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Geisenheyner, R.
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Power Plants, Jet and Turbine (5)
Performance (16)
Propeller turbojets - Performance
(75476.28)

RM E7J02

Preliminary results of an altitude-wind-tunnel investigation of a TG-100A gas turbine-propeller engine - III - Pressure and temperature distributions

National Advisory Committee for Aeronautics, Washington, D. C.

U.S. Eng. Restr. 76 photos, tables, graphs

An investigation was conducted to determine the performance and the operational characteristics of the TG-100A propeller turbojet engine. Pressure and temperature data were recorded for altitudes from 5000 to 35,000 ft. compressoreinlet ram-pressure ratios from 1.00 to 1.17, and engine speeds from 8000 to 13,000 rpm. Changes in ram-pressure ratios from 1.00 to 1.09 did not affect the distribution of pressures and temperatures. Changes in engine speeds had no appreciable effect on the circumferential or radial distribution of pressures and temperatures at any of the measuring stations with the exception of the compressor inlet, compressor outlet, and the tail-pipe-nozzle outlet.
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RESEARCH MEMORANDUM

for the

Air Materiel Command, Army Air Forces

PRELIMINARY RESULTS OF AN ALTITUDE-WIND-TUNNEL INVESTIGATION OF A TG-100A GAS TURBINE-PROPELLER ENGINE

III - PRESSURE AND TEMPERATURE DISTRIBUTIONS

By Robert M. Geisenheyner, and Joseph J. Berdysz

Flight Propulsion Research Laboratory
Cleveland, Ohio

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WASHINGTON

NOVEMBER 13 1947

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III - PRESSURE AND TEMPERATURE DISTRIBUTIONS

By Robert M. Geisenheyner and Joseph J. Berdysz

SUMMARY

An investigation to determine the performance and the operational characteristics of the TG-100A gas turbine-propeller engine has been conducted in the Cleveland altitude wind tunnel. As part of this investigation, pressure and temperature data were obtained at altitudes from 5000 to 35,000 feet, compressor-inlet ram-pressure ratios from 1.00 to 1.17, and engine speeds from 8000 to 13,000 rpm. Average pressures and temperatures measured at each station in the engine are presented in tabular form for all operating conditions. The effects of engine speed, shaft horsepower, and compressor-inlet ram-pressure ratio on pressure and temperature distribution at each measuring station are presented graphically.

Changes in engine speed had no appreciable effect on the circumferential or radial distribution of pressures and temperatures at any of the measuring stations with the exception of the compressor inlet, compressor outlet, and tail-pipe-nozzle outlet. As the engine speed was increased, the radial distribution of total pressure at the compressor inlet became less uniform, whereas the distribution at the tail-pipe-nozzle outlet became more nearly symmetrical with respect to the center of the tail pipe. Large variations in the circumferential distribution of dynamic pressure at the compressor outlet occurred at all engine speeds.

Variations in shaft horsepower did not greatly affect the circumferential or radial distribution of pressures and temperatures at any measuring station except the tail-pipe-nozzle outlet, where the total-pressure distribution became more uniform as the

engine power was increased. Changes in ram-pressure ratio from 1.00 to 1.09 did not affect the distribution of pressures and temperatures. Flow separation in the upper region of the right wing-duct inlet occurred for some operating conditions and was attributed to high inlet-velocity ratio and rotation of the propeller slipstream. Losses in total pressure between the compressor outlet and the turbine inlet were approximately 0.9 of the dynamic pressure at the compressor outlet.

INTRODUCTION

An investigation to determine the performance and the operational characteristics of the TG-100A gas turbine-propeller engine has been conducted in the Cleveland altitude wind tunnel at the request of the Air Materiel Command, Army Air Forces. As part of this investigation, pressure and temperature data were obtained at altitudes from 5000 to 35,000 feet, compressor-inlet ram-pressure ratios from 1.00 to 1.17, and engine speeds from 8000 to 13,000 rpm. Performance characteristics of this engine are presented in reference 1 and windmilling characteristics in reference 2.

Typical surveys of total pressures, static pressures, and indicated temperatures at the measuring stations throughout the engine are presented herein. The effects of engine speed, shaft horsepower, and compressor-inlet ram-pressure ratio on these pressure and temperature distributions are briefly discussed. Average pressures and temperatures measured at each station in the engine are presented in tabular form for all the operating conditions presented in reference 1.

INSTALLATION AND PROCEDURE

The main components of the TG-100A gas turbine-propeller engine are a 14-stage axial-flow compressor, nine cylindrical counterflow combustion chambers, a single-stage turbine, an exhaust cone, and a two-stage planetary reduction gear (fig. 1). The over-all length of the TG-100A gas turbine-propeller engine is 116 inches and the maximum diameter is about 37 inches. The dry weight of the engine, including piping and all accessories, is 1980 pounds. The engine was installed in a streamlined wing nacelle that was mounted in the 20-foot-diameter test section of the Cleveland altitude wind tunnel. A four-blade Hamilton-Standard superhydromatic propeller with a diameter of 12 feet, 7 inches was installed on the engine (fig. 2).

Air entered the installation through two wing ducts with leading-edge inlets behind the propeller. The vertical center lines of the inlets were located along the wing span at about 80 percent of the blade radius (fig. 3). From the ducts, the air flowed through an annular inlet into the compressor. Air discharged from the compressor was turned 180° before entering the combustion chambers. Hot gases leaving the combustion chambers passed through the turbine nozzles and the single-stage turbine into an annular exhaust cone. The exhaust gases were discharged through a straight tail pipe 96 inches in length and 14 inches in diameter.

The operating limits for static sea-level conditions as established by the manufacturer are:

Turbine speed:	
Maximum overspeed, rpm	13,300
Normal rated, rpm	13,000
Idling, rpm	10,000
Exhaust-gas temperatures (at exhaust-cone outlet):	
Military rating, 5 minutes, °F	1265
Normal continuous rating, °F	1170
Starting and acceleration, °F	1600
Bearing temperatures, °F	250
Vibration:	
At turbine frequency, in.	0.004
At propeller frequency, in.	0.025

A description of the instrumentation installed at each measuring station (figs. 1 and 3) is presented in reference 1. Pressures were measured on mercury, alkazene, and water monometers and were photographically recorded. Temperatures were recorded on two self-balancing potentiometers.

The investigation was conducted at altitudes from 5000 to 35,000 feet and compressor-inlet ram-pressure ratios from 1.00 to 1.17. At each altitude and compressor-inlet ram-pressure ratio, engine speeds were varied from 8000 to 13,000 rpm. The engine shaft horsepower measured at the torquemeter ranged from 70 to 1050 horsepower. Ambient pressures and temperatures were maintained at approximately NACA standard altitude conditions.

RESULTS AND DISCUSSION

The average values of total pressure, static pressure, and indicated temperature at each measuring station are presented in table I for all operating conditions investigated. The effects of engine speed, shaft horsepower, and compressor-inlet ram-pressure ratio on pressure and temperature distributions at each measuring station are shown in figures 4 to 32. All instrumentation except that at the wing-duct inlets was viewed in the direction of air flow.

Effect of engine speed. - A typical over-all average pressure profile through the engine is presented in figure 4 to show the effect of engine speed on the average pressure at each measuring station. When the engine speed was increased from 10,000 to 13,000 rpm at approximately constant tail-pipe temperature, the average pressures at the turbine inlet (station 5) were increased approximately 60 percent, whereas the average pressures at the turbine outlet (station 6) were raised approximately 10 percent. The effect of changing the engine speed from 10,000 to 13,000 rpm on the pressure and temperature distribution at each measuring station is shown in figures 5 to 13 for an altitude of 5000 feet and a compressor-inlet ram-pressure ratio of 1.00. For these engine speeds, the average temperature at the junction of the exhaust cone and the tail pipe was approximately 1500° R.

The wing-duct inlet surveys presented in figure 5 show that at engine speeds of 10,000 and 11,000 rpm very low total pressures were obtained in the upper region of the right wing-duct inlet. These low total pressures apparently resulted from flow separation on the inner surface of the upper lip. Although the inlet-velocity ratios for these operating conditions were above unity, the total-pressure distribution at the left duct inlet was uniform. Flow separation at the right duct inlet was probably caused by a combination of the rotation of propeller slipstream and the high inlet-velocity ratios. At engine speeds of 12,000 and 13,000 rpm, the total-pressure distribution was uniform for both inlets.

At the compressor inlet (fig. 6), the radial pressure profiles were uniform at engine speeds of 10,000 and 11,000 rpm. As the engine speed was increased to 13,000 rpm, the total pressure at the middle portion of the annular passage increased and the static pressure decreased, which indicates that the velocity in this region was higher than at the wall. A reasonably uniform circumferential pressure distribution was obtained at all engine speeds.

A survey of the static pressure through the compressor for several engine speeds is shown in figure 7. Compressor-outlet pressure and temperature distributions are shown in figure 8. Close agreement existed between the total-pressure measurements obtained with tubes located on the struts in the compressor-outlet passage and the center tube of the rakes with the exception of rake 3. A uniform circumferential static-pressure distribution was obtained; however, variations in the total-pressure distribution resulted in a large dynamic-pressure gradient around the compressor-outlet annulus. For each engine speed, the dynamic pressure at rake 2 was approximately three times as great as at rake 1. The circumferential distribution of total and static pressures at the turbine inlet was uniform for each engine speed, as shown in figure 9. Because the compressor-outlet static pressures were uniform and the pressure loss through the combustion chambers was approximately 0.9 of the dynamic pressure at the compressor outlet, the resultant distribution of total pressure at the turbine inlet was uniform.

Turbine-outlet total and static pressures are shown in figure 10 and turbine-outlet indicated temperatures in figure 11. The circumferential distribution of total and static pressures was nearly uniform for the four engine speeds presented. A considerable radial total-pressure variation was observed at rake 3 for engine speeds of 12,000 and 13,000 rpm. In general, the static pressures measured by wafer static-pressure tubes were lower than those measured by wall static-pressure tubes. With the exception of combustion chambers 1, 7, and 8, the turbine-outlet indicated temperatures were fairly uniform. The large temperature variation among these three combustion chambers probably resulted from uneven fuel and air distribution. Flow-bench tests showed that the fuel nozzle installed in combustion chamber 7 had the highest fuel flow under all conditions investigated, which accounted in part for the highest temperature occurring in that combustion chamber. As the engine speed was increased to 12,000 rpm, the temperature differential at the turbine outlet was decreased; however, at 13,000 rpm a slightly greater differential was observed than at 12,000 rpm. Owing to the effect of radiation on the thermocouples, temperatures measured at the turbine outlet were used only to determine burner ignition and unbalance.

Circumferential distributions of total pressure, static pressure, and indicated temperature measured at the exhaust-cone outlet (fig. 12) were uniform for the range of engine speeds presented. For some conditions, not shown graphically, however, temperature variations as great as 140° were observed. Two thermocouples located at this station were connected in parallel to a gage on

the engine control panel to indicate limiting exhaust-gas temperatures. The temperature measured by these thermocouples is not shown in figure 12. Exhaust-gas temperature limits were established at this station by the manufacturer.

The distribution of pressures and temperatures in a vertical plane across the tail-pipe-nozzle exit is shown in figure 13. The total-pressure profile at this station changed with engine speed. It is noted that the distribution of total pressure for the top and bottom halves of the rake was not symmetrical. As the engine speed was increased, the total-pressure profile became more uniform with respect to the center of the tail pipe. In order to obtain accurate measurements both vertically and circumferentially, it would be necessary to make surveys in more than one plane. Temperatures measured at the tail-pipe-nozzle-exit rake agreed reasonably well with the average turbine-outlet temperature, but for some conditions these temperatures were higher than those measured at the junction of the exhaust cone and the tail pipe.

Effect of shaft horsepower. - A typical over-all pressure profile through the engine showing the effect of shaft horsepower is presented in figure 14. Total-pressure, static-pressure, and indicated-temperature distributions at each measuring station are shown in figures 15 to 23 for shaft horsepowers of 425 and 951 at an engine speed of 13,000 rpm. These data were obtained at an altitude of 5000 feet and a compressor-inlet ram-pressure ratio of 1.00.

The change in shaft horsepower had no appreciable effect on the pressure and temperature distributions at the wing-duct inlets and the compressor inlet. An increase in shaft horsepower raised the compressor-pressure ratio as shown by the increase in static pressure for each stage of the compressor stator in figure 17. Inasmuch as choking occurred at the turbine nozzles, the higher fuel flow required to increase the shaft horsepower resulted in a higher turbine-inlet temperature and pressure and consequently a higher compressor-pressure ratio.

The change of power had no appreciable effect on the distributions of pressure and temperature at the compressor outlet, the turbine inlet, and the turbine outlet, as shown in figures 18 to 21. The temperature level at the turbine outlet, however, was raised approximately 200° R with the increase in shaft horsepower (fig. 21). The survey at the exhaust-cone outlet shows a slight change in the

circumferential total-pressure distribution (fig. 22). An increase in shaft horsepower resulted in a more uniform distribution of total pressure at the tail-pipe-nozzle outlet (fig. 23).

Effect of ram-pressure ratio. - The effect of ram-pressure ratio on the total-pressure, static-pressure, and indicated-temperature surveys is shown in figures 24 to 32 for compressor-inlet ram-pressure ratios of 1.00 and 1.09 and shaft horsepowers of 340 and 330. These data were obtained at an altitude of 35,000 feet and an engine speed of 13,000 rpm. In general, the variation of compressor-inlet ram-pressure ratio from 1.00 to 1.09 did not have any appreciable effect on the pressure and temperature distributions.

Wing-duct-inlet surveys (fig. 24(a)) show that at a compressor-inlet ram-pressure ratio of 1.00 there was evidence of flow separation in the upper region of the right duct. As was previously discussed, this flow separation is attributed to the rotation of the propeller slipstream and the high inlet-velocity ratio. Higher pressures occurred at the compressor outlet and the turbine inlet when the ram-pressure ratio was increased to 1.09. (See figs. 27 and 28, respectively.)

SUMMARY OF RESULTS

The following results were obtained from an investigation of the TG-100A gas turbine-propeller engine in the Cleveland altitude wind tunnel over a range of altitudes from 5000 to 35,000 feet, engine speeds from 8000 to 13,000 rpm, and ram-pressure ratios from approximately 1.00 to 1.17:

1. Changes in engine speed had no appreciable effect on the circumferential or radial distribution of pressures and temperatures at any of the measuring stations with the exception of the compressor inlet, the compressor outlet, and the tail-pipe-nozzle outlet. As the engine speed was increased, the radial distribution of total pressure at the compressor inlet became less uniform; whereas the distribution at the tail-pipe-nozzle outlet became more nearly symmetrical with respect to the center of the tail pipe. Large variations in the circumferential distribution of dynamic pressure at the compressor outlet occurred at all engine speeds.

2. Variation of shaft horsepower did not greatly affect the circumferential or radial distributions of pressures and temperatures at any measuring station except the tail-pipe-nozzle outlet, where the total-pressure distribution became more uniform with an increase in engine power.

3. The circumferential or radial distributions of pressure and temperature were unaffected by a change in ram-pressure ratio from 1.00 to 1.09.

4. Flow separation, which occurred in the upper region of the right wing-duct inlet for some operating conditions, was attributed to high inlet-velocity ratio and rotation of the propeller slipstream.

5. The total-pressure loss between the compressor outlet and the turbine inlet was approximately 0.9 of the dynamic pressure at the compressor outlet.

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2. Conrad, E. W., and Durham, D. J.: Preliminary Results of an Altitude-Wind-Tunnel Investigation of a TG-100A Gas Turbine-Propeller Engine. II - Windmilling Characteristics. NACA RM No. E7G25, Army Air Forces, 1947.

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TABLE I.- PRESSURE AND TEMPERATURE DATA FOR

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
								Left duct inlet			Right duct inlet			Compressor inlet		
Run	Altitude (ft)	Engine speed (rpm)	Shaft horsepower	Ram-pressure ratio, P_2/P_0	Tunnel airspeed, V_0 (ft/sec)	Tunnel static pressure, p_0, (lb/sq ft)	Tunnel temperature, T_0, (°R)	Total pressure, P_1 (lb/sq ft abs.)	Static pressure, p_1 (lb/sq ft abs.)	Indicated temperature, $T_{i,1}$ (°R)	Total pressure, P_1 (lb/sq ft abs.)	Static pressure, p_1 (lb/sq ft abs.)	Indicated temperature, $T_{i,1}$ (°R)	Total pressure, P_2 (lb/sq ft abs.)	Static pressure, p_2 (lb/sq ft abs.)	Indicated temperature, $T_{i,2}$ (°R)
1	6,000	15,000	425	0.99	211	1760	505	1822	1763	502	1822	1776	601	1749	1542	501
2	5,000	13,000	619	.99	210	1760	500	1825	1768	499	1825	1773	600	1752	1545	498
3	5,000	13,000	825	1.00	200	1760	495	1827	1768	496	1827	1774	496	1760	1545	493
4	5,000	13,000	951	1.00	198	1750	503	1827	1769	602	1828	1775	501	1756	1565	500
5	5,000	13,000	1044	1.00	201	1767	499	1839	1773	495	1839	1786	495	1765	1563	494
6	5,000	12,000	334	1.00	193	1767	503	1819	1773	497	1819	1777	498	1763	1608	497
7	5,000	12,000	482	1.00	192	1760	496	1817	1767	495	1816	1773	495	1759	1596	495
8	5,000	12,000	636	1.00	183	1753	492	1809	1761	493	1810	1766	492	1752	1593	489
9	5,000	12,000	824	1.00	169	1760	500	1816	1768	500	1816	1772	501	1757	1291	501
10	5,000	11,000	308	.99	91	1760	498	1783	1754	490	1776	1748	491	1747	1639	493
11	5,000	11,000	446	.99	92	1760	605	1790	1759	498	1779	1747	502	1752	1646	501
12	5,000	11,000	591	1.00	110	1753	606	1790	1757	501	1776	1740	506	1751	1643	502
13	5,000	11,000	739	1.00	130	1767	606	1812	1776	601	1794	1766	505	1770	1659	505
14	5,000	10,000	209	1.00	136	1760	600	1790	1764	492	1790	1767	493	1760	----	493
15	5,000	10,000	302	1.00	149	1760	500	1794	1768	493	1794	1771	495	1765	1684	495
16	5,000	10,000	403	1.00	101	1767	503	1797	1771	492	1787	1762	495	1765	1686	494
17	5,000	10,000	513	1.00	102	1760	609	1794	1768	494	1782	1754	497	1762	1684	497
18	5,000	8,050	57	1.00	81	1760	600	1770	1760	600	1770	1761	500	1759	1729	500
19	5,000	8,100	85	1.00	92	1760	500	1773	1763	600	1773	1764	500	1762	1730	600
20	6,000	8,000	114	1.00	92	1760	500	1776	1764	600	1775	1766	500	1764	1732	500
21	6,000	8,050	144	1.00	101	1750	603	1778	1767	499	1778	1768	499	1767	1735	499
22	15,000	13,000	352	1.00	250	1197	462	1249	1205	465	1249	1208	464	1192	1028	461
23	15,000	13,000	514	1.00	143	1190	468	1246	1200	469	1246	1212	469	1139	1031	467
24	15,000	13,000	733	1.00	223	1190	462	1248	1203	469	1239	1195	469	1191	1037	468
25	15,000	13,000	776	1.00	220	1190	466	775	----	470	----	----	470	----	----	467
26	15,000	15,000	849	1.00	209	1190	465	815	----	467	----	----	461	----	----	461
27	16,000	11,000	103	1.00	198	1190	461	1225	1197	460	1225	1199	460	1191	1096	459
28	16,000	11,000	211	1.00	172	1190	461	1222	1194	463	1222	1196	463	1191	1099	463
29	15,000	11,000	329	1.00	173	1190	465	1225	1200	463	1221	1194	463	1191	1099	463
30	15,000	11,000	411	1.00	167	1197	460	1233	1204	457	1224	1196	457	1201	1105	467
31	15,000	11,000	530	1.00	143	1197	461	1232	1204	455	1220	1189	452	1196	1105	463
32	15,000	10,000	183	1.00	125	1190	466	1211	1193	459	1208	1191	459	1189	1132	459
33	16,000	10,000	260	1.00	106	1190	466	1210	1193	459	1202	1184	460	1188	1136	462
34	15,000	10,000	360	1.00	106	1190	466	1214	1196	460	1203	1185	462	1192	1141	462
35	16,000	10,000	437	1.00	113	1197	466	1225	1208	462	1213	1194	462	1203	1155	462
36	16,000	10,000	172	1.06	342	1190	469	1287	1261	476	1287	1266	476	1265	1207	476
37	15,000	10,000	248	1.06	345	1197	473	1297	1272	476	1297	1276	476	1274	1220	475
38	15,000	10,000	340	1.07	347	1197	471	1300	1276	476	1300	1279	476	1277	1223	475
39	16,000	10,000	422	1.07	358	1190	469	1296	1272	472	1296	1275	472	1273	1219	472
40	16,000	8,000	55	1.00	71	1197	464	1203	1196	454	1202	1195	459	1195	1170	461
41	16,000	8,000	72	1.00	71	1190	464	1198	1190	455	1195	1189	459	1189	1166	461
42	16,000	8,000	93	1.00	71	1190	465	1199	1192	455	1196	1189	460	1190	1167	461

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TG-100A GAS TURBINE-PROPELLER ENGINE

17	18	19	20	21	22	23	24	26	26	27	28	29	30	31	32	33	34
Compressor outlet			Compressor outlet elbow			Turbine inlet		Turbine outlet				Exhaust-cone outlet			Tail-pipe-nozzle outlet		
Total pressure, p_3 (lb/sq ft abs.)	Static pressure, p_3 (lb/sq ft abs.)	Indicated temperature, $T_{1,3}$ (°R)	Total pressure, p_4 (lb/sq ft abs.)	Static pressure, p_4 (lb/sq ft abs.)	Indicated temperature, $T_{1,4}$ (°R)	Total pressure, p_5 (lb/sq ft abs.)	Static pressure, p_5 (lb/sq ft abs.)	Total pressure, p_6 (lb/sq ft abs.)	Wall-static pressure, p_6 (lb/sq ft abs.)	Water-static pressure, p_6 (lb/sq ft abs.)	Indicated temperature, $T_{1,6}$ (°R)	Total pressure, p_7 (lb/sq ft abs.)	Static pressure, p_7 (lb/sq ft abs.)	Indicated temperature, $T_{1,7}$ (°R)	Total pressure, p_8 (lb/sq ft abs.)	Static pressure, p_8 (lb/sq ft abs.)	Indicated temperature, $T_{1,8}$ (°R)
8260	7975	864	8168	8087	874	7974	7838	2201	1895	1781	1520	1891	1781	1329	1929	1767	1351
8461	8199	869	8408	8329	879	8215	8076	2161	1862	1767	1388	1954	1774	1384	1946	1776	1570
8904	8522	875	8725	8698	884	8541	8399	2126	1842	1748	1486	2028	1784	1444	1952	1768	1449
8792	8518	878	8725	8652	887	8534	8396	2125	1832	1744	1515	2005	1788	1496	1962	1769	1523
9047	8774	874	8981	8913	887	8790	8644	2140	1837	1746	1538	2008	1802	1510	1972	1776	1559
7129	6879	819	7062	6967	829	6891	6775	2090	1877	1783	1269	1836	1788	1261	1894	1766	1276
7471	7225	825	7394	7332	752	7229	7106	2105	1851	1767	1359	1870	1777	1266	1906	1772	1551
7661	7418	828	7593	7525	838	7426	7299	2050	1824	1746	1389	1954	1767	1364	1906	1760	1366
7782	7548	842	7714	7649	852	7563	7424	2061	1825	1746	1628	1973	1784	1495	1920	1767	1529
6051	5847	776	6986	5952	783	5854	5766	1986	1837	1762	1320	1802	1777	1306	1854	1757	1509
6202	6008	788	6144	6093	795	6016	5915	1976	1821	1768	1594	1835	1770	1408	1866	1762	1568
6419	6255	795	6375	6326	802	6242	6136	1958	1800	1741	1484	1894	1767	1466	1859	1767	1468
6715	6654	794	6676	6621	805	6656	6427	1985	1805	1766	1521	1899	1788	1469	1886	1774	1482
5159	4988	724	6107	6069	728	5023	4915	----	----	1758	1269	1781	1774	1246	----	1760	1260
5299	5153	729	6248	6203	757	6159	5054	1953	1817	1758	1545	1797	1770	1394	1838	1762	1334
5447	6291	738	6403	6368	746	5298	6210	1924	1810	1738	1428	1850	1774	1463	1847	1771	1405
5366	6418	748	6628	5484	764	6424	5329	1929	1788	1748	1545	1869	1770	1527	1848	1764	1567
3260	3165	645	5233	3210	651	3167	5112	1826	1802	1760	1456	1772	1760	1401	1790	1760	1399
3374	5282	647	3361	5327	652	5281	3227	1840	1802	1762	1311	1772	1765	1448	1795	1760	1440
3389	3305	651	3365	5344	656	3299	3244	1845	1795	1763	1560	1772	1765	1508	1795	1760	1505
5452	3366	655	5430	3411	661	3366	5309	1844	1791	1760	1614	1776	1765	1566	1795	1760	1648
6140	6927	926	6086	6030	838	6948	6844	1554	1295	1211	1279	1333	1218	1232	1334	1199	1382
6243	6041	837	6196	6145	850	6066	5952	1482	1263	1188	1563	1382	1200	1562	1358	1198	1555
6472	6282	864	6426	6379	066	6298	6196	1484	1253	1183	1495	1578	1218	1465	1343	1197	1497
----	----	850	----	----	864	----	----	----	----	----	1498	----	----	1467	----	----	1497
----	----	846	----	----	860	----	----	----	----	----	1511	----	----	1497	----	----	1317
4372	4216	725	4528	4291	755	4224	4164	1571	1278	1166	1098	1215	1204	1086	1263	1190	1104
4471	4322	738	4452	4395	747	4551	4259	1575	1254	1197	1179	1250	1207	1192	1263	1187	1193
4682	4505	746	4615	4572	766	4615	4438	1376	1233	1184	1279	1285	1200	1500	1276	1194	1273
4622	4471	746	4583	4541	753	4481	4400	1374	1256	1184	1532	1514	1204	1315	1285	1202	1522
5024	4884	755	4990	4965	761	4889	4810	1364	1250	1185	1418	1512	1211	1588	1295	1202	1450
5698	3585	702	5668	5640	710	3690	5527	1321	1240	1199	1508	1223	1197	1290	1241	1189	1283
3799	5690	710	3772	3742	719	3695	3632	1511	1225	1199	1490	1260	1200	1410	1246	1195	1401
3893	3791	722	3869	3841	732	5792	3728	1518	1213	1188	1376	1255	1195	1533	1249	1194	1521
4056	5954	734	4010	5985	745	3956	3871	1517	1216	1199	1676	1276	1211	1669	1262	1203	1631
3694	3579	711	5665	3657	717	5583	5624	1556	1256	1216	1286	1236	1214	1269	1253	1201	1260
3800	3689	717	5770	3742	723	3695	3652	1554	1248	1211	1389	1276	1214	1380	1265	1212	1568
3941	5858	725	3915	3890	731	3910	3777	1559	1255	1211	1521	1276	1221	1472	1271	1214	1470
4092	5991	728	4068	4041	735	3989	5925	1329	1219	1202	1600	1276	1214	1572	1268	1206	1542
2456	2369	608	2422	2408	618	2367	2329	1239	1226	1204	1390	1206	1200	1341	1222	1196	1566
2439	2571	612	2426	2408	620	2373	2533	1256	1216	1196	1441	1201	1195	1400	1216	1189	1400
2476	2414	618	2464	2450	625	2414	2573	1257	1214	1192	1500	1204	1193	1449	1217	1189	1444

