State of California
AIR RESOURCES BOARD

EXECUTIVE ORDER D-138
Relating to Exemptions under Section 27156
of the Vehicle Code

OMNI-COOL CORPORATION
"Blizzard 1 Intercooler"

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 Blizzard 1 Intercooler manufactured by Omni-Cool Corporation, Goleta, CA 93117, 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 the device models listed below:

Device Model		Application
i)	87V1000	1981-1983 Volvo GL Turbo
ii)	87D1000	1981-1983 Datsun 280ZX Turbo
iii)	87M1000	1981-1983 SAAB 900 Turbo
iv)	87T1000	1983 Ford Thunderbird 2300 cc. Turbo

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 BLIZZARD 1 INTERCOOLER.

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 31st day of October, 1983.

K. D. Drachand, Chief
Mobile Source Division

State of California
AIR RESOURCES BOARD

EVALUATION OF OMNI-COOL CORPORATION'S BLIZZARD I INTERCOOLER FOR EXEMPTION FROM THE PROHIBITIONS OF VEHICLE CODE SECTION 27156 IN ACCORDANCE WITH SECTION 2222, TITLE 13, OF THE CALIFORNIA ADMINISTRATIVE CODE

September, 1983

State of California
AIR RESOURCES BOARD

Evaluation of Omni-Cool Corporation's Blizzard I Intercooler for Exemption from the Prohibitions of 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
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

Omni-Cool Corporation has requested exemption from the prohibitions of Vehicle Code Sectin 27156 for their Blizzard 1 Intercooler. This device is intended to be used with limited OEM turbocharger equipped vehicles. The device is designed to cool the air charge from the compressor of the turbocharger by use of an air-to-air heat exchanger.

The Blizzard 1 Intercooler is designed only to be used with turbocharger systems which compress air and not those which compress air and fuel.

An engineering evaluation determined that a vehicle's exhaust emissions would not be adversely affected with the device's use.

Since the use of the device does not cause any adverse emissions impact, the staff recommends that the exemption be granted for the vehicles as requested and that Executive Order D-138 be issued.

CONTENTS

		Page No.
SUMMARY		i
CONTENTS		ii
I.	INTRODUCTION	1
II.	CONCLUSIONS	1
III.	RECOMMENDATION	2
IV.	DEVICE DESCRIPTION	2
V.	DISCUSSION	3
VI.	Appendices	5
	DRAWING 1	
	Figure 1	6
	Figure 2	7
	Figure 3	8
	Figure 4	9

Evaluation of Omni-Cool Corporation's Blizzard I Intercooler for Exemption from the Prohibitions of Vehicle Code Section 27156 in Accordance with Section 2222, Title 13, of the California Administrative Code

I. INTRODUCTION

Omni-Cool Corporation, Goleta, CA 93117, has requested that an add-on device known as the "Blizzard I Intercooler" be exempted from the prohibitions of Vehicle Code Section 27156. The Blizzard I Intercooler is designed to cool the intake air on vehicles originally equipped with a factory installed turbocharger. This is accomplished by an air-to-air heat exchanger which is plumbed into the air intake system between the air cleaner and throttle(s).

The company has designed intercooler kits designated by model numbers for the following vehicles:

Device Model	Application
i) 87V1000	1981-1983 Volvo GL Turbo
ii) 87D1000	1981-1983 Datsun 280ZX Turbo
iii) 87M1000	1981-1983 SAAB 900 Turbo
iv) 87T1000	1983 Ford Thunderbird 2300cc. Turbo

This report describes the evaluation of the Blizzard I Intercoolers and discusses the findings.

II. CONCLUSIONS

Based on the predicted efficiency of the heat exchanger, on air temperature measurements of two representative devices installed and tested on two vehicles, and on a review of the device theory of

operation, the staff has concluded that the use of an intercooler, especially like the ones manufactured by Omni-Cool Corporation, would not adversely affect vehicle emissions or result in the degrading of a vehicle's driveability. Additionally, since the device is installed between the vehicle's air cleaner and the throttle(s) (fuel injection/carburetion), none of the "hang on" emission controlling components are disturbed with its use.

