16.9	13.7	8.8
20	970	27	17.0	16.2	1.64	6.89	34.1	21.0	15.8	23.2
"	920	27	18.0	16.2	1.75	7.37	31.9	20.2	16.0	31.0
Average	945	27	17.5	16.2	1.70	7.13	33.0	20.6	15.9	27.1
30	1,350	34	16.6	17.0	2.66	7.47	31.5	30.9	22.2	91.2
"	1,370	34	17.2	17.0	2.69	7.56	31.1	31.8	22.0	92.1
Average	1,360	34	16.9	17.0	2.68	7.52	31.3	31.4	22.1	91.7
40	1,700	42	15.5	17.3	3.69	7.78	30.2	38.4	24.8	214
"	1,750	41	15.6	17.3	3.85	8.09	29.1	37.6	23.2	224
Average	1,725	42	15.6	17.3	3.77	7.94	29.7	38.0	24.0	219
50	2,100	40	13.6	17.8	5.40	9.09	25.9	50.2	28.5	354
"	2,100	41	13.9	17.7	5.17	8.70	27.0	50.5	27.0	360
Average	2,100	41	13.8	17.8	5.29	8.90	26.5	50.4	27.8	357
60	2,500	40	12.6	17.2	7.72	10.8	21.7	58.2	31.8	746
"	2,550	41	12.5	17.2	7.80	10.9	21.5	58.8	33.0	800
Average	2,525	41	12.6	17.2	7.76	10.9	21.6	58.5	32.4	773

TABLE D-5. - Fuel economy, emissions, and engine parametric adjustments for 1976 Dodge Dart (Car No. 131)

Vehicle speed, mph	Engine speed, rpm	Spark timing, °BTC	Manifold vacuum, in. of Hg	Air fuel ratio	Fuel consumption		Fuel economy, mpg	Emissions, g/hr		
					kg/hr	liters/ 100 km		CO	HC	NO_x
BASELINE (MANUFACTURERS' SPECIFIED ADJUSTMENTS)										
0	600	20	18.4	16.4	1.03	-	-	0.95	0.87	6.9
"	600	20	18.4	16.0	1.03	-	-	.71	.72	6.5
Average	600	20	18.4	16.2	1.03	-	-	.83	.80	6.7
20	900	21	17.0	17.3	1.71	7.21	32.6	11.6	12.6	10.2
"	900	21	15.8	18.3	1.92	8.08	29.1	15.0	16.6	6.8
Average	900	21	16.4	17.8	1.82	7.65	30.9	13.3	14.6	8.5
30	1,300	29	14.7	17.6	2.81	7.89	30.0	3.9	9.6	13.2
"	1,300	30	14.0	17.7	2.94	8.26	29.0	2.7	10.2	15.9
Average	1,300	30	14.3	17.7	2.88	8.08	30.0	3.3	9.9	14.6
40	1,600	35	13.0	17.3	3.96	8.34	28.2	3.2	12.4	20.0
"	1,600	36	13.0	17.5	4.09	8.62	28.5	2.8	10.8	26.4
Average	1,600	36	13.0	17.4	4.03	8.48	28.4	3.0	11.6	23.2
50	2,000	34	12.0	16.8	5.23	8.81	27.0	4.5	9.0	46.5
"	2,000	36	11.5	16.9	5.33	8.97	26.2	4.0	9.0	56.5
Average	2,000	35	11.8	16.9	5.28	8.89	26.6	4.3	9.0	51.5
60	2,400	37	20.0	16.4	6.63	9.30	25.3	6.0	9.6	134
"	2,400	37	11.8	16.4	7.18	10.08	23.3	6.6	9.6	225
Average	2,400	37	15.9	16.4	6.91	9.69	24.3	6.3	9.6	180
BEST ECONOMY ADJUSTMENTS										
0	640	25	18.1	16.4	1.06	-	-	18.0	15.4	11.6
"	640	25	18.3	16.4	.98	-	-	14.6	14.3	9.7
Average	640	25	18.2	16.4	1.02	-	-	16.3	15.0	10.7
20	940	26	16.9	17.9	1.81	7.60	31.0	27.6	24.2	27.2
"	910	25	16.8	18.0	1.56	6.55	36.0	23.8	21.4	19.6
Average	925	26	16.9	18.0	1.69	7.08	33.5	25.7	22.8	23.4
30	1,350	34	16.2	18.3	2.48	6.96	34.0	37.2	30.3	61.2
"	1,350	36	16.2	18.3	2.36	6.63	35.5	33.3	25.5	63.6
Average	1,350	35	16.2	18.3	2.42	6.80	34.8	35.3	27.9	62.4
40	1,675	39	15.4	17.7	3.82	8.05	29.2	42.8	30.0	194
"	1,700	37	15.3	17.7	3.47	7.30	32.2	38.4	26.8	164
Average	1,688	38	15.4	17.7	3.65	7.68	30.7	40.6	28.4	179
50	2,100	40	14.0	17.6	5.15	8.68	27.1	53.0	32.5	386
"	2,100	40	14.0	17.6	4.94	8.31	28.3	49.0	31.5	386
Average	2,100	40	14.0	17.6	5.05	8.50	27.7	51.0	32.0	386
60	2,500	42	12.3	17.1	7.69	10.79	21.8	69.0	42.6	748
"	2,500	40	12.4	17.2	6.87	9.64	24.4	60.0	37.2	682
Average	2,500	41	12.4	17.2	7.28	10.22	23.1	64.5	39.9	715

TABLE D-6. - Fuel economy, emissions, and engine parametric adjustments for 1976 Dodge Dart (Car No. 137)

