

State of California
AIR RESOURCES BOARD

EXECUTIVE ORDER D-171
Relating to Exemptions under Section 27156
of the Vehicle Code

ADVANCED TURBO SYSTEMS
TURBOCHARGER KIT MODEL NO. ATS 6.9L FOR FORD HEAVY-DUTY VEHICLES
POWERED BY A 6.9 LITER NAVISTAR INTERNATIONAL
HEAVY-DUTY DIESEL ENGINE

Pursuant to the authority vested in the Air Resources Board by Section 27156 of the Vehicle Code; and

Pursuant to the authority vested in the undersigned by Sections 39515 and 39516 of the Health and Safety Code and Executive Order G-45-5;

IT IS ORDERED AND RESOLVED: That the installation of the add-on turbocharger kit Model No. ATS 6.9L manufactured by Advanced Turbo Systems, Inc., 5919 South 350 West, Murray, Utah 84107, using an AiResearch turbocharger Model No. T04B with an A/R ratio of 0.96 has been found not to reduce the effectiveness of required motor vehicle pollution control devices and, therefore, is exempt from the prohibitions of Section 27156 of the Vehicle Code for 1983 through 1987 model-year Ford Motor Company heavy-duty vehicles powered by a 6.9 liter Navistar International heavy-duty diesel engine.

Modifications to the OEM emission-related parts due to the installation of the turbocharger kit include replacement of the air cleaner assembly and replacement of the OEM exhaust system with a 3" diameter exhaust system.

This Executive Order is valid provided that installation instructions for this device will not recommend tuning the vehicle to specifications different from those submitted by the device manufacturer.

Changes made to the design or operating conditions of the device, as exempted by the Air Resources Board, that adversely affect the performance of a vehicle's pollution control system shall invalidate this Executive Order.

Marketing of this device using an identification other than that shown in this Executive Order or marketing of this device for an application other than those listed in this Executive Order shall be prohibited unless prior approval is obtained from the Air Resources Board. Exemption of a kit shall not be construed as an exemption to sell, offer for sale, or advertise any component of a kit as an individual device.

This Executive Order does not constitute any opinion as to the effect that the use of this device may have on any warranty either expressed or implied by the vehicle manufacturer.

THIS EXECUTIVE ORDER DOES NOT CONSTITUTE A CERTIFICATION, ACCREDITATION, APPROVAL, OR ANY OTHER TYPE OF ENDORSEMENT BY THE AIR RESOURCES BOARD OF ANY CLAIMS OF THE APPLICANT CONCERNING ANTI-POLLUTION BENEFITS OR ANY ALLEGED BENEFITS OF THE ADVANCED TURBO SYSTEMS TURBOCHARGER KIT FOR INSTALLATION ON FORD MOTOR COMPANY VEHICLES POWERED BY A 6.9 LITER NAVISTAR INTERNATIONAL HEAVY-DUTY DIESEL ENGINE.

No claim of any kind, such as "Approved by Air Resources Board" may be made with respect to the action taken herein in any advertising or other oral or written communication.

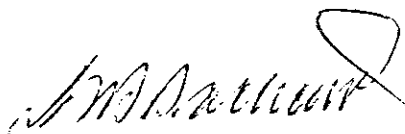
Section 17500 of the Business and Professions Code makes untrue or misleading advertising unlawful, and Section 17534 makes violation punishable as a misdemeanor.

Section 43644 of the Health and Safety Code provides as follows:

"43644. (a) No person shall install, sell, offer for sale, or advertise, or, except in an application to the state board for certification of a device, represent, any device as a motor vehicle pollution control device for use on any used motor vehicle unless that device has been certified by the state board. No person shall sell, offer for sale, advertise, or represent any motor vehicle pollution control device as a certified device which, in fact, is not a certified device. Any violation of this subdivision is a misdemeanor."

Any apparent violation of the conditions of this Executive Order will be submitted to the Attorney General of California for such action as he deems advisable.

Executed at El Monte, California, this 14th day of November, 1986.



K. D. Drachand, Chief
Mobile Source Division

State of California
AIR RESOURCES BOARD

EVALUATION OF THE ADVANCED TURBO SYSTEMS ADD-ON TURBOCHARGER KIT
MODEL NO. ATS 6.9L FOR INSTALLATION IN FORD MOTOR COMPANY
HEAVY-DUTY VEHICLES POWERED BY A 6.9 LITER NAVISTAR
INTERNATIONAL HEAVY-DUTY DIESEL ENGINE

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INTERNATIONAL HEAVY-DUTY DIESEL ENGINE

by

Mobile Source Division

State of California
AIR RESOURCES BOARD
9528 Telstar Avenue
El Monte, CA 91731

(This report has been reviewed by the staff of the California Air Resources Board and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Air Resources Board, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.)

