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TECHNICAL NOTES

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

No. 360

THE PRESSURE DISTRIBUTION OVER A SQUARE WING TIP ON A BIPLANE IN FLIGHT

By Richard V. Rhode and Eugene E. Lundquist
Langley Memorial Aeronautical Laboratory

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Page 14, Table IV, Run No. 76, Pressure orifice No. 10, Rib B,

Change : .94

To read: .09

Figure 1, Neglect pressure rib locations given and use the following:

Rib	Distance from Root Section (ft.)	(% semispan)
X	6.00	26.23
A	11.00	48.1
B	17.37	75.9
C	18.77	82.0
D	20.09	87.8
E	21.27	93.0
F	22.32	97.6

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Summary

This note presents the results obtained in pressure distribution tests on the right upper panel of a Douglas M-3 airplane in flight. These tests are a part of an extensive investigation on the effect of changes in tip shape on the load distribution; the results reported herein apply to the following cases:

	Upper wing tip	Lower wing tip
(a)	Square	Rounded
(b)	Square	Square
(c)	Square with faired end	Square

The results are given in tables and curves in such form that the load distribution for any lift coefficient within the usual range encountered in flight may be determined easily. They show that the shape of the lower tip has no influence on the load distribution over the upper tip and also that a simple end fairing on the square tip results in an appreciable reduction of tip load extending inboard a distance equal to about

40 per cent of the chord length. The reduction in tip load is accompanied by a simultaneous forward shift of the center of pressure on the same part of the wing.

The tests were made at Langley Field, Virginia, by the National Advisory Committee for Aeronautics in the late summer and early fall of 1930.

Introduction

There has been evident for some time a need for reliable, systematic information on the effect of changes in wing-tip plan form on the load distribution. For this reason an investigation, in flight, of the pressure distribution over wing tips has been undertaken by the National Advisory Committee for Aeronautics at Langley Field, Va. The investigation has been outlined to include pressure measurements on the right upper panel of a Douglas M-3 airplane with several variations in tip form, systematic in the main, but also including a few odd shapes, either because such forms are commonly used, or because of the facility with which they could be tested.

Results for the first tip tested, called the "Douglas" tip, have been presented in N.A.C.A. Technical Note No. 347. The present paper is the second of a series of notes presenting the results of this investigation, and it includes the data obtained on the right upper panel with a plain square tip and with a "square" tip having a simple fairing at the end.

It has been desirable, for the sake of expediency in installing new tips, to outline this investigation with the tip on the right lower panel remaining unchanged in form, regardless of the shape of the upper tip. While it was not believed that the shape of the lower tip would prove to be an important variable affecting the load distribution on the upper tip, it was desirable to make tests in at least one case to establish the validity of this belief. For that reason and also because the maximum differences in shape exist between a square tip and a rounded tip of the "Douglas" form, the present tests on the square tips were made with two forms of lower tip: square, and "Douglas." The present tests, therefore, represent three combinations, viz.:

	Upper wing tip	Lower wing tip
(a)	Square	"Douglas"
(b)	Square	Square
(c)	Square with faired end	Square

Method and Apparatus

The M-3 airplane used in these tests is a normal biplane with, however, an aspect ratio somewhat higher than usual. The characteristics of this airplane are given in Table I. The shape of the wing-tip plan form is given in Figure 1, and the rib profiles in Table II. The wings were rigged with a slight washin of about .2°. Deflection measurements made previously

(Reference 1) indicated that this amount would be sufficient approximately to cancel the torsional deflection at the low angles of attack. The results given herein, therefore, closely represent conditions for zero wing twist.

The procedure followed in these tests was the same as that followed in the tests on the Douglas tip (Reference 1) with the exception that an extra pressure rib (X) was installed midway between rib A and the root to enable a more accurate determination of the span load curve. Orifices in ribs C and X were connected to the same pressure capsules by means of Y connections in the tubes, screw clamps being used to stop off the tubes to one rib when pressures on the other were being measured. By this means, although it was not possible to measure pressures at ribs X and C simultaneously, sufficient information was obtained on both ribs to establish the span load and the moment curves at stations X and C.

Precision

As mentioned in Reference 1, the accuracy of these tests was maintained at a high level, largely because of the installation of all instruments in an insulated compartment which was maintained at a constant temperature. Part of the present tests were made during the unusually hot summer of 1930 - a circumstance which decreased the accuracy of those tests in comparison with those on the Douglas tip because of the slight maladjustments of the instruments caused by the abnormal temperatures. In general, therefore, the dispersion of experimental points was greater in the present tests than indicated in Figures 6 and 7 of Reference 1. In addition, the dispersion of points for rib F was somewhat greater than the average on account of the relative unreliability of one of the pressure capsules used with this rib. The faired curves given in the final results are, however, a reliable representation of what may be expected with the square tip.

Results

The results are given in Figures 2 to 5 and in Tables IV to VIII, inclusive. Figure 2 shows representative pressure plots for the plain square tip throughout the range of C_N investigated, the pressures for these cases being tabulated in Table IV. Pressures are tabulated also for the square tip with faired end in Table V. The final results for the plain square tip are given in Figures 3 and 5, which show the variation of rib C_N with wing C_N and the variation of rib C_M with rib C_N, respectively. Figures 4 and 5 give corresponding results for the square tip with faired end. These curves are all well established by a large number of points, which are omitted in the figures to avoid confusion. The curves for the root section were obtained by extrapolating span C_N curves and span C_M curves from a large amount of data, and consequently are quite reliable. However, in view of the extrapolation, they do not represent the true conditions near the fuselage and in the slipstream, but rather more nearly ideal conditions with the influence of the fuselage and slipstream absent.

Curves for rib D in Figures 3, 4 and 5, have been adjusted to give what are believed to be more representative results. Measurements of the rib profiles disclosed the fact that the camber of rib D, which was located near the junction of the new tip and the wing, was somewhat greater than the camber of each of the other ribs which represented more closely true Clark Y sections. The calculated angle of zero lift and the moment coefficient were, therefore, greater for rib D than for the other ribs and for the true Clark Y section. The order of magnitude of these discrepancies was sufficient to account for humps in the span C_N and span C_M curves at rib D. For that reason, corrections were made which eliminate the effect of the slightly excessive camber. While the results given for rib D do not, therefore, strictly represent the measurements, they are representative of a more nearly perfect wing, and are, therefore, more useful.

For convenience, the ordinates of the curves of Figures 3 to 5 are given in Tables VI to VIII, inclusive. To use these curves or tables for any wing C_N (or practically speaking, for any wing lift coefficient), the span C_N distribution may be obtained from Figures 3 or 4 (Tables VI or VII) by plotting the corresponding values of rib C_N at their proper locations on the span base line, as determined from Figure 1. The corresponding values of rib C_M may be obtained from Figure 5 (Table VIII) and the center of pressure locus can then be drawn from the relation $C_P = \frac{C_M}{C_N}$.

Discussion of Results

While it is not intended to go into any extended analysis or discussion of the results of these wing-tip tests until the completion of the investigation justifies such action, several points may be brought out here.

It will have been noted that the final results are presented with no reference to the shape of the lower tip. The reason for this is that tests made on the plain square tip gave the same results, within the experimental error, whether the square or "Douglas" tip was used on the lower wing. This is believed to be sufficient evidence that the shape of one wing tip of a biplane with normal gap-chord ratio has no appreciable effect on the load distribution over the other.

Figures 3 to 5 indicate that the simple fairing on the end of the tip results in an appreciable decrease of load as far inboard as rib E, but does not cause any great difference in the moment for the same local lift coefficient. The magnitude of this effect is a little surprising in view of the apparent minor nature of the alteration to the tip, and leads to the belief that other types of fairing may give appreciably different results.

Langley Memorial Aeronautical Laboratory,
National Advisory Committee for Aeronautics,
Langley Field, Va., December 29, 1930.

Reference

1. Rhode, Richard V. and Lundquist, Eugene E. : The Pressure Distribution Over a Douglas Wing Tip on a Biplane in Flight. N.A.C.A. Technical Note No. 347, 1930.

TABLE I

Characteristics of Douglas M-3 Airplane

Type	Biplane
Airfoil	Clark Y
Span (upper and lower)	45 ft. 10 in.
Chord (upper and lower)	5 " 8 "
Gap	6 " 0 "
Stagger	none
C.G. in per cent of chord	29

Areas (sq.ft.):	Original	*Square upper	Square upper and lower	Square faired
Right upper wing including aileron	126.4	130.0	130.0	129.0
Right lower wing including aileron	126.4	126.4	130.0	130.0
Total wing area	505.6	509.2	512.8	511.8
Horizontal tail surfaces				58.0
Vertical " "				17.7

Weight during tests	4840 lb.
Engine	Liberty
Rated hp at 1750 r.p.m.	420
Power loading	11.52 lb. per hp
Wing loading	9.57 lb. per sq.ft.

*Left wing panels remained unchanged.

