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HEADQUARTERS

TSPFE/PFB/djm/2-6275

AIR FORCE MATERIEL COMMAND

WRIGHT FIELD, DAYTON, OHIO

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by authority of CG, AMC

DATE 1/19/49
by J. J. Schumacher
Date 7 November 1946 W. J. B. B. B.

MEMORANDUM REPORT ON

The P-80A-5LO Airplane, AAF No. 44-85462

SUBJECT: Effect of Surface Filler and Paint
on the Level Flight Performance of
the P-80A.

OFFICE TSPFE

Contract or Order No.

SERIAL No. TSPFE-2040

Expenditure Order No.

A. Purpose

1. To report the results of flight tests conducted to determine the comparative level flight performance of a P-80A airplane with each of the following surface finishes.

- a. Unpainted - The present production finish.
- b. Unpainted - With cracks and major surface irregularities filled with putty.
- c. Painted - The standard production finish for earlier P-80A airplanes.

B. Factual Data

1. These tests were conducted by the Flight Test Division at the request of the Chief, Aircraft Projects Section, Engineering Division. All tests were flown at Van Nuys, California, from 2 October to 25 October 1946 in fifteen flights requiring sixteen hours and thirty minutes flying time. Maintenance, painting, and thrust calibrations were performed by the Lockheed Aircraft Corporation. Tests of a similar nature had been run by the Lockheed Aircraft Corporation and were reported in Lockheed Report No. 5341 dated 10 May 1945. However, the tests run at that time showed only the difference between painted and unpainted surfaces; also, the wing of the airplane used for those tests was hand made and generally of better contour than later production wings.

2. The airplane tested was the P-80A-5LO, AAF No. 44-85462, which was delivered to the Flight Test Division test crew at Van Nuys with the now standard production unfilled and unpainted surface finish. After the first series of tests, the airplane was returned to the factory where the surface was cleaned and where all cracks and major surface irregularities, except those around movable or detachable parts of the airplane, were filled with putty and sanded smooth. On completion of the second series of tests, the airplane was again returned to the factory for the application of the former standard production P-80A paint finish consisting of one coat of zinc chromate primer, four coats of airfoil surfacer sanded smooth, and three coats of airfoil lacquer enamel. The wing was not aerodynamically smooth or of true contour

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with any of these finishes. Numerous small waves and surface irregularities were apparent and this condition was even more noticeable in flight due to the air loads and the relatively thin skin. The external configuration was standard including six 50 caliber machine guns, wing tip racks, a single streamlined antenna aft of the nose wheel doors and a single wire antenna running from the pilot's canopy to the fin. Photographs of the airplane showing the external configuration with each surface finish are included in Appendix III.

3. Instrumentation was also standard except that a calibrated sensitive airspeed indicator, altimeter, sensitive tachometer, burner pressure gage, and free air temperature gage were installed in place of the corresponding production instruments. A shielded free air temperature pick-up was installed on the nose wheel door. All readings were recorded manually by the pilot.

4. Loading consisted of full fuel, pilot and parachute, and 205 pounds of ballast and loose equipment in the nose. The airplane was weighed before and after each change in surface finish and the corresponding gross weights at take-off were determined to be:

- a. Take-off Weight - Unpainted - 11,745 lbs.
- b. Take-off Weight - With Filler - 11,760 lbs.
- c. Take-off Weight - Painted - 11,805 lbs.

The weight of filler was 15 pounds and the weight of the paint was 45 pounds. The total gain in weight due to filler and paint was 60 pounds.

5. The engine installed in this airplane was a J-33-A-17, Serial No. A-071991, and the average diameter of the tail pipe nozzle was 18.55 inches with .25 inches difference between the maximum and minimum diameters. Ground static thrust calibrations were run before and after each series of tests to determine the static thrust of the unit as installed in the airplane and to show any decrease in thrust with engine time. The observed data from these runs is tabulated in Appendix II. This data corrected to sea level standard atmospheric conditions is plotted in Figure 4, Appendix I. The initial static thrust at 11,500 rpm was 3600 pounds. There was an initial decrease in thrust of 90 pounds at this rpm in the first six hours of flying. This was followed by a further loss in thrust of 50 pounds in the next five hours of flying. There was no further decrease in thrust in the last six and one-half hours of flying. There was no apparent change in thrust at engine speeds below 9500 rpm.