Vehicle speed, mph	Engine speed, rpm	Spark timing, °BTC	Manifold vacuum, in. of Hg	Air fuel ratio	Fuel consumption		Fuel economy, mpg	Emissions, g/hr		
					kg/hr	liters/ 100 km		CO	HC	NO_x
BASELINE (MANUFACTURERS' SPECIFIED ADJUSTMENTS)										
0	610	20	18.5	16.3	1.05	-	-	0.4	1.8	5.9
"	630	20	18.4	16.4	1.19	-	-	.6	6.2	8.3
Average	620	20	18.5	16.4	1.12	-	-	.5	4.0	7.1
20	930	20	17.6	17.3	1.86	7.81	30.1	19.0	15.2	19.2
"	940	21	17.5	17.3	2.00	8.44	27.9	25.0	19.0	25.2
Average	935	21	17.6	17.3	1.93	8.13	29.0	22.0	17.1	22.2
30	1,300	28	16.6	17.2	2.65	7.45	31.6	5.7	9.0	32.1
"	1,300	29	16.4	17.0	2.80	7.86	29.9	6.6	12.6	42.6
Average	1,300	29	16.5	17.1	2.73	7.66	30.8	6.2	10.8	37.4
40	1,600	35	13.2	16.9	3.98	8.38	28.1	2.8	9.2	34.4
"	1,600	36	13.4	16.8	4.11	8.66	27.2	2.0	11.6	41.6
Average	1,600	36	13.3	16.9	4.05	8.52	27.7	2.4	10.4	38.0
50	2,000	36	12.3	16.4	5.42	9.12	25.8	4.5	9.5	78.5
"	2,000	36	12.0	16.3	5.75	9.68	24.3	4.0	11.5	101
Average	2,000	36	12.2	16.4	5.59	9.40	25.1	4.3	10.5	89.8
60	2,400	37	11.6	15.9	7.23	10.1	23.2	9.0	10.2	225
"	2,400	38	11.0	15.7	7.87	11.0	21.3	10.8	12.6	303
Average	2,400	38	11.3	15.8	7.55	10.6	22.3	9.9	11.4	264
BEST ECONOMY ADJUSTMENTS										
0	640	25	18.8	16.0	1.10	-	-	23.0	14.4	13.2
"	610	25	19.1	16.0	1.11	-	-	29.5	14.9	11.5
Average	625	25	19.0	16.0	1.11	-	-	26.3	14.7	12.4
20	960	26	17.4	17.3	2.58	7.92	29.7	25.2	14.4	29.8
"	930	26	18.0	17.6	1.53	7.42	31.7	25.0	16.4	23.8
Average	945	26	17.7	17.5	2.06	7.67	30.7	25.1	15.4	26.8
30	1,300	35	17.0	17.4	2.74	7.67	30.7	32.7	21.3	106
"	1,300	35	17.4	17.4	2.67	7.49	31.4	34.2	21.0	84.9
Average	1,300	35	17.2	17.4	2.71	7.58	31.1	33.5	21.2	95.5
40	1,600	41	15.8	17.6	3.67	7.74	30.4	40.8	24.0	197
"	1,600	41	16.2	17.4	3.77	7.95	29.6	43.2	24.8	179
Average	1,600	41	16.0	17.5	3.72	7.85	30.0	42.0	24.4	188
50	1,950	42	14.4	17.7	5.13	8.63	27.3	55.0	29.5	372
"	2,000	41	14.8	17.6	5.34	8.99	26.2	60.5	31.5	324
Average	1,975	42	14.6	17.7	5.24	8.81	26.8	57.8	30.5	348
60	2,300	43	13.2	17.1	7.17	10.1	23.4	67.2	34.5	687
"	2,400	43	13.4	16.9	7.57	10.6	22.1	73.8	36.0	623
Average	2,350	43	13.3	17.0	7.37	10.4	22.8	70.5	35.3	655

TABLE D-7. - Fuel economy, emissions, and engine parametric adjustment for 1976 Chevrolet Nova (Car No. 132)

Vehicle speed, mph	Engine speed, rpm	Spark timing, °BTC	Manifold vacuum, in. of Hg	Air fuel ratio	Fuel consumption		Fuel economy, mpg	Emissions, g/hr		
					kg/hr	liters/ 100 km		CO	HC	NO_x
BASELINE (MANUFACTURERS' SPECIFIED ADJUSTMENTS)										
0	560	27	15.8	15.2	1.26	-	-	363	22.1	1.3
"	580	29	16.0	15.2	1.24	-	-	335	21.5	1.0
Average	570	28	15.9	15.2	1.25	-	-	349	21.8	1.2
20	1,180	30	18.6	15.2	2.24	9.41	25.0	1.6	3.0	10.8
"	1,160	29	18.9	15.6	2.26	9.52	24.7	2.0	4.2	12.2
Average	1,170	30	18.8	15.4	2.25	9.47	24.9	1.8	3.6	11.5
30	1,200	29	17.0	15.7	2.78	7.81	30.1	1.3	4.0	37.2
"	1,250	31	16.8	16.6	2.81	7.89	29.8	2.1	3.6	36.6
Average	1,225	30	16.9	16.2	2.80	7.85	30.0	1.7	3.8	36.9
40	1,550	29	12.1	18.2	4.41	9.30	25.3	1.2	6.4	18.4
"	1,600	31	12.2	18.2	4.55	9.56	24.6	.8	6.0	19.6
Average	1,575	30	12.2	18.2	4.48	9.43	25.0	1.0	6.2	19.0
50	1,800	29	10.2	18.2	6.15	10.4	22.7	1.5	2.7	31.0
"	1,950	30	10.9	18.8	6.19	10.4	22.6	1.5	3.0	29.0
Average	1,875	30	10.6	18.5	6.17	10.4	22.7	1.5	2.9	30.0
60	2,250	28	9.2	18.8	8.83	12.4	19.0	2.4	3.5	53.4
"	2,300	29	9.2	18.8	8.98	12.6	18.7	2.4	3.0	55.8
Average	2,275	29	9.2	18.8	8.91	12.5	18.9	2.4	3.3	54.6
BEST ECONOMY ADJUSTMENTS										
0	590	33	16.0	15.4	1.35	-	-	14.2	21.5	6.8
"	580	33	16.0	15.6	1.27	-	-	15.6	24.0	4.7
Average	585	33	16.0	15.5	1.31	-	-	14.9	22.8	5.8
20	1,180	36	19.0	16.0	2.28	9.60	24.5	31.2	20.8	14.2
"	1,175	35	18.8	16.0	2.24	9.41	25.0	31.4	22.0	13.4
Average	1,178	36	18.9	16.0	2.26	9.51	24.8	31.3	21.4	13.8
30	1,200	35	17.0	16.5	2.80	7.84	30.0	31.2	22.2	37.8
"	1,175	35	17.1	16.9	2.72	7.64	30.8	32.7	23.4	34.8
Average	1,188	35	17.1	16.7	2.76	7.74	30.4	32.0	22.8	36.3
40	1,600	37	15.8	17.4	3.85	8.11	29.0	49.6	27.2	85.2
"	1,600	37	15.6	17.7	4.07	8.55	27.5	56.0	30.8	86.4
Average	1,600	37	15.7	17.6	3.96	8.33	28.3	52.8	29.0	85.8
50	2,000	40	14.9	17.7	5.41	9.12	25.8	72.5	34.5	152
"	2,000	39	14.3	17.8	5.45	9.19	25.6	76.0	34.0	150
Average	2,000	40	14.6	17.8	5.43	9.16	25.7	74.3	34.3	151
60	2,300	40	13.4	18.0	7.30	10.2	23.0	93.0	37.8	297
"	2,300	41	13.4	18.0	7.36	10.3	22.8	95.4	38.4	300
Average	2,300	41	13.4	18.0	7.33	10.3	22.9	94.2	38.1	299

TABLE D-8. - Fuel economy, emissions, and engine parametric adjustment for 1976 Chevrolet Nova (Car No. 133)

