State of California

AIR RESOURCES BOARD

November 12, 1976

Staff Report
(Revised)

Evaluation of the Condensator Inc. "Condensator Model A and B" Device for Exemption from the Provisions of Section 27156 of the Vehicle Code

I. Introduction

The Condensator Inc., 2010 Trimble Way, Sacramento, California 95825, has applied for a Vehicle Code Section 27156 exemption for its "Condensator" device. The applicant intends to market the device for installation on 1976 and older model year vehicles (Exhibit A).

II. System Description

The Condensator device is a crankcase vapor/liquid separator which incorporates an air bleed valve and a "catalytic filter" component. It is installed in the PCV system.

In operation blow-by gas coming from the crankcase via the PCV valve enters the device at point "B" as shown in the attached installation instructions (Exhibit B). The gas mixes with the incoming air bleed from point "H". The mixture enters the glass jar and passes through the "catalytic filter" consisting of "chemically treated" silica glass beads enclosed in a metal screen. The mixture then is directed up and out of the device to the engine induction system.

III. System Evaluation

A. Laboratory Tests

To permit an evaluation for determining if the installation of the device will adversely effect the exhaust emission control system of the motor vehicles the applicant submitted the following test data:

1. Bench flow data of the air bleed valve.
2. Back-to-back emission test data on a 1973 Dodge 318-2V using the CVS-75 Test Procedure, and EPA Highway Fuel Economy Test (HFET). The tests were conducted by Olson Labs, Inc., Anaheim, California.
3. Back-to-back loaded mode test at 12" Hg manifold vacuum on a 1976 Cordoba using a direct tailpipe sampling method. The test was conducted at Engine Energizing and Auto Electric, Citrus Heights, California.
4. Back-to-back 50 MPH loaded mode test on a 1971 Toyota using a direct tailpipe sampling method. The test was conducted at Marconi Technical Center, Sacramento, California.

The ARB Laboratory performed the following confirmatory tests:

1. Air bleed bench flow test with increasing and decreasing vacuum.
2. Back-to-back tests on a 1971 Pinto, 2.0L 2V and on a 1973 Dodge, 318 2V using the following emission test methods:

a) One CVS-75.

b) Two Hot-Start CVS-72.

c) Steady state test at idle, 20, 30, 40 and 50 MPH at road load horsepower.

The applicant and ARB bench flow characteristics are compared in Figure 1. The emission test results are summarized in Table I through V inclusive.

B. Analysis of Test Results

1.) Applicant's Emission Tests

The CVS-75 back-to-back emission test data submitted by the applicant showed that HC decreased by 17%, CO by 18%, and NOx by 11%. A reduction of HC and CO emissions means better fuel combustion and is usually accompanied by an increase in NOx emission. It is likely that one or more of the applicant's data points have been affected by test variability. Additional confirmatory emission tests were performed by the ARB to determine the effect on the emissions.

The loaded mode tests on a 1976 Cordoba and a 1973 Toyota showed about 50% reduction in HC concentration. However these test data were not meaningful since the back-to-back tests were not performed under similar conditions. Table II shows the horsepower and speed changed on the 1976 Cordoba and the horsepower also changed on the 1973 Toyota when tested with and without the device.

2.) ARB Laboratory Emission Test

The ARB Laboratory test data indicates a significant increase of NOx emission on the two vehicles tested as a result of the device installation.

For the 1971 Pinto, Table III shows HC decreased 12%, CO increased 3%, and NOx increased 15% when tested by the CVS-75 cycle. Table IV shows there was no change on HC, CO increased 6%, and NOx increased 17% when tested by the Hot Start CVS-72 cycle. Table V shows no significant change in HC, CO decreased, and NOx increased with a maximum of 54% at 30 MPH during the steady state emission tests.

The test results on a 1973 Dodge also showed an increase in emissions by CVS-75 and CVS-72 tests. Steady state test data however, showed wide data variability and was not acceptable. Table III shows HC increased by 12%, CO decreased 14%, and NOx increased 14% when tested by the CVS-75 cycle for the Dodge. Table IV shows HC increased by 10%, CO decreased 32%, and no significant change in NOx when tested by the hot start CVS-72 cycle.

3.) Bench Flow Test

Data on air bleed flow rates are plotted as shown in Figure 1. Both the applicants and ARB flow curves showed the flow rates exceeded 0.5 CFM at 12 inches and higher vacuum, with a maximum of 0.58 CFM.

