

State of California  
AIR RESOURCES BOARD

EXECUTIVE ORDER D-161-6  
Relating to Exemptions under Section 27156  
of the Vehicle Code

GALE BANKS ENGINEERING  
TURBOCHARGER KIT MODEL NO. 6.9F 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. 6.9F manufactured by Gale Banks Engineering, 546 Duggan Avenue, Azusa, California 91702, using a Rotomaster turbocharger Model No. T04B or a Schwitzer/Banks turbocharger Model No. T04B25 with an A/R ratio of 1.0 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 a new air cleaner assembly, a new 3" low-restriction muffler and 3" diameter exhaust pipe.

This exemption shall not apply to any device, apparatus, or mechanism advertised, offered for sale or sold with, or installed on, a motor vehicle prior to or concurrent with transfer to an ultimate purchaser.

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 GALE BANKS ENGINEERING 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.

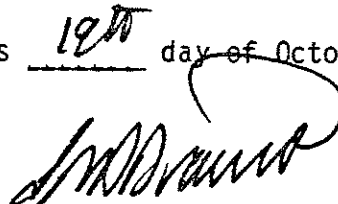
Section 43644 of the Health and Safety Code provides as follows:

"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.

Executive Order No. D-161-2, dated October 23, 1986, is superseded and of no further force and effect.

Executed at El Monte, California, this 19<sup>th</sup> day of October, 1987.



K. D. Drachand, Chief  
Mobile Source Division

State of California  
AIR RESOURCES BOARD

EVALUATION OF GALE BANKS ENGINEERING'S ADD-ON TURBOCHARGER KIT  
MODEL NO. 6.9F FOR INSTALLATION IN FORD MOTOR COMPANY  
HEAVY-DUTY VEHICLES POWERED BY A 6.9 LITER  
NAVISTAR INTERNATIONAL HEAVY-DUTY DIESEL ENGINE  
FOR EXEMPTION FROM THE PROHIBITIONS IN VEHICLE CODE  
SECTION 27156 IN ACCORDANCE WITH SECTION 2222,  
TITLE 13, OF THE CALIFORNIA ADMINISTRATIVE CODE

October, 1987

EVALUATION OF GALE BANKS ENGINEERING'S ADD-ON TURBOCHARGER KIT  
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TITLE 13, OF THE CALIFORNIA ADMINISTRATIVE CODE

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

Gale Banks Engineering (Banks) has requested an update to Executive Order D-161-2, which exempts their turbocharger kit model No. 6.9F for 1983-1987 model-year Ford Motor Company heavy-duty vehicles powered by a 6.9 liter Navistar International heavy-duty diesel engine. They have requested that a turbocharger unit manufactured by an additional source (Schwitzer/Banks) be also exempted.

Based on the following: (1) comparative compressor performance maps submitted by Banks indicating that the two turbochargers have similar operating characteristics; (2) the fact that both turbochargers have an A/R ratio of 1.0; and (3) test data from previous comparative exhaust emission tests performed for exempting the kit, the staff concludes that the Banks turbocharger kit model No. 6.9F using the Schwitzer/Banks turbocharger will not adversely affect exhaust emissions from 1983-1987 model-year Ford Motor Company heavy-duty vehicles powered by a 6.9 liter Navistar International heavy-duty diesel engine.

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EVALUATION OF GALE BANKS ENGINEERING'S ADD-ON TURBOCHARGER KIT MODEL NO. 6.9F FOR INSTALLATION IN FORD MOTOR COMPANY HEAVY-DUTY VEHICLES POWERED BY A 6.9 LITER NAVISTAR INTERNATIONAL HEAVY-DUTY DIESEL ENGINE FOR EXEMPTION FROM THE PROHIBITIONS IN VEHICLE CODE SECTION 27156 IN ACCORDANCE WITH SECTION 2222, TITLE 13, OF THE CALIFORNIA ADMINISTRATIVE CODE

I. INTRODUCTION

Gale Banks Engineering (Banks) of 546 Duggan Avenue, Azusa, California 91702, has requested an update to the existing Air Resources Board Executive Order (E.O.) D-161-2 dated October 23, 1986. E.O. D-161-2 exempted the Bank's turbocharger kit model No. 6.9F from the prohibitions in Vehicle Code Section 27156 for 1983-1987 model-year Ford Motor Company heavy-duty vehicles powered by a 6.9 liter Navistar International heavy-duty diesel engine. The applicant has requested that a turbocharger unit (the major component of the kit) manufactured by an additional source (Schwitzer/Banks) be also exempted. This would give Banks the freedom to procure turbocharger units from two sources when assembling the kits for sale.

