Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AEROSPACE INFORMATION REPORT

AIR 944 A

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PNEUMATIC GROUND POWER SUPPLIES FOR STARTING AIRCRAFT

1. PURPOSE

This report provides descriptive information and performance data of the pneumatic ground power supplies available for starting aircraft engines. The material is intended for general use by the aircraft and airline industries to assist in the selection and utilization of pneumatic power supplies.

2. SCOPE

The material contained in this report has been simplified to facilitate its use. Specific manufacturers should be contacted for more detailed information. Many of the basic power supplies are available in numerous configurations and some provide shaft power or electrical power in addition to the pneumatic capability. Vehicles for the ground transportation of the power supplies are also varied to fit specific requirements. The state-of-the-art in small gas turbines has advanced to a point where they are competitive with the more conventional ground power supplies in practically all areas.

3. MANUFACTURERS

The manufacturers listed in this report are included for reference but do not necessarily represent all sources in this field.

4. CLASSIFICATION OF POWER SUPPLIES

4.1 Power Limited: This type of power supply is a true prime mover and can furnish pneumatic power continuously for unlimited periods of time. They are used to provide low-pressure (40 - 70 psia) to the air turbine starters. Several basic configurations are in use. The majority are either gas turbine bleed, gas turbine-driven compressor, or reciprocating engine-driven compressor.

4.2 Capacity Limited: On units of this type either air compressed and stored at high pressure, or liquid nitrogen stored in cryogenic tanks, is expanded to perform the aircraft starting function or to recharge pneumatic storage tanks on board the aircraft. This type of power supply may or may not contain a prime mover, depending on the vehicle configuration. These units are used to support the low-pressure (40 - 70 psia) pneumatic turbine starters, for impingement starting and the high-pressure fuel air combustion starting systems. In the pneumatic turbine starter system, air or nitrogen is expanded, and applied directly through control valves to the starter. In the combustion starter system, the high-pressure air is transferred from the ground power unit to the airborne storage system at the high pressure where it is expanded, reheated and applied to the starter.

5. DISCUSSION

The power supply unit characteristics drastically affect the engine starts obtained with the system. Uncontrolled pressure variations or pulsations can cause severe mechanical problems in the airborne equipment. The pneumatic temperature and pressure maintained during the starter operation determine the torque output and the shape of the starter torque curve as the engine acceleration takes place. Matching of the motor to the pneumatic source is necessary in many cases to ensure acceptable performance from the starting system. A detailed analysis of the pneumatic starter flow and pressure requirements, as installed engine starting requirements and limitations, of pressure and temperature drop through the pneumatic ducting, potential duct and pneumatic valve leakages, as well as variations in support equipment performance with ambient pressure and temperature, must be completed before an accurate prediction of the actual starting performance can be made. Studies of this type can readily be completed by the various starter manufacturers. It is suggested that problem statements be forwarded to them when the need arises.

6. DETAILED DATA

This report contains generalized information on a cross section of available pneumatic power supplies. Performance data given are exclusive of hose losses.

7. SUGGESTED USE

The data contained herein have been verified by individual manufacturers, where possible, and are believed to be accurate insofar as they are represented. The individual manufacturers should be contacted to obtain further data.

8. NOTES

8.1 Marginal Indicia: The phi (Ø) symbol is used to indicate technical changes from the previous issue of this report.

PREPARED BY
SAE COMMITTEE AE-6, STARTING SYSTEMS

ø INDEX OF EQUIPMENT

A. POWER-LIMITED EQUIPMENT

B. CAPACITY LIMITED EQUIPMENT

C. MILITARY POWER SUPPLY UNITS

PNEUMATIC STARTER AIR SUPPLY
(Power Limited)

MANUFACTUER: AiResearch Manufacturing Co.

MODEL NUMBER: GTCP-30 Series

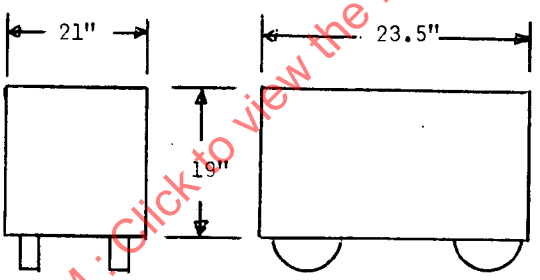
Description

a) Type of Compressor: Single-stage radial outflow

b) Type of Prime Mover: Single-stage radial inflow gas turbine

c) Type of Fuel: MIL-J-5624, Grades JP-4 and JP-5, MIL-G-5572, D1655B

d) Package Dimensions and Type: Aircraft, automotive, etc.



e) Delivery Hose; Type, Length: _____

Rated Output at Compressor Delivery Connection

a) guaranteed performance — 60° F, Sea Level Day

	With zero shaft HP	With 20 shaft HP
Pressure, psig	23.3	26
Air Flow, lb/min	28.5	22
Air Temperature, °F	385	385
Zero Bleed Shaft HP	40	

