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FLIGHT INVESTIGATION OF NACA D_S COWLINGS ON THE XP-42 AIRPLANE

II - LOW-INLET-VELOCITY COWLING WITH AXIAL-FLOW FAN AND PROPELLER CUFFS

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WASHINGTON

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SUMMARY

The results are presented of a series of flight tests of the performance and cooling characteristics in high-speed level flight and in climb of the XP-42 airplane equipped with a short-nose low-inlet-velocity cowling and an axial-flow fan mounted on the spinner. This cowling is one of a series being tested in an effort to improve the performance and cooling characteristics of air-cooled engine installations.

The results of the tests indicated a maximum speed of 330 miles per hour at 890 horsepower at 16,000 feet, which is above the engine critical altitude.

Pressure measurements at the entrances to the cylinder baffles showed a uniform distribution of cooling-air pressures on the front of the engine in high-speed level flight and a fairly even distribution in climb. These front pressures averaged 87 percent of free-stream impact pressure in the high-speed condition, 99 percent in full-power climb at 155 miles per hour, and 105 percent in full-power climb at 140 miles per hour.

Cylinder-head temperatures were well below their specified limit under all conditions, but maximum cylinder-base temperatures in the high-speed condition exceeded their specified limit when corrected to Army summer air. Cylinder-base temperatures in climb were marginal.

When the cylinder baffling was made more nearly standard by removal of the special sealing strips at the bottom of the baffles on the cylinder barrels, maximum base-temperature indications were reduced 15° F. A reduction of this

magnitude brings base temperatures below Army limits in all conditions.

INTRODUCTION

The NACA is conducting an extensive series of flight tests, as outlined in references 1 and 2, in an attempt to improve the characteristics of radial air-cooled engine installations.

In order to differentiate readily between the various installations tested, test numbers have been assigned to each airplane condition. They are as follows:

Test	Type of cowling and flight condition
1	Long-nose high-inlet-velocity cowling with small cowl flaps; high speed
2	Long-nose high-inlet-velocity cowling with modified cowl flaps; climb
3	Short-nose high-inlet-velocity cowling with small cowl flaps; high speed
4	Short-nose low-inlet-velocity cowling with fan, cuffs, and small cowl flaps; high speed
5	Short-nose low-inlet-velocity cowling with fan, cuffs, and modified cowl flaps; climb
6	Short-nose low-inlet-velocity cowling with fan, cuffs, and modified cowl flaps; high speed
7	As in test 6, but with baffle seal strips at base of cylinders removed; high speed

The results of tests 1 and 2 are described in reference 1, and those of test 3 in reference 2. The present paper covers the results of tests 4 to 7.

The design of the cowling and engine installation was a project of the Air-Cooled Engine-Installation Group stationed at the Laboratory. The members of this group associated with this project included Mr. Howard S. Ditsch, of the Curtiss-Wright Corporation; Mr. Peter Torraco, of the Republic

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Aviation Corporation; Mr. William S. Richards, of the Wright Aeronautical Corporation; and Mr. James R. Thompson, of Pratt & Whitney Aircraft. The Army Air Forces, Materiel Command, sponsored the investigation and supplied the XP-42 airplane. The Curtiss-Wright Corporation, Airplane Division, handled the construction as well as the structural and detail design of the cowling and supplied personnel to assist in the servicing and maintenance of the airplane and cowling during the tests. Pratt & Whitney Aircraft prepared the engine and torque meter for the tests and assisted in the operation and servicing of the engine. The propeller, cuffs, and spinner were supplied by the Curtiss-Wright Corporation, Propeller Division.

This paper was originally issued (March 28, 1942) as a memorandum report for the Army.

XP-42 AIRPLANE WITH SHORT-NOSE LOW-INLET-VELOCITY COWLING AND FAN

The XP-42 airplane used in the tests is described in references 1 and 2. Figure 1 is a dimensioned drawing of the short-nose low-inlet-velocity cowling and fan installation. The outer cowling is the same as that of the short-nose high-inlet-velocity installation; but the inner section has been modified by the use of a smaller spinner, the fan, and a straighter diffuser section of greater inlet area designed for an inlet-velocity ratio of 0.3. Figures 2 to 5 are photographs of the cowling as installed on the airplane.

The fan had 30 blades, each $2\frac{7}{8}$ inches long, $3\frac{1}{4}$ inches root chord, and $1\frac{3}{4}$ inches tip chord and set at an angle of approximately 46° to the plane of rotation. The diameter of the spinner at the fan-blade root was 28 inches and the gap between the tip and outer surface of the diffuser was 5/16 inch. The results of wind-tunnel tests of a similar fan are given in reference 3.

The cowling was originally equipped with only two cowl flaps on either side. These four flaps were found to be inadequate for cooling in climb; and three fixed cowl flaps, whose setting could be changed on the ground, were added to each side for the climb tests. The added cowl flaps are shown in the closed position in figure 3.

The airplane, as prepared for the tests, weighed 6000 pounds with pilot and full tanks. The airplane was equipped with a standard aerial but had no provision for guns.

TEST APPARATUS AND PROCEDURE

The installation of the test equipment is described in reference 2.

After preliminary ground-cooling and flight checks, the maximum speed was determined by making level-flight runs at full power at and above the engine critical altitude, as described in reference 2. The cowl skirt was then cut for the installation of additional cowl flaps, and climb tests were made with the cowl flaps fixed open.

The first of these climb tests was a sustained climb to 20,000 feet at approximately 155-miles-per-hour indicated airspeed, an engine speed of 2550 rpm, and 40 inches of mercury manifold pressure to full throttle, with the carburetor setting in automatic rich. The second climb was to the same altitude at 140-miles-per-hour indicated airspeed and an engine speed of 2550 rpm in full rich. The manifold pressure was kept at $42\frac{1}{2}$ inches of mercury for altitudes below 7000 feet, then at $41\frac{1}{2}$ inches of mercury to full throttle. All recording instruments except the manometer, used to record cooling-air pressures, were left on throughout each climb. The manometer was left on for 40 seconds of every minute during the climb.

After the climb tests, the cowl flaps were fixed closed and additional high-speed runs were made to determine the effect of the added cowl flaps on the maximum speed of the airplane.

Nine of the fourteen small sealing strips between and at the bases of the cylinders were then removed, and high-speed runs were made in order to determine the effect of the sealing strips upon the observed cylinder temperatures and cooling-air pressures. The other five sealing strips were not removed because they were difficult to reach without removal of much of the experimental pressure tubing, ignition harness, and other apparatus. The strips remaining in place were between cylinders 12 and 13, 14 and 1, 1 and 2, 2 and 3, and 9 and 10. Each strip was 2 square inches in area.

SYMBOLS

q_c	airplane impact pressure, inches of water
Δp	average pressure drop across engine, inches of water
σ	free-air density ratio
Q	volume flow of free air, cubic feet per minute
η	propulsive efficiency of propeller and exhaust stack combination
S	wing area
C_D	drag coefficient of airplane
bhp	brake horsepower
V	true airspeed

RESULTS AND DISCUSSION

The data obtained during the high-speed runs and during the climbs are presented in tables I and II. The important climb-test data are shown in figure 6 in the form of time histories of the climbs.

Maximum Speed

The values of maximum speed obtained from level runs at full throttle near and above the engine critical altitude are plotted against density altitude in figure 7. In the same figure are plotted the observed brake horsepower and two parameters representative of the aerodynamic refinement and of the effective power, respectively, as explained in references 1 and 2. These data are presented both for the airplane with the original cowl flaps (test 4) and with the modified cowl flaps (tests 6 and 7).

The series of speed determinations with the original cowl flaps gave much more consistent results than were obtained with the modified cowl flaps.

The observed difference in speed for the two installations was 3 miles per hour, or 1 percent of the speed. As may be seen from figure 7, this speed loss is the result of a loss in both power and aerodynamic cleanness. The values of the parameter $\left(\frac{bhp}{\sigma}\right)^{1/3}$ show a loss of approximately 1/3 percent or 1 mile per hour, due to power and the values of the parameter 52.73 $\left(\frac{\eta}{SC_D}\right)^{1/3}$ show a loss of 2/3 percent, or 2 miles per hour, due to increased drag.

The speed comparisons of references 1 and 2 are extended in figure 8 to include the observed maximum speed values for the present installation with the original cowl flaps. The values shown for the previous XP-42 installations (tests 1 and 3) were chosen as being most nearly representative of the best performance of each installation.

Because of the difference in power output from the engine in each series of tests, the three XP-42 installations cannot be compared directly in terms of observed maximum speed. Examination of figure 8 shows that, if in each case the engine had delivered its rated military power (1000 hp at 14,500 ft; $\frac{bhp}{\sigma} = 1564$), the speed comparison would be:

Installation	Observed maximum speed (mph)	Maximum speed at 1000 hp at 14,500 ft (mph)
XP-42 short-nose low-inlet-velocity with fan (test 4)	330	337
XP-42 short-nose high-inlet-velocity (test 3)	336	339
XP-42 long-nose (test 1)	338	344

The engine power observed for the present installation includes the power absorbed by both the fan and the propeller. Although the fan tests reported in reference 3 did not include the blade angle used in the present fan, extrapolations from those tests indicate that the fan absorbed approximately 20 horsepower in high-speed level flight, or the power equivalent of 2 miles per hour in top speed.

Pressures and Temperatures

The distributions of engine cooling-air pressures for tests 4, 5, and 7 are shown in figure 9.

For the high-speed condition, the cooling-air pressures on the front of the engine are very nearly uniform, both as to variation of pressures around the engine and as to variation of pressures with the location of the point of measurement on the individual cylinder. The pressures noted on the exhaust side of the barrel of cylinder 3 may be expected to be low because the points of measurement lay in the wake of a large ignition-cable conduit and next to a hole in the baffling. The variation of pressures at different points on a given cylinder may be expected to be smaller with this cowling than with the cowlings previously tested because of the relatively low velocity of the entering cooling-air jet.

In the climbs at 155- and at 140-miles-per-hour indicated airspeed, the variation of cooling-air pressures on both the front and the rear of the engine was somewhat greater than in the high-speed condition; and, as the angle of attack increased, there was an increase in both front and rear pressures at the bottom of the engine as compared with pressures observed near the top of the engine. It is to be noted that, as the power dropped off at altitudes above critical in climb, average front pressures decreased and average rear pressures increased.

The distribution of cylinder head and barrel temperatures is shown in figure 10 to be very nearly the same at full throttle both in high speed and in climb when the carburetor-mixture control is in automatic rich. Figure 11 indicates that this distribution pattern remains constant at all altitudes in that carburetor setting. Comparison of figure 12 with figure 11, however, shows that, although the temperature distribution in full rich is similar at low altitudes to that in automatic rich, it becomes markedly different at high altitudes as the fuel-air ratio increases.

This change in temperature distribution takes place with no change in cooling-air pressure distribution during the climb. (See fig. 9.)

In general, there is no apparent correlation between individual cylinder temperatures and the pressure drops across those cylinders. The effects of the small observed variations in cooling-air pressure are obscured by variations in other factors, such as mixture distribution, charge weight, cylinder construction, and baffling. The results discussed in the preceding paragraph indicate that, for very rich mixtures, the fuel distribution is the predominating factor in determining the temperature distribution.

The cylinder baffles provided with this engine differ from the baffles ordinarily used in that they fit closer to the fins and include small sealing strips between adjacent cylinder barrels from the bottom barrel fin to the mounting flange. In this test and in previous tests with the same baffling (references 1 and 2), cylinder-head temperatures were well below their specified Army limit but cylinder-barrel temperatures exceeded their limit in the high-speed level-flight condition and were marginal in the climb condition.

It was thought that a more nearly standard baffling arrangement, permitting a flow of cool air around the unfinned portion of the barrel and on the thermocouple, might result in lower temperature indications on the barrels. Those baffle seals which could be reached easily were therefore removed for a series of high-speed runs (test 7). Figure 13 shows a comparison of the head and barrel temperatures observed during these runs with temperatures observed while the baffle seals were in place. There was no change in average or in maximum cylinder-head temperatures, but the maximum barrel temperature was reduced by 15° F to 20° F and average barrel temperatures were reduced by 10° F. Figure 9 and table I show that the cooling-air pressures on the front of the engine did not change. The rear pressures, however, increased by approximately $0.01q_c$, presumably because of the increased air flow where the baffle seals were removed.