II. CONCLUSION

Based on the following: (1) comparative compressor performance maps submitted by Banks indicating that the two turbochargers have similar operating characteristics; (2) the fact that both turbochargers have an A/R ratio of 1.0; and (3) test data from previous comparative exhaust emission tests performed for exempting the kit, the staff concludes that the Banks turbocharger kit model No. 6.9F using the Schwitzer/Banks turbocharger will not adversely affect exhaust emissions from 1983-1987 model-year Ford Motor Company heavy-duty vehicles powered by a 6.9 liter Navistar International heavy-duty diesel engine.

### III. RECOMMENDATIONS

The staff recommends that Banks be granted an update as requested, and that Executive Order D-161-6 be issued.

### IV. TURBOCHARGER KIT DESCRIPTION AND OPERATION

The purpose of the Banks turbocharger kit is to increase the power output of the engine by increasing its volumetric efficiency. This is accomplished by compressing the intake charge to pressures above that of the atmosphere. The 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 kit include a 1.0 A/R ratio Rotomaster model No. T04B or a Schwitzer/Banks Model No. T04B25 turbocharger, custom intake and exhaust tubing, air cleaner assembly, brackets, hoses and the hardware necessary to complete the installation.

Maximum positive manifold pressure is limited to 7 psi 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.

### V. DISCUSSION

Banks has submitted compressor performance maps of both Rotomaster Model No. T04B and Schwitzer/Banks model No. T04B25 turbochargers. Both



turbochargers are designed to have an A/R ratio of 1.0 (critical parameter). The compressor maps indicate that the two turbochargers have similar operating characteristics. A copy of the compressor maps is appended.