III. RECOMMENDATION

Based on the no adverse emissions effects the staff recommends that Omni-Cool Corporation be granted exemption from the prohibitions of Vehicle Code Section 27156 for the vehicles as requested and that Executive Order D-138 be issued.

IV. DEVICE DESCRIPTION

The Blizzard I Intercooler kit consists of a standard sized 63.6 cubic inch air-to-air heat exchanger and 2.250 inch O.D. interconnecting tubing. The inlet and outlet on the upper and lower plenum chambers of the heat exchanger can be arranged at the factory to allow for either "U" or "Z" flow-through design depending upon ease of installation. A typical "U" flow-through design intercooler is found in Drawing 1. The interconnecting tubing varies in length and bends depending upon the vehicle application. The most severe bend used in any of the kits is 90° with a 3 inch radius (on center line). All bends are made with a mandrel type bender to lessen shrinkage which would result in increased flow restriction. Connectors and fasteners are of a silicone type which can withstand high temperatures.

The heat exchanger is normally mounted in the fresh air stream located near the front of the vehicle. Inlet tubing ducts hot compressed air (150-280°F) from the turbocharger compressor to the heat exchanger inlet where, as it passes through baffles within, the hot compressed air transfers its heat to the fresh (ram) air causing the compressed air temperature to drop (50 to 150°F). The cooled compressed air is then passed out of the heat exchanger to the throttle(s) for induction into the engine.

The Omni-Cool intercoolers are not designed to be used with "suck through" turbocharger systems, i.e. ones which compress the air/fuel mixture since the heat exchanger may cause the fuel to condense and remain within it. The Omni-Cool systems are designed only to be used with "blow through" turbocharger systems, i.e., ones which compress the inlet air only.

V. DISCUSSION

A turbocharger increases the engine's volumetric efficiency since the air charge to the cylinders is at a pressure 1-2 times greater than atmospheric (referred to as "boost" pressure).

Since a compresssor increases the pressure and therefore the density of the air charge, the air temperature is also increased. An increase in air temperature will result in higher cylinder temperature and enhance the formation of NOx emissions.

The efficiency of an intercooler is dependent upon (1) the degree of reduction in air charge temperature and (2) the flow resistance (pressure drop) created by the exchanger and its ducting.

A performance analysis was conducted for the applicant by Alpha United, Inc. in El Segundo, CA, using the known design parameters of the Blizzard 1 Intercooler. It was found that the predicted mean thermal efficiency of the air-to-air intercooler ranged from 84% high to 40% low depending upon the air flow rates (Figure 1). The intercooler efficiency (hot side) is defined as T (compressed air in) - T (compressed air out)/T (compressed air in) - T (fresh air in). The calculated pressure drop was found to be 1.5 p.s.i. @ 37 #/min air flow (Figure 2). The applicant also performed an evaluation on two vehicles (1983 Ford and 1982 SAAB) equipped with Blizzard 1 Intercoolers. Figures 3 and 4 show these test results, however, the pressure drop was not recorded. Their results revealed a thermal efficiency of 70-80% at vehicle speeds of 40-55 MPH. The applicant also performed comparative loaded mode testing by Hamilton Test Systems but the tests and results were inconclusive.

Original equipment manufacturers have realized the worth of intercoolers and four 1984 models are now equipped with them. It has been found that an intercooler will increase horsepower due to increased air density and that detonation is suppressed.

The operation and effectiveness of emission control components/sensors are not expected to be adversely affected by lower cylinder inlet air temperatures (approximately 150°F) and the corresponding increases in air charge. In particular, the effect of the intercooler on temperature sensitive emission control components, such as catalytic converter and oxygen sensor, will be minimal. This is mainly due to the counter-balancing factors of lower temperature but increased density of the inlet air for the engines.

It should be noted however that the performance of a vehicle under wide open throttle (WOT) may be somewhat affected due to: a) reduced manifold pressure as a result of a flow restriction; and b) reduced turbocharger's turbine speed by the reduction in cylinder/exhaust temperature. These factors are partially negated by the increase in air charge which promotes engine performance (increase in engine horsepower).

