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PHILADELPHIA, PA.

AERONAUTICAL ENGINE LABORATORY
REPORT ON

CALIBRATION OF PRATT AND WHITNEY R-4360-20 ENGINE

ISSUED BY

NAVAL AIR EXPERIMENTAL STATION

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REPORT

ON

CALIBRATION OF PRATT AND WHITNEY R-4360-20 ENGINE

BY
NAVAL AIR MATERIAL CENTER
NAVAL AIR EXPERIMENTAL STATION
AERONAUTICAL ENGINE LABORATORY
PHILADELPHIA

Project TED No. NAM-PP209.

Authority - Bureau of Aeronautics Restricted Letter Aer-PP-23 23326 of 20 March 1947.

Dates of Test - FROM: 28 July 1947 TO: 15 March 1950.

Number of Pages - Text, 14; Plates, 52.

Reported by _____ Project Engineer.
M. J. DUTSEY, Aeronautical Engineer, GS-9

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Approved by _____ Superintendent.
R. H. PRICKETT, Commander, U. S. N.

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OBJECT

1. The primary object of these tests was to determine the sea-level and altitude characteristics of the Pratt and Whitney Aircraft (P&WA) model R-4360-20 engine.

CONCLUSIONS

2. Calibration results indicate that the original -20 engine, No. P-726 (incorporating 6.91:1 low gear ratio and 8.31:1 high gear ratio) failed to meet the manufacturer's high gear critical altitude guarantees (see reference (d)). Engine No. P-726, after modification to incorporate an 8.90:1 high gear ratio (see references (f) and (h) and the production engine, No. P-2727, with a 9.07:1 high gear ratio (see reference (g)), satisfactorily meet the manufacturer's guaranteed ratings. The following table shows a comparison of each of the three versions of the -20 engine with the manufacturer's guaranteed ratings:

Rating	RPM	BHP	Mfr. Guar. S.F.C.	Altitude - Feet			
				Mfr. Guar.*	AEL Dynamometer		
					Eng. No. P-726	Eng. No. P-726 Modified	Eng. No. P-2727
Low Normal	2550	2650	.72	6000	6100	6500	6600
Low Military	2700	3250	.76	1500	2000	2300	2500
High Normal	2550	2300	.76	18,000	16,300	18,200	19,300
High Military	2700	2500	.84	17,000	15,400	16,500	17,300

*Specification No. N-7056-D of 3 January 1950.

3. Operation with MIL-F-5572 100/130 grade fuel was satisfactory at the manufacturer's guaranteed horsepower ratings and fuel consumption values except during high gear operation at military speed and power. The following table shows the detonation limits of engine No. P-726 (Modified to incorporate and 8.90:1 high gear ratio):

RPM	Gear	BHP*	F/A	CAT (°F)	ASRP (In.Hg.)	Alt. (Ft.)
2700	Low	3250	.099	100	60.8	0
2550	Low	2650	.078	100	50.0	0
2550	High	2300	.084	52	49.5	13,000

* Although these data were obtained on an engine having a low gear ratio of 6.91:1 and a high ratio of 8.90:1, it is believed that a sufficient margin of safety is included to achieve detonation-free operation with later production engines. Late -20 and -20W production engines have a low ratio of 6.95:1 and high ratio of 9.07:1.

4. Mixture response runs made in both low and high gear ratios indicate that the engine is detonation-free considerably below the lean limit of the carburetor setting in the "normal" position. The following table shows the detonation limits of the engine using MIL-F-5572 (115/145) grade fuel:

RPM	Gear	BHP	F/A	CAT (°F)	ASRP (In.Hg.)	Alt. (Ft.)
2550	Low	2650	.057	(Std + 40)	57.4	S.L.
2700	Low	3250	.071	(Std + 40)	59.2	S.L.
2550	High	2300	.064	(Std + 40)	51.8	17,000
2700	High	2500	.0725	(Std + 40)	55.0	16,000

5. The Stromberg PR-100B3 carburetor, metering according to 390941-4 parts list setting, provided satisfactory mixtures for normal engine operation, acceleration, starting, and idling.

6. Overpower runs in low and high gear indicate that the engine is capable of detonation-free operation, while using 115/145 grade fuel, at the following conditions:

RPM	BHP	CAT (°F)	Gear	Alt. (Ft.)	Mixture	ASRP (In.Hg.)	F/A
2700	3350	60	Low	S.L.	Rich	63.0	.101
2800	3475	60	Low	S.L.	Rich	65.8	.1015
2700	2780	16	High	12,000	Rich	66.0	.1085

Detonation was encountered during the overpower high gear operation at the following conditions:

RPM	BHP	CAT (°F)	Gear	Alt. (Ft.)	Mixt.	ASRP (In.Hg)	F/A	Detonation Intensity
2700	2810	17	High	11,700	Rich	65.5	.1085	Incipient
2700	2850	18	High	11,400	Rich	67.3	.1085	Light

7. A high altitude (23,000 - 26,000 ft.) surge was encountered during the calibration at speeds below 2400 rpm. The surge was traced to the method of venting the fuel discharge nozzle. The discharge nozzle was vented to altitude during altitude operation and a severe surge was encountered; however, by venting the discharge nozzle to sea-level during all altitude operation, the surge was eliminated. This condition was also encountered by the engine manufacturer and is apparently caused by the inlet air turbulence downstream of the altitude valve.

8. With the carburetor in the "normal" mixture position, the cooling air baffle pressure drop necessary to maintain the maximum cylinder head or flange temperatures specified in reference (b) was as follows:

Condition	BHP	RPM	Gear	Cooling Air Temp. - °F	Baffle Press. Drop - In. H_2O
Take-Off	3250	2700	Low	63	9.5
Military	3250	2700	Low	57	7.3
Normal	2650	2550	Low	66	3.4
Military	2500	2700	High	57	6.8
Normal	2300	2550	High	65	3.7
Overpower*	3340	2700	Low	54	5.6
Overpower*	3475	2800	Low	59	7.5
Overpower*	2780	2700	High	55	5.7

* Overpower runs made with "Rich" mixtures.

9. Supercharger instability was encountered in the 2200 rpm range during full throttle altitude operation, which resulted in considerable power variation.

10. Operation of the Bendix Eclipse Automatic Power Control, Type 1626, Model 2, was satisfactory. Checks at military and normal rated power (see Plates 20 to 22) indicated a hysteresis of approximately 0.5 in.hg ASRP when varying the altitude from sea level to 30,000 ft. and returning to sea level (with a constant APC setting). The hysteresis was greater (1.5 in.hg ASRP) at military power returning from 32,000 ft. to sea level.

11. Fuel conforming to the requirements of Specification MIL-F-5572, 115/145 grade, is satisfactory for use at the ratings shown in paragraph 2.

12. Engine operation with AC181 spark plugs was satisfactory at all speeds and powers.

13. The torquemeter functioned satisfactorily throughout the test. The constant of 189.4 checked dynamometer determined power results within ±2 per cent for the two engines tested (see Plate 38).

RECOMMENDATIONS

14. It is recommended that the altitude ratings of Engine No. P-2727 determined at the Aeronautical Engine Laboratory and shown in paragraph 2, rather than the values indicated in the P&WA engine specification (reference (b)) be accepted as the actual operating characteristics of the engine.

15. Operation at the guaranteed brake horsepower ratings using P&WA guaranteed fuel consumption values using 115/145 grade fuel is recommended as satisfactory.

16. Grade 100/130 fuel is recommended as satisfactory for all low gear operation; however, high gear operation should be restricted to normal rated speed and power or less.

17. The Stromberg PR-100B3 carburetor, metering according to the "normal" and "rich" mixture positions of the P.L. No. 390941-4 setting is recommended for use with this engine. Operation in the "normal" mixture position is recommended for all speeds up to and including take-off or military with 115/145 grade fuel.

18. Overpower operation with 115/145 grade fuel is recommended as satisfactory for short periods of time at the values shown in the following table if the CAT does not exceed NACA standard values:

RPM	BHP	Gear Ratio	Alt. (Ft.)	Mixt.	ASRP	F/A
2700	3350	Low	S.L.	Rich	63.0	.101
2800	3475	Low	S.L.	Rich	65.8	.1015
2700	2780	High	12,000	Rich	66.0	.1085

19. It is recommended that a complete investigation be made in airplane installations of the subject type engine to determine whether supercharger instability is encountered during full throttle altitude operation at 2200 rpm. See reference (c) for discussion of centrifugal supercharger performance.

20. Use of the Bendix Eclipse Automatic Power Control, Type 1626, Model 2, is recommended as satisfactory with this type engine.

21. Operation with fuel conforming to the minimum requirements of MIL-F-5572, grade 115/145, is recommended as satisfactory using either P&WA guarantee or normal mixtures.

22. On the basis of these tests AC181 spark plugs are recommended as satisfactory for use with this type engine.

23. A torquemeter constant (K) of 189.4 is recommended as satisfactory for calculation of horsepower where

$$BHP = \frac{\text{Engine RPM} \times \text{Torq. Pressure}}{K}$$

DESCRIPTION OF SUBJECT

24. Following is a list of the characteristics of the subject engine.

a. Manufacturer:

Name - Pratt and Whitney Aircraft
Location - East Hartford, Conn.

b. Model, Numbers and Ratings:

Model	- P&WA R-4360-20
Type	- Air-cooled, 28-cylinder, 4-row radial, single stage, variable speed supercharger
Engine Numbers	- P-726, P-726 Modified and P-2727
Normal and Military Ratings	- See paragraph 2.
Dive Rating	- 3060 rpm

c. General Data:

Bore and stroke	- 5.75 X 6.0
Cylinder arrangement	- Four row radial, 7 cylinders each row.
Master Rod Location	- A7, B4, C_4, and D1
Total Displacement	- 4360 cu.in.
Compression Ratio	- 6.70:1
Reduction Gear Ratio	- 0.425:1
Torquemeter Constant	- 189.4
Propeller Shaft Spline	- No. 60A
Propeller and Crankshaft Rotation	- Clockwise
Crankshaft Dampers	- Two 3-1/2 order (front & rear)
Overall Dimensions	- 54-in. diameter 102-in. length
Dry Weight of Engine Including Carburetor, Spark Plugs, etc.	- 3505 lb.
Maximum Specific Outputs (Based on 3250 bhp Take-Off Rating)	- .93 bhp/lb - .75 bhp/cu.in.
Fuel Spec. MIL-F-5572	- Grade 115/145
Oil Spec. AN-O-8	- Grade 1100

d. Supercharger:

Number of Stages (P-2727 Engine Only)	- One stage, variable speed.
Impeller Gear Ratios	- Low 6.95:1 (No Slip) - High 9.07:1 (No Slip)
Impeller Diameter	- 14 in.

e. Carburetor:

Make	-	Stromberg
Model	-	PR-100B3
Setting Number	-	390941-4
Fuel Pressure Desired	-	25 ± 1 psi
Injector Location	-	Impeller

f. Ignition:

Magnetos	-	Bendix Scintilla D4RN-2
Number	-	Seven
Firing Order	-	A1, B5, C2, D6, A3, B7, C4, D1, A5, B2, C6, D3, A7, B4, C1, D5, A2, B6, C3, D7, A4, B1, C5, D2, A6, B3, C7, D4
Ignition Timing (fixed)	-	20° BTC on #D-1 Cylinder
Spark Plugs	-	AC181
Harness	-	Scintilla Rewireable

g. Valve Timing:

The valve timing and tappet clearances are as follows:

Intake Opens	- 20° BTC
Intake Closes	- 76° ABC
Exhaust Opens	- 76° BBC
Exhaust Closes	- 20° ATC
Intake Valve Remains Open	- 276°
Exhaust Valve Remains Open	- 276°
Valve Lift	- 0,562 in.
Overlap	- 40°
Cold Valve Adjusting Clearances	-
Intake	- .030 in.
Exhaust	- .030 in.

h. Accessories:

Accessory Drive	No. of Drives	Type	Ratio to C'shaft	Maximum Continuous Torque lb-in	Max. Static Torque lb-in	Direction of Rotation *
Starter	1	IA	3.000:1	-	12,000	C.
Generator	3	IA	3.000:1	500	2200	C.
Fuel Pump	1		.800:1	50	600	C.C.
Tachometer	1	I	.500:1	7	50	C.
Tachometer	1	II	.500:1	7	50	C.
Governor	1		.956:1	125	825	C.C.

*C. - Clockwise, C.C. - Counter-clockwise

METHOD OF TEST

25. Engines Nos. P-726 and P-2727 were installed in No. 5 Dynamometer Room for conduct of a sea level and altitude calibration, as authorized by reference (a). The engine was attached to the dynamometer by means of a large, hard rubber coupling at the dynamometer end of the extension shaft and a gear-type coupling at the engine end. The engine carburetor air and exhaust were maintained at the required altitude conditions. The breather, fuel, and oil systems were maintained at or near sea level conditions. A standard complement of instruments as is normally used in this Laboratory was employed to measure temperatures, pressures, and air, fuel and oil flows.

26. Fuel conforming to the requirements of Specification MIL-F-5572, grade 115/145, and AN-O-8 (grade 1100) oil were used during all tests. The oil-in temperature and oil-out pressure were maintained at approximately 165°F and 15 psi, respectively.

27. The calibration data were obtained with engine No. P-2727, which accumulated 212 hours total running time during these tests. A Stromberg PR-100B3 carburetor with a 390941-4 parts list No. setting and a straight carburetor scoop were used for all tests. A Bendix Eclipse Automatic Power Control, Type 1626, Model 2, was employed for all calibration runs. A Lockheed Model XR60-1 airplane-type exhaust collector was used.

28. Sperry detonation-detecting units were attached to the intake rocker boxes on each of the 28 cylinders. Detonation was limited to "incipient" defined as "one or more cylinders indicating detonation at irregular intervals, none indicating a definite frequency".

29. A manual mixture control system was installed on the carburetor for obtaining desired fuel flows during mixture control and detonation-limited runs.

RESULTS AND DISCUSSION

30. The location of various plates and photographs in this report are as follows:

Title	Plate Nos.
Altitude Characteristics - Normal Mixture	1 to 5
Part Throttle Characteristics - Normal Mixtures	6 to 8
Altitude Characteristics - Rich Mixtures	9 to 12
Part Throttle Characterisitics - Rich Mixtures	13 to 15
Normal and Military Critical Altitude Runs	16
Sea Level Overpower Runs	17
Altitude Overpower Runs	18 and 19
Automatic Power Control Altitude Characteristics	20 to 22
Mixture Requirement Curves (100/130 and 115/145 Fuels)	23 and 24

Title	Plate Nos.
Mixture Response Runs	25 and 26
Carburetor Characteristics	27 to 30
Correction Curves	
Carburetor Air and Mixture Temperature	31
Exhaust Back Pressure	32 and 33
Cylinder Head Temperature	34
Friction Characteristics	35 and 36
Oil Flow and Heat Rejection Characteristics	22 and 37
Torque Meter Calibration	38
Photographs of Engine Installation	39 and 40
Condition of Engine After Completion of Tests	41 to 46
General Views of the Engine	47 to 52

31. Plates 1 to 15 show the basic engine calibration in low and high gear. The bhp, SFC, altitude, manifold pressure, etc., plotted on these plates at various speeds and powers, indicate the values obtained in rich and normal mixtures using the PR-100B3 carburetor incorporating the P.L. No. 390941-4 setting (see Plates 27 and 28 inclusive). NACA Standard altitude conditions were maintained at the engine inlet and exhaust throughout the calibration. The cylinder head temperatures were maintained at the maximum allowable limits, as specified in reference (b). A Bendix Eclipse Automatic Power Control, Type 1626, Model 2, and an XR60-1 airplane-type exhaust collector were used during these tests. Calibration results indicate that the original -20 engine, No. P-726 (incorporating 6.91:1 low gear ratio and 8.31:1 high gear ratio) failed to meet the manufacturer's high gear critical altitude guarantees (see reference (d)). This engine was then returned to the manufacturer for modification, during which time the high gear ratio was changed to 8.90:1; however, due to mechanical troubles with the modified engine during subsequent qualification tests, the production engines appeared with a low ratio of 6.91:1 and a high ratio 9.07:1 (see reference (b)). Engine No. P-726 after modification and the production model engine, No. P-2727, satisfactorily meet the manufacturer's guaranteed ratings (references (f) and (g)).

32. The critical altitude performance of the engine in low and high gear at normal and military powers is shown on Plate 16. Standard altitude conditions were maintained for these runs and cylinder head and flange temperatures were maintained at the maximum allowable limits as specified in reference (b). The P&WA guaranteed specific fuel consumptions are shown on each of the curves. Additional information on criticals obtained on engine No. P-726 before and after modification, and on engine No. P-2727 is available in references (d), (f) and (g). The following table shows the values obtained in Normal (reference (j)) and Rich Mixture positions for normal rated and military rated powers with low gear supercharging:

Mixture	RPM	BHP	SFC	Altitude (Ft.)	ASRP (In.Hg)	Air Flow: (lb/hr)	F/A
Normal	2550	2650	.70	6800	49	19,400	.094
Rich	2550	2645	.73	6100	49.8	19,250	.101
Normal	2700	3250	.75	2700	60.1	24,600	.099
Rich	2700	3230	.77	2500	60.2	24,210	.105
Normal	2550	2650	.65	Sea Level	50	19,000	.0905
Rich	2550	2650	.71	Sea Level	50.7	19,500	.097
Normal	2700	3250	.73	Sea Level	60.2	24,200	.0975
Rich	2700	3250	.78	Sea Level	61.3	24,700	.102

Supercharger instability was encountered at 2200 rpm during full throttle altitude operation. Two separate full throttle lines with a variation of about 240 hp could be obtained at the same altitude, engine speed, and throttle setting. This condition is believed to have been caused by the inherent static instability (see paragraphs 57 to 64, inclusive, of reference (c)) characteristics of the supercharger and may have been caused or aggravated by the test plant induction system configuration. A similar condition had been encountered on the R-1820-74W and R-3350-26W engines.

33. Plates 17, 18 and 19 show the overpower characteristics of the engine in low and high gear at sea level and altitude using NACA standard altitude conditions. These runs were made using 115/145 grade fuel with "rich" mixture as produced by the PR-100B3 carburetor. The low and high gear overpower ratings are indicated on the plates and tabulated in paragraph 6. Incipient detonation was encountered during high gear operation at the conditions indicated in the second table in paragraph 6.

34. Plates 20, 21 and 22 show the altitude characteristics of the Eclipse Automatic Power Control Unit, Type 1626, Model 2. Some hysteresis of the control was noted, especially at military speed, when the sea level setting was checked after operating up to 32,000 ft. altitude. Performance of the control was generally satisfactory.

35. Plates 23 and 24 show the minimum mixture characteristics of the engine in both low and high gear. These data indicate that the mixtures produced by the PR-100B3 carburetor with P.L. setting No. 390941-4 gave satisfactory detonation-free and stable operation in the cruise range. Included on these plates are check points using cold carburetor air temperatures, and part and full carburetor throttle.

36. Detonation characteristics of the engine in low and high gear are shown on Plates 25 and 26. Plate 25 shows the results obtained with 115/145 grade fuel, while the results obtained with 100/130 grade fuel are shown on Plate 26. Detonation characteristics are satisfactory over the entire engine speed range using 115/145 grade fuel and the present carburetor setting.

37. On plates 27 and 28 are plotted engine data and on plates 29 and 30 airbox characteristics of the [illegible]-100B3 carburetor. A comparison of the sea-level mixtures provided by this carburetor (P.L. Setting No. 390941-4) with the P&WA temporary acceptance limits indicates that it meters within the manufacturer's setting limits at sea level (reference (e)). The carburetor meters on the lean side of both the "rich" and "normal" limits.

38. Plate 31 is a correction curve for carburetor air temperature deviation from standard and correction curve for mixture temperature deviation from the plotted calibration values. These curves were derived from various runs at different powers made at constant manifold pressure and fuel-air ratio for each run and combined to give a percentage power correction.

39. Plates 32 and 33 show exhaust back pressure correction curves in low and high gear. Data were obtained with the cylinder inlet conditions (ASRP, mixture temperature and F/A ratio) constant throughout the run. The exhaust pressure was varied to change the Pe/Pm ratio (exhaust pressure to manifold pressure). The examples illustrated on these plates indicate the proper use of the curves.

40. Plate 34 shows the effect of cylinder head temperature on engine power. Inlet conditions to the cylinders (ASRP, F/A ratio and mixture temperature) were maintained constant throughout these runs.

41. Friction characteristics of the engine in low and high gear are shown on Plates 35 and 36. For these runs, the engine was motored by the dynamometer at approximately the same conditions as those obtained during the altitude calibration. The friction horsepower, which is the difference between indicated and brake horsepower, is the sum of the power absorbed by the supercharger, the mechanical friction of the engine, and the pumping action of the pistons. Since the engine operating temperature was not the same as it would be with the engine firing, there may be minor errors in simulating both the mechanical friction (effect of temperature upon bearing clearances, oil viscosity, etc.) and the pumping losses (because of improper valve timing due to expansion differences at lower temperatures and incorrect temperature of the air flowing through the cylinders). However, since the horsepower absorbed by the supercharger constitutes the greatest portion of the friction horsepower, the friction horsepower values plotted on these plates should be relatively accurate.

42. Plate 37 shows the oil flow and heat rejection characteristics of the engine at propeller load powers and various speeds. The limits as specified in reference (b) are shown for comparison.

43. On Plate 38 is shown a comparison of the brake horsepower output of the engine as determined by the engine torquemeter and by the dynamometer.

44. Plates 39 and 40 are views of the engine installation in No. 5 dynamometer room.

45. Plates 41 to 46 inclusive show the condition of damaged parts of engine No. P-2727 after disassembly. This engine was operated a total of 227 hours, 212 hours of which were accumulated during the calibration. After completing the calibration the engine was used for experimental carburetor tests under Project TED No. NAM-PP3294. The carburetor test program was interrupted when sizable metal chips were found in the main sump. These chips were identified as parts of the supercharger hydraulic coupling impeller nut tab-washer, and it was decided to discontinue tests before the coupling could become completely disassembled and cause major damage to the engine rear section. Several unusual conditions were noted on disassembly of the engine which could not be explained; namely - severe and irregular wear of the high ratio supercharger intermediate pinion gear teeth (see Plate 43), and discoloration of the hydraulic coupling cover caused by excess temperatures (see Plate 41) without any evidence of metal-to-metal contact. Although the hydraulic coupling oil feed manifold assembly was cracked (see Plates 45 and 46), only the line feeding oil to the low ratio coupling was cracked and the low ratio cover did not show any evidence of overheating. The coupling assembly was returned to the engine manufacturer for study.

46. Plates 47 to 52 are general views of the engine.

REFERENCES

a. Project Authorization - Bureau of Aeronautics Restricted letter AER-PP-23 23326 of 20 March 1947.

b. Engine Specification - Pratt and Whitney Aircraft Specification No. N-7056-D of 3 January 1950, Model R-4360-20, -20W Engines.

c. Supercharger Performance - Aeronautical Engine Laboratory Report No. AEL-763 - "Centrifugal Supercharger Performance".

d. Critical Altitude Checks - Naval Air Experimental Station Restricted letter XE-1-PCP:frs F21-1(2)(4360) of 9 October 1947 - Including Preliminary Report No. 1 on Project TED No. NAM-PP209.

e. Carburetor Metering - Naval Air Experimental Station Restricted letter XE-1-PCP:frs F21-1(2)(4360) of 20 November 1947 - Including Preliminary Report No. 2 on Project TED No. NAM-PP209.

f. Critical Altitude Checks Engine P-726 Modified - Naval Air Experimental Station Restricted letter XE-1-WT:frs F21-1(2)(4360) of 14 May 1948 - Including Preliminary Report No. 3 on Project TED No. NAM-PP209.

g. Critical Altitude Checks Revised Production Engine P-2727 - Naval Air Experimental Station Restricted letter XE-1-MJD:mck F21-1(2)(4360)(104) of 26 Aug 1949 - Including Preliminary Report No. 4 on Project TED No. NAM-PP209.

h. Engine No. P-726 Modification - Pratt and Whitney Aircraft Report PWA-731 on "Tests Conducted and Modifications Made to Improve Critical Altitude Performance and Carburetor Altitude Compensation of R-4360-20W Engine P-726."

i. Detonation Checks 100/130 Fuel - Naval Air Experimental Station Restricted letter XE-1-MJD:mck F21-1(2)(4360)(429) of 2 February 1950 - Including Preliminary Report No. 5 on Project TED No. NAM-PP209.

j. Calibration With Normal Mixtures - Naval Air Experimental Station Restricted letter XE-1-MDJ:cts F21-1(2)(4360)(607) of 18 May 1950 - Including Preliminary Report No. 6 on Project TED No. NAM-PP209.