The removal of the baffle-seal strips brought all observed barrel temperatures below the Army limit. (See fig. 13.) Whether this procedure resulted in a cooling of the barrels or of the thermocouples is not established, but the apparent reduction of temperatures so achieved would have been sufficient to reduce barrel-temperature indications below the Army limit for this and all previous cowling arrangements in all climb and level-flight tests. Average and maximum cylinder temperatures during climb have been plotted in the time histories of figure 6. In order to facilitate comparison of these temperatures with their specified Army limits, these temperatures have been replotted in figure 14 in °F above free-air temperature. Cylinder-head temperatures were well below their limit but maximum cylinder-barrel temperatures were marginal. The shape of the cylinder-head maximum-temperature curve for the full-rich climb was caused by a change of the maximum temperature from cylinder 13 to cylinder 9.

In the present installation, the amount of cooling-air flow through the engine could not be calculated from the pressures observed at the survey rakes in the annulus because of the twist imparted to the air by the fan. Except for the case where the baffle seals are removed, the air flow can, however, be calculated on the assumption that the orifice coefficient, based on average front and rear pressures for the present installation, is the same as that of the short-nose high-inlet-velocity cowling installation (reference 2). For that installation, the air flow could be calculated from the equation

$$Q = 4120 \sqrt{\frac{\Delta p}{q_c}} \sqrt{\frac{q_c}{\sigma}}$$

where

Q volume flow of free air, cubic feet per minute

Δp average pressure drop across engine, inches of water

q_c airplane impact pressure, inches of water

σ free-air density ratio

On the basis of the preceding equation, the cooling-air flow through the engine in high-speed level flight with both the original and the modified cowl flaps was approximately 21,100 cubic feet of free air per minute in the range of altitudes tested. The inlet-velocity ratio was then approximately 0.33.

CONCLUSIONS

1. The maximum speed of the XP-42 airplane obtained with the short-nose low-inlet-velocity cowling, the axial-flow fan, and propeller cuffs was about 2 miles per hour less than that obtained with the short-nose high-inlet-velocity cowling, and about 7 miles per hour less than that obtained with the long-nose high-inlet-velocity cowling at the same power and altitude.

2. Cooling-air pressure recoveries on the front of the engine were 87 percent of airplane impact pressure in the high-speed condition, 99 percent in the full-power climb at 155-miles-per-hour indicated airspeed, and 105-percent in the full-power climb at 140-miles-per-hour indicated airspeed.

3. Cylinder-head temperatures were satisfactory in all conditions, but maximum cylinder-base temperatures exceeded the Army limit in the high-speed condition and were marginal in climb. A more nearly standard baffle arrangement, obtained by removing the sealing strips from the bottom of the cylinders, reduced the cylinder-base temperature indications below the Army limit.

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REFERENCES

1. Bailey, F. J., Jr., Johnston, J. Ford, and Voglewede, T. J.: Flight Investigation of the Performance and Cooling Characteristics of a Long-Nose High-Inlet-Velocity Cowling on the XP-42 Airplane. NACA A.R.R., April 1942.

2. Bailey, F. J., Jr., and Johnston, J. Ford: Flight Investigation of NACA D_S Cowlings on the XP-42 Airplane. I - High-Inlet-Velocity Cowling with Propeller Cuffs Tested in High-Speed Level Flight. NACA A.R.R., Jan. 1943.

3. Bell, E. Barton: Test of a Single-Stage Axial-Flow Fan. Rep. No. 729, NACA, 1942.

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Table Ia.–Pressure data

XP-42 Airplane
Short-Nose Low-Inlet-
Velocity Cowling with
Fan and Cuffs

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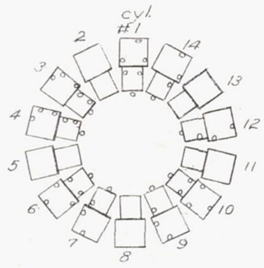
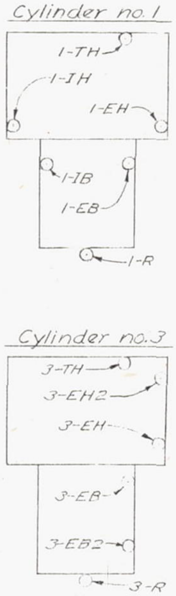
HIGH-SPEED LEVEL FLIGHT

Test – Flight	4-6				4-7				4-9				
Run	1	2	3	4	1	2	3	4	1	2	3	4	5
True Airspeed, mph	329	328	330	330	330	330	329	329	331	329	330	329	329
q_c, impact press., in. H_2O	36.6	35.4	34.6	33.4	32.6	31.4	30.5	29.4	35.6	33.4	32.2	30.2	29.5
Atm. pressure, in. Hg	16.95	16.26	15.62	14.93	1525	14.63	14.04	13.45	16.95	15.90	14.93	14.03	13.48
Ambient air temp., °F	-11	-15	-19	-23	-2	-5	-13	-13	10	1	-4	-8	-15
σ, density ratio	.655	.634	.614	.592	.578	.559	.545	.522	.625	.598	.568	.538	.525
Density altitude, ft.	13750	14750	15750	16900	17550	18550	19300	20600	15200	16500	18050	19650	20400
rpm	←												
bhp	946	918	900	867	853	825	792	769	923	877	839	792	769
Manifold press., in., Hg.	39.6	38.6	37.1	35.8	36.1	34.6	33.6	32.1	39.6	37.6	35.6	33.6	32.1
	← Original Cowl Flaps (Closed) →												

Engine pressure tube locations





Method of designating tube locations for typical cylinders

Pressure ratio, p/q_c

Tube	Location	4-6 run 1	4-6 run 2	4-6 run 3	4-6 run 4	4-7 run 1	4-7 run 2	4-7 run 3	4-7 run 4	4-9 run 1	4-9 run 2	4-9 run 3	4-9 run 4	4-9 run 5
1-R	Sheltered tubes behind engine	.40	.39	.40	.39	.39	.38	.39	.39	.40	.40	.40	.40	.40
3-R		.39	.38	.39	.38	.38	.38	.39	.39	.40	.39	.39	.39	.40
4-R		.38	.38	.38	.38	.38	.37	.38	.38	.39	.39	.38	.39	.39
6-R		.40	.39	.40	.39	.40	.38	.40	.39	.40	.40	.40	.40	.40
7-R		.40	.39	.40	.40	.40	.38	.40	.39	.40	.40	.40	.40	.40
9-R		.40	.39	.40	.40	.40	.38	.40	.40	.40	.40	.40	.40	.41
10-R		.40	.39	.40	.40	.40	.38	.40	.39	.41	.40	.40	.40	.40
12-R		.40	.39	.40	.40	.40	.38	.40	.39	.41	.40	.40	.40	.40
14-R		.40	.39	.39	.39	.39	.38	.40	.39	.40	.40	.40	.40	.40
1-EB	Exhaust side of barrel	.88	.87	.88	.87	.88	.86	.88	.88	.88	.88	.88	.88	.88
3-EB		.77	.77	.78	.77	.78	.77	.78	.78	.78	.78	.78	.78	.78
4-EB		.87	.87	.87	.86	.88	.86	.88	.88	.88	.88	.88	.87	.87
6-EB		.89	.88	.88	.87	.88	.88	.88	.89	.88	.88	.88	.89	.88
7-EB		.86	.85	.86	.86	.87	.86	.87	.86	.86	.87	.86	.86	.86
9-EB		.89	.88	.89	.88	.89	.88	.88	.90	.89	.89	.89	.89	.88
10-EB		.90	.90	.90	.90	.90	.89	.91	.90	.90	.90	.90	.89	.90
12-EB		.91	.90	.91	.90	.92	.90	.91	.90	.93	.91	.91	.91	.91
14-EB		.89	.87	.89	.88	.88	.87	.88	.88	.88	.88	.88	.89	.89
1-EH	Exhaust side of head	.87	.86	.86	.86	.86	.87	.85	.87	.87	.87	.86	.87	.86
3-EH		.81	.81	.82	.80	.82	.81	.81	.81	.82	.82	.81	.82	.81
4-EH		.92	.92	.92	.92	.93	.92	.92	.92	.93	.92	.92	92	.92
6-EH		.85	.84	.85	.84	.85	.84	.85	.85	.84	.84	.84	.84	.84
7-EH		.89	.88	.88	.89	.89	.89	.90	.88	.89	.89	.89	.89	.89
9-EH		.88	.86	.87	.86	.86	.87	.87	.87	.86	.86	.86	.86	.87
10-EH		.92	.92	.92	.91	.93	.91	.93	.91	.92	.92	.91	.92	.92
12-EH		.85	.83	.84	.84	.84	.83	.85	.85	.83	.84	.83	.85	.85
14-EH		.89	.88	.89	.88	.89	.89	.89	.90	.88	.89	.89	.90	.90
1-TH	Top of head	.87	.86	.87	.86	.86	.87	.87	.87	.86	.87	.87	.86	.87
3-TH		.87	.88	.88	.87	.89	.87	.89	.89	.88	.88	.87	.87	.88
4-TH		.83	.82	.83	.82	.83	.83	.83	.83	.83	.83	.83	.83	.83
6-TH		.82	.82	.82	.81	.82	.82	.83	.83	.83	.82	.83	.83	.82
7-TH		.88	.88	.88	.87	.89	.87	.89	.87	.88	.88	.87	.87	.88
9-TH		.90	.90	.90	.90	.90	.90	.91	.91	.91	.90	.90	.91	.92
10-TH		.85	.83	.84	.84	.84	.83	.85	.85	.83	.84	.83	.85	.85
12-TH		.85	.84	.84	.84	.86	.84	.86	.86	.85	.85	.84	.86	.85
14-TH		.81	.80	.81	.80	.81	.80	.82	.82	.80	.82	.81	.82	.82
1-IH	Intake side of head	.87	.87	.87	.86	.87	.86	.86	.88	.86	.87	.87	.88	.88
6-IH		.89	.89	.90	.89	.89	.90	.90	.90	.89	.90	.89	.89	.90
10-IH		.94	.94	.94	.94	.94	.93	.94	.95	.94	.94	.94	.94	.94
1-IB	Intake side of barrel	.85	.84	.85	.85	.85	.84	.86	.85	.85	.86	.84	.85	.85
6-IB		.90	.89	.90	.89	.90	.90	.90	.90	.89	.90	.90	.89	.90
10-IB		.90	.90	.90	.89	.91	.90	.90	.90	.90	.90	.90	.90	.90
3-EH2		.81	.81	.81	[illegible]	.81	.80	.82	.82	.82	.81	.81	.80	.81
4-EH2		.91	.90	.90	.90	.91	.90	.91	.90	.91	.91	.90	.90	.90
3-EB2		.71	.64	.70	.69	.71	.70	.70	.71	.70	.71	.71	.71	.71
4-EB2		.81	.81	[illegible]	.81	.82	.82	.83	.82	.82	.82	.83	.83	.82

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Table Ia (concluded)

