UNCLASSIFIED

| AD NUMBER |
| --- |
| **ADA800202** |
| CLASSIFICATION CHANGES |
| TO: **unclassified** |
| FROM: **restricted** |
| LIMITATION CHANGES |
| TO: **Approved for public release; distribution is unlimited.** |
| FROM: **Distribution authorized to DoD only; Administrative/Operational Use; 16 MAY 1942. Other requests shall be referred to Air Force Materiel Command, Wright-Patterson AFB, OH 45433-6503. Pre-dates formal DoD distribution statements. Treat as DoD only.** |
| AUTHORITY |
| **E.O. 10501 dtd 5 Nov 1953; AFLC ltr dtd 1 May 1973** |

THIS PAGE IS UNCLASSIFIED

Reproduced by

AIR DOCUMENTS DIVISION

TECHNICAL INTELLIGENCE

AMC

HEADQUARTERS AIR MATERIEL COMMAND

WRIGHT FIELD, DAYTON, OHIO

# The U.S. GOVERNMENT

## IS ABSOLVED

FROM ANY LITIGATION WHICH MAY ENSUE FROM THE CONTRACTORS INFRINGING ON THE FOREIGN PATENT RIGHTS WHICH MAY BE INVOLVED.

REEL – C

872

A.T.I.

22777

RESTRICTED

Test of 1/37.5-Scale Materiel Division Design Barrage Ballons X41F1365, X41F1366, and X41F1367 (Five-Foot Wind Tunnel Test Nos. 317 and 324) 22777 none

Young, D. W.; Gilmore, J. H.

Air Materiel Command, Wright-Patterson Air Force Base, Dayton, O R-4774

May '42 Restr. U.S. Eng. 71 photos, tables, diagr, graphs

Tests were conducted to determine the best location for the maximum diameter of the envelope (barrage ballon) with regard to stability, and also the change in longitudinal trim angle caused by a change in the horizontal fin incidence. Results indicate an improvement in longitudinal and directional stability as maximum diameter is moved forward, and an increase in trim angle about the flying cable junction of $1^{0}$ per degree negative horizontal fin movement.

Copies of this report obtainable from Air Documents Division; Attn: MCIDXD

Lighter-Than-Air (40) Balloons, Barrage - Stability and control (15653)

R-40

AIR DOCUMENTS DIVISION, T-2
AMC, WRIGHT FIELD
MICROFILM No.
RC-872 F22777

REPORT NO. 4774

RESTRICTED



DATE May 16, 1942

WAR DEPARTMENT
AIR CORPS
MATERIEL DIVISION
DAYTON, OHIO

ATI No. 22777

RESTRICTED

# AIR CORPS TECHNICAL REPORT

No. 4774

TEST OF 1/37.5-SCALE MATERIEL DIVISION DESIGN
BARRAGE BALLOONS X41F1365, X41F1366, AND X41F1367
(FIVE-FOOT WIND TUNNEL TEST NOS. 317 AND 324)
Title

BY

D. W. Young J. H. Gilmore
D. W. YOUNG AND J. H. GILMORE

F. N. Moyers
Coordinated by: F.N. MOYERS, Major, AIR CORPS

Approved:

Paul H. Kemmer
PAUL H. KEMMER, Lt. Colonel, AIR CORPS, Branch Chief

By direction of the Chief of the Materiel Division.

Keith A. Fitch
for F. O. CARROLL, Colonel, AIR CORPS, Chief, Engineering Section
Experimental

Branch No. EXP-M-51/LA2COT
E. O. No. 626-1-53
No. of Pages 65
No. of Photos 6
No. of Drawings 27
erg

| Chief, Engineering | Secret | Confidential | Restricted | Unrestricted | Inf |
|---|---|---|---|---|---|
| | | | RMK | | |

TABLE OF CONTENTS


| | PAGE NO. |
|---|---|
| SUMMARY | 3 |
| DATES AND PLACE OF TEST | 3 |
| OBJECT | 3 |
| DESCRIPTION OF MODEL | 4 |
| PROCEDURE | 4 |
| DISCUSSION OF RESULTS | 5 |
| CONCLUSIONS | 6 |
| REFERENCES | 6 |
| WIND TUNNEL NOMENCLATURE | 7 |
| TABULATED DATA | 8 |
| PLOTTED DATA | 20 |
| VECTOR DIAGRAMS | 56 |
| LIST OF PHOTOGRAPHS | 65 |

# TEST OF 1/37.5-SCALE MODEL OF MATERIEL DIVISION DESIGN BARRAGE BALLOONS, NO'S. X41F1365, X41F1366, AND X41F1367 (FIVE-FOOT WIND TUNNEL TEST NO'S. 317 & 324)

## SUMMARY

Two series of wind tunnel tests were undertaken by the Materiel Division. The first series, Test No. 317, investigated the effect on directional and longitudinal stability caused by moving the maximum diameter of the envelope forward. The second series, Test No. 324, was run at a later date to determine the effect on the longitudinal trim and stability, placing the horizontal fins at a negative angle of incidence.

Results of the first series of tests on the three envelopes, each with the same fins, indicates an improvement in longitudinal and directional stability as the maximum diameter is moved forward.

The second series of tests indicates an increase in trim angle, about the flying cable junction, of one degree for each degree of negative movement of the horizontal fins. This relation was found to hold for both models which were tested, Nos. X41F1365 and X41F1366.

## DATES AND PLACE OF TEST

The first test was conducted in the Five-Foot Wind Tunnel at Wright Field from November 1 to 4, 1941, and the second test was run on December 22, 1941.

## OBJECT

The object of these tests was first to determine the best location for the maximum diameter of the envelope with regard to stability and second,

to determine the change in longitudinal trim angle caused by a change in the incidence of the horizontal fins.

DESCRIPTION OF MODEL

| Balloon | X41F1365 | X41F1366 | X41F1367 |
|---|---|---|---|
| Length (inches) | 24.3 | 24.21 | 25.3 |
| Maximum Diameter (inches) | 9.0 | 9.00 | 9.0 |
| Position of Max. Diameter (Percentage of length) | 30.0 | 28.10 | 25.8 |
| C.R. Location (Inches aft of nose) | 9.477 | 9.00 | 9.199 |

The envelopes and fins of the three models were made of mahogany, and the envelope was hollowed out to a wall thickness of approximately 0.8 inch. The seams of the fins were parallel to the contour of the envelope at the point of attachment. The same fins were used on the three models. For the tests with horizontal fins placed at -3 and -6 degrees to the center line, mahogany shoes or fairings were made to join the fins to the envelope.

PROCEDURE

The models were mounted on a 7/16-inch diameter spindle attached at the center of buoyancy of the envelope, referred to in this report as the "C.R." The cable junction, about which the full-scale balloons are expected to be flown is located for the model 10.24 inches below the center line of the envelope and 7.36 inches aft of the nose for all three envelopes.

In test No. 317 for each of the conditions tested, cross wind force, drag, and yawing moments about the C.R. were observed for a range of yaw angles from 0 to ± 20 degrees with the model set at 0, +10, and +20 degrees pitch. Lift, drag, and pitching moments were also observed for a range of pitch angles from 0 to ± 20 degrees at zero degrees yaw. The test air speed was 50 miles per hour for all tests, except the yawing moment tests conducted

on the X41F1366 model, which were made at an air speed of 60 miles per hour.

Test No. 324 consisted of tests to determine the effect of incidence of the horizontal fins. Models X41F1365 and X41F1366 were both tested with horizontal fins set at -3 and -6 degrees. Lift, drag, and pitching moments were observed for a range of pitch angles from -20 to +20 degrees, at zero degrees yaw. No yawing moment tests were made for these conditions.

All data were corrected for support interference.

DISCUSSION OF RESULTS

Graphs 1 through 8 are values obtained from Model X41F1365, which has a maximum diameter at 30.0 percent aft of the nose. Graphs 9 through 16 give the values for Model X41F1366, the maximum diameter of which is 28.1 percent aft of the nose.

Graphs 17 through 24 include the values obtained from model X41F1367, which has its maximum diameter at 25.8 percent aft of the nose.

Comparison of graph 17 with graphs 1 and 9, in each case a plot of the yawing moments about the C.R., indicates some improvement as to directional stability for the X41F1367 model. Similarly, a comparison of graphs 5, 13, and 21 indicates a slight improvement in longitudinal stability.

The yawing moments were transferred from the C.R. to the flying cable junction for Model X41F1365. Inspection of these moments, graph 33, indicates the model is directionally stable at zero degrees pitch for all yaw angles tested, except from -2 to +3 degrees, when it is neutrally stable. At +10 degrees pitch the model becomes directionally unstable for angles of yaw from -4 to +4 degrees. Then at +20 degrees pitch it is directionally stable through the entire range of yaw angles tested. In a major portion of tests conducted on other barrage balloon models, the directional stability improves as the pitch angle is increased. However, in this test the directional stability decreased as the pitch angle was increased from 0 to +10 Deg. then in-

creased with an increase in pitch angle from +10 to +20 degrees.

Graph 34 is a plot of the pitching moments about the flying cable junction for the X41F1365 model with fins at zero, -3, and -6 degrees. This graph indicates that a horizontal fin setting of 0 degrees, trims the model for +9 degrees pitch, whereas a -3 degree setting trims for +12.5 degrees and a -6 degree setting produces trim at +15.5 degrees pitch. Briefly, a decrease of one degree in the incidence increases the angle of pitch for trim approximately one degree. Graph 34 also indicates that longitudinal stability, at the angle of pitch for trim, is not altered appreciably by a change in incidence of the horizontal fins. However, at zero degrees pitch, the stability is improved as the incidence of the horizontal fins is increased negatively. The moments given in this report are aerodynamic moments only and do not include the static moment of the gas, envelope, and fin combination.

## CONCLUSION

Both directional and longitudinal stability are improved slightly as the maximum diameter of the envelope is moved forward from 30 percent to 25.8 percent of the envelope length.

The angle of longitudinal trim is increased approximately one degree for each degree decrease in incidence of the horizontal fins.

## REFERENCES

| A.C. Drawing No. | Title |
|---|---|
| X41F1365 | Model Assembly, Barrage Balloon, Wind Tunnel, Envelope A |
| X41F1366 | Model Assembly, Barrage Balloon, Wind Tunnel, Envelope B |
| X41F1367 | Model, Assembly, Barrage Balloon, Wind Tunnel, Envelope C |

RESTRICTED

## WIND TUNNEL NOMENCLATURE

| | |
|---|---|
| d | = diameter of wind tunnel at test section = 5 ft. |
| S | = wing area — sq. ft. |
| b | = wing span—ft. |
| c | = mean aerodynamic chord—ft. (m. a. c.) |
| E. M. A. R. | = equivalent monoplane aspect ratio |
| $\alpha$ | = angle of attack of longitudinal reference axis to wind—deg. |
| $\Psi$ | = angle of yaw relative to wind—deg. |
| $\delta_R$ | = angle of rudder relative to neutral position—deg. |
| $\delta_E$ | = angle of elevator relative to stabilizer—deg. |
| $i_t$ | = angle of stabilizer relative to longitudinal reference axis—deg. |
| v | = airspeed—ft per sec. |
| V | = airspeed—m. p. h. |
| W | = weight of full scale airplane—lb. |
| M | = pitching moment—lb.-ft. |
| N | = yawing moment—lb.-ft. |
| L | = rolling moment—lb.-ft. |
| $\rho$ | = mass density of air—slugs per cu. ft. = .002378 (standard air) |
| q | = $\rho v^2/2$ — lb. per sq. ft. |
| $C_L$ | = lift coefficient = Lift/qS |
| $C_D$ | = drag coefficient = Drag/qS |
| $C_C$ | = cross-wind force coefficient = Cross-wind force /qS |
| $\Delta\alpha$ | = Prandtl's wall correction for angle of attack $= \frac{57.3\, S\, C_L}{2\pi d^2}\left[1 + \frac{3}{16}\left(\frac{b}{d}\right)^4 + \quad\right]$ |
| $\Delta C_D$ | = Prandtl's wall correction for drag coefficient $= \frac{S\, C_L^2}{2\pi d^2}\left[1 + \frac{3}{16}\left(\frac{b}{d}\right)^4 + \quad\right]$ |
| L/D | = lift/drag ratio = $C_L/C_D$ |
| $C_m$ | = pitching moment coefficient = M/qcS |
| $C_n$ | = yawing moment coefficient = N/qbS |
| $C_l$ | = rolling moment coefficient = L/qbS |
| $\Delta C_m/\Delta\alpha$ | = slope of "pitching moment versus angle of attack" curve at trim |
| $\Delta C_n/\Delta\Psi$ | = slope of "yawing moment versus angle of yaw" curve at zero yaw |
| $\Delta C_n/\Delta\delta_R$ | = slope of "yawing moment due to rudder versus rudder angle" curve at zero rudder angle |
| $C_{Di}$ | = induced drag coefficient $= \frac{C_L^2}{\pi \cdot \text{E. M. A. R.}}$ |
| $C_{Do}$ | = profile drag coefficient |
| $C_{Dp}$ | = parasite drag coefficient = $C_D - (C_{Di} + C_{Do})$ |
| $A_e$ | = equivalent flat plate area = $C_{Dp}$ S/1.279 |

Postive distances are upstream, upward and to right viewed from the rear
Positive forces are downstream, upward and to right viewed from the rear
Positive pitching moment is a stalling moment
Positive yawing moment is clockwise viewed from above
Positive rolling moment is clockwise viewed from the rear
Positive angles are in the same direction as moments
Positive stabilizer setting is with leading edge up referred to longitudinal reference axis
Positive elevator setting is with trailing edge down referred to stabilizer
Positive rudder setting is with trailing edge left referred to neutral position and viewed from the rear
Angle of attack of thrust line is referred to wind

TABLE I

MATERIEL DIVISION DESIGN BARRAGE BALLOON X41F1365

50 M.P.H. Standard Air
Test No. 317

Wright Field, November 4, 1941
Plotted on Graphs 1, 2, 3, 4

| Angle of Yaw Deg. | 0° Pitch | | | | +10° Pitch | | | | +20° Pitch | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cross Wind Force Lb. | Net Drag Lb. | C/D | Yaw Moment About C.R. Lb.-In. | Cross Wind Force Lb. | Net Drag Lb. | C/D | Yaw Moment About C.R. Lb.-In. | Cross Wind Force Lb. | Net Drag | C/D. | Yaw Moment About C.R. Lb.-In. |
| 0 | -.020 | .296 | -.07 | -.32 | +.013 | .395 | +.03 | -.25 | +.022 | .918 | +.02 | -.22 |
| +2 | +.220 | .301 | +.73 | +.24 | .219 | .402 | .54 | +.35 | .249 | .927 | .27 | .00 |
| 4 | .479 | .315 | 1.52 | .52 | .451 | .420 | 1.07 | .96 | .503 | .943 | .53 | +.11 |
| 6 | .761 | .354 | 2.15 | .62 | .746 | .453 | 1.65 | .83 | .778 | .972 | .80 | -.08 |
| 10 | 1.394 | .468 | 2.98 | .00 | 1.403 | .576 | 2.44 | -.22 | 1.364 | 1.084 | 1.26 | -.95 |
| 15 | 2.353 | .743 | 3.16 | -2.52 | 2.341 | .848 | 2.76 | -2.91 | 2.309 | 1.373 | 1.68 | -3.89 |
| 20 | 3.424 | 1.179 | 2.90 | -6.66 | 3.339 | 1.285 | 2.60 | -6.74 | 3.223 | 1.817 | 1.77 | -7.71 |
| -2 | -.256 | .305 | -.84 | -.81 | -.200 | .399 | -.50 | -.87 | -.206 | .924 | -.22 | -.51 |
| -4 | -.529 | .322 | -1.64 | -1.04 | -.419 | .419 | -1.00 | -1.47 | -.443 | .939 | -.47 | -.69 |
| -6 | -.812 | .359 | -2.26 | -1.22 | -.699 | .452 | -1.55 | -1.43 | -.716 | .968 | -.74 | -.53 |
| -10 | -1.427 | .467 | -3.06 | -.46 | -1.317 | .552 | -2.39 | -.58 | -1.319 | 1.058 | -1.25 | +.44 |
| -15 | -2.395 | .731 | -3.28 | +2.17 | -2.276 | .812 | -2.80 | +2.07 | -2.252 | 1.323 | -1.70 | 3.22 |
| -20 | -3.456 | 1.169 | -2.96 | 6.42 | -3.302 | 1.237 | -2.67 | 6.22 | -3.196 | 1.765 | -1.81 | 7.24 |

TABLE II

MATERIEL DIVISION DESIGN BARRAGE BALLOON X41F1365

50 M.P.H. Standard Air
Test No. 317

Wright Field, November 4, 1941
Plotted on Graphs 5, 6, 7, 8

| Angle of Pitch Deg. | 0° Yaw | | | |
|---|---|---|---|---|
| | Lift Lb. | Net Drag Lb. | L/D | Pitching Moment About C.R. Lb.-In. |
| 0 | -.016 | .298 | -.05 | -.28 |
| +2 | +.131 | .309 | +.42 | +.54 |
| 4 | .346 | .322 | 1.07 | .90 |
| 6 | .603 | .348 | 1.73 | .72 |
| 10 | 1.184 | .436 | 2.72 | -.63 |
| 15 | 2.013 | .650 | 3.10 | -3.45 |
| 20 | 2.882 | .995 | 2.90 | -7.13 |
| -2 | -.179 | .306 | -.59 | -1.03 |
| -4 | -.405 | .326 | -1.24 | -1.16 |
| -6 | -.680 | .350 | -1.94 | -.76 |
| -10 | -1.256 | .439 | -2.86 | +.45 |
| -15 | -2.081 | .651 | -3.20 | 3.47 |
| -20 | -2.964 | 1.007 | -2.95 | 7.42 |

TABLE III

MATERIEL DIVISION DESIGN BARRAGE BALLOON X41F1366

60 M.P.H. Standard Air
Test No. 317

Wright Field, November 3, 1941.
Plotted on Graphs 9, 10, 11, 12

| Angle of Yaw Deg. | 0° Pitch | | | | +10° Pitch | | | | +20° Pitch | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cross Wind Force Lb. | Net Drag Lb. | C/D | Yaw Moment About C.R. Lb.-In. | Cross Wind Force Lb. | Net Drag Lb. | C/D | Yaw Moment About C.R. Lb.-In. | Cross Wind Force Lb. | Net Drag Lb. | C/D. | Yaw Moment About C.R. Lb.-In. |
| 0 | -.022 | .409 | -.04 | -.23 | -.018 | .566 | -.03 | -.49 | -.031 | 1.232 | -.03 | -.31 |
| +2 | +.321 | .421 | +.76 | +.12 | +.231 | .562 | +.41 | +.53 | +.278 | 1.235 | +.23 | +.14 |
| 4 | .717 | .449 | 1.60 | .31 | .510 | .576 | .89 | 1.47 | .568 | 1.255 | .45 | .37 |
| 6 | 1.107 | .504 | 2.20 | .22 | .917 | .617 | 1.49 | 1.19 | .929 | 1.298 | .72 | .26 |
| 10 | 2.004 | .666 | 3.01 | -1.41 | 1.829 | .771 | 2.37 | -.89 | 1.754 | 1.431 | 1.23 | -1.28 |
| 15 | 3.334 | 1.044 | 3.20 | -5.47 | 3.118 | 1.132 | 2.75 | -4.83 | 3.029 | 1.799 | 1.68 | -5.81 |
| 16 | 3.604 | 1.140 | 3.16 | -6.94 | | | | | | | | |
| 17 | | | | | 3.646 | 1.329 | 2.74 | -7.42 | 3.566 | 2.010 | 1.77 | -8.42 |
| -2 | -.357 | .423 | -.84 | -.58 | -.286 | .571 | -.50 | -1.66 | -.321 | 1.245 | -.28 | -.86 |
| -4 | -.727 | .454 | -1.60 | -.86 | -.577 | .595 | -1.03 | -2.23 | -.621 | 1.267 | -.49 | -1.01 |
| -6 | -1.140 | .503 | -2.24 | -.74 | -1.006 | .643 | -1.57 | -1.82 | -.972 | 1.310 | -.74 | -.82 |
| -10 | -2.009 | .643 | -3.12 | +.63 | -1.[illegible] | .757 | -2.40 | +.08 | -1.798 | 1.440 | -1.25 | +.89 |
| -15 | -3.296 | 1.024 | -3.22 | 4.68 | -3.240 | 1.153 | -2.81 | 4.55 | -3.126 | 1.807 | -1.73 | 5.75 |
| -20 | -4.719 | 1.611 | -2.93 | 10.74 | -4.565 | 1.725 | -2.65 | 10.34 | -4.463 | 2.419 | -1.85 | 12.30 |

TABLE IV

MATERIEL DIVISION DESIGN BARRAGE BALLOON X41F1366

50 M.P.H. Standard Air
Test No. 317

Wright Field, November 3, 1941
Plotted on Graphs 13, 14, 15, 16

| Angle of Pitch Deg. | 0° Yaw | | | |
|---|---|---|---|---|
| | Lift Lb. | Net Drag Lb. | L/D | Pitching Moment About C.R. Lb.-In. |
| 0 | -.014 | .290 | -.05 | -.36 |
| +2 | +.150 | .297 | +.51 | +.09 |
| 4 | .347 | .317 | 1.09 | .29 |
| 6 | .546 | .336 | 1.63 | .54 |
| 10 | 1.065 | .419 | 2.54 | -.52 |
| 15 | 1.851 | .610 | 3.03 | -3.51 |
| 20 | 2.649 | .918 | 2.89 | -7.10 |
| -2 | -.214 | .302 | -.71 | -.66 |
| -4 | -.383 | .319 | -1.20 | -1.15 |
| -6 | -.593 | .343 | -1.73 | -1.12 |
| -10 | -1.166 | .427 | -2.73 | +.45 |
| -15 | -1.955 | .625 | -3.13 | 3.49 |
| -20 | -2.777 | .968 | -2.87 | 7.37 |

TABLE V

MATERIEL DIVISION DESIGN BARRAGE BALLOON X41F1367

[illegible] M.P.H. Standard Air
Test No. 317

Wright Field, November 1, 1941
Plotted on Graphs 17, 18, 19, 20

| Angle of Yaw Deg. | 0° Pitch | | | | +10° Pitch | | | | +20° Pitch | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cross Wind Force Lb. | Net Drag Lb. | C/D | Yaw Moment About C.R. Lb.-In. | Cross Wind Force Lb. | Net Drag Lb. | C/D | Yaw Moment About C.R. Lb.-In. | Cross Wind Force Lb. | Net Drag Lb. | C/D | Yaw Moment About C.R. Lb.-In. |
| [illegible] | -.053 | .302 | -.11 | -.34 | -.046 | .392 | -.12 | -.31 | -.061 | .912 | -.07 | -.08 |
| +2 | .197 | .304 | +.65 | +.08 | +.161 | .394 | +.41 | +.32 | +.147 | .925 | +.16 | +.14 |
| 4 | .457 | .320 | 1.43 | .45 | .383 | .410 | .93 | .89 | .385 | .930 | .41 | .33 |
| 6 | .730 | .351 | 2.08 | .53 | .632 | .440 | 1.55 | .79 | .656 | .964 | .68 | .22 |
| 10 | 1.400 | .466 | 3.00 | -.68 | 1.331 | .546 | 2.44 | -.56 | 1.265 | 1.056 | 1.20 | -1.01 |
| 15 | 2.383 | .728 | 3.27 | -3.62 | 2.310 | .784 | 2.95 | -3.66 | 2.250 | 1.329 | 1.69 | -4.47 |
| 20 | 3.473 | 1.165 | 2.95 | -8.08 | 3.333 | 1.241 | 2.69 | -8.10 | 3.230 | 1.749 | 1.85 | -8.80 |
| -2 | -.286 | .308 | -.93 | -.79 | -.247 | .402 | -.61 | -.86 | -.283 | .922 | -.31 | -.40 |
| -4 | -.540 | .329 | -1.64 | -1.12 | -.480 | .419 | -1.15 | -1.33 | -.530 | .945 | -.56 | -.48 |
| -6 | -.8[illegible] | .370 | -2.22 | -1.18 | -.785 | .451 | -1.74 | -1.03 | -.812 | .974 | -.83 | -.33 |
| -10 | -1.913 | .483 | -3.13 | +.19 | -1.455 | .569 | -2.56 | +.45 | -1.438 | 1.072 | -1.34 | +1.13 |
| -15 | -2.415 | .750 | -3.30 | 3.26 | -2.432 | .840 | -2.90 | 3.56 | -2.383 | 1.351 | -1.76 | 4.46 |
| -20 | -3.541 | 1.198 | -2.95 | 7.91 | -3.461 | 1.278 | -2.71 | 8.21 | -3.368 | 1.791 | -1.88 | 8.91 |

TABLE VI

MATERIEL DIVISION DESIGN BARRAGE BALLOON X41F1367

50 M.P.H. Standard Air
Test No. 317

Wright Field, November 1, 1941
Plotted on Graphs 21, 22, 23, 24

| Angle of Pitch Deg. | 0° Yaw | | | |
|---|---|---|---|---|
| | Lift Lb. | Net Drag Lb. | L/D | Pitching Moment About C.R. Lb.-In. |
| 0 | -.009 | .305 | -.03 | -.18 |
| +2 | +.140 | .312 | +.45 | +.63 |
| 4 | .354 | .331 | 1.07 | .81 |
| 6 | .609 | .353 | 1.73 | .46 |
| 10 | 1.203 | .442 | 2.72 | -.94 |
| 15 | 2.031 | .646 | 3.14 | -4.20 |
| 20 | 2.938 | 1.012 | 2.90 | -8.57 |
| -2 | -.150 | .307 | -.49 | -.96 |
| -4 | -.367 | .327 | -1.12 | -1.09 |
| -6 | -.638 | .349 | -1.83 | -.68 |
| -10 | -1.221 | .434 | -2.81 | +.81 |
| -15 | -2.057 | .639 | -3.22 | 4.00 |
| -20 | -2.916 | .983 | -2.97 | 8.06 |

TABLE VII

MATERIEL DIVISION DESIGN BARRAGE BALLOON X41F1365

50 M.P.H. Standard Air
Test No. 324

Wright Field, December 22, 1941
Plotted on Graphs 25, 26, 27, 28

| -3° Horizontal Fins | | | | | -6° Horizontal Fins | | | |
|---|---|---|---|---|---|---|---|---|
| Angle of Pitch Degrees | Lift Lbs. | Net Drag Lbs. | L/D | Pitching Moment About C.R. Lb.-Ins. | Lift Lbs. | Net Drag Lbs. | L/D | Pitching Moment About C.R. Lb.-Ins. |
| 0 | -0.246 | +0.307 | -0.80 | +1.05 | -0.442 | +0.327 | -1.35 | +3.11 |
| + 5 | +0.246 | .313 | + .79 | 2.28 | + .077 | .320 | + .24 | 3.70 |
| 10 | 0.874 | .376 | 2.32 | 1.84 | .661 | .354 | 1.87 | 3.62 |
| 15 | 1.642 | .538 | 3.05 | - .25 | 1.384 | .491 | 2.82 | 2.17 |
| 20 | 2.445 | .809 | 3.02 | -3.40 | 2.164 | .720 | 3.00 | - .56 |
| - 5 | - 0.797 | .369 | -2.16 | +0.78 | -1.028 | .410 | -2.51 | +3.19 |
| -10 | - 1.551 | .497 | -3.12 | 2.72 | -1.793 | .636 | -2.82 | 5.50 |
| -15 | - 2.422 | .767 | -3.16 | 6.11 | -2.657 | .953 | -2.79 | 9.11 |
| -20 | - 3.304 | 1.184 | -2.79 | 10.30 | -3.556 | 1.408 | -2.53 | 13.67 |

