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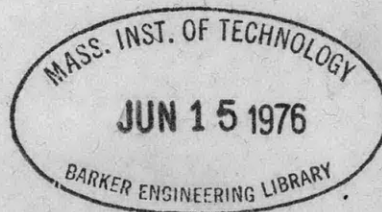
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INCREASE IN FRICTIONAL RESISTANCE
OF SHIPS
DUE TO LAPPED BUTTS.



U.S. EXPERIMENTAL MODEL BASIN,
U.S. Navy Yard, Wash., D.C.

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AN EXPERIMENT TO DETERMINE THE INCREASE IN FRICTIONAL
RESISTANCE DUE TO LAPPED BUTTS.

Among the most important items of the work of an experimental model basin are the estimations made of the effective horse powers of ships from the resistances of their corresponding models. In making these estimations, the resistances of both model and the ship must be divided into two parts, the frictional and residuary resistances, which follow different laws of relationship between ship and model. Of these resistances the one which has possibly been the least thoroughly established is the frictional resistance of the ship.

The curve in general use is in the form $R_f = C A V^n$

where R_f frictional resistance of ship in pounds
A area of wetted surface in square feet
V speed in knots

Values for the constant C and the exponent n are given by Froude and Tideman, those in Tideman's table of frictional constants being used by the U. S. Experimental Model Basin. Tideman's coefficients have been used heretofore because they gave the largest values for frictional resistance of vessels with the hope that the excess would cover the resistance due to eddying or to plate edges and butts. Recent experiments have been undertaken to obtain more definite information on this point.

An 80 foot friction plane, 18 inches wide was used, with removable wedges to simulate the lapped butts of 5/8" plates. These butts were in pairs, one on each side of the plane, reversible, so as to lap forward or lap aft and were tried in three positions along the length of the plane, but with no marked or progressive variation in resistance due to their position.

When three pairs of butts, 20 feet apart were tried, however, it was found that the resistance per butt was decreased, and throughout the test the resistance recorded for the butts lapped forward was about double that for the butts lapped aft.

The curves of resistance obtained when put in the form given above were, for the smooth friction plane, with no butts:

$$R_f = .00911 AV^{1.85}$$

With 6 butts (three pairs, 20 feet apart) lapped aft.

$$R_f = .01007 AV^{1.85} \quad \text{an increase of 10\%}$$

The curve from Tideman's table of constants, for a length of 80 feet and for fresh water, is $R_f = .00950 AV^{1.83}$. This gives a value for the resistance practically the same as one obtained from the bare friction plane, without butts, at a speed of 8.13 knots. It would appear, therefore, that if lapped butts are used in the plating of a ship the frictional resistance might be considerably greater than that obtained by computation using Tideman's constants. Butts lapped forward should of course be avoided if possible.

A table of resistances obtained during the experiment is appended, the speed being six knots, and the area of wetted surface 249.4 square feet. A sheet showing three typical resistance curves is also shown:

TABLE OF AVERAGE OF A NUMBER OF RESISTANCE MEASUREMENTS
FOR 80' FRICTION PLANE AT 6 KNOTS.

No. of butts	Direction of lap	Position on plane	Resistance
0	(Beginning of Tests)		62.3 lbs.
2	Aft	After	65.4 "
2	Forward	"	67.9 "
2	Aft	Intermediate	64.9 "
2	Forward	"	68.2 "
2	Aft	Forward	65.3 "
2	Forward	"	67.8 "
0	(End of Tests)		62.8 "
6	Aft	All	69.3 "
6	Forward	"	76.8 "

