T H E S I S

on

An Investigation of the Fundamental Requirements Necessary for Good Brake Design

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by

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APPROVED:

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Chairman of Committee on Graduate Study

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I. INTRODUCTION

Demands on braking systems have been increased so rapidly within the past few years to meet the advancements in automotive development that successful brake design must be accomplished thru the application of the fundamentals of brake operation. With all systems of braking, power is absorbed by friction and dissipated as heat. Since the frictional force is applied to the brake drum through the use of brake lining, the coefficient of friction is fundamental to good design.

The purpose of this paper is to present the results of brake lining tests made at Oregon State College. Data are presented to show the variation in coefficient of friction with time, speed, and load, and to show the effect on the coefficient of friction by water-soaking and oil-soaking the lining, and by wetting the brake drums. In addition, data are given on water absorption, oil absorption, and density of various linings.

A number of tests on durability and coefficient of friction of brake linings have been conducted by the

Bureau of Standards primairly to select lining for government use. These tests were made with constant power input, and covered long periods of time. The results as reported in the Journals of the Society of Automotive Engineers by S. von Ammon show that the coefficient of friction is materially effected by changes in temperature, the presence of water and oil, and the use of materials which do not have heat resisting properties. The apparatus developed by the Bureau is very complete, thus enabling them to carry on severe durability tests. Such tests permit interesting research, and the results of such tests present reliable comparisons between linings.

It is with regret that the tests reported in this paper were limited as to time, but improvements in the equipment will permit tests on durability, the effect of heat, etc. in the future.

II. DESCRIPTION OF FRICTION TESTING MACHINE

The friction testing machine used in this study was designed and built by the author of this paper under the supervision of Professor F.G.Baender. The complete set-up is shown in figures 1 and 3. Lining is contained on the brake shoe P, and applied to the brake drum O as

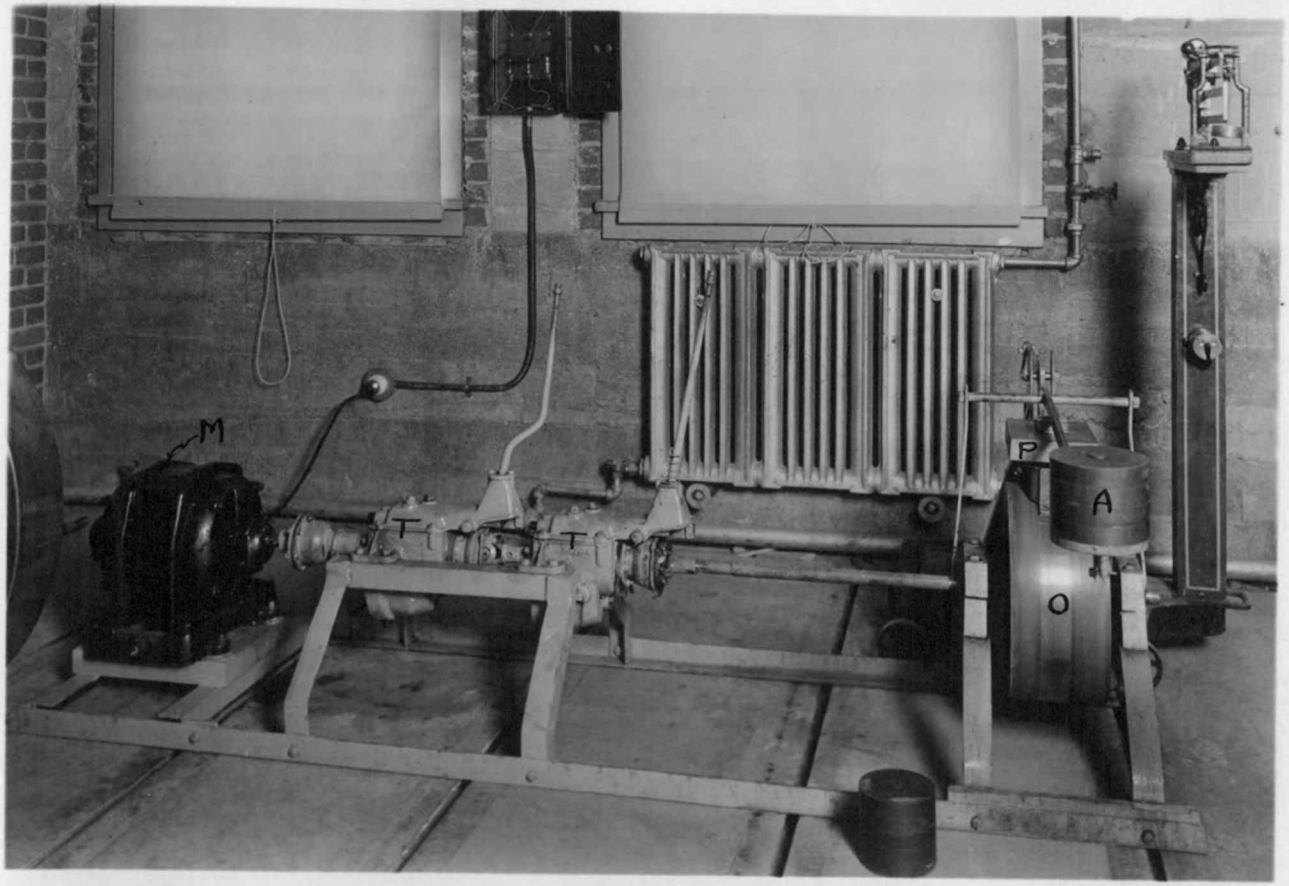


Fig. 1

shown in Fig. 3. Power is supplied for rotating the drum O by a 3 h.p. induction motor M. Seven different speeds are obtained by using two automobile transmissions (T) in series. The 16 inch brake drum is of gray cast iron,has a smooth surface for the lining to rub on, and its temperature range is limited by keeping water within the inside of the rim.

The laws of sliding friction on unlubricated surfaces as applied to this equipment may be stated as follows:

1. Frictional forces occur only when a body is in motion.

2. Frictional force is independent of the area of surface in contact.

3. Frictional forces act opposite to the direction of motion.

4. Frictional force is directly proportional to the load normal to the surfaces in contact.

Figure 2. is a diagram illustrating the friction laws. Body B. is moved along surface A. at uniform velocity by pull P, and F is the frictional force produced by the normal load N. From the fourth law of sliding friction, F. equals f N, where f is the coefficient of friction between the surfaces in contact. For uniform velocity F equals P; consequently the frictional force produced by the normal load N is obtained experimentally

by measuring the pull P necessary to maintain uniform velocity. The same relationship exists when B is held stationary, and the surface A moves at uniform velocity. This is the principle of operation shown in Figure 3. The revolving drum O and the brake shoe R represent body A and B of Figure 2 respectively.

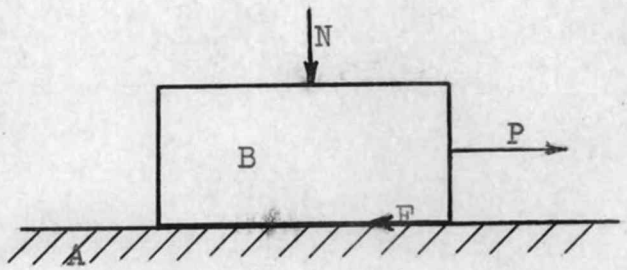


Fig. 2

Provisions for applying load to the lining and measuring the frictional pull are shown in Figure 3, and consist essentially of two systems of levers, A B C D and F G H K. Load is applied normal to the brake shoe by the lever system A B C D, which is pivoted at points C and D. This allows free horizontal and vertical movement of point B, which prevents angularity in the application of the load. Length A B is ten times length B C; therefore when dead weight is applied at A the pressure at B is ten times the load at A. The length of the arc of contact between the lining and drum is eight inches.

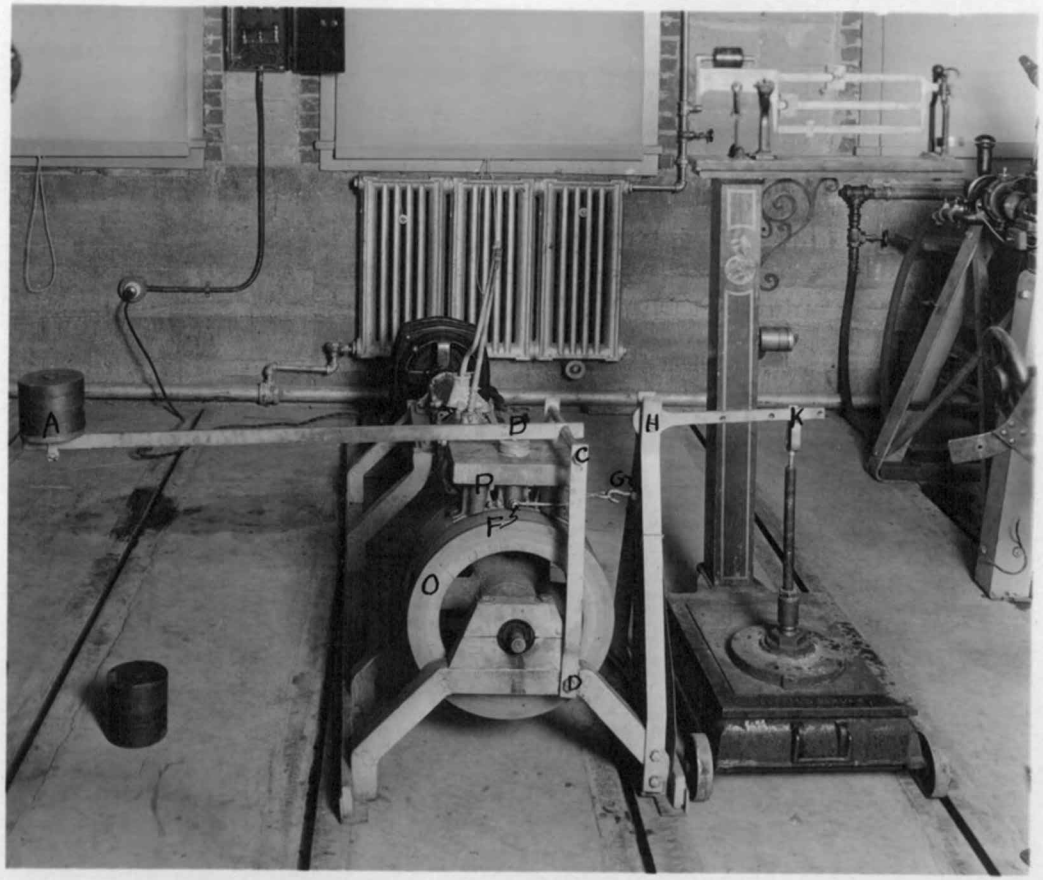


Fig. 3

With the drum rotating in the direction shown and the load applied at B, the frictional pull is measured by the lever system F G H K. The frictional pull is transmitted from the brake shoe to the bell crank G H K by the steel yoke F G. The bell crank is pivoted on a ball bearing at H, and the arm H K is twice the length of G H, this making the scale reading equivalent to one-half the frictional pull.

Fig. 4 shows the design of the brake shoe. To maintain approximately uniform pressure on the lining, the shoe A is divided into three parts, A_1, A_2, and A_3, which are fastened together by the links L. This arrangement allows considerable vertical movement of each segment independently. The load which is applied to Block B is transmitted to A through coil springs S; consequently each part of the shoe A receive approximately one-third of the total load. Since the pressure exerted on A_2 is practically normal to the surface of the brake drum, the pressure on the lining under A_2 is greater than that on A_1 and A_3 due to the curvature of the drum. The unit pressure, however, is made uniform over the surface of the lining by decreasing the area of A_1 and A_3 in the same proportion as the normal pressure on A_1 and A_3 is decreased.

Normal Pressure at A_1 = Normal Pressure at $A_2 \times \cos \theta$

Area A_1 = Area $A_2 \times \cos \theta$ = Area A_3

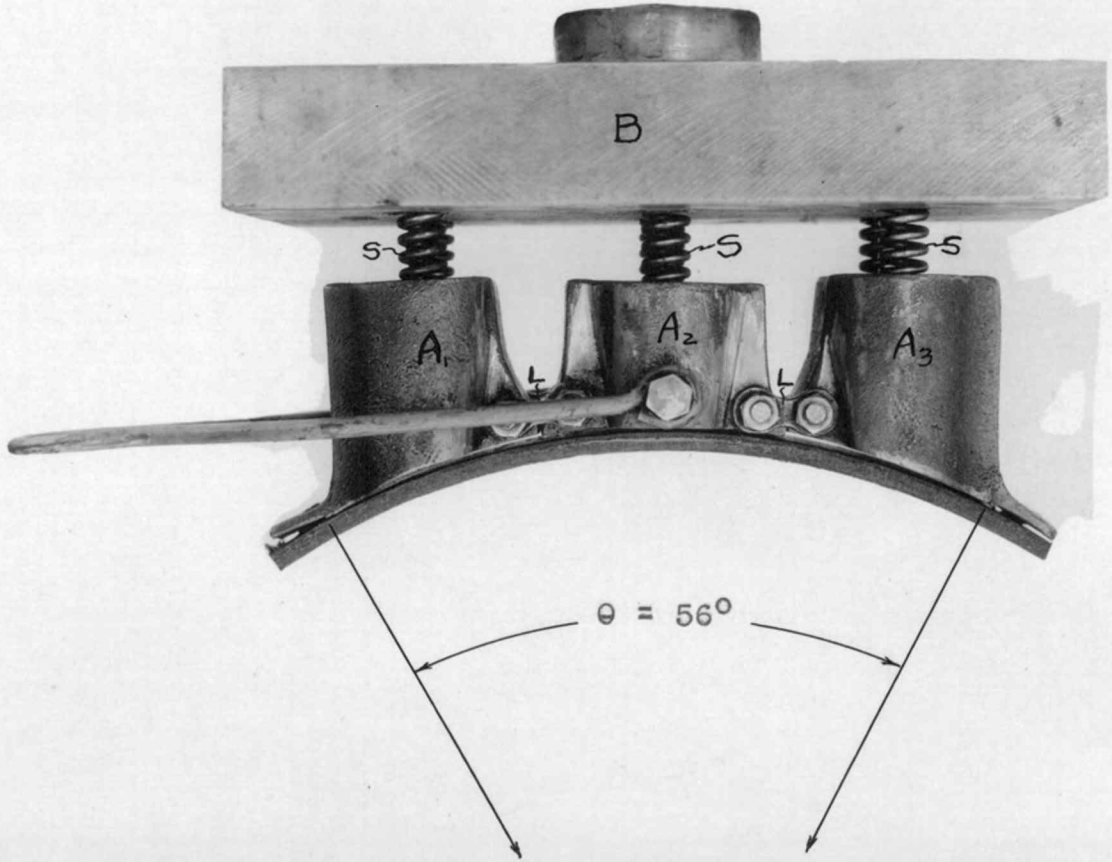


Fig. 4

The tangential component of the normal pressures at A_1 and A_3 also increase the normal pressure at A_2, but with the short arc of contact used the increase is very small.

Before discussing further the tests made which form the basis of this paper it is well to discuss the two general methods of applying brakes.

In the one method, the pedal pressure is applied through suitable levers to the brake shoe which is pressed against the brake drum. By this method only direct pressure is available and the retarding force depends directly upon the pressure exerted by the foot.

In the other type, known as the "servo-action", advantage is taken of the frictional force to cause the shoe to press very hard against the brake drum. It is a wedge action that is produced which becomes very active with only slight pedal pressures. It is to be understood, therefore, that the action of brakes on a vehicle depends not only upon the lining, but in a large measure, upon the mechanical construction of the brakes.

III. METHOD OF CONDUCTING TESTS

1. Friction Tests

Tests were made on each lining "as received", after being "water-soaked" and "oil-soaked" for ten days, and with the drum running in muddy water. The dry linings were tested by holding the load constant and measuring

the frictional pull at different speeds, which ranged from 66 R. P. M. to 1140 R. P. M. Loads of 370 lbs., 270 lbs., 170 lbs., and 70 lbs. were selected after considerable experimenting. Both the range in load and speed were limited because of insufficient power, the 3 H. P. induction motor being the only available source of power.

Before testing linings at constant load, runs of about 35 minutes duration were made at constant load (170 lbs.) and constant speed (356 R. P. M.) to wear them in. During this time a record was kept of the frictional pull. Readings were taken every minute.

Water-soaked and oil-soaked samples were tested under the same conditions as used to wear the linings in. Constant load tests were attempted for these specimens, but the fractional pull varied so much that better comparison were obtained by running over a length of time.

Tests on lining with the brake drum running in muddy water were made at constant speed with loads of 370 lbs., 270 lbs., 170 lbs., and 70 lbs. The lowest speed (66 R. P. M.) was selected because the water remained on the drum while running.

After the tests were completed, several of the linings first tested were repeated to see if the sur-

face of the drum was worn enough to change the coefficient, and in all cases the results were substantially the same. Some linings gave slightly higher coefficients in the first test while others gave slightly lower results.

2. Absorption Tests

The absorption of water and oil in the linings was determined by weighing the friction test samples before putting them to soak and after they had soaked for ten days. Before weighing the samples the surfaces were wiped dry with a rag. The ratio of the increase in weight to the dry weight is taken as the absorption capacity.

3. Density Tests

The density was determined by weighing three samples of each lining in air and in water. As the time of weighing was very short, there was little chance for absorption while weighing. In fact, most linings could be left in the water for five or ten minutes without any appreciable increase in weight. The ratio of the weight in air to the loss of weight in water is the density compared to water as unity.

IV. TYPES OF LININGS TESTED

The nineteen different brands of lining made by

TABLE NO. I

Lining No.	Color	Hardness	Construction	Material	Stiffness	Metal
1	Brown	Hard	Folded	Asbestos	Very Stiff	Yes
2	Light Gray	"	"	"	Fairly Stiff	"
3	Black	Medium	Woven	"	Medium	"
4	"	"	"	"	"	"
5	"	"	"	"	"	"
6	"	"	"	"	"	"
7	"	"	"	"	"	"
8	Brown	"	"	"	"	"
9	Dark Gray	Hard	Folded	"	Stiff	"
10	Black	Medium	Woven	"	Medium	"
11	"	"	"	"	"	"
12	"	"	"	"	"	"
13	Gray	Hard	Folded	"	Stiff	"
14	Black	Fairly Hard	Woven	"	Fairly Stiff	"
15	"	Soft	"	Fiber	Pliable	No
16	"	"	"	Fiber	"	"
17	Brown	Very Hard	Molded	-----	Not Flexible	"
18	Dark Gray	" "	"	Asbestos	" "	"
19	Black	" "	"	Rubber & Asbestos	" "	Yes

Note: The black colored flexible linings have been treated. Linings Nos. 1 to 16 inclusive are flexible and linings Nos. 17 to 19 inclusive are moulded.

six different manufacturers include folded and compressed, woven and t reated, and moulded types. Table 1 gives a brief description of all linings tested.

J.M. Weaver of the Asbestos Brake Lining Association describes asbestos brake lining as follows:

"There are two general types of asbestos brake lining. One is a fabric woven to the thickness desired and finished with a saturant or treating compound, and the other is made by applying a rubber compound upon asbestos metallic-cloth and folded to build up the size and width required. The first type has been used as the base for the application of many kinds of treating compounds, running through the various kinds of asphalts and combinations of them, and various other chemical compounds. In both types of brake lining, the fabric is composed of asbestos metallic-yarn. The yarn is a mixture of asbestos and cotton in the approximate proportions of 80 per cent asbestos and 20 per cent cotton. Ordinarily, the wire used is brass or copper, and the asbestos is spun around the wire. The brake lining manufacturer therefore works with four principal ingredients: asbestos fiber, cotton fiber, brass or copper wire, and treating compound."

V. RESULTS OF TESTS

1. Friction Tests

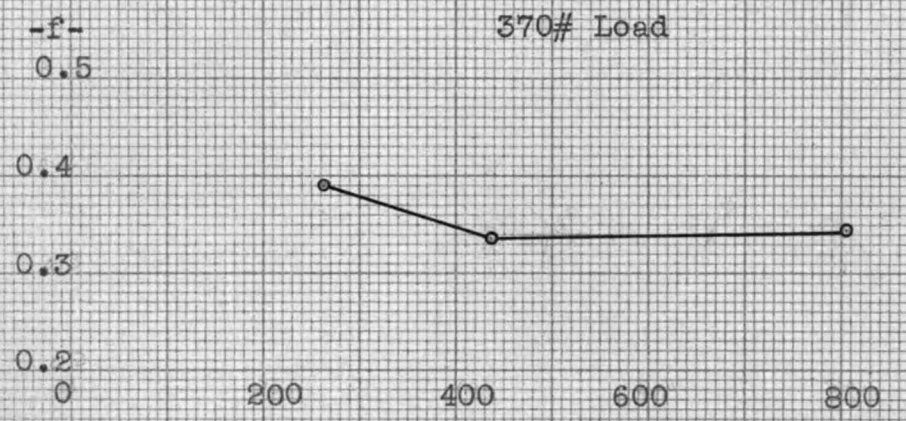
The results of the friction tests are presented graphically for convenience in interpretation. Curves 1 to 72 show the variation in coefficient of friction with speed for linings "as-received"; curves 73 to 126 show the variation in coefficient of friction with load for linings "as-received" and with the drum running in muddy water; and curves 126 to 180 show the variation in coefficient of frict ion with time for linings "as-received", "water-soaked," and "Oil-soaked". The constant load and constant speed curves are plotted from an average of tests 1 and 2, which are tabulated in the test data. In plotting, a smooth curve is used wherever possible, but for linings showing considerable variation, straight lines connecting the points are used.

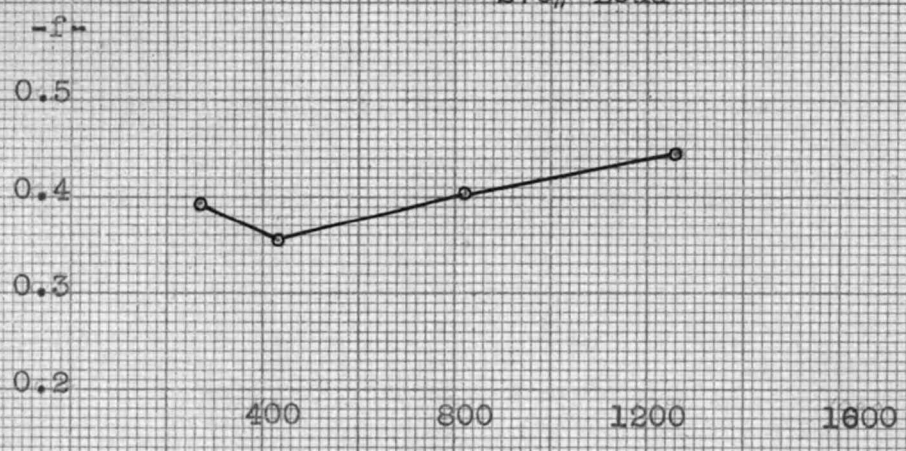
Because of the limited time available for completing the tests, it was impossible to run over long periods, but tests of this kind conducted by the Bureau of Standards show large variations in the coefficient of friction with time and that the coefficient becomes more constant after about three hours running. The results presented in this report, however, give relative comparison between various linings for the conditions previously outlined.

COEFFICIENT OF FRICTION (f)

vs.
SPEED

Lining No. 1 As Received



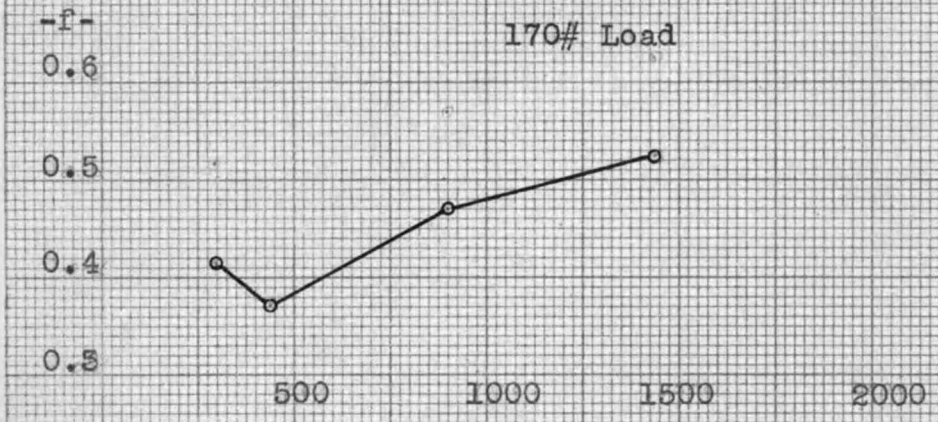


COEFFICIENT OF FRICTION (f)

vs.

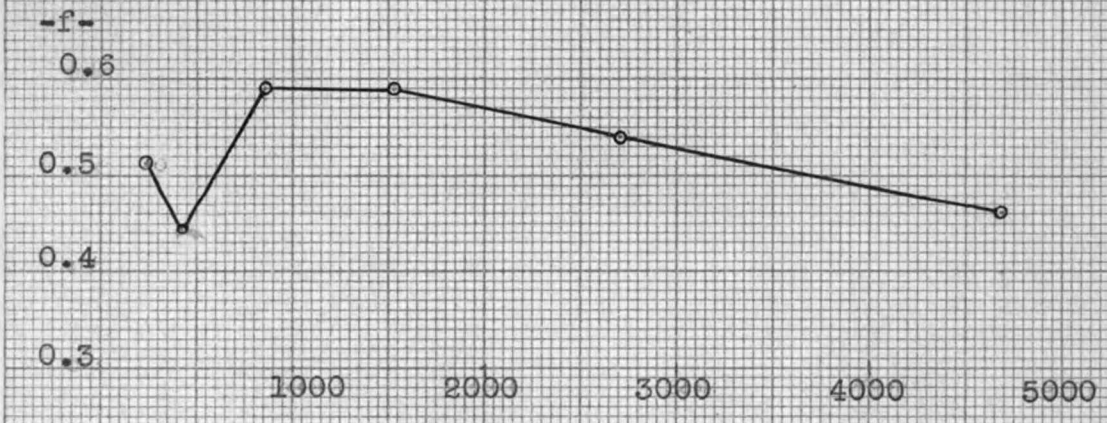
SPEED

Lining #1 As Received



170# Load

Speed in Feet Per Min.



70# Load

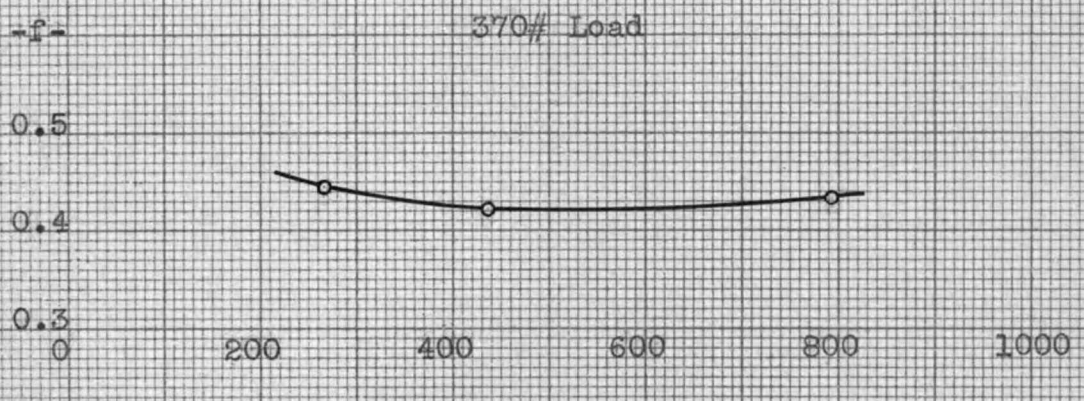
Speed in Feet per Min.

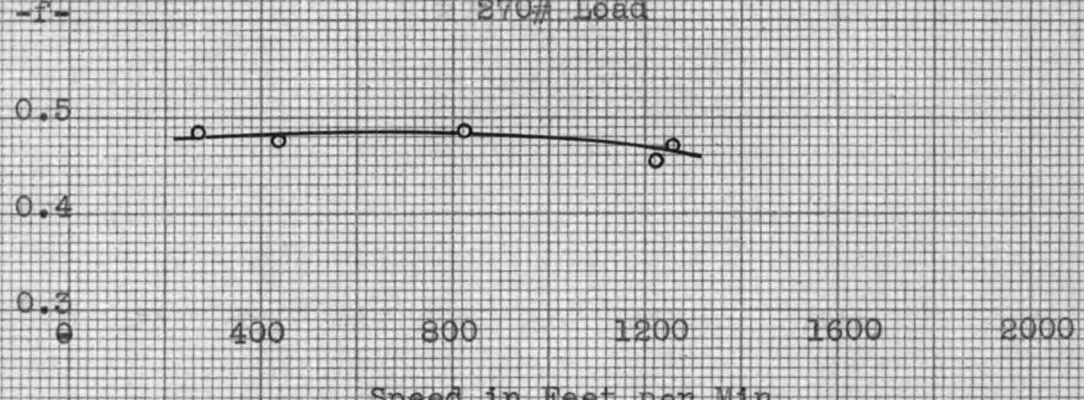
COEFFICIENT OF FRICTION (f)

vs.

SPEED

Lining No. 2 As received



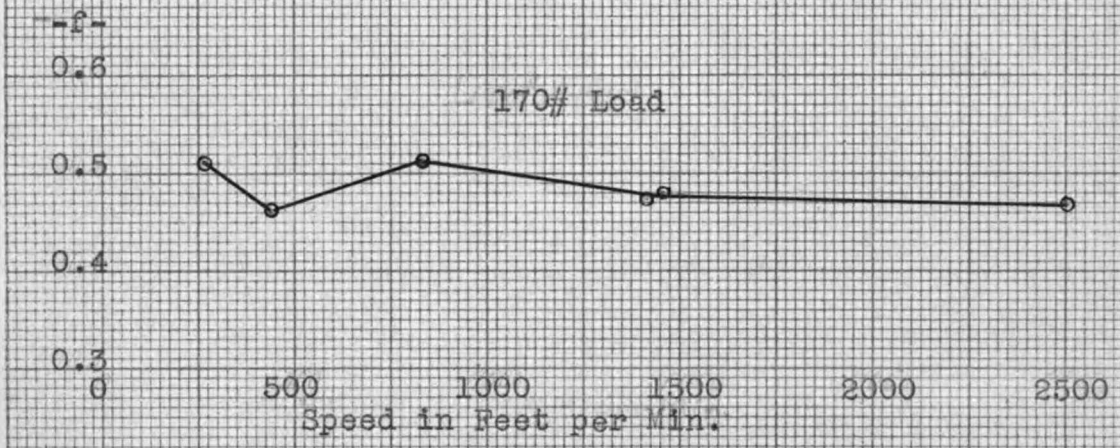


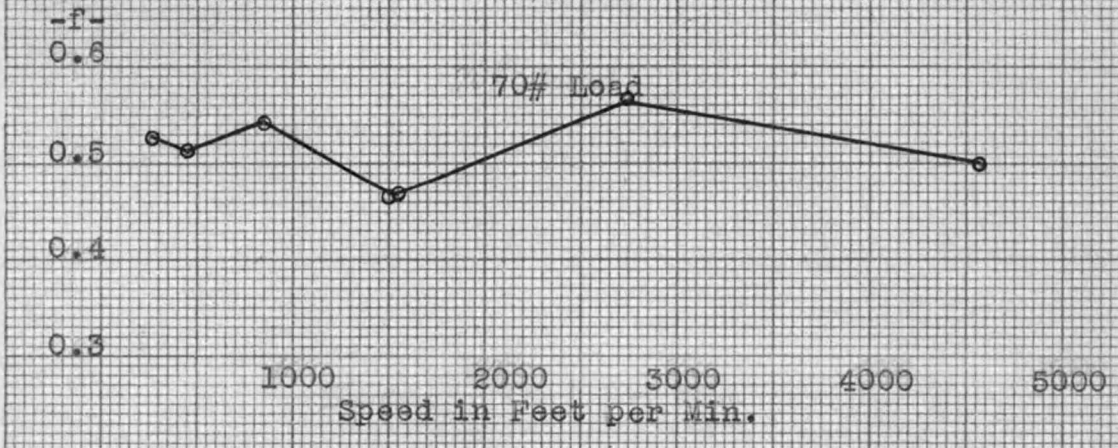
COEFFICIENT OF FRICTION (f)

vs.

SPEED

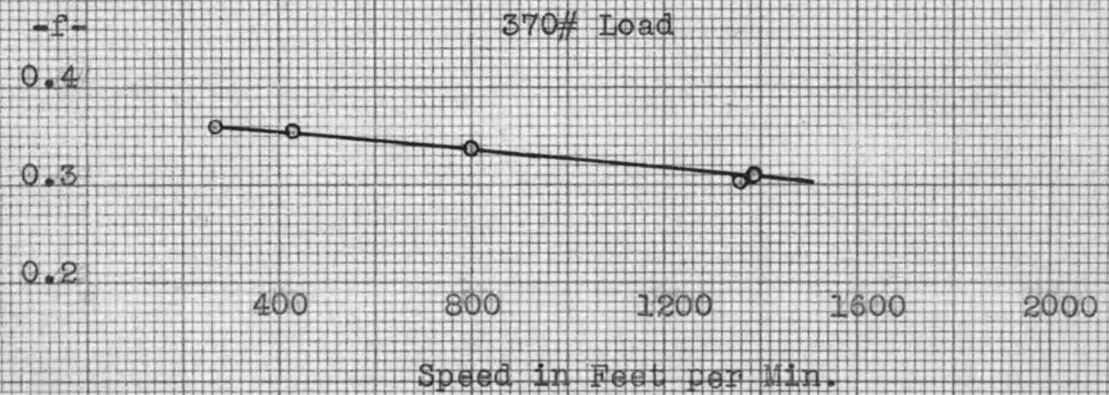
Lining No. 2 as Received

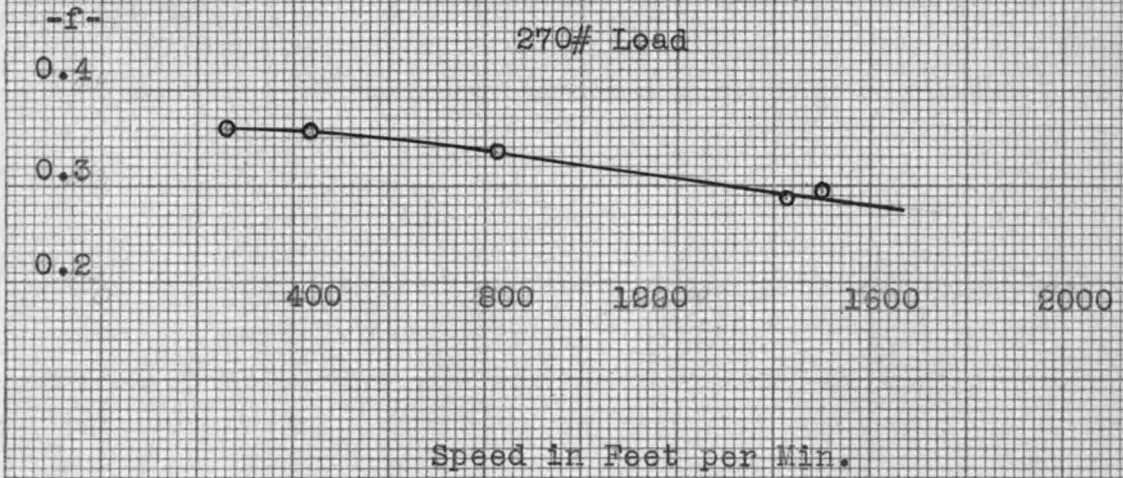




COEFFICIENT OF FRICTION (f)
vs.
SPEED

Lining #3 As Received



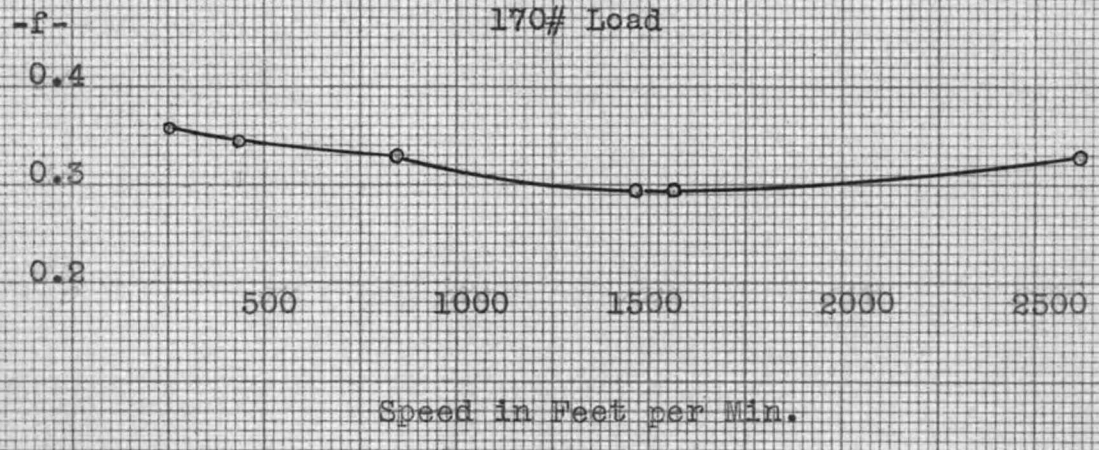


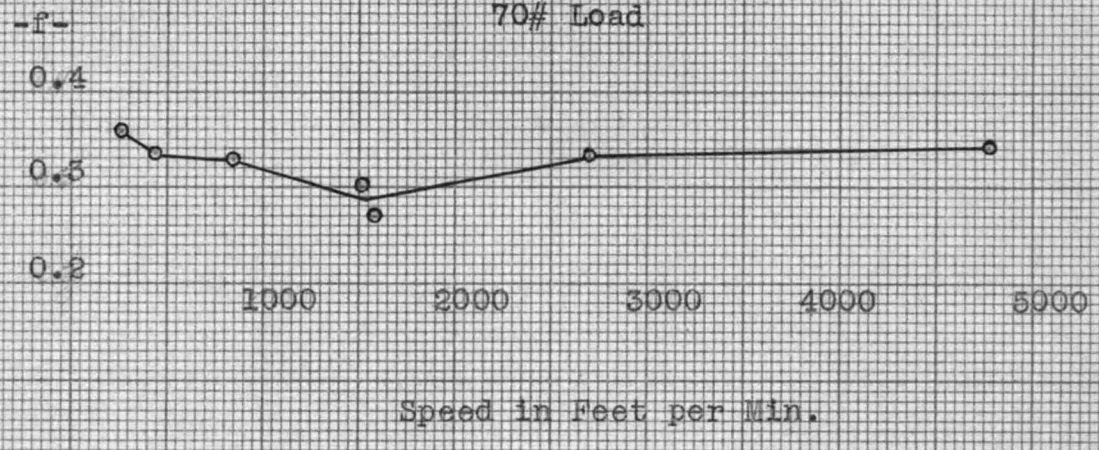
COEFFICIENT OF FRICTION (f)

vs.