MANUFACTURER: AIRESEARCH MODEL: GTCP-30

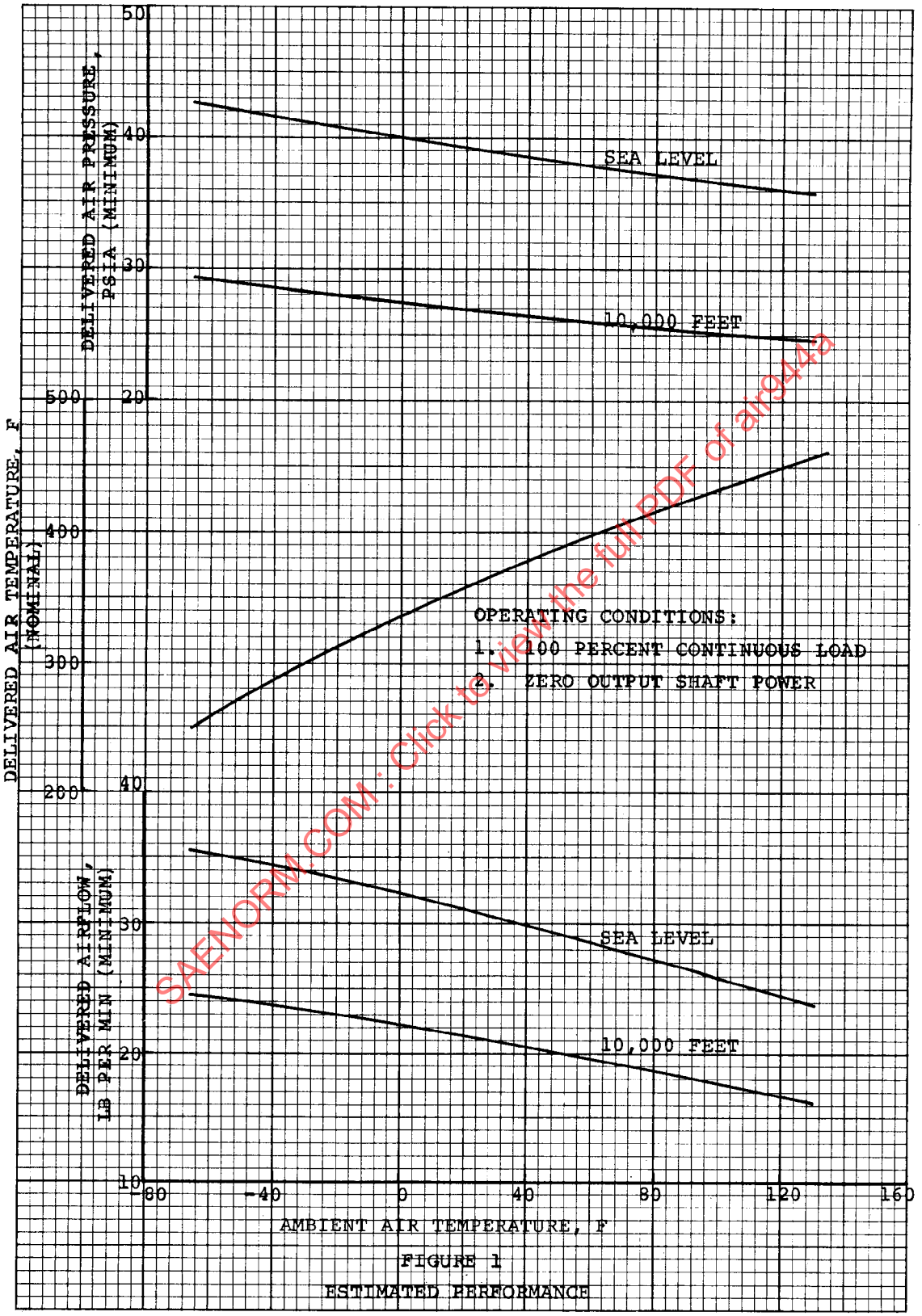


FIGURE 1
ESTIMATED PERFORMANCE

MANUFACTURER: AIRESEARCH MODEL: GTCP-30

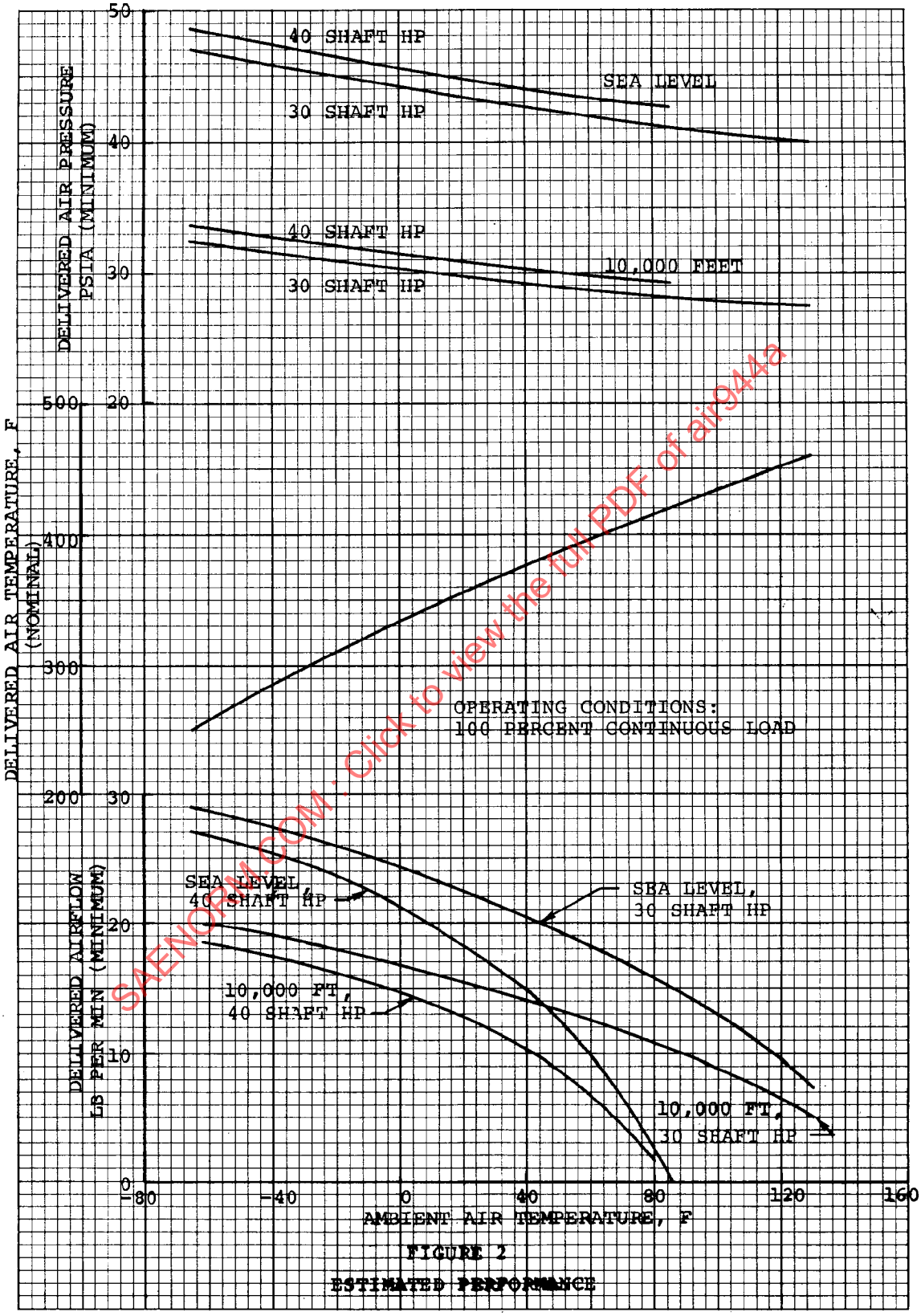


FIGURE 2

ESTIMATED PERFORMANCE

PNEUMATIC STARTER AIR SUPPLY
(Power Limited)

MANUFACTURER: AiResearch Manufacturing Co.

