

DETERMINATION OF POWER REQUIREMENTS OF A SLIDER-BED BELT
CONVEYOR WITH VARIOUS LOADS, BELTS, AND BEDS

by

Jay Goldman

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THESIS

ABSTRACT

A conveyor is a mechanism which is used to move objects from one location to another. The belt conveyor fulfills this requirement by transporting the various items on a moving belt. Because of their low operating costs and the ease of handling large volumes of materials, the use of the belt conveyor spread from its early beginning in the flour mills to other industries. However, this growth was not without its problems of design and construction. The main problems which had to be faced by the design engineers were the proper selection of: belts, belt tension, supporting surfaces, driving mechanisms, speed of flow, unit weights, angle of inclination and the power required. Each of these problems is a variable factor which in itself may change the performance of the conveyor. This thesis concerns itself with the determination of the power requirements of a slider-bed belt conveyor by varying the loads, surfaces and the belts with the other factors held constant.

The apparatus used for this test is a standard slider-bed belt conveyor plus a special dynamometer driving mechanism which was so constructed that the driving force on the conveyor could be easily determined and the power requirements computed. The surfaces which were

used in this test were as follows:

1. Enameled steel
2. Unpainted hot rolled steel
3. Type 302 stainless steel, #4 brush finish
4. Fir plywood
5. Maple plywood
6. 61 ST aluminum

The belts which were used in this test are as follows:

1. Rough-top rubber
2. Smooth-top rubber
3. Neoprene rubber
4. Innerbound canvas
5. Impregnated canvas (Red Gandy 32)
6. Silver duck canvas top, rubber base
7. Chemigum

With the tension, speed, angle of inclination, and the unit load held constant for each of the belts, the test runs were made. The test consisted of taking scale readings at zero, two hundred, four hundred, and six hundred pound total loads with each belt on each surface.

The results of this test must be stated in a general way since each belt acted somewhat differently on the various surfaces. However it can be said that the enameled steel surface required the most power to drive the belts. The aluminum and stainless steel surfaces required somewhat less power than did the enameled surface,

and the maple wood, fir wood, and unpainted hot rolled steel surfaces required the least power. The belts which required the most power to run over all of the surfaces were the impregnated canvas, the innerbound canvas, and the silver duck canvas. The neoprene, chemigum, smooth-top rubber, and rough-top rubber belts required less power than did the canvas belts.

Since none of the conveyor load vs. horsepower required curves start from the origin it is evident that there is a certain amount of power required to drive the conveyor at zero load which can be attributed to the friction of the pulleys, the weight of the belt and the bending of the belt, as well as an additional amount of power required to drive the conveyor once a load has been applied which is due to the additional frictional drag plus the change in velocity to bring the load up to belt speed.

It should be emphasized at this time that all of the variable factors mentioned in this thesis play a very important part in the performance of a conveyor. The figures obtained in this study are the results of an attempt to cancel out as many of the variables as possible and varying the remaining factors under controlled conditions, in order to make a comparison of a number of belts and slider-beds.

John B. Harris
MECHANICAL ENGR.

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FIGURE 1
SLIDER-BED BELT CONVEYOR

INTRODUCTION

A conveyor is a mechanism which is used to move objects from one location to another. The belt conveyor, which transports various items on a moving belt or band, is simply one means of accomplishing this requirement. These conveyors have been used in this country for the past one hundred and fifty years. Moving belts were first used in the processing of flour, because this type of conveyor seemed to be the best for handling the bulky products of the mills. With the development of the large grain elevators, the problem of materials handling became more intensified and the elevator operators were interested in better and more efficient designs which would solve their problems. It follows that since the leading exponent of belt conveyors was the flour industry, the early research, development and testing were undertaken with this one type of product in mind.

Because of the low operating costs and the ease of handling a large volume of materials, the use of belt conveyors gradually spread to other industries. Due to this growth, many new problems arose which demanded changes in design of both the conveyor and its auxiliary equipment. These problems consisted mainly of the proper selection of: belts, belt tension, supporting surfaces,

driving mechanisms, speed of flow, unit weights, angle of inclination, and the power required.

Much experimental work has been done on each of the above problems by the various manufacturers of conveyor equipment. These concerns have tried to incorporate new developments in materials, construction, and driving mechanisms in to their designs. However, it should be realized that each problem is a variable factor and that any one may change the performance of a conveyor. For any given set of circumstances or requirements, each of the problems must be considered in the design of the conveyor.

