STEVENS INSTITUTE OF TECHNOLOGY
DAVIDSON LABORATORY
CASTLE POINT STATION
HOBOKEN, NEW JERSEY

Quarterly Progress Report

Period: 1 January to 1 April 1967

HYDROPLANING OF AIRCRAFT TIRES

NASA Contract NSR ~~31003016~~ 31-003-016
DL Project 477

OBJECTIVE

To make a systematic experimental study of the various parameters affecting hydroplaning of aircraft tires, and to seek a quantitative theoretical description of the hydroplaning phenomenon.

WORK COMPLETED DURING THE PERIOD 1 January 1967 to 1 April 1967

An investigation has been made to establish a suitable flexible coating to eliminate entrainment of water in the open cellular structure of polyurethane tires. Such a coating exhibiting imperviousness to water, high flexture and wear resistance has been found. Preliminary data has indicated no appreciable alteration in deflection of the model tires to be employed in actual hydroplaning tests.

In keeping with the primary objective to verify the basic experimental approach via measurement of hydroplaning inception speed as a function of tire loading and geometry, a test procedure has been decided upon and is herewith presented.

By application of conventional techniques of dimensional analysis, the variables considered to be of importance in describing the dynamic hydroplaning phenomenon may be reduced to the following dimensionless groups:

$$\left(V/\omega D,\ \frac{h}{D},\ \frac{w}{D},\ \frac{\rho D^2 V^2}{L},\ \frac{\delta}{D}\right)$$

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where L = vertical load on tire

ω = angular velocity of tire

h = water thickness

V = water and road velocity

ρ = density of water

D = tire diameter

w = tire width

δ = tire deflection

Since primary concern is placed upon the critical speed of hydroplaning (V_{cr}), i.e., the speed where $\omega = 0$, the parameter $V/\omega D$ is no longer a variable of interest. Considering the dimensionless group $\frac{\rho D^2 V_{cr}^2}{L}$ as the dependent variable, we may therefore write

$$\frac{\rho D^2 (V_{cr})^2}{L} = f\left(\frac{h}{D}, \frac{w}{D}, \frac{\delta}{D}\right)$$

The experiment will consist of an investigation of the effects of each of the independent variables $\frac{h}{D}$, $\frac{w}{D}$, and $\frac{\delta}{D}$ on the "critical dynamic hydroplaning parameter," $\frac{\rho D^2 (V_{cr})^2}{L}$. Table 1 illustrates the design of the test program in terms of a sample data sheet; Figures 1-4 illustrate how the model tire load-deflection data is used to determine the loads necessary to achieve given δ/D values.

Preliminary testing is currently underway. Once all "bugs" have been ironed out of the test procedures and apparatus, NASA representatives will be invited to observe the system.

PLANS FOR THE QUARTER 1 April 1967 to 1 July 1967

Testing will be completed.