Drawing 1

Typical Installation
of a 'U' Type Intercooler

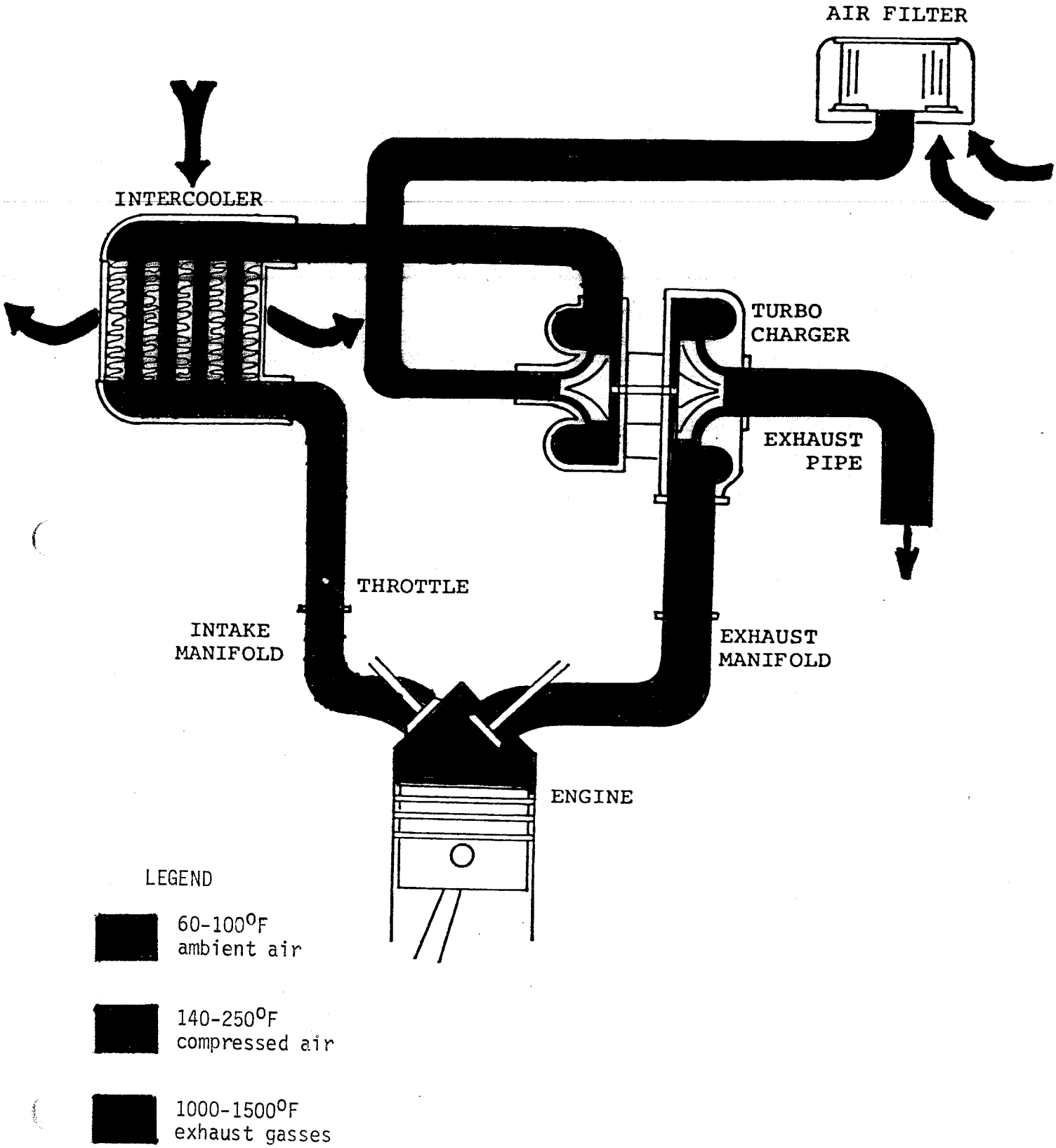


FIGURE 1

