EPA-AA-TAEB 76-20

An Evaluation of the Morse Constant Speed Accessory Drive

June 1976

Technology Assessment and Evaluation Branch
Emission Control Technology Division
Office of Mobile Source Air Pollution Control
Environmental Protection Agency

Background

The Environmental Protection Agency receives information about many systems which appear to offer potential for emission reduction or fuel economy improvement compared to conventional engines and vehicles. EPA's Emission Control Technology Division is interested in evaluating all such systems, because of the obvious benefits to the Nation from the identification of systems that can reduce emissions, improve economy, or both. EPA invites developers of such systems to provide to the EPA complete technical data on the system's principle of operation, together with available test data on the system. In those cases in which review by EPA technical staff suggests that the data available show promise, attempts are made to schedule tests at the EPA Emissions Laboratory at Ann Arbor, Michigan. The results of all such test projects are set forth in a series of Technology Assessment and Evaluation Reports, of which this report is one.

The conclusions drawn from the EPA evaluation tests are necessarily of limited applicability. A complete evaluation of the effectiveness of a system in achieving performance improvements on the many different types of vehicles that are in actual use requires a much larger sample of test vehicles than is economically feasible in the evaluation test projects conducted by EPA. For promising systems it is necessary that more extensive test programs be carried out.

The conclusions from the EPA evaluation test can be considered to be quantitatively valid only for the specific test car used, however, it is reasonable to extrapolate the results from the EPA test to other types of vehicles in a directional or qualitative manner, i.e., to suggest that similar results are likely to be achieved on other types of vehicles.

Morse Chain, Division of Borg Warner Corporation, has developed a variable-ratio drive to replace the fixed-ratio waterpump drive conventionally used on automobiles. Information and data supplied to the EPA by Morse indicated that the Morse variable-ratio drive had potential for fuel economy improvement when compared to conventional fixed-ratio drives. The fuel economy improvement is due to reducing the horsepower used to drive the waterpump, and hence the engine-powered accessories.

To attempt to quantify this potential fuel economy improvement, an evaluation of the Morse drive was scheduled at the EPA's Ann Arbor, Michigan laboratory.

Test Vehicle Description

The vehicle (furnished by Morse) used in the test program was a 1975 Chevrolet Nova powered by a 1976 305 cu. in. engine, and equipped with a three speed automatic transmission. The Nova was tested at an inertia weight of 4000 lbs.

In the standard production configuration, the waterpump is driven at 1.25 times crankshaft speed by means of pulleys and V-belt. Accessories (alternator, air conditioning and power steering) are driven from the waterpump shaft with V-belts and pulleys. The drive ratios for the accessories must be such that adequate output can be obtained from the accessories at low engine speeds (idle, stop-and-go driving, etc.). Consequently, at high engine speeds, the accessories may be driven faster than is necessary to provide required outputs, and thus absorb more power than is necessary.

The Morse Controlled Speed Accessory Drive (CSAD) is designed to reduce this energy loss by using a variable-ratio drive between the crankshaft and waterpump. The Morse CSAD replaces the fixed pulleys on the crankshaft and waterpump with pulleys whose effective diameter is controlled by engine speed (rpm). The waterpump and crankshaft pulleys are connected by a variable speed belt.

The CSAD is designed to maintain a fixed ratio between crankshaft and waterpump up to about 1100 rpm (engine speed). As the engine speed increases above 1100 rpm, the CSAD changes the drive ratio to maintain constant output up to 2100 rpm (engine speed). Above 2100 rpm, the ratio of the CSAD is fixed, so further increases in engine speed result in increased accessory speeds. However, the rate of increase in accessory speeds is less than the rate of increase in engine speed.

In the production configuration, the test vehicle is equipped with a flex-fan. The flex-fan is also used in the Morse CSAD installations, and is driven on the waterpump shaft.

Test Program

Exhaust emissions and fuel economy were measured in accordance with the 1975 Federal Test Procedure ('75 FTP). Emissions and fuel economy were also measured during the EPA Highway Fuel Economy Test and under several steady state conditions. One exception to the '75 FTP was the ambient temperature maintained during the test program. The test cell temperature was maintained between 86 and 91°F during all tests. This was done to provide additional load on the engine accessories during certain portions of the test program.

One of the problems of this test program was to generate sufficient accessory loads during a chassis dynamometer emission test to demonstrate the effects of the Morse CSAD. It was anticipated that the CSAD would show its greatest benefit under conditions of high accessory loading. Of the accessories installed on the test vehicle, the alternator and air conditioning compressor could provide the most easily adjustable loads on the engine.

Tests were conducted under two accessory loads. For the first test condition, no additional accessory loads were imposed on the engine. The benefits of the CSAD were expected to be minimal under this condition. For the second test condition, the air conditioning system was operated with driver controls set at maximum air conditioner settings, and the high-beam headlights were turned on. Operating the air conditioning at maximum output kept the air conditioning compressor operating continuously during the test. Additional load was imposed on the air conditioning system by the higher-than-normal ambient temperature maintained throughout the test program. No attempt was made to vary the power steering pump load.

Tests were conducted with and without (baseline) the CSAD installed on the test vehicle. For each vehicle configuration, tests were conducted with and without increased accessory load.

Test Results

Test results, summarized below, show the effect of the Morse CSAD on exhaust emissions and fuel economy during the '75 FTP.

'75 FTP*
Mass emissions in
grams per mile
(grams per kilometer)
No accessory load

	HC	CO	NOx	Fuel Economy (Fuel Consumption)
Baseline-avg. of 2 tests	0.60 (0.37)	6.3 (3.9)	2.20 (1.37)	14.7 miles/gal. (16.0 liters/100km)
CSAD-avg. of 2 tests	0.69 (0.43)	8.0 (5.0)	2.20 (1.37)	14.6 miles/gal. (16.1 liters/100km)
% Change	+15%	+27%	0	-1% (+1%)

* Ambient temperature between 86-91°F.

'75 FTP*
Mass emissions in
grams per mile
(grams per kilometer)
AC-lights on

	HC	CO	NOx	Fuel Economy (Fuel Consumption)
Baseline-avg. of 2 tests	1.05 (0.65)	21.9 (13.6)	3.13 (1.95)	12.6 miles/gal. (18.7 liters/100km)
CSAD-avg. of 2 tests	0.88 (0.55)	15.6 (9.7)	2.88 (1.79)	13.3 miles/gal. (17.7 liters/100km)
% change from baseline	-16%	-29%	-8%	+6% (-5%)

Similarly, the results obtained during the Highway Fuel Economy Test are summarized below.

HFET*
Mass emissions in
grams per mile
(grams per kilometer)
No accessory load

	HC	CO	NOx	Fuel Economy (Fuel Consumption)
Baseline-avg. of 2 tests	0.14 (0.09)	5.6 (3.5)	1.88 (1.17)	20.1 miles/gal. (11.7 liters/100km)
CSAD-avg. of 2 tests	0.43 (0.27)	17.8 (11.1)	1.72 (1.07)	20.3 miles/gal. (11.6 liters/100km)
% change from baseline	+207%	+218%	-9%	+1% (-1%)

* Ambient temperature between 86-91°F.

HFET*
Mass emissions in
grams per mile
(grams per kilometer)
AC-lights on

	HC	CO	NOx	Fuel Economy (Fuel Consumption)
Baseline-avg. of 2 tests	0.80 (0.50)	30.2 (18.8)	3.06 (1.90)	17.2 miles/gal. (13.7 liters/100km)
CSAD-avg. of 2 tests	0.93 (0.58)	39.1 (24.3)	2.63 (1.63)	18.2 miles/gal. (12.9 liters/100km)
% change from baseline	+16%	+29%	-14%	+6% (-6%)

A detailed breakdown of '75 FTP, HFET and steady state test data can be found in Tables I-VII.

