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State of California
AIR RESOURCES BOARD

EXECUTIVE ORDER D-150
Relating to Exemptions under Section 27156
of the Vehicle Code

K.F. INDUSTRIES, INC.
MAX-25 SUPERCHARGER KIT

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 MAX-25 supercharger kit manufactured by K.F. Industries, Inc. 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 all 1985 and older GMC or AMC light-duty trucks powered by a GMC 2.8 liter V-6 gasoline fueled engine.

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 MAX-25 SUPERCHARGER KIT.

K.F. INDUSTRIES, INC
MAX-25 Supercharger Kit

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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.

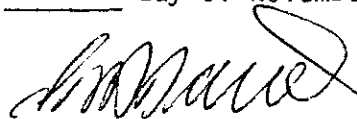
Section 17500 of the Business and Professions Code makes untrue or misleading advertising unlawful, and Section 17534 makes violation punishable as a misdemeanor.

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 16th day of November, 1984.



K. D. Drachand, Chief
Mobile Source Division

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SUMMARY

K. F. Industries, Inc. has requested an exemption from the prohibitions in Vehicle Code Section 27156 for their MAX-25 supercharger kit for installation on 1985 and older model-year GMC or AMC light-duty trucks powered by a GMC 2.8 liter V-6 gasoline engine.

Based on the results from comparative exhaust emission tests performed by K. F. Industries, Inc. at an independent laboratory on a 1984 GMC S-15 pick-up truck, and from the confirmatory tests performed by the ARB, the staff concludes that K. F. Industries, Inc.'s MAX-25 supercharger kit will not adversely affect exhaust emission from vehicles for which exemption is requested.

The staff recommends that K. F. Industries, Inc. be granted an exemption as requested and that Executive Order D-150 be issued.

State of California
AIR RESOURCES BOARD

EVALUATION OF K. F. INDUSTRIES, INC.'s MAX-25 SUPERCHARGER
KIT FOR EXEMPTION FROM THE PROHIBITIONS IN
VEHICLE CODE SECTION 27156 IN ACCORDANCE
WITH SECTION 2222, TITLE 13, OF THE
CALIFORNIA ADMINISTRATIVE CODE

October 1984

Date of Issue: October 1984

EVALUATION OF K. F. INDUSTRIES, INC.'S MAX-25 SUPERCHARGER KIT FOR
EXEMPTION FROM THE PROHIBITIONS IN VEHICLE CODE SECTION 27156 IN
ACCORDANCE WITH SECTION 2222, TITLE 13, OF THE CALIFORNIA ADMINISTRATIVE
CODE

by
Mobile Source Division

State of California
AIR RESOURCES BOARD
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(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.)

EVALUATION OF K. F. INDUSTRIES, INC.'S MAX-25 SUPERCHARGER KIT FOR EXEMPTION FROM THE PROHIBITIONS IN VEHICLE CODE SECTION 27156 IN ACCORDANCE WITH SECTION 2222, TITLE 13, OF THE CALIFORNIA ADMINISTRATIVE CODE

I. INTRODUCTION

K. F. Industries, Inc., of Sun Valley, California 91353, has requested an exemption from the prohibitions in Vehicle Code Section 27156 for their MAX-25 supercharger kit. The supercharger kit is intended for installation on 1985 and older model-year GMC or AMC light-duty trucks powered with a GMC 2.8 liter V-6 gasoline fueled engine.

K. F. Industries, Inc. has submitted data from comparative (stock baseline vs supercharged) emission tests conducted on a 1984 GMC S-15 pick-up truck at Fairway Environmental Engineering, Inc., Torrance, California. Confirmatory tests were conducted on the same vehicle at the Air Resources Board (ARB) laboratory in El Monte, California.

II. CONCLUSION

Based on the results from comparative exhaust emission tests performed by K. F. Industries, Inc. at an independent laboratory on a 1984 GMC S-15, and from the confirmatory tests performed by the ARB on the same vehicle, the staff concludes that K. F. Industries, Inc.'s supercharger kit will not adversely affect exhaust emission from vehicles for which exemption is requested.

III. RECOMMENDATIONS

The staff recommends that K. F. Industries, Inc. be granted an exemption for their add-on MAX-25 supercharger kit for installation on 1985 and older model-year GMC or AMC light-duty trucks powered by a GMC 2.8 liter V-6 gasoline fueled engine. The staff also recommends that Executive Order D-150 be issued.

IV. SUPERCHARGER KIT DESCRIPTION AND OPERATION

During the suction stroke of a 4-cycle gasoline engine the air-fuel mixture, air through the air cleaner and fuel from the carburetor bowl, enters the engine cylinders through intake valves.

The admittance into the cylinder of an aircharge more than what the cylinder would obtain as a result of the regular suction stroke (natural aspiration) is called supercharging. The increase of the air charge is obtained by increasing the inlet pressure of the air. Sometimes supercharging is called boosting.

The main object of supercharging is to permit the burning of a larger amount of fuel to increase the power output of the engine.

The increased air pressure is obtained by using blowers, either of the positive-displacement type, such as Roots blowers, or vane blowers, or of the centrifugal type. Reciprocating-piston blowers are seldom used because they are bulkier, more expensive and less dependable than blowers of the rotary types.

Roots blowers are used with two or three lobes, with cylindrical or helical surfaces. The three lobes and the helical surfaces are used to obtain a more uniform nonpulsating flow of air. The blowers are usually driven by the engine itself by means of spur, helical, or herringbone gears, silent chains, or V-belts at a speed of two to three times that of the engine. Sometimes the blower is driven by an electric motor.