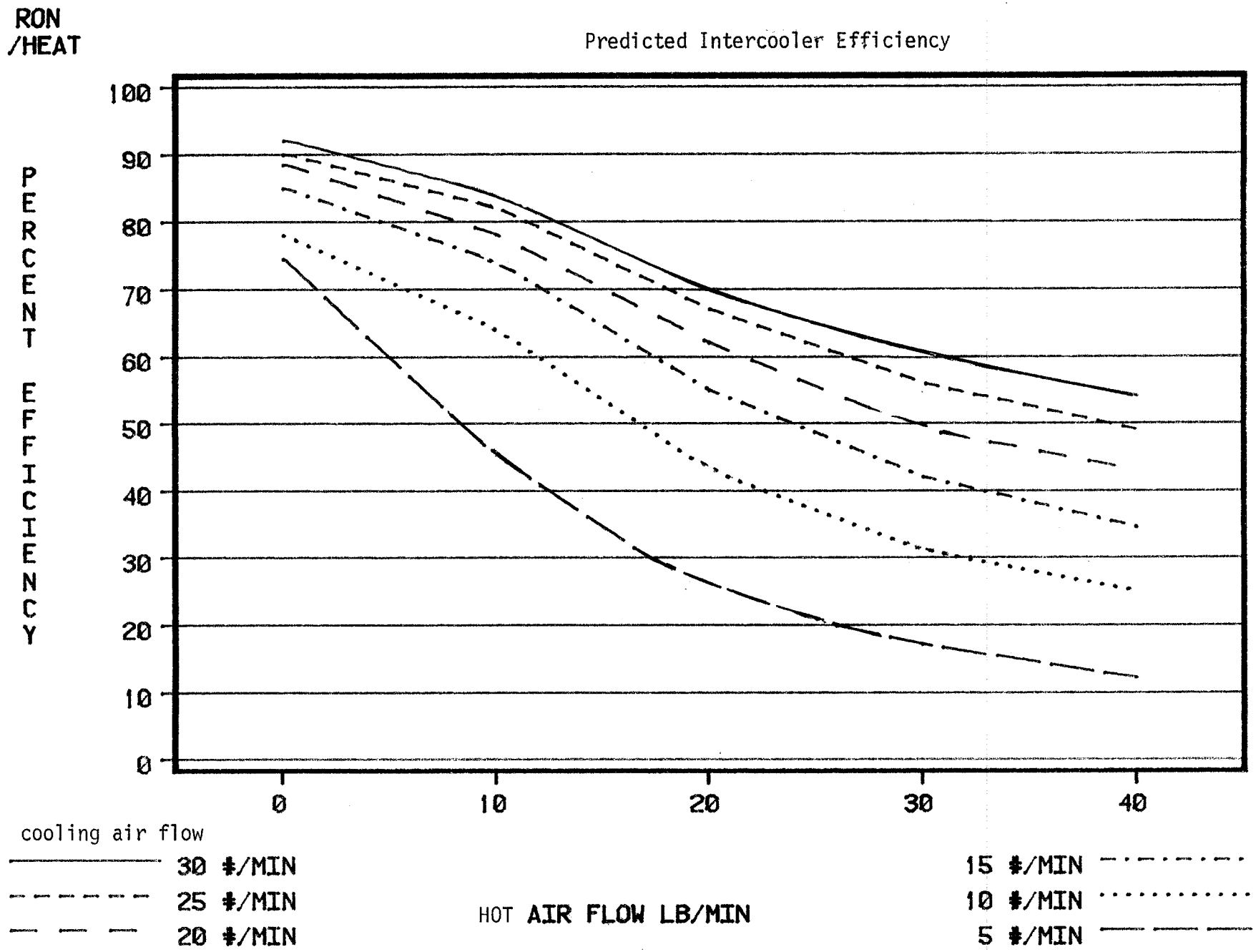
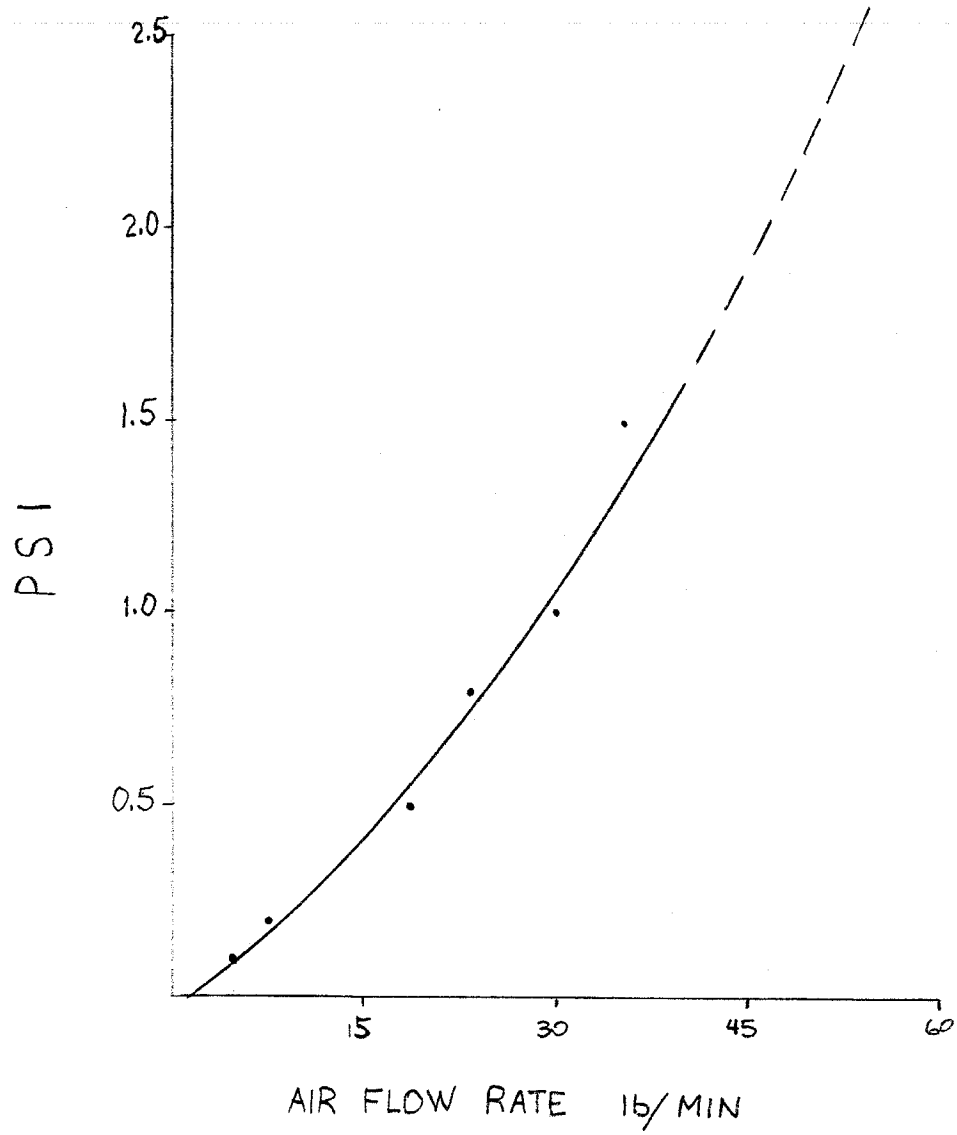

