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PRELIMINARY PERFORMANCE DATA FOR THE J57-P-1 TURBOJET ENGINE AT ALTITUDES UP TO 65,000 FEET

By Robert R. Miller and Harry E. Bloomer

Lewis Flight Propulsion Laboratory
Cleveland, Ohio

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS
WASHINGTON

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SUMMARY

An investigation to determine the high altitude performance (extending the range of ref. 1) of the J57-P-1 turbojet engine and components was conducted at the NACA Lewis altitude wind tunnel. Data were obtained over a corrected inboard rotor speed range from 106 to 79 percent of rated speed, with four modes of engine operation, at altitudes from 35,000 to 65,000 feet and at a flight Mach number of 0.81. The corresponding range of Reynolds number indices was from 0.437 to 0.107.

All engine and component parameters are presented as functions of corrected rotor speed except the data with the automatic engine control; these data are plotted against altitude.

INTRODUCTION

At the request of the Navy Department, Bureau of Aeronautics, an investigation of the J57-P-1 turbojet engine performance was made in the altitude wind tunnel at the NACA Lewis laboratory. Data obtained with a fixed-area exhaust nozzle up to an altitude of 50,000 feet are presented in reference 1; limitations of the test facility prevented operation at higher altitudes. By installing no-flow ejectors at the engine exhaust nozzle and bleed ports it was possible to extend the range of simulated altitudes to an altitude of 65,000 feet. The engine performance data for this extended altitude operation are presented herein.

Data were obtained with a fixed-area exhaust nozzle over a range of corrected inboard rotor speeds from 106 to 79 percent of rated speed at altitudes from 35,000 to 65,000 feet, at a flight Mach number of 0.81. The corresponding range of Reynolds number indices varied from 0.437 to 0.107.

[redacted]

All engine and component parameters are presented as functions of corrected rotor speed with the exception of the automatic control data and ideal jet thrust. Ideal jet thrust $F_{j,i}$ is plotted as a function of exhaust nozzle pressure drop parameter, $1.25\ P_9 - p_0$; and the automatic control data are presented to show the variation in performance parameters with changes in altitude.

At low rotor speeds, to avoid compressor surge during normal engine operation, a portion of the engine air flow is bled overboard.

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Four modes of engine operation were investigated, each over a range of engine speeds and altitudes. The modes are as follows:

(a) Engine operation with both the compressor bleed ports closed.

(b) Engine operation with the large compressor bleed port open.

(c) Engine operation with both compressor bleed ports open.

(d) Normal engine operation with the automatic control.

ENGINE INSTALLATION AND INSTRUMENTATION

Engine

A cross-sectional view of the J57-P-1 turbojet engine is shown in figure 1. The engine is equipped with two compressor bleeds, one large and one small, which bleed engine air from between the compressors at low rotor speeds to prevent surge. The bleeds operate in sequence according to a schedule based on outboard rotor speed and engine inlet temperature. For additional information concerning the engine, consult references 1 and 2.

Instrumentation

The location of the instrumentation stations is shown in the cross-sectional view of the engine, figure 1. In addition, a table is included indicating the amount of instrumentation at each station.

PROCEDURE

Performance data were obtained, at a flight Mach number of 0.81, at altitudes from 35,000 to 65,000 feet by the installation of no-secondary flow ejectors at the exhaust nozzle outlet and at the outlet of the compressor bleed ports. (See ref. 3 for details and performance of no-flow ejectors.) The no-flow ejectors made possible high altitude operation over an inboard rotor speed range of 7000 to 9500 rpm except where limited by compressor surge, over-temperature operation of the turbine, or minimum fuel flow (approximately 200 lb/hr, a minimum allowable setting of test facility fuel control throttle).

Data were obtained defining four modes of engine operation. With the automatic control in operation data were taken with engine throttle settings of "idle" and "maximum," and altitude was increased from 35,000 feet to the altitude at which compressor surge occurred, for each throttle setting.

For further details regarding PROCEDURE, see reference 1.

PRESENTATION OF RESULTS

The figures are grouped according to the dependent variable and an index to the figures is presented in table I. The figures are presented in the same order as in reference 1. In each figure group for a given dependent variable, four modes of engine operation are presented. The modes and corresponding figure parts are as follows:

(a) Engine operation with both the compressor bleed ports closed.

(b) Engine operation with the large compressor bleed port open.

(c) Engine operation with both compressor bleed ports open.

(d) Normal engine operation with the automatic control.

Dashed curves denote 15,000 foot performance data taken from reference 1, and are shown for all conditions for which 15,000 foot data were obtained. The break in the 15,000 foot line is the region of compressor surge at that altitude. All solid symbols represent either the upper or lower boundary of compressor surge as indicated in each particular figure key. Turbine outlet temperature limits, as indicated by the four manufacturer's probes, is denoted with cross marks near the high speed end of the figures.

Complete compressor surge and operational information for the four modes of engine operation described in this report can be found in reference 2.

A tabulation of the data is presented in table II.

Over-all engine performance is presented in figures 2 to 9. Compressor performance is presented in figures 10 to 16. Combustor performance is shown in figure 17 and turbine performance in figure 18.

The data presented herein show some effect of engine deterioration when compared to reference 1, and it should be pointed out that over 120 engine hours were logged between these sets of data. In addition a small difference in compressor bleed air flow exists and is attributed to a change in configuration of the bleed port exit ducting which was installed to facilitate this air flow measurement.

Lewis Flight Propulsion Laboratory
National Advisory Committee for Aeronautics
Cleveland, Ohio, October 29, 1954

APPENDIX - SYMBOLS

The following symbols are used in this report:

F_j jet thrust, lb

$F_{j,i}$ ideal jet thrust lb, calculated from pressure and temperatures at the exhaust nozzle inlet, lb

F_n net thrust, lb

g acceleration due to gravity, 32.2 ft/sec^2

M Mach number

N rotor speed, rpm

P total pressure, lb/sq ft

p static pressure, lb/sq ft

R gas constant, (ft-lb)/(lb $^{\circ}$R)

T total temperature, $^{\circ}$R

t static temperature, $^{\circ}$R

V velocity, ft/sec

W_a air flow, lb/sec

W_f fuel flow, lb/hr

W_g gas flow, lb/sec

γ ratio of specific heats

β function of γ, $\dfrac{\gamma^*}{\gamma_4} \dfrac{\left(\dfrac{\gamma_4 + 1}{2}\right)^{\frac{\gamma_4}{\gamma_4 - 1}}}{\left(\dfrac{\gamma^* + 1}{2}\right)^{\frac{\gamma^*}{\gamma^* - 1}}}$, where $\gamma^* = 1.4$

δ ratio of absolute total pressure in engine to absolute static pressure of NACA standard atmosphere at sea level

η efficiency

ρ density, slugs/cu ft

θ ratio of absolute total temperature in engine to absolute static temperature of NACA standard atmosphere at sea level

θ_{cr} $\theta_{cr} = \frac{\gamma_4 T_4}{\gamma_4 + 1} \cdot \frac{\gamma^* + 1}{T^* \gamma^*}$, where $\gamma^* = 1.4$, $T^* = 519^\circ$ R

φ ratio of absolute viscosity of air in engine to the absolute viscosity of air of NACA standard atmosphere at sea level

$\frac{\delta}{\varphi\sqrt{\theta}}$ Reynolds number index

Subscripts:

a air

b combustor

c compressor

cr critical

i ideal

in inboard

out outboard

t turbine

0 altitude test condition

1 outboard compressor inlet

2 inboard compressor inlet

3 inboard compressor discharge

4 inboard turbine inlet

5 outboard turbine inlet

6 outboard turbine discharge

9 exhaust nozzle inlet

REFERENCES

1. Bloomer, Harry E., and Miller, Robert R.: Preliminary Altitude Performance Characteristics of the J57-P-1 Turbojet Engine with Fixed-Area Exhaust Nozzle. NACA RM SE54D30, 1954.

2. Wallner, Lewis E., and Saari, Martin J.: Preliminary Altitude Operational Characteristics of a J57-P-1 Turbojet Engine. NACA RM SE54C31, 1954.

3. Greathouse, W. K., and Hollister, D. P.: Air-Flow and Thrust Characteristics of Several Cylindrical Cooling-Air Ejectors with a Primary to Secondary Temperature Ratio of 1.0. NACA RM E52L24, 1953

TABLE I. - FIGURE INDEX

Figure number	Dependent variable	Independent variable
1	Sectional view of the J57-P-1 turbojet engine	
	Over-all Engine Performance	
2	Corrected outboard rotor speed	Corrected inboard rotor speed[a]
3	Corrected air flow	Corrected outboard rotor speed
4	Corrected fuel flow	Corrected inboard rotor speed
5	Corrected exhaust gas total temperature	Corrected inboard rotor speed
6	Engine total pressure ratio	Corrected inboard rotor speed
7	Corrected net thrust	Corrected inboard rotor speed
8	Corrected specific fuel consumption	Corrected inboard rotor speed
9	Ideal jet thrust	Exhaust nozzle pressure drop parameter
	Outboard Compressor Performance	
3	Corrected air flow	Corrected outboard rotor speed
10	Compressor pressure ratio	Corrected outboard rotor speed
11	Compressor efficiency	Corrected outboard rotor speed
	Inboard Compressor Performance	
12	Corrected air flow	Corrected inboard rotor speed
13	Compressor pressure ratio	Corrected inboard rotor speed
14	Compressor efficiency	Corrected inboard rotor speed
	Over-all Compressor Performance	
15	Compressor pressure ratio	Corrected inboard rotor speed
16	Compressor efficiency	Corrected inboard rotor speed
	Combustor Performance	
17	Performance parameters	Corrected inboard rotor speed
	Over-all Turbine Performance	
18	Performance parameters	Corrected inboard rotor speed

[a]The "(d)" part of figures 2 to 19 has altitude as the independent variable (abscissa).

TABLE II. - PRELIMINARY ALTITUDE PERFORMANCE DATA OF THE J57-P-1 TURBOJET ENGINE

Run	Altitude, ft	Flight Mach number, M_0	Ambient static pressure, p_0, lb/sq ft abs	Equivalent ambient air temperature, t_0, °R	Engine inlet indicated temperature, T_1, °R	Reynolds number index, (station 1), $\delta_1/\varphi_1\sqrt{\theta_1}$	Reynolds number index, (station 2), $\delta_2/\varphi_2\sqrt{\theta_2}$	Outboard rotor speed: N_{out}, rpm	Outboard rotor speed: Adjusted, $N_{out}/\sqrt{\theta_a}$, rpm	Outboard rotor speed: Corrected, $N_{out}/\sqrt{\theta_1}$, rpm	Inboard rotor speed: N_{in}, rpm	Inboard rotor speed: Adjusted, $N_{in}/\sqrt{\theta_a}$	Inboard rotor speed: Corrected (station 1), $N_{in}/\sqrt{\theta_1}$	Inboard rotor speed: Corrected (station 2), $N_{in}/\sqrt{\theta_2}$
Engine operation with both the compressor bleed ports closed														
1	46,000	0.81	294	391	442	0.2683	0.6136	6176	6188	6695	9394	9413	10,183	8021
2				384	435	.2712	.6184	5994	6060	6545	9208	9309	10,055	7974
3				385	436	.2683	.6007	5745	5802	6268	9020	9110	9,841	7892
4				389	440	.2728	.5800	5485	5512	5957	8803	8847	9,560	7771
5				391	442	.2666	.5495	5285	5296	5729	8607	8624	9,330	7673
6				389	440	.2710	.5283	5091	5116	5529	8406	8448	9,129	7581
7				388	439	.2719	.5064	4868	4897	5292	8154	8203	8,863	7460
8	49,000	0.81	255	390	441	0.2310	0.5367	6101	6125	6620	9322	9359	10,114	7987
9				390	441	.2200	.5064	6102	6126	6621	9315	9352	10,106	7981
10				388	439	.2236	.5131	5939	5975	6456	9158	9213	9,955	7920
11				390	441	.2316	.4967	5515	5537	5984	8821	8856	9,571	7775
12				382	432	.2380	.4928	5335	5410	5847	8603	8723	9,429	7706
13				385	436	.2254	.4530	5133	5184	5600	8408	8492	9,173	7590
14				384	435	.2343	.4406	4936	4990	5390	8203	8293	8,958	7487
15	53,000	0.81	211	389	440	0.1996	0.4646	6041	6071	6560	9258	9304	10,054	7954
16				388	439	.1867	.4322	6013	6049	6536	9223	9278	10,025	7936
17				383	433	.1794	.4108	5793	5865	6340	9007	9124	9,863	7875
18				383	433	.1824	.3974	5557	5629	6085	8807	8921	9,644	7786
19				383	433	.1848	.3831	5356	5426	5865	8606	8718	9,424	7690
20				383	433	.1877	.3697	5167	5234	5658	8406	8515	9,205	7588
21	56,000	0.81	182	388	439	0.1716	0.3973	5961	5997	6480	9175	9230	9,973	7912
22				387	438	.1582	.3652	5875	5922	6398	9091	9164	9,900	7867
23	62,000	0.81	137	386	437	0.1387	0.3198	5870	5923	6398	9075	9157	9,892	7859
24				386	437	.1246	.2817	5725	5777	6240	8949	9030	9,754	7795
25				382	432	.1347	.3099	5704	5784	6252	8905	9030	9,760	7809
26				382	432	.1330	.2918	5500	5577	6028	8708	8830	9,544	7722
27				382	432	.1300	.2715	5356	5431	5870	8550	8670	9,371	7640
28				381	431	.1346	.2737	5263	5342	5774	8452	8579	9,272	7593
29	65,000	0.81	119	386	437	0.1117	0.2502	5665	5716	6175	8865	8945	9,663	7744
Engine operation with the large compressor bleed port open														
1	46,000	0.81	294	399	451	0.2612	0.5566	5930	5886	6363	9359	9289	10,042	8105
2				399	451	.2634	.5450	5641	5599	6053	9095	9027	9,759	7999
3				398	450	.2613	.5195	5321	5287	5715	8804	8749	9,455	7873
4				399	451	.2595	.4904	5026	4988	5393	8500	8436	9,121	7703
5				396	448	.2639	.4670	4763	4745	5125	8200	8169	8,823	7546
6				396	448	.2656	.4449	4489	4472	4830	7902	7872	8,503	7386
7				394	446	.2641	.4300	4315	4319	4656	7706	7714	8,315	7278
8				393	445	.2667	.4077	4059	4059	4384	7406	7406	7,998	7085
9				393	445	.2701	.3810	5705	5705	6161	7002	7002	7,562	6820
10	51,000	0.81	234	387	438	0.2078	0.4446	5825	5872	6343	9191	9265	10,009	8065
11				389	440	.2101	.4301	5498	5525	5971	8908	8953	9,694	7935
12				390	441	.2084	.3915	4998	5018	5423	8408	8442	9,123	7681
13				392	444	.2100	.3883	4973	4978	5376	8393	8401	9,073	7660
14				391	442	.2112	.3608	4624	4633	5012	8008	8024	8,681	7454
15				389	440	.2159	.3334	4177	4198	4536	7511	7549	8,156	7173
16				386	437	.2096	.2973	3780	3814	4120	7030	7093	7,663	6854
17	56,000	0.81	182	403	456	0.1516	0.7139	5644	5573	6022	9067	8953	9,674	7910
18				400	453	.1539	.3198	5643	5593	6044	9057	8977	9,700	7919
19				399	451	.1598	.3123	5234	5194	5616	8665	8599	9,298	7743
20				400	452	.1538	.2816	4895	4852	5243	8300	8227	8,889	7551
21				396	448	.1578	.2636	4480	4463	4820	7827	7796	8,422	7292
22				399	451	.1576	.2403	4120	4089	4421	7403	7347	7,943	7021

Run	Engine total pressure ratio, P_9/P_1	Engine total temperature ratio, T_9/T_1	Net thrust: F_n, lb	Net thrust: Adjusted, F_n/δ_a, lb	Net thrust: Corrected, F_n/δ_1, lb	Jet thrust: Ideal, $F_{j,i}$, lb	Jet thrust: F_j, lb	Jet thrust: Adjusted, F_j/δ_a, lb	Jet thrust: Corrected, F_j/δ_1, lb	Air flow, Outboard: $W_{a,out}$, lb/sec	Air flow, Outboard: Adjusted, $\frac{W_{a,out}\sqrt{\theta_a}}{\delta_a}$, lb/sec	Air flow, Outboard: Corrected, $\frac{W_{a,out}\sqrt{\theta_1}}{\delta_1}$, lb/sec
Engine operation with both the compressor bleed ports closed												
1	2.774	3.416	2197	3799	9999	3342	3258	5,633	14,827	43.41	74.93	182.32
2	2.683	3.290	2047	2798	9396	3156	3077	4,206	14,123	42.58	57.57	178.92
3	2.470	3.122	1796	2315	8315	2845	2774	3,576	12,844	40.33	51.46	171.12
4	2.189	2.889	1521	2041	6848	2504	2441	3,276	10,989	37.76	50.41	156.52
5	1.994	2.724	1247	1713	5711	2137	2084	2,863	9,545	34.32	47.05	145.00
6	1.771	2.573	1029	1420	4662	1853	1807	2,494	8,188	31.97	43.89	133.40
7	1.572	2.396	809	1116	3666	1567	1528	2,109	6,923	29.55	40.54	123.10
8	2.797	3.408	1841	2745	9763	2799	2729	4,069	14,472	36.43	54.10	175.07
9	2.776	3.426	1740	2641	9688	2662	2595	3,939	14,449	35.05	53.00	179.91
10	2.664	3.312	1673	1971	9218	2590	2525	2,982	13,913	35.03	41.13	177.50
11	2.233	2.955	1343	1630	7104	2194	2139	2,597	11,315	32.65	39.47	159.20
12	2.080	2.873	1176	1492	6206	1970	1921	2,438	10,137	30.82	38.56	148.40
13	1.878	2.667	932	1065	5135	1653	1612	1,843	8,882	28.08	31.79	141.80
14	1.653	2.524	779	942	4142	1457	1421	1,718	7,555	26.52	31.72	129.10
15	2.776	3.416	1583	1999	9737	2398	2338	2,953	14,381	30.99	38.95	175.53
16	2.748	3.419	1434	1846	9452	2191	2136	2,749	14,080	28.85	36.90	174.92
17	2.601	3.293	1242	1344	8673	1946	1897	2,053	13,247	27.09	28.93	172.80
18	2.321	3.109	1088	1184	7475	1760	1716	1,867	11,789	26.00	27.92	163.20
19	2.093	2.945	929	1005	6300	1555	1516	1,640	10,282	24.31	25.98	150.60
20	1.861	2.788	776	844	5180	1360	1326	1,443	8,851	22.77	24.45	138.80
21	2.719	3.415	1318	1480	9454	2001	1951	2,191	13,995	26.05	29.07	171.85
22	2.683	3.372	1149	1308	8971	1769	1725	1,963	13,469	23.73	26.79	170.19
23	2.696	3.439	1106	947	9874	1655	1614	1,382	14,410	20.92	17.75	171.38
24	2.568	3.378	881	754	8752	1358	1324	1,134	13,153	18.25	15.49	166.35
25	2.555	3.354	994	703	9266	1524	1486	1,044	13,852	20.37	14.11	173.20
26	2.326	3.190	829	607	7831	1310	1276	935	12,053	18.50	13.37	159.50
27	2.146	3.074	704	521	6802	1142	1113	824	10,754	16.93	12.36	149.30
28	2.022	2.986	693	510	6489	1129	1101	811	10,309	16.92	12.28	144.40
29	2.513	3.378	778	586	8620	1199	1169	880	12,953	16.08	12.00	163.53
Engine operation with the large compressor bleed port open												
1	2.442	3.344	1733	1967	7902	2811	2741	3,111	12,499	40.87	46.76	173.74
2	2.209	3.098	1463	1630	6614	2475	2413	2,688	10,909	38.50	43.24	162.24
3	1.950	2.840	1154	1286	5274	2081	2029	2,260	9,273	35.52	39.82	156.17
4	1.698	2.594	874	974	4012	1716	1673	1,864	7,679	32.38	36.36	138.55
5	1.452	2.391	626	702	2849	1393	1358	1,524	6,180	29.80	33.55	125.99
6	1.265	2.163	405	454	1831	1089	1062	1,192	4,801	26.74	30.11	112.31
7	1.143	2.031	274	306	1252	912	889	994	4,063	25.10	28.04	106.32
8	.9614	1.836	97	109	440	681	664	745	3,015	23.17	26.00	97.43
9	.7712	1.587	-108	-125	-484	389	379	437	1,699	19.88	22.92	82.72
10	2.472	3.406	1317	1557	7828	2132	2079	2,457	12,358	31.37	36.80	171.28
11	2.154	3.111	1091	1258	6377	1865	1818	2,096	10,626	29.87	34.26	160.76
12	1.692	2.687	687	796	4038	1347	1313	1,520	7,718	25.66	29.59	139.03
13	1.656	2.651	671	778	3879	1326	1293	1,369	7,475	25.44	26.92	136.03
14	1.358	2.367	415	483	2399	985	960	1,117	5,550	22.32	25.94	119.08
15	1.062	2.007	170	205	967	656	640	772	3,640	19.30	23.16	101.09
16	.8128	1.716	-69	-87	-408	323	315	398	1,882	15.81	19.83	85.75
17	2.282	3.268	892	529	6914	1488	1451	860	11,247	22.54	13.54	163.75
18	2.244	3.285	900	688	6926	1503	1465	1,120	11,273	22.88	17.65	164.48
19	1.887	2.940	696	656	5186	1254	1223	1,153	9,113	21.36	20.30	148.37
20	1.613	2.666	442	423	3414	901	878	841	6,781	17.67	17.08	127.35
21	1.259	2.328	248	220	1888	653	637	566	4,849	15.84	14.12	112.02
22	.9964	2.038	78	76	589	411	401	388	3,030	13.10	12.78	92.29

[redacted]

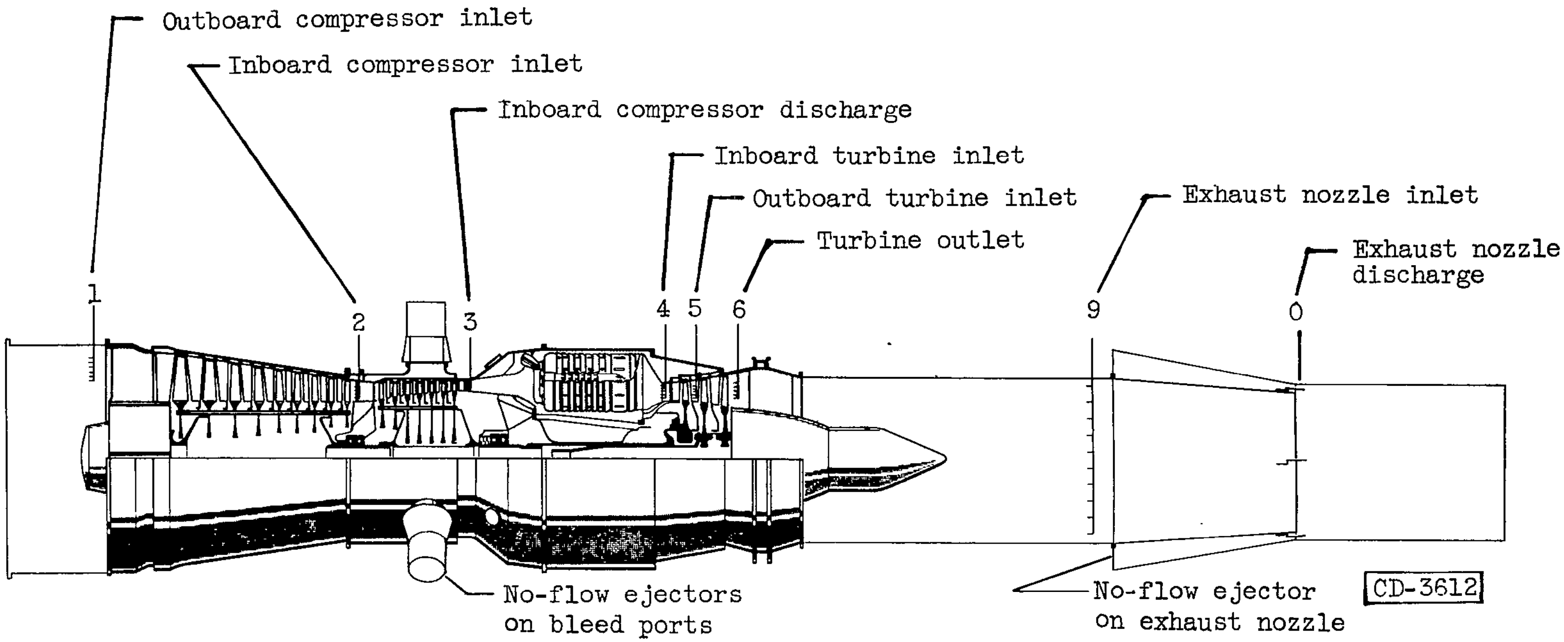
Run	Altitude	Flight Mach number, M_0	Ambient static pressure, p_0, lb/sq ft abs	Equivalent ambient air temperature, t_0, °R	Engine inlet indicated temperature, T_1, °R	Reynolds number index (station 1), $\delta_1/\phi_1\sqrt{\theta_1}$	Reynolds number index (station 2), $\delta_2/\phi_2\sqrt{\theta_2}$	Outboard rotor speed: N_{out}, rpm	Outboard rotor speed: Adjusted, $N_{out}/\sqrt{\theta_a}$, rpm	Outboard rotor speed: Corrected, $N_{out}/\sqrt{\theta_1}$, rpm	Inboard rotor speed: N_{in}	Inboard rotor speed: Adjusted, $N_{in}/\sqrt{\theta_a}$	Inboard rotor speed: Corrected (station 1), $N_{in}/\sqrt{\theta_1}$	Inboard rotor speed: Corrected (station 2), $N_{in}/\sqrt{\theta_2}$	Engine total pressure ratio, P_9/P_1	Engine total temperature ratio, T_9/T_1	Net thrust: F_n, lb	Net thrust: Adjusted, F_n/δ_a, lb	Net thrust: Corrected, F_n/δ_1, lb	Jet thrust: Ideal, $F_{j,i}$, lb	Jet thrust: F_j, lb	Jet thrust: Adjusted, F_j/δ_a, lb	Jet thrust: Corrected, F_j/δ_1, lb	Air flow, outboard: $W_{a,out}$, lb/sec	Air flow, outboard: Adjusted, $W_{a,out}\sqrt{\theta_a}/\delta_a$, lb/sec	Air flow, outboard: Corrected, $W_{a,out}\sqrt{\theta_1}/\delta_1$, lb/sec
23	62,000	0.81	137	393	445	0.1070	0.2472	5535	5535	5978	8893	8893	9,604	7869	2.210	3.328	691	504	6833	1171	1118	815	11,055	17.43	12.70	159.59
24				384	435	.1260	.2632	5463	5523	5966	8800	8897	9,610	7858	2.257	3.313	702	546	6941	1163	1134	883	11,213	17.84	13.74	161.49
25				387	438	.1220	.2418	5213	5255	5677	8554	8622	9,315	7727	1.957	3.091	536	403	5424	946	922	694	9,331	15.88	11.86	147.62
26				385	436	.1244	.2354	5062	5113	5523	8396	8480	9,160	7651	1.788	2.961	463	341	4621	849	828	610	8,264	15.07	10.99	137.86
27				386	437	.1247	.2249	4879	4923	5318	8195	8269	8,933	7541	1.601	2.796	374	273	3715	731	713	520	7,083	13.98	10.10	127.43
28				387	438	.1307	.2138	4560	4592	4966	7835	7890	8,532	7318	1.326	2.532	256	187	2418	574	560	408	5,290	12.50	9.05	108.46
Engine operation with both compressor bleed ports open																										
1	46,000	0.81	294	390	441	0.2628	0.5532	5966	5990	6473	9390	9428	10,188	8180	2.489	3.476	1694	2175	7896	2737	2669	3,427	12,440	40.00	51.16	171.88
2				391	442	.2637	.5325	5534	5545	5999	8996	9014	9,752	8014	2.123	3.063	1338	1741	6195	2321	2263	2,944	10,478	37.90	49.19	161.95
3				390	441	.2657	.4967	5027	5047	5454	8505	8539	9,228	7775	1.706	2.653	856	1124	3946	1688	1646	2,161	7,588	32.40	42.38	137.67
4				389	440	.2670	.4524	4551	4574	4942	7995	8035	8,683	7492	1.326	2.259	456	599	2098	1162	1133	1,488	5,212	27.80	36.31	117.76
5				389	440	.2681	.4161	4128	4149	4483	7506	7544	8,152	7207	1.024	1.889	143	189	655	746	727	963	3,330	24.00	31.61	101.21
6				387	438	.2673	.3814	3704	3734	4034	6997	7053	7,620	6860	.7860	1.612	-120	-155	-554	380	371	478	1,714	20.20	25.84	85.73
7	51,000	0.81	234	390	441	0.2061	0.4345	5814	5837	6308	9210	9247	9,993	8082	2.416	3.404	1284	1330	7632	2103	2050	2,124	12,185	31.39	32.39	171.99
8				389	440	.2101	.4194	5486	5463	5958	8909	8954	9,675	7942	2.105	3.116	1030	1039	6020	1780	1736	1,752	10,147	29.00	29.12	156.08
9				390	441	.2125	.3887	4974	4994	5397	8405	8439	9,119	7696	1.657	2.678	654	663	5771	1298	1266	1,282	7,300	25.11	25.34	133.46
10				386	437	.2207	.3566	4498	4538	4903	7894	7965	8,604	7404	1.279	2.300	344	337	1931	873	851	833	4,777	20.89	20.27	107.58
11				390	441	.2125	.2613	4068	4084	4414	7400	7430	8,029	7111	.9619	1.934	80	81	461	526	513	522	2,958	17.75	18.00	94.34
12				389	440	.2130	.3068	3816	3835	4144	7101	7137	7,712	6917	.8420	1.750	27	28	156	371	362	378	2,087	15.97	16.61	84.78
13	56,000	0.81	182	384	435	0.1708	0.3483	5708	5771	6233	9067	9167	9,901	8022	2.314	3.434	1024	836	7472	1673	1631	1,331	11,901	25.07	20.24	167.47
14				388	439	.1648	.3200	5296	5328	5757	8707	8759	9,465	7847	1.968	3.057	710	593	5309	1261	1229	1,036	9,189	21.34	17.71	146.76
15				389	440	.1619	.2916	4916	4941	5339	8306	8348	9,020	7624	1.624	2.736	467	388	3542	937	914	760	6,932	18.35	15.17	128.14
16				390	441	.1632	.2684	4549	4567	4936	7899	7931	8,570	7390	1.280	2.417	269	237	2019	680	663	583	4,975	16.17	14.16	111.85
17				390	441	.1656	.2488	4191	4208	4547	7502	7532	8,140	7146	1.052	2.118	117	108	866	475	463	426	3,426	14.20	13.00	96.84
18	62,000	0.81	137	388	439	0.1298	0.2652	5607	5641	6095	8965	9019	9,745	7938	2.242	3.433	744	520	7060	1218	1188	830	11,273	18.36	12.69	159.36
19				386	437	.1247	.2513	5396	5445	5882	8755	8834	9,543	7847	2.103	3.259	617	454	6129	1052	1026	756	10,192	16.48	12.29	153.50
20				388	439	.1240	.2397	5180	5211	5631	8549	8600	9,293	7728	1.883	3.077	510	346	5066	915	892	605	8,861	15.70	10.58	143.44
21				389	440	.1294	.2266	4818	4842	5232	8162	8203	8,864	7522	1.516	2.750	356	246	3378	713	695	481	6,595	13.91	9.58	121.53
22				386	437	.1294	.2194	4641	4683	5059	7944	8015	8,659	7425	1.371	2.616	270	199	2585	594	579	426	5,545	12.75	9.31	112.02
23	65,000	0.81	119	397	449	0.1057	0.2095	5453	5425	5862	8822	8777	9,484	7800	2.086	3.323	525	349	5943	889	867	576	9,814	13.91	9.29	146.47
24				395	447	.1110	.2191	5338	5324	5749	8714	8691	9,385	7762	1.938	3.425	533	354	5783	902	879	584	9,537	14.08	9.39	141.79
25				389	440	.1022	.1994	5262	5288	5715	8599	8642	9,339	7731	1.972	3.218	423	278	5084	750	731	481	8,787	12.63	8.26	139.81
26				393	445	.1064	.2019	5235	5235	5654	8599	8599	9,287	7714	1.855	3.166	450	299	5121	799	779	518	8,865	13.44	8.93	141.66
27				392	444	.1108	.2057	5141	5146	5557	8502	8511	9,191	7668	1.782	3.074	442	283	4844	795	775	496	8,494	13.63	8.71	138.21
28				388	439	.1066	.2010	5156	5187	5605	8490	8541	9,229	7682	1.842	3.125	401	262	4636	724	706	462	8,161	12.53	8.14	133.19
29				391	442	.1096	.2015	4959	5066	5481	8406	8423	9,112	7623	1.721	3.025	380	248	4233	706	688	450	7,664	12.80	8.22	129.53
30				391	440	.1084	.1952	5262	4969	5376	8297	8314	8,994	7567	1.660	2.939	338	221	3806	644	628	411	7,071	11.88	7.75	123.43
Normal engine operation with the automatic control																										
1	35,000	0.81	498	401	454	0.4360	0.9687	6047	5986	6464	9338	9244	9,982	7967	2.534	3.148	1698	7630	8634	5010	4885	11,695	13,232	68.64	165.97	173.94
2				398	450	.4390	.6689	4112	4086	4416	7561	7513	8,121	7196	.9743	1.764	979	294	362	1141	1112	2,461	3,025	39.74	88.46	100.86
3	40,000	0.81	392	400	453	0.3420	0.7604	6045	5992	6474	9325	9243	9,987	7962	2.561	3.199	2497	5124	8647	3906	3808	7,814	13,187	53.06	109.83	171.85
4				396	448	.3496	.5503	4284	4268	4610	7747	7718	8,519	7393	2.096	1.949	273	525	938	1092	1065	2,047	3,658	32.22	62.18	102.81
5	45,000	0.81	308	400	453	0.2665	0.5927	6027	5974	6455	9308	9226	9,969	7947	2.582	3.265	1970	3298	8757	3063	2986	4,999	13,273	41.16	69.52	170.94
6				395	447	.2732	.4400	4468	4456	4812	7910	7889	8,519	7393	1.225	2.152	354	535	1560	1033	1007	1,521	4,439	26.59	67.03	108.78
7	50,000	0.81	243	400	453	0.2110	0.4677	6029	5976	6457	9305	9223	9,966	7939	2.594	3.320	1561	2156	8762	2413	2353	3,249	13,207	32.07	44.67	168.18
8				396	448	.2151	.3606	4673	4655	5028	8105	8074	8,721	7500	1.369	2.382	421	525	2350	1007	982	1,224	5,483	22.84	28.57	118.47
9	52,000	0.81	221	398	450	0.1941	0.4181	5974	5936	6416	9256	9198	9,941	7908	2.529	3.358	1400	1852	8611	2165	2111	2,793	12,985	28.85	38.40	165.25
10	53,000	0.81	211	395	447	0.1884	0.3312	4890	4877	5267	8181	8160	8,811	7432	1.517	2.508	553	638	3535	1091	1064	1,227	6,802	20.83	24.08	123.58
11	55,000	0.81	192	400	452	0.1678	0.3590	5875	5823	6292	9147	9067	9,796	7837	2.448	3.294	1156	1314	8181	1803	1758	1,999	12,441	24.39	27.98	161.07
12				394	446	.1695	.3022	4992	4986	5386	8260	8269	8,934	7474	1.616	2.639	541	590	3855	1021	995	1,086	7,089	18.54	20.25	122.46
13	56,000	0.81	182	392	444	0.1613	0.3453	5845	5851	6318	9132	9141	9,872	7885	2.459	3.340	1104	1203	8313	1717	1674	1,825	12,605	23.33	25.41	162.47
14				396	448	.1595	.3447	5723	5701	6156	9048	9014	9,736	7847	2.395	3.228	1003	1086	7553	1582	1542	1,670	11,611	21.92	23.83	153.35
15				393	445	.1631	.2915	5041	5041	5444	8327	8327	8,993	7504	1.628	2.701	541	563	4017	1004	979	1,018	7,269	17.90	18.62	123.08
16	57,000	0.81	174	393	445	0.1528	0.3314	5730	5730	6188	9050	9050	9,774	7866	2.438	3.310	1014	1032	8036	1586	1546	1,574	12,252	21.73	22.13	159.48
17				392	444	.1509	.2761	5116	5121	5530	8395	8403	9,075	7548	1.711	2.795	525	522	4224	956	932	927	7,499	16.66	16.55	123.98

[redacted]