SUMMARY

Advanced Turbo Systems (ATS) has applied for exemption from the prohibitions in Vehicle Code Section 27156 for their add-on turbocharger kit Model No. ATS 6.9L designed for 1983-1987 Ford Motor Company heavy-duty vehicles which are powered by the Navistar International 6.9 liter heavy-duty diesel engine.

ATS has submitted a completed application and all the required information as well as comparative exhaust emissions data which shows that their kit does not have an adverse effect on the emissions from the vehicles described above. Testing performed at the Haagen-Smit Laboratory confirmed the results of the tests performed by ATS.

The staff recommends that ATS be granted an exemption for their add-on turbocharger kit and that Executive Order D-171 be issued.

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EVALUATION OF THE ADVANCED TURBO SYSTEMS ADD-ON TURBOCHARGER KIT
MODEL NO. ATS 6.9L FOR INSTALLATION IN FORD MOTOR COMPANY
HEAVY-DUTY VEHICLES POWERED BY A 6.9 LITER NAVISTAR
INTERNATIONAL HEAVY-DUTY DIESEL ENGINE

I. INTRODUCTION

Advanced Turbo Systems (ATS) of 5919 South 350 West, Murray, Utah, 84107, has applied for exemption from the prohibitions of Vehicle Code Section 27156 for their add-on turbocharger kit Model No. ATS 6.9L for 1983-1987 Ford Motor Company heavy-duty vehicles powered by the 6.9 liter Navistar International heavy-duty diesel engine.

ATS has submitted a completed application, all the necessary information and comparative exhaust emissions data.

II. CONCLUSION

Based on the submitted information and the comparative exhaust emissions tests performed on a 1986 Ford F-250 heavy-duty diesel truck, the staff concludes that the installation of the ATS turbocharger kit Model No. 6.9L will not adversely affect exhaust emissions from the vehicles for which the exemption has been requested.

III. RECOMMENDATIONS

The staff recommends that ATS be granted an exemption for this turbocharger kit for use on 1983-1987 Ford Motor Company heavy-duty vehicles powered by the 6.9 liter Navistar International heavy-duty diesel engine and that Executive Order D-171 be issued.

IV. TURBOCHARGER KIT DESCRIPTION

The purpose of the ATS turbocharger system is to increase the power output of the engine by increasing the volumetric efficiency of it by compressing the intake charge to pressures above that of the atmosphere. This

increased pressure allows a greater charge density to enter the combustion chamber providing more oxygen for combustion. The maximum fuel delivery is slightly increased in order to maintain proper air-fuel ratios with the increased air flow from the turbocharger when it is providing positive manifold pressure (boost).

The major components of the system include a 0.96 A/R ratio AiResearch Model No. T04B turbocharger, custom intake adaptors, exhaust tubing, air cleaner assembly, brackets, hoses and the hardware necessary to complete the installation.

Maximum positive manifold pressure is limited to 12 psig by the size of the turbine and the compressor. The maximum engine speed is regulated by the OEM fuel injection governor which is not modified by the installation of the kit. Therefore, by controlling maximum engine speed, maximum turbine speed and corresponding boost pressures are also controlled.

No OEM emission controls are removed or disconnected when the turbocharger kit is installed.

Installation instructions, included in every kit, show the kit installer how to properly install the turbocharger system and adjust the maximum fuel delivery properly (see Appendix 1). A prototype identification label is shown in Appendix 2.

V. TURBOCHARGER KIT EVALUATION

Evaluation of the ATS turbocharger kit included analysis of all submitted information to confirm that it meets the requirements for the exemption, a comparison of the submitted exhaust emissions data, and a comparison of the confirmatory emissions data generated at the Haagen-Smit Laboratory.

The test vehicle was a 1986 Ford F-250 pick-up with an automatic transmission. ATS had requested in writing that the 1987 Ford heavy-duty diesel vehicles be included in the exemption. The certification documents show no difference between the 1986 and 1987 vehicles. For this reason the 1986 Ford truck was an acceptable test vehicle.