APPENDICES

# Schwitzer

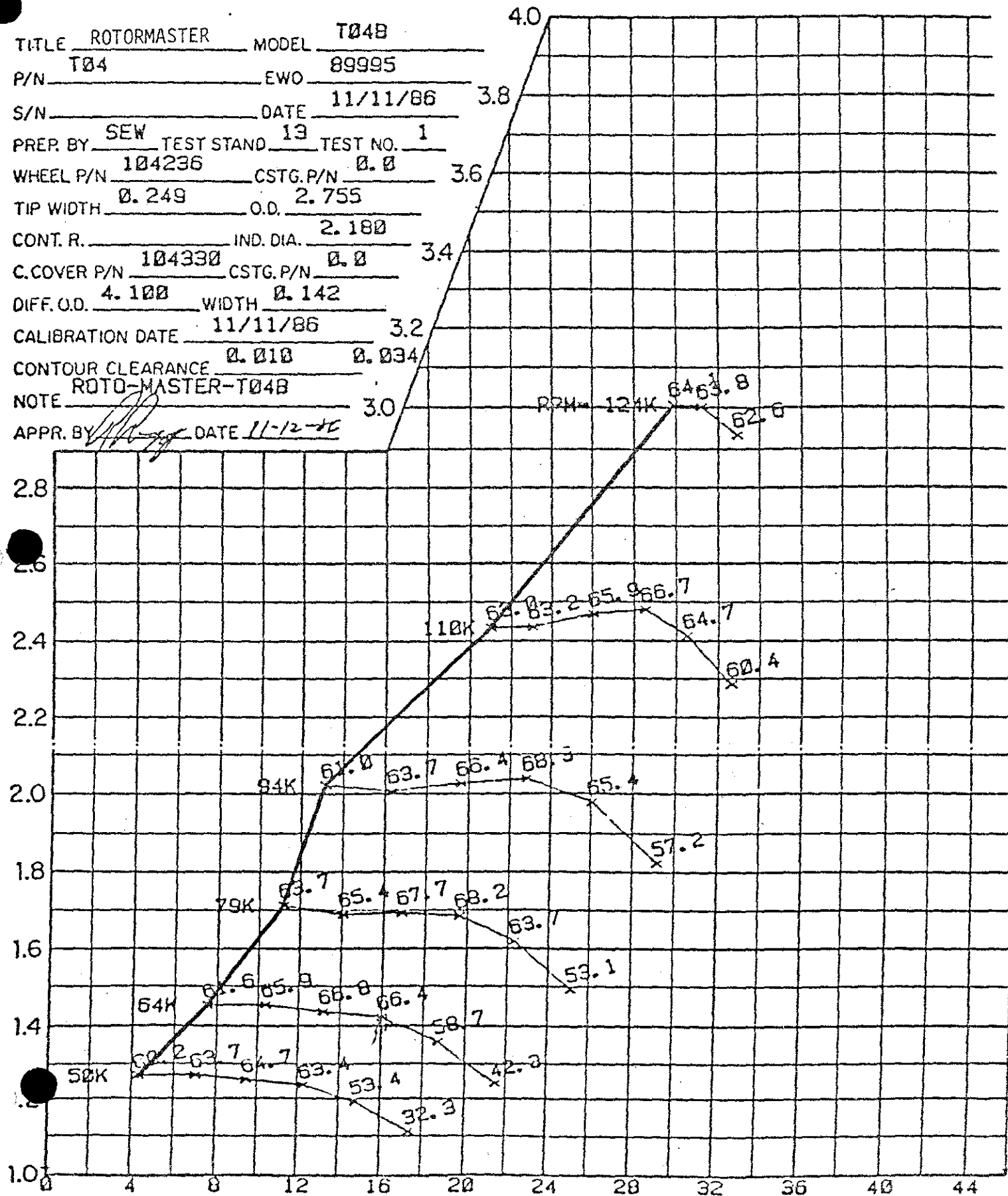
## COMPRESSOR PERFORMANCE MAP

CORRECTION FACTORS  
 $p = 95.70 \text{ kPa}$   
 $t = 302.6 \text{ K (29.4}^\circ\text{C)}$   
 $\theta = T_1 / 302.6 \text{ K}$   
 $\delta = P_1 / 95.7 \text{ kPa}$   
 $\text{RPM} = \text{RPM test} / \sqrt{\theta}$

89995. T1, 2

TITLE ROTORMASTER MODEL T04B  
 P/N T04 EWO 89995  
 S/N \_\_\_\_\_ DATE 11/11/86  
 PREP BY SEW TEST STAND 13 TEST NO. 1  
 WHEEL P/N 104236 CSTG. P/N 0.0  
 TIP WIDTH 0.249 O.D. 2.755  
 CONT. R. \_\_\_\_\_ IND. DIA. 2.180  
 C. COVER P/N 104330 CSTG. P/N 0.0  
 DIFF. O.D. 4.100 WIDTH 0.142  
 CALIBRATION DATE 11/11/86  
 CONTOUR CLEARANCE 0.010 0.034  
 NOTE ROTO-MASTER-T04B  
 APPR. BY [Signature] DATE 11-12-86