SPEED

Lining No. 3 As received



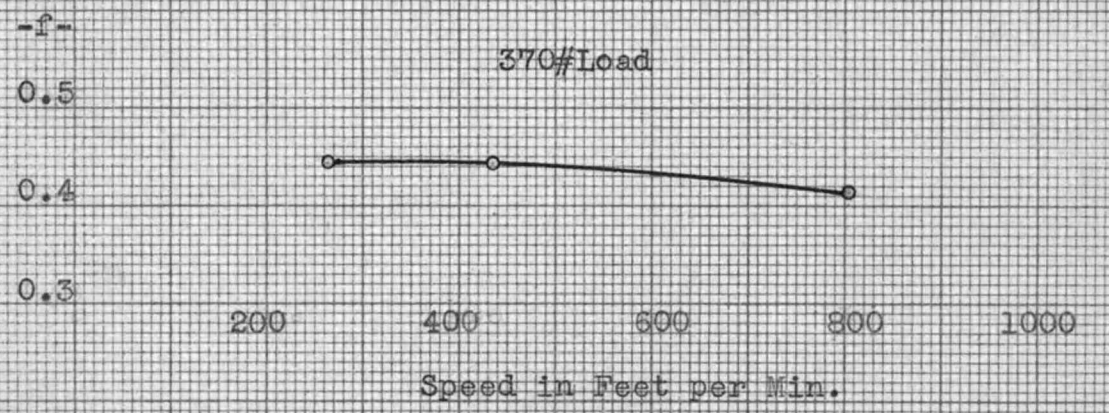


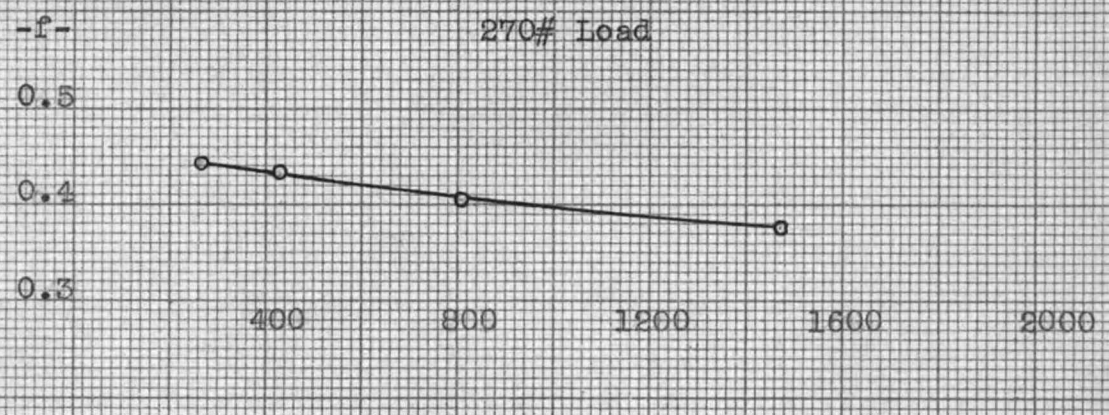
COEFFICIENT OF FRICTION (f)

vs.

SPEED

Lining #4 As received



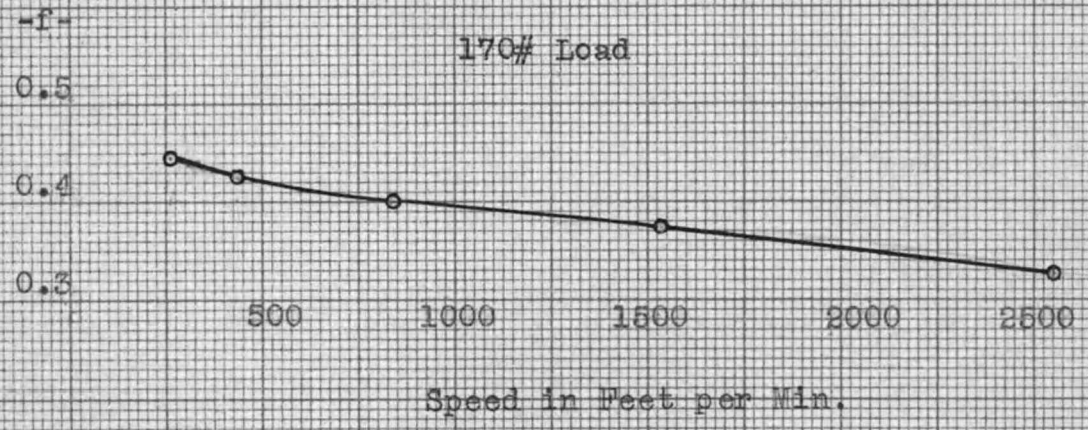


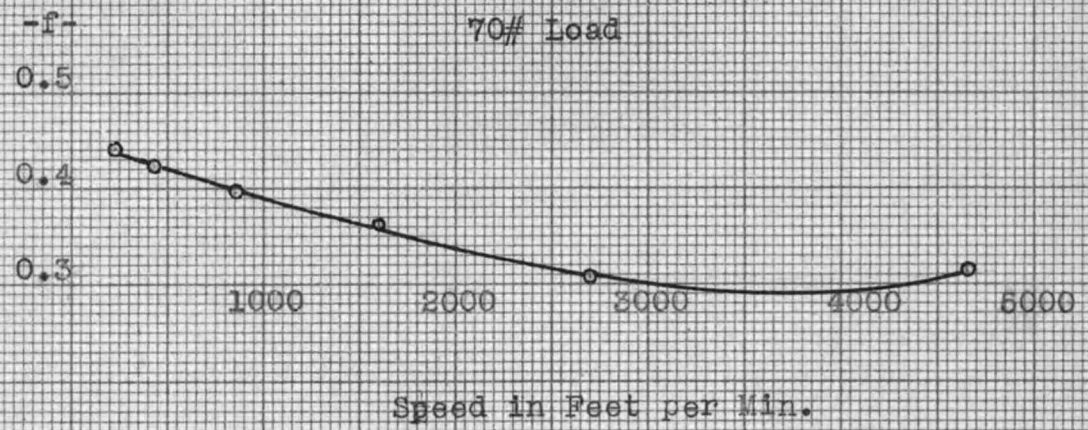
COEFFICIENT OF FRICTION (f)

vs.

SPEED

Lining #4 As Received



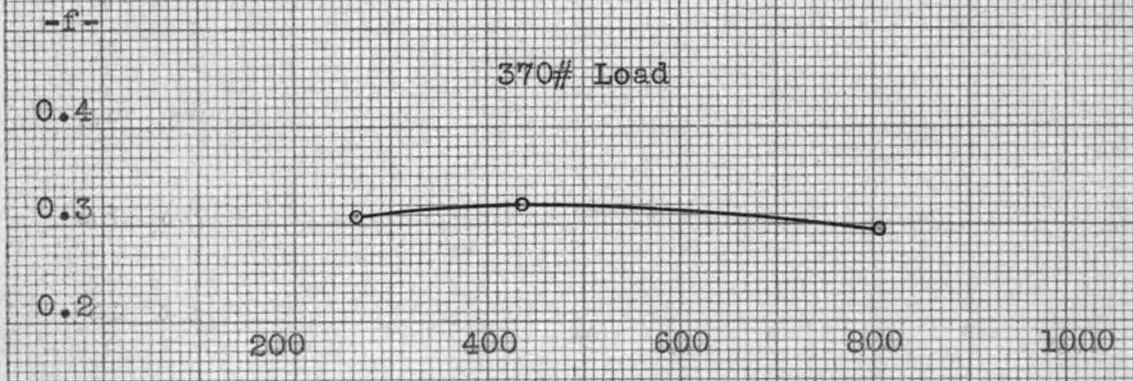


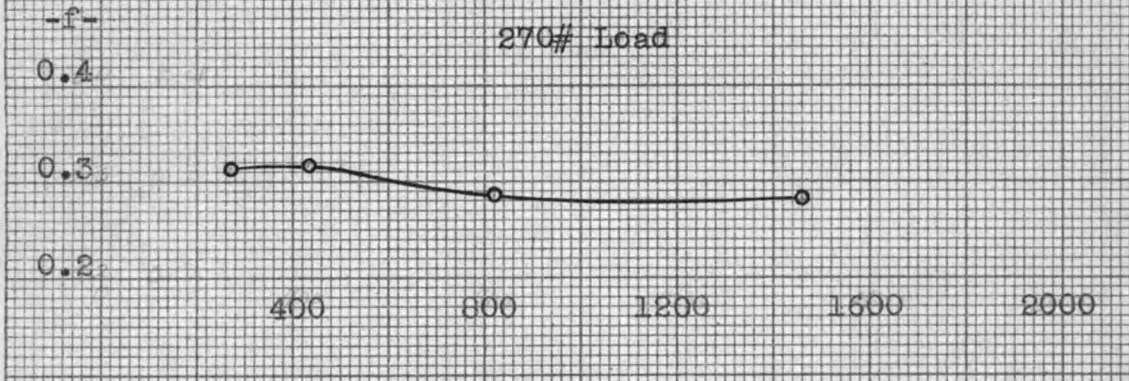
COEFFICIENT OF FRICTION (f)

vs.

SPEED

Lining #5 as received



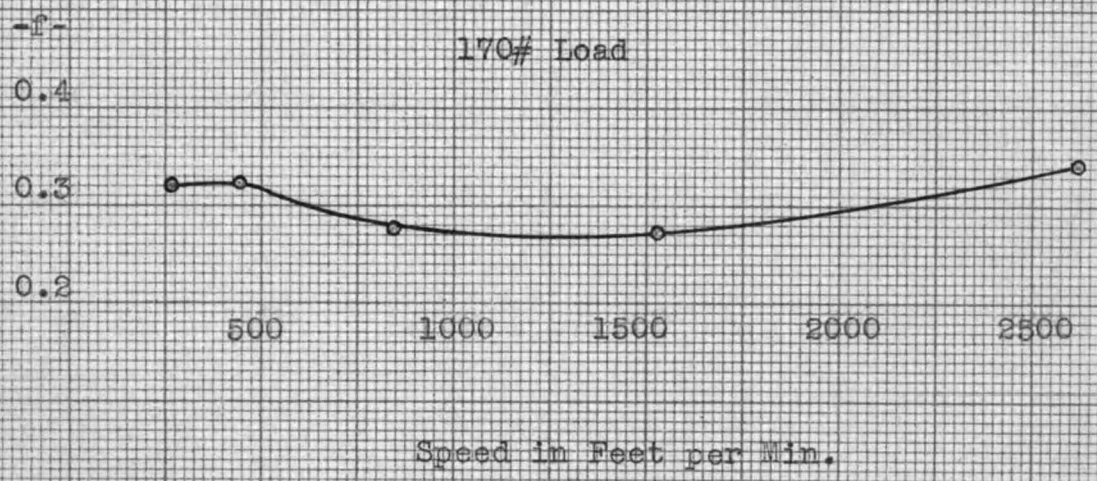


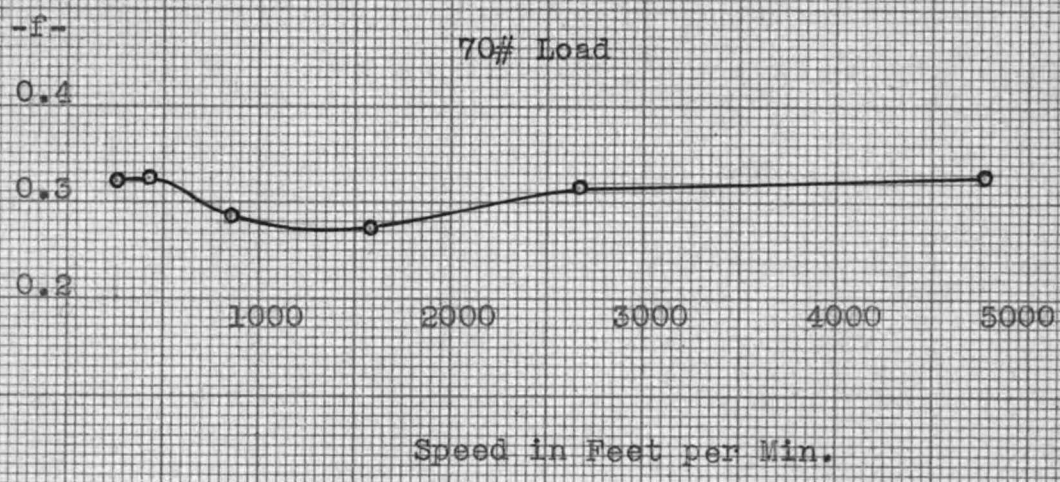
COEFFICIENT OF FRICTION (f)

vs.

SPEED

Lining No. 5 As Received



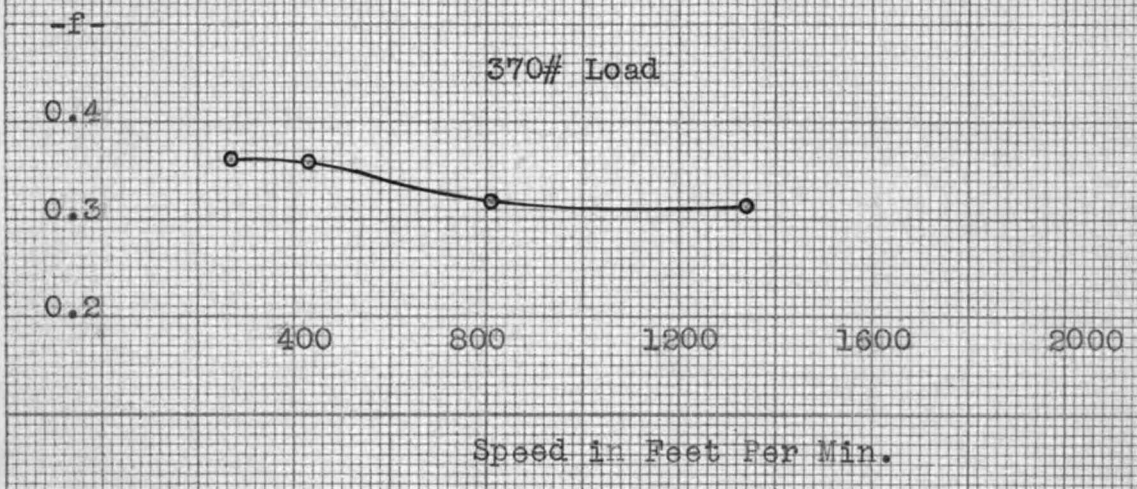


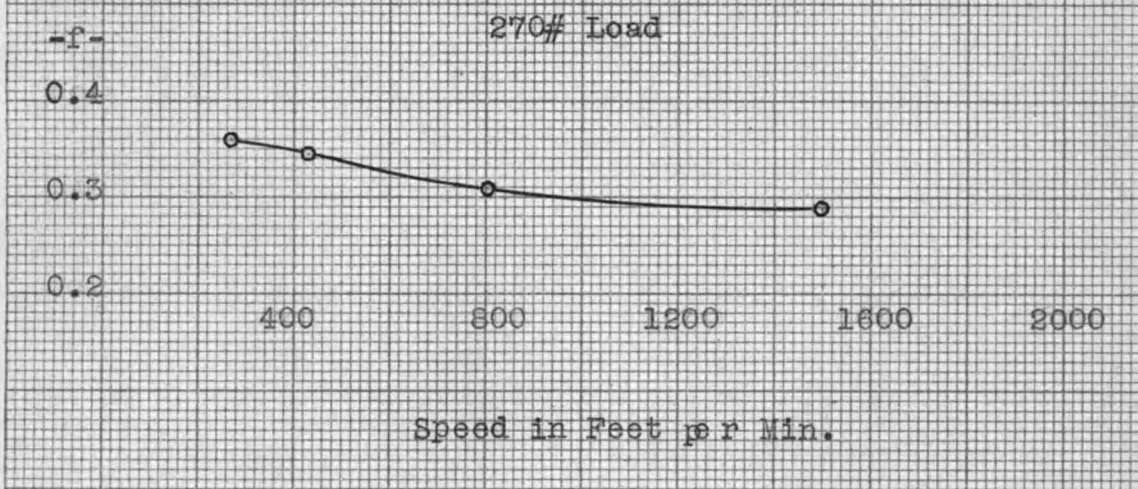
COEFFICIENT OF FRICTION (f)

vs.

SPEED

Lining #6 As Received



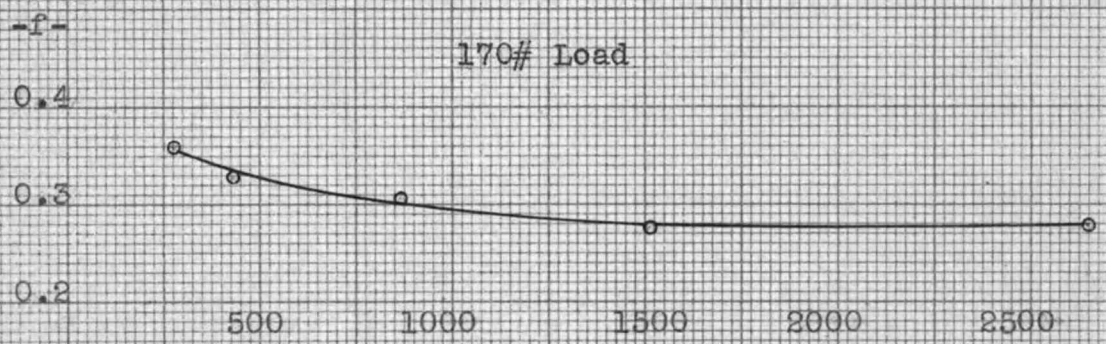


COEFFICIENT OF FRICTION (f)

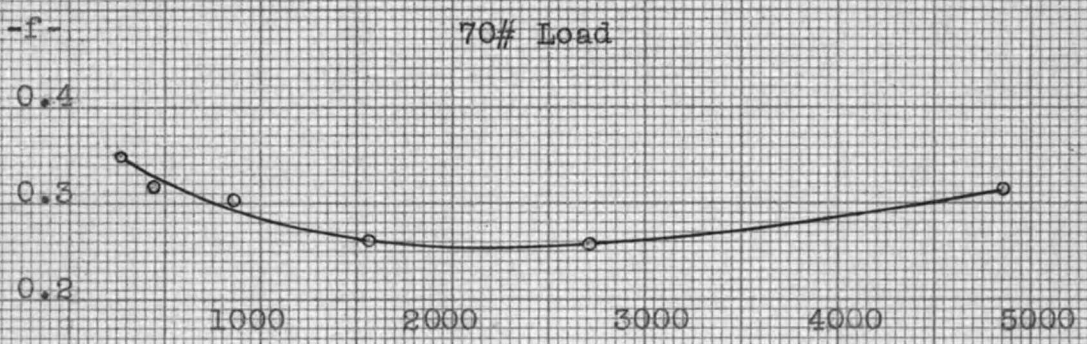
vs.

SPEED

Lining #6 As Received



Speed in Feet per Min



Speed in Feet per Min.

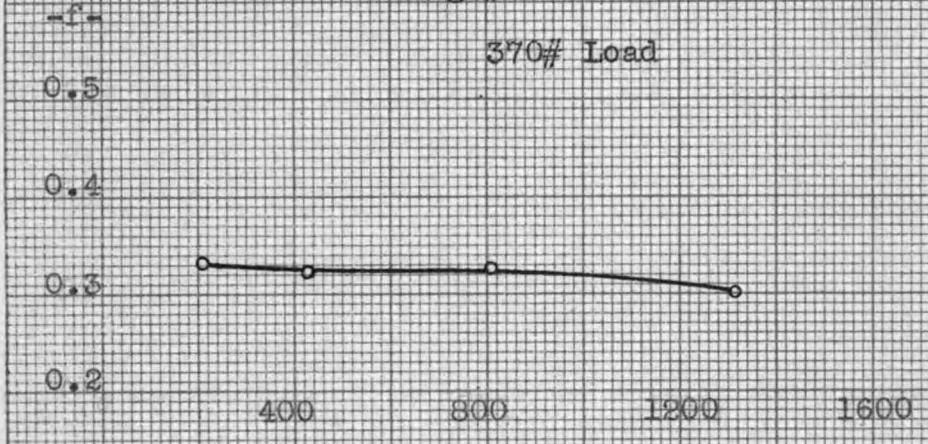
COEFFICIENT OF FRICTION (f)

vs.

SPEED

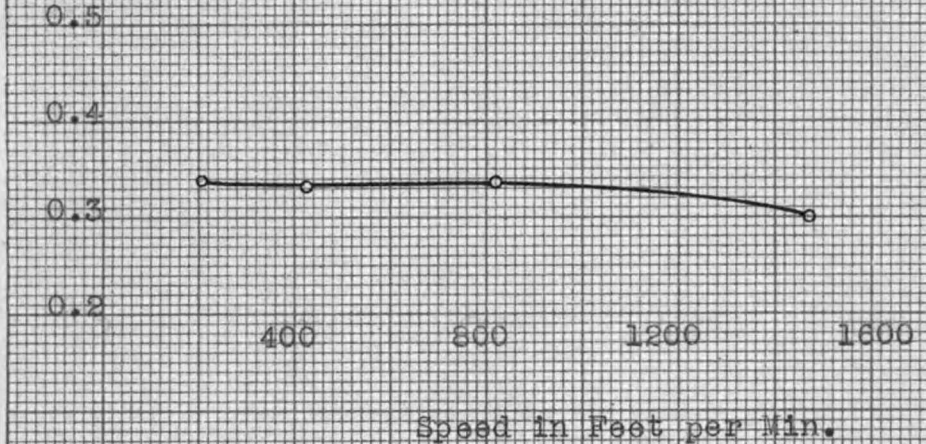
Lining #7 As Received

370# Load



Speed in Feet per Min.

270# Load



Speed in Feet per Min.

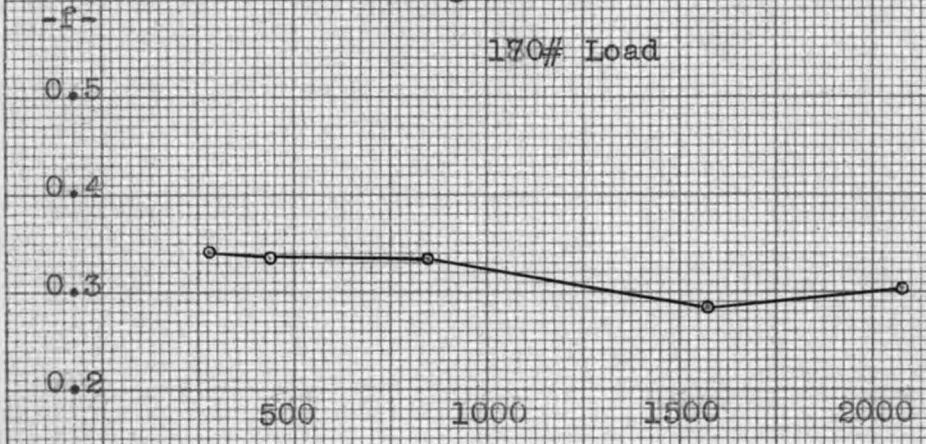
COEFFICIENT OF FRICTION (f)

vs.

SPEED

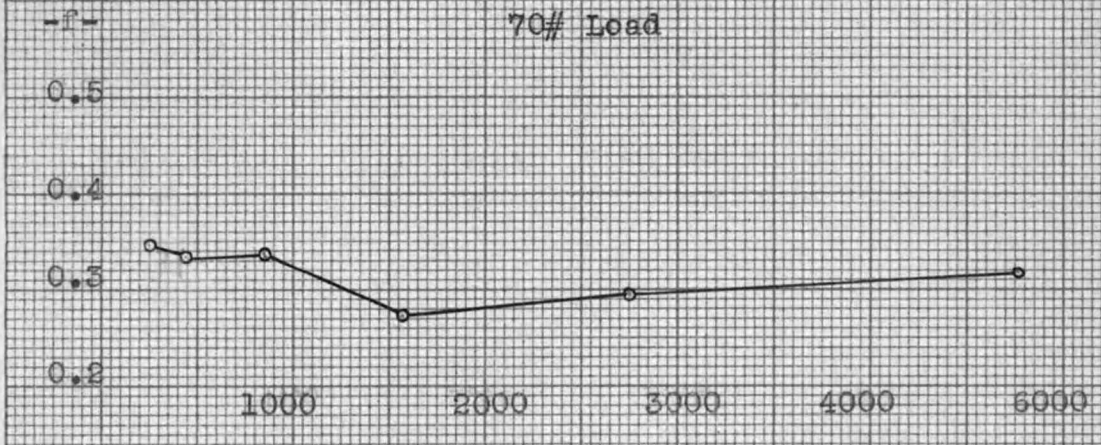
Lining #7 As Received

170# Load



Speed in Feet per Min.

70# Load



Speed in Feet per Min.

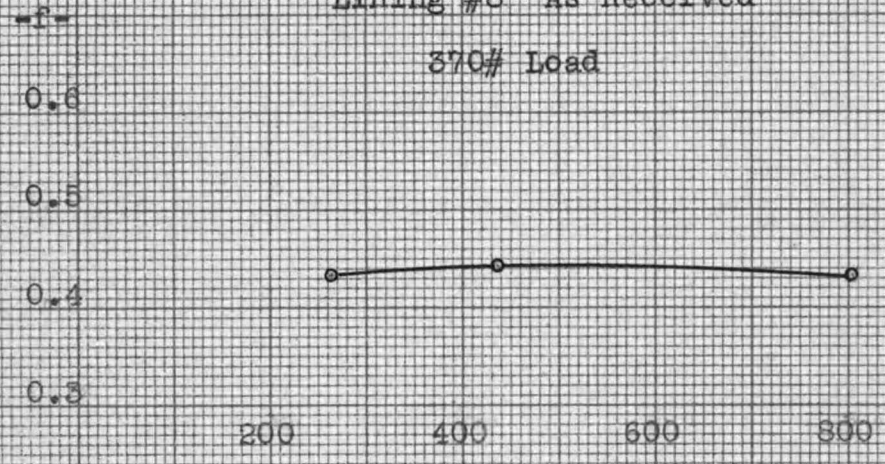
COEFFICIENT OF FRICTION (f)

vs.

SPEED

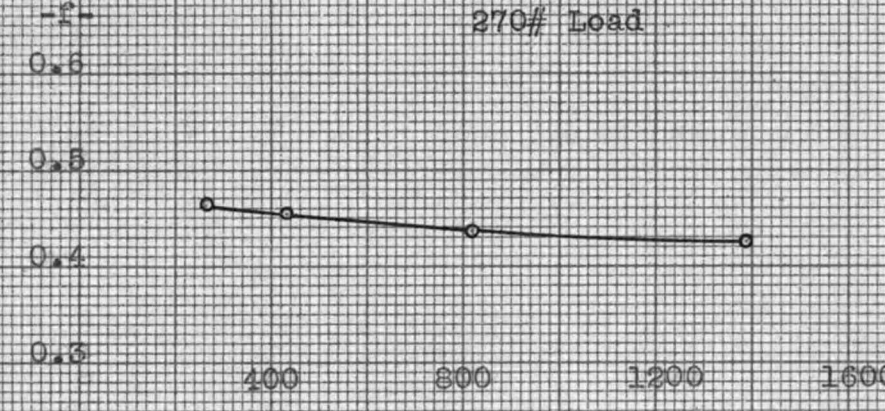
Lining #8 As Received

370# Load



Speed in Feet per Min.

270# Load



Speed in Feet per Min.

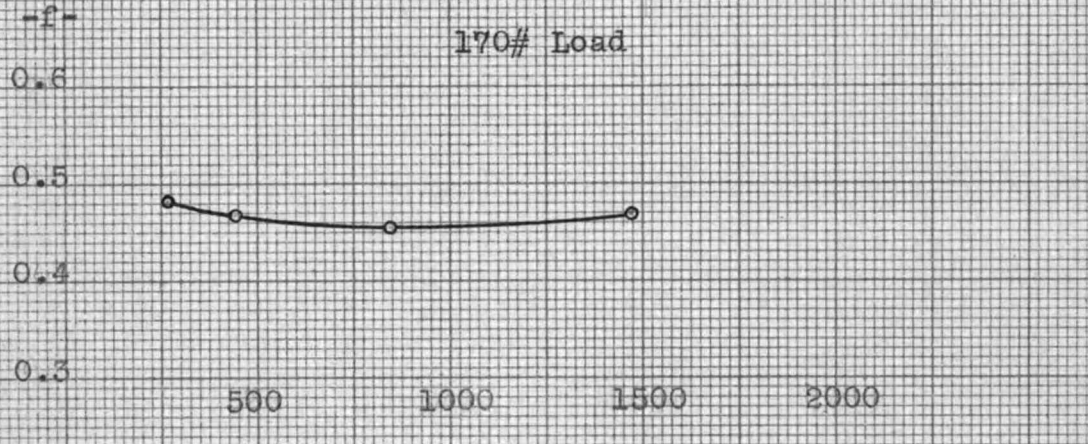
COEFFICIENT OF FRICTION (f)

vs.

SPEED

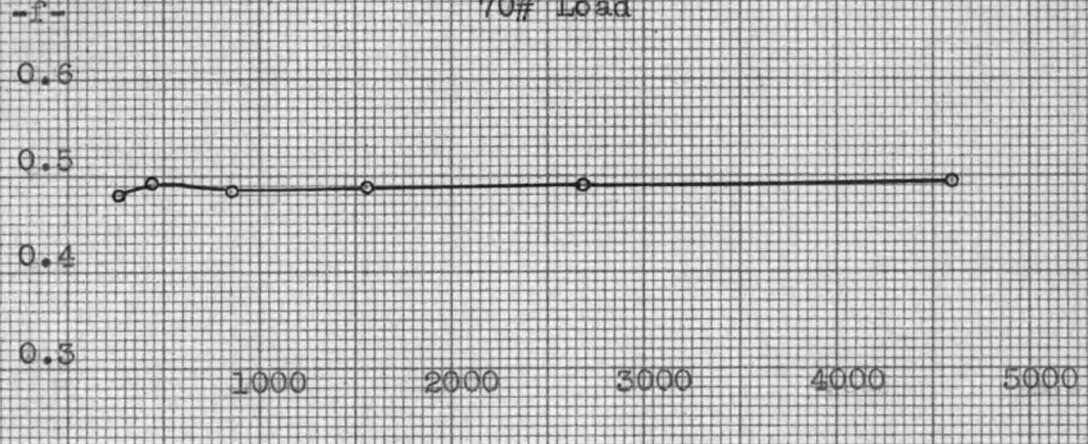
Lining #8 As Received

170# Load



Speed in Feet per Min.

70# Load



Speed in Feet per Min.

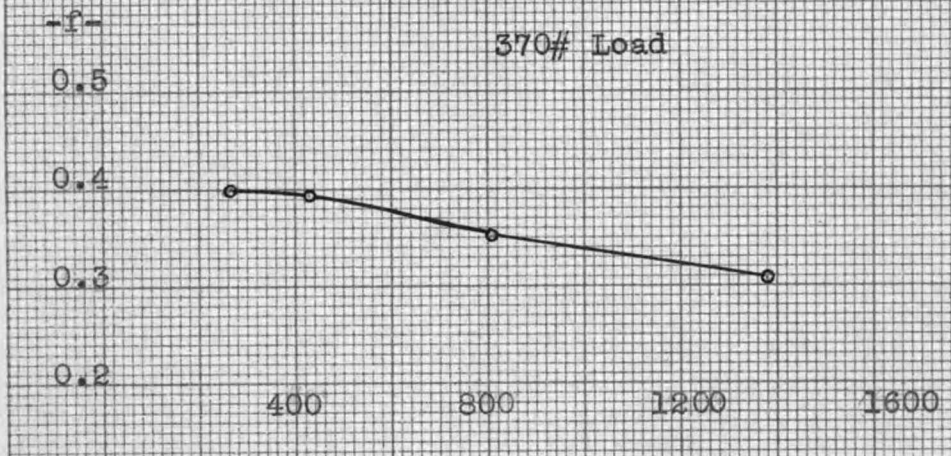
COEFFICIENT OF FRICTION (f)

vs.

SPEED

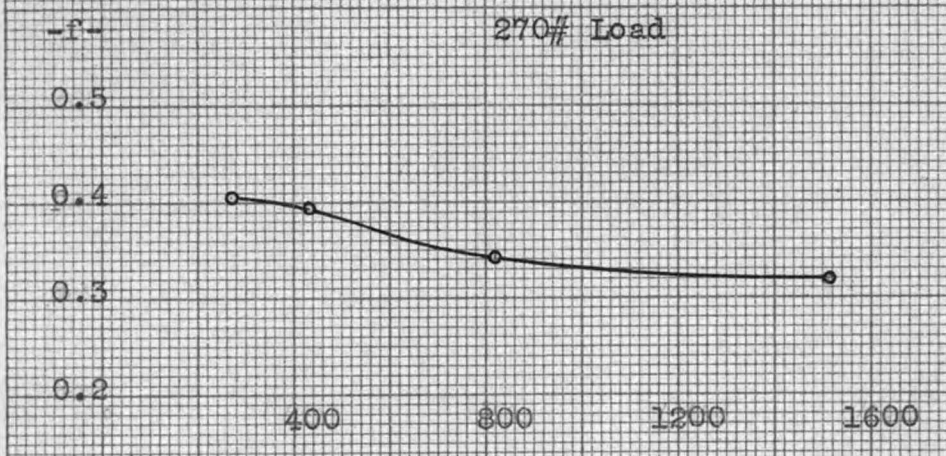
Lining #9 As Received

370# Load



Speed in Feet per Min.

270# Load



Speed in Feet per Min.

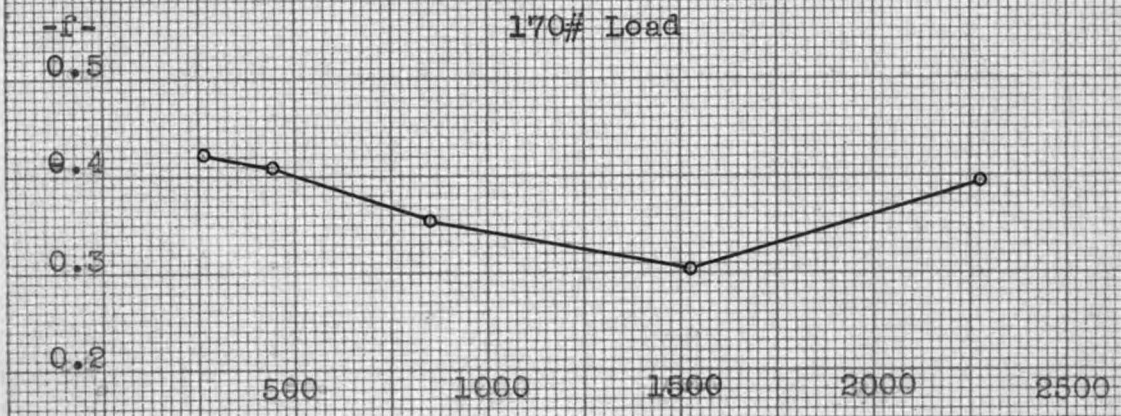
COEFFICIENT OF FRICTION (f)

vs.

SPEED

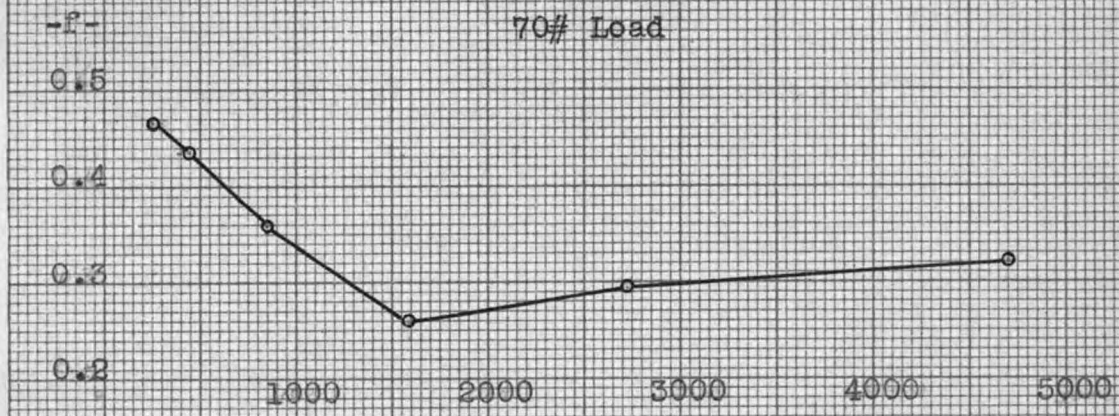
Lining #9 As Received

170# Load



Speed in Feet per Min.

70# Load



Speed in Feet per Min.

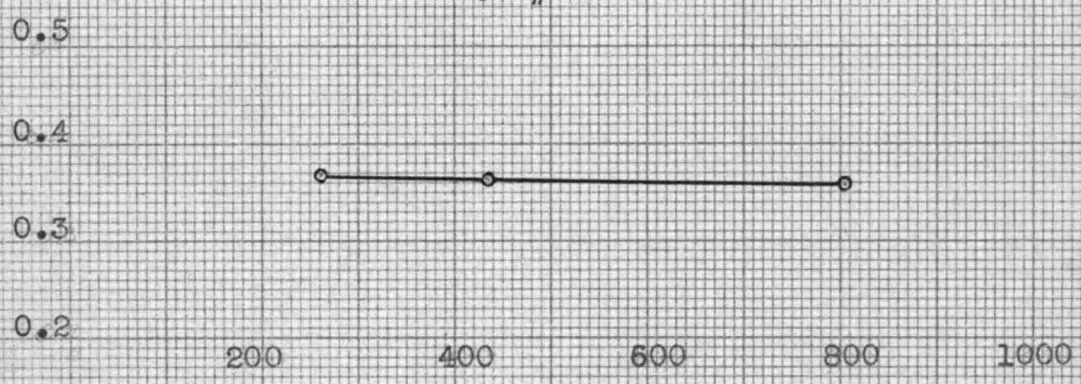
COEFFICIENT OF FRICTION (f)

vs.

SPEED

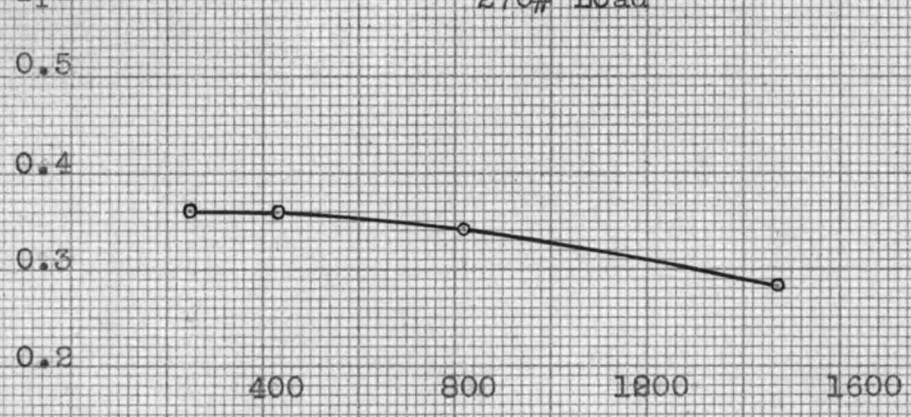
Liming #10 As Received

370# Load



Speed in Feet per Min.