Vehicle speed, mph	Engine speed, rpm	Spark timing, °BTC	Manifold vacuum, in. of Hg	Air fuel ratio	Fuel consumption		Fuel economy, mpg	Emissions, g/hr		
					kg/hr	liters/ 100 km		CO	HC	NO_x
BASELINE (MANUFACTURERS' SPECIFIED ADJUSTMENTS)										
0	670	28	16.0	14.9	1.56	-	-	71.9	12.8	5.2
"	670	27	15.8	15.0	1.60	-	-	68.4	9.9	5.2
Average	670	28	15.9	15.0	1.58	-	-	70.2	11.4	5.2
20	860	28	17.2	15.9	1.81	7.59	31.0	4.0	6.0	6.4
"	1,100	29	18.4	16.3	2.20	9.26	25.4	.6	2.0	6.6
Average	980	29	17.8	16.1	2.01	8.43	28.2	2.3	4.0	6.5
30	1,200	30	16.4	17.2	2.82	7.89	29.8	8.1	6.6	14.7
"	1,200	30	16.3	17.4	2.78	7.79	30.2	2.7	3.9	9.3
Average	1,200	30	16.4	17.3	2.80	7.84	30.0	5.4	5.3	12.0
40	1,550	31	14.8	17.8	4.09	8.58	27.4	1.6	2.8	31.2
"	1,550	31	14.4	18.6	4.20	8.84	26.6	.8	1.2	24.4
Average	1,550	31	14.6	18.2	4.15	8.71	27.0	1.2	2.0	27.8
50	1,900	33	13.2	18.2	5.64	9.48	24.8	1.5	2.0	52.5
"	1,900	33	13.3	18.8	5.66	9.52	24.7	1.0	2.5	44.5
Average	1,900	33	13.2	18.5	5.65	9.50	24.8	1.3	2.3	48.5
60	2,300	35	13.0	17.8	7.31	10.2	23.0	1.8	1.8	162
"	2,300	35	12.2	18.8	7.54	10.6	22.2	1.8	2.4	112
Average	2,300	35	12.6	18.3	7.43	10.4	22.6	1.8	2.1	137
BEST ECONOMY ADJUSTMENTS										
0	550	36	16.4	16.8	1.18	-	-	14.9	29.3	4.1
"	550	34	16.2	16.6	1.25	-	-	13.9	24.0	3.6
Average	550	35	16.3	16.7	1.22	-	-	14.4	26.7	3.9
20	860	36	17.8	16.4	1.85	7.79	30.2	22.4	19.2	10.8
"	1,150	37	19.0	16.8	2.23	9.37	25.1	35.8	18.0	8.2
Average	1,005	37	18.4	16.6	2.04	8.58	27.7	29.1	18.6	9.5
30	1,200	38	17.0	17.1	2.86	8.05	29.2	38.1	20.4	28.8
"	1,200	37	17.2	17.3	2.80	7.87	29.9	37.5	20.7	24.0
Average	1,200	38	17.1	17.2	2.83	7.96	29.6	37.8	20.6	26.4
40	1,600	39	16.4	17.3	4.07	8.55	27.5	54.8	24.4	72.8
"	1,550	39	16.4	17.3	3.99	8.40	28.0	52.4	23.2	63.6
Average	1,575	39	16.4	17.3	4.03	8.48	27.8	53.6	23.8	68.2
50	1,950	41	15.4	17.3	5.41	9.12	25.8	72.5	26.0	142
"	2,000	41	15.3	17.3	5.49	9.26	25.4	69.5	26.0	141
Average	1,975	41	15.4	17.3	5.45	9.19	25.6	71.0	26.0	142
60	2,300	43	14.3	17.4	7.19	10.1	23.3	88.2	25.8	307
"	2,300	43	14.4	17.4	7.22	10.1	23.2	88.2	28.2	287
Average	2,300	43	14.4	17.4	7.21	10.1	23.3	88.2	27.0	297

TABLE D-9. - Fuel economy, emissions, and engine parametric adjustment for 1976 Chevrolet Nova (Car No. 134)

Vehicle speed, mph	Engine speed, rpm	Spark timing, °BTC	Manifold vacuum, in. of Hg	Air fuel ratio	Fuel consumption		Fuel economy, mpg	Emissions, g/hr		
					kg/hr	liters/ 100 km		CO	HC	NO_x
BASELINE (MANUFACTURERS' SPECIFIED ADJUSTMENTS)										
0	630	28	15.4	15.5	1.43	-	-	0.6	0.0	14.9
"	650	27	15.4	16.4	1.42	-	-	.3	.0	13.2
Average	640	28	15.4	16.0	1.43	-	-	.5	.0	14.1
20	1,100	29	18.5	16.0	2.20	9.26	25.4	.6	1.6	12.2
"	880	27	16.8	16.4	1.83	7.71	30.5	.0	.6	8.8
Average	990	28	17.7	16.2	2.02	8.49	28.0	.6	1.1	10.5
30	1,200	29	15.8	17.0	2.78	7.79	30.2	3.3	4.2	26.4
"	1,270	29	15.6	18.4	2.92	8.20	28.7	.6	3.0	9.9
Average	1,235	29	15.7	17.7	2.85	8.00	29.5	2.0	3.6	18.2
40	1,550	27	10.6	18.2	4.13	8.71	27.0	1.2	3.2	43.2
"	1,670	30	11.8	20.0	4.70	9.88	23.8	1.6	10.4	9.2
Average	1,610	29	11.2	19.1	4.42	9.30	25.4	1.4	6.8	26.2
50	1,900	30	9.2	18.8	6.09	10.2	23.0	2.0	5.5	29.5
"	2,000	28	9.8	20.0	6.54	11.0	21.4	2.5	6.5	18.5
Average	1,950	29	9.5	19.4	6.32	10.6	22.2	2.3	6.0	24.0
60	2,300	30	9.0	18.8	8.76	12.3	19.1	3.0	3.0	83.4
"	2,470	30	9.2	18.8	8.98	12.6	18.7	6.0	2.4	66.6
Average	2,385	30	9.1	18.8	8.87	12.5	18.9	4.5	2.7	75.0
BEST ECONOMY ADJUSTMENTS										
0	600	33	16.0	16.6	1.42	-	-	12.4	19.1	20.2
"	600	33	16.0	16.0	1.44	-	-	13.2	20.0	24.3
Average	600	33	16.0	16.3	1.43	-	-	12.8	19.6	22.3
20	1,150	35	19.2	16.4	2.19	9.19	25.6	28.2	21.6	15.6
"	1,110	34	19.2	16.0	2.12	8.94	26.3	28.2	22.0	17.2
Average	1,130	35	19.2	16.2	2.16	9.07	26.0	28.2	21.8	16.4
30	1,200	35	17.2	17.0	2.65	7.44	31.6	33.3	23.4	35.4
"	1,180	34	16.4	16.8	2.65	7.44	31.6	32.7	23.7	41.4
Average	1,190	35	16.8	16.9	2.65	7.44	31.6	33.0	23.6	38.4
40	1,600	37	16.2	17.7	3.98	8.37	28.1	53.2	29.6	77.6
"	1,500	36	16.0	17.7	3.83	8.05	29.2	56.0	30.4	78.4
Average	1,550	37	16.1	17.7	3.91	8.21	28.6	54.6	30.4	78.0
50	2,000	37	15.0	18.2	5.14	8.65	27.2	74.5	36.0	128
"	1,900	39	14.8	18.2	5.32	8.98	26.2	80.0	36.5	256
Average	1,950	38	14.9	18.2	5.23	8.82	26.7	77.3	36.3	192
60	2,300	40	13.6	18.2	7.28	10.2	23.0	100	43.2	288
"	2,300	41	13.2	18.2	7.31	10.3	22.9	102	43.8	308
Average	2,300	41	13.4	18.2	7.30	10.3	23.0	101	43.5	298

