71-22

Exhaust Emissions From An Army M-151 Equipped With A Mitsui Catalyst

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Vehicle Tested

A standard Army 1/4 ton M-151 vehicle was tested for exhaust emissions before and after installation of a Mitsui Catalytic exhaust reactor. This vehicle uses a 141 cubic inch, inline, four cylinder engine and requires an inertia weight of 3000 pounds. For these tests the reactor was installed in place of the standard muffler with an auxillary air line provided to supply air for the reactor and an exhaust by-pass to prevent overtemperature in the reactor. The air was supplied by a shop air system and flow was varied from 1.2 cubic feet per minute (cfm) at idle to 1.8 (cfm) at cruise with 3.6 (cfm) during acceleration.

Tests Conducted

The vehicle was tested using the following test procedures:

1. The 1972 Federal test procedure using the LA4-S4 driving cycle (LA4).

2. The standard 1970 Federal test procedure for exhaust emissions (FTP).

During the FTP tests, oxides of nitrogen were taken continuously using an infrared detector.

Results

When the catalyst was first received it was installed on the Army vehicle and tested on the LA4 driving cycle. Temperature was continuously monitored to prevent over temperature of the catalyst. After about 10 minutes of operation, the tempera-

ture exceeded a previously determined level of 1150°F and the test was halted. The temperature in the reactor, however, continued to rise and eventually liquid CO_2 was used to cool the reactor and prevent melting of the reactor case.

In order to reduce the chance of exceeding the temperature in the second set of tests, a by-pass system was constructed to allow the catalyst to cool if high temperatures were reached. The catalyst was tested under these conditions and the results are reported in Tables 1, 2 and 3. These results are compared to tests run using the same exhaust and the same vehicle but without catalyst. The catalyst temperature is reported in Table 1 during each cycle.

At the conclusion of these tests on the open cycle FTP, a second LA4 was attempted. During this test the catalyst again overheated even though the by-pass system was open to reduce the temperature. The test was stopped at 1200°F but the temperature continued to rise to 1450°F with all air to the catalyst stopped.

Conclusions

The catalyst showed reductions after it reached temperature but achieving the temperature took a long time.

The overtemperature problem appears to be the catalyst beginning to burn at a temperature below the maximum rated temperature of the catalyst. The most effective temperature for reduction appears to be near the maximum temperature of the catalyst.

Table 1

Hydrocarbon Comparison Data
M-151

	Standard ppm	Mitsui ppm	Temperature °F
Cycle 1	2000	919	300
Cycle 2	327	339	500
Cycle 3	394	254	1000
Cycle 4	298	221	1000
Cycle 6	319	182	1100
Cycle 7			
Mode 1	136	67	
Mode 2	348	130	
Mode 3	212	124	
Mode 4	492	145	
Mode 5	221	105	
Mode 6	201	99	
Mode 7	1764	359	
Total	305	143	1100

Table 2

Carbon Monoxide Comparison Data
M-151

	Standard %	Mitsui %
Cycle 1	4.96	7.17
Cycle 2	3.44	3.17
Cycle 3	4.35	3.43
Cycle 4	3.93	3.24
Cycle 6	3.97	2.20
Cycle 7		
Mode 1	2.09	0.29
Mode 2	4.04	2.04
Mode 3	4.98	2.25
Mode 4	3.36	0.82
Mode 5	5.71	2.24
Mode 6	4.04	1.76
Mode 7	4.01	0.79
Total	4.17	2.04

Table 3

Oxides of Nitrogen Comparison Data
M-151

	Standard ppm	Mitsui ppm
Cycle 1	670	464
Cycle 2	868	848
Cycle 3	778	780
Cycle 4	666	546
Cycle 6	605	631
Cycle 7		
Mode 1	140	128
Mode 2	550	443
Mode 3	428	523
Mode 4	178	302
Mode 5	203	243
Mode 6	741	620
Mode 7	295	295
Total	566	577