270# Load



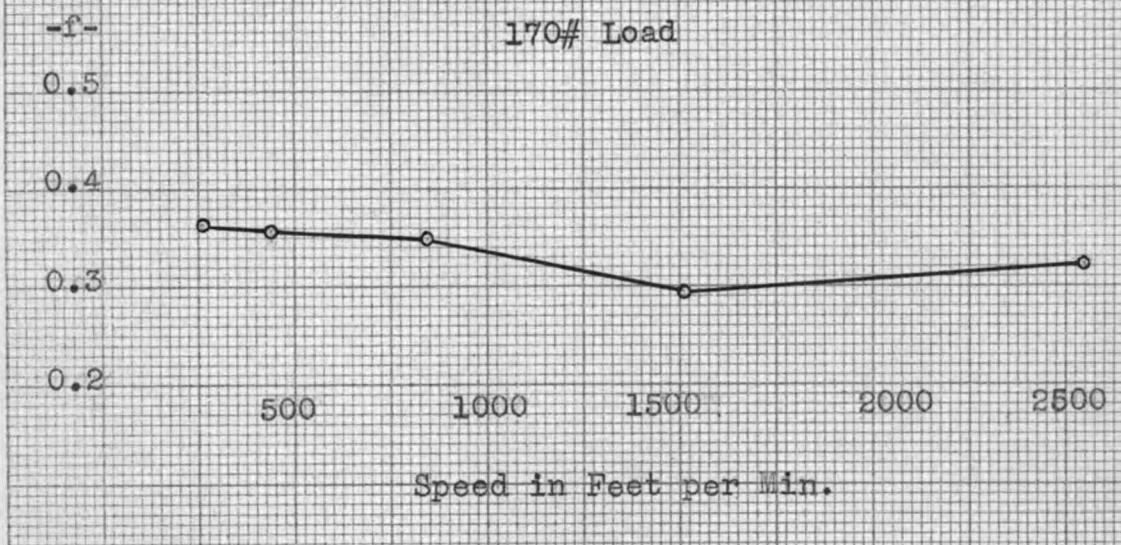
Speed in Feet per Min.

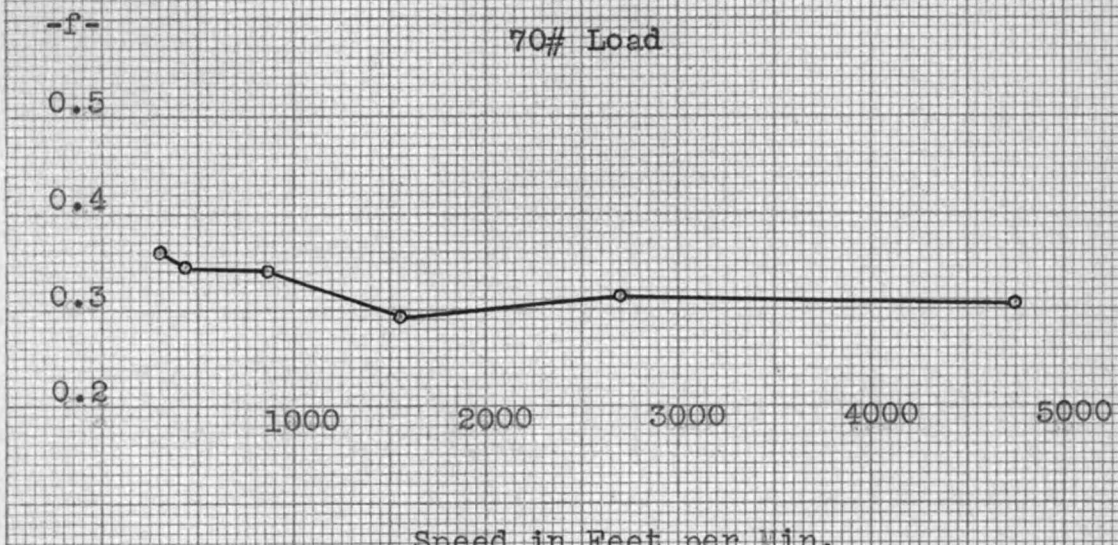
COEFFICIENT OF FRICTION (f)

vs.

SPEED

Lining #10 As Received



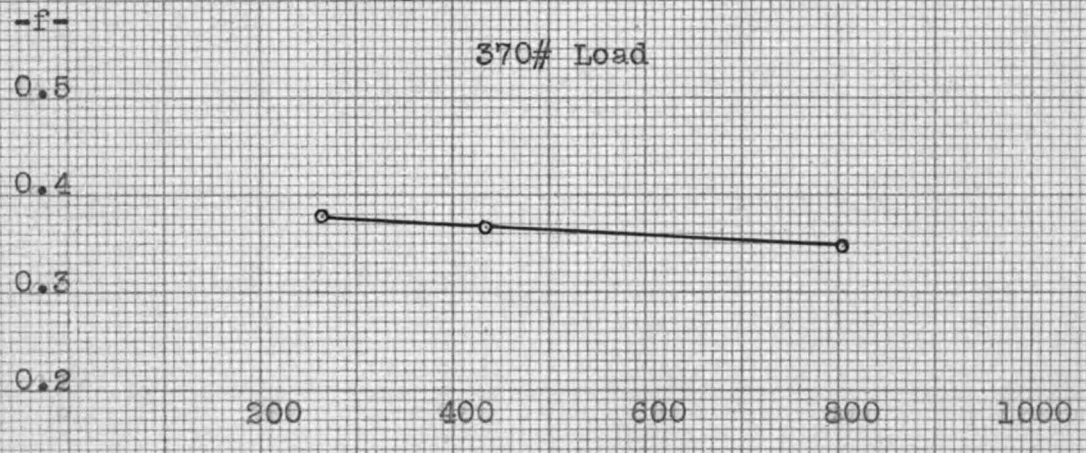


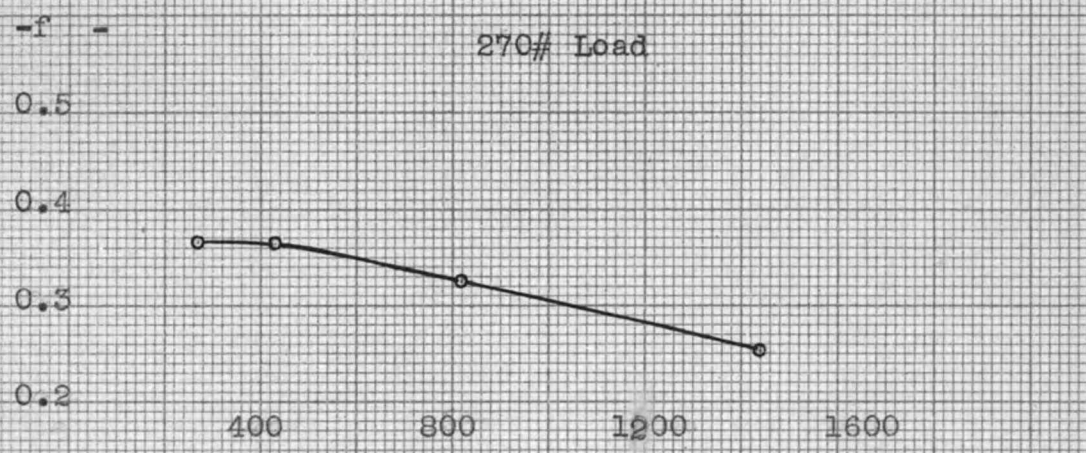
COEFFICIENT OF FRICTION (f)

vs.

SPEED

Lining #11 As Received





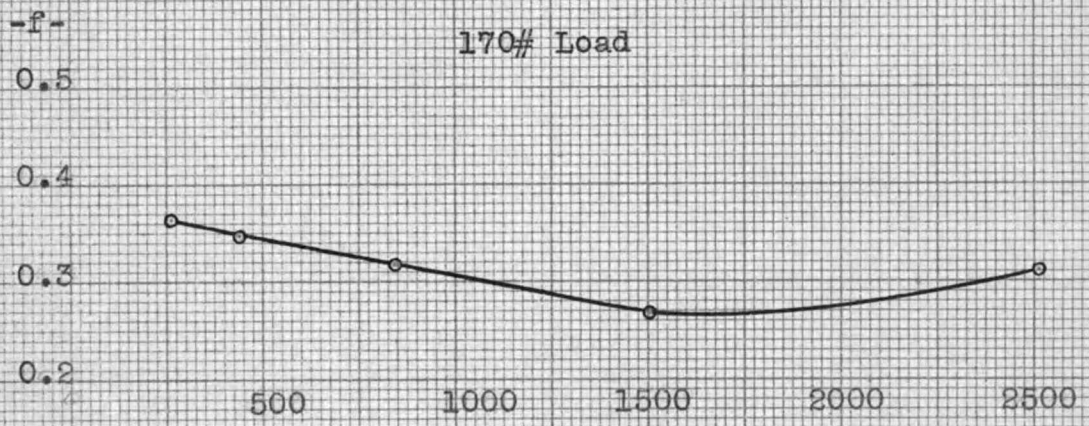
COEFFICIENT OF FRICTION (f)

vs.

SPEED

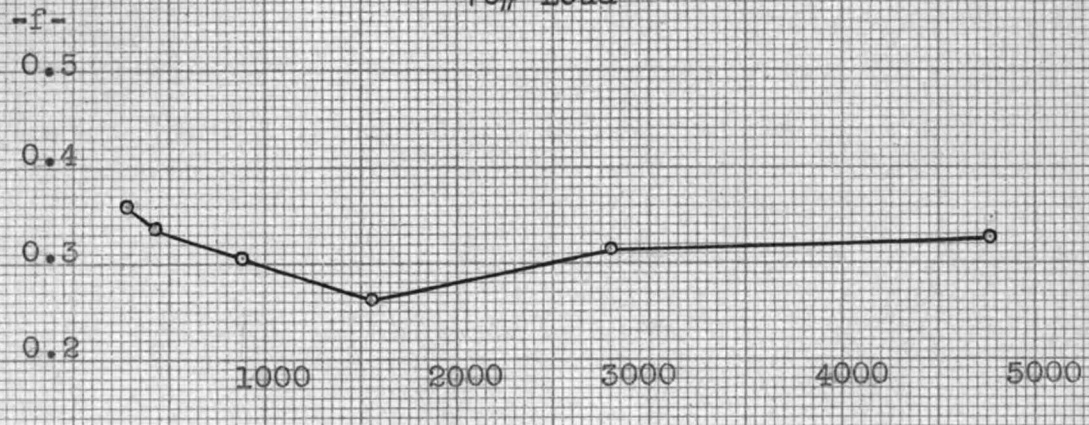
Lining #11 As Received

170# Load



Speed in Feet per Min.

70# Load



Speed in Feet per Min.

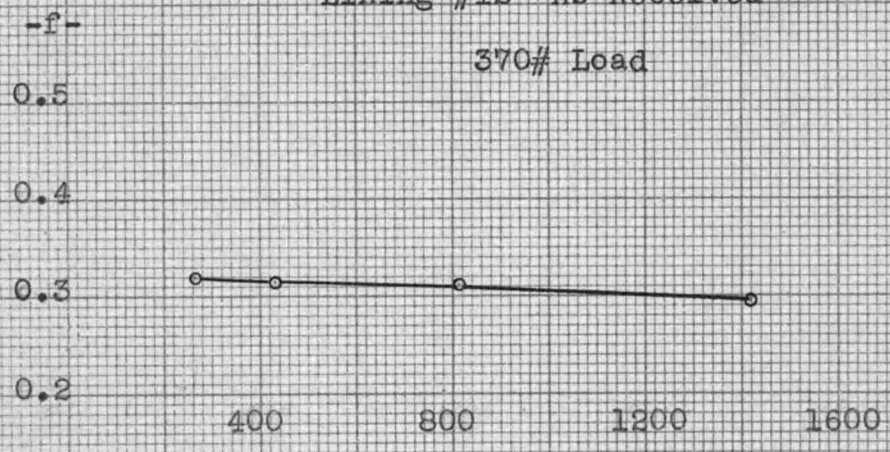
COEFFICIENT OF FRICTION (f)

vs.

SPEED

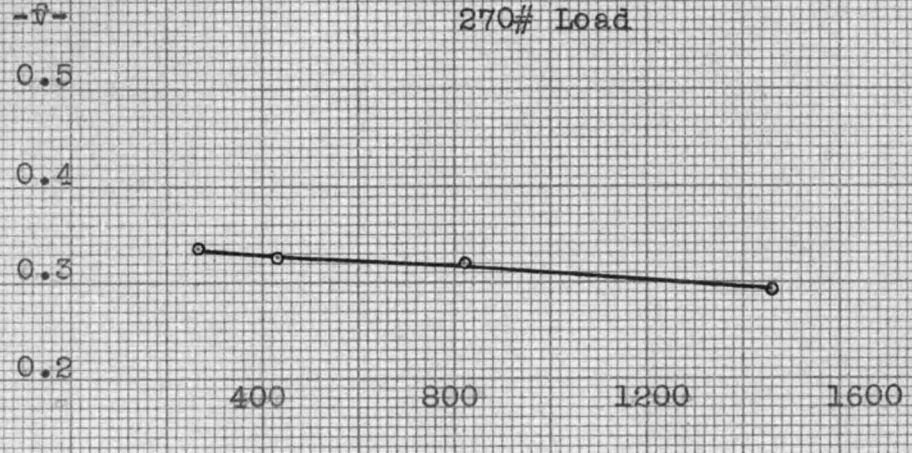
Lining #12 As Received

370# Load



Speed in Feet per Min.

270# Load



Speed in Feet per Min.

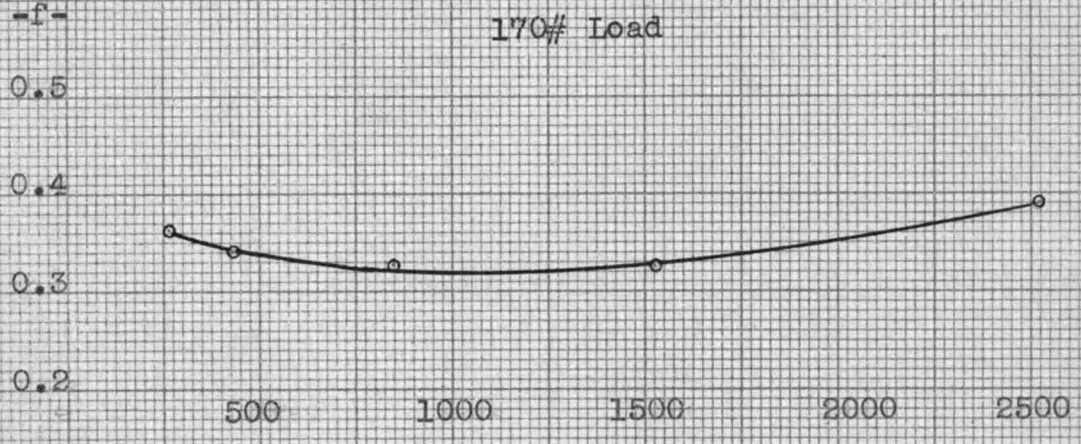
COEFFICIENT OF FRICTION (f)

vs.

SPEED

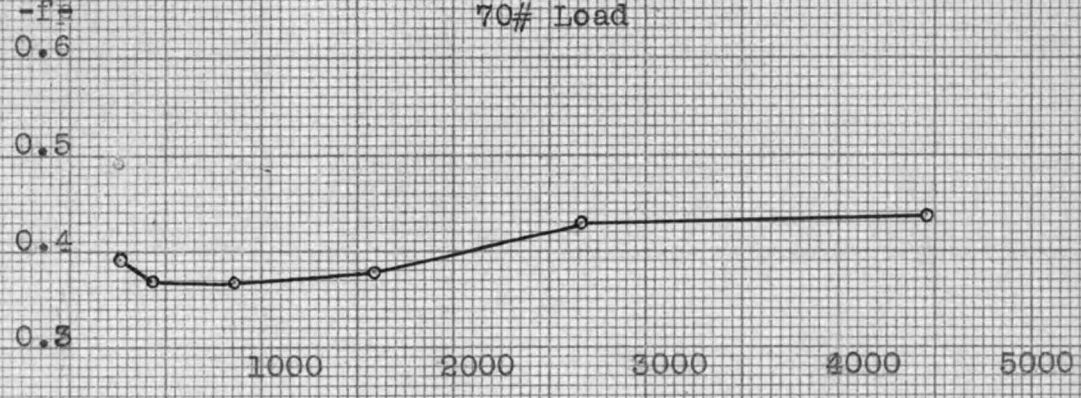
Lining #12 As received

170# Load



Speed in Feet per Min.

70# Load



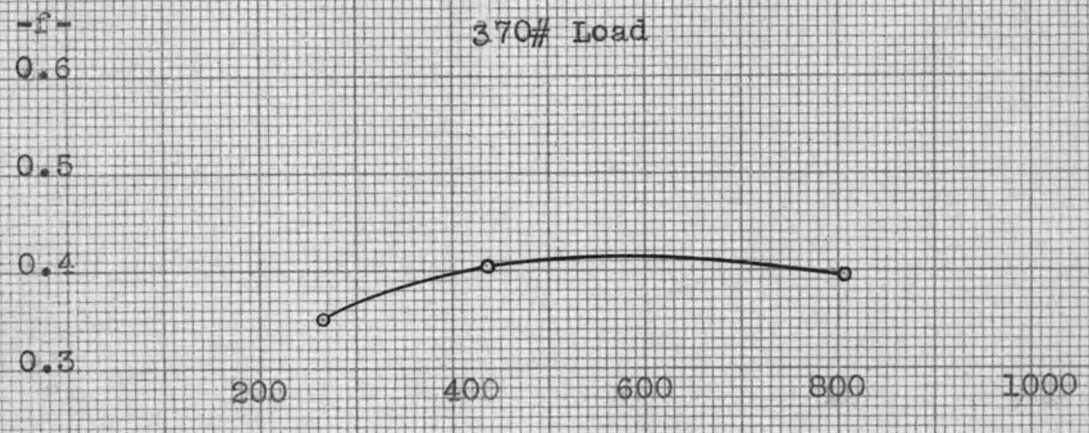
Speed in Feet per Min.

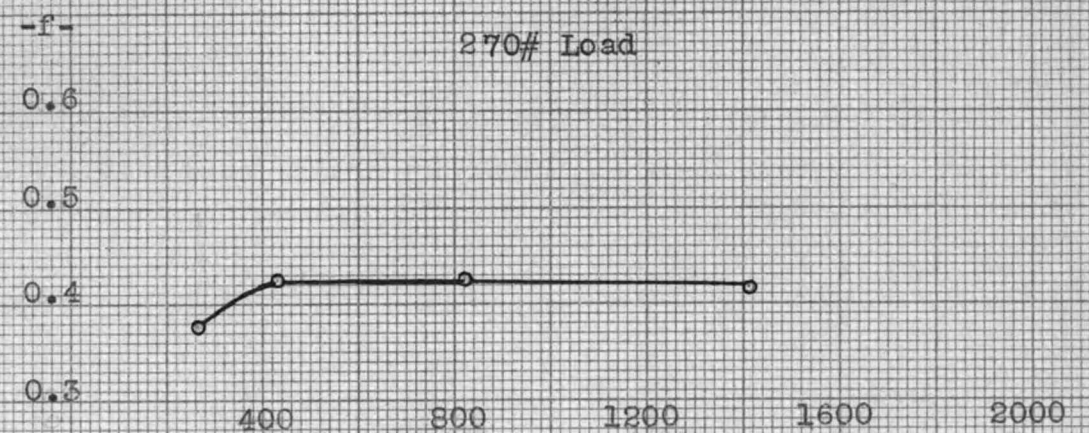
COEFFICIENT OF FRICTION (f)

vs.

SPEED

Lining #13 As Received



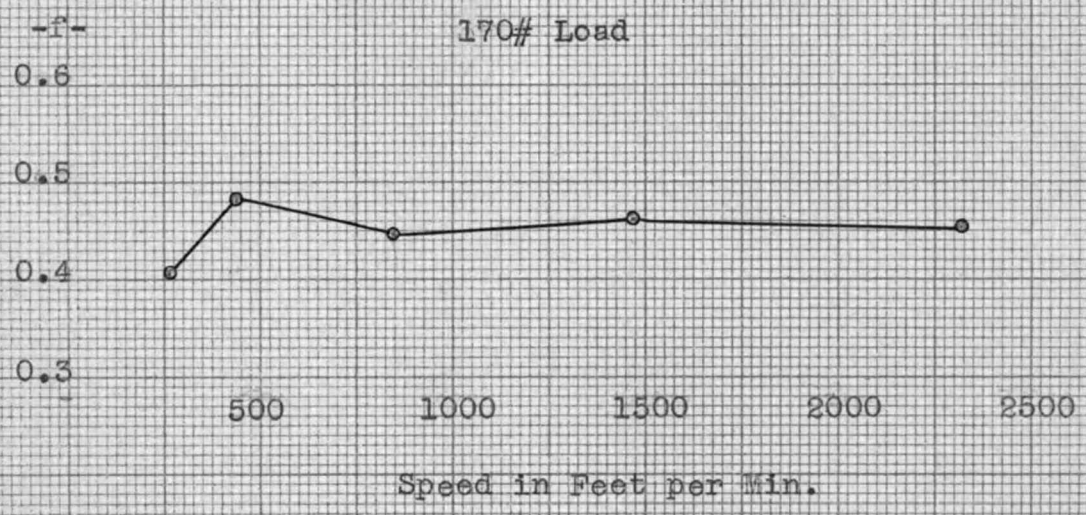


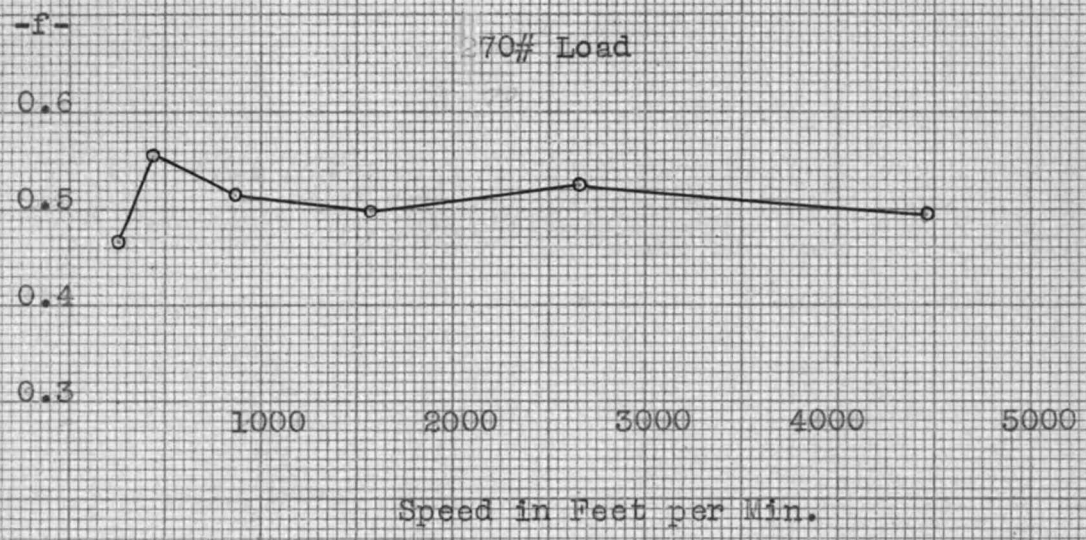
COEFFICIENT OF FRICTION (f)

vs.

SPEED

Lining #13 As Received



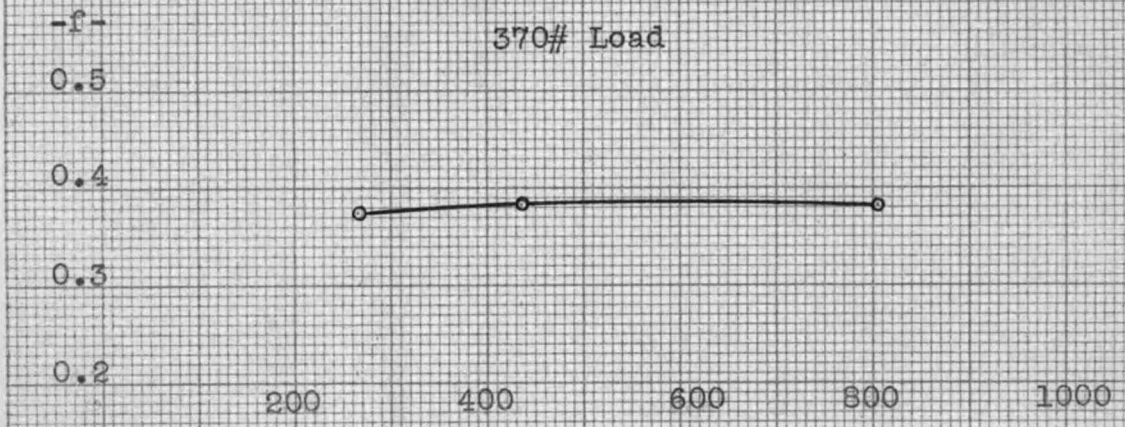


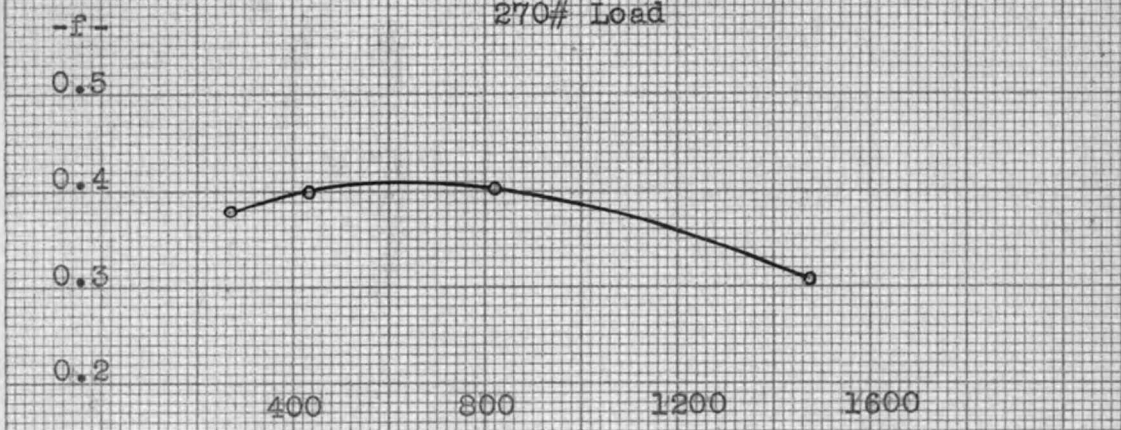
COEFFICIENT OF FRICTION (f)

vs.

SPEED

Lining #14 As Received



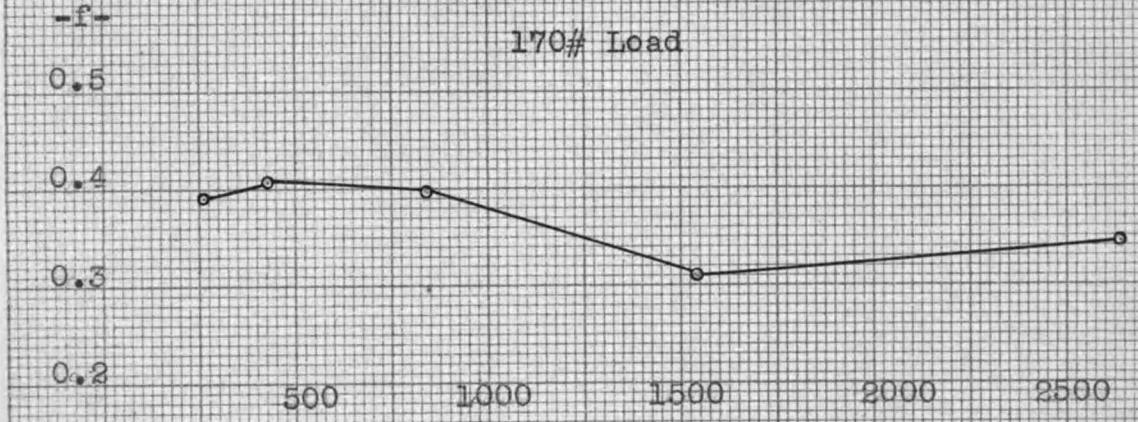


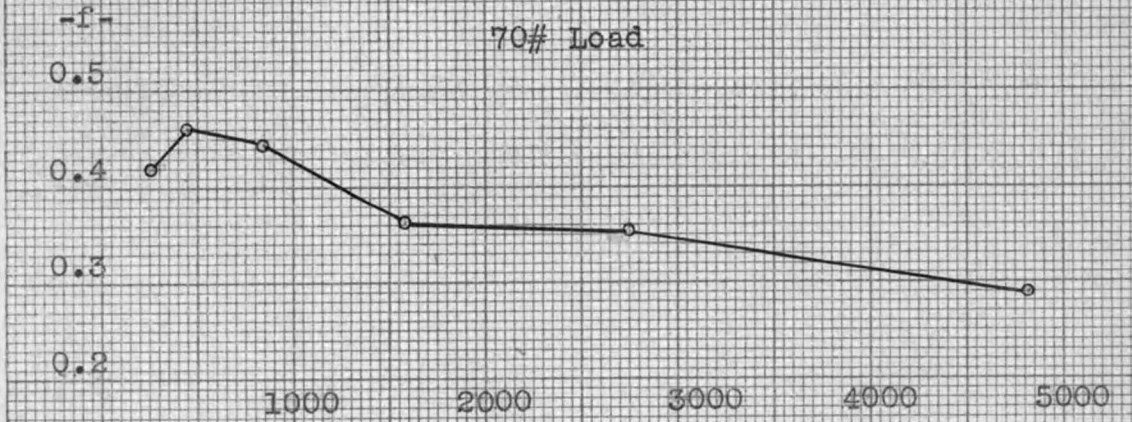
COEFFICIENT OF FRICTION (f)

vs.

SPEED

Lining #14 As Received





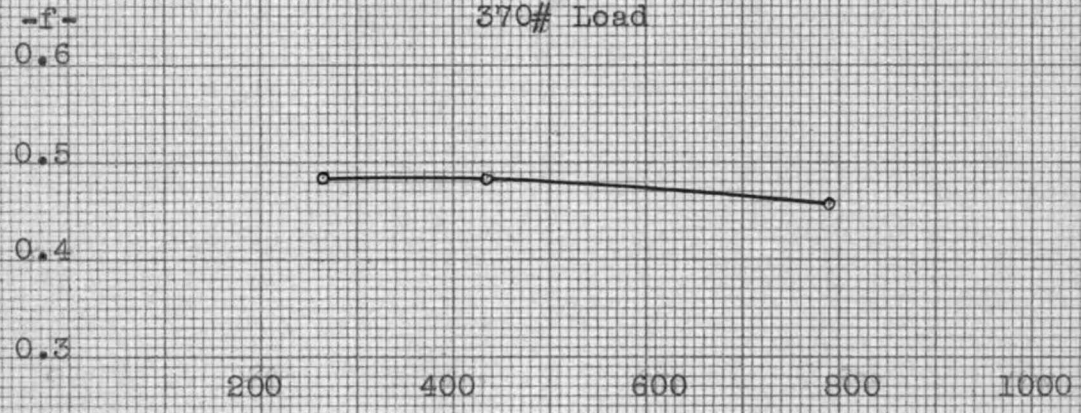
COEFFICIENT OF FRICTION (f)

vs.

SPEED

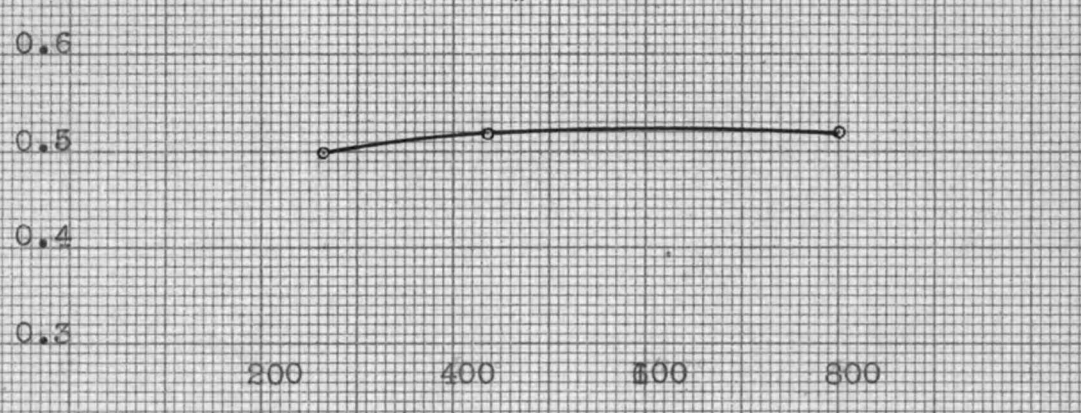
Lining No. 15 As Received

370# Load



Speed in Feet per Min.

270# Load



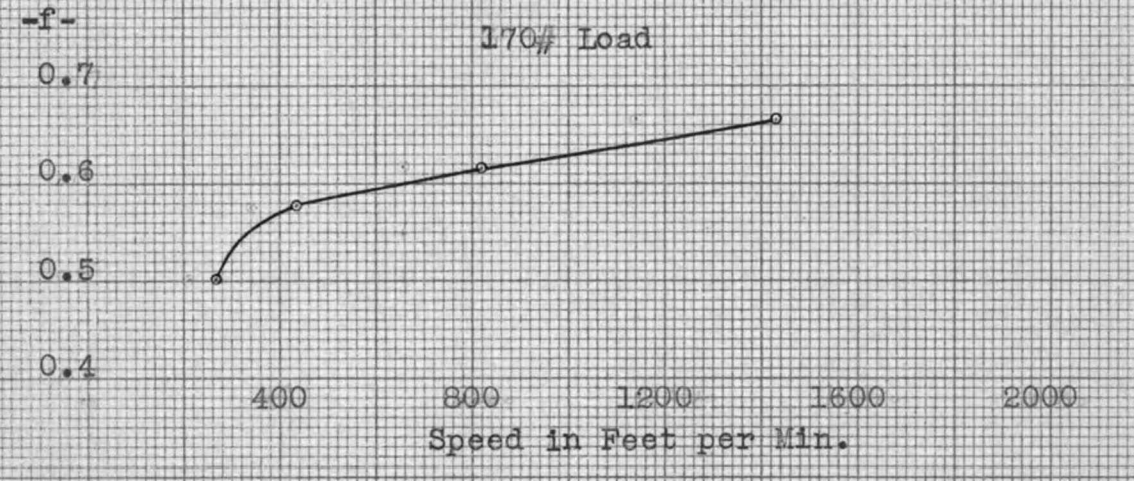
Speed in Feet per Min.

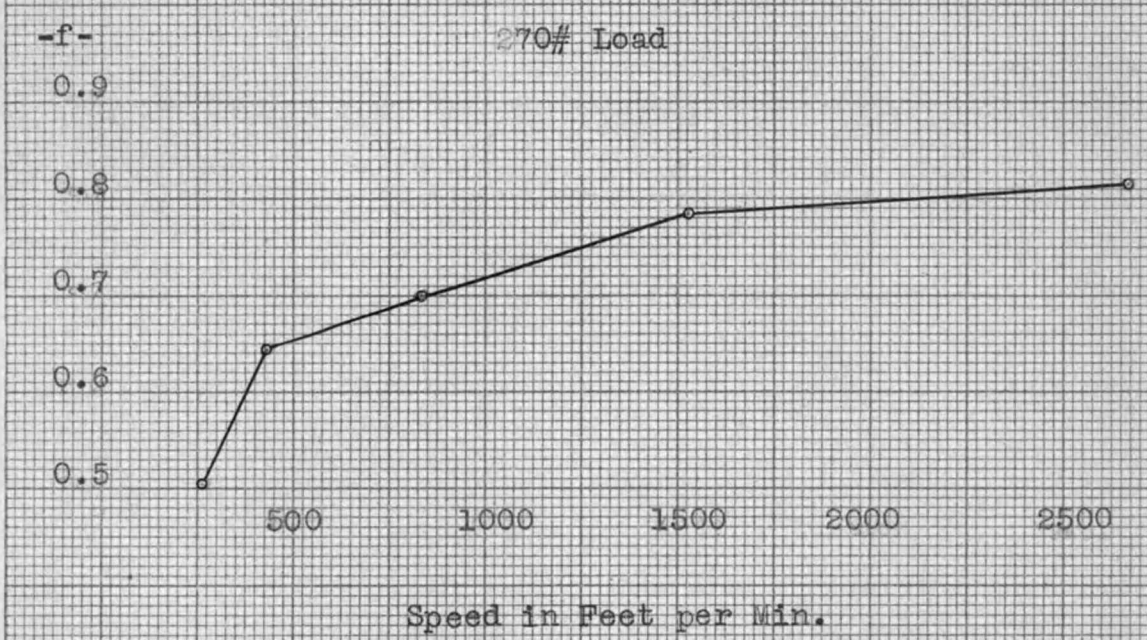
COEFFICIENT OF FRICTION (f)

vs.

SPEED

Lining # 15 As Received



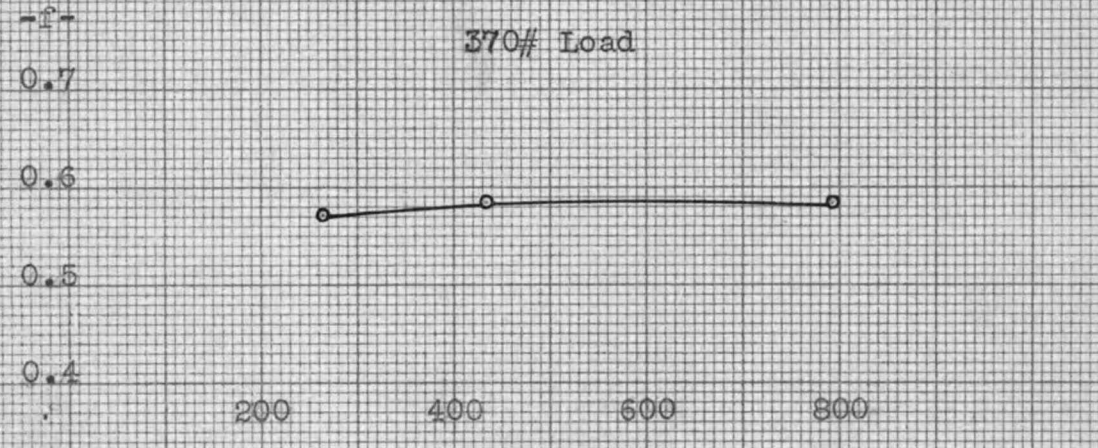


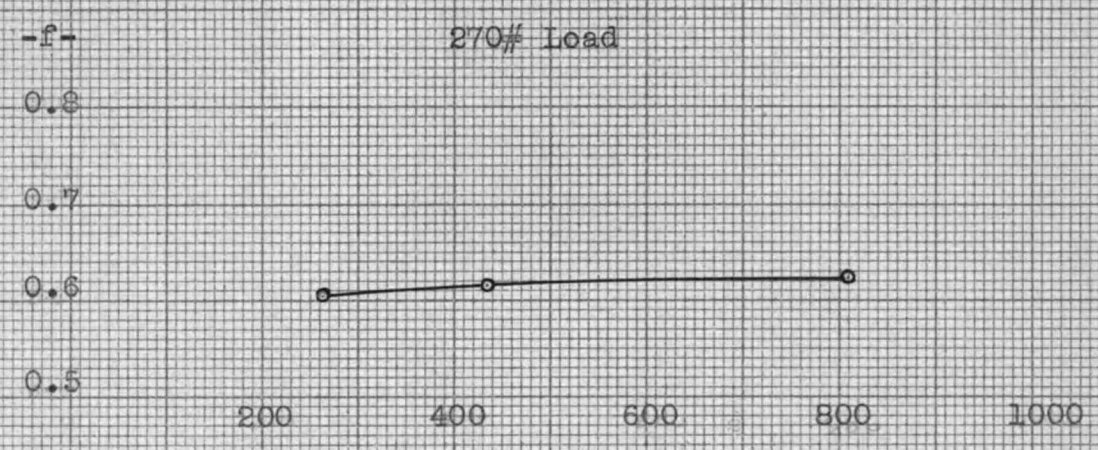
COEFFICIENT OF FRICTION (f)

vs.