TABLE D-10. - Fuel economy, emissions, and engine parametric adjustment for 1976 Ford Granada (Car No. 117)

Vehicle speed, mph	Engine speed, rpm	Spark timing, °BTC	Manifold vacuum, in. of Hg	Air fuel ratio	Fuel consumption		Fuel economy, mpg	Emissions, g/hr		
					kg/hr	liters/ 100 km		CO	HC	NO_x
BASELINE (MANUFACTURERS' SPECIFIED ADJUSTMENTS)										
0	620	31	17.2	24.2	1.14	-	-	0.0	5.2	11.8
"	610	32	17.1	--	1.22	-	-	.6	5.0	12.4
Average	615	32	17.2	24.2	1.18	-	-	.3	5.1	12.1
20	980	33	17.4	23.3	2.06	8.68	27.1	0.0	7.4	62.2
"	980	33	17.0	-	2.12	8.91	26.4	.6	6.4	57.0
Average	980	33	17.2	23.3	2.09	8.80	26.8	.3	6.9	59.6
30	1,300	37	16.4	22.1	3.19	8.94	26.3	0.0	9.9	20.4
"	1,300	37	14.1	-	3.67	10.3	22.9	1.2	18.3	9.6
Average	1,300	37	15.3	22.1	3.43	9.62	24.6	.6	14.1	15.0
40	1,700	38	11.4	21.0	4.55	9.57	24.6	.4	15.6	16.0
"	1,700	38	10.8	-	4.97	10.4	22.5	2.4	16.8	19.6
Average	1,700	38	11.1	21.0	4.76	9.98	23.6	1.4	16.2	17.8
50	2,100	39	10.6	20.6	5.88	9.88	23.8	3.5	15.0	49.0
"	2,100	39	9.9	-	6.40	10.7	21.9	5.0	15.0	49.0
Average	2,100	39	10.3	20.6	6.14	10.3	22.9	4.3	15.0	49.0
60	2,500	41	8.8	20.3	8.11	11.4	20.7	16.2	16.2	164
"	2,500	42	8.1	-	8.77	12.3	19.1	15.6	16.8	148
Average	2,500	42	8.5	20.3	8.44	11.9	19.9	15.9	16.5	156
BEST ECONOMY ADJUSTMENTS										
0	680	34	16.5	16.3	1.39	-	-	20.6	15.9	10.0
"	680	35	16.7	-	1.35	-	-	19.3	16.2	10.0
Average	680	35	16.6	16.3	1.37	-	-	20.0	16.1	10.0
20	970	36	16.9	16.1	2.01	8.46	27.8	21.2	21.8	68.4
"	950	36	17.1	-	2.00	8.40	28.0	20.8	21.4	61.6
Average	960	36	17.0	16.1	2.01	8.43	27.9	21.0	21.6	65.0
30	1,300	40	16.0	16.6	3.12	8.71	27.0	29.7	26.7	178
"	1,350	40	16.3	-	3.10	8.68	27.1	31.8	25.5	177
Average	1,325	40	16.2	16.6	3.11	8.70	27.1	30.8	26.1	178
40	1,700	41	15.5	16.2	4.26	8.68	26.2	45.2	32.0	287
"	1,700	41	15.3	-	4.40	9.22	25.5	46.4	30.4	299
Average	1,700	41	15.4	16.2	4.33	8.95	25.9	45.8	31.2	293
50	2,100	42	13.8	16.6	5.97	10.0	23.4	67.0	38.5	439
"	2,020	42	14.0	-	5.76	9.68	24.3	64.0	35.5	440
Average	2,060	42	13.9	16.6	5.87	9.84	23.9	65.5	37.0	440
60	2,500	44	11.6	16.8	8.27	11.6	20.3	99.6	41.4	557
"	2,420	45	11.8	-	7.93	11.1	21.2	96.6	38.4	545
Average	2,460	45	11.7	16.8	8.10	11.4	20.8	98.1	39.9	551

TABLE D-11. - Fuel economy, emissions, and engine parametric adjustment for 1976 Ford Granada (Car No. 118)

Vehicle speed, mph	Engine speed, rpm	Spark timing, °BTC	Manifold vacuum, in. of Hg	Air fuel ratio	Fuel consumption		Fuel economy, mpg	Emissions, g/hr		
					kg/hr	liters/ 100 km		CO	HC	NO_x
BASELINE (MANUFACTURERS' SPECIFIED ADJUSTMENTS)										
0	620	31	17.5	20.6	1.28	-	-	0.6	1.6	13.6
"	610	31	17.3	-	1.22	-	-	.8	2.0	12.1
Average	615	31	17.4	20.6	1.25	-	-	.7	1.8	12.9
20	970	32	17.6	23.8	2.20	9.22	25.5	.4	4.8	51.2
"	960	32	17.7	-	2.01	8.43	27.9	.8	6.4	42.4
Average	965	32	17.7	23.8	2.11	8.83	26.7	.6	5.6	46.8
30	1,300	36	16.9	22.1	3.37	9.19	25.6	.9	6.9	81.9
"	1,350	37	16.6	22.1	3.27	9.15	25.7	.9	8.7	68.4
Average	1,325	37	16.8	22.1	3.27	9.17	25.7	.9	7.8	75.2
40	1,700	37	12.2	21.0	4.96	10.4	22.6	5.2	14.0	11.6
"	1,700	38	12.3	-	4.68	9.84	23.9	3.2	13.6	10.8
Average	1,700	38	12.3	21.0	4.82	10.12	23.3	4.2	13.8	11.2
50	2,100	39	11.3	20.6	6.32	10.6	22.1	9.5	15.0	36.5
"	2,100	40	10.8	-	6.42	10.8	21.8	7.0	15.5	46.0
Average	2,100	40	11.1	20.6	6.37	10.7	22.0	8.3	15.3	41.3
60	2,500	41	9.4	20.0	9.06	12.5	18.5	17.4	16.8	194
"	2,500	41	8.9	-	9.04	12.6	18.6	15.0	16.8	203
Average	2,500	41	9.2	20.0	9.05	12.6	18.6	16.2	16.8	199
BEST ECONOMY ADJUSTMENTS										
0	660	34	17.1	15.9	1.30	-	-	70.2	20.7	9.1
"	640	34	17.0	-	1.27	-	-	44.6	19.9	9.7
Average	650	34	17.1	15.9	1.29	-	-	57.4	20.3	9.4
20	940	35	17.7	16.4	1.96	8.22	28.6	22.9	24.6	73.4
"	960	34	17.2	-	1.98	8.31	28.3	23.2	25.4	76.0
Average	950	35	17.5	16.4	1.97	8.27	28.5	23.1	25.0	74.7
30	1,300	39	16.2	16.6	2.84	7.97	29.5	33.0	31.8	159
"	1,300	40	16.3	-	2.85	8.00	29.4	32.7	30.6	167
Average	1,300	40	16.3	16.6	2.85	8.00	29.5	32.9	31.2	163
40	1.700	40	15.2	16.4	4.09	8.58	27.4	47.6	36.8	311
"	1,650	41	15.8	-	4.06	8.52	27.6	45.2	34.8	324
Average	1,675	41	15.5	16.4	4.08	8.55	27.5	46.4	35.8	318
50	2,100	42	14.1	16.9	5.74	9.64	24.4	67.5	42.0	491
"	2,150	43	14.2	-	5.74	9.64	24.4	66.5	40.0	491
Average	2,125	43	14.2	16.9	5.74	9.64	24.4	67.0	41.0	491
60	2,500	44	11.5	17.6	8.36	11.7	20.1	106	49.2	595
"	2,450	44	12.0	-	8.14	11.4	20.6	97.2	43.8	586
Average	2,475	44	11.8	17.6	8.25	11.6	20.4	102	46.5	591