ATS performed comparative exhaust emissions tests at FCI International Testing, Inc., in Santa Ana, CA, on the 1986 Ford F-250 described earlier. The test program used was the "Test Program for Add-On Turbocharger Kits for Heavy-Duty Engines" (see Appendix 3). The results of these tests are shown in Table 1.

Table 1
FCI Steady-State Test Results

Mode	Exhaust Emissions (ppm)		
	HC	CO	NOx
Baseline Idle	24	27	31
Turbo Idle	17	18	33
Baseline 20 mph	26	17	57
Turbo 20 mph	18	17	54
Baseline 30 mph	32	30	81
Turbo 30 mph	20	27	75
Baseline 40 mph	43	57	102
Turbo 40 mph	31	53	100
Baseline 50mph	63	83	133
Turbo 50 mph	48	77	147
Baseline 55 mph	84	115	144
Turbo 55 mph	51 -39	88 23%	173 20%

Confirmatory testing was performed at the Haagen-Smit Laboratory and these results are shown in Table 2.

Table 2
 Confirmatory Steady-State Test Results
 Exhaust Emissions* (ppm)

Mode	HC	CO	NOx	
Baseline Idle	25	160	134	15%
Turbo Idle	25	146	154	
Baseline 20 mph	16	86	198	13%
Turbo 20 mph	14	71	225	
Baseline 30 mph	16	110	190	7%
Turbo 30 mph	14	84	204	
Baseline 40 mph	22	152	177	5.6%
Turbo 40 mph	20	115	187	
Baseline 50mph	38	169	192	7.8%
Turbo 50 mph	32	146	207	
Baseline 55 mph	51	169	211	10%
Turbo 55 mph	42	142	233	

*Average of two tests in each condition.

Although it was not required for the evaluation of the ATS turbocharger system, back-to-back CVS-72 emissions tests with particulate sampling were performed. The purpose of these additional tests was to examine the effect of a turbocharger on the particulate emissions from a diesel vehicle and to examine any differences between the pass/fail determination based on steady-state tests and the pass/fail determination based on transient-type tests. With the certification test procedures changing to transient-type testing, for heavy-duty vehicles, the tests used to evaluate aftermarket parts, for heavy-duty vehicles, may need to be changed also. With permission from the ATS representative, these additional tests were performed with the following results shown in Table 3.

Table 3
CVS-72 Test Results With Particulates

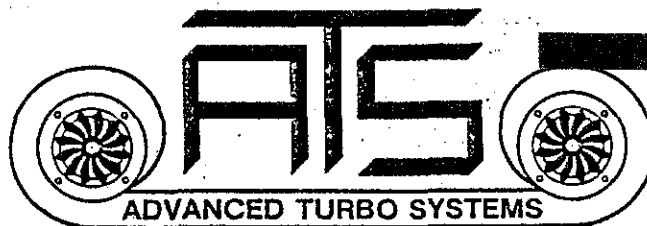
<u>Condition</u>	<u>Exhaust Emissions g/mi</u>			<u>Particulate Emissions</u>
	<u>HC</u>	<u>CO</u>	<u>NOx</u>	<u>g/mi</u>
Baseline	0.41	1.25	3.88	0.6473
Device	0.28	1.15	4.16	0.5413

VI. DISCUSSION

The steady-state test results indicate that emissions at some test points were slightly increased, however, the increases are only a few ppm which are well within the sensitivity limits of the instruments. This demonstrates that the addition of the ATS 6.9L Turbocharger kit will not have an adverse effect on emissions from the 1983-1987 Ford heavy-duty diesel vehicles for which the exemption was requested.

ATS has submitted all the required information and fulfilled the requirements for an exemption.

The CVS-72 test results with particulates indicate that the ATS 6.9L turbocharger system does not increase emissions significantly. This is the same determination made based on the steady-state test results. The particulate emissions were decreased 0.1 g/mi or 16% with the turbocharger system installation. These test results confirm that the ATS 6.9L turbocharger system meets the criteria for an exemption.



P.O. Box 1042 • Vernal, Utah 84078
(801) 789-4167

INSTALLATION PROCEDURE FOR TURBO KIT NUMBER 6.9-085

IMPORTANT: IT IS VERY IMPORTANT TO READ ALL THE INSTRUCTIONS CAREFULLY PRIOR TO ANY INSTALLATION OF THE TURBO SYSTEM!