MODEL NUMBER: GTCP-36 Series

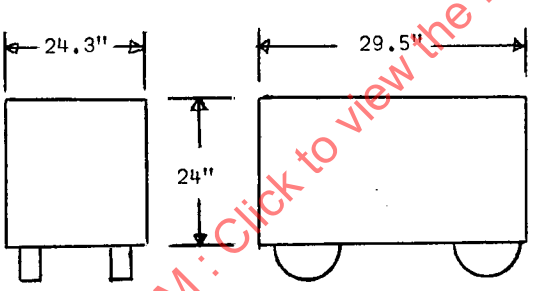
Description

a) Type of Compressor — Single-stage radial outflow 4:1 press ratio

b) Type of Prime Mover — Single-stage radial inflow gas turbine

c) Type of Fuel — MIL-J-5624, JP-4 and JP-5, MIL-G-5572, D1655 A, B, A-1

d) Package Dimensions and Type — APU



e) Delivery Hose; Type, Length

Rated Output at Compressor Delivery Connection

a) guaranteed performance — 60° F, Sea Level Day

With 10 shaft HP

Pressure, psig	29.7
Air Flow, lb/min	60
Air Temperature, °F	390

MANUFACTURER: AIRESEARCH MODEL: GTCP-36

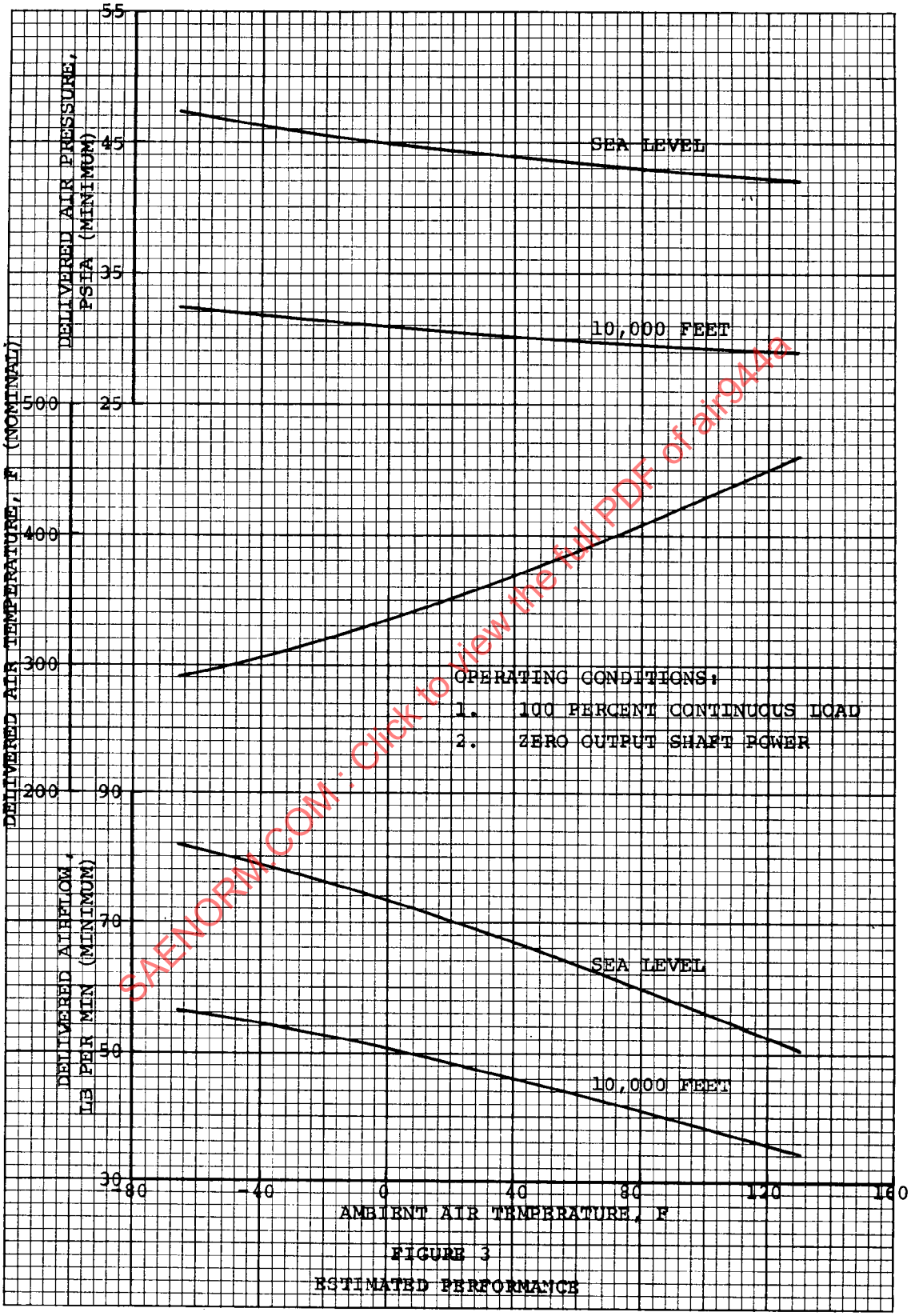


FIGURE 3
ESTIMATED PERFORMANCE

PNEUMATIC STARTER AIR SUPPLY

MANUFACTURER: AiResearch Manufacturing Company

Ø MODEL NUMBER: GTC85-90

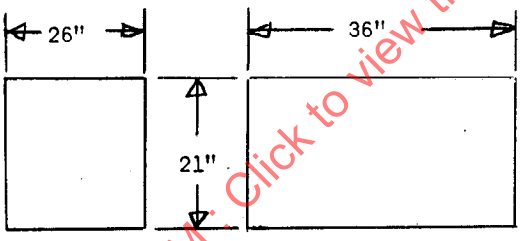
Description:

(a) Type of Compressor: Two-stage radial outflow

(b) Type of Prime Mover: Single-stage radial inflow gas turbine

(c) Type of Fuel: MIL-J-5624, Grades JP-3, JP-4, and JP-5, MIL-G-5572, Shell 640 (Kerosene)

(d) Engine Dimensions and Type: Truck, Trailer, Jeep, and Aircraft



(e) Delivery Hose; Type, Length: _____

Rated Output at Compressor Delivery Connection

(a) guaranteed performance: 60°F, Sea Level Day

Pressure, psig: 34.4

Airflow, lb/min: 120.0

Air Temperature, °F: 360

MANUFACTURER: AIRESEARCH MODEL: GTC85-90

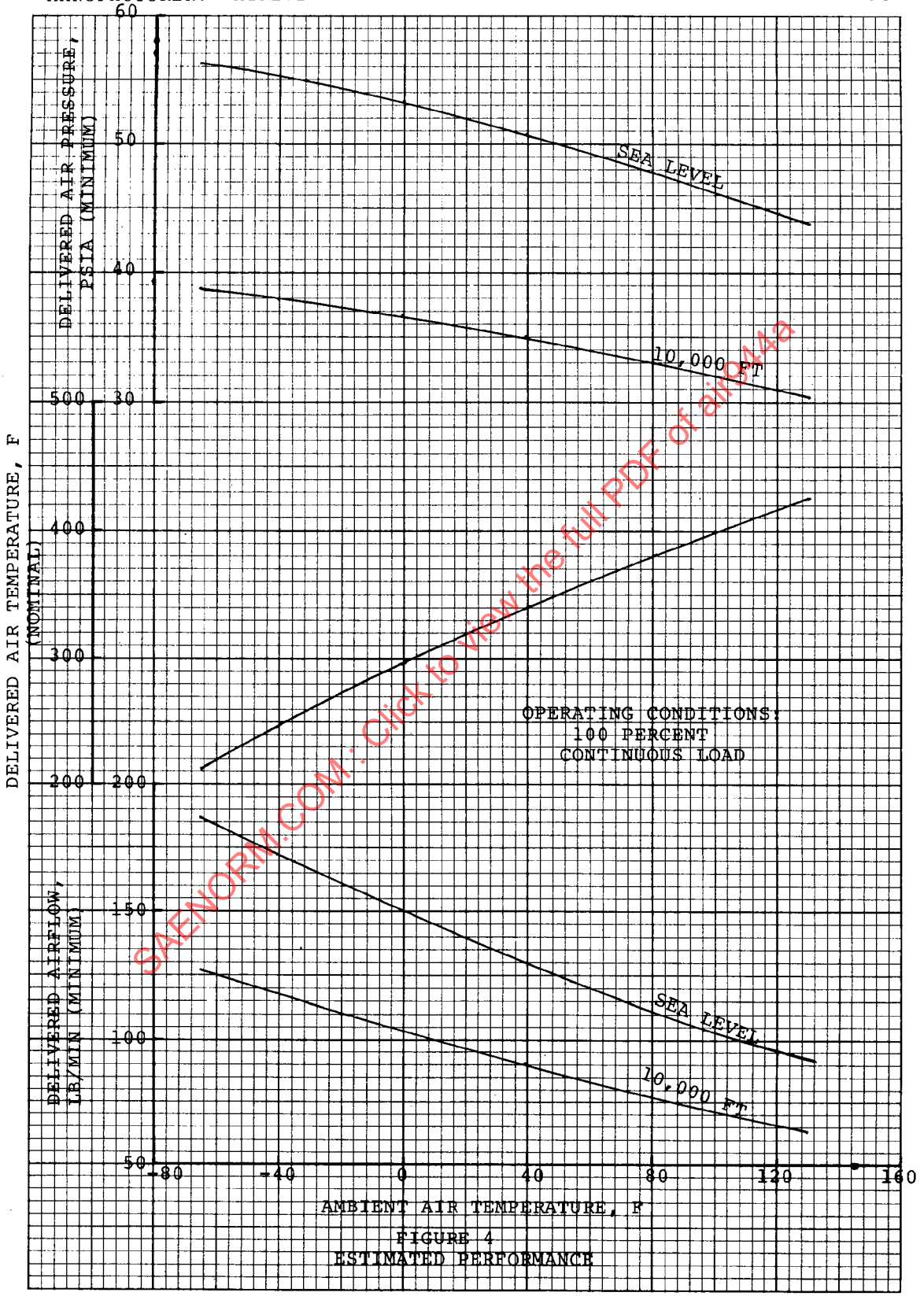


FIGURE 4
ESTIMATED PERFORMANCE

PNEUMATIC STARTER AIR SUPPLY

MANUFACTURER: AiResearch Manufacturing Company

MODEL NUMBER: GTC85-90B

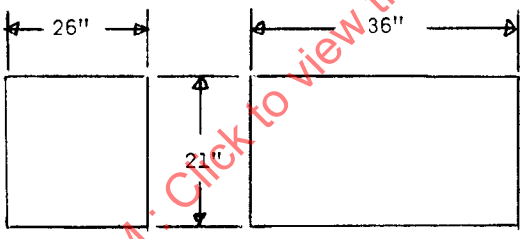
Description:

(a) Type of Compressor: Two-stage radial outflow

(b) Type of Prime Mover: Single-stage radial inflow gas turbine

(c) Type of Fuel: MIL-J-5624, Grades JP-3, JP-4, and JP-5, MIL-G-5572, Shell 640 (Kerosene)