TABLE VIII

MATERIEL DIVISION DESIGN BARRAGE BALLOON X41F1366

50 M.P.H. Standard Air
Test No. 324

Wright Field, December 22, 1941
Plotted on Graphs 29, 30, 31, 32

| | -3° Horizontal Fins | | | | -6° Horizontal Fins | | | |
|---|---|---|---|---|---|---|---|---|
| Angle of Pitch Degrees | Lift Lbs. | Net Drag Lbs. | L/D | Pitching Moment About C.R. Lb.-Ins. | Lift Lbs. | Net Drag Lbs. | L/D | Pitching Moment About C.R. Lb.-Ins. |
| 0 | -0.220 | +0.300 | -0.73 | +1.14 | -0.447 | +0.319 | -1.40 | +3.20 |
| +5 | + .254 | .309 | + .82 | 2.14 | + .053 | .312 | + .17 | 3.49 |
| 10 | .838 | .381 | 2.20 | 1.66 | .603 | .358 | 1.68 | 3.38 |
| 15 | 1.539 | .534 | 2.88 | - .45 | 1.249 | .477 | 2.62 | 2.04 |
| 20 | 2.299 | .801 | 2.87 | -3.61 | 1.966 | .675 | 2.91 | - .56 |
| - 5 | -0.684 | .357 | - 1.92 | +0.83 | -0.971 | .402 | -2.41 | +3.12 |
| -10 | -1.421 | .482 | - 2.95 | 2.98 | -1.752 | .583 | -3.01 | 5.92 |
| -15 | -2.240 | .724 | - 3.09 | 6.24 | -2.614 | .882 | -2.96 | 9.77 |
| -20 | -3.062 | 1.125 | - 2.72 | 10.38 | -3.408 | 1.345 | -2.54 | 13.94 |



MDAC-28-W-F-1 1-41-20M

TABLE IX

MATERIEL DIVISION DESIGN BARRAGE BALLOON X41F1365

MOMENTS ABOUT CABLE JUNCTION

50 M.P.H. Standard Air
Test No. 317

Wright Field, November 4,1941
Plotted on Graphs 33, 34

| Angle of Yaw Degrees | 0° Pitch Yawing Moment Lb.-In. | +10° Pitch Yawing Moment Lb.-In. | +20° Pitch Yawing Moment Lb.-In. |
|---|---|---|---|
| 0 | - .28 | - .28 | - .27 |
| +2 | - .25 | - .14 | - .60 |
| 4 | - .56 | - .04 | -1.07 |
| 6 | -1.06 | - .86 | -1.93 |
| 10 | -3.08 | -3.38 | -4.22 |
| 15 | -7.74 | -8.18 | -9.37 |
| 20 | -14.31 | -14.60 | -15.45 |
| - 2 | - .24 | - .41 | - .01 |
| - 4 | + .13 | - .52 | + .38 |
| - 6 | .58 | + .15 | 1.20 |
| -10 | 2.70 | 2.37 | 3.57 |
| -15 | 7.50 | 7.20 | 8.53 |
| -20 | 14.16 | 13.70 | 14.86 |

| Angle of Pitch Degrees | 0° Yaw Pitching Moment Lb.-In. |
|---|---|
| 0 | +2.65 |
| +2 | 3.29 |
| 4 | 3.16 |
| 6 | 2.18 |
| 10 | -1.05 |
| 15 | -6.92 |
| 20 | -14.50 |
| - 2 | +2.45 |
| - 4 | 2.82 |
| - 6 | 3.64 |
| -10 | 5.53 |
| -15 | 8.15 |
| -20 | 13.64 |

TABLE X

MATERIEL DIVISION DESIGN BARRAGE BALLOON X41F1365

MOMENTS ABOUT CABLE JUNCTION

50 M.P.H. Standard Air
Test No. 324

Wright Field, November 4,1941
Plotted on Graph 34

| Angle of Pitch Degrees | -3° Horiz. Fin<br>0° Yaw<br>Pitching Moment Lb.-In. | -6° Horiz. Fins<br>0° Yaw<br>Pitching Moment Lb.-In. |
|---|---|---|
| 0 | 4.73 | 7.40 |
| +5 | 4.64 | 7.33 |
| 10 | 2.14 | 4.56 |
| 15 | -2.82 | .50 |
| 20 | -9.49 | - 5.95 |
| - 5 | 5.63 | + 8.66 |
| -10 | 8.50 | 12.95 |
| -15 | 11.92 | 17.54 |
| -20 | 17.74 | 23.01 |

TABLE XI

MATERIEL DIVISION DESIGN BARRAGE BALLOON X41F1366

MOMENTS ABOUT CABLE JUNCTION

50 M.P.H. Standard Air
Test No. 324

Wright Field, November 4, 1941
Plotted on Graph 35

| Angle of Pitch Degrees | -3° Horiz. Fins 0° Yaw Pitching Moment Lb.-In. | -6° Horiz. Fins 0° Yaw Pitching Moment Lb.-In. |
|---|---|---|
| 0 | 4.70 | 6.46 |
| + 5 | 4.47 | 6.45 |
| 10 | 2.16 | 4.57 |
| 15 | -2.60 | .67 |
| 20 | -8.99 | -4.38 |
| - 5 | 5.45 | 8.50 |
| -10 | 8.45 | 12.56 |
| -15 | 12.70 | 17.51 |
| -20 | 17.51 | 22.80 |

TABLE XII

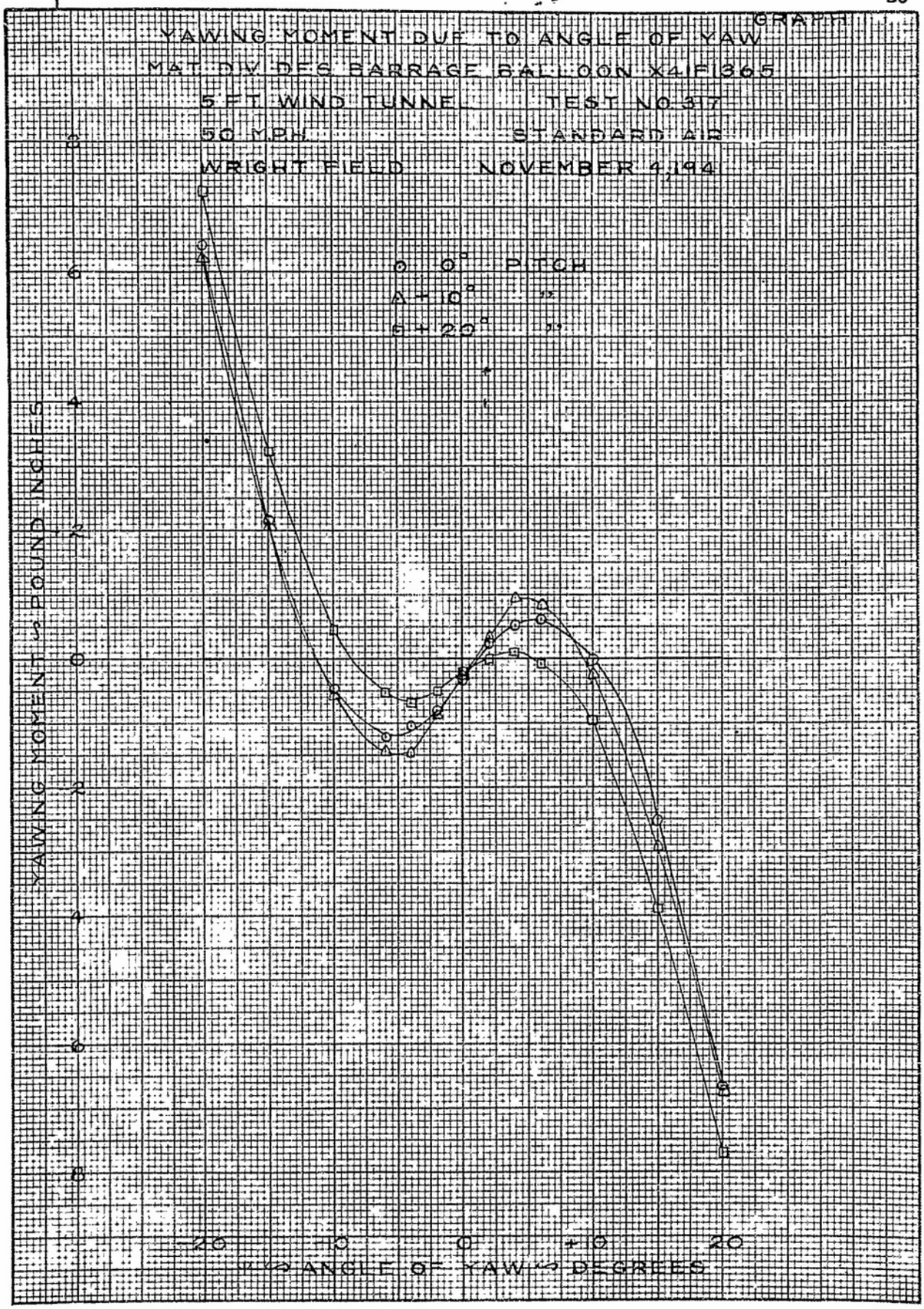
MATERIEL DIVISION DESIGN BARRAGE BALLOON X41F1366

MOMENTS ABOUT CABLE JUNCTION

60 M.P.H. Standard Air
Test No. 317

Wright Field, November 4, 1941
Plotted on Graph 36

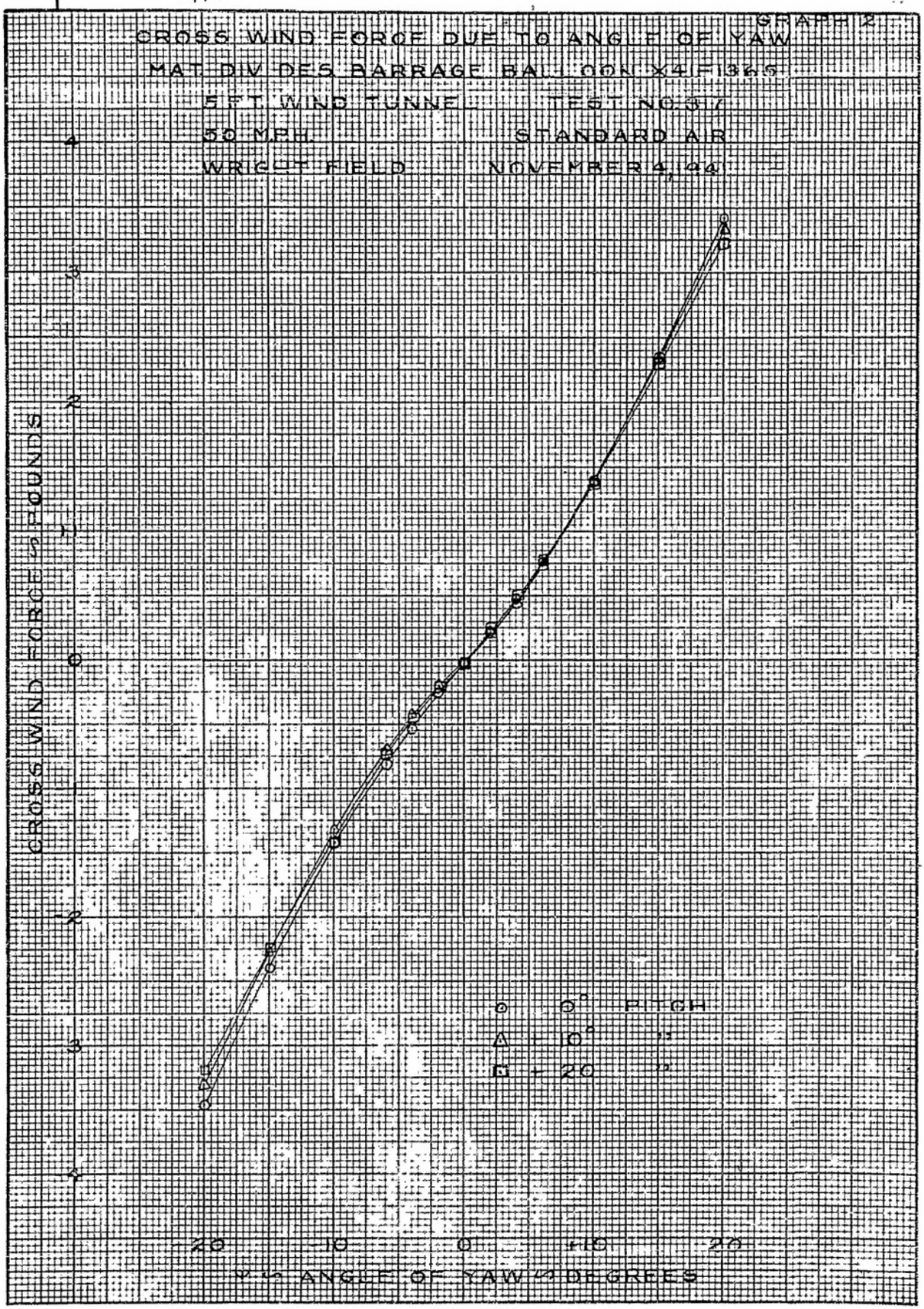
| Angle of Pitch Degrees | 0° Horiz. Fins<br>0° Yaw<br>Pitching Moment Lb.-In. |
|---|---|
| 0° | 2.82 |
| +2 | 2.75 |
| 4 | 2.52 |
| 6 | 2.14 |
| 10 | -.51 |
| 15 | -6.33 |
| 20 | -13.75 |
| - 2 | +2.87 |
| - 4 | 2.76 |
| - 6 | 3.05 |
| -10 | 5.28 |
| -15 | 9.15 |
| -20 | +13.33 |