Normal mechanical and safety procedures should be followed. On all pipe threads and fittings, a thread compound should be used. On exhaust components, an anti-seize compound must be used. Lubricate O-ring seals with an O-ring lubricant or vegetable shorting, such as Crisco. Be sure that all parts of the turbo system are clean and free of any debris.
CAUTION: Any debris in the exhaust or the intake air supply components could cause turbo failure. Turbo failure due to debris would not be covered under any warranty. For warranty to be valid, instructions must be read carefully and followed. The installation procedure must be retained by vehicle owner and read carefully.

-INSTALLATION PROCEDURE-

1. Disconnect both batteries at the negative terminals. (safety precaution only)
2. Remove air cleaner and air cleaner canister.
3. Remove rear engine lifting bracket and shorten the bracket bolts $3/16$ of an inch. Reinstall bolts without the bracket.
Note: Do not install fuel return line retaining clamp, if clamp is present.
- Note: Steps 4-6 only need to be followed if your vehicle is a 1983 or 1984 model.
4. Remove the fuel return line, which was previously held in position with the rear engine lifting bracket bolt. Remove this line only from the passenger side rear injector.
5. Cut $1/8$ of an inch out of the return line between the third and fourth injector on the right bank (passenger side). Install the T fitting supplied in the kit. Connect the return which was removed from the rear injector to this T fitting in such a manner that the return line will lie on the intake manifold directly behind the air intake.
6. Install fuel return cap supplied in kit on the rear injector where the return line was previously located.
7. Vehicles with an insulating blanket covering the firewall, must remove the entire insulating sound blanket.

8. Remove oil pressure sending unit. Install steel adapter where oil pressure sending unit has been removed behind the intake manifold. Tighten fitting so that the 1/4 inch female pipe thread faces the fire wall to the driver's side.
9. Install the oil pressure sending unit in this female pipe thread. Connect oil pressure sending unit lead wire.
10. Install turbo oil pressure line to the steel adapter in such a manner that the L fitting connecting the oil line to the steel adapter faces the number three injector on the left bank (driver's side) when tightened.
11. Remove positive crankcase ventilator from rear of intake manifold.
12. Install rubber plug in rear of intake manifold where positive crankcase ventilator was removed. Do not over-tighten.
Note: The hole where plug is to be installed must be clean and dry.
13. Using a pry bar or a short piece of 2 inch pipe, bend the lip of the firewall upward directly behind the turbo mount exhaust inlet. The center of this bend is 1 1/2 inches to the passenger side of the original location of the oil pressure sending unit.
14. Install one 3/8 inch stud in the upper rear threaded portion of the right bank cylinder head (passenger side). Make sure stud is tightened in head.
15. Relocate the vacuum block on the firewall above the right bank valve cover. Two new holes will need to be drilled. The location of this vacuum block should be 2 inches to the passenger side and 2 inches higher than the original location.
16. Relocate the power brake vacuum hose to the retaining hanger just below the hood in the center of the engine compartment. This moves the vacuum hose away from the turbine housing of the turbo.
17. Vehicles with automatic transmissions, must move the vacuum line from the position over the bell-housing retaining bolt on the passenger side, to a position using the top bell-housing retaining bolt on the driver's side of the vehicle.
18. Assemble turbocharger to turbo mount, using studs, turbo flange, nuts and lock washers provided in kit.
19. Install O-ring seal in oil drain assembly. Attach oil drain assembly to turbo using allen head cap screws provided.
20. At this time, either install a 1/8 inch pipe plug or a manifold pressure adapter in the threaded portion of the pressure chamber.
21. Lubricate the 2 inch I.D. O-ring seal and install O-ring seal in pressure chamber. With O-ring seal lubricated, push pressure chamber over turbo discharge of turbo compressor housing.
22. Install 90 degree adapter fitting in the female pipe threaded portion of the turbo. When fitting is tight, the fitting should be facing the radiator.
23. Install the pyrometer thermocouple adapter in the turbo mount casting in the 1/4-18 NPT threaded portion.

