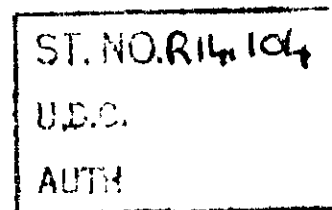


C.P. No. 244
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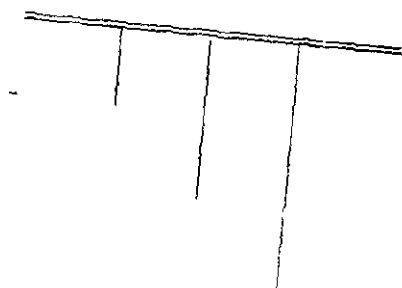
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Technical Note No. Aero.2364

March, 1955

ROYAL AIRCRAFT ESTABLISHMENT

Low Speed Wind Tunnel Calibration of a Mark 9A Pitot-Static Head

by

J. E. Nethaway, B.Sc.(Eng.)

SUMMARY

This note describes the calibration of a Mark 9A pitot-static head in the No.2 $11\frac{1}{2}$ feet wind tunnel. The results show the variation of pitot and static pressure error coefficients with incidence, at constant tunnel speed.

1 Introduction

To assist in the analysis of a series of flight measurements of the pitot and static pressure errors on a Hunter aircraft, the effect of incidence on the pressures recorded by a Mark 9A head was required. This note describes brief tests made in the No.2 11½ feet tunnel on a Mark 9A head over an incidence range of ±20°. The results, although brief, are thought to be of sufficient interest to warrant publication.

2 Description of Tests

A sketch of a Mark 9A head is shown in Fig.1. It consists of the actual pressure head ¾" dia. and 14" long, with the static holes 6½" behind the nose, supported by a tapered tube terminating in a parallel portion 1.68" dia. There is a drain hole 1/32" dia. between the pitot and static lines.

The pressure head was set up in the tunnel, care being taken to ensure that it was horizontal and that a true zero incidence was obtained. The static holes were adjusted circumferentially to be in the same position as on the aircraft nose boom. The head was mounted with its static holes directly above the centre of the turn-table, so that they were in the same tunnel position regardless of incidence, to avoid any errors due to variation of static pressure across the tunnel.

Head static pressure was measured against the pressure at a calibrated hole in the tunnel wall by means of a Betz manometer. Pitot pressure was measured against the tunnel settling chamber pressure by means of a U-tube.

Tunnel speed was maintained constant at 276 ft/sec and incidence was varied from +20° (i.e. aircraft nose up) to -20° (aircraft nose down) in 2° intervals.

3 Results

The results are presented in Table I and plotted in Figs.2 and 3 as pressure error against incidence.

$$\Delta C_p \text{ is defined as } = \frac{\text{Head indicated pressure} - \text{True pressure}}{\text{Tunnel } \frac{1}{2}\rho V^2}$$

where the "true pressure" was obtained from the tunnel calibration.

Pitot error is negligible up to 5° and rises to about 1% of $\frac{1}{2}\rho V^2$ at 10°. Thereafter, the error increases rapidly and at 20° incidence is about 12% of $\frac{1}{2}\rho V^2$.

Static pressure error is 0.3% of $\frac{1}{2}\rho V^2$ at zero incidence, and is about 1% of $\frac{1}{2}\rho V^2$ at 6°. After 6°, the error increases considerably and is about 8.5% of $\frac{1}{2}\rho V^2$ at 20° incidence.

Table I

Mark 9A Head - Pressure errors

$$\Delta C_p = \frac{\text{Indicated} - \text{True Pressure}}{\text{Tunnel } \frac{1}{2}\rho V^2}$$

Incidence degrees	ΔC_p Pitot Error		ΔC_p Static Error	
	Pos. α	Neg. α	Pos. α	Neg. α
0	0	0	-0.003	-0.002
2	0	0	-0.003	-0.004
4	0	0	-0.006	-0.006
6	-0.002	-0.002	-0.011	-0.011
8	-0.005	-0.004	-0.021	-0.019
10	-0.012	-0.012	-0.032	-0.032
12	-0.022	-0.024	-0.045	-0.047
14	-0.038	-0.041	-0.057	-0.058
16	-0.061	-0.066	-0.066	-0.065
18	-0.088	-0.097	-0.075	-0.074
20	-0.121	-0.134	-0.086	-0.083
18	-0.088	-0.097	-0.074	-0.074
15	-0.061	-0.066	-0.066	-0.065
14	-0.039	-0.041	-0.057	-0.057
12	-0.022	-0.024	-0.046	-0.047
10	-0.011	-0.013	-0.032	-0.032
8	-0.005	-0.005	-0.021	-0.020
6	-0.002	-0.001	-0.011	-0.011
4	0	0	-0.006	-0.007
2	0	0	-0.004	-0.004
0	0	0	-0.003	-0.003