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TABLE I.- CONCLUDED. PRESSURE AND TEMPERATURE

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
								Left duct inlet			Right duct inlet			Compressor inlet		
Run	Altitude (ft)	Engine speed (rpm)	Shaft horsepower	Ram-pressure ratio, P_2/P_0	Tunnel airspeed, V_0 (ft/sec)	Tunnel static pressure, p_0, (lb/sq ft)	Tunnel temperature, T_0, (°R)	Total pressure, P_1 (lb/sq ft abs.)	Static pressure, p_1 (lb/sq ft abs.)	Indicated temperature, $T_{1,1}$ (°R)	Total pressure, P_1 (lb/sq ft abs.)	Static pressure, p_1 (lb/sq ft abs.)	Indicated temperature, $T_{1,1}$ (°R)	Total pressure, P_2 (lb/sq ft abs.)	Static pressure, p_2 (lb/sq ft abs.)	Indicated temperature, $T_{1,2}$ (°R)
43	15,000	13,000	105	1.06	327	1190	469	1275	1262	475	1276	1264	475	1264	1241	475
44	15,000	13,000	134	1.05	327	1197	471	1283	1270	477	1283	1272	477	1272	1249	477
46	15,000	13,000	158	1.06	325	1197	458	1284	1271	475	1283	1273	475	1273	1251	475
45	25,000	13,000	223	1.00	254	781	438	823	790	433	823	793	433	780	663	433
47	25,000	13,000	335	1.00	235	781	438	822	790	435	818	787	431	780	653	432
48	25,000	13,000	451	.99	227	781	435	822	789	437	814	781	430	777	550	432
49	25,000	13,000	622	1.00	229	781	434	824	791	435	814	781	430	779	554	431
50	25,000	13,000	587	1.00	245	788	433	835	802	433	825	791	430	790	572	433
51	25,000	13,000	234	1.08	437	788	455	900	851	455	901	866	465	852	738	465
62	25,000	13,000	394	1.08	437	781	457	895	850	454	894	851	464	847	736	454
63	25,000	13,000	614	1.08	437	788	457	904	861	470	903	858	471	835	743	471
54	25,000	13,000	538	1.07	434	781	433	898	858	463	897	852	462	850	739	464
55	26,000	13,000	384	1.12	504	781	485	924	883	495	923	890	495	875	773	495
56	25,000	13,000	522	1.13	507	774	482	920	879	493	920	884	494	873	754	494
57	23,000	13,000	531	1.13	510	788	474	942	900	488	942	905	488	894	763	488
58	25,000	10,000	71	1.00	152	774	420	790	775	421	790	775	418	774	730	421
59	25,000	10,000	172	1.00	92	781	418	797	784	425	790	775	417	780	738	418
60	25,000	10,000	118	1.09	387	781	442	868	848	450	868	861	450	848	802	450
61	26,000	10,000	174	1.09	387	781	442	868	848	450	858	851	450	849	805	450
62	23,000	10,000	251	1.09	385	781	442	869	849	450	869	852	450	850	808	450
63	25,000	10,000	308	1.09	385	778	438	880	860	450	880	852	430	851	819	450
64	26,000	8,100	36	.99	39	788	420	789	784	425	789	785	425	785	755	434
65	25,000	8,100	55	1.00	75	781	423	757	781	429	785	779	429	780	762	431
66	25,000	8,000	97	1.00	76	781	423	790	785	429	785	780	421	783	767	427
67	25,000	8,000	86	1.09	358	781	440	859	848	443	855	847	445	848	850	445
68	25,000	8,000	122	1.09	370	781	439	860	849	445	837	848	445	849	854	445
69	35,000	13,000	153	.99	229	493	433	615	496	439	514	495	430	487	415	432
70	35,000	13,000	240	.99	238	486	432	512	492	440	507	487	432	482	411	435
71	35,000	13,000	289	1.00	238	493	432	521	500	442	614	493	432	491	417	435
72	35,000	13,000	340	1.00	242	493	430	623	502	440	615	494	431	492	419	434
73	35,000	13,000	381	1.00	239	500	427	630	508	440	522	500	428	499	425	433
74	35,000	13,000	166	1.07	429	493	440	563	537	451	552	539	453	629	452	454
75	35,000	13,000	252	1.09	429	493	440	563	539	450	554	540	452	531	454	454
76	35,000	13,000	330	1.09	435	493	441	557	540	454	565	540	464	331	454	455
77	35,000	13,000	432	1.08	436	493	435	570	543	450	555	540	451	534	437	462
78	35,000	13,000	422	1.09	438	507	442	585	558	449	682	555	450	545	470	451
79	35,000	12,000	134	.98	143	493	425	504	490	429	501	486	421	483	425	428
80	36,000	12,000	209	.98	153	600	426	615	600	429	510	493	424	492	433	428
81	35,000	12,000	275	.99	164	493	430	510	494	430	504	485	422	487	428	425
82	35,000	12,000	341	.99	152	493	428	612	495	436	504	485	425	488	431	431
83	35,000	10,050	163	1.15	506	493	437	590	573	431	584	571	449	673	540	448
84	35,000	10,050	210	1.17	503	493	432	593	579	445	589	574	443	577	548	443

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DATA FOR TG-100A GA3 TURBINE-PROPELLER ENGINE

17	18	19	20	21	92	23	24	25	26	27	28	29	30	31	32	33	34
Compressor outlet			Compressor outlet elbow			Turbine inlet		Turbine outlet				Exhaust-cone outlet			Tail-pipe-nozzle outlet		
Total pressure, P_3 (lb/sq ft abs.)	Static pressure, p_3 (lb/sq ft abs.)	Indicated temperature, $T_{i,3}$ (°R)	Total pressure, P_4 (lb/sq ft abs.)	Static pressure, p_4 (lb/sq ft abs.)	Indicated temperature, $T_{i,4}$ (°R)	Total pressure, P_5 (lb/sq ft abs.)	Static pressure, p_5 (lb/sq ft abs.)	Total pressure, P_6 (lb/sq ft abs.)	Wall-static pressure, p_6 (lb/sq ft abs.)	Water-static pressure, p_6 (lb/sq ft abs.)	Indicated temperature, $T_{i,6}$ (°R)	Total pressure, P_7 (lb/sq ft abs.)	Static pressure, p_7 (lb/sq ft abs.)	Indicated temperature, $T_{i,7}$ (°R)	Total pressure, P_8 (lb/sq ft abs.)	Static pressure, p_8 (lb/sq ft abs.)	Indicated temperature, $T_{i,8}$ (°R)
2614	2449	626	2500	2483	635	2447	2407	1268	1223	1204	1483	1218	1204	1448	1229	1201	1443
2639	2496	636	2549	2532	642	2496	2464	1274	1227	1204	1587	1234	1211	1527	1236	1209	1526
2607	2347	637	2598	2584	644	2649	2503	1271	1221	1206	1669	1241	1211	1554	1237	1212	1569
4279	4129	796	4241	4205	811	4146	4076	1017	852	786	1247	888	793	1236	882	783	1255
4387	4251	804	4357	4322	822	4262	4191	1004	833	781	1324	926	793	1292	891	787	1303
4320	4383	815	4486	4449	832	4421	4321	1017	830	779	1413	929	798	1391	894	786	1429
4557	4420	816	4526	4538	834	4434	4358	1000	829	774	1444	926	798	1436	898	787	1470
3916	3778	815	3883	3831	832	3792	3717	1008	834	776	1488	941	805	1459	909	785	1488
4389	4231	826	4343	4305	840	4242	4171	1053	868	803	1260	912	809	1236	903	802	1259
4827	4384	838	4495	4460	850	4396	4321	1017	844	797	1366	941	813	1347	904	798	1359
4679	4336	833	4661	4611	858	4581	4477	1029	848	793	1441	940	819	1440	915	803	1460
4816	4678	864	4790	4755	864	4694	4618	1013	842	790	1537	932	816	1536	917	798	1538
4398	4255	874	4366	4329	884	4966	4193	1010	845	802	1394	940	843	1373	901	799	1383
4592	4454	879	4565	4326	888	4467	4394	1003	836	786	1499	924	806	1489	900	794	1604
4776	4643	878	4752	4713	867	4632	4576	1018	850	793	1548	934	819	1549	926	809	1548
2351	2470	662	2532	2510	670	2474	2434	882	819	786	1133	793	777	1116	812	773	1109
2821	2749	680	9805	2787	691	2748	9702	885	805	786	1400	833	784	1347	827	784	1343
2641	2368	681	2622	2601	689	2361	2517	900	834	807	1161	821	802	1143	830	792	1133
2744	2661	690	2728	2703	698	2662	2621	893	825	807	1260	844	805	1254	834	793	1239
2871	9792	701	2860	2837	710	2794	2749	898	812	797	1417	849	802	1383	838	796	1368
9986	2911	711	2962	2921	722	2901	2863	897	817	802	1502	869	809	1531	850	804	1473
1678	1631	589	1670	1658	599	1632	1604	830	810	793	1346	793	791	1259	806	787	1233
1732	1684	593	1726	1714	603	1688	1660	828	797	783	1343	793	794	1337	799	790	1323
1815	1775	606	1811	1798	618	1773	1747	830	789	781	1392	804	781	1331	802	783	1320
1840	1793	609	1834	1823	617	1794	1766	842	807	793	1402	811	795	1383	812	792	1365
1908	1864	622	1902	1893	634	1864	1836	844	798	790	1610	818	793	1556	814	794	1603
2768	2681	816	9746	2732	836	2686	2641	648	534	498	1341	578	300	1309	663	496	1313
2638	2753	823	2823	2802	843	2759	2718	638	320	488	1424	576	497	1399	358	490	1423
2929	2844	830	9913	2894	849	2852	2803	640	526	495	1483	587	504	1470	567	497	1509
3002	2914	833	2987	2964	853	2928	2876	637	526	493	1536	393	507	1312	370	498	1545
3068	2984	833	3052	3031	863	2996	2943	644	535	498	1565	608	511	1533	382	505	1548
2849	2763	891	2830	2806	834	2763	2718	689	652	516	1197	601	511	1167	571	502	1162
2983	2893	834	2969	2947	847	2904	2854	664	549	312	1367	594	511	1177	575	503	1281
3082	2992	841	3072	3032	834	3002	2937	667	541	309	1422	601	318	1453	376	504	1387
3223	3132	847	3211	3182	861	3146	3094	652	541	509	1561	620	518	1379	586	605	1500
3233	3174	844	3253	3228	852	3186	3136	676	339	514	1278	627	325	1167	607	519	1474
2476	2397	771	9461	2436	789	2405	2365	611	531	500	1226	567	497	1159	534	495	1155
2597	2617	779	2584	2563	793	2323	9481	620	536	507	1313	368	504	1138	666	503	1199
2654	2379	789	2644	2623	806	2587	2348	613	624	493	1395	367	504	1178	553	496	1422
2731	2679	798	2743	2722	814	2683	2641	606	525	493	1455	577	304	1413	558	497	1530
1950	1895	695	1943	1999	708	1900	1866	580	517	647	1333	583	643	1255	636	504	1298
2075	2027	705	2070	2060	716	2031	1997	579	517	607	1511	661	514	1485	543	506	1490

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Figure 1. - Side view of TG-100A engine showing location of measuring stations.

Figure 2. - Front view of TG-100A gas turbine-propeller engine installation in altitude wind tunnel.

Figure 3. - Sketch of TG-100A gas turbine-propeller engine installation showing location of wing ducts and inlets.

Figure 4. - Typical over-all average pressure profile through TG-100A gas turbine-propeller engine for engine speeds from 10,000 to 13,000 rpm. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00.

Figure 5. - Effect of engine speed on distribution of total pressure, static pressure, and indicated temperature at wing-duct inlets. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00.
(a) Engine speed, 10,000 rpm; tail-pipe temperature, 1527° R.
(b) Engine speed, 11,000 rpm; tail-pipe temperature, 1458° R.
(c) Engine speed, 12,000 rpm; tail-pipe temperature, 1495° R.
(d) Engine speed, 13,000 rpm; tail-pipe temperature, 1510° R.

Figure 6. - Effect of engine speed on distribution of total pressure, static pressure, and indicated temperature at compressor inlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00.
(a) Engine speed, 10,000 rpm; tail-pipe temperature, 1527° R.
(b) Engine speed, 11,000 rpm; tail-pipe temperature, 1458° R.
(c) Engine speed, 12,000 rpm; tail-pipe temperature, 1495° R.
(d) Engine speed, 13,000 rpm; tail-pipe temperature, 1510° R.

Figure 7. - Effect of engine speed on distribution of static pressure for each stage of compressor stator. Engine speed, 10,000 to 13,000 rpm; altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00.

Figure 8. - Effect of engine speed on distribution of total pressure, static pressure, and indicated temperature at compressor outlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00.
(a) Engine speed, 10,000 rpm; tail-pipe temperature, 1527° R.
(b) Engine speed, 11,000 rpm; tail-pipe temperature, 1458° R.
(c) Engine speed, 12,000 rpm; tail-pipe temperature, 1495° R.
(d) Engine speed, 13,000 rpm; tail-pipe temperature, 1510° R.

Figure 9. - Effect of engine speed on distribution of total and static pressures at turbine inlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00.
(a) Engine speed, 10,000 rpm; tail-pipe temperature, 1527° R.
(b) Engine speed, 11,000 rpm; tail-pipe temperature, 1458° R.
(c) Engine speed, 12,000 rpm; tail-pipe temperature, 1495° R.
(d) Engine speed, 13,000 rpm; tail-pipe temperature, 1510° R.

Figure 10. - Effect of engine speed on distribution of total pressure and static pressure at turbine outlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00.
(a) Engine speed, 10,000 rpm; tail-pipe temperature, 1527° R.
(b) Engine speed, 11,000 rpm; tail-pipe temperature, 1458° R.
(c) Engine speed, 12,000 rpm; tail-pipe temperature, 1495° R.
(d) Engine speed, 13,000 rpm; tail-pipe temperature, 1510° R.

Figure 11. - Effect of engine speed on distribution of indicated temperature at turbine outlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00.
(a) Engine speed, 10,000 rpm; tail-pipe temperature, 1527° R.
(b) Engine speed, 11,000 rpm; tail-pipe temperature, 1458° R.
(c) Engine speed, 12,000 rpm; tail-pipe temperature, 1495° R.
(d) Engine speed, 13,000 rpm; tail-pipe temperature, 1510° R.

Figure 12. - Effect of engine speed on distribution of total pressure, static pressure, and indicated temperature at exhaust-cone outlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00.
(a) Engine speed, 10,000 rpm; tail-pipe temperature, 1527° R.
(b) Engine speed, 11,000 rpm; tail-pipe temperature, 1458° R.
(c) Engine speed, 12,000 rpm; tail-pipe temperature, 1495° R.
(d) Engine speed, 13,000 rpm; tail-pipe temperature, 1510° R.

Figure 13. - Effect of engine speed on distribution of total pressure, static pressure, and indicated temperature at tail-pipe-nozzle outlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00.
(a) Engine speed, 10,000 rpm; tail-pipe temperature, 1527° R.
(b) Engine speed, 11,000 rpm; tail-pipe temperature, 1458° R.
(c) Engine speed, 12,000 rpm; tail-pipe temperature, 1495° R.
(d) Engine speed, 13,000 rpm; tail-pipe temperature, 1510° R.

Figure 14. - Typical over-all average pressure profile for various shaft horsepowers. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00; engine speed, 13,000 rpm.

Figure 15. - Effect of shaft horsepower on distribution of total pressure, static pressure, and indicated temperature at wing-duct inlets. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00; engine speed, 13,000 rpm.
(a) Shaft horsepower, 425.
(b) Shaft horsepower, 951.

Figure 16. - Effect of shaft horsepower on distribution of total pressure, static pressure, and indicated temperature at compressor inlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00; engine speed, 13,000 rpm.
(a) Shaft horsepower, 425.
(b) Shaft horsepower, 951.

Figure 17. - Effect of shaft horsepower on distribution of static pressure for each stage of compressor stator. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00; engine speed, 13,000 rpm.

Figure 18. - Effect of shaft horsepower on distribution of total pressure, static pressure, and indicated temperature at compressor outlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00; engine speed, 13,000 rpm.
(a) Shaft horsepower, 425.
(b) Shaft horsepower, 951.

Figure 19. - Effect of shaft horsepower on distribution of total and static pressures at turbine inlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00; engine speed, 13,000 rpm.
(a) Shaft horsepower, 425.
(b) Shaft horsepower, 951.

Figure 20. - Effect of shaft horsepower on distribution of total pressure and static pressure at turbine outlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00; engine speed, 13,000 rpm.
(a) Shaft horsepower, 425.
(b) Shaft horsepower, 951.

Figure 21. - Effect of shaft horsepower on distribution of indicated temperature at turbine outlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00; engine speed, 13,000 rpm.
(a) Shaft horsepower, 425.
(b) Shaft horsepower, 951.

Figure 22. - Effect of shaft horsepower on distribution of total pressure, static pressure, and indicated temperature at exhaust-cone outlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00; engine speed, 13,000 rpm.
(a) Shaft horsepower, 425.
(b) Shaft horsepower, 951.

Figure 23. - Effect of shaft horsepower on distribution of total pressure, static pressure, and indicated temperature at tail-pipe-nozzle outlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00; engine speed, 13,000 rpm.
(a) Shaft horsepower, 425.
(b) Shaft horsepower, 951.

Figure 24. - Effect of compressor-inlet ram-pressure ratio on distribution of total pressure, static pressure, and indicated temperature at wing-duct inlets. Altitude, 35,000 feet; engine speed, 13,000 rpm.
(a) Compressor-inlet ram-pressure ratio, 1.00; shaft horsepower, 340.
(b) Compressor-inlet ram-pressure ratio, 1.09; shaft horsepower, 330.

Figure 25. - Effect of compressor-inlet ram-pressure ratio on distribution of total pressure, static pressure, and indicated temperature at compressor inlet. Altitude, 35,000 feet; engine speed, 13,000 rpm.
(a) Compressor-inlet ram-pressure ratio, 1.00; shaft horsepower, 340.
(b) Compressor-inlet ram-pressure ratio, 1.09; shaft horsepower, 330.

Figure 26. - Effect of compressor-inlet ram-pressure ratio on distribution of static pressure for each stage of compressor stator. Altitude, 35,000 feet; engine speed, 13,000 rpm.

Figure 27. - Effect of compressor-inlet ram-pressure ratio on distribution of total pressure, static pressure, and indicated temperature at compressor outlet. Altitude, 35,000 feet; engine speed, 13,000 rpm.
(a) Compressor-inlet ram-pressure ratio, 1.00; shaft horsepower, 340.
(b) Compressor-inlet ram-pressure ratio, 1.09; shaft horsepower, 330.

Figure 28. - Effect of compressor-inlet ram-pressure ratio on distribution of total and static pressures at turbine inlet. Altitude, 35,000 feet; engine speed, 13,000 rpm.
(a) Compressor-inlet ram-pressure ratio, 1.00; shaft horsepower, 340.
(b) Compressor-inlet ram-pressure ratio, 1.09; shaft horsepower, 330.

Figure 29. - Effect of compressor-inlet ram-pressure ratio on distribution of total and static pressure at turbine outlet. Altitude, 35,000 feet; engine speed, 13,000 rpm.
(a) Compressor-inlet ram-pressure ratio, 1.00; shaft horsepower, 340.
(b) Compressor-inlet ram-pressure ratio, 1.09; shaft horsepower, 330.

Figure 30. - Effect of compressor-inlet ram-pressure ratio on distribution of indicated temperature at turbine outlet. Altitude, 35,000 feet; engine speed, 13,000 rpm.
(a) Compressor-inlet ram-pressure ratio, 1.00; shaft horsepower, 340.
(b) Compressor-inlet ram-pressure ratio, 1.09; shaft horsepower, 330.

Figure 31. - Effect of compressor-inlet ram-pressure ratio on distribution of total pressure, static pressure, and indicated temperature at exhaust-cone outlet. Altitude, 35,000 feet; engine speed, 13,000 rpm.
(a) Compressor-inlet ram-pressure ratio, 1.00; shaft horsepower, 340.
(b) Compressor-inlet ram-pressure ratio, 1.09; shaft horsepower, 330.

Figure 32. - Effect of compressor-inlet ram-pressure ratio on distribution of total pressure, static pressure, and indicated temperature at tail-pipe-nozzle outlet. Altitude, 35,000 feet; engine speed, 13,000 rpm.
(a) Compressor-inlet ram-pressure ratio, 1.00; shaft horsepower, 340.
(b) Compressor-inlet ram-pressure ratio, 1.09; shaft horsepower, 330.

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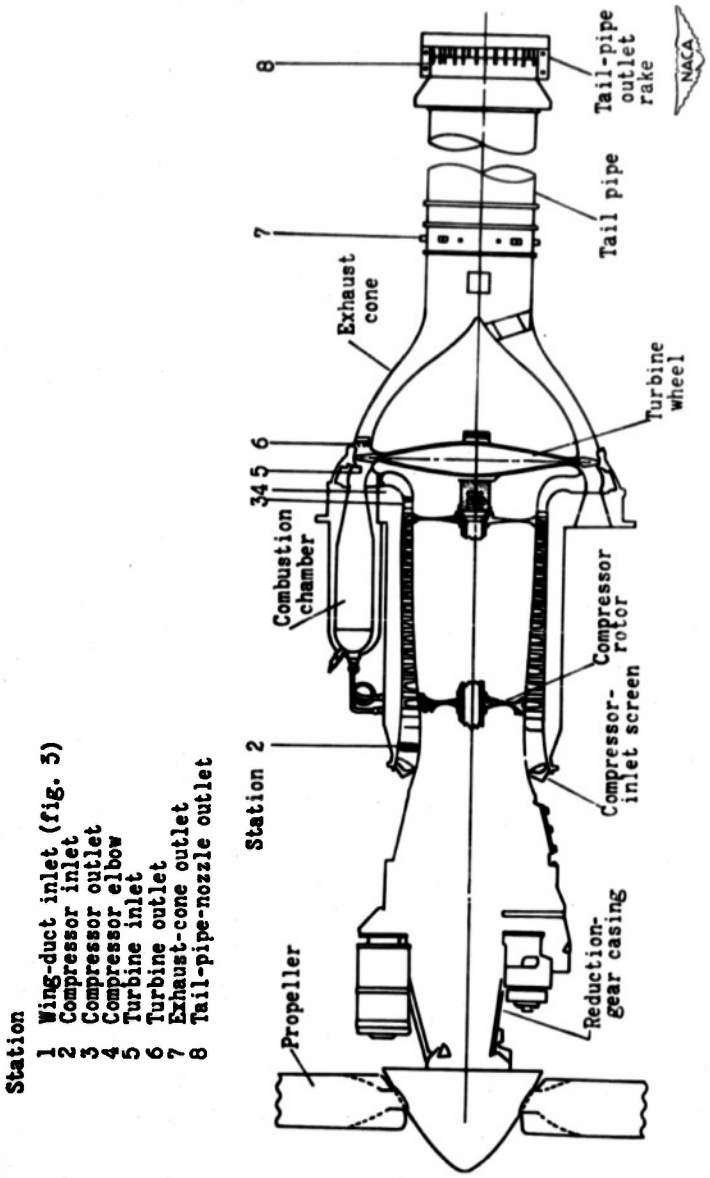

Figure 1. - Side view of TG-100A engine showing location of measuring stations.

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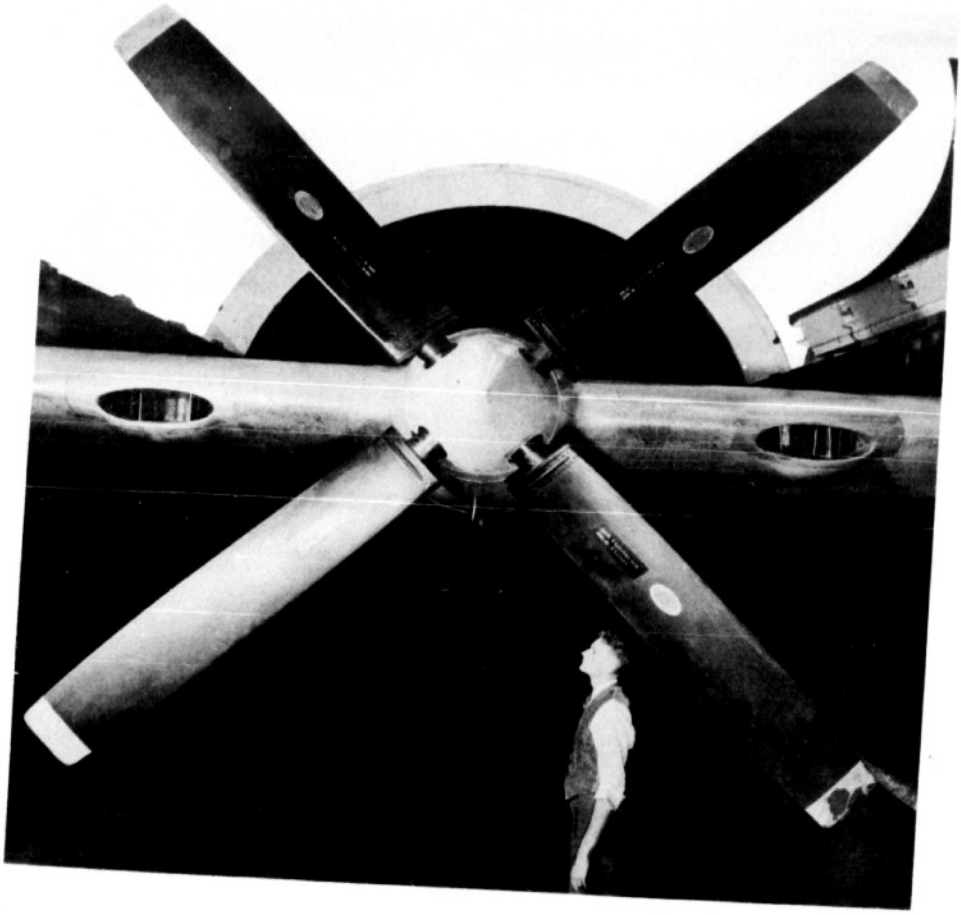

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Figure 2. - Front view of TG-100A gas turbine-propeller engine installation in altitude wind tunnel.