Discussion

The effect of the Morse CSAD on fuel economy ranged from no change with no accessory load, to a 6% improvement with accessory load. The effect on exhaust emissions (during the '75 FTP) was variable, increasing HC and CO emissions without accessory load, and reducing HC, CO and NOx with accessory loads. The changes in exhaust emissions (CSAD installation vs. baseline) could be due to more than one effect of the CSAD. Reduced engine loading with the CSAD installed would tend to increase HC and CO emissions, and lower NOx emissions. Changes in engine cooling as a result of the CSAD installation might also affect emissions (see the following paragraph).

During the Highway Test, it was noted that the engine temperature gauge was reading higher with the Morse CSAD installed (compared to the production configuration). This is probably due to the slower waterpump speed and resultant decrease in coolant circulation, although the cooling fan used during the dynamometer test does not provide air flow equivalent to actual on-the-road driving. Table VIII shows waterpump speed and crankshaft speed measured during the steady state tests. The waterpump speed is reduced 22-31% in the speed range most prevalent during the Highway Test, so the change in engine temperature is not suprising. Inadequate cooling could be a possible problem area for a car equipped with the Morse CSAD. The loads encountered in the EPA tests do not impose much strain on the engine. Higher engine temperatures would be expected when driving in mountainous terrain or when heavily loaded (such as in trailer pulling).

*Ambient temperature between 86-91°F.

For all test conditions, the exhaust emission penalty due to air conditioner operation was greater for the production accessory drive than for the Morse CSAD. The fuel economy penalty due to increased accessory loads was 9-10% with the Morse CSAD installed and 14% with the production accessory drive installed.

It should be noted that normal test procedures for new vehicle certification do not call for operation of the air conditioner at maximum output during the emissions test. For new vehicle certification, air conditioning load is simulated by increasing the normal road load horsepower absorbed by the dynamometer by 10%. Average road load for each inertia weight class is given as part of the '75 FTP in the Federal Register (Federal Register, June 30, 1975, Vol. 40 No. 126, Part III).

Conclusions

1. The Morse Controlled Speed Accessory Drive does have a beneficial effect on fuel economy when the test procedure is modified to provide conditions of high accessory load. For the vehicle used in the EPA test program, the improvement in fuel economy was approximately 6%.

2. The current design of the CSAD might not drive the waterpump at a sufficient speed to provide adequate engine cooling under high load conditions. This point was not investigated during the test program, but engine temperature was unusually high in some portions of the test program.

3. The Morse CSAD reduced the fuel economy penalty caused by operation of the air conditioning and headlights at maximum setting from about 14% to 9-10%. Savings could be greater under more severe air conditioner requirements but this was not quantified in the EPA tests.

Table I

'75 FTP
Mass emissions in
grams per mile
(grams per kilometer)
No accessory load

Test #	HC	CO	CO2	NOx	mpg (ℓ/100km)
Baseline					
77-1279	0.51 (0.32)	5.1 (3.2)	594. (369.)	2.27 (1.41)	14.7 (16.0)
77-1416	0.68 (0.42)	7.4 (4.6)	593. (369.)	2.13 (1.32)	14.6 (16.1)
Average	0.60 (0.37)	6.3 (3.9)	594. (369.)	2.20 (1.37)	14.7 (16.0)
Morse CSAD					
77-1265	0.76 (0.47)	7.6 (4.7)	590. (367.)	2.12 (1.32)	14.7 (16.0)
77-1420	0.62 (0.39)	8.4 (5.2)	595. (370.)	2.28 (1.42)	14.5 (16.2)
Average	0.69 (0.43)	8.0 (5.0)	593. (369.)	2.20 (1.37)	14.6 (16.1)

Table II

'75 FTP
Mass emissions in
grams per mile
(grams per kilometer)
AC-lights on

Test #	HC	CO	CO_2	NOx	mpg (ℓ/100km)
Baseline					
77-1386	1.02 (0.63)	23.4 (14.5)	687. (427.)	3.43 (2.13)	12.2 (19.3)
77-1418	1.08 (0.67)	20.4 (12.7)	645. (401.)	2.82 (1.75)	13.0 (18.1)
Average	1.05 (0.65)	21.9 (13.6)	666. (414.)	3.13 (1.95)	12.6 (18.7)
Morse CSAD					
77-1272	0.95 (0.59)	17.2 (10.7)	643. (400.)	2.76 (1.72)	13.2 (17.8)
77-1773	0.80 (0.50)	13.9 (8.7)	638. (397.)	3.00 (1.87)	13.4 (17.5)
Average	0.88 (0.55)	15.6 (9.7)	641. (399.)	2.88 (1.79)	13.3 (17.7)

Table III

HFET
Mass emissions in
grams per mile
(grams per kilometer)
No accessory load

Test #	HC	CO	CO_2	NOx	mpg (ℓ/100km)
Baseline					
77-1280	0.09 (0.06)	3.2 (2.0)	435. (270.)	1.96 (1.22)	20.1 (11.7)
77-1417	0.19 (0.12)	7.9 (4.9)	430. (267.)	1.79 (1.11)	20.0 (11.8)
Average	0.14 (0.09)	5.6 (3.5)	433. (269.)	1.88 (1.17)	20.1 (11.7)
Morse CSAD					
77-1266	0.37 (0.23)	15.2 (9.4)	409. (254.)	1.64 (1.02)	20.4 (11.5)
77-1421	0.48 (0.30)	20.3 (12.6)	409. (254.)	1.79 (1.11)	20.1 (11.7)
Average	0.43 (0.27)	17.8 (11.1)	409. (254.)	1.72 (1.07)	20.3 (11.6)

Table IV

HFET
Mass emissions in
grams per mile
(grams per kilometer)
AC-lights on

Test #	HC	CO	CO_2	NOx	mpg (ℓ/100km)
Baseline					
77-1287	0.51 (0.32)	21.4 (13.3)	477. (296.)	2.97 (1.85)	17.3 (13.6)
77-1419	1.09 (0.68)	38.9 (24.2)	457. (284.)	3.14 (1.95)	17.0 (13.8)
Average	0.80 (0.50)	30.2 (18.8)	467. (290.)	3.06 (1.90)	17.2 (13.7)
Morse CSAD					
77-1273	0.91 (0.57)	36.2 (22.5)	429. (267.)	2.67 (1.66)	18.2 (12.9)
77-1774	0.95 (0.59)	41.9 (26.0)	422. (262.)	2.58 (1.60)	18.1 (13.0)
Average	0.93 (0.58)	39.1 (24.3)	426. (265.)	2.63 (1.63)	18.2 (12.9)

Table V

Steady State
Mass emissions in
grams per mile
(grams per kilometer)
No accessory load

	HC	CO	CO_2	NOx	MPG (ℓ/100km)
Baseline					
idle (300 sec.)	0	0	498.gms	0.87gms	
15 mph (24 kph)	0.01	0	472. (293.)	0.45 (0.28)	18.8 (12.5)
30 mph (48 kph)	0.04 (0.02)	0	348. (216.)	0.86 (0.53)	25.5 (9.2)
45 mph (72 kph)	0.04 (0.02)	0.01	392. (244.)	1.05 (0.65)	22.6 (10.4)
60 mph (97 kph)	0.20 (0.12)	13.4 (8.3)	430. (267.)	0.81 (0.50)	19.6 (12.0)
Morse CSAD					
idle (300 sec.)	0	0.1gms	516.gms	1.13gms	
15 mph (24 kph)	0.09 (0.06)	0	486. (302.)	0.51 (0.32)	18.2 (12.9)
30 mph (48 kph)	0.06 (0.04)	0	360. (224.)	0.99 (0.62)	24.6 (9.6)
45 mph (72 kph)	0.11 (0.07)	1.42 (0.88)	391. (243.)	0.99 (0.62)	22.5 (10.5)
60 mph (97 kph)	0.43 (0.27)	18.5 (11.5)	403. (250.)	2.2 (1.37)	20.5 (11.5)