6. No test airspeed system was installed for these flights. Because the standard installation (flush static holes) might be affected by the change in surface finish, it was necessary to calibrate the airspeed system during each series of tests. The Flight Test Division pacer P-80A airplane was flown to Van Nuys for this purpose. The airspeed calibrations obtained are plotted in Figure 3, Appendix I. There was no appreciable change in position error due to applying the filler but there was a change due to painting over the static orifices on the nose. This change amounted to a decrease in indicated airspeed readings of from one to one and one-half miles per hour.

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7. Stabilized speed vs rpm points were obtained in level flight at 5,000 ft., 20,000 ft., and 34,000 ft. for each of the three surface finishes. Engine rpm's were selected so that the complete speed range of the P-80A would be covered at each altitude. Observed data from these tests is included in Appendix II. The rpm's were then corrected for the effect of temperature, weight, and change of thrust with engine time. Curves of rpm vs speed (indicated speed corrected for instrument error, position error, and compressibility effect = true speed x the square root of the density ratio) were then plotted in Figure 2. Curves of speed vs altitude at maximum power and cruising power for each of the three surface finishes are plotted in Figure 1. The effect of filler and paint on the level flight performance of this P-80A airplane has been summarized in the following table:

| | Altitude Ft. | Surface Finish | | |
|---|-----------------|--------------------------|-----------------------|------------------------|
| | | Unpainted 10,200 lbs. | Filled 10,215 lbs. | Painted 10,260 lbs. |
| Maximum True Airspeed at 11,500 RPM | 5,000 | 526 | 533 | 536 |
| | 20,000 | 521 | 528 | 530 |
| | 34,000 | 504 | 505 | 505 |
| Cruising True Airspeed at 10,400 RPM | 5,000 | 421 | 426 | 429 |
| | 20,000 | 434 | 442 | 445 |
| | 34,000 | 431 | 439 | 444 |

At speeds near those recommended for maximum rate of climb, the difference in true airspeed due to surface finish amounted to 11 mph at low altitude and 19 mph at high altitude. This is equivalent to a change in rate of climb of approximately 120 ft/min.

C. Conclusions

1. The effect of filler and paint on the high speed of this P-80A airplane amounted to 10 mph TAS at low altitude but was negligible above 30,000 ft.
2. The effect of filler and paint on the cruising speed of this P-80A was 8 mph TAS at low altitude and 13 mph TAS at 34,000 ft.
3. Filling the cracks and major surface irregularities had nearly as much effect as filling and painting the surface.
4. Neither the putty nor the paint would stay on the airplane without cracking and chipping.

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D. Recommendations

1. Until such time as a filler and paint are developed that will adhere to the airplane without cracking, chipping, or weathering, it is recommended that no filler or paint be applied to the surface of P-80 production airplanes.