USE THIS SIDE

SERIAL No. 4774

PAGE




USE THIS SIDE

SERIAL No. 1174

PAGE

GRAPH 3

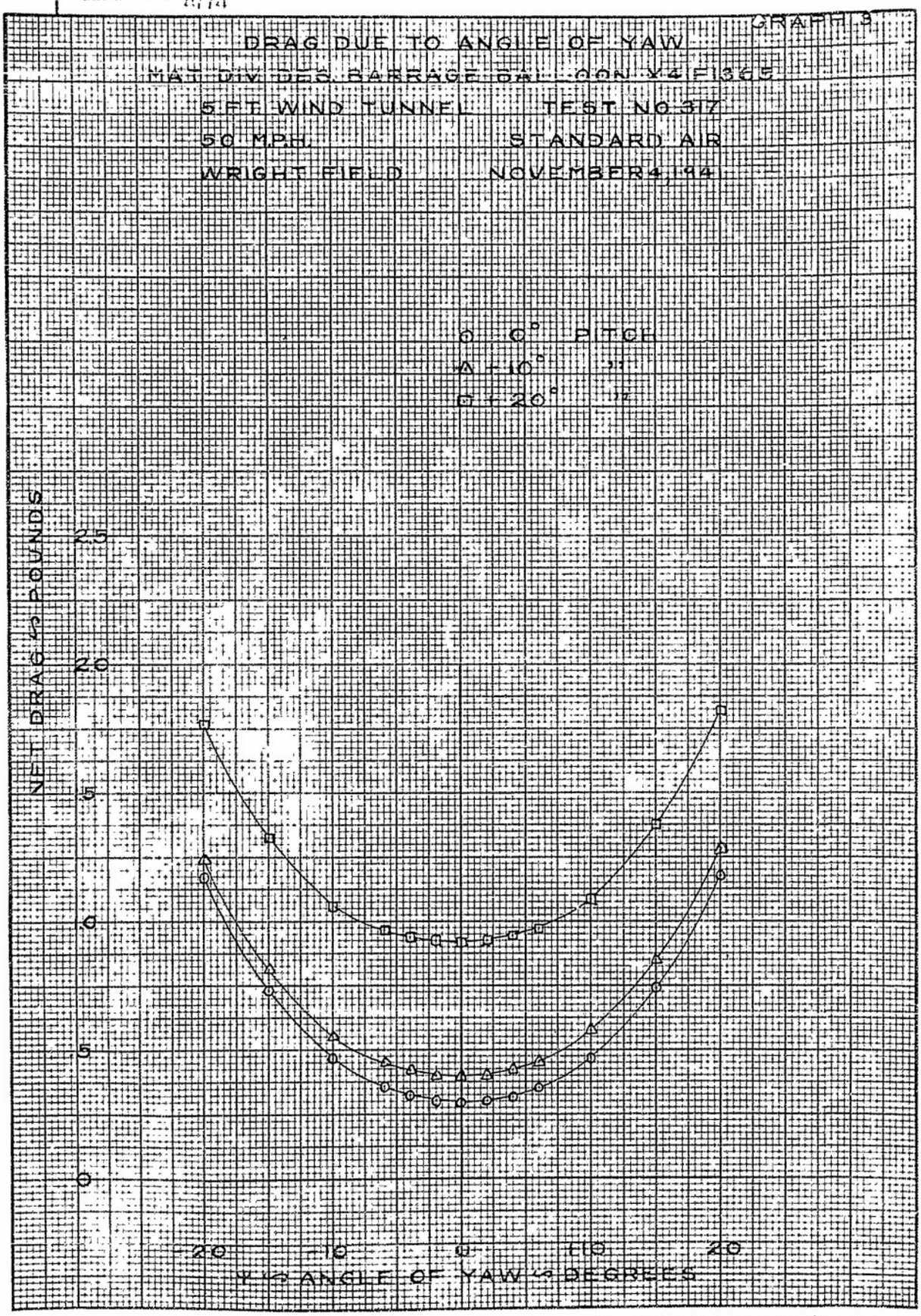
DRAG DUE TO ANGLE OF YAW

MAT. DIV. DES. BARRAGE BAL. CON X4F1365

5 FT. WIND TUNNEL TEST NO 317

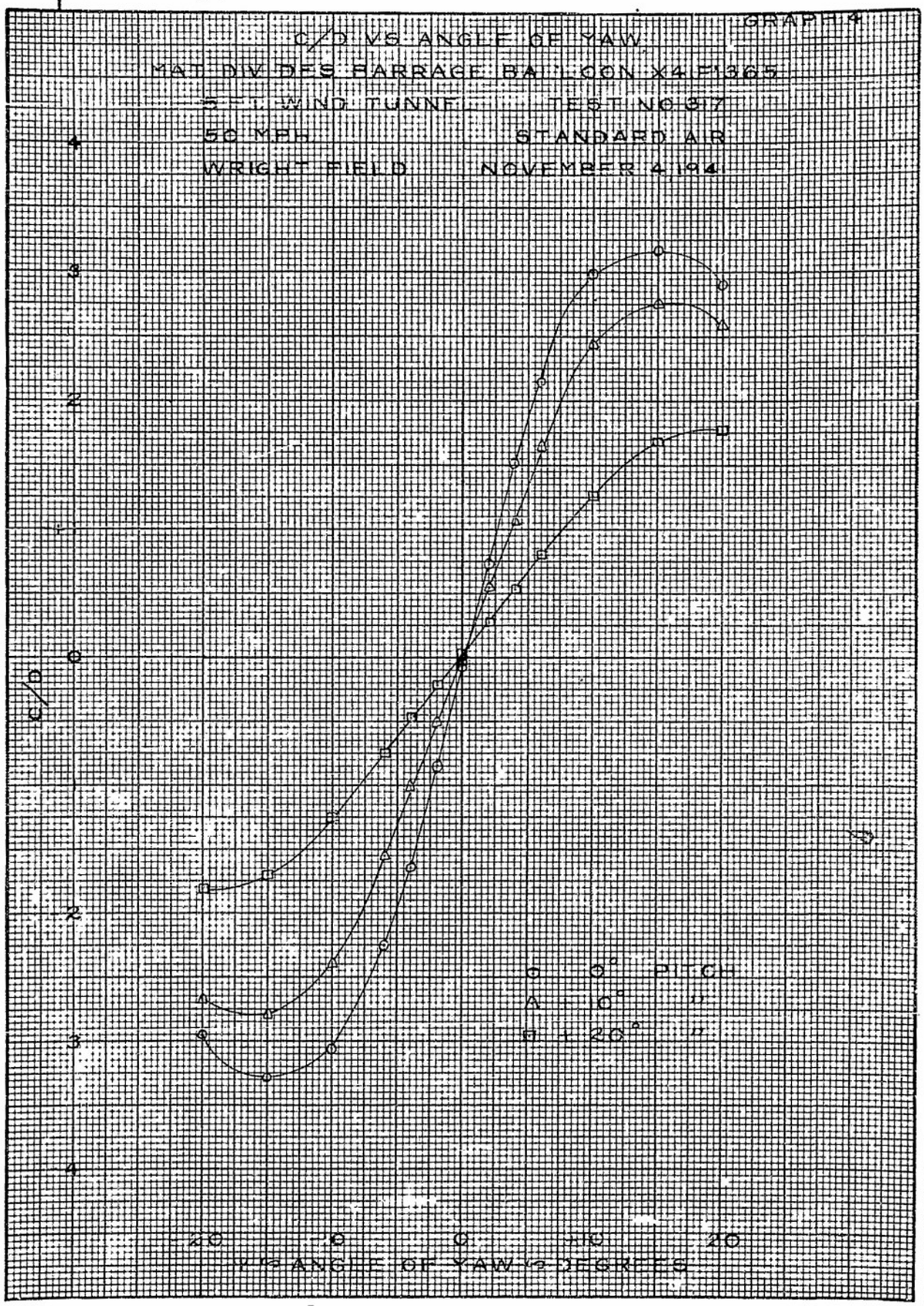
50 M.P.H. STANDARD AIR

WRIGHT FIELD NOVEMBER 4, 1944




USE THIS SIDE

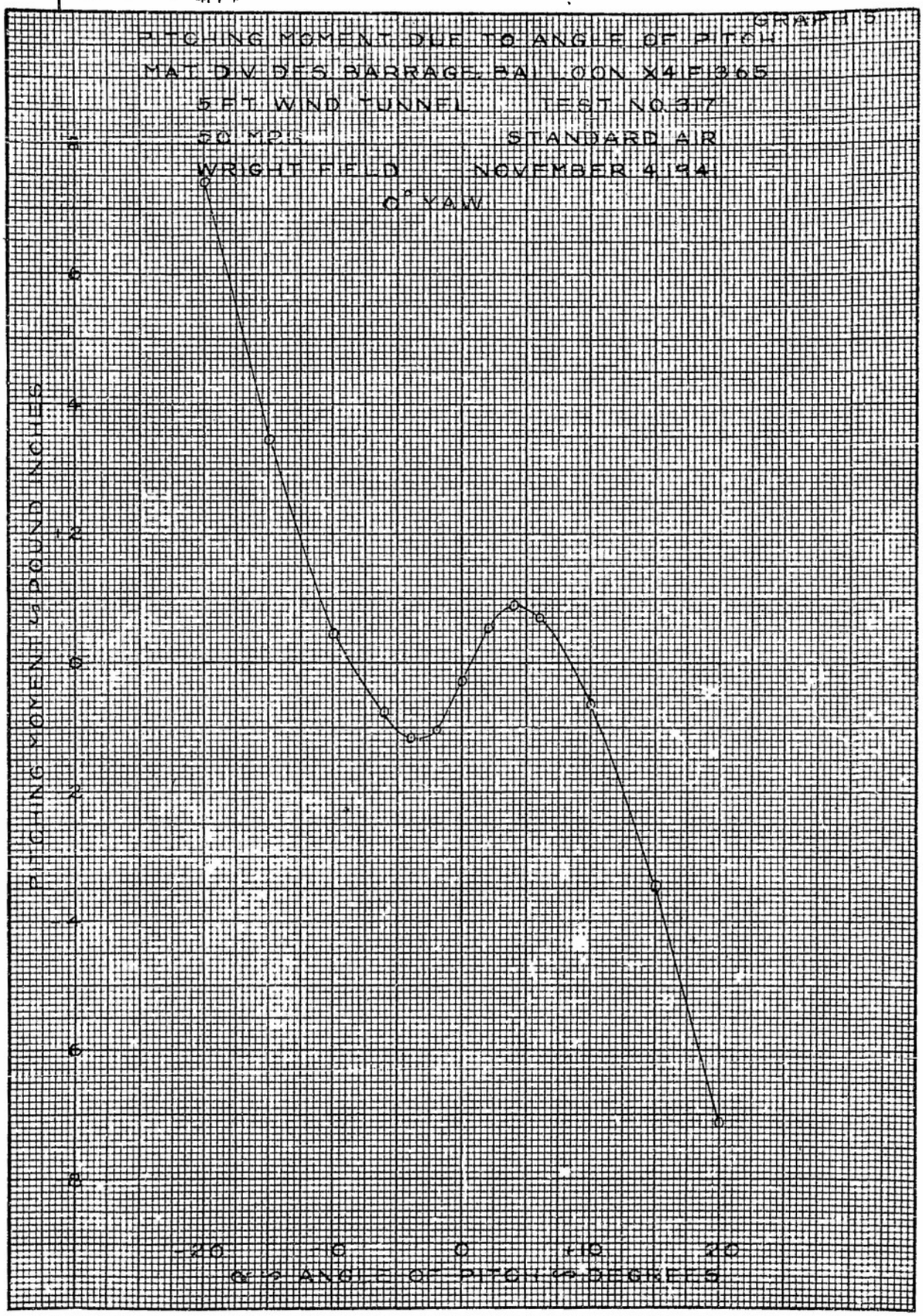
SERIAL No. 1774 PAGE




USE THIS SIDE

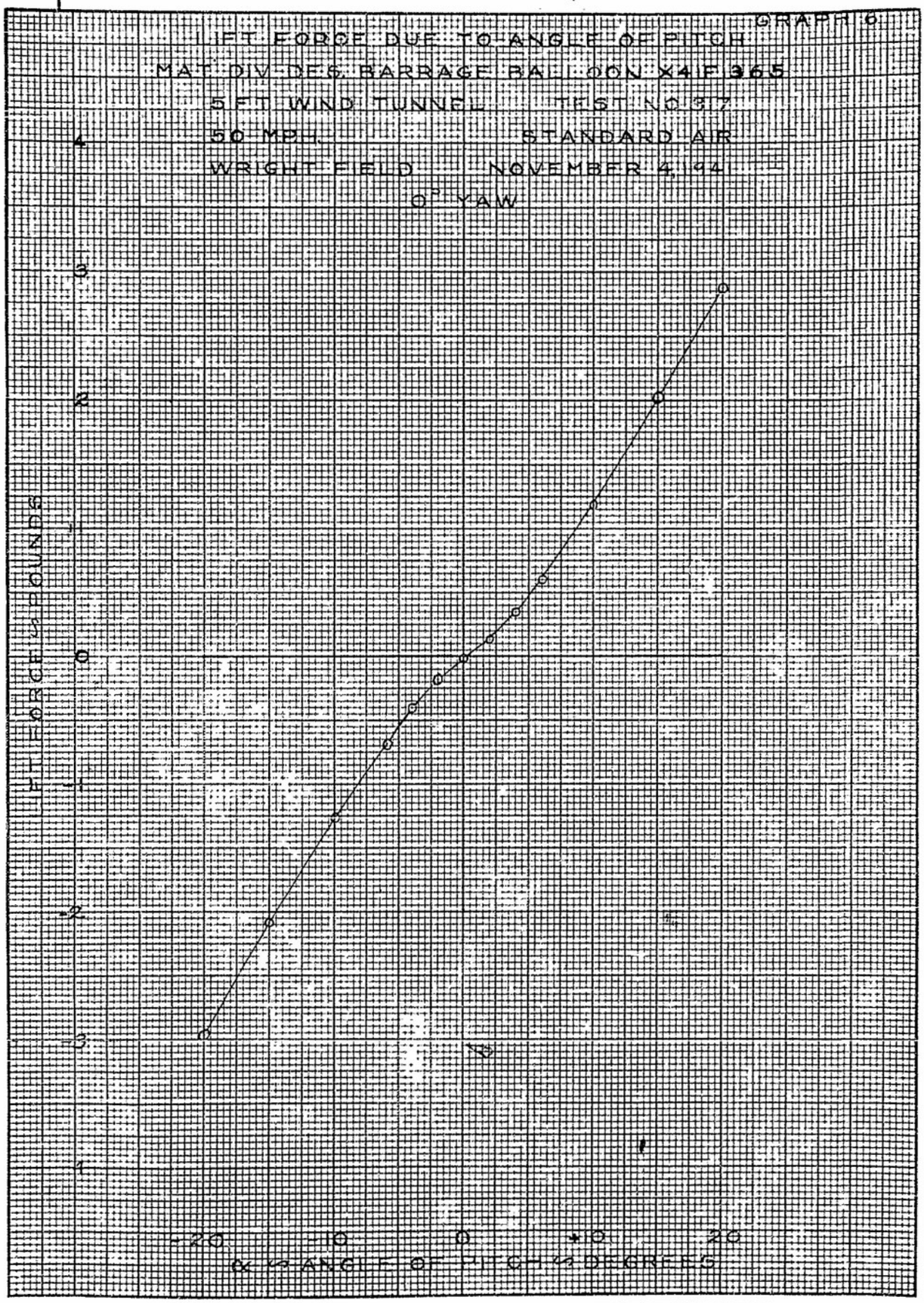
SERIAL No. 4774

PAGE




USE THIS SIDE

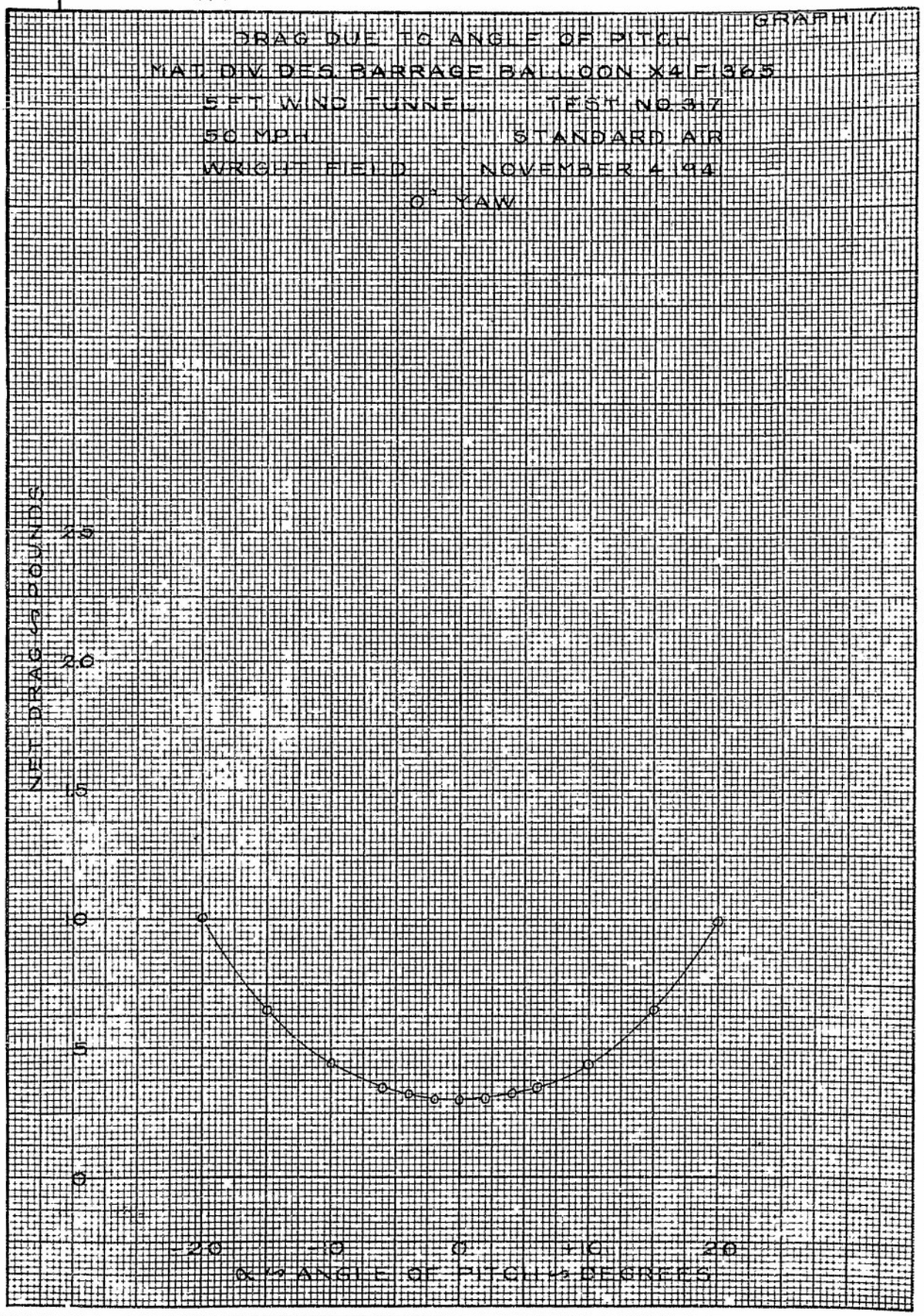
SERIAL No. 774 PAGE




USE THIS SIDE

SERIAL No. 4774

PAGE

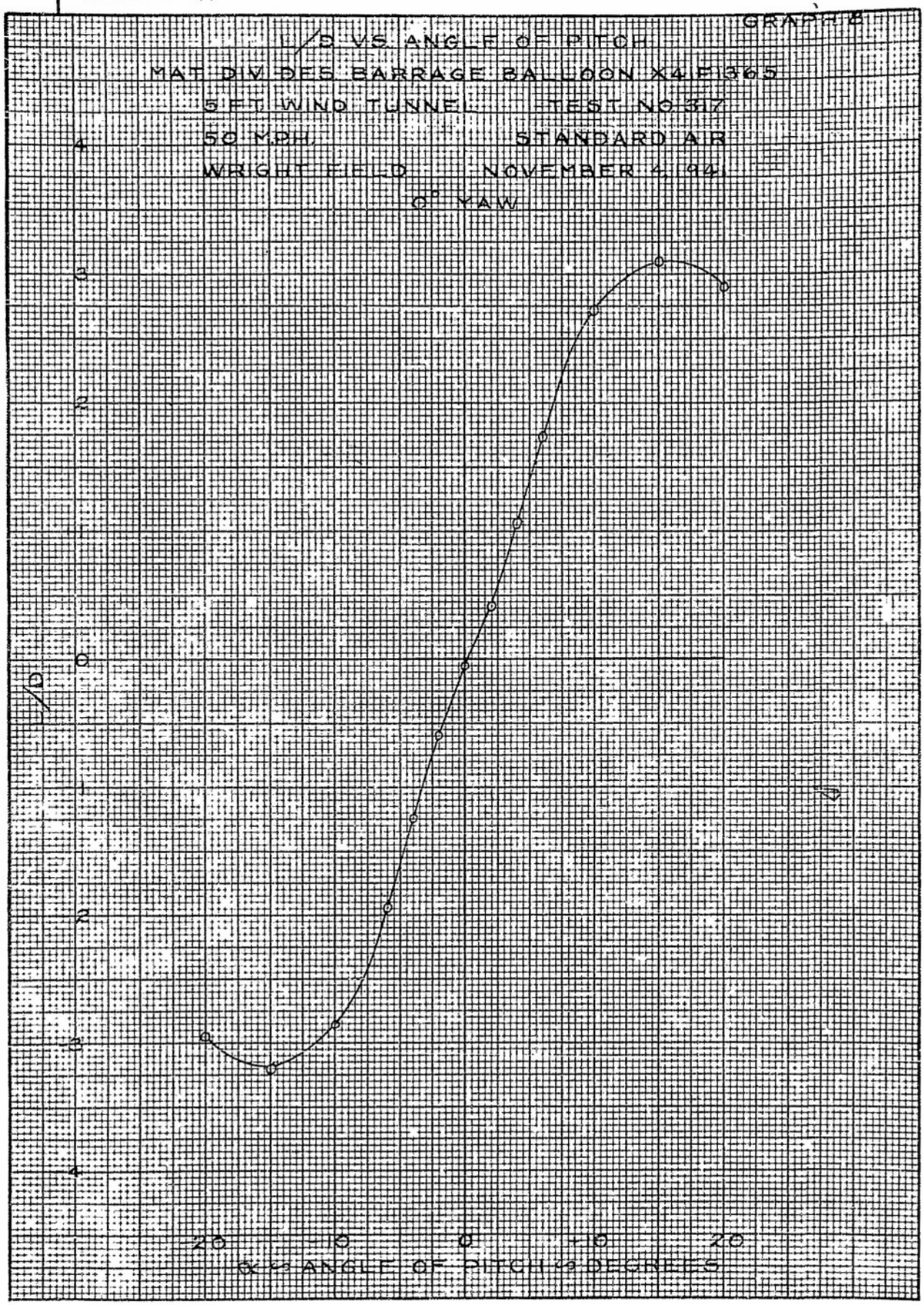



USE THIS SIDE

SERIAL No. 4774

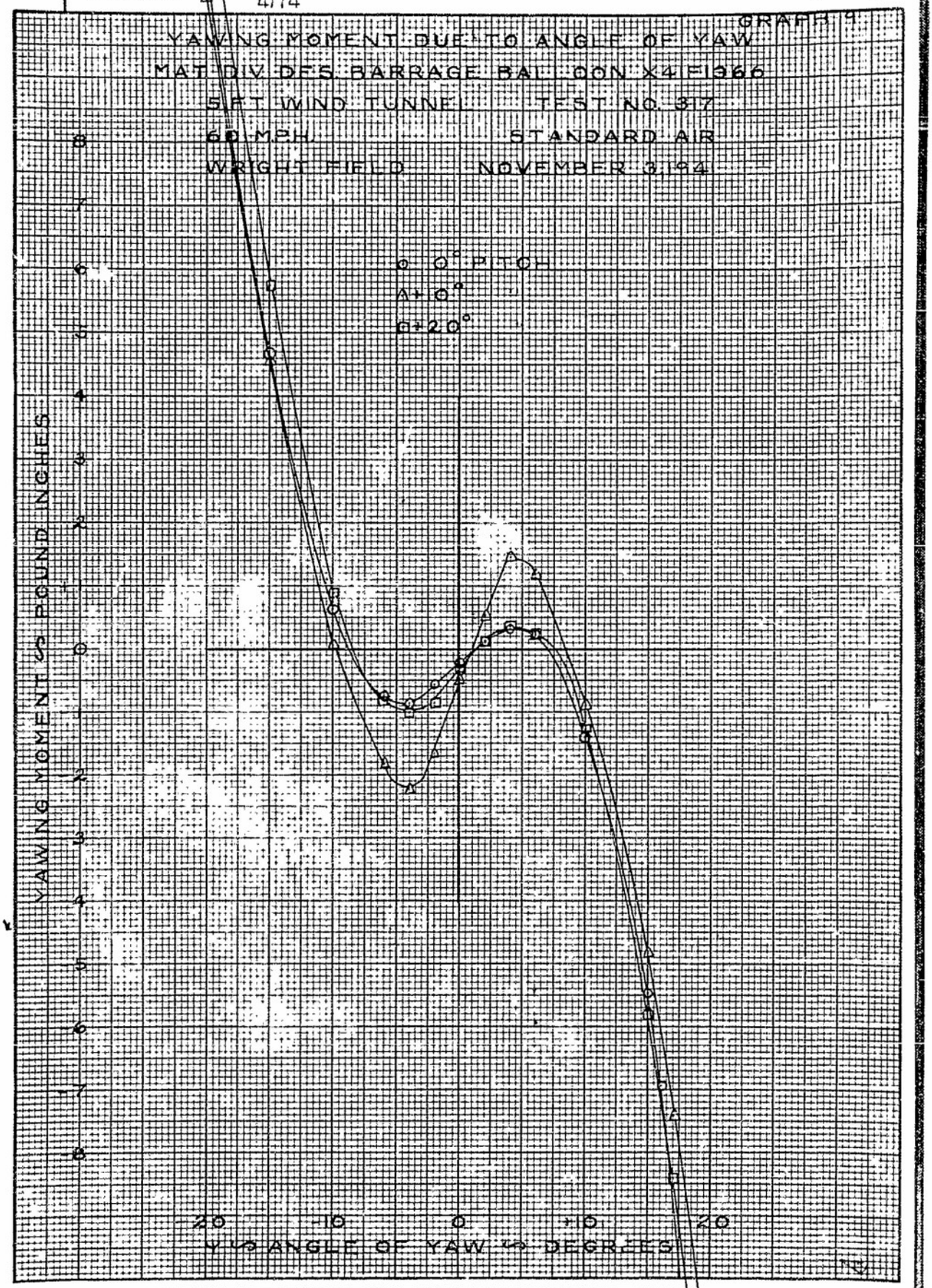