The ARB staff uses maximum air bleed limits as a basis of judgment for the leaning effect of air bleed device. A maximum air flow of 0.3 CFM at greater than 7 inches Hg is the allowable limit for engine sizes 140 CID or less and maximum flow of 0.5 cfm for engine sizes greater than 140 CID. These air flow limits have been judged by the staff to not have a significant effect on the performance of the exhaust emission control system. The tests show the air flow permitted by the "Condensator" device substantially exceeded the established flow limit for vehicles having 140 CID or smaller engines, and marginally exceeded the flow limits for vehicles having greater than 140 CID engines thus accounting for the increase in NOX emission.

C. Manufacturer's Claims

Mr. Elmer Bush, the inventor, claims the installation of the device on the vehicles will reduce emission, engine maintenance, cause the catalytic converter to last longer, and improve fuel

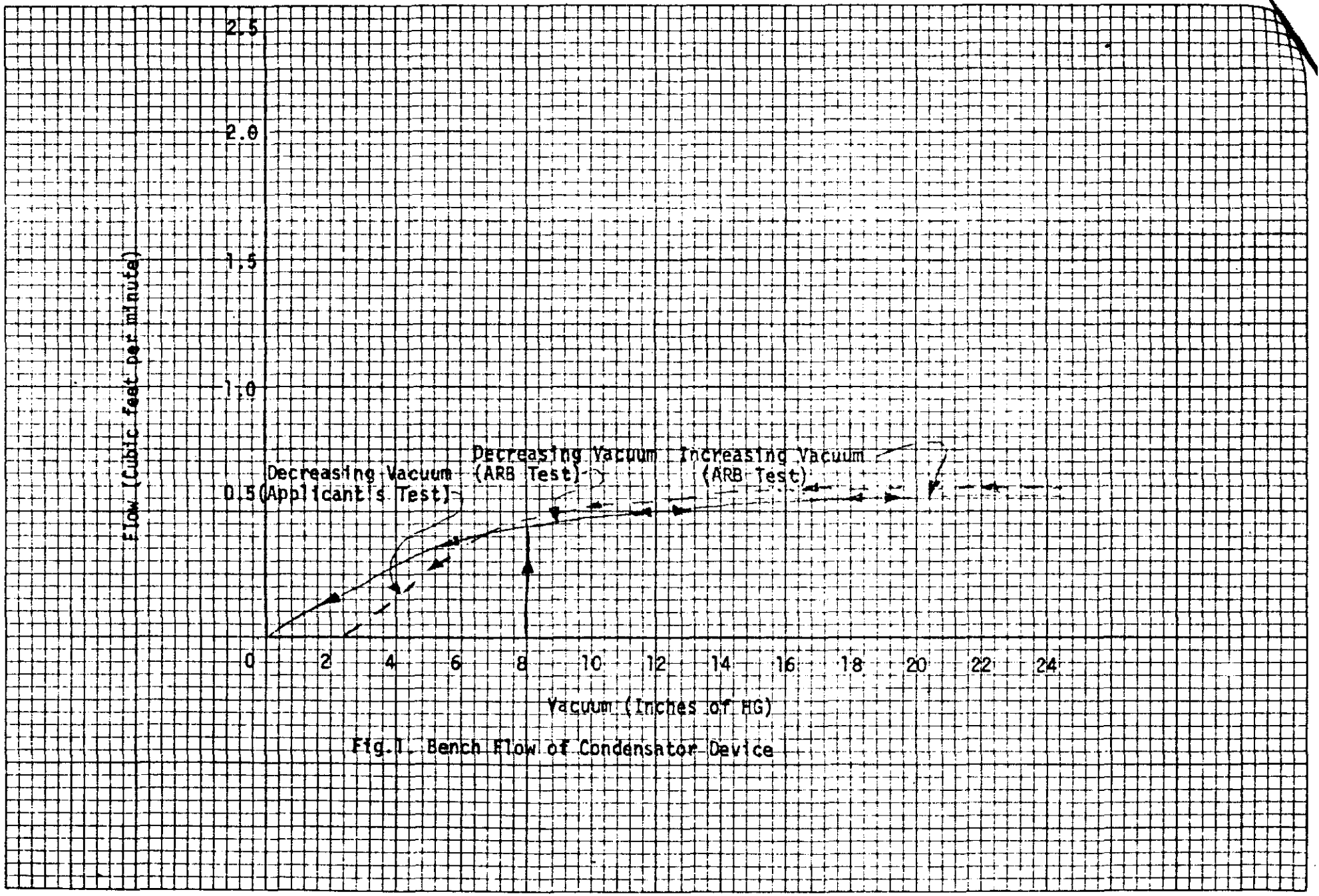

Fig. 1. Bench Flow of Condensator Device

economy. This is done by removing the entrained oil and burning the heavy hydrocarbon in the blow-by gas in the presence of a catalytic filter before allowing the gas to enter the engine induction system. If the heavy oil and hydrocarbons are allowed to enter the engine combustion chamber, the inventor claims, the mixture will not burn sufficiently under normal firing conditions causing the formation of carbon in the cylinders, plugs, and rings, and an increase in exhaust emissions.

After the completion of the exhaust emission tests at the ARB Laboratory the device was disassembled and inspected. There was no observed evidence of any polymerization or gumming around the catalytic filter indicating the absence of any chemical reaction. The inventor was also unable to submit satisfactory documentation showing the chemistry involved in the claimed catalytic reaction. The staff believes that no catalyst is present to induce a reaction of the hydrocarbons at blow-by gas temperature as claimed by the inventor.

It is the staff's judgment that the device simply removes the oil entrained with the blow-by gas which then accumulates in the glass jar. On vehicles with excessive blow-by caused by worn out piston rings the quantity of entrained oil may be significant. Therefore older vehicles, which use excessive

oil, could possibly benefit from the installation of the device. However it is the staff's judgment that the majority of in-use vehicles will not display the benefits claimed by the inventor. The ARB staff has discussed with the applicant our differences of opinion regarding his advertised claims.