TABLE II

Ordinates of Pressure Ribs

Station in % chord	Clark Y		Rib A		Rib B		Rib C		Rib D		Rib E		Rib F	
	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
.00	3.50	3.50	3.49	3.49	3.36	3.36	3.49	3.49	3.35	3.35	3.54	3.54	3.17	3.17
1.25	5.45	1.93	5.56	1.93	5.34	1.79	5.42	1.84	5.38	1.88	5.56	1.93	5.51	1.75
2.50	6.50	1.466	6.52	1.47	6.38	1.33	6.43	1.38	6.39	1.43	6.43	1.43	6.39	1.29
5.00	7.90	.933	8.00	.97	7.90	.83	8.00	.87	7.90	.87	7.90	.83	7.86	.78
7.50	8.85	.629	9.05	.65	8.91	.28	8.96	.46	8.92	.51	9.01	.46	8.82	.51
10.00	9.60	.42	9.74	.46	9.65	.32	9.65	.32	9.65	.37	9.74	.37	9.60	.32
15.00	10.685	.15	10.76	.28	10.67	.14	10.62	.18	10.71	.18	10.75	.18	10.66	.09
20.00	11.36	.033	11.26	.09	11.26	.05	11.26	.05	11.27	.09	11.35	.09	11.30	.00
30.00	11.70	.00	11.73	.00	11.81	.00	11.81	.00	11.72	.00	11.67	.00	11.67	.00
40.00	11.40	.00	11.36	.00	11.40	.05	11.45	.00	11.44	.00	11.40	.00	11.30	.00
50.00	10.515	.00	10.48	.00	10.58	.03	10.58	.08	10.52	.09	10.66	.09	10.48	.05
60.00	9.148	.00	9.19	-.05	9.42	.09	9.25	.14	9.24	.09	9.24	.14	9.24	.09
65.00	8.30	.00	8.27	.00	8.54	.09	8.45	.14	8.36	.09	8.36	.18	8.32	.09
70.00	7.35	.00	7.36	.00	7.68	.09	7.67	.14	7.49	.14	7.40	.14	7.40	.14
80.00	5.216	.00	5.33	.00	5.65	.18	5.70	.23	5.51	.09	5.51	.18	5.51	.14
90.00	2.802	.00	2.80	-.05	3.31	.23	3.31	.18	3.12	.05	3.08	.14	3.12	.14
95.00	1.494	.00	1.52	-.09	2.02	.14	2.02	.09	1.84	-.05	1.88	.05	1.84	.14
100.00	.12	.00	.23	-.23	.74	.00	.65	.00	.46	-.23	.55	-.05	.60	.00

Note: All ordinates given are in per cent of chord.

TABLE III

Orifice Locations in per cent Chord

Orifice No.	Rib					
	A	B	C	D	E	F
1	1.54	1.47	1.47	1.47	1.58	1.54
2	3.06	2.94	3.02	2.94	3.23	4.01
3	4.45	4.41	4.49	4.41	4.70	6.62
4	6.69	6.70	6.69	6.62	6.69	11.17
5	13.31	13.30	13.30	13.24	13.38	18.48
6	25.00	25.00	25.00	25.00	25.00	35.29
7	41.30	41.40	41.30	41.25	41.25	54.54
8	59.50	59.10	58.80	58.89	59.04	72.50
9	73.70	72.00	72.30	72.11	72.21	89.78
10	94.40	94.50	94.40	94.41	94.56	

TABLE IV

Recorded Pressures in Multiples of q
(Square tip)

Run No. 162 Wing $C_N = .168$

Orifice No.	Rib					
	A	B	C	D	E	F
1	-1.28	-1.17	-1.10	-1.06	-1.01	-.80
2	-.75	-.81	-.62	-.59	-.69	-.46
3	-.47	-.39	-.36	-.25	-.49	-.10
4	-.20	-.15	-.29	-.13	-.20	.10
5	.17	0	.10	.31	.20	.28
6	.38	.42	.30	.27	.30	—
7	.44	.35	.31	.44	.33	.17
8	.26	.30	.30	.35	.21	.09
9	.19	.17	.21	.20	.10	.05
10	.09	.17	.05	.09	.07	—

Run No. 147 Wing $C_N = .267$

Orifice No.	Rib					
	A	B	C	D	E	F
1	-.54	-.68	-.67	-.88	-.66	-.73
2	-.34	-.42	-.42	-.42	-.65	-.39
3	-.12	-.08	-.23	-.10	-.27	-.04
4	.20	.08	0	.12	-.09	.15
5	.34	.15	.29	.37	.26	.32
6	.42	.49	.34	.38	.40	.26
7	.55	.49	.33	.49	.39	.26
8	.28	.33	.29	.34	.25	.15
9	.23	.13	.30	.25	.18	.15
10	.10	.10	.05	.13	.07	—

TABLE IV (cont.)

Recorded Pressures in Multiples of q
(Square tip)

Run No. 144 Wing C_N = .378

Orifice No.	Rib					
	A	B	C	D	E	F
1	.03	− .15	− .09	− .41	− .38	− .30
2	.15	.08	.04	.04	− .22	− .07
3	.30	.54	.19	.30	.07	.15
4	.54	.45	.34	.41	.22	.30
5	.59	.38	.52	.58	.45	.41
6	.56	.66	.48	.50	.48	.26
7	.64	.56	.42	.57	.44	.26
8	.34	.37	.34	.37	.28	.19
9	.26	.13	.30	.27	.20	.17
10	.10	.12	.05	.12	.09	−

Run No. 156 Wing C_N = .578

Orifice No.	Rib					
	A	B	C	D	E	F
1	1.45	1.11	1.03	.86	.78	.67
2	1.36	1.20	1.11	1.05	.72	.58
3	1.28	1.22	1.14	1.14	.81	.67
4	1.33	1.17	1.11	1.06	.89	.56
5	1.11	.89	.89	.95	.78	.53
6	.89	.86	.70	.70	.63	−
7	.78	.64	.58	.61	.44	.31
8	.42	.39	.36	.36	.28	.22
9	.28	.20	.22	.25	.19	.28
10	.08	.11	.03	.08	.09	−

TABLE IV (cont.)

Recorded Pressures in Multiples of q
(Square tip)

Run No. 76 Wing C_N = .791

Orifice No.	Rib A	Rib B	Rib C	Rib D	Rib E	Rib F
1	2.12	1.50	1.46	1.12	1.10	.80
2	2.02	1.65	1.49	1.29	1.07	.80
3	1.90	1.73	1.63	1.57	1.17	1.06
4	1.96	1.72	1.54	1.50	1.26	.82
5	1.56	1.26	1.35	1.20	1.18	.83
6	1.20	1.19	1.01	.95	.92	.41
7	1.03	.84	.76	.71	.70	.52
8	.54	.51	.54	.51	.39	.39
9	.37	.25	.39	.35	.30	–
10	.11	.04	.08	.10	.13	–

Run No. 154 Wing C_N = 1.001

Orifice No.	Rib A	Rib B	Rib C	Rib D	Rib E	Rib F
1	3.65	2.85	2.95	2.30	2.20	2.10
2	3.20	3.00	2.70	2.50	2.10	1.60
3	2.95	2.85	2.60	2.50	2.00	1.50
4	2.80	2.55	2.50	2.20	2.00	1.05
5	2.15	1.80	1.75	1.70	1.50	.90
6	1.55	1.45	1.18	1.15	1.05	–
7	1.10	.95	.85	.85	.68	.50
8	.60	.50	.50	.50	.40	.45
9	.30	.25	.25	.33	.30	.50
10	.10	.15	.05	.10	.15	–

TABLE IV (cont.)

Recorded Pressures in Multiples of q
(Square tip)

Run No. 152 Wing C_N = 1.390

Orifice No.	Rib					
	A	B	C	D	E	F
1	5.25	4.32	4.37	3.50	3.50	3.28
2	5.46	4.32	4.21	3.80	3.23	2.53
3	4.92	4.16	3.80	3.75	3.12	2.14
4	4.30	3.67	3.41	3.23	2.84	1.56
5	3.02	2.76	2.47	2.34	2.03	1.25
6	2.03	1.77	1.68	1.56	1.41	.68
7	1.41	1.15	1.04	1.09	.97	.91
8	.70	.55	.64	.62	.65	1.04
9	.41	.29	.42	.47	.54	1.02
10	.21	.19	.10	.17	.23	–

Run No. 164 Wing C_N = 1.502

Orifice No.	Rib					
	A	B	C	D	E	F
1	5.98	4.78	4.68	3.87	3.86	3.54
2	5.56	4.82	4.61	4.15	3.72	2.76
3	5.22	4.68	4.36	4.10	3.44	2.31
4	4.69	4.07	3.92	3.61	3.26	1.75
5	3.32	3.00	2.67	2.56	2.23	1.44
6	2.17	2.04	1.78	1.66	1.52	–
7	1.41	1.26	1.18	1.23	1.04	1.19
8	.65	.59	.68	.70	.70	1.66
9	.40	.40	.41	.51	.59	1.50
10	.28	.16	.12	.19	.26	–