TABLE D-12. - Fuel economy, emissions, and engine parametric adjustment for 1976 Ford Granada (Car No. 119)

Vehicle speed, mph	Engine speed, rpm	Spark timing, °BTC	Manifold vacuum, in. of Hg	Air fuel ratio	Fuel consumption		Fuel economy, mpg	Emissions, g/hr		
					kg/hr	liters/ 100 km		CO	HC	NO_x
BASELINE (MANUFACTURERS' SPECIFIED ADJUSTMENTS)										
0	590	31	16.9	22.5	1.33	-	-	0.8	1.4	12.2
"	590	31	16.9	-	1.31	-	-	.8	1.6	12.7
Average	590	31	16.9	22.5	1.32	-	-	.8	1.5	12.5
20	940	31	17.0	20.0	2.12	8.91	26.4	.4	3.0	59.0
"	940	31	17.2	-	2.05	6.85	27.2	.8	3.8	12.4
Average	940	31	17.1	20.0	2.09	7.88	26.8	.6	3.4	35.7
30	1,350	35	12.3	22.5	3.79	10.6	22.2	.9	7.8	11.7
"	1,350	36	12.5	-	3.36	9.41	25.0	.6	6.6	18.3
Average	1,350	36	12.4	22.5	3.58	10.0	23.6	.8	7.2	15.0
40	1,700	36	11.0	20.6	5.17	10.9	21.7	2.0	8.0	23.2
"	1,700	36	10.9	-	6.20	13.1	18.0	2.4	10.8	23.6
Average	1,700	36	11.0	20.6	5.69	12.0	19.9	2.2	9.4	23.4
50	2,100	40	9.7	20.3	7.15	12.0	19.6	3.0	8.0	62.5
"	2,050	38	9.6	-	6.82	11.5	20.5	2.5	9.0	60.0
Average	2,075	39	9.7	20.3	7.00	11.8	20.1	2.8	8.5	61.3
60	2,500	35	7.6	19.4	9.72	13.6	17.3	6.0	7.2	155
"	2,450	35	7.5	-	9.54	13.4	17.6	5.4	7.8	172
Average	2,475	35	7.6	19.4	9.63	13.5	17.5	5.7	7.5	164
BEST ECONOMY ADJUSTMENTS										
0	650	34	16.7	15.8	1.32	-	-	55.5	17.2	12.4
"	680	34	16.9	-	1.36	-	-	69.4	17.5	13.1
Average	665	34	16.8	15.8	1.34	-	-	62.5	17.3	12.8
20	960	36	16.8	16.2	1.99	8.34	28.2	21.0	21.2	80.2
"	950	35	17.3	-	1.96	8.25	28.5	23.4	21.0	68.6
Average	955	36	17.1	16.2	1.98	8.30	28.4	22.2	21.1	74.4
30	1,300	40	15.9	17.0	3.02	8.46	27.8	33.9	26.4	147
"	1,300	40	16.1	-	2.97	8.34	28.2	36.0	25.8	133
Average	1,300	40	16.0	17.0	3.00	8.40	28.0	35.0	26.1	140
40	1,700	41	15.1	16.2	4.46	9.37	25.1	51.6	32.0	282
"	1,680	40	15.4	-	4.28	8.98	26.2	50.0	28.8	260
Average	1,690	41	15.3	16.2	4.37	9.18	25.7	50.8	30.4	271
50	2,100	42	13.6	16.6	6.12	10.3	22.8	79.0	37.5	404
"	2,080	42	13.5	-	6.01	10.1	23.3	79.0	36.0	408
Average	2,090	42	13.6	16.6	6.07	10.2	23.1	79.0	36.8	406
60	2,430	44	11.0	17.5	8.35	11.7	20.1	117	37.8	502
"	2,450	43	10.4	-	8.76	22.2	19.2	119	36.6	521
Average	2,440	44	10.7	17.5	8.56	17.0	19.7	118	37.2	512

TABLE D-13. - Fuel economy, emissions, and engine parametric adjustment for 1976 Ford Torino (Car No. 126)

Vehicle speed, mph	Engine speed, rpm	Spark timing, °BTC	Manifold vacuum, in. of Hg	Air fuel ratio	Fuel consumption		Fuel economy, mpg	Emissions, g/hr		
					kg/hr	liters/ 100 km		CO	HC	NO_x
BASELINE (MANUFACTURERS' SPECIFIED ADJUSTMENTS)										
0	670	36	16.8	14.7	1.98	-	-	0.7	2.1	6.4
"	660	35	16.8	14.7	2.02	-	-	1.5	3.2	6.1
Average	665	36	16.8	14.7	2.00	-	-	1.1	2.7	6.3
20	840	37	17.6	15.3	2.43	10.2	23.0	.8	2.4	10.0
"	820	36	17.8	15.4	2.39	10.0	23.4	.8	3.0	10.2
Average	830	37	17.7	15.4	2.41	10.1	23.2	.8	2.7	10.1
30	1,150	47	18.7	20.6	3.37	9.45	24.9	1.5	3.6	43.2
"	1,140	47	18.6	21.0	3.54	9.92	23.7	1.8	4.2	53.7
Average	1,145	47	18.7	20.8	3.46	9.69	24.3	1.7	3.9	48.5
40	1,500	51	17.5	20.3	4.90	10.3	22.8	4.0	5.6	54.4
"	1,500	52	17.6	20.6	5.00	10.7	22.0	4.0	5.6	64.8
Average	1,500	52	17.6	20.5	5.00	10.5	22.4	4.0	5.6	59.6
50	1,850	53	16.2	19.4	6.85	11.5	20.4	7.0	7.0	85.5
"	1,800	53	16.6	19.7	6.99	11.8	20.0	6.0	6.5	92.5
Average	1,825	53	16.4	19.6	6.92	11.7	20.2	7.0	6.8	89.0
60	2,180	53	14.7	18.9	9.23	12.9	18.2	17.4	10.2	179
"	2,200	53	14.8	18.9	9.53	13.4	17.6	13.8	10.2	214
Average	2,190	53	14.8	18.9	9.38	13.2	17.9	15.6	10.2	197
BEST ECONOMY ADJUSTMENTS										
0	660	38	16.9	15.2	2.08	-	-	110	30.6	7.04
"	670	38	17.2	15.1	1.86	-	-	130	29.7	7.21
Average	665	38	17.1	15.2	1.97	-	-	120	30.2	7.13
20	830	37	18.0	15.9	2.41	10.1	23.2	28.4	32.0	9.2
"	810	38	18.2	15.8	2.48	10.4	22.6	32.4	29.6	8.6
Average	820	38	18.1	15.9	2.45	10.3	22.9	30.4	30.8	8.9
30	1,160	50	18.0	-	3.54	9.92	23.7	39.3	37.5	34.8
"	1,120	50	18.6	16.7	3.47	9.72	24.2	39.0	30.9	32.4
Average	1,140	50	18.3	16.7	3.51	9.82	24.0	39.2	34.2	33.6
40	1,500	53	17.2	18.0	4.88	10.3	22.9	63.2	28.0	58.4
"	1,500	55	17.4	18.2	4.90	10.3	22.8	66.0	29.2	55.2
Average	1,500	54	17.3	18.1	4.89	10.3	22.9	64.6	28.6	56.8
50	1,850	55	16.9	17.8	6.55	11.0	21.3	79.5	30.5	164
"	1,800	55	17.1	17.8	6.51	11.9	21.5	81.5	30.0	142
Average	1,825	55	17.0	17.8	6.53	11.5	21.4	80.5	30.3	153
60	2,200	57	15.8	17.0	9.06	12.7	18.5	93.6	40.2	605
"	2,200	56	16.0	17.0	8.93	12.5	18.8	97.2	40.2	569
Average	2,200	57	15.9	17.0	9.00	12.6	18.7	95.4	40.2	587