ALTITUDE - THOUSAND FEET

BHP

PROP LOAD

170 BMEP

ABS. SUPER RIN PRESS - IN. HG.

CRANKSHAFT RPM

MFRS. GUAR. CRITICAL ALTITUDE

ALTITUDE CHARACTERISTICS

WITH AUTO. POWER CONTROL UNIT *

"NORMAL" MIXTURES

P & W A R-4360-20 ENGINE

ENGINE NO. P-8727

AERONAUTICAL ENGINE LABORATORY, NAVAL AIR EXPERIMENTAL STATION, PHILA. PA.

PROJECTED NO. PP209 ENGR. DOTSEY

RATIOS: COMP. - 6.7:1, PROP. - .428:1

IMPELLER LOW - 6.95:1

HIGH - 8.07:1

IGNITION - SCINTILLA D4RN-2

PLUGS - AC 161

CARB. - STROMBERG PR-1008 **

FUEL - 115/145

OIL - 1100

* ECLIPSE TYPE 1626, MODEL 2

** SETTING P.L. NO. 390941-4, SER. NO. - 736152-A

NOTE:

1. ALTITUDES MEASURED BY 2 STATIC FITTINGS ON SIDES OF STRAIGHT CARB. SCOOP 5" UPSTREAM OF CARB. TOP DECK.
2. EXHAUST ALTITUDE MEASURED ON TAIL PIPES OF R60-1 COLLECTOR.
3. EACH SPEED RUN WITH A.P.C. UNIT AT CONSTANT SETTING.
4. HEAD TEMPERATURES MAINTAINED AT 480°F (MAX. LIMIT) FOR NORMAL RATED POWER AND ABOVE; AND AT 450°F FOR POWERS BELOW NORMAL RATED.

THIS AREA INDICATES UNSTABLE OPERATING RANGE; IT WAS POSSIBLE TO OBTAIN TWO FULL THROTTLE LINES AT 2200 RPM.

ALTITUDE - THOUSAND FEET

PLATE 1

ALTITUDE THOUSAND FEET

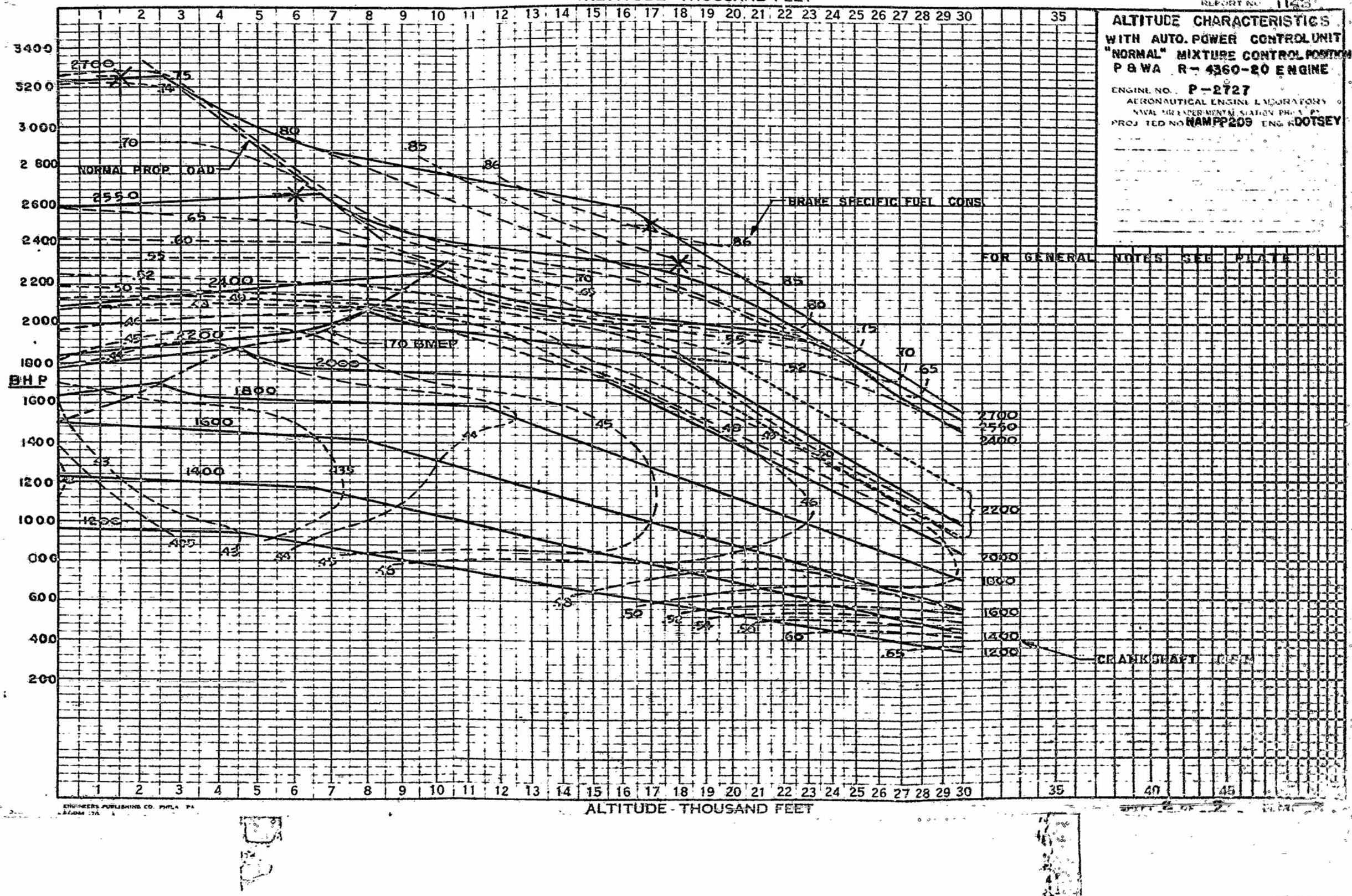
REPORT NO. 1143

ALTITUDE CHARACTERISTICS

WITH AUTO. POWER CONTROL UNIT
"NORMAL" MIXTURE CONTROL POSITION
P & WA R-4360-20 ENGINE

ENGINE NO. P-2727
AERONAUTICAL ENGINE LABORATORY
NAVAL AIR EXPERIMENTAL STATION PHILA. PA.
PROJECTED NO. NAMPP209 ENG'R DOTSEY

FOR GENERAL NOTES SEE PLATE



ALTITUDE - THOUSAND FEET

ENGINEERS PUBLISHING CO. PHILA. PA.
FORM 17A

ALTITUDE THOUSAND FEET

REPORT NO. 1148

ALTITUDE CHARACTERISTICS
WITH AUTO. POWER CONTROL UNIT
"NORMAL" MIXTURES
P&WA R-4360-20 ENGINE

ENGINE NO P-2727
AERONAUTICAL ENGINE LABORATORY
NAVAL AIR EXPERIMENTAL STATION PHILA. PA.
PROJECTED NO PP-209 ENG'R DOTSEY

FOR GENERAL NOTES SEE PLATE 1

AIR FLOW LB./HR.

24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000

CRANKSHAFT R.P.M.

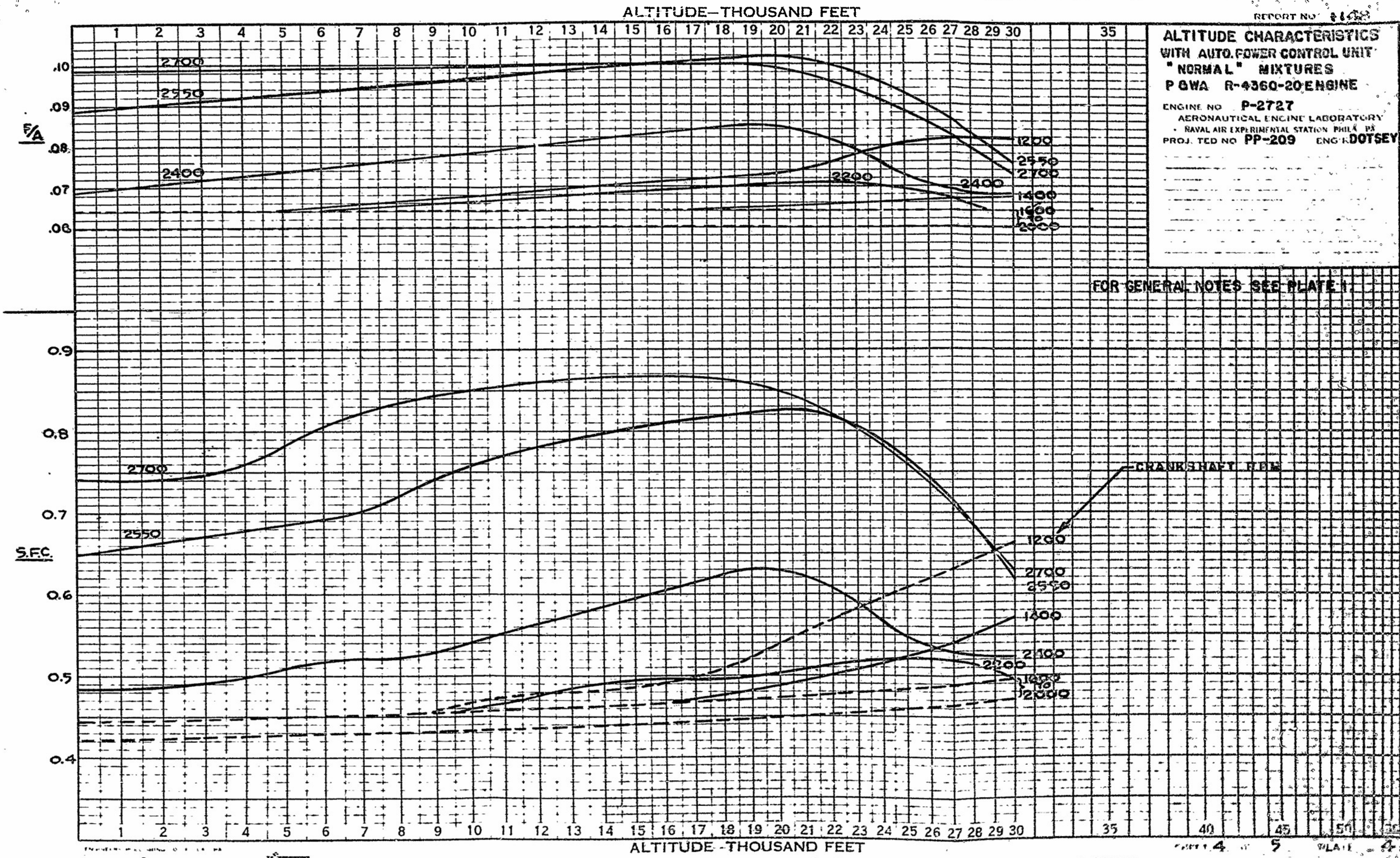
2700
2529
2400
2200
2000
1800
1600
1400
1200

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 35

ALTITUDE THOUSAND FEET

ENGINEERS PHILADELPHIA PA

SHEET 3 OF 5 PLATE 3



REPORT NO. [illegible]

ALTITUDE CHARACTERISTICS
WITH AUTO. POWER CONTROL UNIT
"NORMAL" MIXTURES
P&WA R-4360-20 ENGINE

ENGINE NO. **P-2727**
AERONAUTICAL ENGINE LABORATORY
NAVAL AIR EXPERIMENTAL STATION PHILA. PA.
PROJ. TED NO. **PP-209** ENG'R **DOTSEY**

FOR GENERAL NOTES SEE PLATE 1.

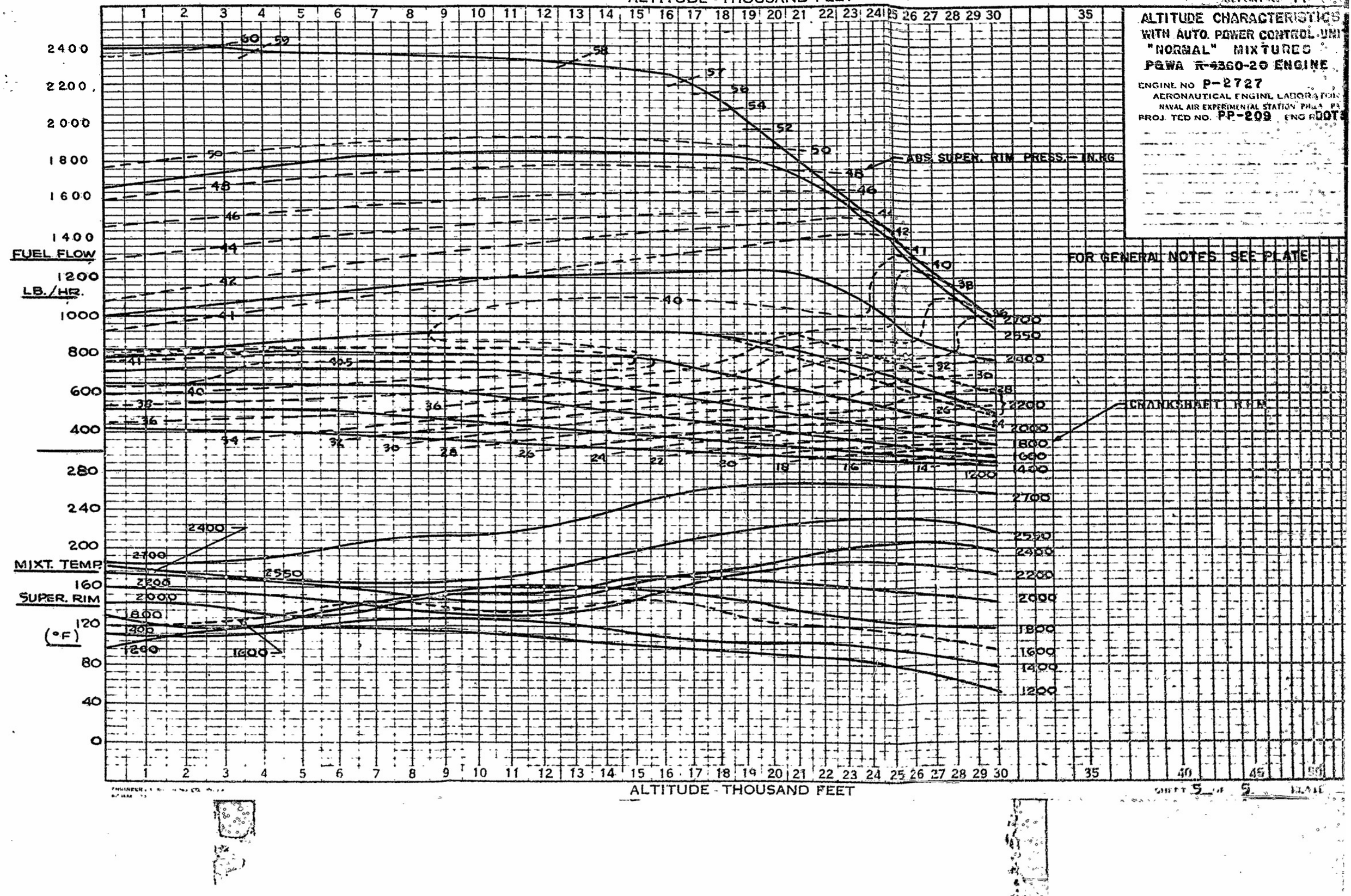
SHEET 4 OF 5 PLATE 4

ALTITUDE - THOUSAND FEET

REPORT NO. [illegible]

ALTITUDE CHARACTERISTICS
WITH AUTO. POWER CONTROL UNIT
"NORMAL" MIXTURES
P&WA R-4360-20 ENGINE

ENGINE NO P-2727
AERONAUTICAL ENGINE LABORATORY
NAVAL AIR EXPERIMENTAL STATION PHILA. PA.
PROJECTED NO. PP-209 ENGINEER ROOT



FOR GENERAL NOTES SEE PLATE 1

ALTITUDE - THOUSAND FEET

SHEET 5 OF 5 PLATE

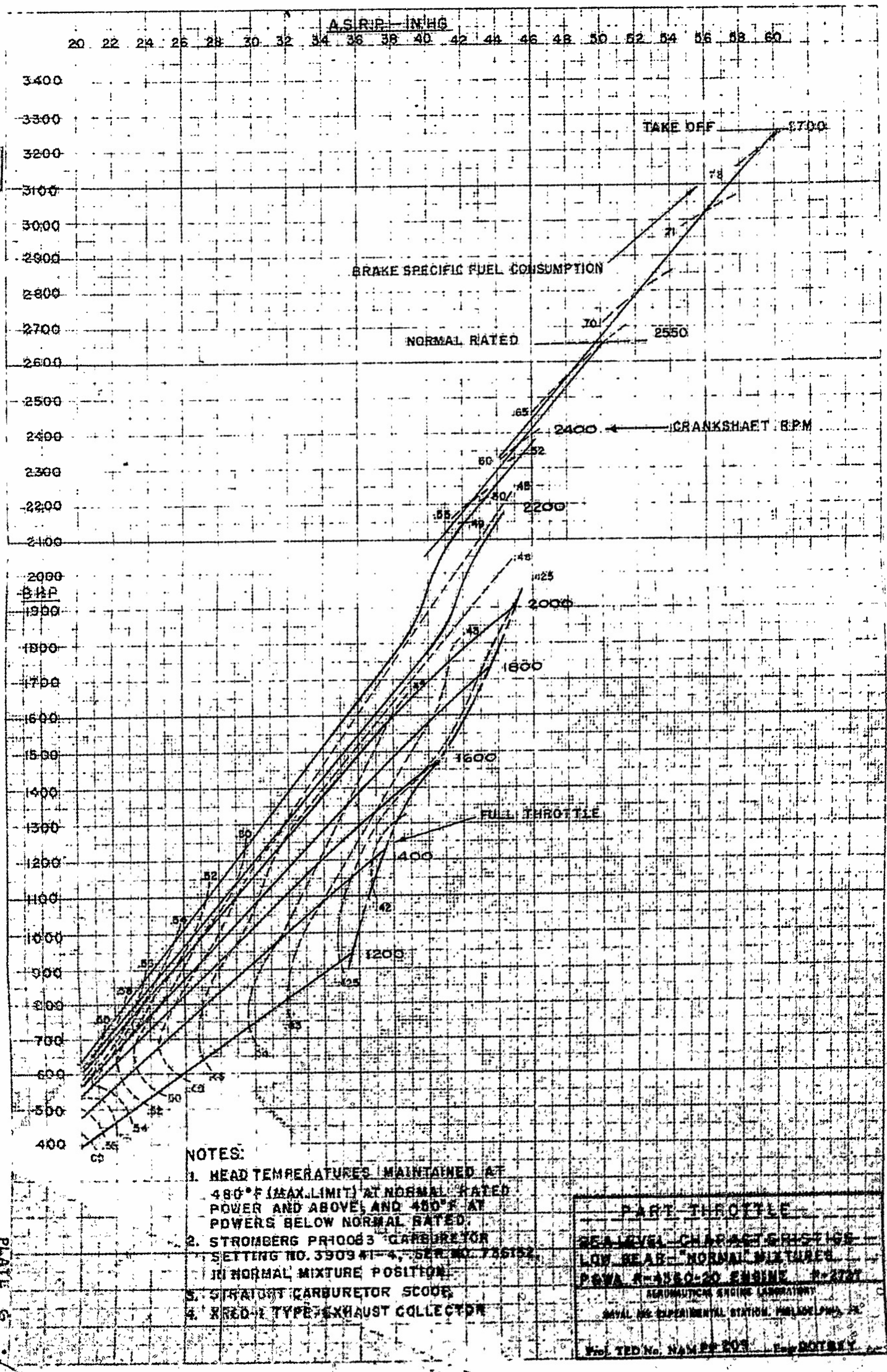
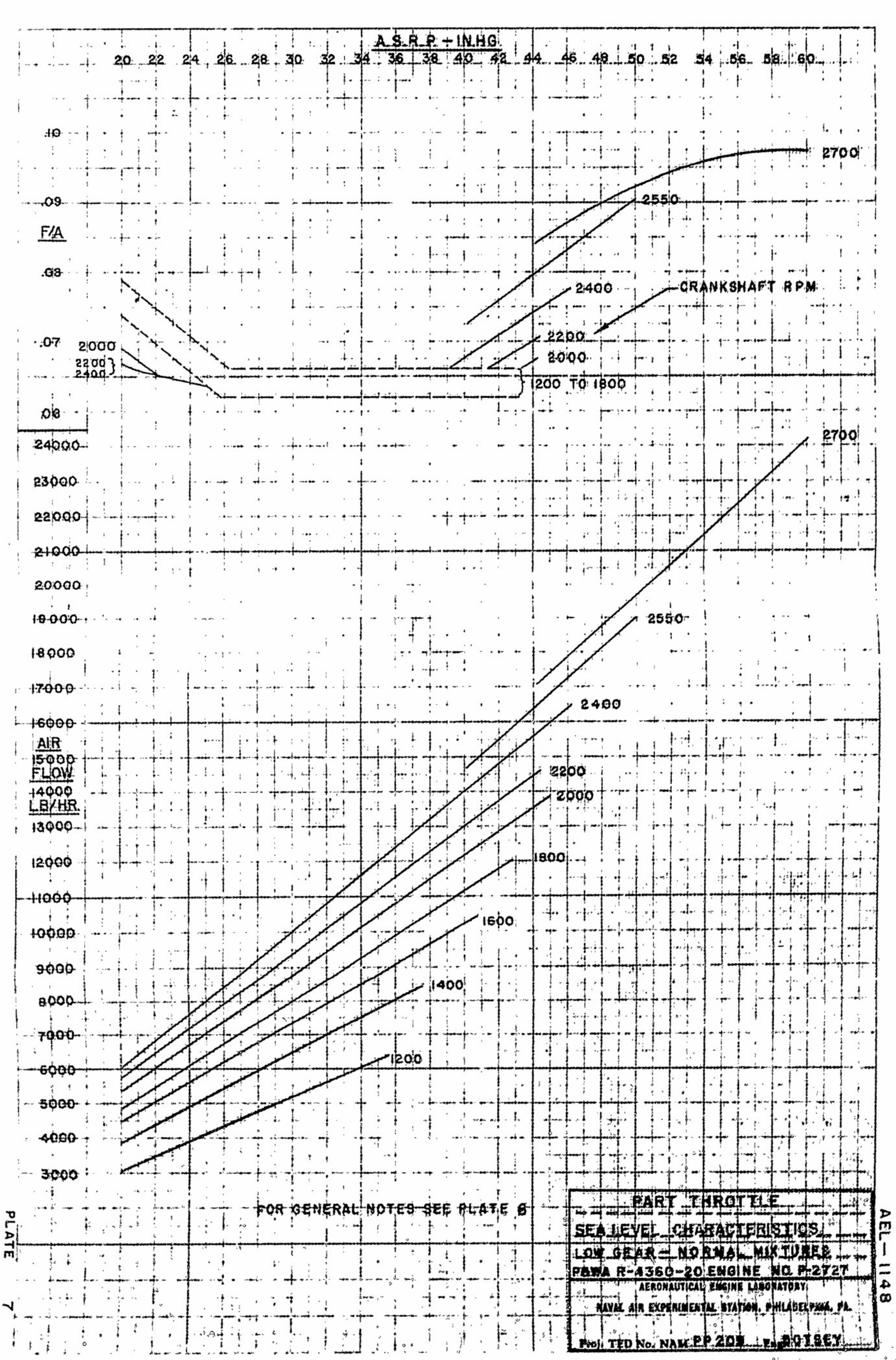