TABLE V

Recorded Pressures in Multiples of q
(Square tip with faired end)

Run No. 176 Wing C_N = -.0953

Orifice No.	Rib					
	A	B	C	D	E	F
1	-2.70	-2.34	-3.32	-1.81	-1.90	-1.32
2	-1.91	-1.79	-1.74	-1.58	-1.69	- .78
3	-1.46	-1.27	-1.48	-1.17	-1.22	- .31
4	-1.01	-1.01	-1.06	- .80	- .88	- .11
5	- .47	- .57	- .40	- .28	- .22	.05
6	- .04	.01	-	.02	.03	.09
7	.23	.16	.11	.19	.17	.07
8	.13	.14	.17	.21	.17	.07
9	.09	.13	.13	.13	.10	0
10	.06	.05	.04	.07	.05	-

Run No. 176 Wing C_N = .1654

Orifice No.	Rib					
	A	B	C	D	E	F
1	-1.22	-1.24	-1.18	-1.04	-1.19	- .72
2	- .77	- .83	- .81	- .62	- .93	- .36
3	- .60	- .43	- .67	- .35	- .58	- .06
4	- .28	- .26	- .32	- .15	- .30	.15
5	.15	- .06	.05	.15	.15	.10
6	.29	.35	-	.25	.23	.15
7	.51	.35	.29	.32	.29	.12
8	.30	.29	.28	.30	.24	.12
9	.19	.18	.16	.22	.15	.03
10	.09	.10	.05	.08	.05	-

TABLE V (cont.)

Recorded Pressures in Multiples of q
(Square tip with faired end)

Run No. 196 Wing C_N = .362

Orifice No.	Rib					
	A	B	C	D	E	F
1	.06	0	.11	-.28	-.41	-.17
2	.23	.23	.18	.05	-.12	.07
3	.37	.51	.52	.31	.08	.28
4	.76	.41	.63	.40	.25	.31
5	.67	.30	.70	.54	.44	.13
6	.56	.62	.81	.48	.44	.24
7	.57	.47	.48	.44	.33	.13
8	.31	.27	.43	.29	.20	.12
9	.18	.18	.30	.19	.14	.10
10	.07	.05	.08	.08	.08	–

Run No. 177 Wing C_N = .572

Orifice No.	Rib					
	A	B	C	D	E	F
1	1.19	.90	.79	.67	.55	.31
2	1.20	1.14	.92	.84	.50	.38
3	1.23	1.17	.92	1.01	.72	.52
4	1.36	1.15	.95	1.00	.80	.42
5	1.11	.79	.90	.96	.75	.26
6	.84	.80	–	.71	.61	.28
7	.79	.65	.54	.58	.46	.19
8	.43	.37	.41	.39	.30	.18
9	.29	.21	.30	.26	.21	.12
10	.07	.15	.05	-.10	.13	–

TABLE V (cont.)

Recorded Pressures in Multiples of q
(Square tip with faired end)

Run No. 200 Wing C_N = .705

Orifice No.	Rib					
	A	B	X	D	E	F
1	1.76	1.37	2.09	1.01	.94	.59
2	1.62	1.50	1.71	1.08	.88	.58
3	1.69	1.58	1.95	1.32	.96	.60
4	1.80	1.45	1.73	1.30	1.04	.56
5	1.37	1.00	1.51	1.13	.94	.36
6	1.04	1.03	1.33	.85	.66	.40
7	.88	.76	.83	.63	.50	.30
8	.49	.42	.60	.38	.35	.36
9	.30	.23	.34	.29	.22	.16
10	.10	.08	.11	.09	.11	–

Run No. 197 Wing C_N = .919

Orifice No.	Rib					
	A	B	X	D	E	F
1	2.52	1.99	3.39	1.52	1.43	1.01
2	2.53	2.08	2.65	1.72	1.42	.87
3	2.48	2.17	2.86	1.56	1.41	.80
4	2.39	1.91	2.48	1.82	1.43	.65
5	1.84	1.43	1.92	1.43	1.17	.54
6	1.29	1.19	1.66	1.04	.89	.50
7	1.04	.86	1.01	.76	.65	.40
8	.58	.49	.71	.49	.44	.65
9	.37	.30	.52	.38	.35	.26
10	.11	.08	.16	.13	.17	–

TABLE V (cont.)

Recorded Pressures in Multiples of q
(Squared tip with faired end)

Run No. 176 Wing C_N = 1.296

Orifice No.	Rib A	B	C	D	E	F
1	5.20	4.02	3.93	3.29	3.21	2.14
2	4.82	4.59	3.72	3.36	3.01	1.75
3	4.39	4.03	3.57	3.50	2.92	1.56
4	4.12	3.43	3.11	3.01	2.60	1.13
5	2.92	2.57	2.28	2.21	1.87	.84
6	1.98	1.72	–	1.44	1.26	.73
7	1.35	1.14	1.00	1.00	.91	.75
8	.73	.60	.63	.60	.68	1.16
9	.43	.34	.39	.46	.55	.23
10	.17	.15	.10	.16	.24	–

Run No. 197 Wing C_N = 1.441

Orifice No.	Rib A	B	X	D	E	F
1	5.50	4.29	5.59	3.55	3.27	2.31
2	4.97	4.84	5.12	3.54	3.19	1.87
3	4.73	4.30	5.16	3.66	2.99	1.68
4	4.32	3.60	4.58	3.17	2.80	1.22
5	3.15	2.66	3.42	2.38	1.94	.90
6	2.12	1.83	2.43	1.52	1.36	.78
7	1.42	1.19	1.44	1.06	.96	.81
8	.76	.57	.85	.65	.70	1.28
9	.41	.33	.50	.50	.43	.24
10	.16	.11	.27	.17	.27	–

TABLE VI

Coordinates of Curves of Figure 3
(Square tip)

Wing C_N	Rib C_N							
	Root	X	A	B	C	D	E	F
0	.000	.000	.000	.000	.000	.000	.000	.000
.1	.115	.112	.105	.091	.086	.079	.070	.055
	1155	1020	1.050	905	855	790	.700	555
.2	.231	.224	.210	.181	.171	.158	.140	.111
.3	.347	.335	.315	.271	.257	.238	.214	.172
	1155	1117	1050	905	855	793	712	588
.4	.462	.447	.420	.362	.342	.317	.285	.835
.5	.577	.558	.525	.452	.428	.396	.360	.300
	1155	1116	1050	903	856	792	725	617
.6	.693	.670	.630	.542	.514	.475	.435	.370
.7	.808	.781	.735	.633	.599	.554	.508	.442
	1.155	1.117	1.050	904	856	792	732	.648
.8	.924	.894	.840	.723	.685	.634	.586	.518
.9	1.039	1.005	.945	.814	.770	.713	.664	.597
1.0	1.154	1.117	1.050	.904	.856	.792	.745	.685
1.1	1.270	1.226	1.150	.994	.943	.871	.828	.790
	1.154	1112	1044	904	857	792	762	.758
1.2	1.384	1.334	1.253	1.085	1.028	.951	.914	.909
1.3	1.495	1.436	1.353	1.175	1.114	1.030	.999	1.042
	1139	1100	1036	904	857	793	781	857
1.4	1.595	1.540	1.450	1.265	1.200	1.110	1,093	1.203
	1126	1088	1021	912	860	800	796	976
1.5	1.690	1.632	1.531	1.368	1.290	1.200	1,195	1.465

TABLE VII

Coordinates of Curves of Figure 4
(Square faired tip)

Wing C_N	Rib C_N							
	Root	X	A	B	C	D	E	F
0	.000	.000	.000	.000	.000	.000	.000	.000
.1	.120	.112	.107	.092	.086	.080	.069	.038
.2	.236	.224	.212	.183	.172	.160	.135	.080
.3	.352	.337	.318	.274	.258	.240	.203	.124
.4	.468	.449	.424	.366	.345	.320	.269	.170
.5	.585	.561	.530	.457	.431	.400	.336	.218
.6	.701	.673	.637	.548	.517	.480	.405	.273
.7	.816	.786	.743	.640	.603	.560	.476	.334
.8	.932	.898	.849	.732	.690	.640	.551	.402
.9	1.048	1.010	.955	.823	.776	.720	.630	.475
1.0	1.164	1.122	1.061	.914	.862	.800	.708	.558
1.1	1.280	1.233	1.165	1.005	.947	.880	.789	.643
1.2	1.397	1.345	1.267	1.098	1.033	.960	.872	.732
1.3	1.510	1.453	1.365	1.188	1.122	1.040	.958	.828
1.4	1.611	1.557	1.463	1.283	1.214	1.126	1.053	.930
1.5	1.710	1.655	1.550	1.388	1.315	1.222	1.160	1.055

