January 22, 1980

MANUFACTURER'S ADVISORY CORRESPONDENCE

Procedure for Demonstrating an Alternative Diurnal Temperature Profile for Motorcycles; Suggestions for Bench Testing.

At the August 23, 1979 Executive Officer Hearing to consider the evaporative emission test procedure for motorcycles, the staff agreed to provide an Advisory Correspondence outlining an acceptable method for demonstrating an alternative diurnal heating profile for the evaporative emissions test. In addition, the staff agreed to hold a workshop to discuss bench testing procedures.

Alternative Profiles

An acceptable demonstration of an alternative heating profile could be accomplished as follows:

1) Equip several motorcycles which have the proposed alternative fuel tank design with temperature sensors located as required in the test procedure.

2) Attach a pre-weighed carbon canister to any vents in the fuel tank evaporative emission control system.

3) Place the motorcycles outside for several typical Southern California days (about 92°F peak temperature) and record the fuel and vapor temperature profiles and the changes in canister weight.

4) Duplicate the heating profile which results from the outside tests in the SHED to determine the actual emissions.

5) The proposed alternative heating profile should provide similar maximum temperatures and emissions to the outdoor and SHED tests above, although the time scale may be changed for experimental convenience.

Bench Testing Procedure

The bench testing procedure used for automobile evaporative emission
control systems by General Motors is attached to show a typical approach to the bench testing requirement.

The staff recommends that the manufacturer establish the bench testing deterioration factors by bench cycling the various emission control system components to the total test distance, then to the useful life distance. At these distances the components are installed on a motorcycle for SHED testing and the deterioration factor is calculated per the test procedure. No pressure checks upon the evaporative emission control system on the durability motorcycle may be performed unless they are performed on the assembly line.

If after reviewing the attached material a manufacturer determines that a workshop is still needed to discuss the bench testing requirement, it may contact the ARB staff and one will be arranged.

If you have any questions concerning this matter, please contact Robert Cross of our staff at (213) 575-6344.

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GENERAL MOTOR TEST PROGRAM
FOR
DETERMINING VEHICLE EVAPORATIVE EMISSION SYSTEM
DURABILITY AND DETERIORATION FACTORS
IN ACCORDANCE WITH
1980 CALIFORNIA EVAPORATIVE EMISSION
STANDARDS AND TEST PROCEDURES

The demonstration of evaporative emission control systems durability and
the establishment of deterioration factors will be the accumulated result
of vehicle testing, bench testing and specific part material
specifications.

General Motors has determined that the satisfactory durability of the
evaporative emission system parts be established as indicated under the
following three categories:

<table>
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<tr>
<th>EXHAUST EMISSION DURABILITY VEHICLE</th>
<th>EVAPORATIVE EMISSION BENCH TEST VEHICLE</th>
<th>MATERIAL SPECIFICATIONS</th>
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<tr>
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<td>Vapor Storage Canister</td>
<td>Rubber Hoses</td>
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<td>Steel Fuel Lines</td>
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<td>Fittings</td>
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<td>Connectors</td>
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<tr>
<td>Clamps</td>
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<td></td>
<td>Thermal Vacuum Switch (Purge)</td>
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<tr>
<td></td>
<td>Carbon Element Air Cleaner</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tank Pressure Control Valve</td>
<td></td>
</tr>
</tbody>
</table>

The performance level of evaporative emission system parts tested on the
exhaust emission durability vehicles will be demonstrated by their SHED
test results.

In regard to the bench test, General Motors has for years set internal
test standards and procedures for component part evaluation to determine
that our products do perform satisfactorily in the customers hands.
These "validation" tests have been used as a baseline in establishing the conditions and procedures needed for this "bench" test program. All of the component part tests set forth in this test program do reflect the flow of liquid and gaseous fuel through the evaporative emission control system and the exposure to cyclic loads, heat, vibration, and other environmental factors expected through 50,000 miles of typical customer use.