This thesis concerns itself with the determination of the power requirements of a slider-bed belt conveyor by varying the loads, surfaces, and the belts with the other factors held constant.

APPARATUS

A belt conveyor consists of an endless belt, a driving pulley, a take up pulley, a belt supporting unit, and accessory devices for loading, unloading, and maintaining proper tension in the belt. The conveyor which was used in this investigation was a slider-bed model FVB-21-16-3/4 Floor-Veyor Jr. which was manufactured by the Rapids Standard Company of Grand Rapids, Michigan. The bed was twenty-one feet long from center to center of the pulleys and carried a belt sixteen inches wide. The diameter of the drive pulley was eight inches and that of the take up pulley was four inches. The slider-bed was equipped with special lugs so that sheets of different types of materials could be fastened on the bed to simulate various bed surfaces.

The power to drive the belt was furnished by a cradle type dynamometer which had a one horsepower, four hundred and forty volt, three phase, sixty cycle right hand gear head motor revolving at fifty-nine revolutions per minute. The thirteen tooth RC-50 sprocket on the motor drove the thirty-five tooth sprocket on the drive pulley through an eight foot length of RC-50 coupling link chain. The conveyor belt speed with this drive was forty-six feet per minute.



FIGURE 2
SLIDER-BED BELT CONVEYOR

In order to allow the load to run on and off the conveyor, two ten-foot feeder sections of 12-BR-10 wheel conveyor complete with case stops were attached to both ends of the conveyor. The load consisted of a number of steel tote pans, into which enough lead weights were placed to give a total weight of fifty pounds per pan. The area of each pan in contact with the belt was exactly one hundred and twenty square inches. Thus the load was distributed in such a way that the unit load on the belt was exactly sixty pounds per square foot.

The surfaces which were used in this test were as follows:

1. Enameled steel
2. Unpainted hot rolled steel
3. Type 302 stainless steel, #4 brush finish
4. Fir plywood
5. Maple plywood
6. 61 ST aluminum

With the exception of the enameled steel, which was the actual slider bed surface, each of the other surfaces were bed cover sheets twenty feet long and twenty inches wide.

The following belts, each cut to exactly forty-four feet and two inches long and sixteen inches wide, were used in the test:

1. Rough-top rubber

2. Smooth-top rubber
3. Neoprene rubber
4. Innerbound canvas
5. Impregnated canvas (Red Gandy 32)
6. Silver duck canvas top, rubber base
7. Chemigum

PROCEDURE

When the conveyor arrived it was assembled, mounted on cast iron legs, and leveled so that the bed was horizontal. Therefore the angle of inclination mentioned in the introduction was held constant for all belts and surfaces. The sections of wheel conveyor were then attached to both ends of the belt conveyor and the case stops placed in position.

The cradle dynamometer with its motor and gear reducing mechanism was mounted in its frame and the coupling link chain was attached between the dynamometer and the drive pulley. It was realized that the torque on the dynamometer would be very high when the belt was loaded and therefore the dynamometer frame was bolted and clamped to the slider-bed and its supports. The tension in the driving chain was adjusted before the dynamometer was secured into place.

This cradle type dynamometer was designed especially for this type of power determination test. The motor and gear reducing mechanism were welded into the cradle upside down with its weight pivoting around the drive shaft. On the opposite end of the cradle enough weights were welded into place so as to counterbalance the weight of the motor. Therefore the cradle was in equilibrium and