TABLE VIII

Coordinates of Curves of Figure 5

Rib C_N	Rib C_M								
	Root	X	A	B	C	D	E	F sq.	F sq. faired
0	-.071	-.070	-.069	-.065	-.063	-.059	-.054	-.034	-.027
.1	-.094	-.092	-.091	-.086	-.084	-.081	-.074	-.061	-.051
.2	-.116	-.114	-.112	-.106	-.105	-.104	-.095	-.092	-.083
.3	-.139	-.137	-.134	-.127	-.127	-.127	-.117	-.125	-.120
.4	-.161	-.159	-.155	-.148	-.148	-.151	-.140	-.161	-.158
.5	-.184	-.181	-.177	-.169	-.169	-.174	-.164	-.199	-.198
.6	-.206	-.203	-.199	-.189	-.190	-.197	-.190	-.239	-.239
.7	-.229	-.225	-.230	-.210	-.211	-.220	-.216	-.282	-.282
.8	-.251	-.248	-.242	-.231	-.233	-.243	-.244	-.327	-.327
.9	-.274	-.270	-.263	-.251	-.254	-.267	-.272	-.374	-.374
1.0	-.296	-.292	-.285	-.272	-.275	-.290	-.300	-.423	-.423
1.1	-.319	-.314	-.307	-.293	-.296	-.314	-.329	-.473	
1.2	-.341	-.336	-.328	-.313	-.317	-.338	-.358	-.524	
1.3	-.364	-.359	-.350	-.334	-.339			-.575	
1.4	-.386	-.381	-.371	-.355				-.629	
1.5	-.409	-.403	-.393					-.684	
1.6	-.431	-.425							
1.7	-.454								

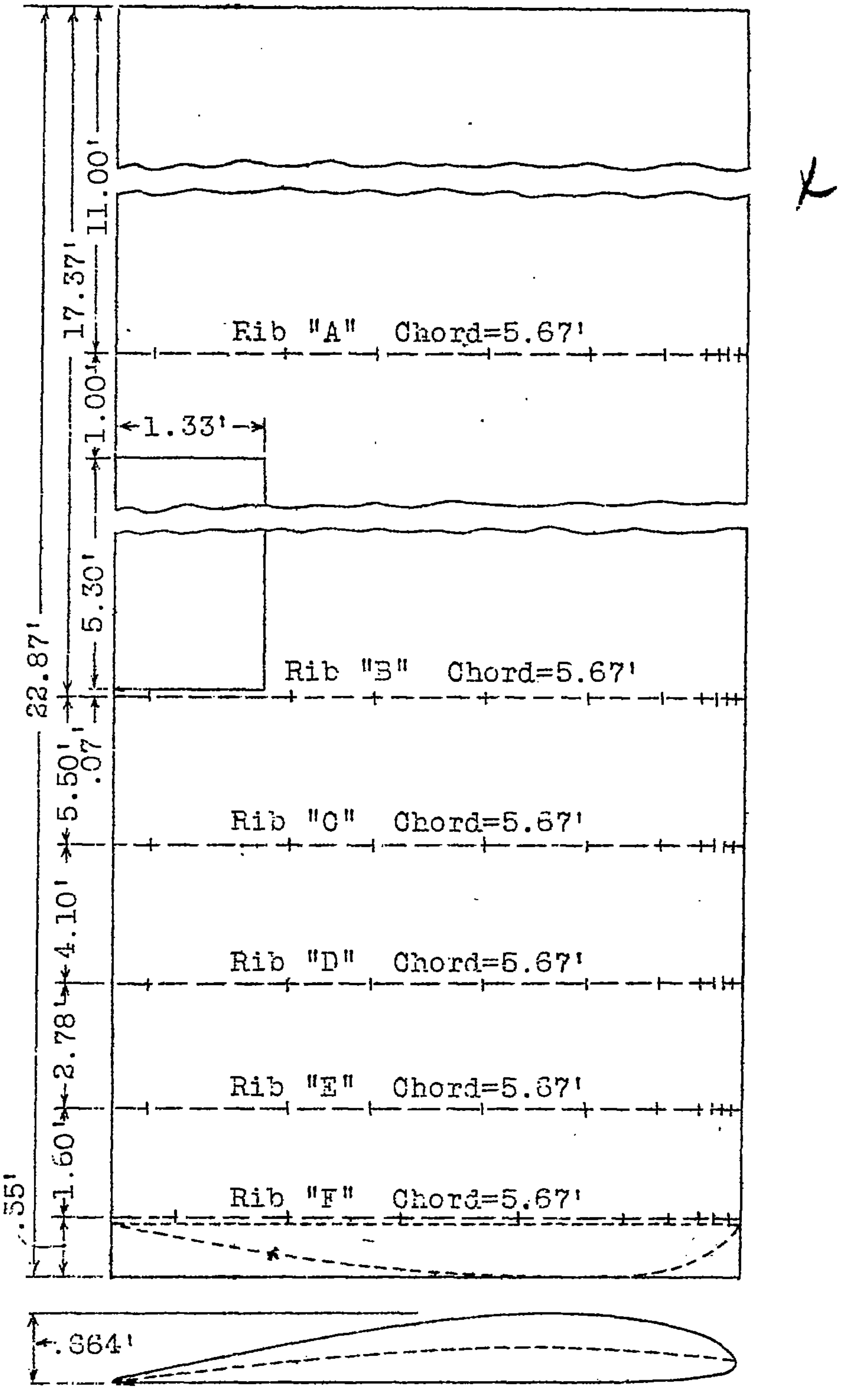
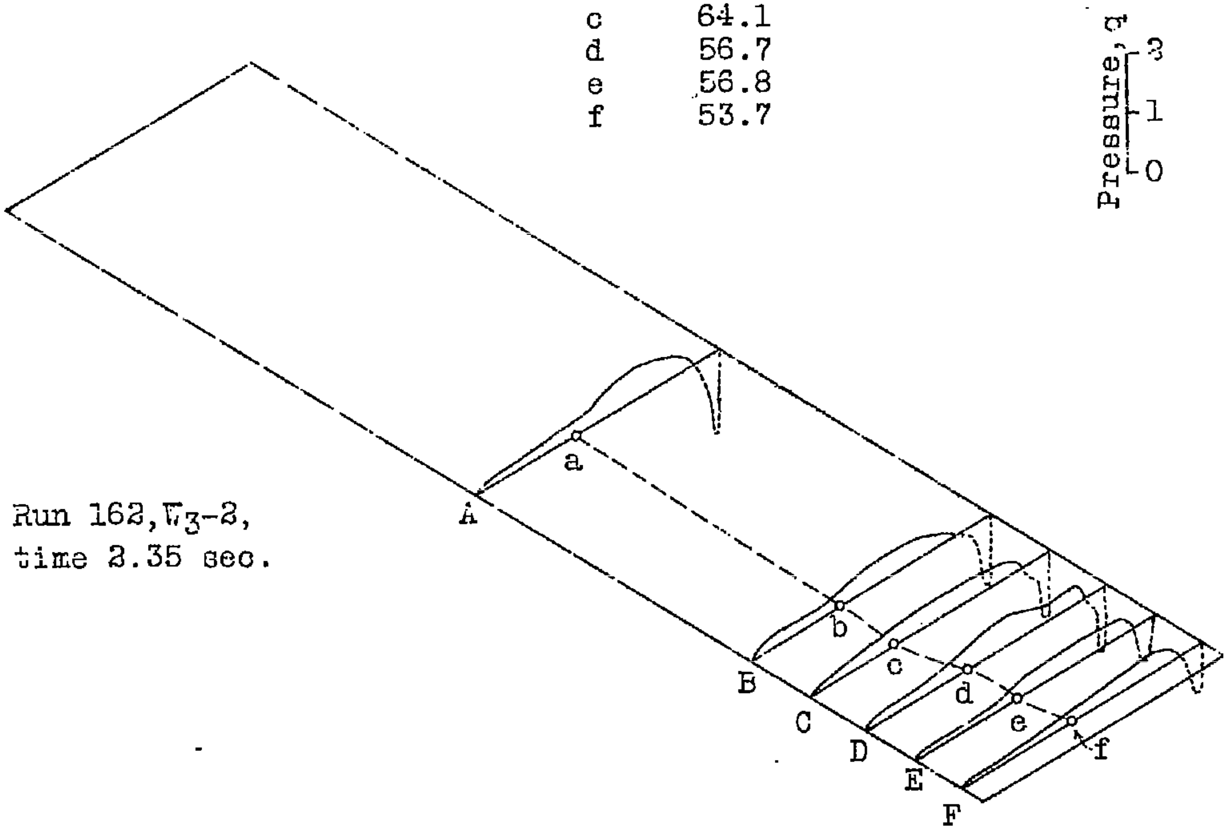


