

Emission Report on the Tsurumi  
Trading Co. Manifold

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## Background

On the basis of locally obtained test results, Tsurumi Trading Company, Ltd. of Japan, requested emission tests on a device they had developed. A commitment to test was made by EPA and arrangements for vehicle delivery were made. The vehicle was delivered in late August 1971, for testing.

## Device

Basically the Tsurumi system provides a method for preheating the air-fuel mixture prior to combustion. A new manifold was designed which involved enclosing the intake manifold in the exhaust manifold forming a heat exchanger arrangement. Additional air is supplied to the intake manifold through the use of an air valve installation below the carburetor. This new arrangement was designed to minimize unequal distribution to the cylinders and provide more efficient combustion. In addition, the engine compression ratio could be slightly lowered by the installation of a spark plug spacer. The vehicle was tested using three different types of fuels.

## Test Program

For this test series a vehicle was supplied by Tsurumi. This vehicle was a Nissan Cedric with a six cylinder engine and manual transmission. For these tests the vehicle choke was disconnected. Three different fuels were used for these tests. Fuel #1 was a mixture of kerosene, toluene, and gasoline, while fuel #2 was a mix of 30% kerosene and 70% toluene. The third fuel was Indolene 30.

The test program consisted of a series of 1975 Federal Test Procedure emission tests as described in the July 2, 1971, Federal Register. This test employs a constant volume sampling system. Because of probable hang-up of the heavy hydrocarbons in tests using fuels #1 and #2, the hydrocarbon results reported are probably lower than the actual value that would be determined if continuous sampling and a heated flame ionization detector were used. Carbon monoxide and carbon dioxide were measured from the sample bag using non-dispersive infrared analyzers. Oxides of nitrogen were measured using a chemiluminescence detector.

### Results

The test results are reported in the Appendix and are separated according to fuel used (Table I). The first test on gasoline was run with no changes in the engine settings. The second test with gasoline was with raised compression and optimized for gasoline. For reference, the Federal standards for 1976 are listed at the bottom of the table. During these tests, starting was difficult and the vehicle seemed to be quite sensitive to starting procedure.

### Conclusions

This modified engine system does not appear to be a likely candidate for future application. Any significant emission reduction would require considerably more control over the air-fuel ratio and probably a catalytic converter.

Table 1

Test Results from Tsurumi Cedric Vehicle  
 Using 1975 Test Procedure  
 (All Results in Grams Per Mile)

Fuel Used	Date	HC	CO	CO <sub>2</sub>	NO <sub>x</sub>
#2	8-30-71	6.2	37	551	3.3
#1	8-31-71	5.2	33	593	4.1
Gasoline	9-1-71	3.1	33	503	2.4
Gasoline	9-2-71	4.6	26	475	5.5
Federal Standards for 1976		0.41	3.4	---	0.4