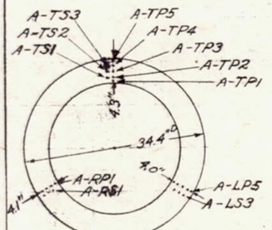
																CLIMB							
6-14					6-15					7-17						5-11				5-18			
1	2	3	4	5	1	2	3	4	5	1	2	3	4	5		1	3	5	7	1	3	5	7
324	328	327	330	326	324	—	323	326	325	326	328	—	326	328	Ind. airspeed, mph	155	155	152	152	136	138	136	136
30.1	32.1	33.0	34.8	35.3	34.2	—	30.3	33.5	35.7	35.7	34.6		31.7	31.2	q_c	12.0	11.9	11.4	11.4	9.2	9.4	9.2	9.1
14.37	14.92	15.64	16.21	16.91	16.15	14.88	14.00	15.52	16.76	16.86	16.08	—	14.80	14.25	Pressure altitude range, ft	2300-4200	8100-9500	13100-14300	17000-17800	4000-5700	9700-10900	14600-15700	18400-19400
-13	-9	-6	-3	0	-15	-19	-26	-17	-14	-10	-11		-16	-19									
.558	.574	.598	.616	.638	.630	.585	.560	.608	.652	.650	.621		.578	.560	Av. free air temp, °F	22	25	12	-2	16	5	-10	-22
18600	17800	16550	15250	14550	14950	17050	18500	16050	13900	14000	15400		17550	18500	" bhp.	910	925	870	780	975	935	790	650
2680															" manifold pr., in. Hg	39.7	39.9	37.3	32.5	42.5	41.5	35.0	30.2
805	835	868	898	922	914	854	812	896	942	933	891	858	830	812	rpm	2540							
34.3	35.7	37.1	38.5	39.9	38.3	35.7	33.7	37.1	39.9	39.9	38.4	37.4	35.7	34.4									
Modified Cowl Flaps (Closed)										Baffle Seals Removed						Modified Cowl Flaps (Open)							
Pressure ratio, P/q_c																Pressure ratio, P/q_c							
.38	.37	.38	.37	.37	.37	.37	.38	.37	.37	.38	.39		.39	.39		-.18	-.18	-.18	-.20	-.30	-.27	-.26	-25
.37	.36	.38	.36	.36	.38	.36	.36	.36	.38	.37	.38		.38	.38		-.17	-.15	-.14	-.14	-.29	-.25	-.26	-26
.37	.36	.38	.35	.36	.36	.36	.36	.36	.37	.38	.35		.36	.36		-.21	-.21	-.18	-.18	-.33	-.30	-.30	-30
.39	.38	.39	.38	.38	.38	.38	.38	.38	.38	.39	.40		.40	.40		-.10	-.08	-.08	-.07	-.16	-.16	-.15	-15
.39	.38	.39	.38	.38	.38	.38	.38	.38	.38	.40	.40		.41	.40		-.10	-.08	-.08	-.07	-.16	-.16	-.13	-15
.40	.36	.40	.38	.38	.39	.39	.39	.39	.39	.41	.41		.41	.41		-.12	-.09	-.09	-.10	-.17	-.14	-.11	-16
.40	.36	.40	.38	.38	.39	.39	.39	.39	.39	.40	.40		.41	.40		-.12	-.10	-.11	-.10	-.18	-.16	-.13	-15
.39	.38	.39	.37	.37	.38	.38	.38	.38	.39	.38	.39		.39	.39		-.21	-.18	-.17	-.18	-.30	-.28	-.25	-22
.38	.37	.38	.37	.37	.37	.37	.37	.37	.38	.38	.39		.39	.39		-.18	-.17	-.17	-.18	-.30	-.30	-.25	-25
.88	.87	.89	.87	.87	.87	.87	.87	.86	.87	.87	.88		.88	.88		1.03	.98	.97	.93	1.06	1.07	.97	.92
.78	.77	.78	.76	.76	.76	.77	.77	.77	.76	.75	.76		.77	.77		.74	.81	.75	.72	.75	.80	.74	.72
.84	.84	.84	.83	.82	.83	.84	.83	.83	.83	.83	.83		.84	.84		.94	.94	.90	.90	.97	.96	.99	.91
.88	.88	.89	.88	.88	.88	.88	.88	.88	.88	.88	.89		.89	.88		1.04	1.08	1.03	1.01	1.23	1.13	1.15	1.07
.86	.86	.86	.85	.86	.86	.86	.86	.86	.85	.86	.87		.87	.87		1.02	.95	.86	.95	1.13	1.04	1.09	1.01
.88	.88	.89	.88	.89	.88	.88	.89	.88	.88	.91	.91		.91	.90		.99	.93	.96	.96	1.12	1.13	1.08	1.07
.91	.90	.91	.89	.90	.90	.90	.89	.88	.90	.89	.89		.89	.89		.87	.98	1.02	1.00	1.20	1.16	1.09	1.06
.91	.90	.91	.89	.90	.90	.90	.90	.90	.90	.90	.91		.91	.90		1.03	.97	.94	.97	1.06	1.09	.99	1.00
.89	.87	.88	.86	.89	.88	.87	.87	.87	.88	.89	.88		.90	.88		1.10	1.04	1.03	.97	1.11	1.09	1.01	.97
.87	.86	.85	.86	.86	.86	.86	.86	.86	.86	.86	.87	Unsteady	.87	.86		.97	.93	.93	.88	.95	.99	.95	.87
.82	.80	.81	.79	.80	.80	.81	.81	.80	.81	.81	.81		.82	.80		.84	.85	.82	.77	.83	.81	.84	.77
.93	.91	.92	.91	.92	.91	.92	.93	.93	.92	.91	.91		.93	.92		1.13	1.12	1.04	1.03	1.17	1.13	1.08	1.10
.83	.82	.83	.81	.82	.81	.82	.83	.82	.82	.81	.81		.82	.82		.98	.90	.90	.86	.98	.98	.92	.90
.90	.89	.90	.88	.88	.89	.89	.89	.88	.88	.89	.89		.89	.88		1.02	.97	.98	.98	1.16	1.13	1.09	1.06
.88	.87	.87	.86	.86	.86	.86	.87	.86	.86	.86	.86		.87	.86		.93	.91	.89	.93	1.17	1.06	.96	.96
.92	.91	.93	.91	.91	.91	.91	.91	.92	.92	.92	.91		.93	.93		1.15	1.08	1.05	1.03	.98	1.19	1.15	1.10
.94	.94	.95	.93	.94	.93	.93	.94	.94	.93	.94	.94		.94	.94		1.17	1.10	1.06	1.04	1.17	1.17	1.15	1.13
.90	.88	.90	.89	.89	.88	.89	.88	.88	.88	.89	.88		.90	.89		1.14	1.13	1.06	1.06	1.17	1.15	1.18	1.11
.87	.86	.87	.85	.85	.86	.86	.86	.86	.86	.86	.86		.84	.86		1.04	1.01	.98	.97	1.18	1.01	1.06	.97
.88	.88	.89	.87	.88	.87	.88	.88	.88	.86	.88	.88		.88	.88		.95	.97	.94	.91	1.00	.97	1.00	.93
.84	.82	.84	.82	.82	.82	.82	.83	.82	.82	.81	.82		.82	.82		.94	.88	.87	.85	1.02	.92	.97	.91
.83	.82	.84	.81	.82	.81	.82	.82	.82	.82	.81	.82		.82	.82		.91	.86	.87	.84	1.03	.99	.91	.91
.89	.88	.89	.86	.89	.87	.87	.88	.88	.88	.88	.88		.88	.88		1.07	.99	1.01	.97	1.01	1.12	1.08	1.05
.93	.91	.91	.90	.90	.90	.90	.90	.90	.90	.91	.91		.91	.90		1.05	1.03	1.03	1.02	1.20	1.21	1.08	1.06
.85	.84	.84	.83	.84	.83	.84	.84	.83	.83	.84	.83		.85	.83		1.03	.91	.89	.88	.98	.95	.90	.86
.86	.85	.86	.83	.84	.85	.85	.85	.84	.84	.84	.83		.85	.84		1.00	.94	.92	.90	1.02	1.03	1.01	.93
.82	.80	.81	.80	.79	.79	.80	.81	.80	.79	.80	.80		.82	.81		.94	.92	.96	.88	1.08	.96	1.00	.93
.88	.87	.88	.87	.87	.86	.87	.87	.86	.86	.87	.87		.87	.86		1.02	1.00	.97	.93	1.05	1.00	1.02	.96
.89	.90	.91	.90	.89	.90	.88	.89	.90	.89	.90	.90		.90	.90		1.09	1.06	1.03	1.02	1.22	1.13	1.08	1.11
.95	.94	.95	.94	.94	.93	.94	.94	.93	.94	.93	.93		.95	.94		1.22	1.13	1.03	1.09	1.32	1.26	1.08	1.19
.85	.84	.86	.84	.84	.84	.84	.85	.85	.84	.85	.85		.85	.85		.99	.95	.89	.90	1.02	1.01	.99	.91
.90	.89	.90	.88	.89	.88	.89	.90	.89	.90	.89	.89		.90	.90		1.15	1.09	1.02	1.01	1.21	1.17	1.07	1.05
.91	.89	.90	.89	.90	.89	.90	.90	.89	.90	.89	.89		.90	.90		1.10	1.05	1.00	.97	1.14	1.12	1.07	1.03
.83	.82	.82	.80	.82	.82	.81	.82	.82	.82	.82	.82		.82	.81		.76	.81	.77	.73	.66	.71	.74	.69
.91	.90	.91	.89	.91	.90	.90	.90	.90	.90	.89	.89		.90	.90		1.07	1.01	.99	.99	1.15	1.06	1.11	1.02
.70	.68	.70	.68	.69	.69	.69	.70	.69	.69	.68	.69		.70	.69		.56	.56	.57	.56	.53	.55	.53	.51
.82	.81	.81	.79	.80	.81	.81	.81	.81	.90	.81	.80		.81	.82		.83	.86	.86	.90	.92	.87	.99	.90

3707

Table Ib. – Pressure Data –

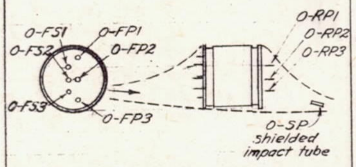
XP-42 Airplane
Short-nose low-inlet-velocity cowling with fan and cuffs

Test – Flight	4-6				4-7				4-9				
	HIGH-SPEED LEVEL FLIGHT												
Run	1	2	3	4	1	2	3	4	1	2	3	4	5
True Airspeed, mph	329	328	330	330	330	330	329	329	331	329	330	329	329
q_c, impact press., in H_2O	36.6	35.4	34.6	33.4	32.6	31.4	30.5	29.4	35.6	33.4	32.2	30.2	29.5
Atm pressure, in. Hg.	16.95	16.26	15.62	14.93	15.25	14.63	14.04	13.45	16.95	15.90	14.93	14.03	13.43
Ambient-air temp, °F	-11	-15	-19	-23	-2	-5	-13	-13	10	1	-4	-8	-15
σ, density ratio	.655	.634	.614	.592	.578	.559	.545	.522	.625	.592	.568	.538	.525
Density altitude, ft	13750	14750	15750	16900	17550	18550	19300	20600	15200	16500	18050	19650	20900
rpm.													
bhp	946	918	900	867	853	825	792	769	923	877	839	792	769
Manifold press, in. Hg.	39.6	38.6	37.1	35.8	36.1	34.6	33.6	32.1	39.6	37.6	35.6	33.6	32.1
	← Original Cowl Flaps (Closed) →												

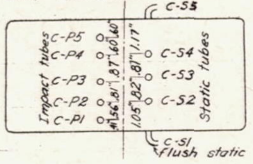


Location of Pressure Tubes in Annulus

Oil Cooler Pressure Tube Locations



Carburetor Scoop Pressure Tube Locations



Pressure Ratio, p/q_c

Tube		Survey	4-6 1	4-6 2	4-6 3	4-6 4	4-7 1	4-7 2	4-7 3	4-7 4	4-9 1	4-9 2	4-9 3	4-9 4	4-9 5
A-TP1	impact tubes	Top Survey Rake	.83	.82	.83	.83	.83	.82	.83	.84	.83	.83	.84	.83	.84
2			.85	.84	.85	.84	.85	.84	.85	.84	.84	.86	.84	.84	.85
3			.89	.88	.88	.87	.89	.87	.89	.89	.88	.89	.89	.89	.89
4			.92	.91	.91	.90	.92	.90	.92	.91	.92	.92	.91	.91	.91
5			.87	.87	.86	.87	.88	.86	.88	.87	.88	.89	.88	.88	.88
A-TS1	static tubes		.77	.77	.78	.77	.78	.77	.78	.78	.77	.78	.77	.78	.78
2			.81	.79	.80	.80	.80	.80	.81	.80	.80	.80	.79	.80	.81
3			.78	.77	.78	.77	.79	.78	.80	.79	.79	.79	.78	.79	.79
A-RP1	impact tubes	Right Survey	.84	.83	.84	.83	.84	.83	.85	.84	.84	.84	.84	.84	.84
2			.85	.84	.85	.83	.86	.84	.85	.84	.85	.85	.84	.84	.84
3			.90	.89	.90	.89	.90	.90	.90	.90	.92	.91	.90	.90	.90
4			.96	.94	.95	.95	.96	.94	.96	.95	.96	.96	.95	.95	.95
5			.90	.88	.90	.89	.90	.89	.89	.90	.90	.91	.90	.90	.89
A-RS1	static tubes		.80	.80	.80	.79	.80	.80	.80	.80	.80	.80	.80	.80	.80
2			.82	.80	.81	.81	.80	.80	.81	.80	.81	.81	.80	.81	.81
3			.82	.81	.82	.82	.83	.81	.83	.82	.83	.82	.81	.82	.82
A-LP1	impact tubes	Left Survey	.83	.83	.83	.83	.83	.81	.83	.84	.83	.83	.83	.83	.84
2			.85	.84	.85	.84	.86	.84	.85	.84	.84	.86	.84	.84	.85
3			.91	.90	.91	.90	.91	.90	.91	.90	.92	.92	.91	.90	.91
4			.93	.92	.93	.92	.92	.91	.93	.94	.92	.93	.93	.93	.94
5			.86	.86	.86	.86	.87	.86	.87	.87	.87	.88	.86	.87	.88
A-LS1	static tubes		.84	.83	.84	.83	.83	.82	.83	.84	.83	.83	.83	.84	.84
2			.85	.84	.84	.84	.84	.84	.85	.84	.84	.84	.84	.84	.85
3			.85	.84	.85	.85	.86	.85	.86	.86	.86	.86	.85	.85	.85
O-FP1	impact tubes	Front Survey	.93	.92	.93	.92	.94	.93	.95	.93	.93	.94	.93	.93	.94
2			.99	.97	.99	.98	.99	.98	1.00	.99	.98	.98	.99	.98	.97
3			1.02	1.00	1.01	1.01	1.02	1.01	1.01	1.02	1.01	1.02	1.01	1.01	1.02
O-FS1	static tubes		.87	.86	.87	.87	.87	.87	.88	.87	.87	.88	.87	.88	.88
2			.87	.86	.88	.87	.88	.88	.89	.89	.88	.89	.87	.89	.88
3			.90	.89	.90	.87	.90	.90	.91	.90	.90	.91	.90	.91	.92
O-RP1	impact tubes	Rear Survey	.65	.64	.65	.64	.65	.64	.65	.65	.64	.65	.65	.65	.65
2			.61	.59	.61	.60	.61	.60	.61	.61	.60	.61	.61	.62	.61
3															
O-SP			.59	.58	.58	.58	.58	.58	.59	.59	.58	.58	.58	.59	.59
C-P1	Impact tubes		.98	.96	.97	.97	.97	.96	.97	.97	.98	.97	.98	.97	.97
2			1.00	.98	1.00	.98	.99	.98	.99	.99	.99	.99	.98	.98	.99
3			1.01	.99	1.00	1.00	1.02	.99	1.00	1.00	1.00	1.01	1.00	.99	1.00
4			1.02	1.01	1.01	1.02	1.02	1.01	1.00	1.02	1.01	1.02	1.01	1.02	1.00
5			1.02	1.02	1.01	1.02	1.02	1.01	1.01	1.02	1.02	1.02	1.01	1.02	1.00
C-S1	Static tubes		.81	.80	.81	.80	.81	.80	.81	.82	.81	.82	.81	.82	.82
2			.79	.78	.79	.78	.79	.78	.78	.79	.79	.79	.79	.79	.79
3			.78	.77	.78	.78	.78	.77	.78	.79	.78	.79	.78	.78	.79
4			.78	.78	.78	.78	.79	.77	.78	.79	.78	.79	.77	.78	.79
5															
C-TH	Impact press in carb. throat		.81	.81	.82	.81	.81	.80	.81	.82	.81	.82	.82	.82	.82