TABLE II. - Concluded. PRELIMINARY ALTITUDE PERFORMANCE DATA OF THE J57-P-1 TURBOJET ENGINE

Run	Air flow			Fuel flow			Specific fuel consumption			Exhaust-gas total temperature			Compressor pressure ratio			Compressor efficiency			Combined turbine pressure ratio, P_4/P_6	Combined turbine efficiency, η_t	Turbine corrected gas flow, $\frac{W_{g,t}\sqrt{\theta_{4cr}}\,\beta}{\delta_4}$, lb/sec	Thrust meter parameter, $(1.25\ P_9-P_0)$	Combustor pressure drop, $\frac{P_3-P_4}{P_3}$	Combustion efficiency, η_b
	Bleed, $W_{a,bleed}$, lb/sec	Inboard $W_{a,in}$, lb/sec	Inboard Corrected (station 2), $\frac{W_{a,in}\sqrt{\theta_2}}{\delta_2}$, lb/sec	W_f, lb/hr	Adjusted, $\frac{W_f}{\delta_a\sqrt{\theta_a}}$, lb/hr	Corrected, $\frac{W_f}{\delta_1\sqrt{\theta_1}}$, lb/hr	W_f/F_n, $\frac{lb/hr}{lb\ thrust}$	Adjusted, $\frac{W_f}{F_n\sqrt{\theta_a}}$, $\frac{lb/hr}{lb\ thrust}$	Corrected, $\frac{W_f}{F_n\sqrt{\theta_1}}$, $\frac{lb/hr}{lb\ thrust}$	T_9, °R	Adjusted, T_9/θ_a, °R	Corrected, T_9/θ_1, °R	Outboard, P_2/P_1	Inboard, P_3/P_2	Combined, P_3/P_1	Outboard, $\eta_{c,out}$	Inboard, $\eta_{c,in}$	Combined, $\eta_{c,comb}$						
Engine operation with both the compressor bleed ports closed																								
1	0	43.41	56.13	2320	4018	11,446	1.056	1.058	1.145	1510	1518	1774	4.123	3.331	13.73	0.8136	0.8413	0.7967	4.495	0.8409	31.04	1319	0.0567	0.9786
2		42.58	55.78	2108	2913	10,566	1.030	1.041	1.125	1431	1464	1706	4.048	3.263	13.21	.8336	.8327	.8026	4.460	.8545	31.11	1252	.0573	.9769
3		40.33	55.17	1812	2359	9,154	1.009	1.019	1.101	1361	1390	1620	3.869	3.166	12.25	.8503	.8384	.8189	4.475	.8418	31.22	1117	.0581	.9958
4		37.76	54.22	1526	2059	7,460	1.003	1.008	1.089	1271	1284	1499	3.553	3.050	10.84	.8490	.8434	.8236	4.479	.8446	31.02	992	.0571	.9905
5		34.32	52.75	1300	1790	6,453	1.042	1.044	1.130	1204	1210	1415	3.342	2.948	9.851	.8636	.8423	.8293	4.491	.8369	30.60	857	.0547	.9596
6		31.97	52.02	1090	1512	5,365	1.059	1.064	1.151	1132	1143	1335	3.090	2.865	8.852	.8431	.8428	.8197	4.490	.8421	30.84	740	.0670	.9556
7		29.55	51.15	889	1234	4,377	1.099	1.106	1.194	1052	1066	1243	2.861	2.722	7.788	.8502	.8336	.8213	4.499	.8293	30.74	624	.0550	.9618
8	0	36.43	54.13	1972	2952	11,348	1.071	1.075	1.162	1503	1515	1769	4.165	3.313	13.80	0.8326	0.8374	0.8065	4.470	0.8391	30.16	1140	0.0574	0.9648
9		35.05	55.17	1888	2877	11,403	1.085	1.089	1.177	1511	1523	1778	4.126	3.322	13.71	.8263	.8368	.8013	4.478	.8343	30.73	1064	.0578	.9787
10		35.03	55.14	1782	2118	10,673	1.065	1.071	1.158	1454	1473	1719	4.047	3.237	13.10	.8464	.8390	.8050	4.454	.8333	31.08	1024	.0553	.9738
11		32.65	54.59	1384	1687	7,946	1.031	1.035	1.119	1303	1313	1534	3.590	3.081	11.06	.8569	.8438	.8257	4.499	.8289	31.10	861	.0543	.9776
12		30.82	53.20	1228	1580	7,103	1.044	1.059	1.145	1241	1277	1490	3.416	3.007	10.27	.8450	.8439	.8192	4.516	.8276	30.82	778	.0561	.9713
13		28.08	53.30	987	1139	5,934	1.059	1.070	1.156	1163	1187	1384	3.216	2.875	9.247	.8589	.8393	.8256	4.449	.8296	31.40	646	.0541	.9784
14		26.52	52.56	841	1028	4,881	1.080	1.092	1.178	1098	1123	1309	2.937	2.765	8.121	.8337	.8414	.8140	4.460	.8268	31.64	568	.0548	.9880
15	0	30.99	53.43	1712	2173	11,435	1.081	1.086	1.174	1503	1518	1772	4.154	3.299	13.70	0.8402	0.8384	0.8094	4.470	0.8278	29.91	982	0.0575	0.9448
16		28.85	53.55	1595	2066	11,431	1.112	1.119	1.209	1501	1521	1774	4.128	3.296	13.60	.8347	.8399	.8083	4.452	.8324	30.03	892	.0570	.9414
17		27.09	54.15	1369	1500	10,468	1.102	1.116	1.207	1426	1463	1710	3.997	3.205	12.81	.8528	.8379	.8217	4.473	.8232	30.77	774	.0549	.9549
18		26.00	54.57	1165	1284	8,766	1.071	1.085	1.173	1346	1381	1614	3.701	3.101	11.48	.8648	.8336	.8176	4.487	.8205	31.38	683	.0532	.9831
19		24.31	53.75	994	1090	7,379	1.070	1.084	1.171	1275	1308	1529	3.433	3.011	10.34	.8426	.8360	.8154	4.450	.8231	31.41	605	.0562	.9907
20		22.77	52.96	853	940	6,234	1.099	1.113	1.203	1207	1238	1447	3.180	2.900	9.221	.8327	.8380	.8093	4.432	.8201	31.53	527	.0554	.9898
21	0	26.05	52.80	1444	1632	11,262	1.096	1.103	1.191	1499	1518	1772	4.105	3.272	13.43	0.8408	0.8383	0.8137	4.438	0.8256	29.82	821	0.0568	0.9349
22		23.73	52.54	1293	1483	10,994	1.125	1.134	1.226	1477	1501	1752	4.074	3.234	13.17	.8467	.8401	.8165	4.400	.8274	29.89	727	.0572	.9301
23	0	20.92	52.99	1154	997	11,231	1.043	1.052	1.137	1503	1530	1786	4.072	3.216	13.10	0.8423	0.8306	0.8093	4.421	0.8187	30.52	662	0.0557	0.9483
24		18.25	52.94	968	836	10,480	1.099	1.109	1.197	1476	1503	1753	3.934	3.171	12.47	.8420	.8327	.8095	4.411	.8095	30.76	547	.0553	.9570
25		20.37	54.22	1035	737	10,571	1.041	1.056	1.141	1449	1491	1740	3.996	3.170	12.67	.8645	.8358	.8250	4.487	.8012	31.35	588	.0543	.9775
26		18.50	53.13	868	645	8,983	1.047	1.062	1.147	1378	1418	1655	3.710	3.071	11.39	.8592	.8317	.8215	4.441	.8038	31.31	514	.0568	.9717
27		16.93	52.82	749	563	7,933	1.064	1.079	1.166	1328	1367	1595	3.466	3.011	10.43	.8432	.8336	.8146	4.423	.8013	31.42	451	.0573	.9784
28		16.92	52.79	707	529	7,266	1.020	1.035	1.120	1287	1327	1548	3.341	2.950	9.854	.8386	.8316	.8090	4.430	.8027	31.70	434	.0570	.9863
29	0	16.08	52.71	847	644	10,227	1.089	1.099	1.186	1476	1503	1753	3.869	3.130	12.11	0.8430	0.8278	0.8091	4.362	0.8072	31.13	481	0.0571	0.9639
Engine operation with the large compressor bleed port open																								
1	3.12	37.75	54.93	2053	2312	10,046	1.185	1.176	1.271	1508	1485	1736	3.619	3.371	12.20	0.8290	0.8169	0.7948	4.508	0.8400	30.46	1122	0.0585	0.9786
2	3.02	35.48	53.89	1706	1887	8,278	1.166	1.157	1.201	1397	1376	1608	3.385	3.247	10.99	.8544	.8223	.8130	4.464	.8395	30.32	999	.0611	.9815
3	2.86	32.66	53.30	1359	1504	6,672	1.178	1.171	1.211	1278	1262	1474	3.130	3.106	9.719	.8745	.8310	.8285	4.480	.8322	30.43	835	.0602	.9809
4	2.78	29.80	52.57	1070	1183	5,669	1.224	1.215	1.252	1170	1152	1347	2.872	2.936	8.432	.8782	.8346	.8373	4.464	.8309	30.72	685	.0594	.9775
5	2.63	27.17	51.46	850	950	4,164	1.356	1.353	1.384	1071	1063	1240	2.613	2.803	7.325	.8611	.8468	.8336	4.545	.8254	30.49	550	.0578	.9746
6	2.57	24.17	49.16	651	728	3,165	1.607	1.601	1.621	969	962	1122	2.378	2.626	6.265	.8229	.8417	.8366	4.535	.8230	29.90	446	.0580	.9394
7	2.40	22.70	48.49	544	609	2,683	1.985	1.987	1.977	906	909	1054	2.266	2.520	5.711	.8681	.8376	.8320	4.526	.8302	30.09	367	.0567	.9211
8	2.28	20.89	47.96	428	480	2,098	4.412	4.412	4.050	817	817	953	2.067	2.381	4.921	.8459	.8458	.8252	4.550	.8144	30.53	266	.0654	.8839
9	2.15	17.73	44.75	313	361	1,515	------	------	------	706	706	823	1.824	2.149	3.919	.8238	.8355	.8119	4.520	.8072	29.73	181	.0663	.7243
10	2.43	28.94	53.74	1613	1921	10,444	1.225	1.235	1.334	1492	1516	1770	3.649	3.370	12.30	0.8307	0.8201	0.7972	4.487	0.8266	29.93	866	0.0571	0.9513
11	2.40	27.47	53.90	1290	1495	8,189	1.182	1.188	1.231	1369	1383	1614	3.345	3.206	10.72	.8411	.8333	.8128	4.470	.8228	30.65	742	.0593	.9830
12	2.19	23.47	52.46	871	1013	5,555	1.268	1.273	1.311	1185	1194	1395	2.881	2.952	8.503	.8618	.8333	.8247	4.545	.8188	30.77	527	.0572	.9850
13	2.22	23.22	52.22	862	914	5,388	1.285	1.286	1.324	1177	1181	1376	2.814	2.919	8.216	.8555	.8346	.8228	4.510	.8175	30.85	524	.0552	.9687
14	2.01	20.31	50.61	623	726	3,902	1.501	1.504	1.534	1046	1051	1229	2.492	2.711	6.754	.8404	.8404	.8206	4.512	.8115	30.84	387	.0546	.9537
15	1.88	17.42	48.79	418	507	2,582	2.459	2.471	2.440	883	892	1041	2.126	2.444	5.196	.8220	.8292	.8045	4.395	.8137	31.07	260	.0564	.8945
16	1.65	14.16	45.82	299	382	1,927	------	------	------	750	764	891	1.912	2.195	4.115	.8161	.8312	.7959	4.529	.8046	30.42	130	.0591	.7265
17	1.76	20.78	53.11	1127	660	9,324	1.263	1.247	1.349	1490	1453	1696	3.476	3.254	11.31	0.8619	0.8195	0.8164	4.416	0.8118	30.38	597	0.0606	0.9619
18	1.81	21.07	54.09	1127	854	9,288	1.252	1.241	1.341	1488	1462	1707	3.429	3.476	11.23	.8453	.8252	.8094	4.465	.8118	30.80	589	.0605	.9756
19	1.77	19.59	53.09	856	801	6,840	1.230	1.221	1.319	1326	1306	1526	3.074	3.079	9.465	.8634	.8298	.8212	4.459	.8105	31.01	488	.0610	.9944
20	1.59	16.08	49.68	626	595	5,174	1.416	1.404	1.516	1205	1184	1382	2.748	2.878	7.909	.8681	.8263	.8300	4.410	.8102	30.01	371	.0618	.9554
21	1.46	14.38	49.09	442	390	3,623	1.782	1.775	1.919	1043	1035	1208	2.392	2.612	6.248	.8472	.8386	.8238	4.427	.7899	31.06	256	.0622	.9399
22	1.33	11.77	45.69	316	304	2,562	4.051	4.020	4.350	919	905	1058	2.054	2.379	4.886	.8179	.8384	.8100	4.396	.7864	30.06	167	.0585	.8526

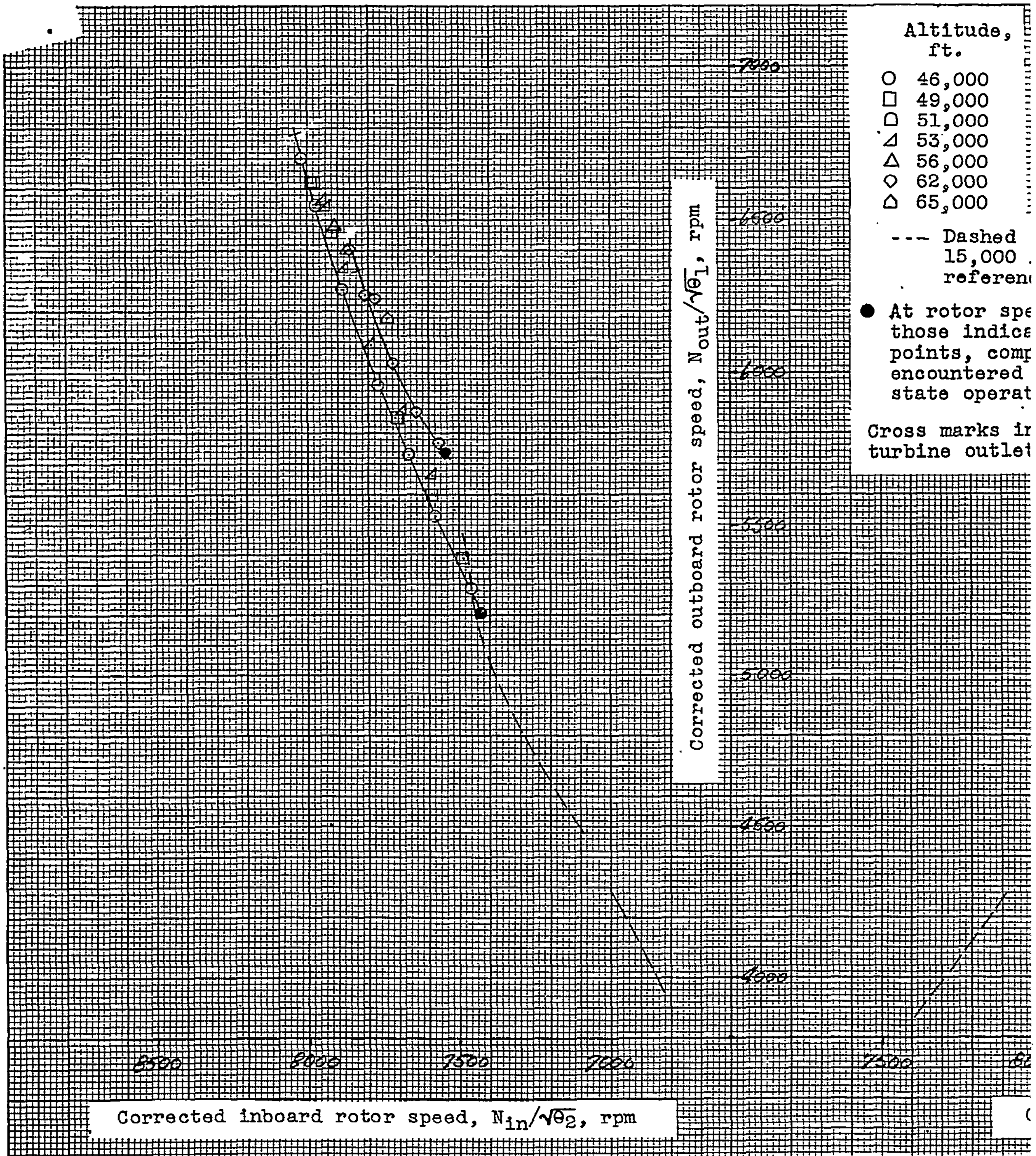
Run	Air flow: Bleed, $W_{a,bleed}$, lb/sec	Air flow: Inboard, $W_{a,in}$, lb/sec	Air flow: Inboard, Corrected (station 2), $\frac{W_{a,in}\sqrt{\theta_2}}{\delta_2}$, lb/sec	Fuel flow: W_f, lb/hr	Fuel flow: Adjusted, $\frac{W_f}{\delta_a\sqrt{\theta_a}}$, lb/hr	Fuel flow: Corrected, $\frac{W_f}{\delta_1\sqrt{\theta_1}}$, lb/hr	Specific fuel consumption: W_f/F_n, $\frac{lb/hr}{lb\ thrust}$	Specific fuel consumption: Adjusted, $\frac{W_f}{F_n\sqrt{\theta_a}}$, $\frac{lb/hr}{lb\ thrust}$	Specific fuel consumption: Corrected, $\frac{W_f}{F_n\sqrt{\theta_1}}$, $\frac{lb/hr}{lb\ thrust}$	Exhaust-gas total temperature: T_9, °R	Exhaust-gas total temperature: Adjusted, T_9/θ_a, °R	Exhaust-gas total temperature: Corrected, T_9/θ_1, °R	Compressor pressure ratio: Outboard, P_2/P_1	Compressor pressure ratio: Inboard, P_3/P_2	Compressor pressure ratio: Combined, P_3/P_1	Compressor efficiency: Outboard, $\eta_{c,out}$	Compressor efficiency: Inboard, $\eta_{c,in}$	Compressor efficiency: Combined, $\eta_{c,comb}$	Combined turbine pressure ratio, P_4/P_6	Combined turbine efficiency, η_t	Turbine corrected gas flow, $\frac{W_{g,t}\sqrt{\theta_{4cr}}\ \beta}{\delta_4}$, lb/sec	Thrust meter parameter, $(1.25\ P_9-P_0)$	Combustor pressure drop, $\frac{P_3-P_4}{P_3}$	Combustion efficiency, η_b
23	1.43	16.00	51.90	889	648	9,492	1.287	1.287	1.389	1481	1481	1727	3.435	3.222	11.07	0.8623	0.8227	0.8186	4.488	0.7870	30.21	454	0.0562	0.9402
24	1.46	16.38	52.68	865	680	9,344	1.232	1.246	1.346	1441	1474	1718	3.444	3.217	11.08	.8514	.8251	.8140	4.410	.8049	30.51	467	.0569	.9604
25	1.35	14.53	51.73	686	520	7,560	1.280	1.290	1.394	1354	1376	1604	3.148	3.087	9.718	.8589	.8309	.8218	4.457	.7922	30.60	374	.0586	.9644
26	1.30	13.77	50.98	612	456	6,667	1.322	1.335	1.443	1291	1318	1536	2.958	3.018	8.925	.8411	.8308	.8110	4.503	.7905	30.41	337	.0576	.9556
27	1.21	12.77	50.21	525	386	5,682	1.404	1.417	1.529	1222	1244	1452	2.746	2.894	7.948	.8294	.8254	.8057	4.483	.7857	30.56	289	.0573	.9435
28	1.16	11.34	47.95	410	301	4,213	1.602	1.613	1.742	1109	1126	1315	2.393	2.690	6.438	.7878	.8381	.7904	4.373	.7903	30.22	234	.0569	.9052
Engine operation with both compressor bleed ports open																								
1	3.58	36.42	53.76	2097	2704	10,604	1.238	1.243	1.343	1533	1545	1804	3.626	3.406	12.35	0.8062	0.8071	0.7751	4.482	0.8362	29.79	1119	0.0558	0.9637
2	3.39	34.51	54.63	1574	2052	7,899	1.176	1.178	1.275	1354	1361	1591	3.282	3.227	10.59	.8428	.7616	.7719	4.491	.8679	30.94	919	.0574	.9960
3	3.09	29.31	51.70	1087	1433	5,435	1.270	1.275	1.377	1170	1179	1377	2.861	2.979	8.521	.8608	.8258	.8204	4.478	.8321	29.98	685	.0588	.9720
4	2.83	24.97	50.11	698	921	3,487	1.531	1.539	1.662	994	1004	1172	2.446	2.704	6.613	.8481	.8307	.8193	4.477	.8362	30.33	469	.0595	.9639
5	2.60	21.40	48.43	463	616	2,304	3.238	3.254	3.518	631	839	980	2.108	2.439	5.143	.8441	.8362	.8244	4.507	.8367	30.30	297	.0572	.8769
6	2.39	17.81	45.36	316	410	1,589	------	------	------	706	717	837	1.852	2.178	4.033	.8327	.8230	.8142	4.518	.8072	30.11	156	.0704	.7333
7	2.79	28.60	54.34	1588	1652	10,242	1.237	1.242	1.342	1501	1513	1767	3.565	3.371	12.02	0.8283	0.8201	0.7962	4.445	0.8256	30.36	843	0.0578	0.9647
8	2.68	26.32	53.01	1272	1290	8,072	1.235	1.241	1.341	1371	1385	1616	3.257	3.220	10.49	.8317	.8223	.8004	4.464	.8291	30.09	720	.0593	.9624
9	2.53	22.58	50.99	867	883	5,432	1.327	1.332	1.440	1181	1190	1390	2.787	2.975	8.292	.8427	.8406	.8209	4.480	.8175	29.75	528	.0587	.9497
10	2.26	18.56	47.49	560	553	3,424	1.628	1.643	1.773	1005	1023	1194	2.347	2.643	6.204	.7902	.8346	.7893	4.350	.8348	29.36	371	.0552	.9258
11	1.97	15.78	46.54	381	390	2,381	4.763	4.782	5.165	853	860	1004	2.035	2.383	4.850	.8201	.8141	.7963	4.469	.8081	30.02	209	.0584	.8352
12	1.90	14.07	44.11	318	334	1,989	------	------	12.750	770	778	908	1.861	2.245	4.240	.8047	.8444	.8161	4.418	.7955	29.07	154	.0630	.7274
13	2.23	22.84	54.77	1238	1021	9,866	1.209	1.222	1.320	1494	1528	1781	3.438	3.294	11.32	0.8062	0.8136	0.7789	4.395	0.8225	31.27	657	0.0539	0.9868
14	2.04	19.30	51.76	908	763	7,380	1.279	1.287	1.390	1342	1359	1586	3.095	3.135	9.703	.8333	.8181	.8032	4.411	.8170	30.06	514	.0586	.9582
15	1.85	16.50	49.83	657	549	5,415	1.407	1.414	1.529	1204	1216	1420	2.735	2.904	7.943	.8341	.8245	.8057	4.389	.8102	30.03	384	.0573	.9467
16	1.67	14.50	48.95	479	423	3,902	1.781	1.788	1.933	1066	1075	1255	2.376	2.681	6.369	.8159	.8345	.8029	4.411	.7563	30.20	269	.0568	.9257
17	1.62	12.58	47.05	361	333	2,900	3.085	3.097	3.349	934	941	1099	2.077	2.465	5.119	.7859	.8258	.7854	4.336	.8095	30.18	194	.0581	.8433
18	1.68	16.58	52.31	952	669	9,821	1.280	1.288	1.391	1507	1527	1781	3.399	3.284	11.16	0.8243	0.8216	0.7964	4.467	0.7965	30.03	488	0.0542	0.9407
19	1.60	15.24	51.63	810	602	8,772	1.313	1.325	1.431	1424	1450	1692	3.272	3.195	10.46	.8423	.8288	.8108	4.448	.7950	30.10	423	.0593	.9344
20	1.51	14.19	51.01	668	456	7,212	1.310	1.318	1.424	1351	1369	1597	3.056	3.049	9.319	.8404	.8201	.8086	4.471	.7857	30.51	364	.0584	.9651
21	1.33	12.58	49.20	508	353	5,238	1.427	1.434	1.551	1210	1222	1427	2.632	2.848	7.498	.8195	.8163	.7938	4.381	.7883	30.25	286	.0568	.9416
22	1.33	11.42	47.10	442	329	4,615	1.637	1.652	1.785	1143	1164	1358	2.484	2.732	6.787	.8271	.8130	.7956	4.422	.7813	29.64	242	.0587	.9003
23	1.35	12.56	50.01	722	478	8,784	1.375	1.368	1.478	1492	1477	1725	3.214	3.161	10.16	0.8275	0.8251	0.8005	4.367	0.7904	29.54	369	0.0553	0.9195
24	1.37	12.71	51.23	671	445	7,845	1.259	1.256	1.357	1447	1440	1679	3.021	3.098	9.359	.8008	.8158	.7813	4.308	.7665	31.43	354	.0581	1.035
25	1.28	11.35	48.65	618	408	8,065	1.461	1.468	1.586	1416	1430	1669	3.119	3.098	9.665	.8351	.8268	.8062	4.376	.7911	29.09	315	.0559	.9022
26	1.30	12.14	51.23	615	409	7,556	1.367	1.367	1.475	1409	1409	1643	3.005	3.079	9.253	.8250	.8205	.7955	4.518	.7750	30.68	312	.0575	.9552
27	1.31	12.32	51.44	580	371	6,827	1.312	1.313	1.419	1365	1369	1596	2.912	3.025	8.808	0.8194	0.8220	0.7953	4.407	0.7792	30.95	311	0.0565	0.9784
28	1.27	11.26	48.32	577	379	7,248	1.439	1.448	1.563	1372	1390	1622	2.978	3.039	9.049	.8248	.8217	.7982	4.360	.7908	29.19	302	.0574	.9129
29	1.32	11.28	48.48	547	359	6,606	1.439	1.442	1.561	1337	1344	1571	2.858	2.972	8.495	.8212	.8217	.7947	4.396	.7800	29.56	290	.0576	.9232
30	1.23	10.65	47.58	500	328	6,103	1.479	1.482	1.604	1299	1305	1526	2.761	2.908	8.027	.8169	.8160	.7931	4.346	.7862	29.48	271	.0583	.9087
Normal engine operation with the automatic control																								
1	0	68.64	56.16	3246	7692	9,400	1.019	1.009	1.089	1429	1400	1635	3.881	3.197	12.41	0.8296	0.8381	0.8049	4.449	0.8554	31.47	1976	0.0556	1.000
2	4.23	35.51	49.32	618	1359	1,806	4.647	4.617	4.989	794	784	915	2.058	2.376	4.889	.8373	.8315	.8189	4.476	.8511	30.91	450	.0610	.9517
3	0	53.06	55.34	2063	5294	9,655	1.044	1.035	1.117	1449	1424	1662	3.887	3.235	12.58	0.8299	0.8479	0.8085	4.430	0.8452	30.87	1564	0.0568	0.9884
4	3.49	28.73	47.95	629	1204	2,325	2.303	2.294	2.479	873	866	1001	2.180	2.498	5.446	.8380	.8310	.8157	4.471	.8447	29.68	452	.0805	.9492
5	0	41.16	55.07	2075	3443	9,877	1.054	1.045	1.128	1479	1453	1696	3.889	3.233	12.57	0.8299	0.8319	0.8011	4.413	0.8412	31.04	1228	0.0570	1.000
6	2.72	23.87	49.10	634	955	3,011	1.791	1.786	1.930	962	957	1116	2.294	2.600	5.965	.8153	.8402	.8078	4.395	.8288	30.15	427	.0590	.9469
7	0	32.07	54.36	1706	2335	10,255	1.093	1.083	1.170	1504	1478	1725	3.881	3.241	12.58	0.8224	0.8305	0.7972	4.395	0.8372	30.73	980	0.0665	0.9677
8	2.34	20.50	50.70	645	801	3,875	1.532	1.526	1.649	1067	1059	1236	2.441	2.724	6.649	.8232	.8380	.8116	4.378	.8197	30.90	406	.0668	.9657
9	0	28.85	54.79	1531	2013	10,112	1.093	1.086	1.174	1511	1492	1742	3.791	3.236	12.27	0.7959	0.8370	0.7856	4.378	0.8363	31.13	867	0.0681	0.9785
10	0.43	20.40	53.45	648	745	4,462	1.171	1.168	1.262	1121	1115	1300	2.686	2.704	7.263	0.8028	0.8283	0.7880	4.342	------	32.94	417	0.0537	1.018
11	0	24.39	54.17	1266	1427	9,596	1.095	1.085	1.173	1489	1463	1708	3.719	3.180	11.83	0.8059	0.8359	0.7914	4.395	0.8284	31.07	724	0.0586	0.9744
12	.40	18.14	51.61	651	709	5,002	1.203	1.201	1.298	1177	1174	1370	2.774	2.769	7.684	.7908	.8404	.7888	4.295	------	31.58	409	.0552	.9793
13	0	23.33	54.50	1182	1290	9,623	1.071	1.072	1.158	1483	1487	1734	3.733	3.184	11.89	0.8050	0.8302	0.7847	4.392	0.8225	31.37	686	0.0545	1.004
14	0	21.92	51.60	1134	1223	9,187	1.130	1.126	1.216	1446	1435	1674	3.687	3.149	11.61	.8625	.8271	.8030	4.395	.8232	29.79	659	.0555	.9446
15	.39	17.51	51.55	648	674	5,198	1.196	1.198	1.294	1202	1202	1402	2.800	2.798	7.835	.7833	.8288	.7793	4.355	------	31.62	398	.0560	.9929
16	0	21.73	53.39	1077	1096	9,225	1.063	1.063	1.148	1473	1473	1718	3.712	3.159	11.73	0.8348	0.8320	0.8131	4.371	0.8133	30.98	640	0.0562	1.015
17	.37	16.29	50.43	651	648	5,664	1.240	1.241	1.341	1241	1245	1451	2.890	2.836	8.194	.7916	.8187	.7796	4.326	------	30.93	389	.0566	.9707



Station	Number of rakes	Total pressure tubes	Static pressure tubes	Number of thermocouples	Wall static pressure orifices	Annular area, sq ft
1	4	36	16	16	4	5.800
2	4	24	0	12	0	1.637
3	4	24	0	12	0	.952
4	2 rakes; 8 single					
	pressure probes	18	0	8	0	
5	4	16	0	0	0	
6	8	24	0	24	8	3.142
9	4	24	0	24	4	4.550
0	0	0	4	0	0	2.580

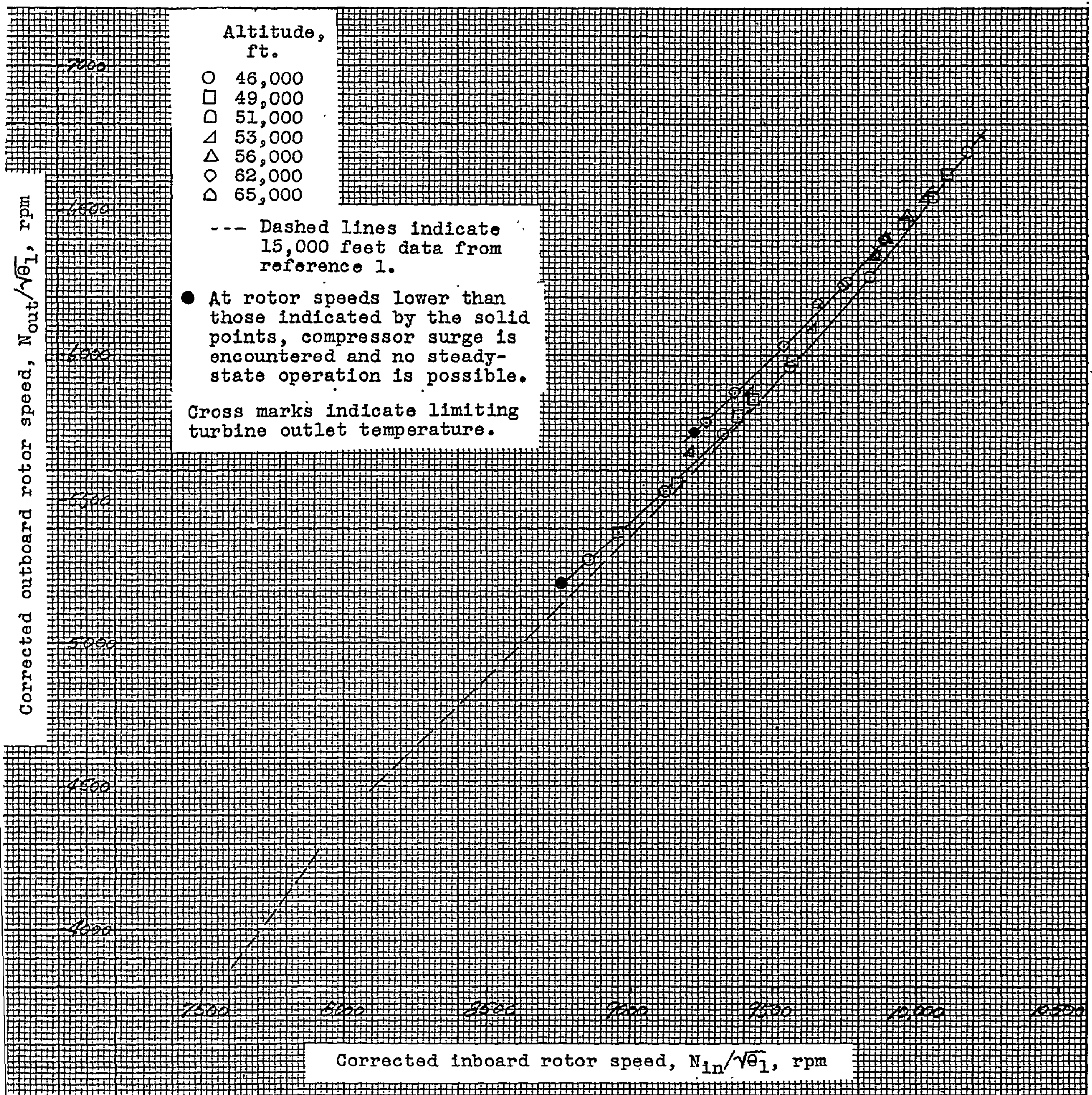
Figure 1. - Cross-section of J57-P-1 turbojet engine showing location of instrumentation.

3387



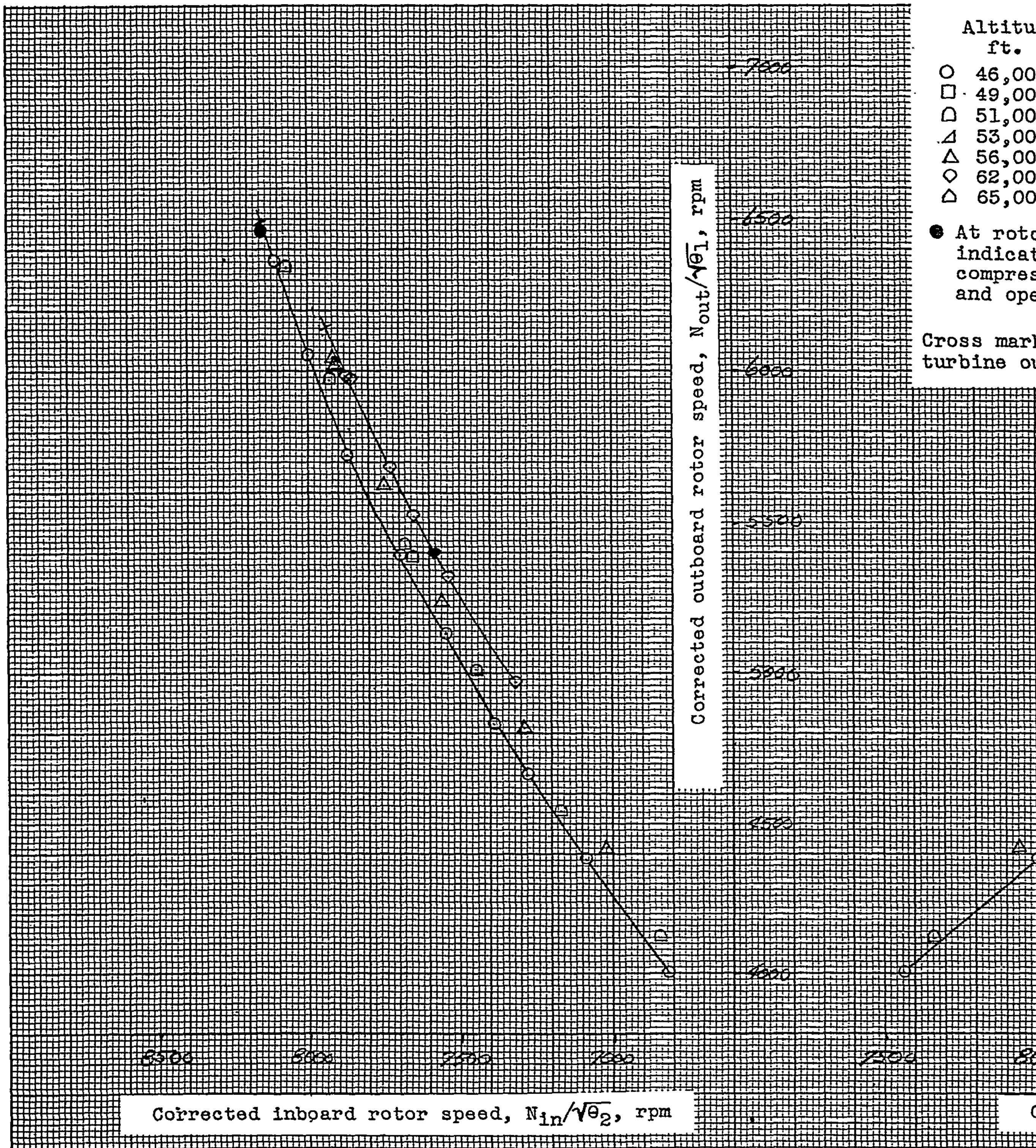
(a) Engine operation with both compressor ble

Figure 2. - The variation of corrected outboard rotor with corrected inboard rotor speed over a range of Flight Mach number 0.81.



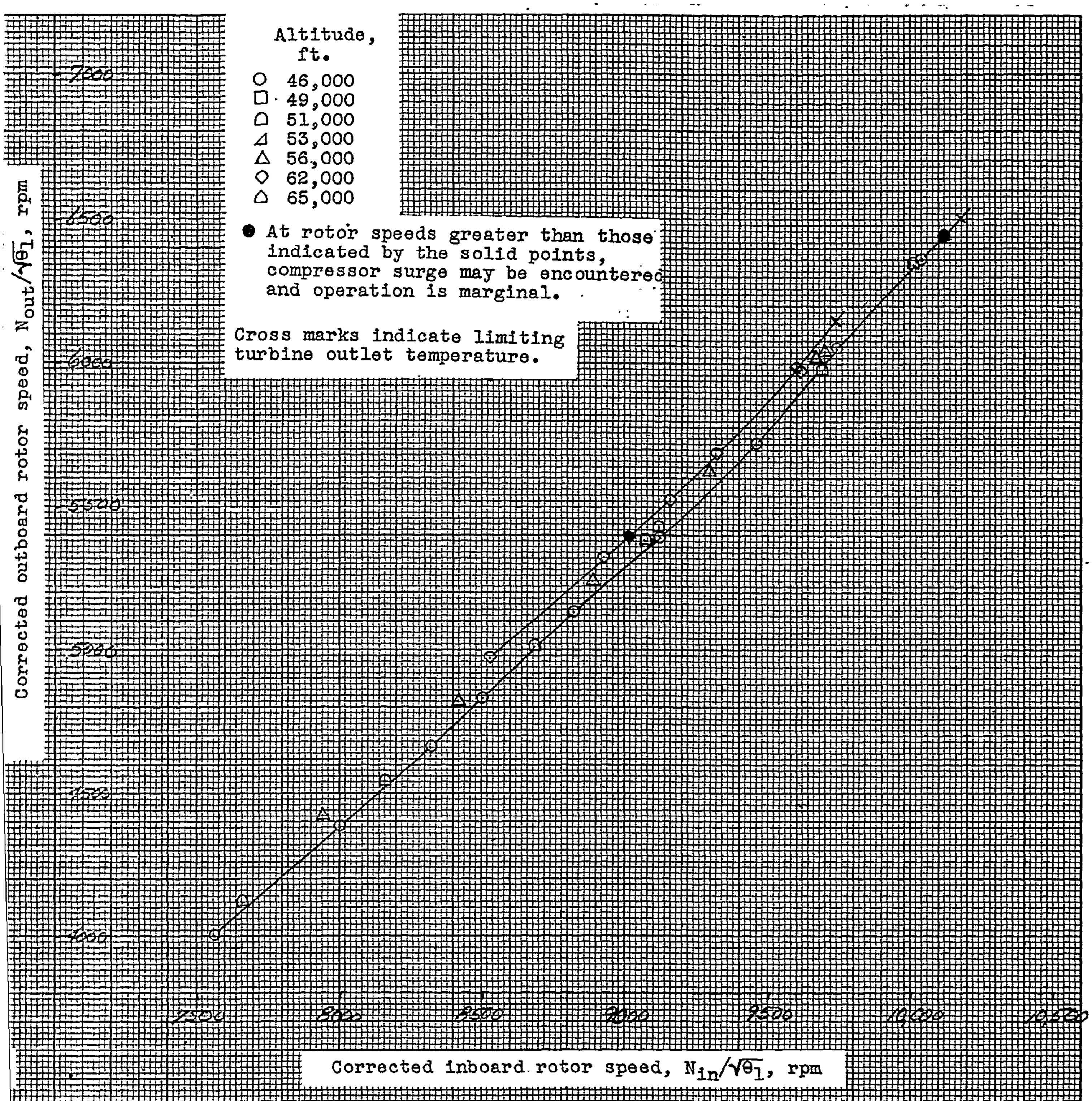
ation with both compressor bleed ports closed.

on of corrected outboard rotor speed
rotor speed over a range of altitudes.
.



(b) Engine operation with the large compressor b

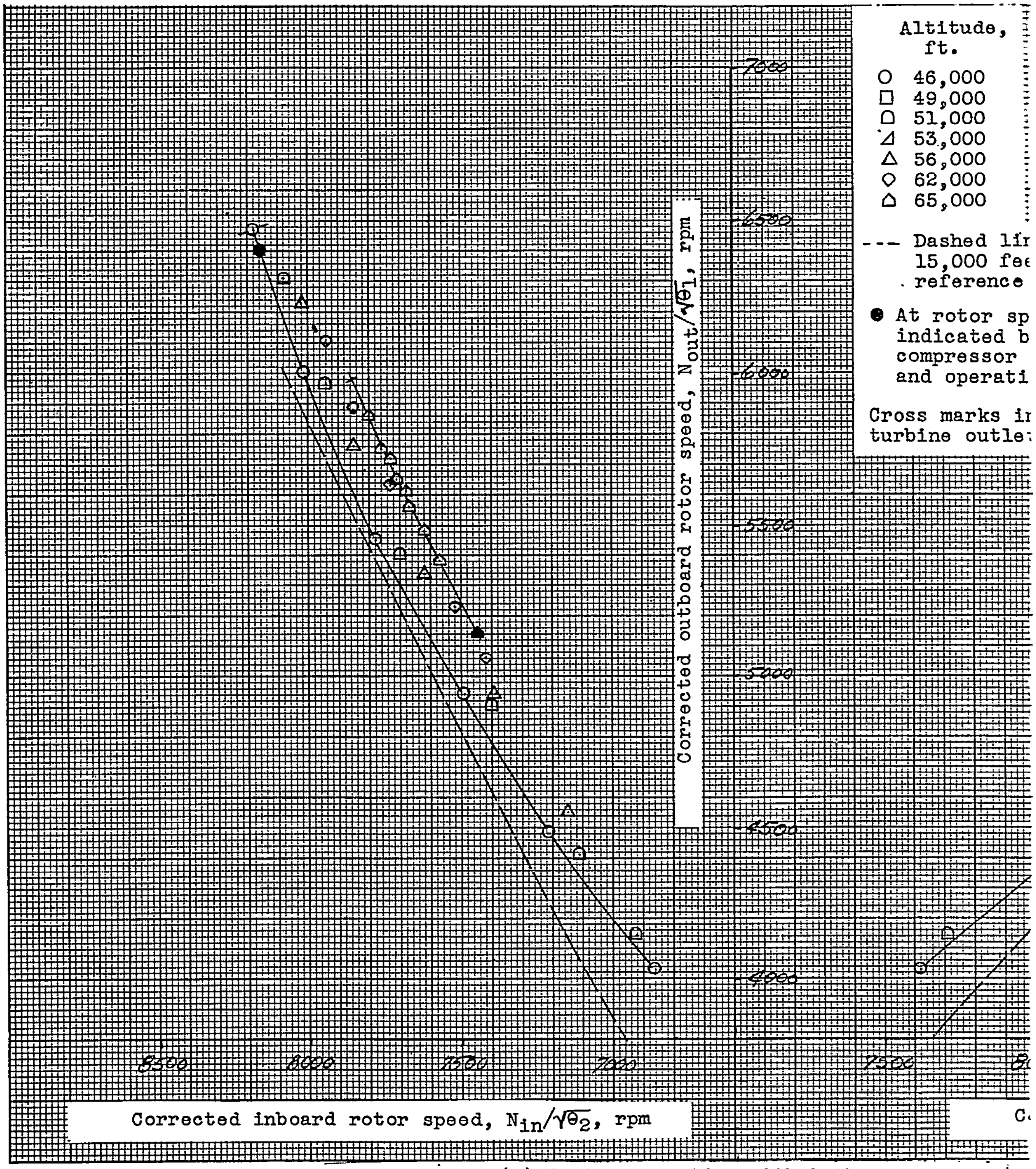
Figure 2. - The variation of corrected outboard rotor sp with corrected inboard rotor speed over a range of alti Flight Mach number 0.81.



ı with the large compressor bleed port open.