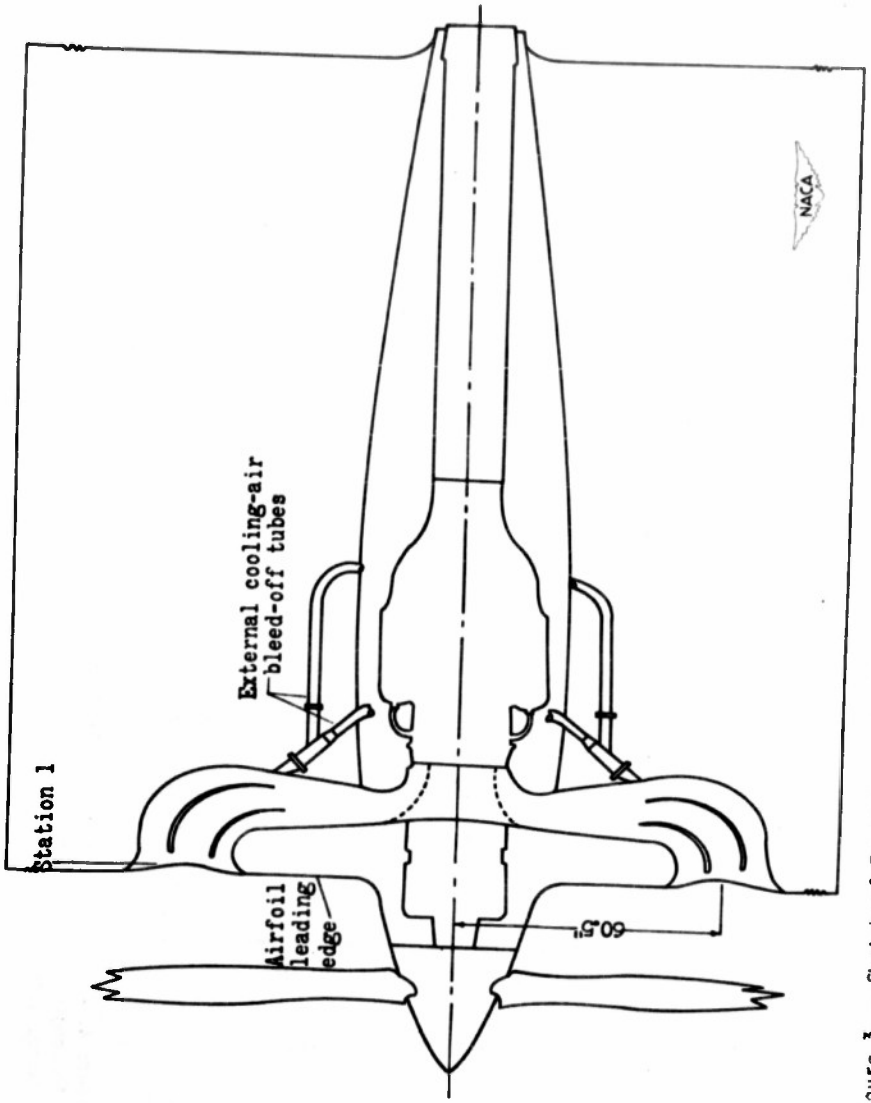


Figure 3. - Sketch of TG-100A gas turbine-propeller engine installation showing location of wing ducts and inlets.

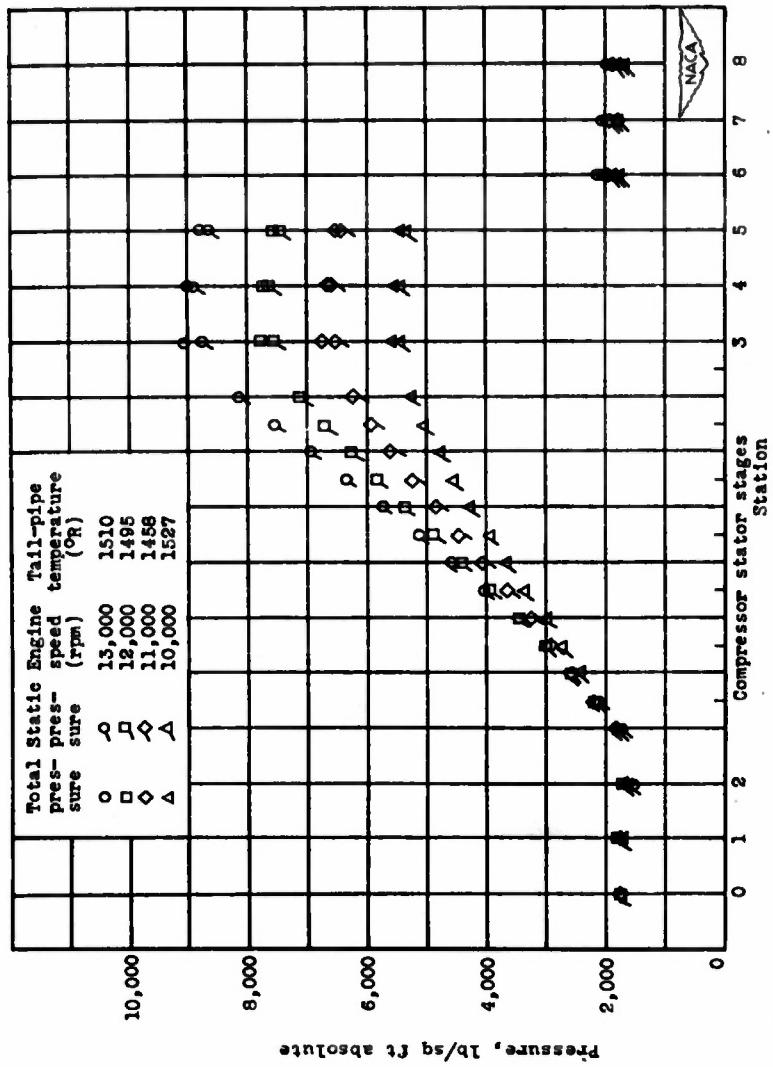
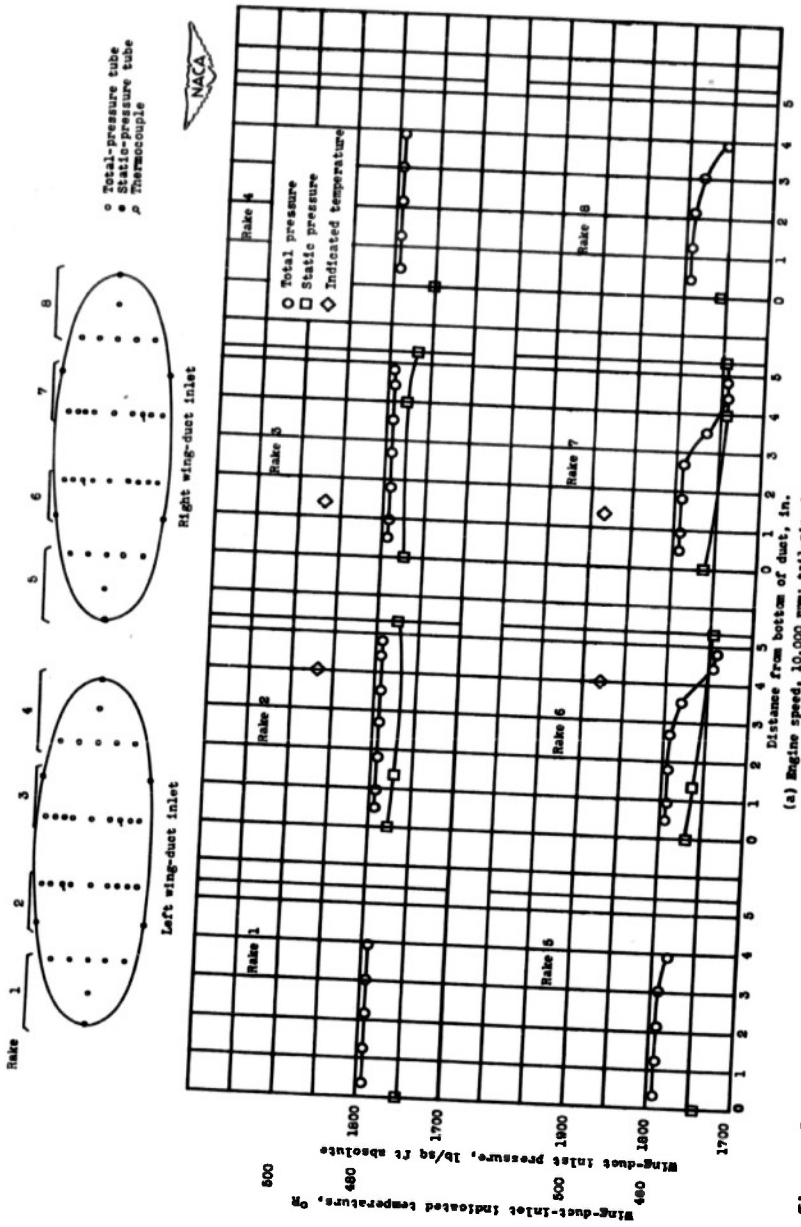
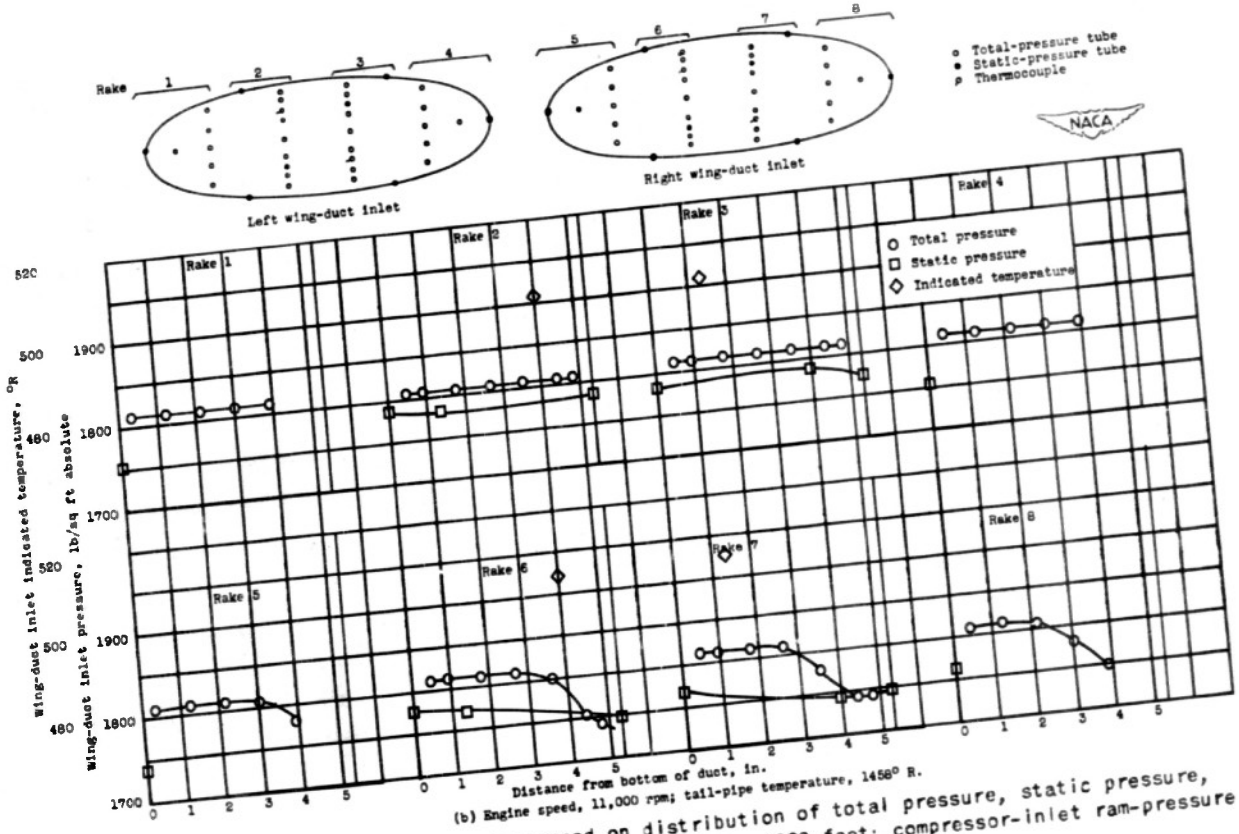


Figure 4. - Typical over-all average pressure profile through TG-100A gas turbine-propeller engine for engine speeds from 10,000 to 13,000 rpm. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00.



(a) Engine speed, 10,000 rpm; tail-pipe temperature, 1827° R.

Figure 5. - Effect of engine speed on distribution of total pressure, static pressure, and indicated temperature at wing-duct inlets. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00.



(b) Engine speed, 11,000 rpm; tail-pipe temperature, 1458° R.

Figure 5. - Continued. Effect of engine speed on distribution of total pressure, static pressure, and indicated temperature at wing-duct inlets. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00.

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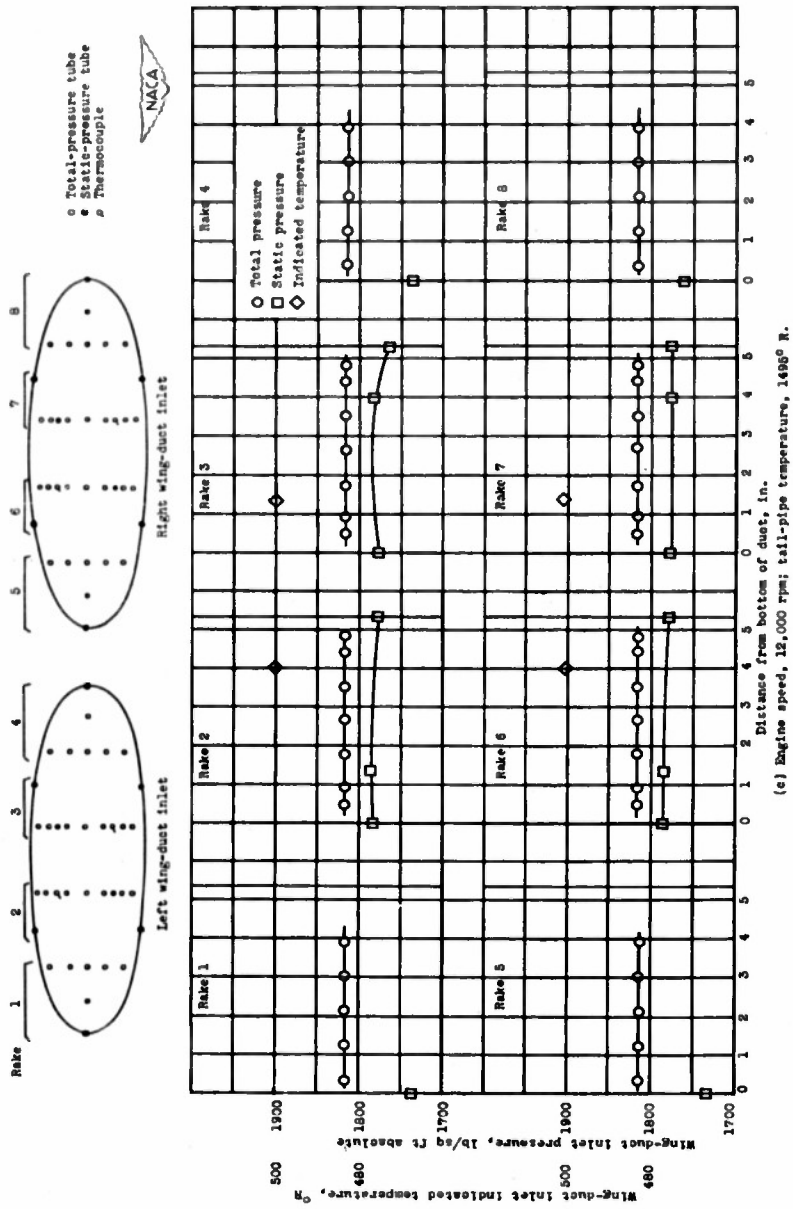
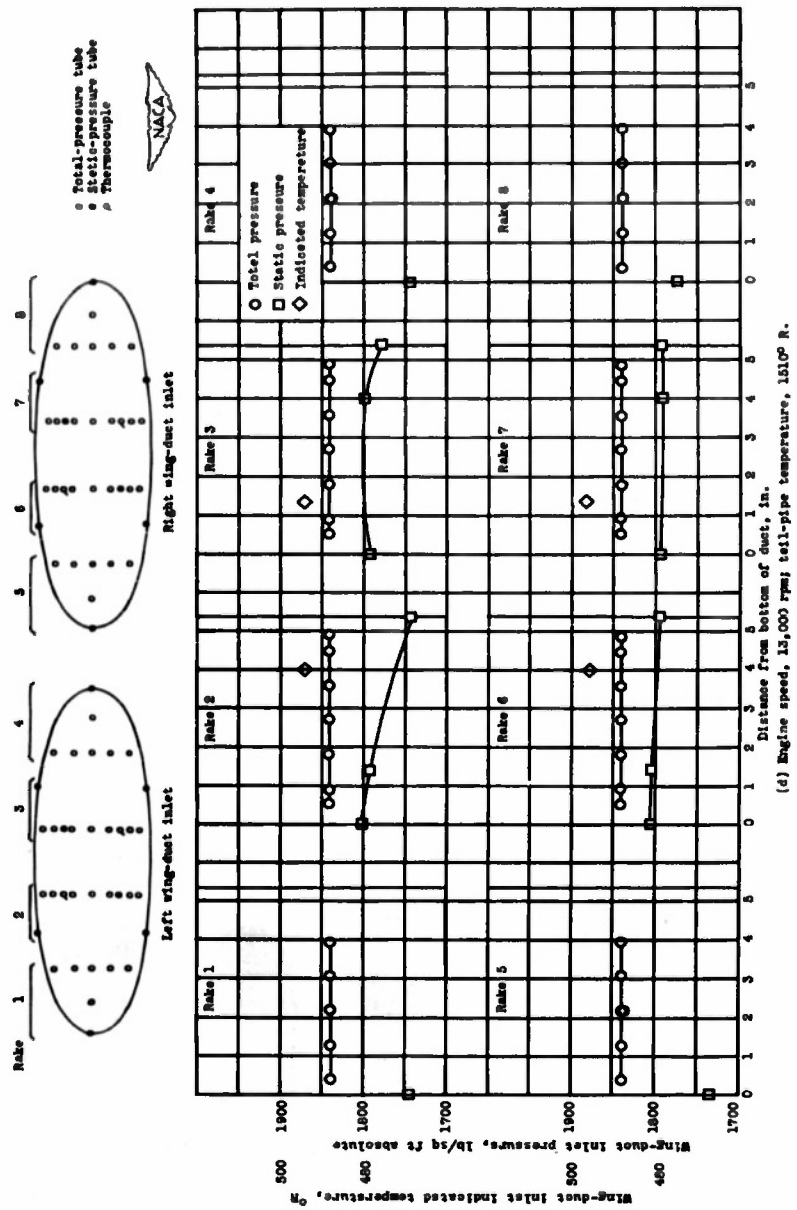


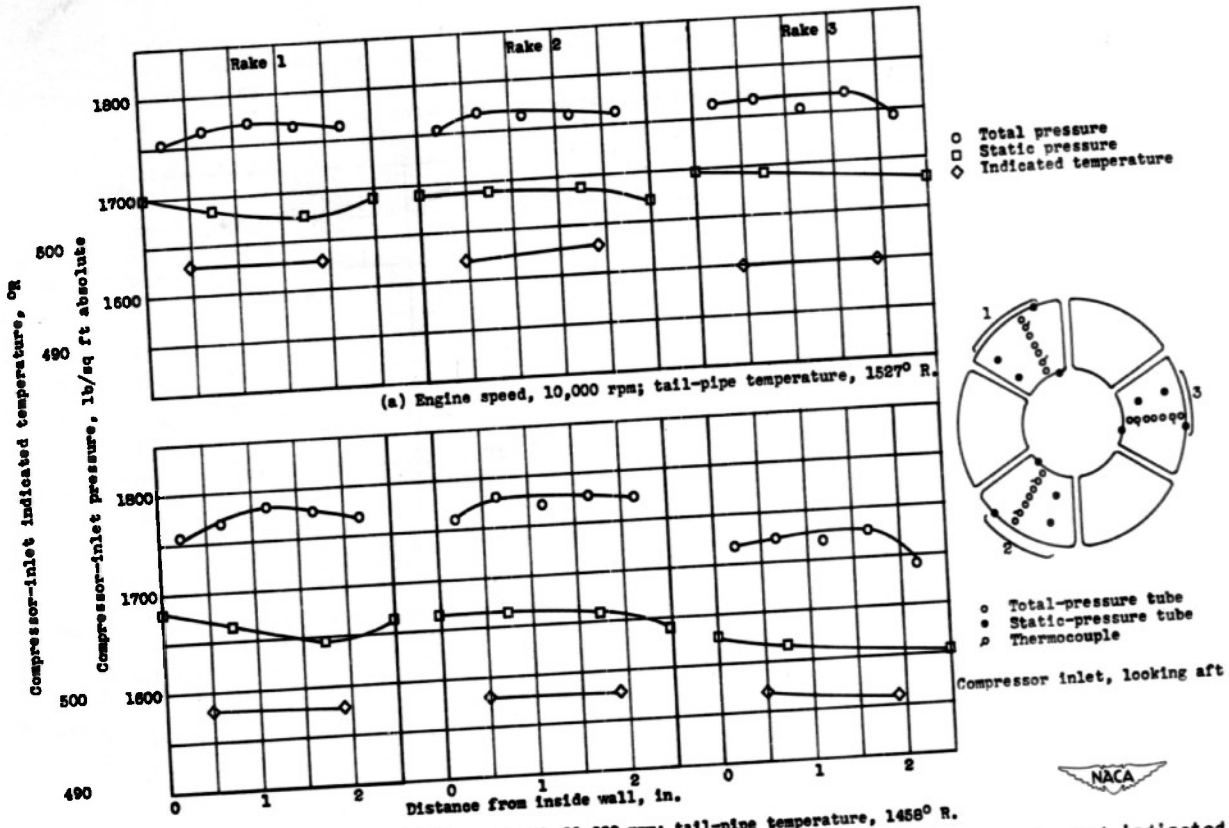
(c) Engine speed, 12,000 rpm; tail-pipe temperature, 1496° R.

Figure 5. - Continued. Effect of engine speed on distribution of total pressure, static pressure, and indicated temperature at wing-duct inlets. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00.



(d) Engine speed, 13,000 rpm; tail-pipe temperature, 1510° R.

Figure 5. - Concluded. Effect of engine speed on distribution of total pressure, static pressure, and indicated temperature at wing-duct inlets. Altitude, 5,000 feet; compressor-inlet ram-pressure ratio, 1.00.



(a) Engine speed, 10,000 rpm; tail-pipe temperature, 1527° R.

(b) Engine speed, 11,000 rpm; tail-pipe temperature, 1458° R.

Figure 6. - Effect of engine speed on distribution of total pressure, static pressure, and indicated temperature at compressor inlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00.

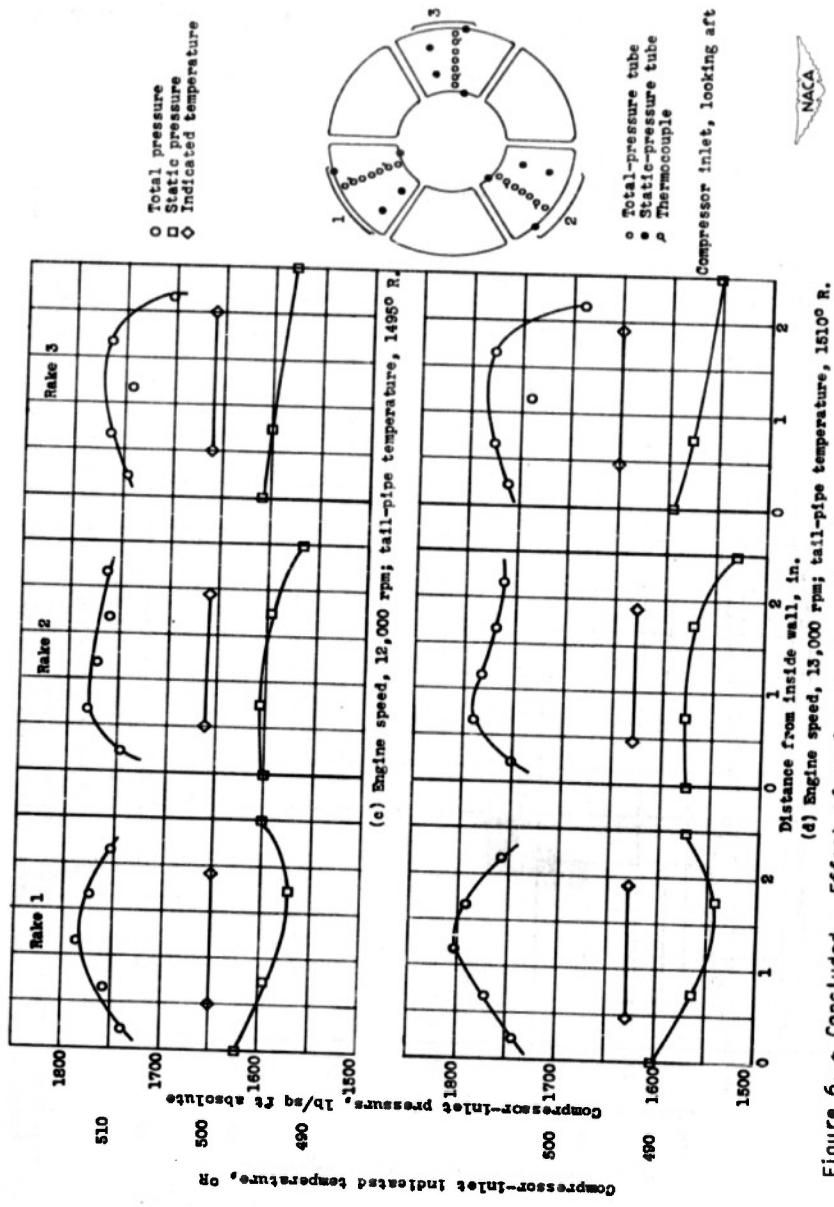


Figure 6. - Concluded. Effect of engine speed on distribution of total pressure, static pressure, and indicated temperature at compressor inlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00.

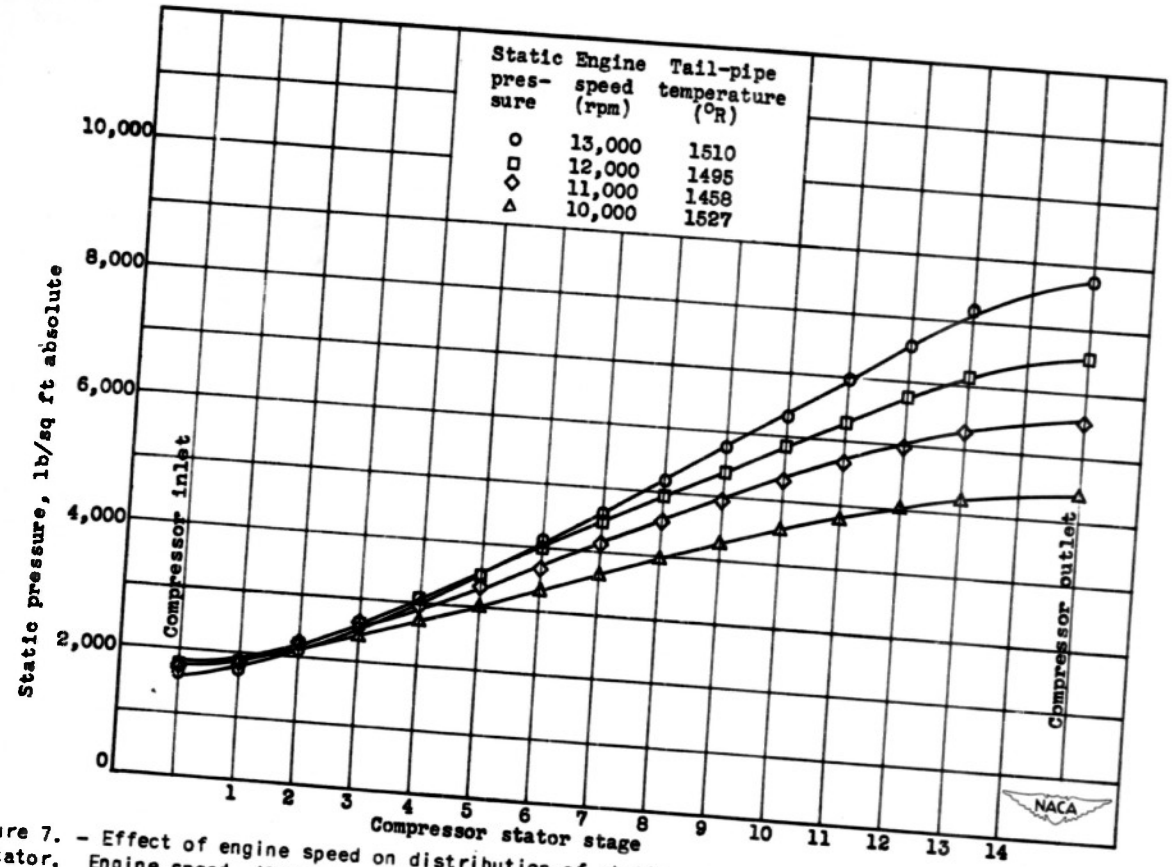


Figure 7. - Effect of engine speed on distribution of static pressure for each stage of compressor stator. Engine speed, 10,000 to 13,000 rpm; altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00.