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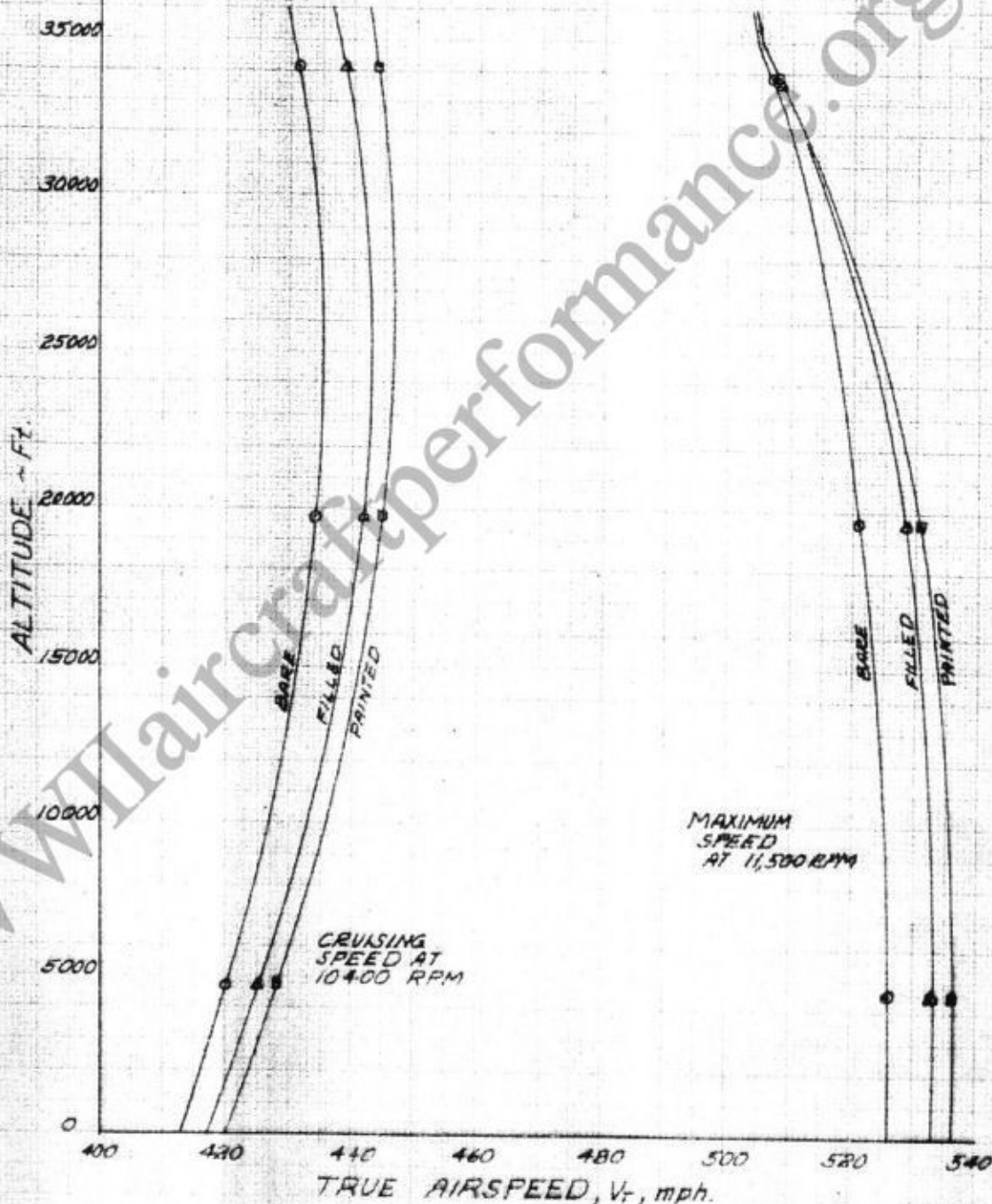
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FIG. 1
EFFECT OF PAINTING + VIRE
ON LEVEL FLIGHT PERFORMANCE

P-80A AAF No. 44-85462
10,800 lbs. BARE
10,260 lbs. PAINTED



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FIG. 2.