The power increase through supercharging is about 1.3 times greater than the increase of the volumetric efficiency. The increase of friction losses with a supercharger driven by the engine itself is considerably smaller than the power gained through supercharging. As a result, the mechanical efficiency, referred to the maximum load, increases with supercharging.

The higher the supercharger, or booster, pressure is raised, the more air will be forced into the cylinder and the greater will be the power-output increase. At the same time a greater supercharger pressure absorbs more power to produce it. The polytropic compression of air has an exponent of 2 for Roots blowers.

K. F. Industries, Inc. is using a three lobe cylindrical Roots blower, belt driven with a speed of 1.7 times the speed of the engine.

At reduced speeds, down to 50 percent or less, the engine torque can be maintained constant without an excessive temperature increase. An increase of the mean effective pressure by 30 to 50 percent is obtainable. The power to drive the booster pump increases rapidly with an increase of compression ratio; and with a high booster pressure at high engine rpm, the power to drive the supercharger may absorb all the gain received by the engine. This condition limits the MAX-25 boost pressure to 5 psig at 5000 engine rpm.

The MAX-25 supercharger kit has been specifically designed for installation on the GMC made 2.8 liter, V-6 gasoline fueled engine. This kit operates in conjunction with the emission control systems already certified with the stock engine. All the necessary hardwares and supplies are included in the kit. A complete manual describing the parts, and step-by-step installation procedure is supplied with the kit. None of the original OEM parts are removed or discarded as per installation procedure of this kit. Adapters are supplied; hood and air cleaner housing modification instructions are clearly spelled out in the instruction manual.

Lubrication and cooling of the supercharger is provided by a 24-in. long high pressure hose with a swivel fitting teed to the oil pressure switch connection. The other end of this hose is connected to the supercharger bearing house. On the opposite side, end bearing of the supercharger, the return oil hose is connected on one end; the other end to the rocker cover fitting.

The maximum positive pressure boost of 5 psig at 5000 engine RPM is limited by an ACM-30 computer that functions to retard the distributor spark curve above the normal driving range. This electronic computer module is also employed to suppress detonation during boost conditions or heavy operations. It utilizes a sensor, mounted on the intake manifold or cylinder head, to detect detonation (pinging). When detonation is detected, the module electronically retards the spark until detonation is eliminated.

The kit also utilizes the OEM fuel enrichment system. The system connects to the intake manifold and coolant temperature sensor. When boost pressure reaches 4 psig, the system increases the electrical resistance of the temperature sensors. This increase in electrical resistance dictates the vehicle's computer to increase the fuel flow through the injector nozzles, thus enriching the fuel charge during the boost conditions above 4 psig.

V. SUPERCHARGER KIT EVALUATION

A 1984 GMC S-15, light-duty pick-up truck with a 2.8 liter, V-6 throttle-body gasoline fuel injected engine was used for the evaluation of the supercharger kit. The dynamometer inertia weight and loading used were 3500-lbs and 12.0-hp, respectively.

Comparative emissions tests conducted by Fairway Environmental Engineering, Inc. for K. F. Industries, Inc. and by the ARB, consisted of cold-start CVS-75 and hot-start Highway Fuel Economy tests. These tests were used to determine exhaust emissions in the unmodified (baseline) and supercharged (device installed) configurations for comparison. A summary of the test results is shown below:

Exhaust Emissions Test Results
On A 1984 GMC S-15 Pick-Up Truck

A. Applicants Test Results

<u>Test Mode</u>	<u>Exhaust Emissions (gm/mi)</u>			<u>Fuel Economy (mpg)</u>	
	<u>HC</u>	<u>CO</u>	<u>NOx</u>	<u>City</u>	<u>Hwy.</u>
Baseline	0.20	3.80	0.50	17.15	27.05
Device	0.19	3.20	0.56	18.40	29.61

B. ARB's Confirmatory Test Results After Device Modification

Baseline	0.41	6.80	0.54	16.5	26.45
Device	0.24	5.16	0.55	14.0	21.97

California Standards: HC = 0.39; CO = 9.00; NO_x = 1.00
(all in grams per mile).

VI. DISCUSSION

The test data submitted by the applicant showed an increase in NOx when the supercharger was installed according to K. F. Industries, Inc.'s instructions. The applicant modified their ACM-30 computer to lower the NOx emissions. ARB confirmatory emission test results after the modification show that the installation of a supercharger kit did not have an adverse effect on exhaust emissions on the test vehicle.

The original application requested an exemption for 1984 and older model-year vehicles only. Upon completion of the evaluation tests, the 1985 model vehicles were being introduced in California. K. F. Industries, Inc., has requested, in writing, that their application be updated to include the 1985 models as well, since the engines used in the 1985 models are identically designed as the ones in 1984 models.

In response to the applicant's request, the staff reviewed the certification documents and compared the engine design of both 1985 and 1984 model-year GMC S-15, 2.8 liter, V-6, gasoline fuel injected engines. Since the engines in the 1985 models are identically designed as the 1984 engines, the staff is of the opinion that the 1985 vehicles will have the same degree of performance/emissions impact as in the 1984 models. Because the test data on a 1984 test vehicle did not show adverse effects on the vehicle exhaust emissions with the supercharger kit installed, the kit will not adversely affect the emissions on the 1985 models either. No additional testing was required or performed to incorporate K. F. Industries, Inc.'s request to include the 1985 models in their application for exemption.