SPEED

Lining # 16 As Received





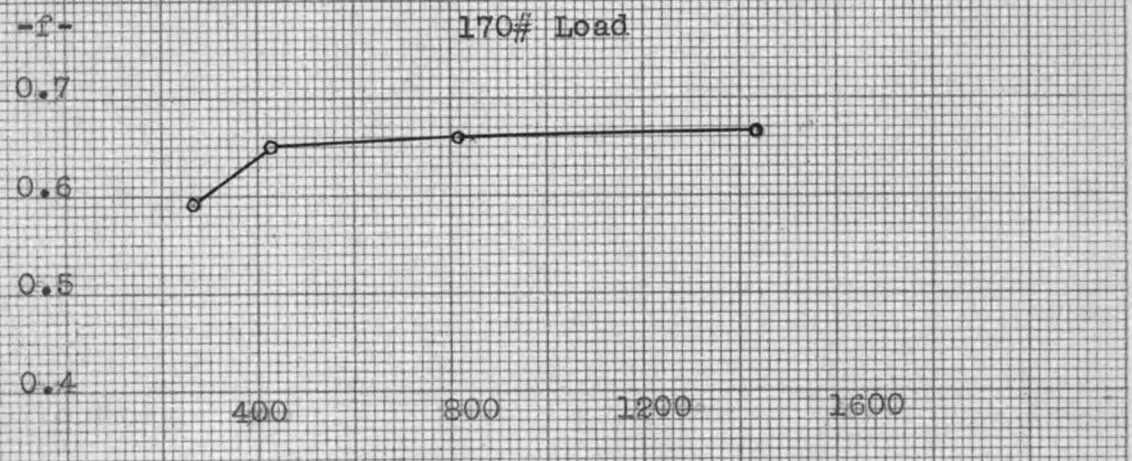
COEFFICIENT OF FRICTION (f)

vs.

SPEED

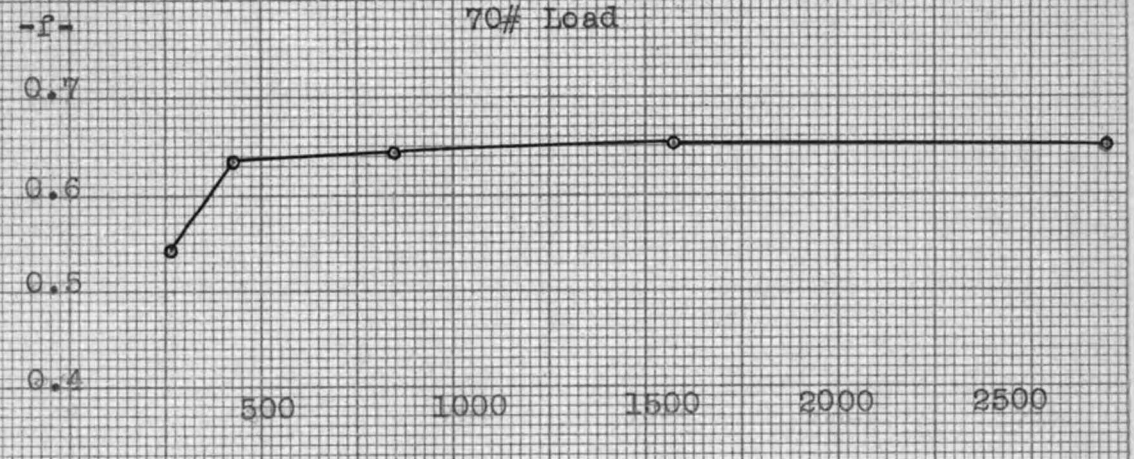
Lining #16 As Received

170# Load



Speed in Feet per Min.

70# Load



Speed in Feet per Min.

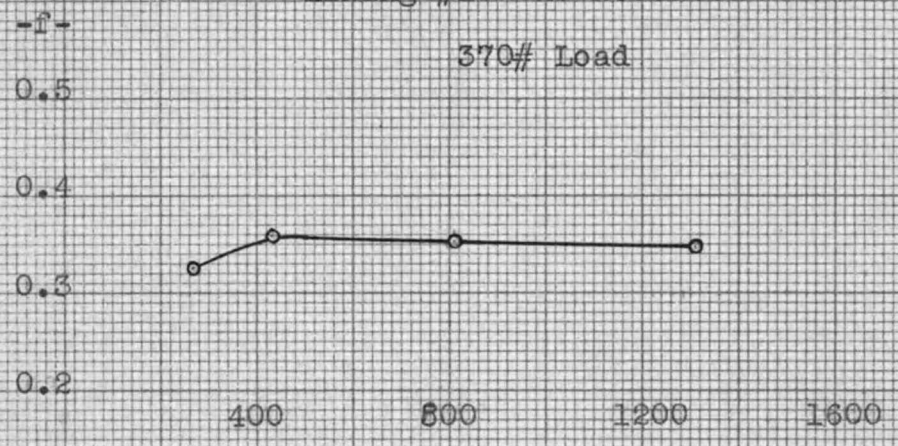
COEFFICIENT OF FRICTION

vs.

SPEED

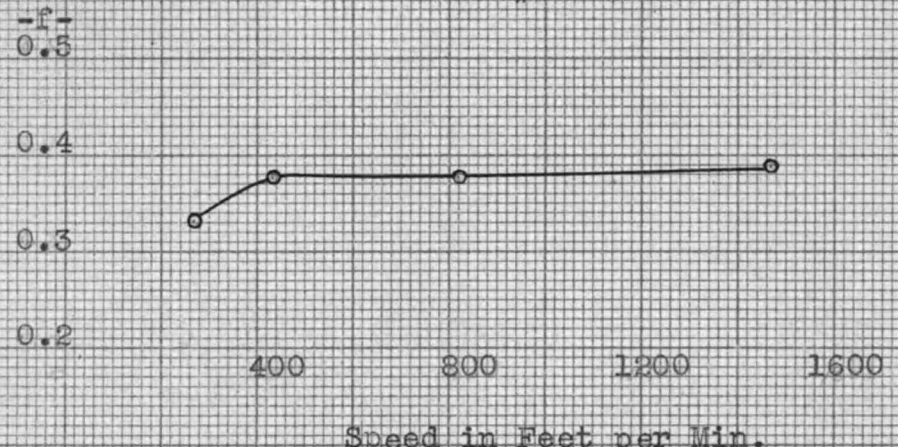
Lining #18 As Received

370# Load



Speed in Feet per Min.

270# Load



Speed in Feet per Min.

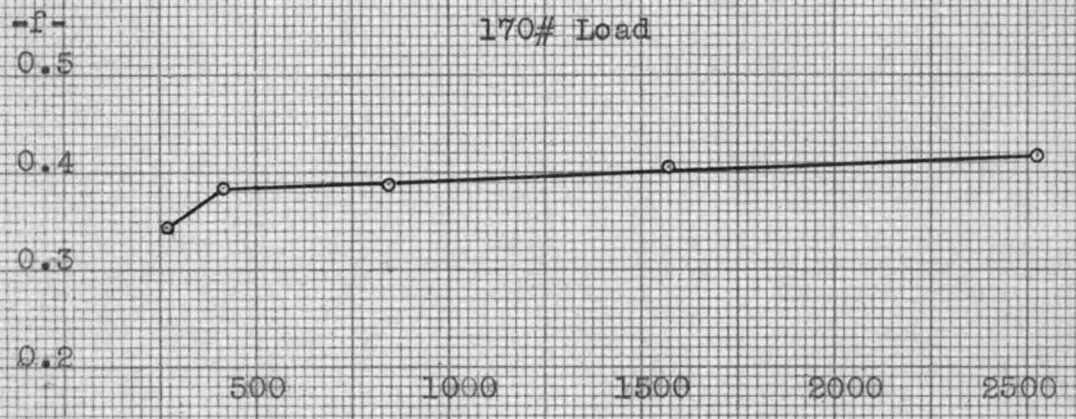
COEFFICIENT OF FRICTION (f)

vs.

SPEED

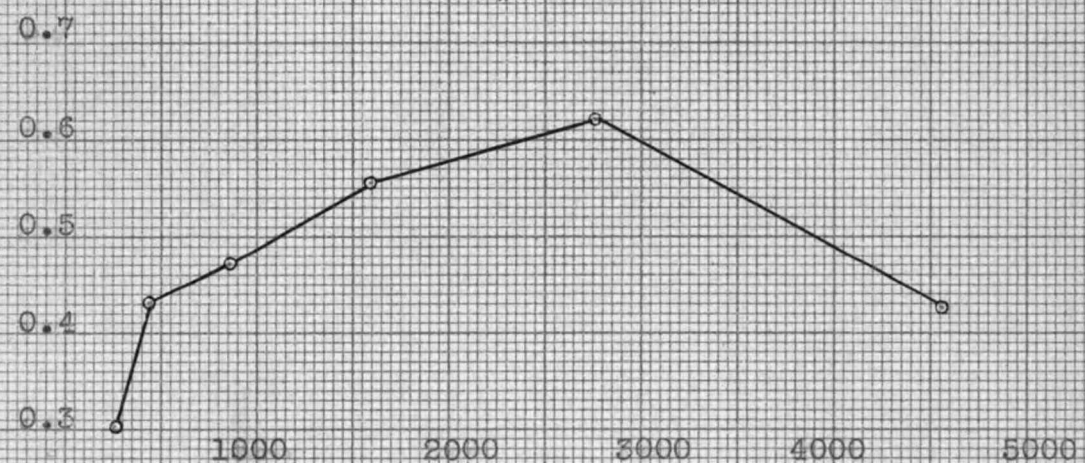
Lining # 18 As Received

170# Load



Speed in Feet per Min.

70# Load



Speed in Feet per Min.

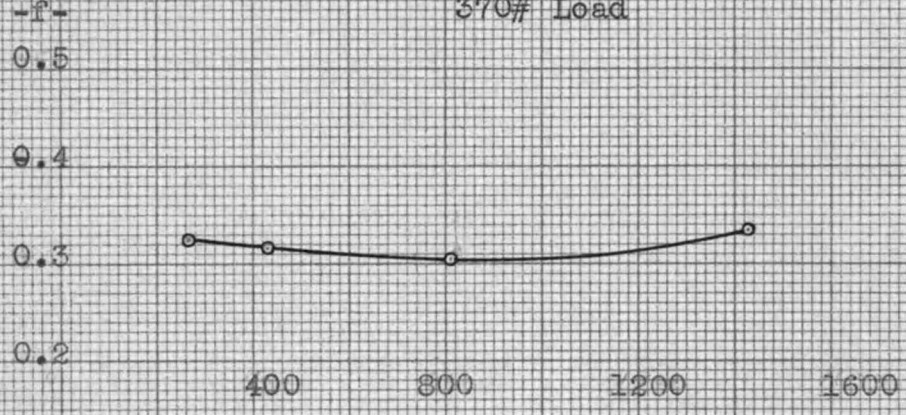
COEFFICIENT OF FRICTION (f)

vs.

SPEED

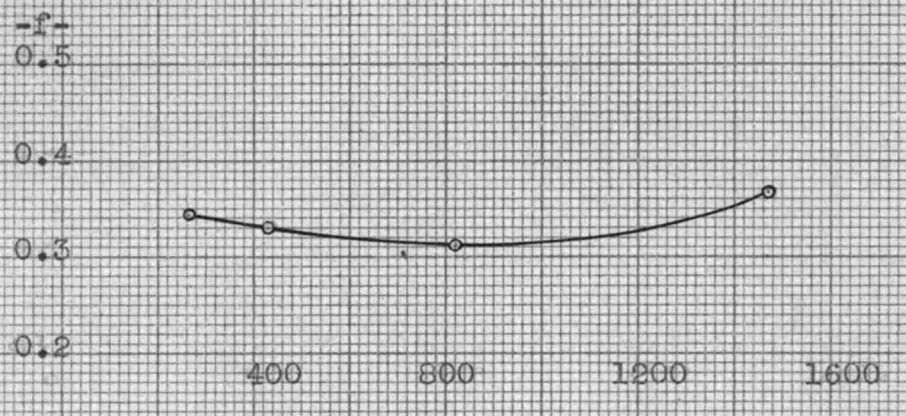
Lining # 19 As Received

370# Load



Speed in Feet per Min.

270# Load



Speed in Feet per Min.

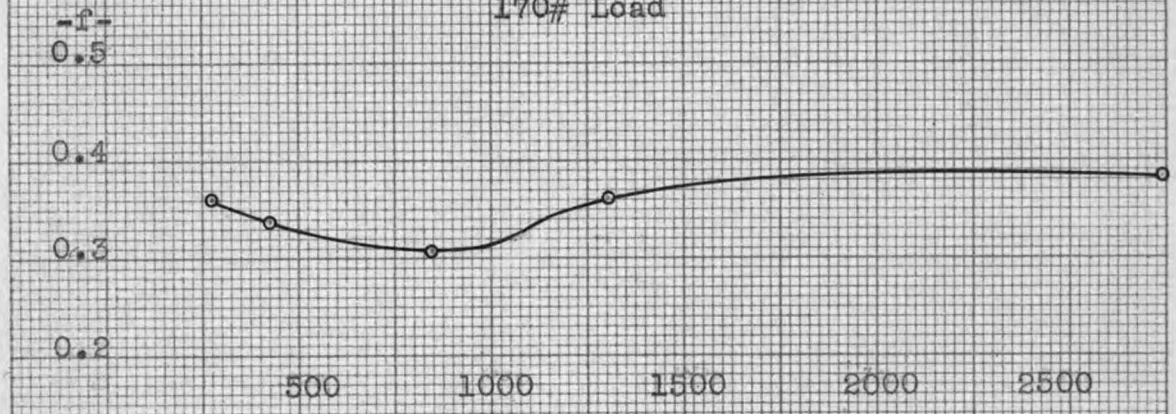
COEFFICIENT OF FRICTION (f)

vs.

SPEED

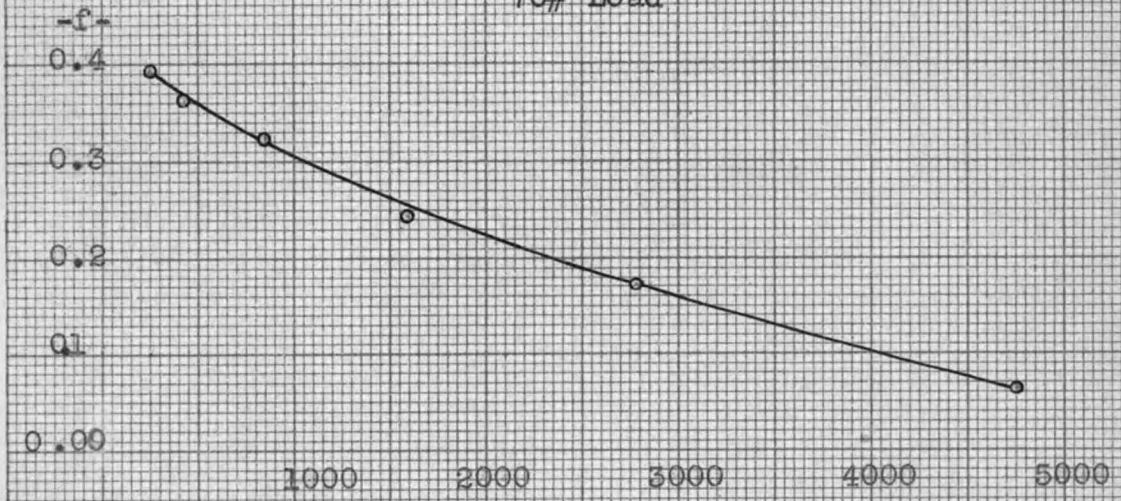
Lining #19 As Received

170# Load



Speed in Feet per Min.

70# Load



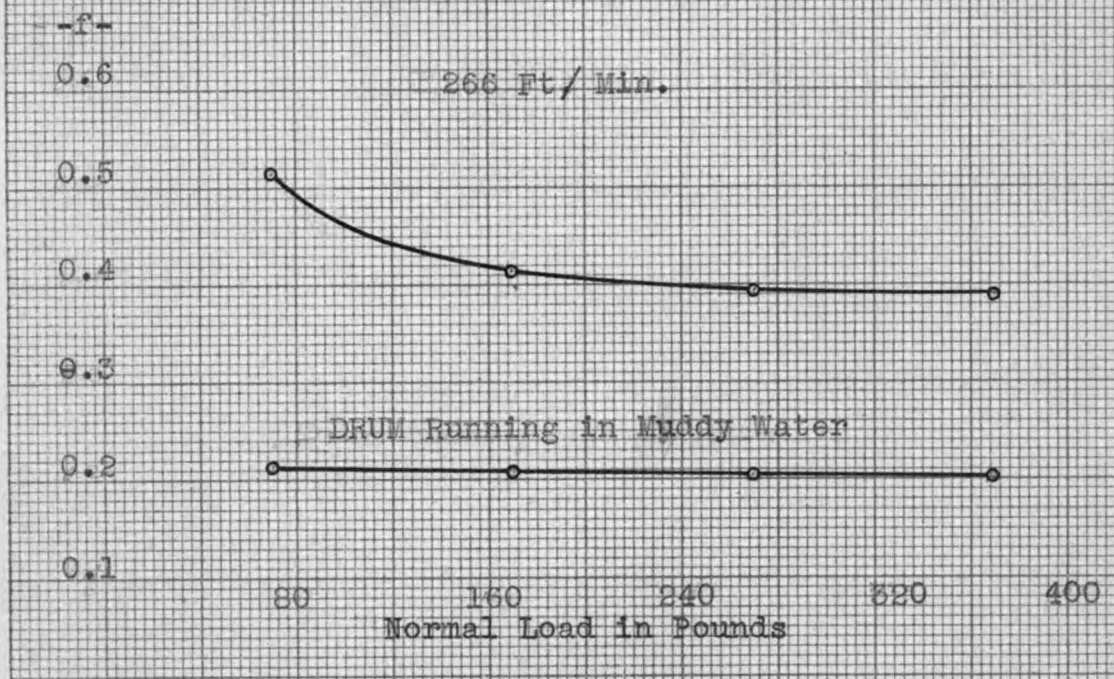
Speed in Feet per Min.

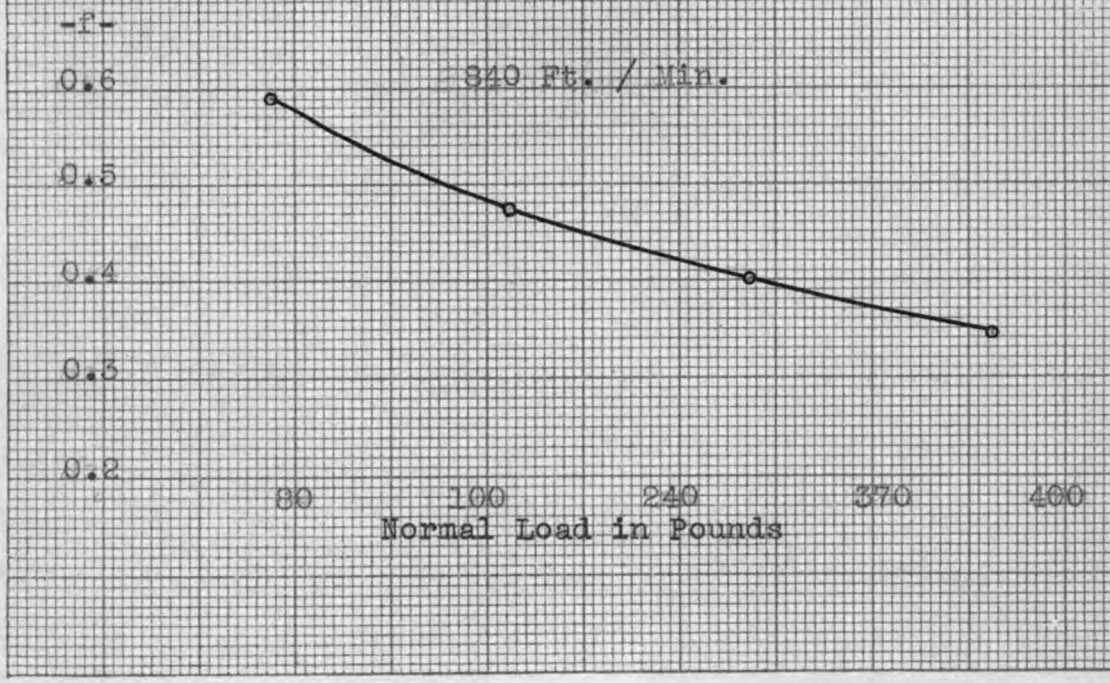
COEFFICIENT OF FRICTION (f)

vs.

NORMAL LOAD

Lining #1 As Received



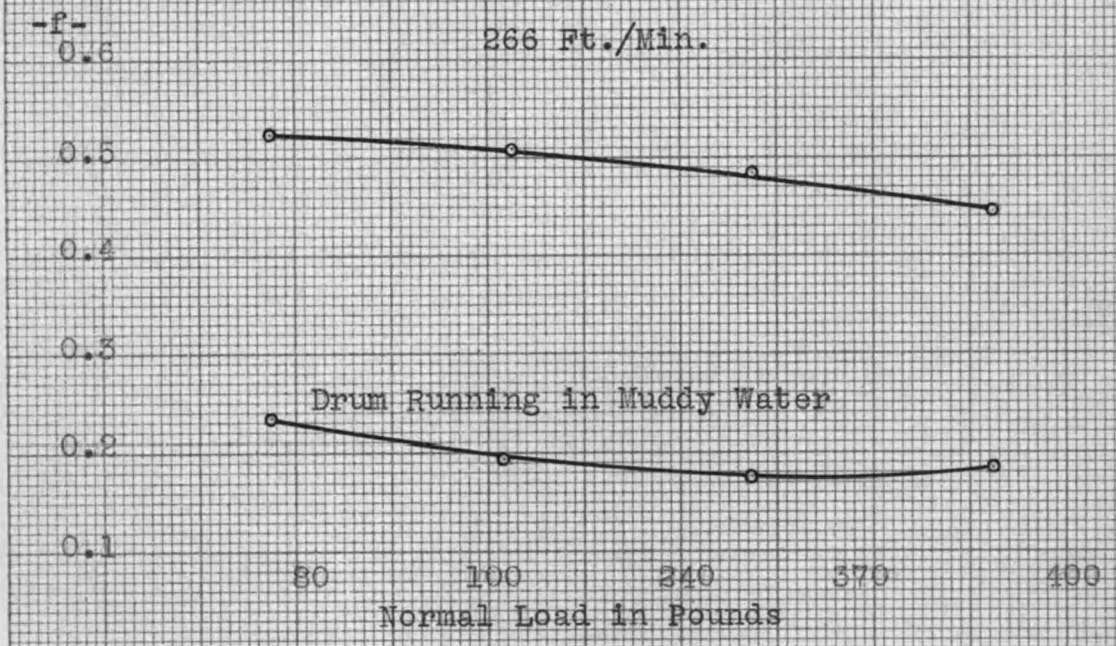


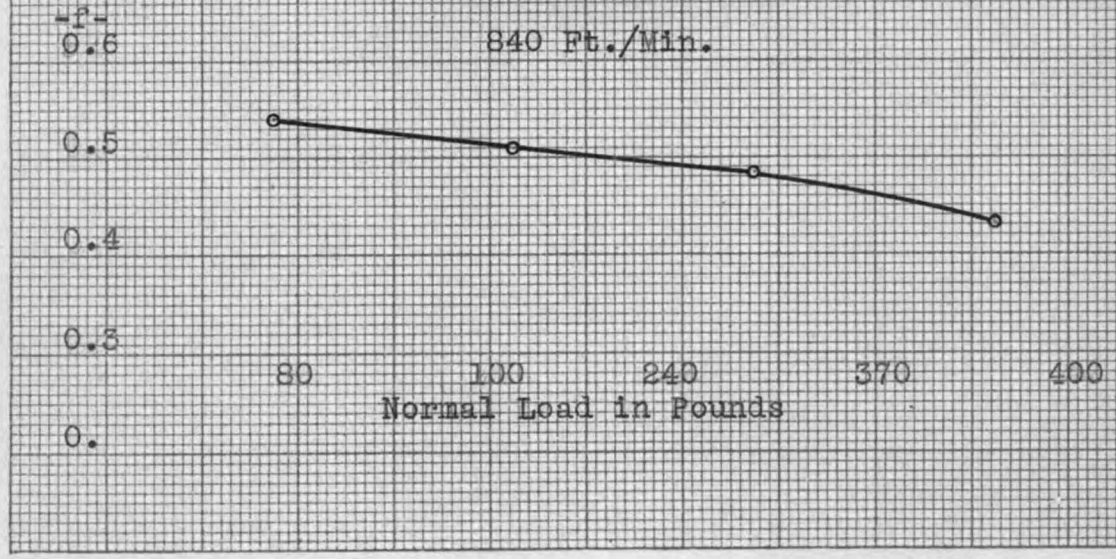
COEFFICIENT OF FRICTION (f)

vs.

NORMAL LOAD

Lining #2 As Received



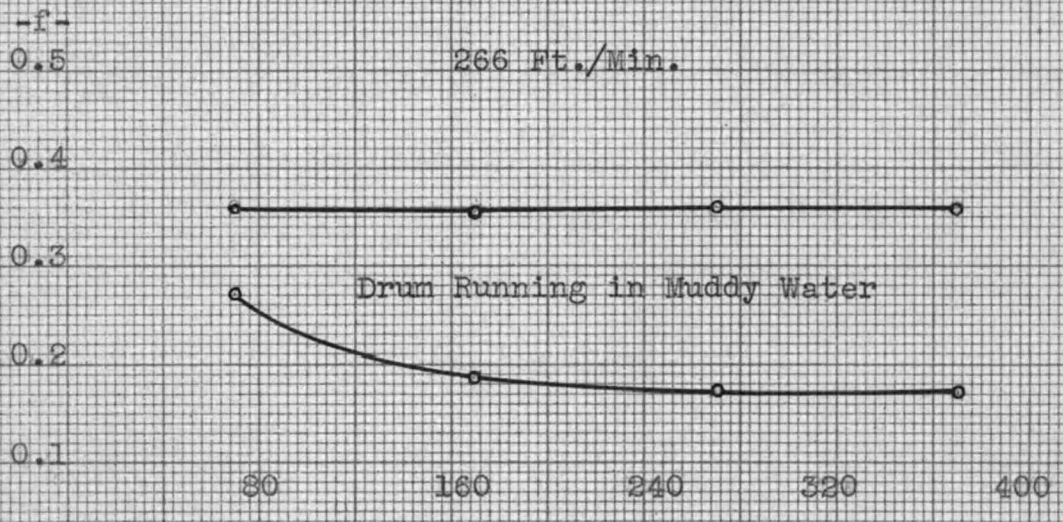


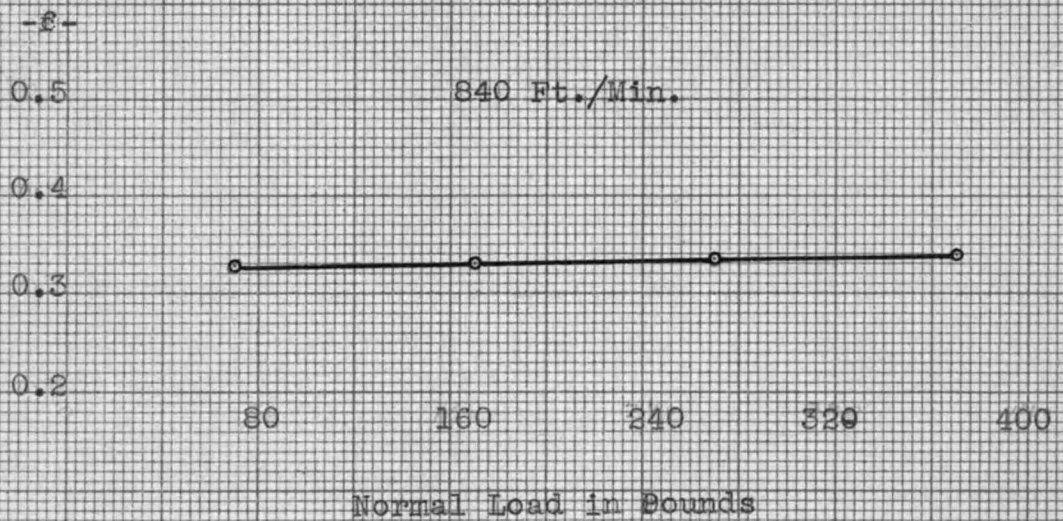
COEFFICIENT OF FRICTION (f)

vs.

NORMAL LOAD

Lining #3 As Received



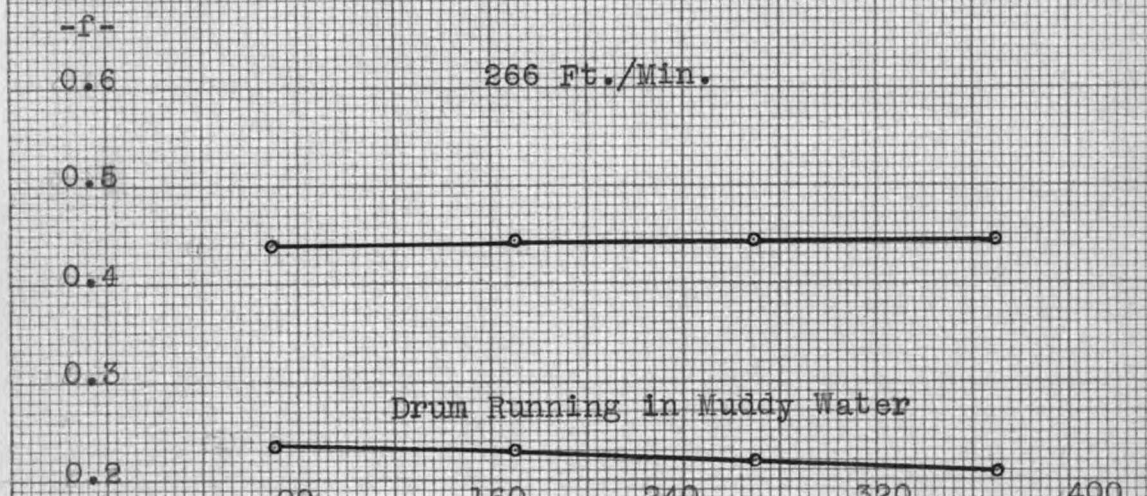


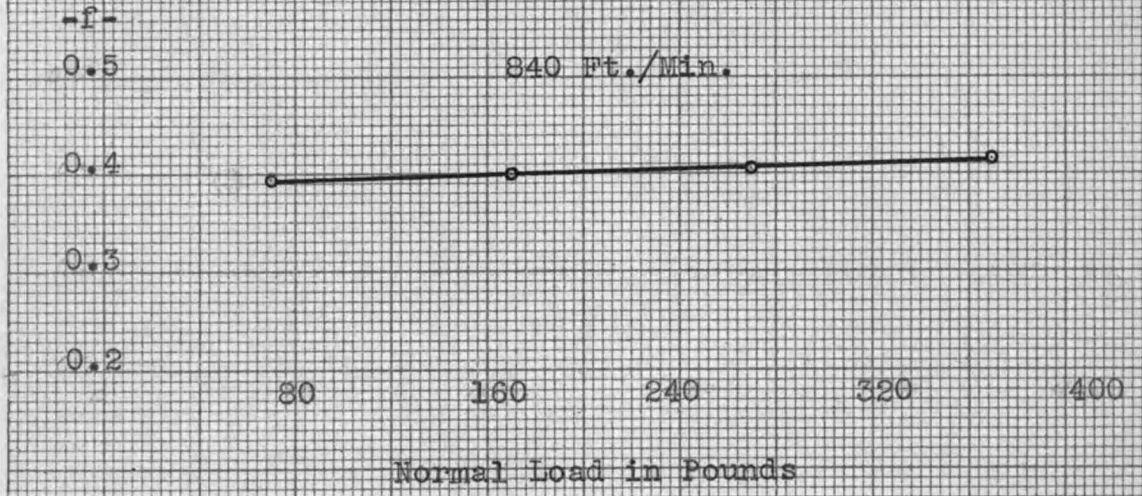
COEFFICIENT OF FRICTION (f)

vs.

NORMAL LOAD

Lining #4 As Received



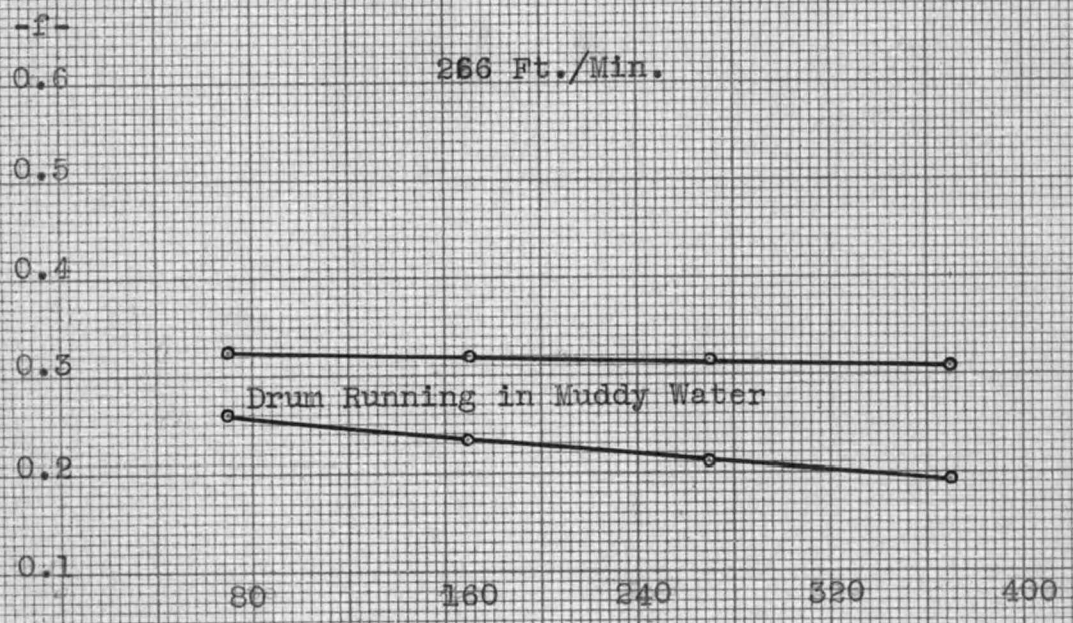


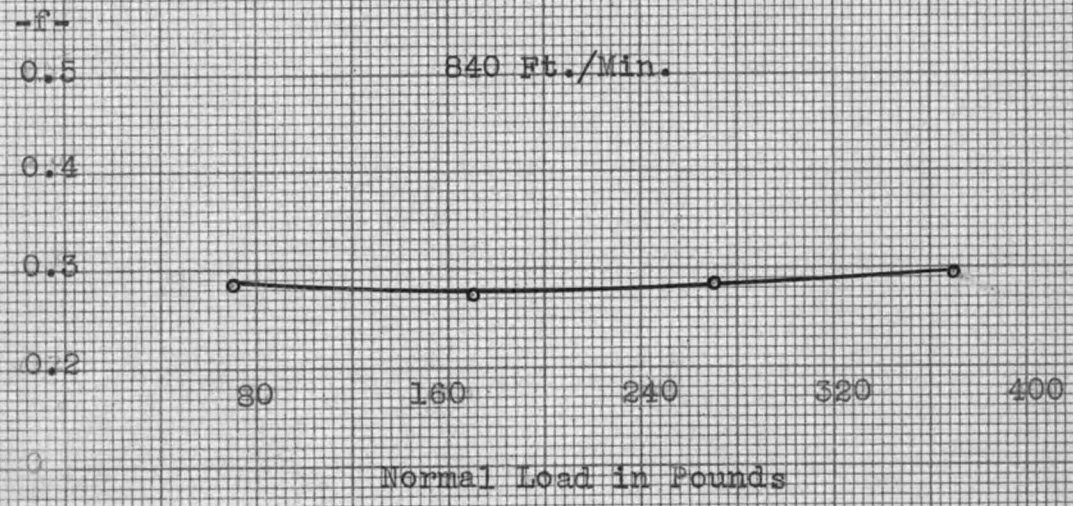
COEFFICIENT OF FRICTION (f)

vs.

NORMAL LOAD

Lining #5 As Received



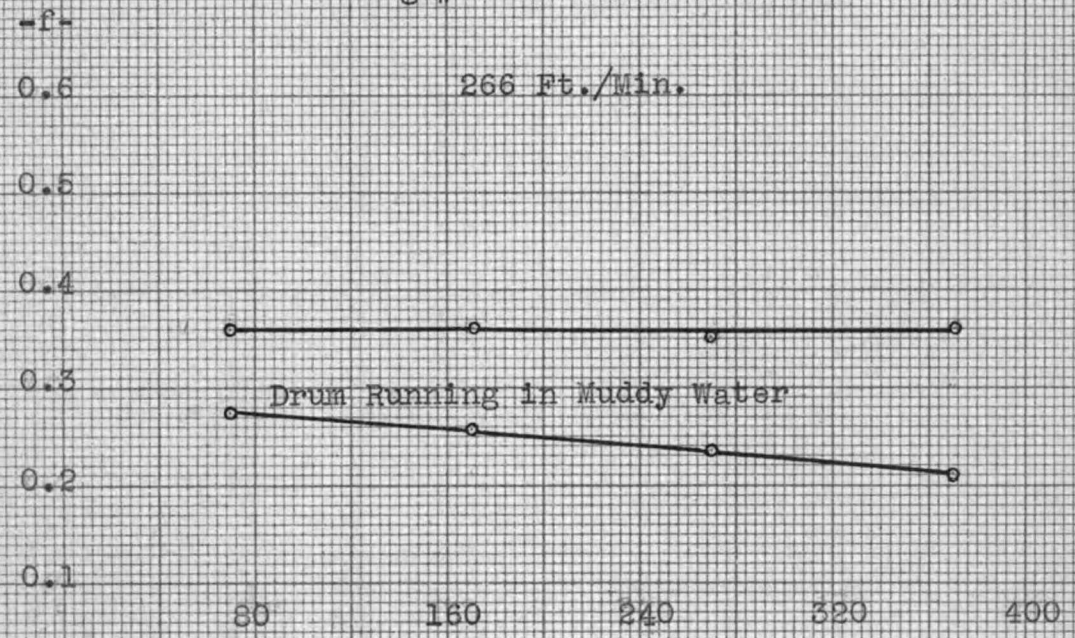


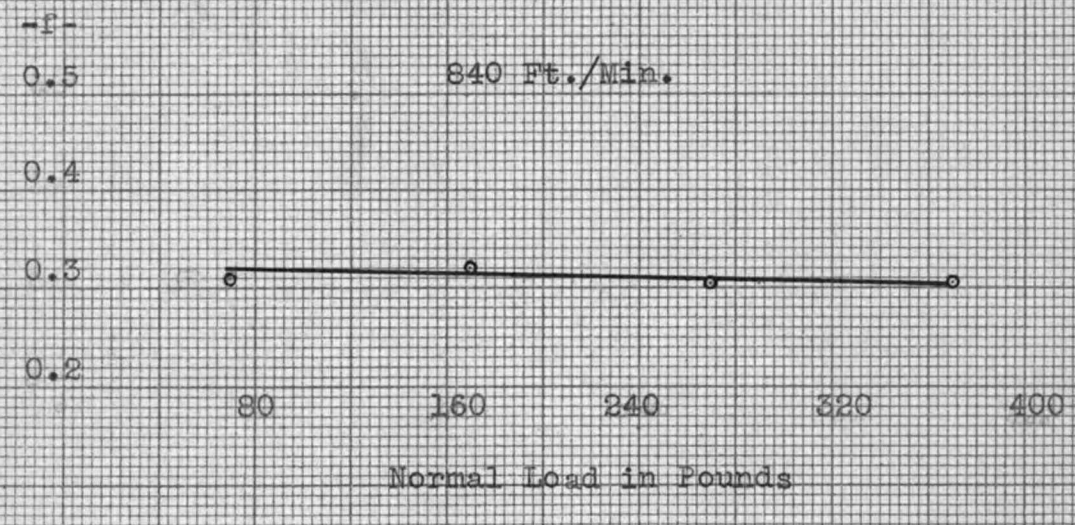
COEFFICIENT OF FRICTION (f)

vs.