PLATE 6

AEL-1148

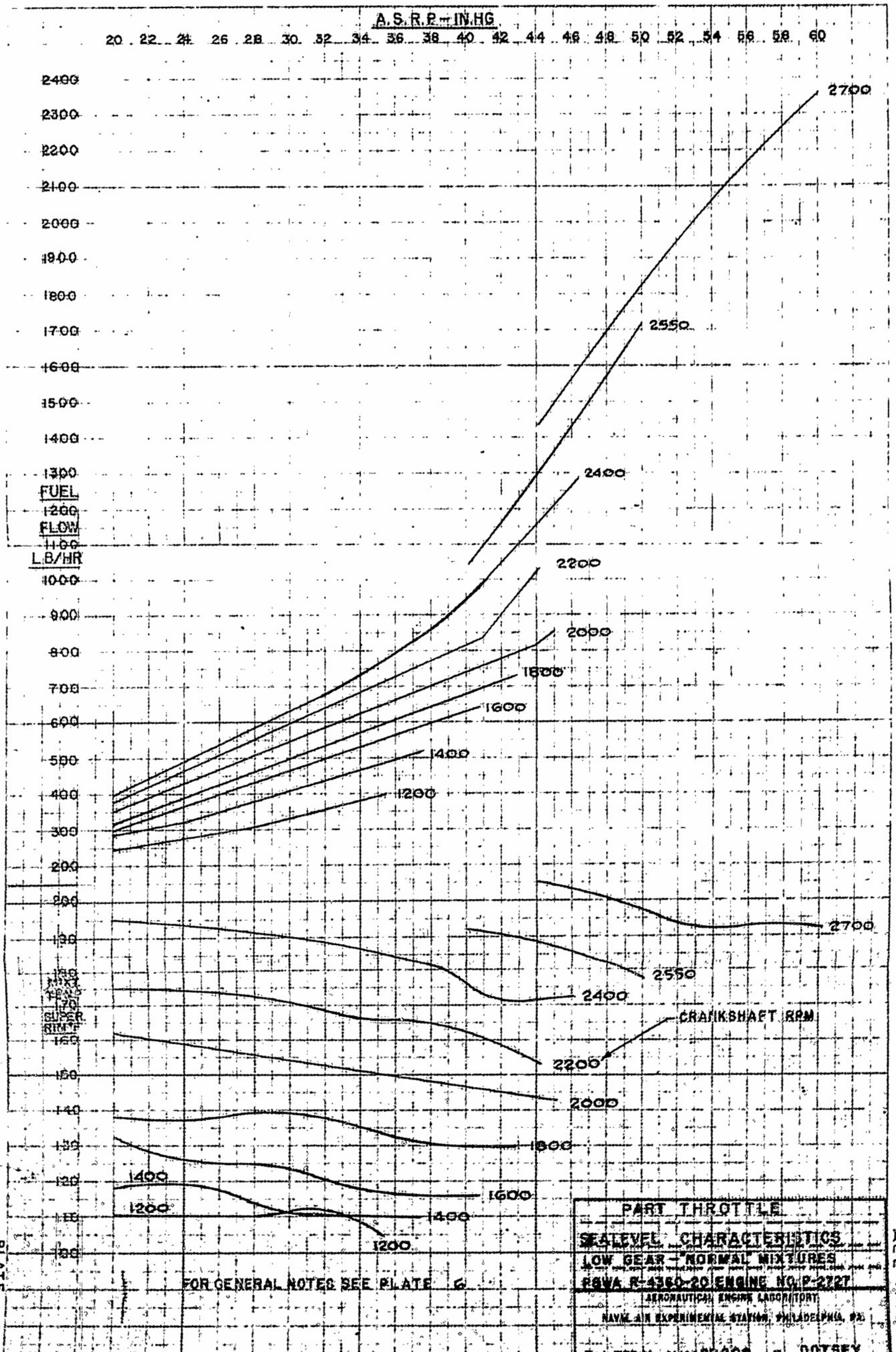


FOR GENERAL NOTES SEE PLATE 6

PART THROTTLE
SEA LEVEL CHARACTERISTICS
LOW GEAR — NORMAL MIXTURES
PAWA R-4360-20 ENGINE NO. P-2727
AERONAUTICAL ENGINE LABORATORY
NAVAL AIR EXPERIMENTAL STATION, PHILADELPHIA, PA.
Proj. TED No. NAM PP 203 Eng. ROISEY

PLATE 7

AEL-1148



PART THROTTLE
SEALEVEL CHARACTERISTICS
LOW GEAR - "NORMAL" MIXTURES
P&WA R-4360-20 ENGINE NO. P-2727
AERONAUTICAL ENGINE LABORATORY
NAVAL AIR EXPERIMENTAL STATION, PHILADELPHIA, PA.
Proj. TED No. NAM PP 209 Engr. DOTSEY

FOR GENERAL NOTES SEE PLATE 6

PLATE 8

AEL-1148

ALTITUDE THOUSAND FEET

ALTITUDE CHARACTERISTICS
WITH AUTO. POWER CONTROL UNIT
"RICH" MIXTURE CONTROL POSITION
POWA R-4360-20 ENGINE
P-2727
PP-209 DOTSEY

FOR GENERAL NOTES SEE PLATE

X- MFRS. GUAR. CRITICAL ALTITUDE

NORMAL PROP. LOAD

MILITARY RATED

NORMAL RATED

CRANKSHAFT RPM

BHP

A.S.R.P

2700
2550
2400

ALTITUDE THOUSAND FEET

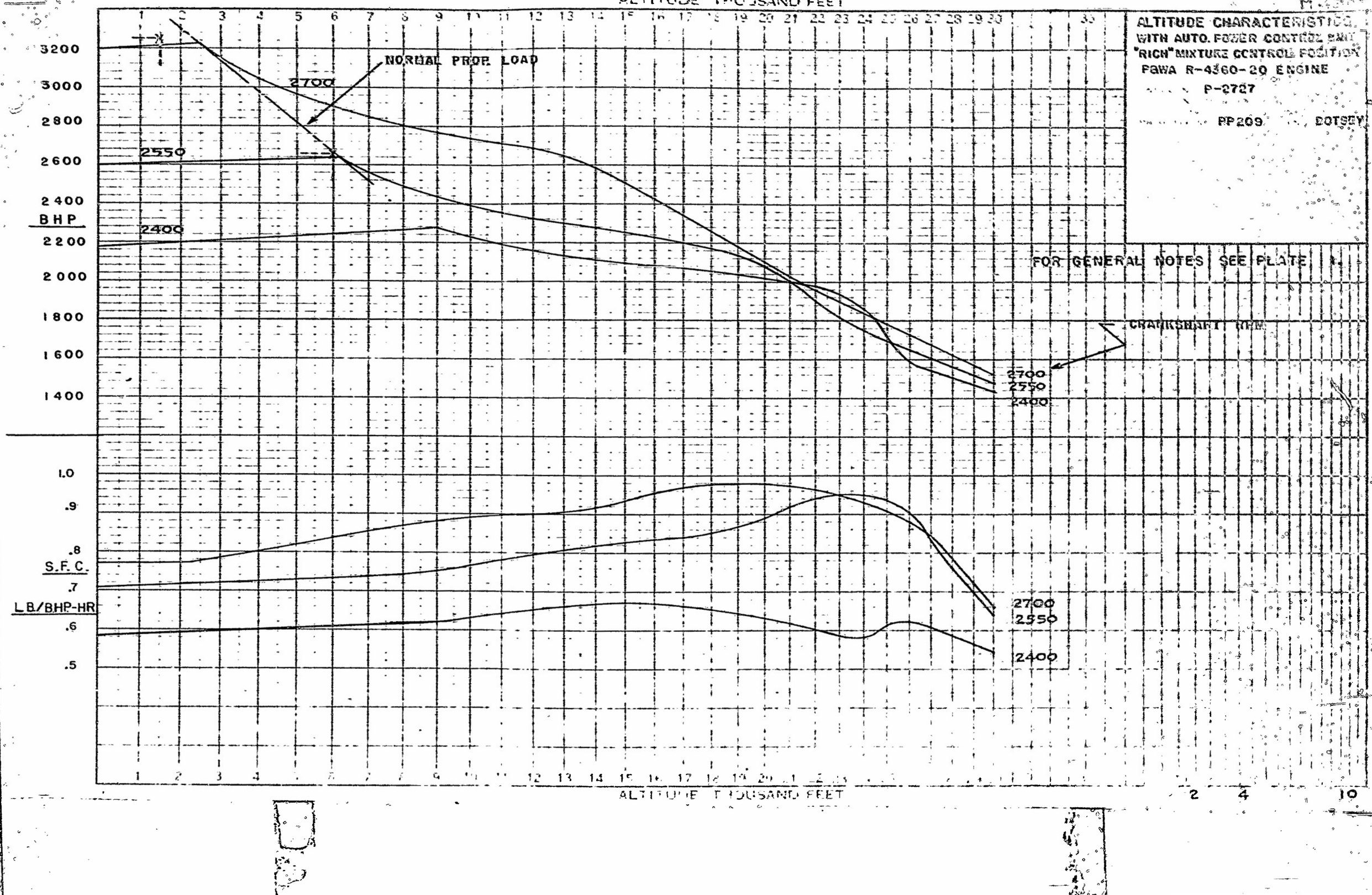
ALTITUDE THOUSAND FEET

ALTITUDE CHARACTERISTICS

WITH AUTO. POWER CONTROL UNIT
"RICH" MIXTURE CONTROL POSITION
PRWA R-4360-20 ENGINE

P-2727

PP209 DOTSOY



FOR GENERAL NOTES SEE PLATE

ALTITUDE THOUSAND FEET

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

F/A

.110
.100
.090
.080
.070
.060

2700
2550
2400

2550
2700
2400

FOR GENERAL NOTES SEE PLATE 1.

AIR FLOW LB./HR.

24000
22000
20000
18000
16000
14000
12000

CRANKSHAFT R.P.M.

2700
2550
2400

ALTITUDE THOUSAND FEET

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

ALTITUDE CHARACTERISTICS
WITH AUTO. POWER CONTROL UNIT
"RICH" MIXTURE CONTROL POSITION
P&WA R-4360-20 ENGINE

P-2727

PP 209 DOTSEY

ALTITUDE THOUSAND FEET

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 35

FUEL FLOW LB/HR

2600 2400 2200 2000 1800 1600 1400 1200 1000

60.4 59 58 56 54 52 50 48 46 44 43 42 40 38 36 34 32

50 49.7 43.0

ABSOLUTE SUPER. RIM PRESS. — IN. HG

2700 2550 2400

MIXT. TEMP. SUPER. RIM °F

260 240 220 200 180 160 140

2700 2550 2400

ALTITUDE CHARACTERISTICS WITH AUTO. POWER CONTROL UNIT "RICH" MIXTURE CONTROL POSITION P&WA R-4360-20 ENGINE

ENGINE NO. P-2727

PP-209 ENG. DOTSEY

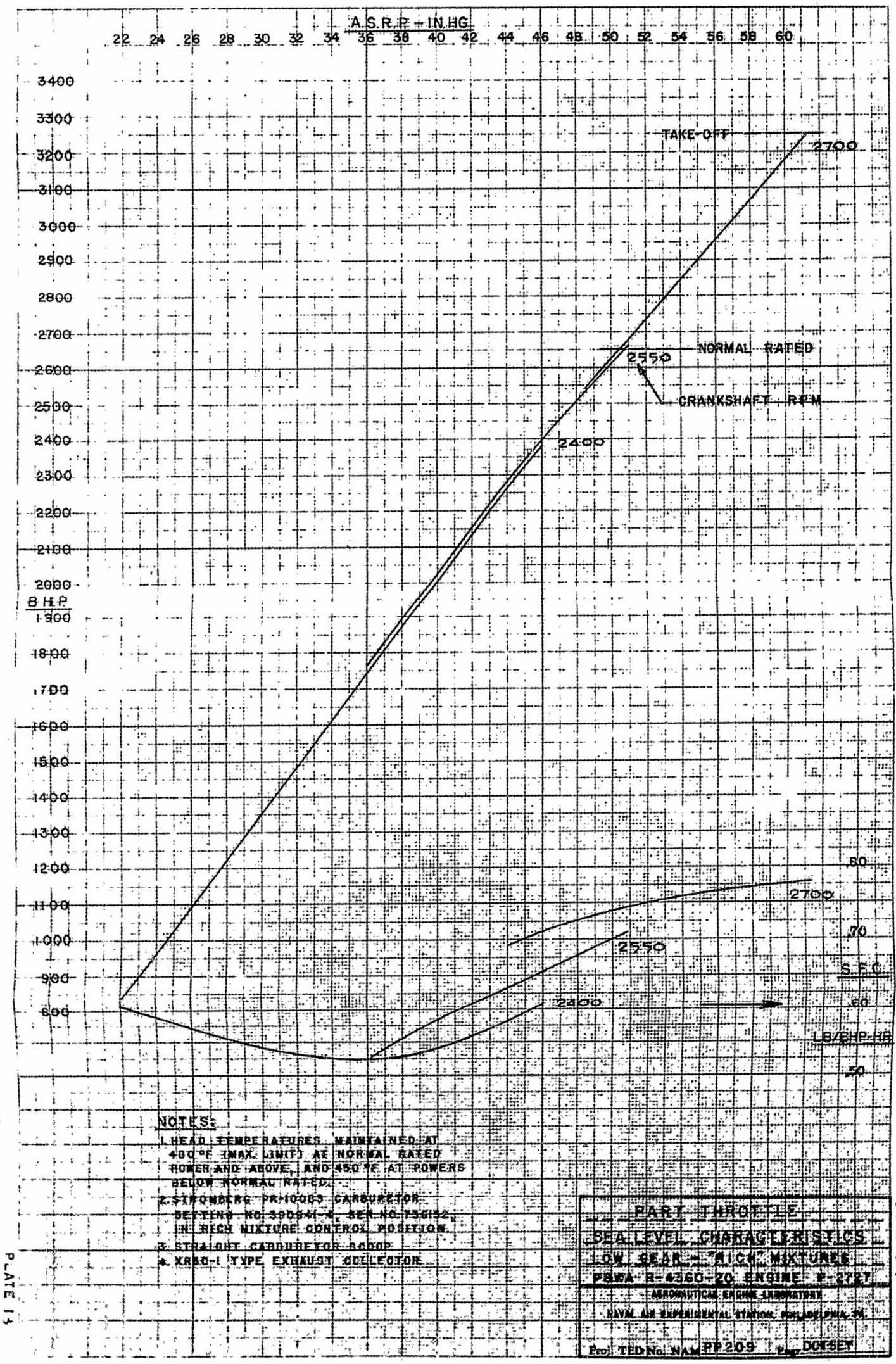
FOR GENERAL NOTES SEE PLATE 1.

CRANKSHAFT RPM

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

ALTITUDE THOUSAND FEET

4 4 12



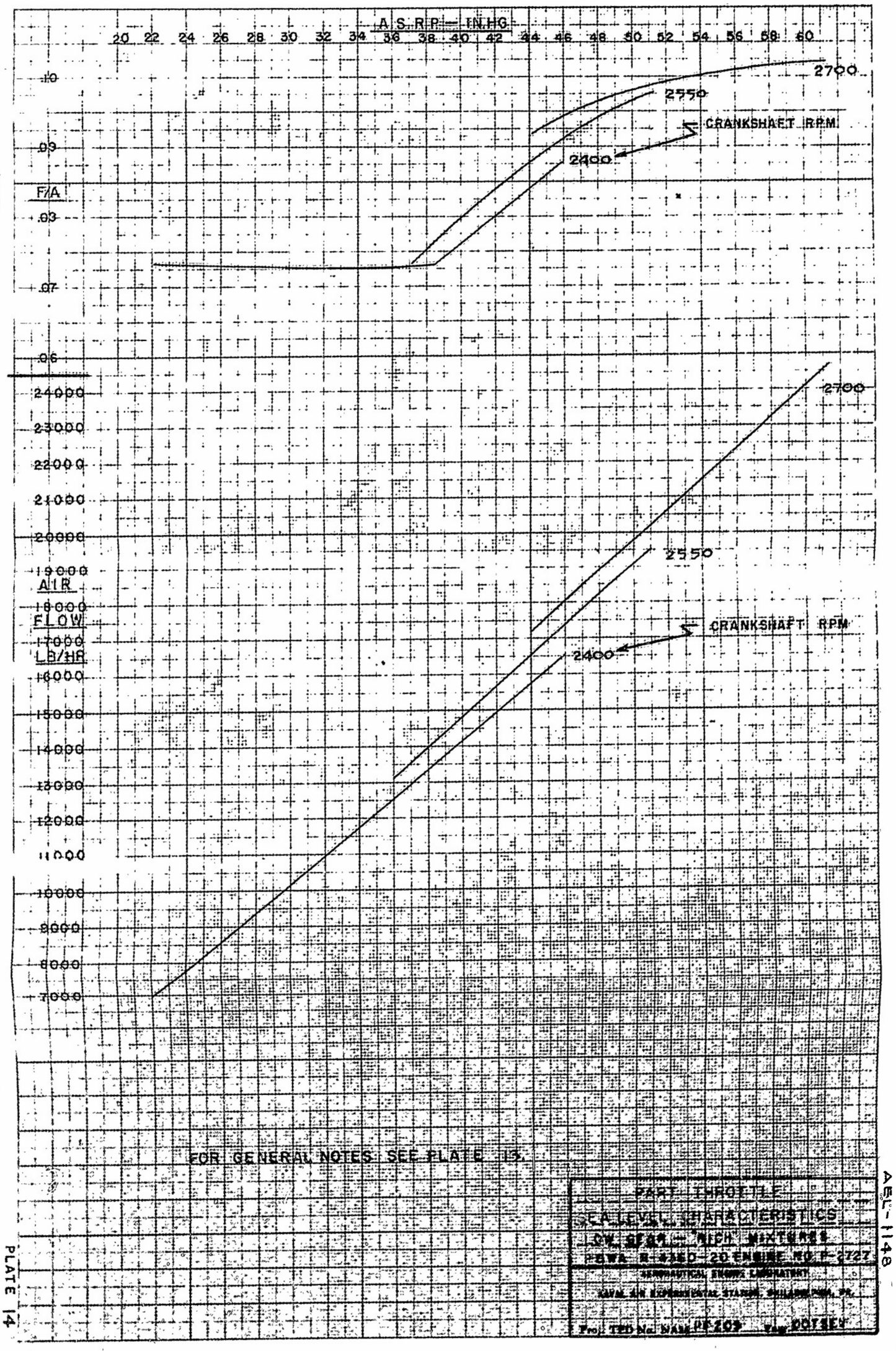
NOTES:

1. HEAD TEMPERATURES MAINTAINED AT 480°F (MAX. LIMIT) AT NORMAL RATED POWER AND ABOVE, AND 460°F AT POWERS BELOW NORMAL RATED.
2. STROMBERG PR-10083 CARBURETOR SETTING NO. 390341-4, SER. NO. 136152, IN RICH MIXTURE CONTROL POSITION.
3. STRAIGHT CARBURETOR SCOOP.
4. XRSO-1 TYPE EXHAUST COLLECTOR.

PART THROTTLE
SEA LEVEL CHARACTERISTICS
LOW GEAR — "RICH" MIXTURES
PWA R-4360-20 ENGINE E-2727
AERONAUTICAL ENGINE LABORATORY
NAVAL AIR EXPERIMENTAL STATION, PHILADELPHIA, PA.
Proj. TED No. NAM PP209 Plot DOTSET

AEL-1149

PLATE 13

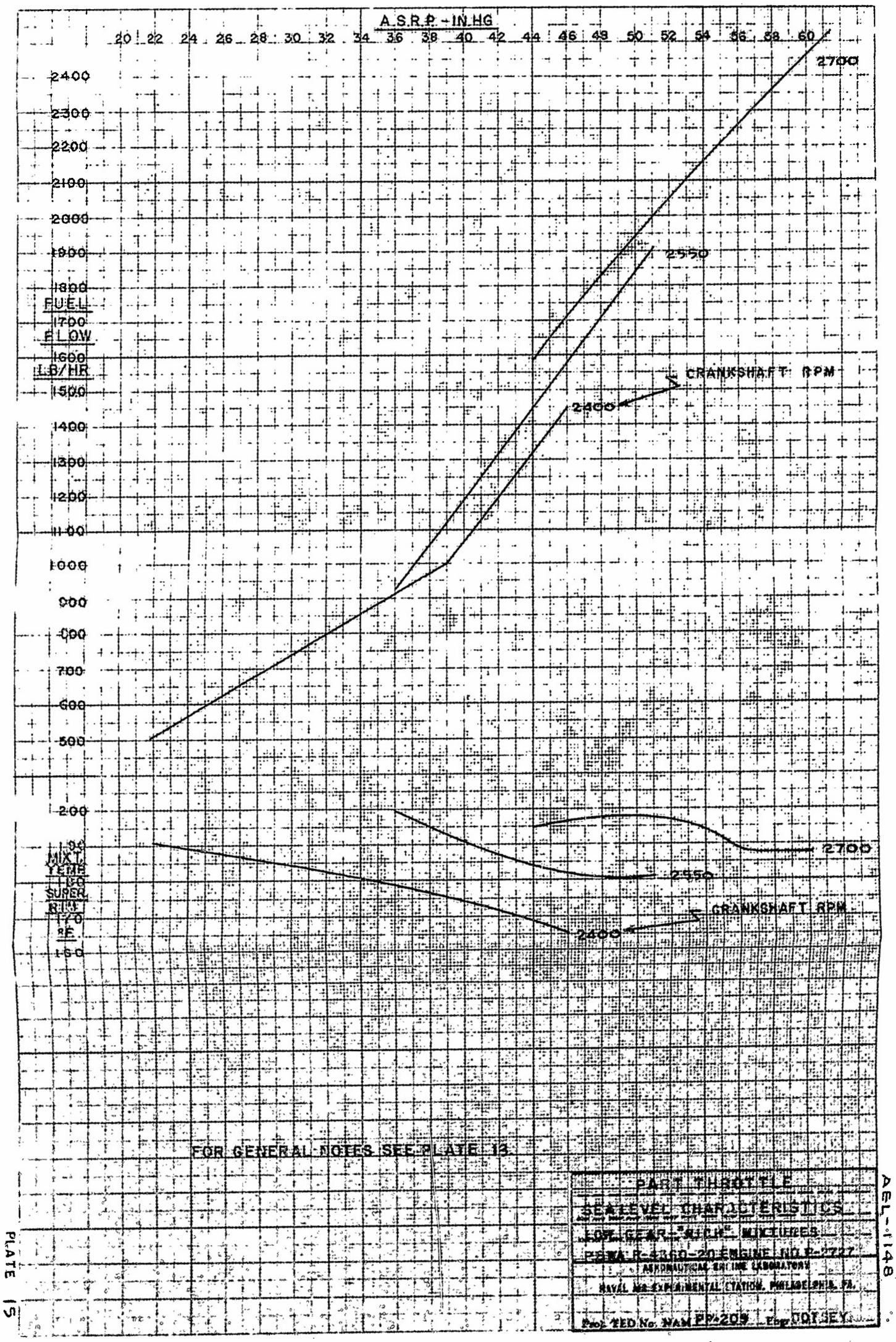


FOR GENERAL NOTES SEE PLATE 13.