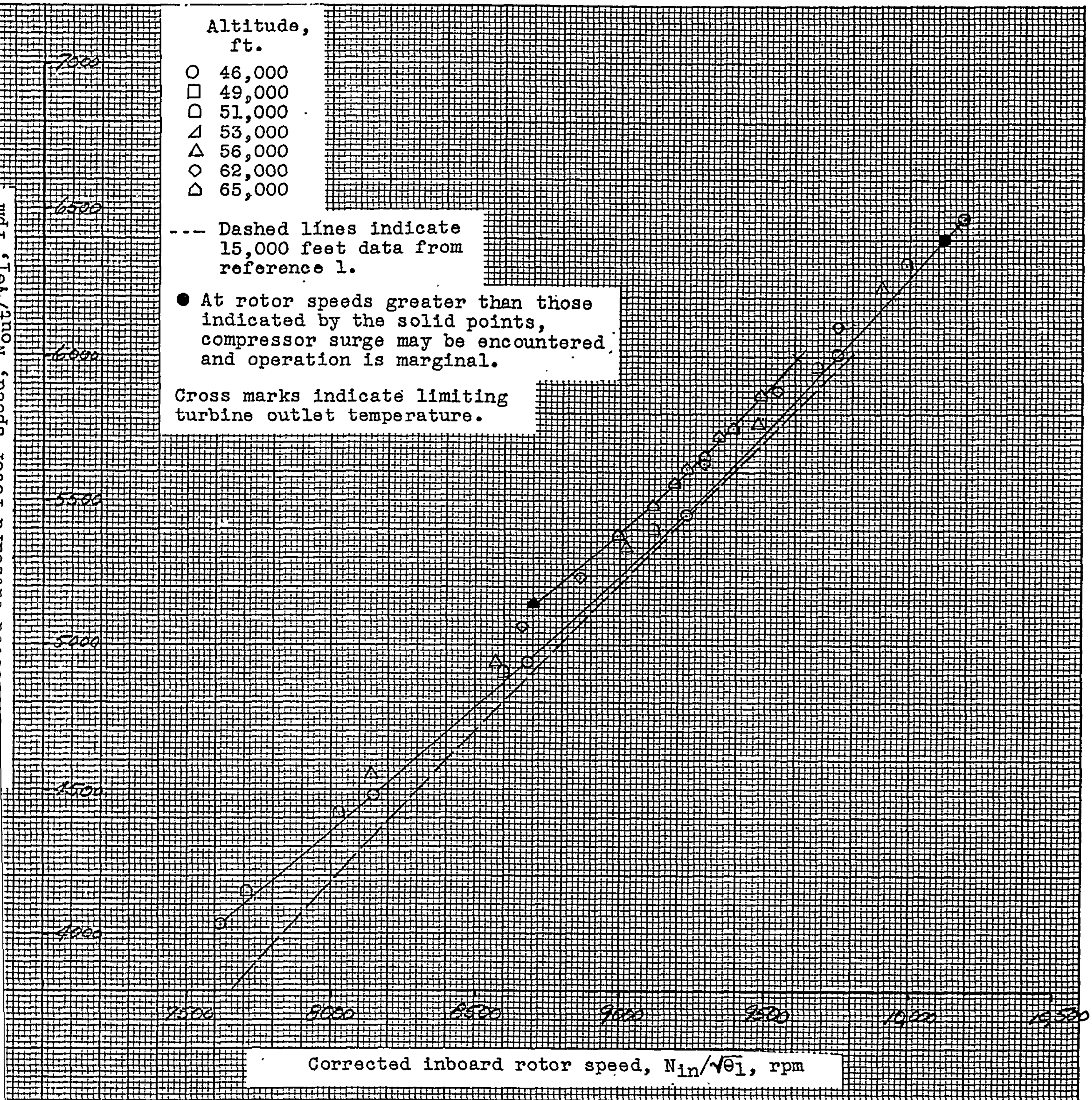
ɔf corrected outboard rotor speed
;or speed over a range of altitudes.

5387



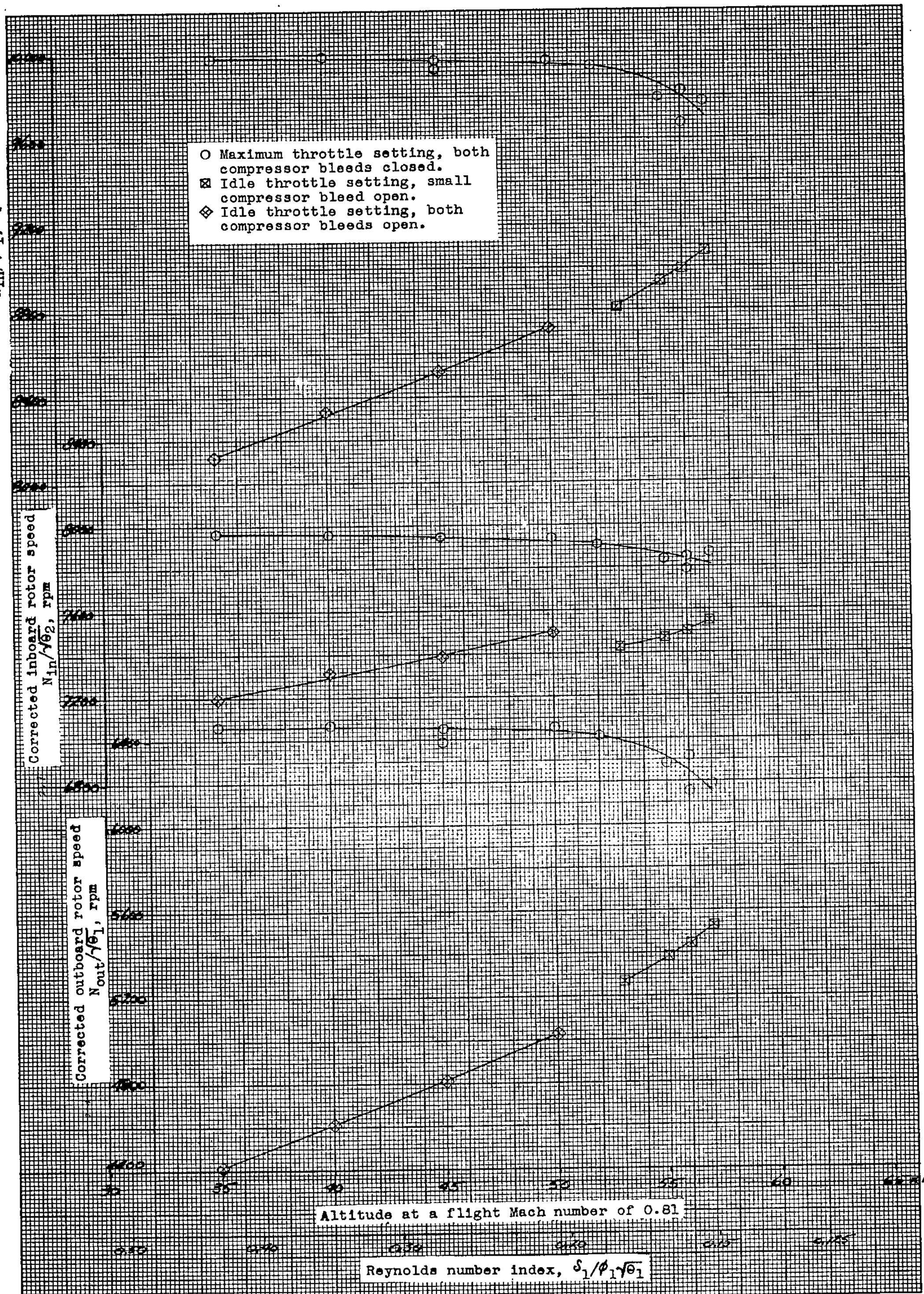
(c) Engine operation with both compressor bl

Figure 2. - The variation of corrected outboard rotor with corrected inboard rotor speed over a range of a Flight Mach number 0.81.



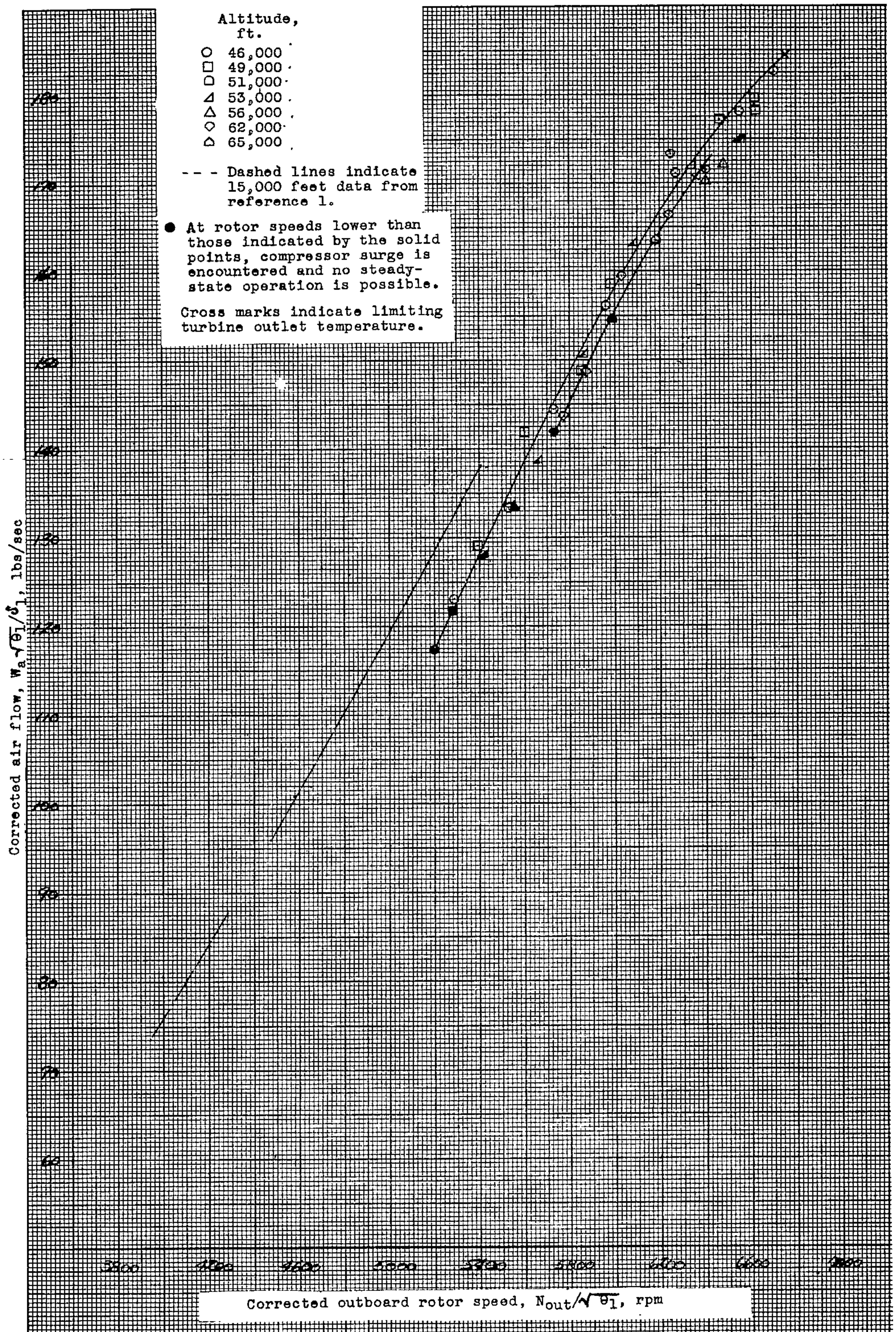
ion with both compressor bleed ports open.

of corrected outboard rotor speed
tor speed over a range of altitudes.



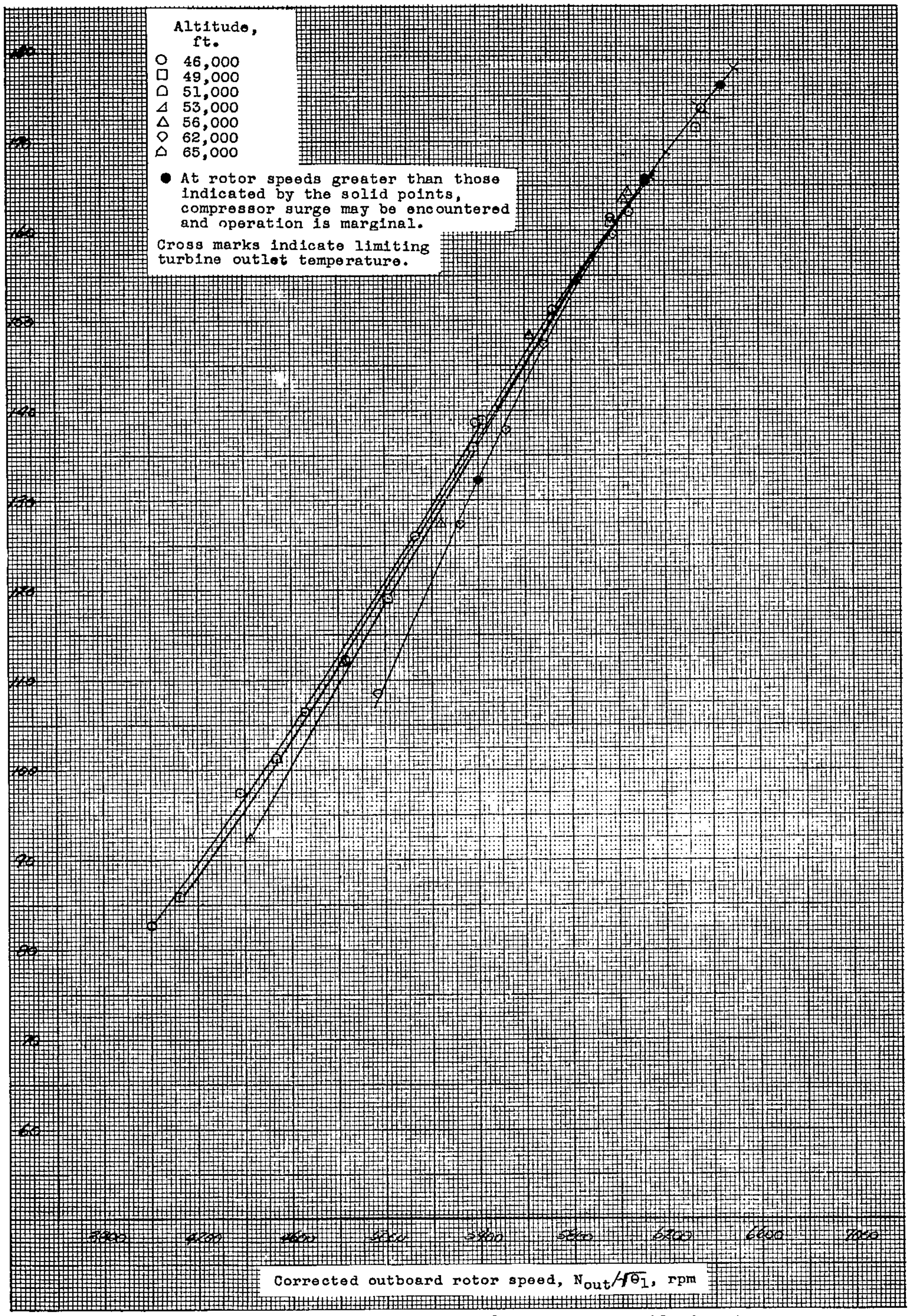
(d) Engine operation with the automatic control.

Figure 2. - The variation of corrected rotor speed with altitude at a flight Mach number of 0.81. Engine automatic control throttle settings of maximum and idle.



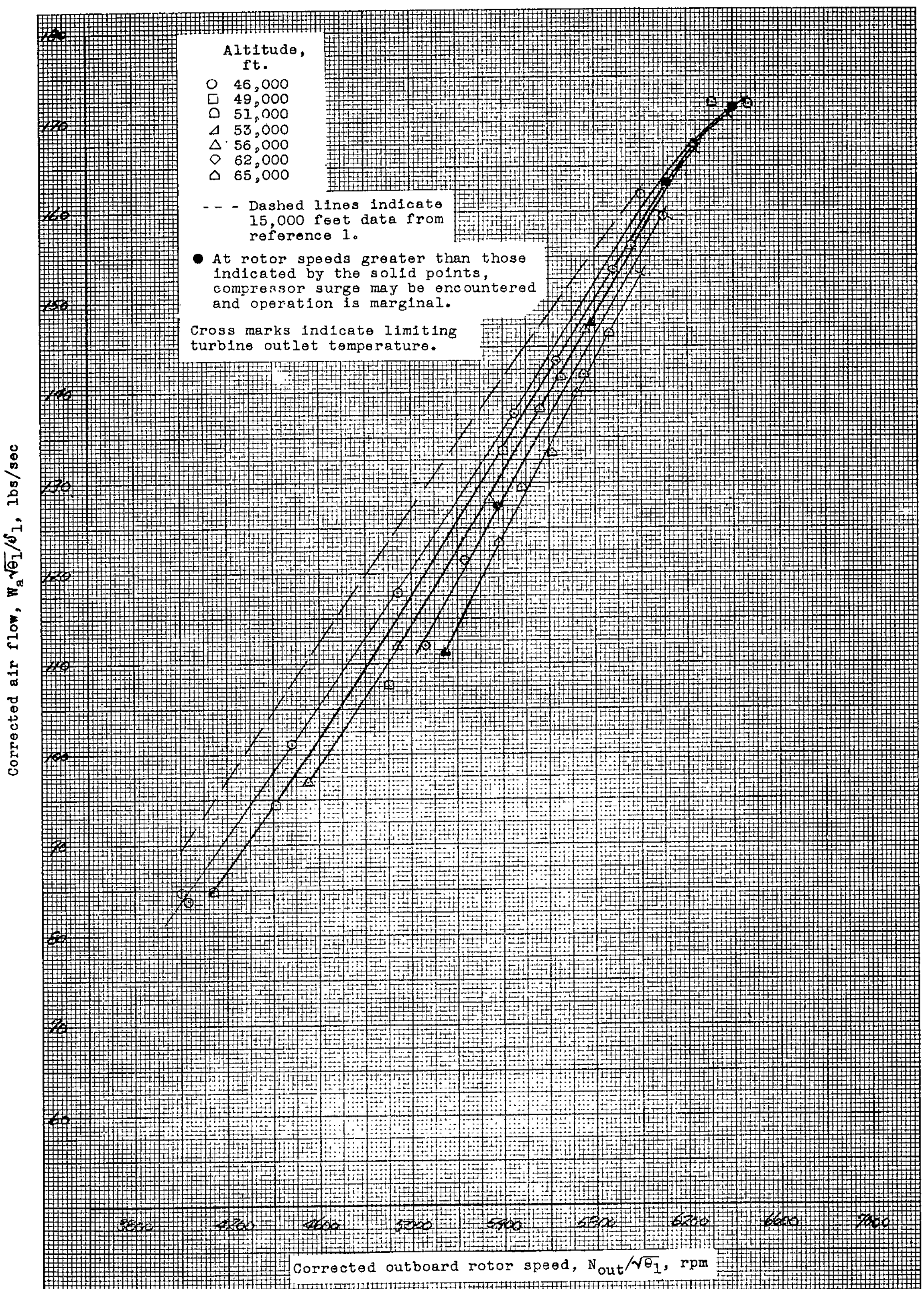
(a) Engine operation with both compressor bleed ports closed.

Figure 3. - The variation of corrected air flow with corrected outboard rotor speed over a range of altitudes. Flight Mach number 0.81.



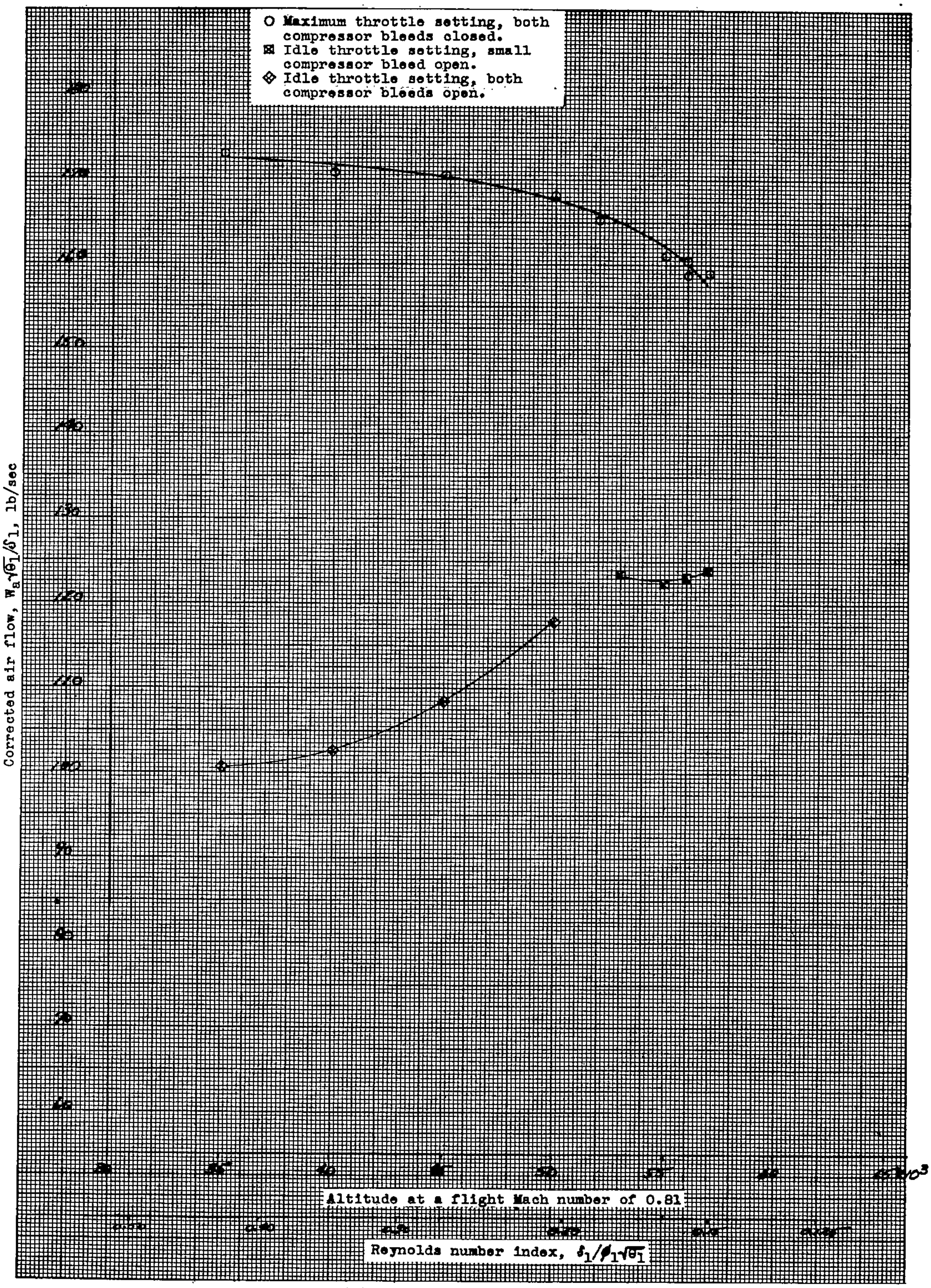
(b) Engine operation with the large compressor bleed port open.

Figure 3. - The variation of corrected air flow with corrected outboard rotor speed over a range of altitudes. Flight Mach number 0.81.



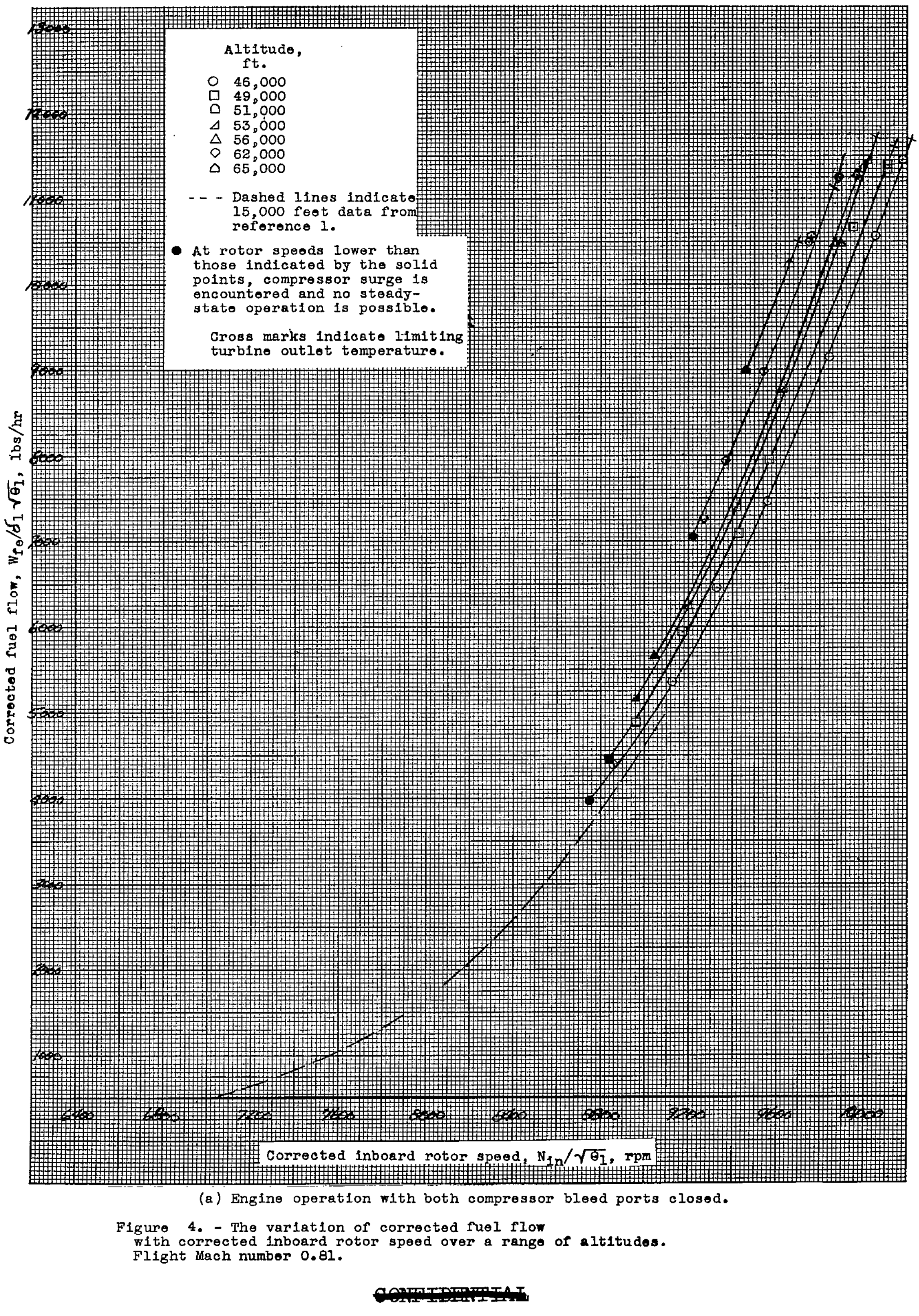
(c) Engine operation with both compressor bleed ports open.

Figure 3. - The variation of corrected air flow with corrected outboard rotor speed over a range of altitudes. Flight Mach number 0.81.



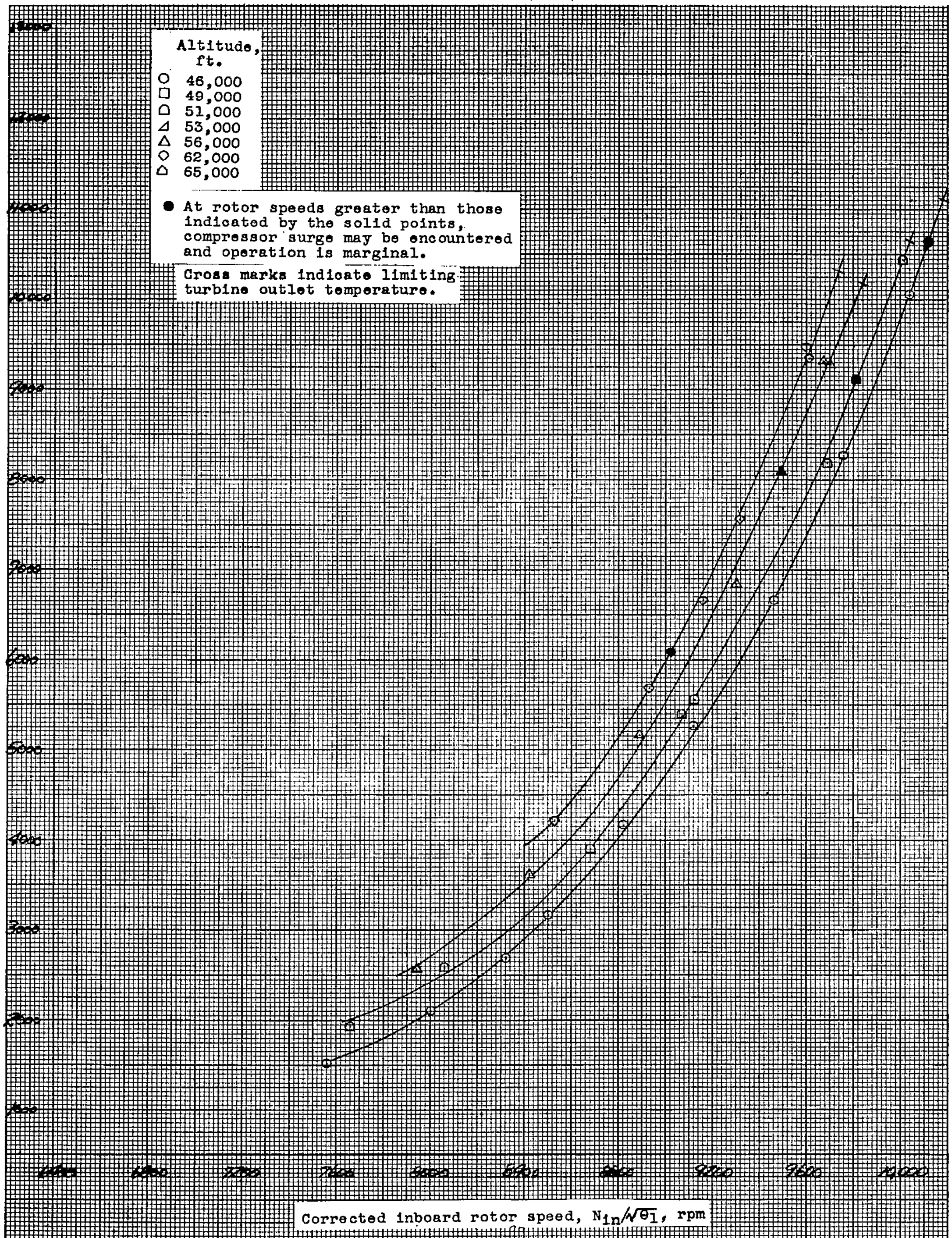
(d) Engine operation with the automatic control.

Figure 3. - The variation of corrected air flow with altitude at a flight Mach number of 0.81. Engine automatic control throttle settings of maximum and idle.



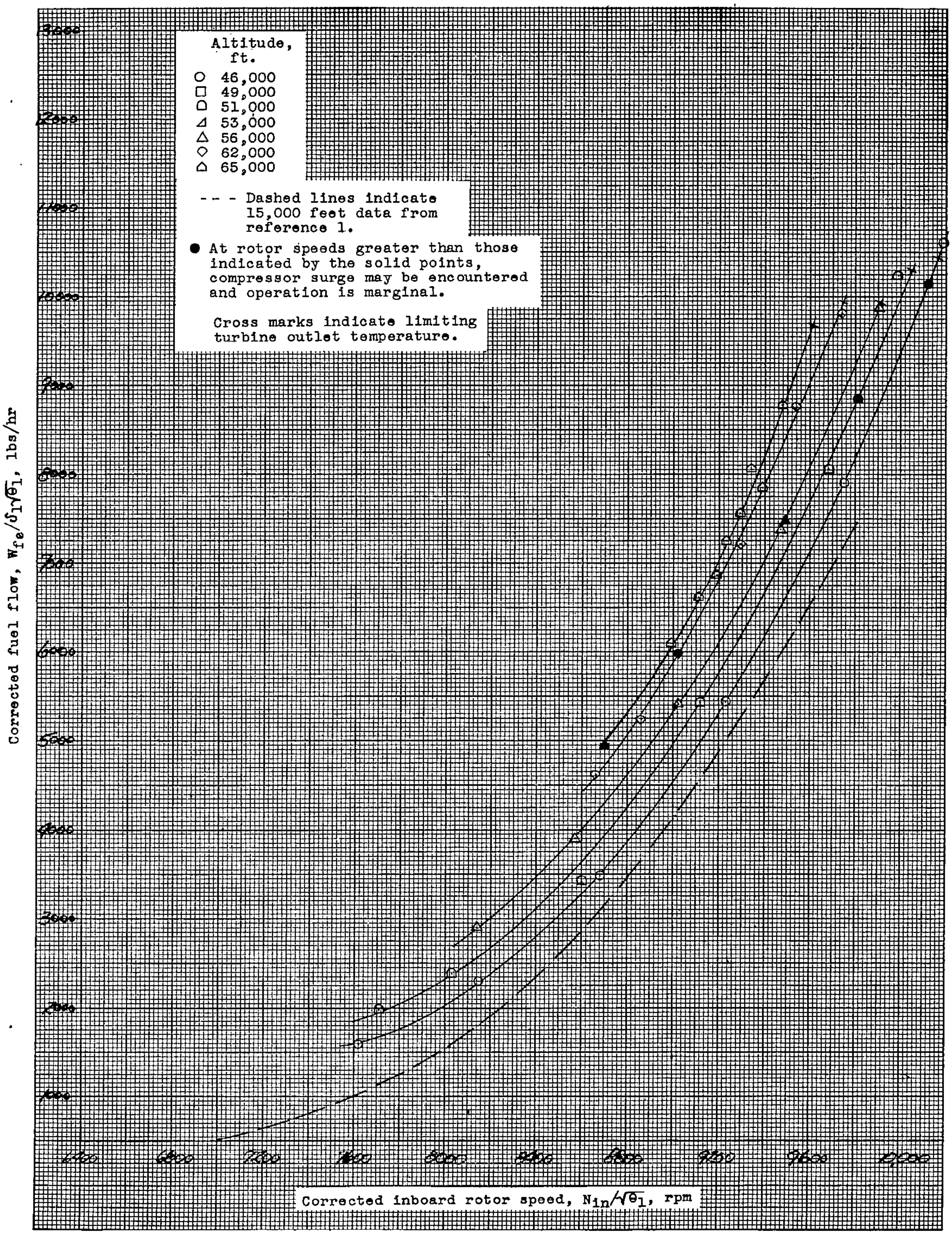
(a) Engine operation with both compressor bleed ports closed.

Figure 4. - The variation of corrected fuel flow with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



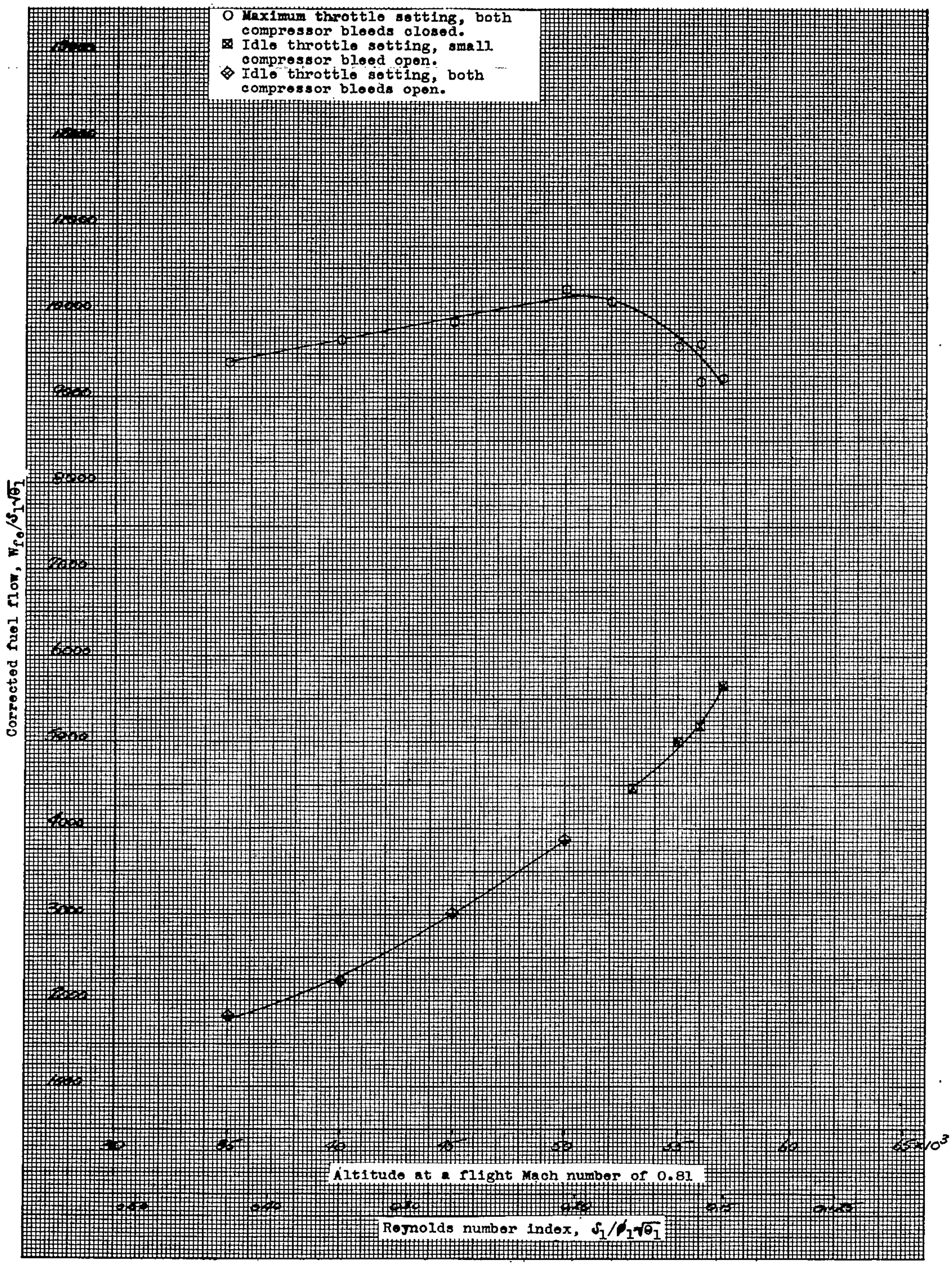
(b) Engine operation with the large compressor bleed port open.

Figure 4. - The variation of corrected fuel flow with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



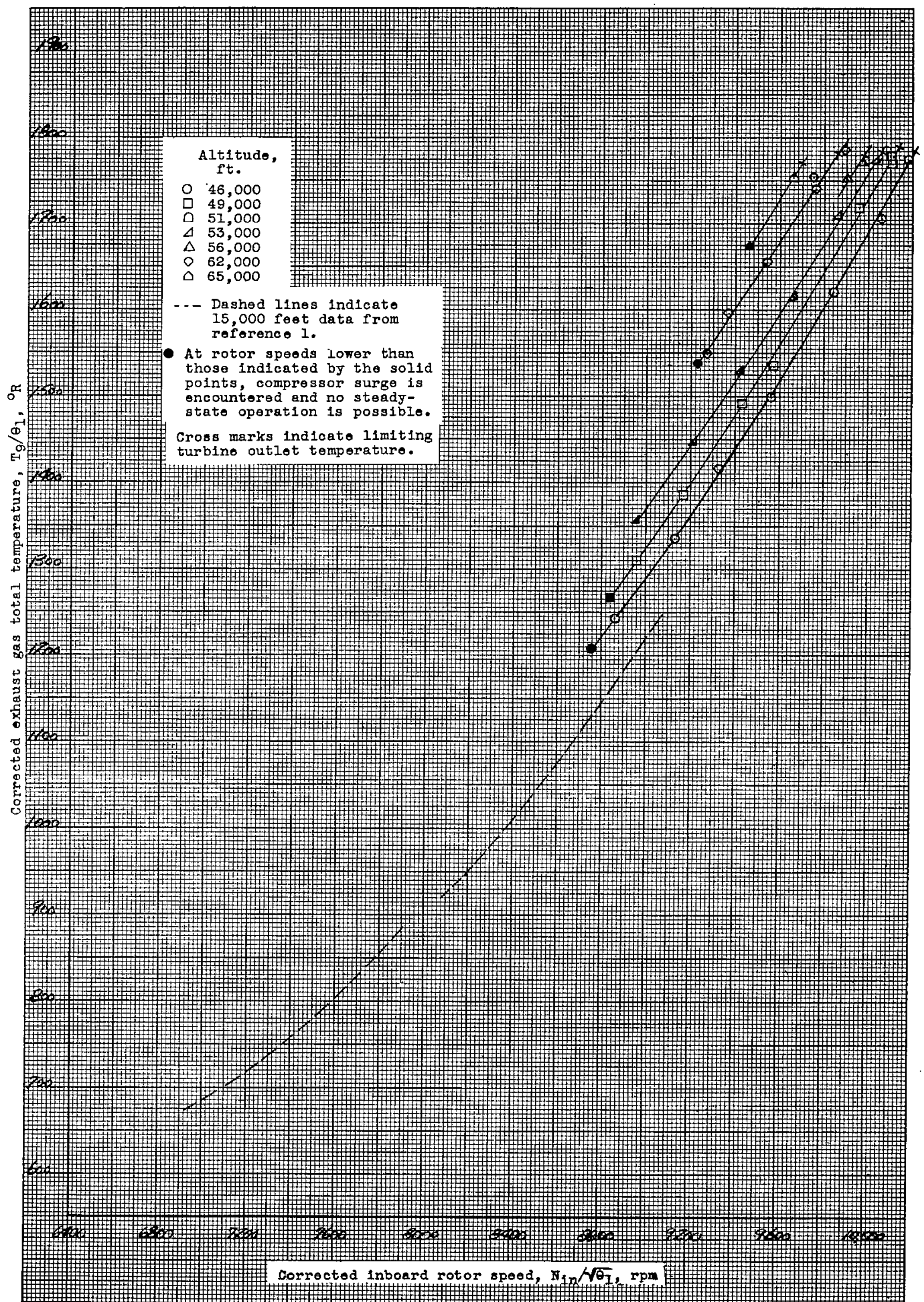
(c) Engine operation with both compressor bleed ports open.