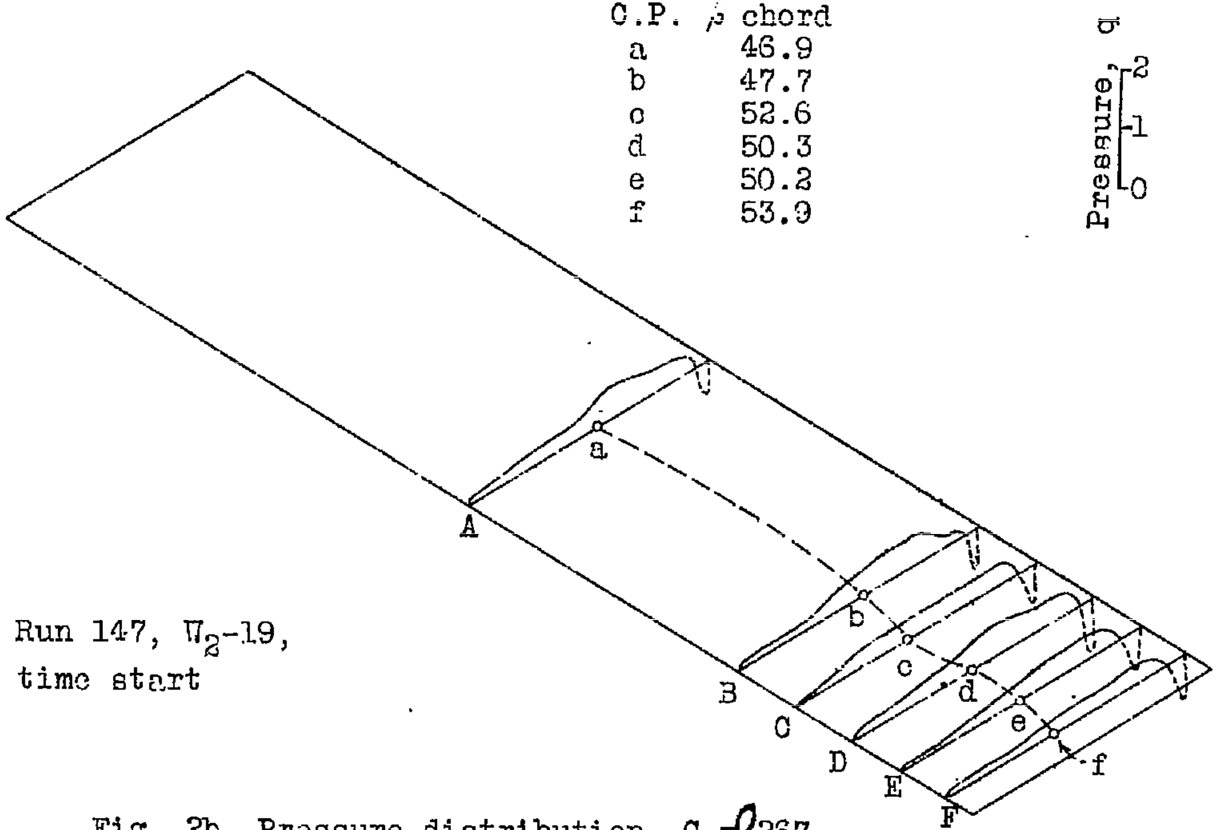
Fig. 1 M-3 wing with pressure ribs & orifice locations.
(Square & square-faired tips)

C.P.	% chord
a	59.4
b	61.5
c	64.1
d	56.7
e	56.8
f	53.7



Run 162, W_3-2,
time 2.35 sec.

Fig. 2a Pressure distribution. C_N=.168

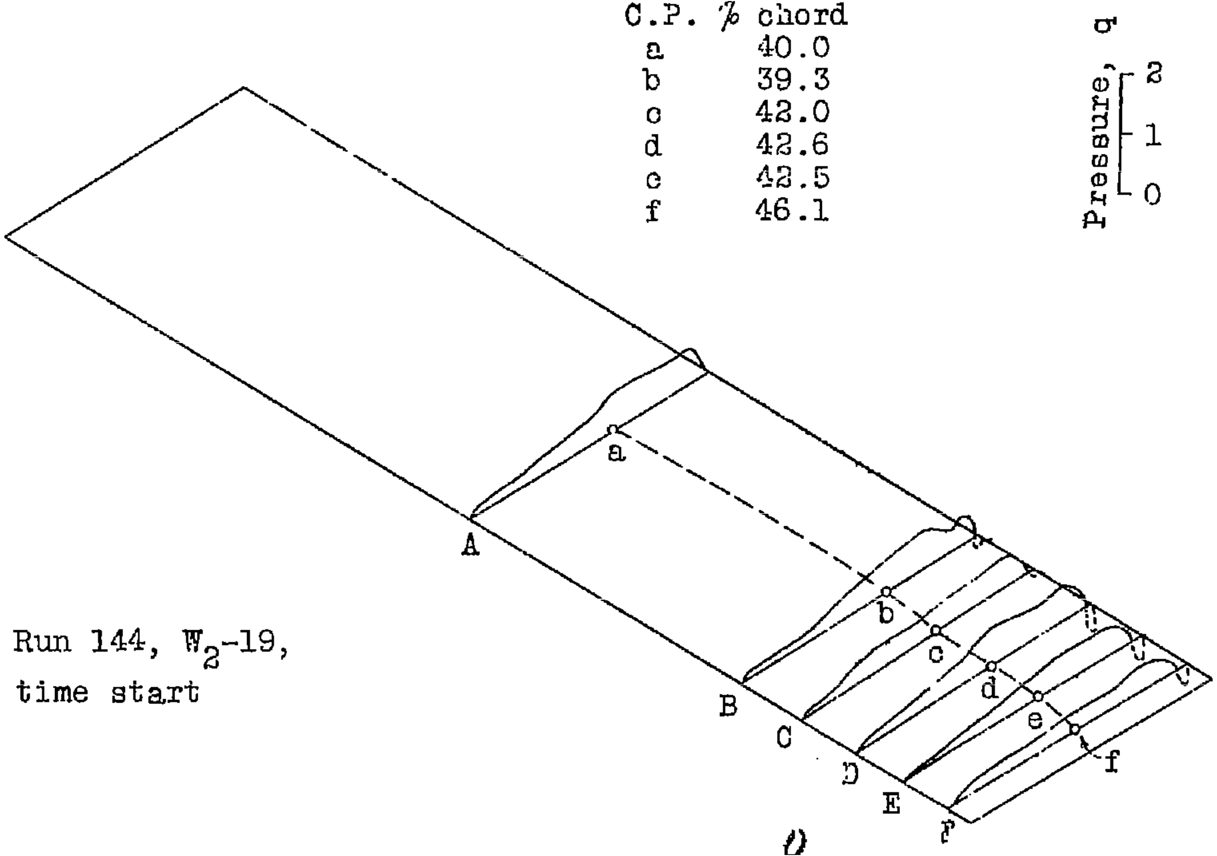


C.P.	% chord
a	46.9
b	47.7
c	52.6
d	50.3
e	50.2
f	53.9

Run 147, W_2-19,
time start

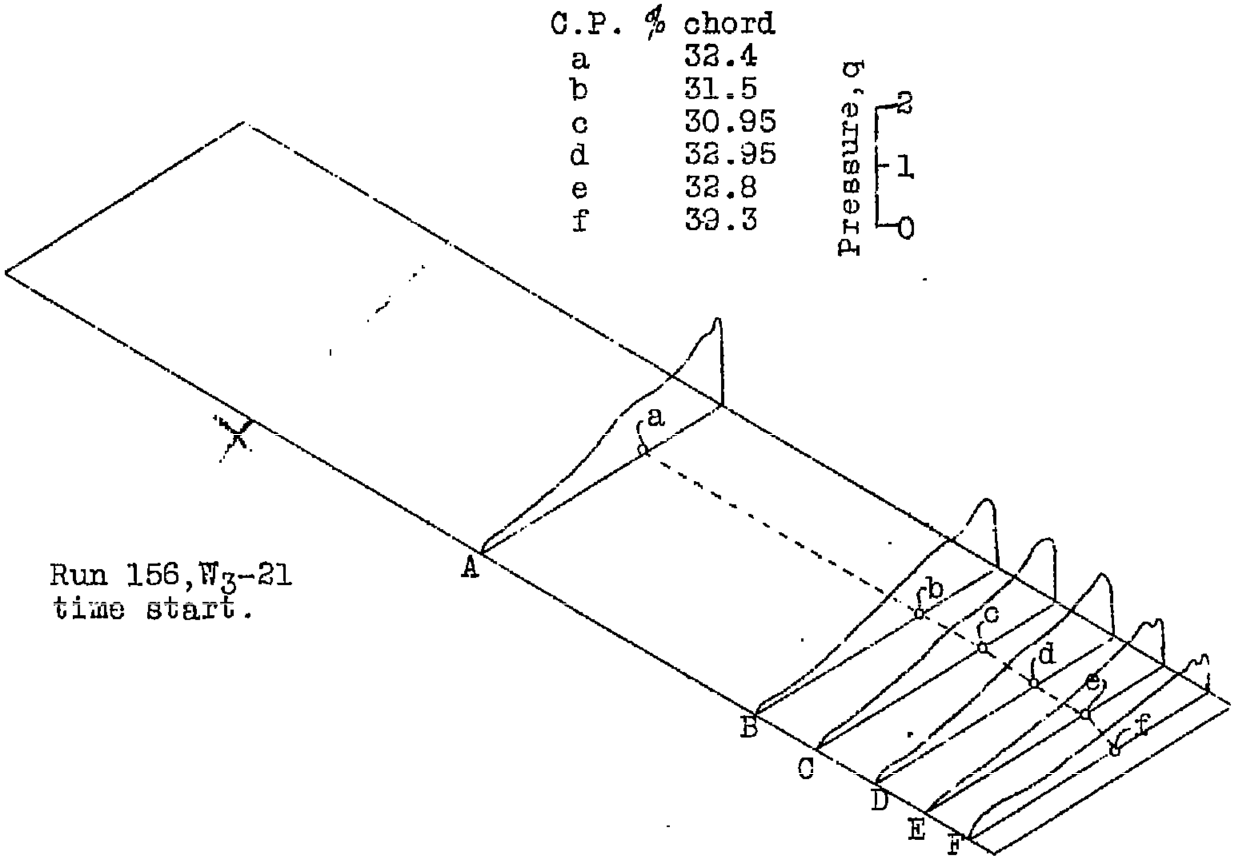
Fig. 2b Pressure distribution. C_N=0.267