TABLE D-14. - Fuel economy, emissions, and engine parametric adjustment for 1976 Ford Torino (Car No. 128)

Vehicle speed, mph	Engine speed, rpm	Spark timing, °BTC	Manifold vacuum, in. of Hg	Air fuel ratio	Fuel consumption		Fuel economy, mpg	Emissions, g/hr		
					kg/hr	liters/ 100 km		CO	HC	NO_x
BASELINE (MANUFACTURERS' SPECIFIED ADJUSTMENTS)										
0	750	35	14.6	15.2	2.55	-	-	1.1	1.5	15.7
"	760	35	14.8	15.1	2.60	-	-	.7	1.0	16.5
Average	755	35	14.7	15.2	2.58	-	-	.9	1.3	16.1
20	860	35	16.4	15.3	2.57	10.9	21.8	1.2	1.8	10.4
"	880	36	16.6	15.4	2.54	10.6	22.1	.8	1.2	9.8
Average	870	36	16.5	15.4	2.56	10.8	22.0	1.0	1.5	10.1
30	1,140	46	16.3	18.8	3.74	10.5	22.4	1.5	3.3	25.2
"	1,180	47	16.2	20.6	3.91	10.9	21.5	1.2	3.0	28.2
Average	1,160	47	16.3	19.7	3.83	10.7	22.0	1.4	3.2	26.7
40	1,550	50	15.0	20.0	5.35	11.3	20.9	3.6	6.0	39.2
"	1,600	50	15.0	20.6	5.88	12.4	19.0	3.2	4.8	39.2
Average	1,575	50	15.0	20.3	5.62	11.9	20.0	3.4	5.4	39.2
50	1,950	51	13.4	19.4	7.74	13.0	18.1	6.5	6.5	64.5
"	1,950	51	13.4	20.0	7.79	13.1	18.0	6.0	5.5	67.5
Average	1,950	51	13.4	19.7	7.76	13.1	18.1	6.3	6.0	66.0
60	2,300	52	12.3	19.4	9.76	13.7	17.2	8.4	10.2	149
"	2,320	53	12.3	20.0	9.41	13.2	17.8	7.8	9.0	156
Average	2,310	53	12.3	19.7	9.59	13.5	17.5	8.1	9.6	153
BEST ECONOMY ADJUSTMENTS										
0	660	38	15.7	14.9	2.04	-	-	59.3	48.8	4.0
"	690	38	15.8	14.9	1.81	-	-	64.6	45.0	1.3
Average	675	38	15.8	14.9	1.93	-	-	62.0	46.9	2.7
20	840	38	16.8	15.3	2.37	10.0	23.6	33.5	28.5	8.8
"	860	39	17.0	15.4	2.14	9.01	26.1	22.4	42.7	7.0
Average	850	39	16.9	15.4	2.26	9.51	24.9	28.0	35.6	7.9
30	1,160	49	17.4	16.6	3.51	9.84	23.9	37.6	53.3	42.3
"	1,250	49	16.8	16.8	3.23	9.05	26.0	37.6	62.2	39.0
Average	1,205	49	17.1	16.7	3.37	9.45	25.0	37.6	57.8	40.7
40	1,600	52	16.0	18.0	5.09	10.7	22.0	75.2	42.2	59.8
"	1,600	53	15.5	18.2	5.12	9.80	24.0	62.4	45.7	64.0
Average	1,600	53	15.8	18.1	5.11	10.30	23.0	68.8	44.0	61.9
50	1,920	52	15.0	18.2	6.97	11.8	20.0	116	63.3	174
"	2,000	53	15.3	18.2	5.87	9.88	23.8	87.3	58.4	166
Average	1,960	53	15.2	18.2	6.42	10.8	21.9	101.7	60.9	170
60	2,300	53	13.4	18.2	9.39	13.1	17.9	135	75.6	536
"	2,380	54	14.6	18.2	7.57	10.6	22.1	98.4	54.5	392
Average	2,340	54	14.0	18.2	8.48	11.9	20.0	116.7	65.1	464

TABLE D-15. - Fuel economy, emissions, and engine parametric adjustment for 1976 Ford Torino (Car No. 136)