Figure 4. - The variation of corrected **fuel flow** with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



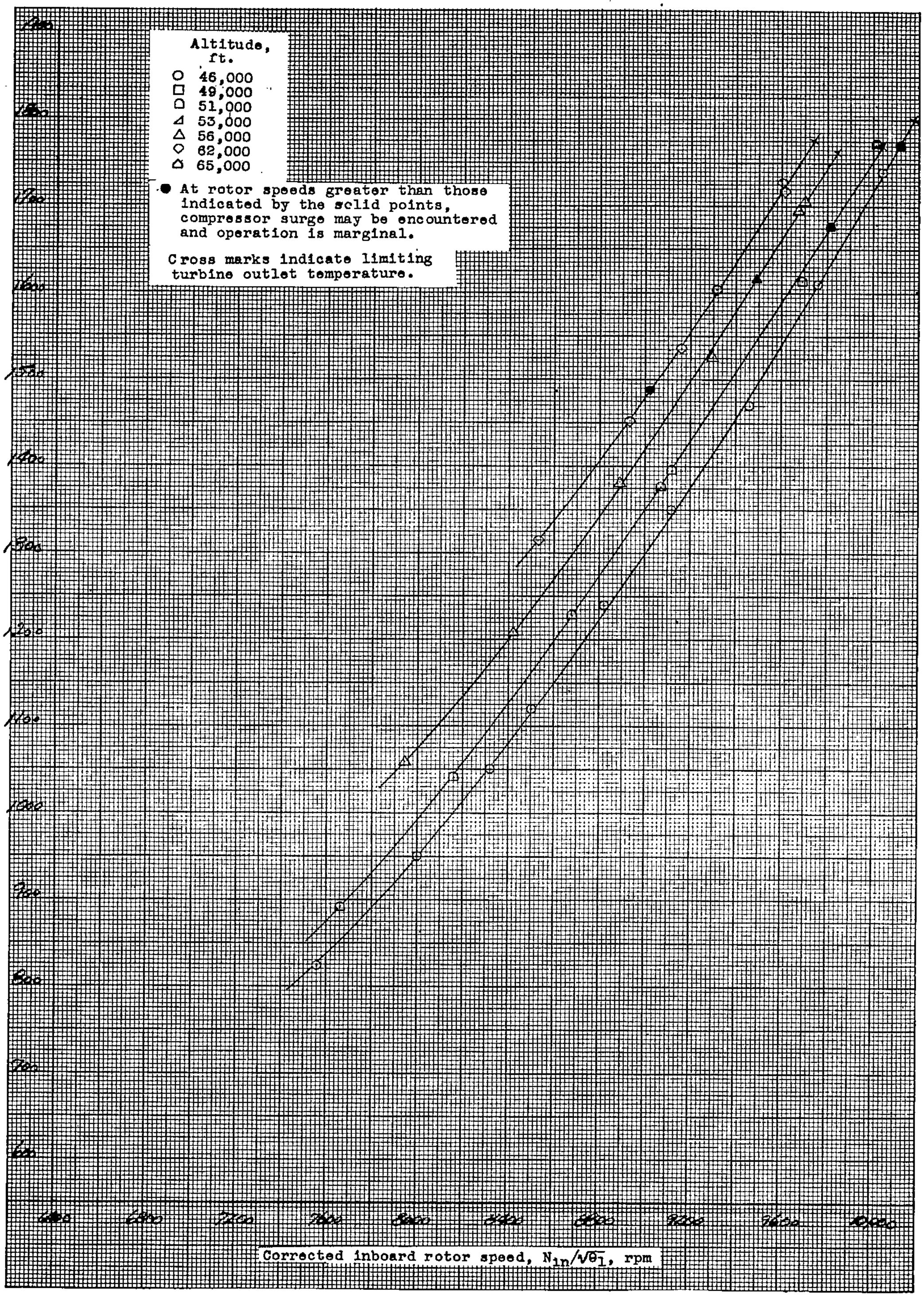
(d) Engine operation with the automatic control.

Figure 4. - The variation of corrected fuel flow with altitude at a flight Mach number of 0.81. Engine automatic control throttle settings of maximum and idle.



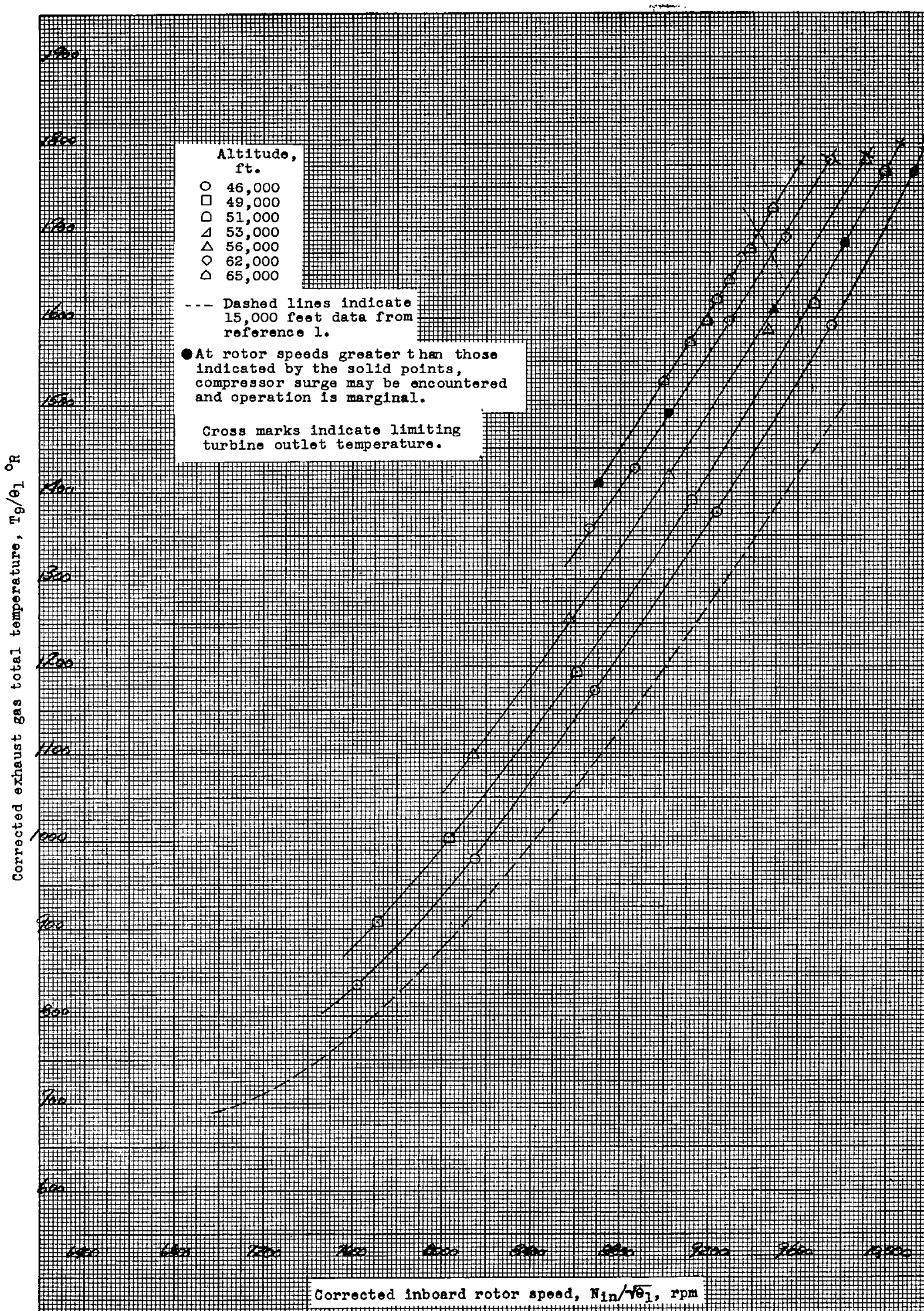
(a) Engine operation with both compressor bleed ports closed.

Figure 5. - The variation of corrected **exhaust-gas total temperature** with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



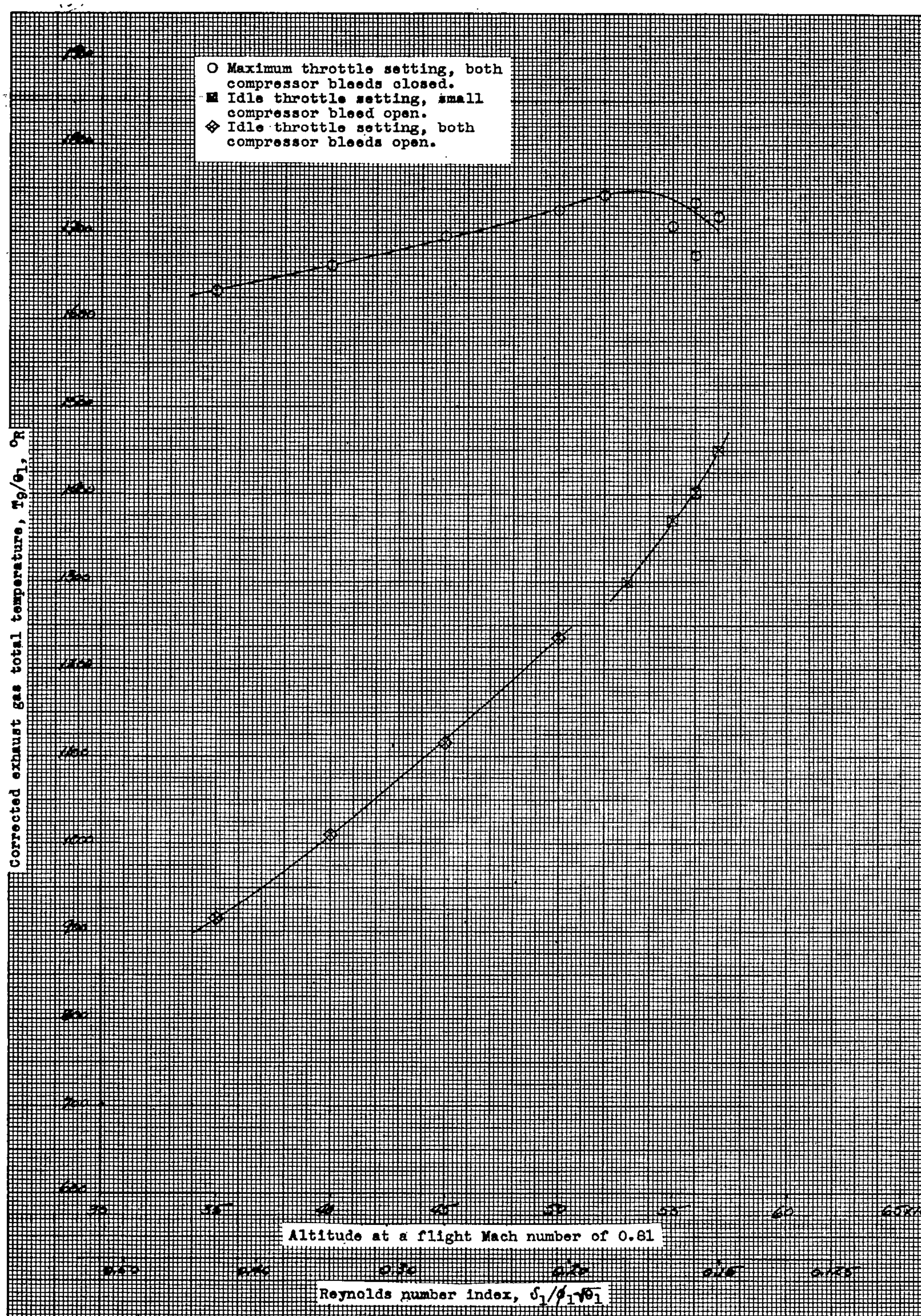
(b) Engine operation with the large compressor bleed port open.

Figure 5. - The variation of corrected exhaust-gas total temperature with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



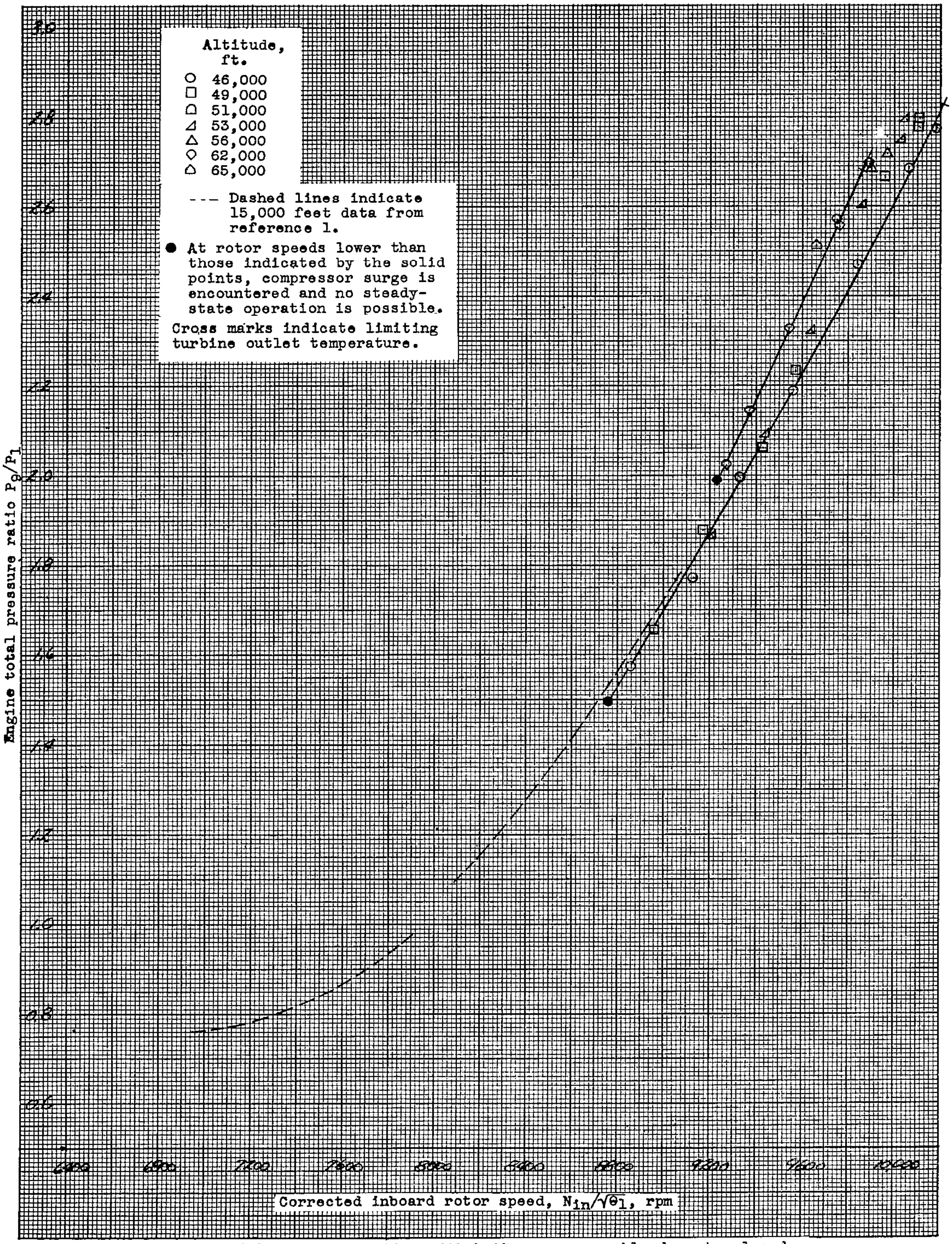
(c) Engine operation with both compressor bleed ports open.

Figure 5. - The variation of corrected exhaust-gas total temperature with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



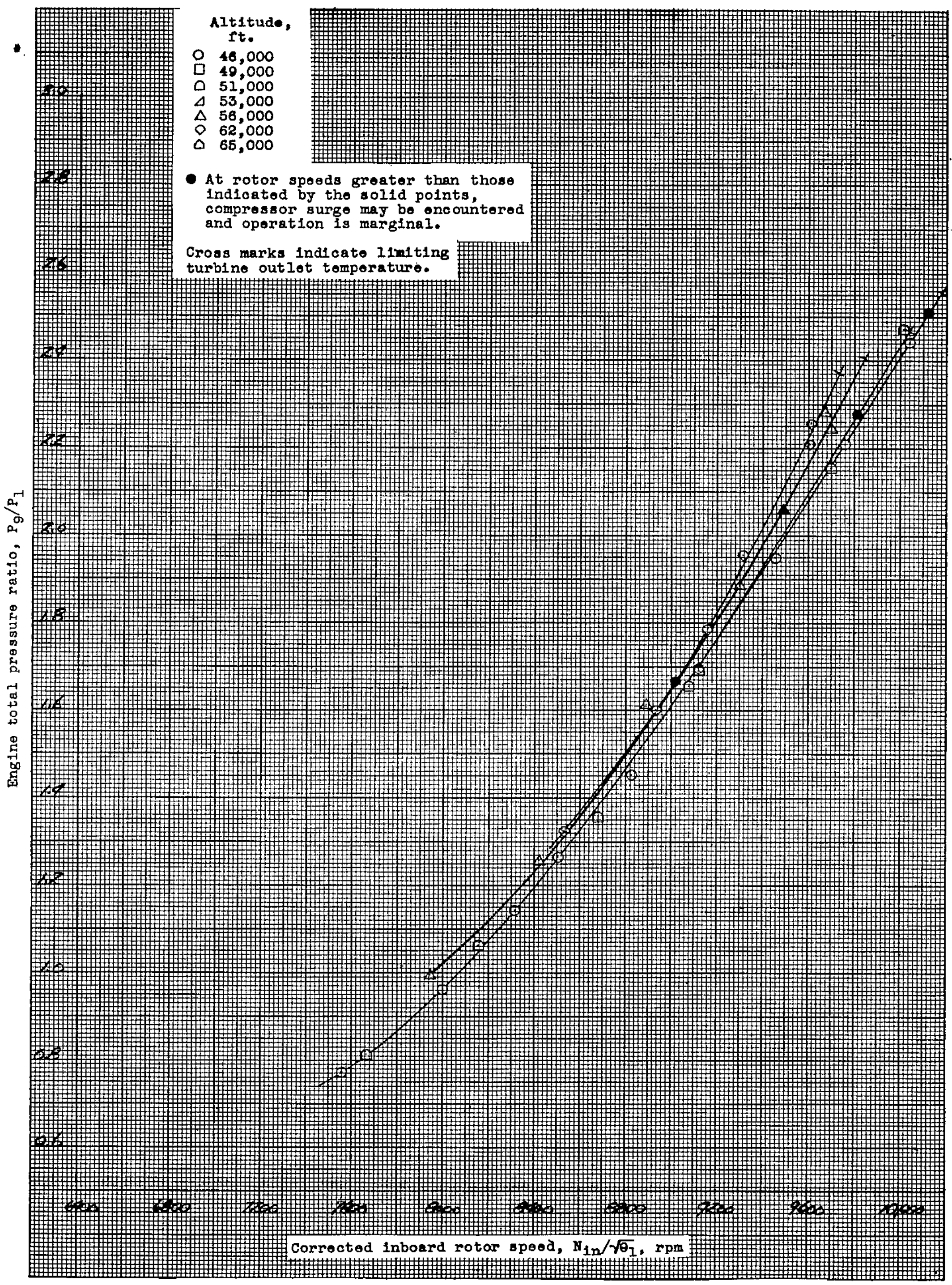
(d) Engine operation with the automatic control.

Figure 5. - The variation of corrected exhaust-gas total temperature with altitude at a flight Mach number of 0.81. Engine automatic control throttle settings of maximum and idle.



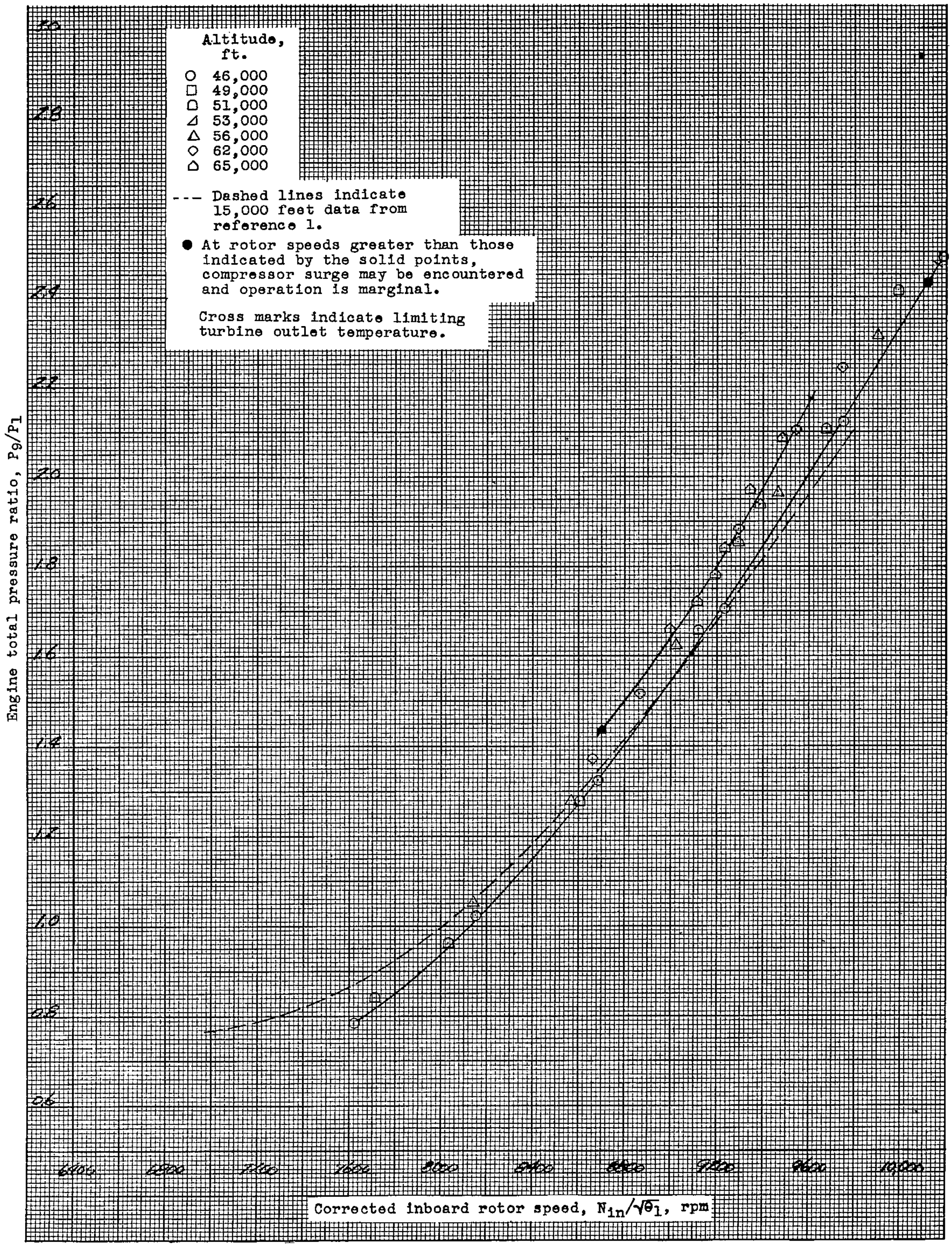
(a) Engine operation with both compressor bleed ports closed.

Figure 6. - The variation of engine total pressure ratio with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



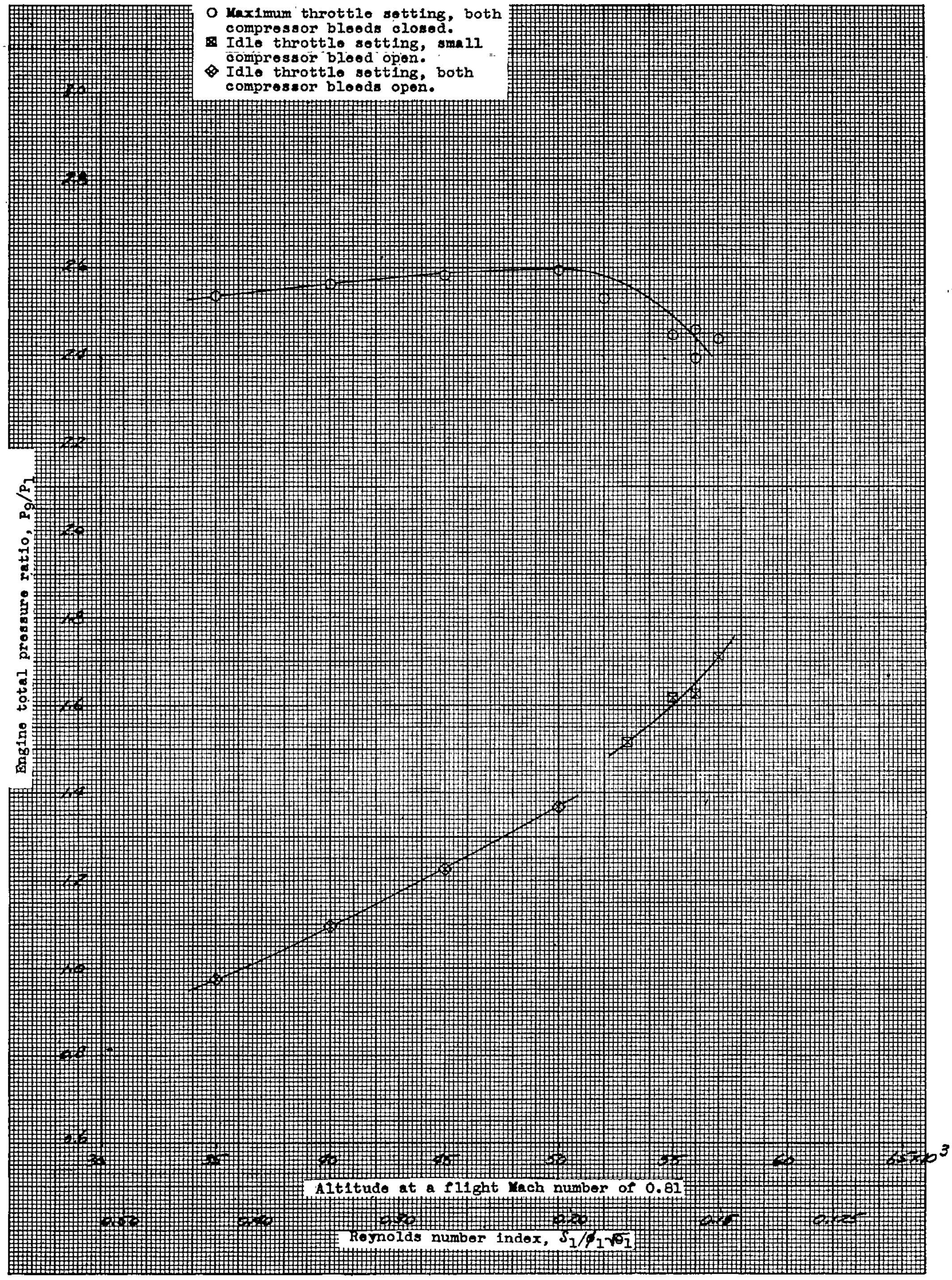
(b) Engine operation with the large compressor bleed port open.

Figure 6. - The variation of engine total pressure ratio with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



(c) Engine operation with both compressor bleed ports open.

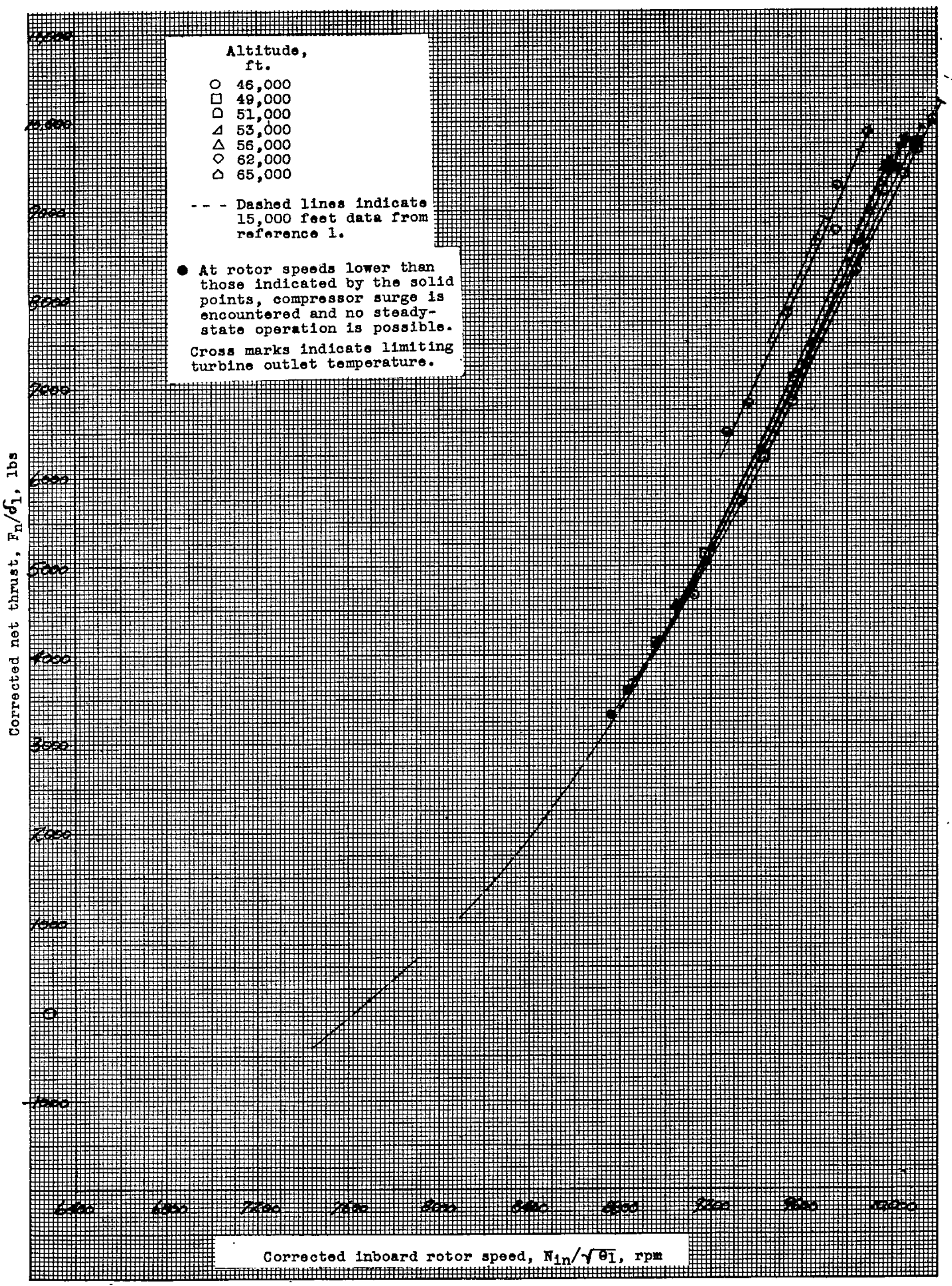
Figure 6. - The variation of engine total pressure ratio with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



(d) Engine operation with the automatic control.

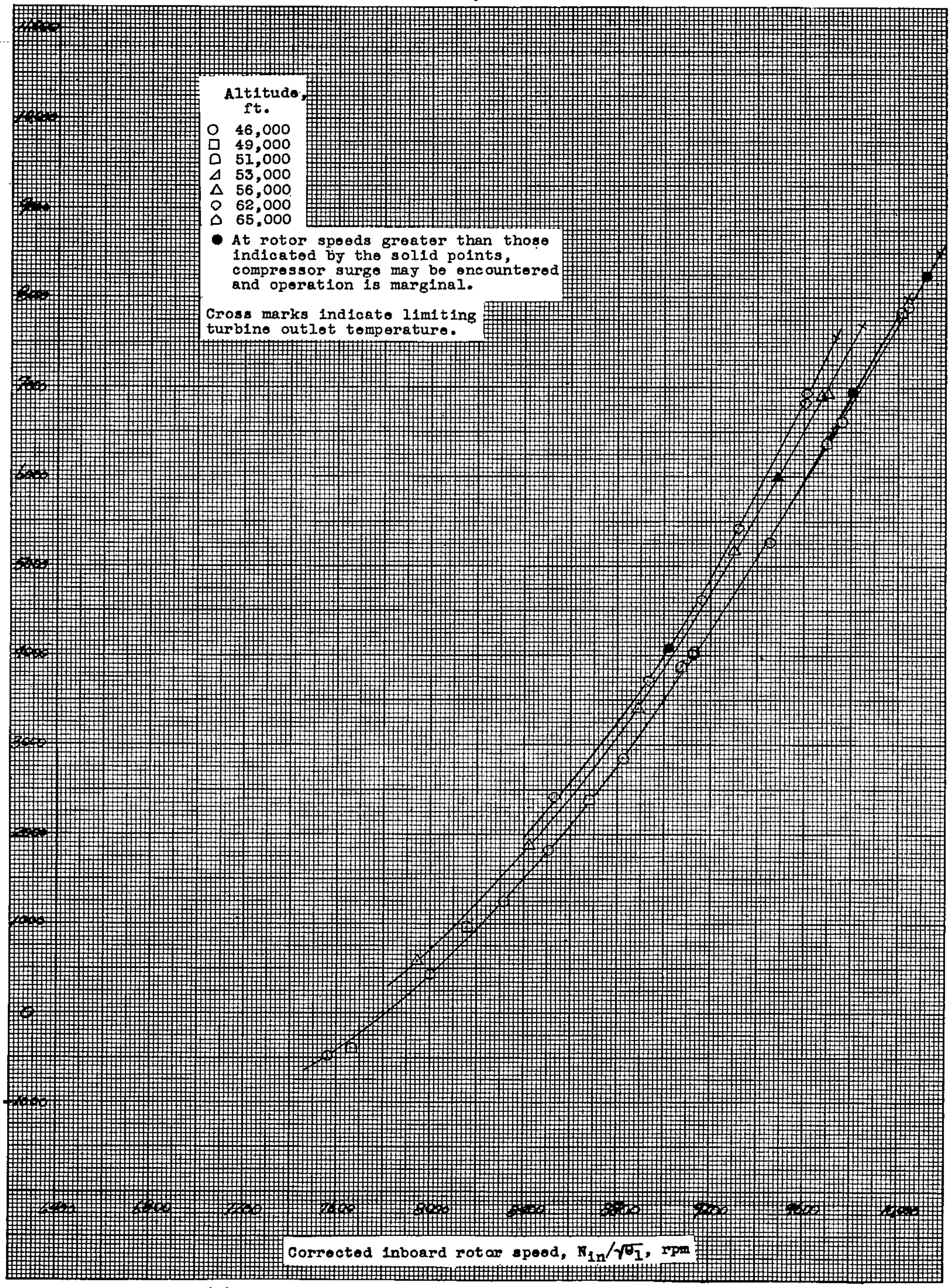
Figure 6. - The variation of engine total pressure ratio with altitude at a flight Mach number of 0.81. Engine automatic control throttle settings of maximum and idle.

[redacted]



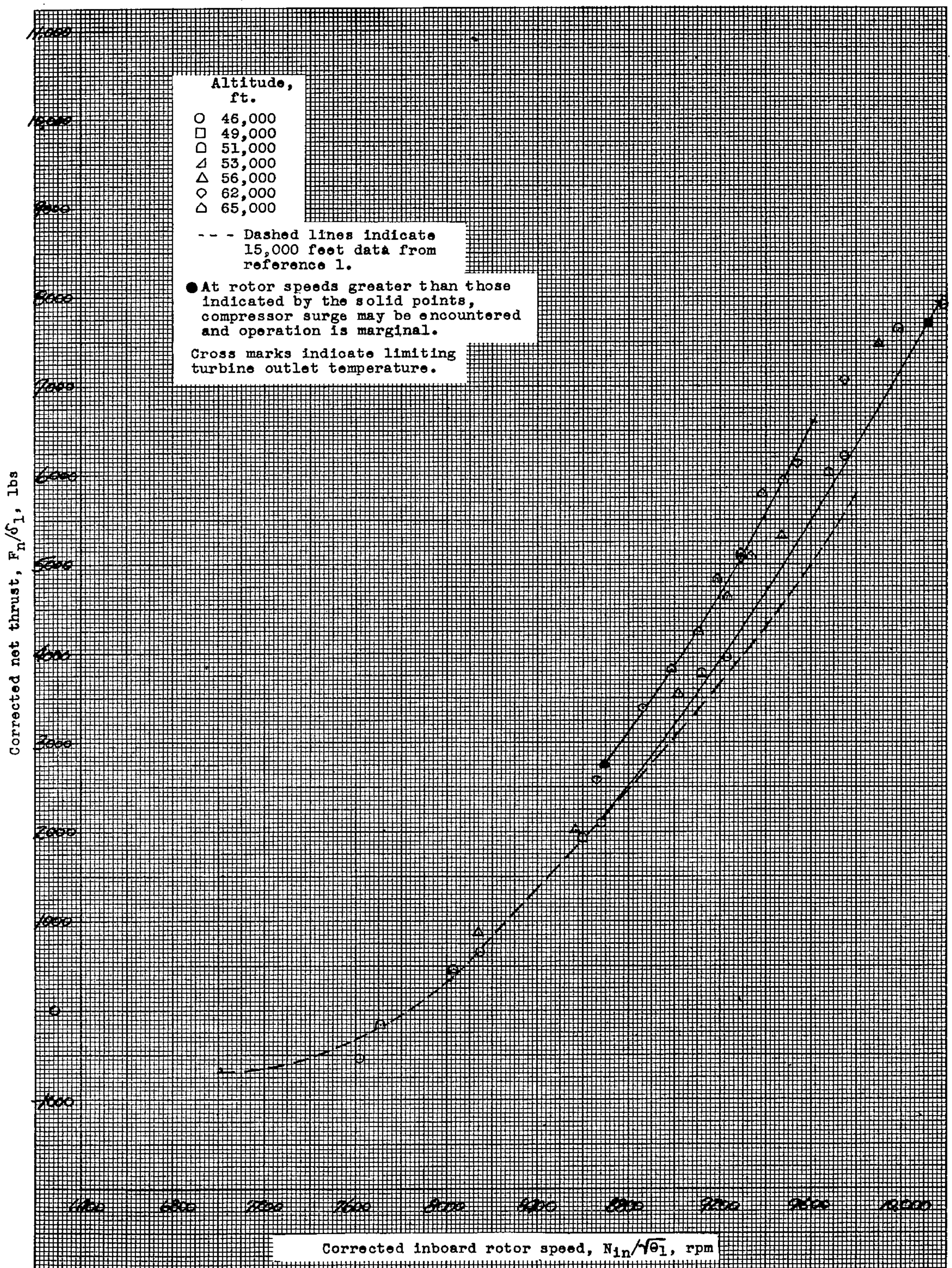
(a) Engine operation with both compressor bleed ports closed.

Figure 7. - The variation of corrected net thrust with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



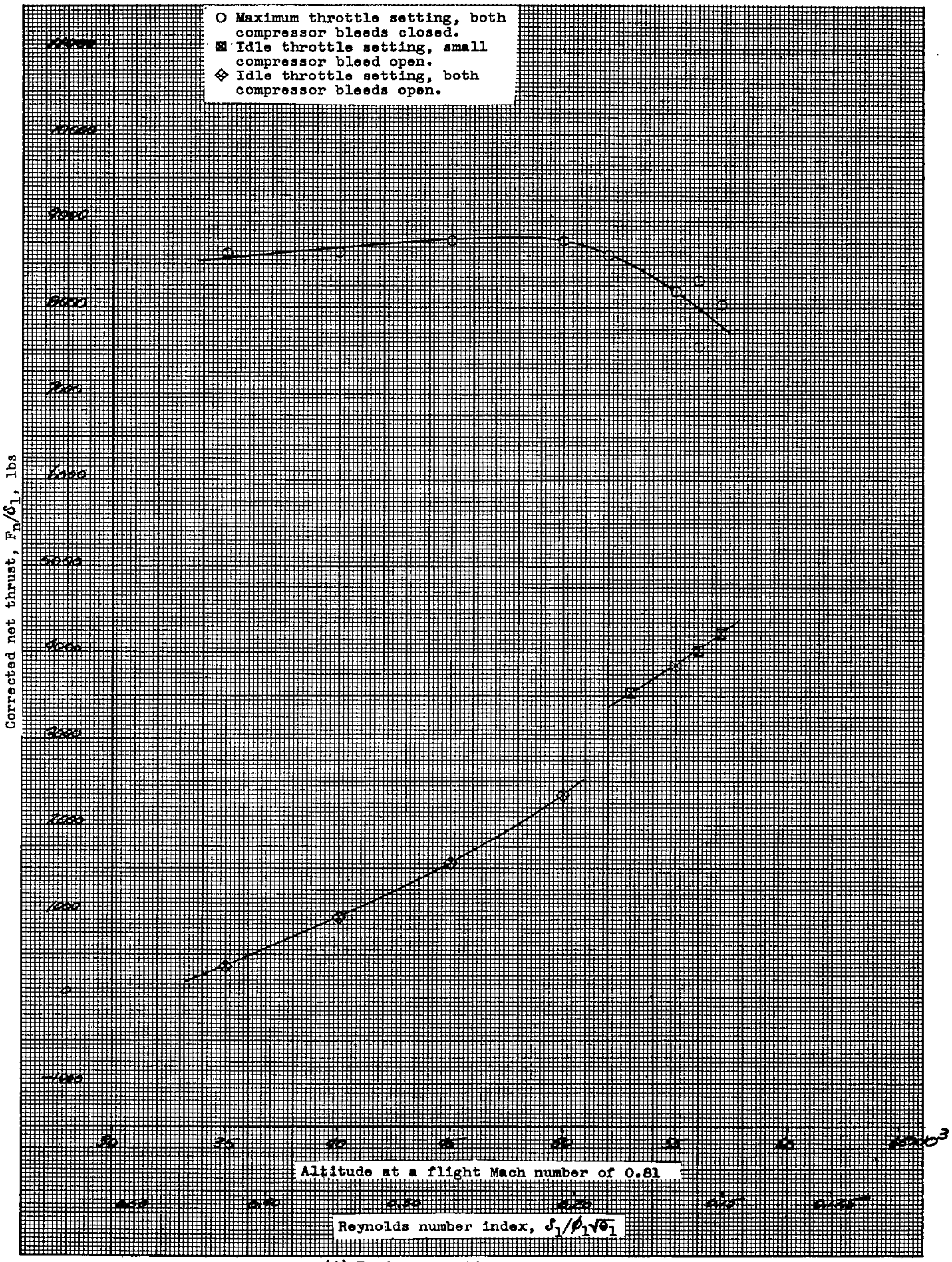
(b) Engine operation with the large compressor bleed port open.