PART THROTTLE
SEA LEVEL CHARACTERISTICS
LOW GEOR — RICH MIXTURES
PBWA R-4360-20 ENGINE NO P-2727
AERONAUTICAL ENGINE LABORATORY
NAVAL AIR EXPERIMENTAL STATION, PHILADELPHIA, PA.
Proj. TED No. NAM PF 209 Eng. DOTSEY

AEL-1148

PLATE 14

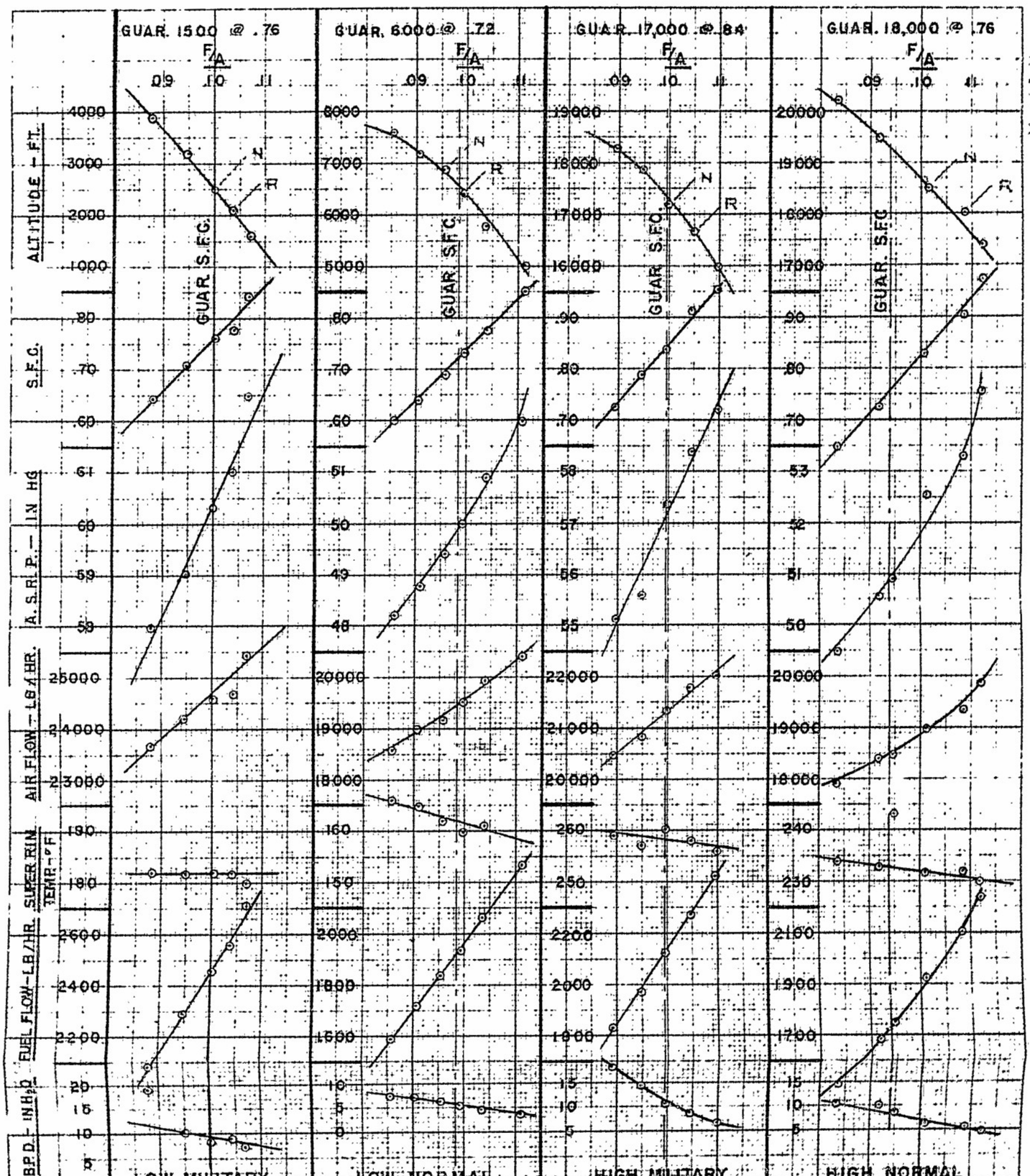


FOR GENERAL NOTES SEE PLATE 13.

PART THROTTLE
SEA LEVEL CHARACTERISTICS
LOW GEAR - "RICH" MIXTURES
P&WA R-4360-20 ENGINE NO. P-2727
AERONAUTICAL ENGINE LABORATORY
NAVAL AIR EXPERIMENTAL STATION, PHILADELPHIA, PA.
Prod. TED No. NAM PP-209 Engr. DOTSEY

PLATE 15

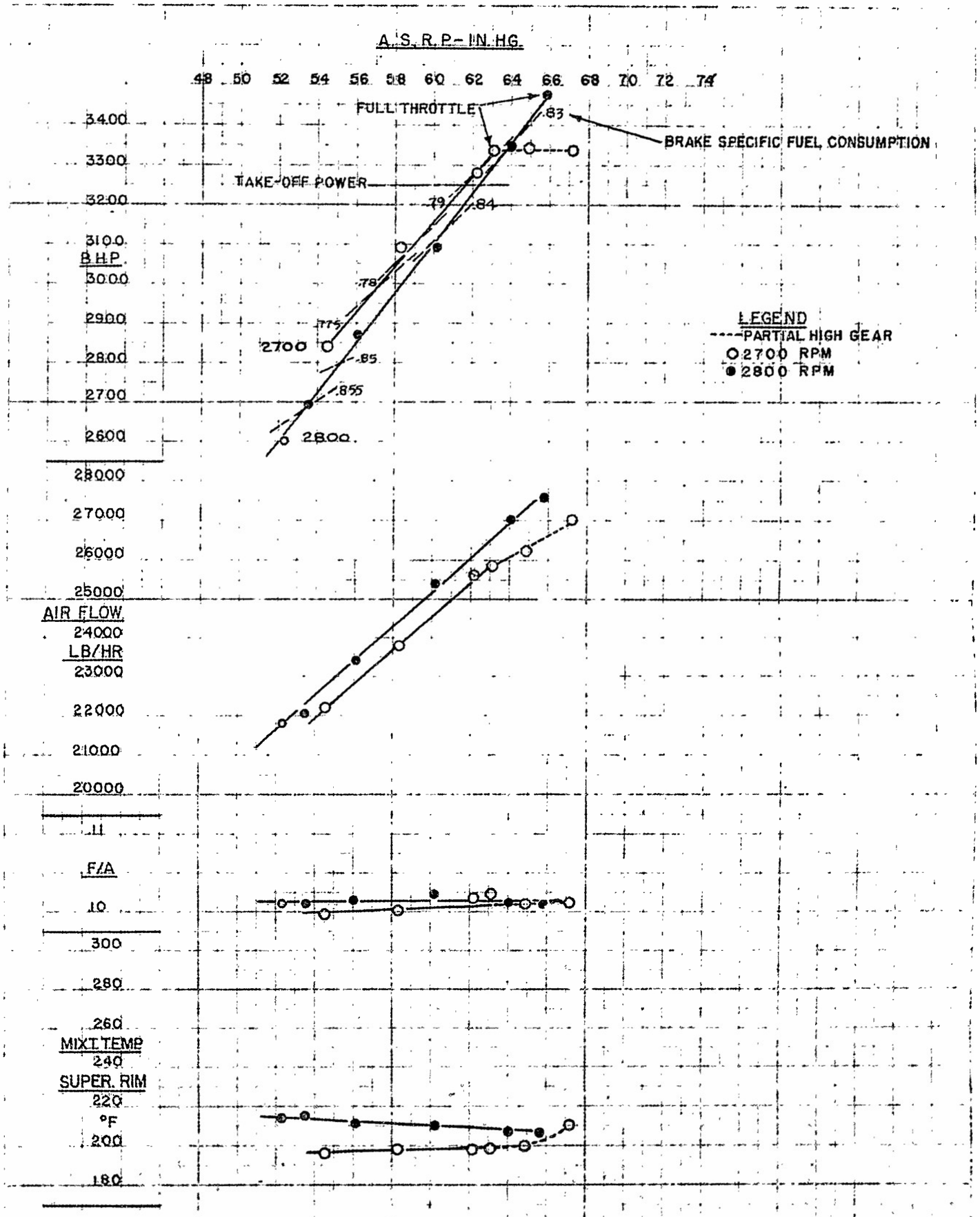
AEL-1148



NOTE:
1. CARB. ALTITUDE MEASURED BY STATIC FITTING 5" ABOVE TOP DECK OF CARB. (ON RIGHT SIDE OF STRAIGHT SCOOP).
2. XR60 - AIRPLANE - TYPE EXH. COLLECTOR USED FOR ALL OPERATION.
3. GUAR. S.F.C. AS PER P.B.Y. SPEC. NO. N-70568 OF 23 FEB. 43.
4. PR 100-B2 CARB. USED, MANUALLY CONTROLLED.
5. FUEL AN-F-48 (115/145).
6. B.P.D. IN IN H2O IS AVERAGE DROP FROM D4 AND D7 TO ALL CYLINDER HEADS.
7. IMPELLER RATIOS — LOW 6.95:1, HIGH 9.07:1.

CRITICAL ALTITUDE CHECKS
NORMAL & MILITARY
P&W R-4360-20 ENGINE
SER. NO. P-2727
AERONAUTICAL ENGINE LABORATORY
NAVAL AIR EXPERIMENTAL STATION, PHILADELPHIA, PA.
Proj. TED No. NAM PP-209 Engr. DOTSEY

PLATE 16



NOTES:

1. AN-F-48 (115-145) GRADE FUEL.
2. 60° F CAT.
3. STRAIGHT CARB. SCOOP.
4. FOR GENERAL NOTES SEE PLATE 13.

SEA LEVEL
OVERPOWER CHARACTERISTICS
LOW GEAR - "RICH" MIXTURES
P&WA R-4360-20 ENGINE NO. P-2727
AERONAUTICAL ENGINE LABORATORY,
NAVAL AIR EXPERIMENTAL STATION, PHILADELPHIA, PA.
Proj. TED No. NAMPP-203 Engr. DOTSEY

AEL-1140

PLATE 17

REPORT NO 1148

ALTITUDE CHARACTERISTICS OVER-POWER RUNS

HIGH GEAR—"RICH" MIXTURE

P&WA R-4360-20 ENGINE

ENGINE NO P-2727

AERONAUTICAL ENGINE LABORATORY

NAVAL AIR EXPERIMENTAL STATION PHILA., PA.

PROJECTED NO PP209 ENGR DOTSEY

ALTITUDE - THOUSAND FEET

BHP

LIGHT DETONATION

INCIPIENT DETONATION

MFR'S. GUAR. CRITICAL ALTITUDE

ABSOLUTE SUPER RIM PRESS. - IN HG

67.3

65

60

55

50

45

2700 RPM

FOR GENERAL NOTES SEE PLATE 1.

BHP

LIGHT DETONATION

INCIPIENT DETONATION

.975

BRAKE SPECIFIC FUEL CONSUMPTION

.97

.95

.93

2700 RPM

ALTITUDE THOUSAND FEET

SHEET 1 OF 2 PLATE 18

REPORT NO. 1148

ALTITUDE CHARACTERISTICS
OVER-POWER RUNS
HIGH GEAR—"RICH" MIXTURE
P&WA R-4360-20 ENGINE

ENGINE NO P-2727
AERONAUTICAL ENGINE LABORATORY
NAVAL AIR EXPERIMENTAL STATION PHILA. PA.
PROJECTED NO PP209 ENG HOOTSEY

FOR GENERAL NOTES SEE PLATE 1

ALTITUDE—THOUSAND FEET

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 35

AIR FLOW LB/HR
26000
24000
22000
20000
18000
16000
14000

2700 RPM

F/A
.11
.10

MIXT. TEMP °F
290
280
270

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 35 40 45 50 55

ALTITUDE THOUSAND FEET

SHEET 2 OF 2 SHEETS 19

REPORT NO. 1148

ALTITUDE THOUSAND FEET

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 35

B.H.P.
3200
3000
2800
2600
2400
2200
2000
1800

A.S.R.P.
60
55
50
45
40
35

IN. HG.

ALTITUDE THOUSAND FEET

ALTITUDE CHARACTERISTICS
WITH AUTO. POWER CONTROL UNIT
"NORMAL" MIXTURE CONTROL POS.
P&WA R-4360-20 ENGINE

ENGINE NO P-2727
AERONAUTICAL ENGINE LABORATORY
NAVAL AIR EXPERIMENTAL STATION PHILA. PA.
PROJECTED NO PP209 ENGR DOTSEY

FOR GENERAL NOTES SEE PLATE I

CRANKSHAFT RPM
2700
2550

LEGEND
(2700 RPM)
○ INCREASING ALTITUDE
△ DECREASING ALTITUDE
(2550 RPM)
● INCREASING ALTITUDE
+ DECREASING ALTITUDE
X MEAS. QUAR. CRITICAL ALTITUDES

CRANKSHAFT RPM
2700
2550

SHEET 3 PLATE 20

REPORT NO. 1148

ALTITUDE THOUSAND FEET

ALTITUDE CHARACTERISTICS
WITH AUTO. POWER CONTROL UNIT
"NORMAL" MIXTURE CONTROL POS.
P&WA R-4360-20 ENGINE

ENGINE NO P-2727
AERONAUTICAL ENGINE LABORATORY
NAVAL AIR EXPERIMENTAL STATION PHILA. PA.
PROJ. TED NO PP209 ENG R DOTSEY

FOR GENERAL NOTES SEE PLATE 1.

AIR FLOW LB/HR

F/A

MIXT. TEMP. °F

2700
2550

LEGEND
(2700 RPM)
○ INCREASING ALTITUDE
△ DECREASING ALTITUDE
(2550 RPM)
● INCREASING ALTITUDE
+ DECREASING ALTITUDE

CRANKSHAFT R.P.M.

ALTITUDE--THOUSAND FEET

REPORT NO. 1148

ALTITUDE THOUSAND FEET

ALTITUDE CHARACTERISTICS
WITH AUTO. POWER CONTROL UNIT
"NORMAL" MIXTURE CONTROL POS.
P&WA R-4360-20 ENGINE

ENGINE NO P-2727
AERONAUTICAL ENGINE LABORATORY
NAVAL AIR EXPERIMENTAL STATION PHILA PA
PROJ TED NO PP209 ENGR DOTSEY

FOR GENERAL NOTES SEE PLATE 1.

OIL FLOW LB/MIN

HEAT REJ. TO OIL BTU/MIN

S.F.C. LB/BHP-HR

2700

2550

2700

2550

2700

2550

LEGEND
(2700 RPM)
○ INCREASING ALTITUDE
△ DECREASING ALTITUDE
(2550 RPM)
● INCREASING ALTITUDE
+ DECREASING ALTITUDE

SPEC LIMITS

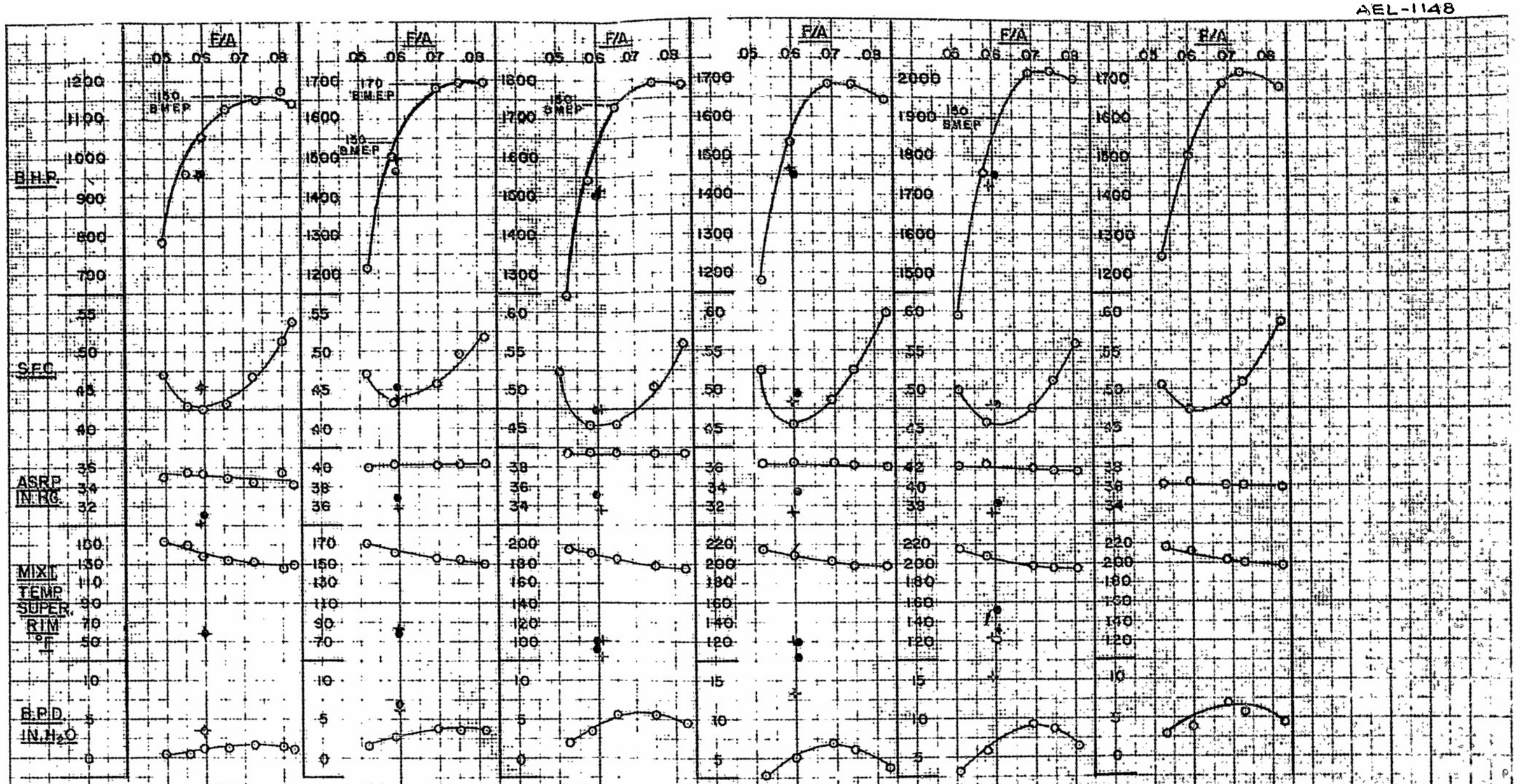
	NORMAL	MILITARY
OIL IN TEMP °F	165	185
OIL FLOW — LB/MIN	400	500
HEAT REJ. TO OIL BTU/MIN	11,000	12,500

CRANKSHAFT RPM

ALTITUDE - THOUSAND FEET

SHEET 3 OF 3 PLATE 22

AEL-1148



R.P.M.	1400	1800	2100	2300	2300	2300
AIR FLOW ~ LB/HR.	7400	11100	12000	12000	14000	12000
CARB. AIR TEMP. °F.	100	100	100	100	100	100
MAX CYL. HD. TEMP. °F.	450	450	450	450	450	450
EXHAUST BACK PRESS.	—	—	—	—	—	5" HG

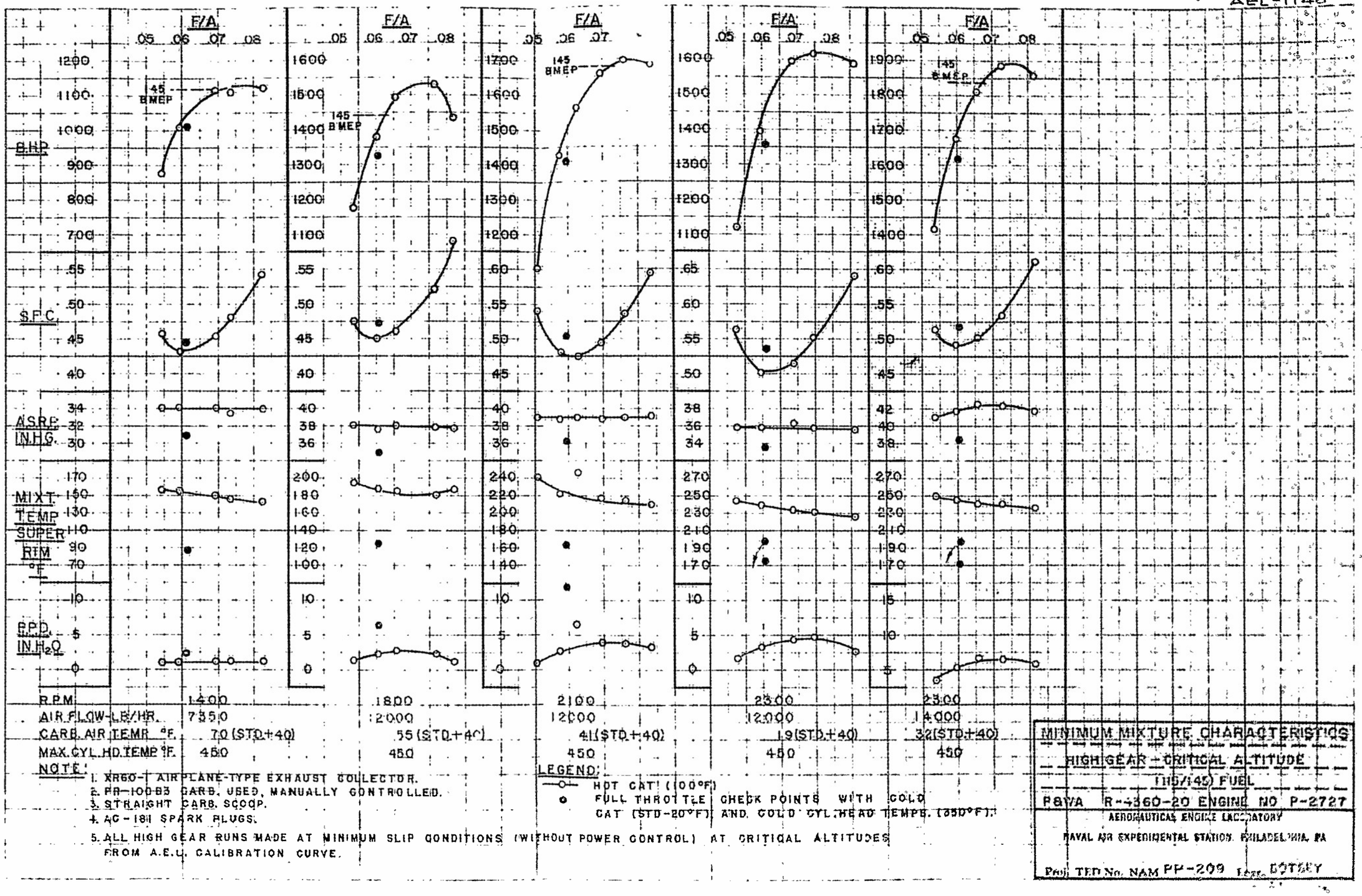
NOTE:
1. XR60-1 AIRPLANE-TYPE EXHAUST COLLECTOR.
2. PR-10003 CARB. USED, MANUALLY CONTROLLED.
3. STRAIGHT CARB. SCOOP.
4. AC-181 SPARK PLUGS.

LEGEND:
- O HOT CAT (100°F)
- o PART THROTTLE CHECK POINTS WITH 0°F. CAT. AND 350°F. CYL. HEAD TEMPS.
- + FULL THROTTLE CHECK POINTS WITH 0°F. CAT. AND 350°F. CYL. HEAD TEMPS.