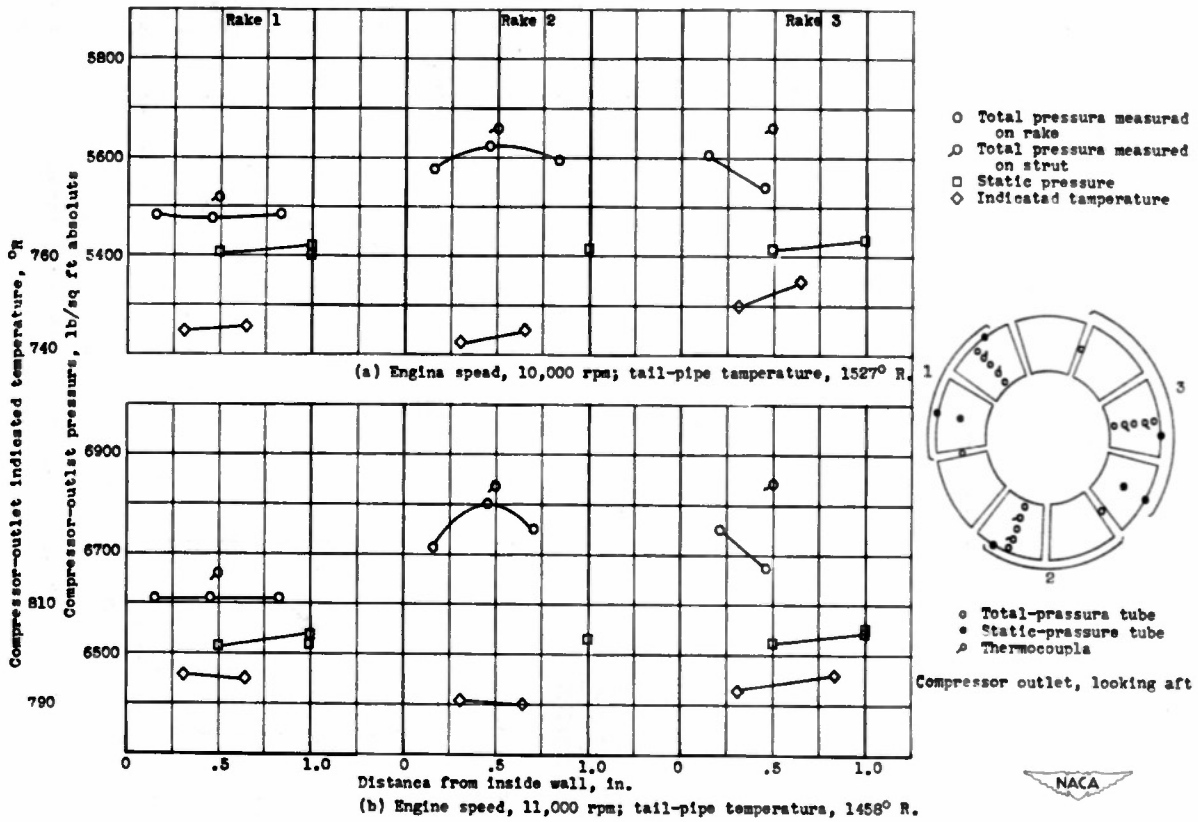


Figure 8. - Effect of engine speed on distribution of total pressure, static pressure, and indicated temperature at compressor outlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00.

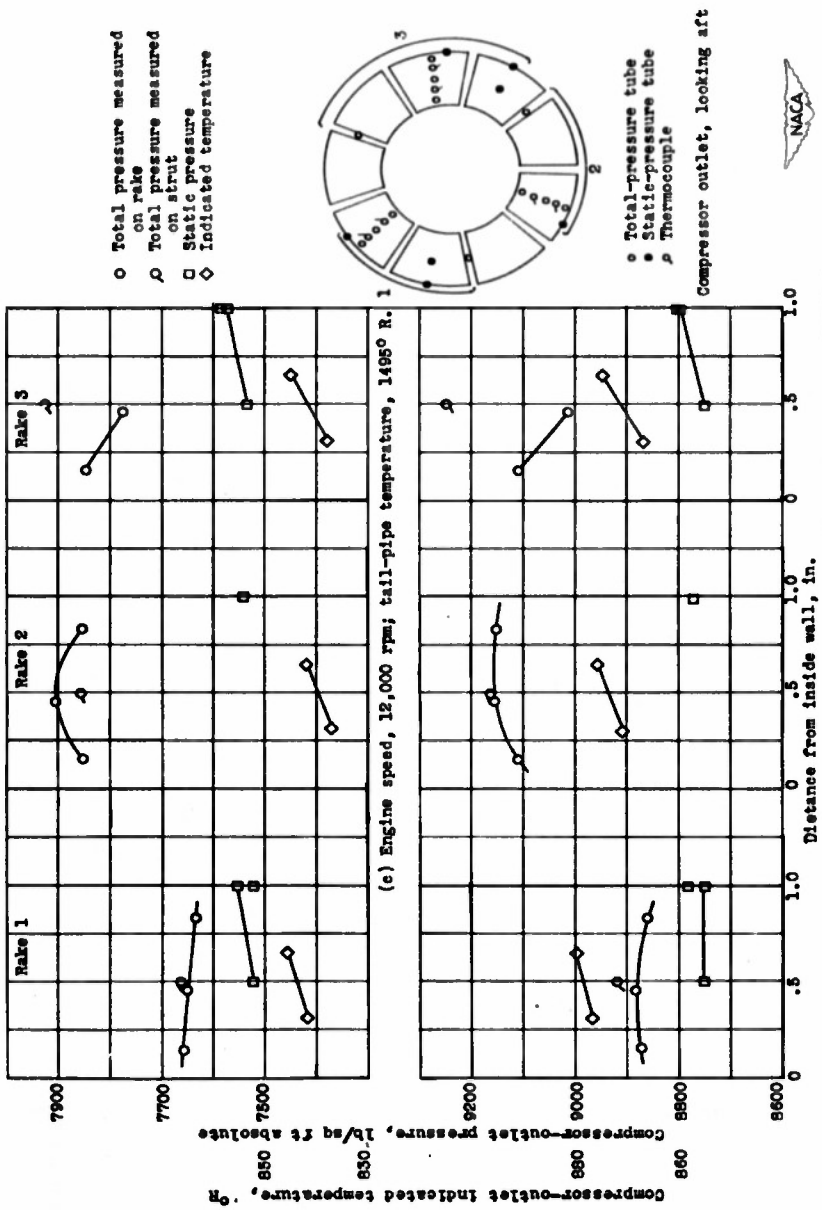
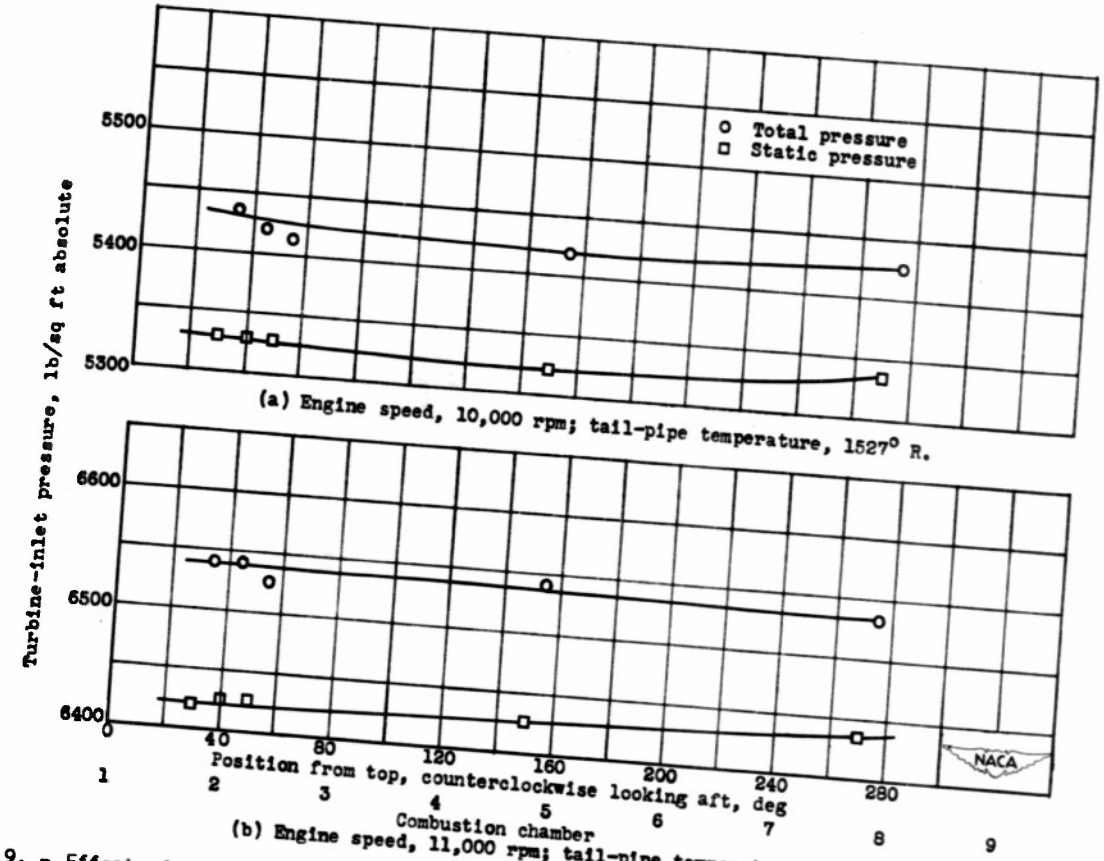


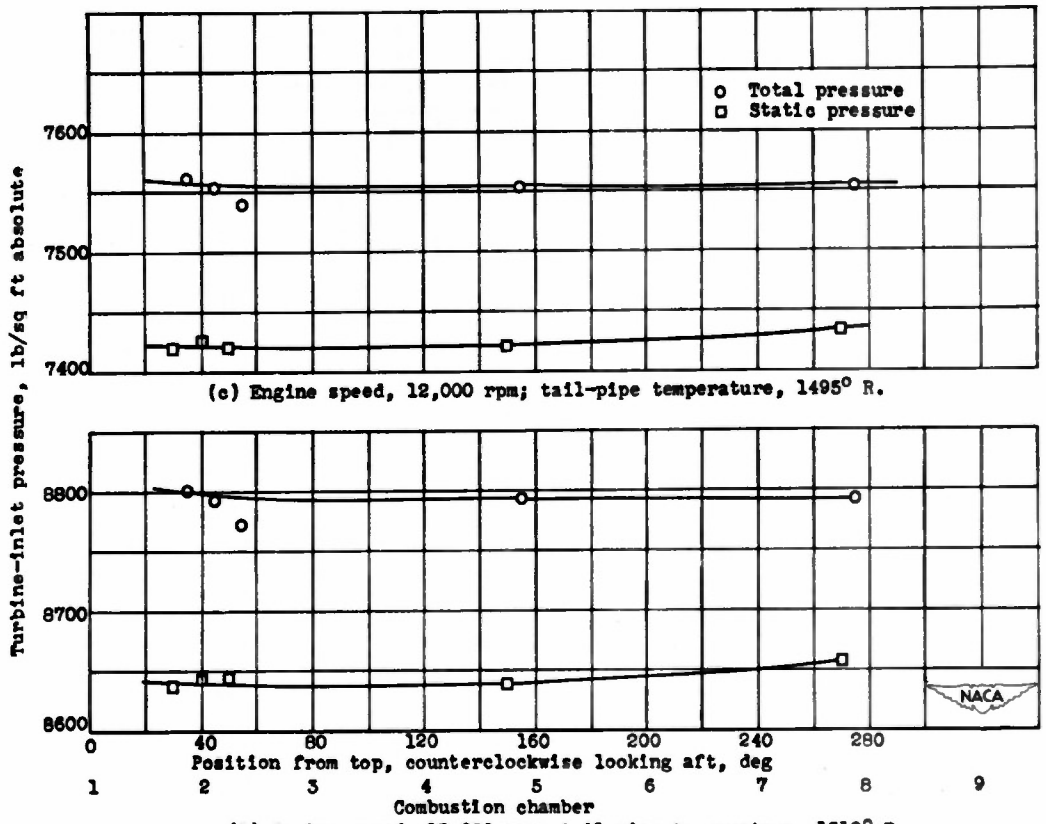
Figure 8. - Concluded. Effect of engine speed on distribution of total pressure, static pressure, and indicated temperature at compressor outlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00.



(a) Engine speed, 10,000 rpm; tail-pipe temperature, 1527° R.

(b) Engine speed, 11,000 rpm; tail-pipe temperature, 1458° R.

Figure 9. - Effect of engine speed on distribution of total and static pressures at turbine inlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00.



(c) Engine speed, 12,000 rpm; tail-pipe temperature, 1495° R.

(d) Engine speed, 13,000 rpm; tail-pipe temperature, 1510° R.

Figure 9. - Concluded. Effect of engine speed on distribution of total and static pressures at turbine inlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00.

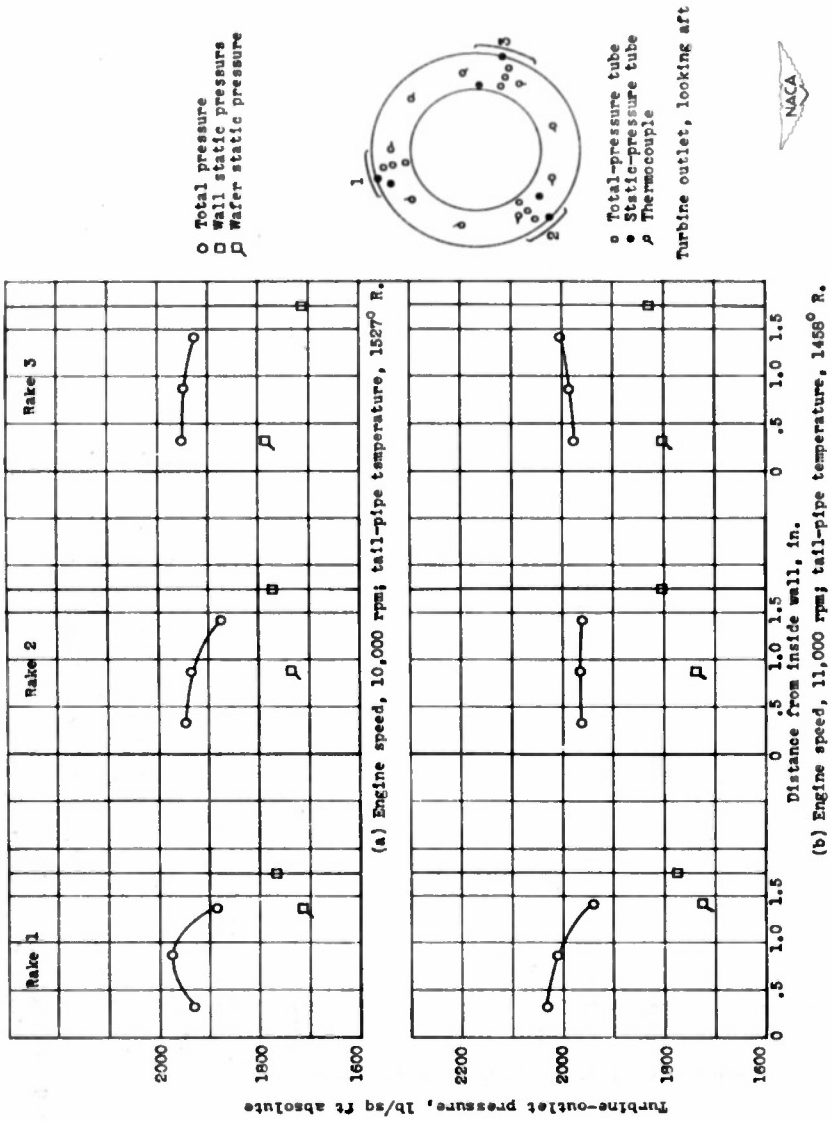


Figure 10. - Effect of engine speed on distribution of total pressure and static pressure at turbine outlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00.

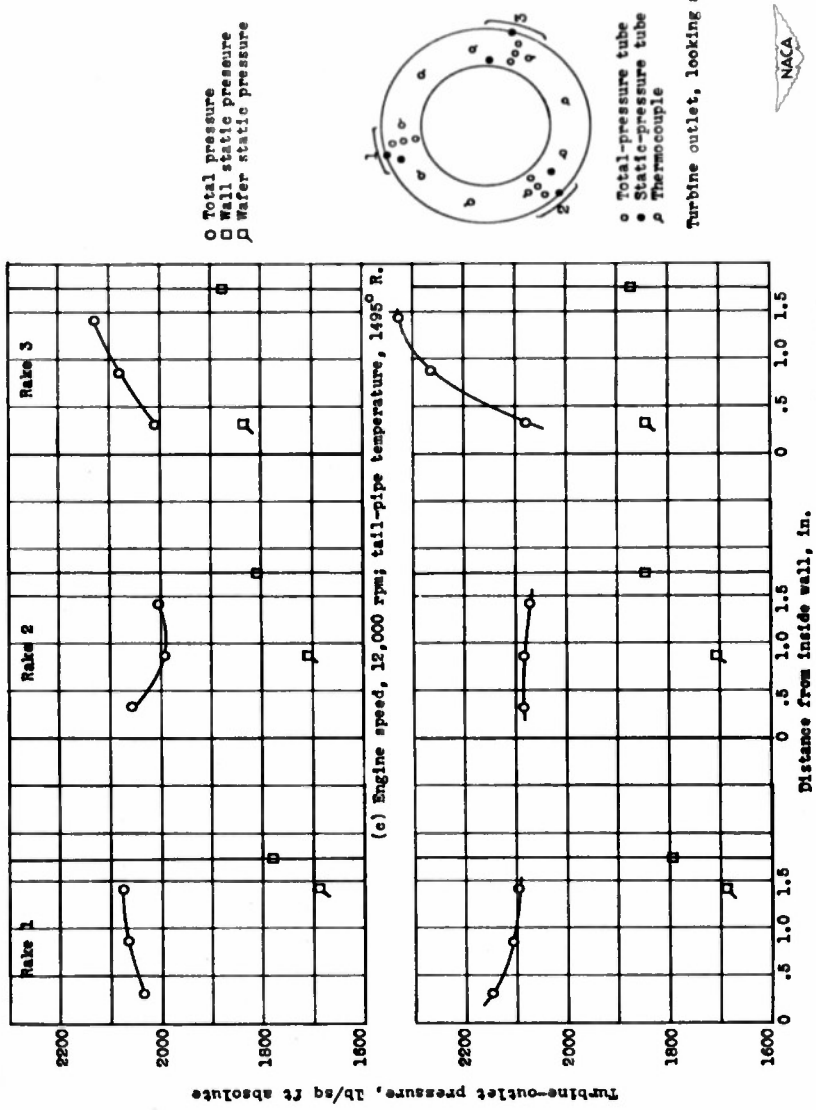


Figure 10. - Concluded. Effect of engine speed on distribution of total pressure and static pressure at turbine outlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00.

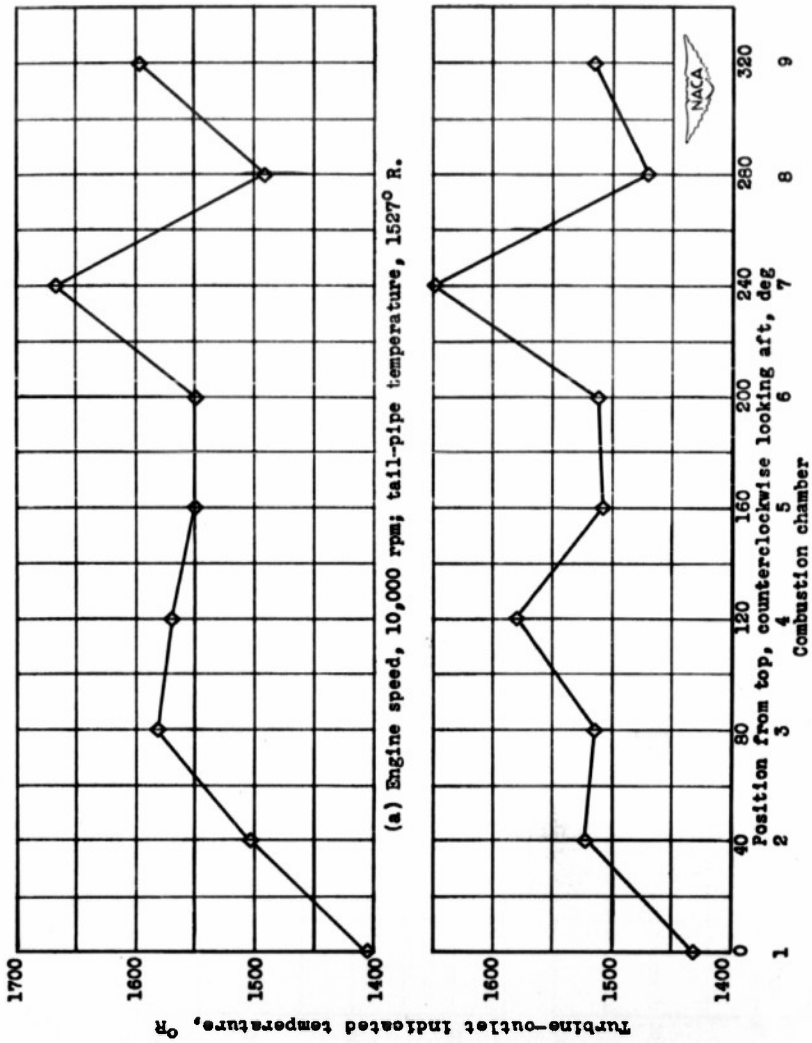
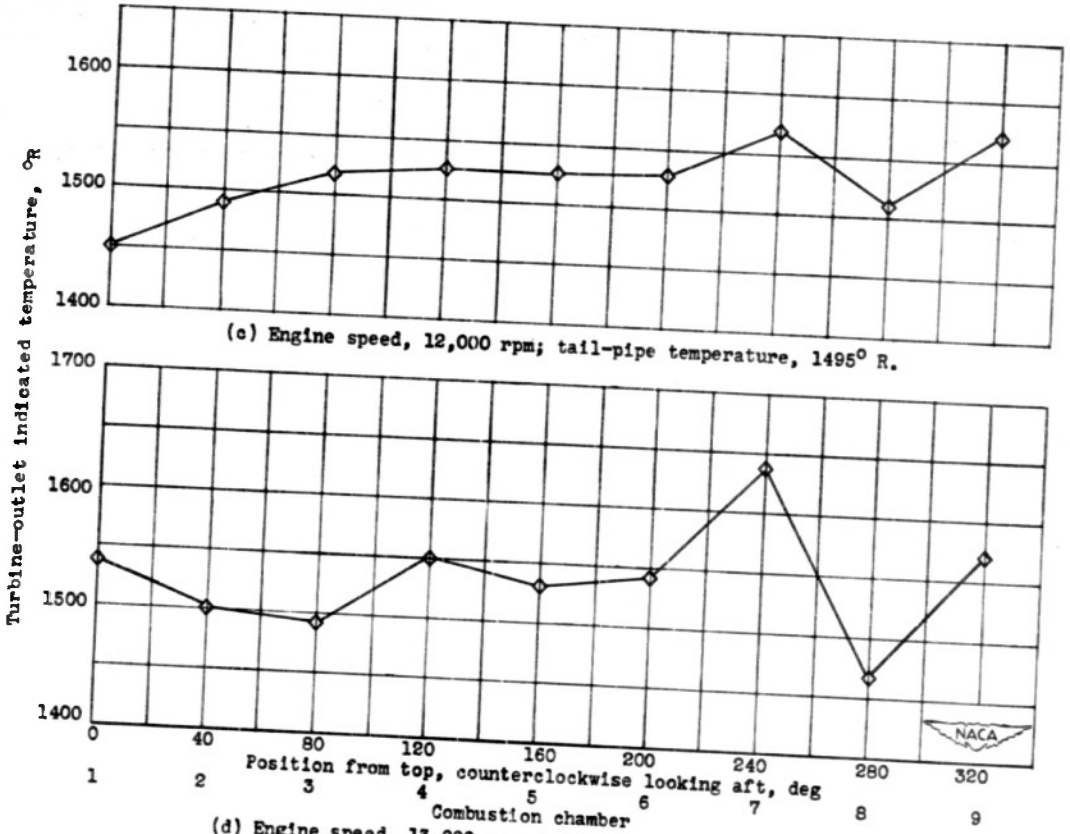


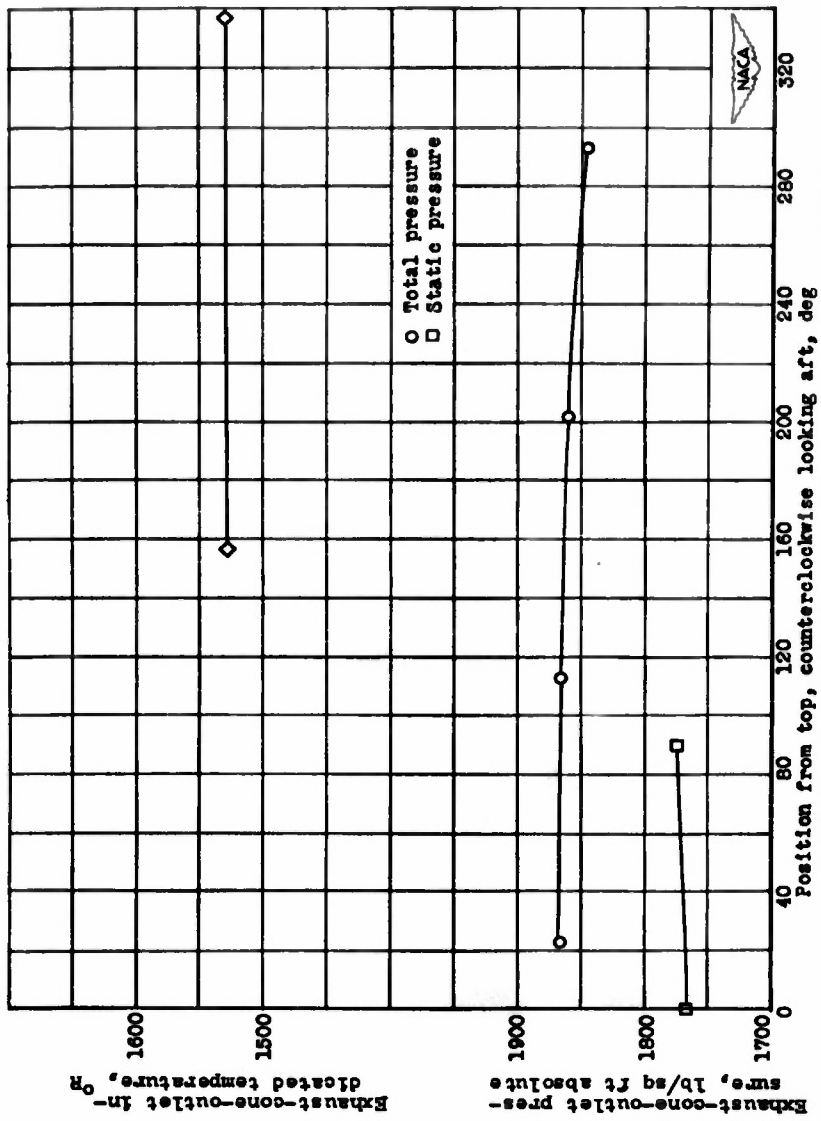
Figure 11. - Effect of engine speed on distribution of indicated temperature at turbine outlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00.



