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9 TECHNICAL NOTE, WCLP 54-210

6 THEORETICAL AIR HORSEPOWER AVAILABLE FROM A  
NON-DUCTED WINDMILL TYPE RAM AIR TURBINE.

10 W. C. BROWN  
POWER PLANT LABORATORY

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Page 1 of 4 pages

TECHNICAL NOTE WCLP 54-210  
23 November 1954

Power Plant Laboratory  
Directorate of Laboratories

THEORETICAL AIR HORSEPOWER AVAILABLE FROM A  
NON-DUCTED WINDMILL TYPE RAM AIR TURBINE

A. PURPOSE.

1. To report on a graphical means of estimating theoretical air horsepower available from a non-ducted windmill type ram air turbine at various given conditions of altitude and velocity.

B. FACTUAL DATA.

2. Portions of a Hydro-Aire document relative to McDonnell specification 25-69012 were used as a basis for calculations resulting in curves included in Exhibit "A."

3. The curves were derived from a basic equation using an Army Summer Standard Day and a wheel diameter of 12 inches to obtain various values.

4. The basic equation used was  $AHP = \frac{\pi D^2 V^3 \gamma}{4400 g}$ , where  $D$  = wheel diameter in feet,  $V$  = velocity in feet per second,  $\gamma$  = air density in pounds per cubic foot, and  $g$  = acceleration of gravity. This equation was modified to contain velocity in knots, and density in pounds per cubic foot, with  $D$  and  $g$  as constants for a given 12 inch wheel. The simplified equation is:  $AHP = 0.000107 V^3 \gamma$ , from which curves were directly plotted. (In this equation  $V$  is in knots.)

5. To obtain air horsepower available under a certain condition for other than a 12 inch wheel, the value read from the graph should be multiplied by the ratio  $(D'/12)^2$  where  $D'$  = diameter of wheel in question.

C. CONCLUSIONS.

6. It is concluded, after checking several such actual units, that this information is relatively reliable.

*A graphical method is presented*

TECHNICAL NOTE WCLP 54-210  
23 November 1954

D. RECOMMENDATIONS.

7. It is recommended that this information be used for the purpose of estimating air horsepower available from a non-ducted windmill type ram air turbine.

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PUBLICATION REVIEW

This report has been reviewed and is approved.

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for NORMAN C. APPOLD  
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