Table VI

Steady State
Mass emissions in
grams per mile
(grams per kilometer)
AC-lights on

	HC	CO	CO_2	NOx	mpg (ℓ/100km)
Baseline					
idle (300 sec.)	0	0.9gms	495gms	2.53gms	
15 mph (24 kph)	1.19 (0.74	13.2 (8.2)	548. (341.)	1.26 (0.78)	15.5 (15.2)
30 mph (48 kph)	0.87 (0.54)	21.0 (13.1)	441. (274.)	0.68 (0.42)	18.6 (12.6)
45 mph (72 kph)	0.05 (0.03)	2.0 (1.2)	465. (289.)	1.75 (1.09)	18.9 (12.4)
60 mph (97 kph)	0.82 (0.51)	35.0 (21.8)	436. (271.)	4.27 (2.65)	18.0 (13.1)
Morse CSAD					
idle (300 sec.)	0	1.8gms	511.gms	2.74gms	
15 mph (24 kph)	1.07 (0.67)	11.2 (7.0)	584. (363.)	1.15 (0.71)	14.7 (16.0)
30 mph (48 kph)	1.07 (0.67)	25.1 (15.6)	406. (252.)	0.64 (0.40)	19.8 (11.9)
45 mph (72 kph)	0.44 (0.27)	28.7 (17.8)	404. (251.)	1.30 (0.81)	19.7 (11.9)
60 mph (97 kph)	1.18 (0.73)	49.4 (30.7)	426. (265.)	3.26 (2.03)	17.5 (13.4)

Table VII

Individual Bag Emissions in Grams per Mile

Test #	Bag 1: Cold Transient HC	CO	CO2	NOx	MPG	Bag 2: Stabilized HC	CO	CO2	NOx	MPG	Bag 3: Hot Transient HC	CO	CO2	NOx	MPG
Baseline: No accessory load															
77-1279	1.32	10.0	608.	3.39	14.1	0.09	2.6	616.	1.62	14.3	0.70	6.4	540.	2.65	16.1
77-1416	1.25	9.4	610.	3.58	14.1	0.31	5.0	618.	1.39	14.2	0.94	10.6	534.	2.44	16.0
Morse CSAD: No accessory load															
77-1265	1.98	14.7	587.	3.12	14.4	0.30	5.2	620.	1.48	14.1	0.69	6.9	535.	2.60	16.2
77-1420	1.33	9.9	603.	3.47	14.3	0.25	6.8	627.	1.63	13.9	0.81	10.5	530.	2.61	16.2
Baseline: AC - lights on															
77-1386	1.53	20.6	702.	4.93	12.0	0.74	21.7	717.	2.77	11.8	1.17	28.6	618.	3.58	13.3
77-1418	1.40	13.8	666.	4.48	12.8	0.75	19.5	676.	2.05	12.5	1.46	27.2	570.	3.06	14.4
Morse CSAD: AC - lights on															
77-1272	1.38	13.9	656.	4.00	13.0	0.61	16.5	680.	2.05	12.5	1.28	21.1	563.	3.17	14.8
77-1773	1.24	10.2	651.	4.43	13.2	0.61	13.7	668.	2.32	12.8	0.82	17.2	571.	3.23	14.8

Table VIII

Morse CSAD
Crankshaft rpm vs. Waterpump rpm

Vehicle Speed	Crankshaft rpm	Waterpump rpm
Idle (neutral)	600	750
Idle (drive)	550	600
15 mph (24 kph)	800	900
30 mph (48 kph)	1100	1100
45 mph (72 kph)	1600	1250
60 mph (97 kph)	2250	1550

TEST VEHICLE DESCRIPTION

Chassis model year/make - 1975 Chevrolet Nova
Emission control system - 1976 Engine, OC/EGR/EFE

Engine

type	4 stroke, Otto Cycle, V-8 ohv
bore x stroke	3.74 x 3.48 in./95 x 88.4mm
displacement	305 cu. in./4999cc
compression ratio	8.5:1
maximum power @ rpm	140 hp/104kW at 3800 rpm
fuel metering	2 barrel carburetor
fuel requirement	91 RON, unleaded

Drive Train

transmission type	3 speed automatic

Chassis

type	Front engine, rear wheel drive
tire size	FR 78 x 14
curb weight	3797 lbs/1722 kg
inertia weight	4000 lbs.
passenger capacity	5

Emission Control System

basic type	OC/EGR/EFE
oxidation catalyst location	Underfloor
substrate	Pellet
volume	260 cu. in./4261cc
loading	.05 troy oz./1.56gm
EGR type	Ported
durability accumulated on system	33000 mi/5300km

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EPA-AA-TEB-511-82-14

EPA Evaluation of the P.A.S.S. KIT Device Under Section 511 of the Motor Vehicle Information and Cost Savings Act

by

Edward Anthony Barth

September, 1982

Test and Evaluation Branch
Emission Control Technology Divison
Office of Mobile Sources
U.S. Environmental Protection Agency

EPA Evaluation of the P.A.S.S. KIT Device Under Section 511 of the Motor Vehicle Information and Cost Savings Act

The Motor Vehicle Information and Cost Savings Act requires that EPA evaluate fuel economy retrofit devices and publish a summary of each evaluation in the Federal Register.

EPA evaluations are originated upon the application of any manufacturer of a retrofit device, upon the request of the Federal Trade Commission, or upon the motion of the EPA Administrator. These studies are designed to determine whether the retrofit device increases fuel economy and to determine whether the representations made with respect to the device are accurate. The results of such studies are set forth in a series of reports, of which this is one.

The evaluation of the P.A.S.S KIT device was conducted upon the application of the marketer of the device. This device is claimed to eliminate the load of air conditioning compressor when accelerating and thereby improve fuel economy and performance. The device is an intake manifold vacuum switch that is designed to disengage the air conditioning compressor during periods of high power demand.

The following is a summary of the information on the device as supplied by the Applicant and the resulting EPA analysis and conclusions.

1. Title:

   Application for Evaluation of the P.A.S.S. KIT Device Under Section 511 of the Motor Vehicle Information and Cost Savings Act

2. Identification Information:

   a. Marketing Identification of the Product:

      Model Number - 07-06-10

   b. Inventor and Patent Protection:

      (1) Inventor

      Fasco Industries Inc.
      1100 Airport Road
      Shelby, NC 28150

      (2) No patent at this time. Patent application being prepared.

   c. Applicant:

      (1) Cartel Products Division
      Vandenberg Corporation
      3133 Madison SE
      Grand Rapids, MI 49508

(2) President: Charles Vandenberg
Executive Vice President: Gene Goulooze
Vice President: Jay Kuiper

(3) Jay Kuiper is authorized to represent the Cartel Products Division of the Vandenberg Corporation in communication with EPA.

d. Manufacturer of the Product:

(1) Cartel Products Division
Vandenberg Corporation
3133 Madison SE
Grand Rapids, MI 49508

(2) President: Charles Vandenberg
Executive Vice President: Gene Goulooze
Vice President: Jay Kuiper

3. Description of Product (as supplied by Applicant):

a. Purpose:

"The objective of this product is to provide a means of eliminating the power requirement of the air conditioner compressor during periods of high engine power demand, in an effort to reduce fuel consumption with no increase in pollutant levels."

b. Theory of Operation:

"During acceleration or passing, a higher than average power output is required of an automotive engine resulting in a corresponding drop in manifold vacuum. When this reducing vacuum signal falls below a predetermined level, the diaphragm operated switch provided in this 'kit' breaks the electrical circuit to the air conditioner compressor clutch. This action renders the compressor inoperative until manifold vacuum again rises above the preset level causing the switch to close thus allowing the air conditioner compressor to operate again."

c. Construction and Operation:

"Exhibit attached." The exhibit was a sample of the product.

d. Specific Claims for the Product:

"We feel that positive claims can be made in two categories in future media and printed advertising.

(1) "Regarding fuel mileage when the air conditioner is in operation, we feel there is a definite increase in fuel economy. However, we have no certified tests to substantiate this.