(c) Engine speed, 12,000 rpm; tail-pipe temperature, 1495° R.

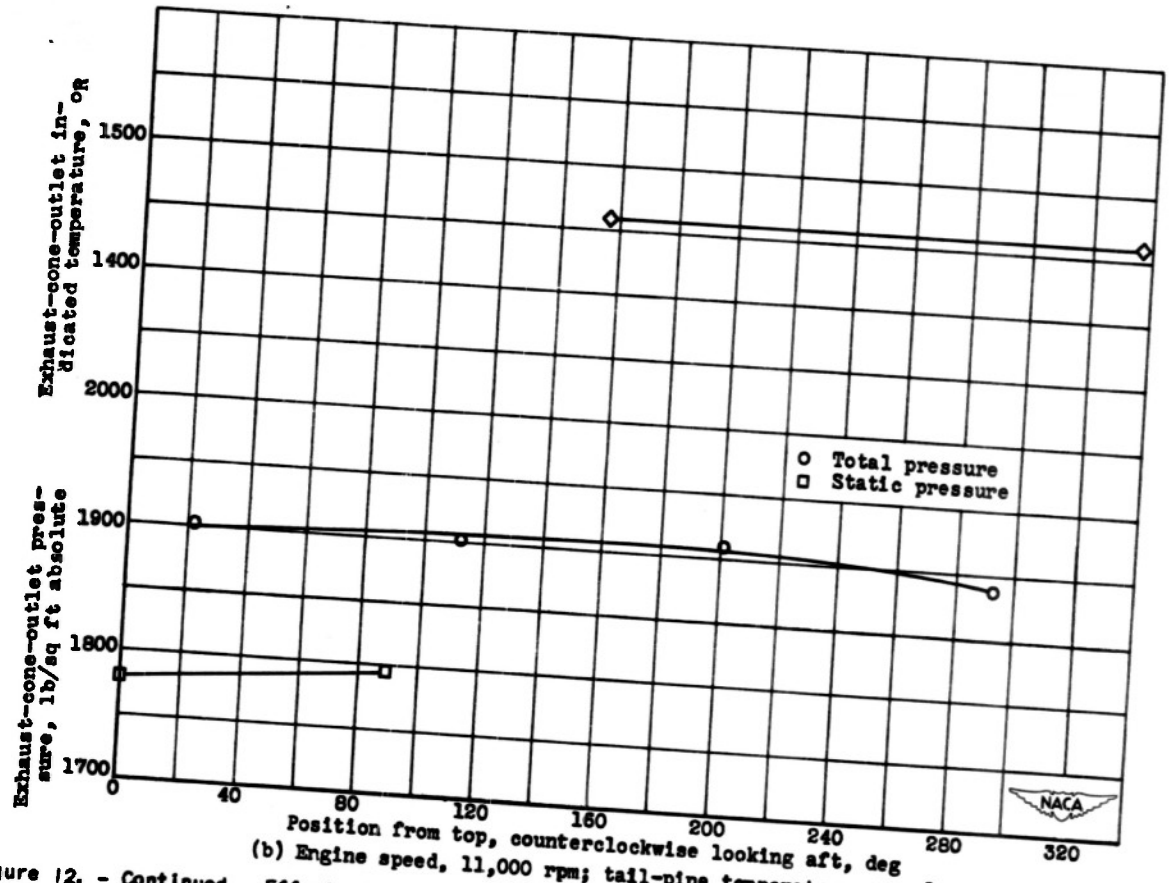
(d) Engine speed, 13,000 rpm; tail-pipe temperature, 1510° R.

Figure 11. - Concluded. Effect of engine speed on distribution of indicated temperature at turbine outlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00.



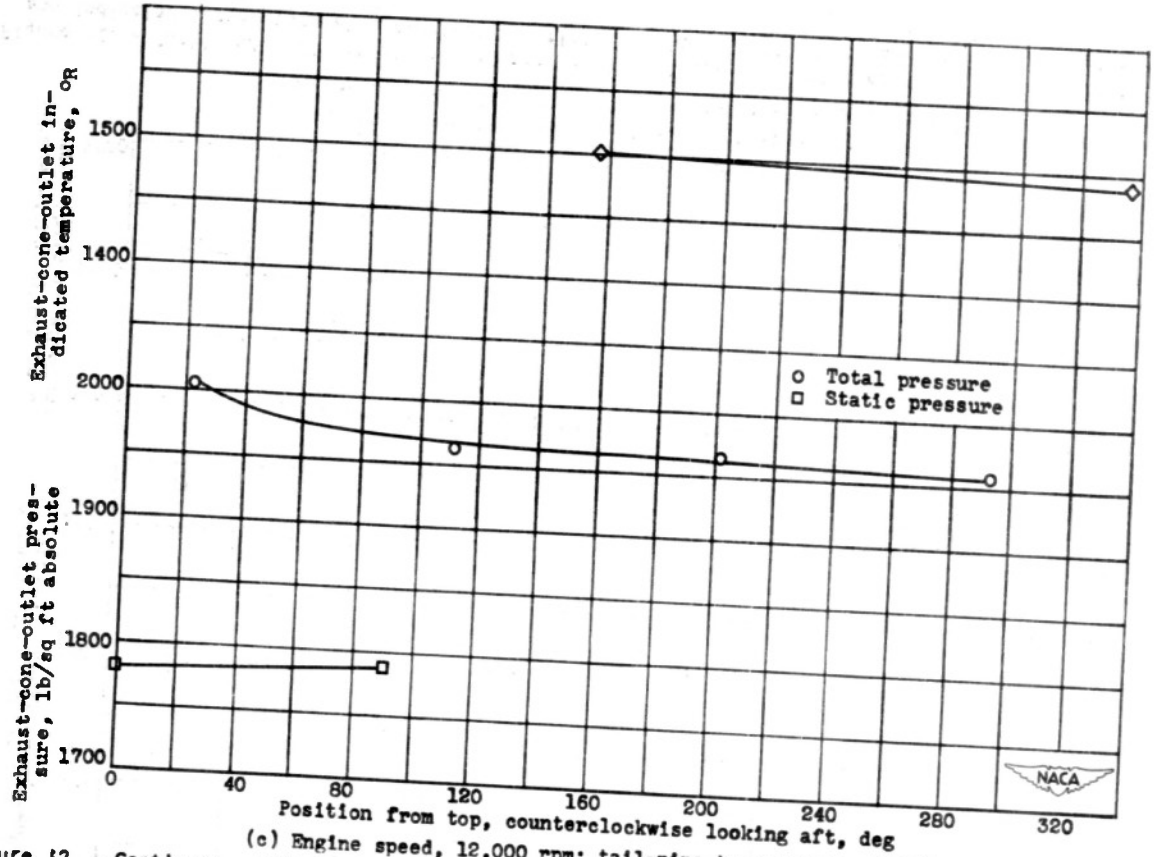
(a) Engine speed, 10,000 rpm; tail-pipe temperature, 1527° R.

Figure 12. - Effect of engine speed on distribution of total pressure, static pressure, and indicated temperature at exhaust-cone outlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00



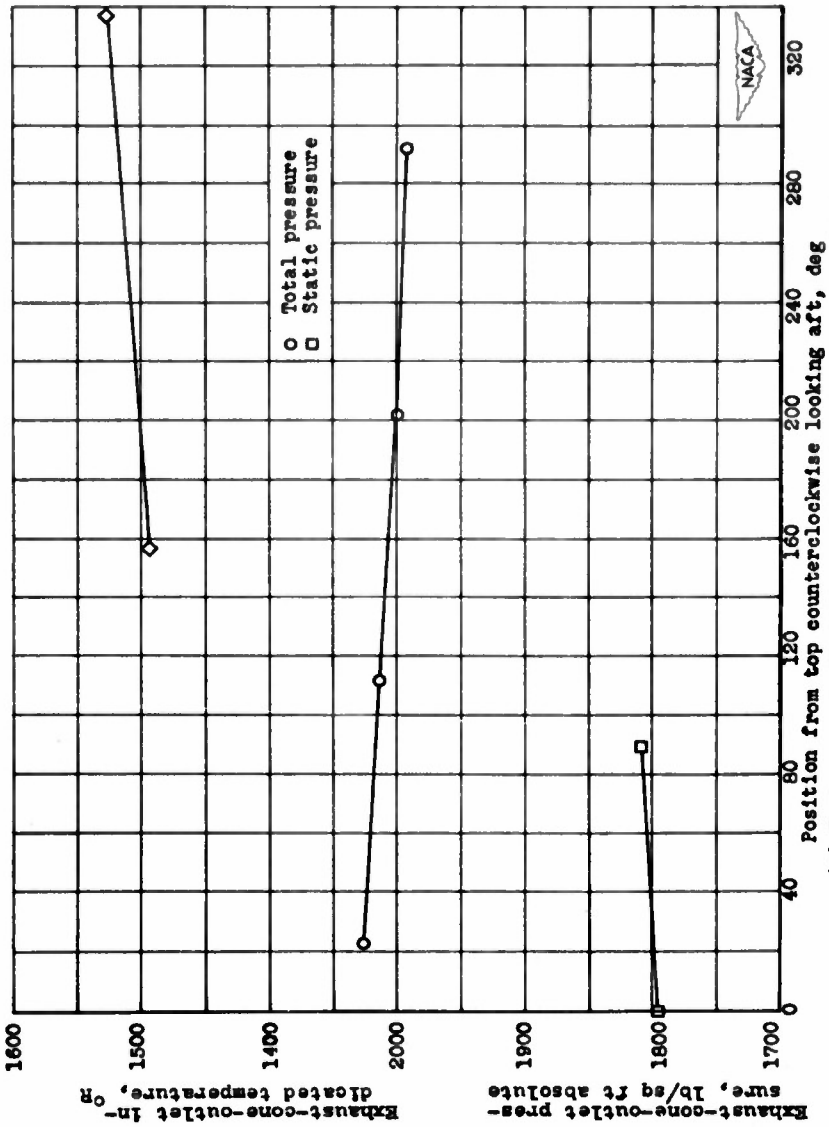
(b) Engine speed, 11,000 rpm; tail-pipe temperature, 1458° R.

Figure 12. - Continued. Effect of engine speed on distribution of total pressure, static pressure, and indicated temperature at exhaust-cone outlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00.



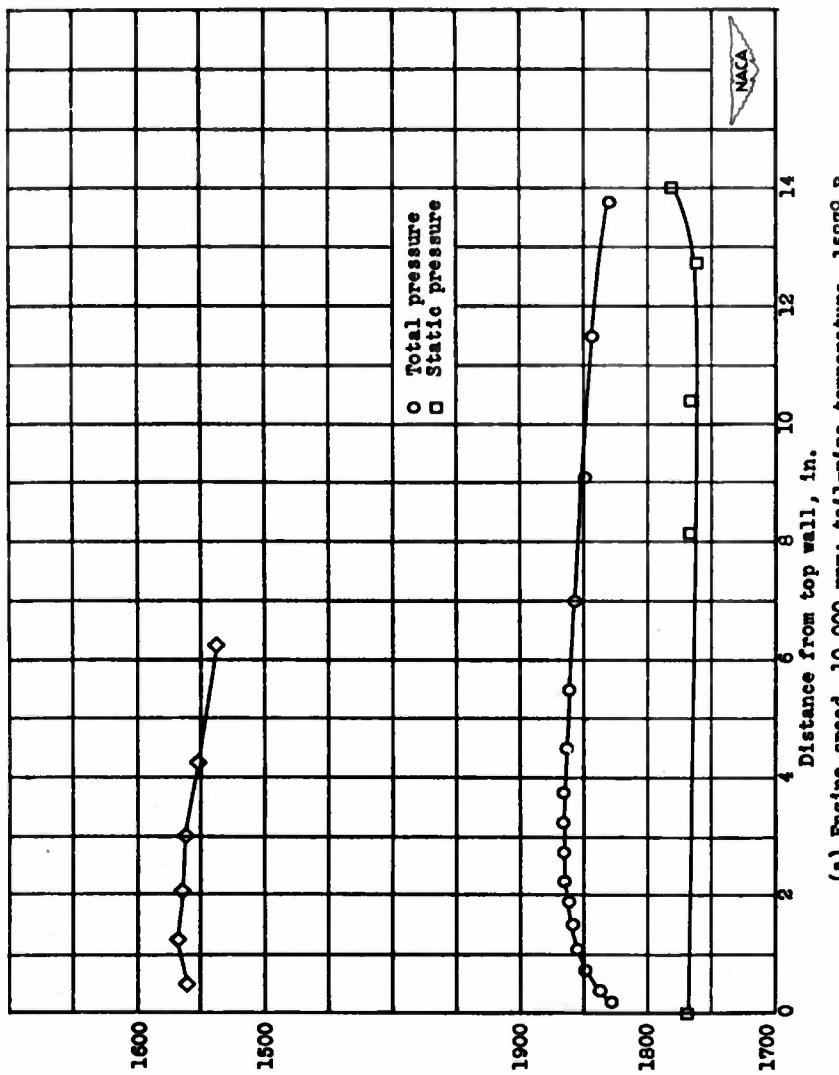
(c) Engine speed, 12,000 rpm; tail-pipe temperature, 1495° R.

Figure 12. - Continued. Effect of engine speed on distribution of total pressure, static pressure, and indicated temperature at exhaust-cone outlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00.



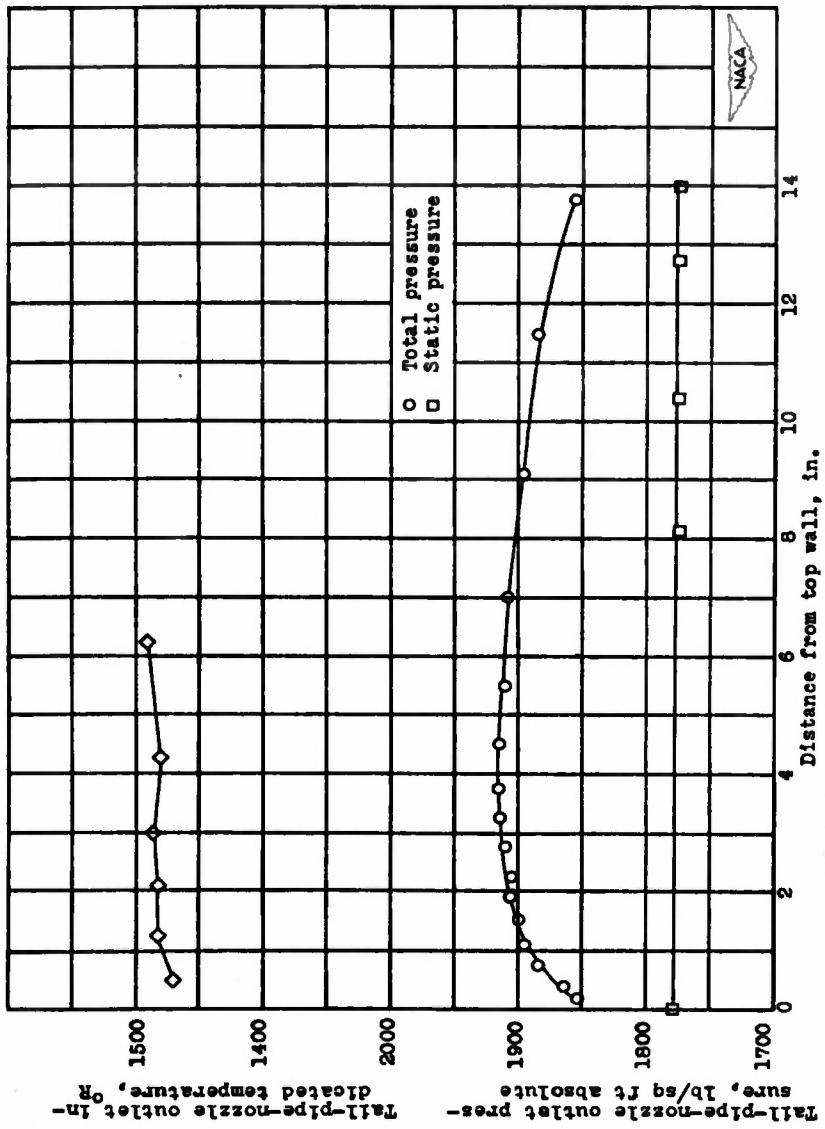
(d) Engine speed, 13,000 rpm; tail-pipe temperature, 1510° R.

Figure 12. - Concluded. Effect of engine speed on distribution of total pressure, static pressure, and indicated temperature at exhaust-cone outlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00.



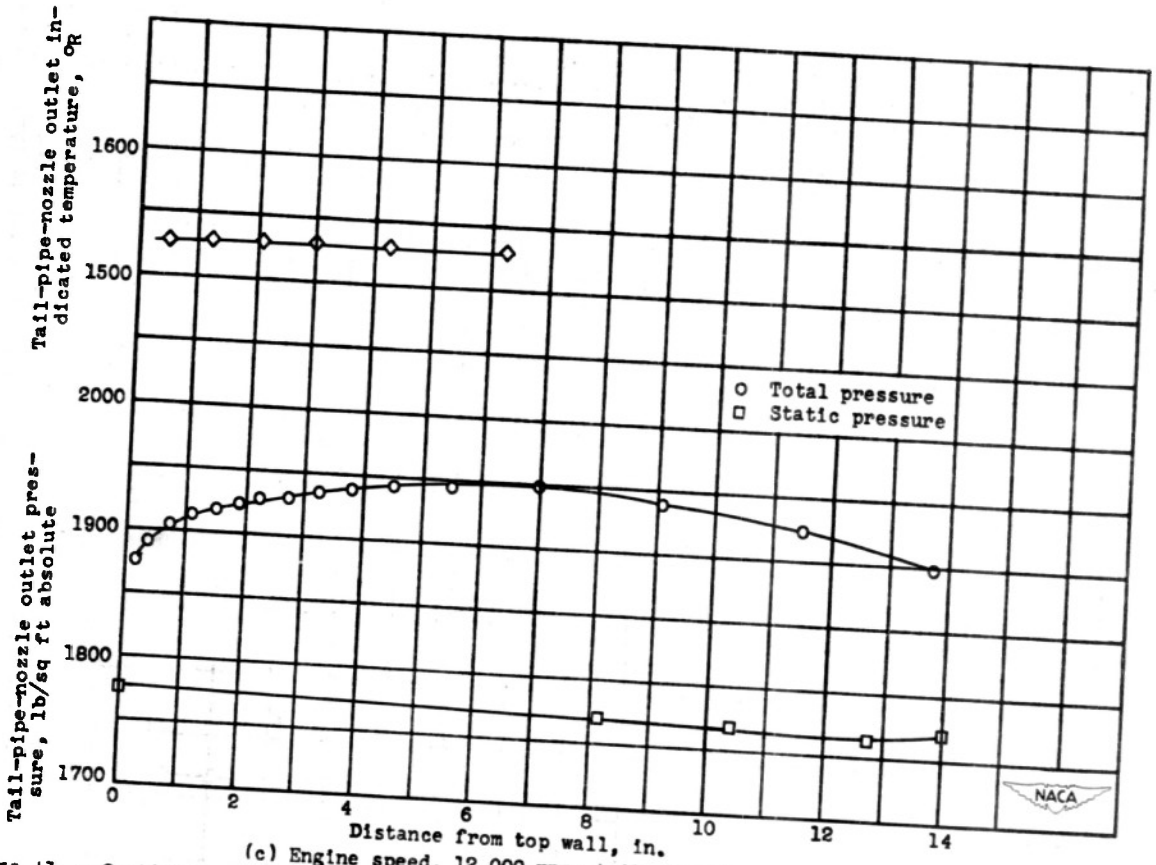
(a) Engine speed, 10,000 rpm; tail-pipe temperature, 1527° R.

Figure 13. - Effect of engine speed on distribution of total pressure, static pressure, and indicated temperature at tail-pipe-nozzle outlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00.



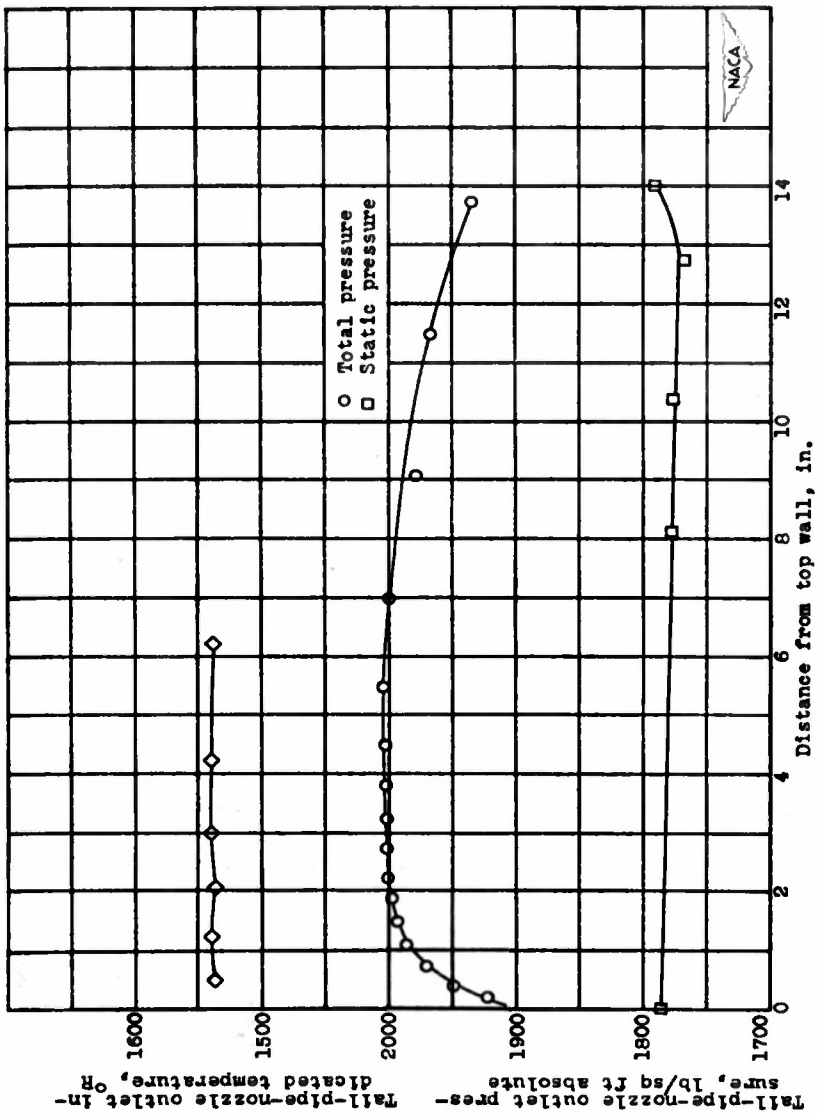
(b) Engine speed, 11,000 rpm; tail-pipe temperature, 1458° R.

Figure 13. - Continued. Effect of engine speed on distribution of total pressure, static pressure, and indicated temperature at tail-pipe-nozzle outlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00.



(c) Engine speed, 12,000 rpm; tail-pipe temperature, 1495° R.

Figure 13. - Continued. Effect of engine speed on distribution of total pressure, static pressure, and indicated temperature at tail-pipe-nozzle outlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00.



(d) Engine speed, 13,000 rpm; tail-pipe temperature, 1510° R.

Figure 13. - Concluded. Effect of engine speed on distribution of total pressure, static pressure, and indicated temperature at tail-pipe-nozzle outlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00.