Figure 7. - The variation of corrected **net thrust** with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



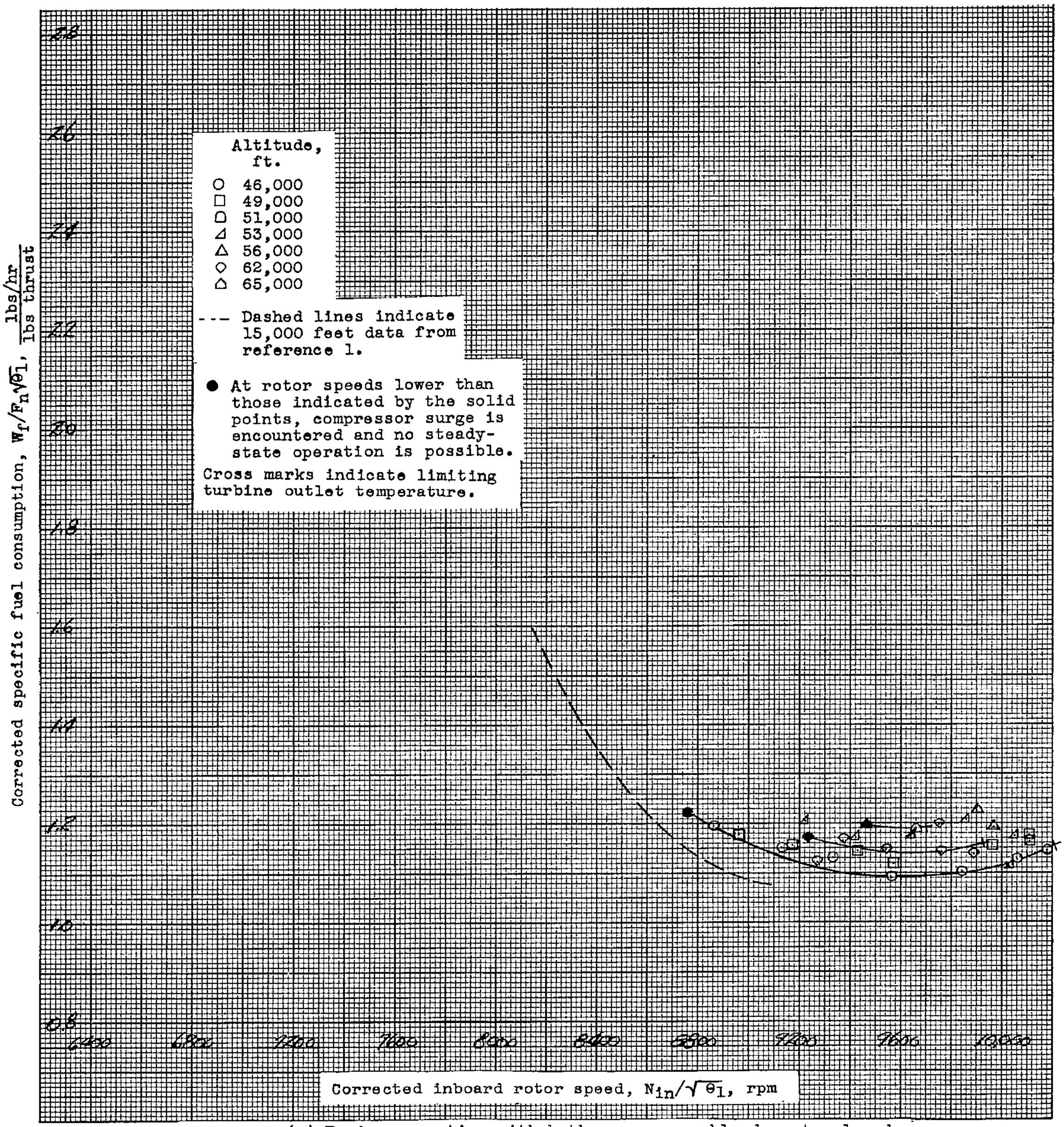
(c) Engine operation with both compressor bleed ports open.

Figure 7. - The variation of corrected net thrust with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



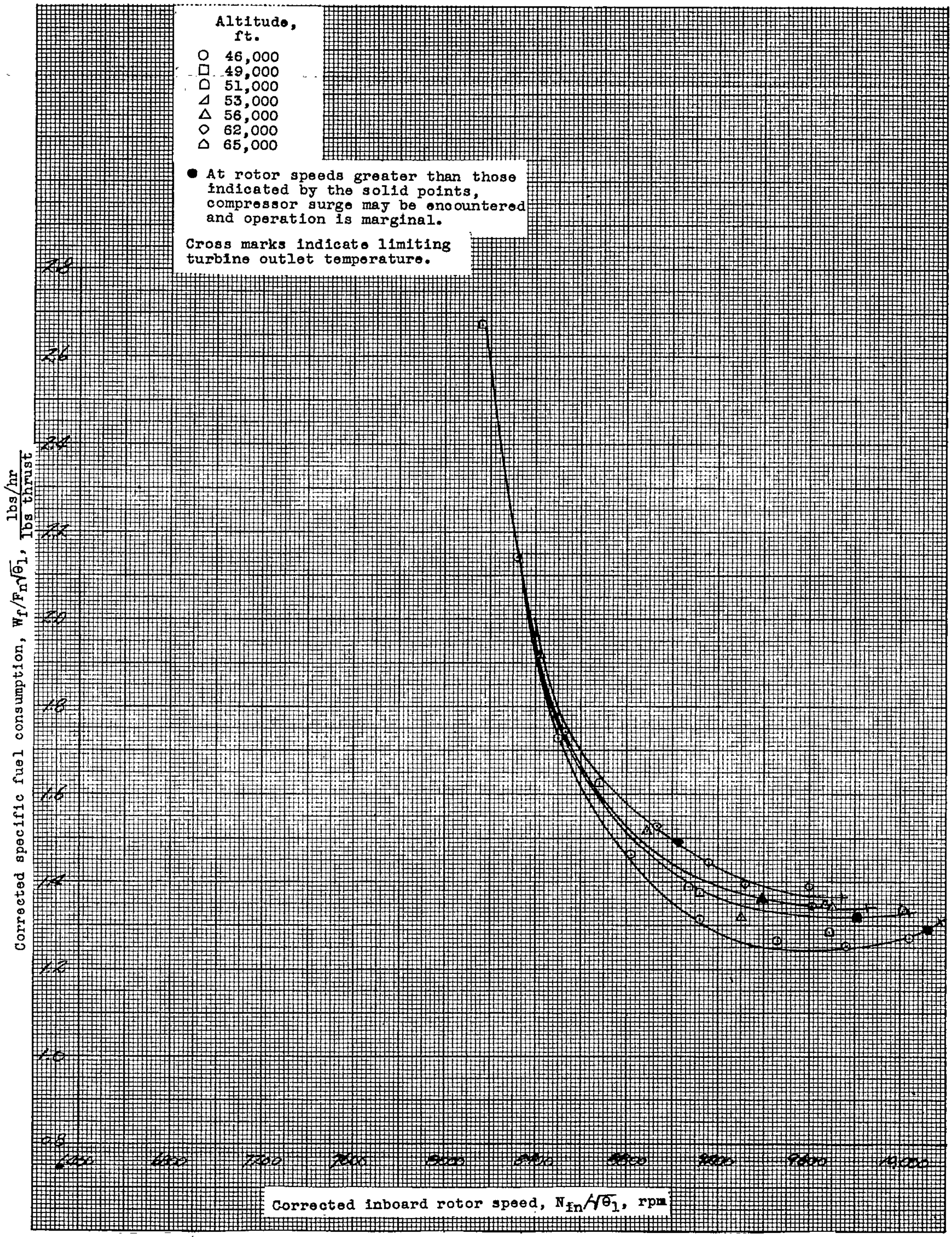
(d) Engine operation with the automatic control.

Figure 7. - The variation of corrected net thrust with altitude at a flight Mach number of 0.81. Engine automatic control throttle settings of maximum and idle.



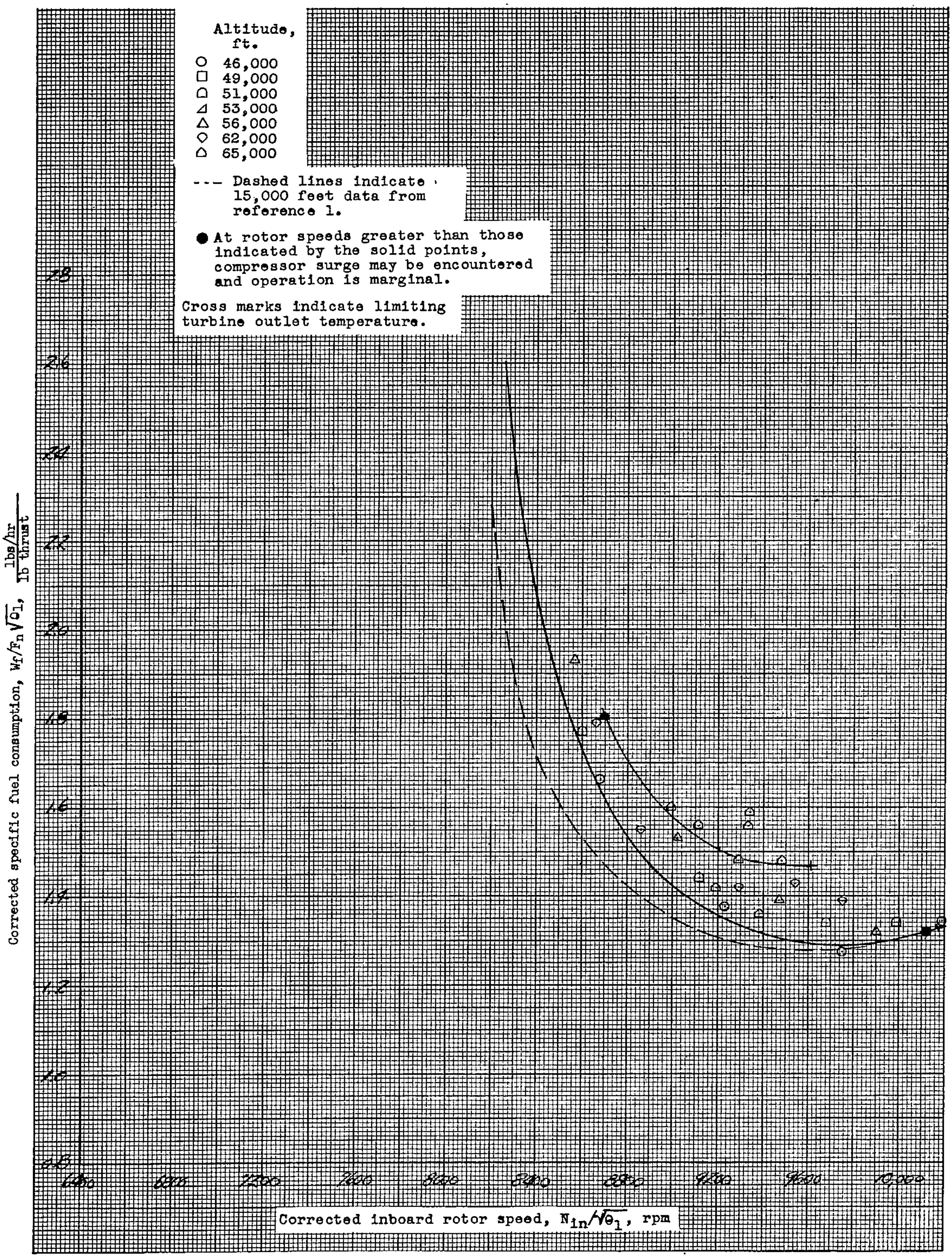
(a) Engine operation with both compressor bleed ports closed.

Figure 8. - The variation of corrected **specific fuel consumption** with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



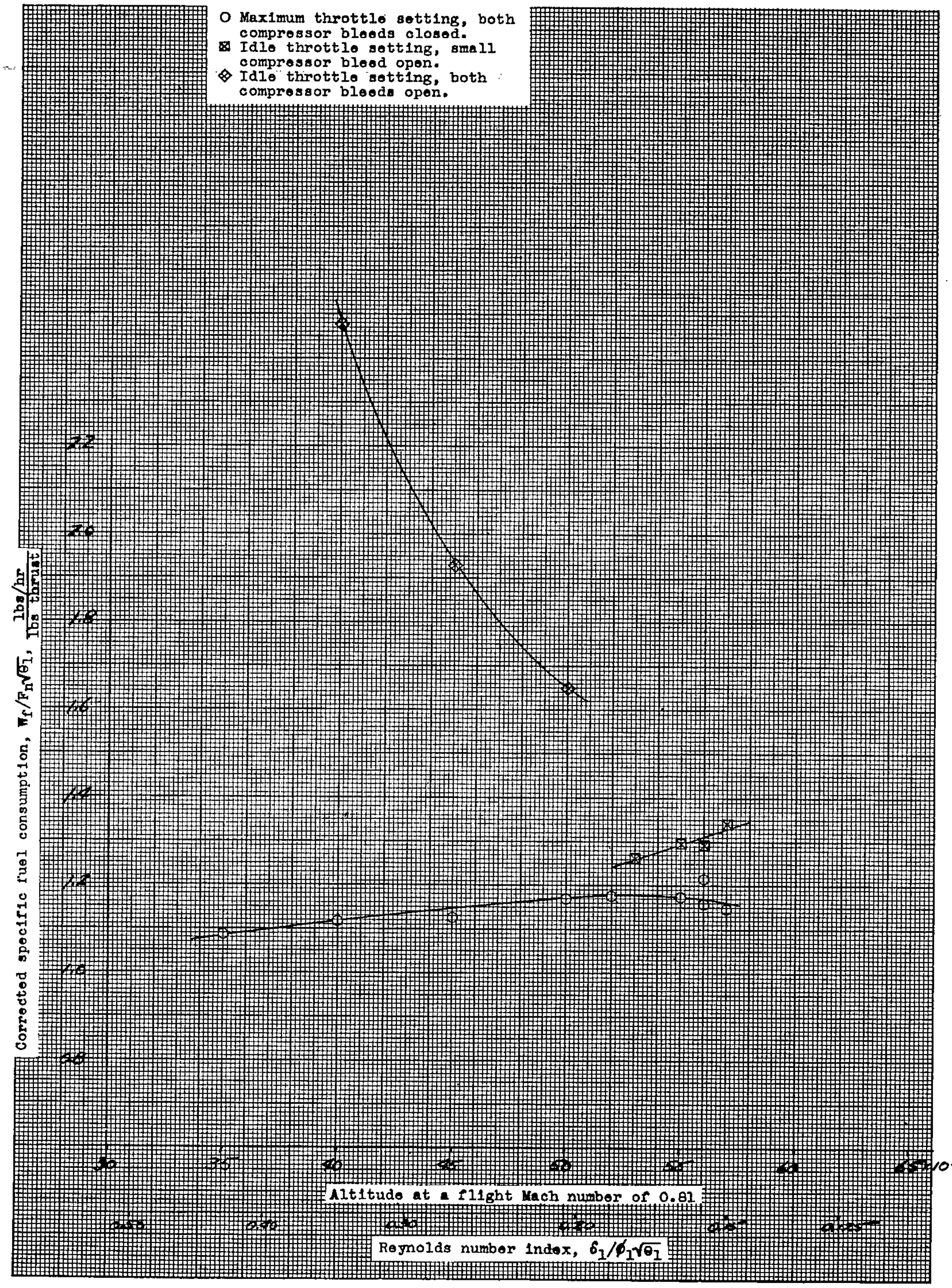
(b) Engine operation with the large compressor bleed port open.

Figure 8. - The variation of corrected specific fuel consumption with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



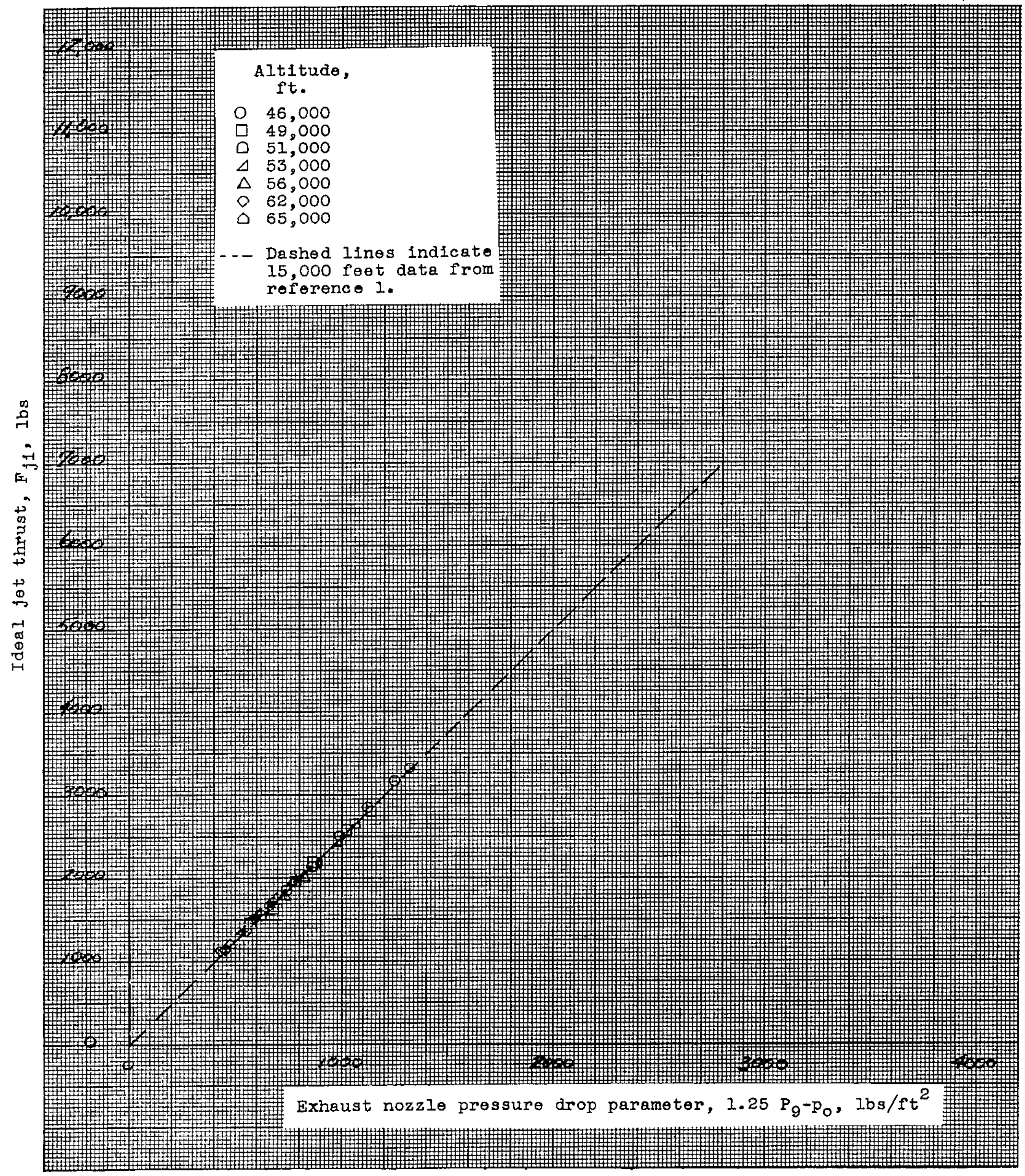
(c) Engine operation with both compressor bleed ports open.

Figure 8. - The variation of corrected **specific fuel consumption** with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



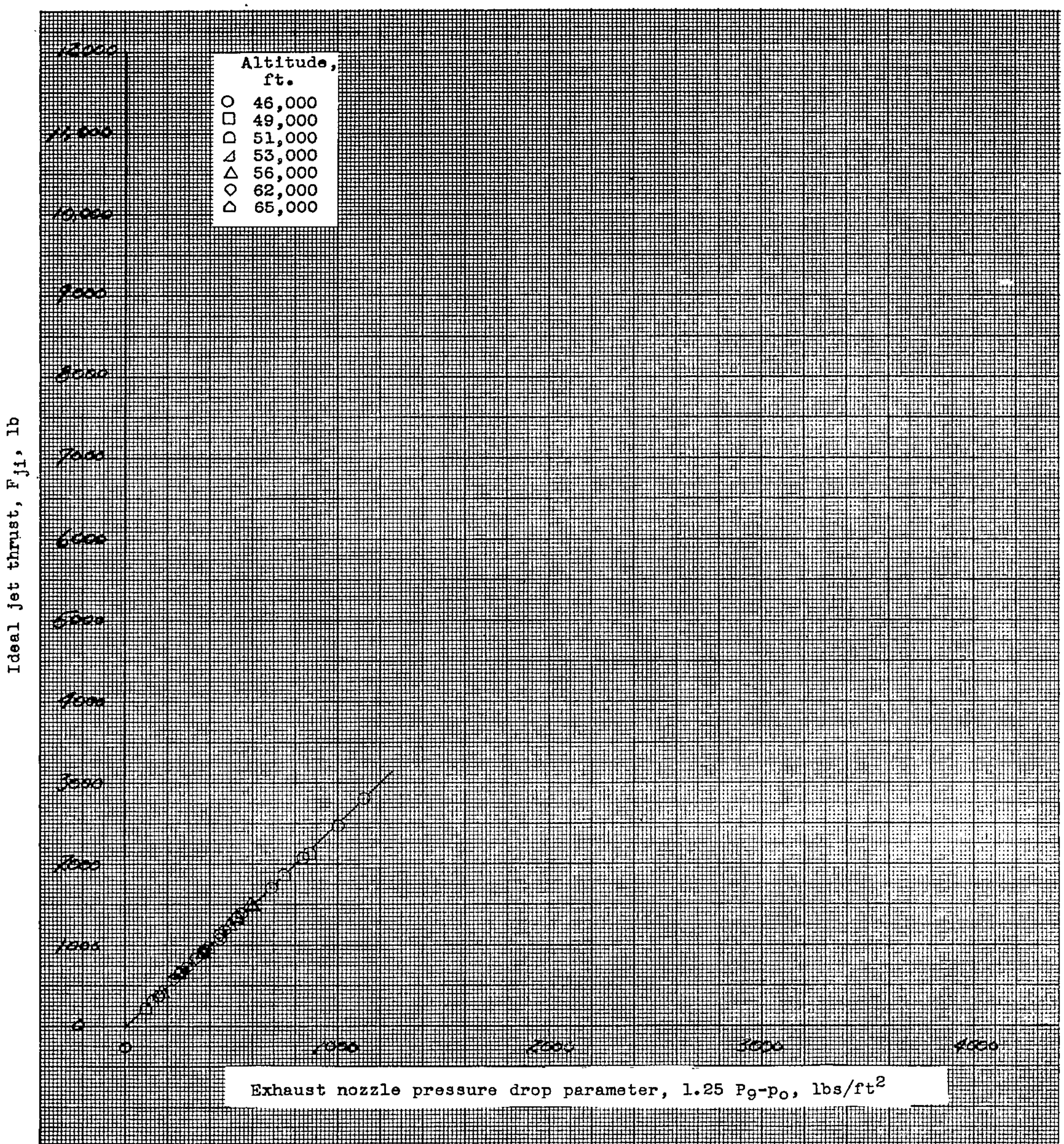
(d) Engine operation with the automatic control.

Figure 8. - The variation of corrected specific fuel consumption with altitude at a flight Mach number of 0.81. Engine automatic control throttle settings of maximum and idle.



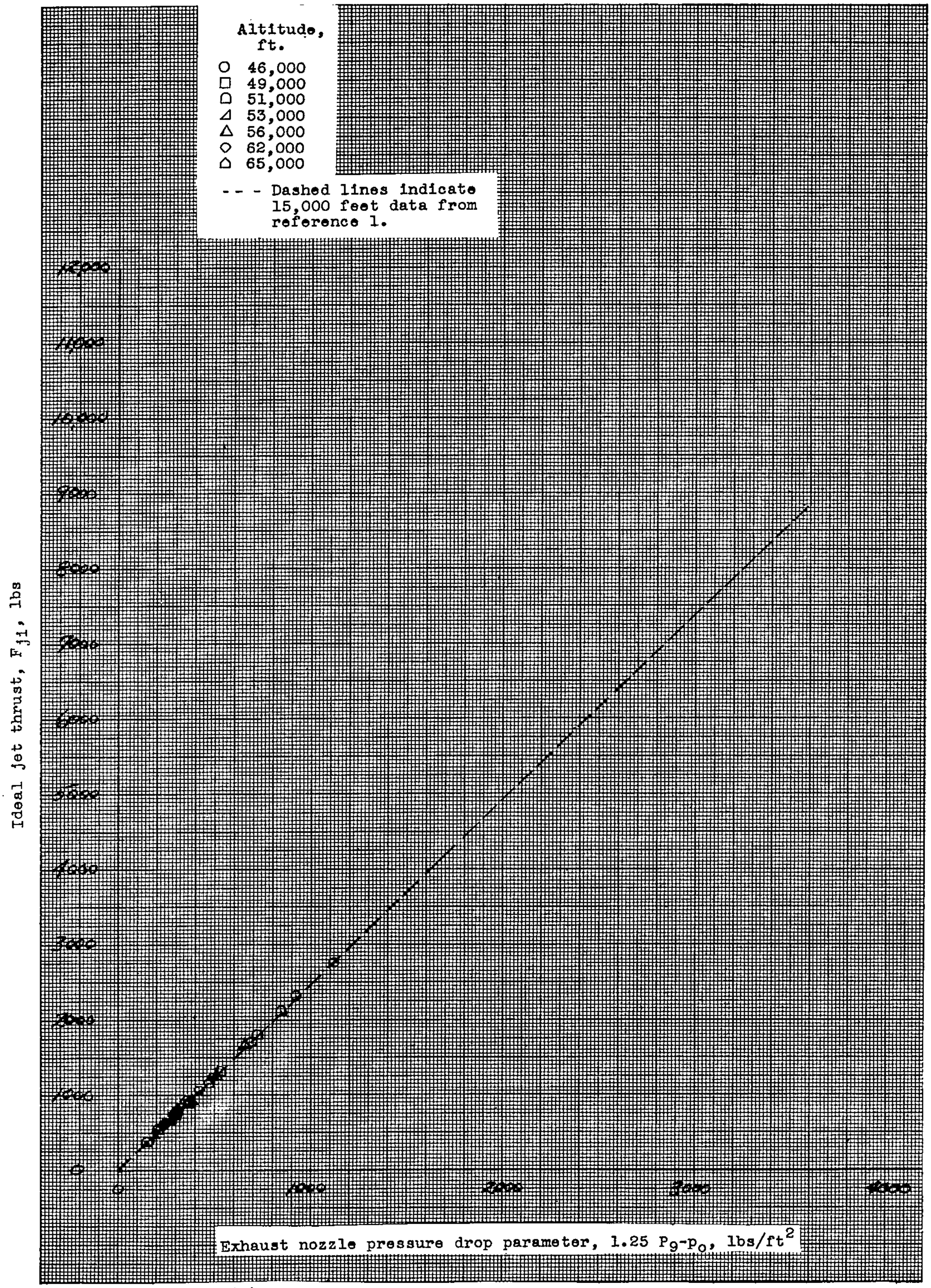
(a) Engine operation with both compressor bleed ports closed.

Figure 9. - The variation of ideal jet thrust with exhaust nozzle pressure drop parameter over a range of altitudes. Flight Mach number 0.81.



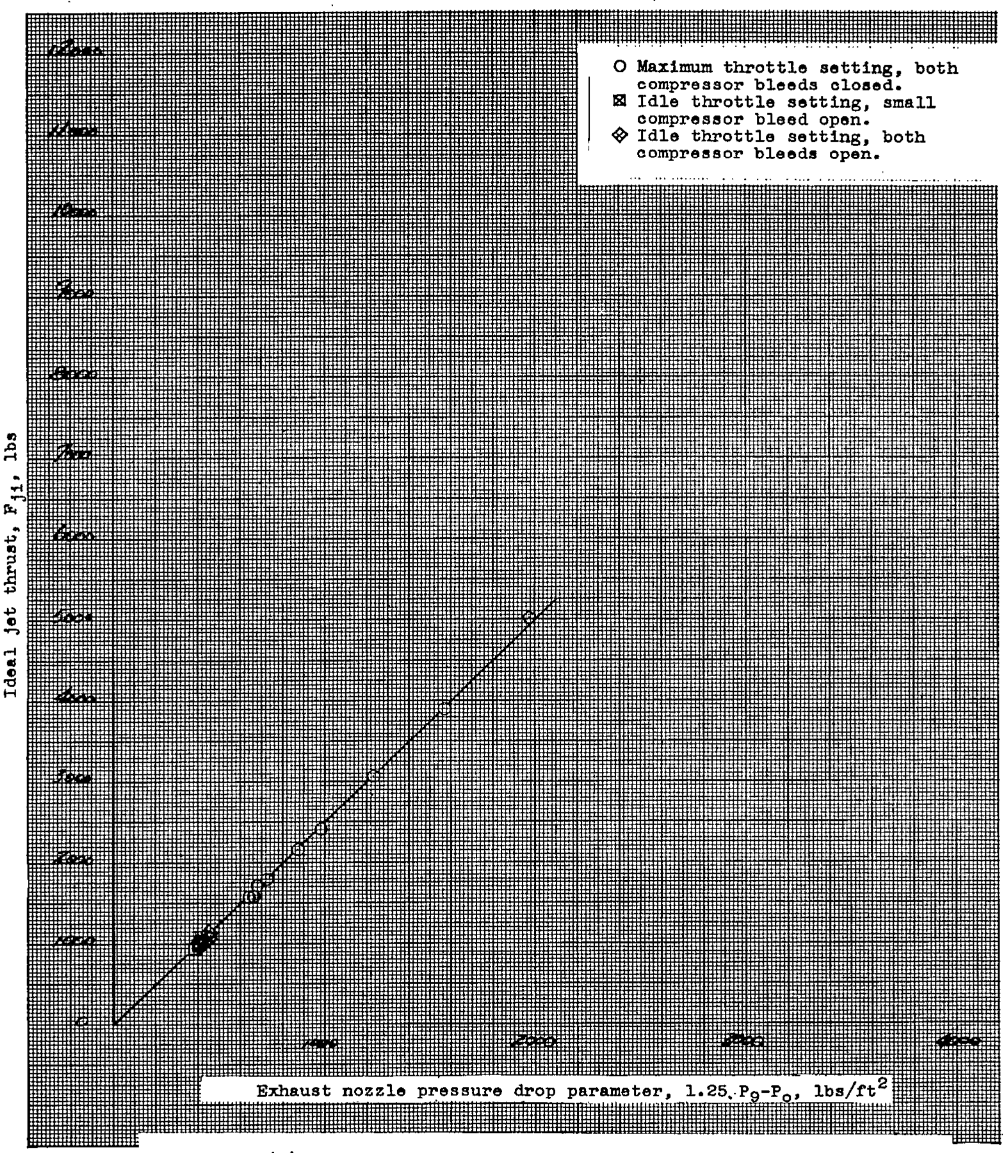
(b) Engine operation with the large compressor bleed port open.

Figure 9. - The variation of ideal jet thrust with exhaust nozzle pressure drop parameter over a range of altitudes. Flight Mach number 0.81.



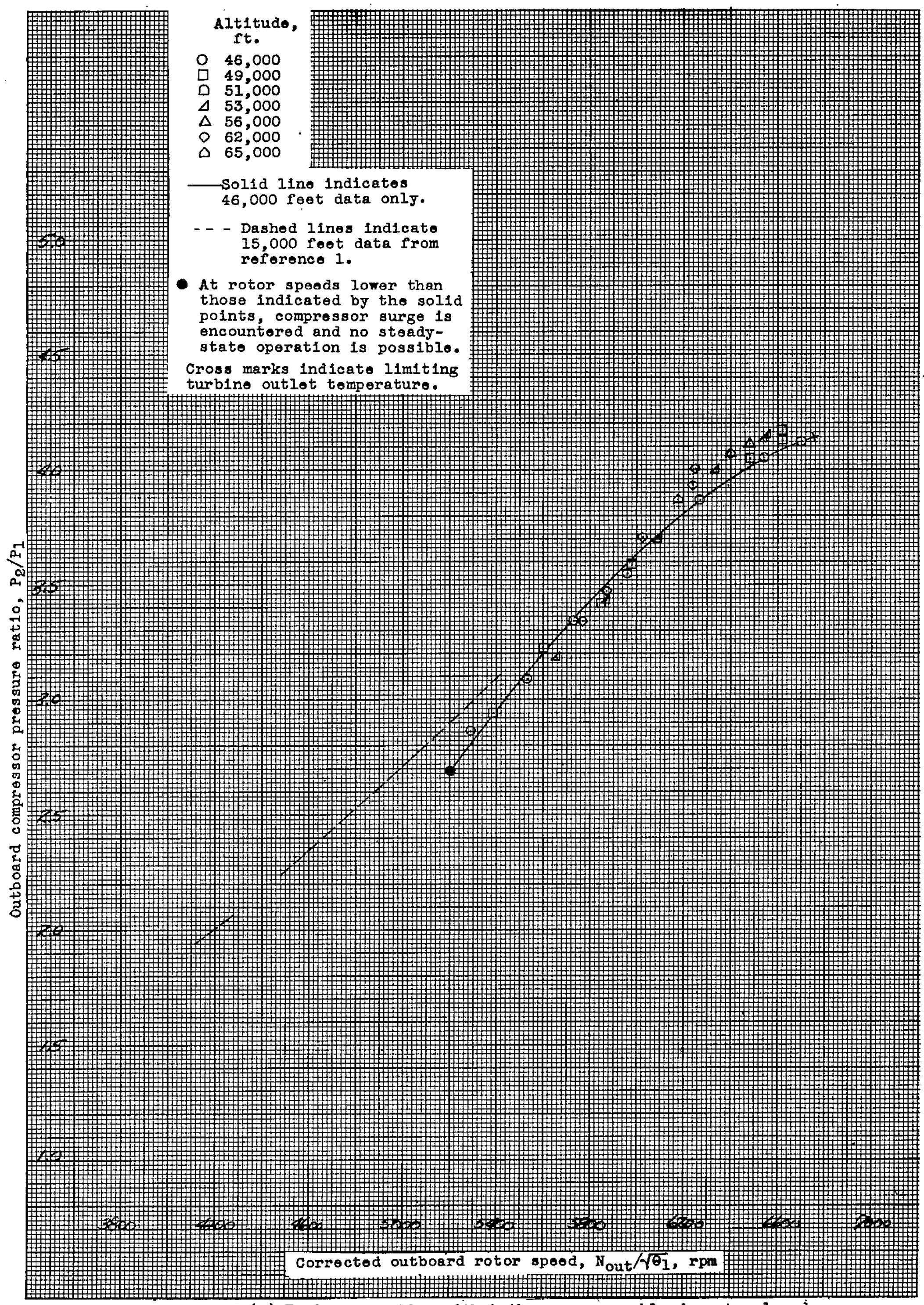
(c) Engine operation with both compressor bleed ports open.

Figure 9. - The variation of ideal jet thrust with exhaust nozzle pressure drop parameter over a range of altitudes. Flight Mach number 0.81.



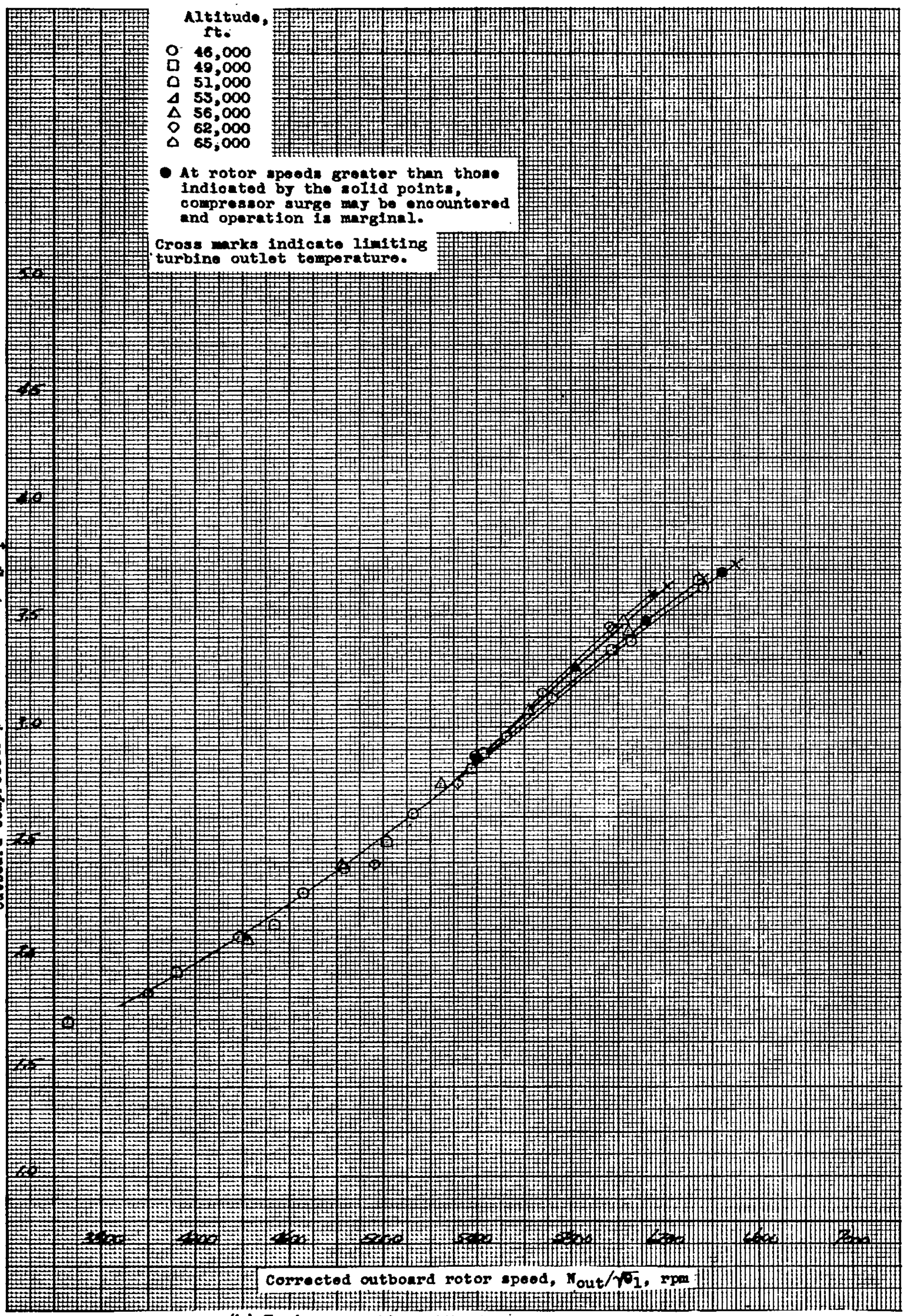
(d) Engine operation with the automatic control.

Figure 9. - The variation of ideal jet thrust with exhaust nozzle pressure drop parameter over a range of altitudes. Flight Mach number 0.81. Engine automatic control throttle settings of maximum and idle.



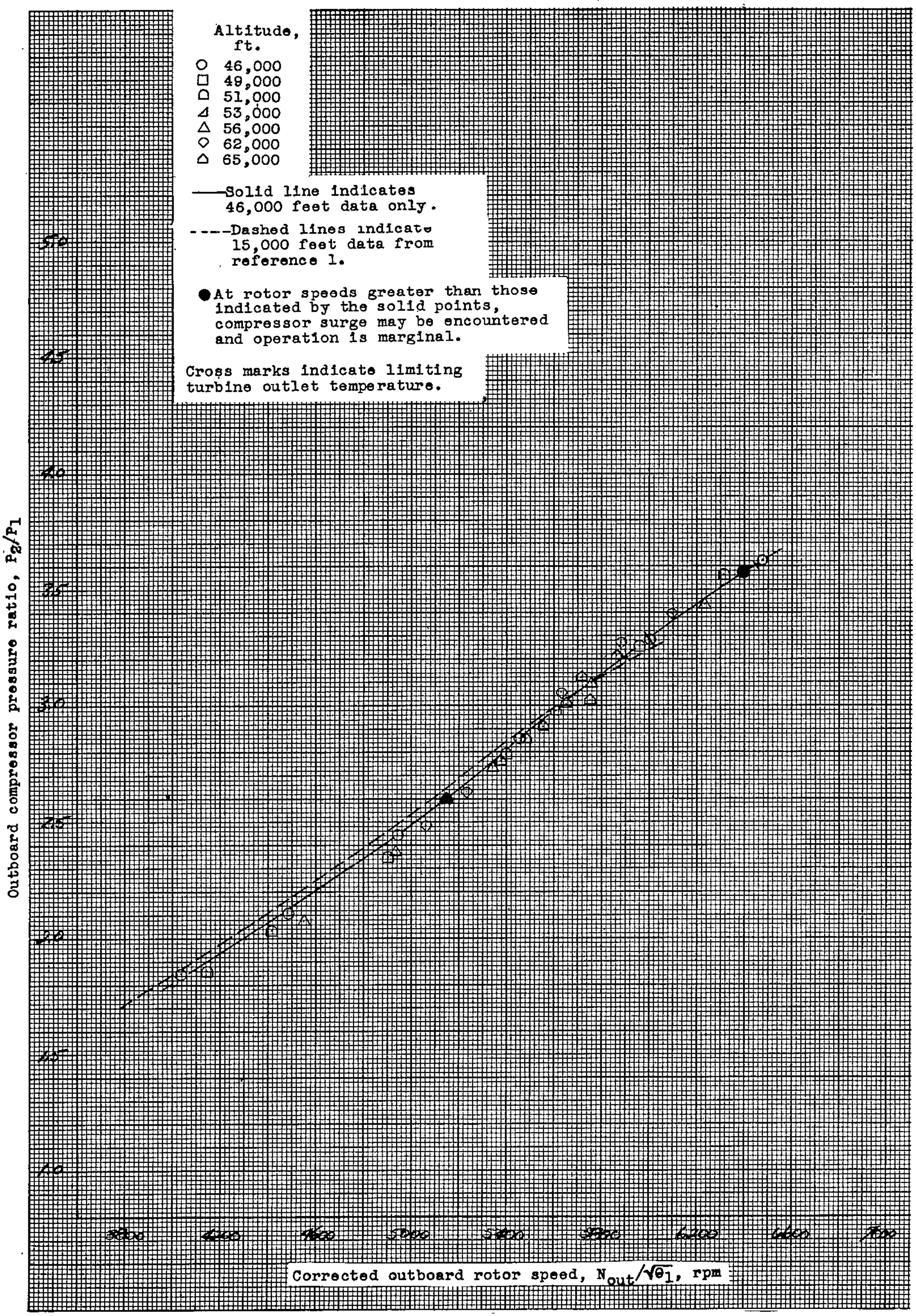
(a) Engine operation with both compressor bleed ports closed.