NORMAL LOAD

Lining #6 As Received



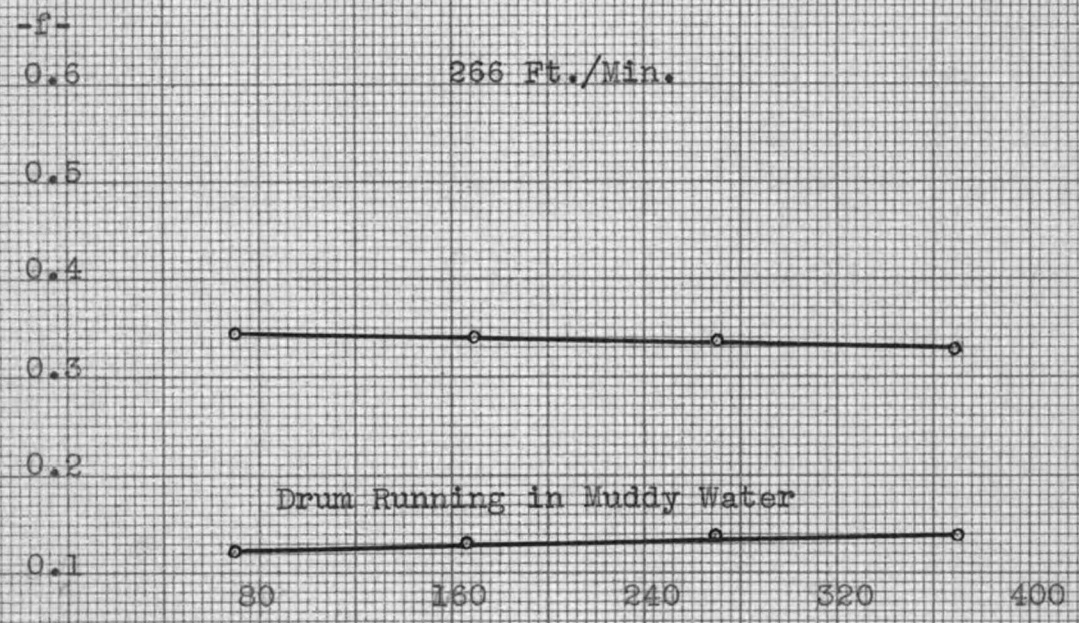


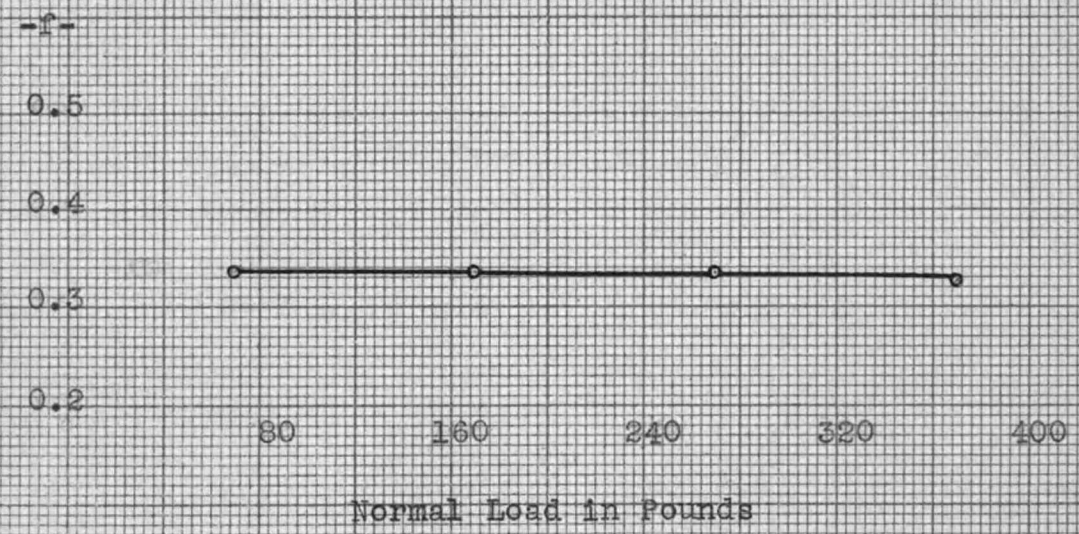
COEFFICIENT OF FRICTION (f)

vs.

NORMAL LOAD

Lining #7 As Received



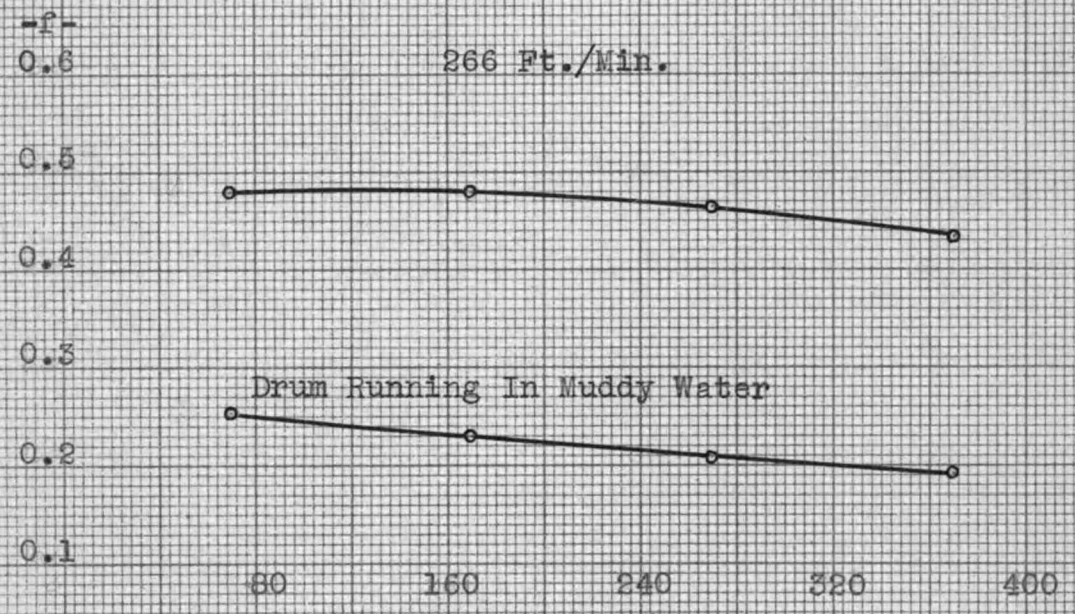


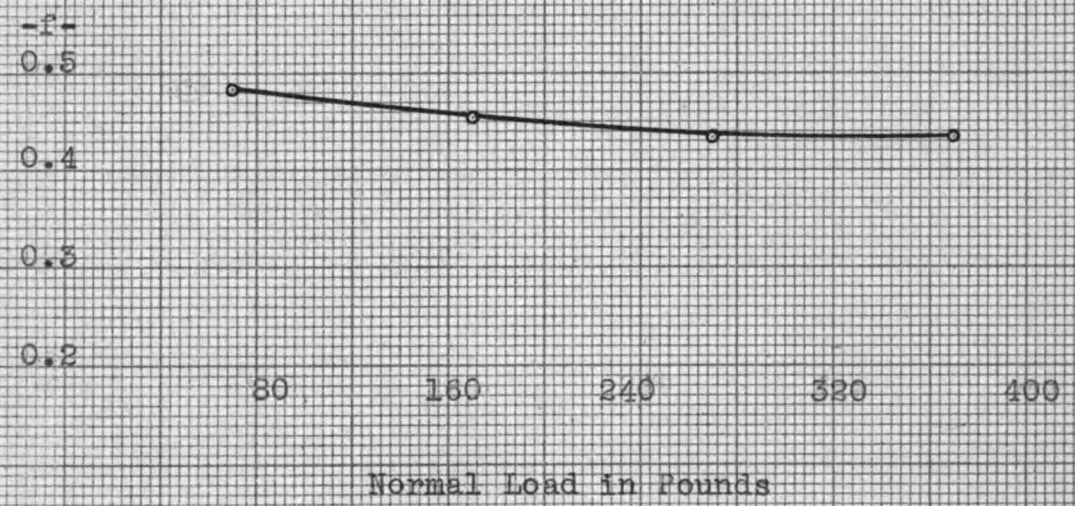
COEFFICIENT OF FRICTION (f)

vs.

NORMAL LOAD

Lining #8 As Received



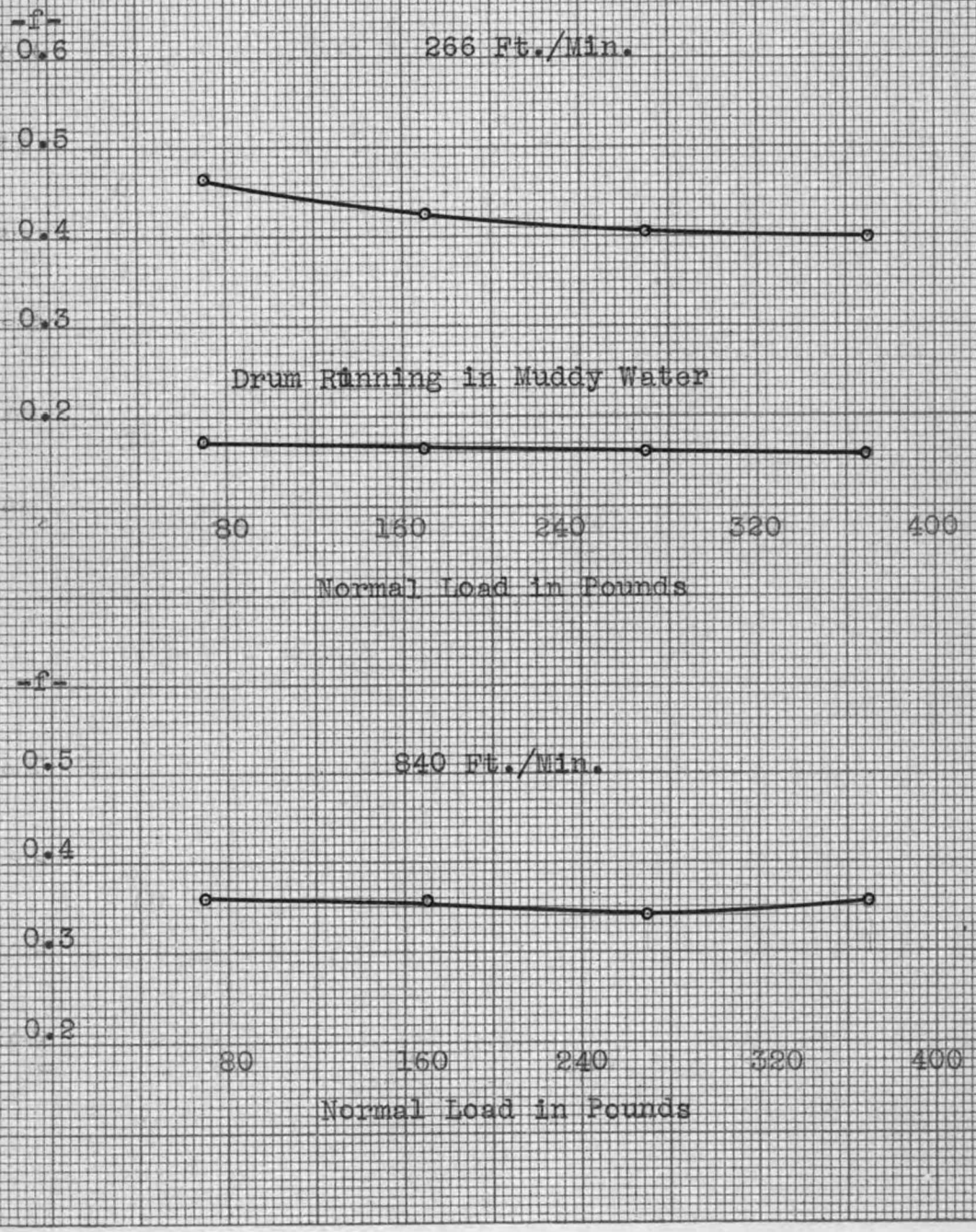


COEFFICIENT OF FRICTION (f)

vs.

NORMAL LOAD

Lining #90 As Received

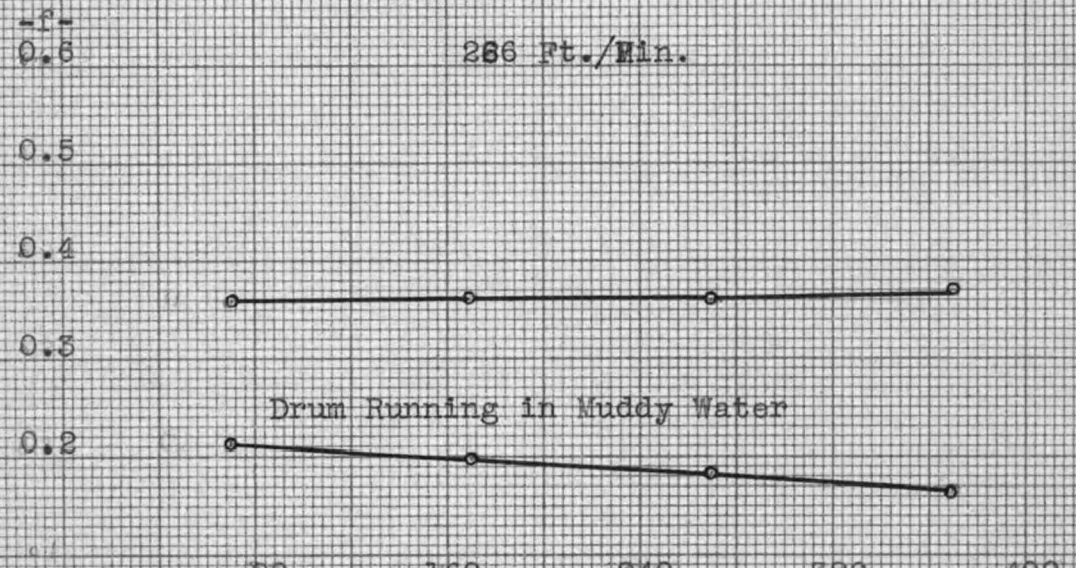


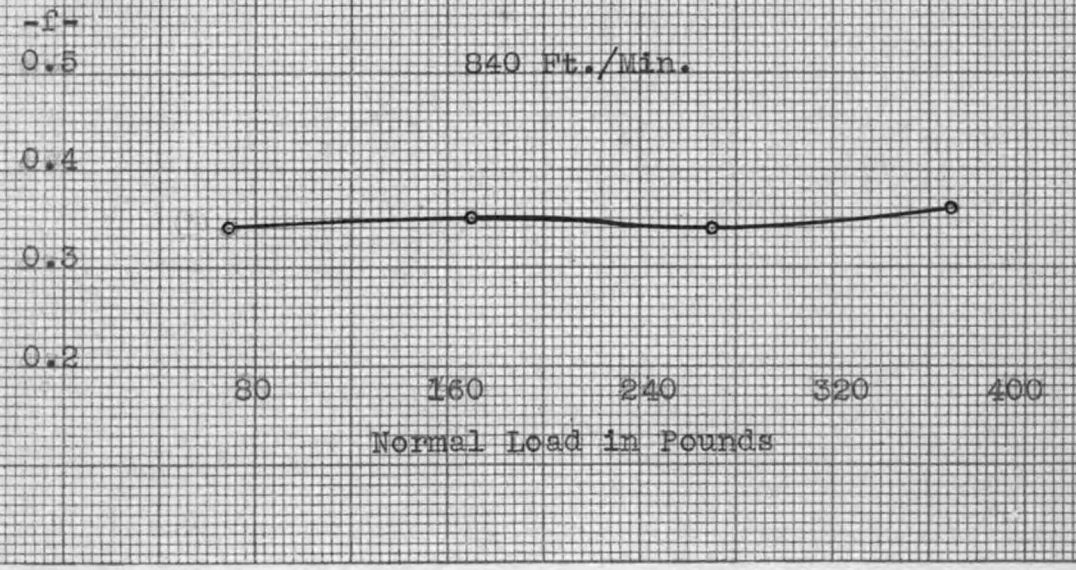
COEFFICIENT OF FRICTION (f)

vs.

NORMAL LOAD

Lining #10 As Received



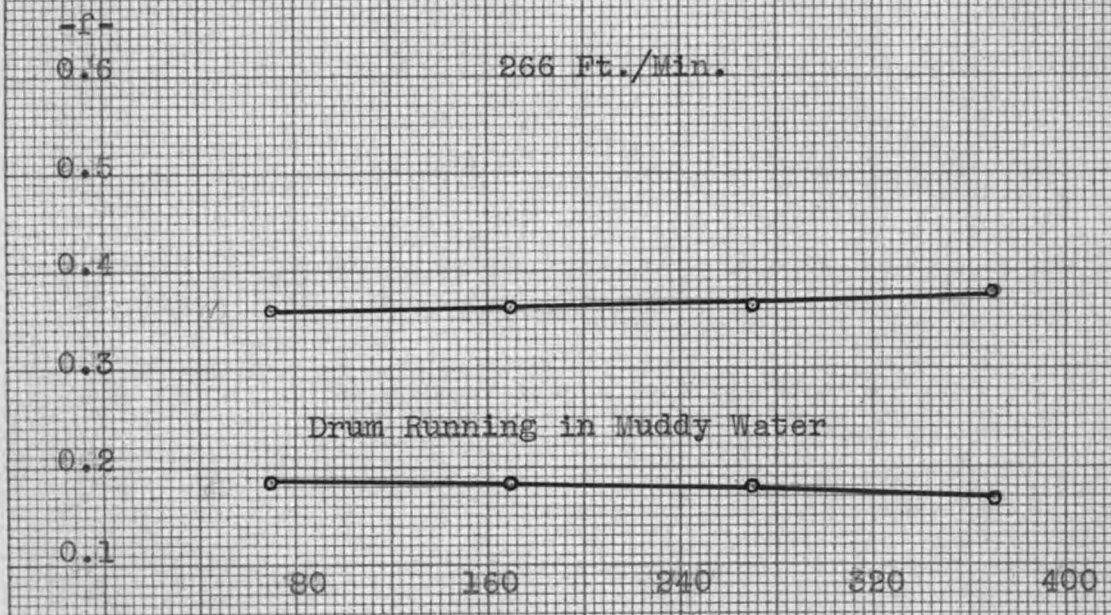


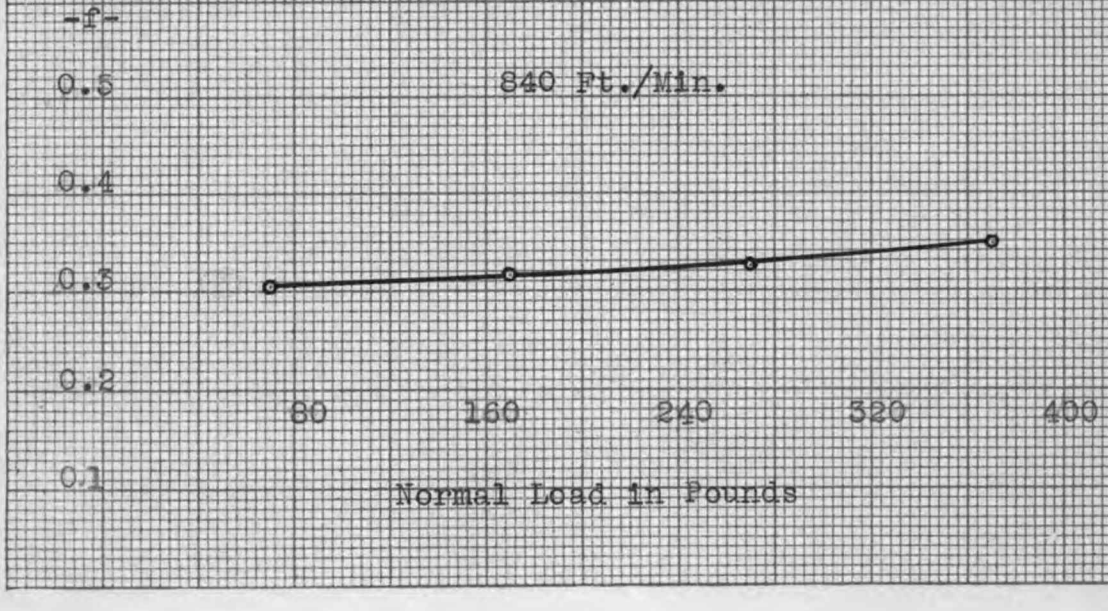
COEFFICIENT OF FRICTION (f)

vs.

NORMAL LOAD

Lining #11 As Received



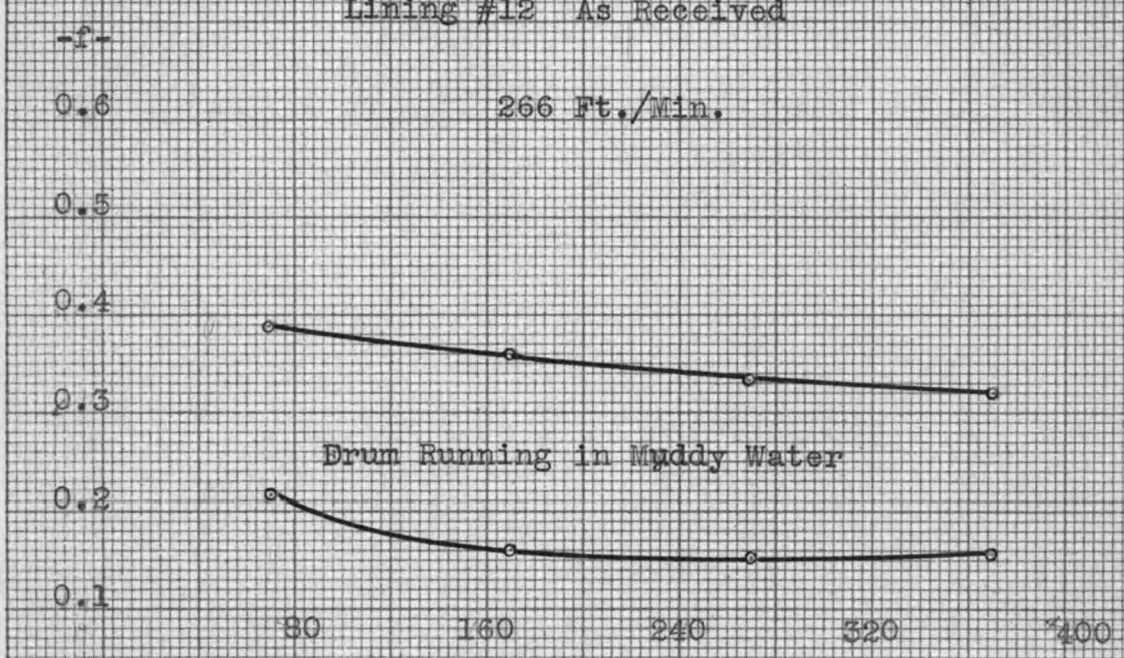


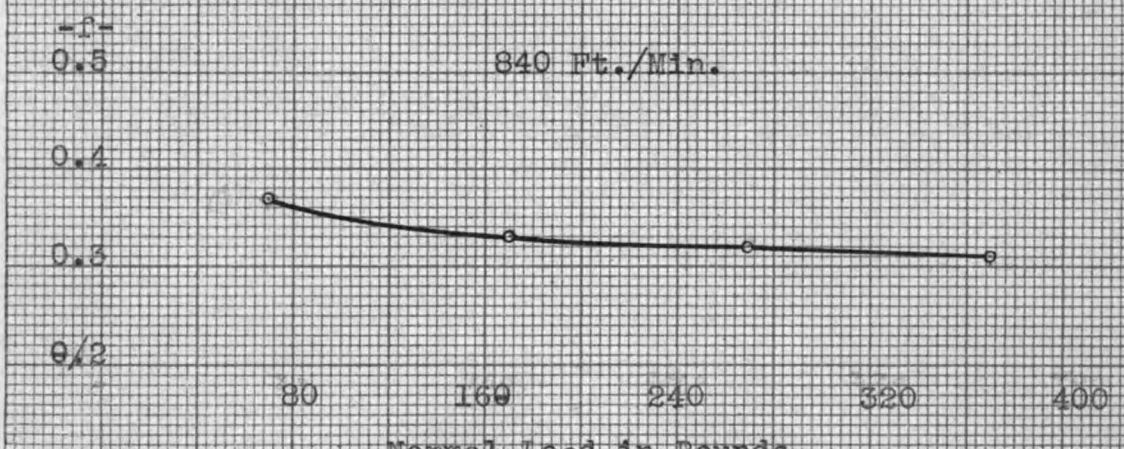
COEFFICIENT OF FRICTION (f)

vs.

NORMAL LOAD

Lining #12 As Received



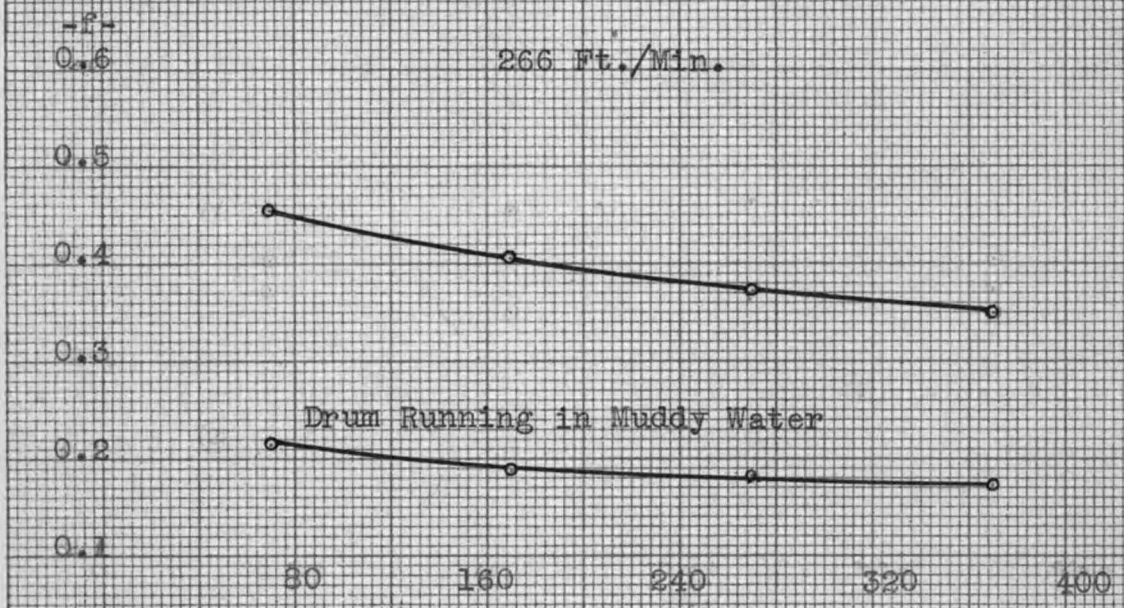


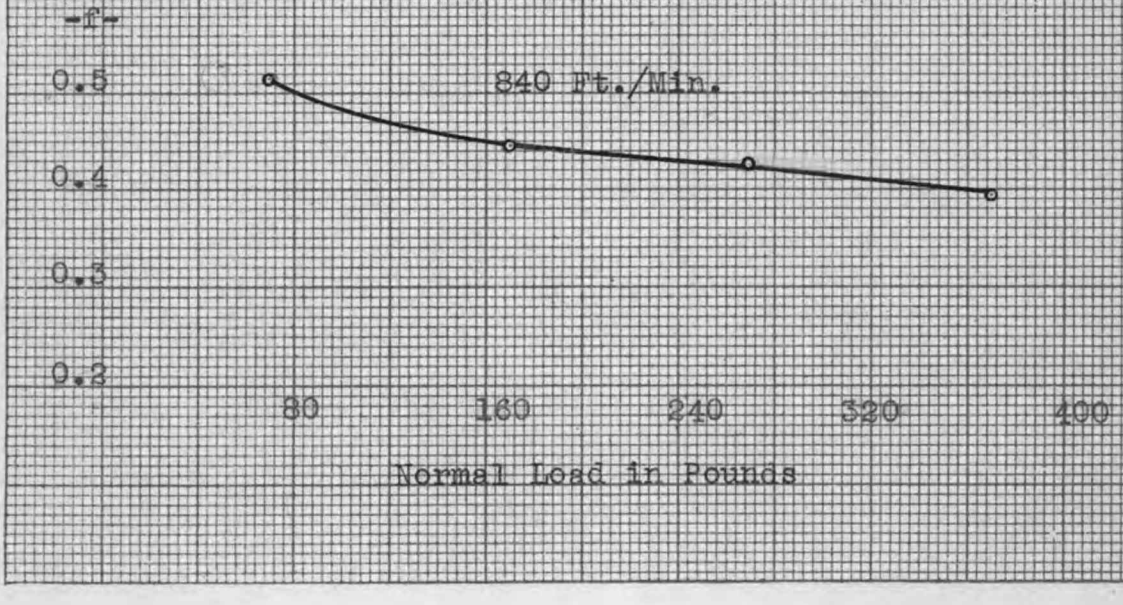
COEFFICIENT OF FRICTION (f)

vs.

NORMAL LOAD

Lining #13 As Received



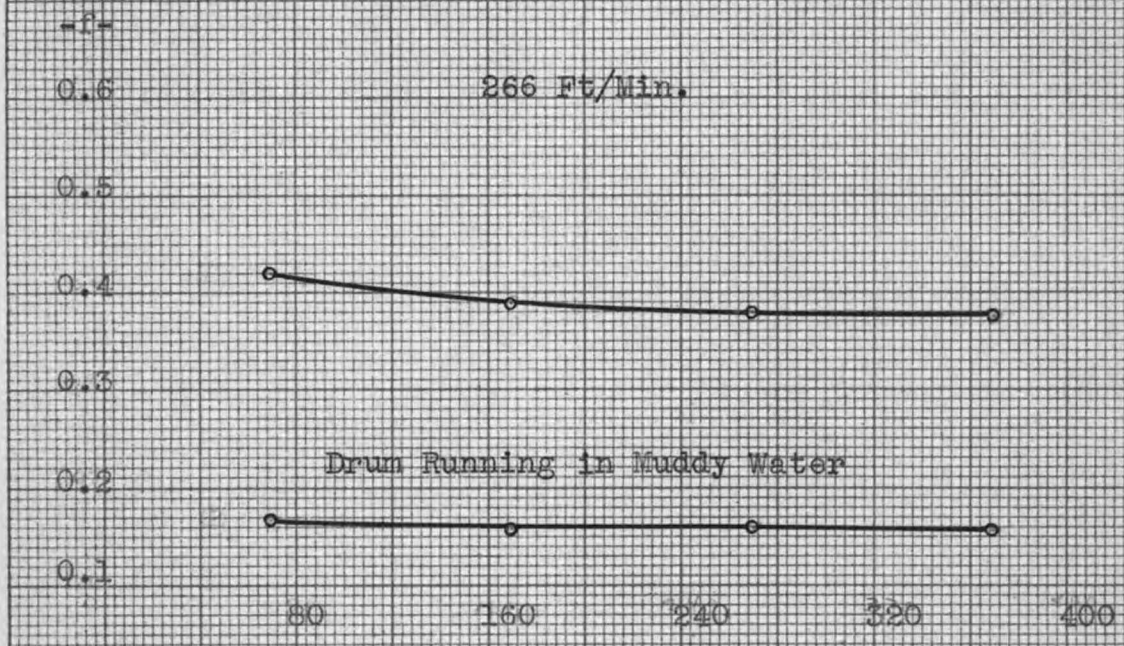


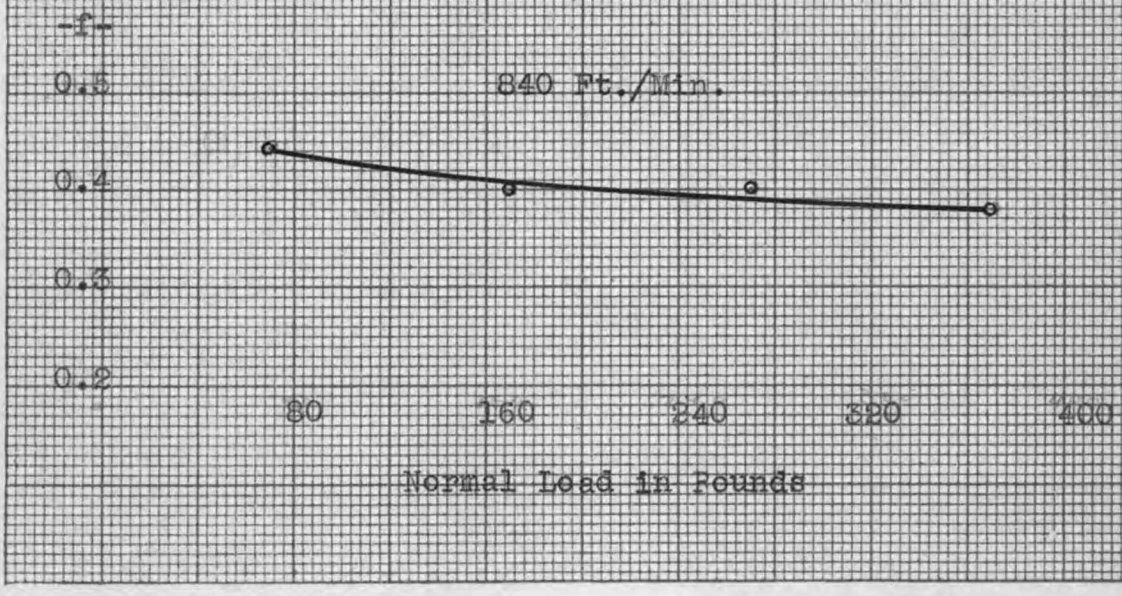
COEFFICIENT OF FRICTION (f)

vs.

NORMAL LOAD

Lining #14 As Received





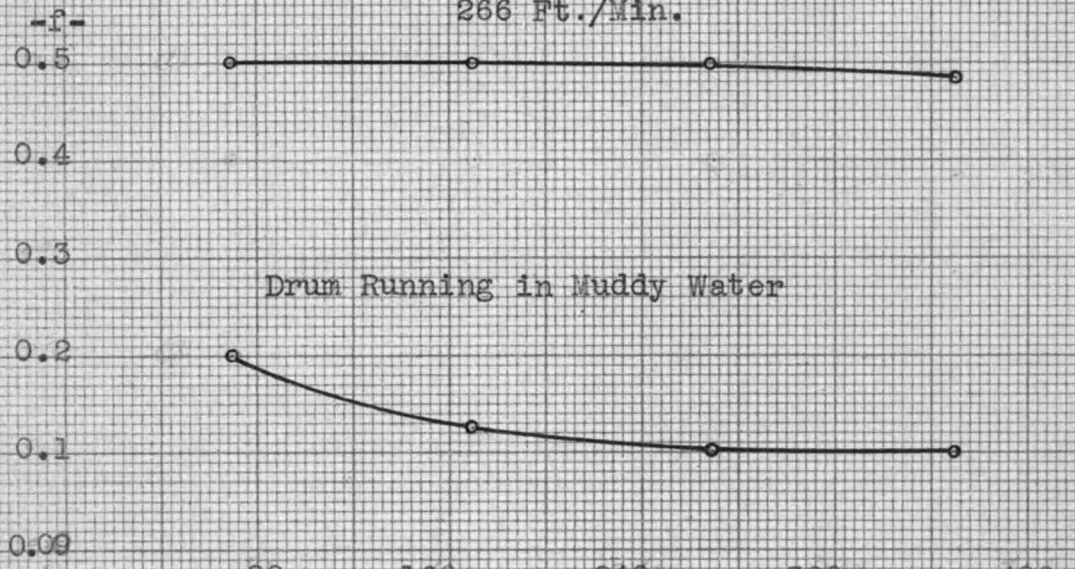
COEFFICIENT OF FRICTION (f)

Vs.

NORMAL HEAD

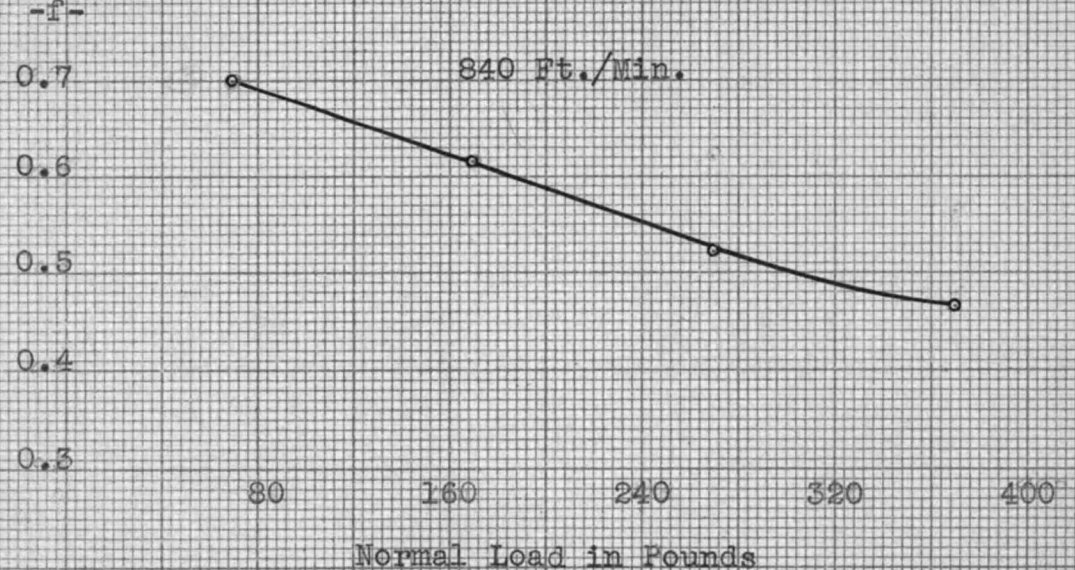
Lining #15 As Received

266 Ft./Min.



Drum Running in Muddy Water

840 Ft./Min.



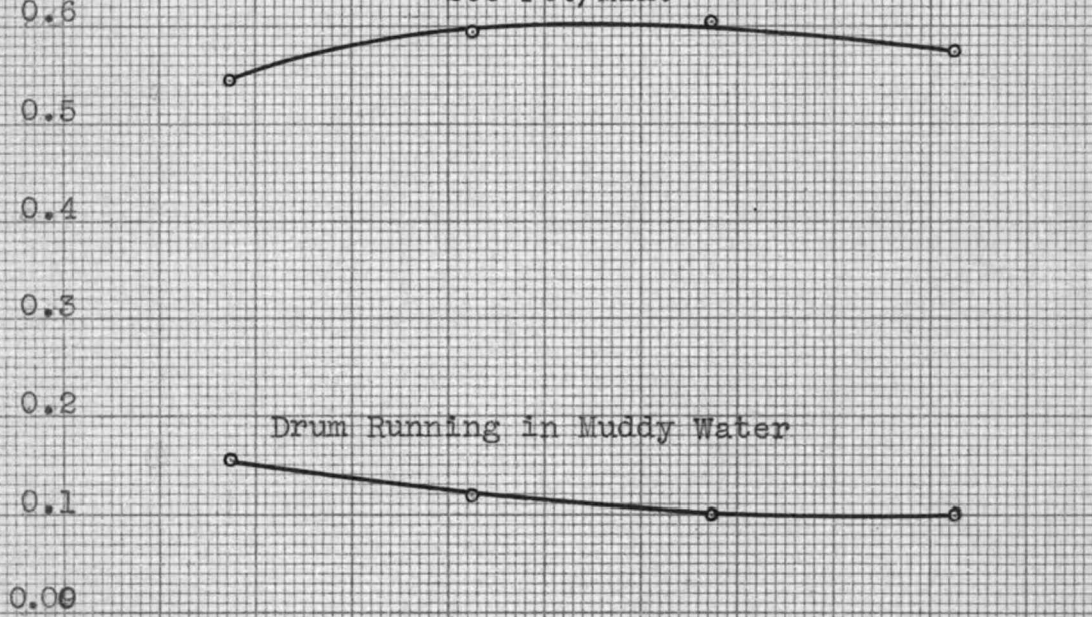
COEFFICIENT OF FRICTION (f)

vs.