MINIMUM MIXTURE CHARACTERISTICS
LOW GEAR - SEA LEVEL
(115/145) FUEL
PBWA R-4360-20 ENGINE P-2/27
AERONAUTICAL ENGINE LABORATORY
NAVAL AIR EXPERIMENTAL STATION, PHILADELPHIA, PA.
Proj. TED No. NAM PP200 DOTSEY

PLATE 23

AEL-1148



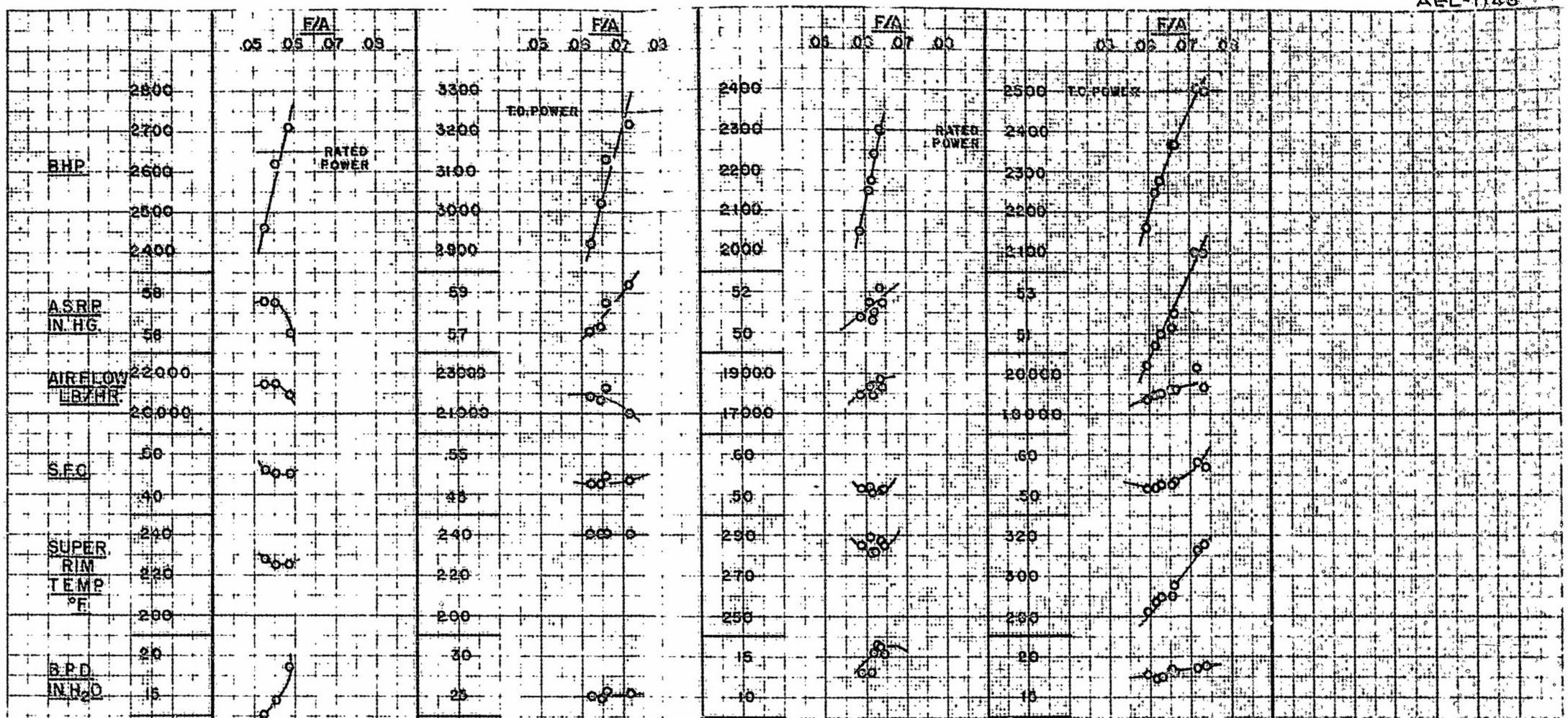
R.P.M.	1400	1800	2100	2300	2500
AIR FLOW-LB/HR.	7350	12000	12000	12000	14000
CARB. AIR TEMP °F.	70 (STD+40)	55 (STD+40)	41 (STD+40)	19 (STD+40)	32 (STD+40)
MAX. CYL. HD. TEMP °F.	450	450	450	450	450

NOTE:
1. XR60-1 AIRPLANE-TYPE EXHAUST COLLECTOR.
2. PR-100-B3 CARB. USED, MANUALLY CONTROLLED.
3. STRAIGHT CARB. SCOOP.
4. AC-181 SPARK PLUGS.
5. ALL HIGH GEAR RUNS MADE AT MINIMUM SLIP CONDITIONS (WITHOUT POWER CONTROL) AT CRITICAL ALTITUDES FROM A.E.L. CALIBRATION CURVE.

LEGEND:
—o— HOT CAT (100°F)
• FULL THROTTLE CHECK POINTS WITH COLD CAT (STD-20°F) AND COLD CYL. HEAD TEMPS. (350°F).

MINIMUM MIXTURE CHARACTERISTICS
HIGH GEAR – CRITICAL ALTITUDE
(115/145) FUEL
P&WA R-4360-20 ENGINE NO P-2727
AERONAUTICAL ENGINE LABORATORY
NAVAL AIR EXPERIMENTAL STATION, PHILADELPHIA, PA
Proj. TED No. NAM PP-209 Ltr. DOTSEY

AEL-1148

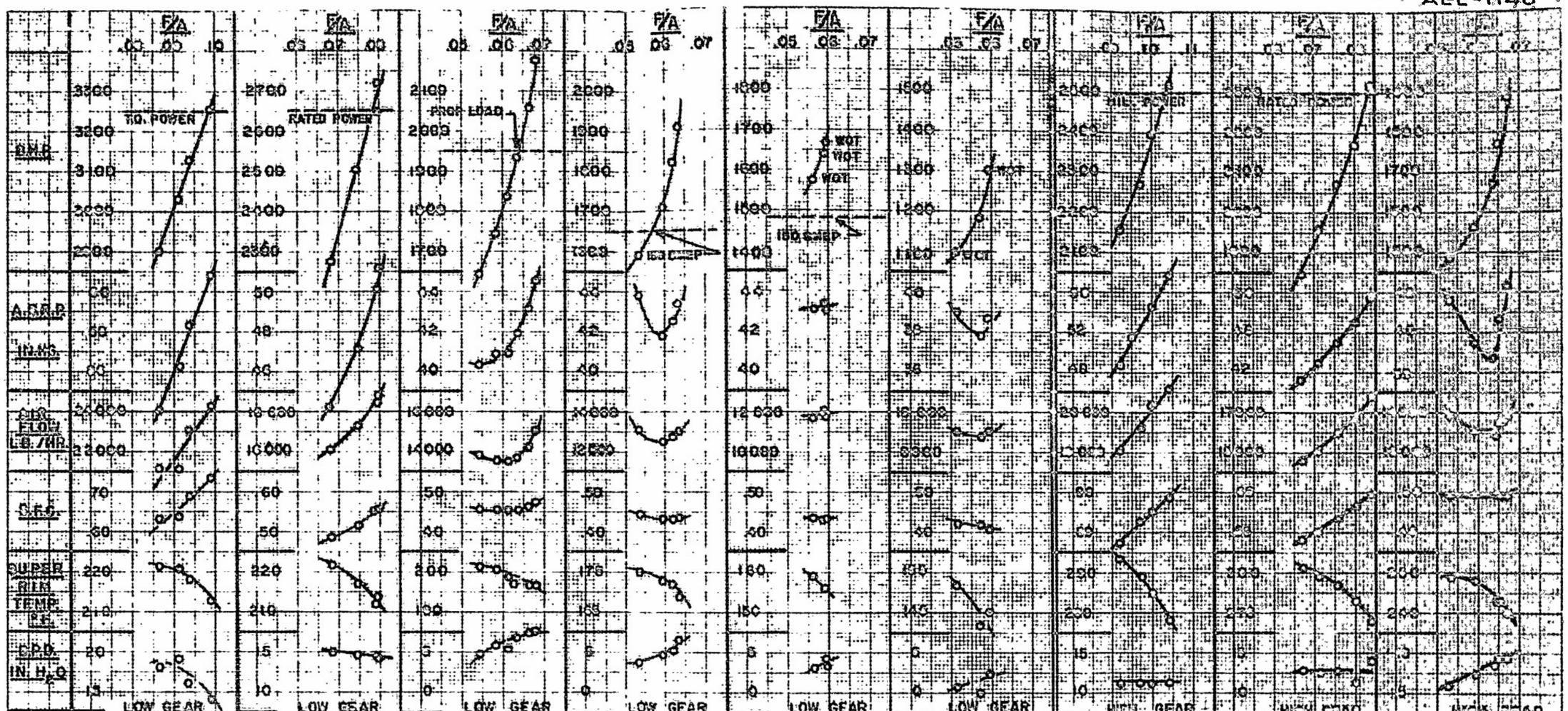


	LOW GEAR	LOW GEAR	HIGH GEAR	HIGH GEAR
R.P.M.	2550	2700	2550	2700
ALT., FT.	S.L.	S.L.	17000	16000
C.A.T., °F	100 (STD+40)	100 (STD+40)	39 (STD+40)	43 (STD+40)
MAX. HD TEMP. °F	480	493	479	481
MAX. FLANGE TEMP. °F	278	285	276	284
COOLING AIR TEMP. °F	64	57	69	69

NOTE:
1. ALL HIGH GEAR RUNS MADE AT CRITICAL ALTITUDES (WITHOUT POWER CONTROL).
2. MODIFIED ENGINE INCORPORATING 9.07:1 HIGH GEAR RATIO.
3. CARB. ALTITUDE MEASURED BY STATIC FITTING 5" ABOVE TOP DECK OF CARB. (ON RIGHT SIDE OF STRAIGHT CCOOP).
4. XR60-1 AIRPLANE-TYPE EXHAUST COLLECTOR.
5. PR-10083 CARB. USED, MANUALLY CONTROLLED.

DETONATION-LIMITED MIXTURE
RESPONSE CURVES, LOW & HIGH GEAR
P&WA R-4360-20 ENGINE NO. P-2727
(115/145) FUEL
AERONAUTICAL ENGINE LABORATORY
NAVAL AIR EXPERIMENTAL STATION, PHILADELPHIA, PA.
Proj. TED No. NAM PP-200 Type DDTSEM

PLATE 25



	LOW GEAR	LOW GEAR	LOW GEAR	LOW GEAR	LOW GEAR	LOW GEAR	HIGH GEAR	HIGH GEAR	HIGH GEAR
R.P.M.	2700	2550	2300	2000	1800	1600	2700	2000	[illegible]
ALT. FT.	S.L.	S.L.	S.L.	S.L.	S.L.	S.L.	12,500	13,000	12,000
CAT. °F.	100 (STD.+40)	100 (STD.+40)	100 (STD.+40)	100 (STD.+40)	100 (STD.+40)	100 (STD.+40)	64 (STD.+40)	62 (STD.+40)	[illegible]
MAX. HD. °F.	478	480	483	445	445	460	477	470	[illegible]
MAX. FL. GE. °F.	268	263	255	247	254	263	[illegible]	[illegible]	[illegible]
COOL. AIR, °F.	74	73	65	71	74	75	[illegible]	[illegible]	[illegible]

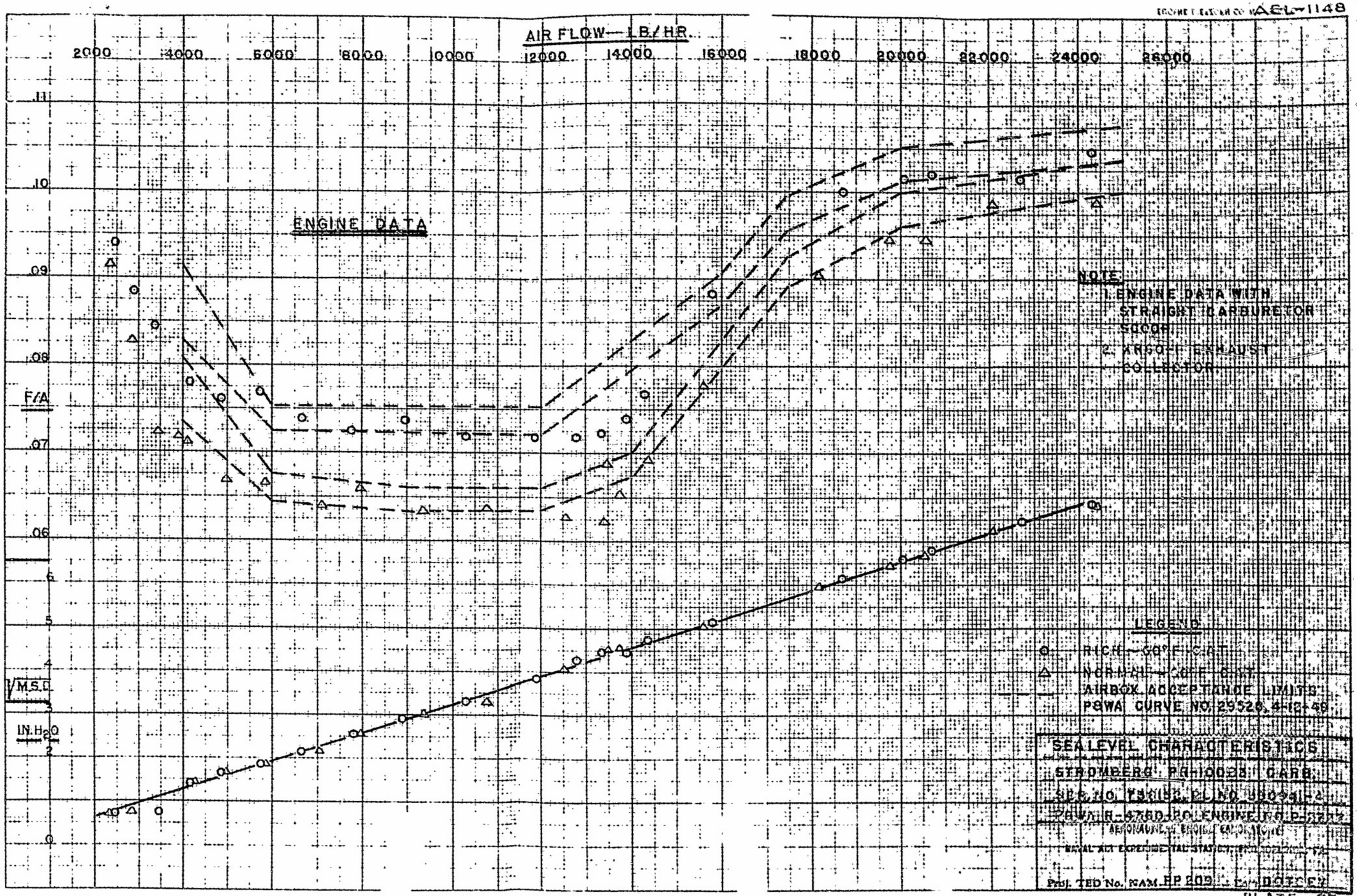
NOTE:

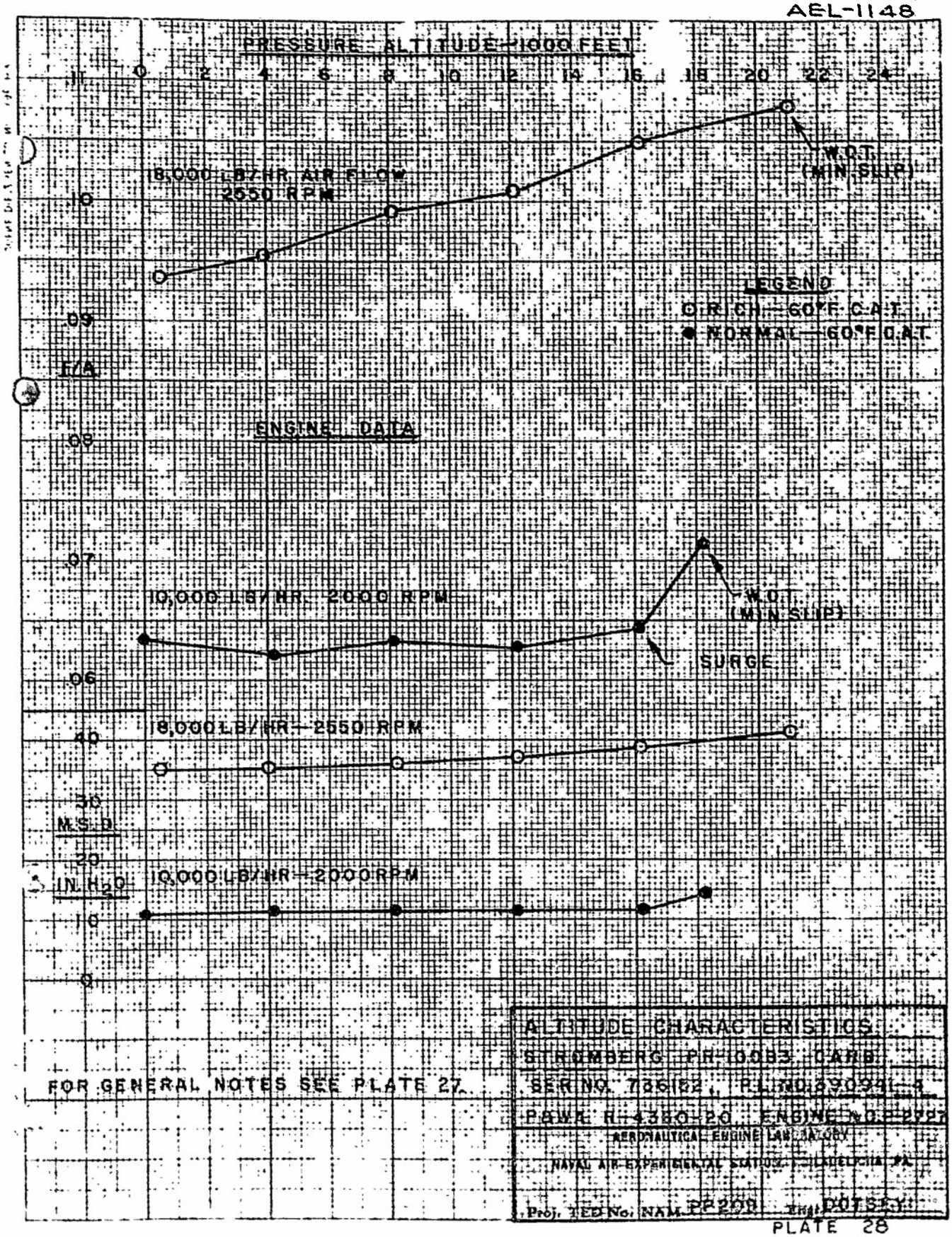
1. ENGINE OPERATION AT 1000 AND 2000 RPM IN HIGH BLOWER WERE SURGE-LIMITED BELOW .001, NO DETONATION.
2. ALL HIGH GEAR RUNS MADE AT MINIMUM SLIP CONDITIONS (WITHOUT POWER CONTROL) AT APPROX. SHIFT ALTITUDES SELECTED FROM P.&W. ESTIMATED CALIBRATION CURVE NO. INST. 7264-3.
3. MODIFIED ENGINE INCORPORATING 8.90:1 HIGH RATIO, 22-BLADE IMPELLER AND 11-BLADE INDUCER.
4. CARB. ALTITUDE MEASURED BY STATIC FITTING 6" ABOVE TOP DECK OF CARB. (ON RIGHT SIDE OF STRAIGHT SCOOP).
5. XR 60-1 AIRPLANE-TYPE EXHAUST COLLECTOR.
6. PR 100 B3 CARB. USED, MANUALLY CONTROLLED.

DETONATION-LIMITED MIXTURE
RESPONSE CURVES, [illegible] GEAR
P.&W. R-[illegible] ENGINE NO. [illegible]
USING GRADE 100/130 FUEL
[illegible]
[illegible]
[illegible]

PLATE 26

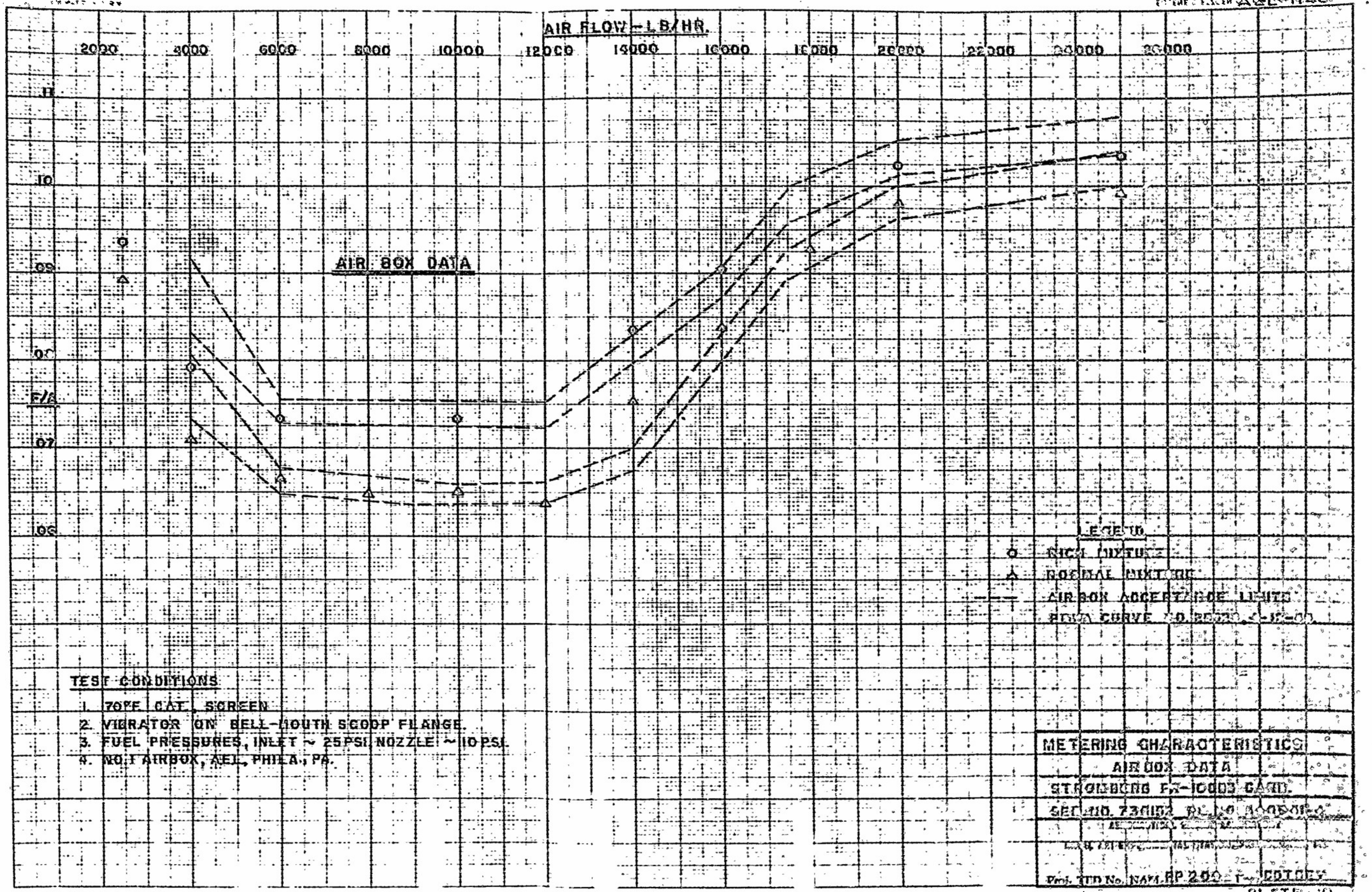
ENGINE EXHAUST CO. AEL-1148





FOR GENERAL NOTES SEE PLATE 27.