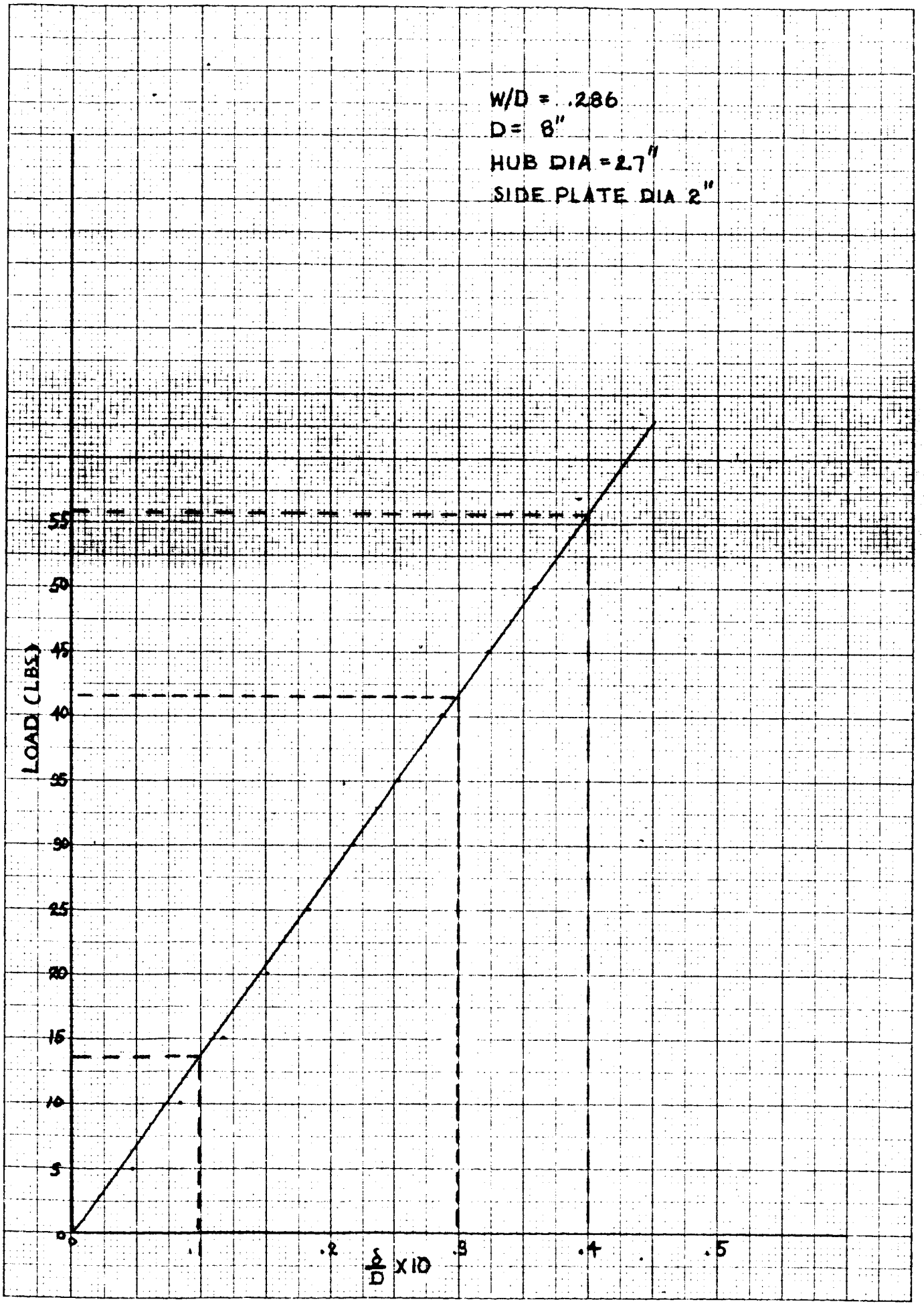
A request will be made to NASA for a no-additional-cost time extension of three months to complete data handling, compile the results, and prepare a final technical report.

TABLE 1

Typical Data Sheet

L Load	δ/D	W	W/D	h_1/D	V_{c_r}	h_2/D	V_{c_r}	h_3/D	V_{c_r}	h_4/D	V_{c_r}
L_1	δ_1/D										
L_2	δ_2/D		.668								
L_3	δ_3/D										
L_4	δ_1/D										
L_5	δ_2/D		.400								
L_6	δ_3/D			CONSTANT		CONSTANT		CONSTANT		CONSTANT	
L_7	δ_1/D										
L_8	δ_2/D		.285								
L_9	δ_3/D										
L_{10}	δ_1/D										
L_{11}	δ_2/D		.222								
L_{12}	δ_3/D										

FIG. 1



K+E 10 X 10 TO ½ INCH 46 1326
7 X 10 IN. • ALBANENE
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FIG. 2