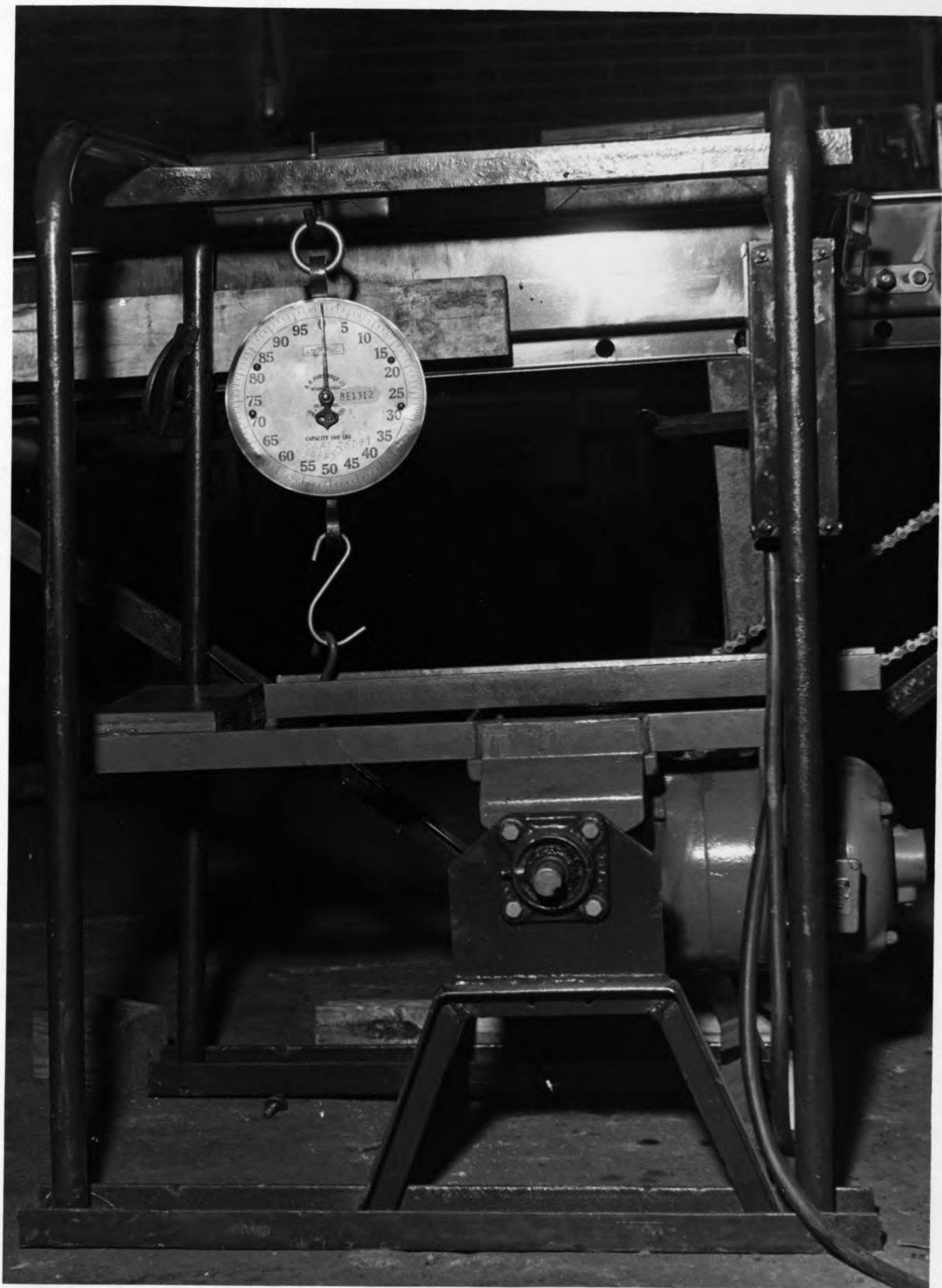


FIGURE 3
CRADLE TYPE DYNAMOMETER

the weight of the motor was automatically canceled out. To one end of the cradle at a distance of ten inches from the drive shaft was placed a hook and directly above this on the frame, another hook was placed. A scale was then hung between these hooks so that any turning moment of the cradle in the proper direction registered on the scale.

The principle upon which the dynamometer operated was a very simple one. The motor was mounted longitudinally in the cradle and by using a right-hand worm-driven gear-head reduction unit, the output drive shaft was perpendicular to the drive shaft of the motor. Through this type of arrangement it was possible to pivot the motor around the output drive shaft. When the motor was running and there was no load on the drive shaft, the motor stayed in equilibrium or in a horizontal position. As soon as a load was applied to the drive shaft, the normal tendency was to slow the motor down, but since the motor was free to pivot it produced an equal and opposite reaction to the load. Since the motor was welded to the cradle, the entire cradle rotated and in so doing registered the amount of the force on the scale. From this scale reading, the horsepower applied to the drive chain was determined. This was the actual horsepower required to drive the belt and not the motor horsepower. The difference