PAGE

GRAPH 8



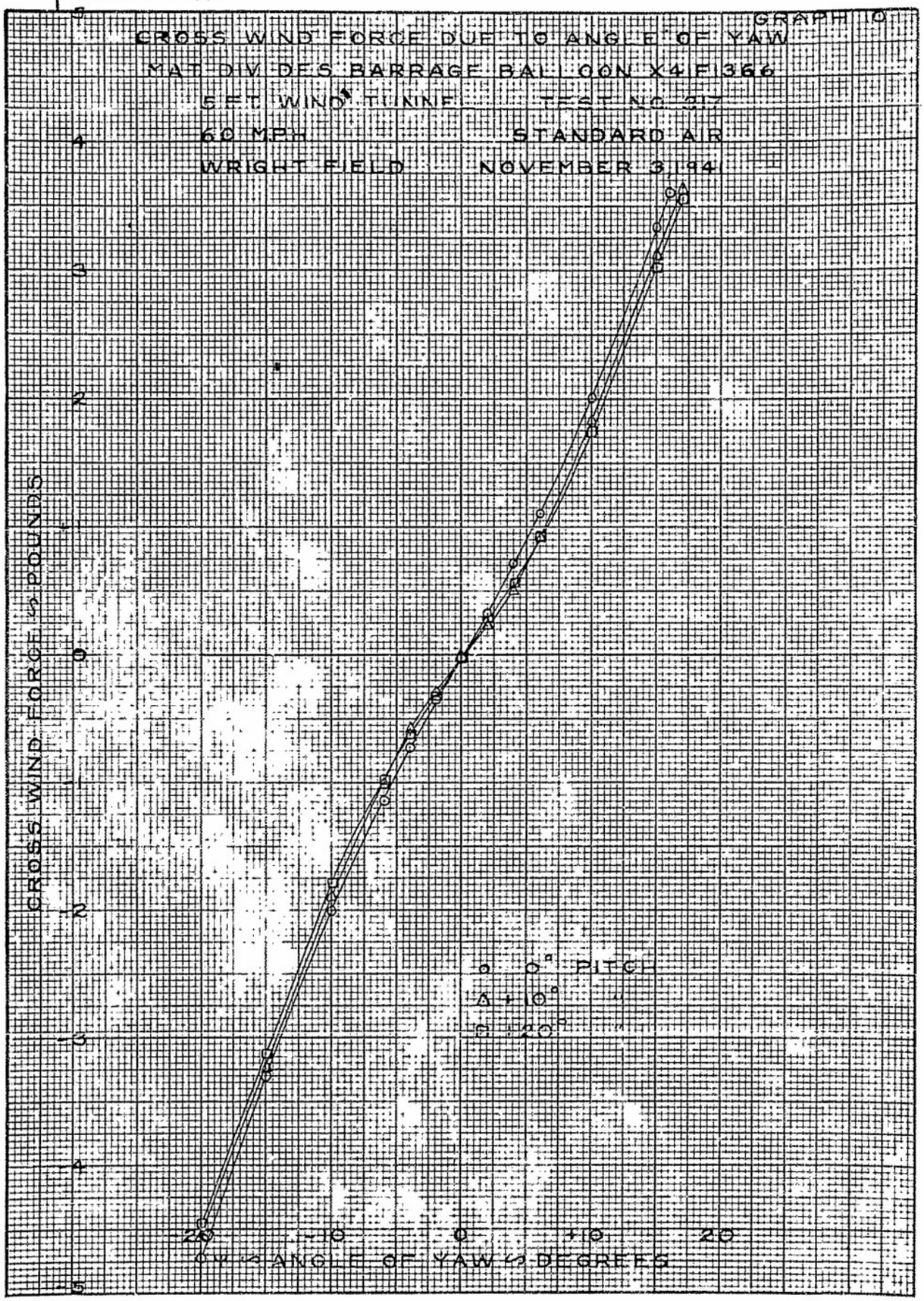

USE THIS SIDE

SERIAL No. A 4474 PAGE



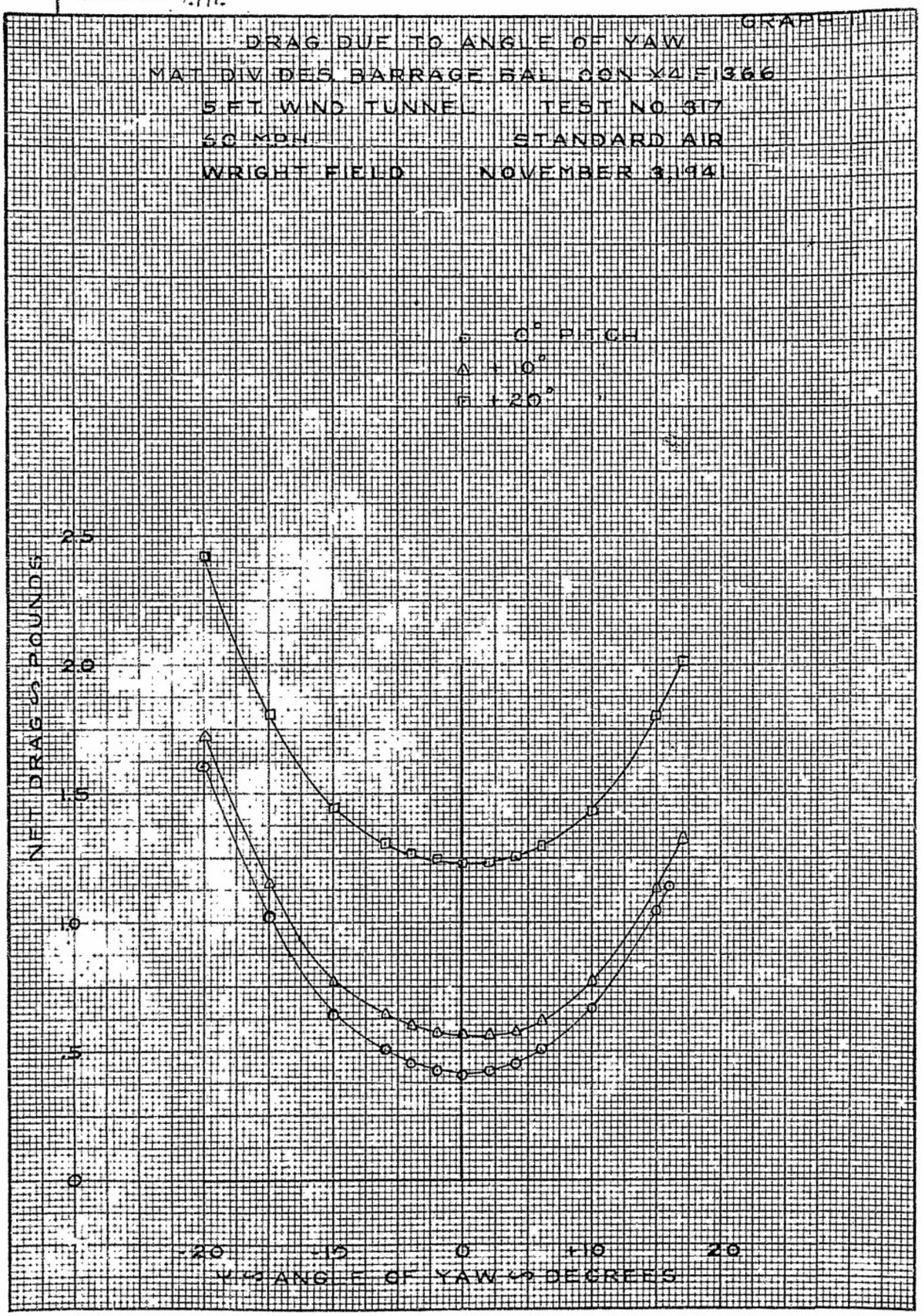

USE THIS SIDE

SERIAL No. 4774 PAGE




USE THIS SIDE

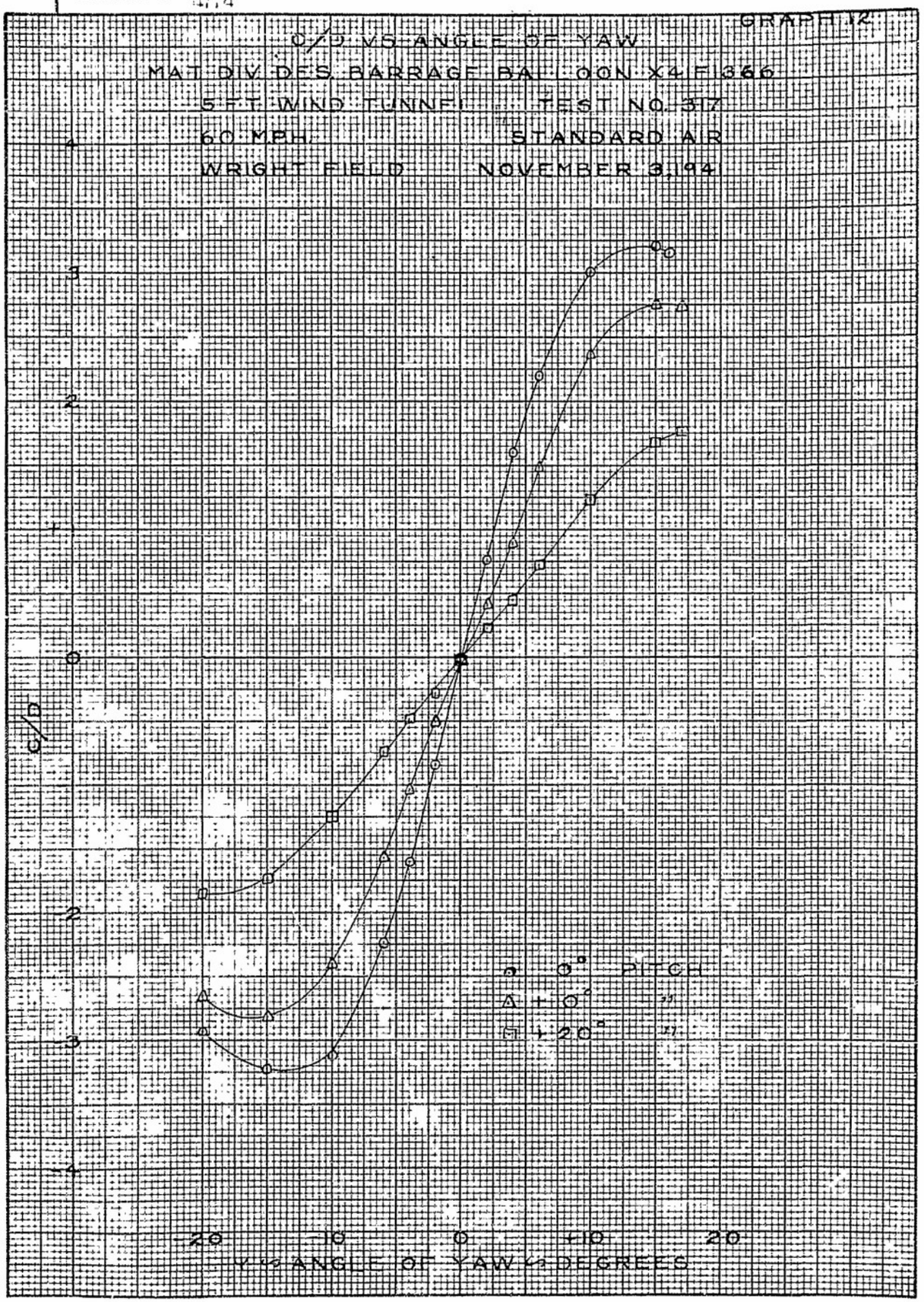
SERIAL No. 1771 PAGE




USE THIS SIDE

MDVC-292-V-WE-3-27-41-SPW

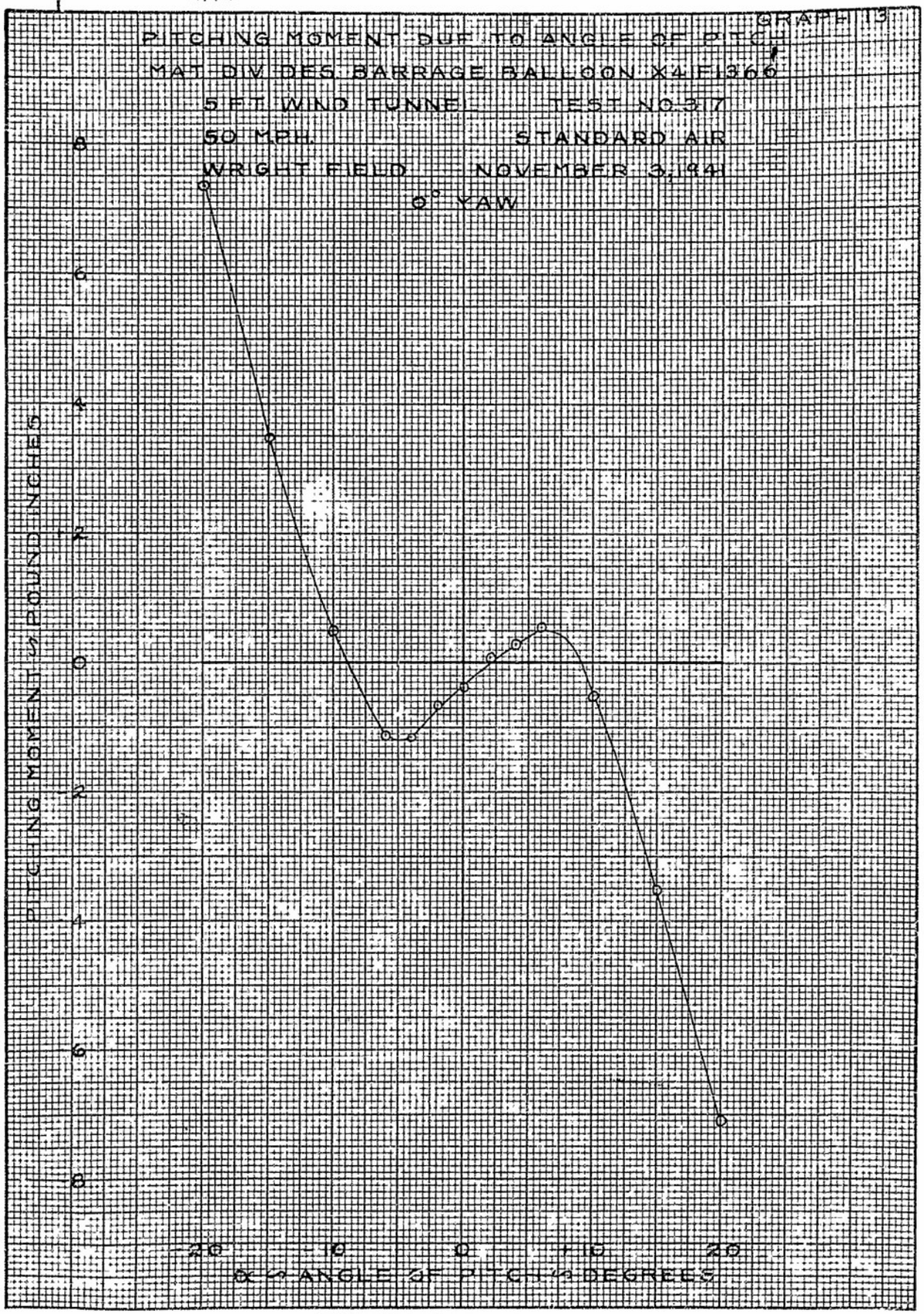
SERIAL No. 4774 PAGE




USE THIS SIDE

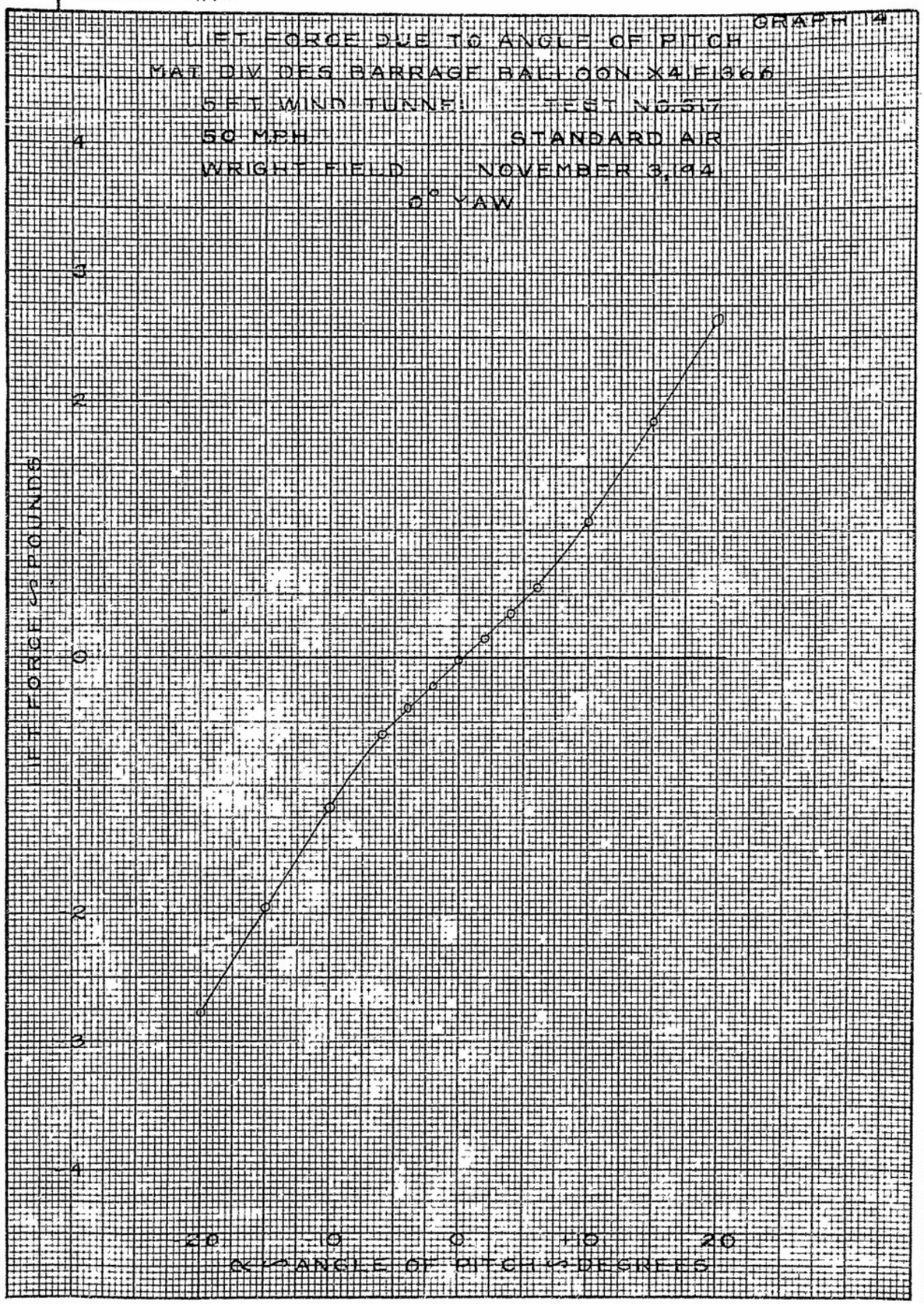
SERIAL No. 4774

PAGE




USE THIS SIDE

SERIAL No. 4774 PAGE




USE THIS SIDE

SERIAL No. 4174 PAGE

GRAPH 15

DRAG DUE TO ANGLE OF PITCH

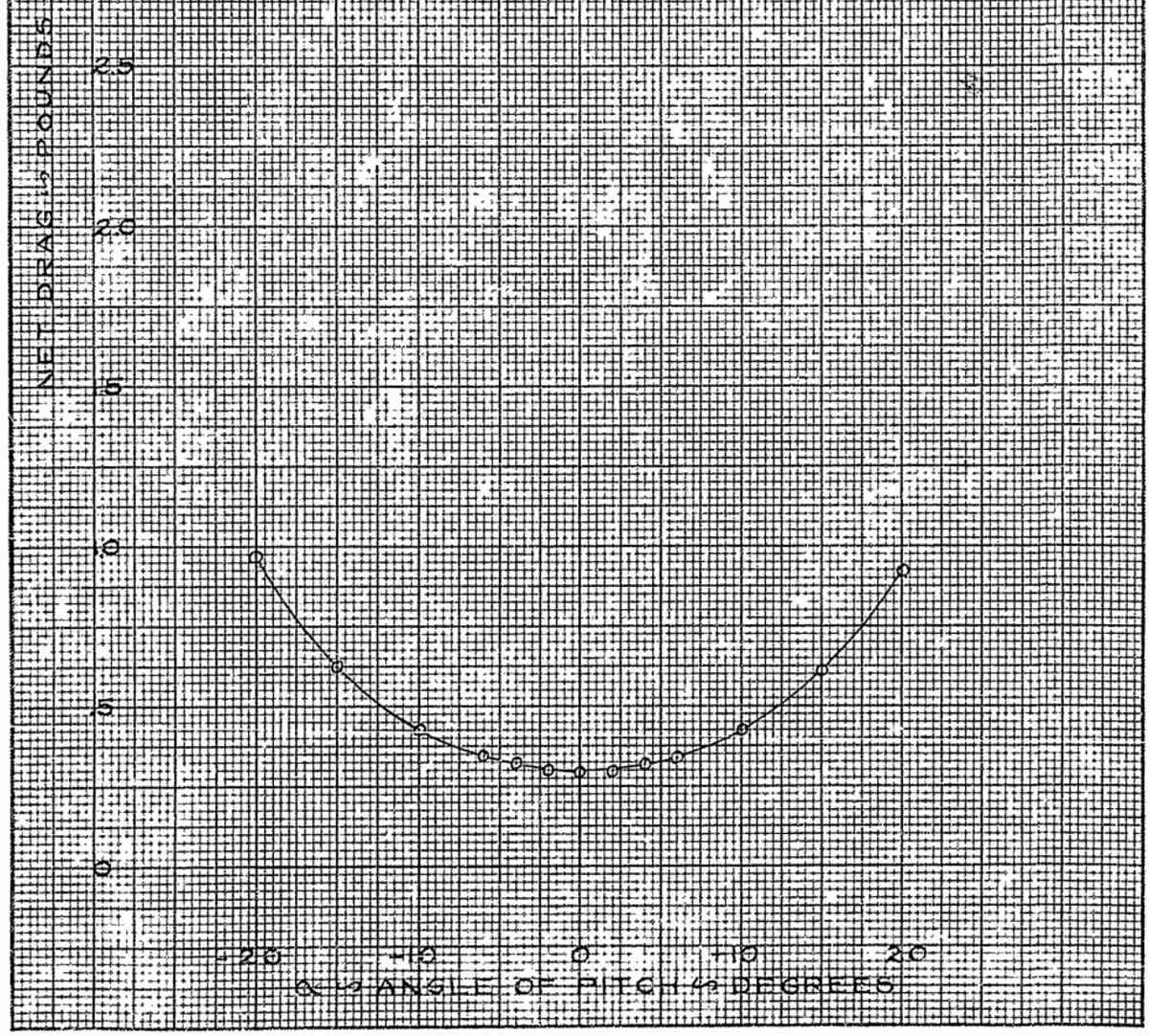
MAT. DIV. DES. BARRAGE BAL. DGN X4F366

5 FT. WIND TUNNEL TEST NO. 317

50 M.P.H. STANDARD AIR