C.P.	% chord
a	40.0
b	39.3
c	42.0
d	42.6
e	42.5
f	46.1



Run 144, W_2-19,
time start

Fig. 2c Pressure distribution. $C_N = 0.378$

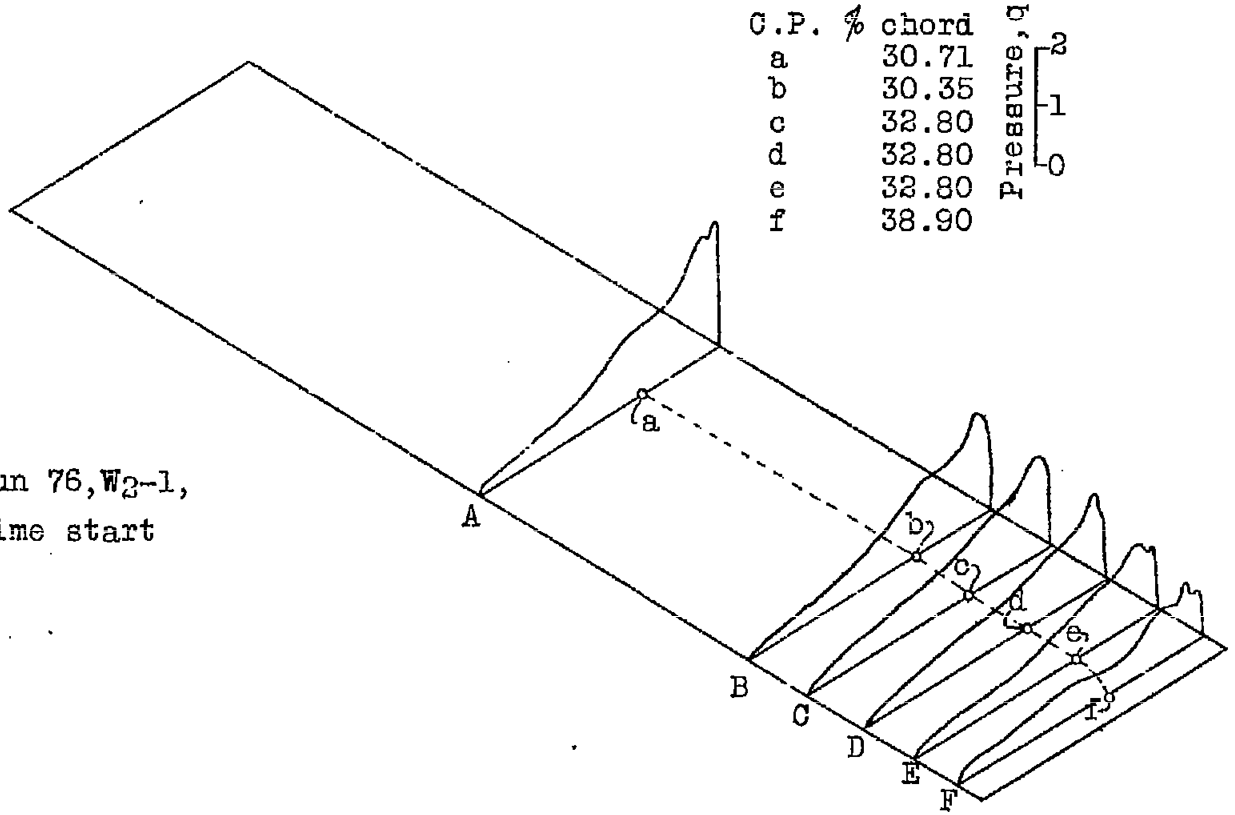


C.P.	% chord
a	32.4
b	31.5
c	30.95
d	32.95
e	32.8
f	39.3

Run 156, W_3-21
time start.

