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A.R.C. Technical Report



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Tests in the N.P.L. Electric Tank
on a
4:1 Axi-Symmetrical Diffuser
having a
Discontinuity in the Wall Velocity

By

F. Cheers, B.A. and W. G. Rayner, B. Sc. (Eng.)

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Tests in the H.P.L. Electric Tank on a 4:1 Axi-Symmetrical Diffuser having a Discontinuity in the Wall Velocity

- By -

F. Cheers, B.A. and W. G. Raymer, B.Sc. (Eng.)
of the Aerodynamics Division, N.P.L.

26th March, 1946

Summary

This report describes a series of tests extending the work done in the Bristol Aeroplane Company's electric tank on a 4:1 axi-symmetrical diffuser having a single velocity discontinuity at the surface. A shape which is thought satisfactory is shown.

1. Introduction

A series of tests was carried out by the Bristol Aeroplane Company⁽¹⁾ at the request of the Aerodynamics Division, N.P.L. to design a 4:1 axi-symmetrical diffuser having a single velocity discontinuity at the wall, with constant wall velocity up- and down-stream. A reasonably good shape was obtained (Fig. 1) but it was considered that further tests should be made to eliminate variations in the wall velocity before wind tunnel tests would be possible. Accordingly the Bristol model was made up and tested in the N.P.L. tank⁽²⁾, and a number of modifications was made. Owing to the difficulty which was found in controlling the changes near the actual discontinuity, it was decided to aim at a shape having a steep velocity gradient over a short length of wall. Fig. 2 shows the final shape, which gives a satisfactory distribution.

2. Description of Tests

The final shape (shape F) obtained in the tests in the Bristol Aeroplane Company's electric tank was tested first; its ordinates are given in Table I and the shape and velocity distribution along the surface in Fig. 1. This shape was then modified in steps, in order to remove the unevenness in the velocity, and to steepen the actual discontinuity. The effect of a typical modification is shown in Fig. 4. It was found easy to make slight changes away from the discontinuity; but as this was approached closely, accurate control became impossible. Fig. 2 shows the final shape tested; the velocity distribution obtained is very flat, with a sharp change over a short length of wall. The radial distribution of velocity parallel to the axis at each end is shown in Fig. 3, and the ordinates in Table II.

3. Future Work

It is hoped in the future to design (in the tank) a diffuser with slot, in order to investigate sink effect.