(2) "Additional power is available for passing, acceleration and maintaining speed on upgrades by temporarily eliminating the power requirements of the air conditioning compressor. We are aware that the EPA has evaluated a similar product and has published its findings in the EPA Environmental News on August 27, 1980, which stated that the device produced an increase in gas mileage without an increase in pollutant emissions."

e. Cost and Marketing Information (as supplied by Applicant):

"Suggested retail price is $15.95 per kit. Methods of marketing are through the standard automotive parts distribution channels which are Warehouse, Jobber and Dealer. Final sale is to the end user who would purchase from a dealer."

4. Product Installation, Operation, Safety and Maintenance (as supplied by Applicant):

a. Applicability:

(1) "This product is applicable to all automobiles and light trucks using gasoline engines with carburetion type intake systems. The product will operate properly with all engine sizes, ignition types and transmission types.

"The product is not generally applicable to gasoline engines using fuel injection or turbocharged type intake systems.

"The product is not generally applicable to diesel engines."

(2) "Applicability is not affected, in our experience, by weather conditions, types of driving, or topographical differences."

b. Installation - Instructions, Equipment, and Skills Required:

"Please refer to Exhibit A attached. (maintenance procedures)." Exhibit A is Attachment A to this evaluation.

c. Operation:

"Please refer to Exhibit A attached. (maintenance procedures)." Exhibit A is Attachment A to this evaluation.

d. Effects on Vehicle Safety:

"Not applicable."

e. Maintenance:

"No maintenance is required of the installed product. However, the vacuum hose added by this installation should be included in the periodic inspection of all engine vacuum hoses and fittings - for signs of deterioration or aging. The use of this product should not cause any effect in the normal maintenance schedule for the vehicle."

5. Effects on Emissions and Fuel Economy (submitted by Applicant):

a. Unregulated Emissions:

"Not applicable."

b. Regulated Emissions and Fuel Economy:

"Not applicable."

6. Analysis

a. Description:

(1) As stated in Section 3a, the primary purpose of the P.A.S.S. KIT is to eliminate the power requirements of the air conditioning compressor when the engine is operating under heavy load and thus reduce the fuel consumption. This is in agreement with the theory of operation given in 3b and the function of the sample of the device submitted with the application. That is, the product operates as an engine intake manifold vacuum switch that is capable of interrupting the electrical power to the air conditioner clutch when the engine is under heavy load, and thereby disengaging the air conditioner (A/C).

(2) The theory of operation given in Section 3b is judged to be correct but incomplete. As stated, manifold vacuum drops as the power output is increased by depressing a vehicle's accelerator pedal. This vacuum signal can be readily used to automatically declutch the air conditioning compressor with a vacuum switch like the P.A.S.S. KIT. This will provide more power for hill climbing or accelerating. However, this theory does not give a reason why fuel economy might be expected to improve.

Generally, vehicles are designed to provide their optimum fuel efficiency while cruising and thus are not as fuel efficient when accelerating. Air conditioning imposes an additional load which tends to cause a vehicle to consume fuel even less efficiently. By disabling the air conditioner compressor when accelerating, the air conditioning load is imposed on the engine only when it is operating in a more fuel efficient regime. However, the

fuel economy benefit, if any, actually obtained would depend on the vehicle and how well the device is matched to the vehicle.

(3) The P.A.S.S. KIT device provided consisted of a vacuum switch and all the hardware necessary to install the device on an air conditioned vehicle. The switch itself consisted of a normally open switching element encased in a plastic housing. The switch is connected to the vehicle as shown in Attachment A. Under high manifold vacuum, e.g., light loads, the switch contacts are closed, thus allowing the air conditioning compressor to operate.

(4) In Section 3d, the applicant claimed the device would improve the fuel economy and performance of a vehicle. These claims are in agreement with the purpose, theory of operation and construction of the device. However no specific numerical improvements were claimed. The applicant was advised by letters (Attachments B, D, and I) and at several meetings that substantiating test data would be required. The applicant requested the evaluation be conducted without this data based on the similiarity of the function of the P.A.S.S. KIT device to the Pass Master device previously tested by EPA.

(5) The cost of the device plus installation would be approximately $26.00 for those users who elect to have the device installed by a mechanic. This is based on a cost of $15.95 plus $10.00 for installation (1/2 hour of a mechanic's labor at $20.00 per hour). However, as noted in Section 6b(2), the installation is relatively easy and most individuals with basic mechanical skills should be able to install the device themselves.

b. Installation, Operation, Safety and Maintenance:

(1) Applicability:

The applicability of the device is adequately described in Section 4b. However, it should be noted that the P.A.S.S. KIT is only applicable to vehicles with air conditioning systems.

Also, the air conditioning systems of many late model vehicles have devices to turn off the compressor under some operating conditions. For example, the A/C systems of some GM vehicles turn the compressor off when accelerating in the lower transmission gears. Some Chrysler cars have switches that disengage the compressor based on the position of the throttle. Also, a number of other late model vehicles are equipped with devices similar to the P.A.S.S. KIT.

Therefore, EPA asked the applicant to indicate for which vehicles the sales literature and packaging would state that the device did not apply.

The response of the applicant (Attachment H) stated that the device packaging would show the device was not intended for diesel vehicles, 1982 Ford Escort and Mercury Lynx with automatics, 1982 Buick and Oldsmobile 4 cylinder and V-6 with automatics, and 1982 Cadillacs. This labeling is incomplete because it fails to list the many vehicles for which the device would have no benefit since it would either duplicate an existing vehicle device or not function (diesel, fuel injection, turbocharged). As a result, the potential customer for the device would be expected to determine if his vehicle was already equipped with a similar device.

(2) Installation - Instructions, Equipment and Skills Required:

The installation instructions (Attachment A) that were provided with the application did not adequately describe how the user should make the optional adjustments to the device. As a result of several discussions and letters (Attachments D, E, F, G, and H), the applicant revised the installation instructions to include the changes given in Attachment G.

These modified instructions are judged to be adequate for the installation and adjustment of the P.A.S.S. KIT by persons with average mechanical skills.* Installation and adjustment will require a minimal amount of tools (drill, knife, and screwdriver). Installation should require no more than 15 to 30 minutes.

(3) Operation:

In Section 4c, the applicant referred to the installation instructions for operating information. These instructions contained no specific operating instructions. However, since the device is designed to function automatically, none were judged to be necessary.

(4) Effects on Vehicle Safety:

The applicant states that the P.A.S.S. KIT should not affect vehicle safety. The device actually has the potential to improve vehicle safety when the A/C is in operation by providing additional power for passing.

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*However, as noted by EPA in Attachment A, the installer may encounter moderate difficulty in locating the proper vacuum line for connecting the device.

(5) Maintenance:

The recommended maintenance requirements given in Section 4e are judged to be adequate.

c. Effects on Emissions and Fuel Economy:

(1) Unregulated Emissions:

Since the device does not change the emission control system of a vehicle but only changes the engine load a small amount, the device is judged to be unlikely to affect unregulated emissions.

(2) Regulated Emissions and Fuel Economy:

The applicant did not submit test data in accordance with the Federal Test Procedure and the Highway Fuel Economy Test. These two test procedures are the primary ones recognized by EPA for evaluation of fuel economy and emissions for light duty vehicles. The requirement for test data following these procedures is stated in the policy documents that EPA sends to potential applicants. Other data which have been collected in accordance with other standardized procedures are acceptable as supplemental data in EPA's preliminary evaluation of a device.