ALTITUDE CHARACTERISTICS
STROMBERG PR-10083 CARB.
SER NO. 736152, P.L. NO. 390941-4
P&WA R-4360-20 ENGINE NO. P-2727
AERONAUTICAL ENGINE LABORATORY
NAVAL AIR EXPERIMENTAL STATION, PHILADELPHIA, PA.
Proj. TED No. NAM PP209 Engr. DOTSEY


AGL-1148
AIR FLOW - LB/HR.
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
22000
24000
26000
11
10
09
08
F/A
07
06
AIR BOX DATA
LEGEND
RICH MIXTURE
NORMAL MIXTURE
AIRBOX ACCEPTANCE LIMITS
PDWA CURVE NO. 25020, 4-12-60
TEST CONDITIONS
1. 70°F CAT. SCREEN
2. VIBRATOR ON BELL-MOUTH SCOOP FLANGE.
3. FUEL PRESSURES, INLET ~ 25PSI NOZZLE ~ 10PSI.
4. NO.1 AIRBOX, AEL, PHILA., PA.
METERING CHARACTERISTICS
AIRBOX DATA
STROMBERG PR-10003 CARD.
SER. NO. 730152 PL. NO. 400901-4
Proj. TED No. NAM. RP 200 - COTSEY
PLATE 29

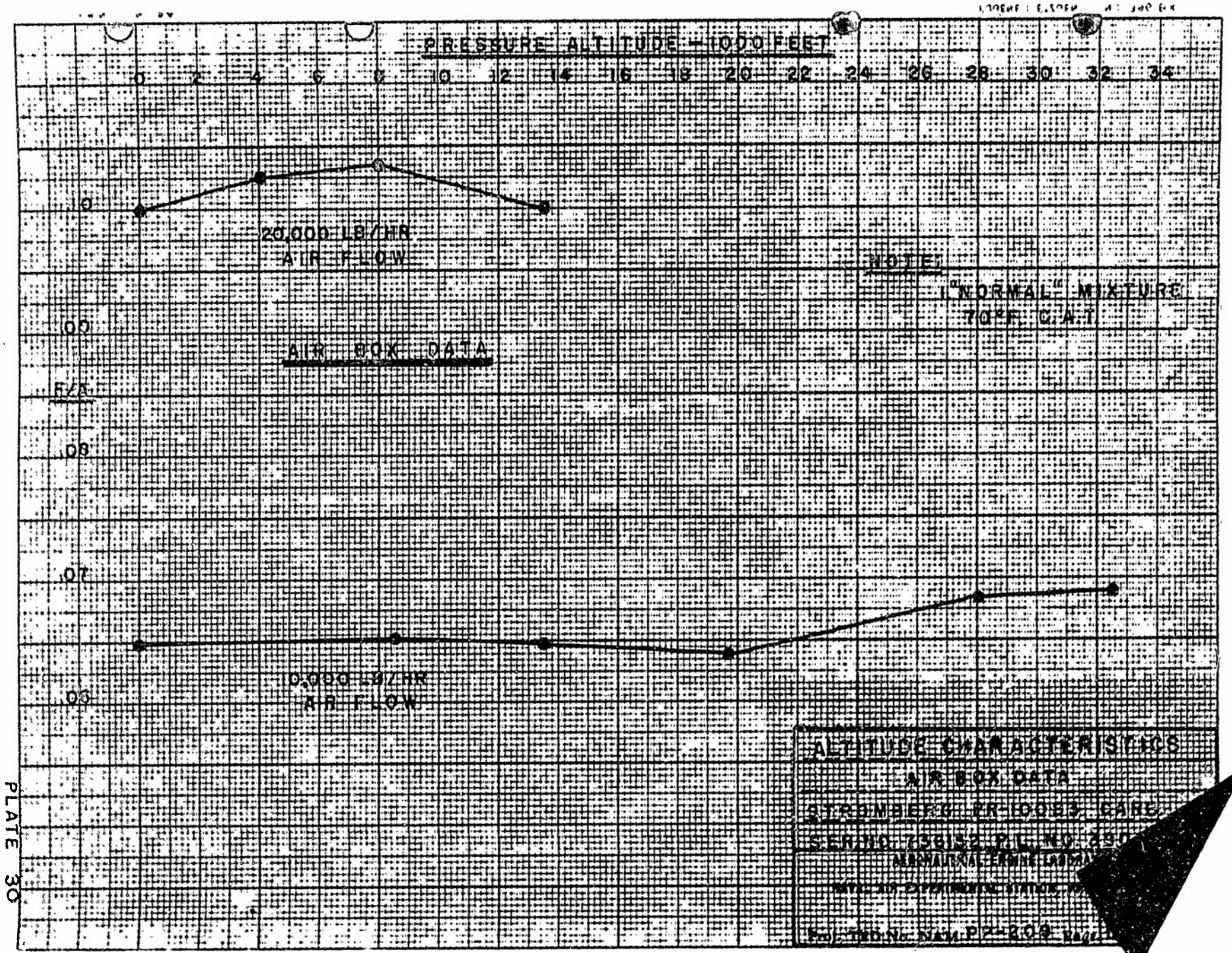
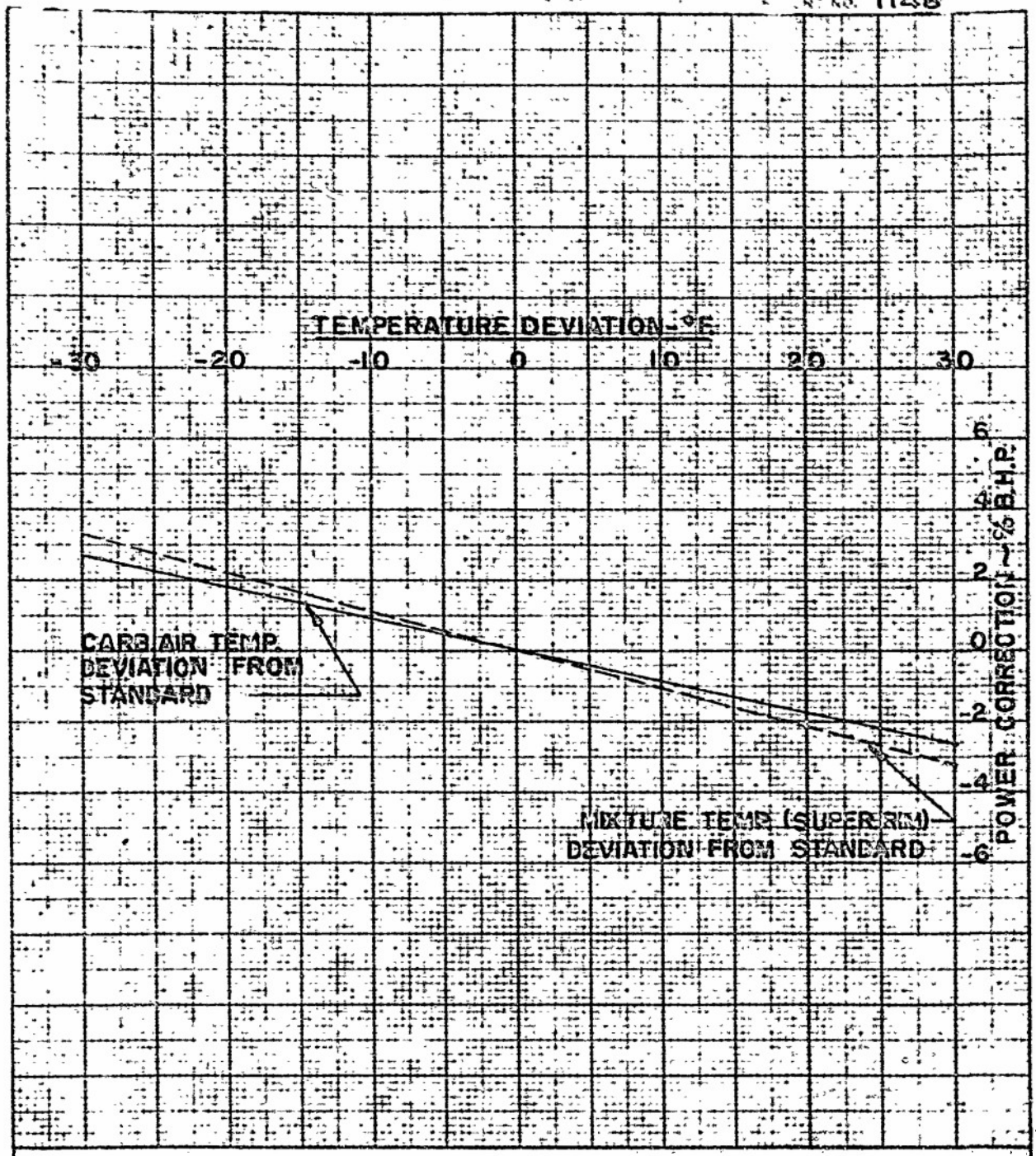

PRESSURE ALTITUDE ÷1000 FEET
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34
.10
.08
.06
.04
F/A
AIR BOX DATA
20,000 LB/HR AIR FLOW
10,000 LB/HR AIR FLOW
NOTE:
1. "NORMAL" MIXTURE
70°F. C.A.T.
ALTITUDE CHARACTERISTICS
AIR BOX DATA

PLATE 30

REPORT NO. 1148



DATA OBTAINED FROM RUNS MADE AT MILITARY, RATED AND CRUISE POWERS AT SEA LEVEL AND HIGH GEAR CRITICAL ALTITUDES.

CONSTANT A-S.R.P., FUEL-AIR RATIO AND CYLINDER HEAD TEMPERATURES.

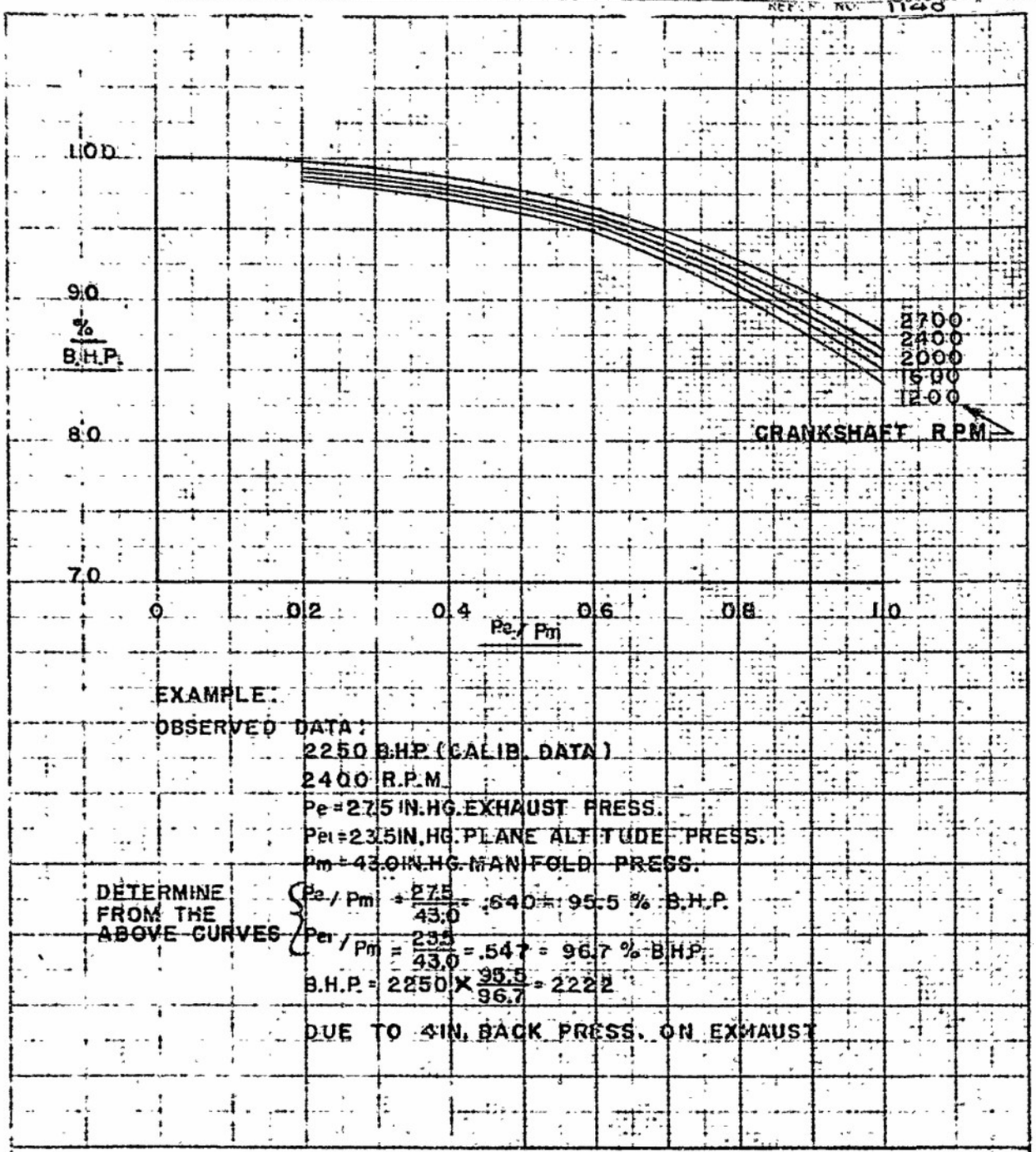
CARBURETOR AIR AND MIXTURE TEMPERATURE CORRECTION CURVES

P & W R-4360-20 ENGINE NO. P-2727

AERONAUTICAL ENGINE LABORATORY
NAVAL AIR EXPERIMENTAL STATION PHILA. PA.

PROJECTED NAME PP-209 ENGR. DOTSEY

PLATE 31



EXAMPLE:

OBSERVED DATA:

2250 B.H.P. (CALIB. DATA)

2400 R.P.M.

Pe = 27.5 IN. HG. EXHAUST PRESS.

Pei = 23.5 IN. HG. PLANE ALTITUDE PRESS.

Pm = 43.0 IN. HG. MANIFOLD PRESS.

DETERMINE FROM THE ABOVE CURVES

$Pe / Pm = \frac{27.5}{43.0} = .640 = 95.5\ \%$ B.H.P.

$Pei / Pm = \frac{23.5}{43.0} = .547 = 96.7\ \%$ B.H.P.

$B.H.P. = 2250 \times \frac{95.5}{96.7} = 2222$

DUE TO 4 IN. BACK PRESS. ON EXHAUST

NOTE:

1. THIS CORRECTION FOR EXHAUST PRESS. ONLY - ADDITIONAL CORRECTION MUST BE MADE FOR MIXTURE OR CARB. AIR TEMP. VARIATION FROM CALIB. DATA.
2. RUNS MADE AT CONSTANT F/A, MIXT. TEMP. AND CYLINDER HEAD TEMP.

EXHAUST BACK PRESSURE CORRECTION CURVES

LOW GEAR

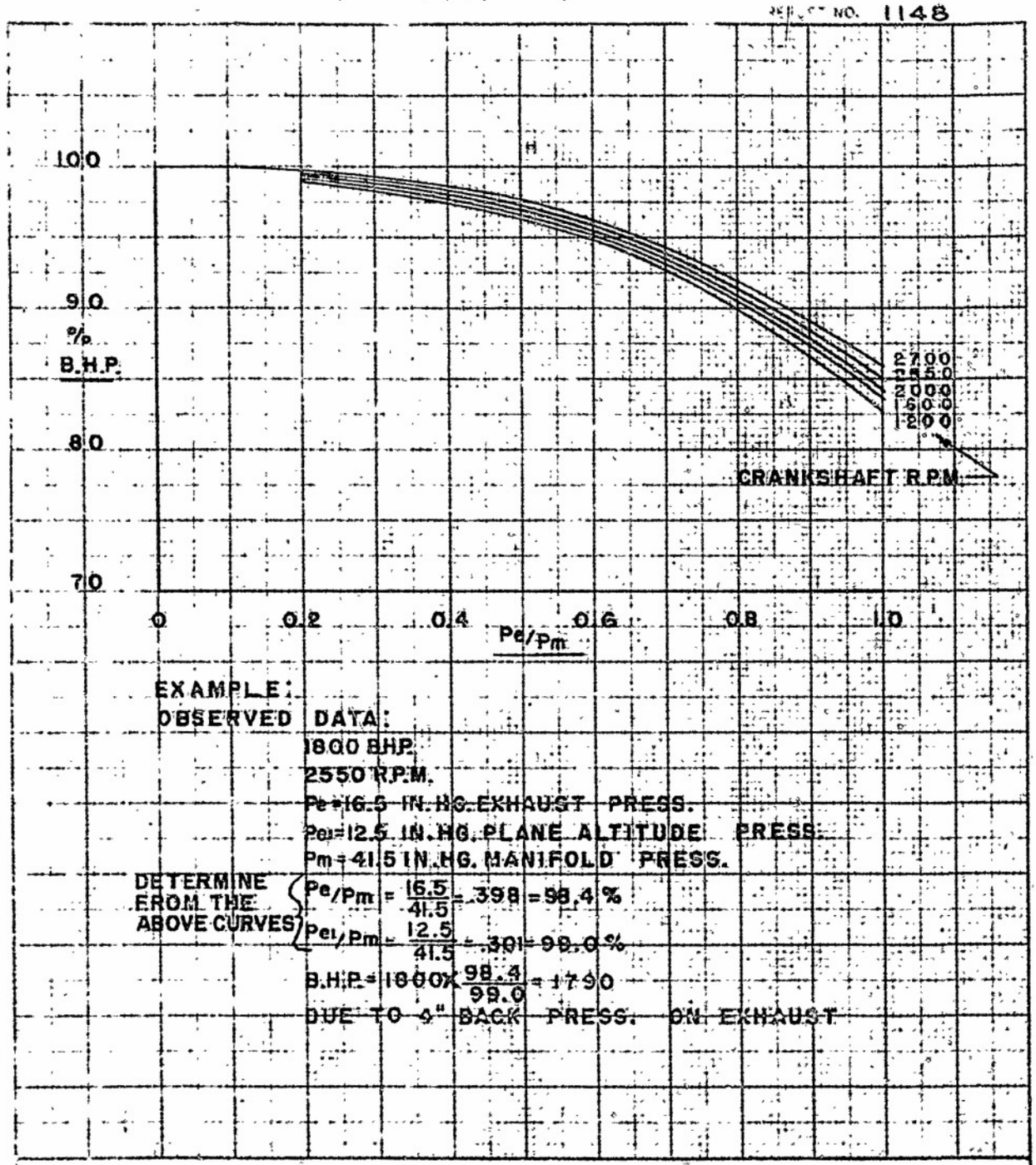
P & W R-4360-20 ENG. NO. P-2727

AERONAUTICAL ENGINE LABORATORY

NAVAL AIRCRAFT EXPERIMENTAL STATION

NAME PP-209 DOTSEY

PROJECT NO. 1148



EXAMPLE:

OBSERVED DATA:

1800 B.H.P.

2550 R.P.M.

Pe = 16.5 IN. HG. EXHAUST PRESS.

Pei = 12.5 IN. HG. PLANE ALTITUDE PRESS.

Pm = 41.5 IN. HG. MANIFOLD PRESS.

DETERMINE FROM THE ABOVE CURVES

$Pe/Pm = \frac{16.5}{41.5} = .398 = 98.4\%$

$Pei/Pm = \frac{12.5}{41.5} = .301 = 99.0\%$

$B.H.P. = 1800 \times \frac{98.4}{99.0} = 1790$

DUE TO 4" BACK PRESS. ON EXHAUST

SEE PLATE 32 FOR NOTES.

EXHAUST BACK PRESSURE CORRECTION CURVES

HIGH GEAR

P & W R-4360-20 ENG. NO. P-2727

AERONAUTICAL ENGINE LABORATORY

NAVAL AIR EXPERIMENTAL STATION, PHILA. PA

PROJECTED BY NAM PP-209 ENGR DOTSEY

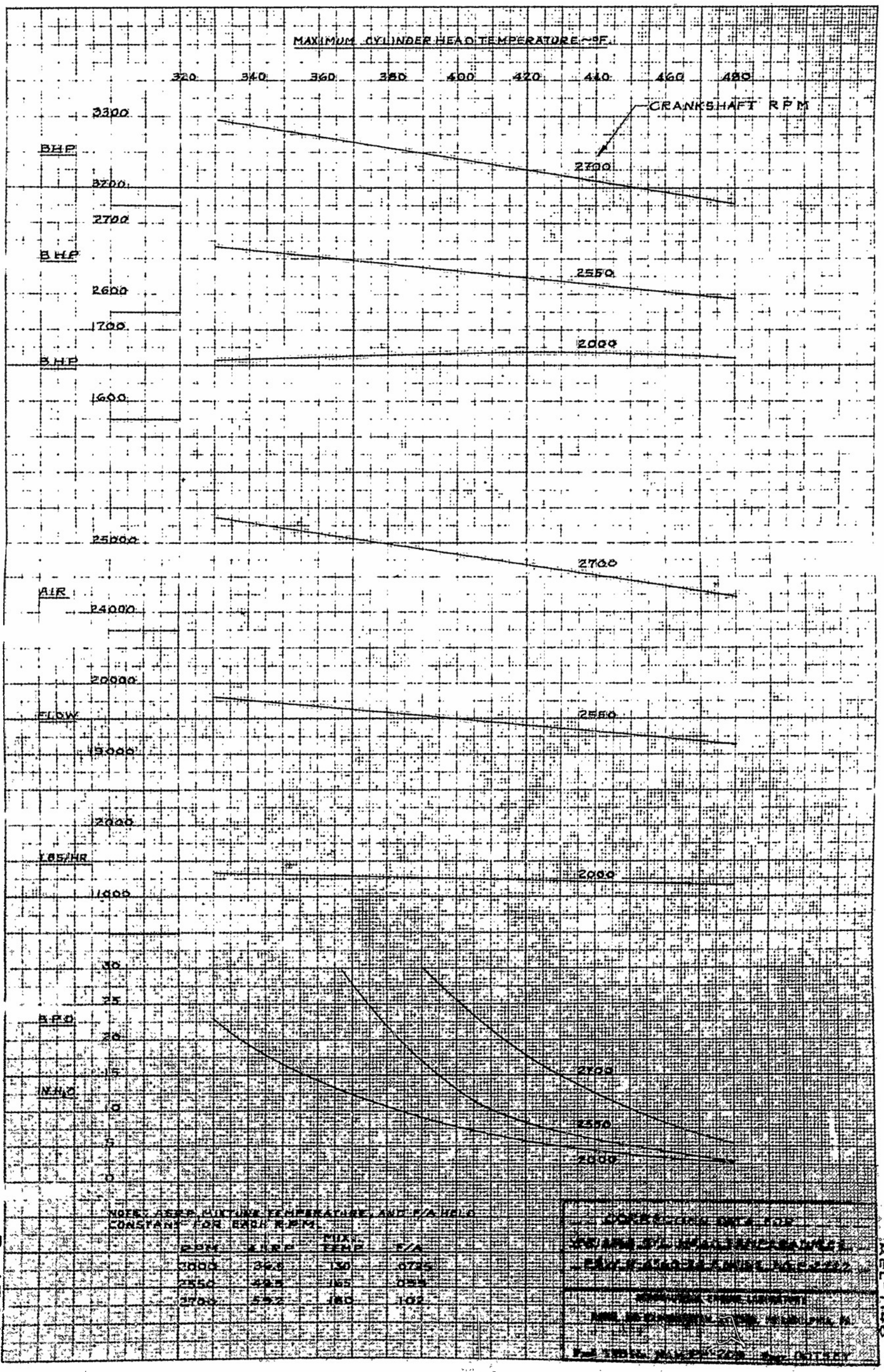
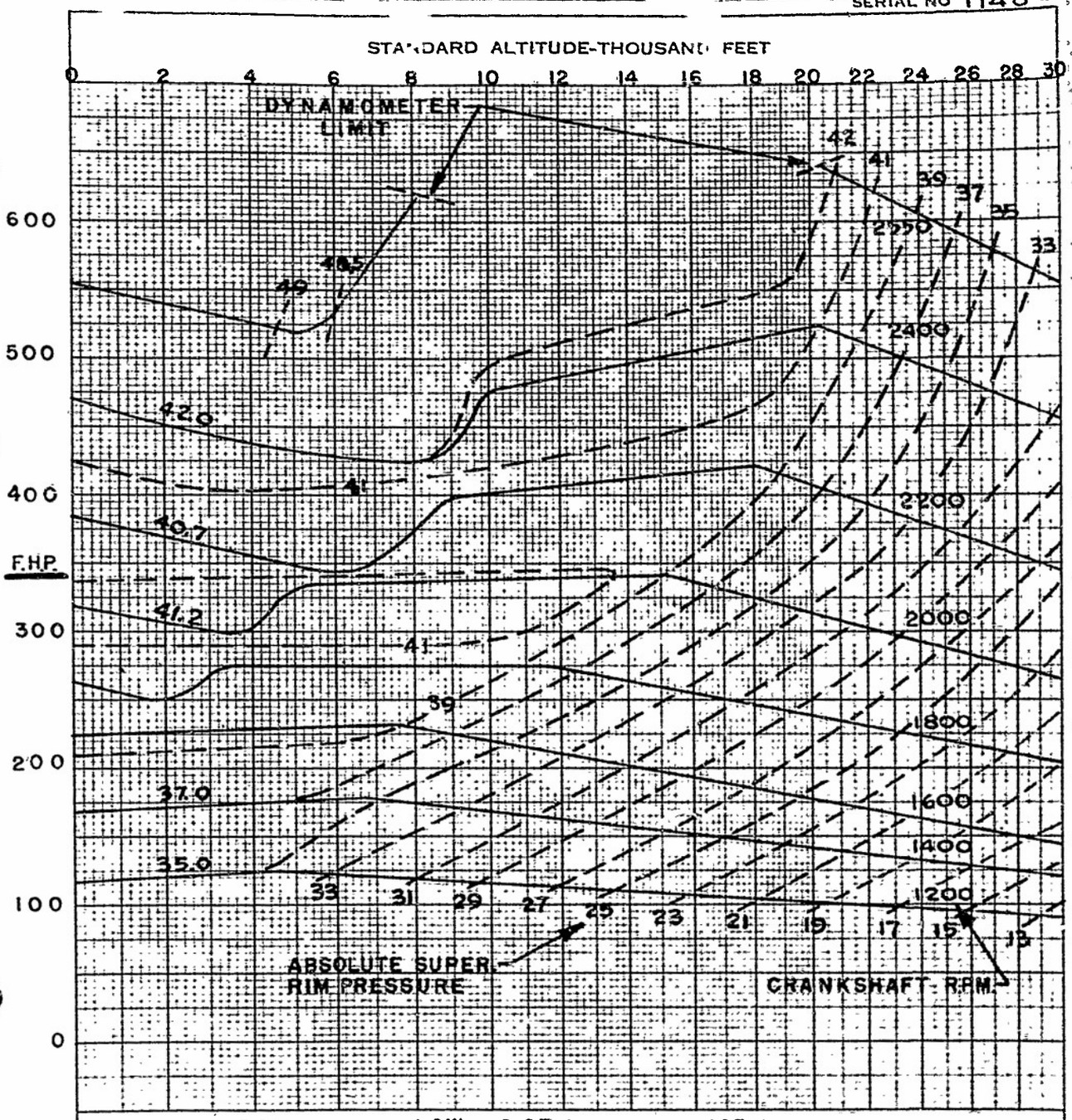


PLATE 34

AEC-1148

SERIAL NO 1148



RATIOS COMP. 6.7:1 IMPELLER LOW 6.95:1 PROP .425:1
CARB. PR-100B4 HIGH 9.07:1 OIL GRADE 1120
SPARK ADV PLUGS FUEL
IMPELLER DIAM 14 IN.