Table Ib.-(Concluded)

HIGH-SPEED LEVEL FLIGHT CONTINUED

6-14					6-15					7-17				
1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
324	328	327	330	326	324	—	323	326	325	326	328	—	326	328
30.1	32.1	33.0	34.8	35.3	34.2	—	30.3	33.5	35.7	35.7	34.6		31.7	31.2
14.37	14.92	15.64	16.21	16.91	16.15	14.88	14.00	15.52	16.76	16.86	16.08	—	14.80	14.25
-13	-9	-6	-3	0	-15	-19	-26	-17	-14	-10	-11		-16	-19
.558	.574	.598	.616	.638	.630	.585	.560	.608	.652	.650	.621		.578	.560
18600	17800	16550	15250	14550	14950	17050	18500	16050	13900	14000	15400		17550	18500
2680														
805	835	868	898	922	914	954	812	896	942	933	891	858	830	812
34.3	35.7	37.1	38.5	39.9	38.3	35.7	33.7	37.1	39.9	39.9	38.4	37.4	35.7	34.4

← Modified Cowl Flaps (Closed) →

Baffle Seals Removed

CLIMB

	5-11				5-18			
	1	3	5	7	1	3	5	7
Ind. airspeed mph	155	155	152	152	136	138	136	136
q_c	12.0	11.9	11.4	11.4	9.2	9.4	9.2	9.1
Pressure altitude range, ft	2300- 4200	8100- 9500	13100- 14300	17000- 17800	4000- 5700	9700- 10400	14601- 15700	18400- 19400
Av Free air temp, °F	22	25	12	-2	16	5	-10	-22
" bhp	910	925	870	780	975	935	790	650
" manifold pr., in. Hg	39.7	39.9	37.3	32.5	42.5	41.5	35.0	30.2
rpm	2540							

Modified Cowl Flaps (Open)

Pressure ratio, p/q_c

6-14					6-15					7-17						5-11				5-18			
1	2	3	4	5	1	2	3	4	5	1	2	3	4	5		1	3	5	7	1	3	5	7
.83	.83	.84	.82	.82	.83	.83	.83	.82	.82	82	.84		.83	.82		.89	.83	.85	.81	.85	.86	.86	.84
.86	.85	.86	.84	.86	.85	.85	.84	.84	.84	.85	.86		.86	.85		.98	.93	.92	.89	.96	.96	.90	.88
.89	.88	.89	.88	.88	.88	.88	.89	.89	.89	.89	.90		.90	.89		1.02	1.01	.97	.95	.96	1.00	.98	.93
.92	.92	93	.91	.92	.91	.92	.91	.91	.91	.92	.92		.92	.92		1.07	1.02	1.03	1.01	1.11	1.09	1.03	1.02
.89	.87	.88	.87	.88	.87	.87	.87	.87	.89	.88	.88		.88	.88		.91	.89	.93	.91	.92	.92	.89	.89
.77	.76	.77	75	.76	.76	.76	.76	.76	.76	.76	.76		.77	.76		.64	.69	.70	.70	.64	.65	—	.68
.82	.77	.79	77	.77	77	.78	.79	.77	.77	.79	.79		.81	.78		.69	.70	.72	.73	.65	.69	—	.72
.79	.78	.79	.77	.77	.78	.78	.78	.77	.77	.77	.78		.79	.79		.74	.75	.77	.75	.65	.72	.76	.74
.85	.84	.85	.83	.84	.84	.84	.84	.83	.83	.84	.84		.84	.84		.93	.89	.88	.84	.97	.95	.92	.87
.86	.86	.86	.85	.85	.85	.85	.85	.85	.85	.85	.86		.86	.85		1.06	1.01	1.01	.94	1.14	1.02	1.02	.97
.91	.90	.91	.90	.90	.90	.90	.90	.91	.90	.91	.91		.91	.91		1.16	1.10	1.08	1.05	1.24	1.16	1.22	1.12
.97	.95	.96	.95	.96	.95	.96	.95	.95	.95	.95	.96		.95	.94		1.13	1.08	1.08	1.10	1.25	1.21	1.17	1.14
.90	.89	.90	89	.89	.90	.89	.90	.89	.90	.89	.89		.90	.89		1.00	.93	.90	.96	1.05	.99	1.01	1.00
										.80	.78		.77	.76		.72	.73	.73	.78	.69	.74	—	.77
.80	.81	.81	.79	.79	.79	.80	.80	.80	.81	.79	.80		.81	.80		.77	.78	.79	.80	.80	.83	—	.82
.83	.82	.80	.82	.82	.82	.82	.82	.81	.81	.82	.82		.82	.81		.80	.78	.81	.82	.79	.81	.88	.83
.84	.83	.84	.82	.83	.83	.83	.83	.83	.83	.82	.83	Unsteady	.83	.82		.73	.74	.76	.78	.73	.74	.74	.74
.86	.86	.86	.85	.85	.85	.85	.84	.85	.85	.85	.85		.86	.85		.91	.86	.85	.89	.90	.88	.93	.89
.91	.90	.91	.90	.90	.90	.90	.90	.91	.90	.91	.91		.91	.91		1.00	.93	.94	.97	1.03	.95	.99	1.03
.94	.92	.93	.92	.93	.92	.93	.93	.92	.92	.93	.94		.94	.93		1.02	.99	1.00	1.03	1.11	1.09	1.07	1.00
.87	.85	.87	.85	.86	.86	.86	.86	.86	.86	.86	.86		.87	.87		.81	.82	.85	.86	.76	.76	.84	.83
.83	.82	.84	.83	.83	.83	.83	.83	.84	.83	.82	.82		.83	.83		.86	.85	.83	.84	.91	.86	—	.88
.85	.84	.85	.83	.84	.83	.84	.84	.84	.81	.83	.84		.84	.83		.93	.98	.87	.88	1.00	.98	—	.91
.86	.86	.87	.84	.85	.85	.85	.85	.85	.85	.85	.85		.86	.85		.97	.93	.88	.91	1.08	.92	.98	.96
										.94	.94		.95	.94		1.13	1.15	1.16	1.15	1.34	1.30	1.24	1.17
										.98	.97		.99	.97		1.21	1.19	1.20	1.20	1.35	1.32	1.13	1.20
										1.01	1.02		1.02	1.01		1.17	1.17	1.17	1.16	1.29	1.30	1.11	1.18
.88	.87	.88	.87	.87	.87	.87	.87	.87	.86	.87	.87		.87	.87		.95	.98	.98	1.01	1.11	1.03	1.10	1.04
										.87	.87		.88	.88		.93	.97	.96	1.00	1.13	1.01	1.07	1.04
										.89	.90		.90	.90		.91	.93	.98	1.01	1.11	1.13	1.05	1.02
.65	.63	.65	.63	.64	.64	.64	.64	.64	.63	.63	.65		.65	.64		.48	.47	.47	.48	.49	.50	.49	.47
.62	.60	.61	.60	.59	.61	.61	.61	.61	.61	.59	.60		.61	.61		.34	.37	.35	.39	.41	.43	.42	.40
.58	.58	.58	.57	.57	.57	.57	.58	.57	.57	.56	.57		.58	.58		.35	.35	.36	.37	.39	.41	.39	.40
.97	.97	.99	.97	.98	.97	.97	.97	.97	.98	.98	.99		.99	.97		1.12	1.06	1.05	1.01	1.20	1.14	1.06	1.03
1.00	.98	1.00	.98	1.00	.98	.99	.98	.99	.99	1.00	1.00		1.00	.99		1.17	1.11	1.09	1.04	1.24	1.18	1.09	1.05
1.01	.99	1.00	1.00	1.01	1.00	1.00	1.00	1.01	1.00	1.01	1.01		1.02	1.00		1.23	1.16	1.12	1.05	1.27	1.16	1.10	1.09
1.02	1.00	1.01	1.01	1.02	1.01	1.01	1.01	1.01	1.02	1.02	1.02		1.02	1.01		1.20	1.14	1.15	1.06	1.23	1.21	1.14	1.10
1.00	1.01	1.02	1.02	1.02	1.01	1.01	1.01	1.02	1.02	1.02	1.02		1.03	1.01		1.20	1.14	1.14	1.09	1.26	1.21	1.14	1.09
.82	.80	.81	.81	.82	.81	.81	.81	.82	.82	.83	.84		.83	.84		.85	.75	.64	.66	.68	.55	.55	.58
.79	.79	.81	.79	.79	.79	.79	.79	.80	.80	.80	.81		.81	.80		.79	.72	.63	.62	.66	.46	.49	.51
.78	.78	.79	.77	.77	.77	.78	.79	.78	.77	.78	.79		.79	.80		.80	.66	.58	.60	.57	.39	.43	.45
.79	.79	.79	.77	.77	.78	.78	.79	.78	.77	.79	.79		.77	.79		.78	.66	.57	.59	.58	.41	.45	.46
.81	.81	.83	.81	.82	.81	.81	.81	.81	.82	.83	.83		.83	.82		.87	.76	.67	.67	.67	.52	.53	.53