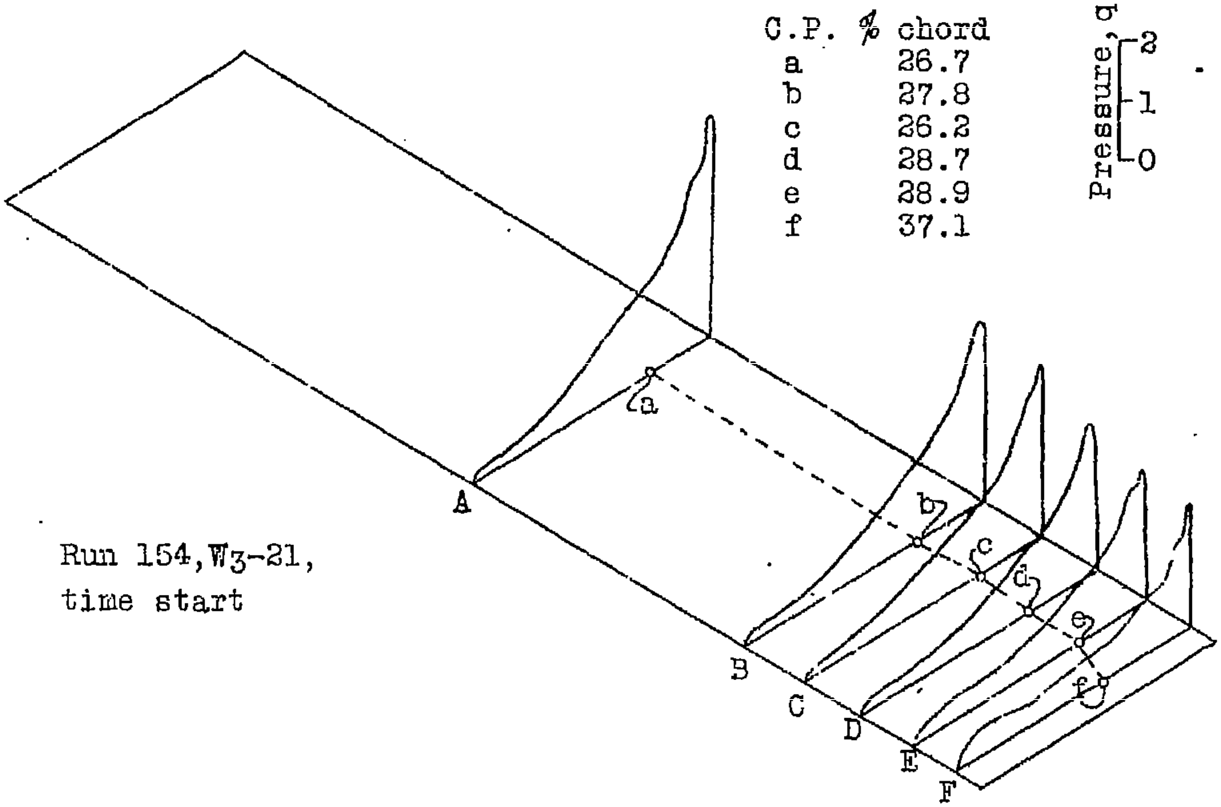
Fig.2d Pressure distribution. C_N=.578

C.P.	% chord
a	30.71
b	30.35
c	32.80
d	32.80
e	32.80
f	38.90



Run 76, W_3-1,
time start

Fig.2e Pressure distribution. C_N=.791

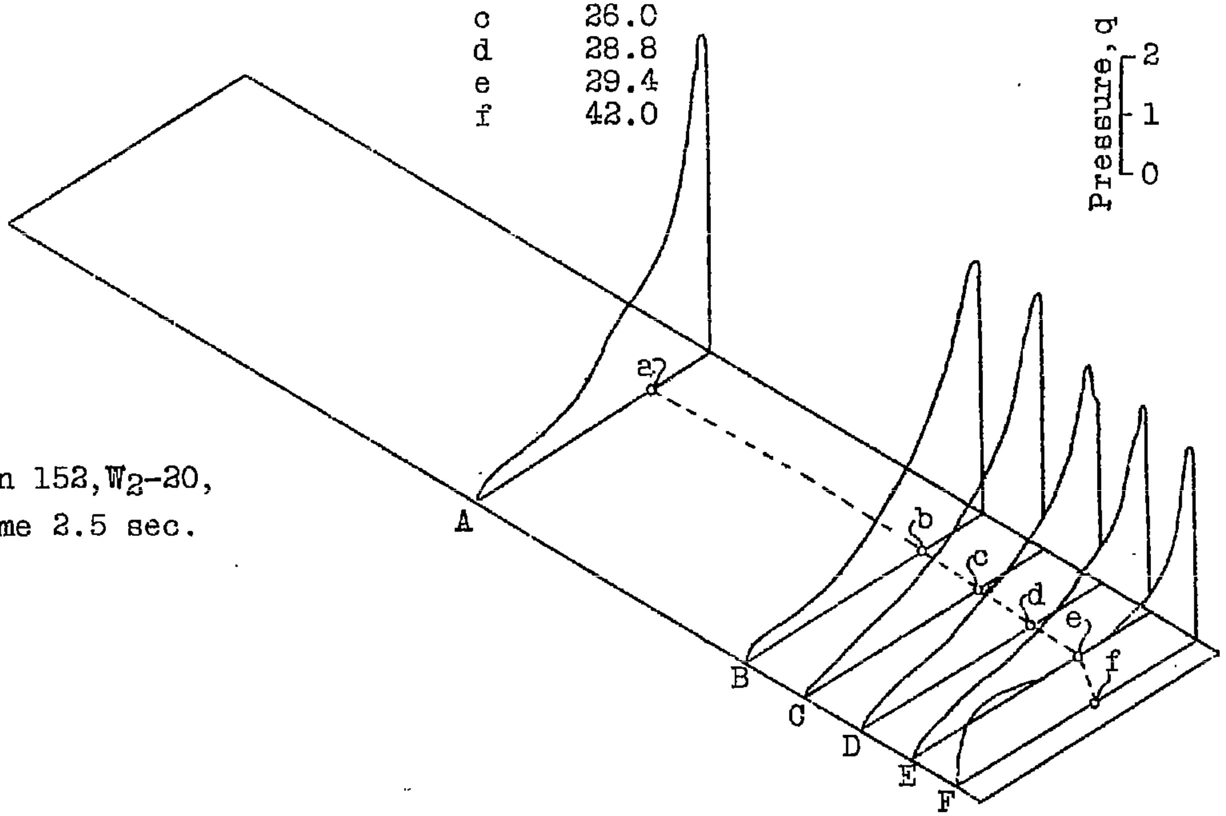


C.P.	% chord
a	26.7
b	27.8
c	26.2
d	28.7
e	28.9
f	37.1

Run 154, W_3-21,
time start

Fig.2f Pressure distribution. C_N=1.001

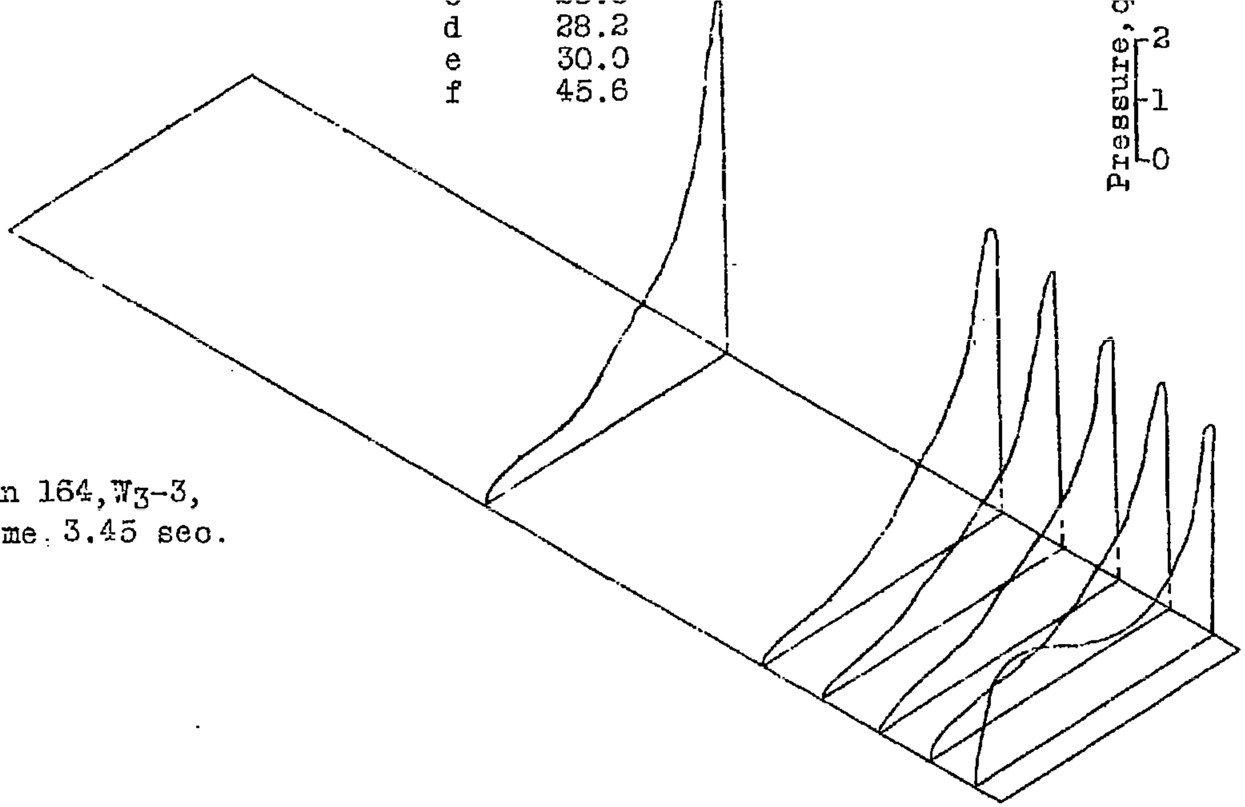
C.P.	% chord
a	25.6
b	24.4
c	26.0
d	28.8
e	29.4
f	42.0



Run 152, W_2-20,
time 2.5 sec.

Fig. 2g Pressure distribution, C_N=1.390

C.P.	% chord
a	25.2
b	25.5
c	25.8
d	28.2
e	30.0
f	45.6



Run 164, W3-3,
time 3.45 sec.