(d) Engine Dimensions and Type: Truck, Trailer, Jeep, and Aircraft



(e) Delivery Hose; Type, Length

Rated Output at Compressor Delivery Connection

(a) guaranteed performance: 60° F, Sea Level Day

Pressure, psig: 37.2

Airflow, lb/min: 122.0

Air Temperature, °F: 400

MANUFACTURER: AIRESEARCH MODEL: GTC85-90B

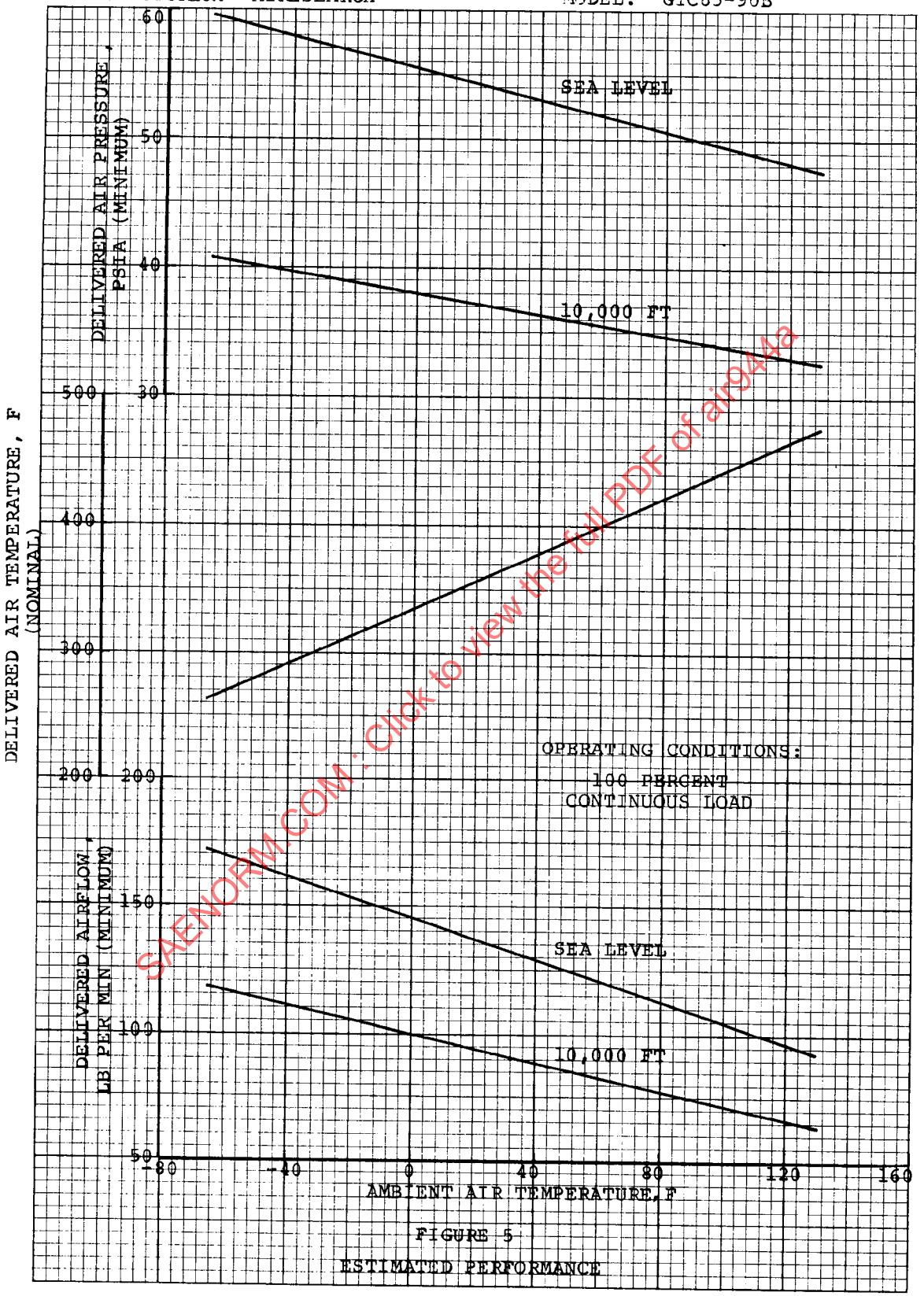


FIGURE 5
ESTIMATED PERFORMANCE

PNEUMATIC STARTER AIR SUPPLY

MANUFACTURER: AiResearch Manufacturing Company

Ø MODEL NUMBER: GTCP85-184

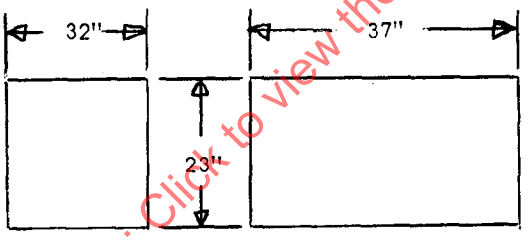
Description:

(a) Type of Compressor: Two-stage radial outflow

(b) Type of Prime Mover: Single-stage radial inflow gas turbine

(c) Type of Fuel: MIL-J-5624, Grades JP-3, JP-4, and JP-5, MIL-G-5572, Shell 640 (Kerosene)

(d) Engine Dimensions and Type: Truck, Trailer, Jeep and Aircraft



(e) Delivery Hose; Type, Length: _____

Rated Output at Compressor Delivery Connection

(a) guaranteed performance: 60° F, Sea Level Day (Zero shaft horsepower)

Pressure, psig	36.4
Airflow, lb/min	155.0
Air Temperature, °F	400

(b) Performance: 60° F, Sea Level Day (150 shaft horsepower)

