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TECHNICAL NOTES

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No. 292

THE DRAG OF A J-5 RADIAL AIR-COOLED ENGINE

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Summary

This note describes tests of the drag due to a Wright "Whirlwind" (J-5) radial air-cooled engine mounted on a cabin type airplane. The tests were made in the 20-foot Propeller Research Tunnel of the National Advisory Committee for Aeronautics. The drag was obtained with three different types of exhaust stacks: short individual stacks, a circular cross section collector ring, and a streamline cross section collector ring. The drag due to the engine was found to be 85 pounds at 100 M.P.H. with the individual stacks, and 83 pounds at 100 M.P.H. with each of the collector rings.

Tests

At the present time there is considerable interest in the drag due to radial air-cooled engines. In connection with an investigation in the 20-foot Propeller Research Tunnel (Reference 1) on the cowling of air-cooled engines, in which a Wright "Whirlwind" (J-5) engine was mounted on a cabin fuselage, it was found convenient to obtain the drag due to the engine. This was

done with three different types of exhaust stacks.

The engine with individual exhaust stacks, 1-3/4 inches in diameter and about 5 inches long, in shown in Figure 1, mounted on the cabin fuselage in the experiment chamber of the Propeller Research Tunnel. The fuselage was 48 inches by 64 inches at the maximum cross section, and the cowling ended at the mounting ring, leaving the engine practically entirely exposed. A landing gear, and a stub wing of 7 ft. chord and 16 ft. span having the Göttingen 398 profile, were attached to the fuselage.

Figure 2 shows the engine fitted with an exhaust collector ring of 36 in. mean diameter. This ring had a circular cross section 3 in. in diameter, the exhaust from all nine cylinders coming out on the left side.

In Figure 3, a streamline section exhaust collector ring is shown on the engine. This was similar to the circular section ring in all respects excepting the cross sectional shape, which was of streamline form, 2 in. wide and 5 in. long. Both rings had approximately the same cross sectional area.

The drag of the installation (without a propeller) was measured with each of the three exhaust systems, at air velocities from 60 to 100 M.P.H. The drag was also measured throughout the same range with the engine removed and the nose rounded as shown in Figure 4.

The observed drag readings for all four conditions are plotted against dynamic pressure and velocity in M.P.H. in Figure 5.

The difference between the drag without engine and the drag with engine represents the drag due to the engine.

There was a noticeable scale effect within the range of speeds used. The results, which are tabulated below, are therefore given for both 60 and 100 M.P.H.

Increase in Drag Due to Engine

60 M.P.H.

	Drag	$\frac{D}{q}$	Equivalent Flat Plate Area
With individual stacks	33 lb.	3.61	2.86 sq.ft.
With round section collector ring	31 "	3.39	2.68 "
With streamline section collector ring	31 "	3.39	2.68 "

100 M.P.H.

	Drag	$\frac{D}{q}$	Equivalent Flat Plate Area
With individual stacks	85 lb.	3.32	2.66 sq.ft.
With round section collector ring	83 "	3.24	2.60 "
With streamline section collector ring	83 "	3.24	2.60 "

The results show that the drag was slightly less with either the round or streamline collector rings than with the short individual stacks, which at first thought may appear surprising. It is also rather surprising to find that the streamline col-

lector ring, although having a fair strut section and only two-thirds the projected area of the round section ring, had the same drag. However, both rings are in a position behind the engine where they apparently affect the drag very little one way or another. The individual stacks, which are nearly normal to the air flow at the outer portion of the cylinders, evidently increase the drag slightly.

Reference

1. Weick, Fred E. and Wood, Donald H. : The Twenty-Foot Propeller Research Tunnel of the National Advisory Committee for Aeronautics. N.A.C.A. Technical Report No. 300. (1928)

Langley Field, Virginia,

July 9, 1928.