The Condensator is also an air bleed device. Previous tests by the ARB have shown the leaning effect of this device may produce some measurable improvements in fuel economy of older vehicles which operate on richer air fuel mixtures. On newer engines with leaner air fuel mixtures the use of an air bleed device will not have any significant effect on fuel economy and may in fact cause misfiring due to excessive leaning. ARB tests on the "Condensator" and the applicant's test data did not show any significant improvement in fuel economy of the vehicles tested.

IV. Conclusion and Recommendation

The ARB staff's engineering evaluation of the "Condensator" indicates the device when installed on a motor vehicle removes the heavy oil entrained in the blow by gas in the PCV system. There is no catalytic reaction taking place in the device as claimed by the manufacturer. The device also acts as an air bleed valve, producing a maximum leaning effect at idle conditions.

Our laboratory tests indicated the installation of the device increased NOx emission of the motor vehicles tested. It is the staff's opinion that this increase in NOx emission is primarily due to the leaning effect of the device.

The applicant, by letter dated August 25, 1976 (Exhibit C), stated he has modified the design of the "Condensator" to meet the ARB Criteria for air bleed devices by reducing the orifice size. Model A incorporates an orifice size of 0.06" diameter, for applications on engine sizes of more than 140 CID, and Model B incorporates an orifice size of 0.04" diameter for applications on engine sizes 140 CID and less. The ARB staff has determined mathematically that the above orifice sizes limit air flow rate to the established limits used by the ARB on air bleed devices. No further flow tests are therefore necessary.

The ARB staff believes the installation of the "Condensator" device incorporating the modified orifice size will meet ARB air bleed criteria and will not adversely affect the exhaust emission control system of motor vehicles. The staff therefore recommends that the Condensator Inc. be granted an exemption from the prohibitions of Vehicle Code Section 27156 for its "Condensator" device for installation on 1976 and older vehicles, Model A for vehicles with engine size greater than 140 CID, and Model B for vehicles with engine sizes 140 CID and less.

This report is being circulated to the persons listed in the attached distribution list for whatever action they may deem advisable.