The applicant was fully aware of this requirement (Attachments B and D) but requested (Section 3d(2) and Attachment G) that the evaluation be conducted using the information available on a similar device, the Pass Master, which was previously tested and evaluated by the EPA. EPA agreed to conduct the evaluation without test data on the P.A.S.S. KIT but informed the applicant that no specific fuel economy benefits could be claimed (Attachments D and I and meetings with the applicants).

d. EPA Test Results on a Similar Device:

EPA previously tested and evaluated another air conditioner cutoff device called Pass Master*. EPA found that the reduced engine loading of this device would result in a small but real

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*"EPA Evaluation of the Pass Master Vehicle Air Conditioner Cut-Off Device", EPA-AA-TEB-511-80-5.

reduction in vehicle emissions and fuel consumption.** However, although the P.A.S.S. KIT and Pass Master operate in an identical manner, their A/C on/off set points are significantly different. EPA has no information available to evaluate whether one device would function better than the other. Thus, EPA is unable to quantify the fuel economy benefits for the P.A.S.S. KIT based on the testing of the Pass Master.

e. Potential Effectiveness of an Air Conditioning Cutoff Device:

Since the P.A.S.S. KIT is similar to the device previously tested and evaluated, most of the previous statements still apply, and are included in the following:

(1) Usage

(a) The device is generally applicable to gasoline-powered vehicles with carbureted engines which are equipped with air conditioning systems.

(b) The device functions only when the A/C system is turned on. The device is then supposed to negate part of the fuel economy penalty incurred by using the air conditioner. This important characteristic of the device is called the "buy-back". This is the amount of the fuel economy penalty due to the A/C that is saved by the device.

(2) Effect of air conditioning design

There are several types of air conditioning systems found on American cars. While most systems incorporate similar major components (compressor, condenser, evaporator, receiver-dryer, and expansion valve), the method of controlling the interior temperature of the vehicle varies. The effect of the "P.A.S.S. KIT" compressor cutout switch will depend on the type of system installed in the vehicle and to what position the A/C control unit is set.

Present air conditioning systems sense an evaporator coil parameter such as refrigerant pressure or temperature or outlet air temperature and use this parameter to control the amount of refrigerant to the evaporator coil. The

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**The fuel economy gains with the "Pass Master" device varied from 0 to 4% depending on the vehicle and test conditions. These tests were designed to give the device the best opportunity to display the maximum benefit in that they were conducted with the A/C set to maximum cooling and the windows open. Given the similarity of the devices, it is our engineering judgment that such tests reasonably quantify the maximum fuel economy benefit of either the Pass Master or the P.A.S.S. KIT devices.

method of controlling the refrigerant varies. The cooling of the vehicle interior is controlled by opening or closing baffles which control the air flow, not the refrigerant, and by reheating the air if necessary. There are basically two refrigerant control systems:

(a) The Thermostatic Switch type and the Accumulation type sense the evaporative temperature or pressure and turn the compressor clutch on or off to maintain proper evaporator temperature. This is called the "Cycling Type".

(b) Three other types, (1) the Suction Throttling Valve (STV) type, (2) the Valves in Receiver (VIR) type, and (3) Evaporator Pressure Regulator (EPR) type regulate the refrigerant to the compressor to maintain proper evaporator temperature. This is called the "Continuous" type. The Compressor runs continuously when the air conditioner is turned on.

Several vehicle manufacturers have incorporated both types of control on vehicles. When the A/C switch is on "Max Cool", the compressor runs continuously. When at Normal or "FE" (Fuel Economy) settings, the compressor cycles.

The P.A.S.S. KIT device will work best on systems designed to operate in a "Continuous" mode. During the acceleration modes, the compressor will be cut out by the P.A.S.S. KIT device. Since the compressor will run enough during nonacceleration modes to control evaporator temperature, the reduced engine load in acceleration may result in some fuel economy savings (buy-back).

On "Cycling" type systems, the P.A.S.S. KIT may or may not have an effect. If the car accelerates while the compressor is not engaged, the P.A.S.S. KIT will have no effect. If the compressor is engaged, the P.A.S.S. KIT will disengage the compressor and allow the engine to accelerate the vehicle with a reduced load on the engine. Upon completion of the acceleration, the compressor will run to restore the evaporative pressure/temperature. The fuel saving will be caused by making the compressor run during a more efficient operating mode (cruise versus acceleration). Due to the intermittent cycling and the delayed compressor operation, less fuel economy gain (buy-back) is expected on this type of system.

Obtaining the optimum match of an A/C cutout device to each type of vehicle would be an impossible task with all the varied engine sizes, manifold vacuum modifiers, vehicle sizes, axle ratios, and transmissions that are available.

The P.A.S.S. KIT partially overcomes this difficulty by allowing the user to adjust the cutout point. The cut-in (on) setting for the P.A.S.S. KIT is fixed.

(3) Operating Variables

The final considerations on the potential effectiveness are the operating variables.

(a) Since the device only functions when the A/C is used, the overall benefit would depend on how much the vehicle A/C is used.

(b) Higher ambient temperatures and humidity cause a greater fuel economy penalty due to the use of A/C and, thus, offer the opportunity for a greater buy-back.

(c) The effectiveness will also depend upon driving habits of the operator. Thus drivers who repeatedly use heavy acceleration, and thereby activate the device more frequently, will realize a greater benefit from the device than drivers who use more moderate accelerations.

(d) The type of driving cycle used will influence the effectiveness of the device. The system will be more effective in urban driving with its increased acceleration modes operation than in highway steady state driving.

(e) The effectiveness will also depend on the penalty in comfort the operator is willing to accept. Usually, a vehicle is in a heavy acceleration mode for only 5 to 30 seconds. Since the evaporator fan remains on and there is stored cooling, only a slight change in air conditioning comfort would be noted. However, prolonged steep grades or heavy loads may cause the device to cut out excessively and thereby noticeably reduce the cooling. This also will tend to occur as the device is adjusted to maximize the fuel economy buy-back by adjusting the P.A.S.S. KIT to activate sooner.

8. Conclusions

EPA fully considered all of the information submitted by the applicant. The evaluation of the P.A.S.S. KIT device was based on that information and the results of the EPA confirmatory testing of a similar device. The overall conclusion is that P.A.S.S. KIT should recover part of the emissions and fuel economy penalty incurred by using the air conditioner of some vehicles.

The amount of this fuel economy benefit depends on several factors. The most important factor is the amount that the vehicle air conditioner is used. Drivers in warm climates who frequently use their air conditioner would experience the greatest change in fuel economy when driving in situations that frequently activate the device. The second important factor is the suitability of the device to the manifold vacuum characteristics of the particular vehicle. The improvement in fuel economy with the air conditioner on can range up to a few percent depending on the vehicle and the specific adjustments the user performs to match the P.A.S.S. KIT to his vehicle. Another factor affecting the performance is the type of vehicle air conditioning unit to which the "P.A.S.S. KIT" is applied. Systems which operate continuously should realize a larger benefit than those which cycle. The final factor is the type of driving. The "P.A.S.S. KIT" system is expected to show the greatest improvement in urban stop-and-go driving.

The emissions from vehicles operating with the air conditioning on are expected to be reduced when the "P.A.S.S. KIT" is used.

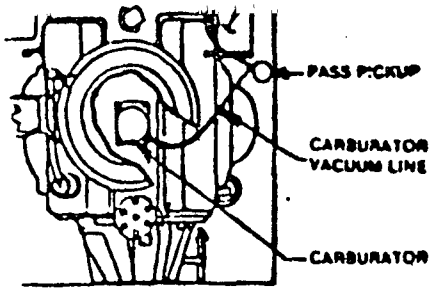
FOR FURTHER INFORMATION CONTACT: Merrill W. Korth, Emission Control Technology Division, Office of Mobile Sources, Environmental Protection Agency, 2565 Plymouth Road, Ann Arbor, Michigan 48105, (313) 668-4299.