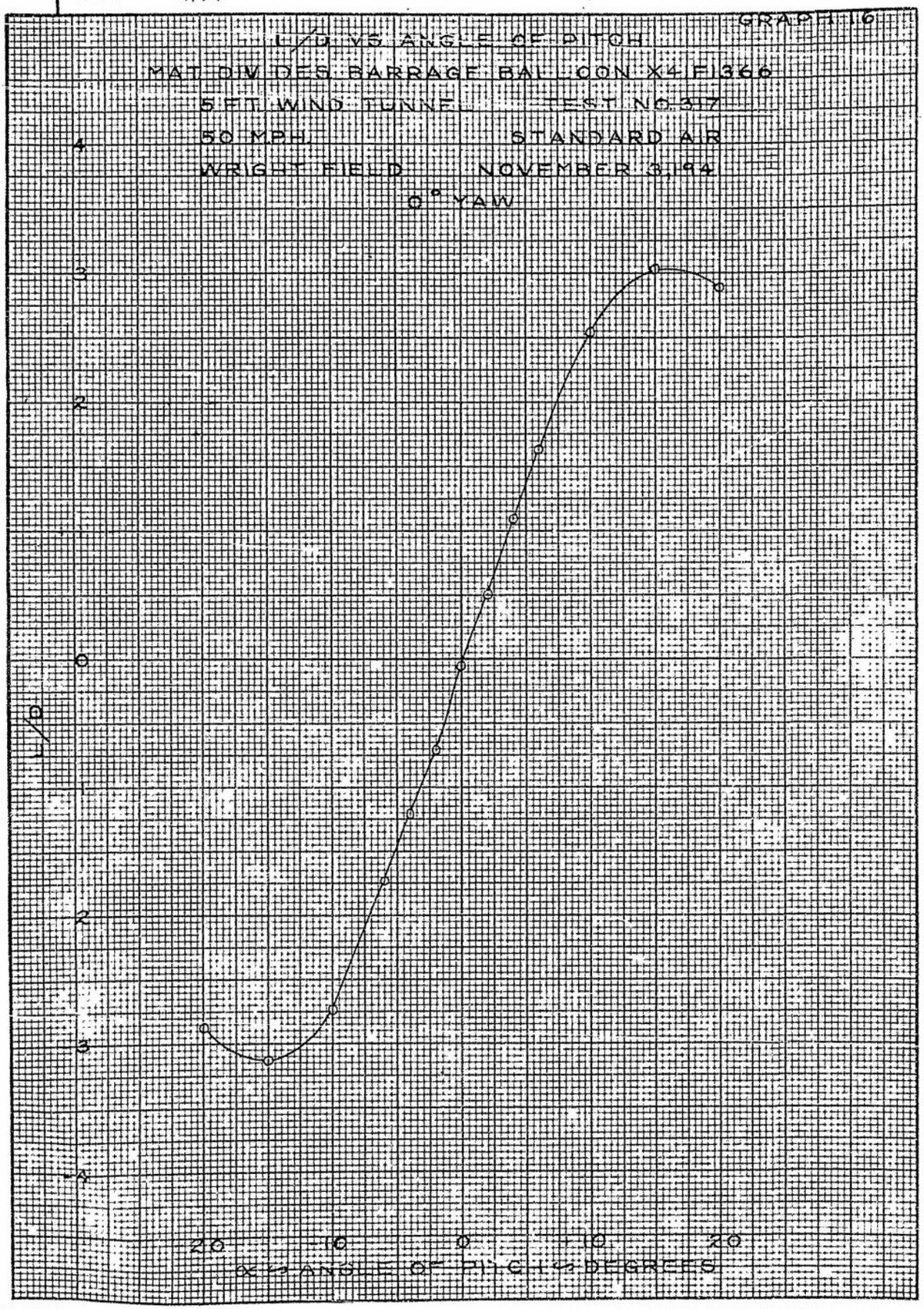
WRIGHT FIELD NOVEMBER 3, 1944

0° YAW



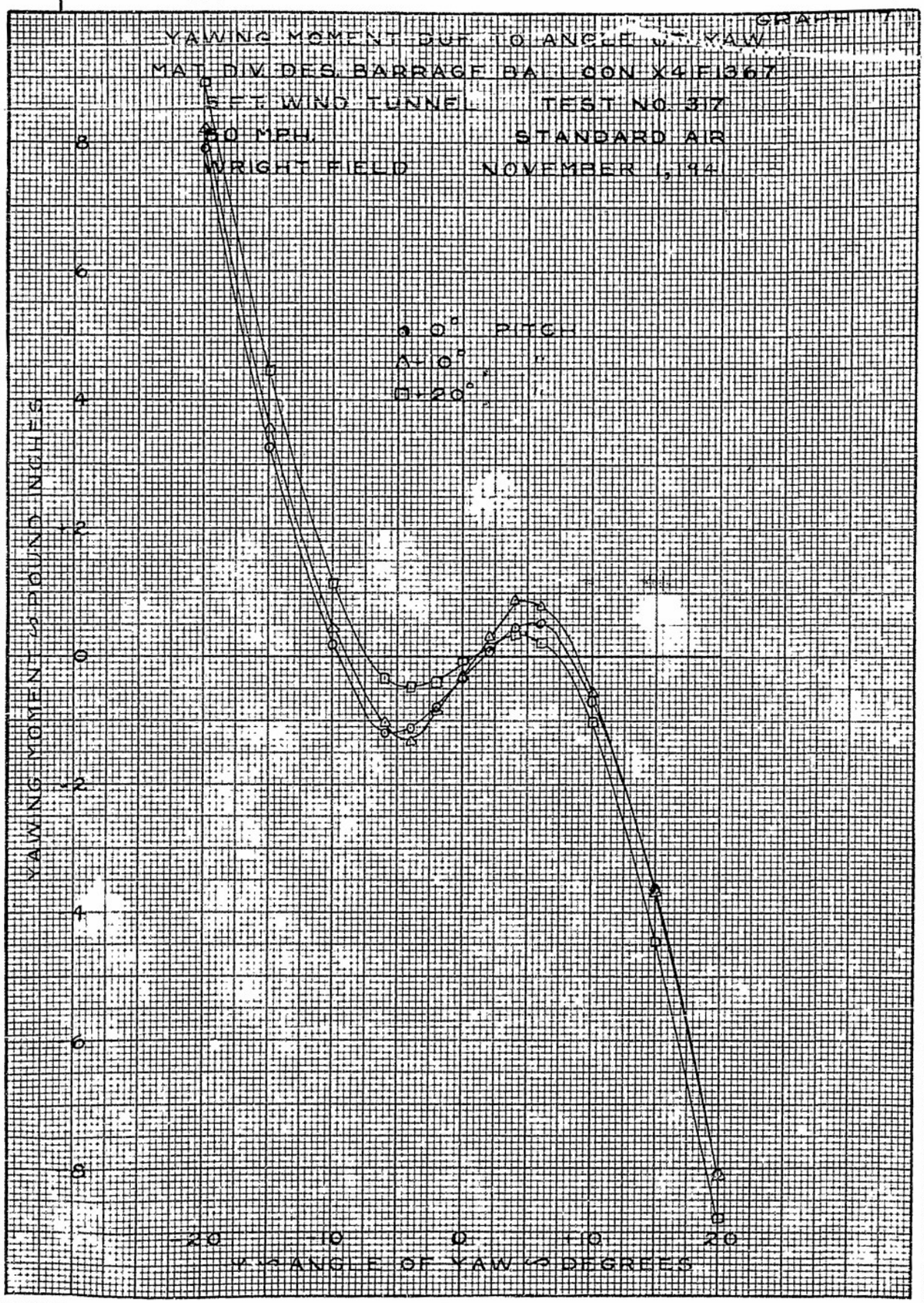

USE THIS SIDE

SERIAL No. 1774 PAGE



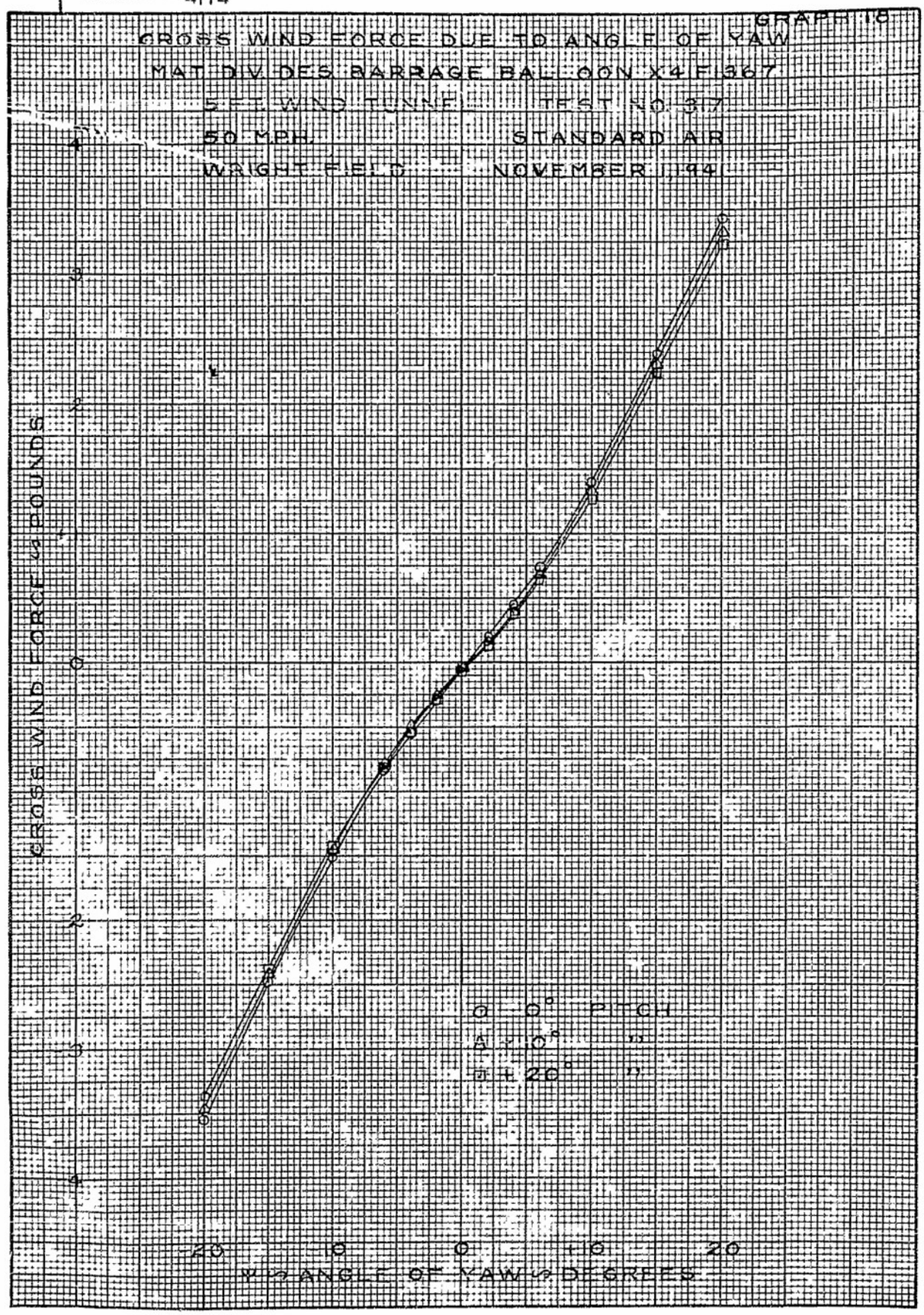

USE THIS SIDE

SERIAL No. 4774 PAGE




USE THIS SIDE

SERIAL No. 4774 PAGE

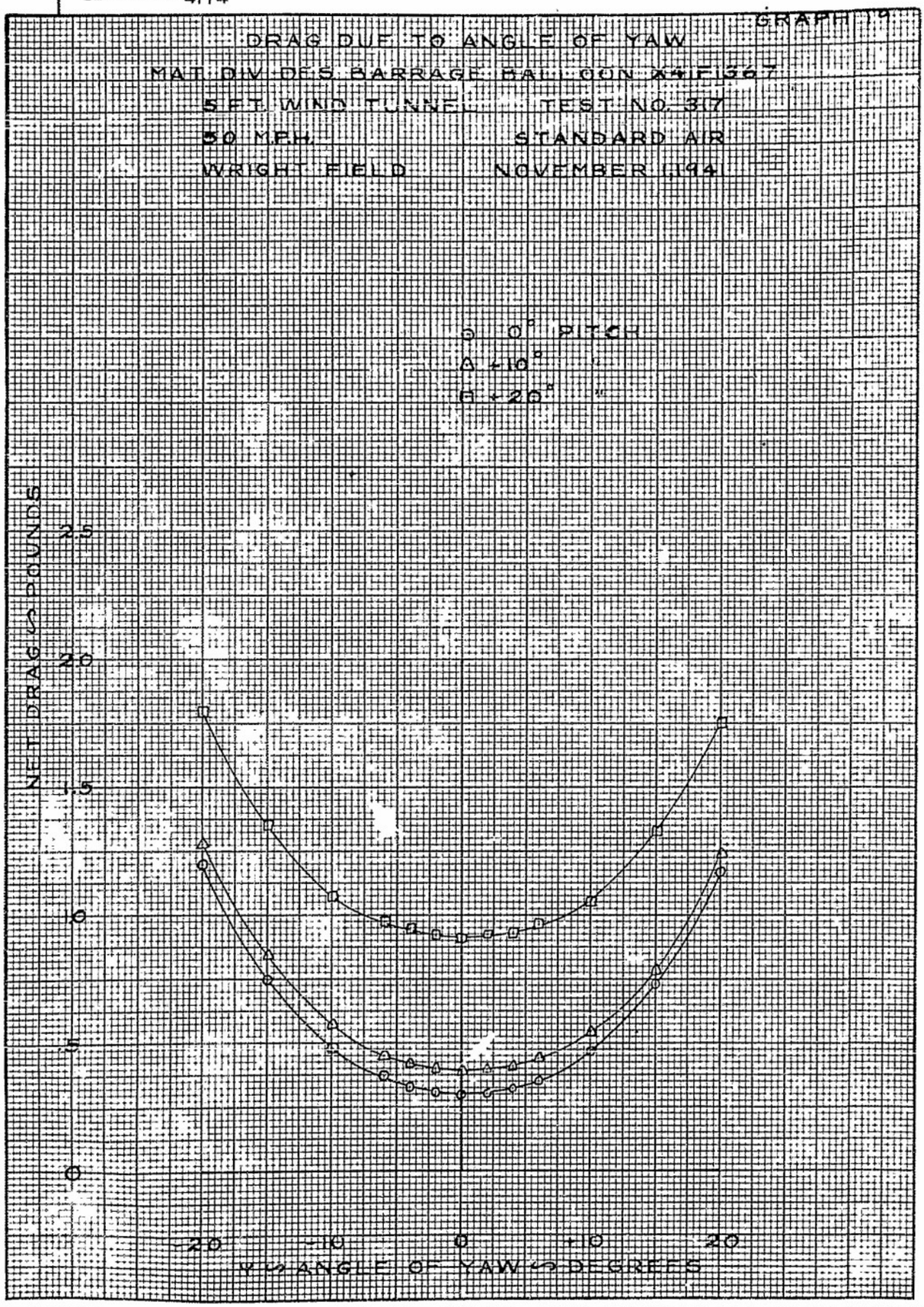



USE THIS SIDE

SERIAL No. 4774

PAGE

GRAPH 19

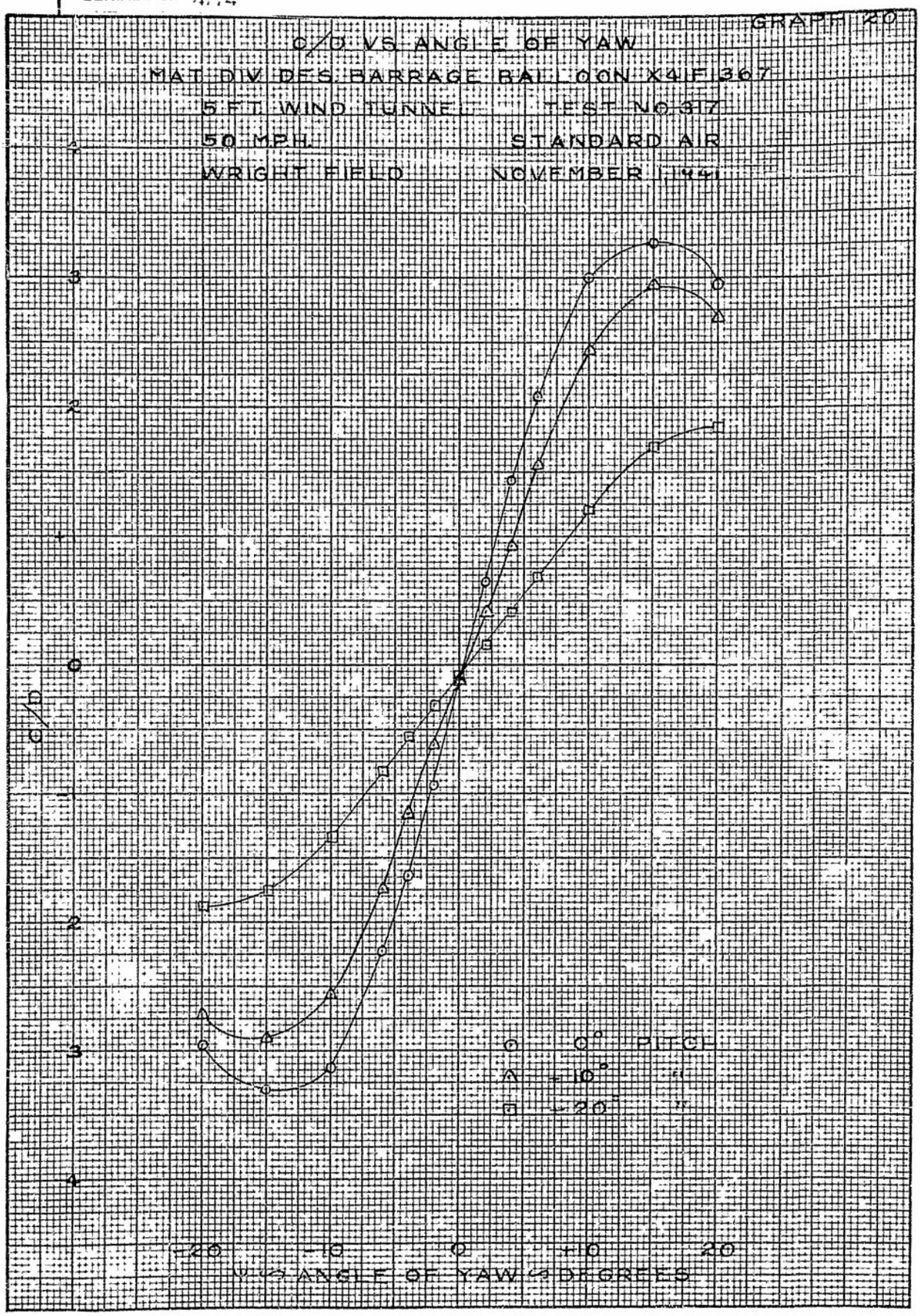



USE THIS SIDE

SERIAL No. 1774

PAGE

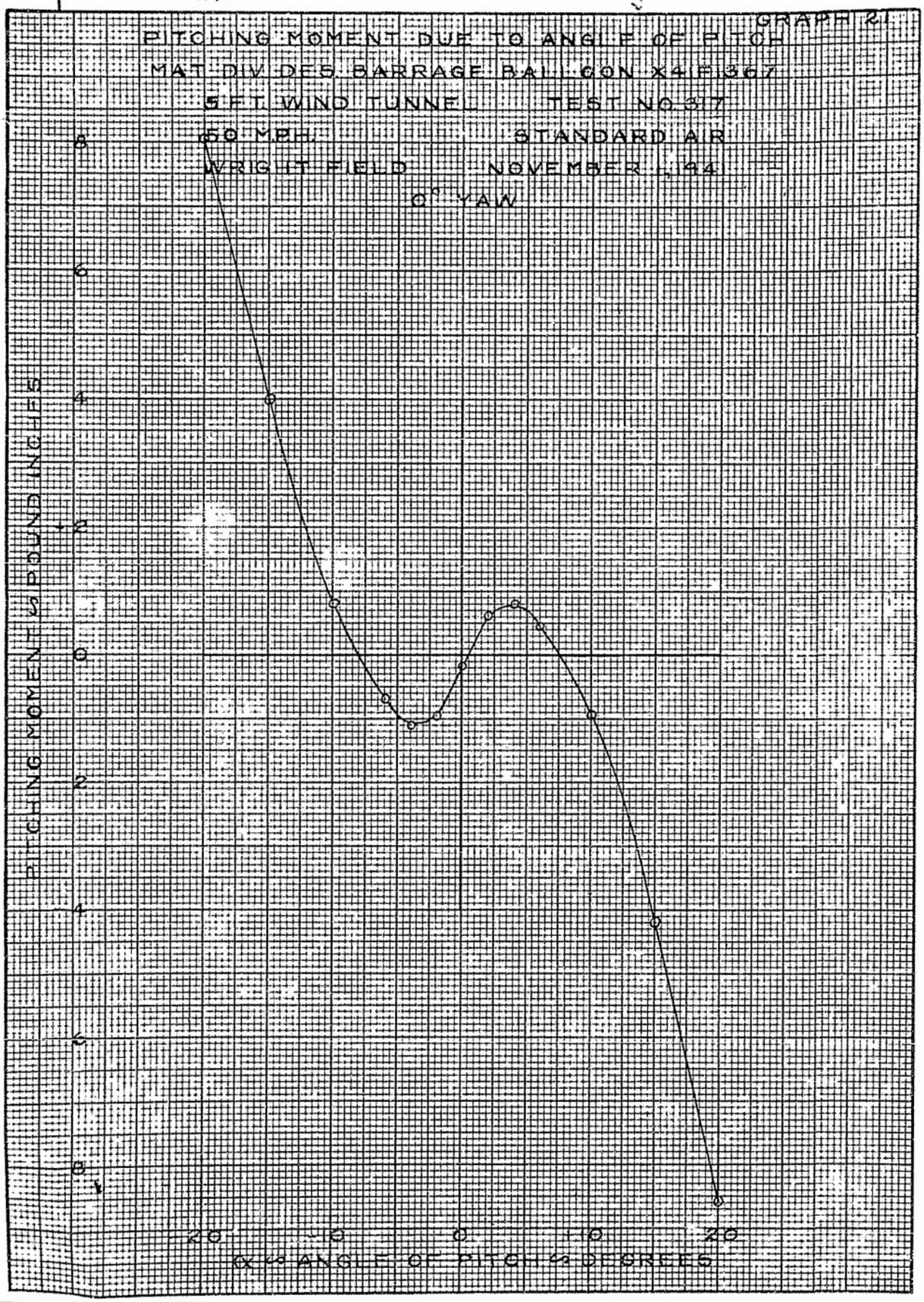
GRAPH 20




USE THIS SIDE

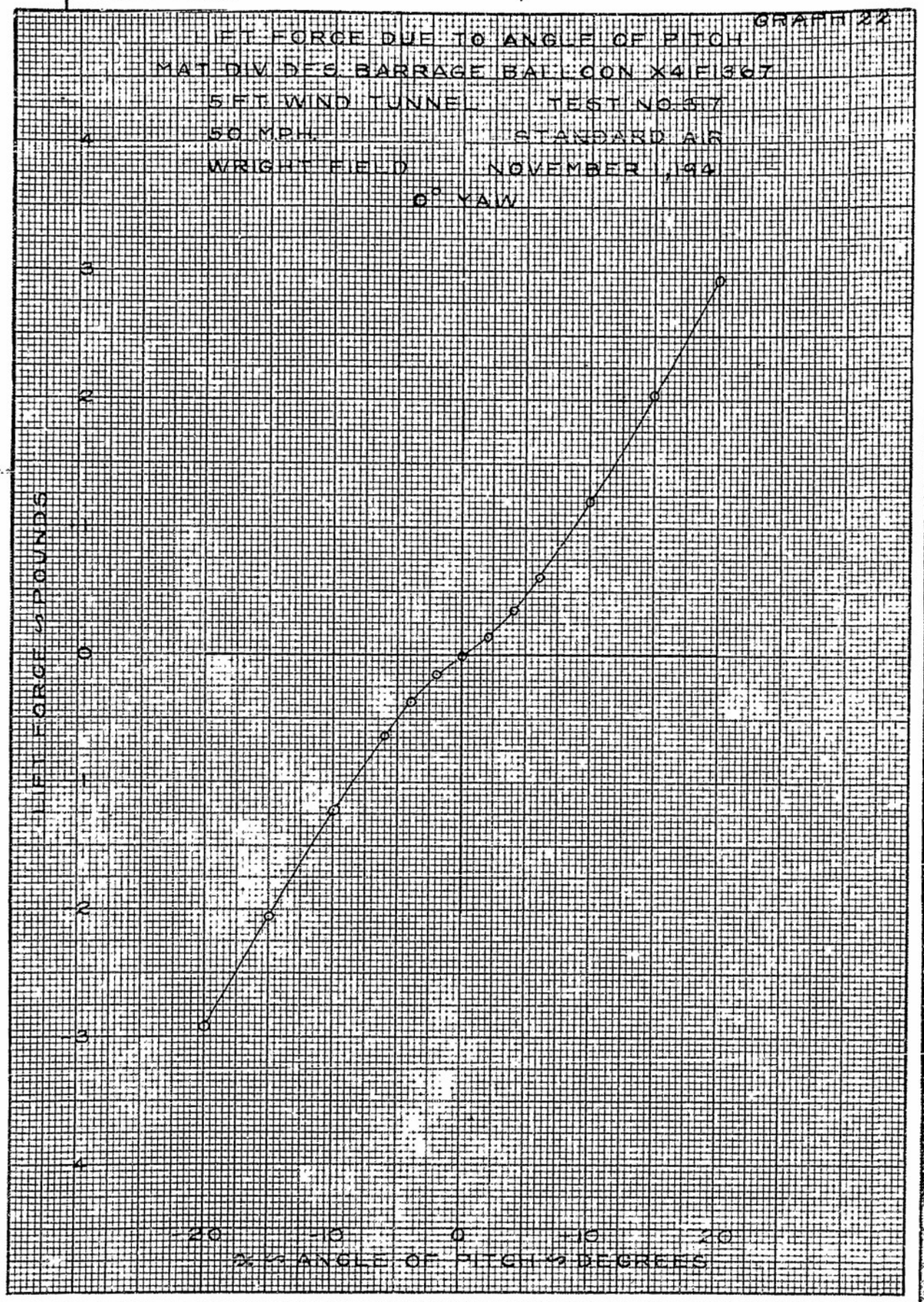
SERIAL No. 374 PAGE

GRAPH 21




USE THIS SIDE

SERIAL No. 4774 PAGE

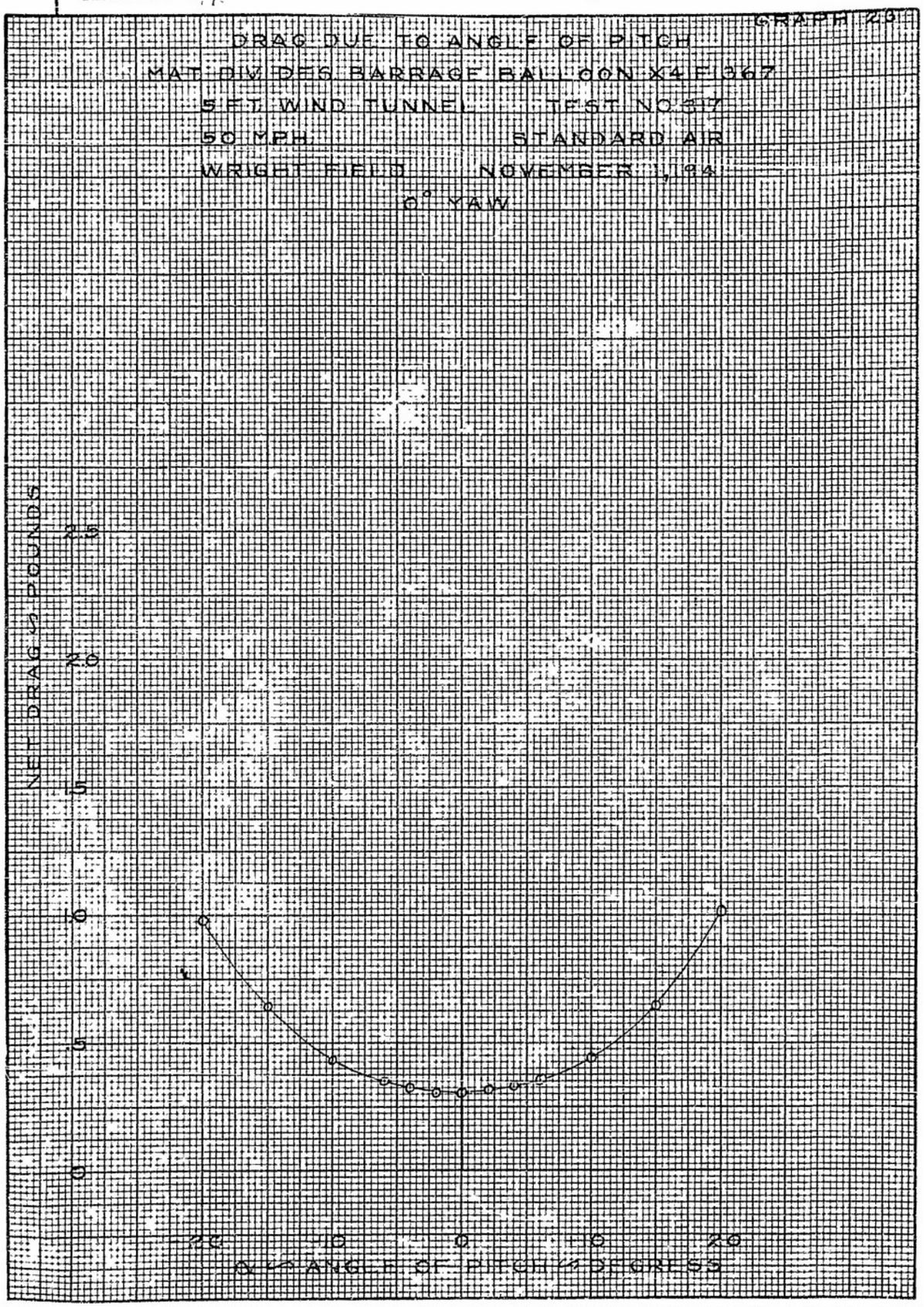



USE THIS SIDE

SERIAL No.