References./

REFERENCES

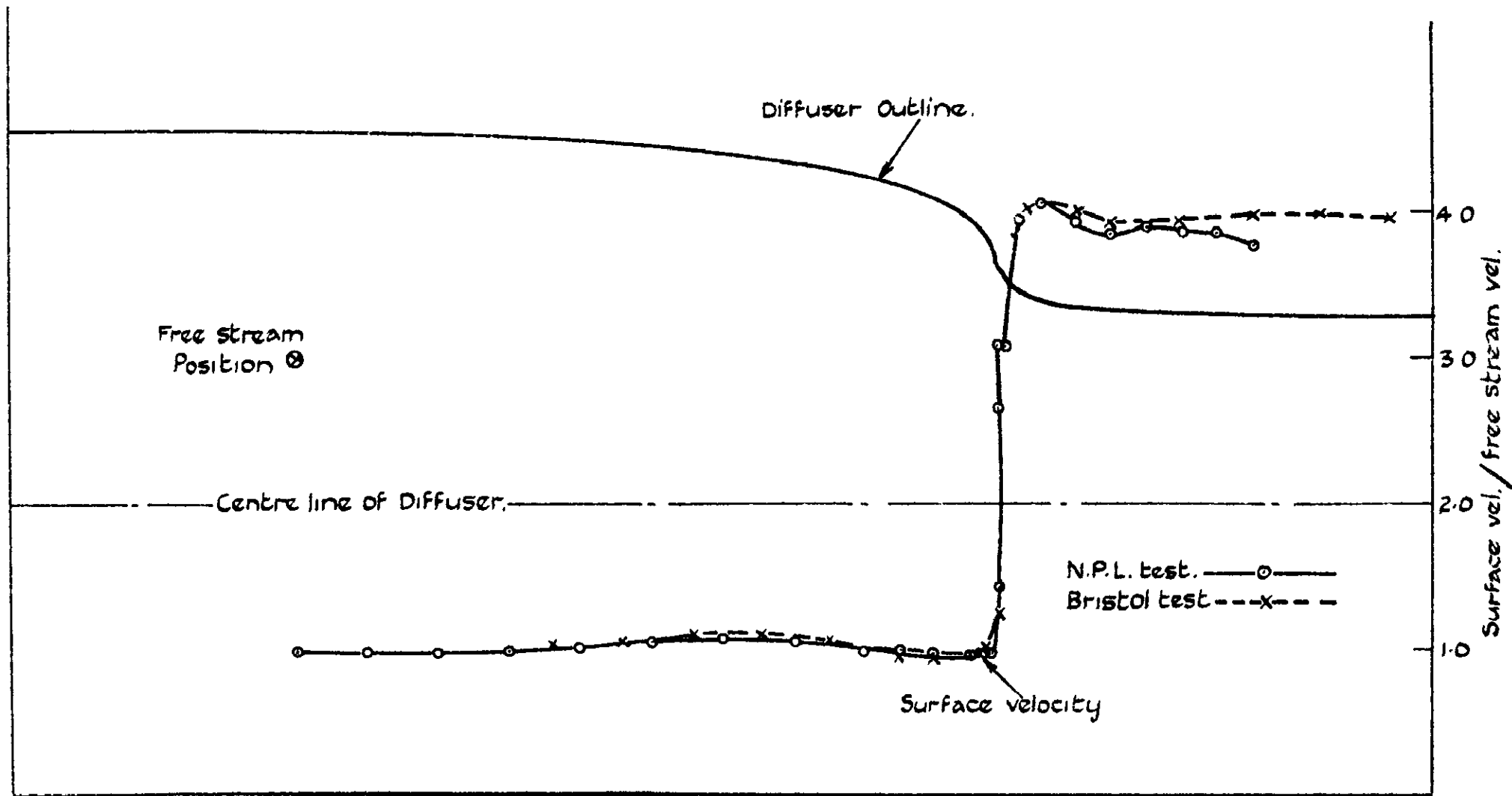
1. W. T. O. Lewis and E. J. E. Newman: The Development of a Diffuser Outline having Specific Velocity Distribution Characteristics by means of the Potential Flow Apparatus
Bristol Aeroplane Company Report No. KR. 76/45.
2. F. Cheers, G. Raymer and R. G. Fowler: Preliminary Tests on Electric Potential Flow Apparatus. 9195, F.M.86C.