24. At this time, the final exhaust brace must be checked for proper alignment. Bolt the final exhaust brace to the turbo mount. Without the piston ring seal installed, install the final exhaust from the turbo, holding the casting flat against the inside of the turbine housing, rotate the casting towards the brace that has been mounted to the turbo mount. If the two holes do not line up exactly, the brace hole must be elongated so that a proper alignment is obtained. After proper alignment is obtained, remove the final exhaust casting and brace.
25. Install large O-ring seal over intake manifold where the air cleaner gasket was located. Be sure O-ring seal is well lubricated.
26. With steps 18-25 completed on work bench, install assembly on engine using the one stud and two $\frac{3}{8}$ X 1 inch cap screws lock washers and nut provided.
27. Install the base of the oil drain line in the grommet where the positive crankcase ventilator was removed. Be sure that the fuel return line is forward (towards radiator) of the oil drain line.
28. Secure pressure chamber with the O-ring washer and bolt provided.
29. Route the oil supply line, so that the throttle cable, the cruise control cable, and the plastic wire assembly are under the oil supply line. This helps keep the cables and wire assembly away from the turbine housing of the turbo.
30. Route the oil supply line to the driver's side of the oil drain line. Now route the line between the turbo and the pressure chamber. Connect the straight end of the oil supply line to the fitting in the turbo and tighten securely.
31. Using a hack-saw or pipe cutter, cut the stock exhaust pipe approximately $1 \frac{3}{4}$ inches to the rear of the stock Y assembly. This is where the left and right bank exhaust tubing come together. Also cut the same exhaust pipe approximately 3 inches forwards of the front exhaust hanger.
Note: If three inch exhaust is going to be used, only the first cut is necessary and the rest of the exhaust system must now be removed.
32. Using a piece of solid stock approximately $2 \frac{3}{16}$ inches in diameter, drive this into the remaining Y portion of the pipe. This is to make the pipe round in this area. The O.D. of the remaining Y pipe should not exceed $2 \frac{1}{2}$ inches in diameter. Using a file, clean and remove any burrs from the inside and outside of the Y pipe.
33. Before installing exhaust feed pipe, loosen (do not remove), the exhaust flange retaining nuts that hold the exhaust Y assembly to the exhaust manifolds. Now install exhaust feed pipe. With washers and nuts started, make sure that the feed pipe is pushed as far forward on the Y pipe as possible, then install the $2 \frac{1}{2}$ inch muffler clamp and tighten securely. Now tighten the exhaust flange securely at the turbo mount. Once feed pipe assembly has been tightened securely, tighten the exhaust flanges at both exhaust manifolds.
34. Vehicles with automatic transmissions, must now remove the dip stick tube from the automatic transmission.
35. Install piston ring seal in final exhaust and using the brace and two $\frac{3}{8}$ X $\frac{5}{8}$ inch cap screws and lock washers, install final exhaust assembly and bolt this assembly into position.

36. Using the two 5/16 X 3/4 inch cap screws and flat washers provided, bolt the angle bracket with the two holes to the intake manifold in FRONT of the throttle bracket. Before tightening these cap screws, level the bracket using a small level.
37. Lubricate the 2 3/4 inch I.D. O-ring seal and install O-ring seal in the machined groove on the inside of the air cleaner base casting. With O-ring lubricated, push base casting over turbo inlet and locate the air cleaner base against the angle bracket. With the air cleaner base in position, mark the angle bracket through the 5/16 inch taped holes in the air cleaner base. Rotate the base casting upward and remove the angle bracket from the intake manifold.
38. Drill the angle bracket where it has been marked with a 3/8 inch drill bit. CAUTION: Do not drill bracket with bracket mounted on intake manifold.
39. Install the drilled bracket with bracket bolts and flat washers in a level position.
40. Rotate the air cleaner base casting downward and secure into position using two 5/16 X 3/4 inch cap screws and flat washers provided.
41. Remove the left bank (driver's side) valve cover, being careful not to harm the valve cover gasket.
42. Using a 7/8 inch hole saw, put a hole in the rear most round portion of the valve cover and install the grommet provided.
43. Install the valve cover on the engine using the original valve cover gasket.
44. Install the vent hose assembly to the air cleaner base casting with the hardware provided. Lubricate the inside of the valve cover grommet and install the vent hose fitting in this lubricated grommet.
45. Vehicles with automatic transmissions should now install the optional dipstick tube. Use the same O-ring from the original tube and secure the new tube by using the rear valve cover bolt. Dipstick tube part number 6.9-86
46. Install air cleaner element in air cleaner cover casting. Secure air cleaner cover to air cleaner by first centering the cover casting length-wise and then latching the over-center latches.
Note: A small amount of grease should be used on the underside of the air cleaner element gasket surface.
47. Reconnect both battery cables.
48. Disconnect the oil supply line at the turbo oil inlet. Preoil the turbo using a squirt can and also fill the turbo oil supply line.
49. Connect oil supply line to turbo inlet fitting and tighten securely.
50. Start engine and check for any exhaust leaks or oil leaks.
CAUTION: Do not rev engine until oil pressure is obtained.

