Exhaust Emissions From Two Passenger Vehicles Equipped with the ADAKS Device

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Background

The ADAKS Vacuum Breaker demonstrated impressive emission reductions when evaluated on five vehicles by a commercial laboratory. It was desired to conduct confirmative testing utilizing the 1972 Federal emission test procedure. Two units were provided by ADAKS Products, Inc. of Rochester, New York.

Device

The ADAKS Vacuum Breaker is basically an air bleed device resulting in leaner engine combustion. A valve activated by high manifold vacuum, with oil damping to preclude undesireable oscillations, allows air to flow through a filter to a base plate inlet below the carburetor. Flow is shut off when the vehicle is operating under load conditions - low manifold vacuum.

Installation of the device seemed to require considerable effort. The carburetor had to be removed to facilitate installation of the base plate or air inlet. Some automatic choke linkages (typically Chrysler Corporation vehicles) would require modification. Carbon monoxide at idle must be set at a rich level (about 6.5% without AVB). The AVB valve required adjustment while monitoring manifold vacuum. Thus, installation of the AVB system requires good shop equipment as well as several hours of a competent mechanic's time.

Test Program

Two vehicles were outfitted with the AVB system. A 1963 Chevrolet Impala with a 283 cubic-inch engine and manual three-speed transmission and a 1970 Plymouth Valiant with a 225 cubic-inch engine and automatic transmission were employed.

A series of 1972 Federal emission tests, as described in the November 10, 1970, Federal Register, were performed on both the Chevrolet and the Plymouth equipped with AVB. This testing employed the LA4-S4 driving cycle and the constant volume sampling technique to obtain bag samples. These samples were analyzed using NDIR analysis for carbon monoxide and carbon dioxide, FID analysis for hydrocarbons, and chemiluminescent analysis for oxides of nitrogen.

The Plymouth Valiant was driven 2000 miles subsequent to this testing and then retested as described above. This additional analysis was desired to note any degradation or improvement of emissions with mileage.

Results

The emission results for the Chevrolet and Plymouth are presented in Table I and II respectively in the appendix. As indicated in Table I, hydrocarbons were reduced 14% and carbon monoxide 31% from

baseline on the Chevrolet. Similarly Table II indicates a 36% reduction in hydrocarbon, and a 75% reduction in carbon monoxide from baseline for the Valiant prior to mileage accumulation. In both cases carbon dioxide and oxides of nitrogen increased. For the Chevrolet these increases above baseline were 20% and 7%. For the Valiant increases of 7% and 19% were noted.

In addition to these baseline comparisons, data is presented on another device evaluated on the Chevrolet. The GM retrofit device employs enleanment of the carburetor in addition to vacuum advance disconnect. Hydrocarbon levels were lower with the GM device than ADAKS while carbon monoxide was higher.

Table II also presents emission data acquired after 2000 miles were driven in the Valiant. As is shown, the toxic emissions dropped somewhat during this mileage accumulation. Carbon dioxide increased during this time. It is of interest to note that no adverse driveability effects were reported during the mileage accumulation, indicating that the Valiant was operating rich enough to tolerate the enleanment effect.

Conclusions

The ADAKS Vacuum Breaker is an effective control system for the reduction of carbon monoxide. The system has a lesser effect on hydrocarbon emissions. As was anticipated oxides of nitrogen rose as a result of the enleanment process. This increase is minimized, however, by the cutoff of excess air at high load operation. Carbon dioxide increased with the installation of the ADAKS device indicating a potential increase in fuel consumption.

When considering an air bleed device it should be kept in mind that in the population of vehicles currently in operation there exists a significant proportion already operating near the lean limit of combustion. It is probable that installation of any device whose operation is similar to that of the ADAKS device, an enleanment effect will result in misfire and/or severe adverse driveability affects on those vehicles.

Table I

Emission Data - 1972 FTP

1963 Chevrolet Impala, 283 CID
Standard Transmission

ADAKS Equipped

	HC gpm	CO gpm	CO_2 gpm	NOx gpm
	7.3	83.8	467.5	1.1
	7.2	82.2	510.8	1.7
	7.4	76.1	496.1	1.3
	6.4	70.4	469.8	1.7
Average	7.1 gpm	78.1 gpm	486.1 gpm	1.5 gpm
Baseline (no device)				
Average	8.3 gpm	113.8 gpm	404.5 gpm	1.5 gpm
% Reduction over Baseline	14%	31%	20% increase	7% increase
GM Retrofit Device				
Average	6.5 gpm	92.3 gpm	---	---
% Reduction over Baseline	22%	19%	---	---

Table II

Emission Data - 1972 CID

1970 Plymouth Valiant, 225 CID
Automatic Transmission

ADAKS Equipped (prior to mileage accumulation)

	HC gpm	CO gpm	CO_2 gpm	NOx gpm
	1.8	13.5	494.7	7.7
	1.6	8.7	433.9	5.9
	1.9	13.3	434.0	8.9
Average	1.8 gpm	11.8 gpm	454.2 gpm	7.5 gpm
Baseline (no device)				
Average	2.8 gpm	48.0 gpm	426.0 gpm	6.3 gpm
% Reduction ADAKS over Baseline	36%	75%	7% increase	19% increase

ADAKS Equipped (after 2000 miles accumulated)

	HC gpm	CO gpm	CO_2 gpm	NOx gpm
	1.7	10.9	489.0	5.9
	1.4	10.1	641.2	5.5
	1.5	11.0	497.9	6.0
Average	1.5	10.7	542.7	5.8