Table I & II

4.1 Diffuser - Ordinates

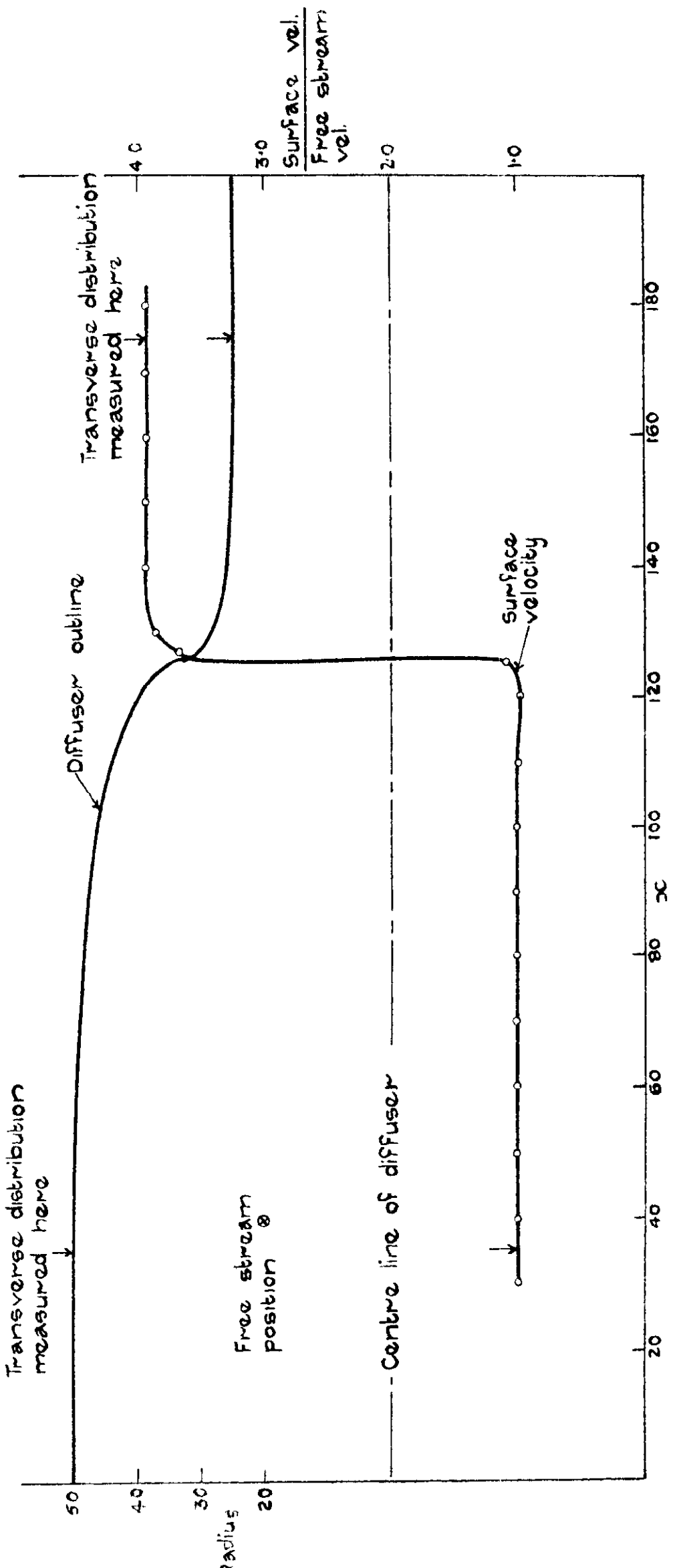
As Tested in N.P.L. Electric Tank

Table I Bristol Shape 'P'		Table II Final Shape	
X	R	X	R
0	51	0	50.2
20	51	10	50.2
45	51	20	50.2
55	50.8	30	50.2
65	50.4	40	50.1
75	49.9	50	49.95
85	49.2	60	49.6
95	48.4	70	49.2
105	47.4	80	48.7
115	46.5	90	47.95
120	45.4	100	46.5
125	44.0	110	44.2
129	42.5	115	42.45
131	41.6	120	40.05
133	40.5	122	38.65
135	39.5	124	36.75
137	37.7	125	35.35
138	36.5	125.5	34.5
138.5	35.7	126	33.4
139	34.2	126.05	33.0
139	32.4	125.9	32.6
140	31.0	125.6	32.5
141	30.0	125.6	32.4
143	28.8	126	31.3
145	27.9	127	30.0
150	26.9	128	29.3
155	26.4	130	28.25
160	26.0	133	27.3
165	25.8	135	26.85
180	25.8	140	26.1
200	25.8	145	25.75
		150	25.5