Vehicle speed, mph	Engine speed, rpm	Spark timing, °BTC	Manifold vacuum, in. of Hg	Air fuel ratio	Fuel consumption		Fuel economy, mpg	Emissions, g/hr		
					kg/hr	liters/ 100 km		CO	HC	NO_x
BASELINE (MANUFACTURERS' SPECIFIED ADJUSTMENTS)										
0	680	36	16.7	15.6	1.98	-	-	0.7	2.9	5.8
"	640	35	16.1	15.4	2.00	-	-	.3	2.1	5.1
Average	660	36	16.4	15.5	1.99	-	-	.5	2.5	5.5
20	900	39	17.8	15.6	2.66	11.2	21.0	1.0	4.6	15.2
"	810	36	17.4	16.0	2.49	10.4	22.5	.4	2.8	9.2
Average	855	38	17.6	15.8	2.58	10.8	21.8	.7	3.7	12.2
30	1,150	49	18.2	21.3	3.53	9.92	23.7	2.1	6.0	40.5
"	1,200	46	17.8	21.3	3.65	10.2	23.0	1.8	5.1	31.5
Average	1,175	48	18.0	21.3	3.59	10.1	23.4	2.0	5.6	36.0
40	1,500	55	17.2	20.6	5.33	11.2	20.9	4.8	9.6	83.2
"	1,500	52	17.2	20.5	5.08	10.7	22.0	3.6	8.4	58.8
Average	1.500	54	17.2	20.6	5.21	11.0	21.5	4.2	9.0	71.0
50	1,900	55	16.0	20.0	7.23	12.2	19.3	6.5	12.0	138
"	1,900	53	15.8	20.3	7.82	13.1	17.9	6.5	11.0	94.5
Average	1,900	54	15.9	20.2	7.53	12.7	18.6	6.5	11.5	116.3
60	2,220	55	14.0	19.4	8.48	11.9	19.8	7.8	14.4	208
"	2,200	53	14.3	19 4	9.45	13.3	17.7	8.4	13.8	193
Average	2,210	54	14.2	19.4	8.96	12.6	18.8	8.1	14.1	201
BEST ECONOMY ADJUSTMENTS										
0	640	38	16.8	16.0	2.00	-	-	61.3	42.5	5.34
"	640	38	17.0	16.0	2.09	-	-	67.0	53.4	5.52
Average	640	38	16.9	16.0	2.05	-	-	64.2	48.0	5.43
20	820	38	18.0	16.0	2.46	10.3	22.8	39.4	31.8	9.40
"	820	38	18.2	16.0	2.54	10.7	22.0	44.2	48.4	11.6
Average	820	38	18.1	16.0	2.50	10.5	22.4	41.8	40.1	10.5
30	1,110	49	18.4	16.6	3.57	10.0	23.4	39.6	38.7	46.8
"	1,140	49	18.4	16.7	3.57	10.0	23.5	41.4	47.1	48.3
Average	1,125	49	18.4	16.7	3.57	10.0	23.5	40.5	42.9	47.6
40	1,500	55	17.8	18.0	4.93	10.4	22.7	70.0	41.7	98.8
"	1,500	55	17.6	18.0	4.88	10.3	22.9	69.6	52.0	102
Average	1,500	55	17.7	18.0	4.91	10.4	22.8	69.8	46.9	100.4
50	1,800	55	16.8	18.3	6.65	11.2	21.0	96.0	50.5	202
"	1,850	56	17.0	18.2	6.74	11.4	20.7	101	57.0	194
Average	1,825	56	16.9	18.3	6.70	11.3	20.8	98.5	53.8	198
60	2,200	56	15.5	17.5	9.47	13.3	17.7	117	61.8	647
"	2,200	56	15.8	17.6	9.28	13.0	18.1	118	67.2	697
Average	2,200	56	15.7	17.6	9.38	13.2	17.9	118	64.5	672

TABLE D-16. - Fuel economy, emissions, and engine parametric adjustment for 1976 Chevrolet Impala (Car No. 114)

Vehicle speed, mph	Engine speed, rpm	Spark timing, °BTC	Manifold vacuum, in. of Hg	Air fuel ratio	Fuel consumption		Fuel economy, mpg	Emissions, g/hr		
					kg/hr	liters/ 100 km		CO	HC	NO_x
BASELINE (MANUFACTURERS' SPECIFIED ADJUSTMENTS)										
0	630	24	15.0	15.3	1.80	-	-	0.6	0.3	4.1
"	610	24	15.2	15.5	1.86	-	-	0.7	.2	5.0
Average	620	24	15.1	15.4	1.83	-	-	0.7	.3	4.6
20	910	22	17.1	16.1	2.68	11.2	21.0	.6	.8	12.0
"	920	24	15.0	15.9	2.81	11.8	20.0	.6	1.0	15.6
Average	915	23	16.1	16.0	2.75	11.5	21.0	.6	.9	13.8
30	1,300	25	14.8	15.0	4.38	12.2	19.2	.9	2.1	11.1
"	1,300	25	15.0	15.2	4.56	12.8	18.4	.6	2.1	12.0
Average	1,300	25	14.9	15.1	4.47	12.5	18.8	.8	2.1	11.6
40	1,650	30	15.6	15.6	5.59	11.8	20.0	.8	1.2	29.2
"	1,700	31	15.5	15.7	5.76	12.1	19.4	.8	1.2	31.6
Average	1,675	31	15.6	15.7	5.68	12.0	19.7	.8	1.2	30.4
50	2,050	35	15.1	15.9	7.56	12.7	18.5	1.5	1.0	126
"	2,100	36	14.7	16.6	7.71	13.0	18.1	1.5	1.0	88
Average	2,075	36	14.9	16.3	7.64	12.9	18.3	1.5	1.0	107
60	2,500	38	13.8	16.0	10.2	14.3	16.4	1.2	0.6	201
"	2,500	37	13.6	16.5	10.4	14.5	16.2	0.6	.6	199
Average	2,500	38	13.7	16.3	10.3	14.4	16.3	0.9	0.6	200
BEST ECONOMY ADJUSTMENTS										
0	600	39	16.4	15.6	1.73	-	-	29.5	23.5	13.2
"	610	37	16.6	15.6	1.77	-	-	49.9	16.6	15.1
Average	605	38	16.5	15.6	1.75	-	-	39.7	20.1	14.2
20	900	39	18.0	15.2	2.39	10.0	23.5	153	27.0	21.6
"	910	36	18.0	15.3	2.51	10.6	22.3	174	30.6	20.8
Average	905	38	18.0	15.3	2.45	10.3	22.9	164	28.8	21.2
30	1,300	41	18.4	15.0	3.65	10.2	23.0	333	32.7	64.8
"	1,200	38	18.5	15.0	3.88	10.7	22.0	319	33.0	76.2
Average	1,250	40	18.5	15.0	3.77	10.5	23.0	326	32.9	70.5
40	1,650	46	18.0	15.3	5.30	11.2	21.1	276	35.2	192
"	1,650	44	17.9	15.4	5.14	10.8	21.8	294	34.4	163
Average	1,650	45	18.0	15.4	5.22	11.0	21.5	285	34.8	178
50	2,000	51	16.2	17.4	7.14	12.0	19.6	96.0	36.5	265
"	2,000	49	16.0	18.0	7.20	12.1	19.4	92.5	38.0	270
Average	2,000	50	16.1	17.7	7.17	12.1	19.5	94.3	37.3	268
60	2,400	54	15.1	17.7	9.64	13.5	17.4	124	38.4	462
"	2,400	51	14.2	18.0	9.32	13.1	18.0	119	36.0	389
Average	2,400	53	14.7	17.9	9.48	13.3	17.7	122	37.2	426

TABLE D-17. - Fuel economy, emissions, and engine parametric adjustment for 1976 Chevrolet Impala (Car No. 121)