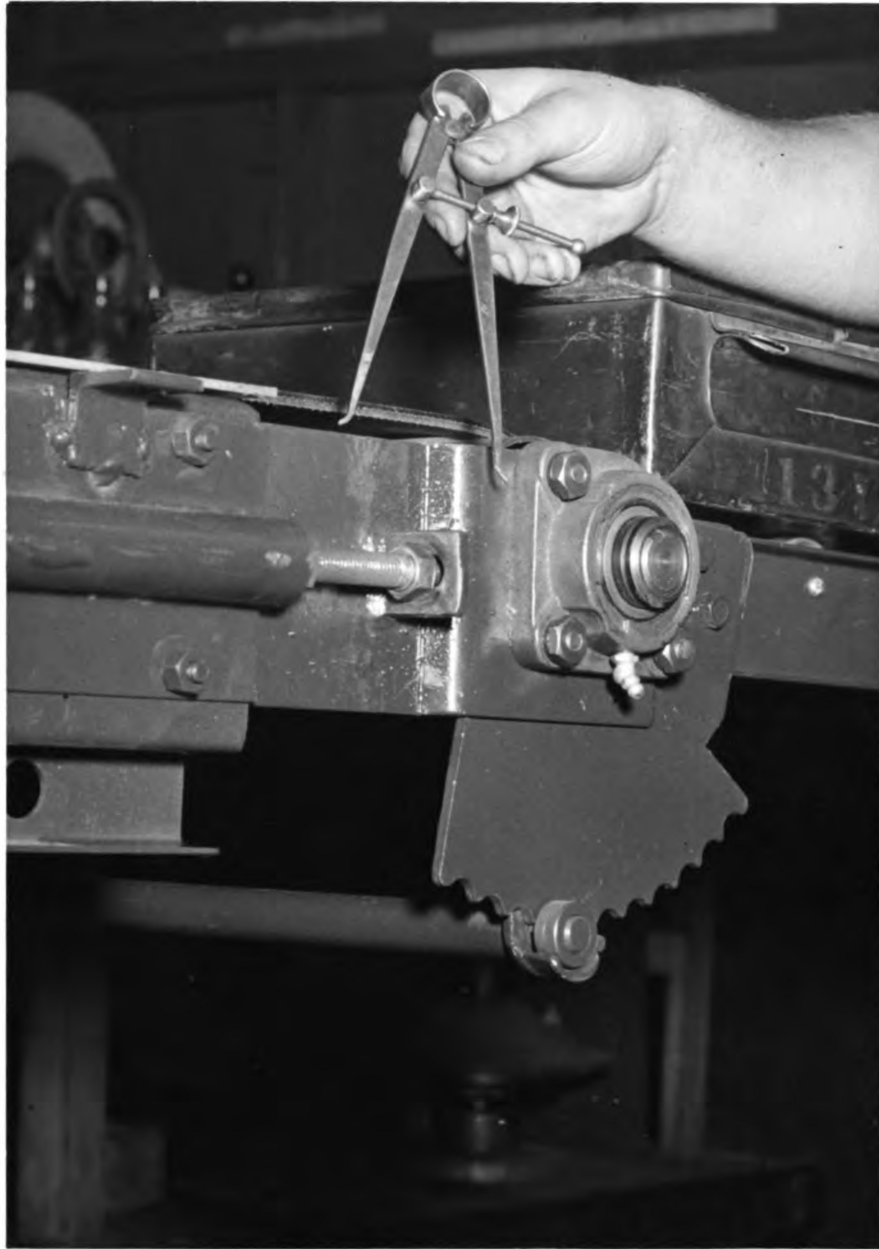


FIGURE 4
TENSION TAKE UP ADJUSTMENT
ON SLIDER-BED BELT CONVEYOR

between these readings and the motor horsepower was the losses in the motor and gear reducing mechanism.

Each belt was then placed on the conveyor and the tension take up was adjusted to the point where the belts would pull the maximum load of six hundred pounds without any noticeable slippage. It was decided that the tension to use in the test would be that which would move the load on the belt with the highest coefficient of friction. This tension amounted to exactly a two and one-half inch extension on the take up screws. Throughout the test this tension was held constant for each belt. It was felt that by using this constant take up gap and by having all of the belts cut to exactly the same length, the problem of belt tension would be held fairly constant for all of the belts. It should be realized however that the stretch characteristics of each belt were different, but it was felt that the slight amount of change in belt tension due to the difference in stretch characteristics would be a very small part of the total power required to move the belt, especially under load. This fact became evident when a test was made in which the tension gap was doubled and the resulting increase in power required to drive the belt was negligible.

Before starting the actual test run each belt was run on all of the surfaces for three or four hours. Also



FIGURE 5
DRIVING MECHANISM FOR SLIDER-BED BELT CONVEYOR

the speed of the belt was checked and found to be forty-six feet per minute. This speed was held constant throughout the test. Conversion tables can be used if it is necessary to know the power requirements at different speeds.