Pressure, psig	43.2
Airflow, lb/min	109.0
Air Temperature, °F	418

MANUFACTURER: AIRESEARCH MODEL GTCP85-184

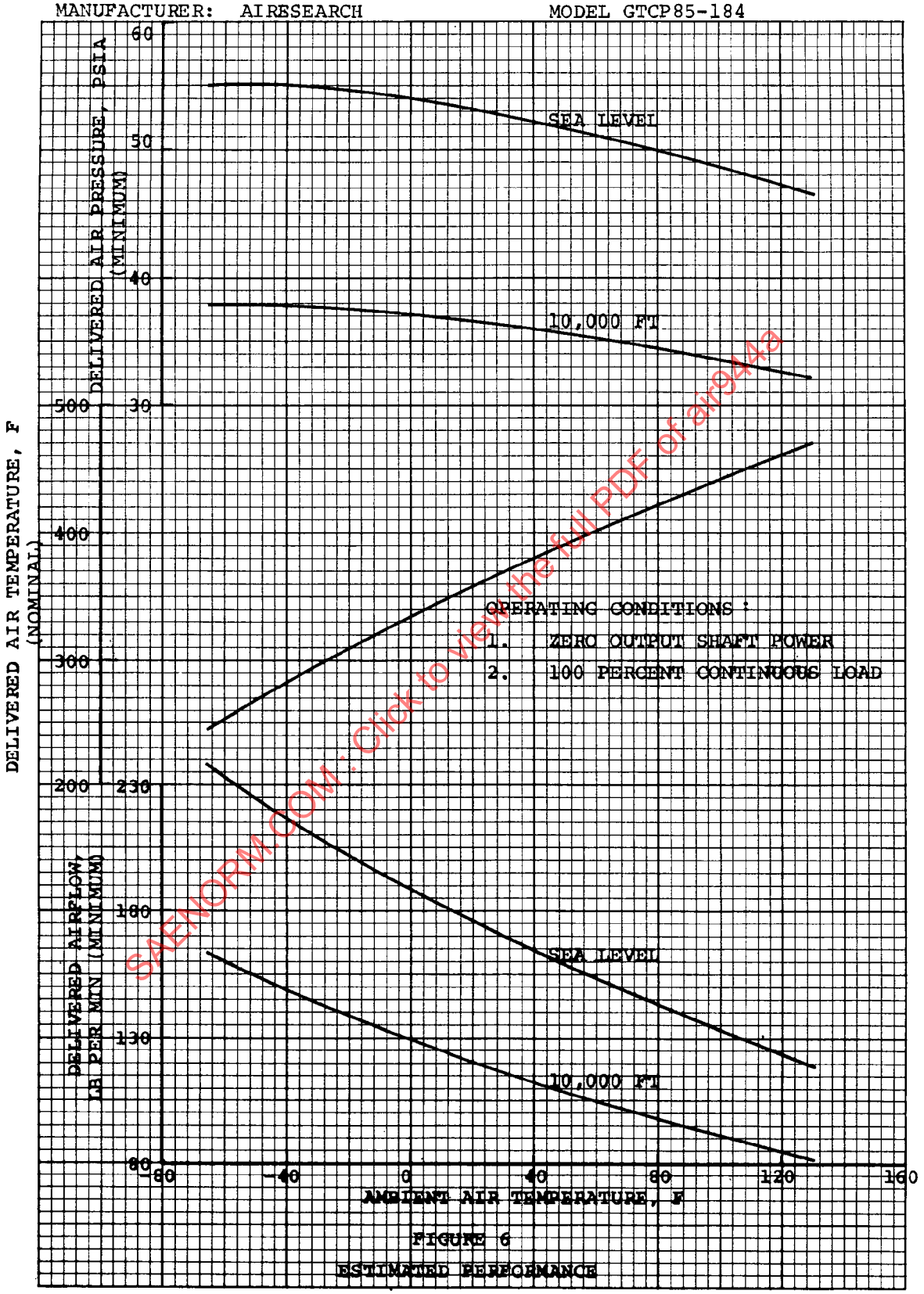


FIGURE 6

ESTIMATED PERFORMANCE

MANUFACTURER: AIRESEARCH

MODEL GTCP85-184

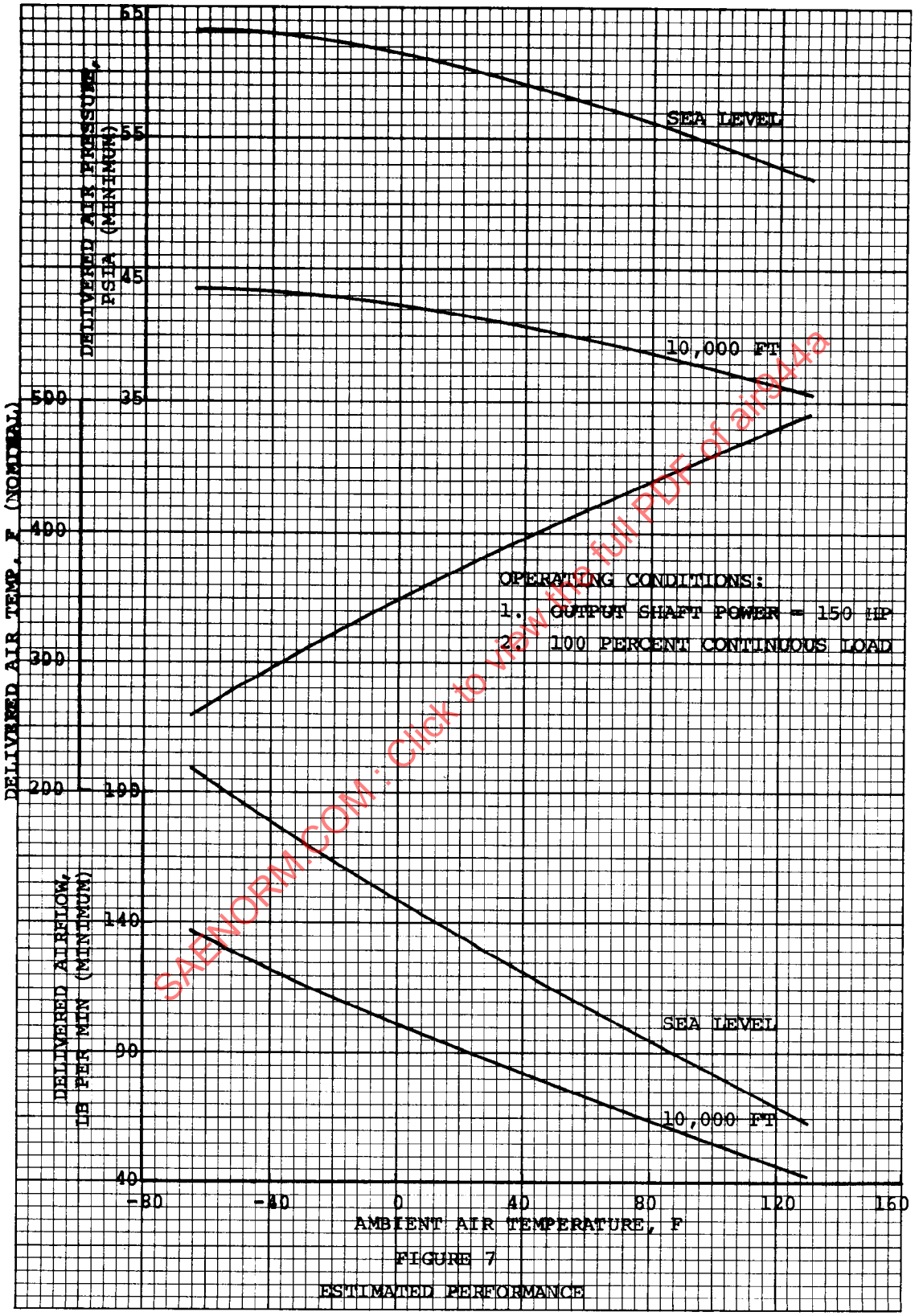


FIGURE 7

ESTIMATED PERFORMANCE

PNEUMATIC STARTER AIR SUPPLY

MANUFACTURER: AiResearch Manufacturing Company

Ø MODEL NUMBER: GTCP100-54

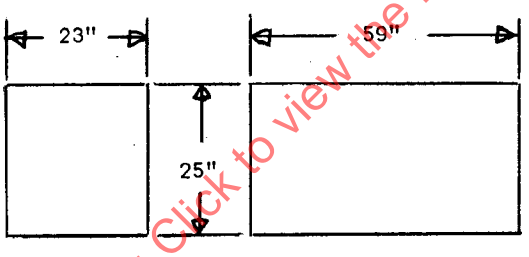
Description:

(a) Type of Compressor: Two-stage radial outflow

(b) Type of Prime Mover: Two-stage radial/axial gas turbine

(c) Type of Fuel: MIL-J-5624, Grades JP-3, JP-4 and JP-5, MIL-G-5572

(d) Engine Dimensions and Type: Truck, Trailer, Ship Pod, Stationary



(e) Delivery Hose; Type, Length

Rated Output at Compressor Delivery Connection

(a) guaranteed performance: 60° F, Sea Level Day

Pressure, psig	60.3
Airflow, lb/min	203
Air Temperature, °F	515

MANUFACTURER: AIRESEARCH MODEL: GTCP100-54

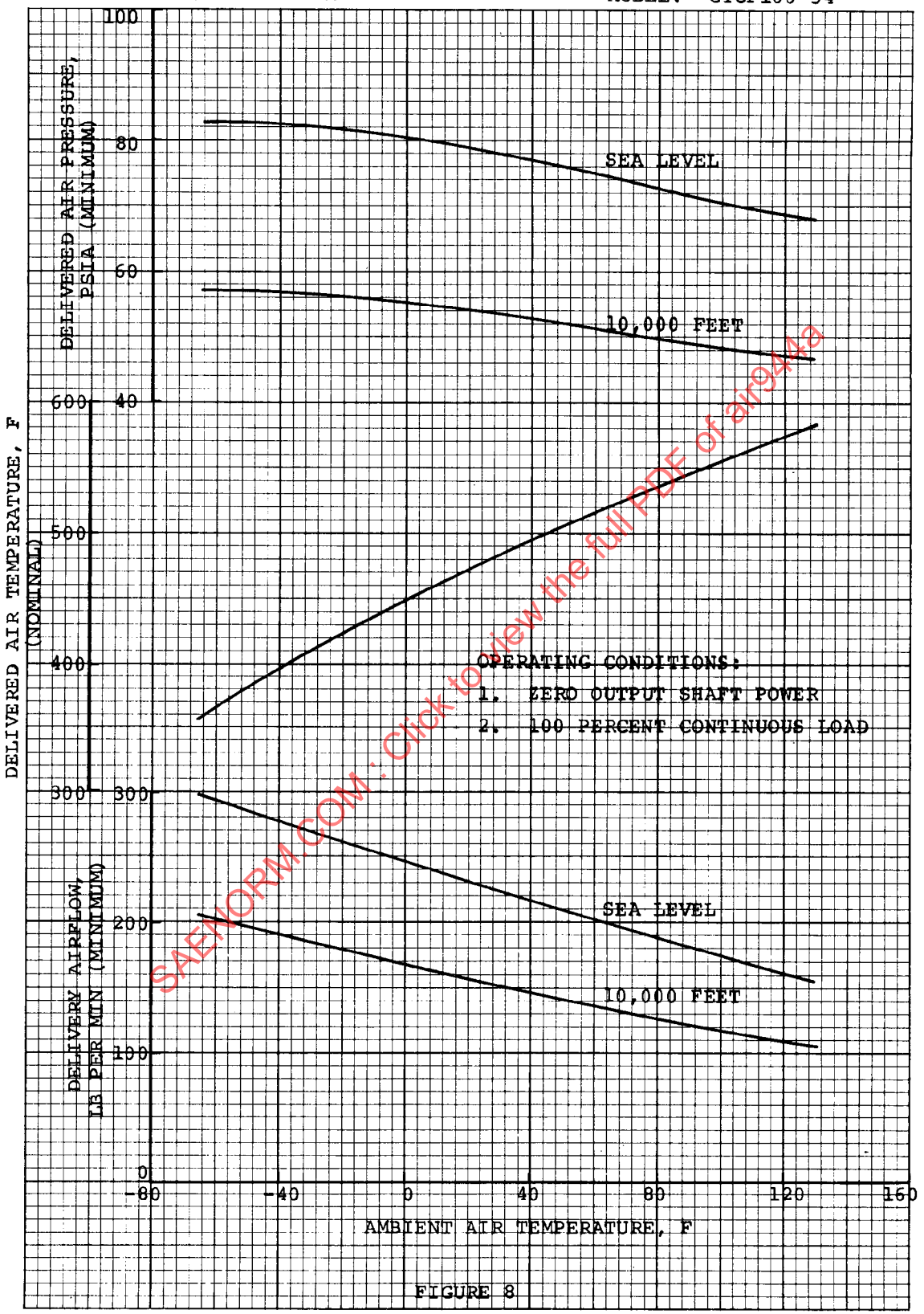


FIGURE 8

ESTIMATED PERFORMANCE

PNEUMATIC STARTER AIR SUPPLY
(Power Limited)

MANUFACTURER: AiResearch Manufacturing Co.