Table II — Temperature Data

	HIGH-SPEED LEVEL FLIGHT																	
Test — Flight	4 - 6				4 - 7				4 - 9					6 - 14				
Run	1	2	3	4	1	2	3	4	1	2	3	4	5	1	2	3	4	5
XP-42 airplane — Short-nose low-inlet-velocity cawling with fan and cuffs.																		
True airspeed, mph	329	328	330	330	330	330	329	329	331	329	330	329	329	324	328	327	330	326
q_c, impact press., in. H_2O	36.6	35.4	34.6	33.4	32.6	31.4	30.5	29.4	35.6	33.4	32.2	30.2	29.5	30.1	32.1	33.0	34.8	35.3
Atm. pressure, in. Hg	16.95	16.26	15.62	14.93	15.25	14.63	14.04	13.45	16.95	15.90	14.93	14.03	13.48	14.37	14.92	15.64	16.21	16.91
Ambient air temp., °F	-11	-15	-19	-23	-2	-5	-13	-13	10	1	-4	-8	-15	-13	-9	-6	-3	0
σ, density ratio	.655	.634	.614	.592	.578	.559	.545	.522	.625	.598	.568	.538	.525	.558	.574	.598	.616	.638
Density altitude, ft	13750	14750	15750	16900	17550	18550	19300	20600	15200	16500	18050	19650	20400	18600	17800	16550	15250	14550
Rpm	2680																	
Bhp	946	918	900	867	853	825	792	769	923	877	839	792	769	805	835	868	898	922
Manifold press., in. Hg	39.6	38.6	37.1	35.8	36.1	34.6	33.6	32.1	39.6	37.6	35.6	33.6	32.1	34.3	35.7	37.1	38.5	39.9
	Original cowl flaps (Closed)													Modified				
Cylinder- Point of measurement	Temperature, °F																	
1 — Gasket thermocouple at rear sp. plug																		
2	324	317	324	328	354	354	354	360	344	347	352	360	358	335	339	339	333	331
3	353	347	349	349	370	367	367	374	367	365	367	376	372	356	354	354	350	350
4	340	336	337	337	347	347	347	354	333	338	338	344	344	337	339	341	337	337
5																		
6	328	326	326	326	340	338	335	338	339	340	338	342	338	329	329	331	331	329
7	378	376	381	381	398	397	399	402	395	395	397	402	397	384	380	382	382	380
8	340	333	333	335	354	349	356	358	358	354	356	360	356	350	344	348	346	341
9	365	367	369	371	383	390	390	392	383	390	390	395	392	373	373	373	373	371
10	371	371	374	376	390	392	390	390	386	390	388	390	386	375	371	376	371	369
11	360	360	365	369	388	388	388	390	388	386	381	390	388	375	373	373	369	369
12	347	342	346	351	367	367	370	370	367	370	370	372	365	359	356	358	356	352
13	358	358	369	371	392	395	397	399	388	390	392	399	397	386	386	386	380	378
14	347	342	351	358	379	381	381	386	376	379	381	386	383	367	369	369	365	363
1 — Rear ℄ flange at base of cylinder	269	267	269	272	285	283	287	289	280	278	282	287	287	284	279	279	277	279
2	274	272	274	274	287	287	287	289	285	285	287	287	287					
3	269	267	267	267	278	278	278	282	278	276	278	280	278	278	273	275	273	273
4	267		265	267		273	271	276	276	276				274	271	273	271	271
5	264	262	262	262	273	271	271	273	269	269	269	271	272	263	264	264	264	261
6	274	272	276	276	287	285	285	285	283	282	282	285	282	278	277	279	277	277
7	260	258	258	258	259	255								250	247	247	245	243
8	267	265	267	267	278	276	276	278	275	276	276	278	276	274	271	271	271	269
9	283	283	285	285	296	294	294	296	289	292	292	294	292	291	286	286	286	286
10	292	292	294	294	306	306	303	306	301	303	301	303	301	299	297	297	294	292
11	263	260	265	265	276	273	273	278	273	273	273	276	273	272	271	271	271	269
12	281	281	283	285	296	296	299	301	294	296	296	296	296	291	290	290	289	286
13	269	267	272	274	287	285	287	288	280	280	285	285	285	282	279	279	277	277
14	272	272	274	276	289	287	287	289	287	287	287	287	287	284	286	284	284	281
10 — Intake port	184	181	181	179	199	197	194	194	201	199	197	194	192	193	193	193	193	193
Mixture at blower rim	123	120	120	120	137	137	133	133	144	139	134	130	128	130	130	130	133	133
Fuel on suction side of pump	51	51	51	54	56	59	59	62	56	60	59	62	66	55	55	58	58	61
" " pressure " " "	54	54	54	54	59	62	62	66	60	63	63	66	69	55	55	58	61	61
" in carburetor float chamber	51	51	51	51	62	62	62	62	63	63	66	62	63	55	58	58	58	61
11 Front spark plug elbow	14	11	5	-2	22	19	15	12	34	30	21	18	12	12	18	18	24	24
11 rear " " "	42	36	33	30	53	50	47	47	63	57	53	50	47	46	49	49	55	55
Recorded free air	6	2	-2	-6	16	13	5	5	27	18	13	9	2	5	9	12	15	18
Air in carburetor scoop	14	17	14	-2	32	25	18	15						12	18	18		27
" at top annular rake	11	8	1	-2	22	19	12	11	33	27	18	15	6	9	15	18	21	24
" in front of cyl. #1	14	11	8	1	25	22	18	15	37	30	21	18	15	12	18	21	24	27
" at exit from oil cooler	11	5	1	-5	28	28	18	21	56	47	25	28	21	12	18	18	24	
Oil-in line	132	132	129	129	134	131	130	130	128	130	131	127	131	139	133	143	139	136
Oil out	191	191	188	191	199	196	197	198	194	195	195	194	195	195	192	195	199	195
Accessory compartment	81	78	75	75	96	95	94	94	102	98	94	97	94	91	88	91	91	94
Left magneto	69	66	63	63	80	80	78	78	70	85	82	81	78	73	73	76	76	79
Pilot's cockpit	56	54	53	51	64	67	68	67	73	71	69	67	64	59	60	63	63	66
Recording instrument compartment	51	51	45	45	62	59	59	56	67	66	63	62	56	52	55	58	58	63

Table II - (concluded)

HIGH-SPEED LEVEL FLIGHT, CONTINUED											CLIMB									
6 - 15					7 - 17						5 - 11					5 - 18				
1	2	3	4	5	1	2	3	4	5		a	b	c	d	e	a	b	c	d	e
324	—	323	326	325	326	328	—	326	328	Ind. airspeed mph	157	154	153	154	152	137	137	137	135	137
34.2	—	30.3	33.5	35.7	35.7	34.6		31.7	31.2	q_c	12.2	11.8	11.6	11.8	11.5	9.3	9.3	9.3	9.0	9.3
16.15	14.88	14.00	15.52	16.76	16.86	16.08	—	14.80	14.25	Pressure altitude range, ft	1100-	6400-	10700-	14600-	17600-	3500-	8700-	13200-	16800-	19900-
-15	-19	-26	-17	-14	-10	-11		-16	-19		3800	8600	12700	16100	18800	5900	10800	14800	18400	20800
.630	.585	.560	.608	.652	.650	.621		.578	.560	Av. free air temp., °F	19	26	18	6	-6	15	7	-6	-18	-27
14950	17050	18500	16050	13900	14000	15400		17550	18500	" bhp	900	920	920	840	760	975	930	830	710	600
										" manifold press., in. Hg	39.5	39.9	39.8	35.3	31.6	42.5	41.6	36.5	31.7	28.5
914	854	812	896	942	933	891	858	830	812	Rpm	2540									
38.3	35.7	33.7	37.1	39.9	39.9	38.4	37.4	35.7	34.4											
cowl flaps (Closed)											Modified cowl flaps (Open)									
					Baffle seals removed															
Temperature, °F										Temperature, °F										
317	332	331	324	318	318	322	332	337	332		302	326	344	336	334	290	330	307	288	275
338	348	343	341	337	337	339	345	347	341		318	340	356	357	357	305	344	336	326	313
328	334	331	331	329	330	340	337	339	332		301	328	347	347	344	296	330	319	309	296
370	374	371	371	369	373	375	379		375		323	351	368	378	378	313	336	342	342	332
319	328	324	324	320	326	328	330	333	328		273	302	321	334	334	283	300	307	300	290
372	382	381	375	373	381	381	383	388	385		334	355	372	385	387	317	338	357	357	349
340	346	343	339	337	341	339	351	354	349		292	319	338	355	357	292	313	328	328	324
357	365	366	360	356	362	366	368	373	370		332	351	372	387	389	317	342	363	361	351
359	370	369	366	362	367	368	375	375	373		305	340	359	374	376	311	336	342	334	321
357	368	366	360	352	360	366	373	377	375		328	344	361	380	382	313	349	324	305	294
342	351	352	348	339	343	349	356	360	356		302	328	347	361	361	307	334	305	286	271
353	372	374	371	358	354	362	373	381	377		338	357	372	376	378	330	365	313	290	269
338	355	356	354	339	339	345	356	362	358		324	348	359	361	364	321	349	302	280	265
266	275	276	268	268	271	271	275	277	275		230	256	269	271	273	243	267	260	252	248
					271	273	277	279	275		228	259	271	273	273	243	265	260	252	245
263	269	270	264	264	267	264	269	271	269		222	250	265	269	271	241	260	260	256	248
263	266	266	259	261	258	258	260	262	260		217	245	260	267	267	232	252	252	245	241
256	260	259	255	259	250	250	251	251	250		209	237	250	256	256	228	237	243	239	235
269	275	274	268	270	263	262	264	267	264		217	245	262	271	271	232	250	256	254	250
											200	228	241	250	250		224	232	230	226
260	269	268	259	261	260	262	264	264	262		209	241	260	267	269	230	250	258	256	254
277	285	285	276	278	275	275	277	279	277		230	260	275	284	285	248	267	275	271	267
285	294	293	285	287	273	277	277	279	277		235	265	284	294	294	250	269	273	267	260
260	264	264	259	259	258	258	260	264	260		226	247	260	269	271	239	256	252	241	235
279	285	287	278	278	260	264	267	269	266		230	258	273	281	284	245	265	256	248	241
264	275	276	268	268	264	269	271	275	273		232	260	273	275	275	245	265	254	243	241
266	277	276	272	270	258	260	264	267	264		228	254	269	271	271	248	267	258	250	243
178	183	178	180	180	185	187	187	187	185		174	183	185	183	179	175	169	163	153	155
119	119	116	119	121	123	126	123	123	120		103	122	119	134	134	117	128	117	108	96
47	47	47	50	53	50	50	53	56	56		39	42	39	39	36	37	37	37	37	37
47	50	50	50	56	50	53	53	56	60		42	42	39	39	39	40	40	40	40	37
47	47	47	50	56	53	53	53	53	53		44	43	43	43	40	48	42	36	36	30
7	4	2	7	10	16	16	16	13	7		30	37	34	27	15	33	24	14	5	-7
38	38	35	41	41	44	47	47	44	41		50	59	58	49	43	54	48	39	30	21
3	-2	-8	1	4	8	7	5	2	-1		25	30	23	12	0	19	10	-2	-12	-21
7	1	-2	7	10	16	16	13	10	3		27	31	24	15	0	20	14	2	-11	-20
13	7	4	13	17	19	19	16	13	7		23	34	28	15	9	27	18	5	-1	-11
10	4	1	7	10	13	13	10	7	3		27	46	43	24	9	39	18	21	21	-14
136	136	139	133	136	135	129	129	129	129		129	142	145	131	131	150	152	146	131	125
186	189	191	186	189	188	188	188	188	188		149	175	187	193	193	176	190	190	184	181
80	80	77	80	80	84	84	84	84	81		74	84	89	86	80	63	63	54	51	45
62	62	62	62	65	72	72	68	68	65		50	50	53	56	56	60	60	57	54	51
48	48	47	49	52	60	60	60	60	57		40	43	43	40	37	42	42	39	36	30
41	41	41	41	44	50	50	50	50	44		37	43	43	40	37	42	42	39	33	27

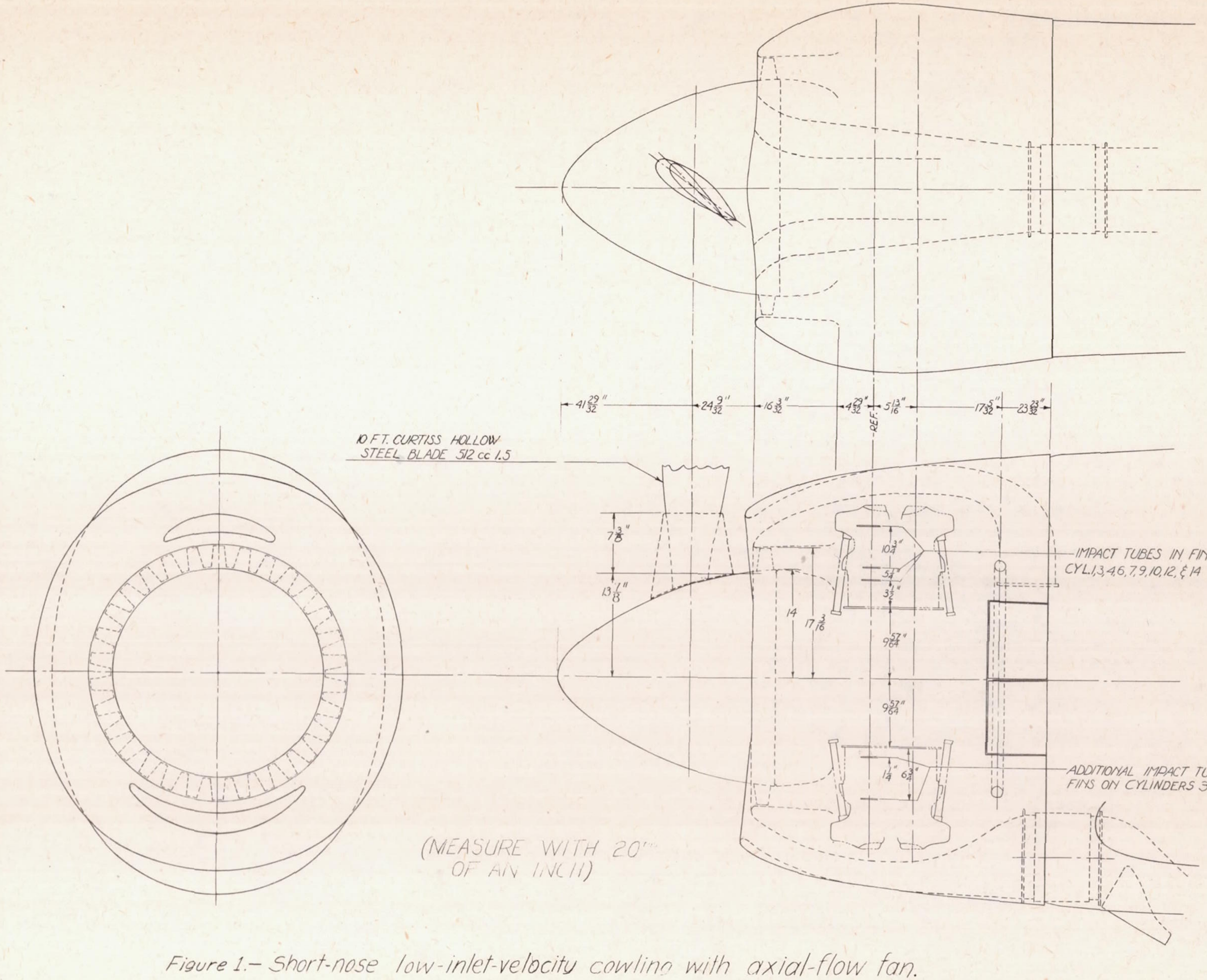


Figure 1.- Short-nose low-inlet-velocity cowling with axial-flow fan.