PAGE

GRAPH 29

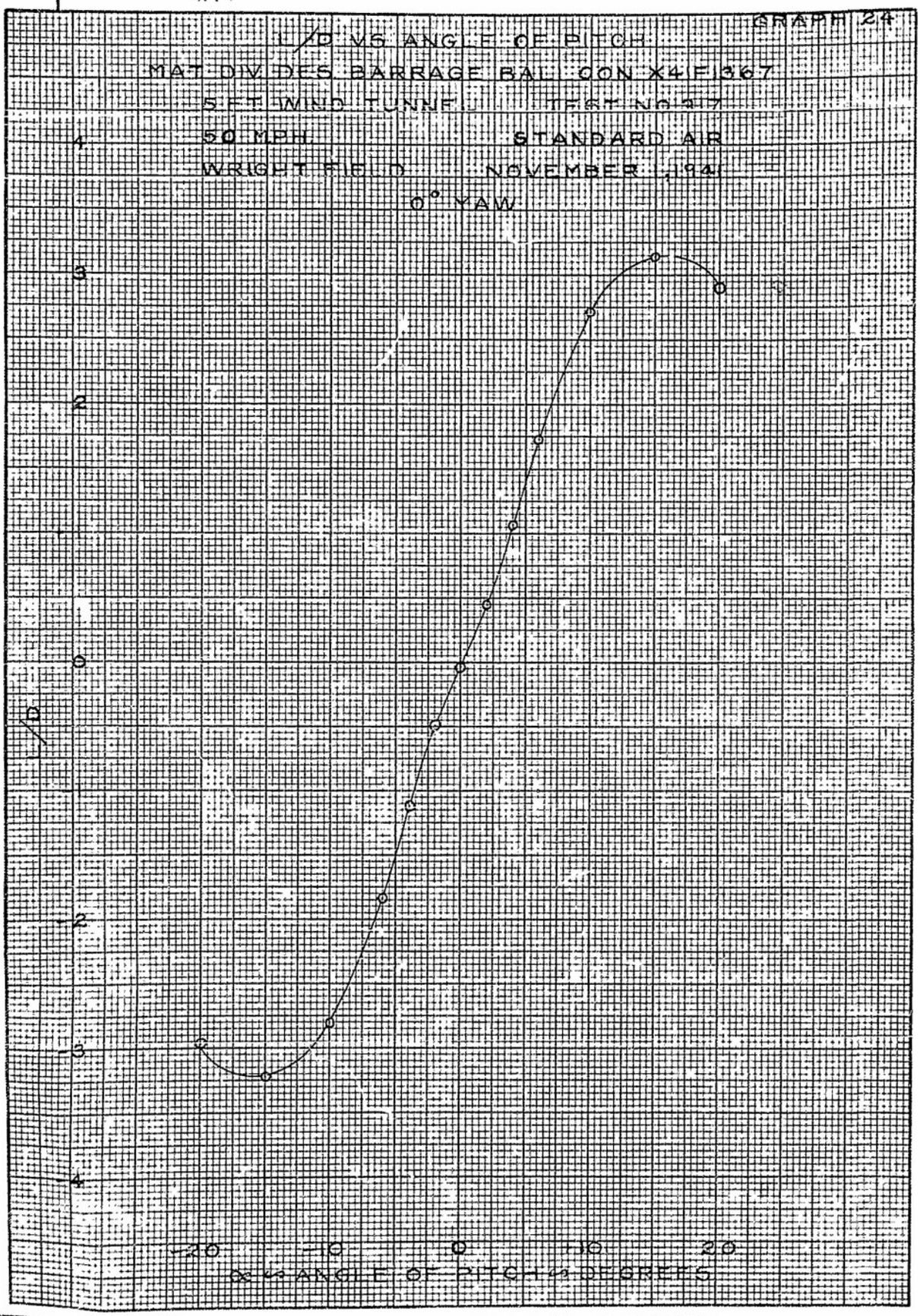



USE THIS SIDE

SERIAL No. 474

PAGE

GRAPH 24

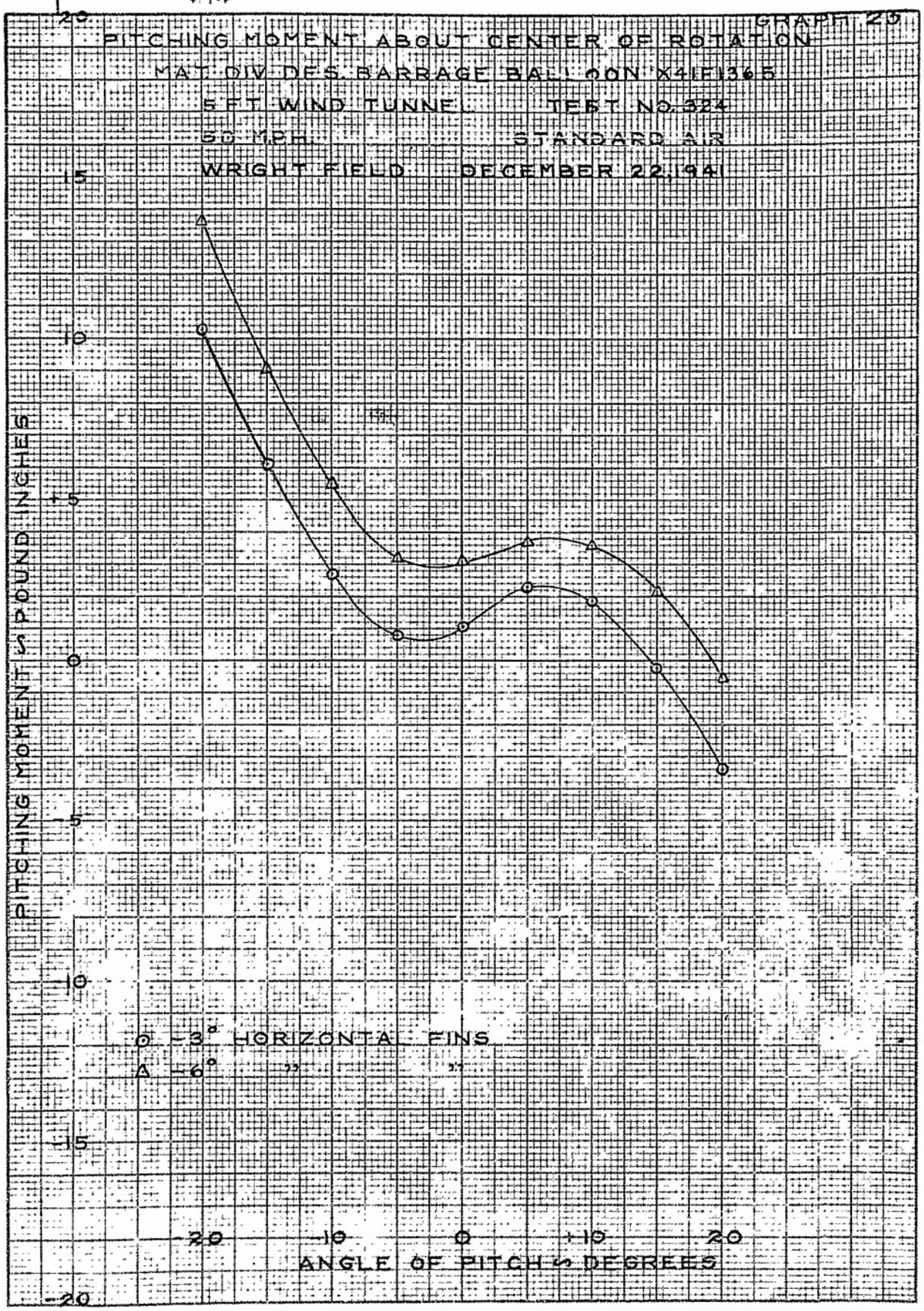



USE THIS SIDE

SERIAL No. 474

PAGE

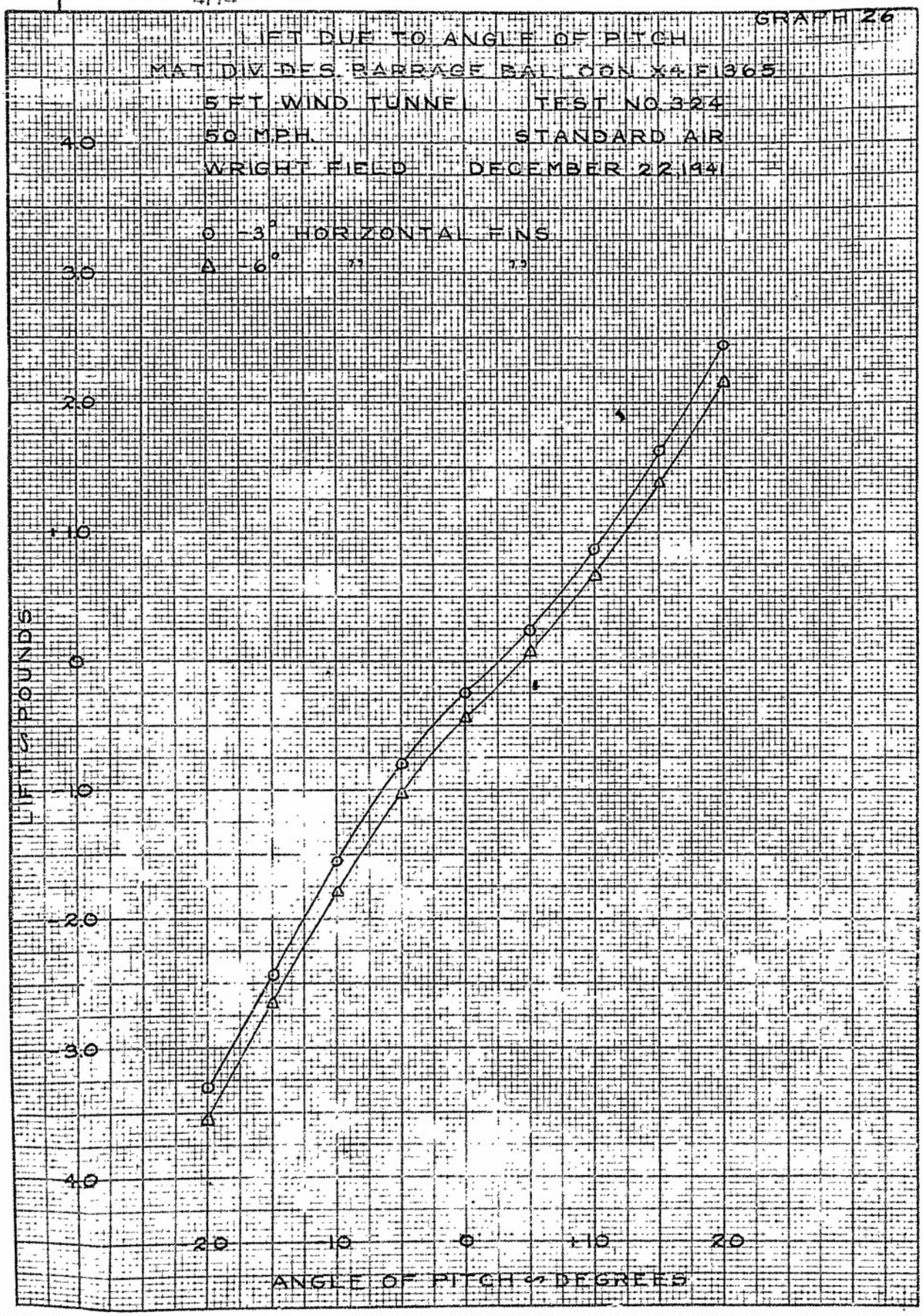
GRAPH 29




USE THIS SIDE

SERIAL No. 4774

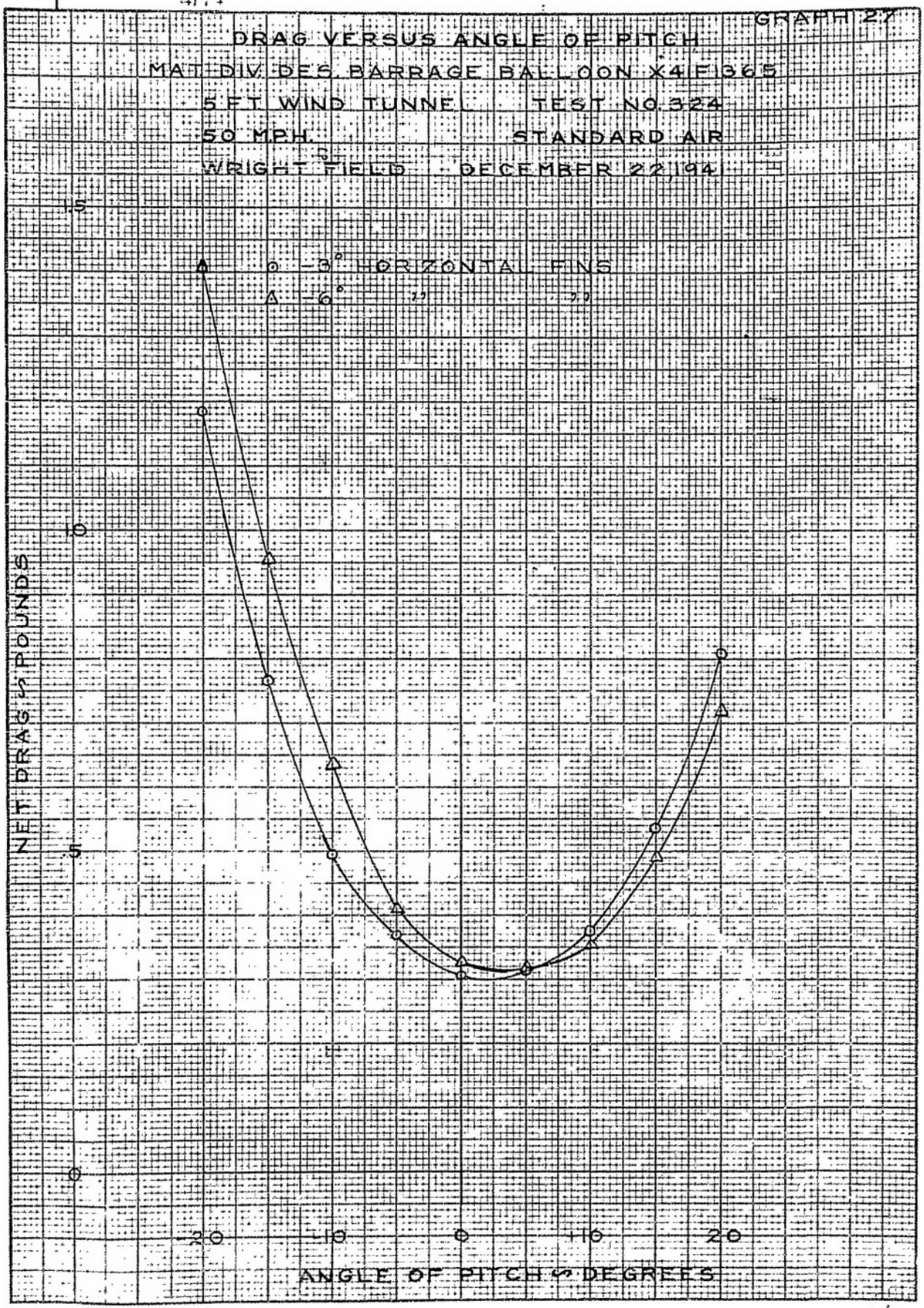
PAGE




USE THIS SIDE

SERIAL No. 4771 PAGE

GRAPH 27



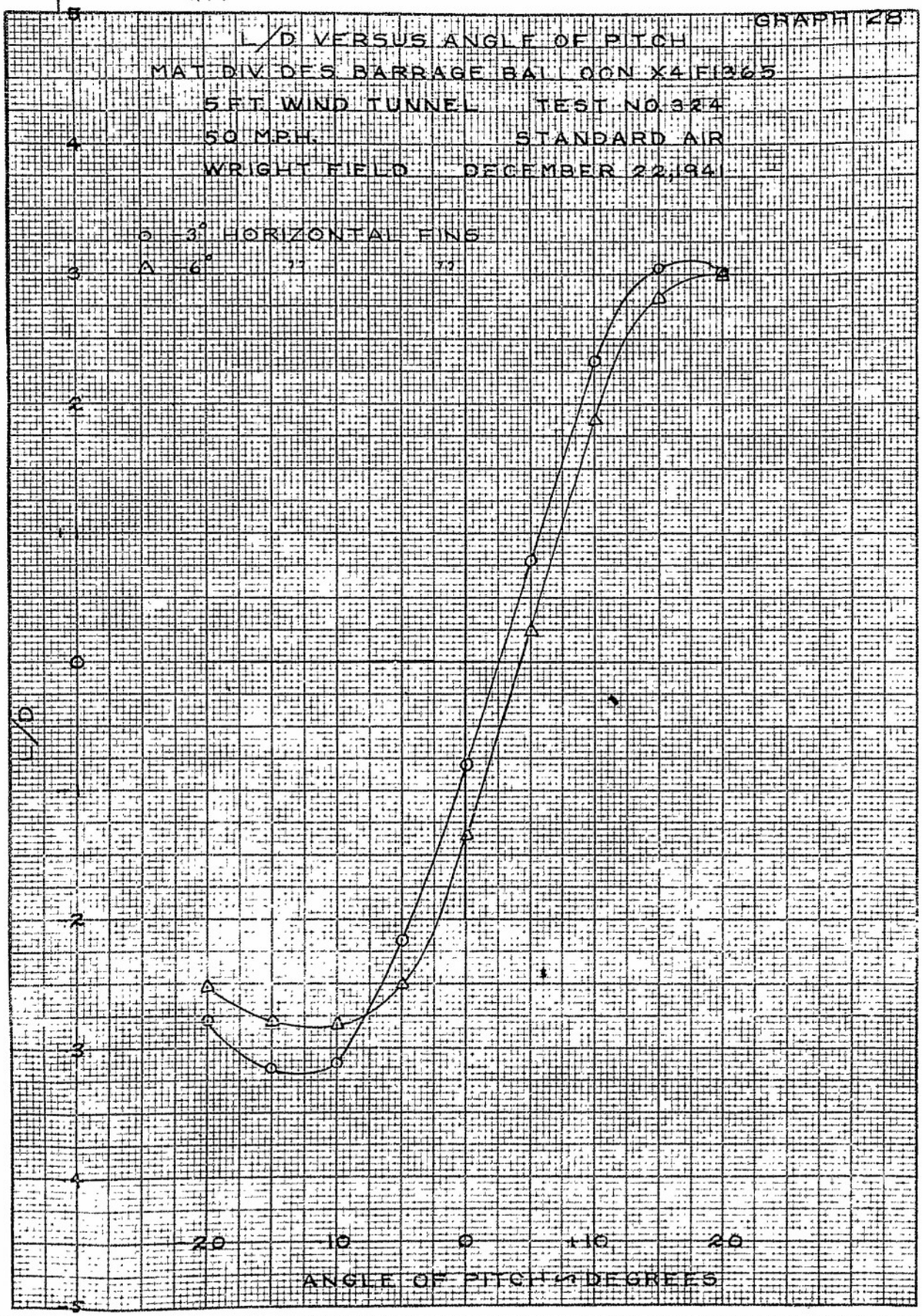

USE THIS SIDE

WDVC-282-V-ME-8-21-41-25M

SERIAL No. 4774

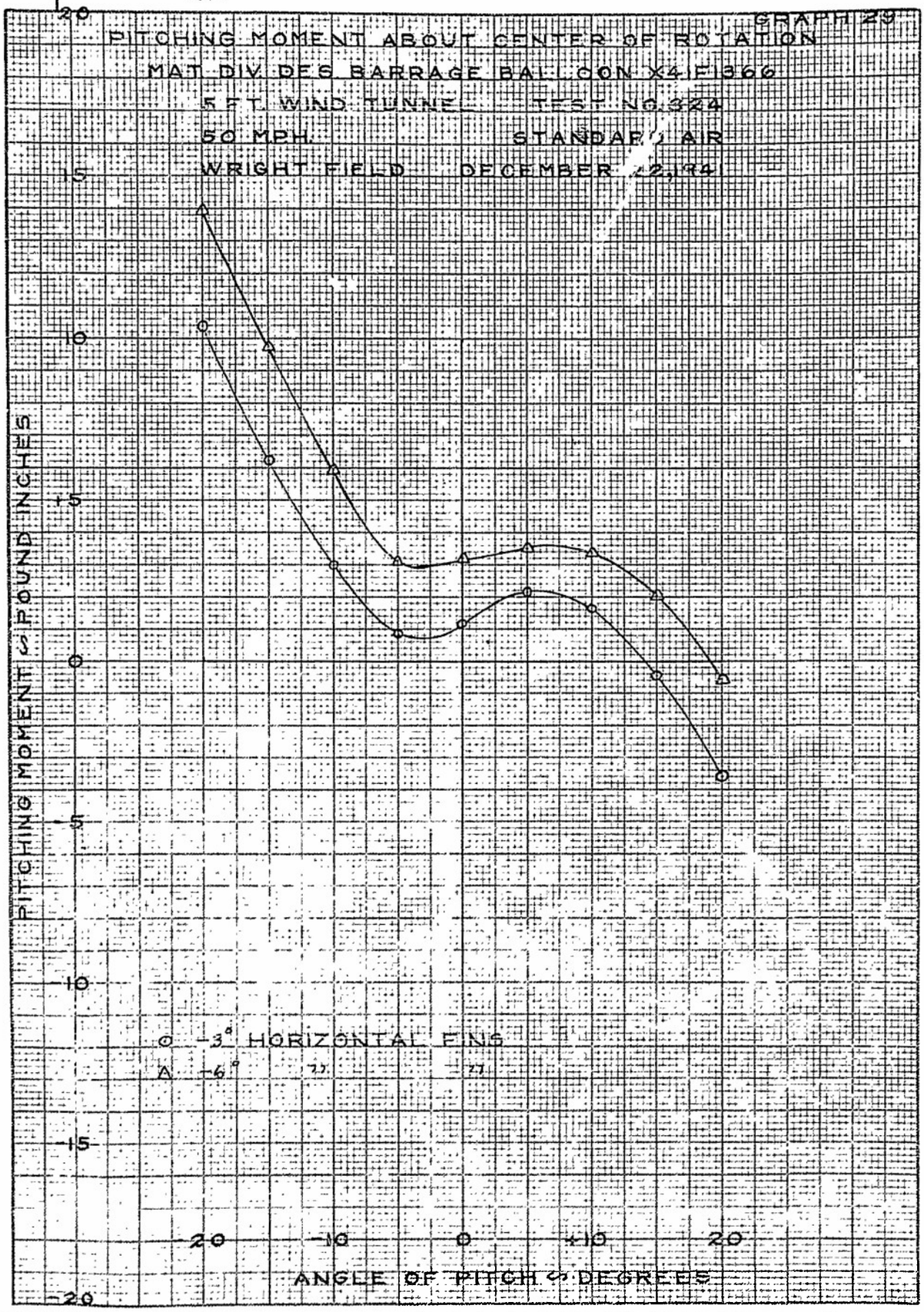
PAGE

GRAPH 28



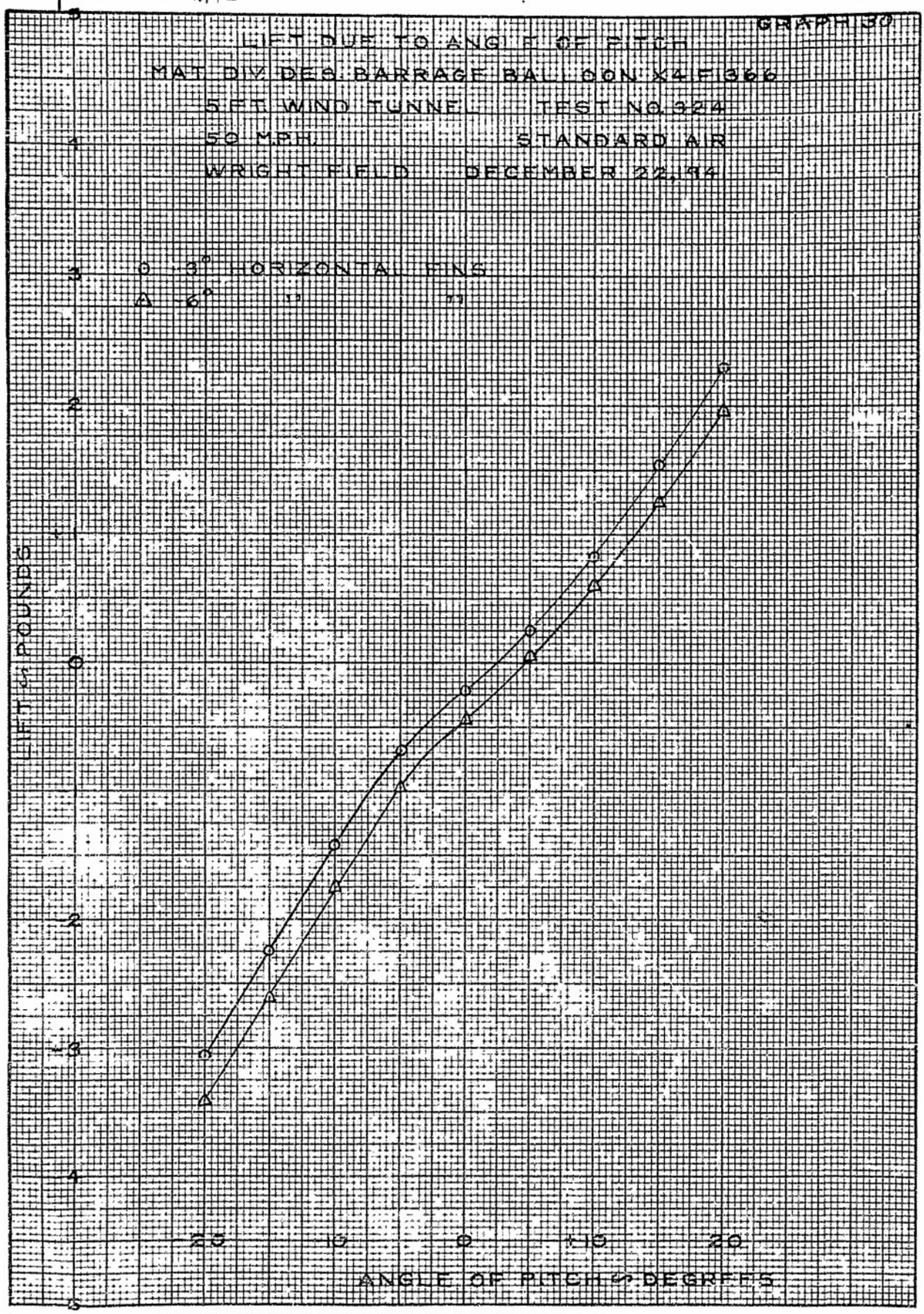

USE THIS SIDE

SERIAL No. PAGE




USE THIS SIDE

SERIAL No. PAGE




USE THIS SIDE

SERIAL No. 474

PAGE

GRAPH 37

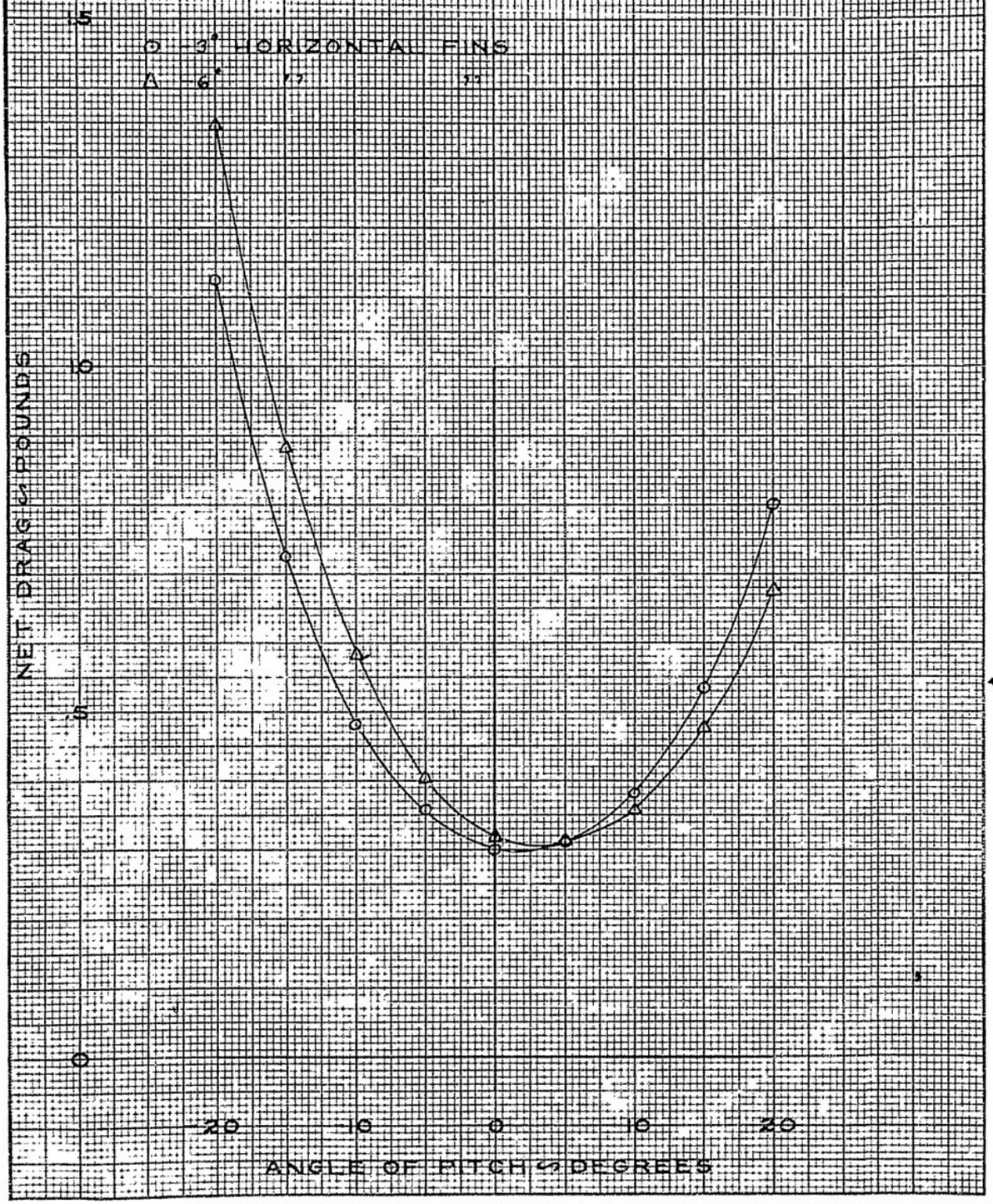
DRAG VERSUS ANGLE OF PITCH

MAT DIV DES. BARRAGE BAL. OON X4 F 366

5 FT. WIND TUNNEL TEST NO 324

50 MPH STANDARD AIR

WRIGHT FIELD DECEMBER 22, 194

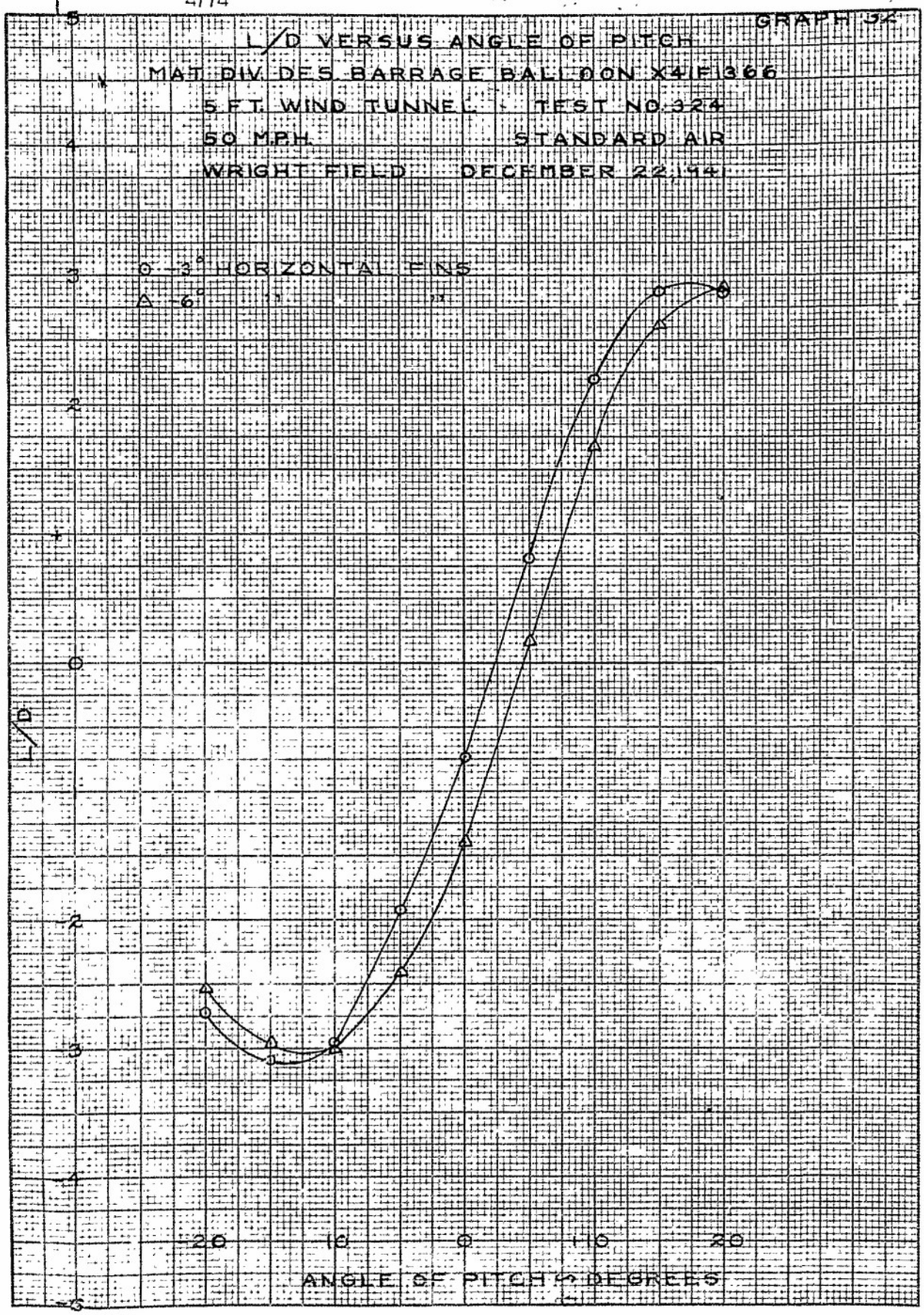



USE THIS SIDE

SERIAL No. 4774

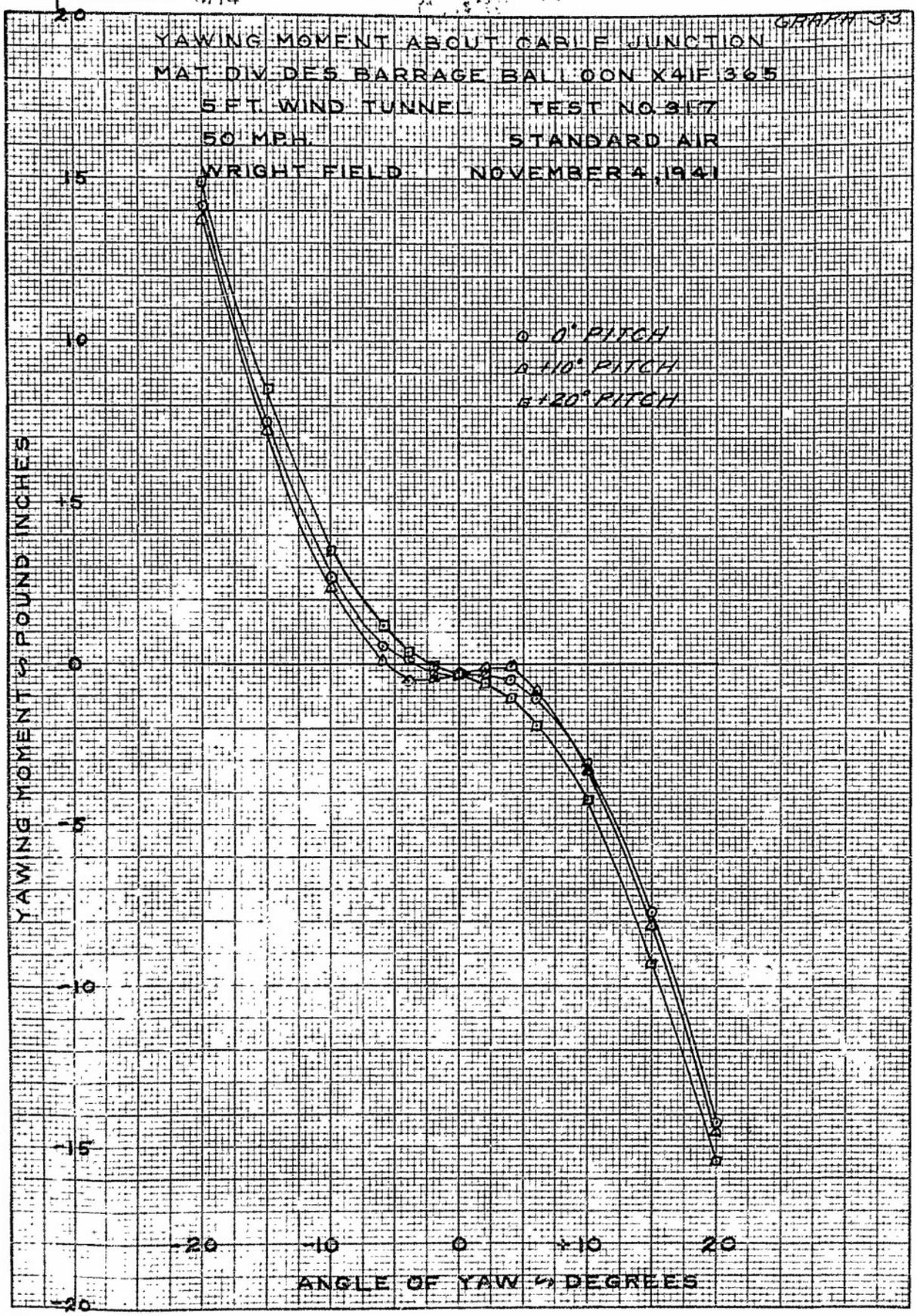
PAGE

GRAPH 32




USE THIS SIDE

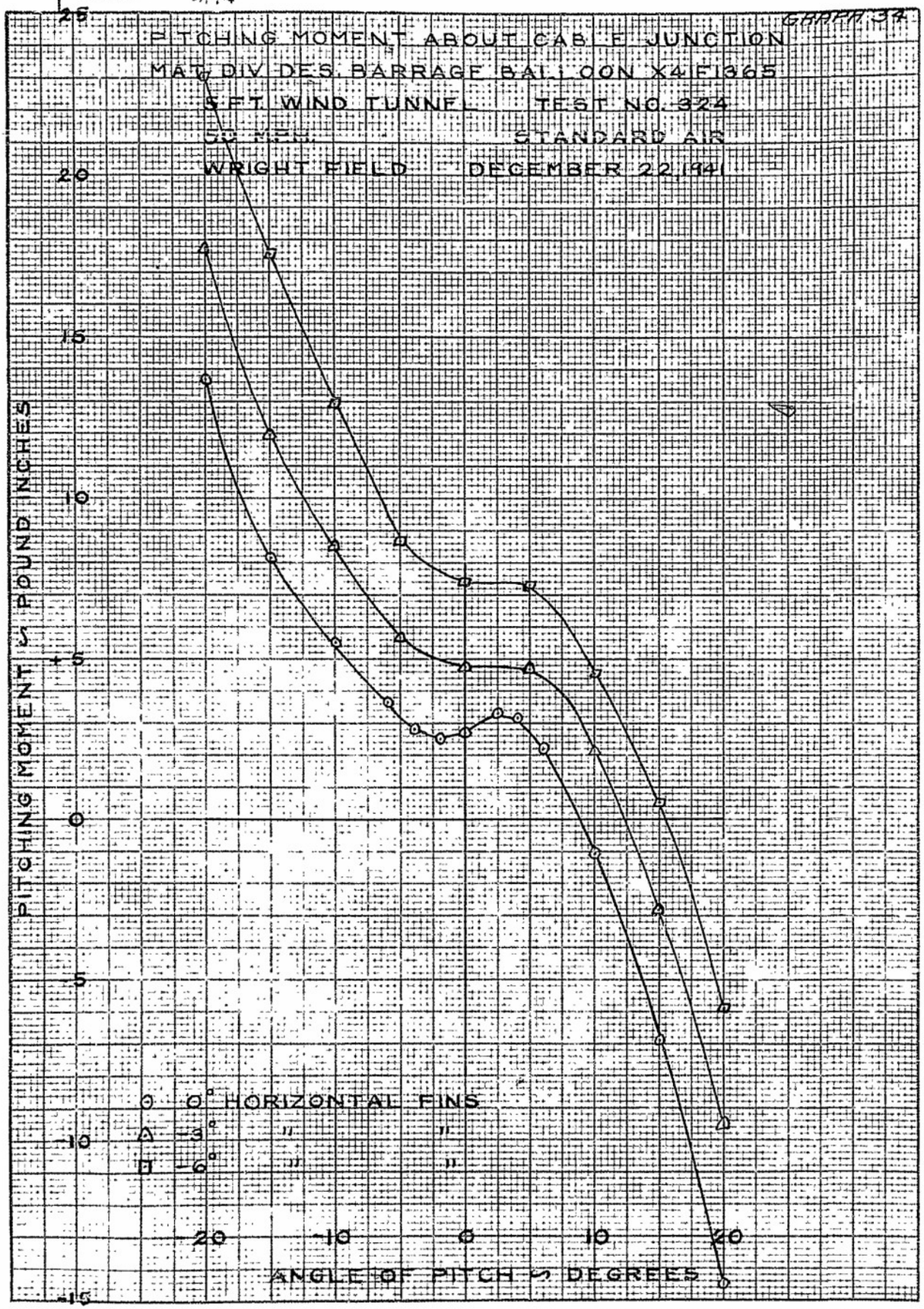
SERIAL No. 574 PAGE




USE THIS SIDE

SERIAL No. 4174 PAGE

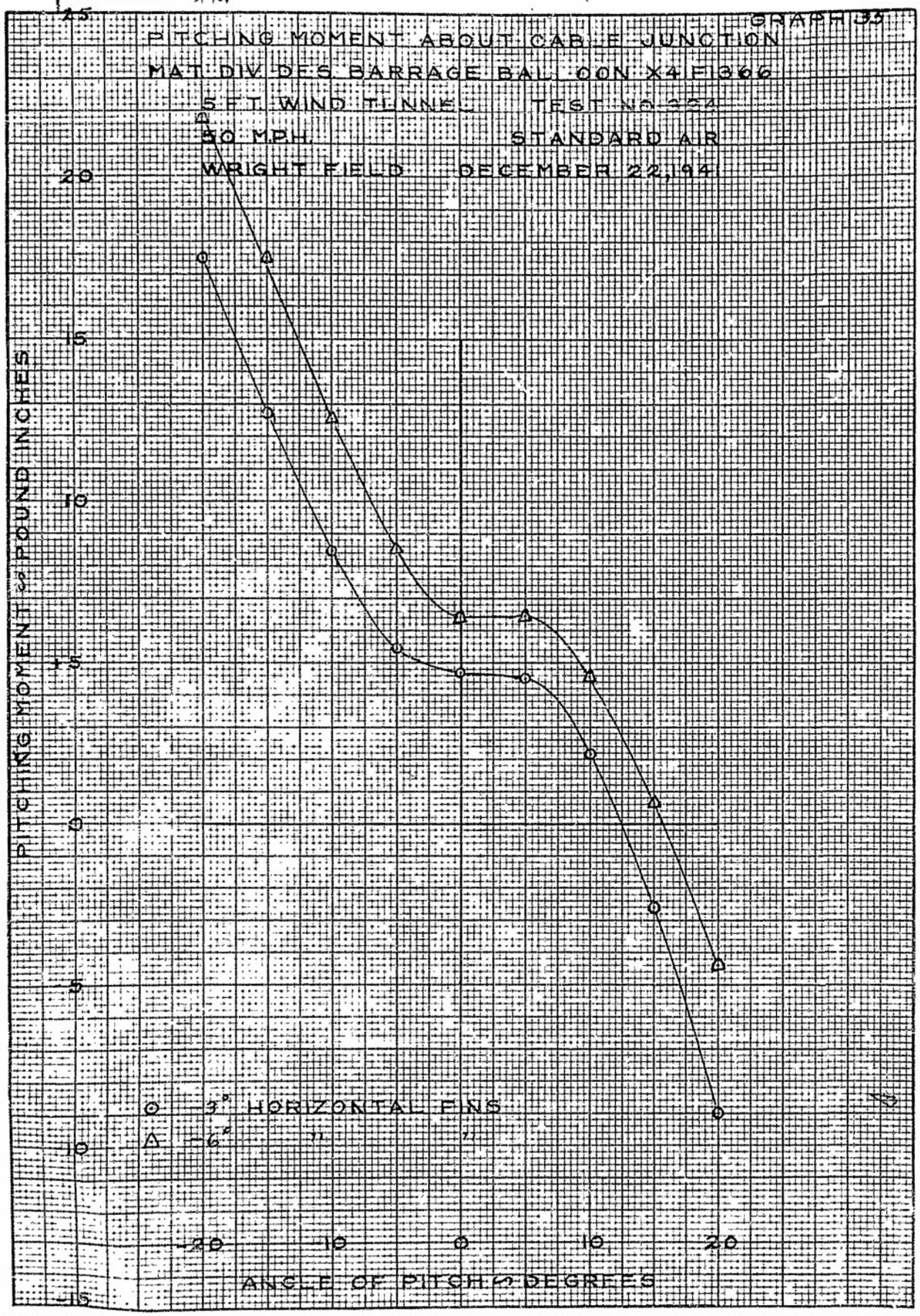
GRAPH 32




USE THIS SIDE

SERIAL No. 114 PAGE

GRAPH 33




USE THIS SIDE

SERIAL No. 4174

PAGE

GRAPH 36

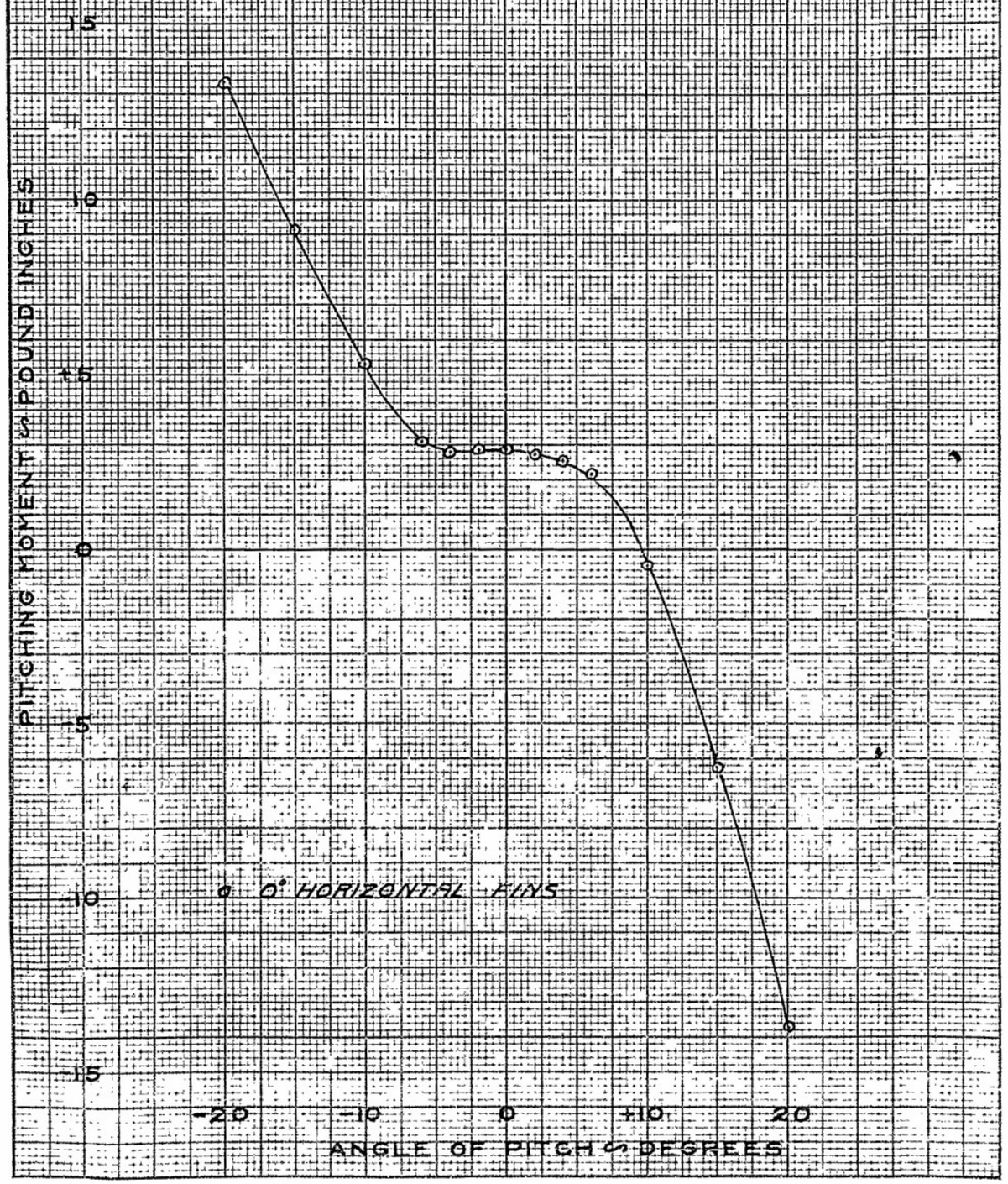
PITCHING MOMENT ABOUT CABLE JUNCTION

MAT DIV DES BARRAGE BALLOON X41F1366

5 FT WIND TUNNEL TEST NO. 317

60 M.P.H. STANDARD AIR

WRIGHT FIELD NOVEMBER 4, 1941




USE THIS SIDE

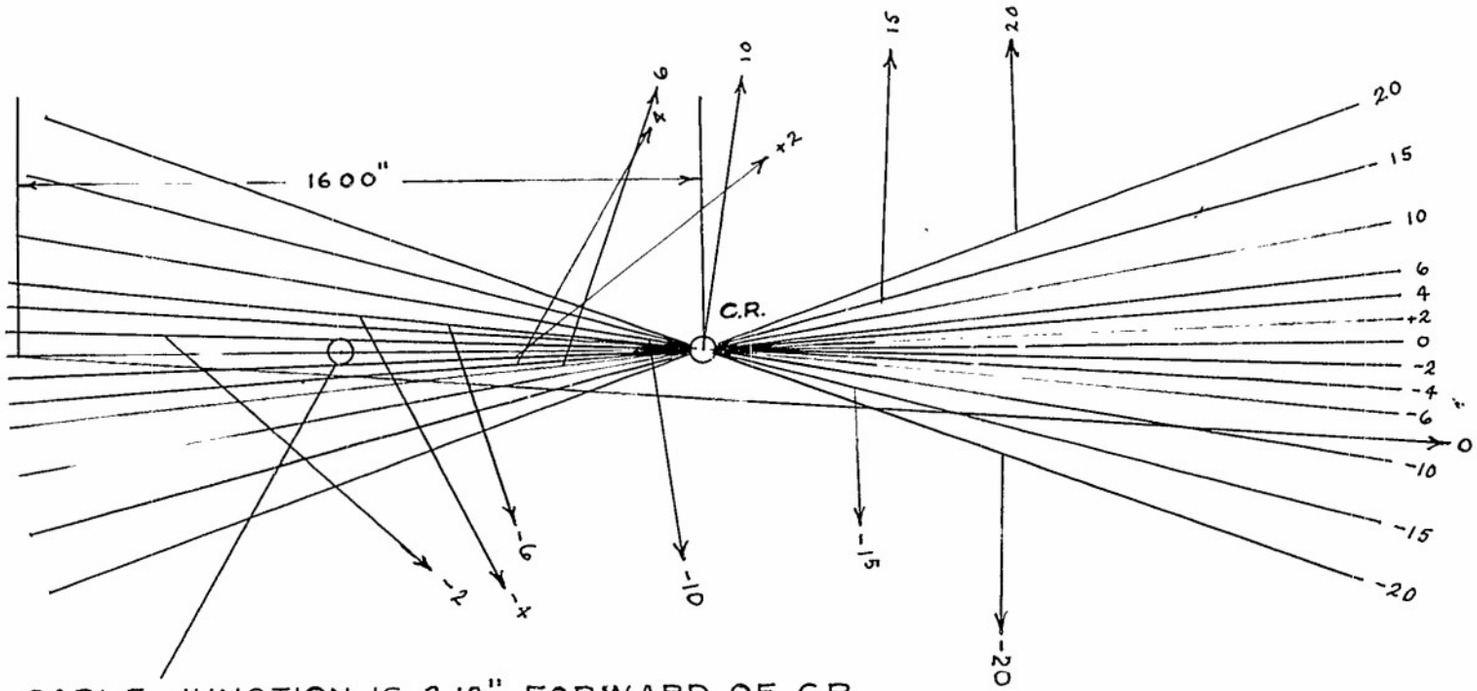
YAWING MOMENT VECTORS AT ZERO DEGREES PITCH

MAT. DIV. DES. BARRAGE BALLOON X41F1365 ∽ 0° HOR. FINS

5 FT. WIND TUNNEL — TEST NO. 317

50 M.P.H. — STANDARD AIR

WRIGHT FIELD — NOVEMBER 4, 1941



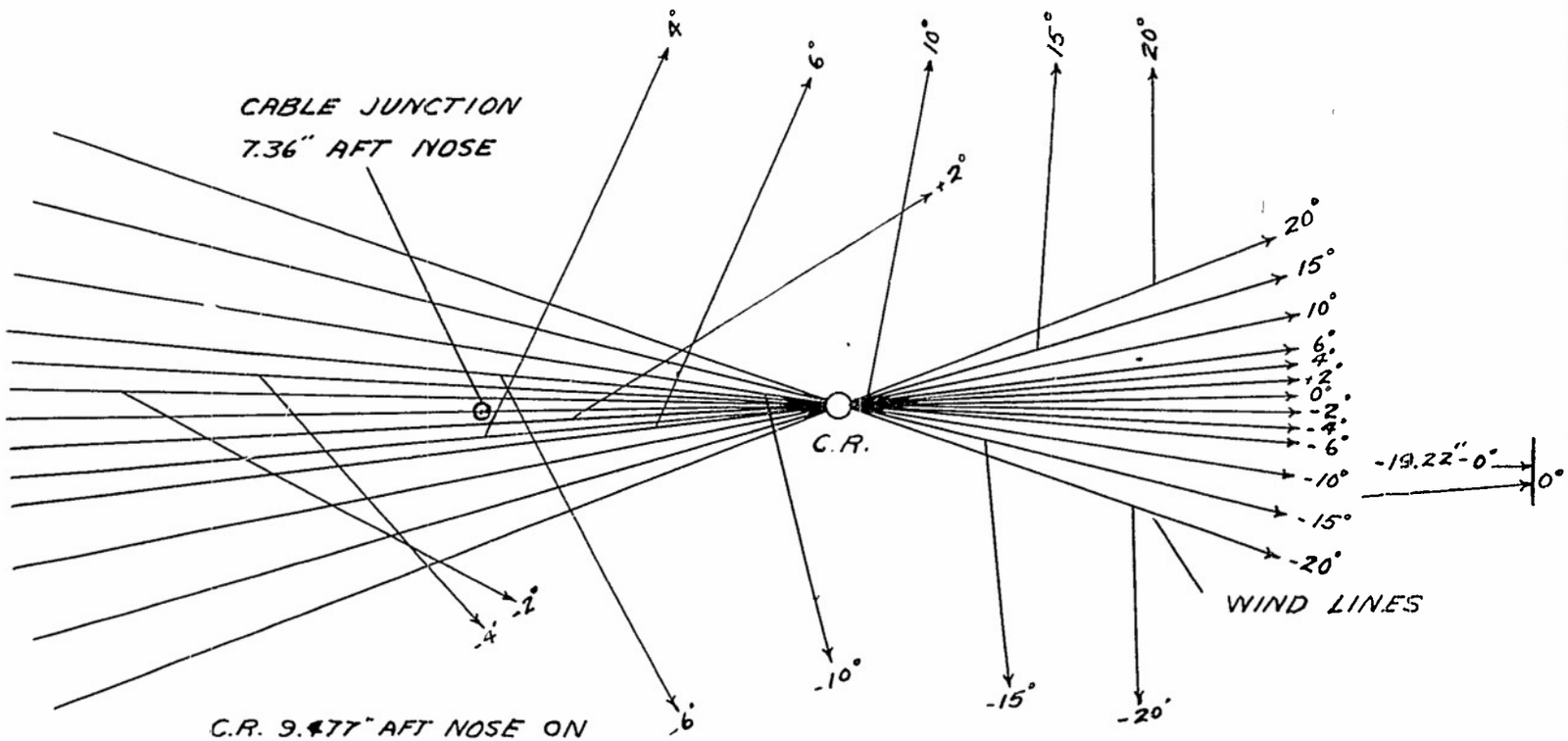