MODEL NUMBER: GTCP-105 Series

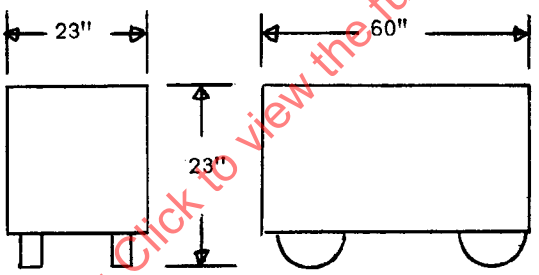
Description

a) Type of Compressor: Two-stage radial outflow

b) Type of Prime Mover: Two-stage gas turbine

c) Type of Fuel: MIL-J-5624, Grades JP-3, JP-4, and JP-5, MIL-G-5572

d) Package Dimensions and Type: Truck, trailer, ship pod, stationary



e) Delivery Hose; Type, Length: _____

Rated Output at Compressor Delivery Connection

a) guaranteed performance — 60° F, Sea Level Day

	With zero shaft HP		With 55 shaft HP
Pressure, psig	62	38	65
Air Flow, lb/min	210	123	188
Air Temperature, ° F	515	365	521
Pressure Ratio	5.0	3.6	

MANUFACTURER: AIRESEARCH MODEL: GTCP105 SERIES

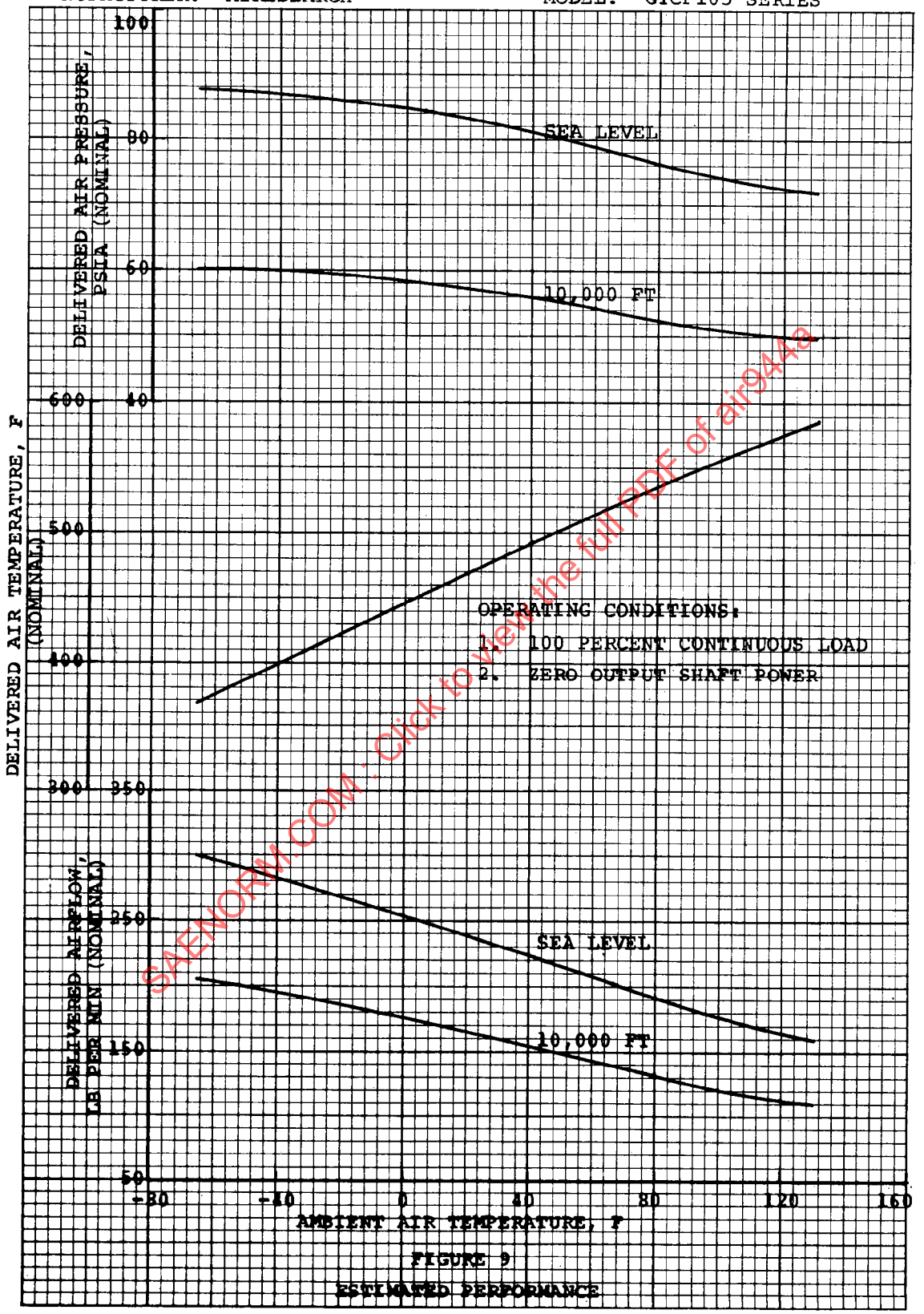


FIGURE 9
ESTIMATED PERFORMANCE

MANUFACTURER: AIRESEARCH MODEL GTCP105 SERIES

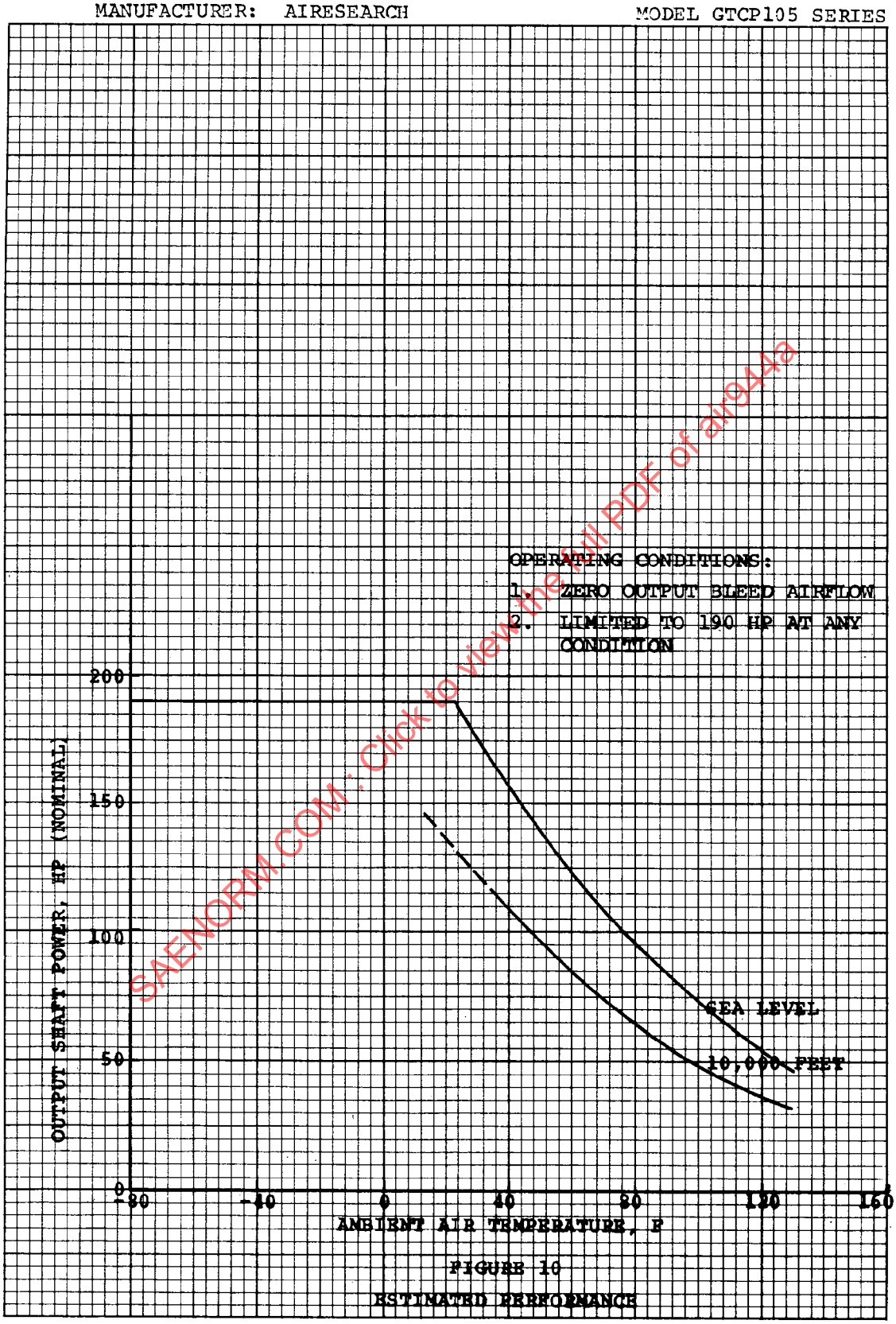


FIGURE 10
ESTIMATED PERFORMANCE

PNEUMATIC STARTER AIR SUPPLY
(Power Limited)

Ø MANUFACTURER: Steward, Davis Inc.