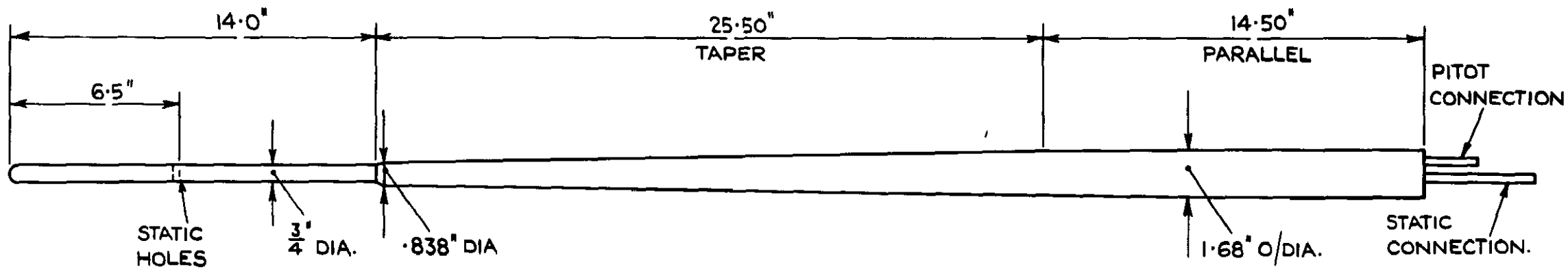


FIG. I. DETAIL OF MARK 9A PITOT - STATIC HEAD.

FIG. 2.