TEST DATE
AV. ROOM BAR IN HG
AV. CARB AIR TEMP °F STD. ALTITUDE
AV. OIL INLET TEMP °F 170
AV COOL AIR TEMP °F 102

TEST EQUIPMENT NO. 5 DYN. ROOM

FRICTION CHARACTERISTICS

LOW & HIGH GEARS

P&WA R-4360-20 ENGINE

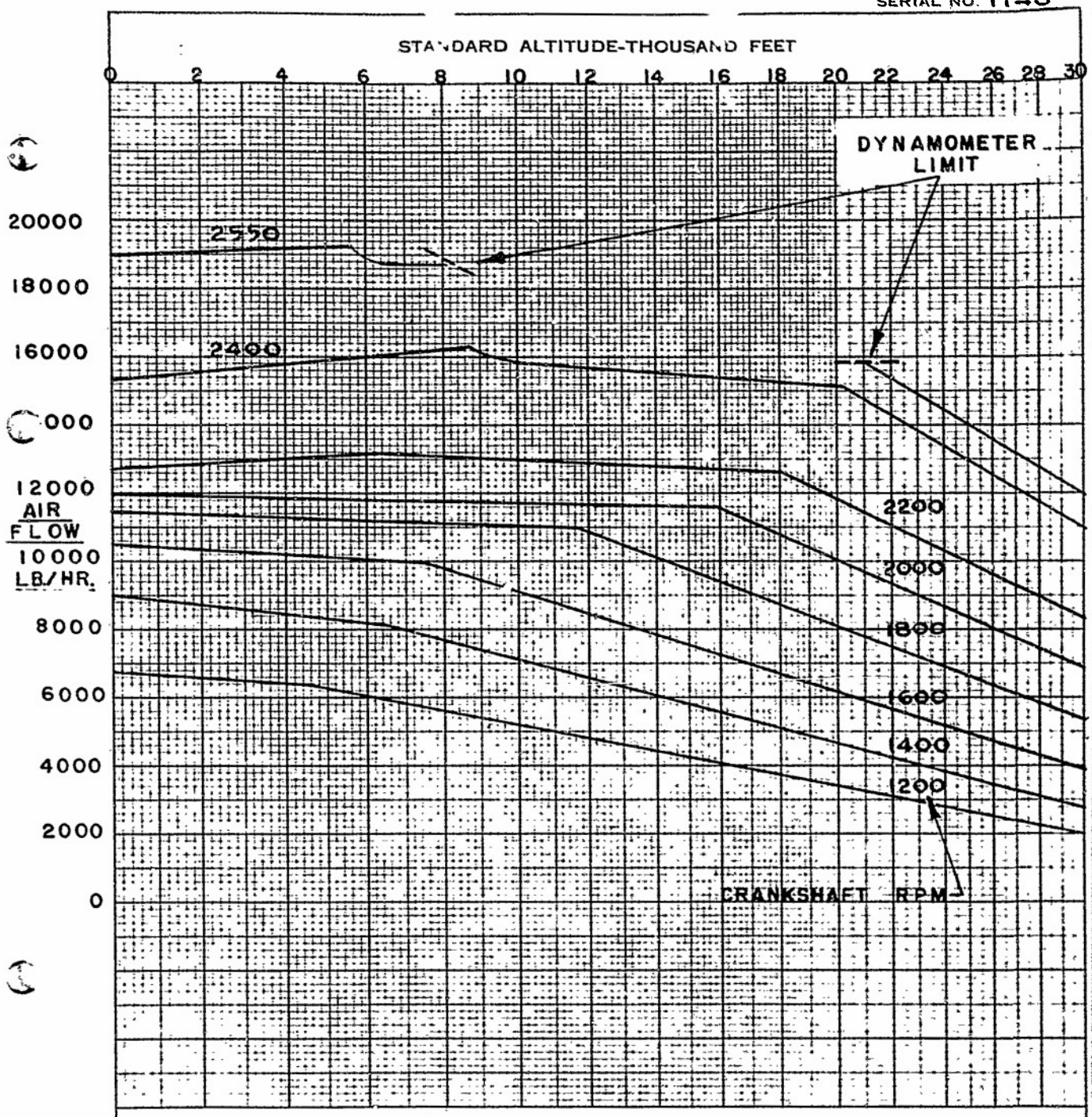
ENGINE BU NO MFG NO P-2727

AERONAUTICAL ENGINE LABORATORY
NAVAL AIRCRAFT FACTORY, PHILA. PA

PROJ PP-202 ENG R DOTSEY

PLATE 35

SERIAL NO. 1148



RATIOS COMP. IMPELLER PROP
CARB. OIL
SPARK ADV. PLUGS FUEL
IMPELLER DIAM.

FOR GENERAL DATA SEE PLATE 35.

TEST DATE
AV. ROOM BAR IN. HG.
AV CARB. AIR TEMP °F
AV. OIL INLET TEMP °F
AV COOL. AIR TEMP °F

TEST EQUIPMENT

FRICTION CHARACTERISTICS
LOW & HIGH GEARS
P&WA R-4360-20 ENGINE

ENGINE BU NO MFG NO P-2727
AERONAUTICAL ENGINE LABORATORY
NAVAL AIRCRAFT FACTORY PHILA PA

PROJ PP-209 ENG R DOTSEY

PLATE 36

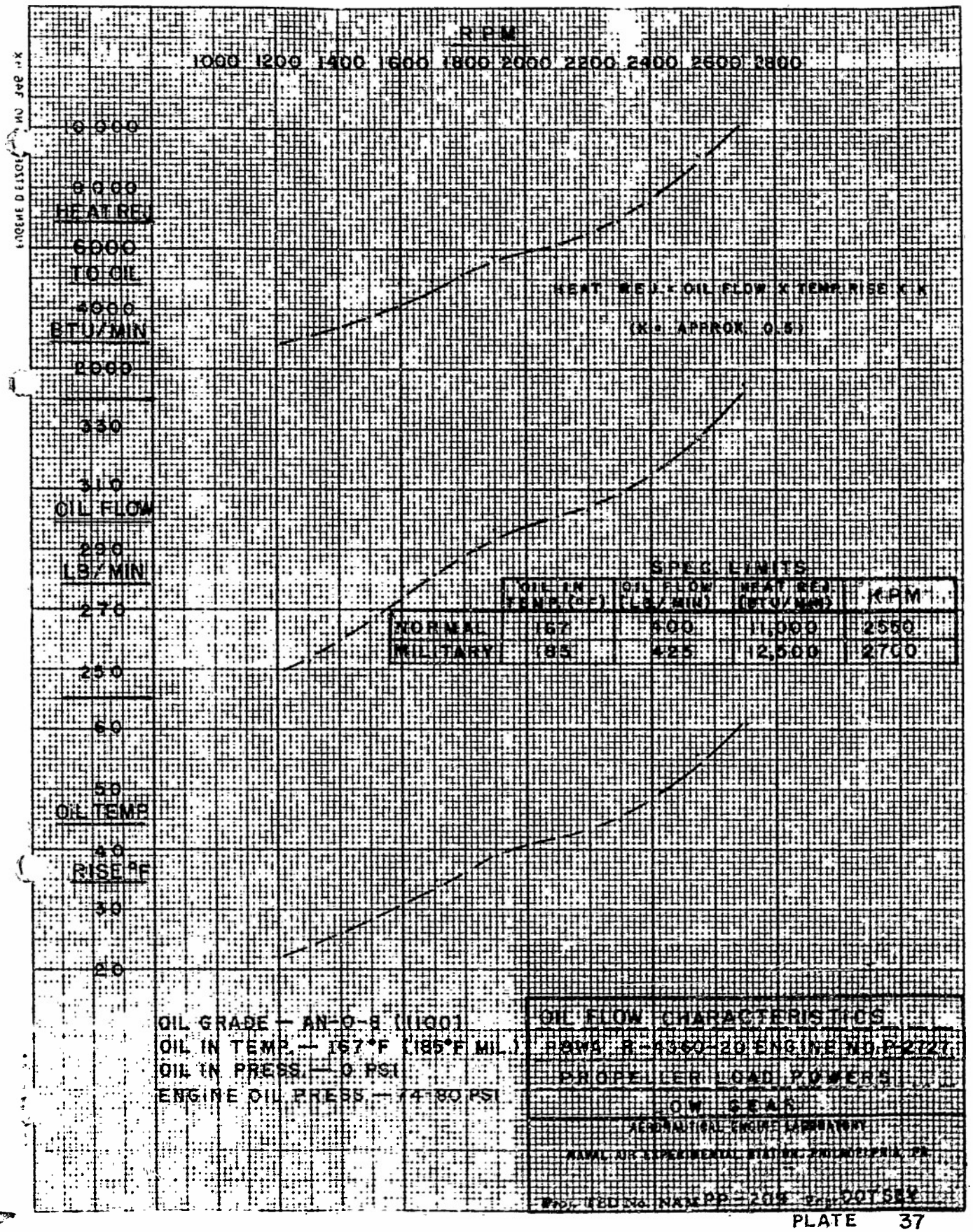
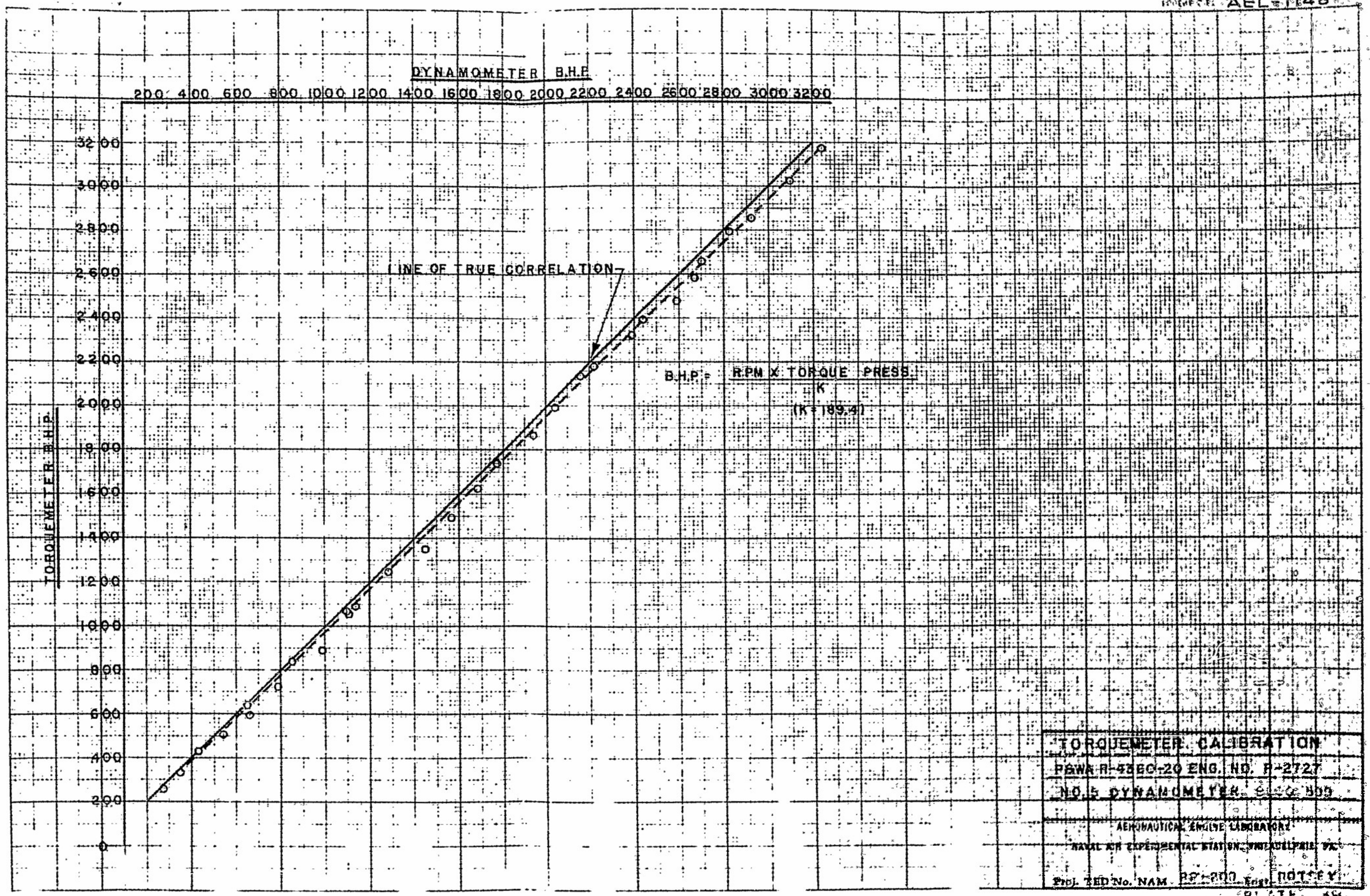
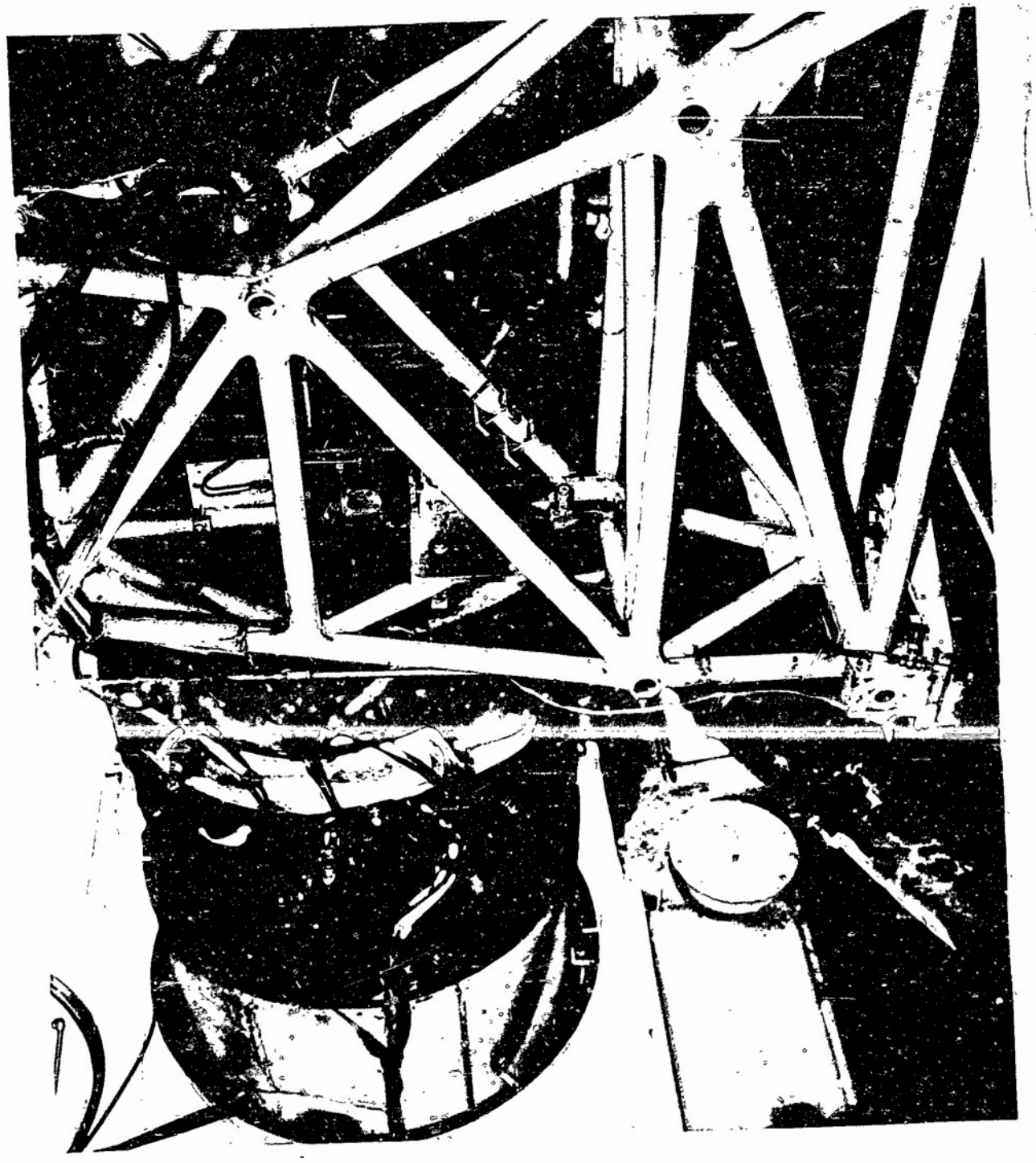

RPM
1000 1200 1400 1600 1800 2000 2200 2400 2600 2800
10,000
8000
HEAT REJ
6000
TO OIL
4000
BTU/MIN
2000
330
310
OIL FLOW
290
LB/MIN
270
250
60
50
OIL TEMP
40
RISE °F
30
20
HEAT REJ = OIL FLOW X TEMP RISE X K
(K = APPROX. 0.5)
SPEC. LIMITS
OIL IN TEMP (°F)
OIL FLOW (LB/MIN)
HEAT REJ (BTU/MIN)
RPM
NORMAL 167 400 11,000 2550
MILITARY 185 425 12,500 2700
OIL GRADE — AN-O-8 (1100)
OIL IN TEMP. — 167°F (185°F MIL.)
OIL IN PRESS. — 0 PSI
ENGINE OIL PRESS. — 74-80 PSI
OIL FLOW CHARACTERISTICS
PBWA R-4360-20 ENGINE NO. P-2727
PROPELLER LOAD POWERS
LOW GEAR
AERONAUTICAL ENGINE LABORATORY
NAVAL AIR EXPERIMENTAL STATION, PHILADELPHIA, PA.
Proj. FED No. NAM PP-209 Eng. DOT SEX

PLATE 37

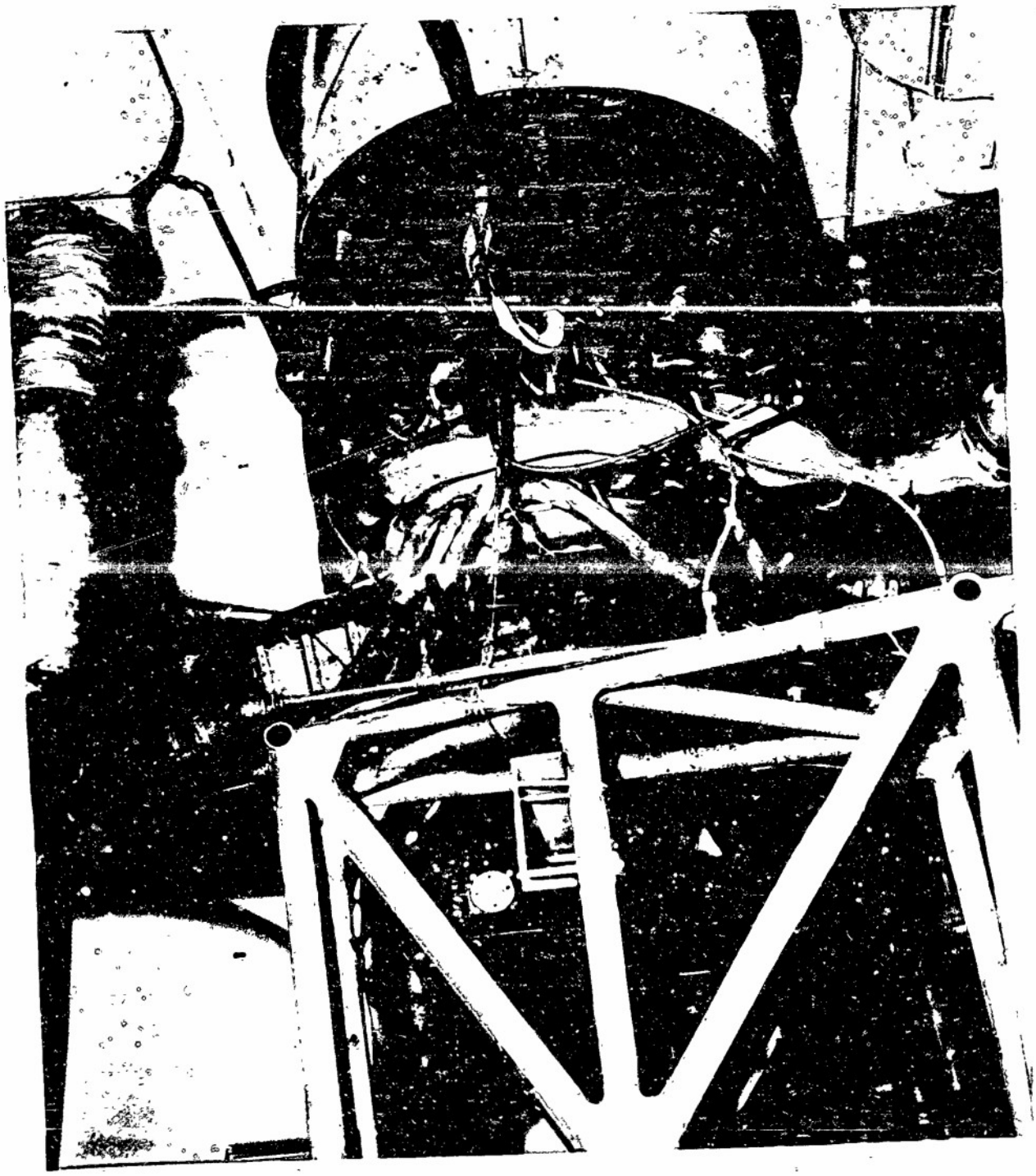


TORQUEMETER CALIBRATION
PSWA R-4360-20 ENG. NO. P-2727
NO. 5 DYNAMOMETER S/N 309
AERONAUTICAL ENGINE LABORATORY
NAVAL AIR EXPERIMENTAL STATION, PHILADELPHIA, PA.
Proj. TED No. NAM PS-2110 Engr. NOTTEY