Vehicle speed, mph	Engine speed, rpm	Spark timing, °BTC	Manifold vacuum, in. of Hg	Air fuel ratio	Fuel consumption		Fuel economy, mpg	Emissions, g/hr		
					kg/hr	liters/ 100 km		CO	HC	NO_x
BASELINE (MANUFACTURERS' SPECIFIED ADJUSTMENTS)										
0	600	24	15.2	16.6	1.91	-	-	0.5	0.2	8.6
"	610	24	15.3	16.5	1.89	-	-	.7	.3	8.8
Average	605	24	15.3	16.6	1.90	-	-	.6	.3	8.7
20	890	23	17.5	15.0	2.58	10.8	21.7	.4	1.4	11.0
"	920	23	17.6	15.1	2.62	11.0	21.3	.4	1.6	12.2
Average	905	23	17.6	15.1	2.60	10.9	21.5	.4	1.5	11.6
30	1,300	26	16.5	14.7	4.24	11.9	19.8	.9	3.0	11.7
"	1,300	26	16.0	15.1	4.49	12.4	19.0	.9	3.3	12.3
Average	1,300	26	16.2	14.9	4.37	12.2	19.4	.9	3.2	12.0
40	1,650	32	16.4	15.4	5.75	12.1	19.5	.8	2.8	35.6
"	1,650	32	16.3	15.6	5.78	12.1	19.4	.8	2.4	38.0
Average	1,650	32	16.4	15.5	5.77	12.1	19.5	.8	2.6	36.8
50	2,050	37	16.3	15.5	7.59	12.8	18.4	1.0	2.0	110
"	2,000	37	16.2	15.6	7.63	12.8	18.3	1.5	2.0	108
Average	2,025	37	16.3	15.6	7.61	12.8	18.4	1.3	2.0	109
60	2,400	39	15.8	15.0	10.2	14.3	16.4	1.8	3.0	275
"	2,400	38	15.8	14.8	10.5	14.7	16.0	3.0	3.0	272
Average	2,400	39	15.8	14.9	10.4	14.5	16.2	2.4	3.0	274
BEST ECONOMY ADJUSTMENTS										
0	650	40	17.7	15.7	1.84	-	-	209	35.5	13.7
"	610	40	16.6	16.1	1.79	-	-	169	37.5	12.4
Average	630	40	17.2	15.9	1.82	-	-	189	36.5	13.1
20	940	40	19.7	15.0	2.55	10.7	22.0	315	40.8	24.4
"	925	40	18.7	15.0	2.53	10.5	22.4	262	39.0	20.0
Average	933	40	19.2	15.0	2.54	10.6	22.2	289	39.9	22.2
30	1,300	43	20.5	14.9	3.72	10.45	22.5	431	47.1	76.8
"	1,300	43	19.2	14.9	3.74	10.45	22.4	308	43.2	75.9
Average	1,300	43	19.9	14.9	3.73	10.45	22.5	370	45.2	76.4
40	1,700	48	20.0	15.9	5.18	10.7	22.0	395	48.4	202
"	1,700	47	18.4	15.6	5.40	11.2	21.0	308	45.6	178
Average	1,700	48	19.2	15.8	5.29	11.0	21.5	352	47.0	190
50	2,100	53	19.0	17.4	7.05	11.9	19.8	98	45.5	370
"	2,150	52	17.3	16.9	7.44	12.4	19.0	149	46.5	333
Average	2,125	53	18.2	17.2	7.25	12.2	19.4	124	46.0	352
60	2,500	55	18.0	16.3	10.1	14.2	16.6	138	59.4	575
"	2,500	54	16.8	16.3	10.0	14.1	16.7	141	55.8	541
Average	2,500	55	17.4	16.3	10.1	14.2	16.7	140	57.6	558

TABLE D-18. - Fuel economy, emissions, and engine parametric adjustment for 1976 Chevrolet Impala (Car No. 122)

Vehicle speed, mph	Engine speed, rpm	Spark timing, °BTC	Manifold vacuum, in. of Hg	Air fuel ratio	Fuel consumption		Fuel economy, mpg	Emissions, g/hr		
					kg/hr	liters/ 100 km		CO	HC	NO_x
BASELINE (MANUFACTURERS' SPECIFIED ADJUSTMENTS)										
0	610	25	15.4	16.1	1.76	-	-	0.7	0.4	9.4
"	600	24	14.8	16.6	1.67	-	-	.9	0.0	7.6
Average	605	25	15.1	16.4	1.72	-	-	.8	0.4	8.5
20	920	24	17.3	14.9	2.59	10.9	21.6	1.0	1.4	11.6
"	940	24	16.4	14.7	2.56	10.7	21.9	.8	.8	15.4
Average	930	24	16.9	14.8	2.58	10.8	21.8	.9	1.1	13.5
30	1,350	28	17.4	14.6	3.86	10.9	21.8	748	36.6	28.8
"	1,300	27	17.0	14.7	3.80	10.6	22.1	474	28.5	31.2
Average	1,325	28	17.2	14.7	3.83	10.8	22.0	611	32.6	30.0
40	1,650	33	15.8	14.6	5.52	11.6	20.3	645	30.0	19.6
"	1,600	32	15.0	14.6	5.61	11.8	20.0	472	18.0	18.8
Average	1,625	33	15.4	14.6	5.57	11.7	20.2	559	24.0	19.2
50	2,000	38	15.2	15.0	7.14	11.8	20.0	1.5	2.5	102
"	2,000	37	14.4	15.6	7.32	12.3	19.1	1.5	1.0	104
Average	2,000	39	14.8	15.3	7.23	12.1	20.0	1.5	1.8	103
60	2,400	38	13.2	15.6	9.84	13.8	17.1	1.8	1.8	256
"	2,400	36	14.9	15.7	9.76	13.7	17.2	1.8	1.2	255
Average	2,400	37	14.1	15.7	9.80	13.8	17.2	1.8	1.5	256
BEST ECONOMY ADJUSTMENTS										
0	650	40	16.7	15.5	1.84	-	-	62.7	26.9	25.2
"	620	40	16.9	15.8	1.79	-	-	32.5	28.9	23.7
Average	635	40	16.8	15.7	1.82	-	-	47.6	27.9	24.5
20	910	40	18.6	15.0	2.44	10.2	23.0	192	31.6	26.4
"	900	40	18.8	15.2	2.31	9.72	24.2	127	30.2	84.3
Average	905	40	18.7	15.1	2.38	9.96	23.6	160	30.9	55.4
30	1,300	42	18.9	14.9	3.78	10.6	22.2	673	42.3	75.6
"	1,300	42	19.0	14.9	3.77	10.6	22.2	562	40.5	84.3
Average	1,300	42	19.0	14.9	3.78	10.6	22.2	618	41.4	80.0
40	1,700	47	18.0	15.0	5.03	10.6	22.2	566	44.0	175
"	1,700	46	18.4	15.2	5.01	10.5	22.4	416	43.2	204
Average	1,700	47	18.2	15.1	5.02	10.6	22.3	491	43.6	190
50	2,100	52	16.3	17.7	6.98	11.8	20.0	89.0	38.5	361
"	2,100	52	16.4	17.9	6.75	11.4	20.7	93.0	40.5	312
Average	2,100	52	16.4	17.8	6.87	11.6	20.4	91.0	39.5	337
60	2,500	54	15.0	17.8	9.43	13.2	17.8	125	49.6	506
"	2,500	54	14.8	17.9	9.60	13.4	17.5	145	62.4	530
Average	2,500	54	14.9	17.9	9.52	13.3	17.7	135	56.0	518