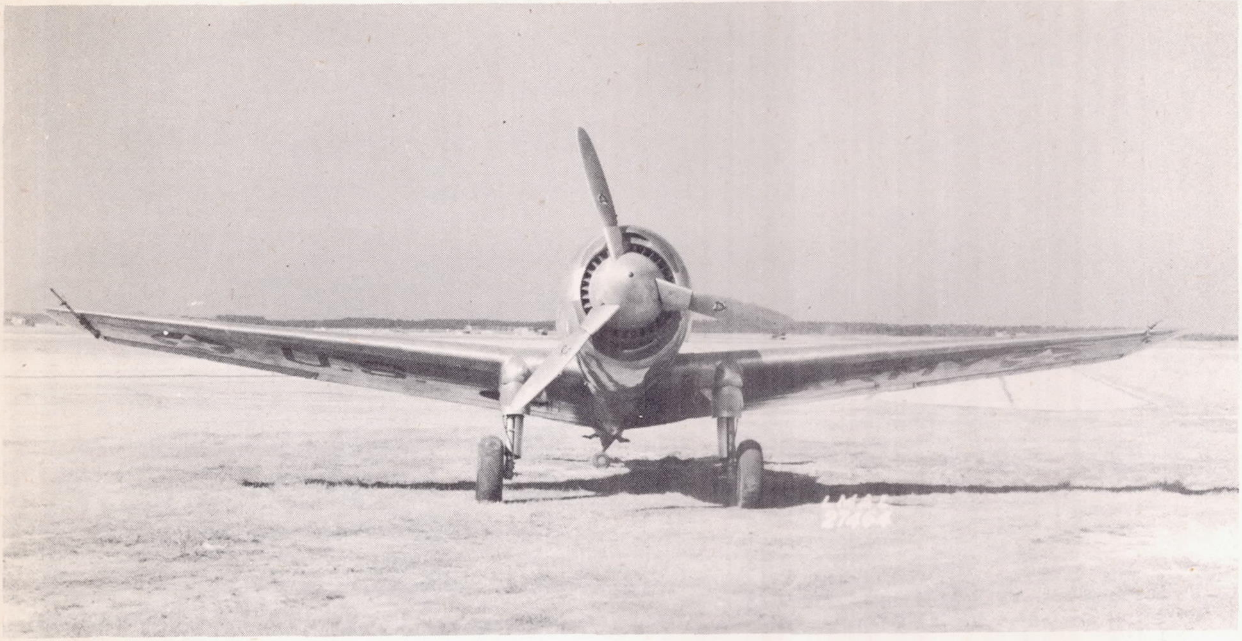


Figure 2.- Front view of XP-42 airplane with short-nose low-inlet velocity cowling and fan (test condition 6).

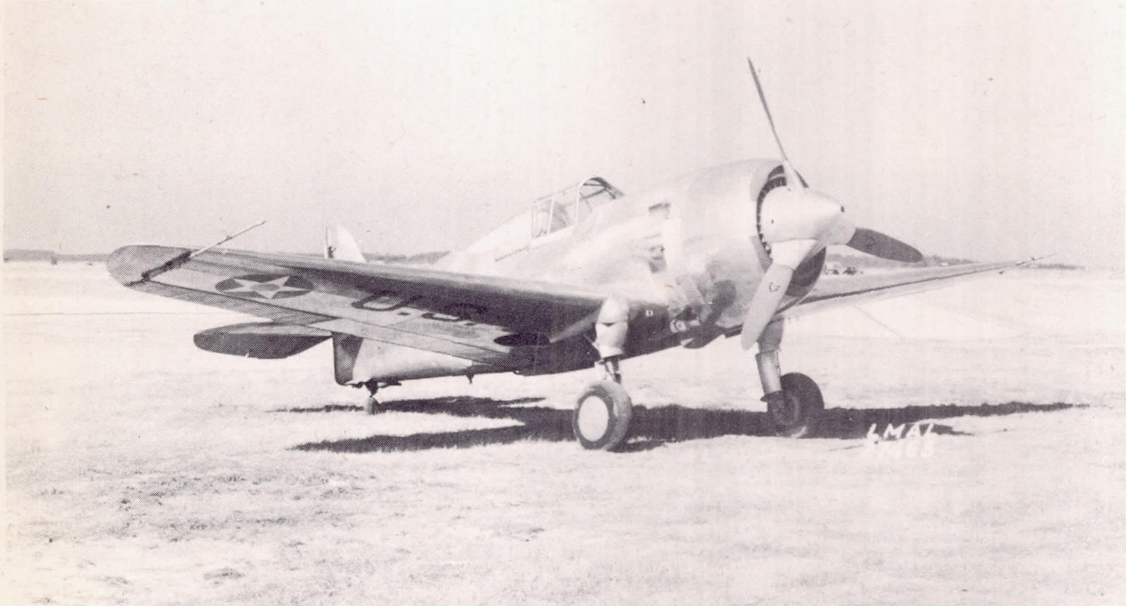


Figure 3.- Three-quarter front view in test condition 6.

Figure 4.- Three-quarter rear view in test condition 6.

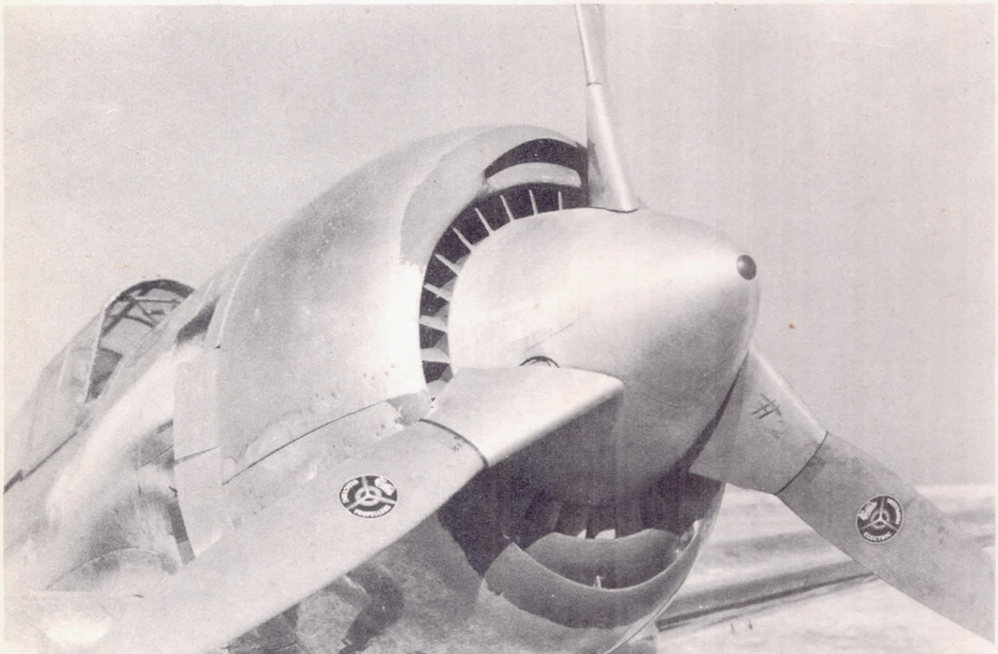
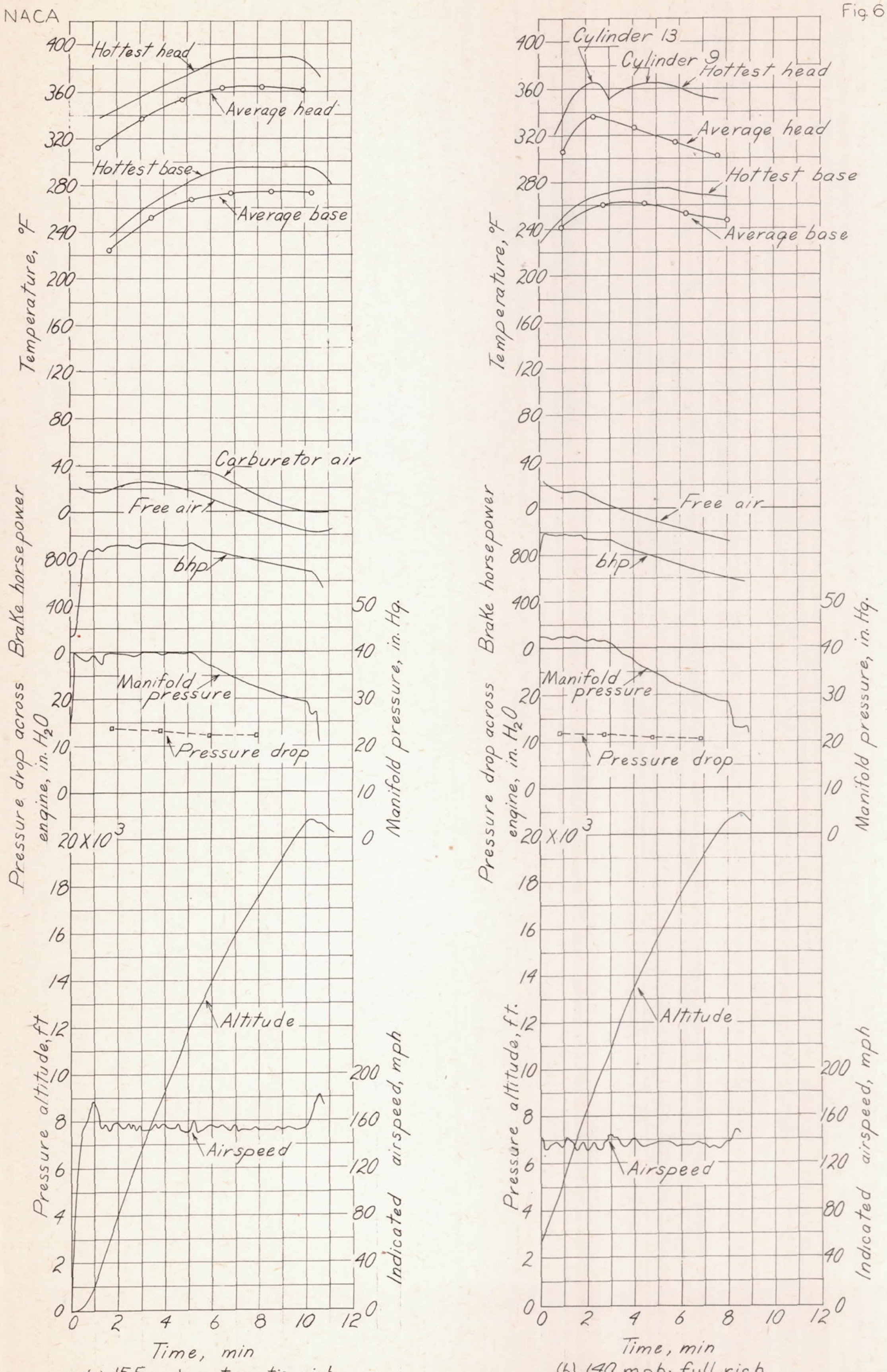


Figure 5.- Close-up of cowling and fan (test condition 6).