-FINAL EXHAUST-

The best turbo response is going to be realized by using three inch exhaust tubing without a muffler. The next best response will be realized by using three inch exhaust tubing and a good low restriction muffler. The third best response is obtained by using three inch exhaust tubing back to where the 2 1/2 inch exhaust was cut near the welded bracket and then using no muffler. CAUTION: Excessive back pressure will result in excessive exhaust temperature. A pyrometer is supplied in the kit. DO NOT exceed 1150 degrees Fahrenheit. This reading is taken from the turbo feed and not the discharge side of the turbo. We recommend that the final exhaust be done in one of the three ways just mentioned.

-INJECTION PUMP SETTING-

To realize the benefit from turbocharging your engine, the injection pump maximum fuel delivery should be increased. This is done by removing the timing cover on the passenger side of the injection pump and rotating the engine in direction of engine rotation until the allen head leaf spring adjusting screw is centered in the opening. Using a 5/32 allen wrench, turn the allen head screw inward (clockwise) to increase pump output and outward (counter-clockwise) to reduce injection pump output. The injection pump output will determine maximum exhaust temperature. We recommend an increase of 1/4 of a turn.

~~CAUTION: Excessive back pressure will result in excessive exhaust temperature.~~
~~When reinstalling the injection pump timing cover, DO NOT over-tighten the small retaining bolts, this will make the gasket leak.~~

-DOES-

1. Keep air cleaner element clean. When the element becomes dirty, change it. A dirty air cleaner element will cause excessive exhaust temperature and excessive oil consumption.
2. Change oil at intervals of not more than 2,500 miles. Change oil filter element with every oil change.
3. When shutting down engine, make sure that exhaust temperature is below 350 degrees Fahrenheit.
4. Keep fuel filter element clean. Drain water from fuel regularly. Clean diesel fuel will assure long trouble free injection pump and injector life.
5. When starting your engine, DO NOT rev your engine until oil pressure is showing on your gauge.

If these cautions are followed, long trouble free miles will be experienced with your turbocharged engine.

ADVANCED TURBO SYSTEMS, INC.
6.9L FORD DIESEL
TURBOCHARGER SYSTEM
CARB E.O. NO. D-XXX

Test Program for Add-On Turbocharger Kits for Heavy-Duty Engines

Testing will consist of back-to-back chassis dynamometer tests. Baseline (unmodified configuration) emission results will be compared to turbocharged (modified configuration) emission results on the same vehicle.

A. STEADY STATE TESTS

- 1) Idle
- 2) 20, 30, 40, 50 and 55 mph at 1XRL.

Prior to measuring exhaust emission at any steady state test point, the vehicle's engine temperature shall be stabilized. This is satisfied when engine oil temperature is stabilized as monitored and indicated by a temperature recorder.

If a steady state point is unattainable in the baseline configuration, then the last point at a specified horsepower should be WOT and the speed should be recorded. The test in the turbocharged configuration will be performed at the same speeds and horsepower as the baseline configuration.

Any steady state may be deleted if 1) the steady state exceeds or can be expected to exceed the engine redline or 2) steady state conditions might cause serious damage to vehicle components or dynamometer, or create a hazard for test personnel.

B. STEADY STATE DATA REQUIREMENTS

- 1) CO concentration
- 2) CO₂ concentration
- 3) HC concentration (by HFID)
- 4) NO_x concentration
- 5) engine rpm
- 6) engine oil temperature

C. MISCELLANEOUS

- 1) The same fuel will be used for both the unmodified and modified configurations unless the turbocharger manufacturer's written instructions specify a different fuel for the turbocharged configuration.

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- 2) Tire pressure in the drive wheels will be the maximum indicated on the tire sidewall.
- 3) Test vehicles from secondary manufacturers may be tested without a body shell if 1) the cab is intact, 2) the vehicle is legally driveable on the street, 3) the frontal area is identical to the built-up vehicle, 4) the chassis is loaded to a weight simulating loaded vehicle weight. Loaded vehicle weight is defined as the manufacturer's estimated weight of the vehicle in operational status with all standard equipment, the weight fuel at nominal tank capacity, and the weight of optional equipment.