Table I - CVS-75 TEST DATA COMPARISON
CONDENSATOR DEVICE
(Applicant's Test Data)

		Grams Per mile				
		HC	CO	NOx	MPG	*HFET MPG
1973 Dodge 318 CID 2V	Baseline	2.1	20.4	2.9	14.8	21.2
	Device	1.8	17.2	2.6	15.4	21.8
	% Change	-17	-18	-11	+4	-3

Table II - LOADED MODE TEST DATA COMPARISON
CONDENSATOR DEVICE
(Applicant's Test Data)

At 12 inches Manifold Vacuum

		HC (PPM)	CO (%)	MPH	HP
1976 Cordoba	Baseline	20	0.1	45	23.3
	Device	10	0.05	47	26.0

At Constant 50 MPH Speed

		HC (PPM)	CO (%)	HP
1971 Toyota	Baseline	175	1.0	35
	Device	70	1.0	40

*Highway Fuel Economy Test

Table III - CVS-75 TEST DATA COMPARISON
CONDENSATOR DEVICE
(ARB Confirmatory Test)

		Grams per Mile			
		HC	CO	NOx	MPG
1971 Ford Pinto	Baseline	2.4	26.5	3.8	21.9
2.0L - 2V	Device	2.1	21.4	4.9	18.7
	% Change	-12	+3	+29	-15
1973 Chrysler	Baseline	2.4	25.1	2.8	13.8
318 - 2V	Device	2.7	21.5	3.2	13.0
	% Change	+12	-14	+14	-6

Table IV - Hot Start CVS-72 TEST DATA COMPARISON
CONDENSATOR DEVICE
(ARB Confirmatory Test)

		Grams Per Mile			
		HC	CO	NOx	MPG
1971 Ford Pinto 2.0L-2V	Baseline	1.8	15.9	3.6	24.6
	Device	1.8	16.9	4.2	24.2
	% Change	0	+6	+17	-2
1973 Chrylser 318 CID - 2 V	Baseline	2.0	23.0	3.4	13.3
	Device	2.2	15.6	3.3	14.4
	% Change	+10	-32	-3	+8

Table V - STEADY STATE DATA COMPARISON FOR 1971 FORD PINTO,
2.0L, 2V, CONDENSATOR DEVICE
(ARB Confirmatory Test)

		Grams per Mile			
		HC	CO	NOx	MPG
50 MPH	Baseline	1.4	3.8	5.4	33.2
	Device	1.4	2.7	6.0	32.8
	% Change	0	-29	+11	-1
40 MPH	Baseline	1.2	2.1	2.9	39.7
	Device	1.3	1.6	4.1	36.9
	% Change	+8	-24	+41	-7
30 MPH	Baseline	1.3	5.5	1.3	38.6
	Device	1.3	3.2	2.0	38.3
	% Change	0	-42	+54	-1
20 MPH	Baseline	1.6	14.4	0.6	32.6
	Device	1.1	4.0	0.6	38.1
	% Change	-31	-72	0	+17
Idle	Baseline	0.26	2.8	0.02	0.01
	Device	0.3	4.3	0.01	0.01

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EXHIBIT A

State of California
AIR RESOURCES BOARD

Air Bleed and Vapor Injector Devices Specification and Application for a Board Finding

1. Device name and model: Condensator/Supplementary Carburetor Model:

2. Manufacturer: Condensator Inc.

   Address: 2010 Trimble Way

   Sacramento, California 95825 Telephone (916) 485-4014

3. Authorized representative: Elmer W. Bush, President

   Address: 2010 Trimble Way

   Sacramento, Calif. 95825 Telephone (916) 485-4014

4. Purpose of the device and operating principles: crankcase emission collector and supplementary carburetor

   see exhibit "A"

5. Engine system in which the device is installed: PCV line

6. Technical drawings enclosed: Yes X No

7. Device description: enclosed - see exhibit "A" and "B".

8. Installation instructions including required adjustments of device and engine: enclosed - adjustments see #9 on installation instructions. Exhibit "B".

Elmer W Bush
6-9-76

9. List of vehicles requested for the Board finding: Model-Year(s)

X less than 140 CID X 140 CID and greater X

Exemptions: systems with no PCV

10. 2 devices submitted for ARB evaluation:

Yes X No _____

11. When engine is turned off is device normally: Open ___ Closed X

12. Safety features (Explain): see Exhibit "D".

13. Backfire and syphon protection (Explain): Backfire will not penetrate catalytic filter which is incorporated into PCV line for double protection. see Exhibit "B" and "D".

14. Emission test data supplied: Yes X No _____
see Exhibit "E", "F" and "G".

15. Air flow data in CFM admitted into the manifold through the device over 0-24 in. Hg. vacuum range submitted: Yes X No _____
see Exhibit "C"

For Vapor Injectors Only

16. Size and material of fluid container: _____

17. Fluid specifications: _____

Comments: _____

(Use extra sheets if needed)