Figure 10. - The variation of outboard compressor pressure ratio with corrected outboard rotor speed over a range of altitudes. Flight Mach number 0.81.



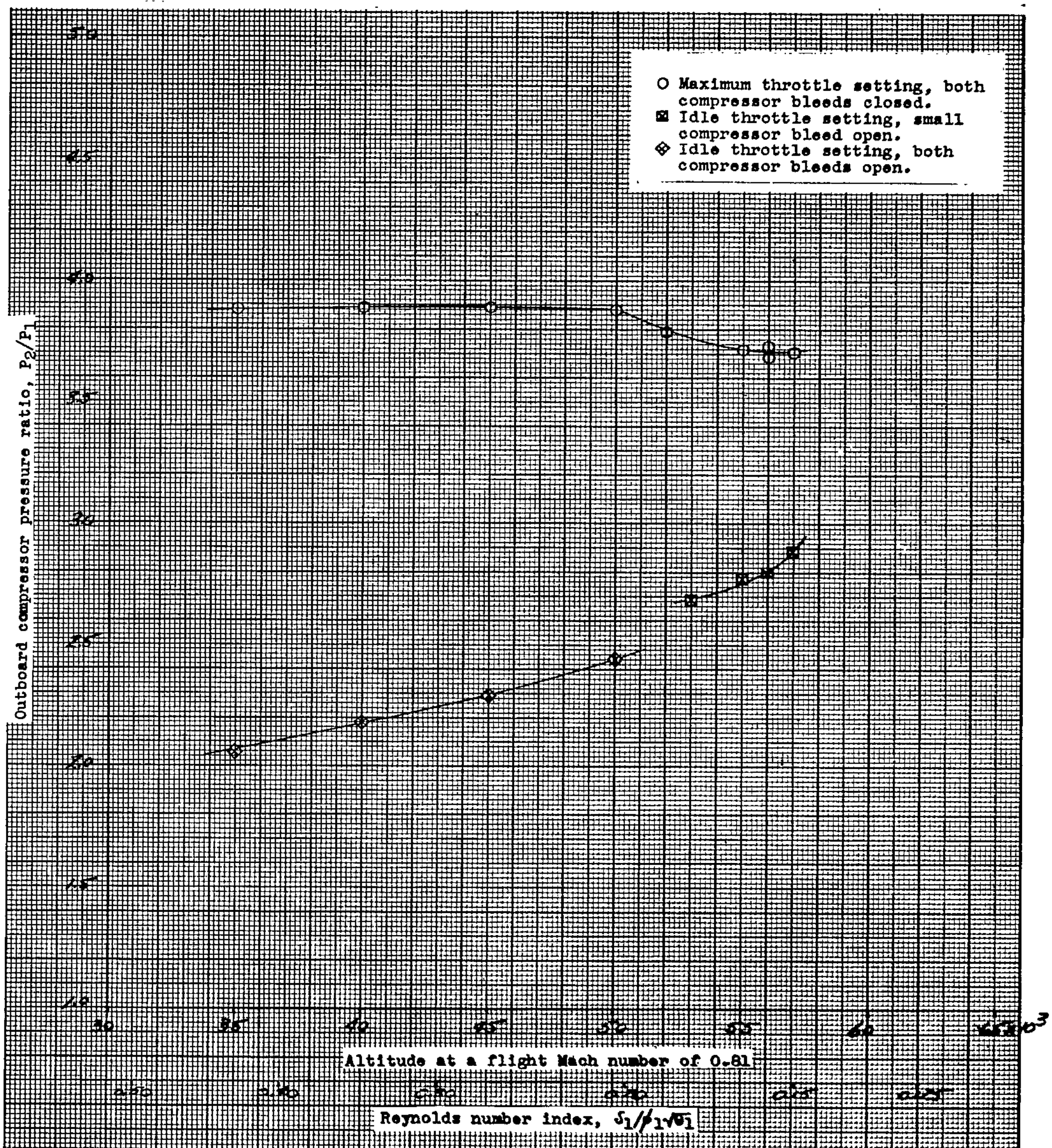
(b) Engine operation with the large compressor bleed port open.

Figure 10. - The variation of outboard compressor pressure ratio with corrected outboard rotor speed over a range of altitudes. Flight Mach number 0.81.



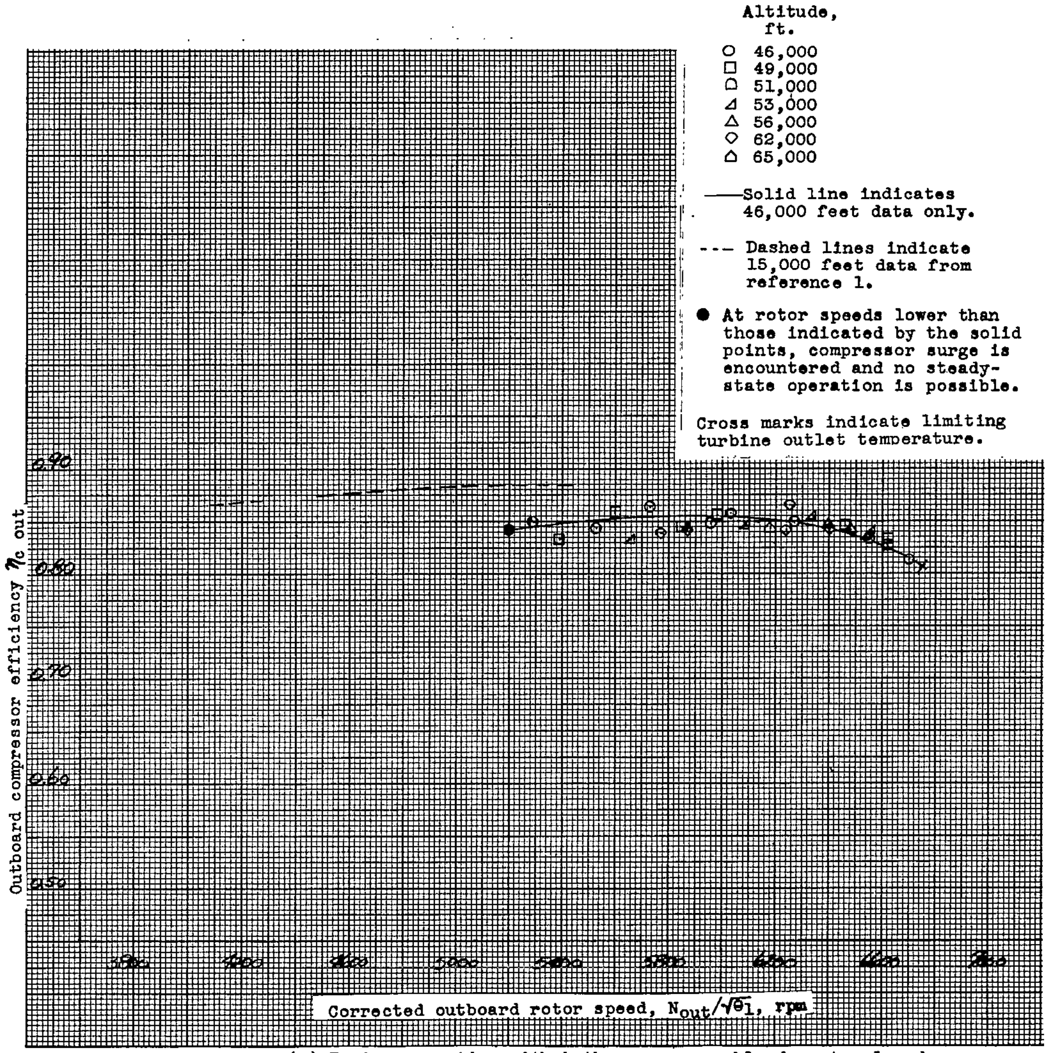
(c) Engine operation with both compressor bleed ports open.

Figure 10. - The variation of outboard compressor pressure ratio with corrected outboard rotor speed over a range of altitudes. Flight Mach number 0.81.



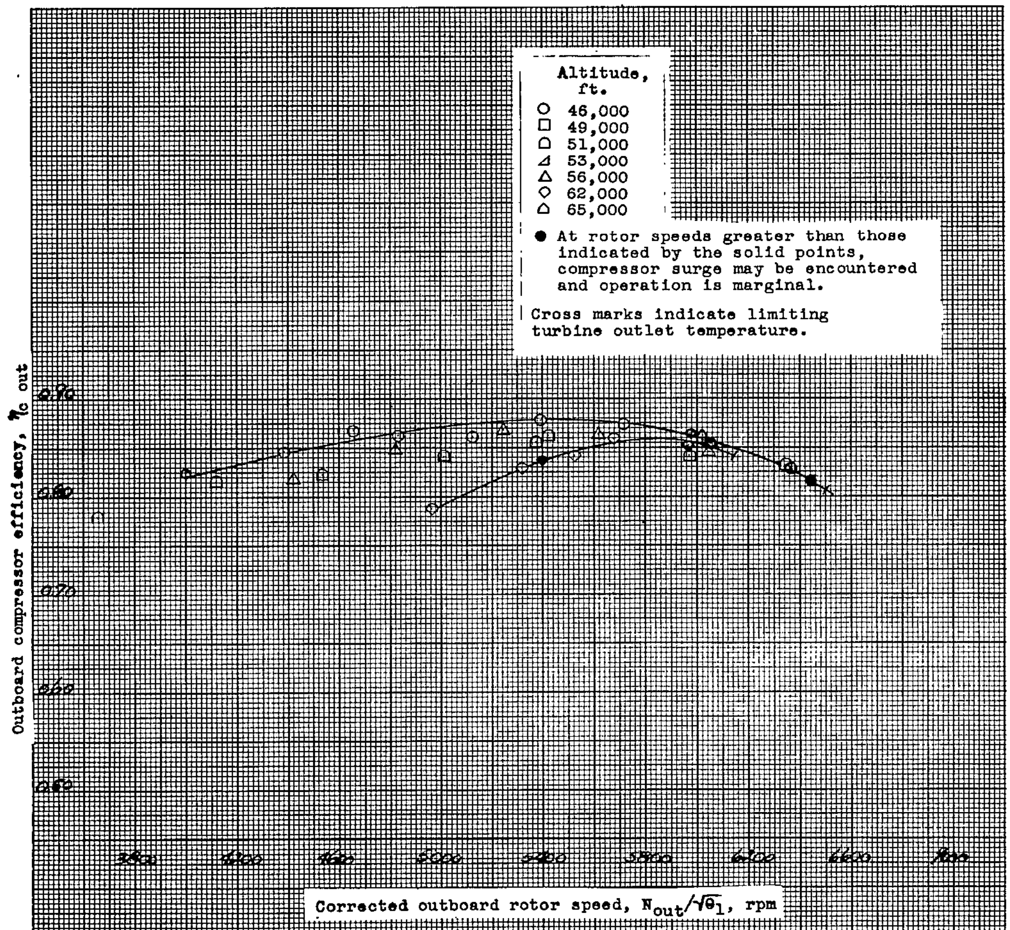
(d) Engine operation with the automatic control.

Figure 10. - The variation of outboard compressor pressure ratio with altitude at a flight Mach number of 0.81. Engine automatic control throttle settings of maximum and idle.



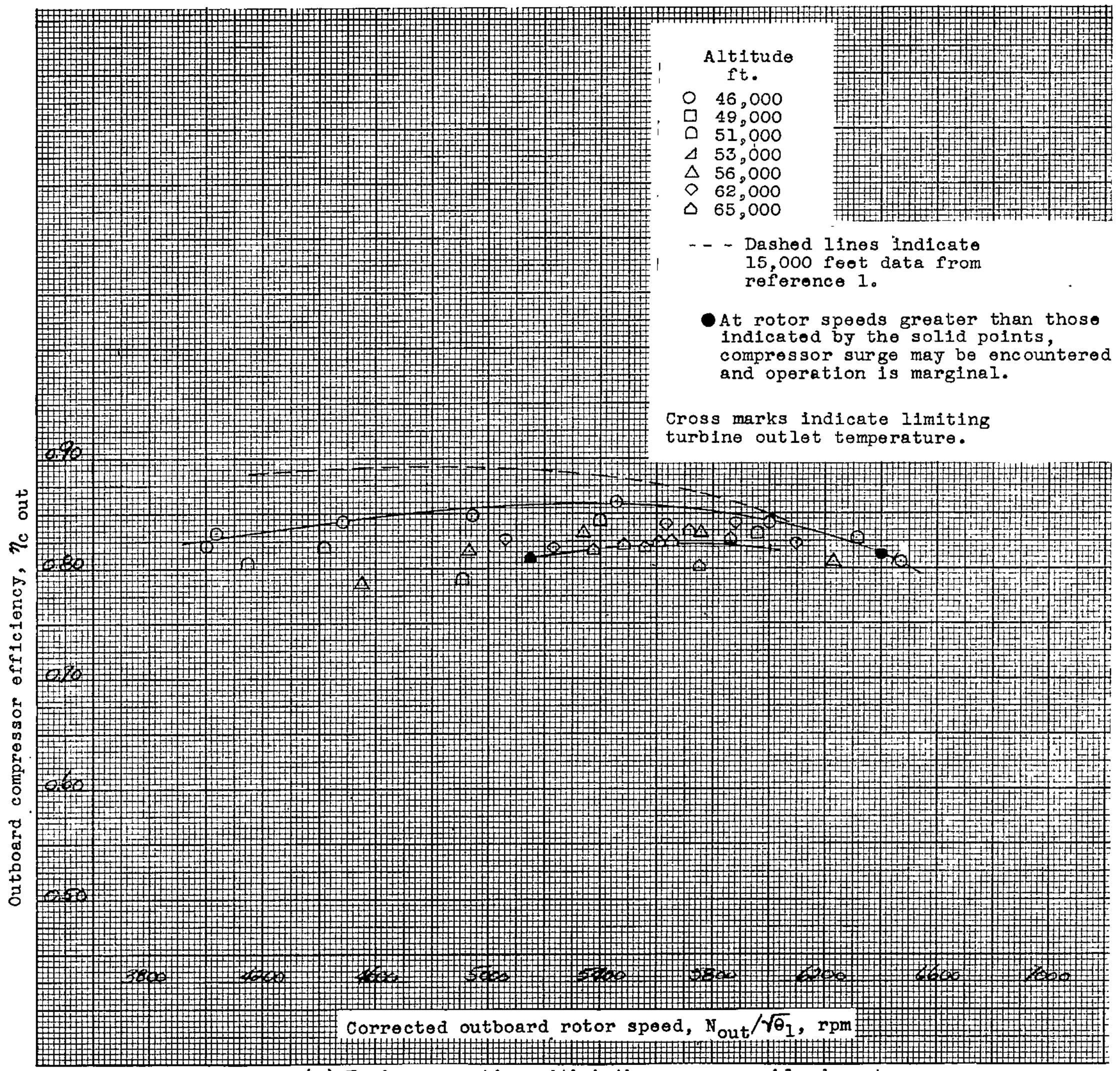
(a) Engine operation with both compressor bleed ports closed.

Figure 11. - The variation of outboard compressor efficiency with corrected outboard rotor speed over a range of altitudes. Flight Mach number 0.81.



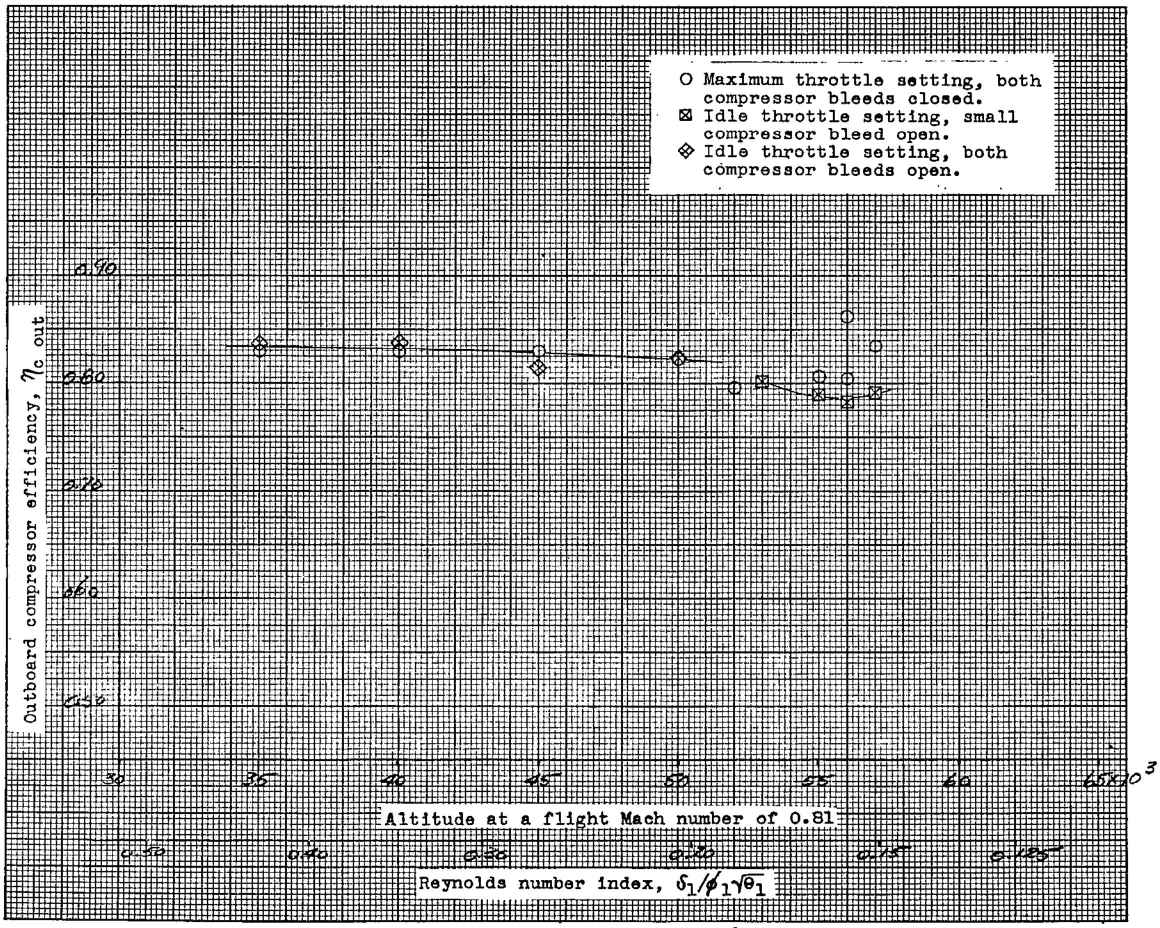
(b) Engine operation with the large compressor bleed port open.

Figure 11. - The variation of outboard compressor efficiency with corrected outboard rotor speed over a range of altitudes. Flight Mach number 0.81.



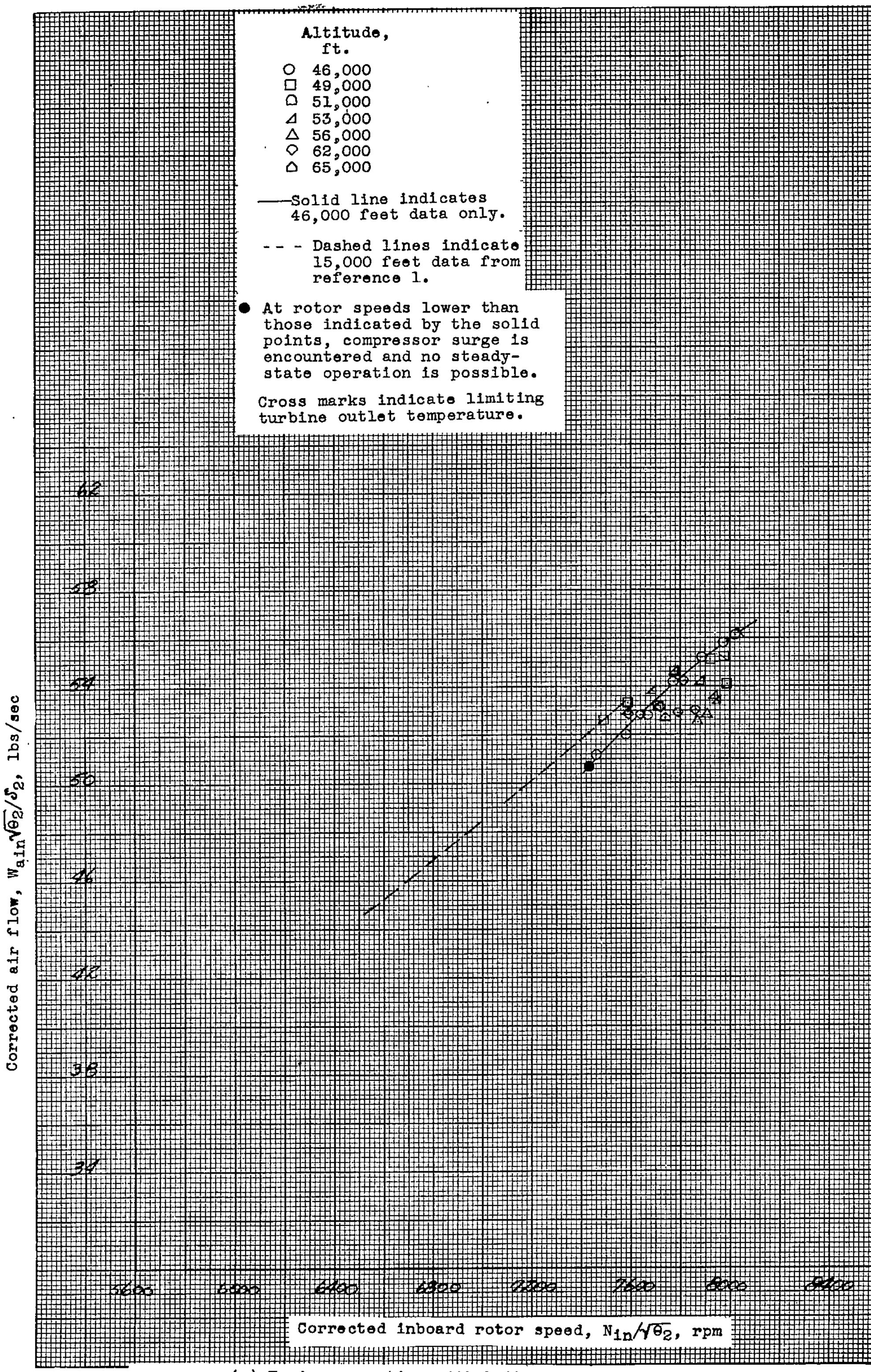
(c) Engine operation with both compressor bleed ports open.

Figure 11. - The variation of outboard compressor efficiency with corrected outboard rotor speed over a range of altitudes. Flight Mach number 0.81.



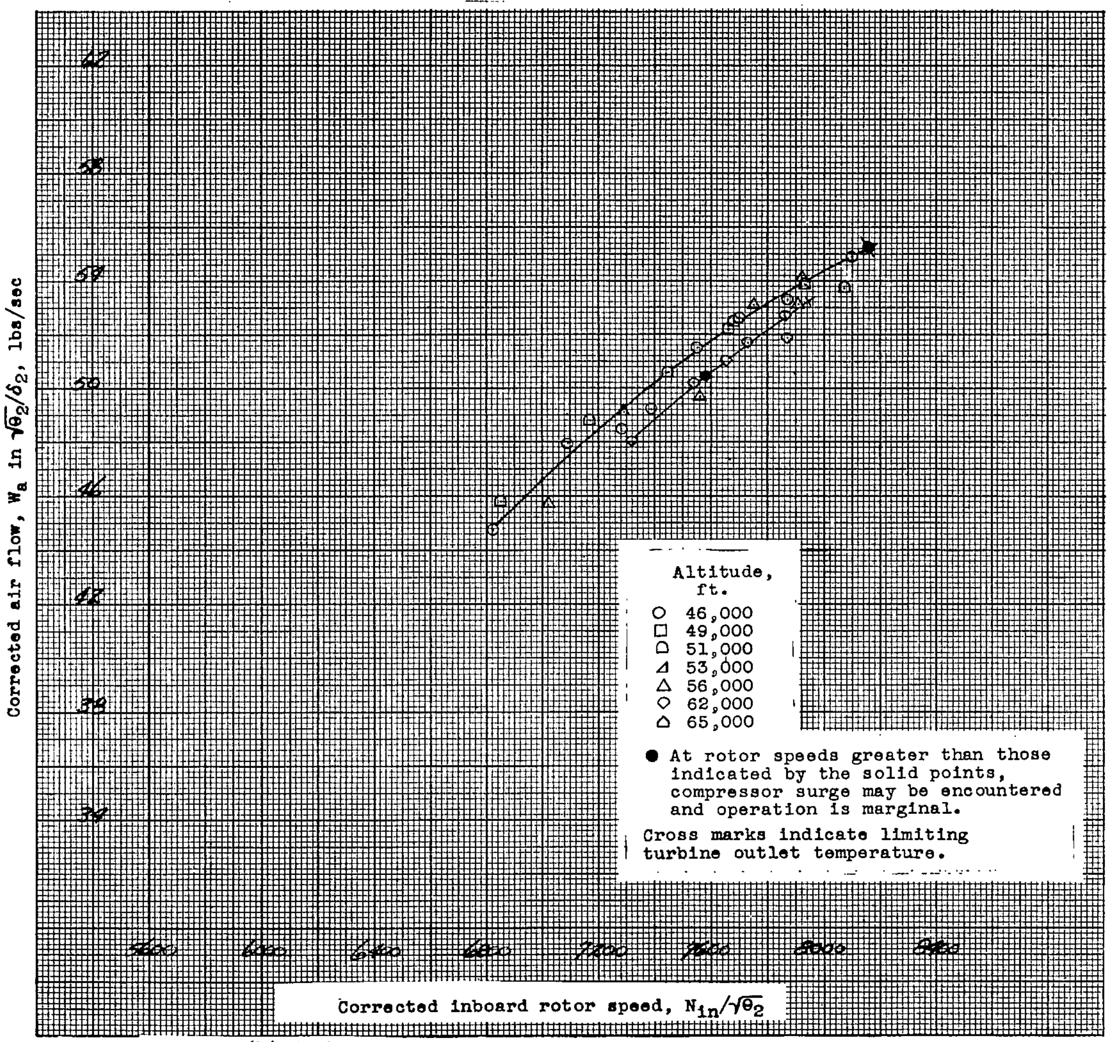
(d) Engine operation with the automatic control.

Figure 11. - The variation of outboard compressor efficiency with altitude at a flight Mach number of 0.81. Engine automatic control throttle settings of maximum and idle.



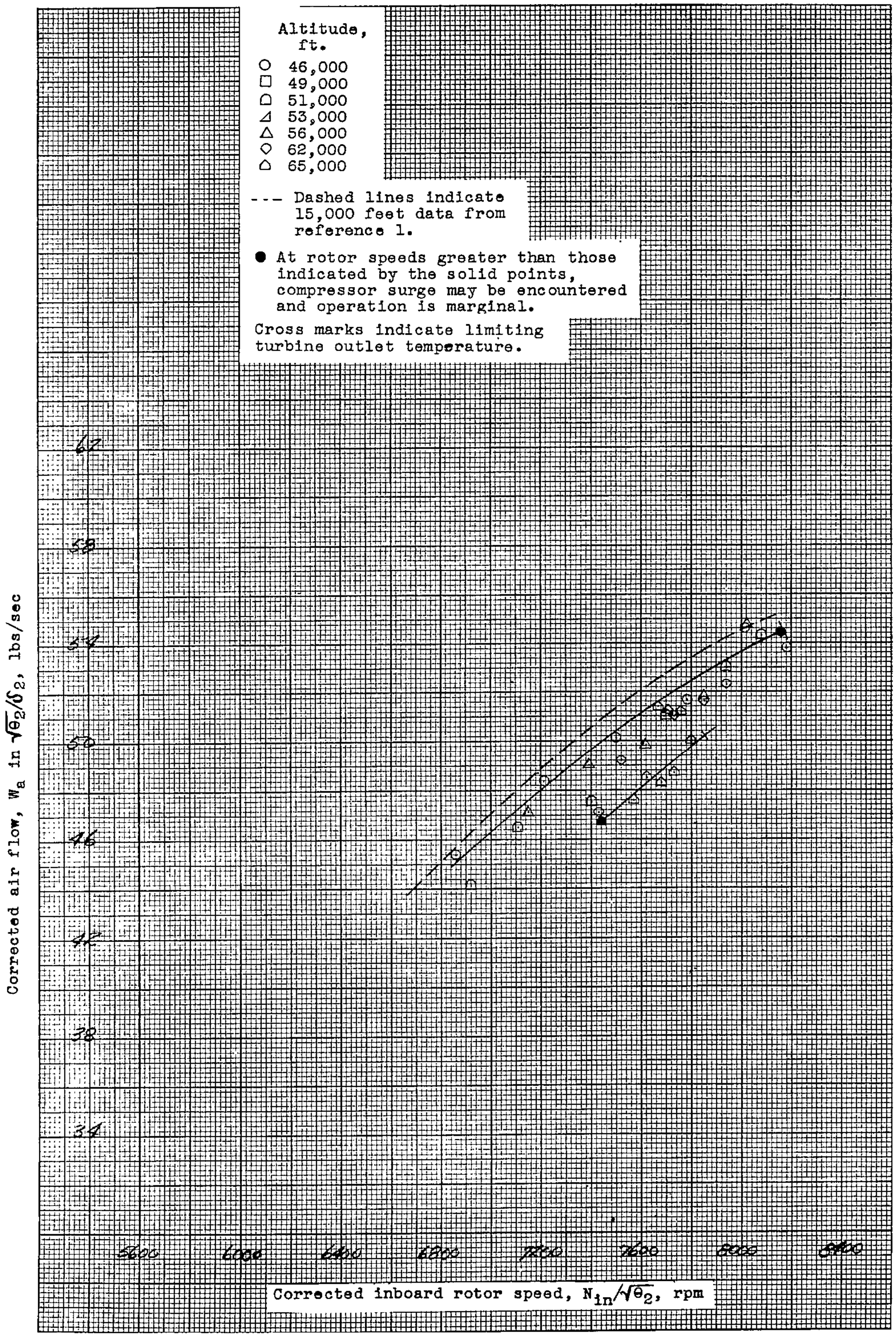
(a) Engine operation with both compressor bleed ports closed.

Figure 12. - The variation of corrected air flow with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



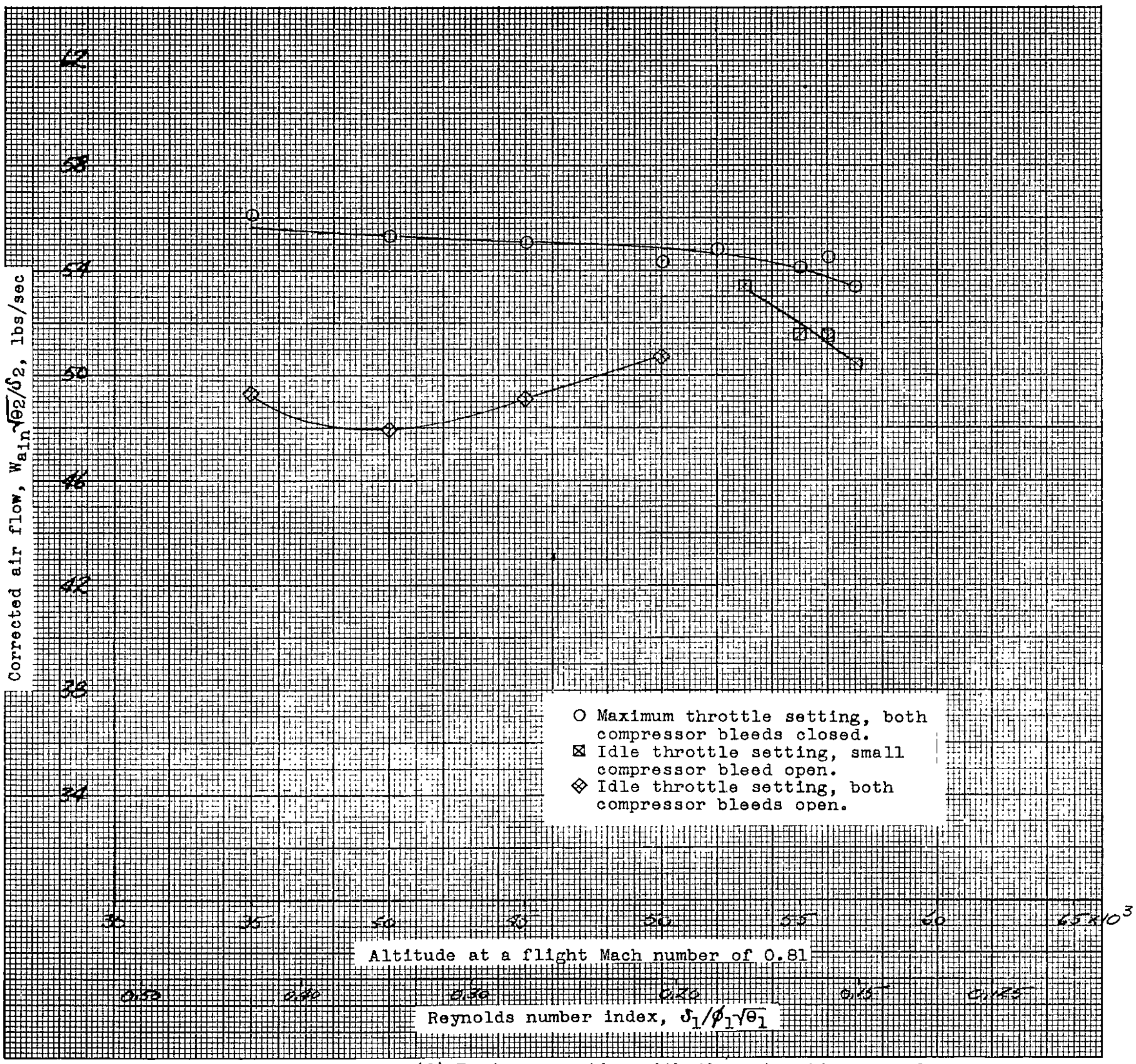
(b) Engine operation with the large compressor bleed port open.

Figure 12. - The variation of corrected air flow with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



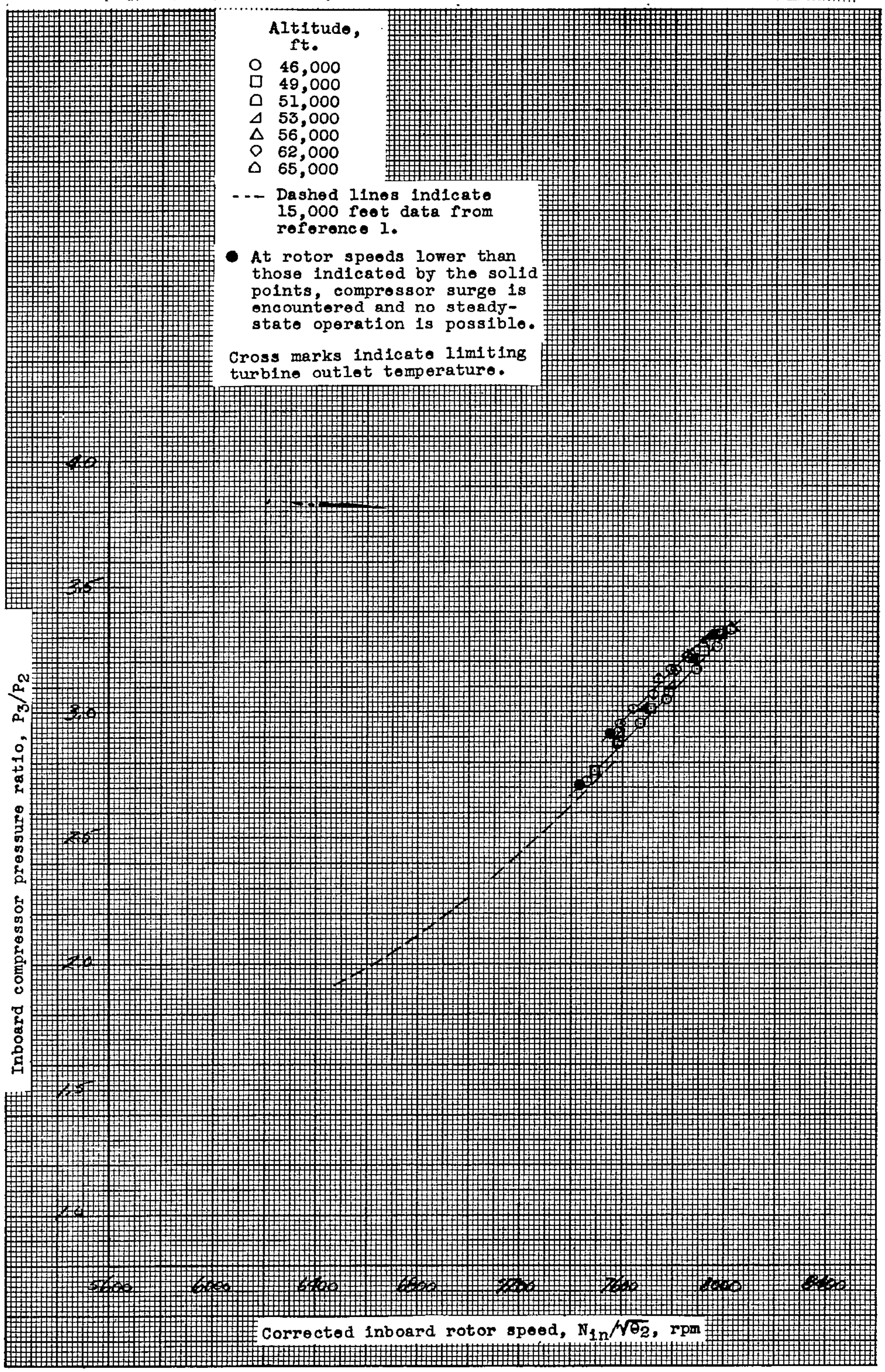
(c) Engine operation with both compressor bleed ports open.

Figure 12. - The variation of corrected air flow with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



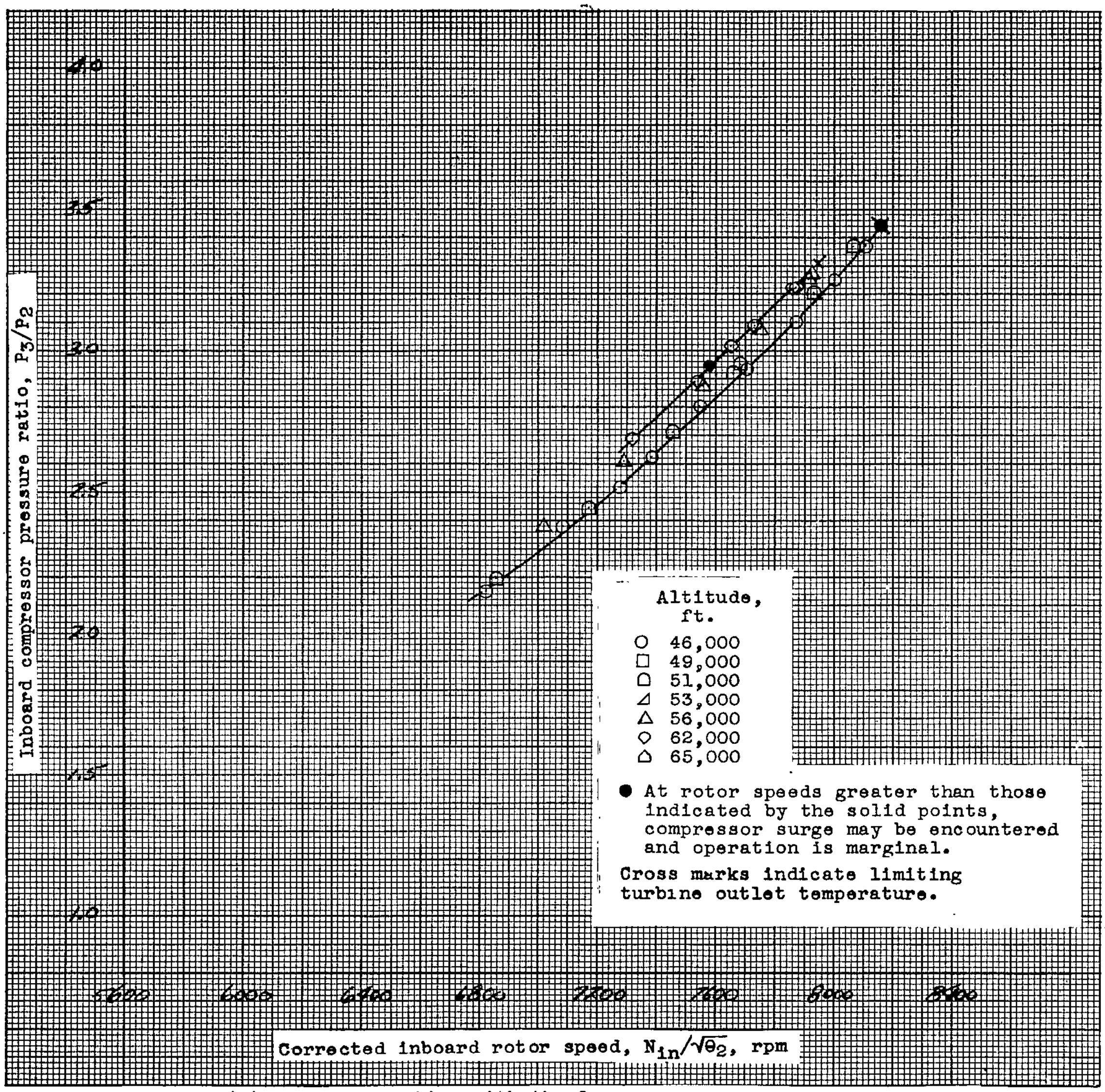
(d) Engine operation with the automatic control.