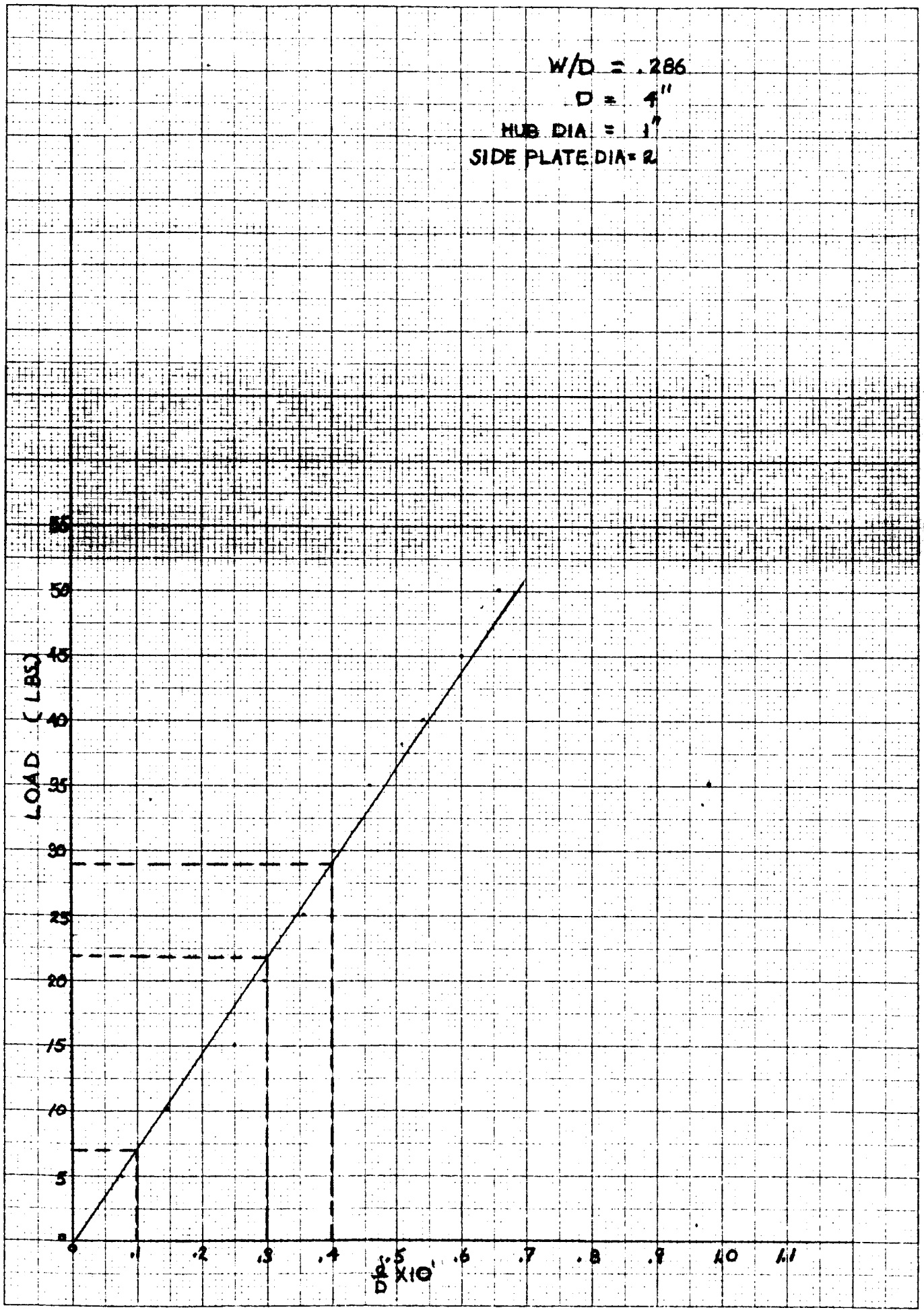

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FIG. 3