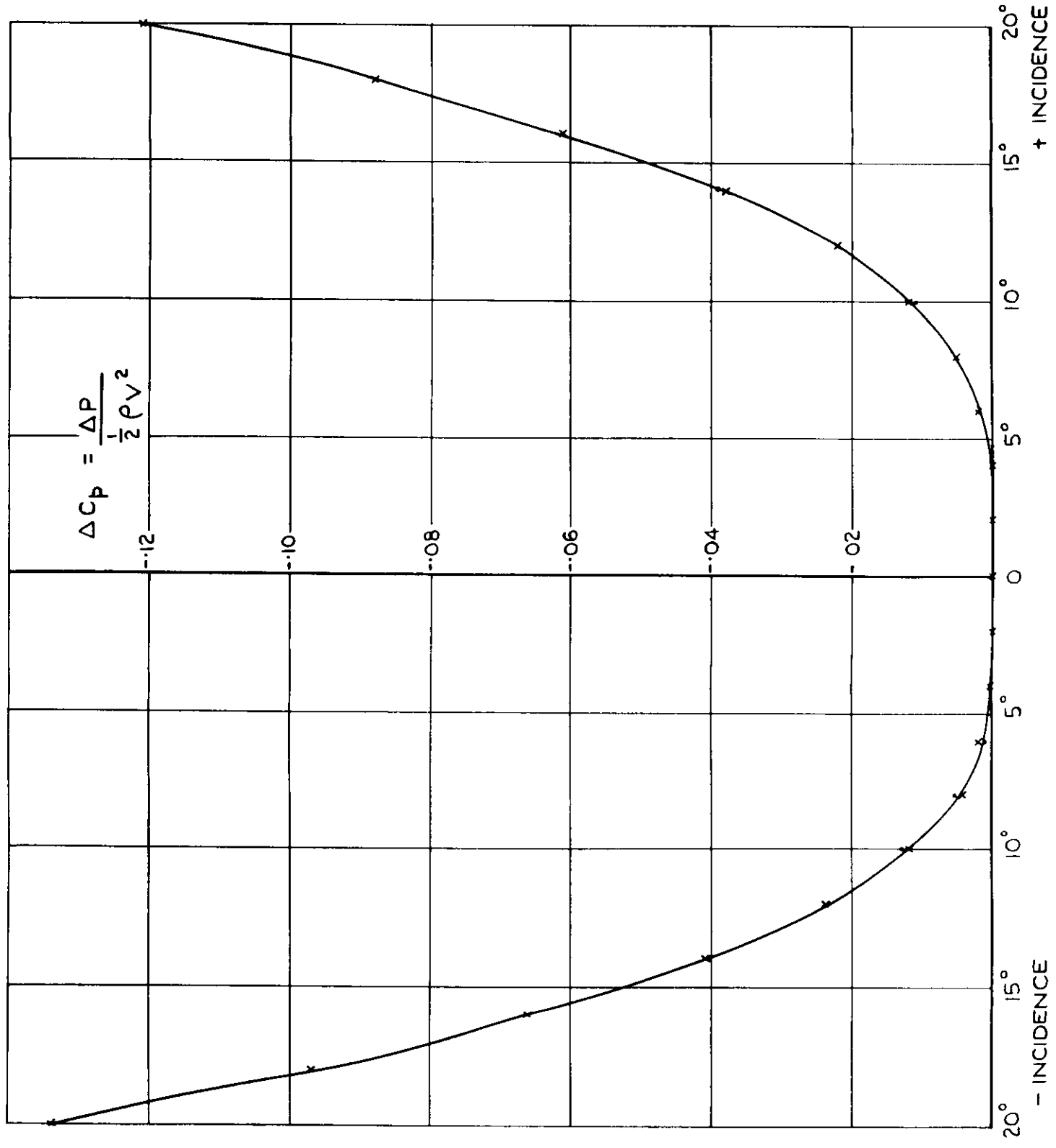


FIG. 2. MK. 9A HEAD - PITOT PRESSURE ERROR.

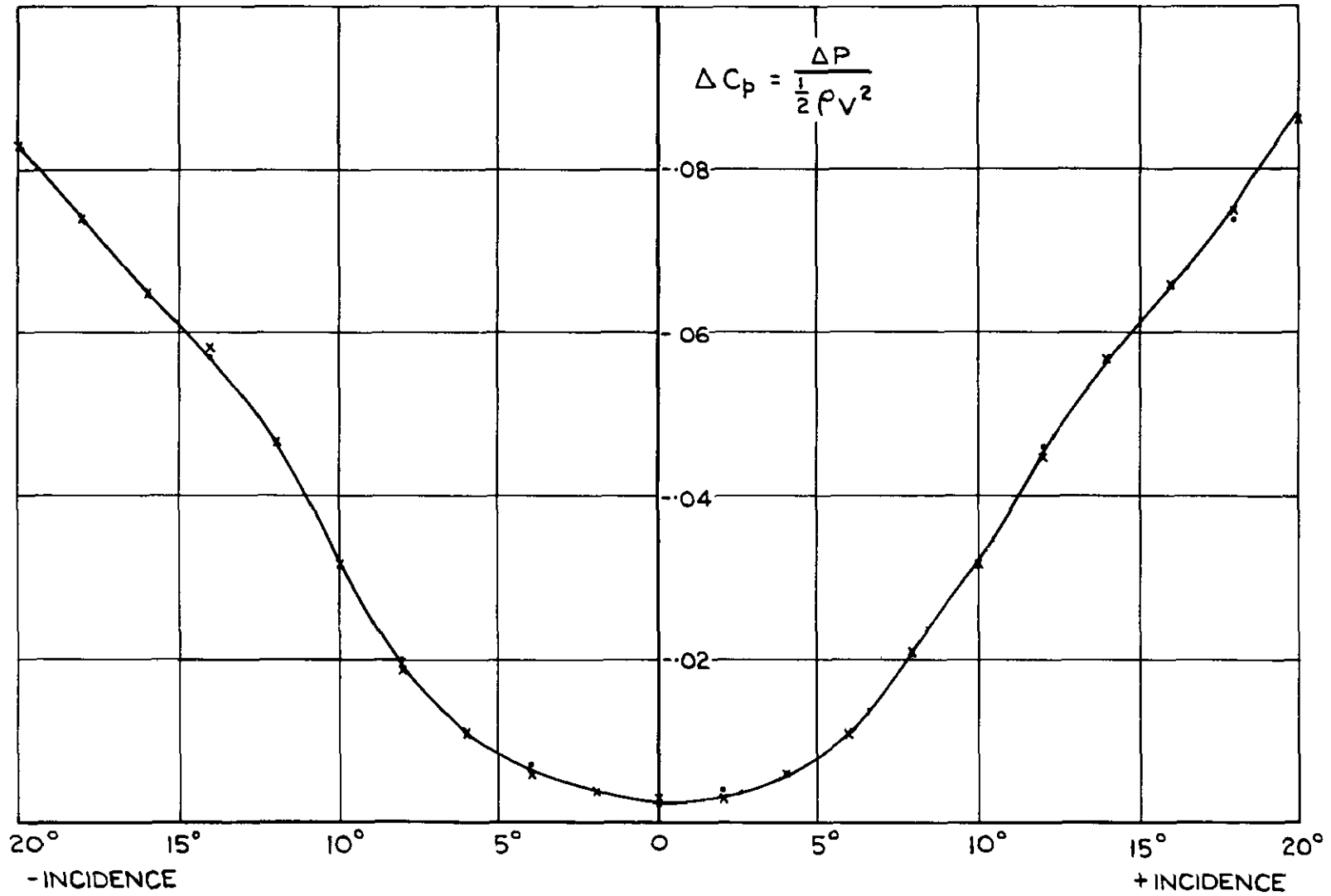


FIG. 3. MK. 9A HEAD - STATIC PRESSURE ERROR.

FIG. 3.



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