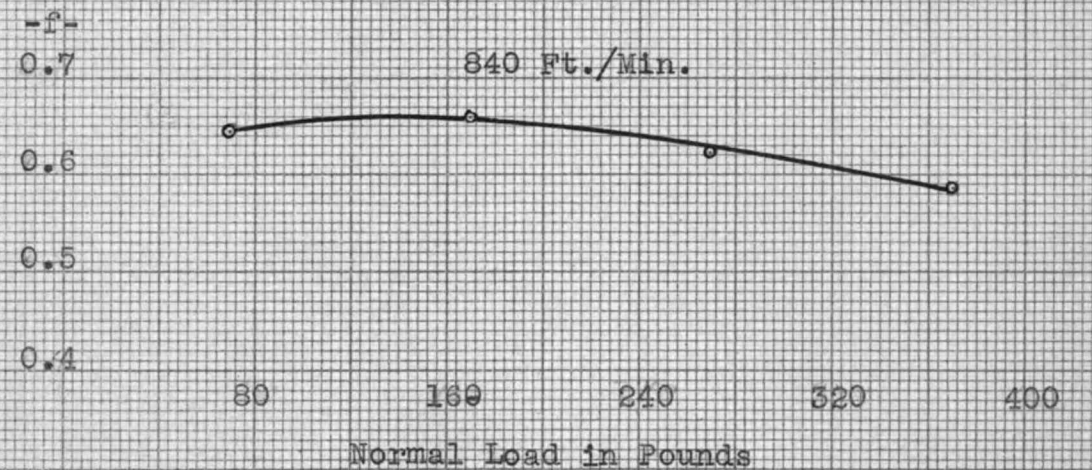
NORMAL LOAD

Lining #16 As Received

266 Ft./Min.



840 Ft./Min.

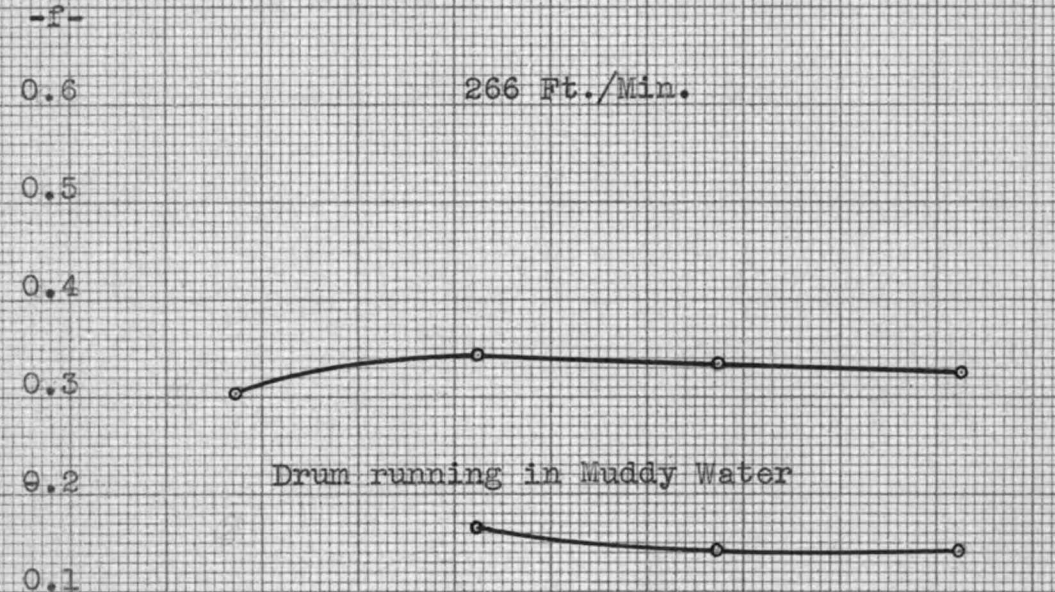


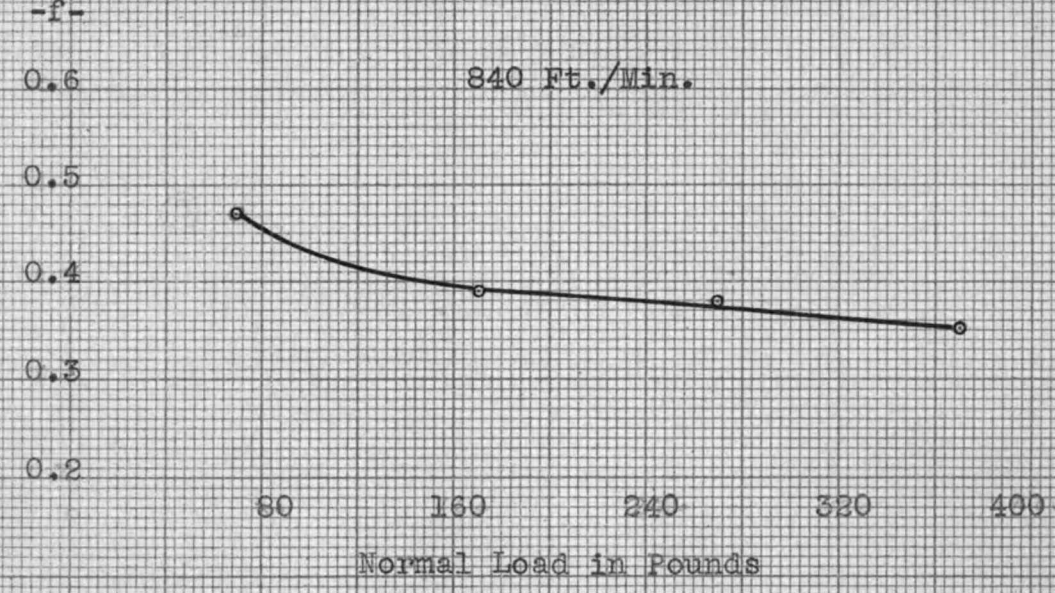
COEFFICIENT OF FRICTION (f)

vs.

NORMAL LOAD

Lining #18 As Received



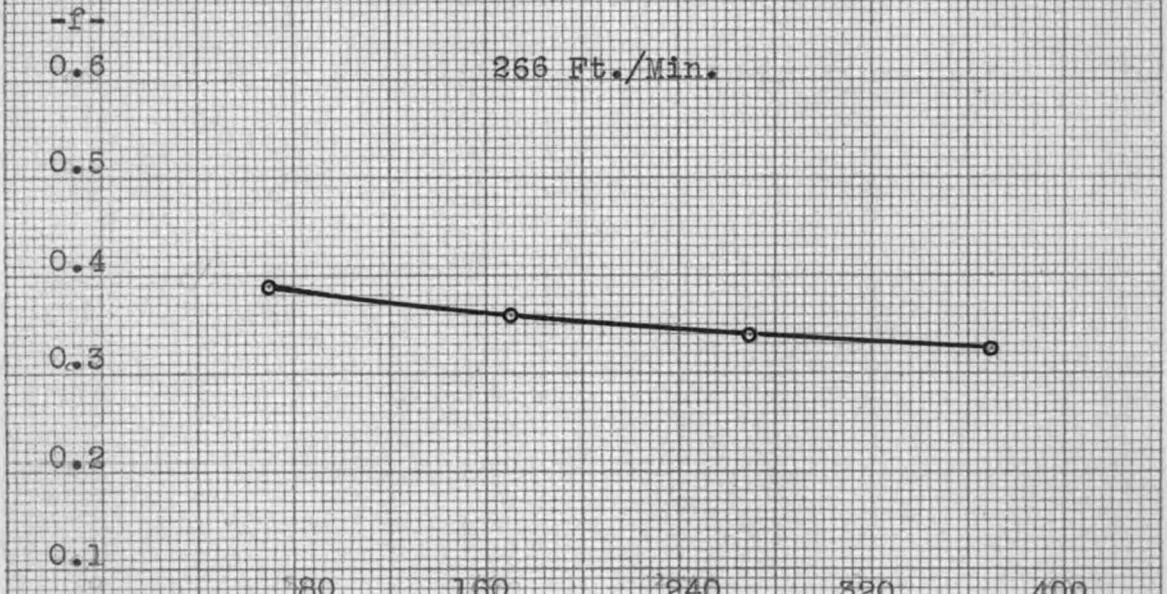


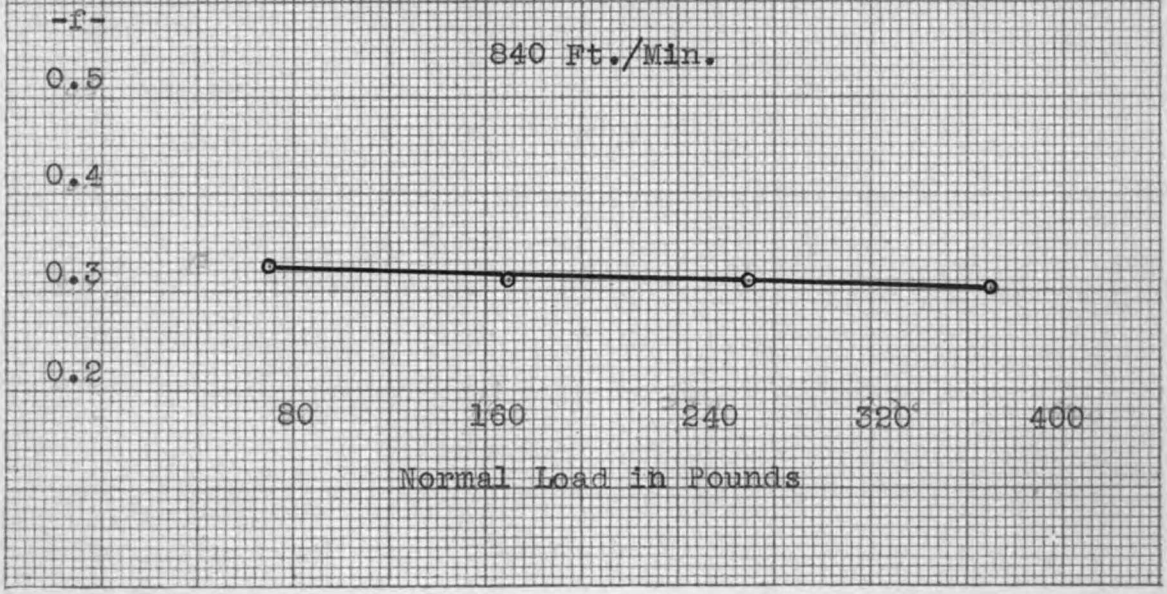
COEFFICIENT OF FRICTION (f)

Vs.

NORMAL LOAD

Lining #19 As Received





COEFFICIENT OF FRICTION (f)

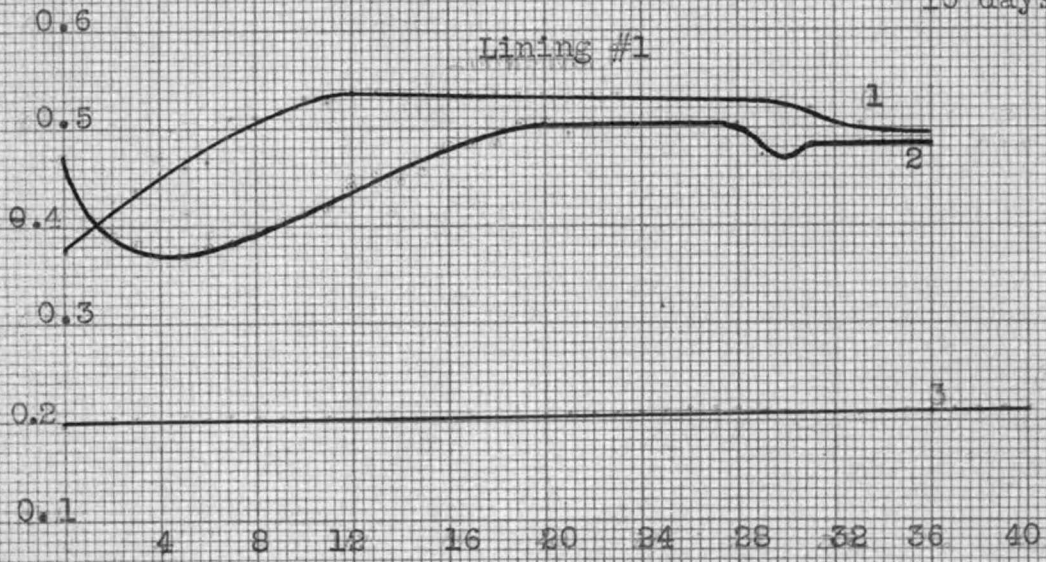
vs.

TIME

Load 170# Speed 1436 Ft./Min.

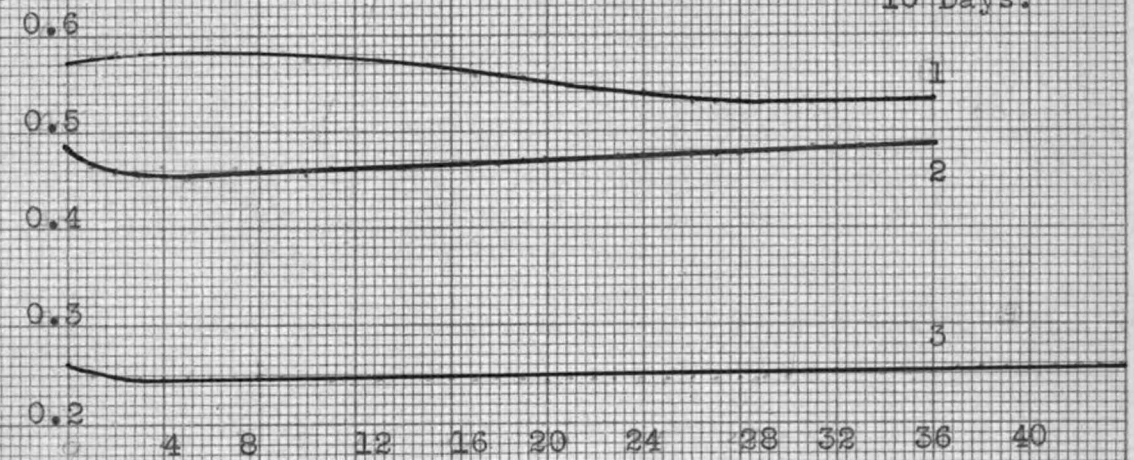
-f- (1) As Received (2) Water Soaked 10 Days (3) Oil Soaked 10 days.

Lining #1



Lining #2

-f- (1) As Received (2) Watersoaked 10 Days (3) Oil-Soaked 10 Days.



COEFFICIENT OF FRICTION (f)

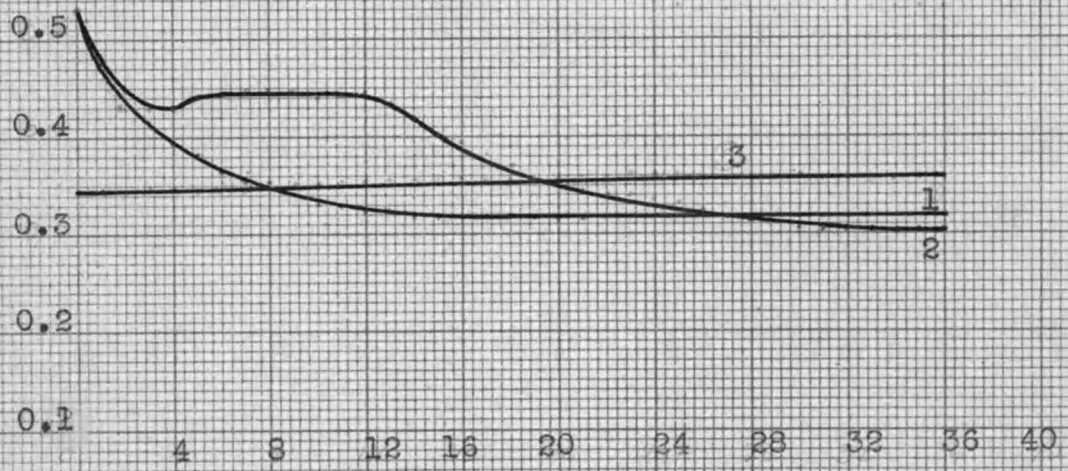
Vs.

TIME

Load 170# Speed 1436 Ft./Min.

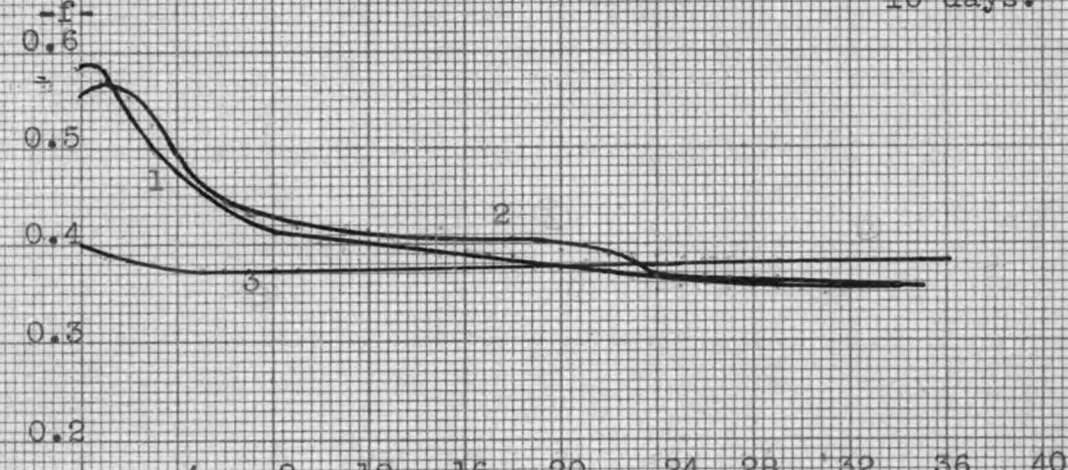
(1) As Received (2) Water-Soaked 10 Days (3) Oil-Soaked 10 days

Lining #3



Lining #4

(1) As Received (2) Water-soaked 10 days (3) Oil-Soaked 10 days.



COEFFICIENT OF FRICTION (f)

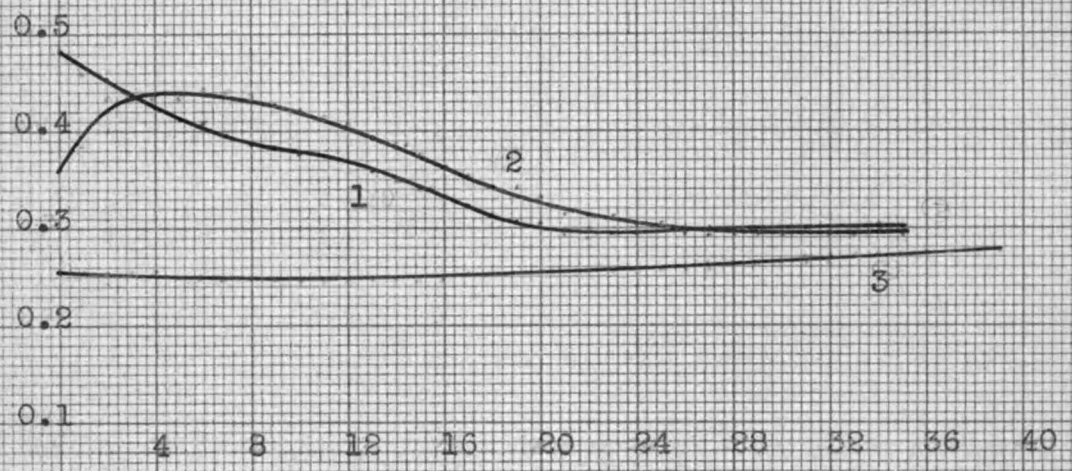
vs.

TIME

Load 170# Speed 1436 Ft./Min.

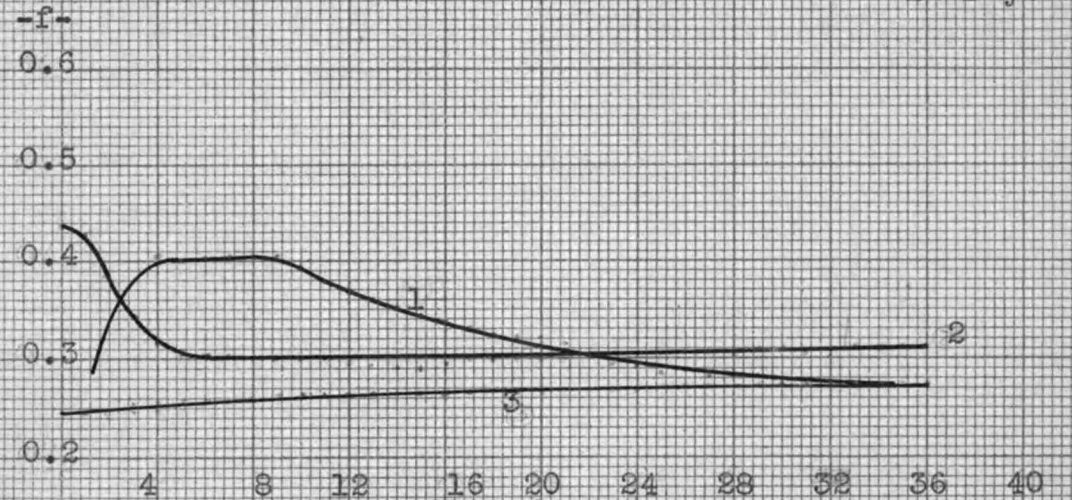
Lining #5

(1) As Received (2) Water-soaked 10 days (3) Oil-Soaked 10 Days.



Lining #6

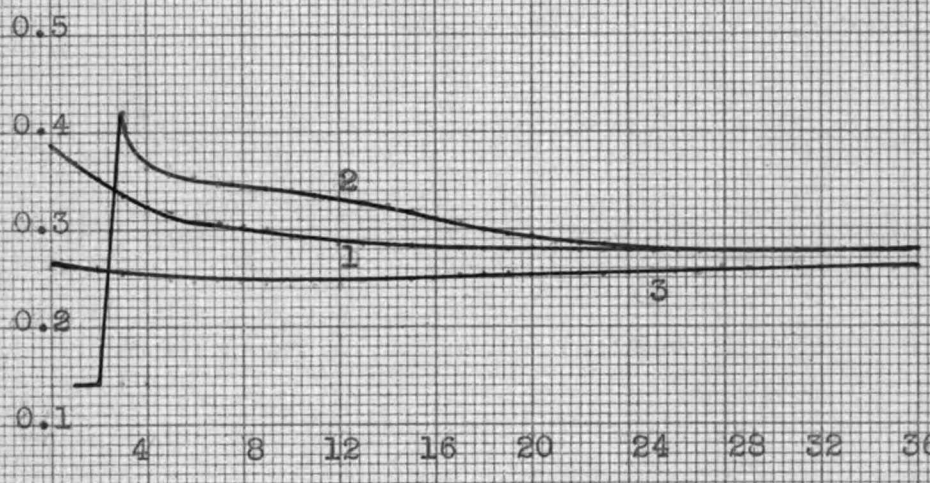
(1) As Received (2) Water-soaked 10 days (3) Oil-Soaked 10 Days.



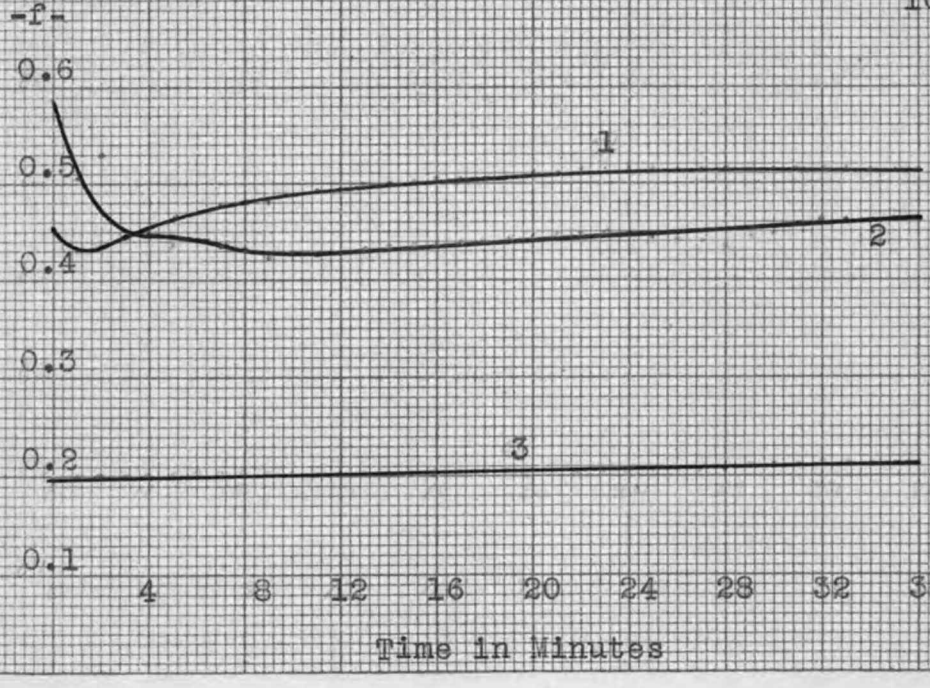
COEFFICIENT OF FRICTION (f)
vs.
TIME

Load 170# Speed 1436 Ft/Min.

Lining #7
(1) As Received (2) Water-soaked 10 days (3) Oil-Soaked 10 Days.

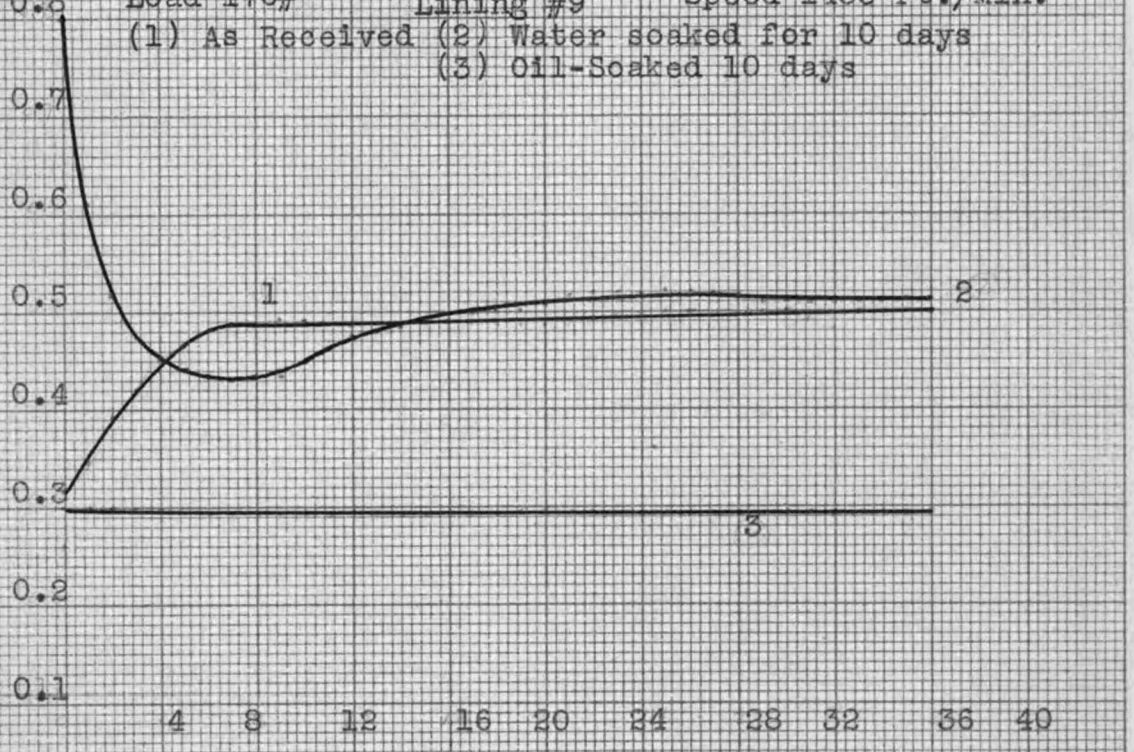


Lining #8
(1) As Received (2) Water-soaked 10 days (3) Oil-Soaked 10 days.

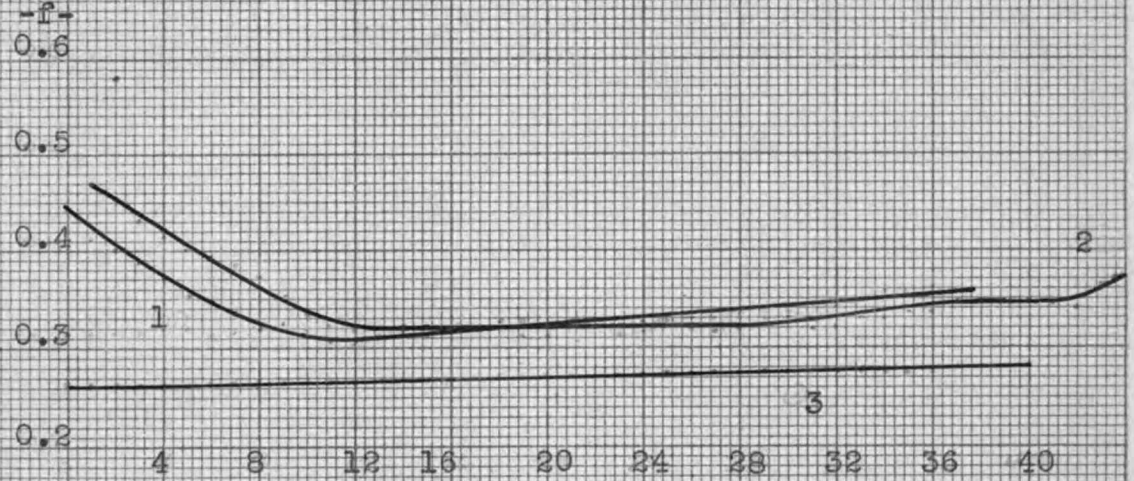


COEFFICIENT OF FRICTION (f)
Vs.
TIME

Load 170# Lining #9 Speed 1435 Ft./Min.
(1) As Received (2) Water soaked for 10 days
(3) Oil-Soaked 10 days



Lining #10
(1) As Received (2) Water Soaked 10 days (3) Oil-Soaked 10 Days.

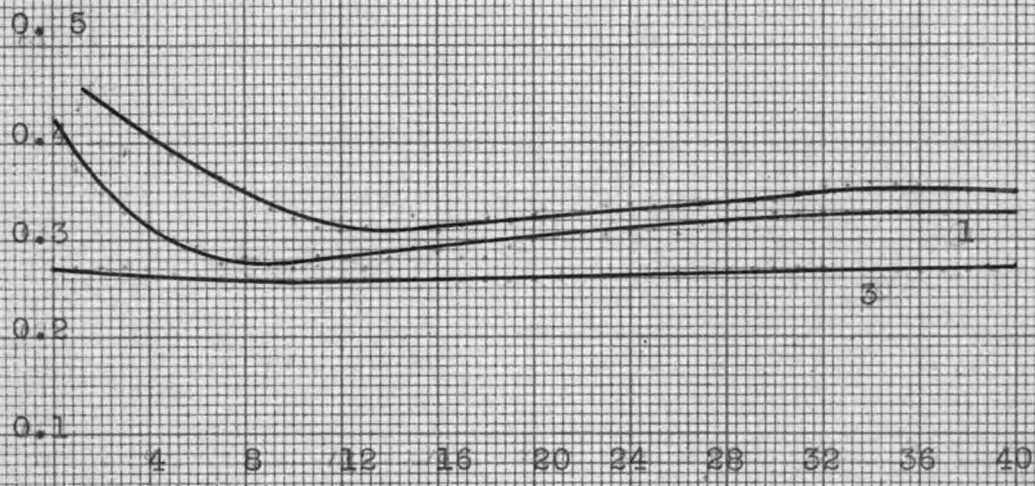


COEFFICIENT OF FRICTION (f)
vs.
TIME

Lining #11

Load 170# Speed 1436 Ft/Min.

-f-
(1) As Received (2) Water-Soaked 10 days (3) oil-Soaked 10 Days.

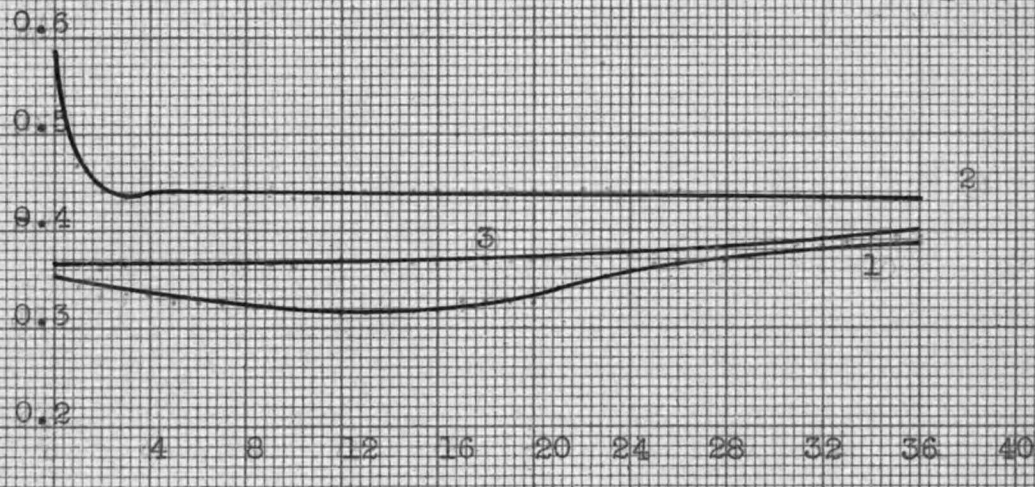


Time in Minutes

-f-

Lining #12

(1) As Received (2) Water Soaked 10 Days (3) Oil Soaked 10 Days.



Time in Minutes

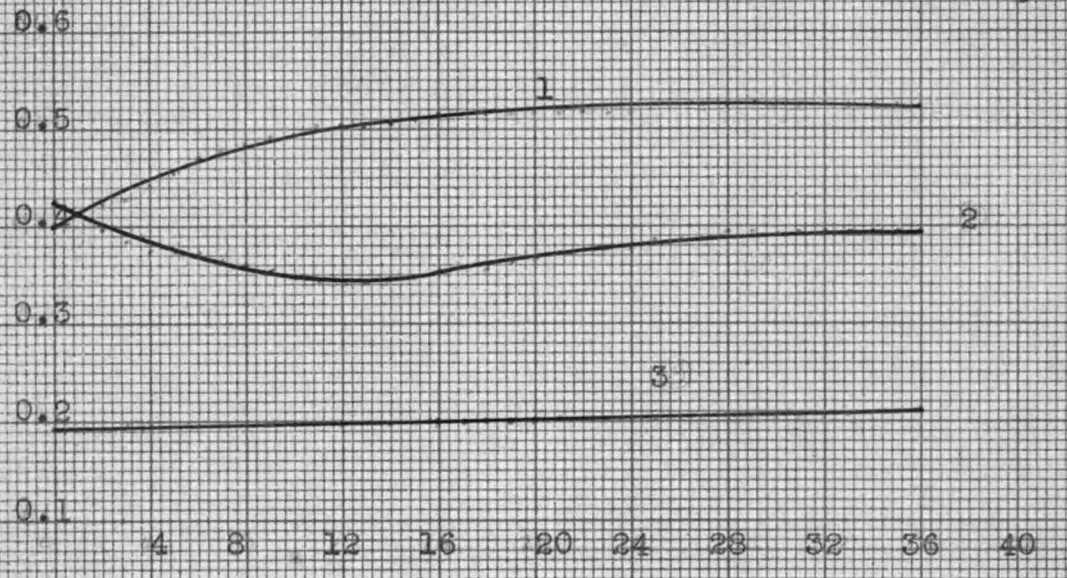
COEFFICIENT OF FRICTION (f)
vs.
TIME

Load 170# Speed 1436 Ft./Min.

Lining #13

-f-

(1) As Received (2) Water Soaked 10 Days (3) Oil Soaked 10 Days.

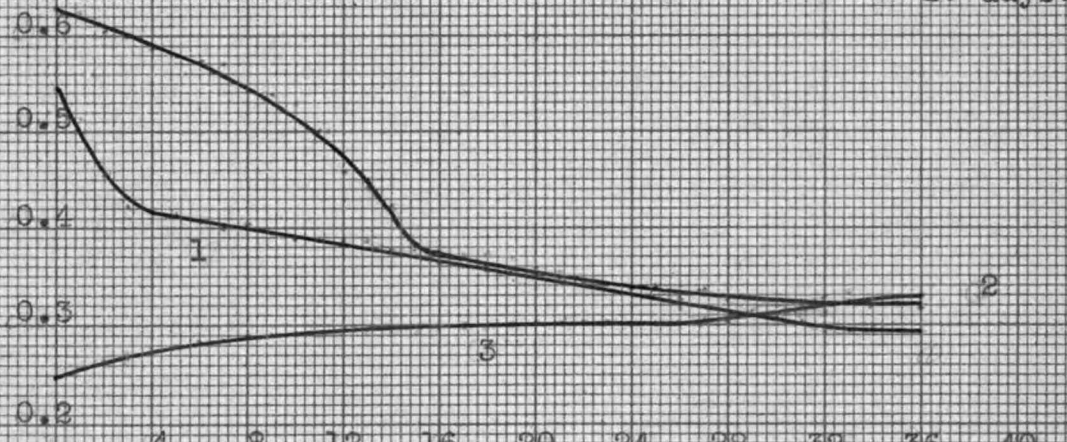


Time in Minutes

-f-

Lining #14

(1) As Received (2) Water Soaked 10 Days (3) Oil Soaked 10 days.