MODEL NUMBER: 502-12B Trailer-Mounted Installation

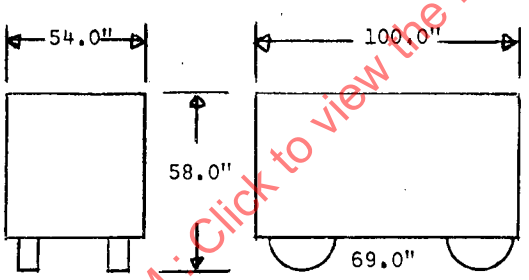
Description Gas Turbine-Driven Air Compressor--Split Shaft Turbine

a) Type of Compressor: Single-stage centrifugal

b) Type of Prime Mover: Gas turbine

c) Type of Fuel: Multifuel--kerosene, JP fuels, diesel

d) Package Dimensions and Type



e) Delivery Hose; Type, Length: 3.5" I.D. dacron and glass reinforced W/#7223 silicone tube with outer rubber scuff jacket - operating temperature range from -65° F to +600° F - available in 20- or 30-foot lengths.

Rated Output at Compressor Delivery Connection

a) guaranteed performance: 60° F, Sea Level Day

Pressure, psig: 37.3

Air Flow, lb/min: 118

Air Temperature, °F: 420° F

PNEUMATIC STARTER AIR SUPPLY
(Power Limited)

ø MANUFACTURER: Steward, Davis Inc.

MODEL NUMBER: 502-12B Turbo Starter (Econoline Van)

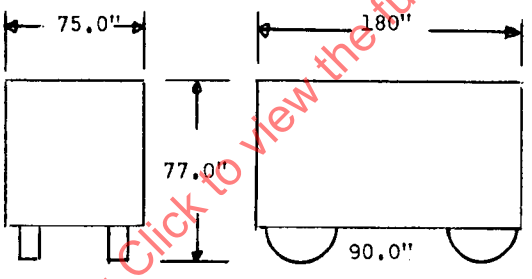
Description Gas Turbine-Driven Air Compressor--Split Shaft Turbine

a) Type of Compressor: Single-stage centrifugal

b) Type of Prime Mover: Gas turbine

c) Type of Fuel: Multifuel--kerosene, JP fuels, diesel

d) Package Dimensions and Type



e) Delivery Hose; Type, Length: 3.5" I.D. dacron and glass reinforced W/#7223 silicone tube with outer rubber scuff jacket - operating temperature range from -65° F to +600° F - available in 20- or 30-foot lengths.

Rated Output at Compressor Delivery Connection

a) guaranteed performance: 60° F, Sea Level Day

Pressure, psig: 37.3

Air Flow, lb/min: 118

Air Temperature, °F: 420° F

PNEUMATIC STARTER AIR SUPPLY
(Power Limited)

Ø MANUFACTURER: Steward-Davis, Inc.

Ø MODEL NUMBER: 502-12B Turbo Starter Flyaway

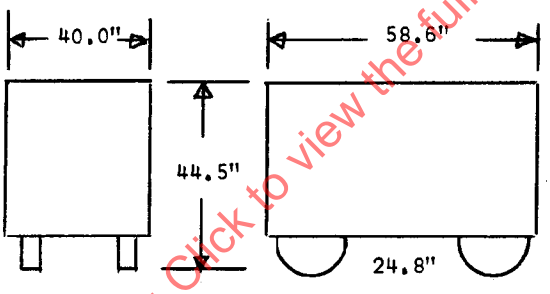
Description Gas Turbine-Driven Air Compressor--Split Shaft Turbine

a) Type of Compressor: Single-stage centrifugal

b) Type of Prime Mover: Gas turbine

c) Type of Fuel: Multifuel--kerosene, JP fuels, diesel

d) Package Dimensions and Type



e) Delivery Hose; Type, Length: 3.5" I.D. dacron and glass reinforced W/#7223 silicone tube with outer rubber scuff jacket - operating temperature range from -65° F to +600° F - available in 20- or 30-foot lengths.

Rated Output at Compressor Delivery Connection

a) guaranteed performance: 60° F, Sea Level Day

Pressure, psig: 37.3

Air Flow, lb/min: 118

Air Temperature, ° F: 420° F

PNEUMATIC STARTER AIR SUPPLY
(Power Limited)

ø MANUFACTURER: Steward-Davis, Inc.

ø MODEL NUMBER: 502-12B Turbo Starter Container Mounted

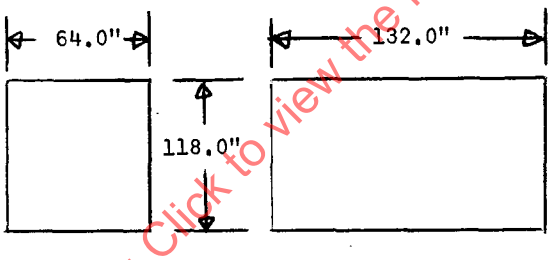
Description Gas Turbine-Driven Air Compressor--Split Shaft Turbine

a) Type of Compressor: Single-stage centrifugal

b) Type of Prime Mover: Gas turbine

c) Type of Fuel: Multifuel--kerosene, JP fuels, diesel

d) Package Dimensions and Type



e) Delivery Hose; Type, Length: 3.5" I.D. dacron and glass reinforced W/#7223 silicone tube with outer rubber scuff jacket - operating temperature range from -65° F to +600° F - available in 20- or 30-foot lengths.