Fig.2h Pressure distribution, C_N=1.502

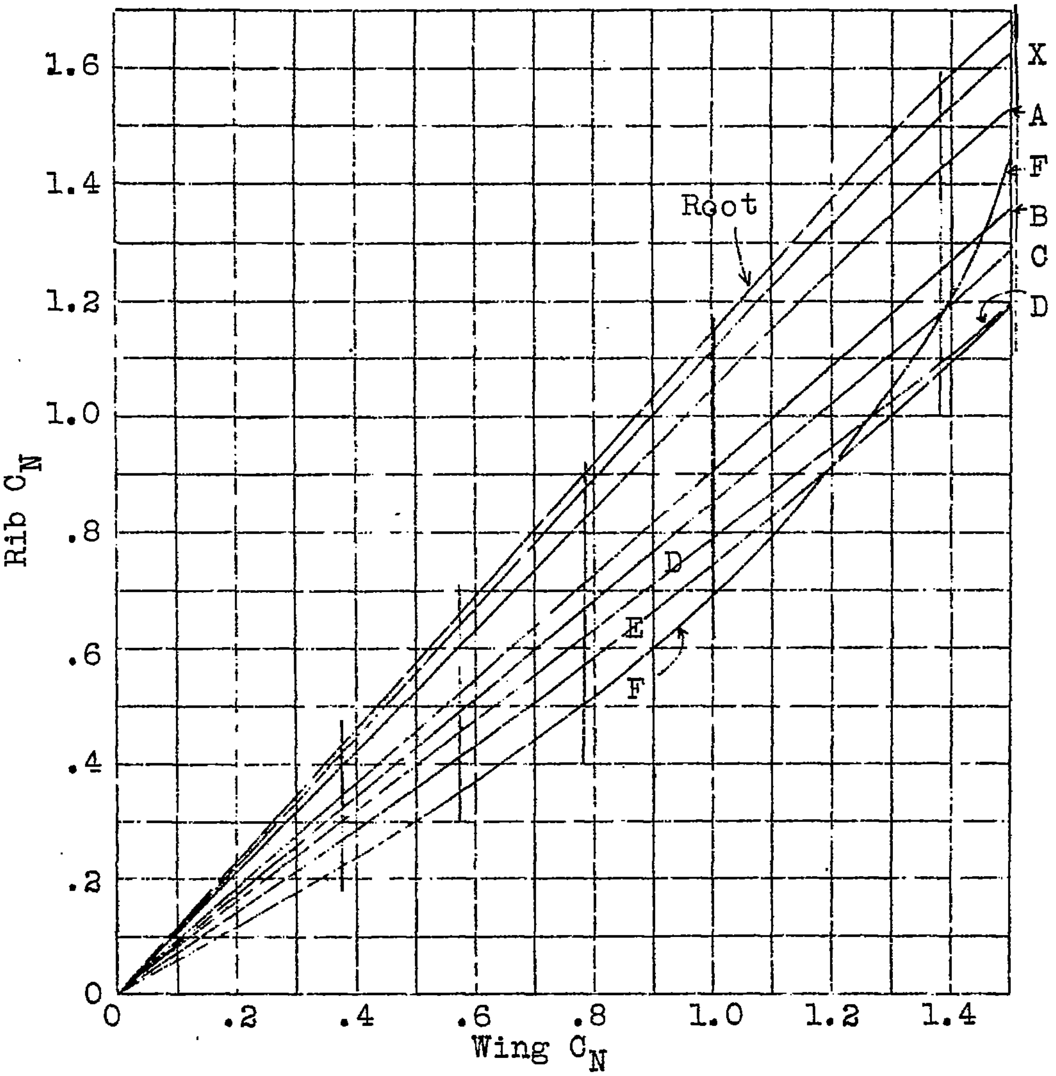


Fig.3 Rib C_N vs wing C_N (square tip)

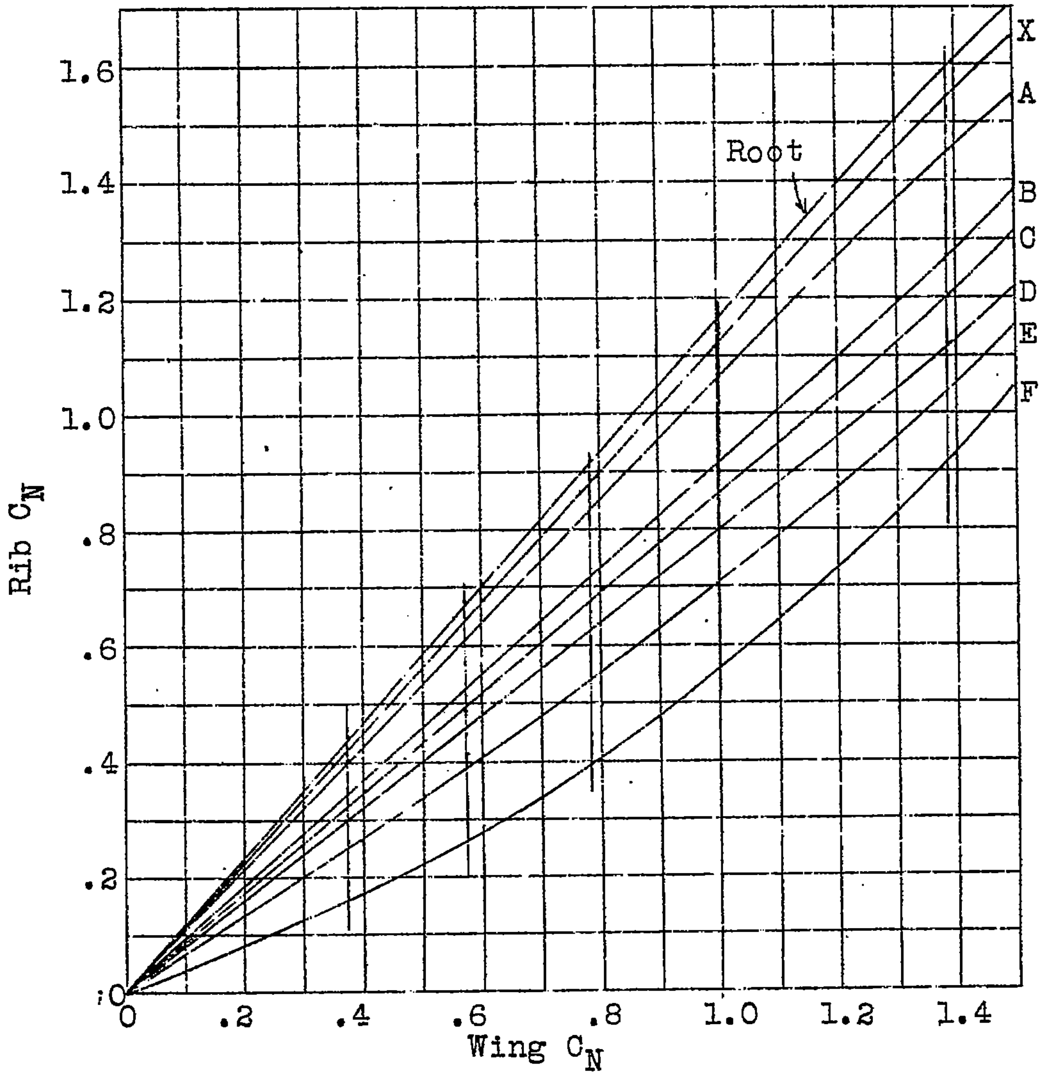


Fig.4 Rib C_N vs wing C_N (square faired tip)

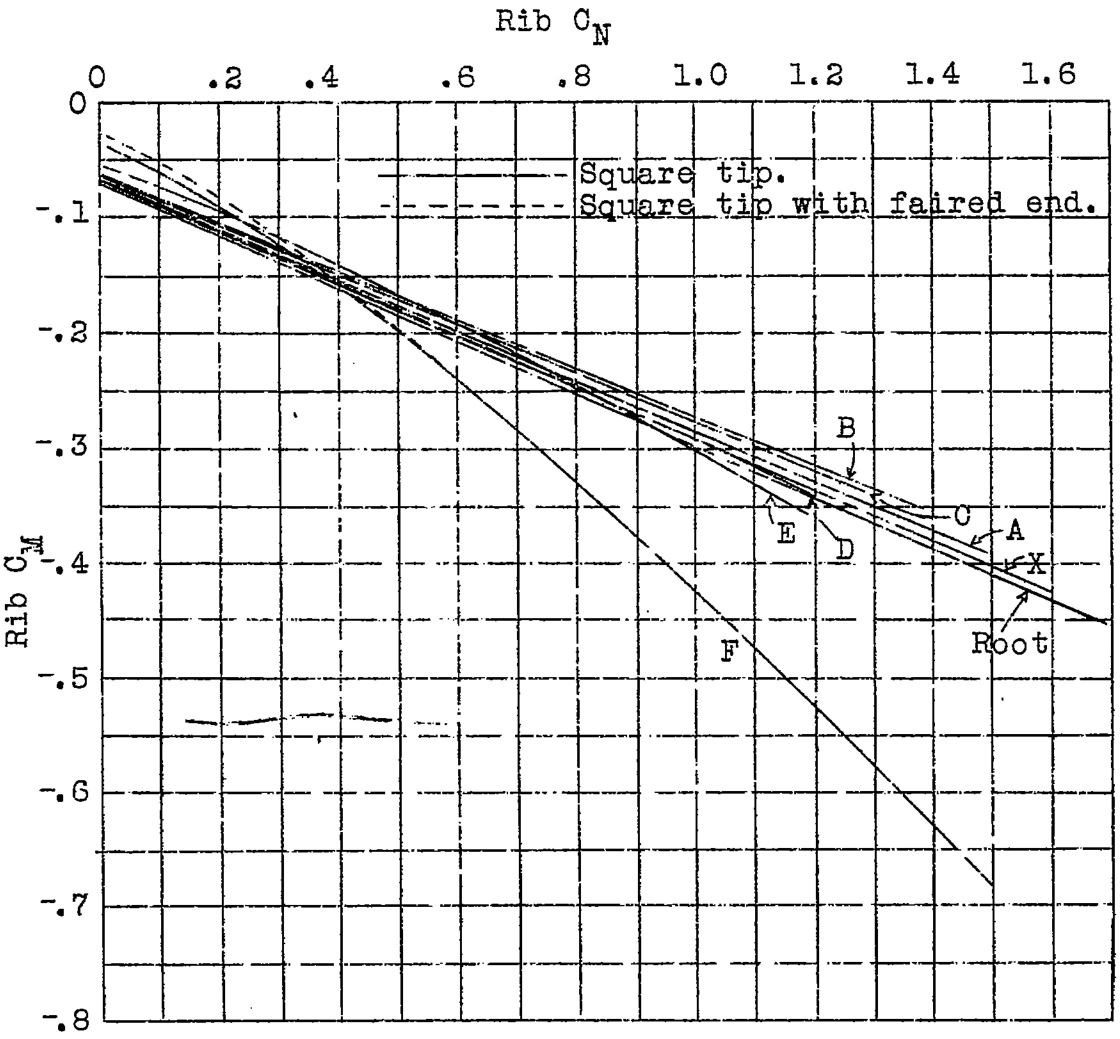


Fig.5 Rib C_M vs rib C_N