COMPRESSION TOTAL PRESSURE RATIO



CORRECTED MASS FLOW  $\frac{\dot{m}}{\sqrt{\theta}} \sqrt{\delta} / 1000$

# Schwitzer

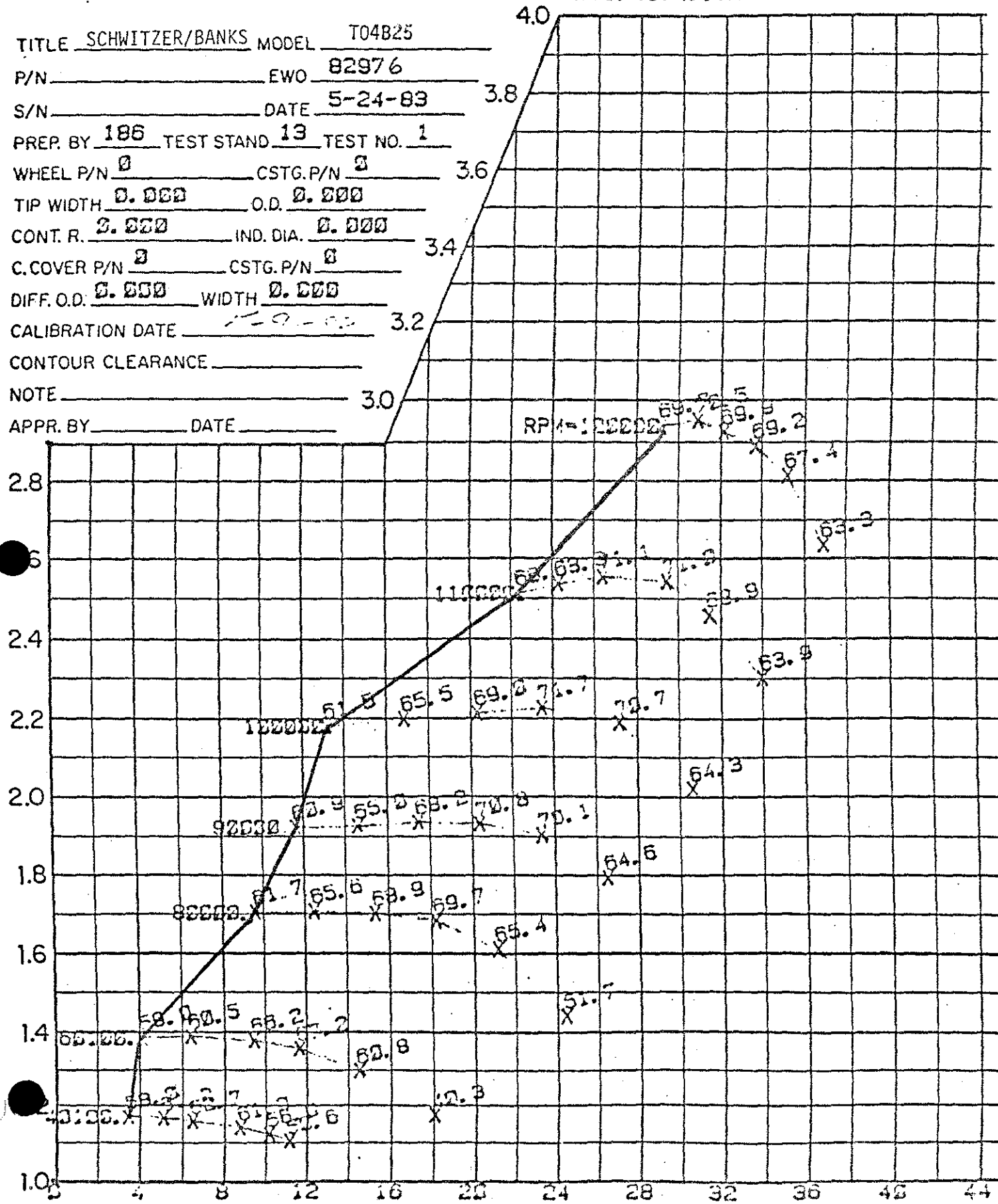
## COMPRESSOR PERFORMANCE MAP

STANDARD CONDITIC  
 $p = 95.70 \text{ kPa}$   
 $t = 302.6 \text{ K (29.4}^\circ\text{C)}$   
 CORRECTION FACTOR  
 $\theta = T_1/302.6 \text{ K}$   
 $\delta = P_1/95.7 \text{ kPa}$   
 $\text{RPM} = \text{RPM test} / \sqrt{\theta}$

DY1: 4174. DAT

TITLE SCHWITZER/BANKS MODEL T04B25  
 P/N \_\_\_\_\_ EWO 82976  
 S/N \_\_\_\_\_ DATE 5-24-83  
 PREP. BY 186 TEST STAND 13 TEST NO. 1  
 WHEEL P/N 0 CSTG. P/N 2  
 TIP WIDTH 0.000 O.D. 0.000  
 CONT. R. 2.000 IND. DIA. 0.000  
 C. COVER P/N 2 CSTG. P/N 8  
 DIFF. O.D. 0.000 WIDTH 0.000  
 CALIBRATION DATE 1-9-82  
 CONTOUR CLEARANCE \_\_\_\_\_  
 NOTE \_\_\_\_\_  
 APPR. BY \_\_\_\_\_ DATE \_\_\_\_\_

COMPRESSOR TOTAL PRESSURE F TIO



CORRECTED MASS FLOW.  $M\sqrt{\theta/\delta}$ .  $\Gamma \text{ kg/s} \times 1007$