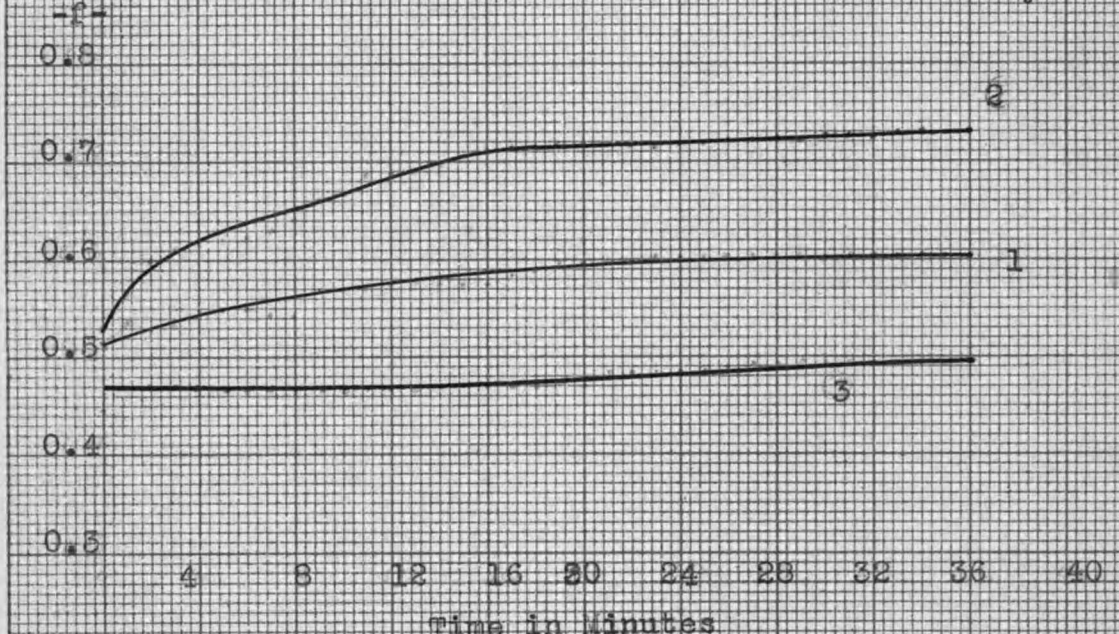
Time in Minutes

COEFFICIENT OF FRICTION (f)
Vs.
TIME

Load 170# Speed 1436 Ft./Min.

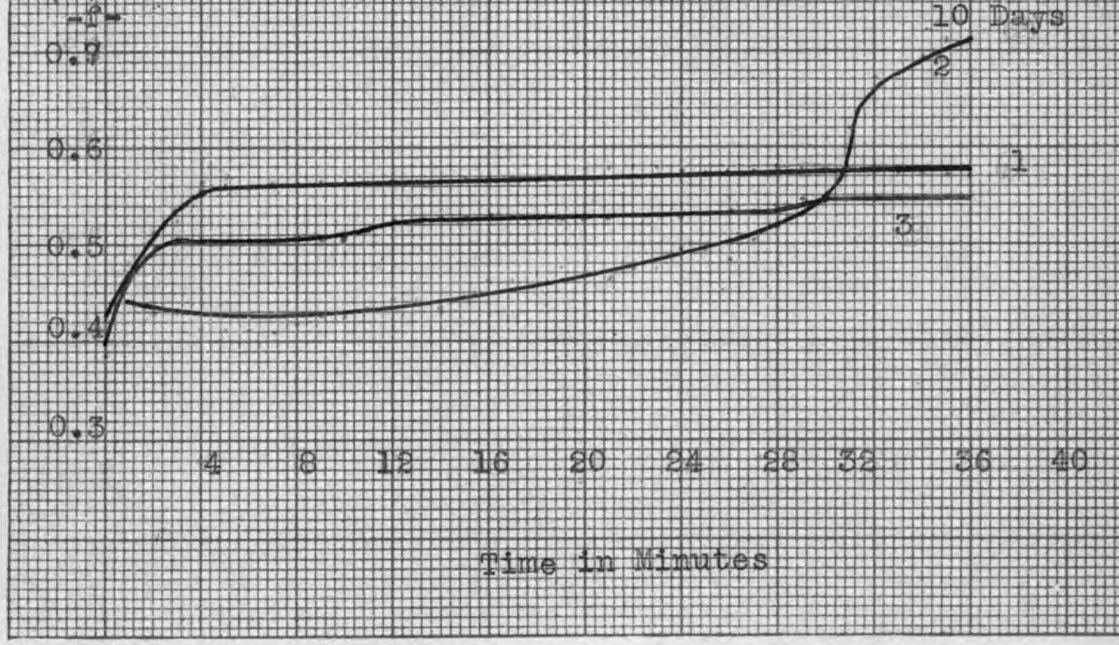
Lining#15

(1) As Received (2) Water-Soaked 10 Days (3) Oil-Soaked 10 Days.



Lining #16

(1) As Received (2) Water-Soaked 10 Days (3) Oil Soaked 10 Days

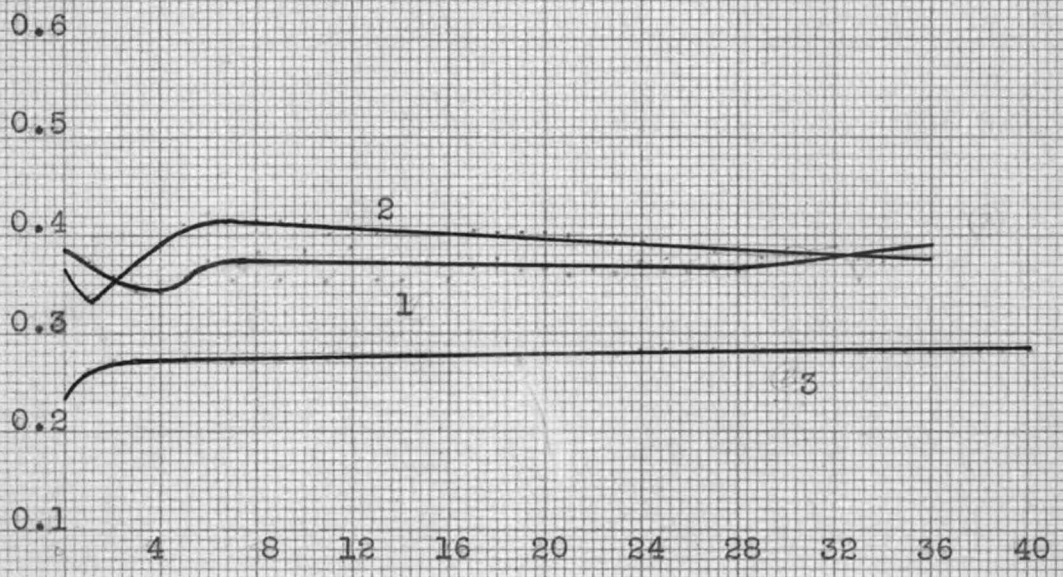


COEFFICIENT OF FRICTION (f)
Vs.
TIME

Load 170# Speed 1435 Ft/Min

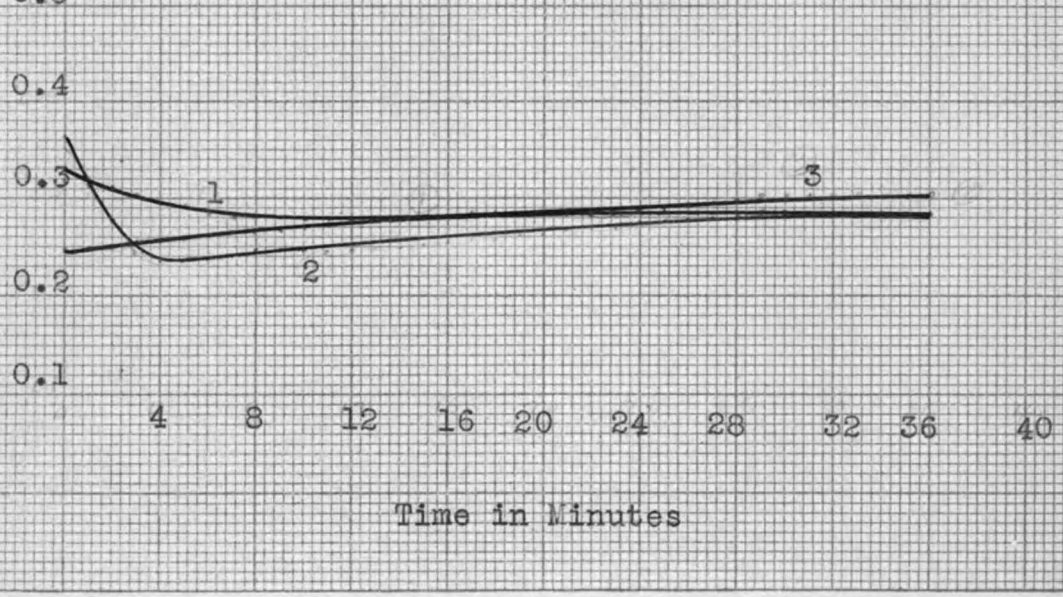
Lining #18

(1) As Received (2) Water-soaked 10 days (3) Oil-soaked 10 days.



Lining #19

(1) As Received (2) Water soaked 10 days (3) Oil-soaked 10 days.



2. Absorption Tests

Results of the absorption tests are given in Table 2. These tests are presented to show the tendency of various linings to absorb water and oil, and to see whether a relation exists between absorption and coefficient of friction.

3. Density Tests

Results of the density tests are given in table 3. These determinations are presented as additional information, although the purpose of making such tests was to study the relation between density and durability. It is probable that severe durability tests generally would show linings of high density to be more desirable than those of low density.

TABLE NO. 2

RESULTS OF ABSORPTION TESTS

Lining No.	Weight before soaking	Weight after soaking	Increase in weight	Absorption per cent
		Water Absorption		
1	93.3	101.9	8.6	9.22
2	106.8	120.2	13.4	12.54
3	74.5	91.7	17.2	23.10
4	87.9	104.6	16.7	19.00
5	87.0	105.4	18.4	21.12
6	81.0	101.1	21.1	26.02
7	102.9	120.0	17.1	16.61
8	95.7	117.2	21.5	22.45
9	100.4	117.2	16.8	16.71
10	114.4	139.1	24.7	21.60
11	129.5	153.0	23.5	18.14
12	113.1	138.9	25.8	22.80
13	126.3	155.8	29.5	23.35
14	158.0	175.5	17.5	11.09
15	76.7	88.5	11.8	15.40
16	72.5	88.9	16.4	22.60
17	114.2	123.1	8.9	7.78
18	131.8	136.4	4.6	3.49
19	128.6	131.2	2.6	2.02
		Oil Absorption		
1	99.1	107.6	8.5	8.58
2	107.4	120.0	12.6	11.72
3	76.5	98.5	22.0	28.76
4	92.9	111.9	19.0	20.44
5	82.0	102.8	22.8	27.80
6	80.8	100.5	19.7	24.36
7	103.7	119.6	15.9	15.35
8	95.8	113.5	17.7	18.48
9	100.1	114.1	14.0	13.98
10	112.3	134.7	22.4	19.92
11	135.3	151.0	21.7	16.10
12	113.8	136.8	23.0	20.21
13	124.5	150.2	25.7	20.61
14	156.2	168.7	12.5	8.00
15	75.7	80.8	6.1	6.74
16	74.0	82.1	7.1	9.59
17	105.8	108.8	3.0	2.84
18	130.3	132.0	1.7	1.30
19	130.4	138.3	7.9	6.05

Note: Weights are in grams.

TABLE NO. 3

RESULTS OF DENSITY DETERMINATIONS

Lining No.	Weight in air	Weight in water	Loss in weight	Specific Gravity	Average Sp. Gr.
1	29.2	13.7	15.5	1.88	
1	30.3	14.2	16.1	1.88	1.89
1	28.1	13.3	14.8	1.90	
2	106.8	52.4	54.4	1.96	
2	104.7	49.5	55.2	1.90	1.92
2	107.5	50.6	56.9	1.89	
3	116.1	31.9	89.2	1.38	
3	75.0	20.4	55.4	1.35	1.37
3	74.1	20.6	53.5	1.38	
4	87.5	32.2	55.3	1.58	
4	92.3	35.1	57.2	1.61	1.60
4	93.2	35.5	57.7	1.61	
5	84.8	28.5	56.3	1.51	
5	81.9	27.0	54.9	1.49	1.50
5	87.0	28.6	58.4	1.49	
6	77.8	23.4	54.4	1.43	
6	80.7	24.0	56.7	1.42	1.42
6	80.5	24.0	56.5	1.42	
7	107.2	46.4	60.8	1.76	
7	103.5	44.4	59.1	1.75	1.75
7	102.1	43.7	58.4	1.75	
8	95.0	34.3	60.7	1.56	
8	95.4	33.6	61.8	1.54	1.55
8	94.9	33.5	61.4	1.55	
9	101.3	42.1	59.2	1.71	
9	99.8	40.0	59.8	1.67	1.69
9	99.9	40.6	59.3	1.69	
10	113.7	39.4	74.3	1.53	
10	112.2	39.3	72.9	1.54	1.54
10	114.0	40.0	74.0	1.54	
11	136.0	54.0	82.0	1.66	
11	134.8	54.3	80.5	1.67	1.66
11	128.7	50.6	78.1	1.65	
12	112.9	32.9	80.0	1.41	
12	113.7	35.8	77.9	1.46	1.44
12	112.6	34.7	77.9	1.44	

TABLE NO. 3 (Continued)

Lining No.	Weight in air	Weight in water	Loss in weight	Specific Gravity	Average Sp. Gr.
13	125.4	44.5	80.9	1.55	
13	123.8	44.2	79.6	1.55	1.55
13	126.0	44.8	81.2	1.55	
14	159.7	76.1	83.6	1.96	
14	155.6	73.4	82.2	1.89	1.92
14	157.7	74.8	82.9	1.90	
15	75.2	7.1	68.1	1.11	
15	72.6	6.0	66.6	1.11	1.11
15	76.8	8.7	68.1	1.11	
16	70.0	4.3	66.7	1.05	
16	71.3	4.6	66.7	1.07	1.06
16	69.9	3.4	66.5	1.05	
17	32.7	13.6	19.1	1.71	
17	36.6	15.2	21.3	1.72	1.71
17	31.8	13.0	18.8	1.69	
18	130.0	48.3	81.7	1.59	
18	105.5	38.7	66.8	1.57	1.58
18	128.0	47.2	80.8	1.58	
19	125.4	45.4	80.0	1.57	
19	122.9	41.5	81.4	1.51	1.55
19	128.7	47.0	81.7	1.57	

Note: Weights are in grams.

VI. SUMMARY AND CONCLUSIONS

The following is a brief summary of the results obtained.

1. Speed seems to have little effect on the coefficient of friction for linings "as-received". Some linings show an increase in the coefficient of friction with an increase in speed while others show a decrease. In most cases, however, there is a definite speed at which the coefficient is lowest. Although this may be due to variations in temperature or changes in the condition of the lining, it is likely that there is a critical speed at which each lining produces its lowest coefficient.

2. Generally, the hydraulic pressed asbestos linings show higher coefficients than the woven asbestos linings, but the variation in coefficient, which is an undesirable characteristic, is also greater for these linings.

3. The fiber linings treated with a tarry substance give coefficients considerably higher than those obtained with other linings. The coefficient increases greatly with time, and since a tarry deposit was deposited on the drum, it is thought that its presence accounts for the high coefficient.

4. The moulded linings show variable results. The coefficient is fairly uniform for heavy loads but for light loads it varies considerably with changes in speed.

This is probably due to hardness and stiffness, as the linings do not easily adapt themselves to the curvature of the drum.

5. Variation in load has little effect on the coefficient of friction for flexible linings, but the general tendency is for the coefficient to decrease with increases in load. Except for the soft fiber linings containing tarry filler, the stiff linings show greater variation in coefficient than the more flexible types.

6. The effect of a wet brake drum is to decrease the coefficient considerably. As a general rule, the coefficient is practically constant for all linings when running on a wet drum, although the moulded linings show lower coefficients than other types of linings. The coefficient for lining No. 19 is so low that a curve cannot be plotted on the same scale with the other curves.

7. Since the coefficient for wet drums is practically constant for all linings, those linings giving the highest value when dry are most effected.

8. The variation in coefficient with time of running depends upon each particular lining. Most linings show high coefficients at the beginning, which gradually

decrease to a minimum and then increase to approximately an average value, although some linings give the opposite results. The linings containing considerable tarry filler give their lowest coefficient at the beginning of the run.

9. The effect of water soaking is to give a greater variation in the coefficient. In many cases the coefficient for water soaked linings is higher than for dry linings until the absorbed water is evaporated. After the water is evaporated, the coefficient is practically the same as for dry linings.

10. The effect of oil soaking is to give a practically constant coefficient for all linings. In most cases the coefficient is less than for either dry or water soaked linings. However, where the coefficient for dry lining is very low, the coefficient for oil soaked lining may be equal to or greater than that of the dry lining. Lining No. 19 is a good example. Of the four linings showing coefficient greater than 0.30 when oil-soaked, two are high in absorption capacity, and the other two which are fiber linings containing the tarry filler, are low in absorption capacity. All linings show very little tendency to recuperate after being oil-soaked, although tests over long periods of time may show that the oil is gradually expelled from the lining, and

that the coefficients approach the values obtained with dry linings.

11. The absorption capacity varies from 1.30 per cent for a moulded linings to 28.76 per cent for one of the woven linings. Generally speaking, the linings of high density show less absorption than the lighter linings. Howevever, the soft fiber linings containing tarry filler show less absorption than any of the flexible linings. Since the presence of water and oil tend to reduce the wearing qualities of asbestos, linings having high absorption capacity may show greater loss of durability from the presence of water and oil than linings having low absorption capacity.

12. The results of density determinations range in value from 1.06 for the soft fiber linings containing no metal to 1.92 for heavy pressed linings containing considerable metal. Light woven linings containing average quantities of metal range in density from 1.42 to 1.75. With other factors favorable, linings of high density should give greater durability than those of low density. High density coupled with good pliability should give high uniform coefficients.

In concluding it may be said that the tests completed in this investigation are only an introduction to the study of brake lining characteristics and their relation

to good brake design, and that the study should be continued to include the following tests.

1. Durability of dry, water-soaked, and oil-soaked linings.
2. Effect of heat on durability.
3. Analysis for volatile, fixed carbon and non-combustibles.
4. Strength - Tension and compression.
5. Hardness.

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VIII. FRICTION TEST DATA

LINING NO. 1 AS RECEIVED

370# Load

Test No.	1	2	1	2	1	2
R. P. M.	66	66	104	104	192	192
Friction	145	144	130	122	128	128
Coef.	.392	.389	.352	.330	.346	.346

270# Load

Test No.	1	2	1	2	1	2	1	2
R.P.M.	66	66	104	104	196	196	300	300
Friction	107	106	98	98	100	120	120	120
Coef.	.397	.393	.363	.363	.370	.445	.445	.445

170# Load

Test No.	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	200	200	340	340
Friction	72.6	70	64	64	74	86	89	90
Coef.	.427	.412	.377	.377	.435	.506	.524	.530

70# Load

Test No.	1	2	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	202	202	360	360	650	650	1120	1120
Friction	37	35	30	32	40	43	42	41	38	37.6	33	32
Coef.	.529	.500	.428	.456	.571	.614	.600	.586	.542	.536	.471	.456

Friction denotes tangential pull in pounds.
Coef. denotes coefficient of friction, the ratio of the tangential pull to the normal load.

LINING NO. 2 AS RECEIVED

370# Load

Test No.	1	2	1	2	1	2
R. P. M.	66	66	104	104	190	190
Friction	165	166	157	154	154	166
Coef.	.445	.448	.425	.416	.416	.448

270# Load

Test No.	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	195	196	288	292	290	312
Friction	131	131	125	130	130	134	123	123	126	125
Coef.	.485	.485	.473	.481	.481	.496	.455	.455	.466	.473

170# Load

Test No.	1	2	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	198	198	342	352	340	334	600	600
Friction	87	87	77	80	86	90	84	80	80	82	77	82
Coef.	.511	.511	.454	.470	.505	.528	.494	.470	.470	.482	.454	.482

70# Load

Test No.	1	2	1	2	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	200	200	370	370	354	362	648	654	1078	1088
Friction	37	37	36	36	37	39	33	32	33	32	41	38	35	35
Coef.	.528	.528	.515	.515	.528	.556	.471	.467	.471	.467	.586	.544	.500	.500

LINING NO. 3 AS RECEIVED

370# Load

Test No.	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	188	196	328	336	328	320
Friction	133	132	135	130	126	125	118	112	112	112
Coef.	.360	.357	.365	.351	.340	.338	.318	.303	.303	.303

270# Load

Test No.	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	196	200	360	356	336	344
Friction	97	97	96	95	90	90	80	79	78	77.2
Coef.	.359	.359	.355	.352	.333	.333	.296	.292	.289	.286

170# Load

Test No.	1	2	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	200	200	372	372	632	620	348	356
Friction	61	61	59	59	56	56	49	50	55	56	50	49
Coef.	.359	.359	.347	.347	.330	.330	.288	.294	.323	.330	.294	.288

70# Load

Test No.	1	2	1	2	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	202	202	380	372	648	652	1148	1132	360	360
Friction	25	25	24	23	23	23	18.6	19	22	23	23	24.8	21	21
Coef.	.357	.357	.343	.329	.329	.329	.266	.271	.314	.329	.329	.354	.300	.300

LINING NO. 4 AS RECEIVED

37 0# Load

Test No.	1	2	1	2	1	2
R. P. M.	66	66	104	104	192	192
Friction	166	162	164	164	155	152
Coef.	.448	.438	.443	.443	.418	.411

270# Load

Test No.	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	196	196	352	352
Friction	120	119.2	116	116.6	108.8	109.0	103	101
Coef.	.445	.441	.430	.432	.402	.403	.381	.374

170# Load

Test No.	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	200	200	372	372	620	620
Friction	76	75	72	72	68	68	63	63.2	56.2	54.6
Coef.	.446	.441	.424	.424	.400	.400	.371	.372	.331	.321

70# Load

Test No.	1	2	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	202	202	384	384	648	648	1116	1116
Friction	31	30.8	30.0	29.2	27.6	28	25.4	25.2	21.6	21.5	22.0	22.0
Coef.	.443	.440	.428	.417	.394	.400	.363	.360	.308	.307	.314	.314

LINING NO. 5 AS RECEIVED

370# Load

Test No.	1	2	1	2	1	2
R. P. M.	66	66	104	104	192	192
Friction	115	114.4	119	118	119	102
Coef.	.311	.309	.321	.319	.321	.276

270# Load

Test No.	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	196	196	348	348
Friction	84	85	85	87	78	75	74	78
Coef.	.311	.315	.315	.322	.289	.278	.279	.289

170# Load

Test No.	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	200	200	372	372	628	628
Friction	54	55	56	54	47.6	47	47	47.2	56	60
Coef.	.318	.324	.330	.318	.280	.276	.276	.278	.330	.353

70# Load

Test No.	1	2	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	202	202	376	376	660	660	1140	1140
Friction	22.4	22.6	23	22.4	20.0	20.0	19	19.6	21	23	23	22.8
Coef.	.320	.323	.329	.320	.286	.286	.272	.280	.300	.329	.329	.326

LINING NO. 6 AS RECEIVED

370# Load

Test No.	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	192	192	328	328
Friction	136	132	134	131	121	114	120	112
Coef.	.367	.357	.362	.354	.327	.308	.324	.303

270# Load

Test No.	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	196	196	360	360
Friction	97	96	94	91	85	82	78	78
Coef.	.359	.355	.348	.337	.315	.304	.289	.289

170# Load

Test No.	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	200	200	360	360	632	632
Friction	61	60.4	57.0	55	52.4	52	47	47	47.6	47.6
Coef.	.359	.355	.335	.324	.308	.306	.276	.276	.280	.280

70# Load

Test No.	1	2	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	202	202	376	276	646	646	1160	1160
Friction	24.4	24.4	22.4	21.4	21.4	21.5	18.4	18.4	18.0	18.2	22.0	22.0
Coef.	.349	.349	.320	.306	.306	.307	.263	.263	.257	.260	.314	.314

LINING NO. 7 AS RECEIVED

370# Load

Test No.	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	192	192	320	320
Friction	122.4	118.6	118.2	118	120.4	120.0	111.0	110
Coef.	.331	.321	.320	.319	.325	.324	.300	.298

270# Load

Test. No.	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	196	196	352	352
Friction	91	91	89	89.6	90.0	90.0	82	78.6
Coef.	.337	.337	.330	.332	.333	.333	.304	.291

170# Load

Test No.	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	200	200	376	376	624	624
Friction	68	58	56.4	57.2	56.6	56.0	49.2	48.0	52	52.6
Coef.	.341	.341	.331	.337	.333	.330	.290	.283	.302	.310

70# Load

Test No.	1	2	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	202	202	376	376	656	656	1136	1136
Friction	24.2	24.2	23.2	24.0	23.6	23.4	19.4	19.2	21	20.4	22.2	22.3
Coef.	.346	.346	.331	.343	.337	.334	.277	.274	.300	.291	.317	.318

LINING NO. 8 AS RECEIVED

370# Load

Test No.	1	2	1	2	1	2
R. P. M.	66	66	104	104	192	192
Friction	162	160.6	164	162	160.4	160
Coef.	.438	.434	.443	.438	.434	.432

270# Load

Test No.	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	196	196	332	332
Friction	124	123.6	124	121	119.8	118	114	115.2
Coef.	.461	.458	.461	.447	.436	.435	.422	.426

170# Load

Test No.	1	2	1	2	1	2	1	2	1
R. P. M.	66	66	104	104	200	200	352	352	568
Friction	82	82	80.8	78	77.6	76.8	80	80	
Coef.	.482	.482	.476	.458	.457	.451	.47	.47	

70# Load

Test No.	1	2	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	202	202	372	372	644	644	1100	1100
Friction	34.8	32.4	35.2	33.6	33.6	34	34	34.4	34.6	34	35	34.4
Coef.	.497	.464	.502	.48	.48	.486	.486	.492	.494	.486	.50	.492

LINING NO. 9 AS RECEIVED

370# Load

Test No.	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	192	192	328	328
Friction	148.2	147.2	148.4	144	125	135.2	113.6	115
Coef.	.401	.398	.401	.390	.338	.366	.307	.311

270# Load

Test No.	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	196	196	362	362
Friction	110.2	109.4	108.6	104.6	90	95.4	80	92
Coef.	.408	.405	.402	.387	.333	.353	.296	.340

170# Load

Test No.	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	200	200	368	368	612	612
Friction	72.4	71.8	70.8	67.6	59.2	61.4	47.6	55	65	69
Coef.	.425	.422	.416	.398	.348	.361	.280	.323	.382	.406

70# Load

Test No.	1	2	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	202	202	380	380	652	652	1132	1132
Friction	32.4	32.4	31.2	29.4	25	25	17	19	20.6	20.6	22	23
Coef.	.463	.463	.446	.420	.357	.357	.243	.271	.294	.294	.314	.329

LINING NO. 10 AS RECEIVED

370# Load

Test No.	1	2	1	2	1	2
R. P. M.	66	66	104	104	192	192
Friction	136.2	135.6	135.6	133.4	133.6	132
Coef.	.369	.366	.366	.361	.361	.357

270# Load

Test No.	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	196	196	352	352
Friction	97	97.6	97.6	96.2	93.8	91	76	75.6
Coef.	.359	.361	.361	.356	.347	.337	.282	.280

170# Load

Test No.	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	200	200	360	360	604	604
Friction	61.6	62	61	60.4	60	58.4	47.6	52	54	55
Coef.	.363	.365	.359	.355	.353	.343	.280	.306	.318	.323

70# Load

Test No.	1	2	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	202	202	372	372	648	648	1124	1124
Friction	25.2	25.4	24.2	24.2	24	23.4	19.4	21.6	22	22	21	22
Coef.	.360	.363	.345	.345	.343	.384	.277	.309	.314	.314	.300	.314

LINING NO. 11 AS RECEIVED

370# Load

Test No.	1	2	1	2	1	2
R. P. M.	66	66	104	104	192	192
Friction	140.4	138	136	136.2	132	125
Coef.	.380	.373	.367	.368	.357	.339

270# Load

Test No.	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	196	196	352	352
Friction	98.6	99.4	96.2	96.4	90	85.2	74	62
Coef.	.365	.368	.356	.367	.333	.315	.274	.230

170# Load

Test No.	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	200	200	360	360	616	616
Friction	61.8	61.6	59.4	59.4	55	52.8	46	45	52	54
Coef.	.364	.363	.349	.349	.324	.311	.271	.265	.306	.318

70# Load

Test No.	1	2	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	202	202	372	372	668	668	1140	1140
Friction	25	25.4	23.8	23.6	21.6	21	19	19	22	22.2	21.8	24
Coef.	.357	.363	.340	.337	.309	.300	.271	.271	.315	.317	.311	.343

LINING NO. 12 AS RECEIVED

370# Load

Test No.	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	192	192	336	336
Friction	118.4	119.2	117.0	116	115.0	115.	109.2	109
Coef.	.320	.322	.316	.313	.311	.311	.295	.294

270# Load

Test No.	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	196	196	348	348
Friction	89	91.6	88	88.2	86.4	86.4	.79.2	80
Coef.	.329	.339	.326	.327	.320	.320	.293	.296

170# Load

Test No.	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	200	200	54.4	364	600	600
Friction	61	62.4	58	57.6	56	55.4	.320	56	66	66
Coef.	.359	.367	.341	.339	.329	.326		.329	.388	.388

70# Load

Test No.	1	2	1	2	1	2	1	2	1	2	1	2
R. P.M.	66	66	104	104	202	202	376	376	636	636	1088	1088
Friction	26.8	28.6	26	26	25.8	25	26.6	26.4	30	30	30.4	30.8
Coef.	.383	.407	.371	.371	.369	.367	.380	.377	.428	.428	.434	.440

LINING NO. 13 AS RECEIVED

370# Load

Test No.	1	2	1	2	1	2
R. P. M.	66	66	104	104	192	192
Friction	129.2	131	144	154	147.2	146.2
Coef.	.349	.354	.389	.416	.397	.395

270# Load

Test No.	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	196	196	336	336
Friction	102	102.4	112	122	115	114.4	114.8	111.0
Coef.	.378	380	.405	.452	.426	.424	.425	.411

170# Load

Test No.	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	200	200	352	352	552	552
Friction	69	68.6	75.6	88	76	76	79	78	75.6	77.6
Coef.	.406	.404	.445	.517	.447	.447	.465	.459	.445	.456

70# Load

Test No.	1	2	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	202	202	364	364	632	632	1080	1080
Friction	32.6	32.6	35.6	42.0	35.8	36	35	35	36	38	35	34
Coef.	.466	.466	.509	.600	.511	.514	.500	.500	.514	.543	.500	.486

LINING NO. 14 AS RECEIVED

370# Load

Test No.	1	2	1	2	1	2
R. P. M.	66	66	104	104	192	192
Friction	137	140	140	143	142	140.5
Coef.	.370	.379	.379	.387	.384	.380

270# Load

Test No.	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	196	196	352	352
Friction	101.6	103	107	109.6	109	107.2	80.8	85
Coef.	.376	.382	.396	.406	.404	.397	.299	.315

170# Load

Test No.	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	200	200	368	368	632	632
Friction	66	67	69	70	68	67	51	53.6	57.4	59.8
Coef.	.388	.394	.406	.412	.400	.394	.300	.316	.334	.352

70# Load

Test No.	1	2	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	202	202	380	380	660	660	1148	1148
Friction	29.4	29.6	31.4	33	31.2	31	25.6	25.2	24	25.2	20	20.4
Coef.	.420	.423	.449	.471	.446	.443	.366	.360	.343	.360	.286	.292

LINING NO. 15 AS RECEIVED

370# Load

Test No.	1	2	1	2	1	2
R. P. M.	66	66	104	104	190	190
Friction	180	180	180	180	174	166
Coef.	.486	.486	.486	.486	.470	.449

270# Load

Test No.	1	2	1	2	1	2
R. P. M.	66	66	104	104	194	194
Friction	134.4	135	140	140	143	138
Coef.	.498	.500	.519	.519	.530	.511

170# Load

Test No.	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	196	196	340	340
Friction	84	86.4	98	99	105	105	112.4	114
Coef.	.494	.508	.576	.582	.618	.618	.662	.671

70# Load

Test No.	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	200	200	364	364	612	612
Friction	34	36.4	44	46	44	54	54	56	57.4	57
Coef.	.485	.520	.628	.657	.628	.771	.771	.800	.820	.814

LINING NO. 16 AS RECEIVED

370# Load

Test No.	1	2	1	2	1	2
R. P. M.	66	66	104	104	190	190
Friction	209	214	214	218	212	220
Coef.	.566	.579	.579	.590	.573	.595

270# Load

Test No.	1	2	1	2	1	2
R. P. M.	66	66	104	104	194	194
Friction	162	164	164	168	169	169
Coef.	.600	.607	.607	.622	.619	.626

170# Load

Test No.	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	196	196	344	344
Friction	100	102	108	115	113	115	113	113
Coef.	.589	.600	.635	.676	.665	.676	.665	.665

70# Load

Test No.	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	200	200	372	372	644	644
Friction	37	39	44	45	45	45	46	46	45.4	45.6
Coef.	.528	.556	.628	.643	.643	.643	.657	.657	.648	.651

LINING NO. 18 AS RECEIVED

370# Load

Test No.	1	2	1	2	1	2	1	2
R.P.M.	66	66	104	104	192	192	312	312
Friction	118.8	120.4	134	132	136	130	128	130
Coef.	.321	.325	.362	.356	.368	.351	.346	.351

270# Load

Test No.	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	196	196	352	352
Friction	89.2	89.6	102.6	100.4	102	101	104	105
Coef.	.330	.332	.380	.372	.378	.374	.385	.389

170# Load

Test No.	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	200	200	372	372	604	604
Friction	56.2	58.6	66	65.2	67	65	69	69	70	72
Coef.	.343	.345	.388	.384	.394	.383	.405	.405	.411	.424

70# Load

Test No.	1	2	1	2	1	2	1	2	1	2	1	2
R. P.M.	66	66	104	104	202	202	380	380	660	660	1092	1092
Friction	24	25.2	30.4	30	33	33	39	39	43	44	30	30
Coef.	.343	.260	.434	.428	.471	.471	.556	.556	.614	.628	.428	.428

LINING NO. 19 AS RECEIVED

370# Load

Test No.	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	192	192	340	340
Friction	1192	120.2	118	118	115.2	110	122.4	126
Coef.	.322	.325	.319	.319	.312	.297	.331	.341

270# Load

Test No.	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	196	196	352	352
Friction	92.6	92	86.6	91	85.6	82	96	102
Coef.	.343	.341	.321	.337	. 317	.304	.355	.378

170# Load

Test No.	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	200	200	372	372	632	632
Friction	61.4	61.6	56.4	59	53.2	51.6	60	63	66	n64
Coef.	.361	.363	.331	.347	.313	.304	.353	.370	.388	.376

70# Load

Test No.	1	2	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	104	104	202	202	380	380	664	664	1140	1140
Friction	27.6	27.6	24.4	26.2	22.6	230	17	17	12	12	7	6.4
Coef.	.394	.394	.349	.374	.323	.379	.243	.243	.172	.172	.100	.0925

VARIATION OF COEFFICIENT WITH TIME
LINING NO. 1 AS RECEIVED

Speed 356 R.P.M. 170# Load

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	112	12
Friction	63	67	72	74	77	78	79	87	87	87.6	90	89	91
Coef.	.371	.394	.424	.435	.453	.459	.465	.511	.511	515	.530	.524	.535

Time Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	90.6	91	91	91	91	91	91	91	91	91	91	90	90
Coef.	.533	.535	.535	.535	.535	.535	.535	.535	.535	.535	.535	.530	.530

Time, Min.	26	27	28	29	30	31	32	33	34	35	36
Friction	90	90	89.6	89.6	88.4	88.4	86	86	84	84	84
Coef.	.530	.530	.528	.528	.520	.520	.506	.506	.494	.494	.494

LINING NO. 2 AS RECEIVED

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	97	984	98.8	99	98.8	99	99	99	98.8	98.8	98	97.8	97.8
Coef.	.570	.578	.581	.582	.581	.582	.582	.582	.581	.581	.576	.575	.575

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	97.6	97	96.6	96	95	95	94.6	94	93	93	92	92	91
Coef.	.574	.570	.569	.565	.559	.559	.557	.553	.547	.547	.541	.541	.535

Time, Min.	26	27	28	29	30	31	32	33	34	35	36
Friction	90	90	90	90	90	90	90.4	90.4	90.4	90.6	90.4
Coef.	.530	.530	.530	.530	,530	.530	.531	.531	.531	.533	.531

VARIATION OF COEFFICIENT WITH TIME
LINING NO. 3 AS RECEIVED

Speed 356 R. P. M. 170# Load

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	1	12
Friction	90	81	73	71	67	65	62	60	60	58	56	56	55
Coef.	.530	.476	.430	.417	.394	.382	.365	.353	.353	.341	.330	.330	.329

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	55	54	54	54	54	54	54	54	54	54	54	54	54
Coef.	.324	.318	.318	.318	.318	.318	.318	.318	.318	.318	.318	.318	.318

Time, Min.	26	27	28	29	30	31	32	33	34	35	36
Friction	54	54	54	54	53.6	54	54	54	54	54	54
Coef.	.324	.318	.318	.318	.318	.318	.318	.318	.318	.318	.318

LINING NO. 4 AS RECEIVED

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	100	99	90	85	81	77	76	73	70	70	68	67	68.4
Coef.	.588	.582	.530	.500	.476	.453	.446	.430	.412	.412	.400	.394	. 402

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	69	69	68	66.4	66.4	66	64	64	65	63	63	62	60
Coef.	.406	.406	.400	.390	.390	.388	.376	.376	.382	.370	.370	.365	.353

Time, Min.	26	27	28	29	30	31	32	33	34	35	36
Friction	61	61	62	62	61	61	60.2	61	61	60.2	61
Coef.	.358	.358	.365	.365	.358	.358	.354	.358	.358	.354	.358

VARIATION OF COEFFICIENT WITH TIME
LINING NO. 5 AS RECEIVED

Speed 356 R. P. M. 170# Load

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	82	78	77	74	72	70	69.4	67.2	66	65	64	74	63
Coef.	.482	.459	.453	.435	.424	.412	.408	.395	.385	.383	.376	.376	.370

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	61	59	58	57	55	53	52	51.6	50	51	50.4	50.4	51.8
Coef.	.359	.347	.341	.335	.324	.312	.306	.304	.294	.300	.296	.296	.305

Time, Min.	26	27	28	29	30	31	32	33	34	35	36	37	38
Friction	51	51	51	51	50.4	53	51	51	51	51	51		
Coef.	.300	.300	.300	.300	.296	.312	.300	.300	.300	.300	.300		

LINING NO. 6 AS RECEIVED

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	74	72	65	58	54	53	52	52	52	51	51	51	50.6
Coef.	.435	.424	.383	.341	.318	.312	.306	.306	.306	.300	.300	.300	.298

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	50.4	50.4	50.6	50.6	51	51	51	51	51	52	52	52	52.4
Coef.	.296	.296	.296	.298	.300	.300	.300	.300	.300	.306	.306	.306	.308

Time, Min.	26	27	28	29	30	31	32	33	34	35	36
Friction	51.4	52.6	52.6	53	52	51.4	53	53	53	53	53
Coef.	.302	.310	.310	.312	.306	.302	.312	.312	.312	.312	.312

VARIATION IN COEFFICIENT WITH TIME
LINING NO. 7 AS RECEIVED

Speed 356 R. P. M. 170# Load

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	66	63	60	57	55	54	52.4	52	51.4	51	50	50	49
Coef.	.388	.370	.353	.335	.324	.318	.308	.306	.302	.300	.294	.294	.285

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	49	49	49	48	48	48	48	48	47.6	47.4	47.4	47.4	47.4
Coef.	.288	.288	.288	.282	.282	.282	.282	.282	.280	.279	.279	.279	.279

LINING NO. 8 AS RECEIVED

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	77	73	74	75	76.4	79	80	81.4	81.8	82	83	84	84
Coef.	.453	.430	.435	.441	.449	.465	.470	.479	.481	.482	.488	.494	.494

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	85	85.4	85.4	86	86	86	86	87	87	87.6	87.6	87.6	87.6
Coef.	.500	.502	.502	.506	.506	.506	.506	.511	.511	.515	.515	.515	.515

Time, Min.	26	27	28	29	30	31	32	33	34	35	36
Friction	87.6	87.6	87.6	87.6	87.6	87.6	87.6	87.6	87.6	87.4	87.4
Coef.	.515	.515	.515	.515	.515	.515	.515	.515	.515	.514	.514

VARIATION OF COEFFICIENT WITH TIME
LINING NO. 9 AS RECEIVED

Speed 356 R. P. M. 170# Load

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	54	59	67	71.4	77	79	82	83	83	84	83.4	83.2	83
Coef.	.317	.347	.394	.420	.453	.465	.482	.488	.488	.494	.490	.489	.488

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	83	83	83.2	83	83	83	83	83	83.6	84	84.8	85	85
Coef.	.488	.488	.489	.489	.488	.488	.488	.488	.492	.494	.499	.500	.500

Time, Min.	26	27	28	29	30	31	32	33	34	35	36
Friction	85	84	84	85	84.4	82	82	85	85	85	85
Coef.	.500	. 494	.494	.500	.496	.482	.482	.500	.500	.500	.500

LINING NO. 10 AS RECEIVED

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	74	70	68	66	63	60	58.4	56.6	54.4	54.8	53	52.4	52.4
Coef.	.435	.411	.400	.388	.370	.353	.343	.333	.320	.322	.312	.308	.308

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	53	54	53	54	54.4	54.4	53	54	55.6	55.6	54	55	56
Coef.	.312	.317	.312	.317	.320	.320	.312	.317	.327	.327	.317	.324	.329

Time, Min.	26	27	28	29	30	31	32	33	34	35	36
Friction	56	57	57	57	56	56	58	59	59	59	59
Coef.	.529	.335	.335	.335	.329	.329	.341	.347	.347	.356	.347

VARIATION OF COEFFICIENT WITH TIME
LINING NO. 11 AS RECEIVED

Speed 356 R. P. M. 170# Load

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	72	63	59	56	53	51	50	47	48	47	46	48	48
Coef.	.424	.371	.347	.329	.312	.300	.294	.276	.282	.276	.271	.282	.282
Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	47.2	48	50	48	48	48	50	51	52	52	52	53	53
Coef.	.272	.282	.294	.288	.282	.282	.294	.300	.306	.306	.306	.312	.312
Time, Min.	26	27	28	29	30	31	32	33	34	35	36		
Friction	52	54	54	54.4	56	56	56	56	56	56	56		
Coef.	.306	.318	.318	.320	.329	.329	.329	.329	.329	.329	.329		

LINING NO. 12 AS RECEIVED

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	60	58	57	57	57	56	56	55.4	55.	55	54.4	54	53.4
Coef.	.353	.341	.335	.335	.329	.329	.329	.326	.324	.324	.320	.318	.314
Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	53.4	53.4	54	54	54	56	55	56	58	58	60	61	62
Coef.	.314	.314	.318	.318	.329	.329	.324	.329	.341	.341	.353	.359	.365
Time, Min.	26	27	28	29	30	31	32	33	34	35	36		
Friction	62	62	62.6	63	64	65	65	66	65.4	66	66		
Coef.	.365	.365	.369	.371	.377	.383	.383	.388	.385	.388	.388		

VARIATION OF COEFFICIENT WITH TIME
LINING NO. 13 AS RECEIVED

Speed 356 R. P. M. 170# Load

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	68	70	72	73	75	77	80	81	82	84	84	85.4	85.6
Coef.	.400	.411	.424	.429	.441	.454	.470	.476	.482	.494	.494	.502	.503

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	86	86	86.8	87.6	87.6	87.6	87.6	88	88	88	88	88	89
Coef.	.505	.505	.510	.515	.515	.515	.515	.518	.518	.518	.518	.518	.524

Time, Min.	26	27	28	39	30	31	32	33	34	35	36
Friction	89.2	89.2	89.2	89.6	89.6	89.6	89.2	89	89	89	89
Coef.	.525	.525	.525	.527	.527	.527	.525	.524	.524	.524	.524

LINING NO. 14 AS RECEIVED

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	93	87	77	72	71	70	69	68	68.4	67.4	66	66	66
Coef.	.547	.512	.453	.424	.417	.411	.406	.400	.402	.396	.388	.388	.388

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	66	64.4	64.4	61.6	61.2	60.4	60	59.6	59.6	58	58	58	58
Coef.	.388	.379	.379	.363	.360	.353	.353	.351	.341	.341	.341	.341	.341

Time, Min.	26	27	28	29	30	31	32	33	34	35	36	37	38
Friction	54	52	52	54	54	51.2	50	50	50.3	50.3	50.3	50.3	50.3
Coef.													