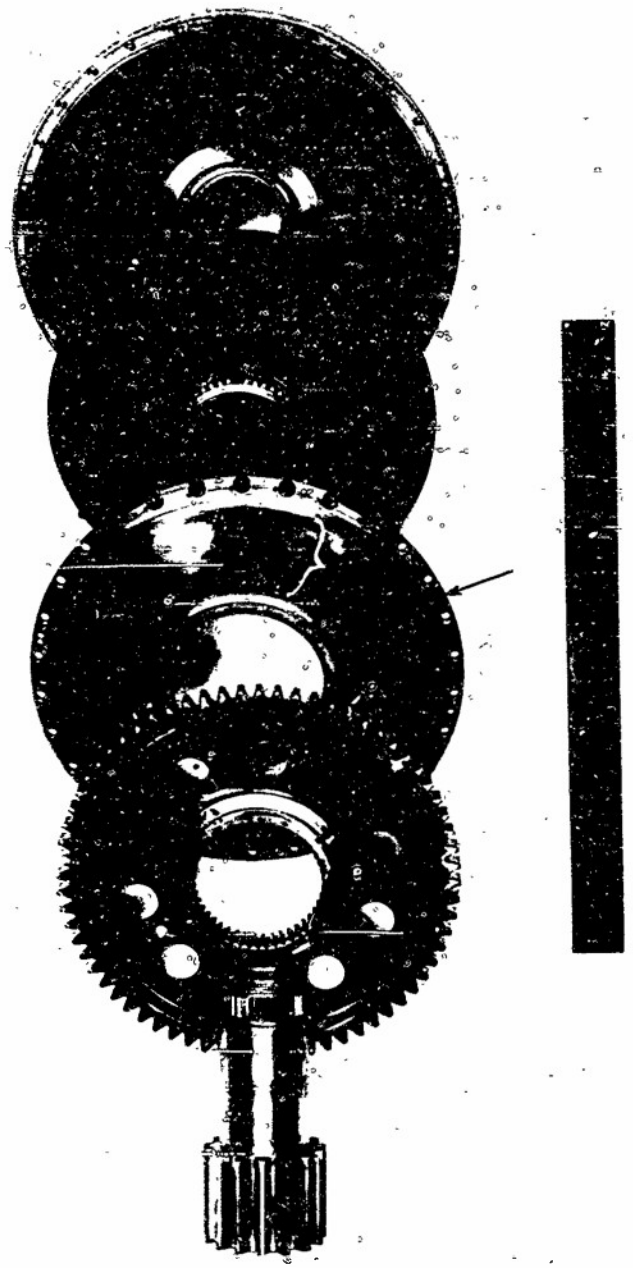
PLATE 58



NP(3)-264950(L)-4-50 LEFT SIDE VIEW OF ENGINE INSTALLATION PLATE 39



NP(3)-264951(L)-4-50 RIGHT SIDE VIEW OF ENGINE INSTALLATION PLATE 40



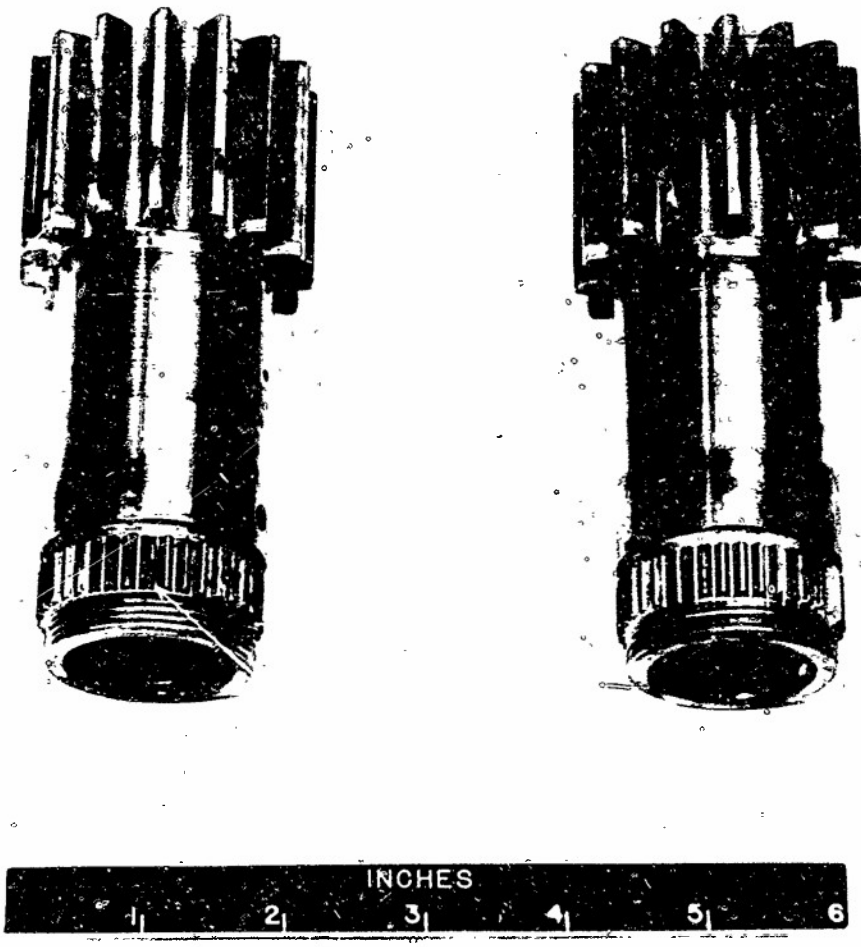
NP(3)-264376(L)-8-50
EXPLODED VIEW OF HYDRAULIC COUPLING ASSEMBLY,
HIGH GEAR - SHOWING DISCOLORATION

PLATE 41

NP(3)-264378(L)-8-50

HYDRAULIC COUPLING RUNNER ASSEMBLY
SHOWING INNER SPLINE DAMAGE

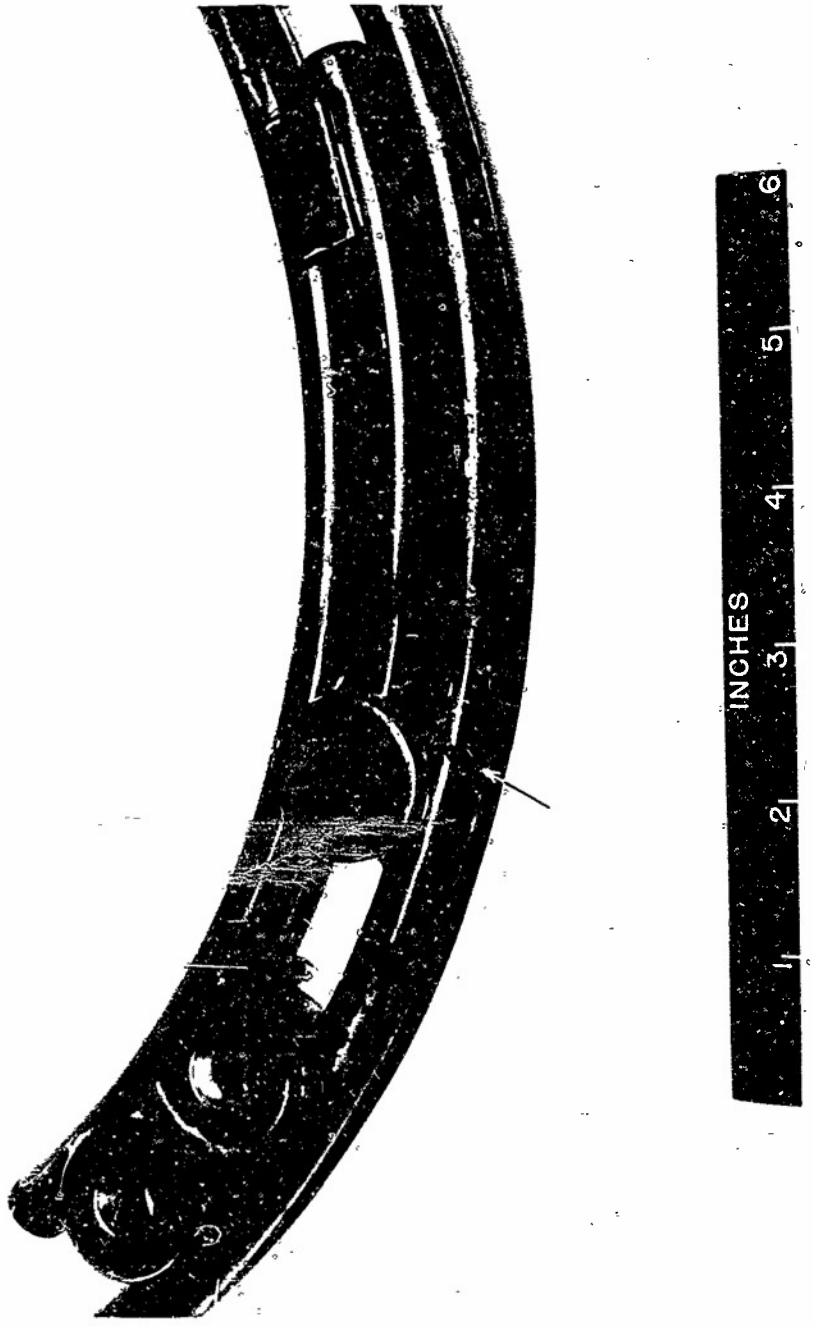
PLATE 42



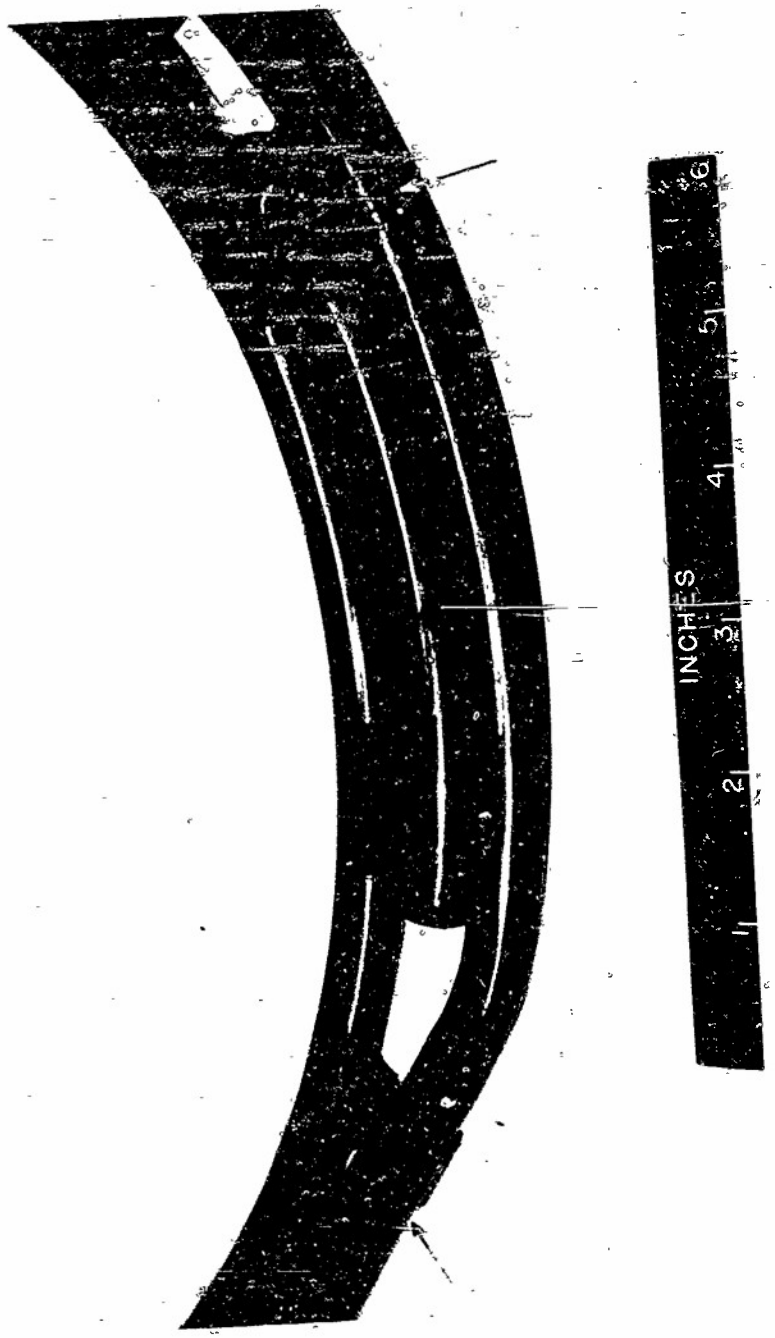
NP(3)-264377(L)-8-50
SUPERCHARGER INTERMEDIATE PINIONS, HIGH GEAR
SHOWING IRREGULAR GEAR TOOTH WEAR AND DAMAGED SPLINE PLATE 43

NP(3)-264379(L)-8-50
HYDRAULIC DAMPING SPRING DRIVE GEAR
SHOWING OUTER GEAR TOOTH WEAR

PLATE 44



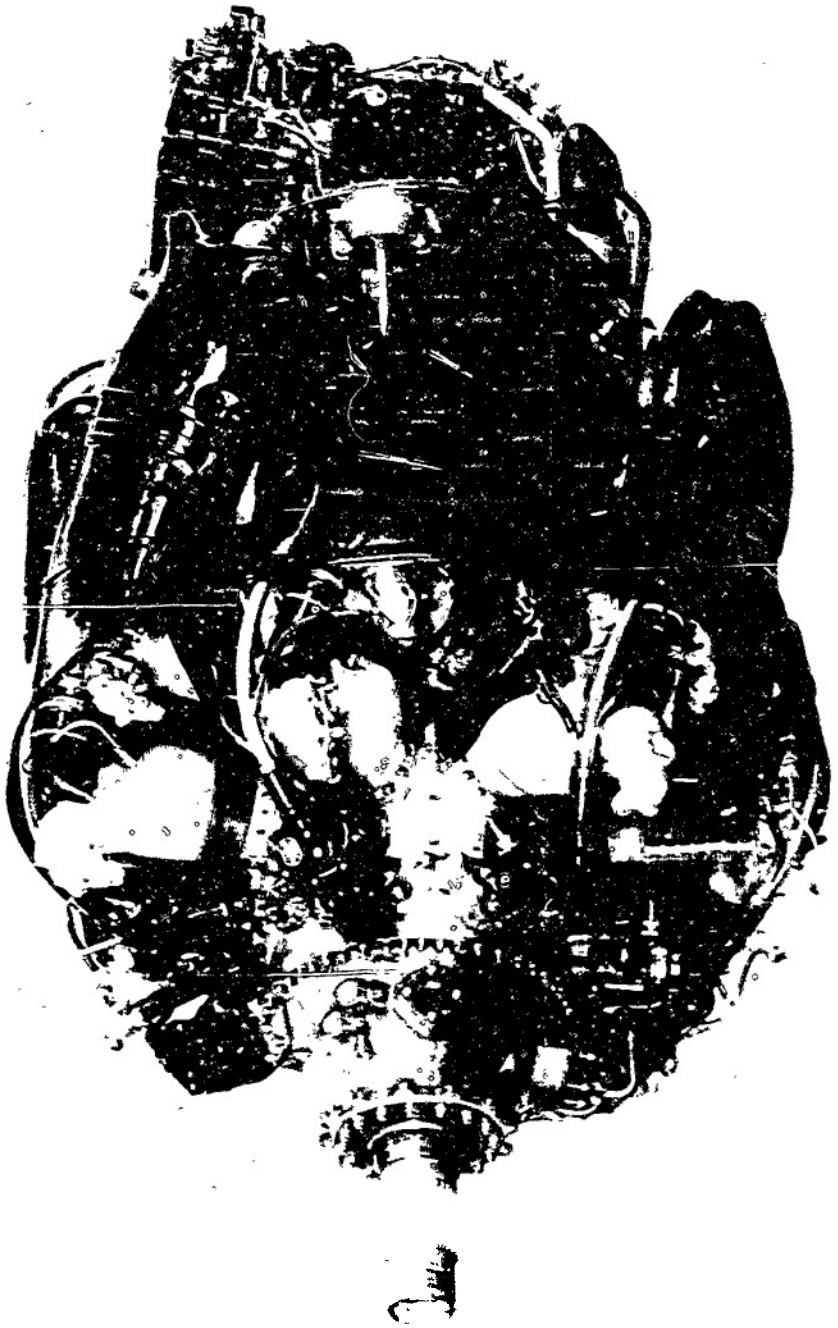
NP(3)-264375(L)-8-50
HYDRAULIC COUPLING OIL FEED MANIFOLD
ASSEMBLY (FRONT VIEW) SHOWING CRACKED MANIFOLD PLATE 45



D

3

NP(3)-264374(L)-8-50 HYDRAULIC COUPLING OIL FEED MANIFOLD ASSEMBLY (REAR VIEW) SHOWING CRACKED MANIFOLD PLATE 46



NP(3)-263084(L)-4-50
3/4 LEFT FRONT VIEW R-4360-20 ENGINE PLATE 47

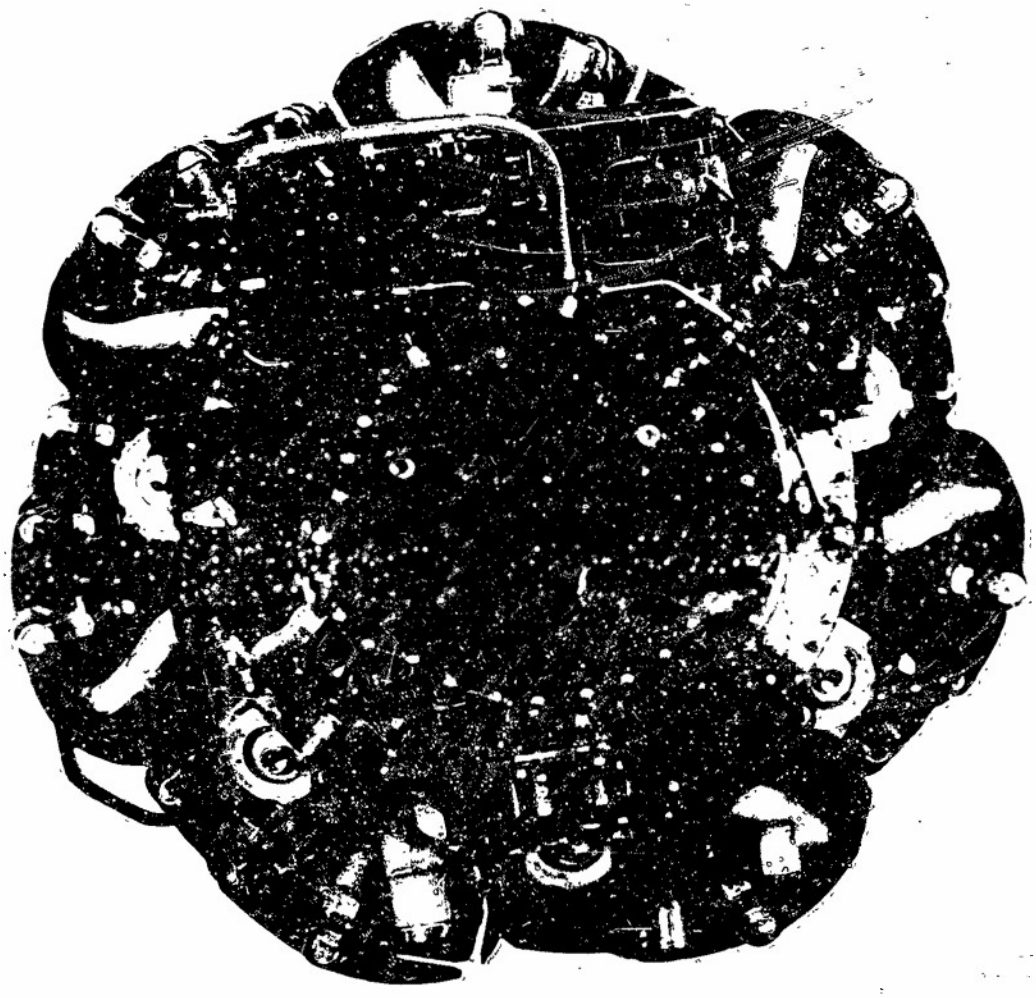
NP(3)-[illegible] FRONT VIEW, R-[illegible]-2D ENGINE

PLATE 4

NP(3)-26033(L)-4-50

3/4 LEFT REAR VIEW, R-4360-20 ENGINE

PLATE 43

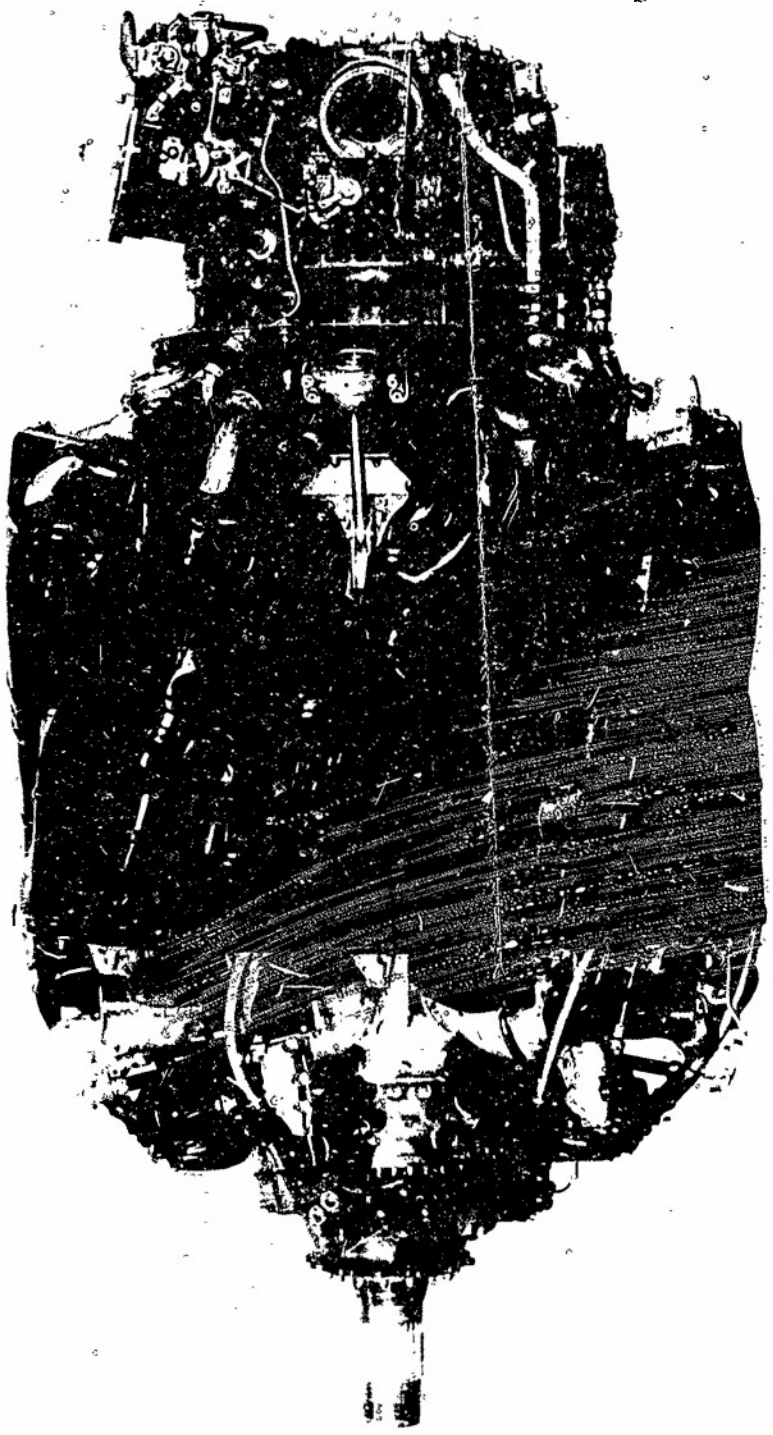


NP(3)-263086(L)-4-50

REAR VIEW, R-4360-20 ENGINE

PLATE 50

NP(3)-263088(L)-4-50 RIGHT SIDE VIEW, R-4360-20 ENGINE PLATE 51



NP(3)-263087(L)-4-50

LEFT SIDE VIEW, R-4360-20 ENGINE

PLATE 52