List of Attachments

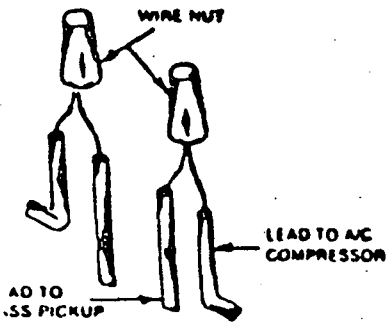
Attachment A	P.A.S.S. KIT Installation Instructions (provided with 511 Application).
Attachment B	Letter of December 14, 1981 from EPA to Jay Kuiper of Cartel Products providing information on the 511 evaluation process.
Attachment C	Letter of December 22, 1981 from Jay Kuiper of Cartel Products to EPA acknowledging receipt of 511 evaluation information.
Attachemnt D	Letter of January 28, 1982 from EPA to Jay Kuiper of Cartel Products acknowledging receipt of 511 application for P.A.S.S. KIT and requesting clarification and additional information.
Attachment E	Letter of April 13, 1982 from Jay Kuiper of Cartel Products to EPA discussing proposed changes to the P.A.S.S. KIT device.
Attachment F	Letter of April 19, 1982 from EPA to Jay Kuiper of Cartel Products requesting copy of proposed changes for P.A.S.S. KIT.
Attachment G	Letter of April 27, 1982 from Jay Kuiper of Cartel Products to EPA providing modified installation instructions for P.A.S.S. KIT.
Attachment H	Letter of May 18, 1982 from Charles Vandenberg of Cartel Products to EPA discussing P.A.S.S. KIT sample variability and providing additional proposed installation instructions and device applicability.
Attachment I	Letter of June 10, 1982 from EPA to Charles Vandenberg of Cartel Products stating application was now complete but that, since no testing was performed, no specific percentage improvements could be cited in this evaluation.

"P.A.S.S. KIT"

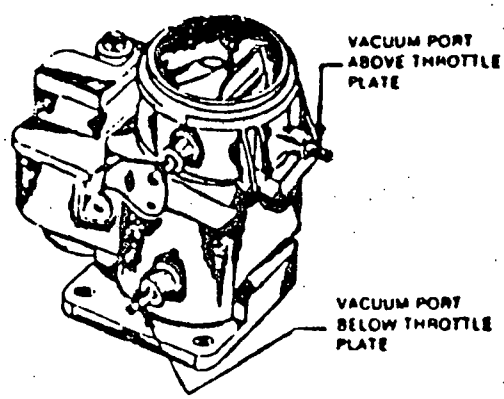
ATTACHMENT A

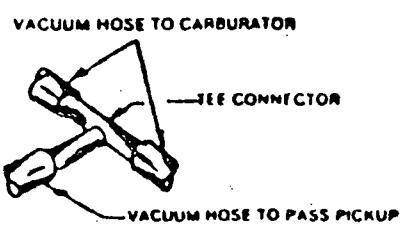


INSTALLATION INSTRUCTIONS



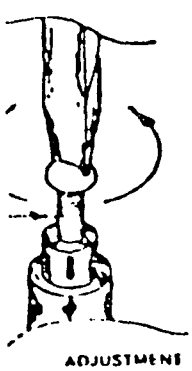
1. Select a mounting location in the engine compartment to allow the leads from the P.A.S.S. KIT to reach the A/C compressor electrical lead(s), and the rubber hose supplied to reach the carburetor vacuum line.
2. Locate a suitable existing mounting bolt, or drill a 1/8" hole and mount the unit with the sheet metal screw provided.
3. Cut one of the wires connected to the A/C compressor clutch. Strip about 3/8" of insulation from the ends. Attach to the P.A.S.S. KIT leads with the wire nuts provided. Push the wire terminals over the terminals on the base of the P.A.S.S. KIT.
4. Locate the "*Manifold vacuum*" line. The "manifold vacuum" source will be near the base of the carburetor below the throttle plate(s). This is the same vacuum source that is connected to the distributor vacuum advance mechanism. *
   Note:
   — *DO NOT* connect to the auxiliary vacuum pump
   — DO NOT use the vacuum hose connected to the charcoal filter (it has a constant vacuum)
   — Some cars may require trial and error to find the correct vacuum source -especially those with fuel injection.
   If you cannot locate the vacuum source, ask a mechanic.
5. IF YOUR CAR HAS A RUBBER VACUUM LINE cut the vacuum hose near its source - insert the appropriate TEE provided, and attach to the P.A.S.S. KIT with the rubber hose provided.
   IF YOUR CAR HAS A METAL VACUUM LINE cut the line with a tubing cutter or hacksaw. Do not use side cutters as they will close the end of the tubing. Cut two 1" pieces from the rubber hose provided. Slide one onto each end of the metal tubing. Insert the Tee, and push the rubber hose over the nipple on the Tee and the P.A.S.S. KIT.
6. You have now completed the installation of your P.A.S.S. KIT. This unit has been preset at the factory, however, it is adjustable to switch off earlier or later as follows:
   1. Remove black protective cap.
   2. To have compressor clutch cut out earlier, turn screw clockwise one/tenth turn at a time.
   3. To have compressor clutch cut out later, turn screw counter clock-wise one/tenth turn at a time
   4. Replace black protective cap. (The black protective cap *must* be replaced.)





WARNING: Do not connect to auxiliary vacuum pump.

SWITCH SPECIFICATIONS



Switch - Vacuum

Contacts - Silver, Heavy Duty

Electrical - Automotive Clutch Load

Diaphragm - Metal

Set Point - On - 8" Vacuum
*Off - 4" Vacuum

*Adjustable: From 2.5" Vacuum to 5" Vacuum

COMPLETE • READY TO INSTALL

CARTEL PRODUCTS DIV.

VANDENBERG CORPORATION

* EPA NOTE: The installer may encounter moderate difficulty in locating the proper vacuum line. Vacuum port elevation/location is not always indicative of the type of vacuum signal. Also, some Fords have dual advance (two vacuum lines).

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
ANN ARBOR, MICHIGAN 48105

December 14, 1981

OFFICE OF
AIR, NOISE AND RADIATION

Mr. Jay Kuiper
Carter Products Division
Vandenberg Corporation
3757 Lake Drive
Grand Rapids, MI 49506

Dear Mr. Kuiper:

This is in response to your recent inquiry regarding an EPA evaluation of your Pass Kit device. The Environmental Protection Agency is charged by Congressional mandate to evaluate fuel economy and emission control devices. While the EPA does not actually "approve" such devices, it does conduct evaluations for the purpose of increasing the common knowledge in the area. For this reason, the outcome of any testing by EPA becomes public information. It is this information which may be cited, although no claims can be made that any EPA findings constitute "approval" of the device or system.

Enclosed with this letter is a packet of materials which you will need to apply for an EPA evaluation of your device. This packet consists of 1) an application format, 2) a document entitled "EPA Retrofit and Emission Control Device Evaluation Test Policy", 3) "Basic Test Plans and Testing Sequences", and 4) a copy of the applicable Federal Regulations. In all of these documents the term "device" includes fuel additives. Motor vehicle oils, lubricants and oil additives do not fall under the provisions of Section 511 of the Motor Vehicle Information and Cost Savings Act. However, EPA is prepared to work with manufacturers of these products, using the same procedures and protocols defined in the enclosed documents.

In order for the EPA to conduct an evaluation of your device, we must have an application. Once you have reviewed all the documents in the packet, you should prepare an application in accordance with the guidelines of the application format. A critical part of the application is the substantiating test data. The required test results will have to be obtained at a laboratory of your choice. Such testing would be conducted at your expense. A list of laboratories, which are known to have the equipment and personnel to perform acceptable tests, has been included in the enclosed packet. The laboratory list is revised periodically, so be certain that the list you are using is current. Please allow EPA to comment on your test plan before beginning testing at an independent laboratory. If you desire, we can assist in the development of a satisfactory test plan.

There are, however, several aspects concerning testing at an outside laboratory which I would like to bring to your attention at this time:

Minimum Test Requirements - Although different types of devices may require a more complex test plan, the minimum we require involves two vehicles and two test sequences run in duplicate. The vehicles should be selected from those listed in Table 1; if possible. Each vehicle is to be set to manufacturer's tune-up specifications for the baseline tests.

