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REPRESENTATIVE OPERATING CHARTS OF PROPELLERS TESTED
IN THE NACA 20-FOOT PROPELLER-RESEARCH TUNNEL

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CASE FILE COPY

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L - 286
Extensive tests of full-scale propellers have been made in the 20-foot propeller-research tunnel (PET) at the Langley Memorial Aeronautical Laboratory during its many years of operation. The results were usually presented in the form of charts showing thrust coefficient, power coefficient, and efficiency, each plotted separately against \( V/nD \). The type of chart now being employed by airplane and propeller manufacturers for performance estimates consists of power coefficients plotted against \( V/nD \) with lines of constant efficiency superimposed. As a result of numerous requests to issue this type of chart directly and on a large scale, the present report has been compiled from data taken from a series of fairly recent reports. Charts are presented only for the conditions considered to be useful in present-day design (see table I), although charts covering other conditions have been developed and are available.

In the preparation of the plots presented, the data were cross-faired and do not necessarily check exactly the previously published data. The power coefficients of all dual-rotating propellers in this report represent the sum of the power coefficients of the front and rear propellers and are for the test conditions in which blade angles of the front and rear propellers were set to absorb approximately equal power at peak efficiency only.

The usual coefficients and symbols have been used and are defined as follows:

- \( C_p \) power coefficient \( \left( \frac{\text{engine power}}{\rho n^3 D^5} \right) \)
- \( C_T \) thrust coefficient \( \left( \frac{\text{effective thrust}}{\rho n^2 D^4} \right) \)
- \( \eta \) propeller efficiency \( \left( \frac{C_T}{C_p} \right) \left( \frac{V}{nD} \right) \)

and

- \( \rho \) mass density of air, slugs per cubic foot
<table>
<thead>
<tr>
<th>Figure</th>
<th>Blade activity factor</th>
<th>Number of blades</th>
<th>Rotation</th>
<th>Propeller location</th>
<th>Body configuration</th>
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Blade design, Hamilton Standard 3156-6 and 3156-6

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THREE-BLADE PROPELLER
RADIAL ENGINE NACELLE
WITHOUT WING

TEN-FOOT PROPELLER 596B-9
TESTED AT HP4, NACA, FEB. 1937.
SEE NACA REP. NO. 662.
Fig. 2

THREE-BLADE PROPELLER LIQUID-COOLED ENGINE NACELLE WITHOUT WING

TEN-FOOT PROPELLER 5668-9
TESTED AT PRT, NACA, FEB., 1937
SEE NACA REP. NO. 658
Figure 3

Two-blade tractor propeller in front hub without wing.

TEN-FOOT PROPELLE 3159-6
SEE NACA A-0-8.
FULL-SCALE TESTS OF SEVERAL
PROPELLERS EQUIPPED WITH SPINNERS,
STIFFS, AIRFOIL AND ROUND SHANKS,
AND NACA 16-SERIES SECTIONS BY
GERHARDT, HARTMAN, AND PEPPER,
OCT. 1950.

\[ \frac{C_p}{n} \text{ vs. } \frac{V}{nD} \]

\[ \text{Angle } \theta = 0 \text{ to } 90^\circ \]

\[ \text{Airfoil } \text{ and } \text{Round Shank} \]
Fig. 9

EIGHT-BLADE DUAL-ROTATING TRACTOR PROPELLER WITH WING

TEN-FOOT PROPellers 3155-6 & 3156-6
TESTED AT PRT, NACA, APRIL 1961.
SEE NACA A.R. 8
WIND-TUNNEL TESTS OF EIGHT-BLADE SINGLE- AND DUAL-ROTATING PROPellers
IN THE TRACTOR POSITION BY BIEHMANN AND GRAY, NOV. 1961.

\[ \frac{C_p}{V/n D} \]

\[ \theta \text{ in percent} \]
NACA 2.0 10

TEN-FOOT PROPELLER 5-95-6
TESTED AT PRT, NACA, JAN. 1934
SEE NACA A. P. 6
*WIND-TUNNEL TESTS OF SINGLE-
AND DUAL-ROTATING PUSHER PRO-
PELLERS HAVING FROM TWO TO
EIGHT BLADES* BY BIERMANN AND
GRAY, FEB. 1942.

THREE-BLADE
PUSHER PROPELLER
WITHOUT WING

Fig. 10
FOUR-BLADE SINGLE-ROTATING FUSHER PROPELLER WITHOUT RING

TEN-FOOT PROPELLER 5155-6
TESTED AT NACA, JAN. 1941.
SEE NACA N.R.

*WIND-TUNNEL TESTS OF SINGLE- AND DUAL-ROTATING FUSHER PROPELLERS HAVING FROM TWO TO EIGHT BLADES BY BIERMANN AND GRAY*,
FEB. 1942.
TEN-FOOT PROPELLERS 3155-6 & 3156-6
TESTED AT NACA, JAN. 1941.
SEE NACA A-156.
WIND-TUNNEL TESTS OF SINGLE- AND
DUAL-ROTATING PUSHER PROPELLERS
HAVING FROM TWO TO EIGHT BLADES*
BY BIERNACKI AND GRAY, FEB. 1952.
Fig. 13

EIGHT-BLADE DUAL-ROTATING PUSHER PROPELLER WITHOUT WING


\[ \text{C}_p \] vs \[ V/nd \]
THREE WIDE BLADES IN REAR HUB TRACTOR PROPELLER WITH WING

TEN-FOOT PROPELLER 5195.6.15
TESTED AT 001, NACA, FEB. 1922.
SEE NACA A.R.R.
WIND-TUNNEL TESTS OF SINGLE-
AND DUAL-ROTATING TRACTOR PRO-
PELLERS OF LARGE BLADE WIDTH
BY BERMANN, GRAY, AND MAYNARD,
SEP. 1922.
Fig. 15

FOUR WIDE BLADES IN REAR HUB
TRACTOR PROPELLER
WITH WING

TEN-FOOT PROPELLER 3193-6-10
TESTED AT NPS, NACA, FEB. 1942.
WIND-TUNNEL TESTS OF SIMPLE
AND DUAL-ROTATING TRACTOR PRO-
PELLERS OF LARGE BLADE WIDTH
BY BIERMANN, GRAY, AND MAYNARD,
SEPT. 1942.
Fig. 17

TEN-FOOT PROPELLERS 3156-6-1.5
3156-6-1.5
TESTED AT NACA, JAN., FEB. 1932.
SEE NACA A.1.8.8
WIND-TUNNEL TESTS OF SINGLE-
AND DUAL-ROTATING TRACTOR PRO-
PELLERS OF LARGE BLADE WIDTH
BY BIERMANN, GRAY, AND WAYNARD,
SEPT. 1932.

V/n D

Cp

-1.0 percent