RON
/HEAT
Predicted Intercooler Efficiency
PERCENT EFFICIENCY
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
cooling air flow
30 #/MIN
25 #/MIN
20 #/MIN
HOT AIR FLOW LB/MIN
15 #/MIN
10 #/MIN
5 #/MIN

FIGURE 2

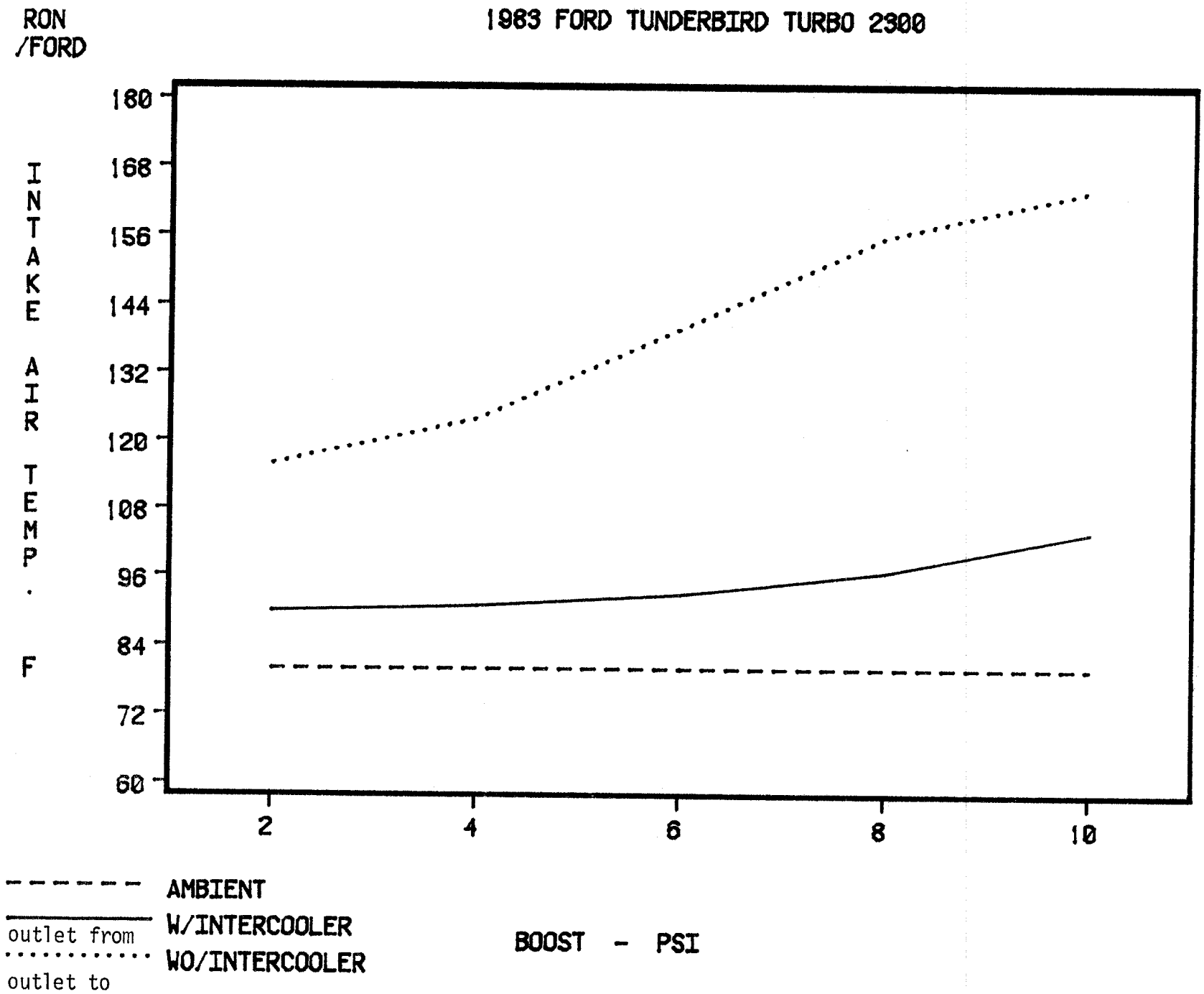
Predicted Pressure Drop
of Blizzard 1 Intercooler