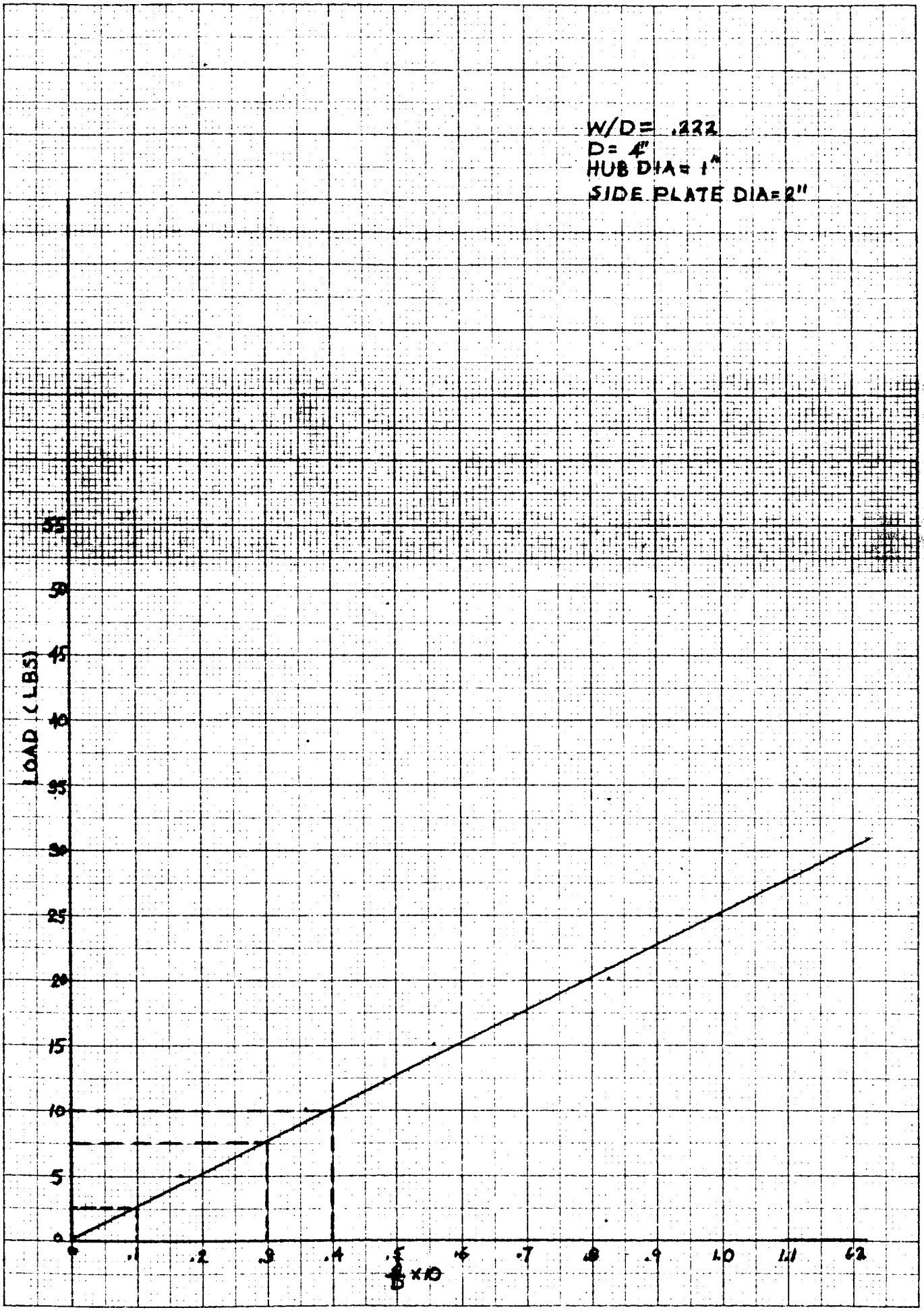

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