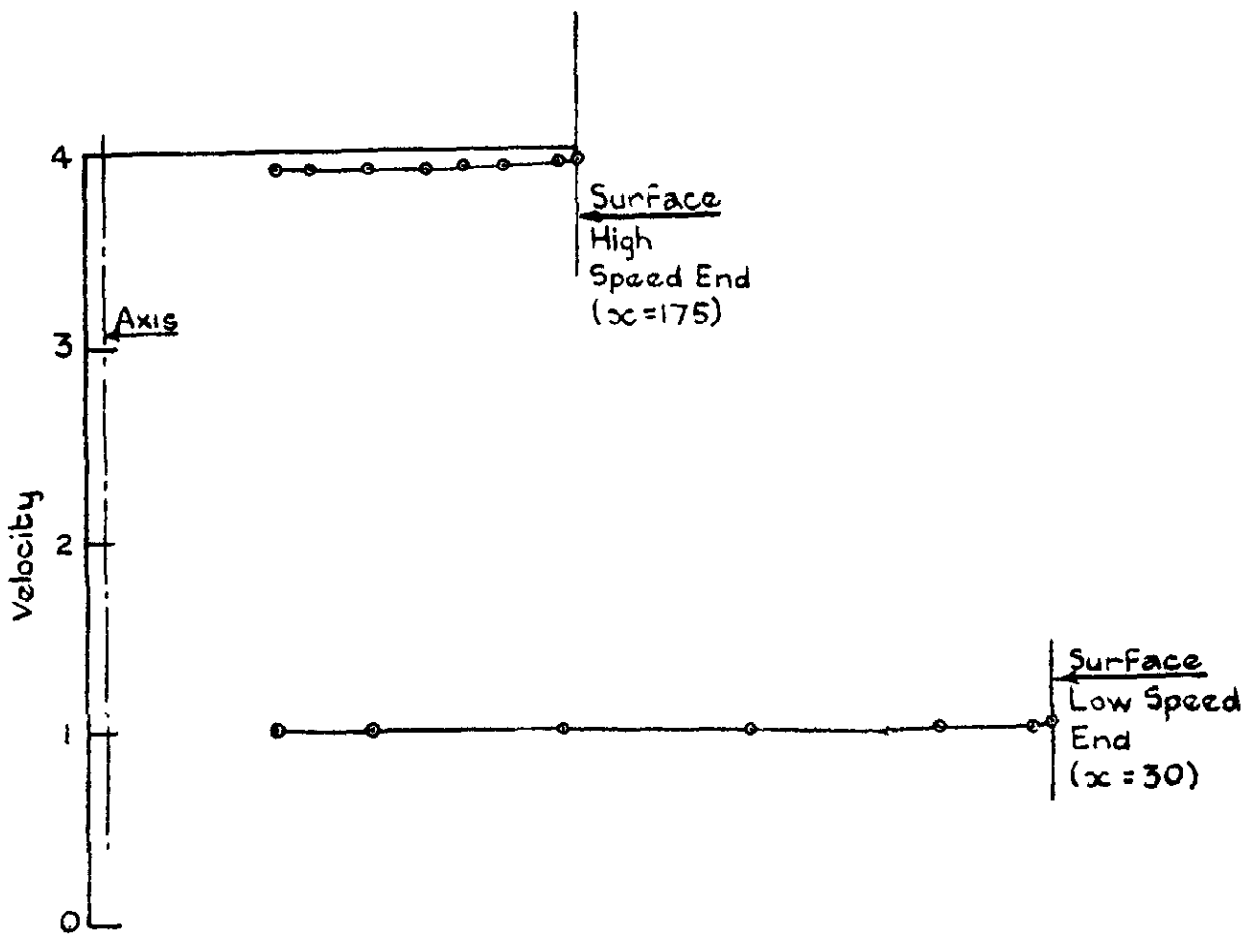


4:1 Diffuser — shape and surface velocity

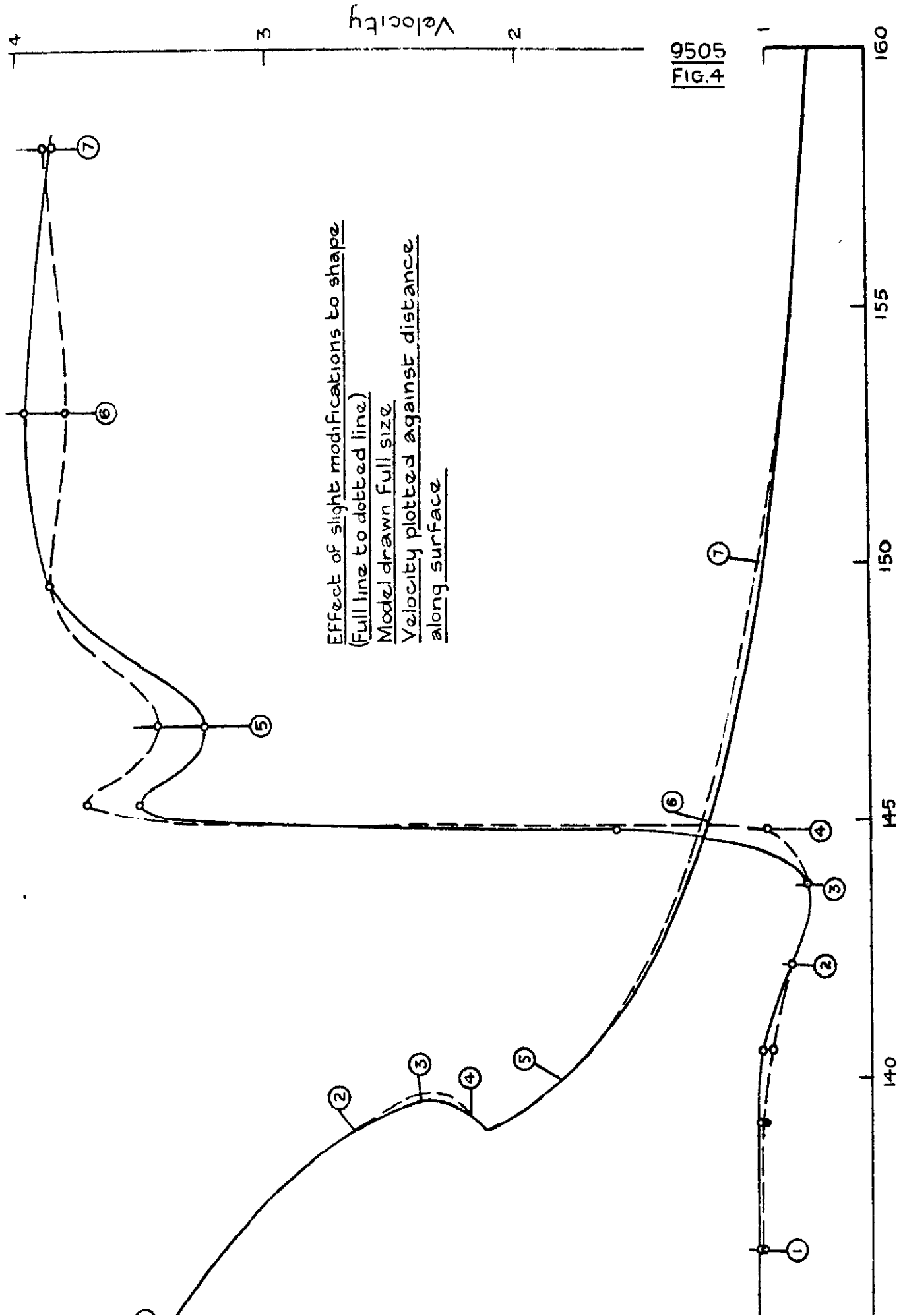
Shape From Bristol report — tested in N.P.L tank.



41 Diffuser - final shape and surface velocity.



41 Diffuser (Final shape)
Transverse Distribution of Velocity



Effect of slight modifications to shape
 (Full line to dotted line)
Model drawn full size
 Velocity plotted against distance
 along surface

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FIG.4

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