(a) 155 mph; automatic rich.

(b) 140 mph; full rich.

(Measure with 5/16" scale)

Fig. 6—Time histories of climbs in test 5.

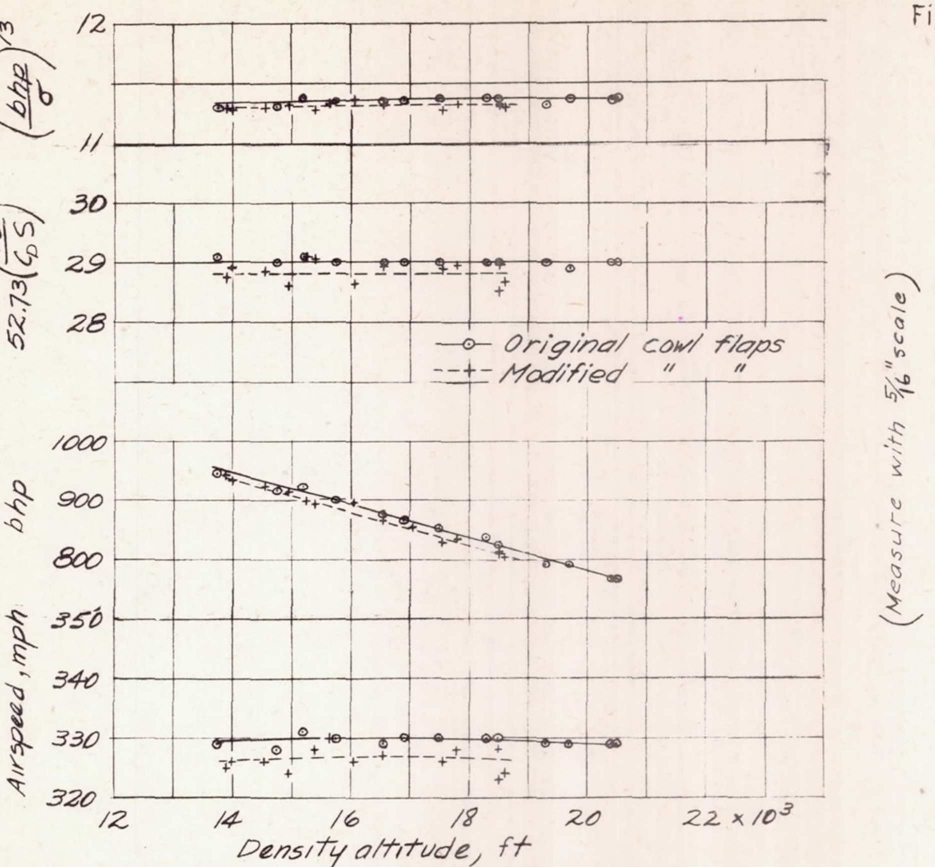


Figure 7. - High-speed performance of XP-42 airplane in tests 4, 6 and 7.

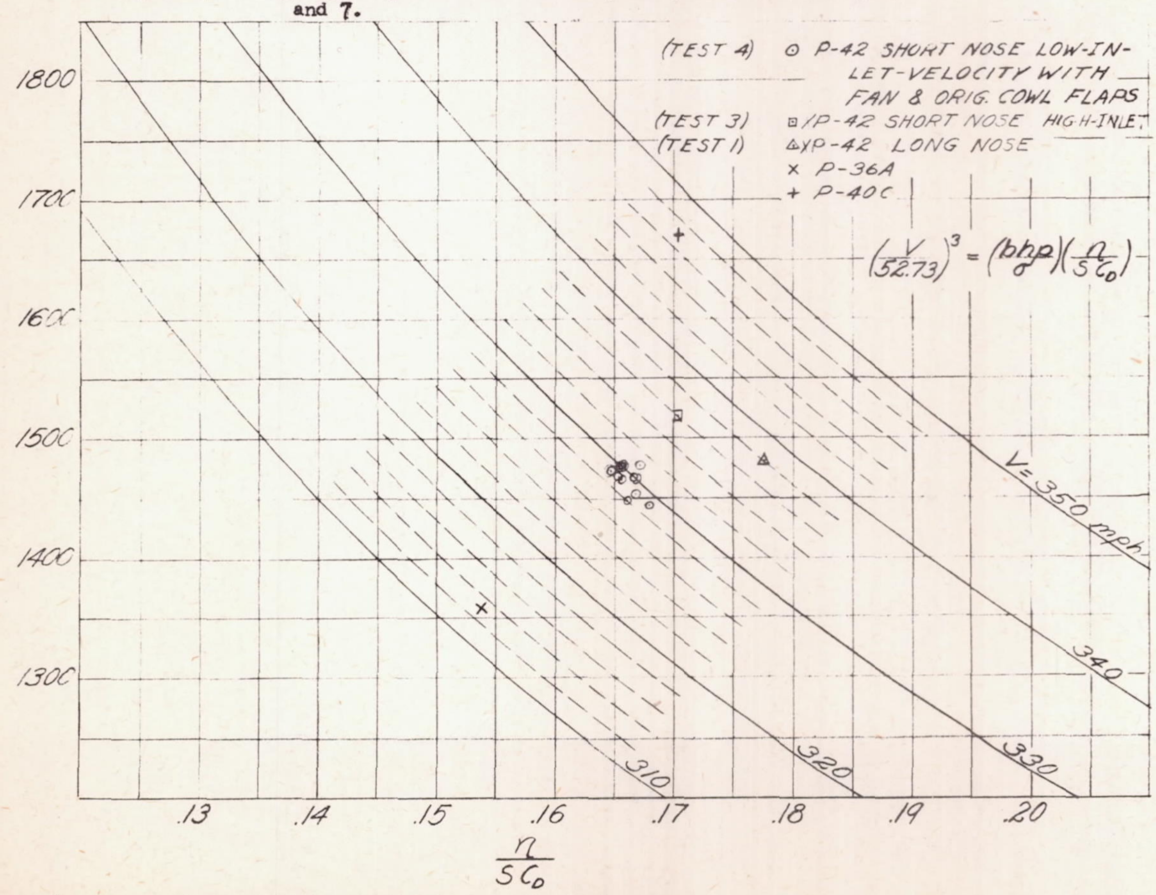
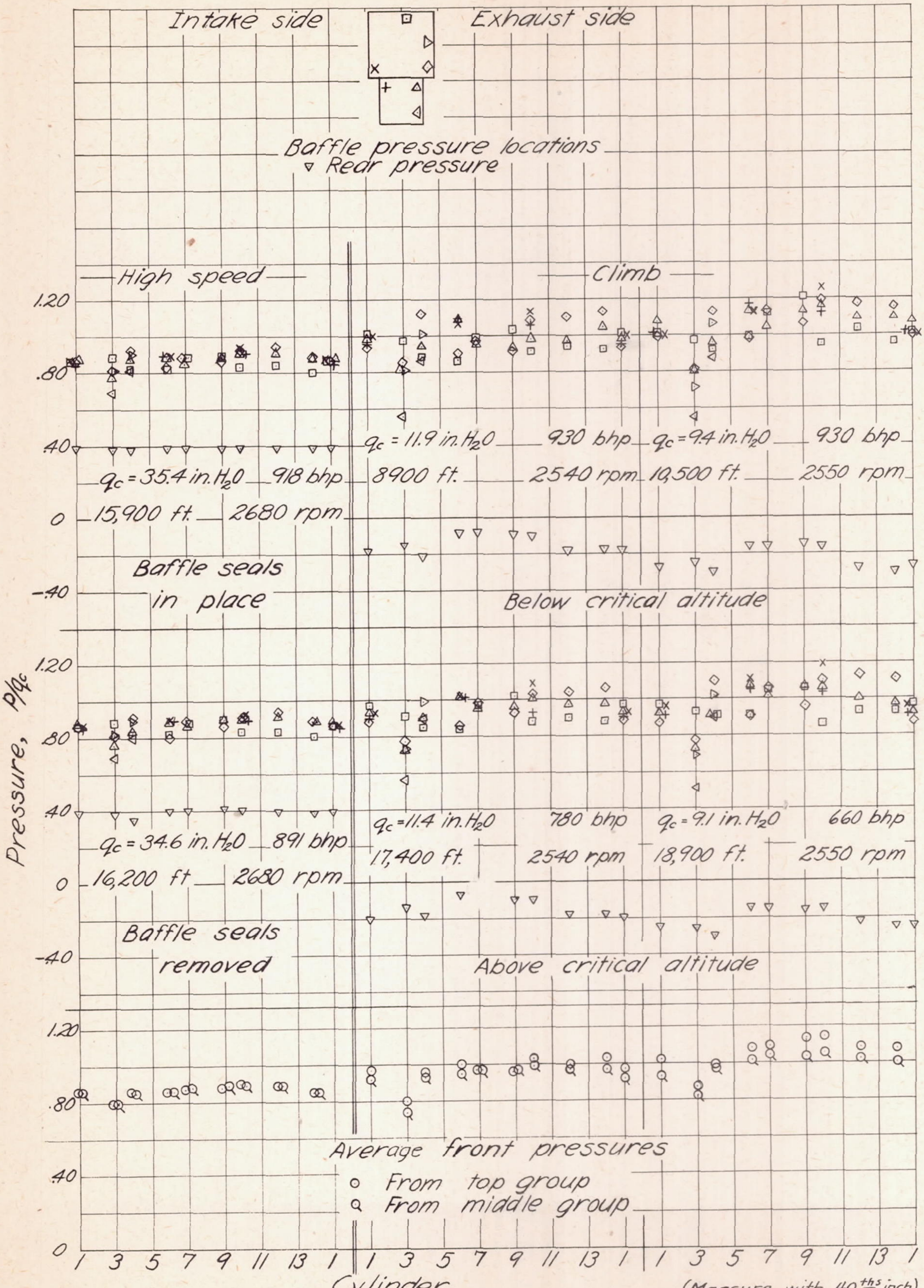


Figure 8. - Comparison of high speeds of several airplanes.



(Measure with 40ths inch)

Figure 9.- Engine cooling-air pressure distributions.

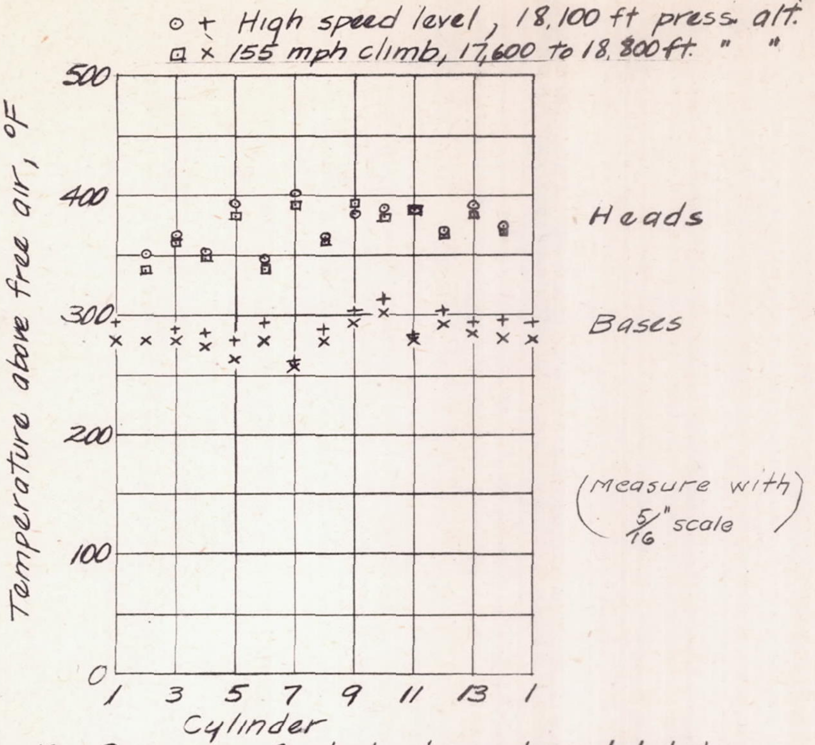


Figure 10.- Comparison of cylinder temperture distribution for climb and high speed at full power in automatic rich (Test 4 and 5).