Figure 12. - The variation of corrected air flow with altitude at a flight Mach number of 0.81. Engine automatic control throttle settings of maximum and idle.



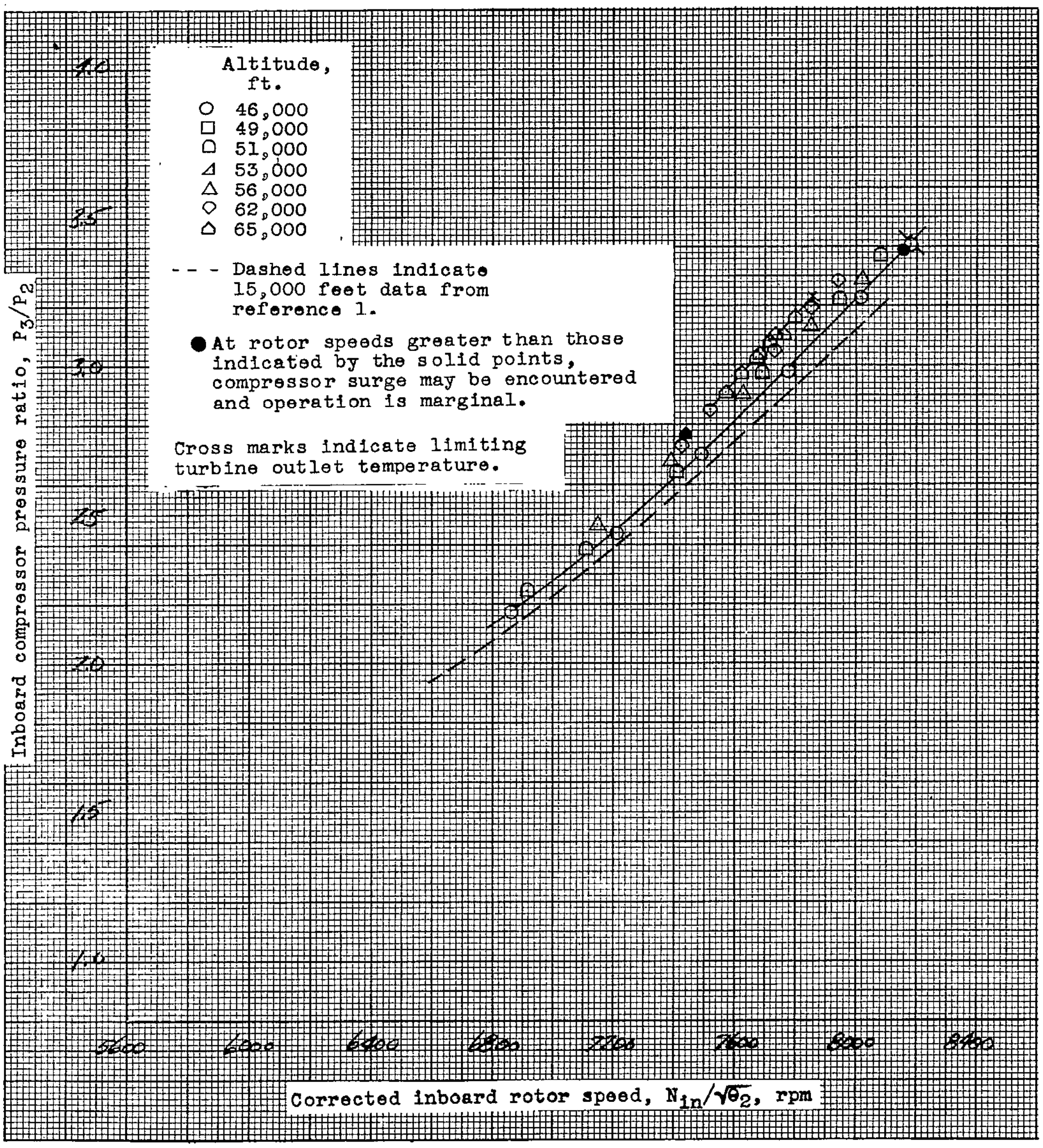
(a) Engine operation with both compressor bleed ports closed.

Figure 13. - The variation of inboard compressor pressure ratio with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



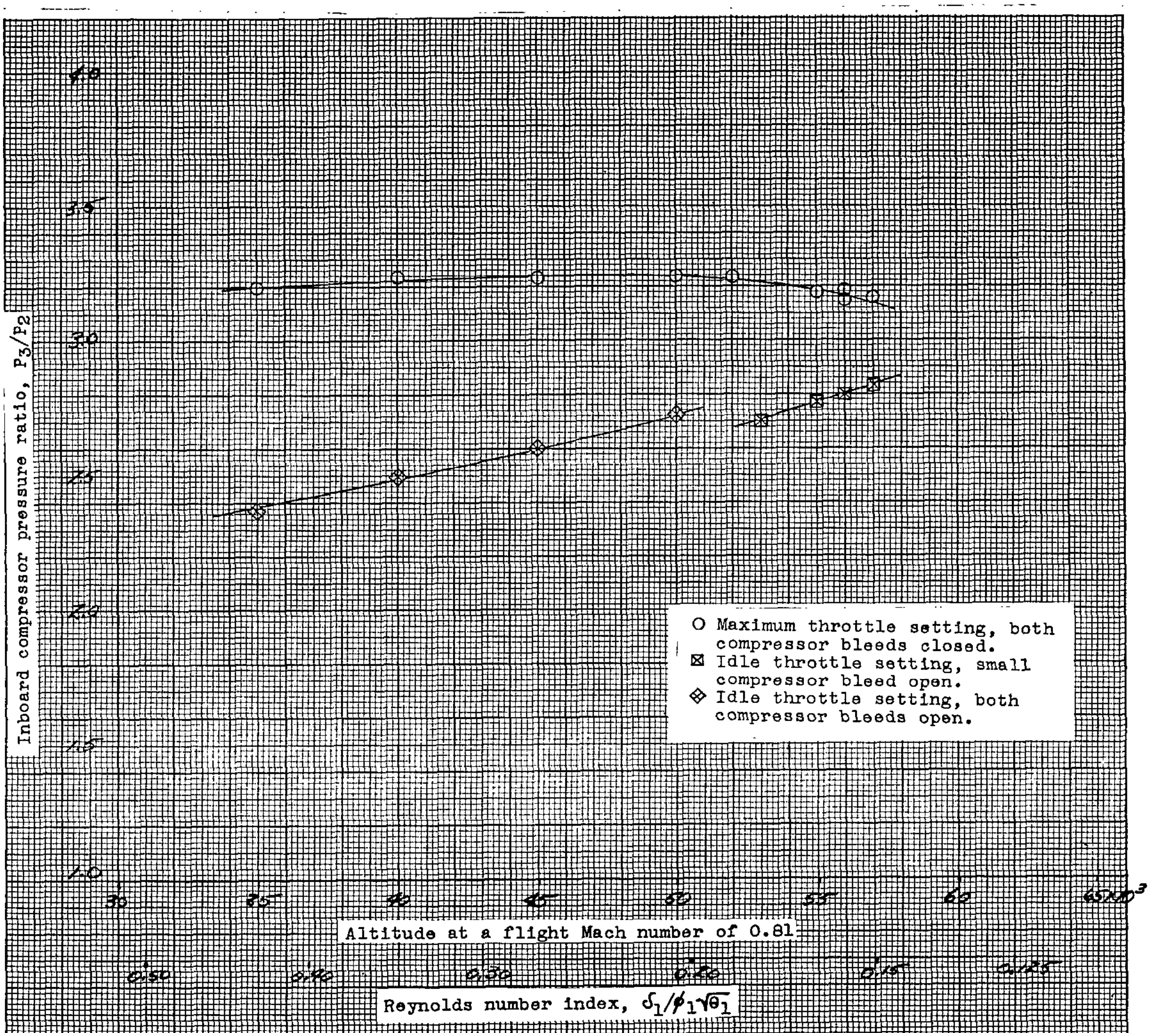
(b) Engine operation with the large compressor bleed port open.

Figure 13. - The variation of inboard compressor pressure ratio with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



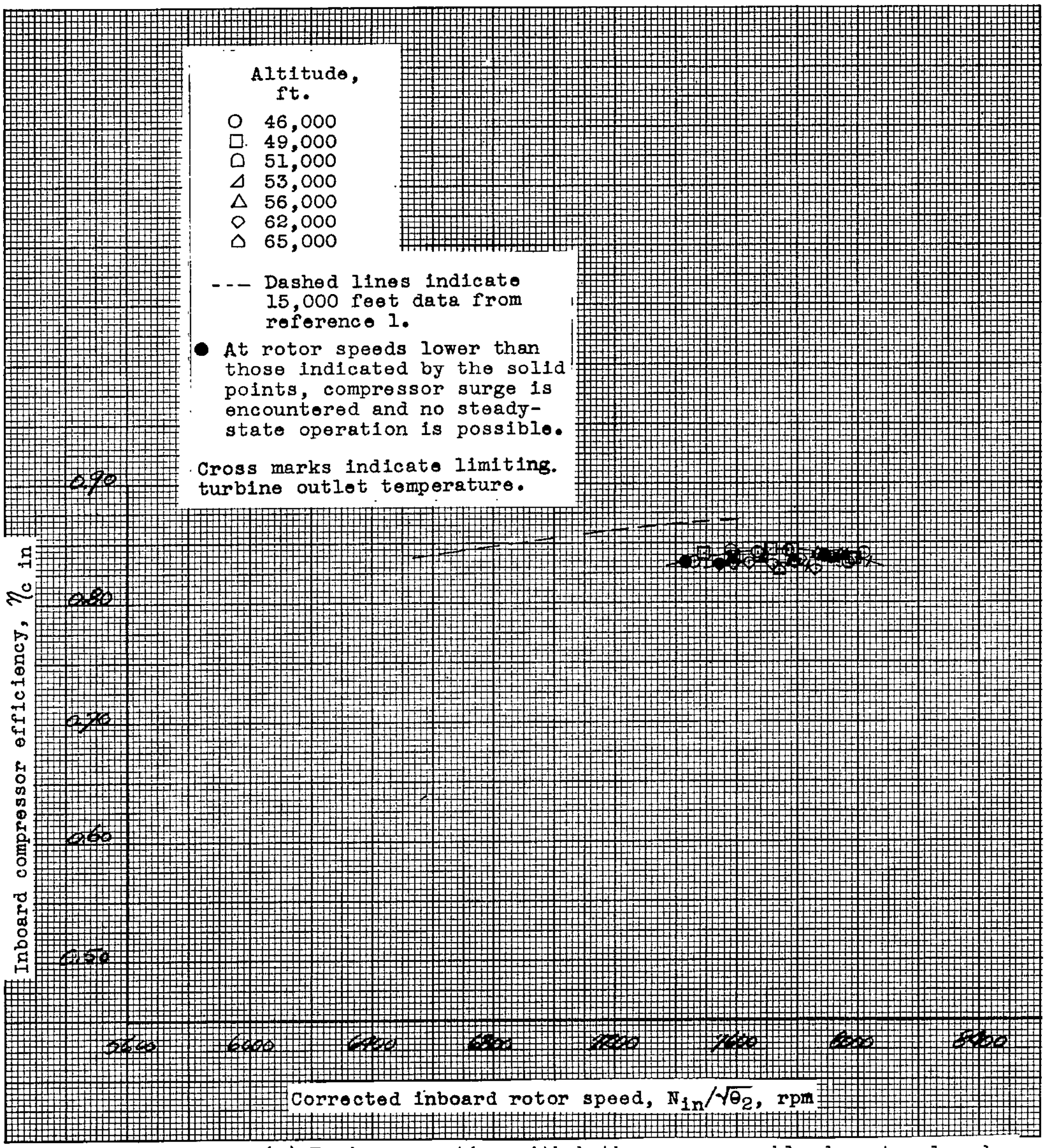
(c) Engine operation with both compressor bleed ports open.

Figure 13. - The variation of inboard compressor pressure ratio with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



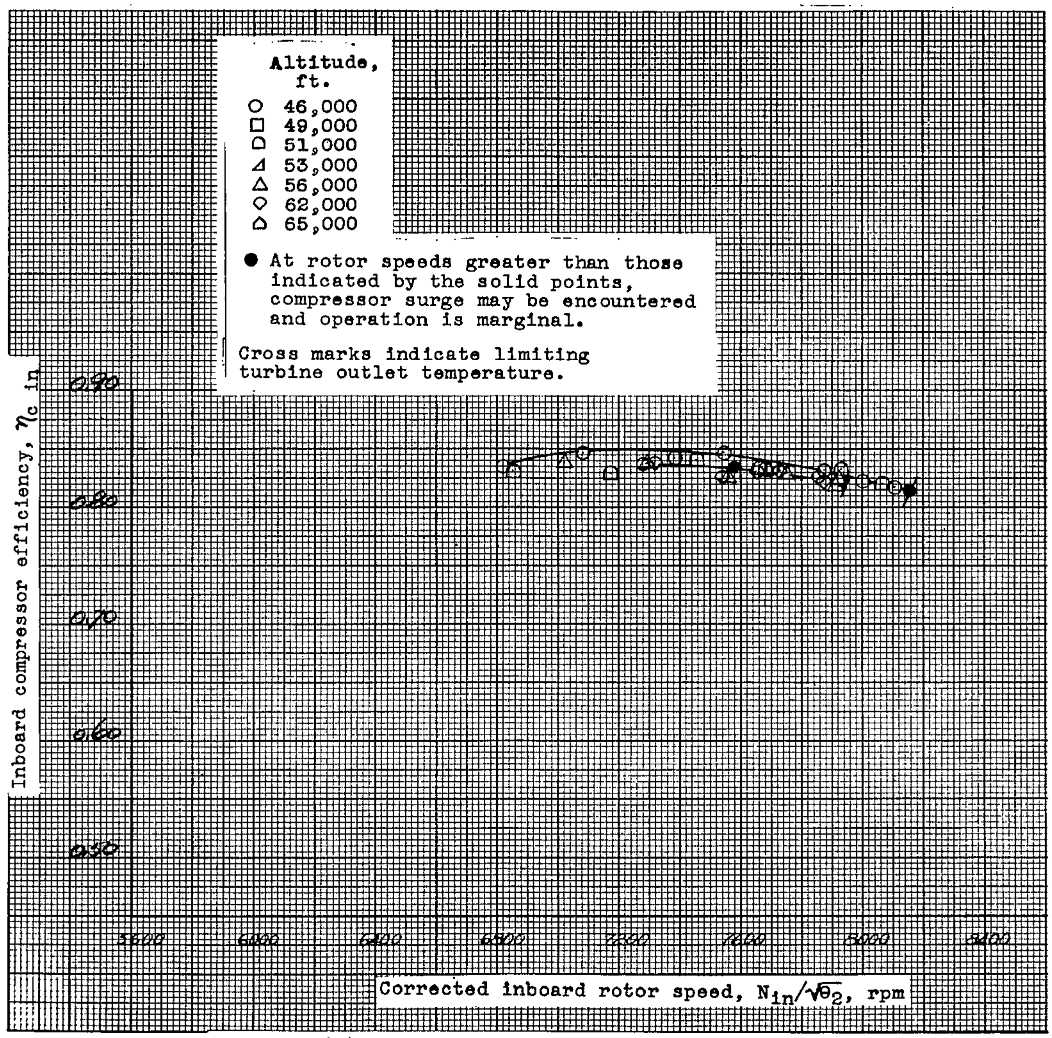
(d) Engine operation with the automatic control.

Figure 13. - The variation of corrected inboard compressor pressure ratio with altitude at a flight Mach number of 0.81. Engine automatic control throttle settings of maximum and idle.



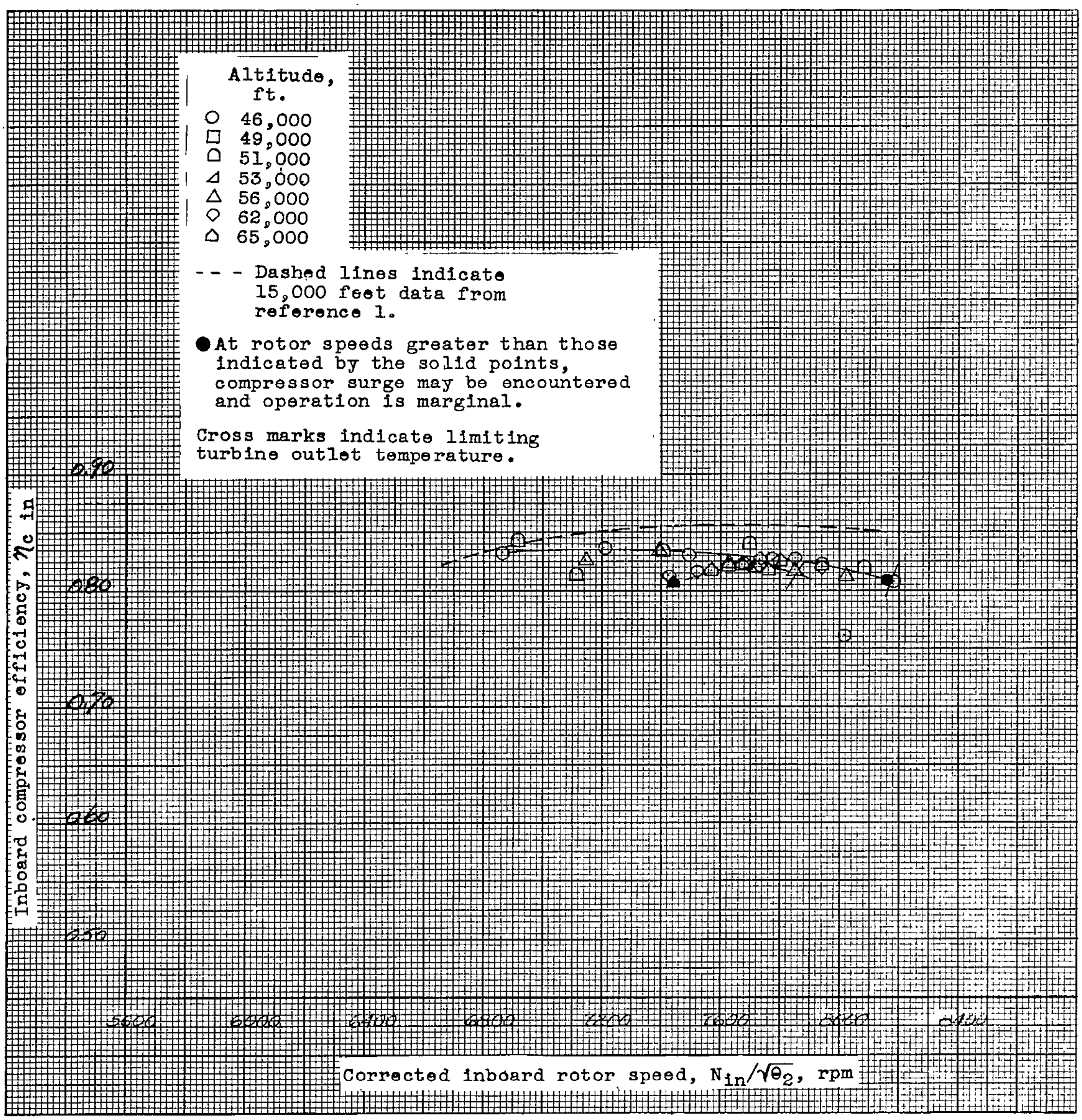
(a) Engine operation with both compressor bleed ports closed.

Figure 14. - The variation of inboard compressor efficiency with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



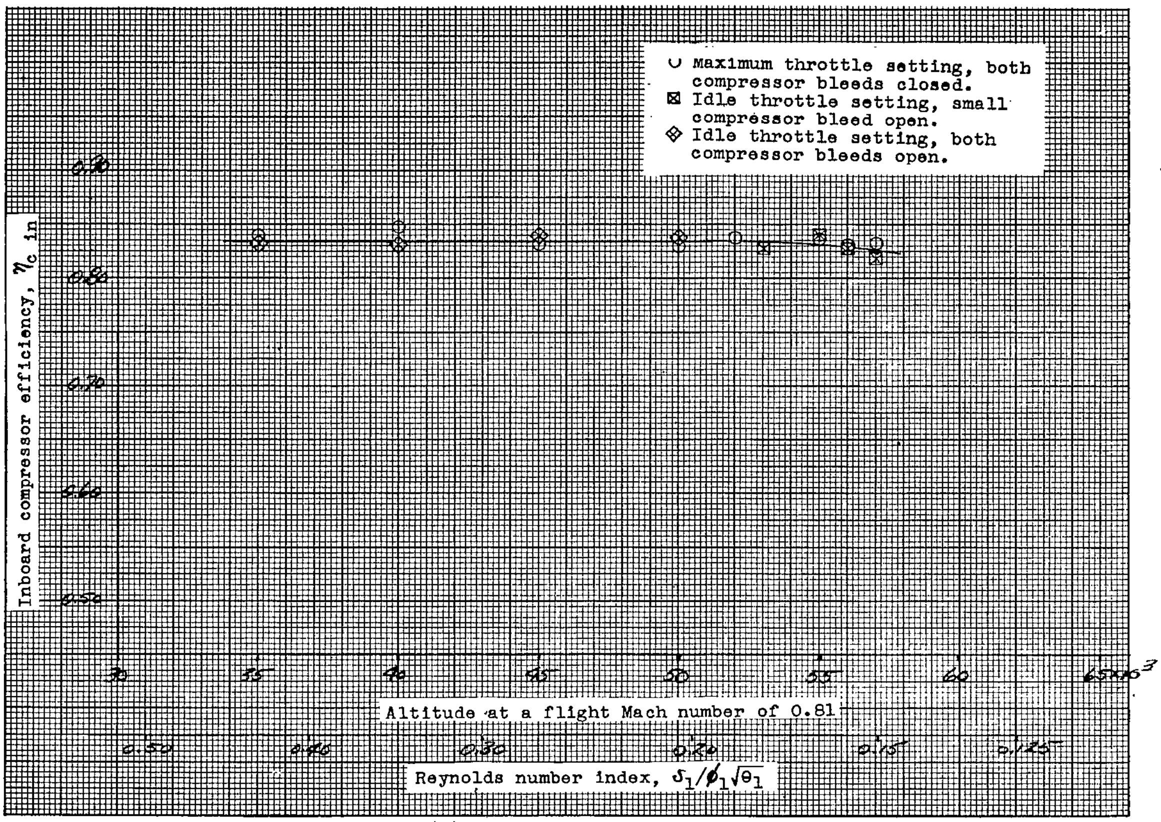
(b) Engine operation with the large compressor bleed port open

Figure 14. - The variation of inboard compressor efficiency with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



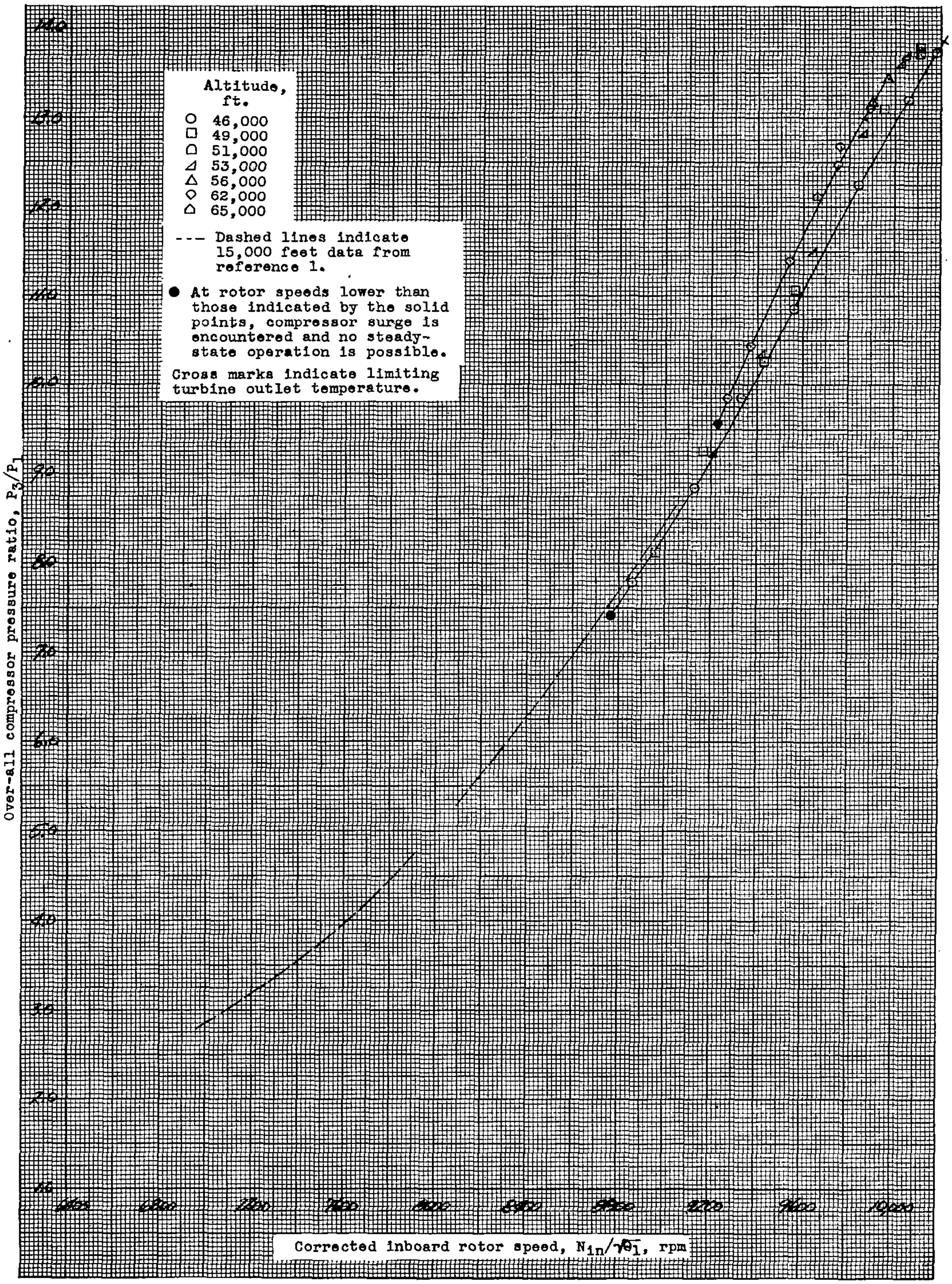
(c) Engine operation with both compressor bleed ports open.

Figure 14. - The variation of inboard compressor efficiency with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



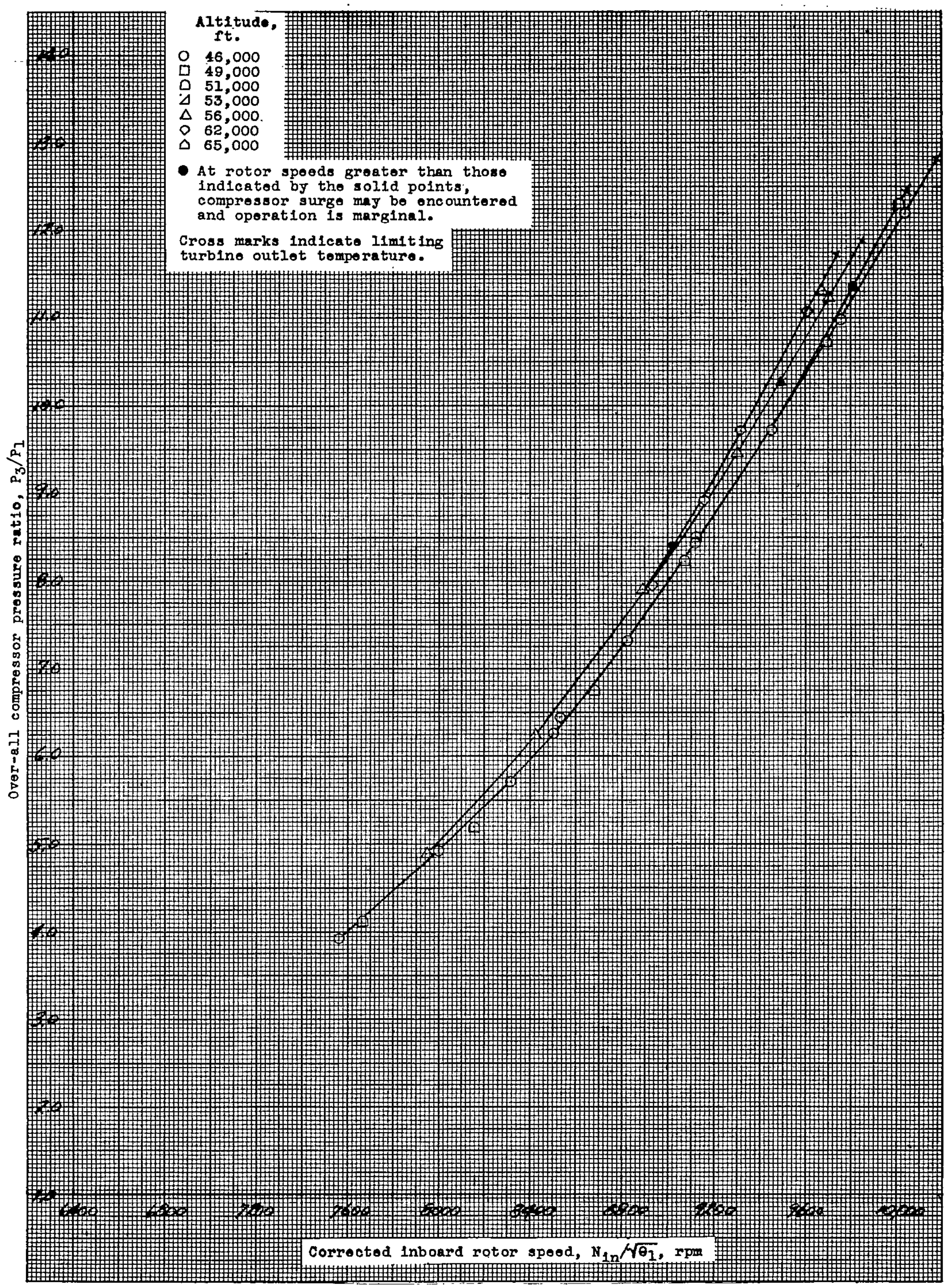
(d) Engine operation with the automatic control.

Figure 14. - The variation of inboard compressor efficiency with altitude at a flight Mach number of 0.81. Engine automatic control throttle settings of maximum and idle.



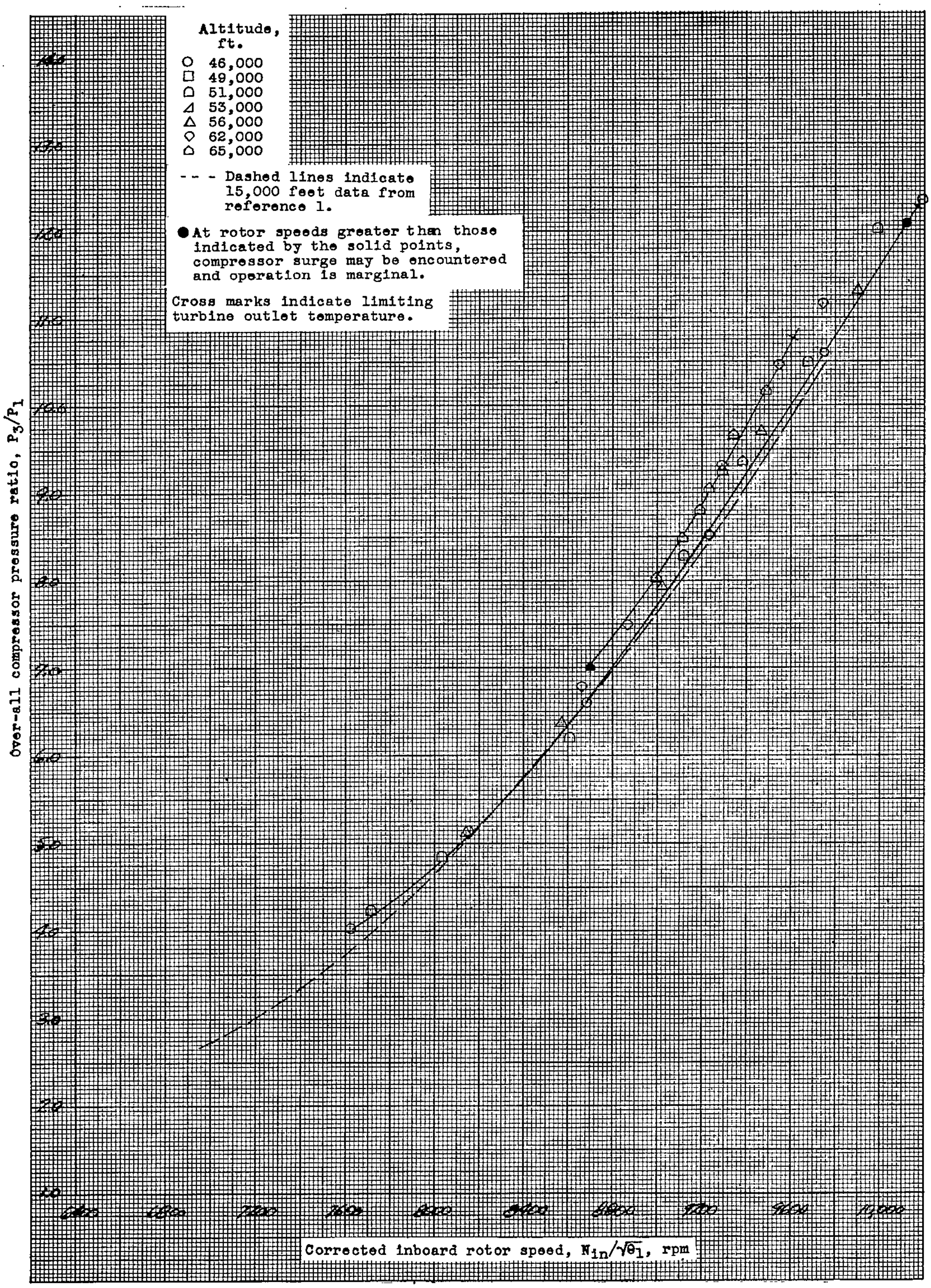
(a) Engine operation with both compressor bleed ports closed.

Figure 15. - The variation of over-all compressor pressure ratio with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



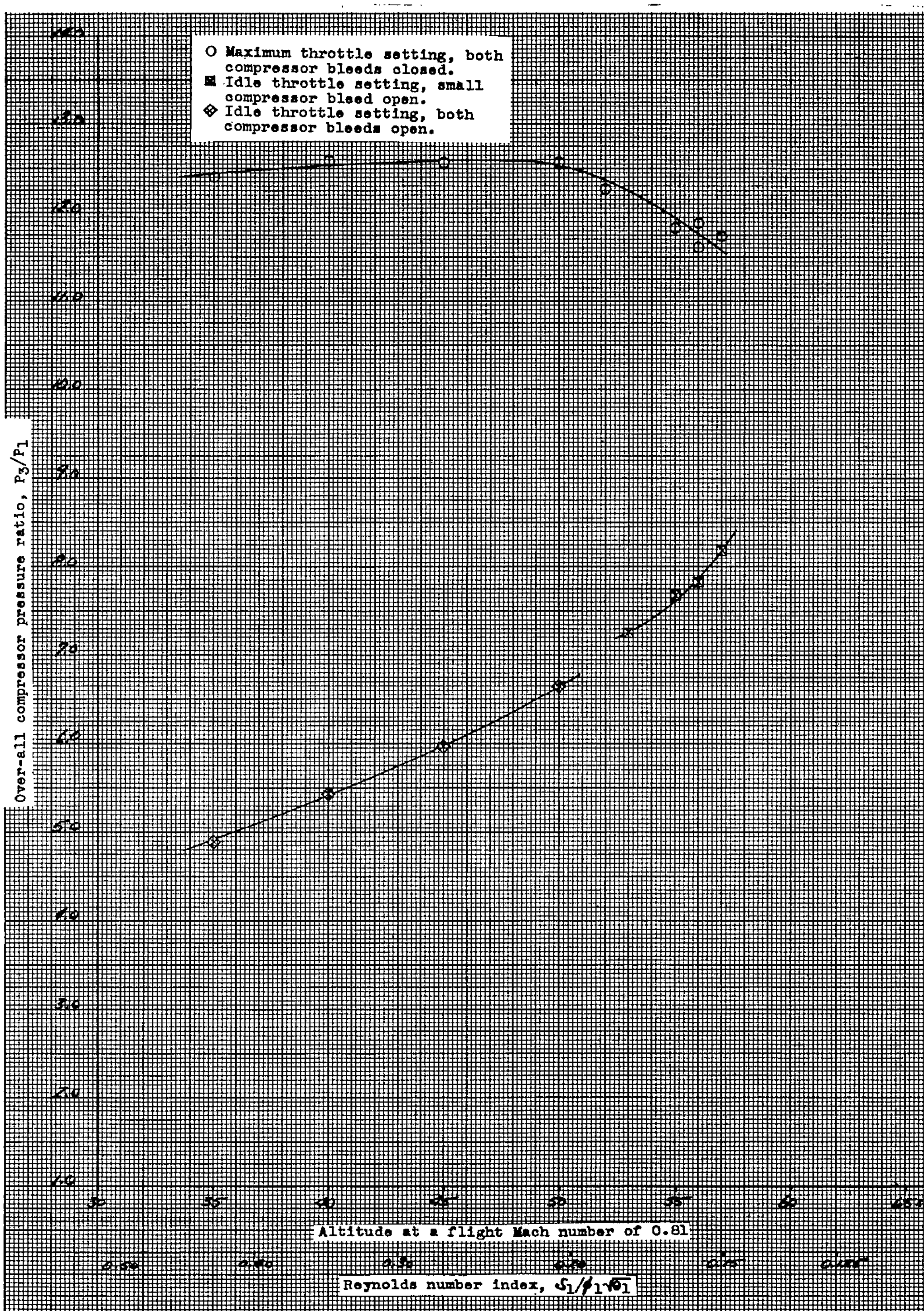
(b) Engine operation with the large compressor bleed port open.

Figure 15. - The variation of over-all compressor pressure ratio with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



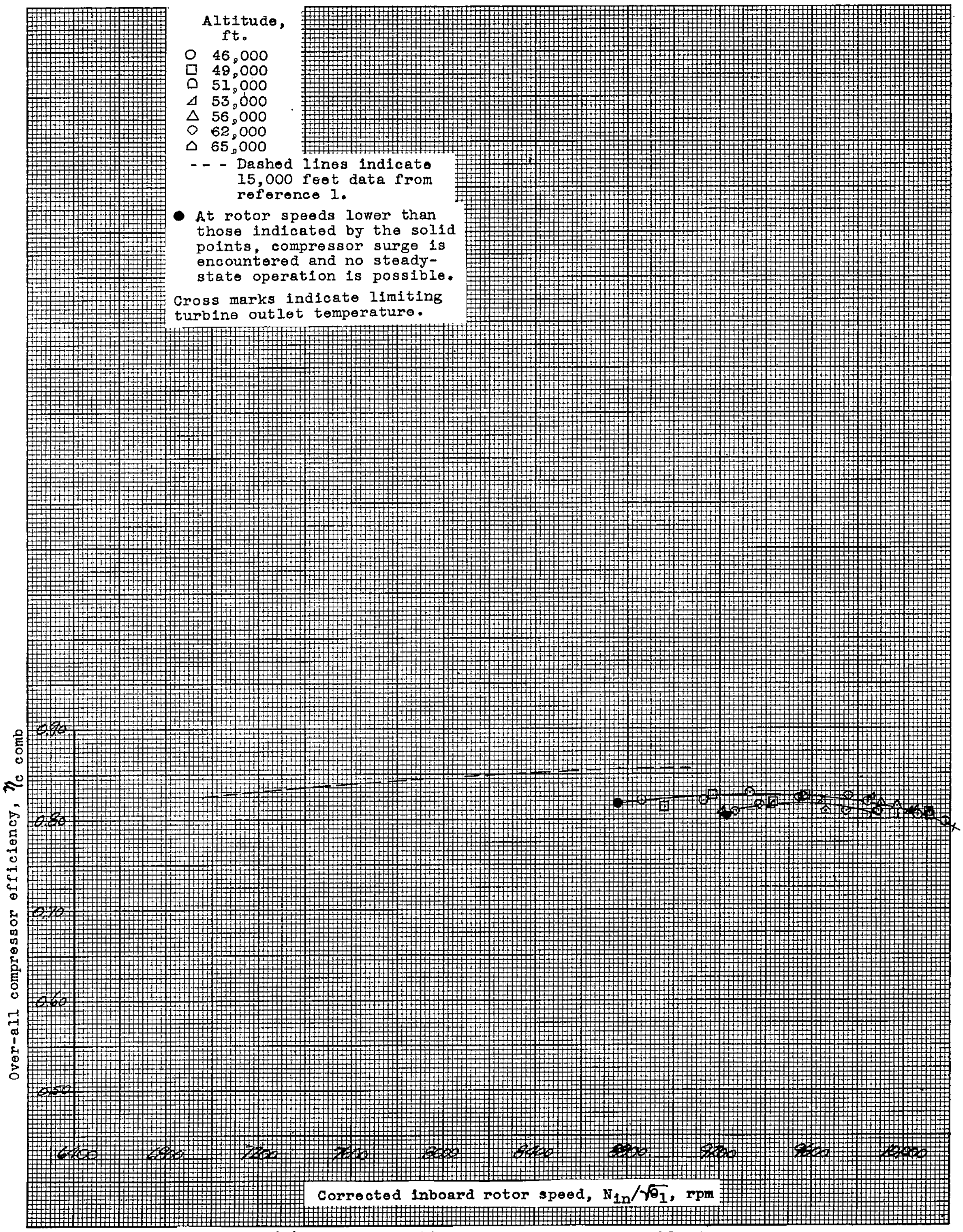
(c) Engine operation with both compressor bleed ports open.