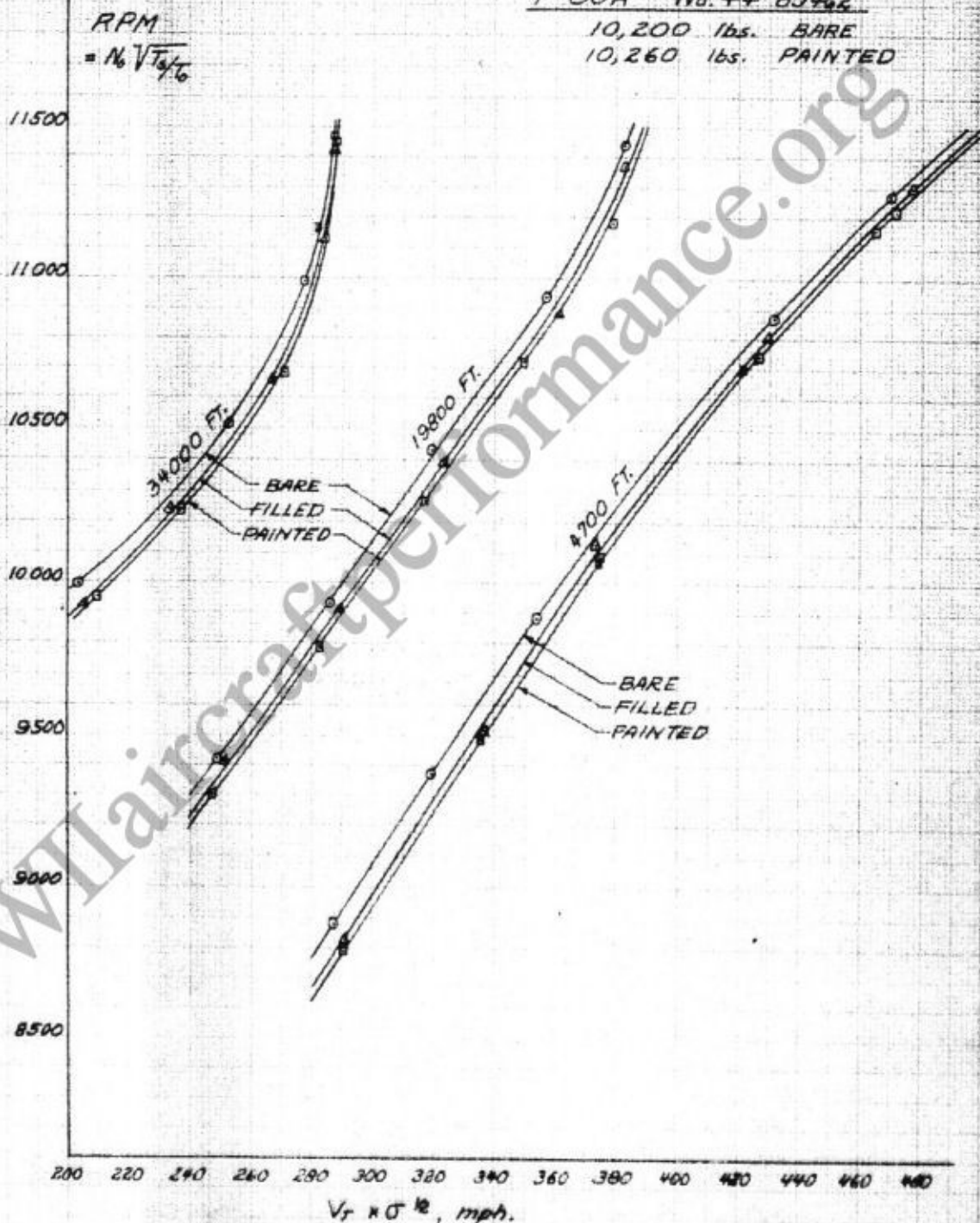
PAINT EVALUATION TESTS

SPEED $\sqrt{1/2}$ RPM

P-80A No. 44-85462

10,200 lbs. BARE

10,260 lbs. PAINTED



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- May - USAF

FIG. 3

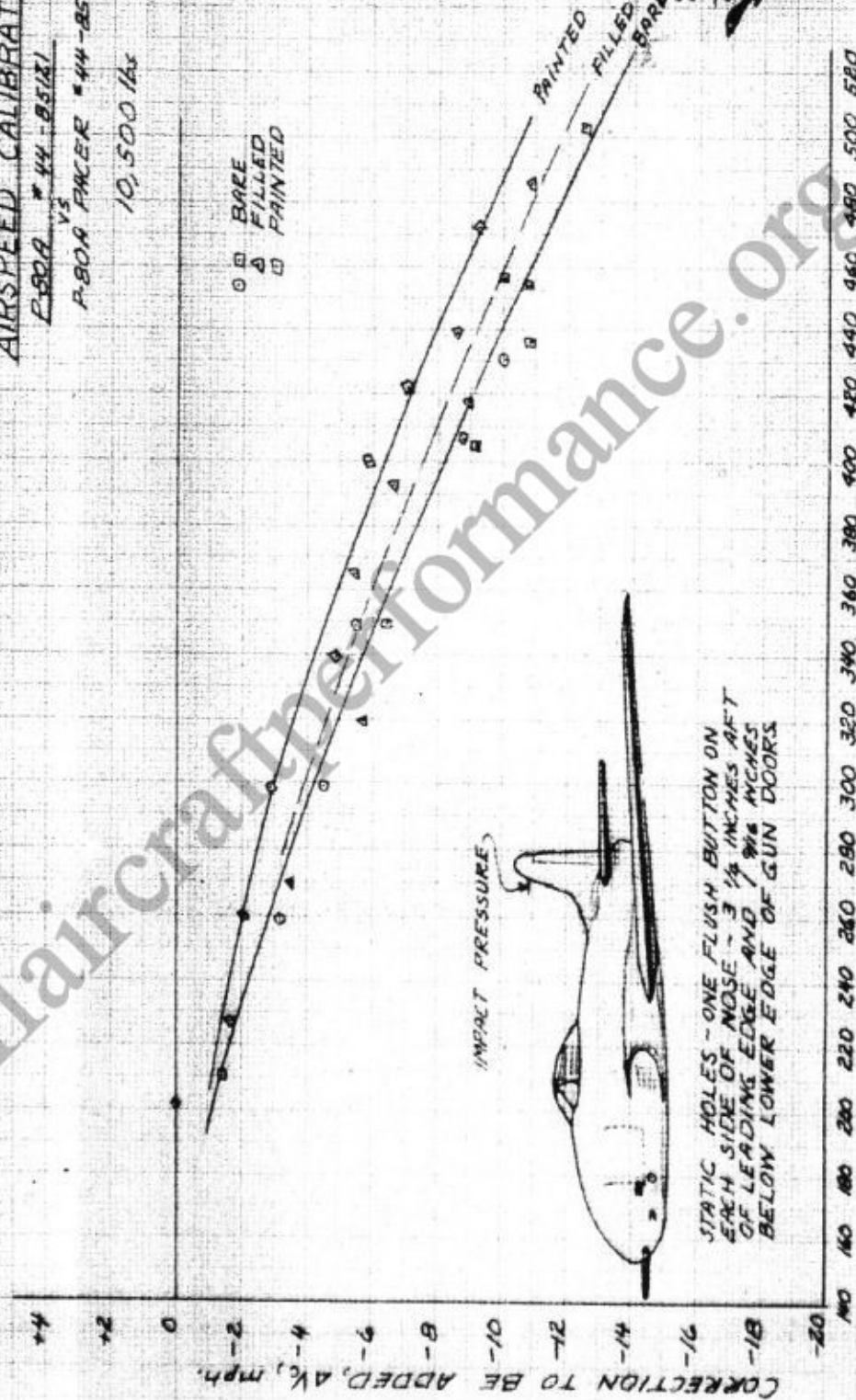
AIR SPEED CALIBRATION

P-80A #44-85121

P-80A PACER #44-85121

10,500 ft

○ BARE
△ FILLED
□ PAINTED



STATIC HOLES - ONE FLUSH BUTTON ON
EACH SIDE OF NOSE - 3 1/4 INCHES AFT
OF LEADING EDGE AND 1 3/4 INCHES
BELOW LOWER EDGE OF GUN DOORS

INDICATED AIRSPEED, V_i , mph.