The tests are conducted in a "back-to-back" manner, once with the vehicle in baseline condition, and again with the device installed with no vehicle adjustments between tests. If installation of the device also involves some adjustments, e.g. timing, fuel-air mixture, choke or idle speed, another test sequence with only these adjustments should be inserted between the first and last. If mileage accumulation is necessary in order to realize the full benefit, the same number of miles that are accumulated before the test runs must also be accumulated before baseline runs. In addition, the method of mileage accumulation should be kept constant. Also, as a minimum, the test sequence shall consist of a hot-start LA-4 portion (bags 1 and 2) of the Federal Test Procedure (FTP) and a Highway Fuel Economy Test (HFET). The details of these tests are contained in the enclosed packet. Although only a hot-start FTP is required to minimize the costs to you, you are encouraged to have the entire cold-start test performed, since any confirmatory testing and evaluation performed by EPA will be based on the complete FTP, and you may wish to know how a vehicle with your device performs over this official test. As a final requirement, the personnel of the outside laboratory you select should perform every element of your test plan. This includes preparation of the test vehicle, adjustment of parameters, and installation of the device.

Submission of Data - We require that all test data obtained from the outside laboratories in support of your application be submitted to us. This includes any results you have which were declared void or invalid by the laboratory. We also ask that you notify us of the laboratory you have chosen, when testing is scheduled to begin, what tests you have decided to conduct, allow us to maintain contact with the laboratory during the course of the testing, and allow the test laboratory to directly answer any questions at any time about the test program.

Cost of the Testing - The cost of the minimum test plan (two vehicles, two test sequences in duplicate) described above should be less than $3000 per vehicle and less than $6000 for the total test at any of the laboratories on the list. It should be recognized that additions to the minimum test plan (such as mileage accumulation, parameter adjustment, or additional testing) will result in additional costs. In any case, you will have to contact them individually to obtain their latest prices.

Outcome of the Tests - In order for EPA to best utilize our facilities, confirmatory testing will be performed only on those devices that demonstrate a statistically significant improvement in fuel economy or emissions based on data from an EPA-recognized independent laboratory. We have established some guidelines which will help you determine whether the test results with your device should be considered encouraging. These values have been chosen to assure both of us that a real difference in fuel economy exists, and that we are not seeing only the variability in the results. The table below presents the minimum number of cars that need to be tested for varying degrees of fuel economy improvement, assuming a typical amount of variability in fuel economy measurement. For a minimum test plan which was conducted on a fleet of two cars, the average improvement should be at least 6%. If at least a 6% difference in average fuel economy can be shown, then we would be able to say statistically at the 80% confidence level that there is a real improvement.

Similarly, we would expect a minimum of 3% improvement for a fleet of 5 vehicles. Test results which display a significant increase in emission levels should be reason for concern.

Minimum Fuel Economy Improvements versus Size of Test Fleet

Fleet Size	Average Improvement Required
2	6%
3	5%
4	4%
5	3%
10	2%

Once we receive your application, it will be reviewed to determine if it meets the requirements listed in the format. Please do not submit confidential, trade secret, or proprietary information as EPA cannot assure that such information can be protected in all situations. If your application is not complete, we will ask you to submit further information or data. After any missing information has been submitted, your application will be reconsidered, and once it meets our requirements, you will be advised of our decision whether or not EPA will perform any confirmatory testing. Any EPA testing will be performed at no cost to you and you will be given the opportunity to concur with our test plan. Once this testing is complete, an evaluation report will be written. If no further testing is required, the report will be written solely on the basis of the test data submitted and our engineering analysis.

EPA intends to process your application in as expeditious a manner as possible. We have established a goal of twelve weeks from the receipt of a complete application to the announcement of our report. The attainment of this objective requires very precise scheduling, and we are depending on the applicant to respond promptly to any questions, or to submit any requested data. Failure to respond in a timely manner will unduly delay the process. In the extreme case, we may consider lack of response as a withdrawal of the application.

I hope the information above and that contained in the enclosed documents will aid you in the preparation of an acceptable application for an EPA evaluation of your device. I will be your contact with EPA during this process and any subsequent EPA evaluation. My address is EPA, Motor Vehicle Emission Laboratory, 2565 Plymouth Road, Ann Arbor, Michigan, 48105. The telephone number is (313) 668-4299. Please contact me if you have any questions or require any further information.

Sincerely,

Merrill W. Korth
Device Evaluation Coordinator
Emission Control Technology Division

Enclosures

CARTEL PRODUCTS DIV.

December 22, 1981

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Ann Arbor, MI 48105

ATTN: Mr. Merrill W. Korth
Device Evaluation Coordinator
Emission Control Technology Division

Dear Sir,

I wanted to take this opportunity to thank you for your help in providing the information necessary to complete our application for a EPA evaluation.

After compiling the necessary documentation, we will be forwarding the application to you.

Have a joyous holiday season.

Sincerely,

Jay Kuiper

JK/rg

cc

VANDENBERG CORPORATION
3133 MADISON AVE., S.E. GRAND RAPIDS, MICHIGAN 49508 • PHONE (616) 243-0457

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
ANN ARBOR, MICHIGAN 48105

OFFICE OF
AIR AND WASTE MANAGEMENT

January 28, 1982

Mr. Jay Kuiper, Vice President
Cartels Product Division
Vandenberg Corporation
3133 Madison, SE
Grand Rapids, MI 49508

Dear Mr. Kuiper:

We received your letter of January 13, 1982 in which you applied for an EPA evaluation of the P.A.S.S. KIT, a fuel economy retrofit device.

Our Engineering Evaluation Group has made a preliminary review of your application. Although the application is essentially complete, we will need additional information in the two areas discussed below.

Exhibit A, installation instructions, shows that the off set-point is adjustable. Although you do provide instructions for making this adjustment, you provide no guidance on how to determine the most desireable set point for the user's specific vehicle and driving conditions. The installation instructions should either describe such a procedure or include a list of settings for specific vehicles and driving conditions. Please send us any information on adjustment procedures or recommended settings.

As you noted in Section 3d(2) of your application, EPA has previously tested and evaluated another air conditioning compressor cut-off device called Pass Master. Although your device operates in an identical manner, the on/off set points of your device are significantly different. Thus, we are unable to quantify any fuel economy benefits which may be attributed to your device. In order to support specific claims for your device, it will be necessary for you to have it tested at an independent laboratory. We will be glad to assist you in developing a test plan. Please inform me if you plan to undertake such testing. For your information, I have enclosed the EPA test report on the Pass Master and a copy of the manufacturer's literature which lists the off/on set points for his various models.

We will need your response to the preceding items to properly evaluate your device. In order to process applications efficiently, we establish a schedule for each one. I ask that you respond to this letter by February 20 and plan to complete your testing by March 20. If you have any questions or require further information, please contact me at (313) 668-4299.

Sincerely,

Merrill W Korth

Merrill W. Korth, Device Evaluation Coordinator
Test and Evaluation Branch

Enclosures

CARTEL PRODUCTS DIV.

April 13, 1982

United States Environmental
Protection Agency
Ann Arbor, Michigan 48105

Attn: Merrill W. Korth
Device Evaluation Coordinator
Test and Evaluation Branch

Dear Mr. Korth:

Chuck and I enjoyed our meeting and appreciated your constructive comments. We are rewriting the instruction sheet so that it reflects the changes we have made in the P.A.S.S. Kit.

The changes center around the fact that we have physically identified the setting for 4-6-8 cylinder cars and have also made a suggestion to the do-it-yourselfer how he can set the device to cut out the air conditioner to fine tune it even further.

In the next few weeks we will set up a meeting and present the changes to you.

Looking forward to working with you.

Sincerely,

Jay Kuiper

JK/rt

cc

VANDENBERG CORPORATION
3133 MADISON AVE., S.E. GRAND RAPIDS, MICHIGAN 49508 • PHONE (616) 243-0457

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
ANN ARBOR, MICHIGAN 48105

April 19, 1981

OFFICE OF
AIR, NOISE AND RADIATION

Mr. Jay Kuiper, Vice President
Cartels Product Division
Vandenberg Corporation
3133 Madison, SE
Grand Rapids, MI 49508

Dear Mr. Kuiper:

You stated in your letter of April 13 that you had modified set points and installation instructions for the P.A.S.S. KIT. On the other hand, I was disappointed that you did not actually include this information with your letter but intend to present it to us at a future date.