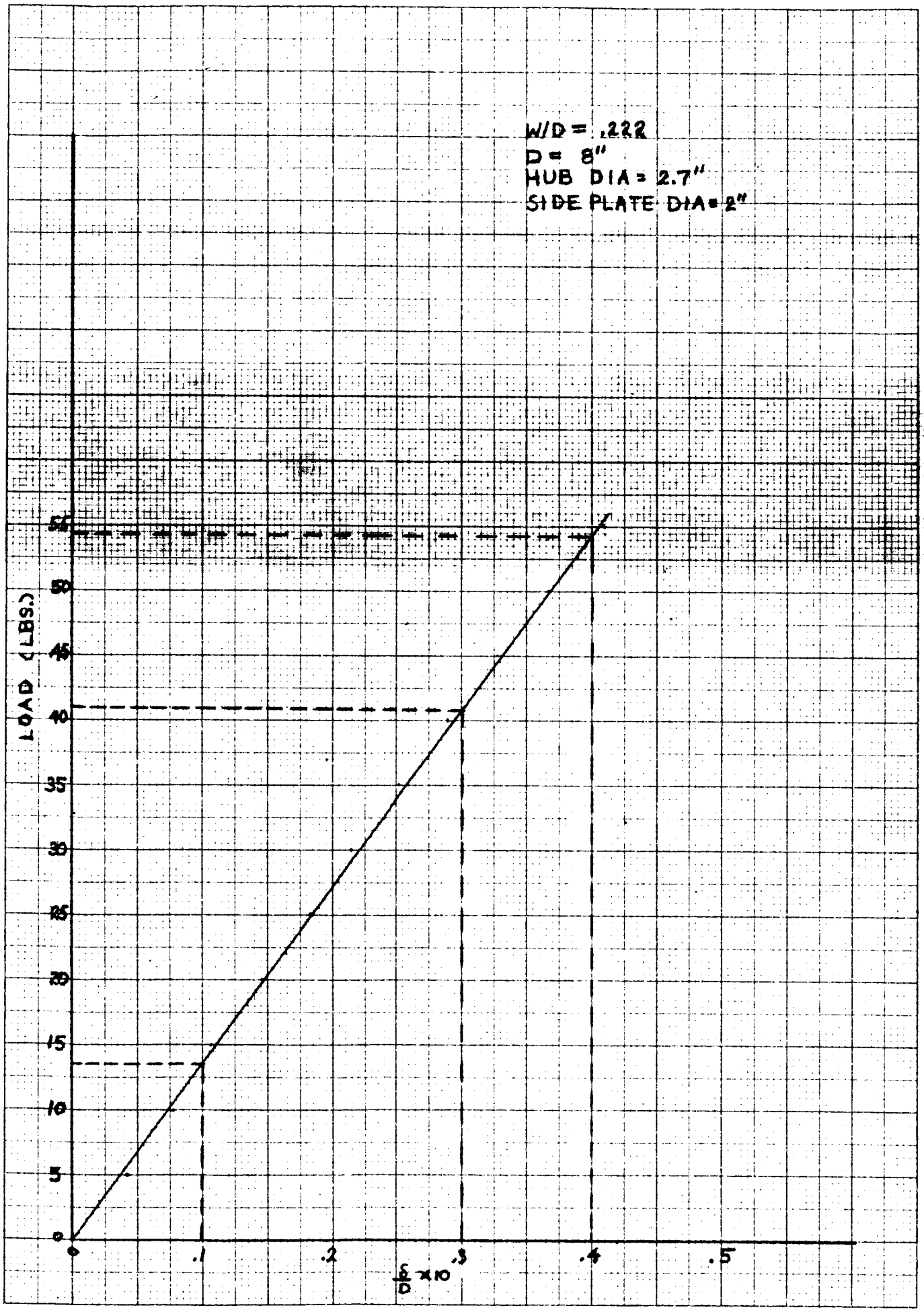
FIG. 4



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