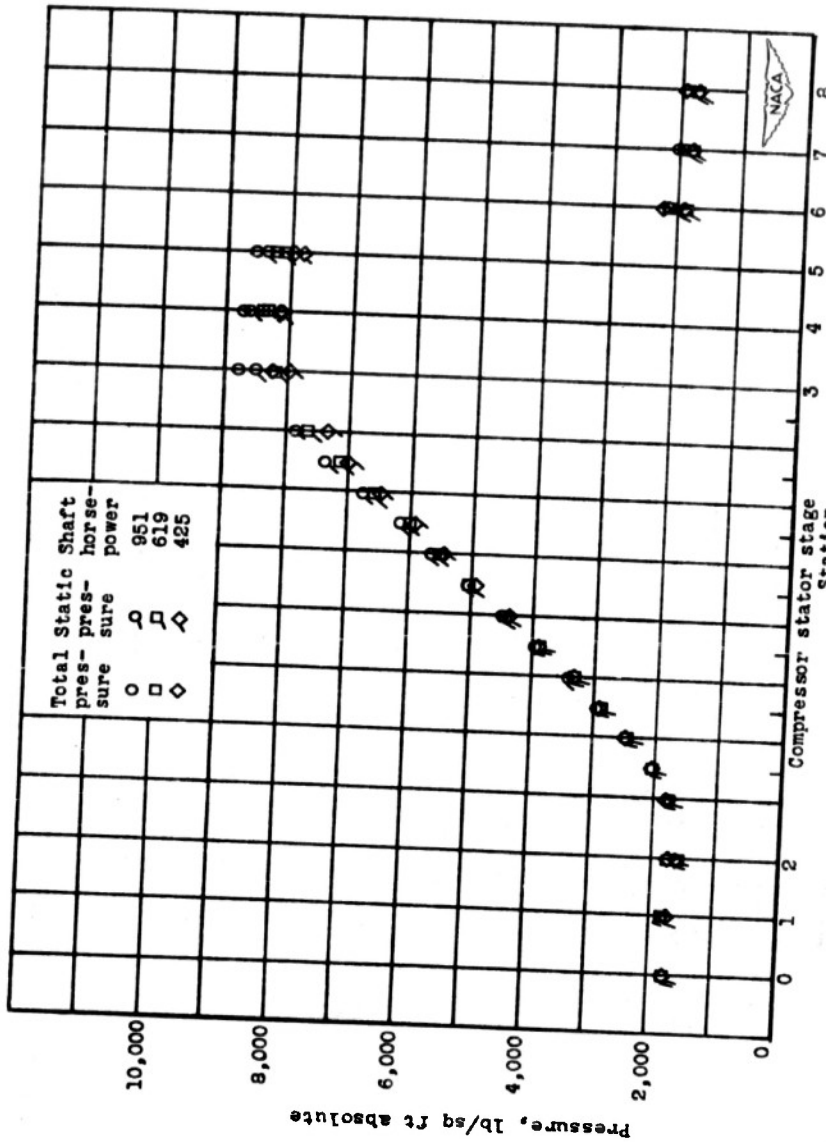
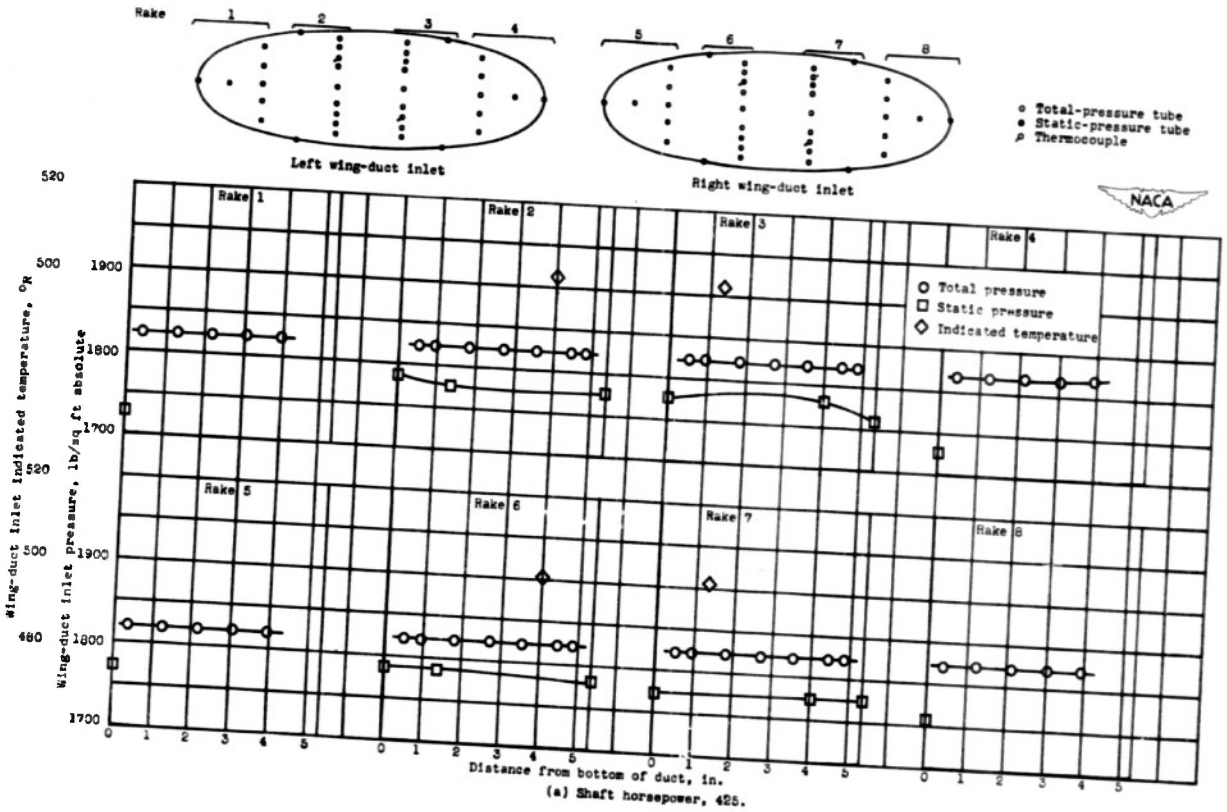
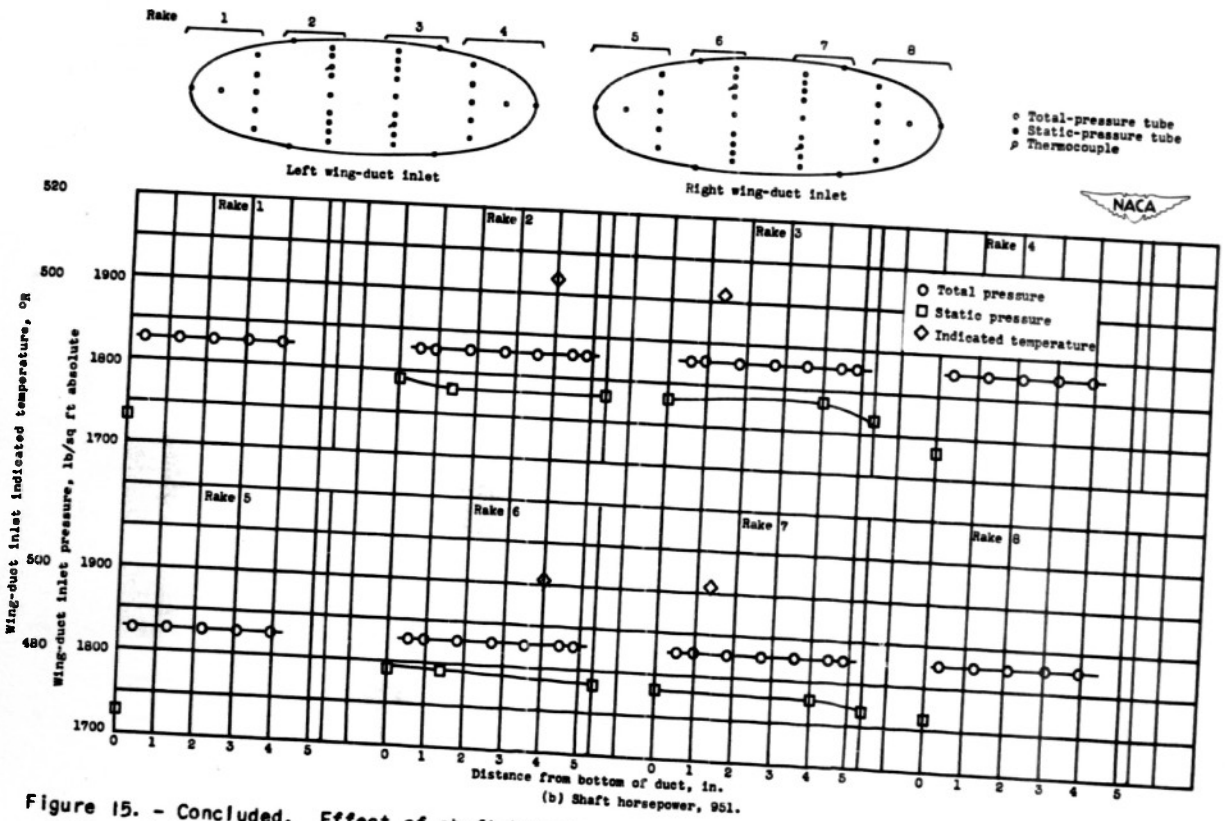


Figure 14. - Typical over-all average pressure profile for various shaft horsepowers. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00; engine speed, 13,000 rpm.



(a) Shaft horsepower, 425.

Figure 15. - Effect of shaft horsepower on distribution of total pressure, static pressure, and indicated temperature at wing-duct inlets. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00; engine speed, 13,000 rpm.



(b) Shaft horsepower, 951.

Figure 15. - Concluded. Effect of shaft horsepower on distribution of total pressure, static pressure, and indicated temperature at wing-duct inlets. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00; engine speed, 13,000 rpm.

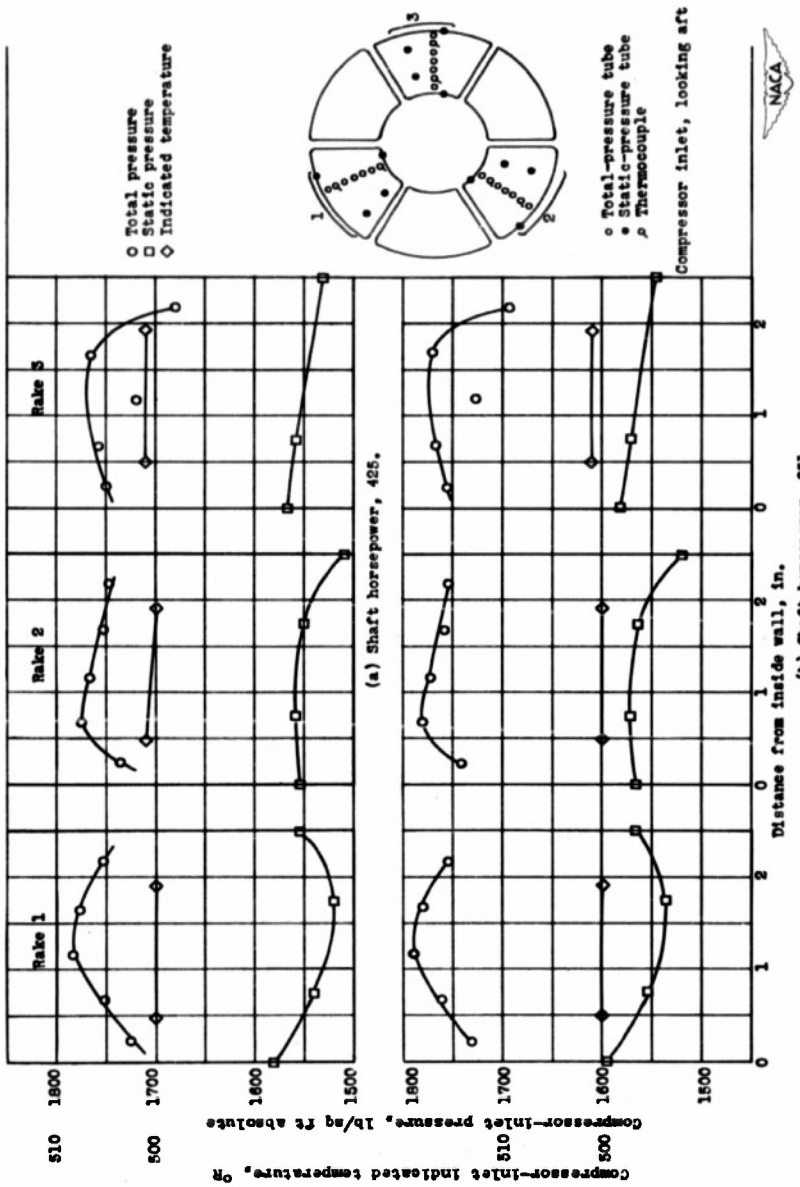


Figure 16. - Effect of shaft horsepower on distribution of total pressure, static pressure, and indicated temperature at compressor inlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00; engine speed, 13,000 rpm.

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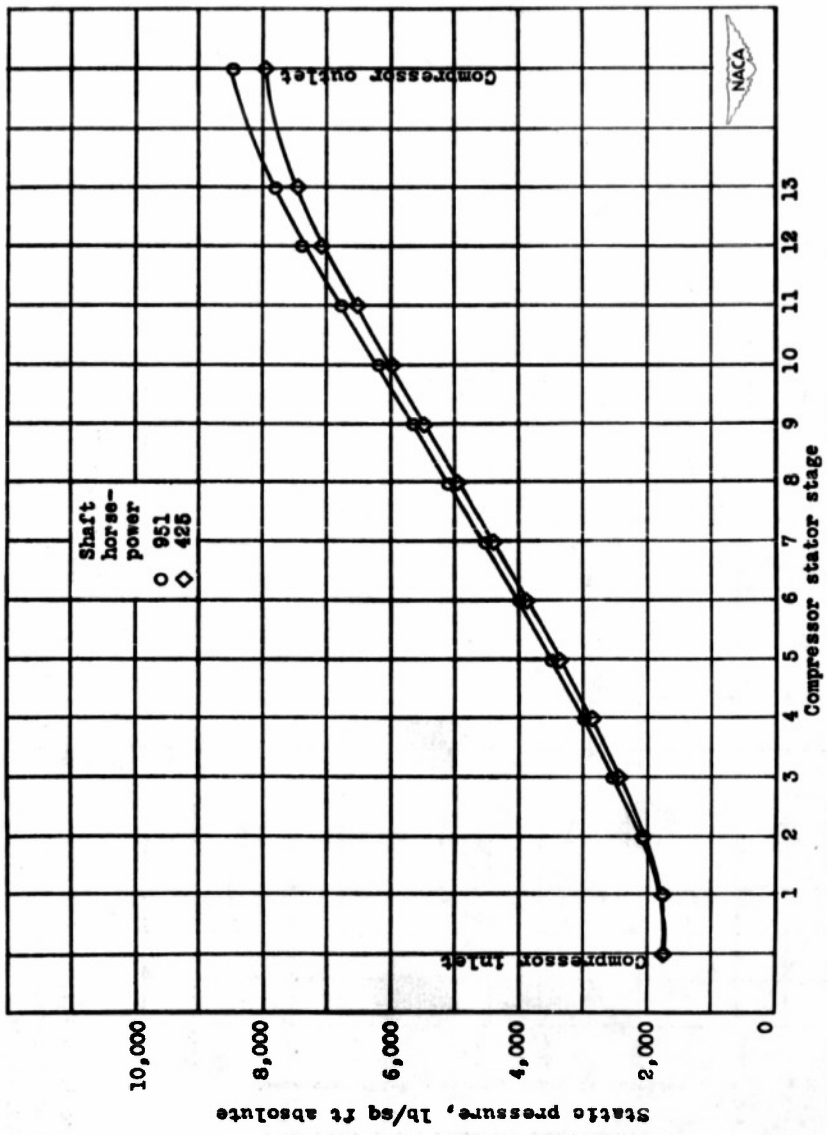
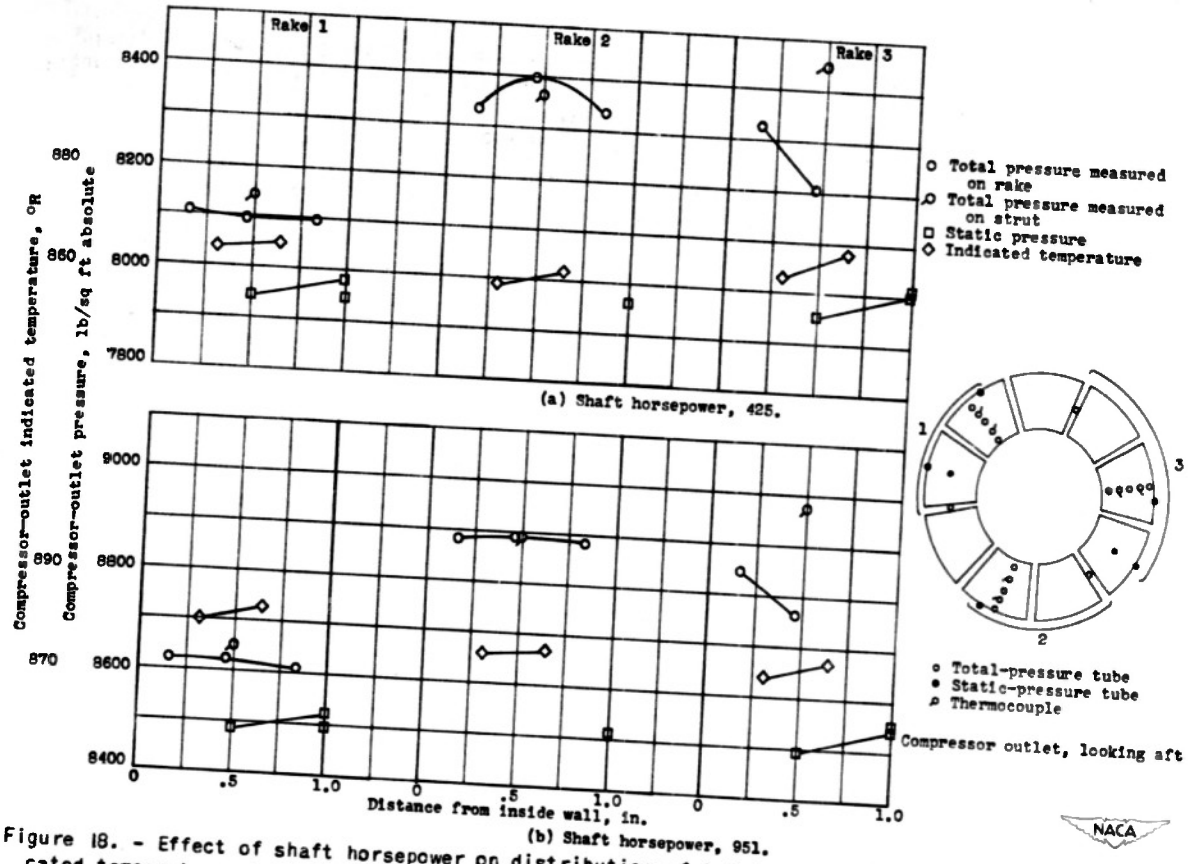


Figure 17. - Effect of shaft horsepower on distribution of static pressure for each stage of compressor stator. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00; engine speed, 13,000 rpm.



(a) Shaft horsepower, 425.

(b) Shaft horsepower, 951.

Figure 18. - Effect of shaft horsepower on distribution of total pressure, static pressure, and indicated temperature at compressor outlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00; engine speed, 13,000 rpm.

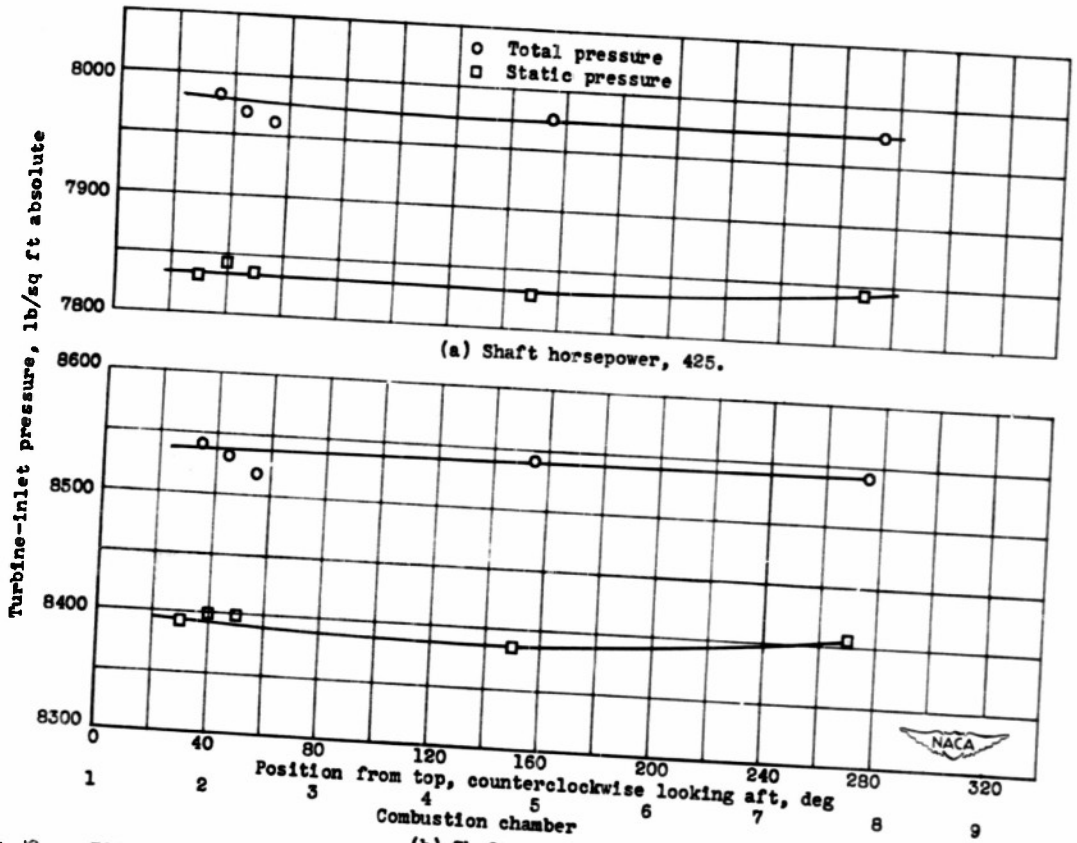


Figure 19. - Effect of shaft horsepower on distribution of total and static pressures at turbine inlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00; engine speed, 13,000 rpm.

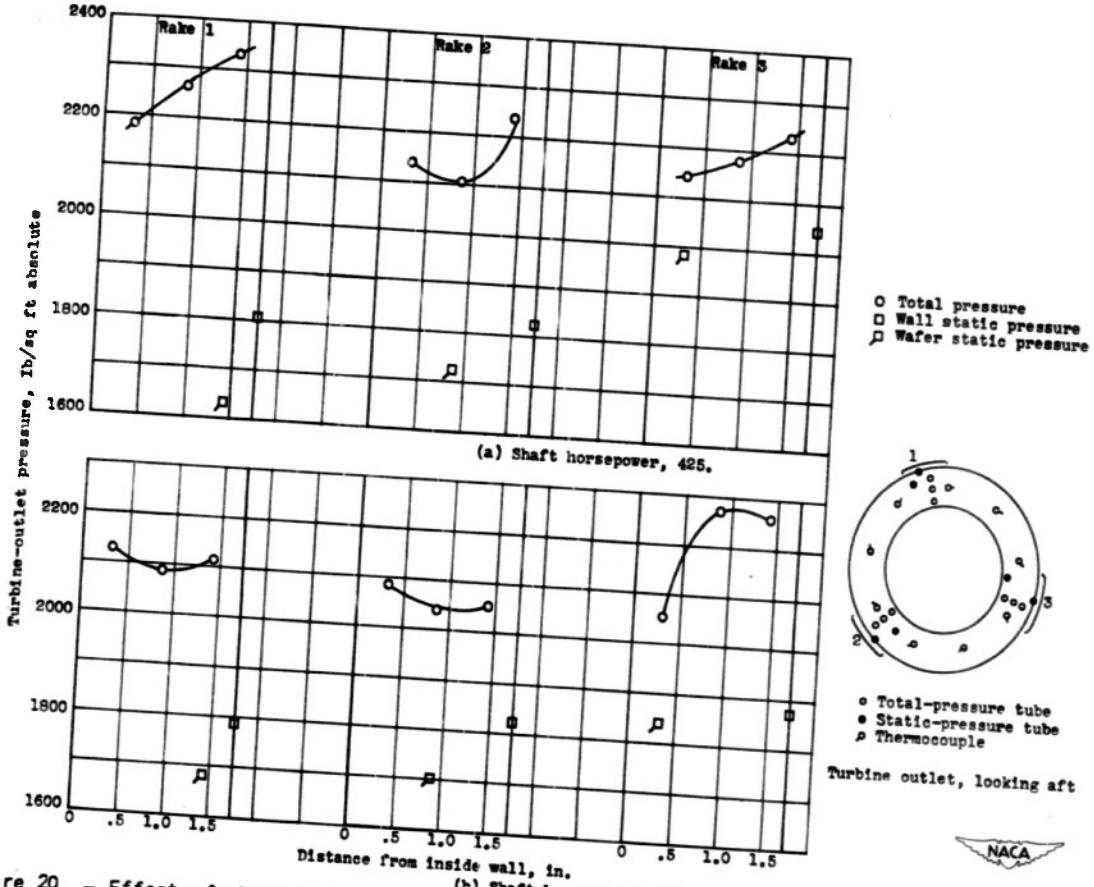
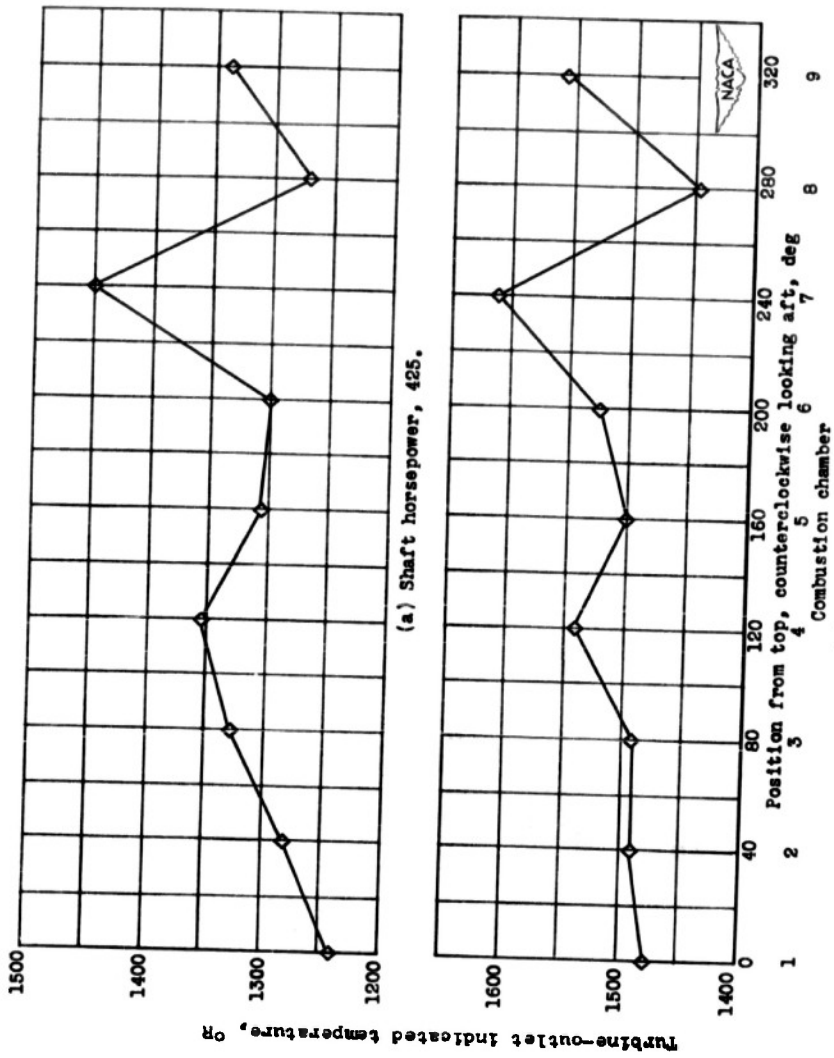


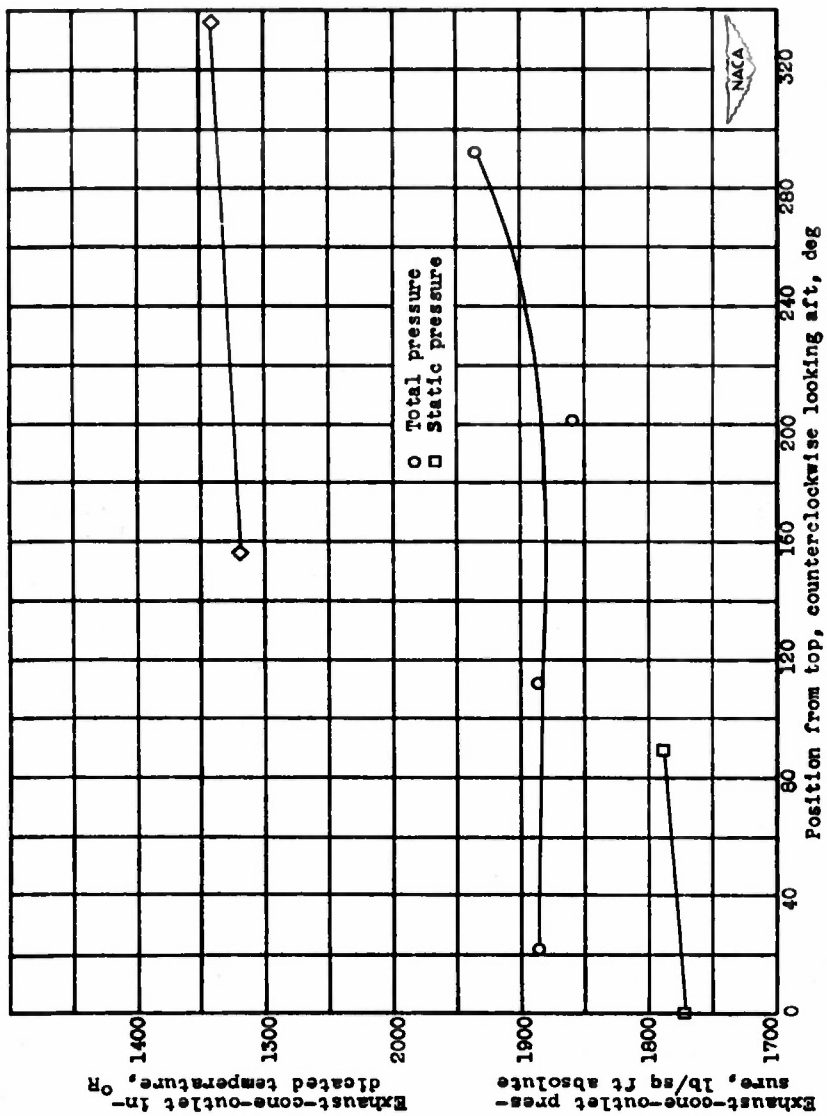
Figure 20. - Effect of shaft horsepower on distribution of total pressure and static pressure at turbine outlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00; engine speed, 13,000 rpm.



(a) Shaft horsepower, 425.

(b) Shaft horsepower, 951.

