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Air Resources Board

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MEMORANDUM

TO: Mr. Steve Albu, Chief, Engineering Studies Branch
Mr. Jack Kitowski, Chief, On-Road Control Regulation Branch

FROM: Mr. Michael W. Carter, Chief
Emission Research and Off-Road Controls Branch

DATE: March 3, 1998

SUBJECT: **ZERO-EVAPORATIVE EMISSIONS TEST PLAN (REVISED)**

As you are aware, my staff has been asked to generate test data in support of the proposed zero-evaporative emissions standard. This document communicates our design and test plan for the generation of these data. All testing would be performed under Project Number 2R9801.

I. Test Program Overview

In general, the testing will consist of two components: testing of manufacturers' zero-evaporative emissions prototypes (subject to availability), and testing of current rental vehicles modified to have the lowest possible evaporative emissions. With the exception of the Mitsubishi HEV, no manufacturer prototypes are currently available to test (although another prototype may become available). Therefore, this plan will focus on the rental vehicles. Should additional prototypes become available, my staff will write an addendum to this test plan to cover the testing of these vehicles.

The rental vehicles in Table 1 are listed in the general order desired for procurement. At a minimum, four of the vehicles are to be tested. Additional vehicles may be tested subject to time constraints. The rental vehicles would be tested in as-received condition as well as in modified condition. The vehicle modifications that ARB staff will perform are as follows:

- Tighter sealing of the fuel and evaporative systems;
- Use of an auxiliary canister to reduce canister vapor emissions; and

-Use of a carbon filter located behind the engine air-filter to capture and control engine breathing losses.

These modifications are expected to reduce evaporative emissions from the baseline levels on the vehicles tested.

Table 1 - Test Vehicles for Zero-Evaporative Testing
All Vehicles are 1998 Model-Year Vehicles

Vehicle	Engine Size (l)	Evaporative Family
1. Toyota Corolla (Chevrolet Prizm)	1.8	WTYXR0115AK1 (WNTXR0115AK1)
2. Toyota Camry	2.2	WTYXR0135AK1
3. Toyota Avalon	3.0	WTYXE0095AE1
4. Honda Civic	1.6	WHNXE0065AAD
5. Ford Escort Coupe	2.0	WFMXE0080BOE
6. Ford Taurus	3.0	WFMXE0115BOE
7. Toyota 4-Runner	2.7	WTYXE0095AEO
8. Hyundai Accent	1.5	WHYXV007021A
9. Acura Integra	1.8	WHNXE0080AAB
10. Toyota Camry	3.0	WTYXE0095AE1
11. Toyota Tercel	1.5	WTYXE0065AE1

II. Test Program Personnel

The project managers for this test program will be David Parker, available at x6693. Should Mr. Parker not be available, testing staff may contact Susan O'Connor at x6696, or Kathleen Nolan at x6632.

We request that the test engineer for this test program be John Karim, available at x4303 or x4340. Mr. Karim would oversee vehicle procurement and supervise the testing of all vehicles in the running loss and SHED facilities located in the Annex 4 building. Mr. Karim would also ensure that the Phase II fuel is sampled for RVP monthly.

We also request that additional engineering support for this project be provided by the Low-Emission Testing Section, headed by Ron Waggoner. A vehicle engineer within this testing section would be selected and would supervise the vehicle modifications to be performed.

III. Testing and Engineering Procedure

Each vehicle tested is to be run through a series of evaporative tests including the full extended evaporative procedure and an abbreviated version of this procedure. The abbreviated test procedure is designed to give near-equivalent emissions results to the full procedure in a fraction of the time. Also, the abbreviated test procedure will be used to initially assess the emissions benefits obtained by staff's vehicle modifications. Finally, these tests will be used to stabilize the emissions results prior to performing an official and complete extended evaporative test. This extended test will only be performed if the diurnal plus hot-soak results from the final abbreviated test are less than 0.8 grams.

All tests will be performed using Phase II certification gasoline from the underground storage tank. This fuel would be sampled for RVP on a monthly basis to ensure that this certification specification is met throughout the test program.

The full extended evaporative procedure is described in Mail-Out 96-31, available from Ms. Angela Iniguez at x6632. In general, this procedure begins with a series of fuel filling and draining, separated by preconditioning driving and soak periods. The procedure continues with butane/nitrogen loading of the evaporative canister to 1.5 x working capacity, followed by a cold-start FTP. This FTP is then followed by a stabilization period in which the vehicle is gradually raised to 105 F. The running loss test is then run, followed by the high-temperature hot-soak test and the full 72-hour diurnal test. Please note that the running loss test will be unsampled for our testing. A flowchart diagram of this procedure is attached.

The shortened procedure begins with the 105 F temperature stabilization described above, followed by an unsampled running loss test (the running loss facility does not yet have the capability to run this test). The hot-soak and then a one-day diurnal test are then performed. Both tests are run using the same temperatures profiles in the official evaporative test. The fuel tank is filled to 40% prior to the beginning of the test.

We expect each vehicle to undergo approximately 4 shortened tests, and 2 of the full tests. In general, the full tests will be performed once all vehicle modifications are complete and the vehicle is exhibiting stable emissions levels over the shortened procedure. For the first Toyota vehicle tested, a full baseline test shall be run first, prior to the shortened test. This test will be performed in order to confirm Toyota laboratory test results, as requested by Tom Cackette. A flow-chart of the vehicle testing sequence follows.

Vehicle Testing Sequence

A. Vehicle Arrival and Check-in at HSL

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B. Evaporative System Visual Inspection

(to ensure that all hoses are properly connected and that none are damaged).

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C. Drain and fill fuel tank to 40% of capacity.

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D. Perform baseline evaporative test using shortened test sequence. For first Toyota vehicle tested, use the full extended test sequence for this test.

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E. Complete vehicle hardware modifications. Add auxiliary canister in series with main canister by connecting auxiliary canister to fresh air-vent on main canister. Attach carbon filter to outside surface of air-filter. Add additional hose seals, as available and feasible to hose connections on evaporative system. Perform 1-hour on-road drive to condition added seals.

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F. Perform shortened evaporative test, including drain and fill outlined in step C. Repeat this test step (including drain and fill) a minimum of one time, or as many times as necessary to ensure that the vehicle emissions are stable over this test. If stabilized diurnal plus hot-soak emissions are below 0.8 grams, continue with step G. Otherwise, proceed to step H.

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G. Perform full evaporative procedure test (refer to mail-out 96-31 for details of this procedure). The Running Loss and FTP tests, while performed, shall not be sampled (the FTP results are unnecessary, while the Running Loss facility is not yet capable of running this test). Repeat this test, including drain and fill sequence at beginning of test. Test-to-test variability is to be no more than 50%. If greater variability occurs, additional tests will need to be performed.

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H. Once testing is complete, inform project manager. Remove additional components used for testing, and upon project manager approval, release vehicle for return.