Figure 15. - The variation of over-all compressor pressure ratio with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



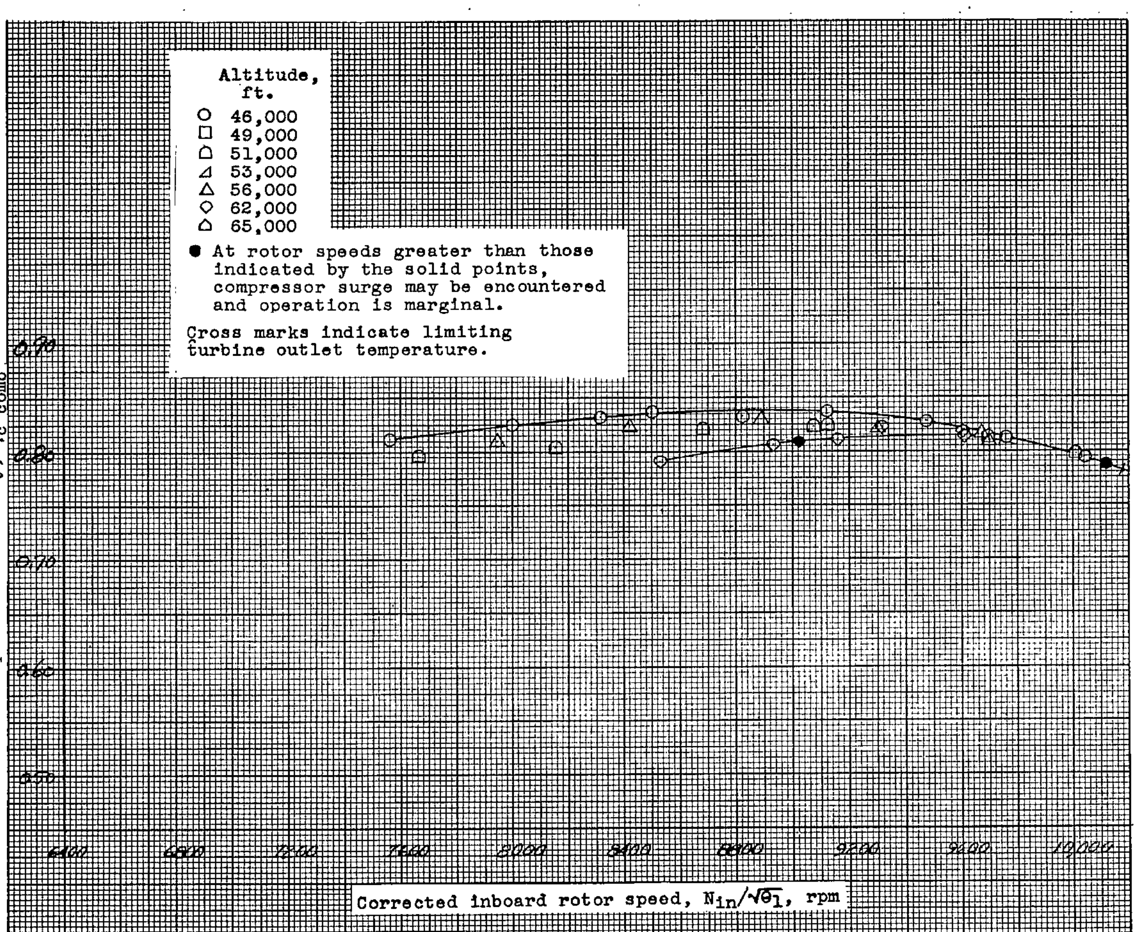
(d) Engine operation with the automatic control.

Figure 15. - The variation of over-all compressor pressure ratio with altitude at a flight Mach number of 0.81. Engine automatic control throttle settings of maximum and idle.



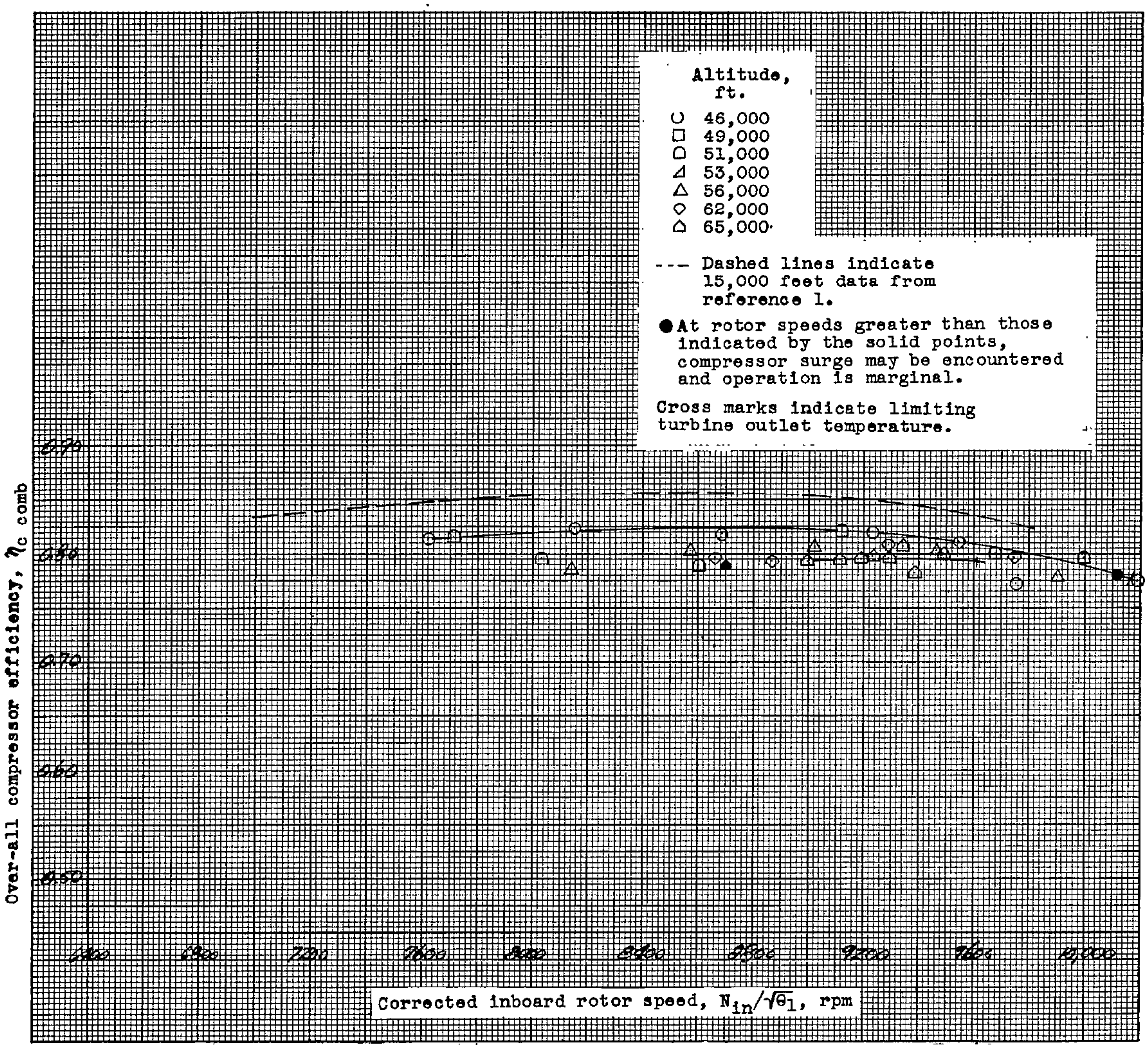
(a) Engine operation with both compressor bleed ports closed.

Figure 16. - The variation of over-all compressor efficiency with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



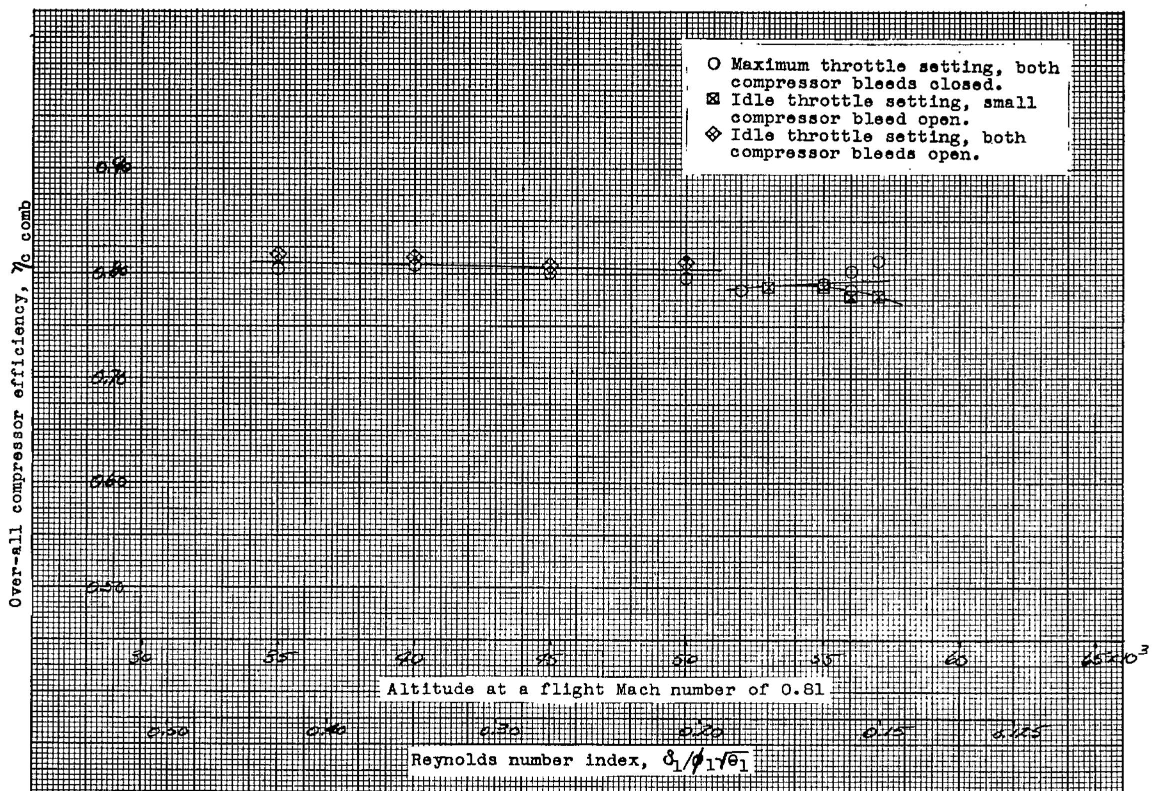
(b) Engine operation with the large compressor bleed port open.

Figure 16. - The variation of over-all compressor efficiency with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



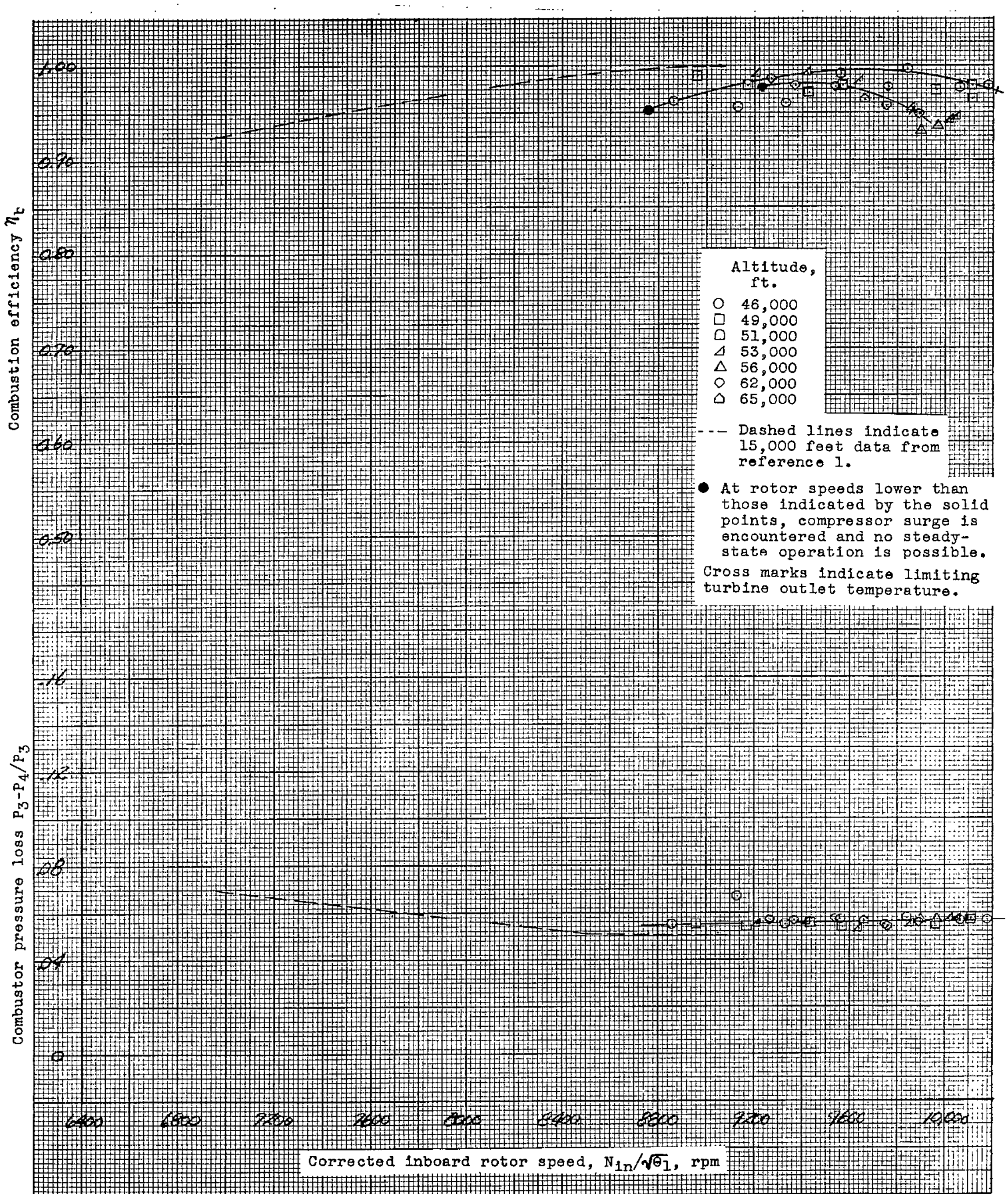
(c) Engine operation with both compressor bleed ports open.

Figure 16. - The variation of over-all compressor efficiency with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



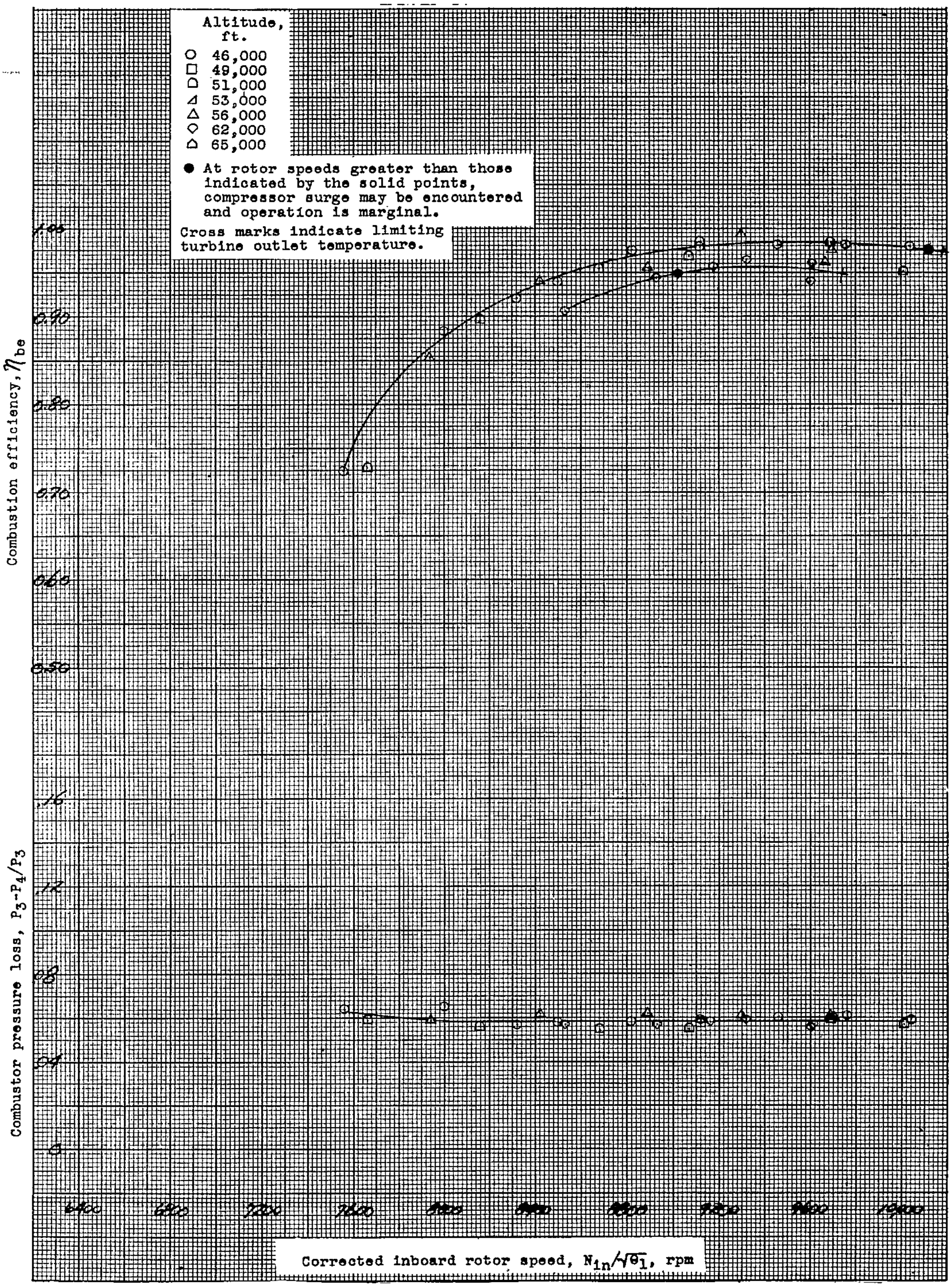
(d) Engine operation with the automatic control.

Figure 16. - The variation of over-all compressor efficiency with altitude at a flight Mach number of 0.81. Engine automatic control throttle settings of maximum and idle.



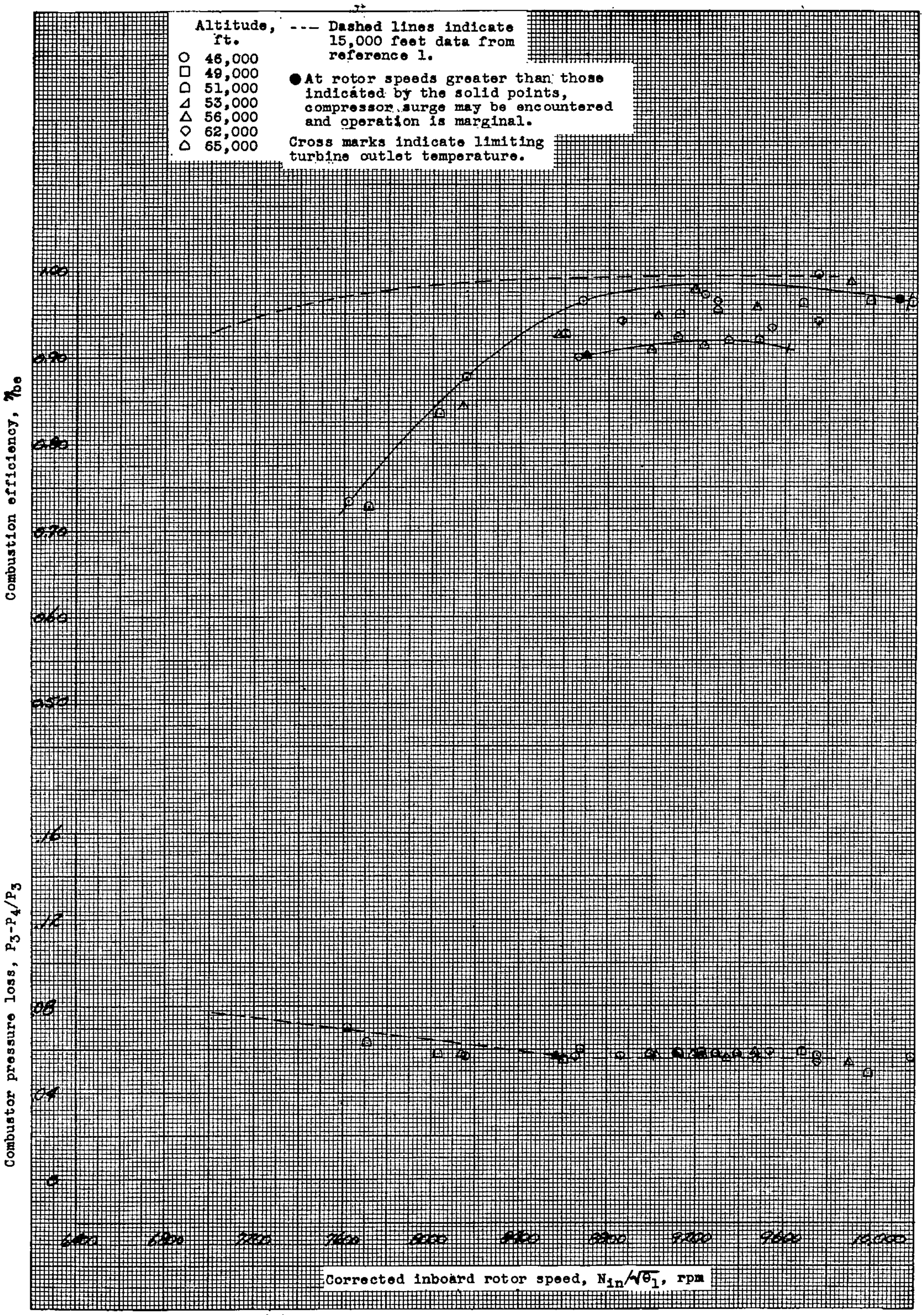
(a) Engine operation with both compressor bleed ports closed.

Figure 17. - The variation of combustor performance parameters with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



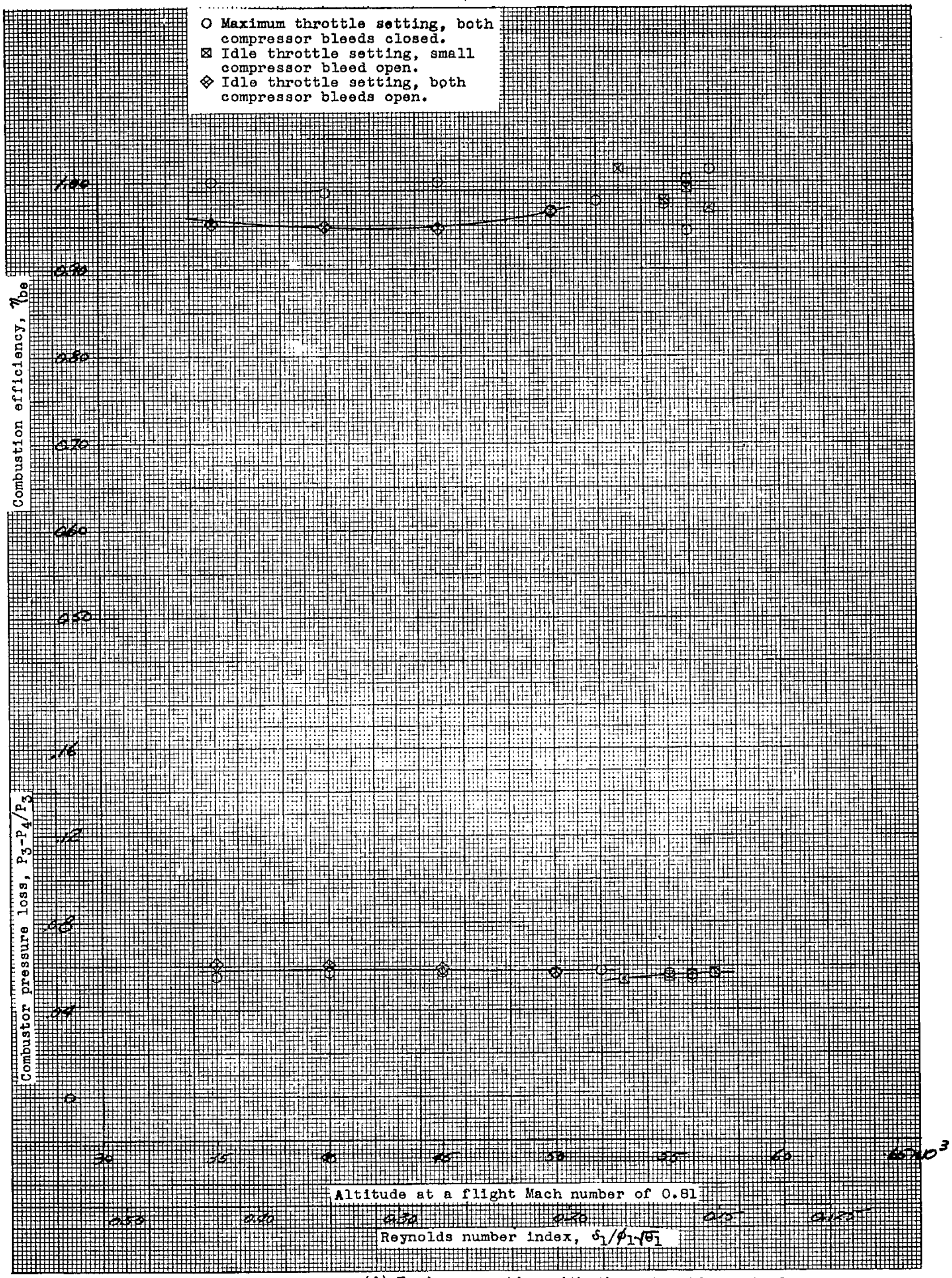
(b) Engine operation with the large compressor bleed port open.

Figure 17. - The variation of combustor performance parameters with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



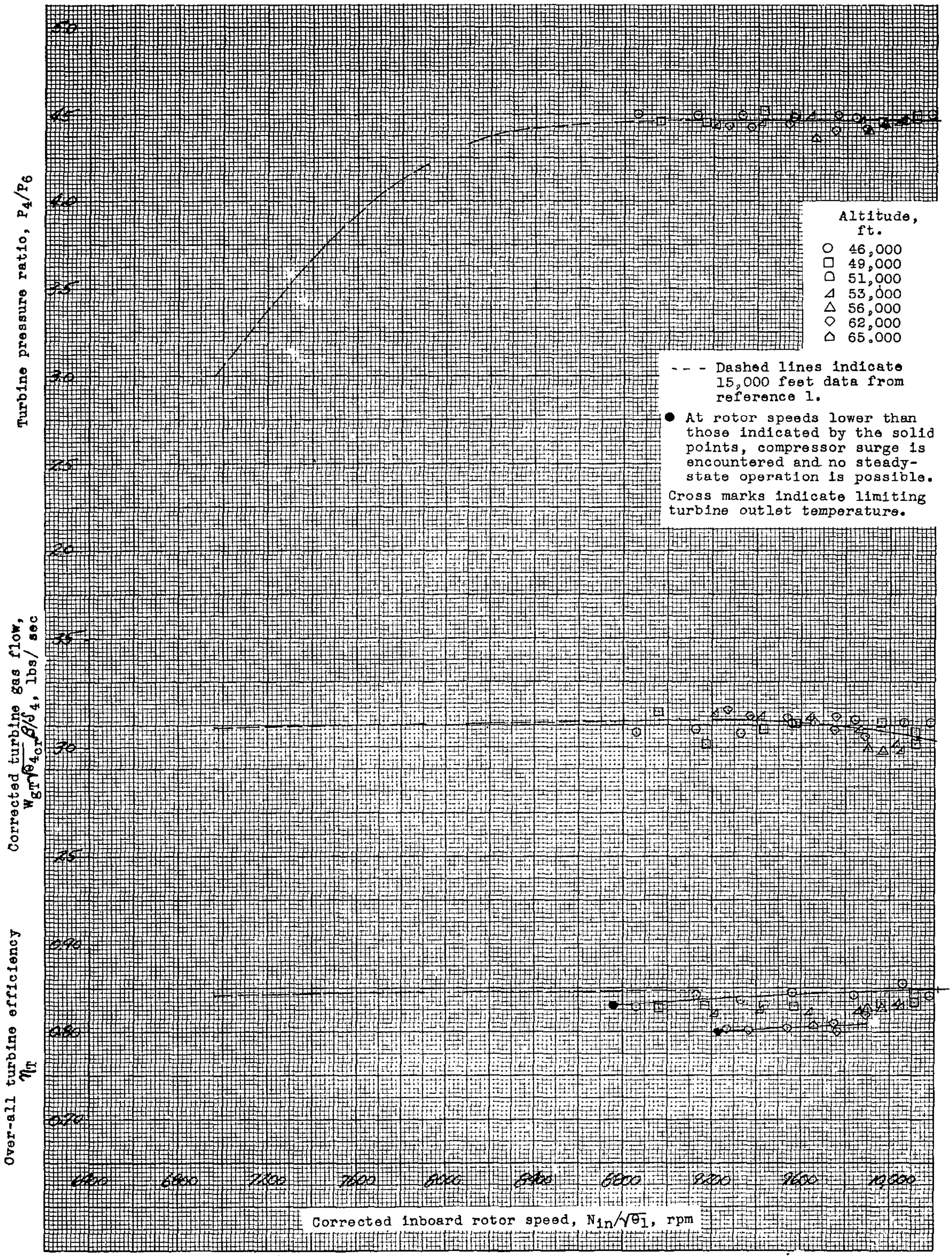
(c) Engine operation with both compressor bleed ports open.

Figure 17. - The variation of corrected combustor performance parameters with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



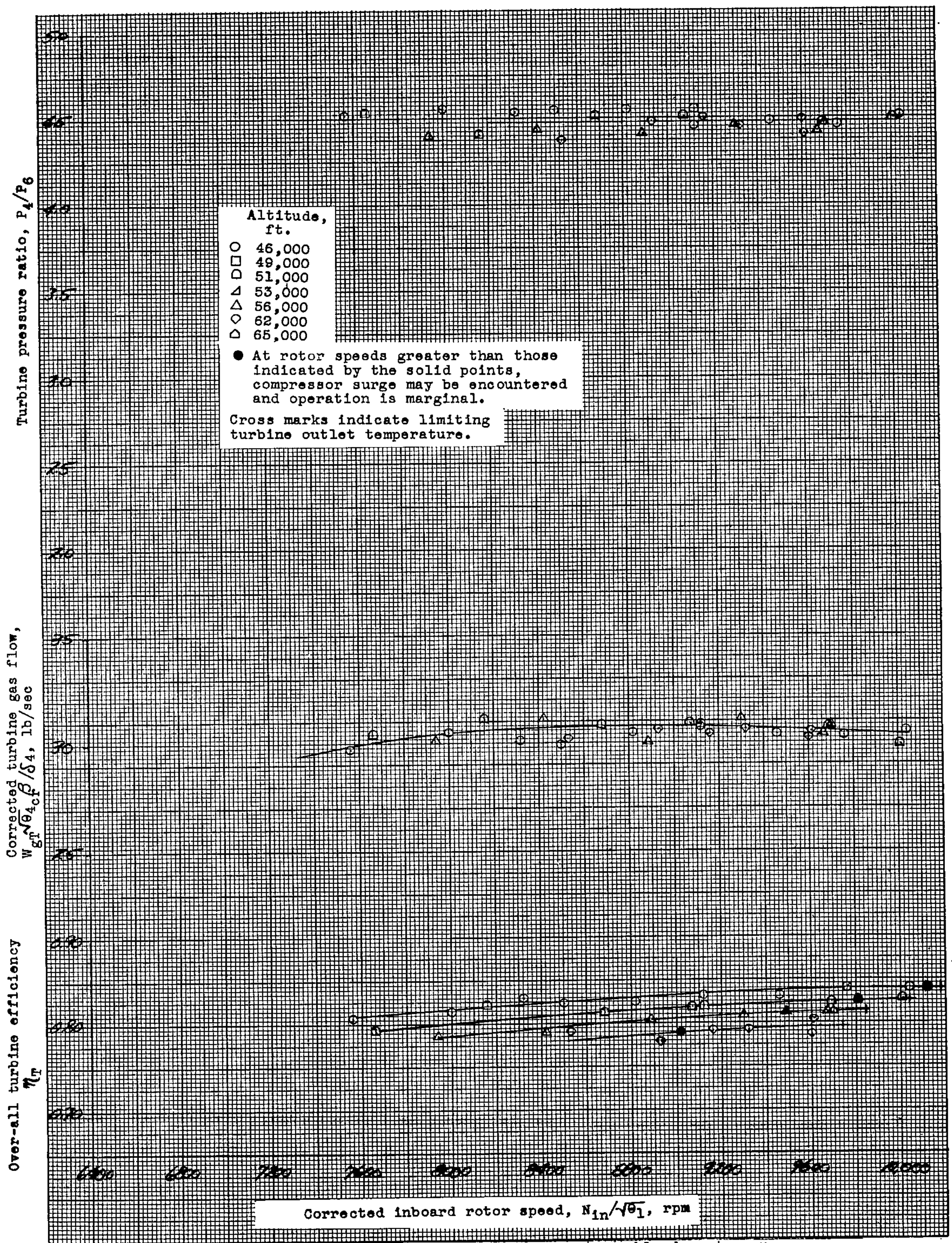
(d) Engine operation with the automatic control.

Figure 17. - The variation of combustor performance parameters with altitude at a flight Mach number of 0.81. Engine automatic control throttle settings of maximum and idle.



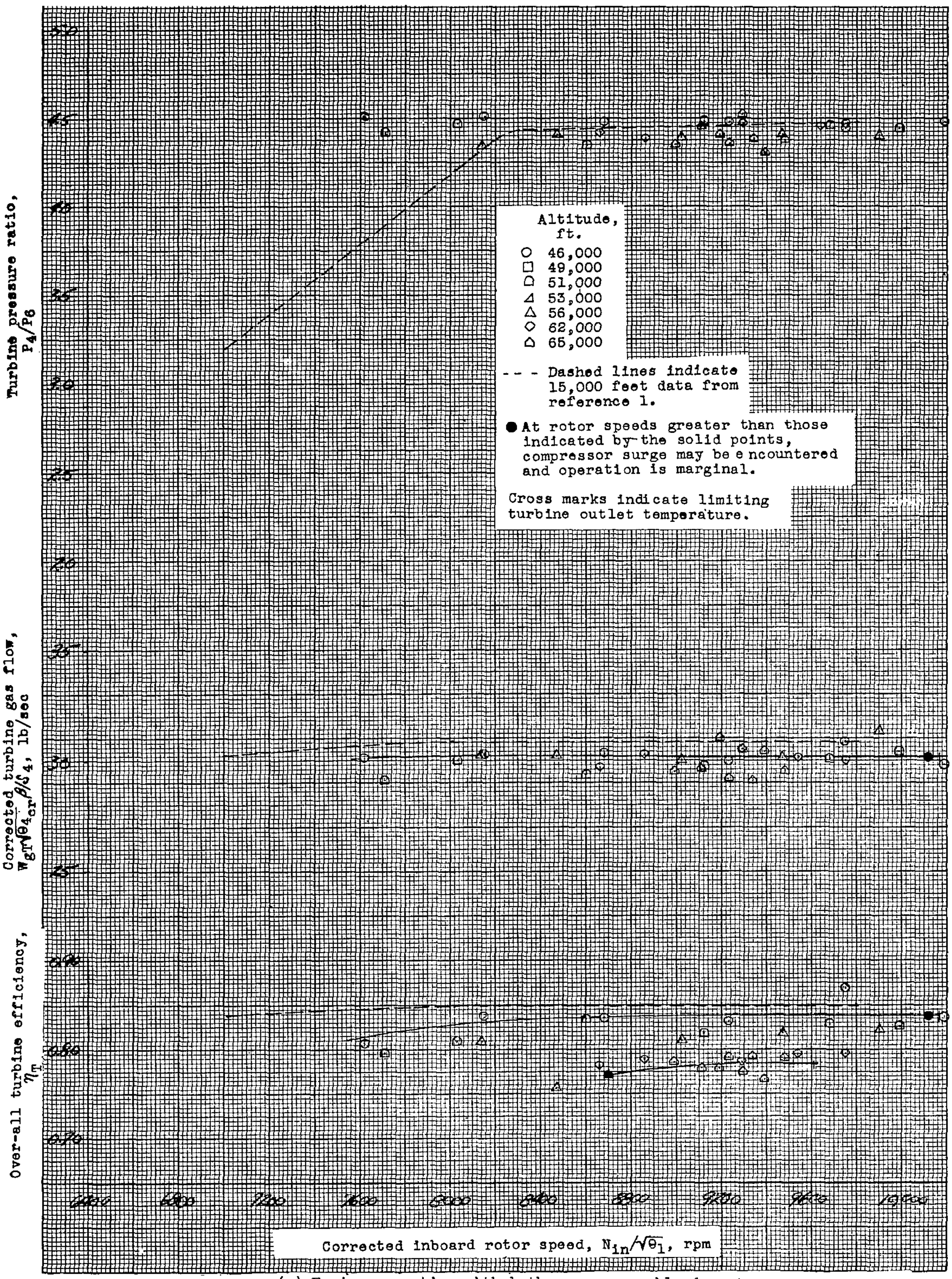
(a) Engine operation with both compressor bleed ports closed.

Figure 18. - The variation of turbine performance parameters with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



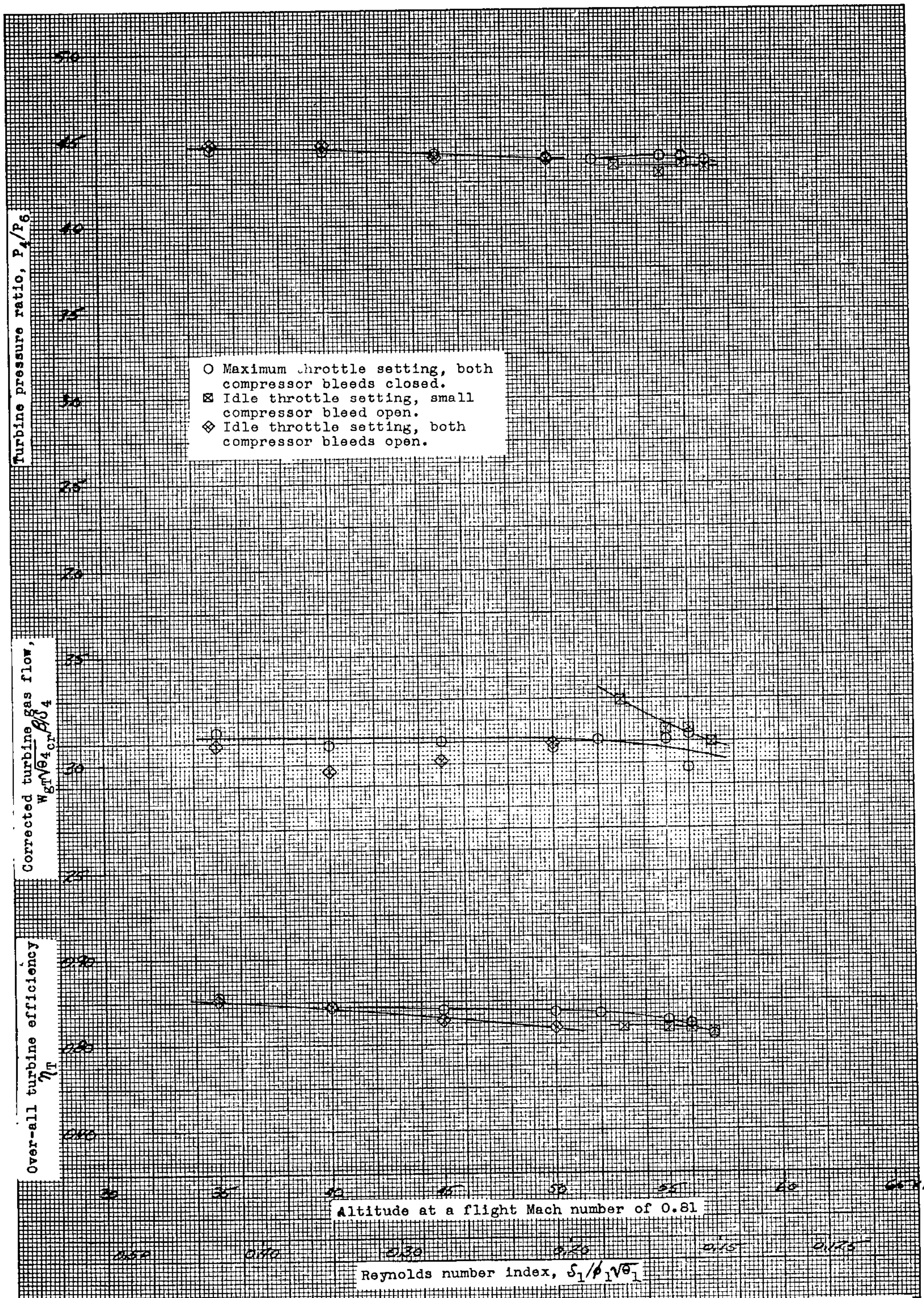
(b) Engine operation with the large compressor bleed port open.

Figure 18. - The variation of turbine performance parameters with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



(c) Engine operation with both compressor bleed ports open.

Figure 18. - The variation of turbine performance parameters with corrected inboard rotor speed over a range of altitudes. Flight Mach number 0.81.



(d) Engine operation with the automatic control.

Figure 18. - The variation of turbine performance parameters with altitude at a flight Mach number of 0.81. Engine automatic control throttle settings of maximum and idle.

PRELIMINARY PERFORMANCE DATA FOR THE J57-P-1 TURBOJET ENGINE AT ALTITUDES UP TO 65,000 FEET

Robert R. Miller
Aeronautical Research Scientist
Propulsion Systems

Harry E. Bloomer
Aeronautical Research Scientist
Propulsion Systems

Approved:

H. Dean Wilsted
Aeronautical Research Scientist
Propulsion Systems

Bruce T. Lundin
Chief
Engine Research Division

gah/5-27-54

[redacted]