Figure 21. - Effect of shaft horsepower on distribution of indicated temperature at turbine outlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00; engine speed, 13,000 rpm.



(a) Shaft horsepower, 425.

Figure 22. - Effect of shaft horsepower on distribution of total pressure, static pressure, and indicated temperature at exhaust-cone outlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00; engine speed, 13,000 rpm.

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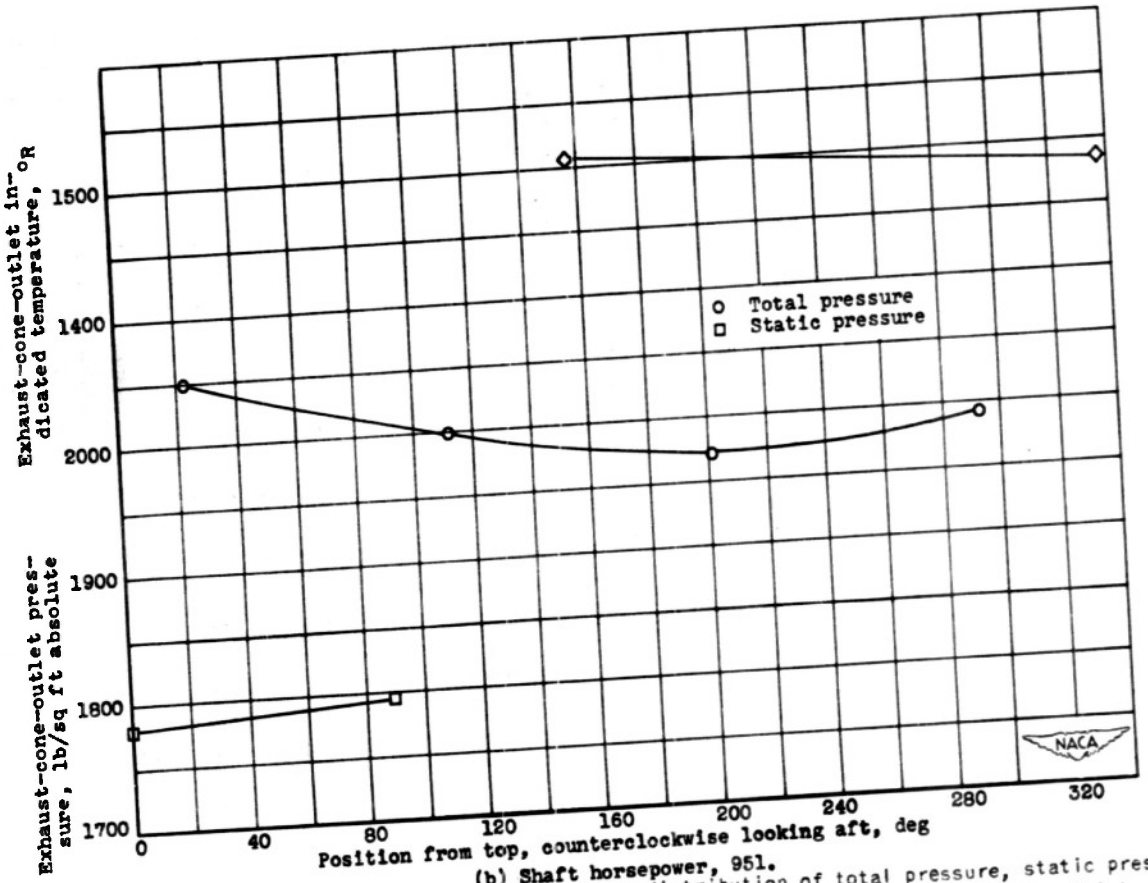

(b) Shaft horsepower, 951.

Figure 22. - Concluded. Effect of shaft horsepower on distribution of total pressure, static pressure, and indicated temperature at exhaust-cone outlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00; engine speed, 13,000 rpm.

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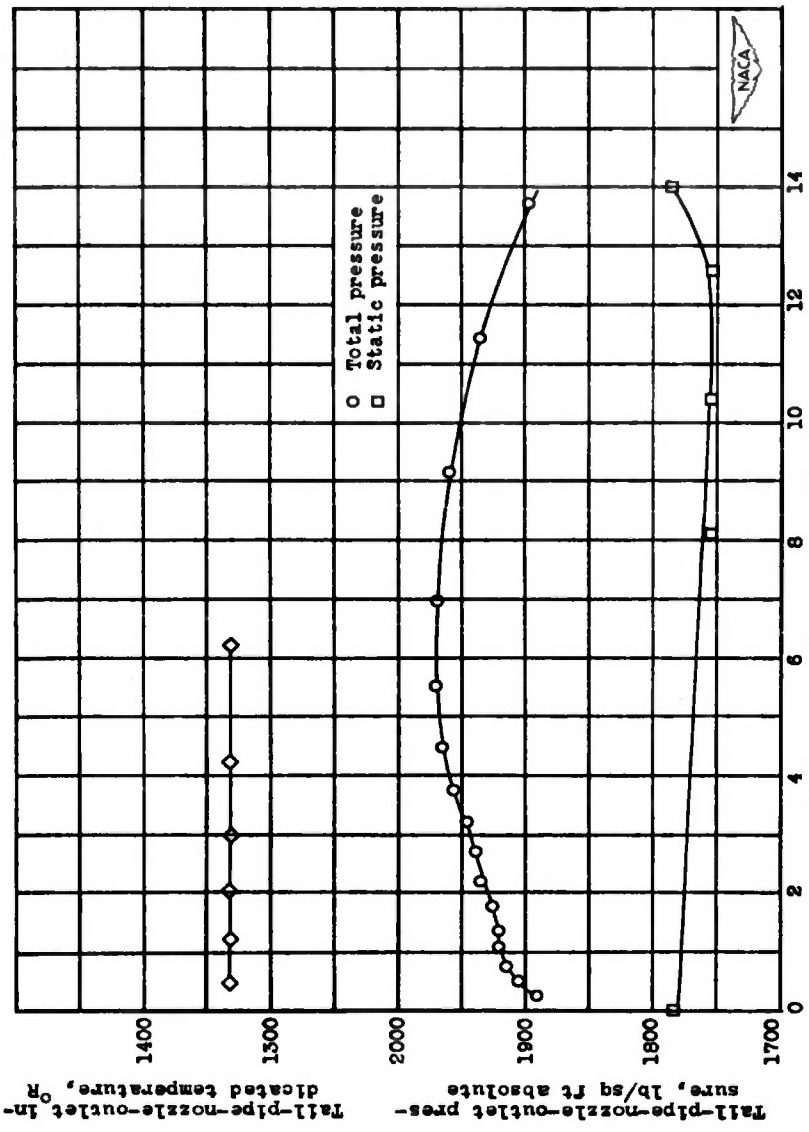
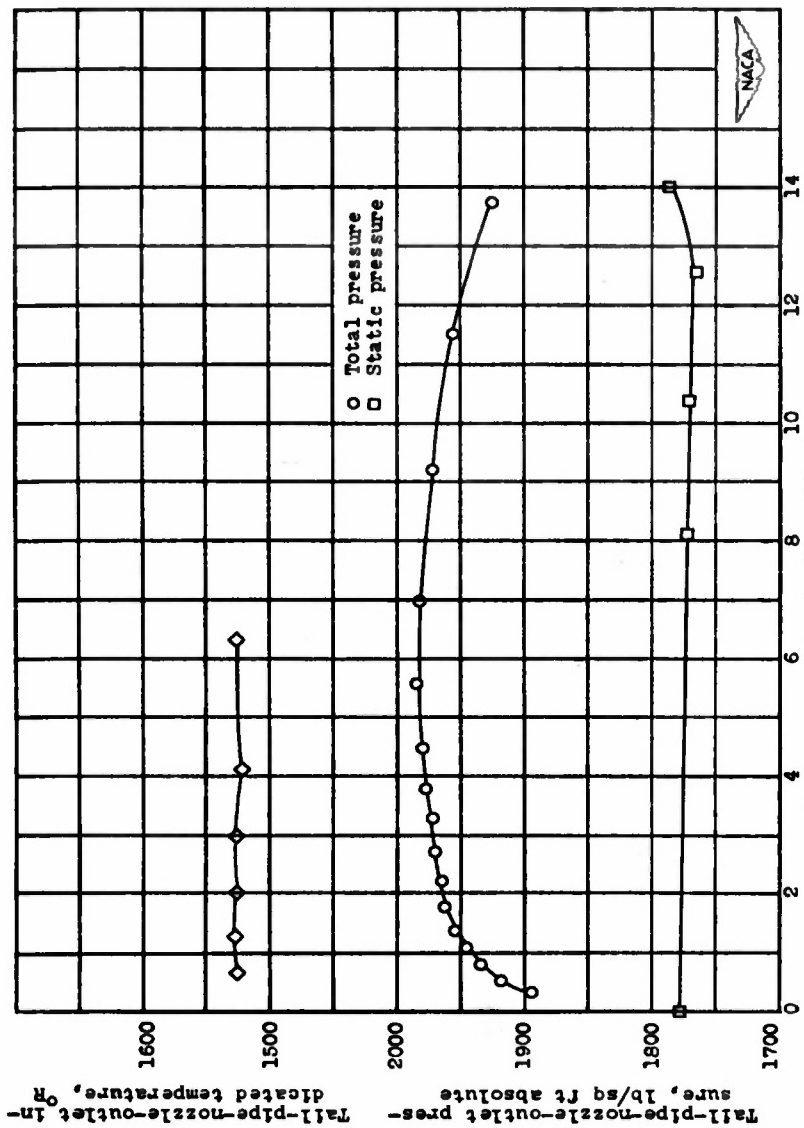


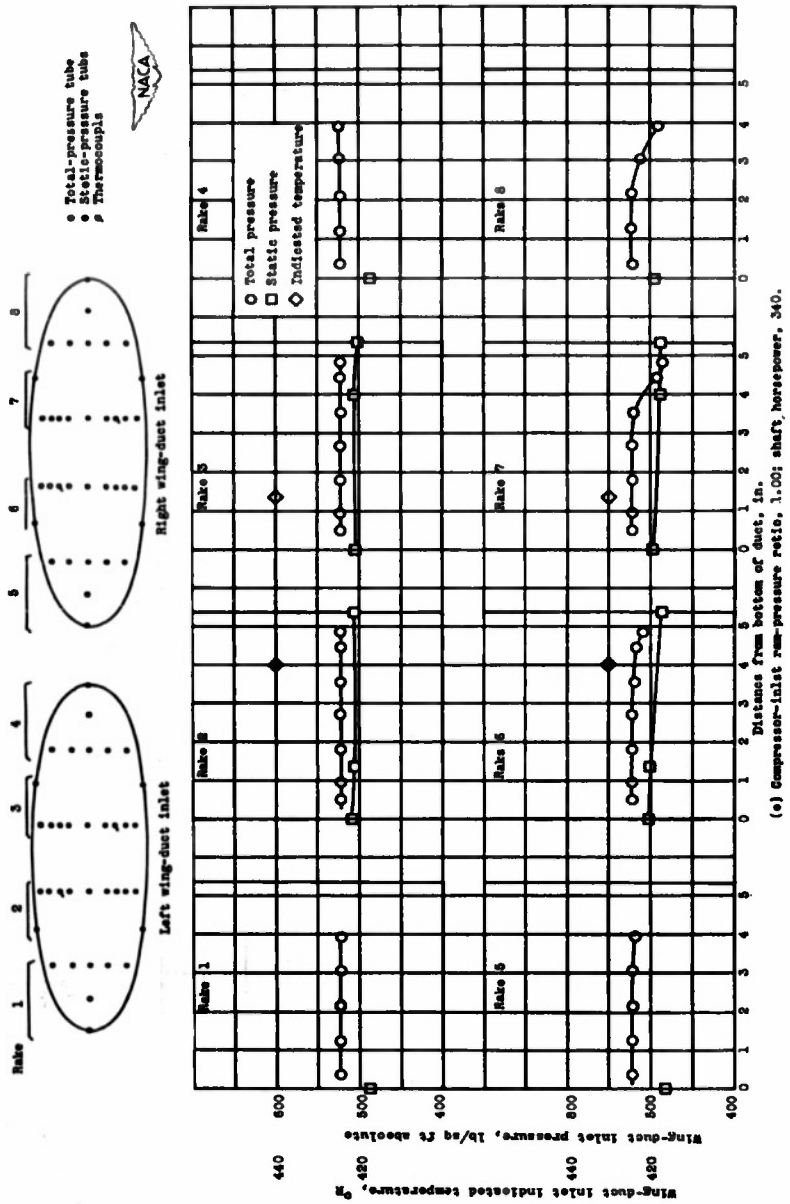
(a) Shaft horsepower, 425.

Figure 23. - Effect of shaft horsepower on distribution of total pressure, static pressure, and indicated temperature at tail-pipe-nozzle outlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00; engine speed, 13,000 rpm.



(b) Shaft horsepower, 951.

Figure 23. - Concluded. Effect of shaft horsepower on distribution of total pressure, static pressure, and indicated temperature at tail-pipe-nozzle outlet. Altitude, 5000 feet; compressor-inlet ram-pressure ratio, 1.00; engine speed, 13,000 rpm.



(e) Compressor-inlet ram-pressure ratio, 1.00; shaft horsepower, 340.

Figure 24. - Effect of compressor-inlet ram-pressure ratio on distribution of total pressure, static pressure, and indicated temperature at wing-duct inlets. Altitude, 35,000 feet; engine speed, 13,000 rpm.

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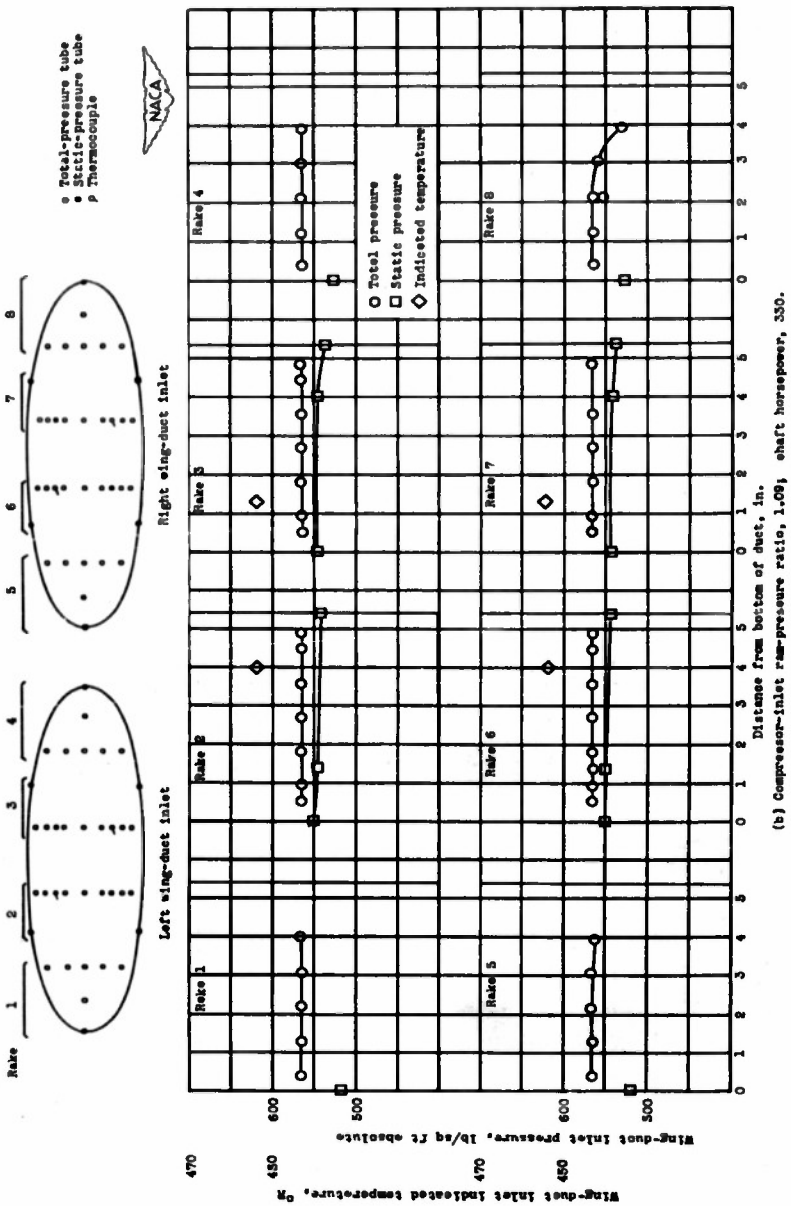
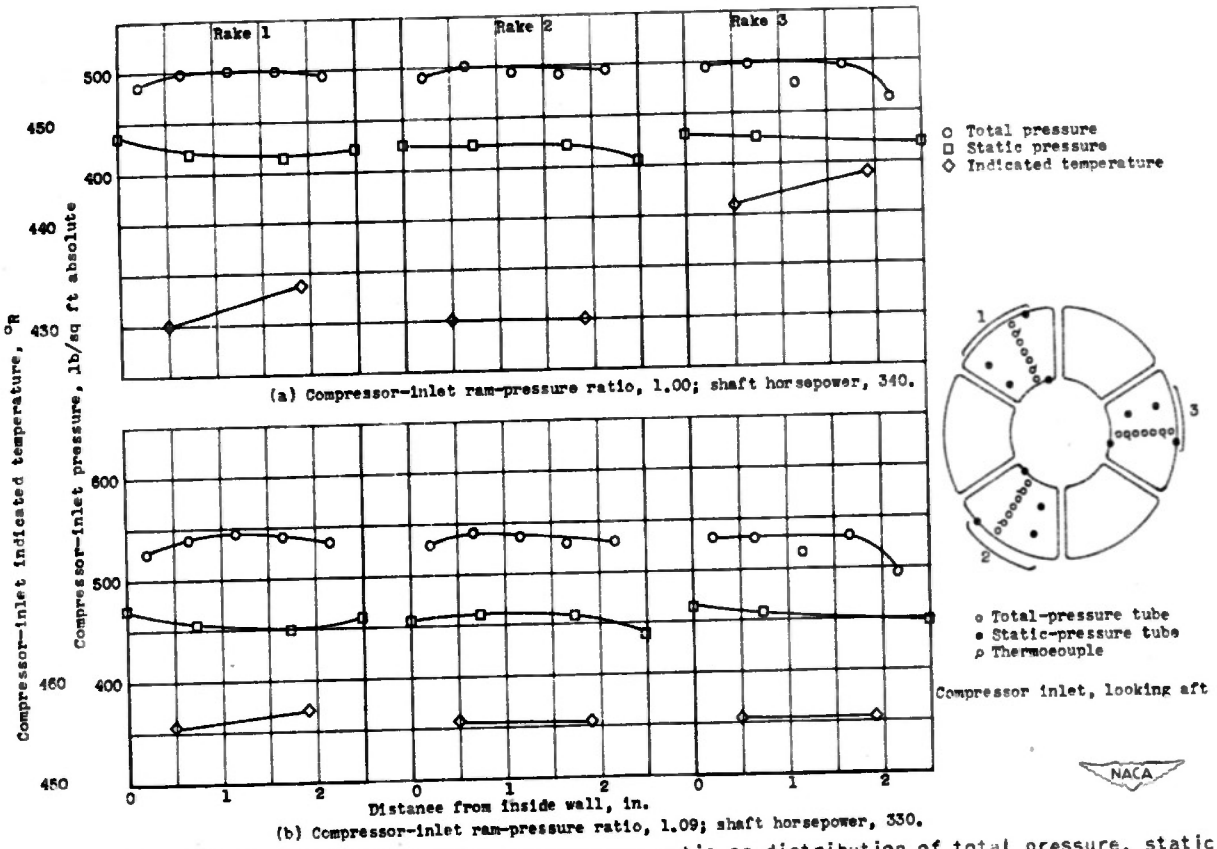


(b) Compressor-inlet ram-pressure ratio, 1.09; shaft horsepower, 330.

Figure 24. - Concluded. Effect of compressor-inlet ram-pressure ratio on distribution of total pressure, static pressure, and indicated temperature at wing-duct inlets. Altitude, 35,000 feet; engine speed, 13,000 rpm.



(a) Compressor-inlet ram-pressure ratio, 1.00; shaft horsepower, 340.

(b) Compressor-inlet ram-pressure ratio, 1.09; shaft horsepower, 330.

Figure 25. - Effect of compressor-inlet ram-pressure ratio on distribution of total pressure, static pressure, and indicated temperature at compressor inlet. Altitude, 35,000 feet; engine speed, 13,000 rpm.

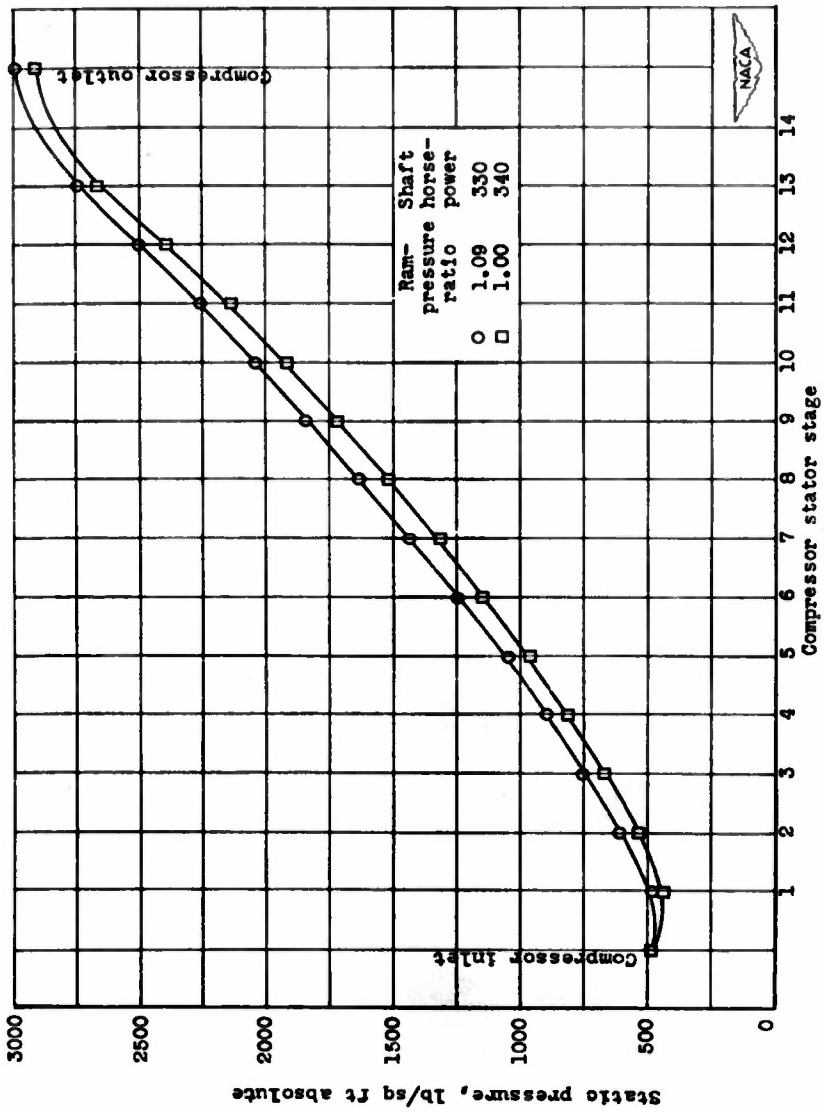
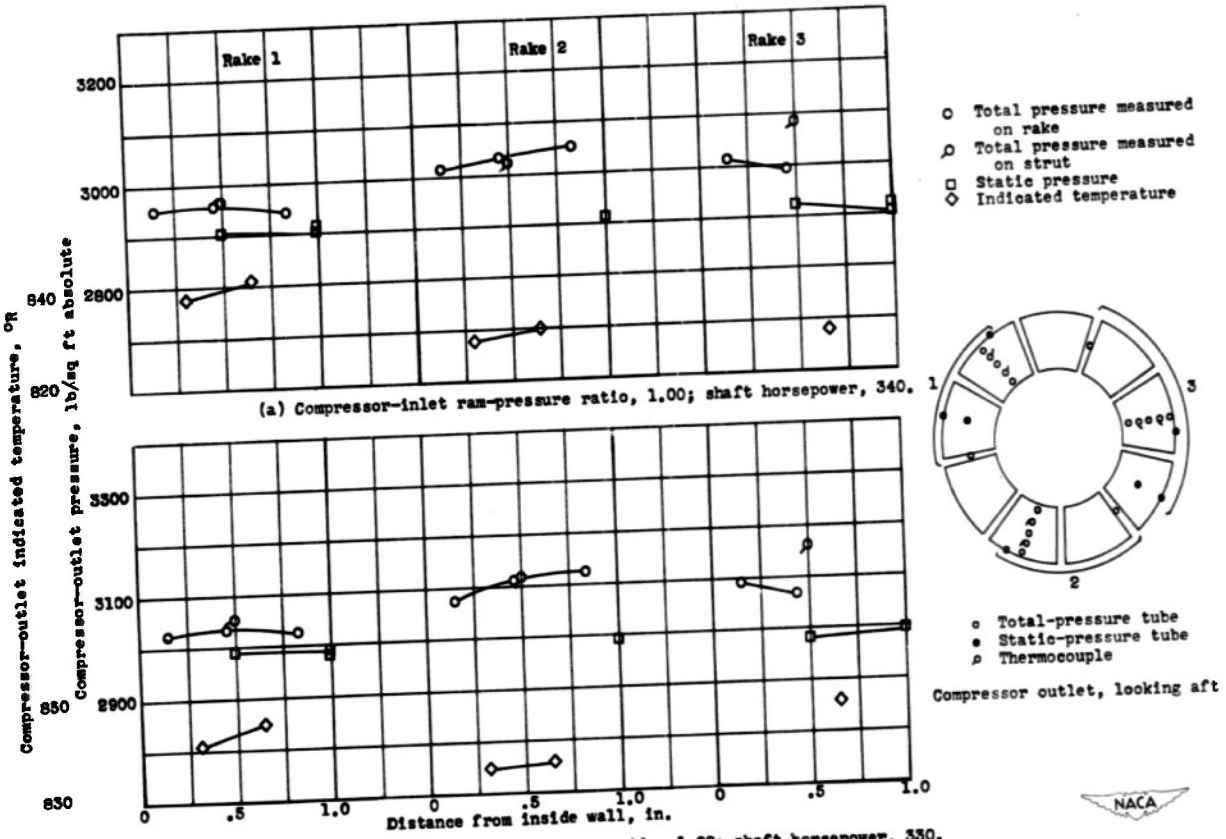


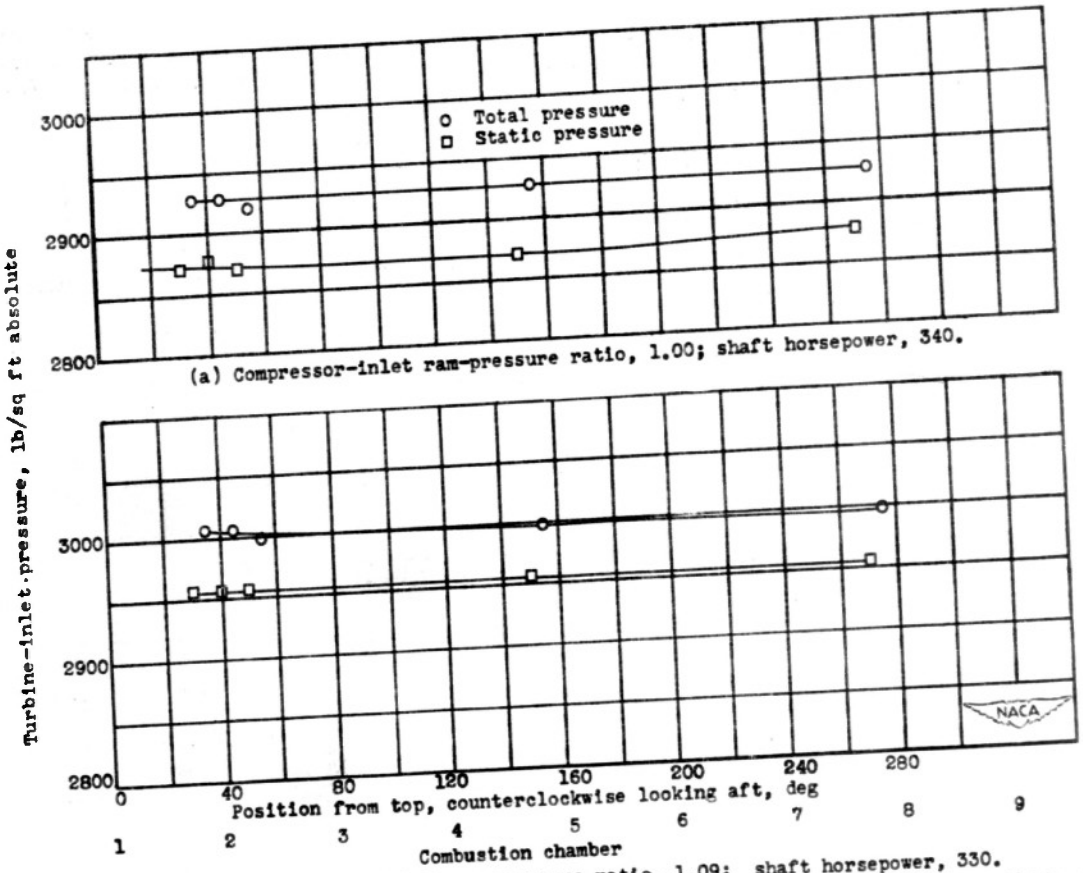
Figure 26. - Effect of compressor-inlet ram-pressure ratio on distribution of static pressure for each stage of compressor stator. Altitude, 35,000 feet; engine speed, 13,000 rpm.