Fig.1 Airplane and engine with individual exhaust stacks

Fig.2 Circular section ring

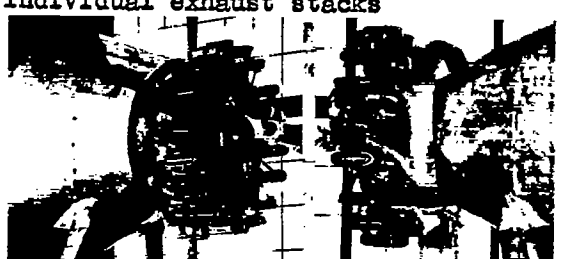

Fig.3 Streamline section ring

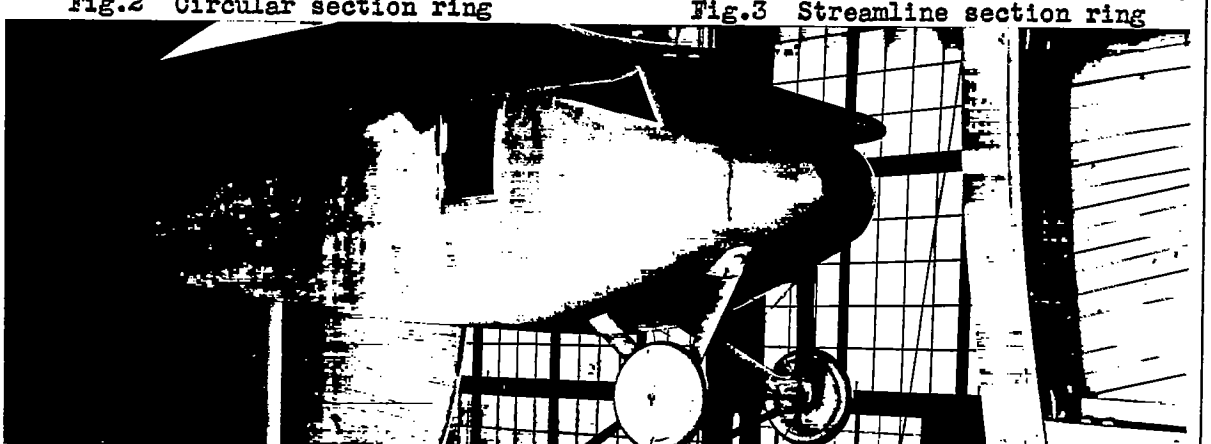

Fig.4 Engine removed and nose rounded

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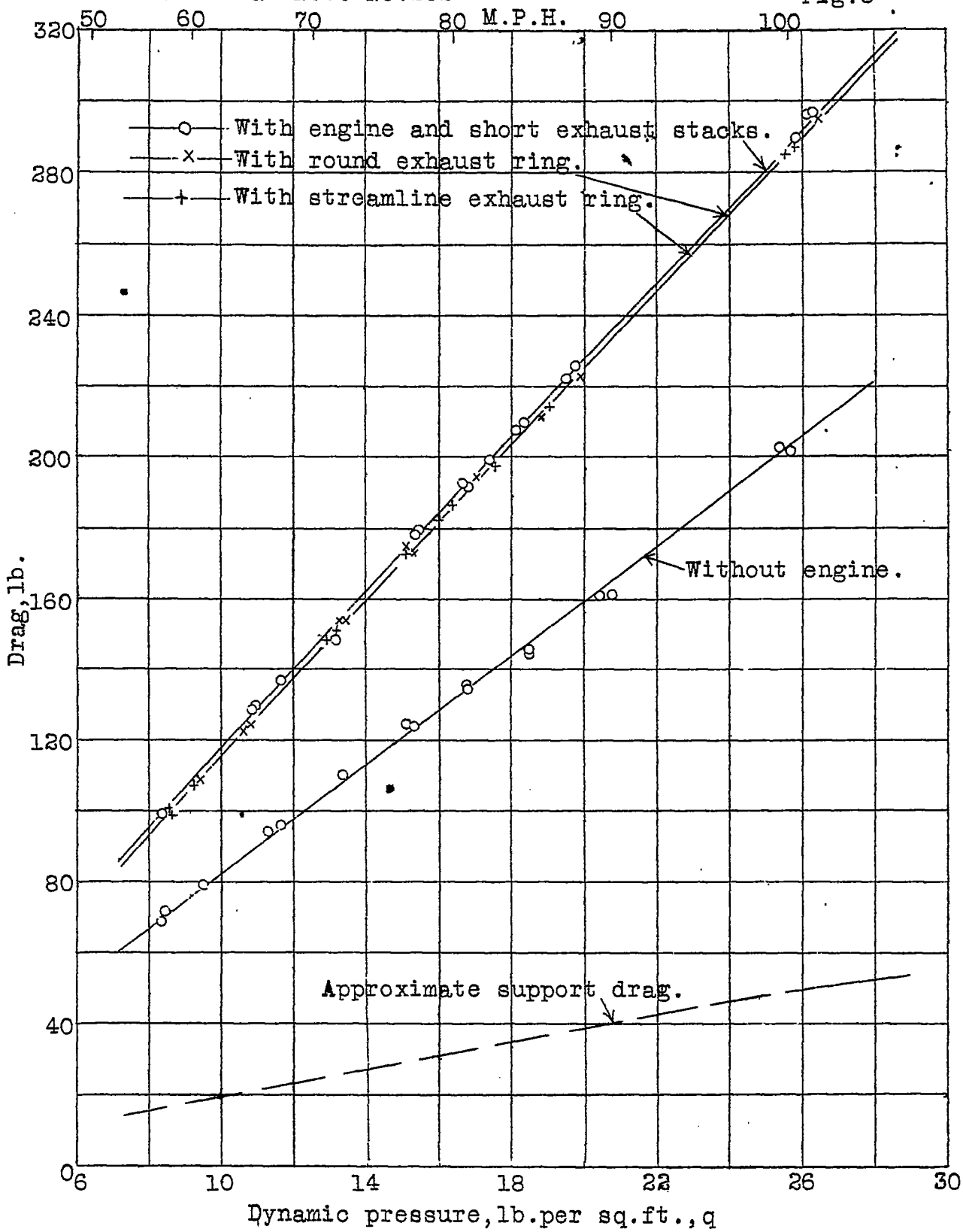

Fig.5 Observed drag.