The material specifications of the rubber hoses will be provided as requested.

"BENCH" TEST PROGRAM

The General Motors evaporative emission control system "bench" test program has been patterned after the suggestions set forth in Mr. G. C. Hass' letter of February 11, 1977. Basically, selected components will be bench tested to an equivalent of 4000 miles. They will then be installed on a background stabilized vehicle and SHED tested. The components will be further bench tested to an equivalent 50,000 total miles and SHED tested on the same stabilized vehicle. The evaporative emission system deterioration factors shall then be determined.

We shall eventually establish a "GMECS Bench Test Fleet" that represents our full California production vehicle offering. However, we are submitting this procedure to implement early testing of some carlines. It is planned that the vehicle(s) tested, using this procedure, will adequately prove the durability of their respective evaporative family-system combinations to be marketed by General Motors in 1980.

For each fleet vehicle, there will be three sets of bench test components tested during the 1980 bench test program. No maintenance will be performed on the bench test components during the testing program.
The detailed description of our Bench Test Fleet test procedure is presented below.

Bench Test Fleet Test Procedure

1. A special vehicle fleet will be selected representative of the evaporative emission families requiring testing and will be referred to as the "GMECS Bench Test Fleet".

   These vehicles will have been prepared similar to certification data vehicles, with special emphasis placed on obtaining vehicles with stabilized evaporative emission background.

2. Each fleet vehicle will then run "Durability Driving Schedule" (AMA) stabilizing mileage followed by three SHED tests to establish the soundness of each test vehicle. These vehicles will then be retained by our Vehicle Emission Laboratory for the "bench" test program.

3. While the test fleet is being built and during AMA run-in mileage accumulation, the selected evaporative emission control components will be cycled for an equivalent of 4000 miles on the bench test.
4. When the selected components have completed an equivalent 4000 mile bench test, the test vehicle will be prepared for test by accumulating a maximum of four hours of AMA mileage.

The first set of bench test components will then be installed on the vehicle and one hour of AMA mileage will be run followed by three SHED tests. After the SHED tests with the first set of bench test components, the second set of identical components will be installed and evaluated in similar manner. This procedure will be followed for each of the three sets of components.

5. Following the 4000-mile SHED tests, the bench test components will continue their bench cycling to represent the additional 46,000 miles of operation. The test fleet cars will be parked during this period.

6. When the components have completed the additional 46,000 miles of bench testing, the test vehicle will again be prepared for test by accumulating a maximum of four hours of AMA mileage.

7. Three SHED tests of the non-bench test components will be run to confirm the stability of each test vehicle.

8. The first set of bench test components will be installed on the test vehicle. One hour of AMA mileage will then be run followed by three SHED tests. This procedure will be followed for each of the three sets of components.
9. At the conclusion of bench testing, evaporative emission system deterioration factors shall be determined for each evaporative family. These bench test deterioration factors shall be averaged with the deterioration factors of evaporative families required to be run under exhaust emission durability testing requirements to determine a single evaporative emission deterioration factor for each evaporative family.

A flow diagram of the GMECS bench test is shown in Figure I.

In addition to the preceding "Bench Test Fleet" test procedure, the individual bench test procedure for each required component part and representative flow diagrams of each are presented on the following pages. These specific component parts are:

- Vapor Storage Canister, Including
  - Bowl Vent Valve
  - Purge Control Valve
  - Tank Pressure Control Valve
- Carburetor
- Fuel Filler Cap
- Thermal Vacuum Switch (Purge)
- Carbon Element Air Cleaner
FLOW DIAGRAM—EVAPORATIVE EMISSION CONTROL BENCH TEST

Prepare "Bench Test" Car

Provide AMA Run-In Miles

SHED Test (s)

Park Car

AMA Mileage

50k Bench Components Installed

One Hour AMA Mileage

4k SHED Test (s)

Remove Bench Components

Park Car

AMA Mileage

SHED Test (s) (Non-Bench Components)