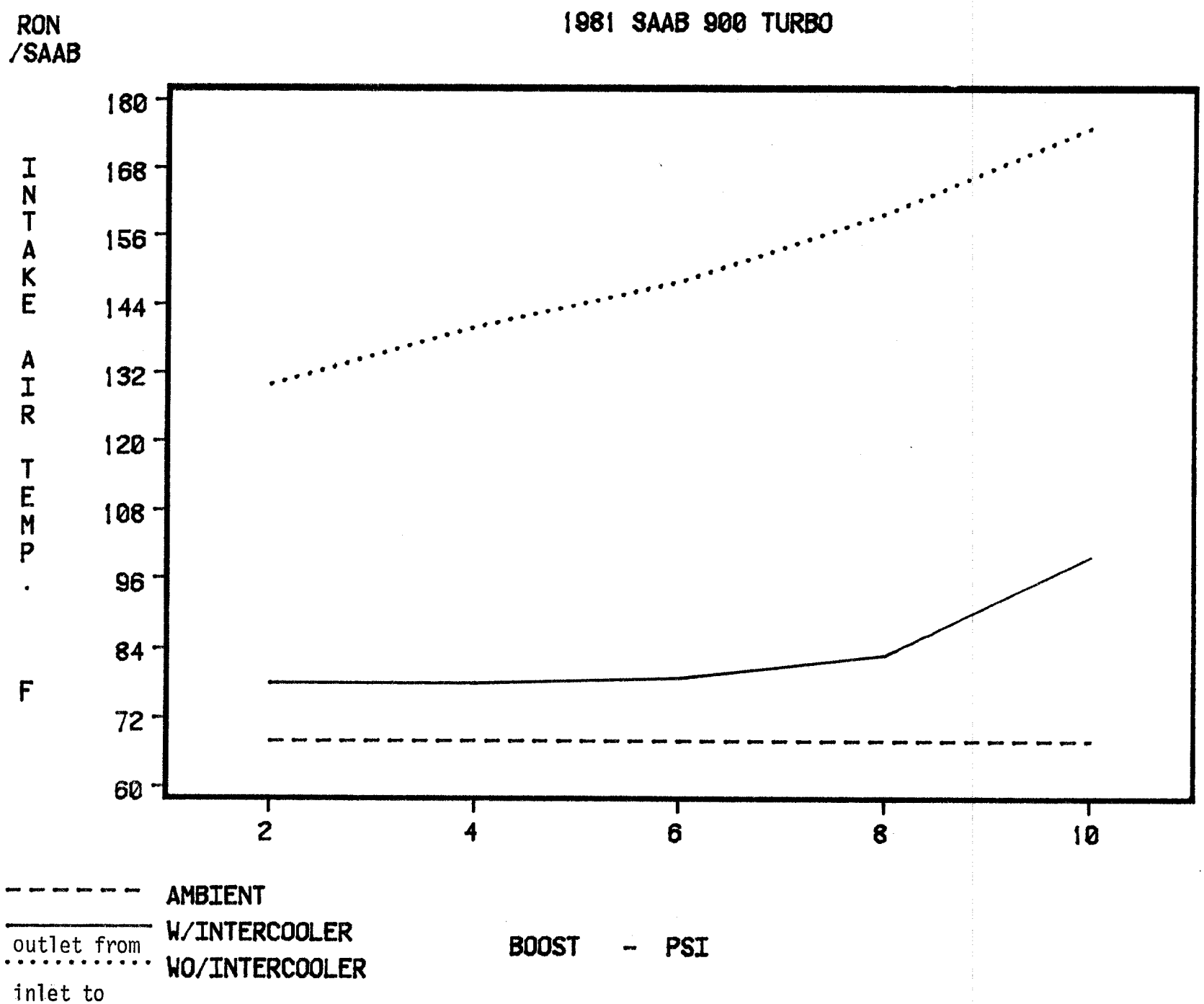
Predicted At:

Inlet Air Temp. 280°F
Inlet Air Pressure 28.7 psia

FIGURE 3


RON
/FORD
1983 FORD TUNDERBIRD TURBO 2300
INTAKE AIR TEMP. F
180
168
156
144
132
120
108
96
84
72
60
2
4
6
8
10
AMBIENT
W/INTERCOOLER
outlet from
WO/INTERCOOLER
outlet to
BOOST - PSI

igure 4


1981 SAAB 900 TURBO
RON
/SAAB
INTAKE AIR TEMP. F
180
168
156
144
132
120
108
96
84
72
60
2
4
6
8
10
AMBIENT
W/INTERCOOLER
WO/INTERCOOLER
outlet from
inlet to
BOOST - PSI