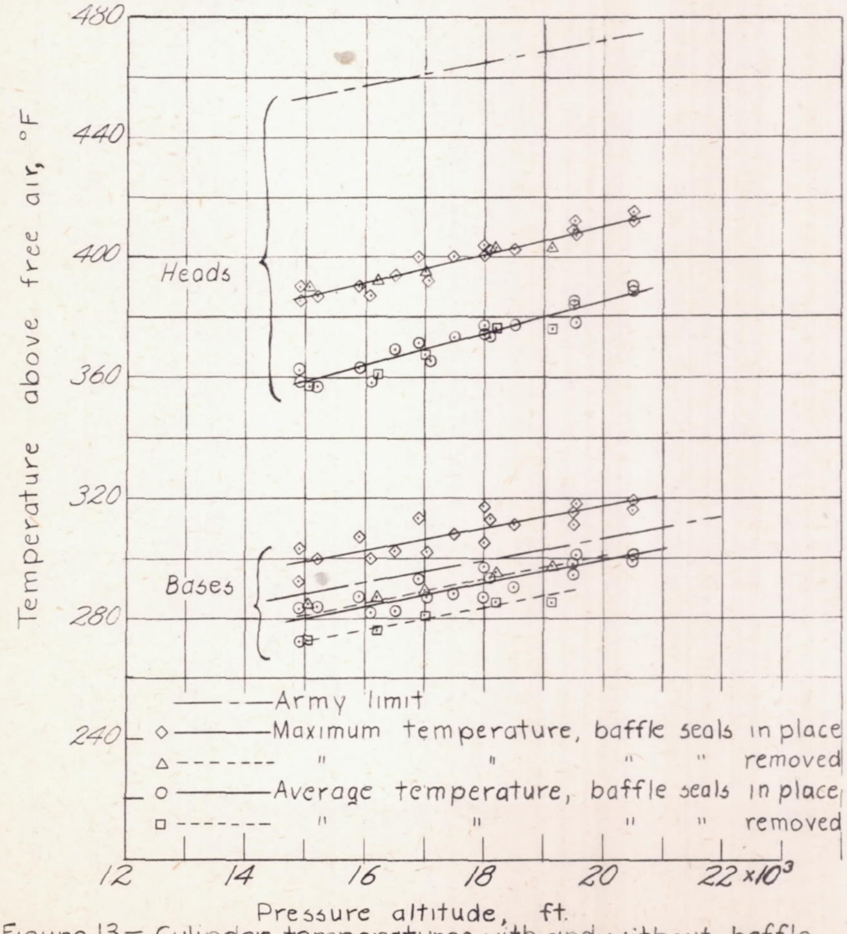


Figure 13.- Cylinder temperatures with and without baffle seal strips in relation to Armu limits (tests 4,6, and 7).

(Measure with 5/16" scale)

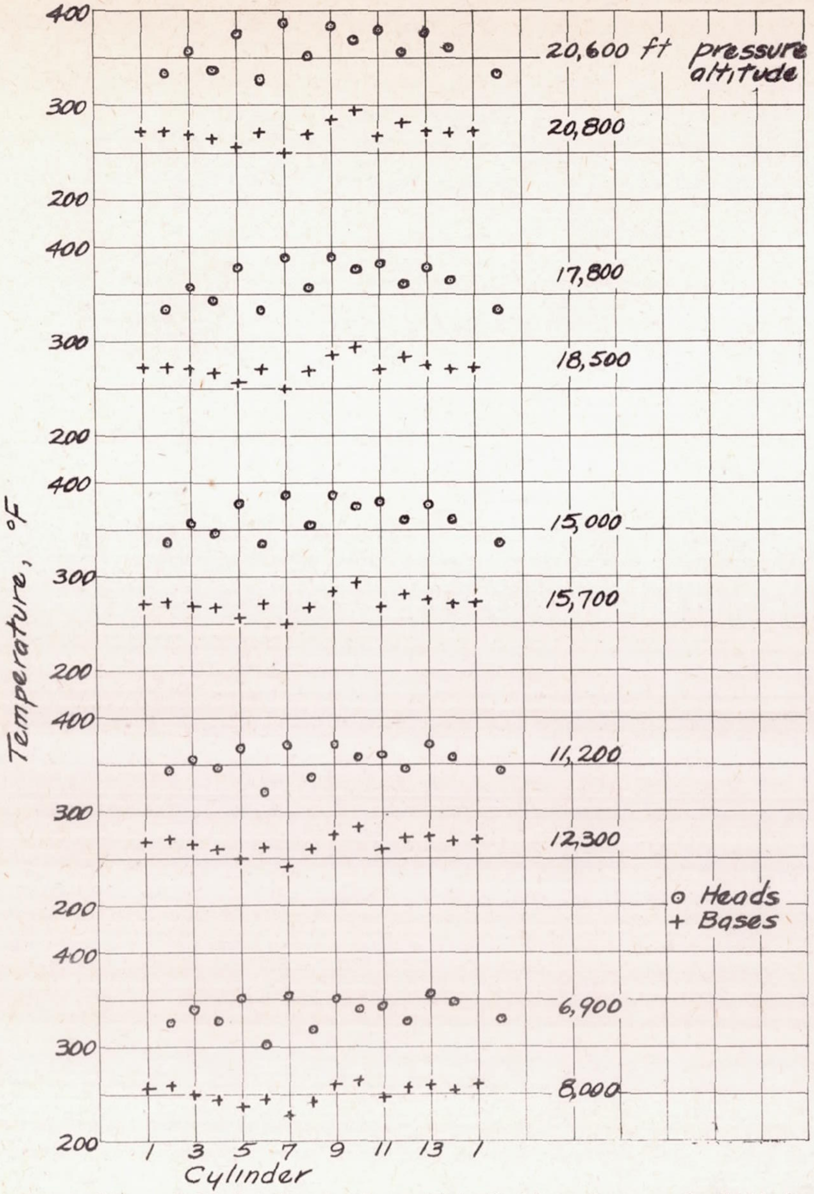


Figure 11. - Cylinder temperature distribution at several altitudes in full-power climb in automatic rich. (Test 5)

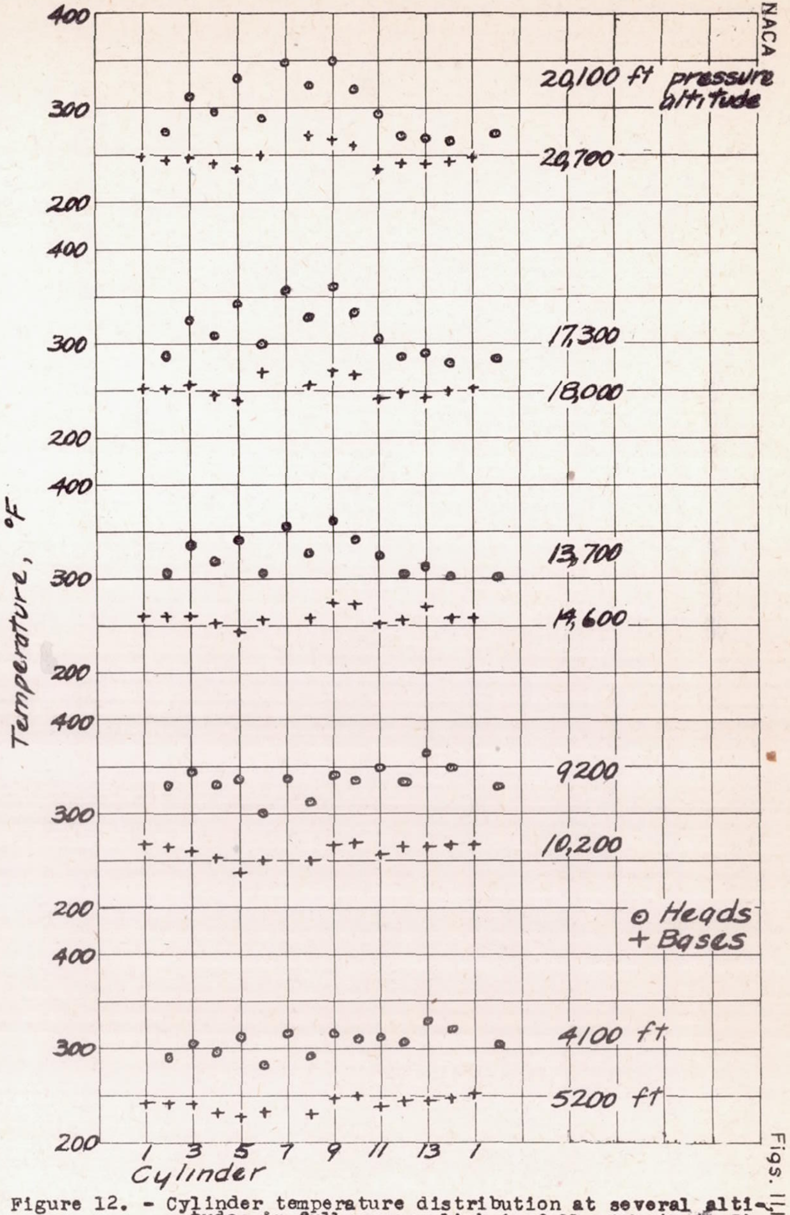


Figure 12. - Cylinder temperature distribution at several altitudes in full-power climb in full rich (Test 5)

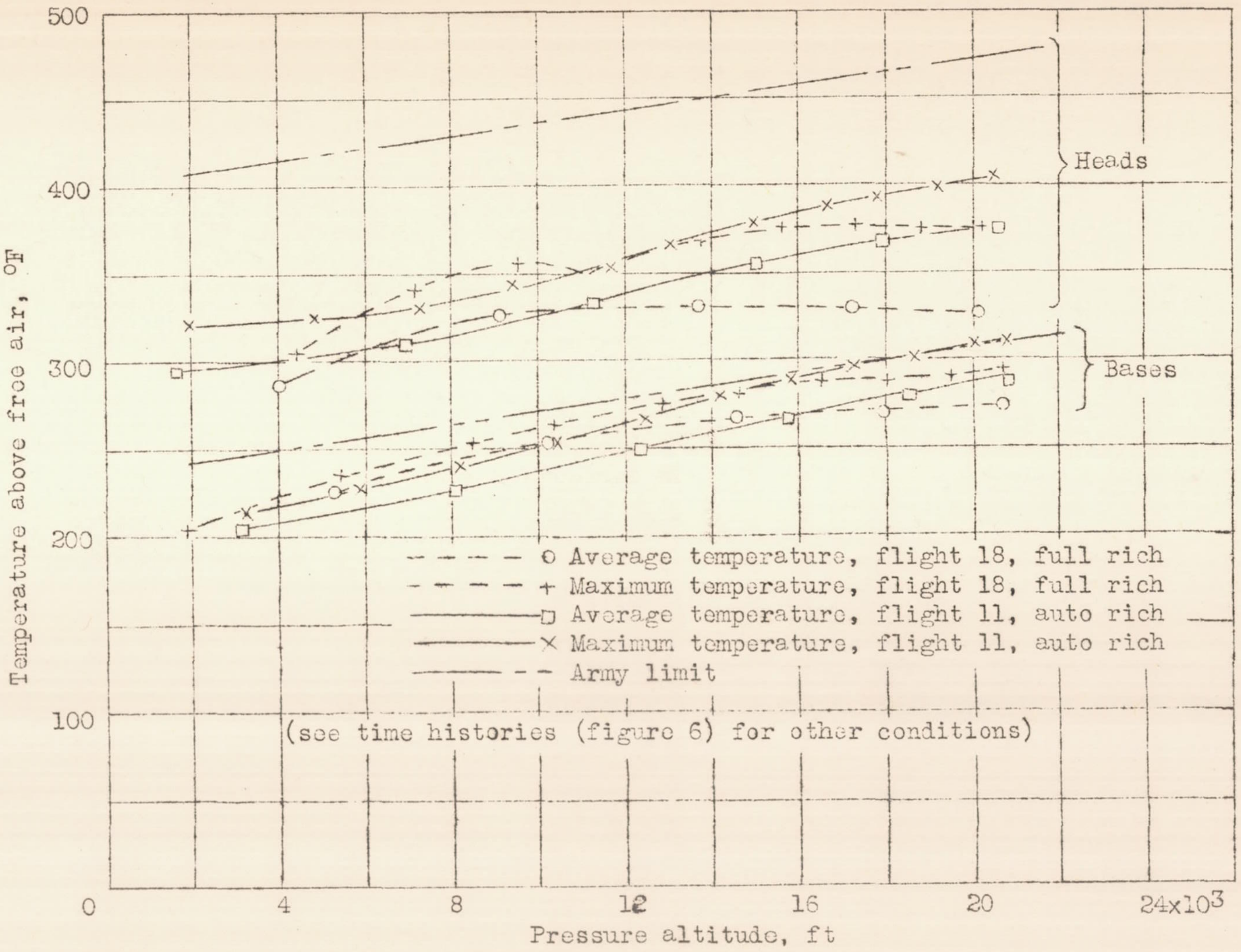


Fig. 14

Figure 14.- Cylinder temperatures in climb in relation to Army limits (test 5).