(a) Compressor-inlet ram-pressure ratio, 1.00; shaft horsepower, 340.

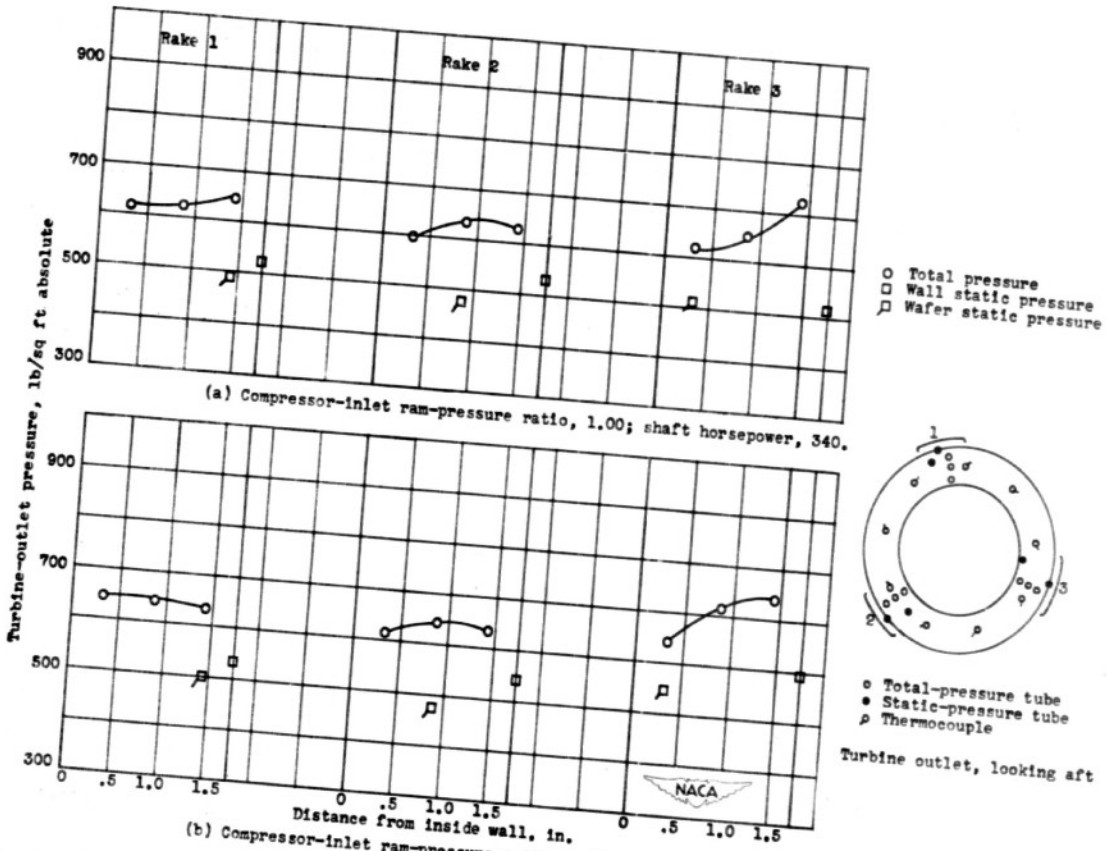
(b) Compressor-inlet ram-pressure ratio, 1.09; shaft horsepower, 330.

Figure 27. - Effect of compressor-inlet ram-pressure ratio on distribution of total pressure, static pressure, and indicated temperature at compressor outlet. Altitude, 35,000 feet; engine speed, 13,000 rpm.



(b) Compressor-inlet ram-pressure ratio, 1.09; shaft horsepower, 330.

Figure 28. - Effect of compressor-inlet ram-pressure ratio on distribution of total and static pressures at turbine inlet. Altitude, 35,000 feet; engine speed, 13,000 rpm.



(a) Compressor-inlet ram-pressure ratio, 1.00; shaft horsepower, 340.

(b) Compressor-inlet ram-pressure ratio, 1.09; shaft horsepower, 330.

Figure 29. - Effect of compressor-inlet ram-pressure ratio on distribution of total and static pressure at turbine outlet. Altitude, 35,000 feet; engine speed, 13,000 rpm.

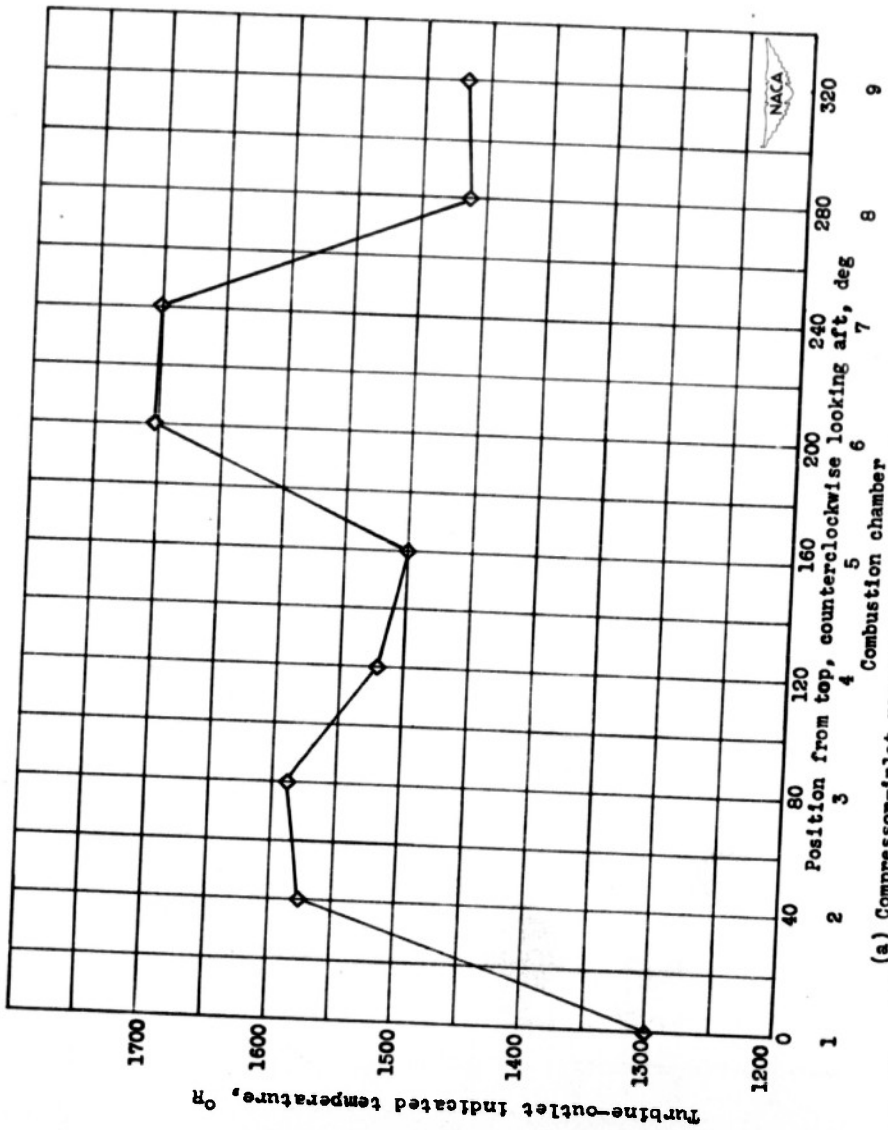
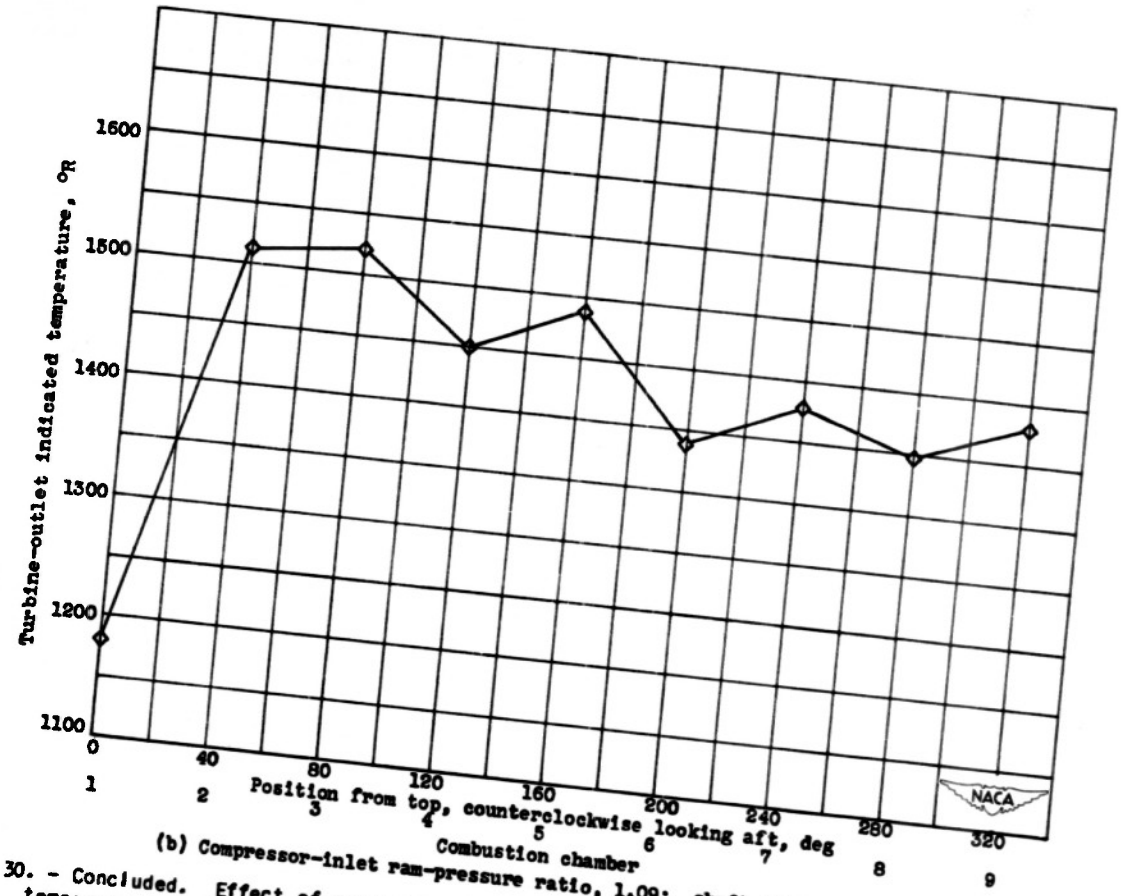
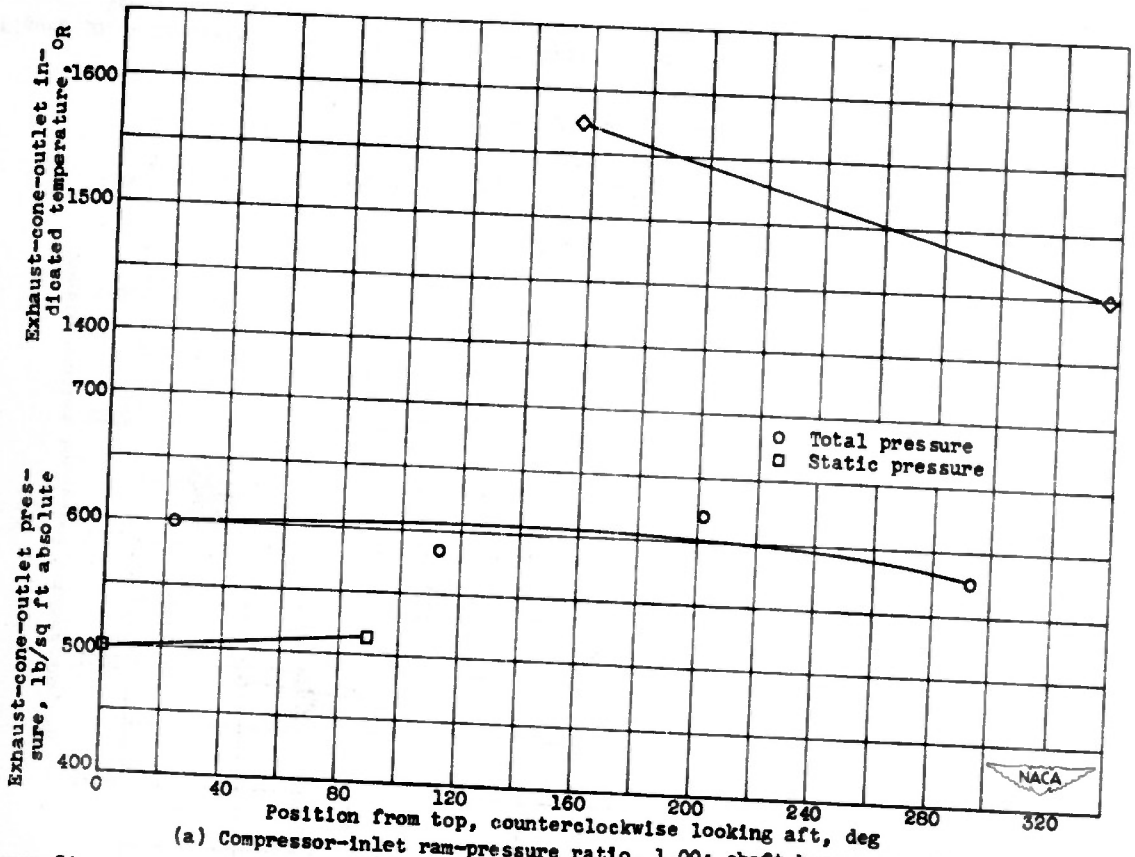


Figure 30. - Effect of compressor-inlet ram-pressure ratio, 1.00; shaft horsepower, 340. (a) Compressor-inlet ram-pressure ratio, 1.00; shaft horsepower, 340. at turbine outlet. Altitude, 35,000 feet; engine speed, 13,000 rpm.



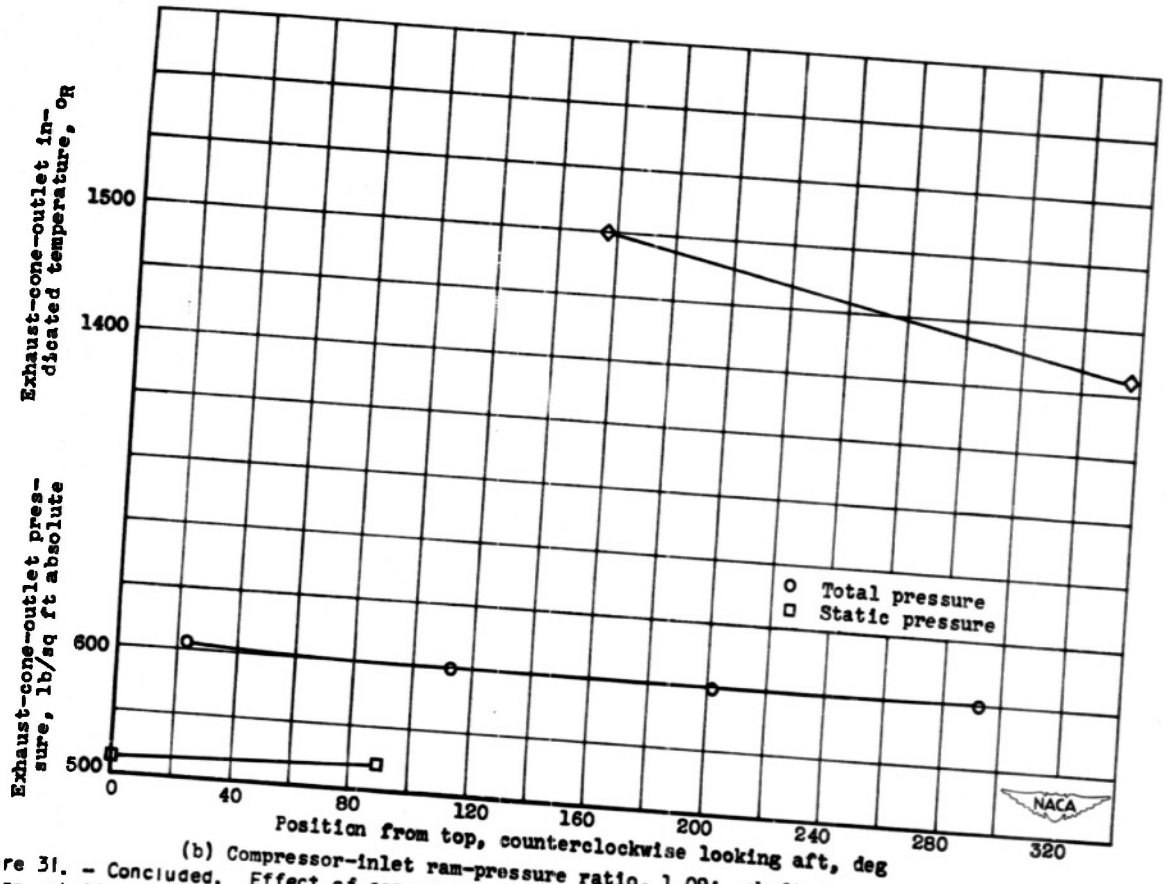
(b) Compressor-inlet ram-pressure ratio, 1.09; shaft horsepower, 330.

Figure 30. - Concluded. Effect of compressor-inlet ram-pressure ratio on distribution of indicated temperature at turbine outlet. Altitude, 35,000 feet; engine speed, 13,000 rpm.



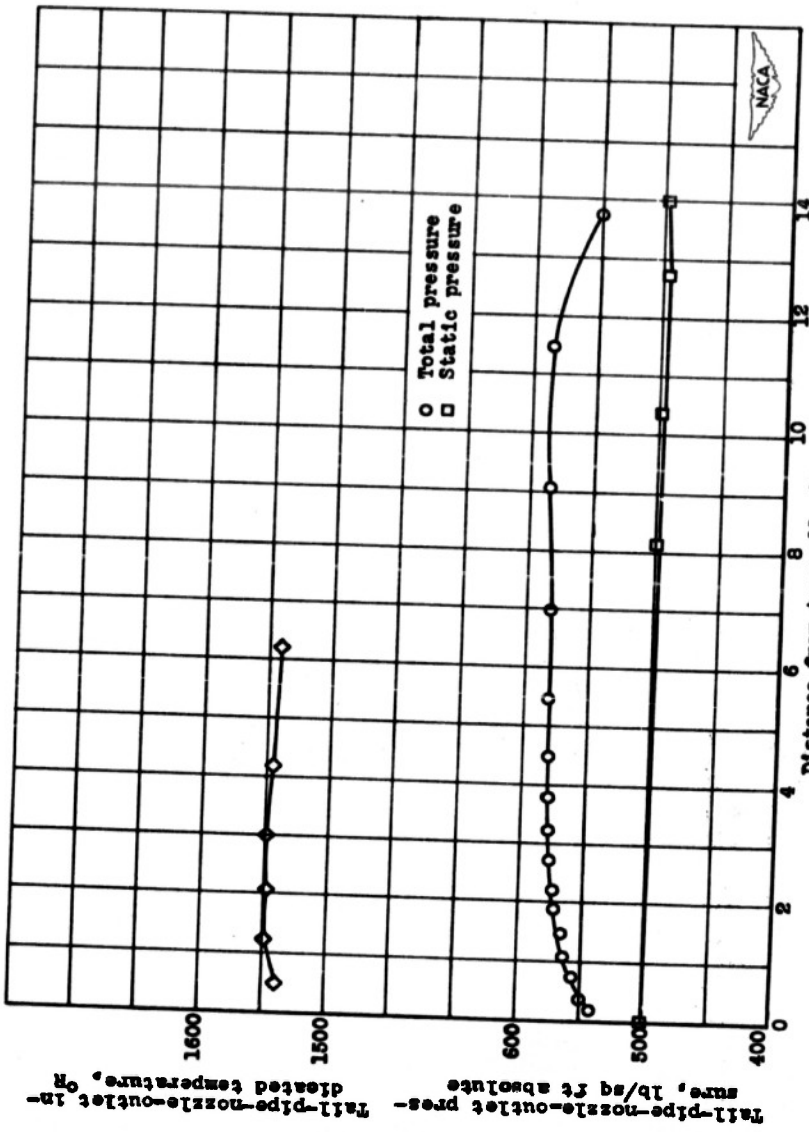
(a) Compressor-inlet ram-pressure ratio, 1.00; shaft horsepower, 340.

Figure 31. - Effect of compressor-inlet ram-pressure ratio on distribution of total pressure, static pressure, and indicated temperature at exhaust-cone outlet. Altitude, 35,000 feet; engine speed, 13,000 rpm.



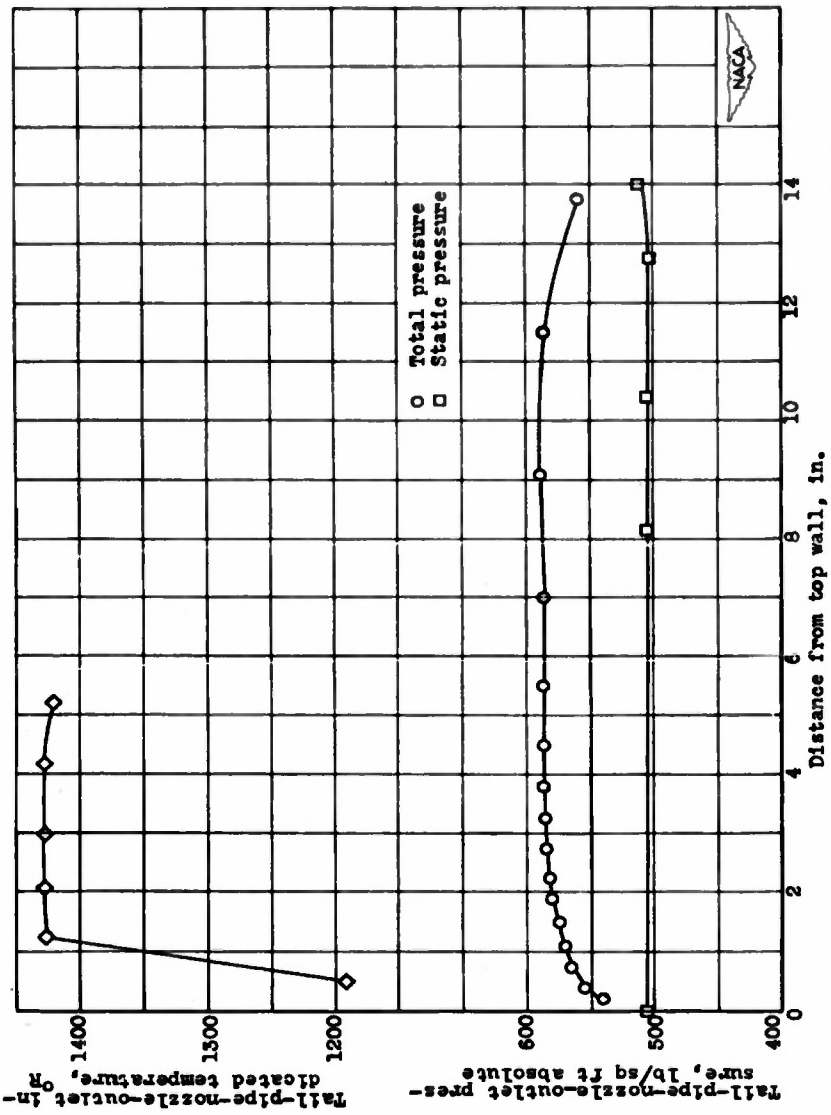
(b) Compressor-inlet ram-pressure ratio, 1.09; shaft horsepower, 330.

Figure 31. - Concluded. Effect of compressor-inlet ram-pressure ratio on distribution of total pressure, static pressure, and indicated temperature at exhaust-cone outlet. Altitude, 35,000 feet; engine speed, 13,000 rpm.



(a) Compressor-inlet ram-pressure ratio, 1.00; shaft horsepower, 340.

Figure 32. - Effect of compressor-inlet ram-pressure ratio on distribution of total pressure, static pressure, and indicated temperature at tail-pipe-nozzle outlet. Altitude, 35,000 feet; engine speed, 13,000 rpm.



(b) Compressor-inlet ram-pressure ratio, 1.09; shaft horsepower, 330.

Figure 32. - Concluded. Effect of compressor-inlet ram-pressure ratio on distribution of total pressure, static pressure, and indicated temperature at tail-pipe-nozzle outlet. Altitude, 35,000 feet; engine speed, 13,000 rpm.

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Propulsion - Complete Systems 3.1

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Compressors 3.6

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REVISION

[redacted]

Geisenheyner, R.
Berdysz, J. J.

AUTHOR(S)

DIVISION: Power Plants, Jet and Turbine (5)

SECTION: Performance (16)

CROSS REFERENCES: Propeller turbojets - Performance (75476.28)

AMER. TITLE: Preliminary results of an altitude-wind-tunnel investigation of a TG-100A gas turbine-propeller engine - III - Pressure and temperature distributions [redacted]

FORG'N. TITLE:

ORIGINATING AGENCY: National Advisory Committee for Aeronautics, Washington, D. C.

TRANSLATION:

COUNTRY	LANGUAGE	FORG'N.CLASS	U. S.CLASS.	DATE	PAGES	ILLUS.	FEATURES
U.S.	Eng.		[redacted]		76		photos, tables, graphs

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TSDIN FORM 69 A (19 Oct 47)

AUTHOR(S)		ORIG. AGENCY NUMBER
Geisenheyner, R. Berdysz, J. J.	DIVISION: Power Plants, Jet and Turbine (5) SECTION: Performance (16) CROSS REFERENCES: Propeller turbojets - Performance (75476.28)	ATI- 20138 RII E7J02 REVISION

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