50k Bench Components Installed

One Hour AMA Mileage

50k SHED Test (s)

Cycle Bench Test Components to Represent Additional 46,000 Miles of Operation
FLOW DIAGRAM – VAPOR STORAGE CANISTER BENCH TEST

Canisters Without Control Valves

Canisters With Control Valves

Vacuum Cycle Control Valves 484 Cycles in Presence of Vapor

Purge Canister for 90 Minutes

Install Canister on Equilibrator, Load Purge 100 Cycles

Ship Canister to Test Vehicle

Install on Test Vehicle

Run 4k SHED Test(s)

Return Canister to Bench Test

Canisters Without Control Valves

Canisters With Control Valves

Vacuum Cycle Control Valves 5,566 Cycles in Presence of Vapor

Purge Canister for 90 Minutes

Install Canister on Equilibrator, Load Purge 1,150 Cycles

Ship Canister to Test Vehicle

Install on Test Vehicle

Run 50k SHED Test(s)
FLOW DIAGRAM—CARBURETOR BENCH TEST

- Install Carb. on Vibrator
- Vibrate Carb. 48 Minutes
- Install Carb. on Adapter Plate
- Linkage and Vacuum Cyclo Test 4000 Cycles
- Drain Carb. Bowl
- Cold Soak -20°F - 2 Hr.
- Normalize at Room Temperature for 1 Hour

- Hot Soak 175°F - 2 Hr.
- Remove from Adapter
- Ship Carburetor to Test Vehicle
- Install on Test Vehicle
- Run 4k SHED Test (s)
- Remove Carb. from Vehicle
- Return Carburetor to Bench Test

- Install Carb. on Vibrator
- Vibrate Carb. 9 Hours 12 Minutes
- Install on Adapter Plate
- Linkage and Vacuum Cycle Test 46,000 Cycles
- Drain Carb. Bowl
- Cold Soak -20°F for 24 Hr.
- Ship Carburetor to Test Vehicle
- Install on Test Vehicle
- Run 50k SHED Test (s)

- Hot Soak 175°F for 24 Hr.
- Cold Soak -20°F for 24 Hr.
- Normalize at Room Temperature for 1 Hour
- Normalize at Room Temperature for 1 Hour
- Run 50k SHED Test (s)
FLOW DIAGRAM – THERMAL VACUUM SWITCH (TVS)

FIGURE V

Install TVS on Test Fixture

Temperature Cycle TVS from Full Open to Full Closed 292 Cycles in Presence of Vacuum and Fuel Vapor, Ambient Temperature to be 220°F

Soak TVS at -20°F for 50 Minutes

Soak TVS in Coolant at 225°F for 10 Minutes

Send TVS to Test Vehicle

Install TVS on Test Vehicle

Run 4k SHED Test (s)

Install TVS on Test Fixture

Return TVS to Bench Test Facility

Remove TVS from Vehicle

Soak TVS at 0°F for 50 Minutes

8 Cycles

Soak TVS in Coolant at 225°F for 10 Minutes

Send TVS to Test Vehicle

Install TVS on Test Vehicle

Run 50k SHED Test (s)
INSTALL ON VIBRATION STAND AND SHAKE FOR 48 MINUTES

INSTALL ON EQUILIBRATOR AND LOAD-PURGE 100 CYCLES

SHIP AIR CLEANER TO TEST VEHICLE

INSTALL ON TEST VEHICLE AND RUN 40,000-MILE SHED TEST

RETURN AIR CLEANER TO BENCH TEST

INSTALL ON VIBRATION STAND AND SHAKE FOR 9 HRS. 12 MIN.

INSTALL ON EQUILIBRATOR AND LOAD-PURGE FOR 1,150 CYCLES

SHIP AIR CLEANER TO TEST VEHICLE

INSTALL ON TEST VEHICLE AND RUN 50,000-MILE SHED TEST