CABLE JUNCTION IS 2.12" FORWARD OF C.R.
AND 10.24" BELOW, PERPENDICULAR TO CENTERLINE

SERIAL No.

PAGE

PLEASE USE THIS SIDE

PLAN VIEW




+ 10° PITCH

MAT. DIV. DES. BARRAGE BALLOON X41F1365

5 FT. WIND TUNNEL TEST NO. 317

50 M.P.H. STANDARD AIR

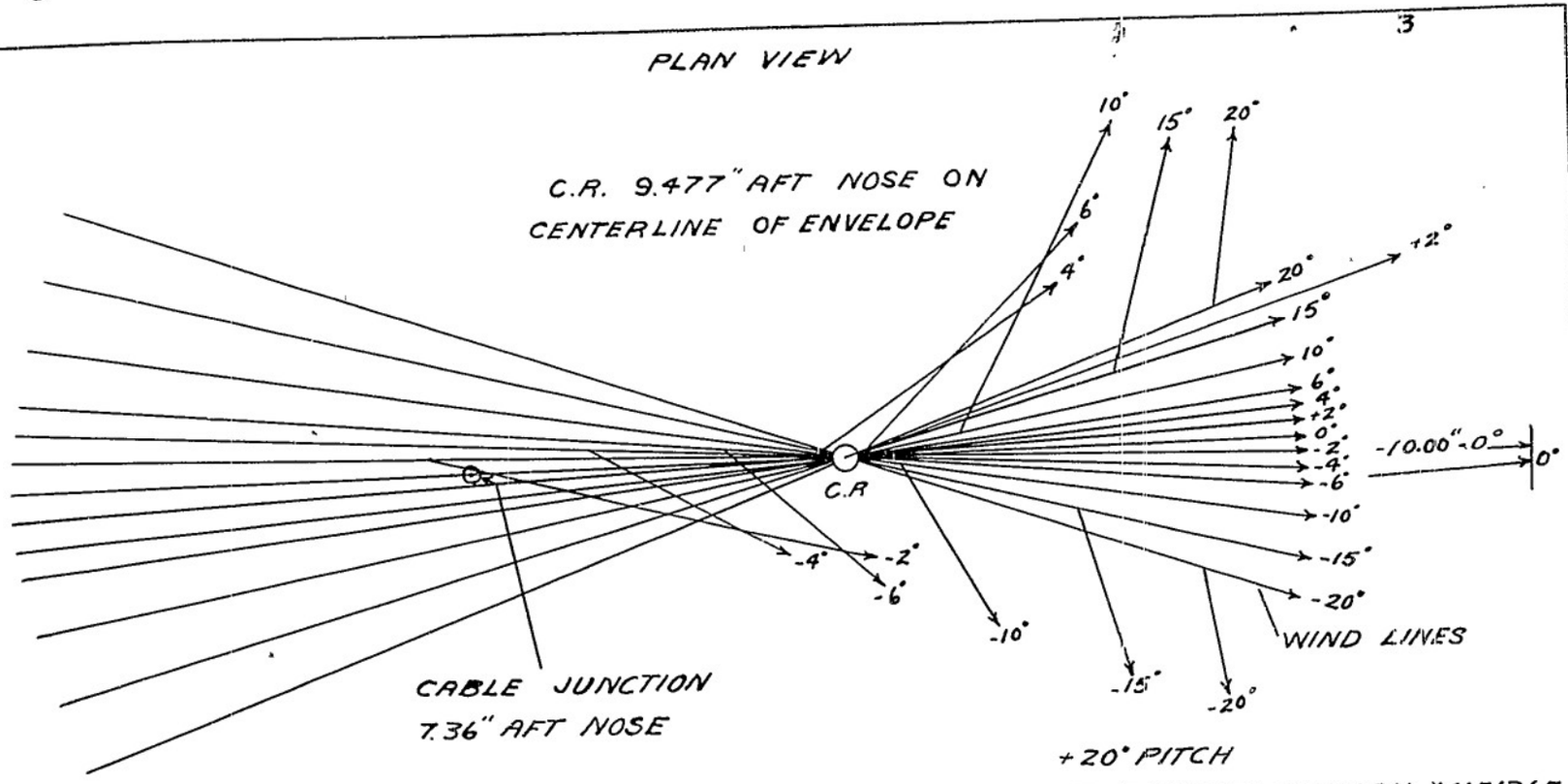
WRIGHT FIELD NOVEMBER 4, 1941

VECTORS NOT DRAWN TO SCALE

SERIAL NO.

PAGE

PLEASE USE THIS SIDE




+20° PITCH

MAT. DIV. DES. BARRAGE BALLOON X41F1365

5FT. WIND TUNNEL TEST NO. 317

50 M.P.H. STANDARD AIR

WRIGHT FIELD NOVEMBER 1, 1941

VECTORS NOT DRAWN TO SCALE

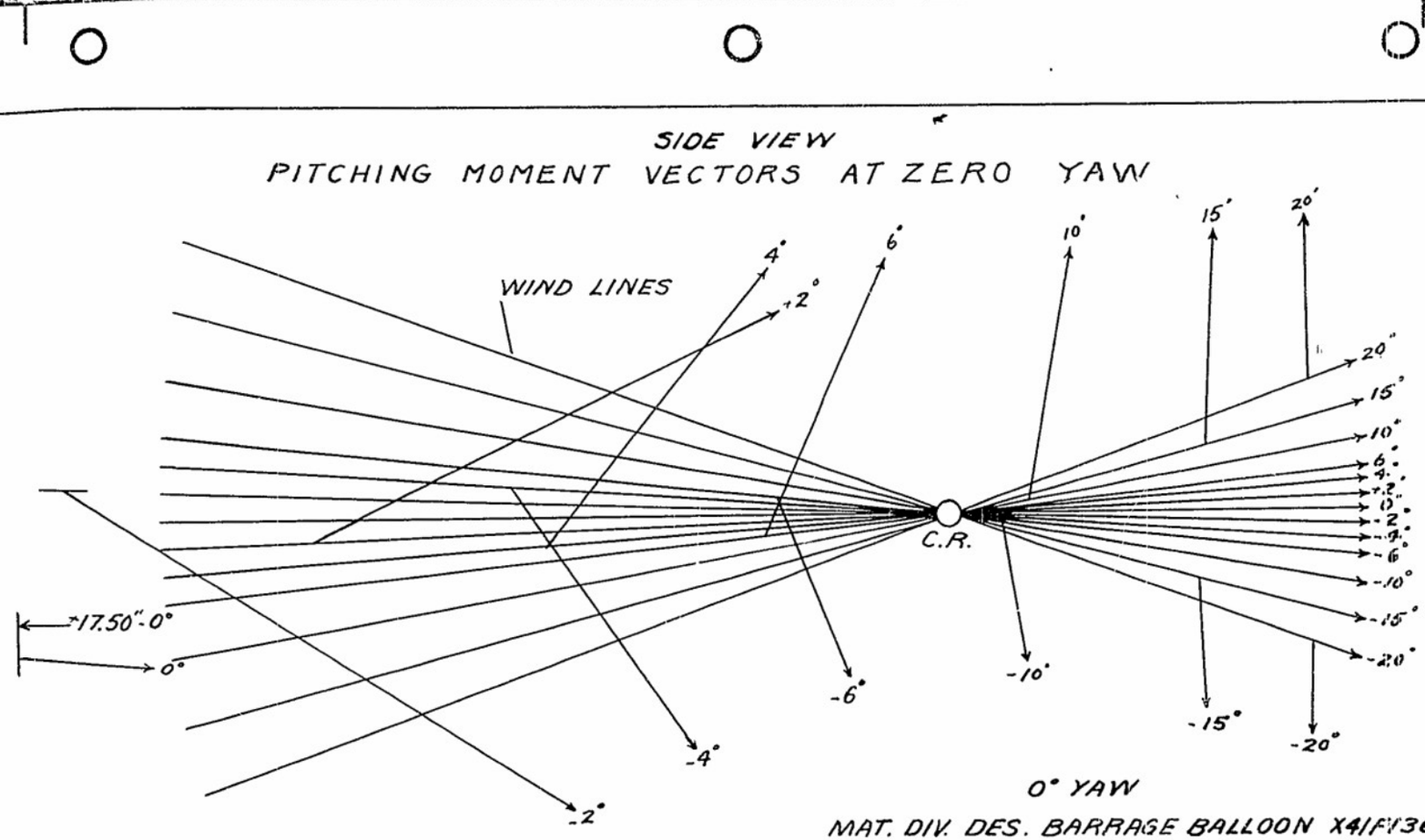
SERIAL No. 7714

PAGE

PLEASE USE THIS SIDE

SIDE VIEW

PITCHING MOMENT VECTORS AT ZERO YAW




0° YAW

MAT. DIV. DES. BARRAGE BALLOON X41F1365

5FT. WIND TUNNEL TEST NO. 317

50 M.P.H. STANDARD AIR

WRIGHT FIELD NOVEMBER 4, 1941

VECTORS NOT DRAWN TO SCALE

C.R. 9.477" AFT NOSE ON CENTERLINE OF ENVELOPE

CABLE JUNCTION 10.24" BELOW CENTERLINE OF ENVELOPE AND 7.36" AFT NOSE

SERIAL NO. 1774

PAGE

PLEASE USE THIS SIDE

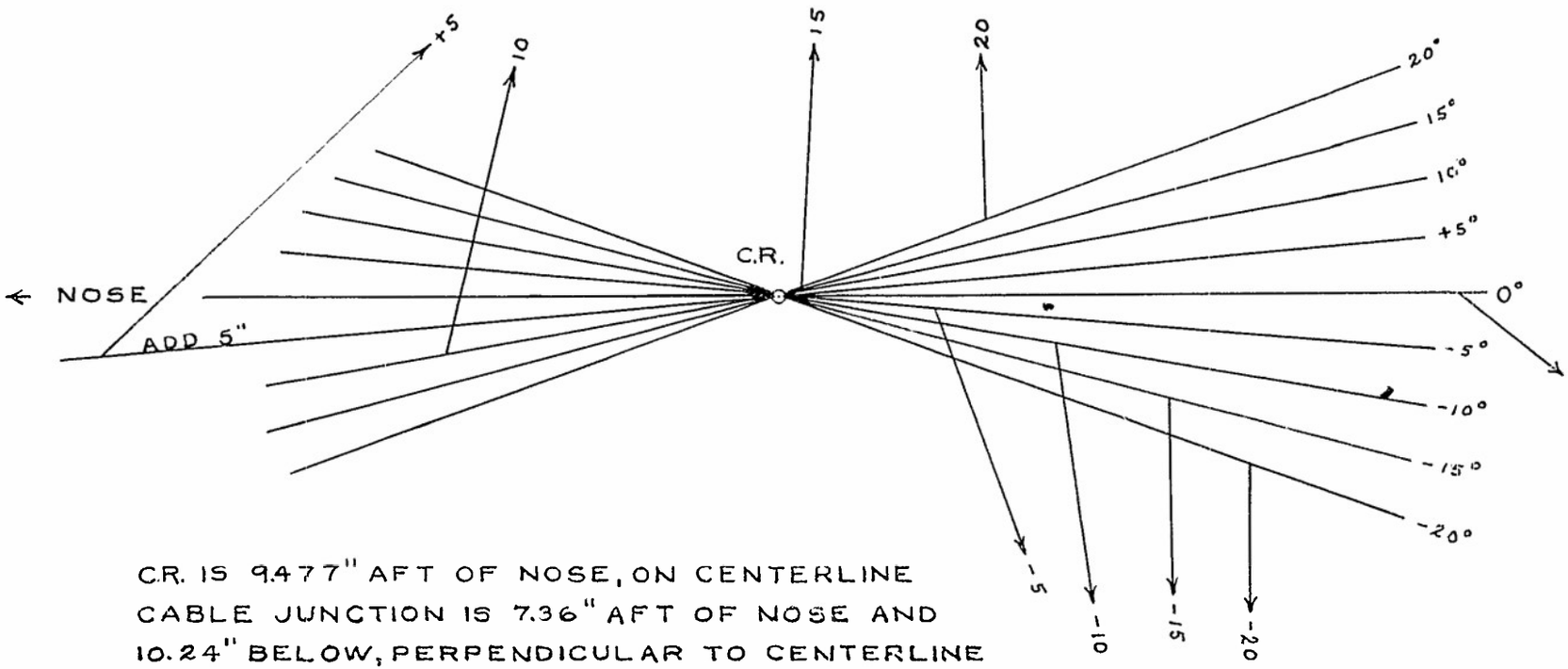
PITCHING MOMENT VECTORS AT ZERO DEGREES YAW

MAT. DIV. DES. BARRAGE BALLOON X41F1365 ~ -3° HOR. FINS

5 FT. WIND TUNNEL — TEST NO. 324

50 M.P.H. — STANDARD AIR

WRIGHT FIELD — DECEMBER 22, 1941




C.R. IS 9.477" AFT OF NOSE, ON CENTERLINE

CABLE JUNCTION IS 7.36" AFT OF NOSE AND

10.24" BELOW, PERPENDICULAR TO CENTERLINE

PLEASE USE THIS SIDE

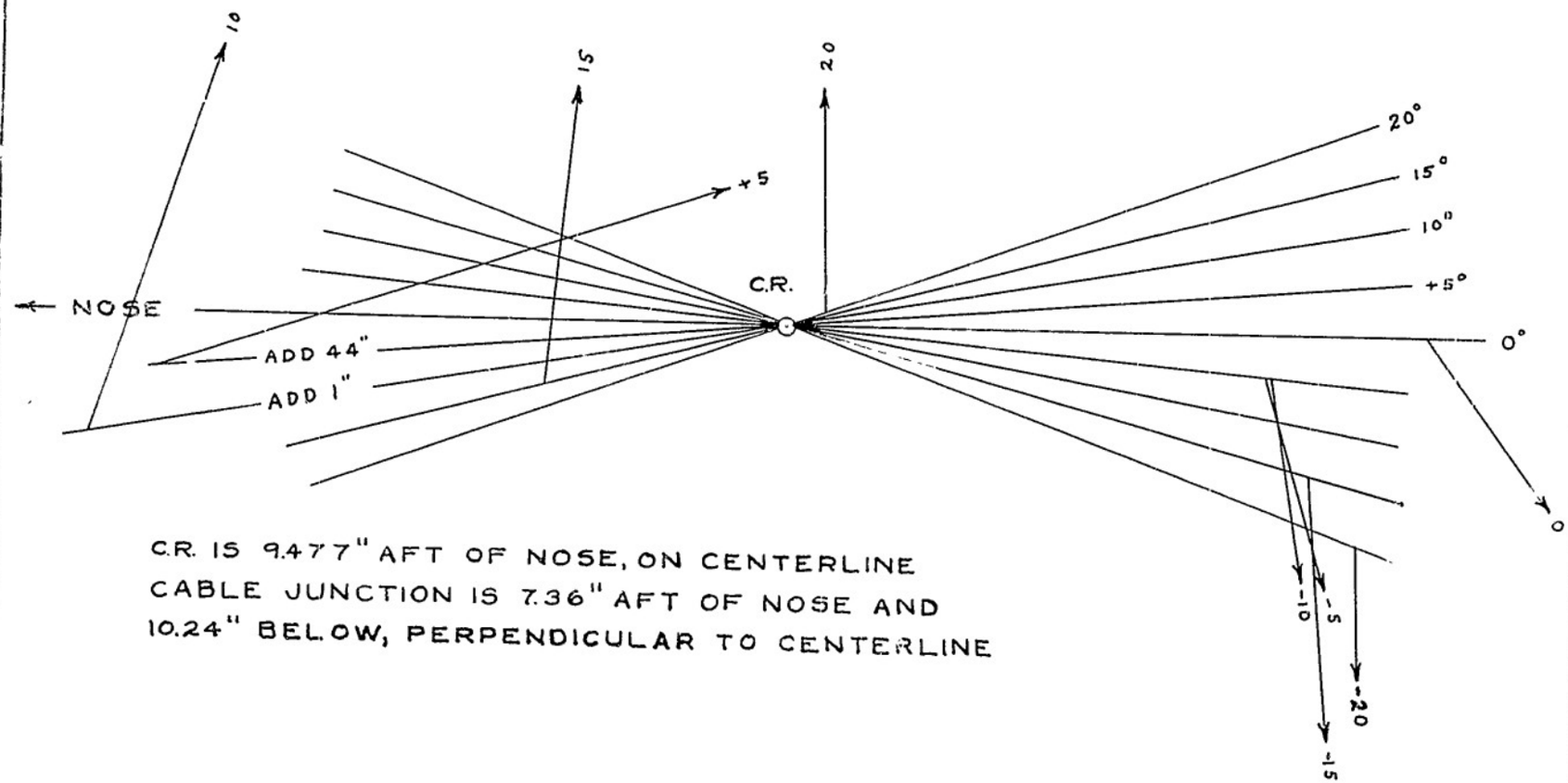
PITCHING MOMENT VECTORS AT ZERO DEGREES YAW

MAT. DIV. DES. BARRAGE BALLOON X41F1365 ∽ -6° HOR. FINS

5 FT. WIND TUNNEL — TEST NO. 324

50 M.P.H. — STANDARD AIR

WRIGHT FIELD — DECEMBER 22, 1941




C.R. IS 9.477" AFT OF NOSE, ON CENTERLINE

CABLE JUNCTION IS 7.36" AFT OF NOSE AND

10.24" BELOW, PERPENDICULAR TO CENTERLINE

SERIAL NO.