I feel that a meeting would be more productive if this information were available beforehand. Accordingly, I ask that you submit it by May 3. If you have any questions or require further information, please contact me.

Sincerely,

Merrill W. Korth
Device Evaluation Coordinator
Test and Evaluation Branch

CARTEL PRODUCTS DIV.

Rec'd 4-29-82
mmk

April 27, 1982

United States Environmental
Protection Agency
Ann Arbor, Michigan 48105

Attn: Merrill W. Korth
Device Evaluation Coordinator
Test and Evaluation Branch

Dear Mr. Korth:

As of today, I have sent you two new P.A.S.S. KITS via UPS for your evaluation. The switches are prototypes and when completed will have much sharper engine type numbers on the flange of the switch.

Enclosed for your evaluation are changes which we propose in the instruction sheet as they relate to items 2 and 6 of the Installation Instructions.

At our last meeting, you challenged us to develop a switch that can be set for 4-6-8 cylinder engines. We have also proposed changes in the instructions which would give the installer the ability to further adjust the switch to its most optimum position.

In the E.P.A. evaluation of the "Pass Master Vehicle Air Conditioner Cut - Off Device" you state that the largest drawback with the "Pass Master" device is that it is not optimized for each type of vehicle. We hope that our proposed changes in items 2 and 6 in the installation instructions will give the installer an opportunity to "fine tune" the device so that it will operate correctly for each vehicle.

With the changes we have submitted, I would hope that you can release a report similar to the report prepared for the "Pass Master".

Thank you for your suggestions and encouragement.

Sincerely,

Jay Kuiper

JK/rt

VANDENBERG CORPORATION
3133 MADISON AVE., S.E. GRAND RAPIDS, MICHIGAN 49508 • PHONE (616) 243-0457

P.A.S.S. KIT

Additional Proposed Installation Instructions.

New Instruction #2:

Set red dot on adjusting screw (found under removable rubber cover) to line up with the 4,6, or 8 cylinder setting position shown on the body of the switch. Locate a suitable existing mounting bolt, or drill a 1/8" hole and mount the unit with the sheet metal screw provided. Mount switch to allow screwdriver access to adjustment screw.

New Instruction #6:

You have now completed the installation of your P.A.S.S. KIT. However, if you wish, additional "fine tuning" can be accomplished as follows:

1. Remove black protective cap.
2. To have compressor clutch cut out earlier, turn screw clockwise one/tenth turn at a time.
3. To have compressor clutch cut out later, turn screw counter clockwise one/tenth turn at a time.
4. Replace black protective cap. (The black protective cap must be replaced.)

The above described fine adjustment is easily accomplished if you can hear or "feel" your A/C disengage. If not - we suggest that you temporarily run a wire from the P.A.S.S. KIT switch into the passenger compartment. Connect to a 12 volt bulb or circuit tester and run wire back to the A/C clutch lead. When bulb is lit, A/C clutch is engaged. When bulb is off, A/C clutch is disengaged.

When adjustment is completed, remove wire and indicator light from passenger compartment and connect electrical leads permanently as described in instruction #3.

CARTEL PRODUCTS DIV.

File: "Pass Kit"

May 18, 1982

United States Environmental
Protection Agency
Ann Arbor, Michigan 48105

Attn: Merrill W. Korth
Device Evaluation Coordinator
Test and Evaluation Branch

Dear Merrill:

In response to your discovery of the variation in the upper (on) set point of our P.A.S.S. KIT vacuum switches, we have bench tested the switches on hand and found that approximately 12% of those tested exceeded 9" Hg. We subsequently discovered that the latest shipment of these switches supplied by our vendor were manufactured to a tolerance of 7-10" Hg instead of our requirement of 8"±1" Hg.

Although our vendor has taken steps to preclude this from happening again, we will do a spot check in our shop as standard operating procedure in the future.

I have enclosed a revised copy of the "Additional Proposed Installation Instructions", and copy for the exterior of the package regarding vehicles to which the kit does not apply.

Please feel free to contact Jay or me if there is any additional data required to write a draft of your report.

Thank you very much foryour help Merrill and Tony, we look forward to hearing from you.

Sincerely,

Charles Vandenberg

CV/rt

Enclosures

cc: Tony Barth

VANDENBERG CORPORATION
3133 MADISON AVE., S.E. GRAND RAPIDS, MICHIGAN 49508 • PHONE (616) 243-0457

P.A.S.S. KIT

Additional Proposed Installation Instructions. (revised 5/11/82)

New Instruction #2:

Set red dot on adjusting screw (found under removable rubber cover) to line up with the 4,6, or 8 cylinder setting position shown on the body of the switch. Locate a suitable existing mounting bolt, or drill a 1/8" hole and mount the unit with the sheet metal screw provided. Mount switch to allow screwdriver access to adjustment screw.

New Instruction #6:

You have now completed the installation of your P.A.S.S. KIT. However, it is adjustable to switch off earlier or later if you wish. The objective being to achieve a minimum of A/C compressor operating time - while still maintaining acceptable cooling under your normal driving conditions. This additional "fine tuning" can be accomplished as follows:

1. Remove black protective cap.
2. To have compressor clutch cut out earlier, turn screw clockwise one/tenth turn at a time.
3. To have compressor clutch cut out later, turn screw counter clockwise one/tenth turn at a time.
4. Replace black protective cap. (The black protective cap must be replaced.)

The above described fine adjustment is easily accomplished if you can hear or "feel" your A/C disengage. If not, we suggest that you temporarily run a wire from the P.A.S.S. KIT switch into the passenger compartment. Connect to a 12 volt bulb or circuit tester and run wire back to the A/C clutch lead. When bulb is lit, A/C clutch is engaged. When bulb is off, A/C clutch is disengaged.

When adjustment is completed, remove wire and indicator light from passenger compartment and connect electrical leads permanently as described in instruction #3.

P.A.S.S. KIT
Application Notice

NOTICE

Some 1982 vehicles have been factory equipped with a device similar to P.A.S.S. KIT. Therefore, the P.A.S.S. KIT would not be effective on the following vehicles:

- 1982 Ford Escort with automatic transmission
- 1982 Mercury Lynx with automatic transmission
- 1982 Cadillac, all models.
- 1982 Buick Oldsmobile - 4 cylinder and V-6 with automatic transmissions.

P.A.S.S. KIT is NOT recommended for use on vehicles with Diesel engines as they do not have a reliable source of "manifold vacuum".

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

ANN ARBOR, MICHIGAN 48105

June 10, 1982

OFFICE OF
AIR, NOISE AND RADIATION

Mr. Charles Vandenberg
Cartel Products Division
Vandenberg Corporation
3133 Madison, SE
Grand Rapids, MI 49508

Dear Mr. Vandenberg:

We received your letter of May 18. It appears you have adequately addressed our comments on the P.A.S.S. KIT installation instructions and vehicle applicability. Since you did not mention testing, it appears you do not plan to test the P.A.S.S. KIT using a test plan approved by EPA. Therefore, we are preparing the evaluation of your device based on the information now available to us.

If you do decide to test at an independent laboratory, please send us your test plan by June 30th so that we have the opportunity to review it to preclude the risk of an oversight that might invalidate your whole effort. We recognize that such testing is expensive and want to ensure that any testing you undertake will meet our needs. Also let us know at that time which laboratory you have selected and the scheduled dates for testing. Please plan to have the test program completed by August 15 so that our evaluation can still be completed in a timely manner.

Although we will be able to complete our evaluation without you providing any test results, it will not include any percentage values which you can use in your literature or advertising. Our position on this matter was expressed to you in our meeting on May 5. If you have any questions about our requirements, please contact me at (313) 668-4299.

Sincerely,

Merrill W. Korth, Device Evaluation Coordinator
Test and Evaluation Branch