39	40	
50.3	50.3	
.296	.296	

VARIATION OF COEFFICIENT WITH TIME
LINING NO. 15 AS RECEIVED

Speed 356 R. P. M. 170# Load

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	87	91	90	90.6	92.4	93.2	93.4	92.4	92.0	96.8	96.8	97.2	97.6
Coef.	.512	.535	.530	.533	.543	.548	.549	.543	.541	.570	.570	.571	.575

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	97.6	98	98	98	99	100	101.2	101.4	101.4	101.4	102.4	102.4	102.4
Coef.	.575	.576	.576	.576	.581	.588	.596	.597	.597	.597	.603	.603	.603

Time, Min.	26	27	28	29	30	31	32	33	34	35	36
Friction	102.4	102.4	102.4	102.4	102.4	102.4	102.4	103.2	102.4	102.4	102.4
Coef.	.603	.603	.603	.603	.603	.603	.603	.607	.603	.603	.603

LINING NO. 16 AS RECEIVED

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	72	82	87	91	94	95	95	95.6	95.6	95.4	96	96	96
Coef.	.423	.482	.511	.535	.554	.559	.559	.562	.562	.562	.565	.565	.565

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	96	96	96.6	96.6	97	97	97	97	98.2	98.6	98.6	98	96
Coef.	.565	.565	.569	.569	.570	.570	.570	.578	.578	.580	.580	.576	.576

Time, Min.	26	27	28	29	30	31	32	33	34	35	36	37	38
Friction	97.6	97.6	98.2	98.2	98.2	98.2	98	97.2	97.2	97	97	97	97
Coef.	.575	.575	.578	.578	.578	.576	.572	.572	.572	.570	.570	.570	.570

VARIATION IN COEFFICIENT WITH TIME
LINING NO. 18 AS RECEIVED

Speed 356 R. P. M. 170# Load

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	65.6	63	60	59	58	61	64	60	65	60	66	60	66
Coef.	.386	.371	.353	.347	.341	.359	.377	.353	.382	.353	.388	.353	.388

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	60	60	63	60	62	64	62	62.6	61	61.8	61.2	63	62
Coef.	.353	.353	.371	.353	.365	.377	.365	.369	.359	.364	.360	.3 71	.365

Time, Min.	26	27	28	29	30	31	32	33	34	35	36	37	38
Friction	62	62	62	63	66	65	66	62	65	66	66		
Coef.	.365	.365	.365	.371	.388	.382	.388	.365	.382	.388	.388		

LINING NO. 19 AS RECEIVED

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	42	42	42.4	43	43	44	44.4	44.8	45.4	45.8	46.4	46.8	.47.2
Coef.	.247	.247	.249	.253	.253	.259	.261	.264	.267	.270	.273	.276	.278

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	47.6	47.8	47.8	47.8	48.4	482	48	48.2	48	48	48.2	48.4	48.4
Coef.	.280	.281	.281	.281	.285	.284	.282	.284	.282	.282	.284	.285	.285

Time, Min.	26	27	28	29	30	31	32	33	34	35	36	3
Friction	48.2	48.4	48.4	48.4	48.2	48.8	48.8	48.6	48.6	48.6	48.6	
Coef.	.284	.285	.285	.285	.284	.287	.287	.286	.286	.286	.286	

LINING NO. 1 WATER SOAKED

Speed 356 R. P. M. - 170# Load

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	80	70	67	65	63	63	64	65	67	69	70	71	75
Coef.	.470	.411	.394	.383	.370	.370	.377	.383	.394	.406	.411	.418	.441

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	76	76	77	82	82	82	86	86	84	86	86	86	86
Coef.	.446	.446	.453	.482	.482	.482	.506	.506	.494	.506	.506	.506	.506

Time, Min.	26	27	28	29	30	31	32	33	34	35	36
Friction	86	86	86	80	80	82	82	82	82	82	83
Coef.	.506	.506	.506	.470	.470	.482	.482	.482	.482	.482	.482

LINING NO. 2 WATER SOAKED

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	82	79	78	77.6	78.8	77.0	77.8	78.4	78.4	78.0	77.6	78.4	78.2
Coef.	.482	.465	.458	.456	.464	.453	.457	.461	.461	.458	.456	.461	.460

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	78.4	78.4	89.6	78.8	79.2	79.2	80.0	80.0	80.0	80.0	81.0	81.0	80.6
Coef.	.461	.461	.463	.464	.466	.466	.471	.471	.471	.471	.476	.476	.474

Time, Min.	26	27	28	29	30	31	32	33	34	35
Friction	80.6	81.0	81.0	81.2	81.4	82.8	82.8	82.6	82.6	82.6
Coef.	.474	.476	.476	.478	.479	.487	.487	.486	.486	.486

LINING NO. 3 WATER SOAKED

Speed 356 R. P. M. - 170 # Load

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	90	82	76	73.2	73.2	75	75.4	76.0	76.4	76.0	75.4	75.4	73.8
Coef.	.530	.482	.447	.430	.430	.441	.443	.447	.447	.447	.443	.443	.434

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	71.0	68.4	67.2	65.0	62.8	61.0	60.0	58.8	58	58	57.2	56.2	55
Coef.	.418	.402	.395	.383	.370	.359	.353	.346	.341	.341	.337	.331	.324

Time, Min.	26	27	28	29	30	31	32	33	34
Friction	54	53.2	52.8	52	52	52	52	52	
Coef.	.318	.313	.311	.306	.306	.306	.306	.306	

LINING NO. 4 WATER SOAKED

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	94	96.8	94	89	84.8	79.0	75.2	74.0	73.0	71.0	75.0	70.6	70.4
Coef.	.554	.570	.554	.524	.495	.465	.442	.435	.430	.418	.441	.415	.414

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	69	69	71.0	68.6	69.0	68.6	68.4	67.0	67.6	66.0	65.2	62.6	62
Coef.	.406	.406	.418	.404	.406	.404	.402	.394	.398	.388	.384	.369	.365

Time, Min.	26	27	28	29	30	31	32	33	34	35
Friction	62.6	62	62	62.4	61.8	61.0	60.4	61.0	61.0	60.4
Coef.	.369	.365	.365	.367	.364	.359	.355	.359	.359	.355

LINING NO. 5 WATER SOAKED

Speed 356 R. P. M. - 170 # Load

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	12	65.0	74	74.4	74.4	74.4	75	74.8	74.2	73	71.8	70.4	69.4
Coef.	.071	.383	.435	.437	.437	.437	.441	.440	.436	.429	.422	.414	.408

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	67	65.8	64	61.4	60.4	58.4	58.4	56.6	53.6	53.6	63.2	51.4	52.2
Coef.	.394	.387	.377	.361	.355	.344	.344	.334	.316	.316	.313	.302	.307

Time, Min.	26	27	28	29	30	31	32	33	34	35
Friction	50.4	50	50	50	51	51	50	50	52	50
Coef.	.296	.294	.294	.294	.294	.300	.294	.294	.306	.294

LINING NO. 6 WATER SOAKED

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	13	13	28	68.8	68	68.4	68.4	68.6	68.6	67	64.4	62.6	61.2
Coef.	.0765	.0765	.165	.405	.400	.402	.402	.404	.404	.394	.379	.369	.360

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	60	58.6	57.6	56.4	55.4	54.8	59.6	53.2	51.6	51.2	50	49.6	48.8
Coef.	.353	.345	.339	.331	.325	.322	.321	.313	.304	.301	.294	.392	.287

Time, Min.	26	27	28	29	30	31	32	33	34	35
Friction	49	48	48	48	47	47	47	46	46	46.6
Coef.	.288	.282	.282	.282	.276	.276	.276	.271	.271	.374

LINING NO. 7 WATER SOAKED

Speed 356 R. P. M. - 170# Load

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	16	15	24	71	62	60.6	60.4	59	58.4	58.2	58	57	56.4
Coef.	.094	.088	.141	.419	.364	.357	.355	.347	.343	.342	.341	.335	.331

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	55.4	55	54	53	52.4	51	50.2	50	49	48.6	48.2	47.4	47.4
Coef.	.328	.324	.318	.312	.308	.300	.295	.294	.288	.286	.284	.279	.279

Time, Min.	26	27	28	29	30	31	32	33	34	35
Friction	47.4	46.4	46.6	46.6	46.6	46.6	46.6	46.6	46.6	46.6
Coef.	.279	.279	.279	.279	.279	.279	.279	.279	.279	.279

LINING No. 8 WATER SOAKED

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	10	86	90	77.4	76	75.6	75.4	74.4	73.4	72.8	72.8	72.6	72.8
Coef.	.0588	.505	.530	.435	.447	.445	.443	.437	.432	.428	.428	.427	.428

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	73.2	74	74.2	74.6	74.8	74	75.4	75.6	76.2	76.2	76.6	76	75.8
Coef.	.431	.435	.435	.439	.440	.441	.443	.445	.448	.448	.450	.447	.446

Time, Min.	26	27	28	29	30	31	32	33	34	35
Friction	75.8	75.2	74.8	74	75.4	78.4	78.4	78.6	78.6	78.6
Coef.	.442	.440	.435	.444	.449	.460	.462	.462	.462	.462

LINING NO. 9 WATER SOAKED

Speed 356 R. P. M. - 170# Load

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	136	104	88	81	77	75	74	73	74	74.6	77	78.6	81
Coef.	.800	.612	.518	.476	.453	.491	.435	.430	.435	.433	.453	.463	.476

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	81.6	82.2	83.4	83.4	84.8	85.4	85.4	86.4	88	88.4	88.4	88	88.8
Coef.	.480	.484	.490	.490	.499	.502	.502	.508	.518	.520	.520	.518	.520

Time, Min.	26	27	28	29	30	31	32	33	34	35	36	37
Friction	88.4	88.4	88	87.4	87	86.8	86.8	87	87	87	87	
Coef.	.520	.520	.518	.514	.511	.510	.510	.511	.511	.511	.511	

LINING NO. 10 WATER SOAKED

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	9	80	100	73	70	68	67	65	63	60	57	55	54
Coef.	.053	.470	.488	.430	.421	.400	.394	.383	.371	.353	.335	.324	.318

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	54.6	54.6	54.6	54.2	54.2	55.2	55.2	54.4	54.4	54.4	54.4	55.4	55.6
Coef.	.321	.321	.321	.319	.319	.325	.325	.320	.320	.320	.320	.326	.327

Time, Min.	26	27	28	29	30	31	32	33	34	35	36	37	38
Friction	54.4	54.2	54.4	56	56	54.2	54.4	56	56	56	57	58.8	58.8
Coef.	.320	.319	.320	.329	.329	.319	.320	.329	.329	.335	.335	.346	.346

Time, Min.	39	40	41	42	43	44	45	46	47	48	49	50
Friction	5818	59	58.6	58	62	63	63	64	62	62	63	63
Coef.	.346	.347	.345	.3411	.365	.371	.376	.365	.365	.365	.371	.371

LINING NO. 11 WATER SOAKED

Speed 356 R. P. M. - 170 # Load

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	18	74	80	70	66	64	62	60	56.6	54.6	53.4	52.6	53
Coef.	.0945	.435	.470	.413	.388	.376	.365	.353	.333	.321	.312	.310	.312

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	54.4	54.2	52.6	53.6	54.6	54.4	54.4	55.4	56	58	57	57	57
Coef.	.320	. 312	.310	.316	.321	.320	.324	.326	.329	.335	.335	.335	.335

Time, Min.	26	27	28	29	30	31	32	33	34	35	36	37	38
Friction	56.8	57.2	58	58	58	59.4	60	60.4	61	60.8	60.8	60	60
Coef.	.334	.336	.341	.341	.341	.349	.353	.355	.359	.358	.358	.353	.353

Time, Min.	39	40
Friction	60	60
Cof.	.353	.353

LINING NO. 12 WATER SOAKED

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	100	80	75	74	74.8	74.8	74.8	73.6	73.6	75	74	74	75
Coef.	.577	.470	.441	.435	.440	.440	.440	.433	.433	.441	.435	.435	.441

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	75	75	75	75	75	75	75	75	74.8	75	75	75	75
Coef.	.441	.441	.441	.441	.441	.441	.441	.441	.440	.441	.441	.441	.441

Time, Min.	26	27	28	29	30	31	32	33	34	35	36
Friction	75	74	74	74	74	73.6	73/8	73.8	73.8	73.8	73.8
Coef.	.441	.435	. 435	.435	. 435	.433	.434	.434	.434	.434	.434

LINING NO. 13 WATER SOAKED

Speed 356 R. P. M. - 170# Load

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	72	70.8	67.4	65	64	63.2	63	62.2	61.2	60.2	59	59.6	58.4
Coef.	.424	.416	.396	.482	.476	.372	.371	.366	.360	.354	.347	.345	.343

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	58.4	59	59	59.8	60.4	60.4	61.4	62.2	63.2	63.6	64.4	64.4	65.8
Coef.	.343	.347	.347	.352	.355	.355	.361	.366	.372	.374	.378	.378	.387

Time, Min.	26	27	28	29	30	31	32	33	34	35	36
Friction	65.8	65.8	67	67	66.8	67.2	67.4	67.4	67.4	67.4	67.4
Coef.	.387	.387	.394	.394	.393	.395	.396	.396	.396	.396	.396

LINING NO. 14 WATER SOAKED

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	107	106	103	102	100	98.6	97.2	96	92	91.2	90	85.	78
Coef.	.630	.624	.606	.600	.589	.580	.572	.570	.591	.539	.530	.500	.549

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	75	72	65	63.6	63.4	64	62.8	61	59	58	58	57.6	57.6
Coef.	.441	.424	.382	.375	.373	.374	.369	.359	.347	.341	.341	.339	.339

Time, Min.	26	27	28	29	30	31	32	33	34	35	36
Friction	56	57.4	55.2	53	52	55	55.6	56.4	54	54.6	54
Coef.	.329	.337	.325	.312	.306	.323	.327	.331	.318	.321	.318

LINING NO. 15 WATER SOAKED

Speed 356 R. P. M. - 170# Load

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	90	96	102	104	105	105	106	107	109	112.6	115	117	117
Coef.	.530	.565	.600	.612	.618	.618	.624	.630	.641	.662	.666	.689	.689

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	117	118	120	121	121	121.2	121.2	121.2	121.6	121.8	121.8	122	122
Coef.	.689	.695	.706	.713	.713	.714	.714	.714	.715	.716	.716	.718	.718

Time, Min.	26	27	28	29	30	31	32	33	34	35	36
Friction	122.4	122.4	122.8	122.8	123	123.4	123.4	124	124	123.8	124
Coef.	.721	.721	.722	.722	.724	.727	.727	.730	.730	.728	.730

LINING NO. 16 WATER SOAKED

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	66	76	73	73	70	70	70	68	71	72	72	73.6	75
Coef	.388	.441	.430	.430	.411	.411	.411	.400	.418	.424	.424	.434	.441

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	68.2	68.2	68.2	6812	68.2	68.2	68.2	68.2	68.2	67	67	66.8	64
Coef.	.441	.435	.446	.463	.463	.470	.476	.482	.465	.475	.475	.494	.494

Time, Min.	26	27	28	29	30	31	32	33	34	35	36
Friction	82	85.4	88	90	93	106	114	115	118	121	121
Coef.	.482	.502	.518	.530	.546	.624	.671	.676	.695	.712	.712

LINING NO. 18 WATER SOAKED

Spee d 356 R. P. M. - 170# Load

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	62	57.6	60	63	67.6	70	72	71	70.4	70.4	70	68	68.2
Coef.	.365	.339	.353	.371	.392	.412	.423	.417	.414	.414	.412	.400	.401

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	68.2	68.2	68.2	68.2	68.2	68.2	68.2	68.2	68	67	67	66.8	64
Coef.	.401	.401	.401	.401	.401	.401	.401	.401	.400	.394	.394	.393	.376

Time, Min.	26	27	28	29	30	31	32	33	34	35	36
Friction	66	65	66	64.4	65	64.2	64.4	64	64.2	64	64.2
Coef.	.388	.382	.388	.378	.382	.377	.378	.376	.377	.376	.377

LINING NO. 19 WATER SOAKED

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	62	54	47	42	40	40	40	40.6	40.8	41.2	41.8	41.8	42
Coef.	.365	.318	.276	.247	.236	.236	.236	.239	.240	.243	.246	.246	.247

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	42.2	42.4	42.8	43	43.6	43.6	44.4	44.4	45	45.6	45.6	46.6	46.6
Coef.	.248	.249	.252	.253	.257	.257	.261	.261	.265	.269	.269	.274	.274

Time, Min.	26	27	28	29	30	31	32	33	34	35	36
Friction	47.2	47.2	47.8	47.8	47.8	47.8	47.9	47.8	48.4	48.4	48.4
Coef.	.278	.278	.281	.281	.281	.281	.281	.281	.284	.284	.284

LINING NO. 1 OIL SOAKED

Speed 356 R. P. M. - 170# Load

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	33	34	35	34.4	34	35.2	34.8	34.6	35.0	34.4	34.4	34.4	34.6
Coef.	.194	.20	.20	.202	.200	.207	.203	.203	.206	.202	.202	.202	.203

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	34.8	34.8	34.8	34.8	35	35	35.2	35.6	35.4	35.4	35.4	35.4	35.6
Coef.	.204	.204	.204	.204	.206	.206	.207	.209	.208	.208	.208	.208	.209

Time, Min.	26	27	28	29	30	31	32	33	34	35	36	37	38
Friction	36.2	36.2	36.0	35.6	35.6	35.6	35.6	35.6	35.6	35.8	36.0	36.0	36.0
Coef.	.213	.213	.211	.209	.209	.209	.209	.209	.209	.211	.212	.212	.212

Time, Min.	39	40	41	42	43	44	45
Friction	36.0	36.0	36	36	36	36	36
Coef.	.212	.212	.212	.212	.212	.212	.212

LINING NO. 2 OIL SOAKED

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	44.2	42	43	42.4	42	41.6	41.6	41.6	41.4	41.2	41.2	42	42
Coef.	.260	.247	.253	.249	.247	.243	.245	.245	.243	.241	.241	.247	.247

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	41.6	41.6	41.6	41.6	41.4	42.0	42.0	41.8	41.8	41.8	42.0	42	42.6
Coef.	.245	.245	.245	.245	.243	.247	.247	.246	.246	.246	.247	.247	.25

Time, Min.	26	27	28	29	30	31	32	33	34	35	36	37	38
Friction	42.4	42.4	42.4	42.4	42.6	42.8	42.8	43	43	43	43.2	43.6	44
Coef.	.249	.249	.249	.249	.25	.252	.252	.253	.253	.253	.254	.256	.259

Time, Min.	39	40	41	42	43	44	45
Friction	44	44	43.8	43.8	43.8	43.8	43.8
Coef.	.259	.259	.258	.258	.258	.258	.258

LINING NO. 3 OIL SOAKED

Speed 356 R. P. M. - 170# Load

Time, Min	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	58	58.6	58.8	58.8	59	59	59.2	59.4	59.4	59.6	59.6	60	60.2
Coef.	.341	.345	.346	.346	.347	.347	.348	.349	.349	.351	.351	.353	.354

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	60.4	60.4	60.6	60.4	60.6	60.6	60.6	60.6	60.6	61.4	61.4	61.4	61.2
Coef.	.355	.355	.357	.355	.357	.357	.357	.357	.357	.361	.361	.361	.360

Time, Min.	26	27	28	29	30
Friction	61.2	60.8	60.8	60.8	60.8
Coef.	.360	.358	.358	.358	.358

LINING NO. 4 OIL SOAKED

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	68	66.4	65.6	64.6	64.2	64.0	63.6	63.4	63.4	63.2	63.2	63.2	63.2
Coef.	.400	.390	.386	.380	.378	.377	.375	.373	.373	.372	.372	.372	.372

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	63.2	63.4	63.4	63.8	63.8	63.6	63.6	66.0	66.0	66.0	66.0	66.0	65.2
Coef.	.372	.373	.373	.376	.376	.375	.375	.388	.388	.388	.388	.386	.384

Time, Min.	26	27	28	29	30	31
Friction	65.2	65.0	65.0	65.0	65.0	
Coef.	.384	.383	.383	.383	.383	

LINING NO. 5 OIL SOAKED

Speed 356 R. P. M. - 170# Load

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	43	43.2	43.2	42.8	42.8	42.4	42	42	41.8	41.8	41.8	42.2	42.2
Coef.	.253	.254	.254	.252	.252	.429	.247	.247	.246	.246	.246	.248	.248

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	42.4	42.4	42.8	42.8	43	43.4	43.4	43.8	43.8	44	44.6	44.6	45
Coef.	.249	.249	.252	.252	.253	.255	.255	.258	.258	.259	.262	.262	.265

Time, Min.	26	27	28	29	30	31	32	33	34	35
Friction	45.4	45.6	46	46	46	46.4	46.4	46.8	46.8	46.8
Coef.	.267	.268	.271	.271	.271	.273	.273	.276	.276	.276

LINING NO. 6 OIL SOAKED

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	42	42.4	42.8	43.6	43.6	43.6	43.7	44	44.4	44.4	44.4	44.8	44.8
Coef.	.247	.249	.252	.257	.257	.257	.259	.259	.261	.261	.261	.264	.264

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	45	45	45	45.4	45.4	45.4	45.4	45.4	45.4	45.6	45.6	46	46
Coef.	.265	.265	.265	.267	.267	.267	.267	.267	.267	.268	.268	.271	.271

Time, Min.	26	27	28	29	30	31	32	33	34	35
Friction	46	46.4	46.6	46.6	47	47	47	47	47	47
Coef.	.271	.273	.274	.274	.276	.276	.276	.276	.276	.276

LINING NO. 7 OIL SOAKED

Speed 356 R. P. M. - 170# Load

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	44.4	44.4	44	43	43	42.4	42.4	42	42	42	42	42	42
Coef.	.261	.261	.259	.253	.253	.249	.249	.247	.247	.247	.247	.247	.247

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	42.4	42.4	42.4	42.4	42.6	43	43	43	43.2	43.4	43.6	43.8	43.8
Coef.	.249	.249	.249	.249	.251	.253	.253	.253	.254	.255	.257	.258	.258

Time, Min.	26	27	28	29	30	31	32	33	34	35
Friction	44	44.2	44.2	44.2	44.2	44.2	44.2	44.2	44.2	44.2
Coef.	.259	.260	.260	.260	.260	.260	.260	.260	.260	.260

LINING NO. 8 OIL SOAKED

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	33	34	34	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.4
Coef.	.194	.200	.200	.200	.201	.201	.201	.201	.201	.201	.201	.201	.202

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	34.6	34.7	34.8	34.8	34.8	34.8	34.8	35.2	35.2	35.2	35.2	35.4	35.6
Coef.	.204	.204	.205	.205	.205	.205	.205	.207	.207	.207	.207	.208	.209

Time, Min.	26	27	28	29	30	31	32	33	34	35
Friction	35.6	35.8	35.8	36	36	36	36	36	36	36
Coef.	.209	.211	.211	.212	.212	.212	.212	.212	.212	.212

LINING No. 9 OIL SOAKED

Speed 356 R. P. M. - 170# Load

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	51	51	51	50.6	50.4	50	50	n50	49.6	49.6	49.4	49.4	49.2
Coef.	.300	.300	.300	.298	.296	.294	.294	.294	.292	.292	.290	.290	.289

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.4	49.8	49.8	49.8
Coef.	.289	.289	.289	.289	.289	.289	.289	.289	.289	.290	.293	.293	.293

Time, Min.	26	27	28	29	30	31	32	33	34	35	36	37	38
Friction	49.8	50.6	50.6	50.6	50.6	50.6	50.6	50.6	50.6	50.6	50.6		
Coef.	.293	.298	.298	.298	.298	.298	.298	.298	.298	.298	.298		

LINING NO. 10 OIL SOAKED

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	44.6	44.6	45	45	45.2	45.2	45.2	45.4	45.4	45.4	45.4	45.6	45.6
Coef.	.263	.263	.265	.265	.266	.266	.266	.267	.267	.267	.269	.269	.269

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	45.6	45.6	46	46	46	46	46	46.8	46.8	46.8	46.8	46.8	46.8
Coef.	.269	.267	.271	.271	.271	.271	.271	.276	.276	.276	.276	.276	.276

Time, Min.	26	27	28	29	30	31	32	33	34	35	36
Friction	46.8	474	47.4	47.4	47.4	47.4	47.4	48	48	48	48
Coef.	.276	.279	.279	.279	.279	.279	.279	.282	.282	.282	.282

LINING NO. 11 OIL SOAKED

Speed 356 R. P. M. - 170# Load

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	45.8	46.4	46.4	46	45.2	45	44.8	44.6	49.4	44.4	44	44	44
Coef.	.270	.273	.273	.271	.266	.265	.264	.263	.261	.261	.259	.259	.259

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	44	44	44	44	44	44	44	44	44	44	44.4	44.4	45
Coef.	.259	.259	.259	.259	.259	.259	.259	.259	.259	.259	.261	.261	.265

Time, Min.	26	27	28	29	30	31	32	33	34	35	36
Friction	45	45	45	45.4	45.4	45.4	45.4	46	46	45.8	46
Coef.	.265	.265	.265	.267	.267	.267	.267	.271	.271	.270	.271

LINING NO. 12 OIL SOAKED

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	58	59.6	60.6	60.6	60.6	60.6	61	61	61	61.4	61.4	61.4	61.6
Coef.	.341	.351	.357	.357	.357	.357	.359	.359	.359	.361	.361	.361	.363

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	61.6	61.6	62	62	62.6	62.6	62.6	63.4	63.4	64	64	64	64
Coef.	.363	.363	.365	.365	.369	.369	.369	.373	.373	.376	.376	.376	.376

Time, Min.	26	27	28	29	30	31	32	33	34	35	36
Friction	64	64.8	64.8	64.8	64.8	65.4	66	66.2	66.8	67.2	67.8
Coef.	.376	.381	.381	.381	.381	.385	.388	.389	.393	.395	..399

LINING NO. 13 OIL SOAKED

Speed 356 R. P. M. - 170# Load

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	32	32.6	32.8	33	33.2	33.2	33.6	33.6	33.6	33.6	33.6	33.6	33.8
Coef.	.188	.192	.193	.194	.195	.195	.198	.198	.198	.198	.198	.198	.199

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	33.8	33.8	34	34	34.4	34.4	34.6	34.8	34.8	34.4	35.4	35.4	35.4
Coef.	.199	.199	.200	.200	.202	.202	.204	.205	.205	.208	.208	.208	.208

Time, Min.	26	27	28	29	30	31	32	33	34	35	36
Friction	35.4	35.4	35.4	35.6	356	35.8	35.8	35.8	35.8	35.8	35.8
Coef.	.208	.208	.208	.209	.209	.211	.211	.211	.211	.211	.211

LINING NO. 14 OIL SOAKED

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	42	44	45.4	46.2	47	47.6	48.6	48.8	49.6	49.8	49.8	50	50
Coef.	.247	.259	.267	.272	.276	.280	.286	.287	.292	.293	.293	.294	.294

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	50	50.6	50.6	50.8	51	51.4	51.4	51.6	51.6	52	52	52	52.4
Coef.	.294	.298	.298	.299	.300	.301	.302	.304	.304	.306	.306	.306	.308

Time, Min.	26	27	28	29	30	31	32	33	34	35	36
Friction	52.6	52.8	53.2	54	54.4	54.4	55	55.2	55.2	55.2	55.2
Coef.	.310	.311	.313	.317	.320	.302	.323	.325	.325	.325	.325

LINING NO. 15 - OIL SOAKED

Speed 356 R. P. M. - 170# Load

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	76	80	81.6	81.6	81.4	81.2	81.2	81.2	81.2	81.2	81.2	81.2	80.8
Coef.	.446	.470	.480	.480	.478	.478	.478	.478	.478	.478	.478	.478	.476

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	80.8	81.6	81.6	81.6	81.4	81.4	81.4	82.4	82.4	82.4	82.2	82.2	82.8
Coef.	.476	.480	.480	.480	.479	.479	.479	.485	.485	.485	.484	.484	.487

Time, Min.	26	27	28	29	30	31	32	33	34	35	36
Friction	84	84.6	84.6	84.6	84.6	84.6	84.4	84	84	84	84
Coef.	.495	.498	.498	.498	.498	.498	.496	.494	.495	.495	.495

LINING NO. 16 OIL SOAKED

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	68	80	85	86	85.4	85.4	85.4	85.6	86	86.4	87	88	89
Coef.	.400	.470	.500	.506	.502	.500	.502	.504	.506	.508	.512	.517	.524

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	89.2	89.6	90	90	90	90	90	89.6	89.6	89.6	89.6	89.6	90
Coef.	.525	.527	.529	.529	.529	.529	.529	.527	.527	.527	.527	.527	.529

Time, Min.	26	27	28	29	30	31	32	33	34	35	36
Friction	90.6	92	92.8	93	93.4	93.4	93.2	93.2	93	93	93
Coef.	.534	.541	.546	.547	.549	.549	.549	.548	.547	.547	.547

LINING NO. 18 OIL SOAKED

Speed 356 R. P. M. - 170# Load

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	40	45	46.2	46.4	46.4	46.4	46.2	46	46.4	46.6	46.8	46.8	46.8
Coef.	.235	.265	.272	.273	.273	.273	.272	.271	.273	.275	.276	.276	.276

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	46.8	46.6	46.8	46.8	46.8	47	47	47	47	47.4	47.6	47.6	47.4
Coef.	.276	.275	.276	.276	.276	.277	.277	.277	.278	.281	.281	.281	.278

Time, Min.	26	27	28	29	30	31	32	33	34	35	36
Friction	47.6	47.6	47.4	47.6	47.6	47.6	47.8	47.8	47.8	47.8	47.8
Coef.	.281	.281	.278	.281	.281	.281	.282	.282	.282	.282	.282

LINING NO. 19 OIL SOAKED

Time, Min.	0	1	2	3	4	5	6	7	8	9	10	11	12
Friction	54	53.5	52.6	51.6	50	49.6	48.6	48	47.6	47.6	47.4	47.4	47.4
Coef.	.318	.314	.310	.304	.294	.292	.286	.283	.281	.281	.278	.278	.278

Time, Min.	13	14	15	16	17	18	19	20	21	22	23	24	25
Friction	47.4	47.4	47.4	47.4	47.6	48	48	48.2	48.6	48.8	49.2	49.4	49.6
Coef.	.278	.278	.278	.278	.281	.283	.284	.284	.286	.287	.289	.290	.292

Time, Min.	26	27	28	29	30	31	32	33	34	35	36
Friction	.50	50.6	51	51	51.2	51.2	51.6	52	52	52	52
Coef.	.294	.298	.300	.300	.301	.301	.304	.306	.306	.306	.306

BRAKE DRUM RUNNING IN MUDDY WATER

Lining No.	1	1	2	2	3	3	4	4	5	5	6	6	7	7
Load 370#														
Test No.	1	2	1	2	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	66	66	66	66	66	66	66	66	66	66	66	66
Friction	75	73	70	66	65	61	77.2	76.0	72.8	68.4	78	77.6	52	50.4
Coef.	.203	.197	.189	.178	.176	.165	.209	.206	.197	.185	.211	.210	.140	.136
Load 270#														
Test No.	1	2	1	2	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	66	66	66	66	66	66	66	66	66	66	66	66
Friction	56	53	50	47	48	44	60	59	59.2	54.6	63.4	63.0	38	36.4
Coef.	.208	.196	.185	.174	.178	.163	.222	.218	.219	.202	.234	.233	.141	.135
Load 170#														
Test No.	1	2	1	2	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	66	66	66	66	66	66	66	66	66	66	66	66
Friction	36	35	34	32	33	31	39.6	38.4	40.6	38.8	44	43.6	23	22
Coef.	.212	.206	.200	.188	.194	.182	.233	.226	.239	.228	.259	.257	.135	.130
Load 70#														
Test No.	1	2	1	2	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	66	66	66	66	66	66	66	66	66	66	66	66
Friction	16	14	17	16	19	19	16.4	16.2	18.6	17.8	19.4	19	8.8	8.22
Coef.	.229	.200	.243	.229	.272	.272	.234	.232	.266	.254	.277	.272	.126	.117

BRAKE DRUM RUNNING IN MUDDY WATER

Lining No.	8	8	9	9	10	10	11	11	12	12	13	13	14	14
Load 370#														
Test No.	1	2	1	2	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	68	66	66	66	66	66	66	66	66	66	66	66	66
Friction	71	71	58	58	62	63	62	61	60	56	63	64	57	58
Coef.	.192	.192	.157	.157	.168	.170	.168	.165	.162	.151	.170	.173	.154	.157
Load 270 #														
Test No.	1	2	1	2	1	2	1	2	1	2	1	2½	1	2
R. P. M.	66	66	66	66	66	66	66	66	66	66	66	66	66	66
Friction	56	56	44	43	50	50	48	47.6	41	41.2	49	49	44	42
Coef.	.208	.208	.163	.159	.185	.185	.178	.177	.152	.153	.182	.182	.163	.156
Load 170#														
Test No.	1	2	1	2	1	2	1	2	1	2	1	2	1	2
R. P. M.	66	66	66	66	66	66	66	66	66	66	66	66	66	66
Friction	39.4	38.6	28.4	27.4	34	33	31	30.6	28	27.4	32	32	27	27
Coef.	.232	.227	.167	.161	.200	.194	.182	.180	.165	.161	.188	.188	.159	.159
Load 70#														
Test No.	1	2	1	2	1	2	1	2	1	2	1	2	1	2
R. P.M.	66	66	66	66	66	66	66	66	66	66	66	66	66	66
Friction	18	17.4	12	12	15	14.6	13.4	12.4	15.2	15	15	15	11.6	12
Coef.	.257	.249	.172	.172	.214	.209	.192	.177	.217	.214	.214	.214	.166	.172

BRAKE DRUM RUNNING IN MUDDY WATER

Lining No.	15	15	16	16	18	18	19	19
					Load 370#			
Test No.	1	2	1	2	1	2	1	2
R. P. M.	66	66	66	66	66	66	66	66
Friction	37	37	38	36	54	50	22	22
Coef.	.100	.100	.103	.097	.146	.135	.060	.060
					Load 270#			
Test No.	1	2	1	2	1	2	1	2
R. P. M.	66	66	66	66	66	66	66	66
Friction	28	27	28	26	42	35	12	11
Coef.	.104	.100	.104	.096	.156	.130	.045	.041
					Load 170#			
Test No.	1	2	1	2	1	2	1	2
R. P. M.	66	66	66	66	66	66	66	66
Friction	21	21	20	20	30	25	3	2.4
Coef.	.124	.124	.118	.118	.176	.147	.018	. 014
					Load 70#			
Test No.	1	2	1	2	1	2	1	2
R. P. M.	66	66	66	66	66	66	66	66
Friction	14	14	11	10.4	6	4	0.4	0.4
Coef.	.200	.200	.157	.149	.086	.057	.0057	.0057