PAGE

PITCHING MOMENT VECTORS AT ZERO DEGREES YAW

MAT. DIV. DES. BARRAGE BALLOON X41F1366 S - 3° HOR. FINS

5 FT. WIND TUNNEL

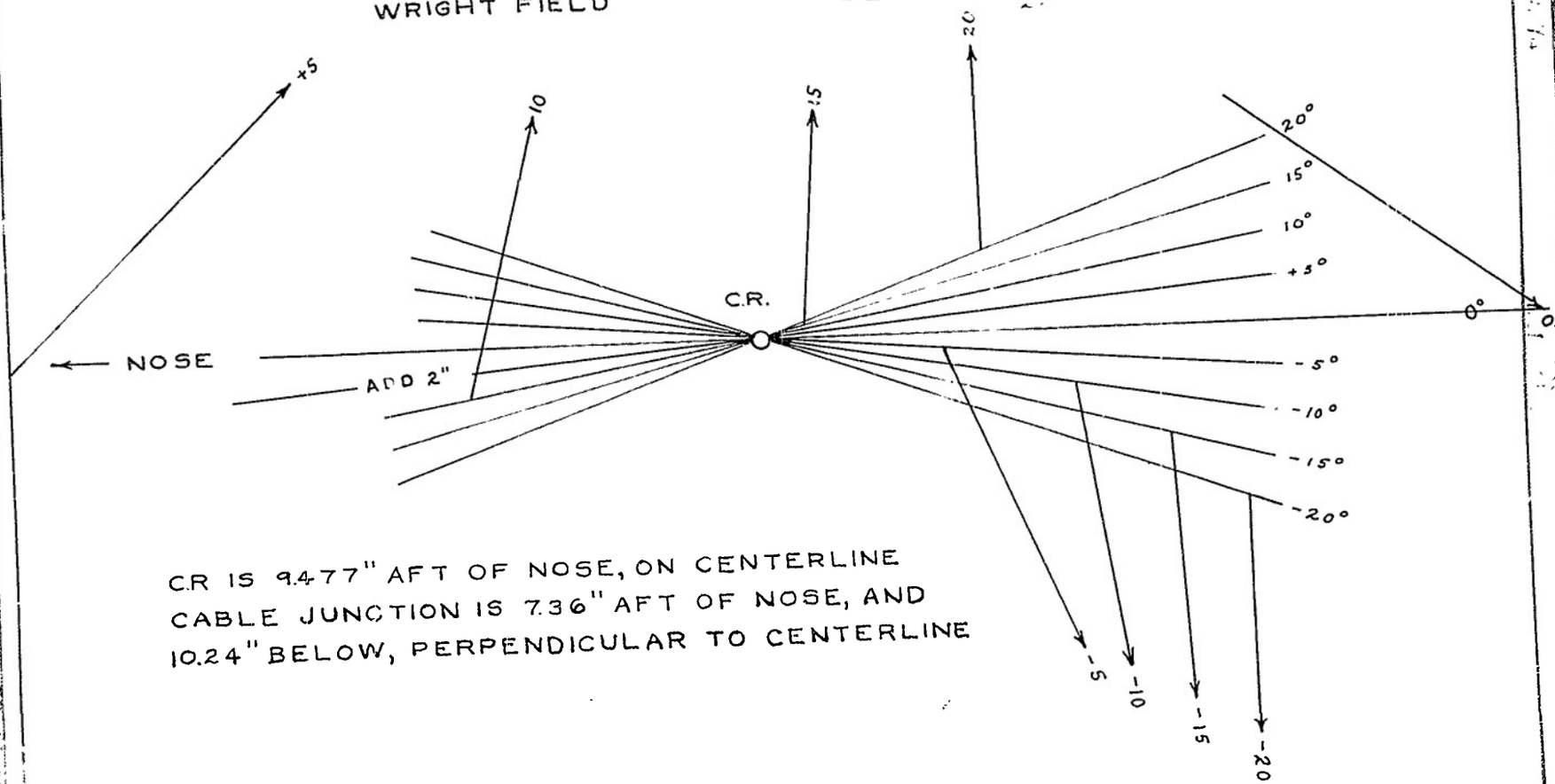
50 M.P.H.

WRIGHT FIELD

TEST NO. 324

STANDARD AIR

DECEMBER 22, 1941




C.R IS 9.477" AFT OF NOSE, ON CENTERLINE

CABLE JUNCTION IS 7.36" AFT OF NOSE, AND

10.24" BELOW, PERPENDICULAR TO CENTERLINE

SERIAL NO.

PAGE

PLEASE USE THIS SIDE

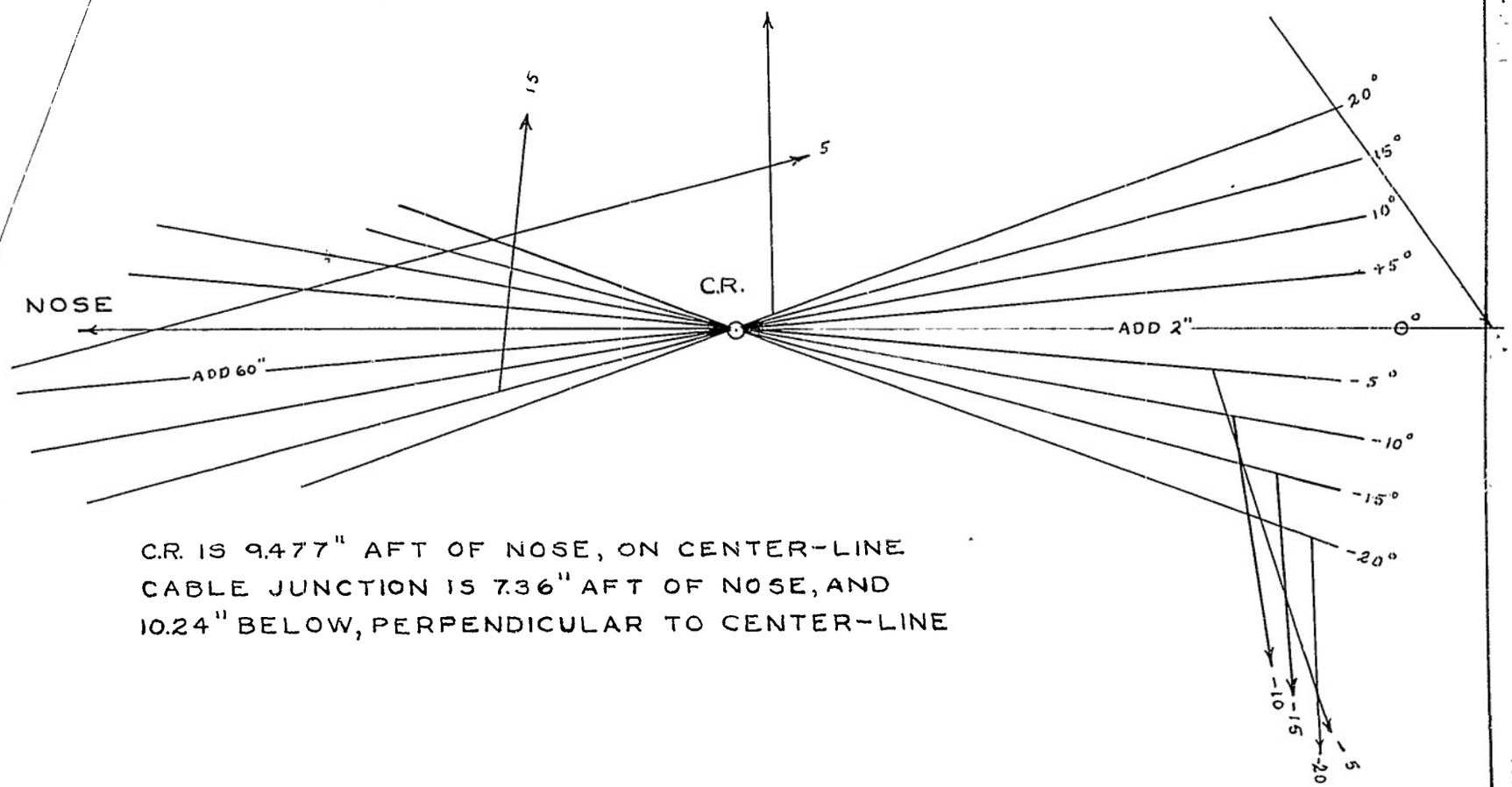
PITCHING MOMENT VECTORS AT ZERO DEGREES YAW

MAT. DIV. DES. BARRAGE BALLOON X41F1366 w-6° HOR. FINS

5 FT. WIND TUNNEL — TEST NO. 324

50 M.P.H. — STANDARD AIR

WRIGHT FIELD — DECEMBER 22, 1941




C.R. IS 9.477" AFT OF NOSE, ON CENTER-LINE

CABLE JUNCTION IS 7.36" AFT OF NOSE, AND

10.24" BELOW, PERPENDICULAR TO CENTER-LINE

SERIAL No.

PAGE

PLEASE USE THIS SIDE

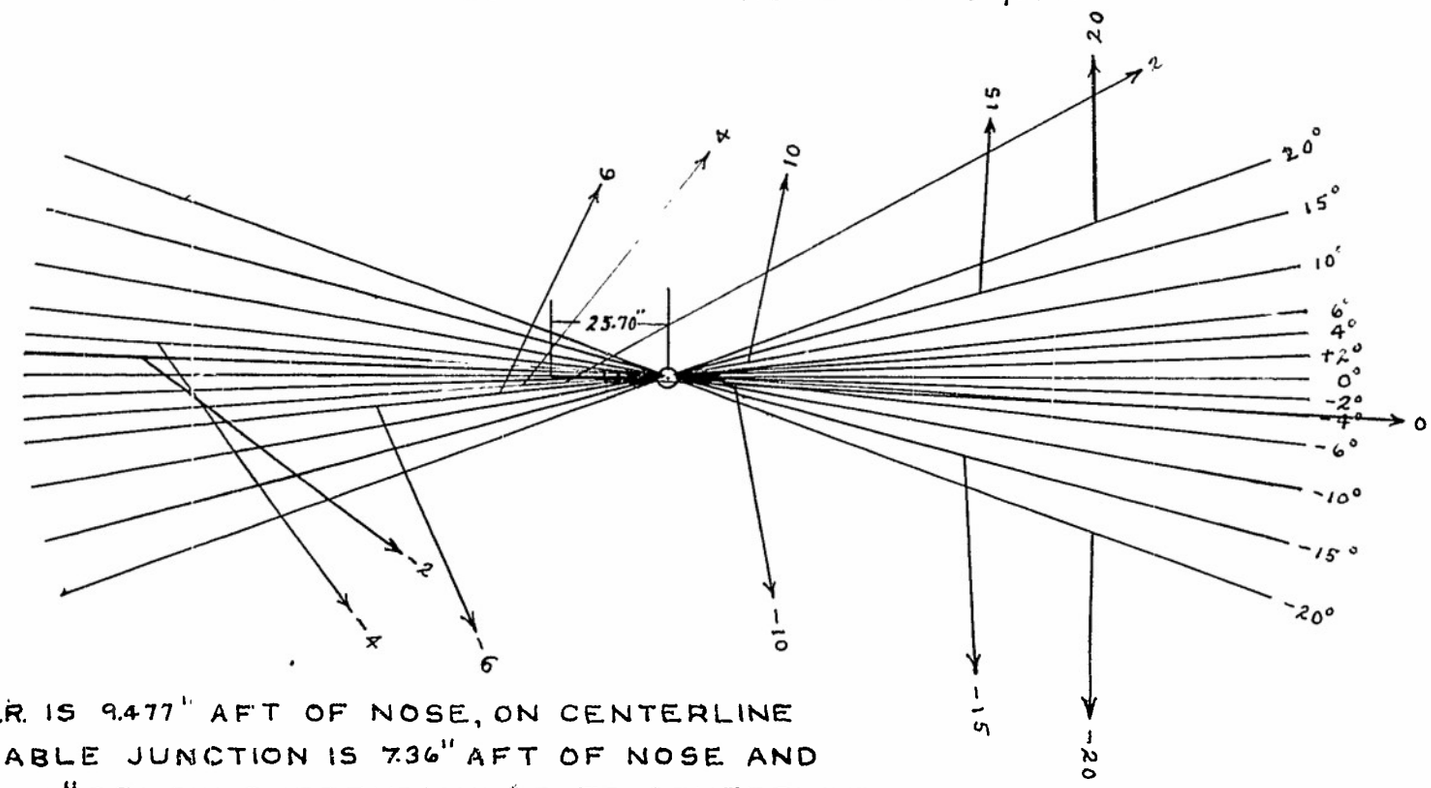
PITCHING MOMENT VECTORS AT ZERO DEGREES YAW

MAT. DIV. DES. BARRAGE BALLOON X41F1366 ∽ 0° HOR. FINS

5 FT. WIND TUNNEL — TEST NO. 324

60 M.P.H. — STANDARD AIR

WRIGHT FIELD — NOVEMBER 3, 1941




C.R. IS 9.477" AFT OF NOSE, ON CENTERLINE

CABLE JUNCTION IS 7.36" AFT OF NOSE AND

10.24" BELOW, PERPENDICULAR TO CENTERLINE

PLEASE SEE THE SIDE

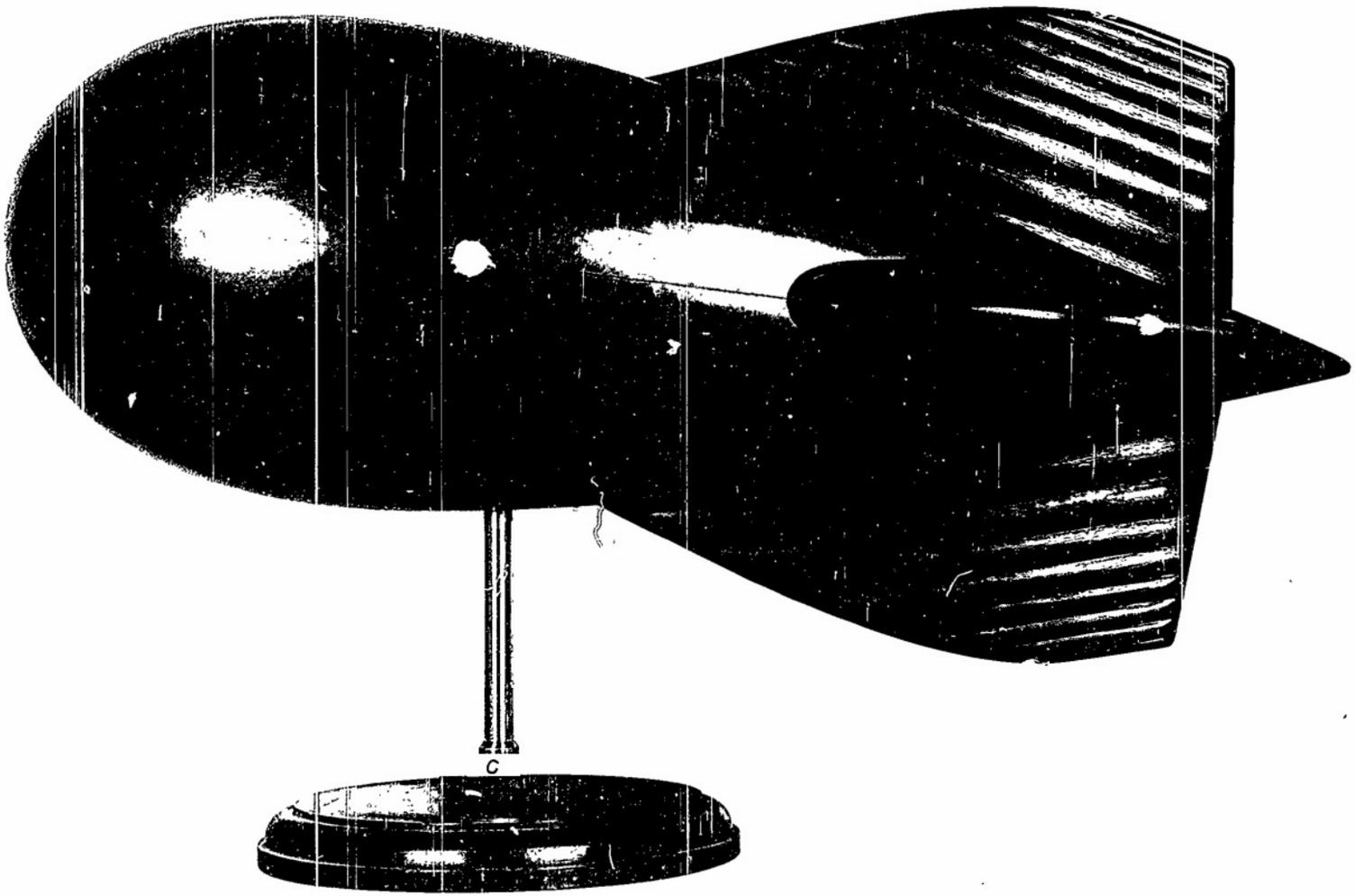
LIST OF PHOTOGRAPHS


| NO. | TITLE |
|---|---|
| 81949 | Top view of Materiel Division Design Barrage Balloon X41F1365, Envelope A |
| 81948 | Side view of Materiel Division Design Barrage Balloon X41F1365, Envelope A |
| 81953 | Top view of Materiel Division Design Barrage Balloon X41F1366, Envelope B |
| 81952 | Side view of Materiel Division Design Barrage Balloon X41F1366, Envelope B |
| 81951 | Top view of Materiel Division Design Barrage Balloon X41F1367, Envelope C |
| 81950 | Side view of Materiel Division Design Barrage Balloon X41F1367, Envelope C |

81648

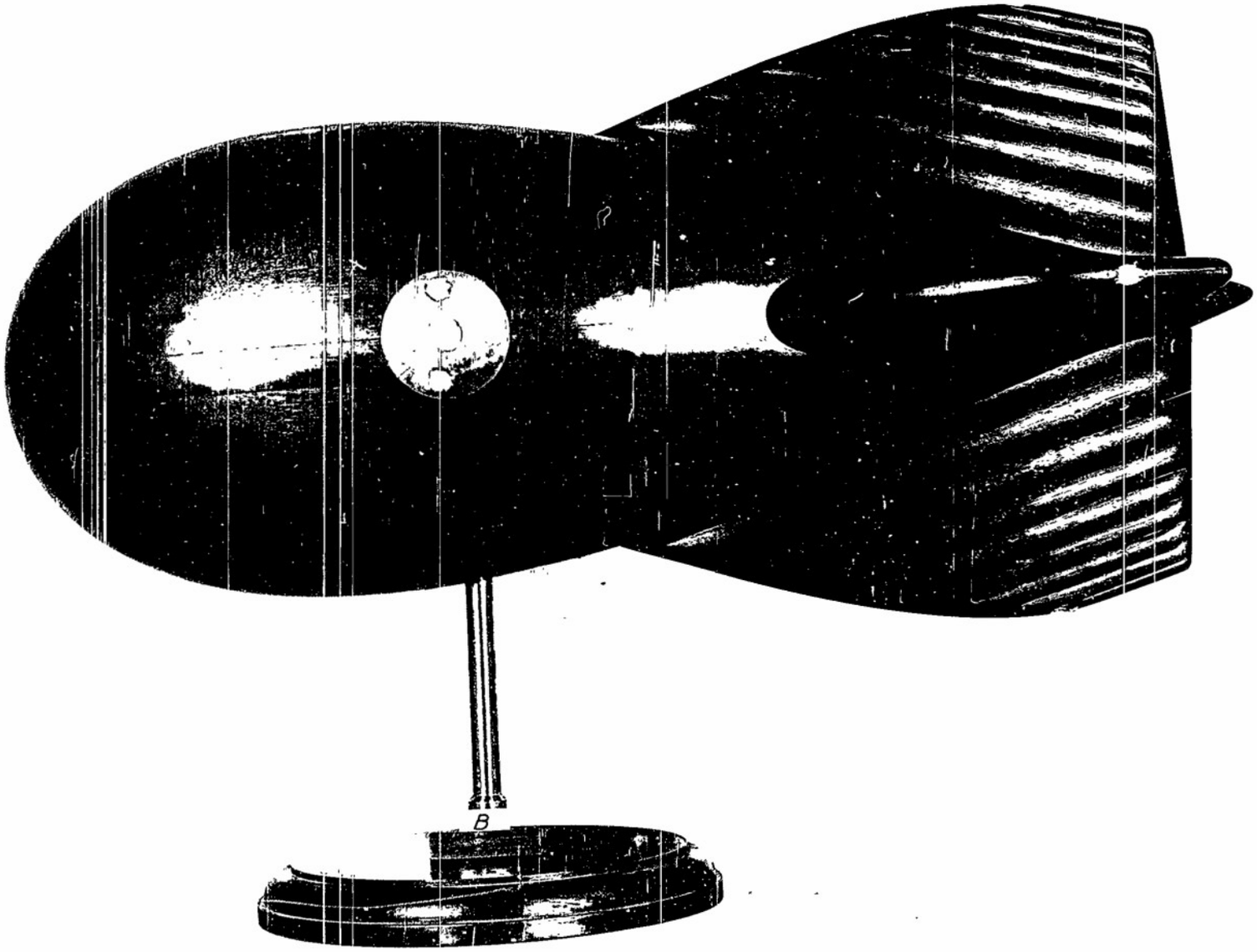
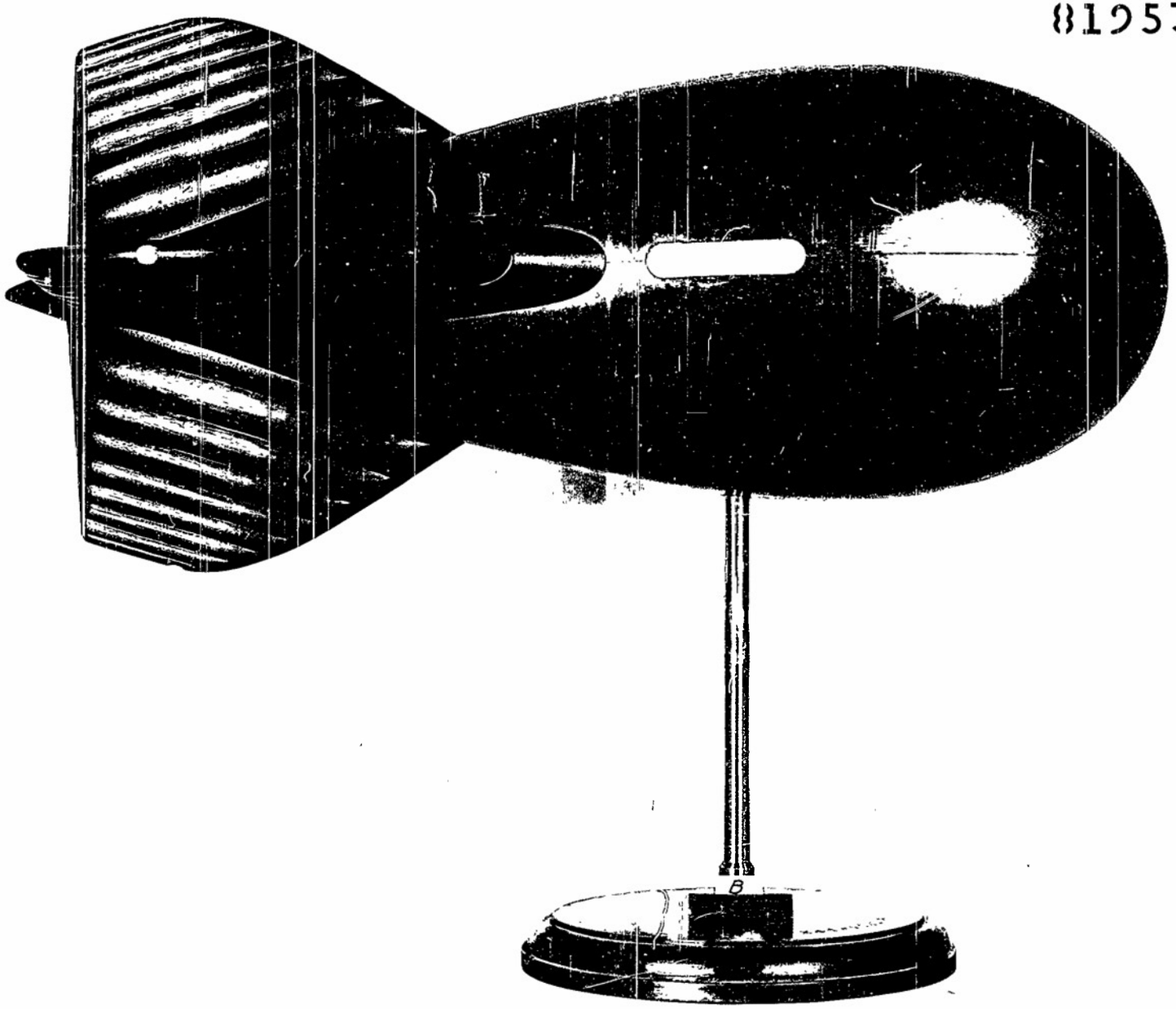
64218

81250



811951

81952



81953