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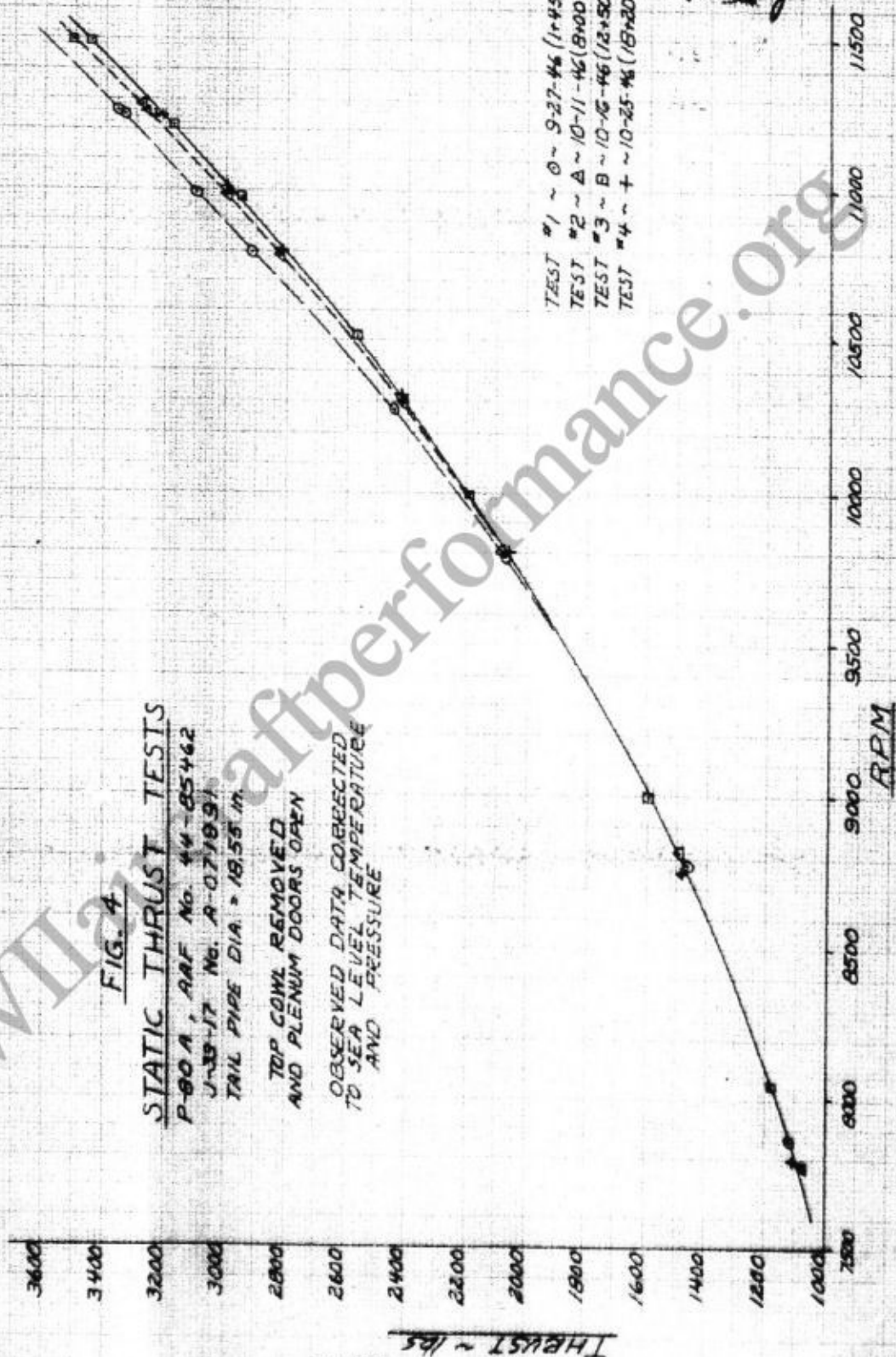
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