Rated Output at Compressor Delivery Connection

a) guaranteed performance: 60° F, Sea Level Day

Pressure, psig: 37.3

Air Flow, lb/min: 118

Air Temperature, ° F: 420° F

MANUFACTURER: STEWARD, DAVIS INC. MODEL NO. 502-12B

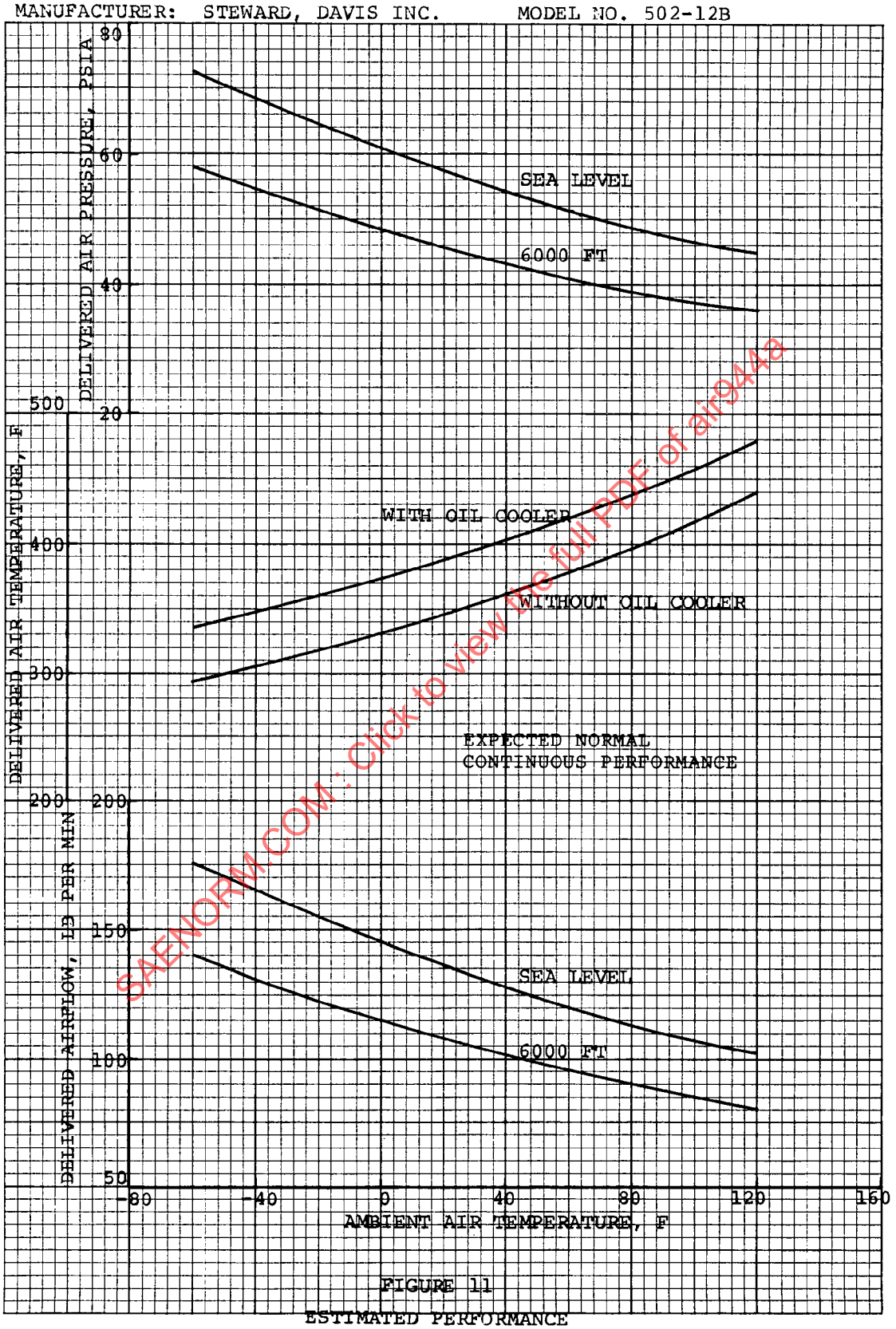


FIGURE 11
ESTIMATED PERFORMANCE

PNEUMATIC STARTER AIR SUPPLY
(Power Limited)

MANUFACTURER: Teledyne CAE (Formerly Continental Aviation and Engineering Corporation)

MODEL NUMBER: TC106

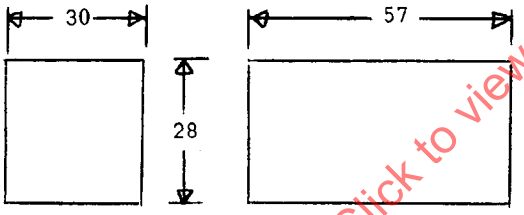
Description (Turbocompressor)

a) Type of Compressor — Single-stage Centrifugal

b) Type of Turbine — 2-stage axial

c) Type of Fuel — MIL-J-5624, JP-4 and JP-5; MIL-G-5572

d) Package Dimensions and Type — 4-wheel trailer mounted, complete with fuel tanks, controls, hose storage, etc.



Note
Also available W/O trailer chassis for customer installation. Dimensions shown are pod only.

e) Delivery Hose; Type — Hose conforms to MIL-D-26124, 30 ft length.

Rated Output at Compressor Delivery Connection

a) guaranteed performance — 60° F, Sea Level Day

Pressure, psig — 50.5

Air Flow, lb/min — 126

Air Temperature, °F — 430

MANUFACTURER: TELEDYNE CAE

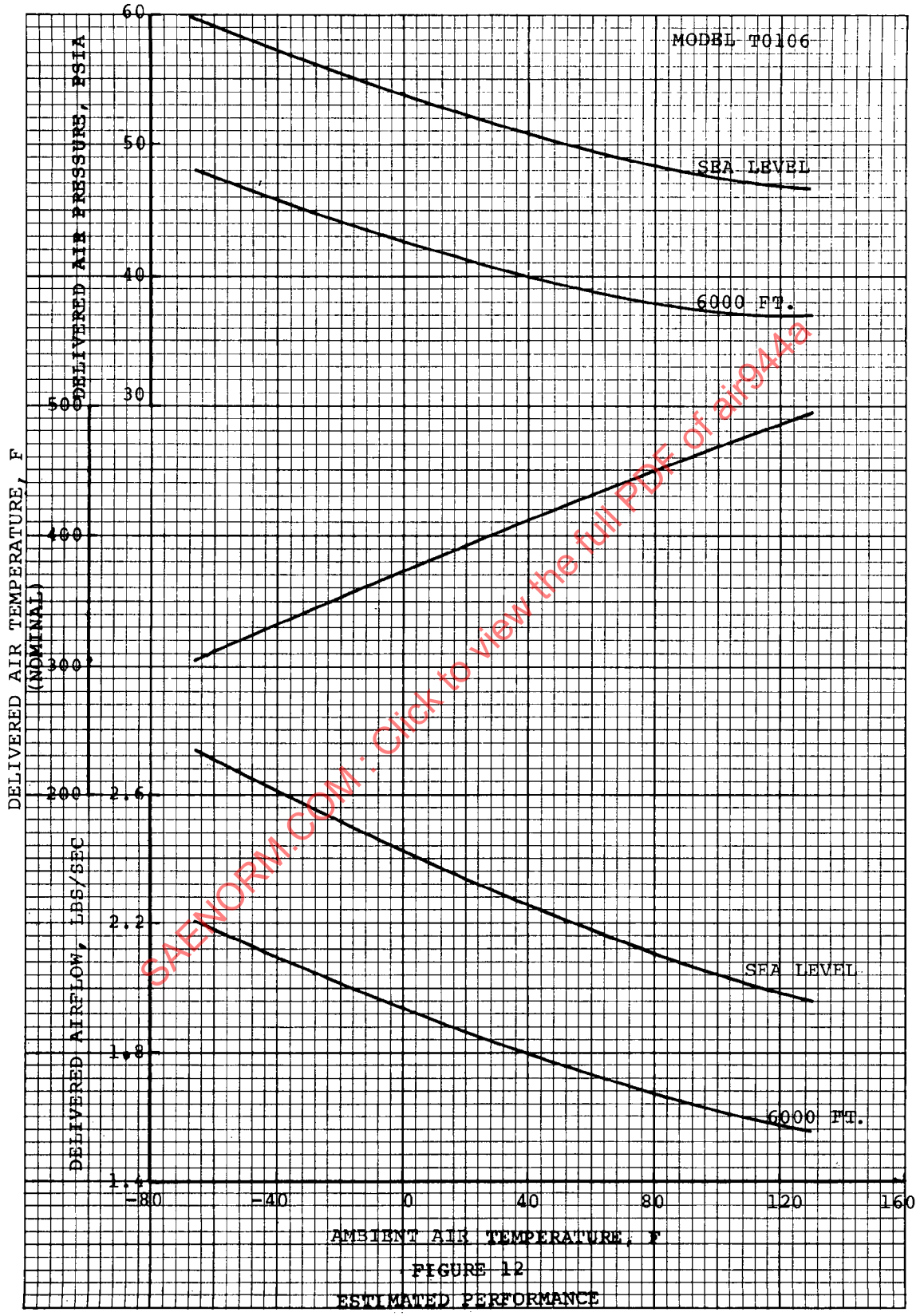


FIGURE 12

ESTIMATED PERFORMANCE

PNEUMATIC STARTER AIR SUPPLY
(Power Limited)

Ø MANUFACTURER: Teledyne Sprague

Ø MODEL NUMBER: JSS-DSP

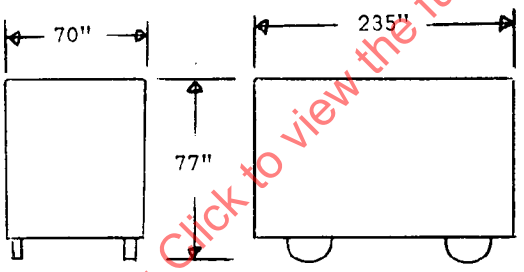
Description:

(a) Type of Compressor: Rotary screw type (Atlas Copco)

(b) Type of Prime Mover: Diesel Engine (Cummins)

(c) Type of Fuel: Diesel

(d) Package Dimensions and Type: Truck



(e) Delivery Hose: Flexible hose & coupling (Roylyn Inc.)

Rated Output at Compressor Delivery Connection

(a) maximum performance: 60° F, Sea Level Day

Pressure, psig: 35

Airflow, lb/min: 120

Air Temperature, °F: 320