The test run consisted of taking scale readings at zero, two hundred, four hundred, and six hundred pound loads with each belt on each surface. The conveyor was allowed to run freely and the loads were applied at intervals. The scale was read only while the load was moving towards the drive pulley. It was found that during the run the scale had a tendency to waver from one-fourth to one-half of a pound from the average readings. This shows that the load does not move smoothly across the surface but tends to start and stop all the way across. Also the initial effect of placing the load on the moving belt caused a very high scale reading. Because of this, the dynamometer had to be dampened by hand until the scale readings were fairly constant.

After each belt was completely tested, it was re-run over the same surfaces and rechecked until the readings coincided with those taken during the first run. The results of these rechecks were also plotted in the graph section. During the test run the enameled surface had to be repainted several times to assure accuracy of results.

POWER REQUIREMENTS OF SLIDER-BED BELT CONVEYOR

TYPE OF BELT--ROUGH TOP RUBBER

Observer - Mr. Goldman

Revolutions per Minute of
Motor - 59

July 30, 1951

Lever Arm to Scale - 10"

LOAD in PoundsLOAD in Pounds

0 200 400 600

0 200 400 600

Enameled Steel Surface-

Fir Wood Surface-

1. 4.0 19.0 35.0 46.0
 2. 4.25 18.5 35.25 47.0
 3. 4.0 21.0 36.0 46.5
 S 4. 4.25 20.0 34.0 47.0

1. 3.75 13.25 22.5 33.25
 2. 3.5 19.5 22.75 33.0
 3. 4.0 13.5 22.75 32.5
 4. 3.75 13.75 23.0 33.25

C

A Stainless Steel Surface-

Maple Wood Surface-

L 1. 4.0 17.5 31.75 47.0
 E 2. 3.75 18.0 31.0 47.25
 3. 4.25 17.75 32.0 45.0
 R 4. 4.0 18.0 32.25 47.0

1. 3.75 14.0 24.75 35.25
 2. 4.0 14.0 24.75 35.25
 3. 3.75 14.25 24.75 35.5
 4. 3.75 14.25 25.0 35.0

E

A Aluminum Surface-

Recheck - Enameled Steel Surface-

D 1. 4.0 16.5 28.5 40.5
 I 2. 4.5 17.0 29.0 40.0
 N 3. 4.25 17.25 29.25 39.75
 G 4. 4.25 17.0 29.0 39.75

1. 4.0 13.0 24.5 34.0
 2. 3.75 13.75 24.75 34.5
 3. 4.25 13.25 25.5 36.5
 4. 4.0 13.5 25.25 36.25

S

Unpainted Steel Surface-

i 1. 3.25 14.5 23.5 34.0
 n 2. 3.25 13.5 24.5 34.5
 3. 3.5 14.0 25.0 35.0
 p 4. 3.25 14.0 24.5 34.5

p

o

u

n

d

s

POWER REQUIREMENTS OF SLIDER BED FELT CONVEYOR

TYPE OF BELT--INNERBOUND CANVAS

Observer - Mr. Goldman

July 31, 1951

<u>LOAD</u> in Pounds						<u>LOAD</u> in Pounds					
0 200 400 600						0 200 400 600					
Enameled Steel Surface-						Fir Wood Surface-					
S	1.	4.0	18.0	34.0	46.0	1.	4.75	16.25	26.5	37.0	
C	2.	3.75	18.25	34.25	46.25	2.	4.75	16.0	26.75	36.75	
A	3.	4.25	18.25	34.0	45.5	3.	5.0	16.5	27.0	37.25	
L	4.	4.0	18.5	34.0	46.0	4.	4.5	16.5	26.75	37.0	
E											
Stainless Steel Surface-						Maple Wood Surface-					
R	1.	4.5	21.0	35.5	50.0	1.	4.5	17.5	30.0	42.5	
E	2.	4.25	21.25	35.75	48.5	2.	4.75	17.75	30.25	42.75	
A	3.	4.5	21.0	36.0	49.0	3.	5.0	18.0	30.25	43.0	
D	4.	4.5	21.25	35.5	49.0	4.	4.75	18.0	30.5	43.0	
I											
Aluminum Surface-						Recheck-Enameled Steel Surface-					
G	1.	5.0	18.5	31.5	44.0	1.	4.0	13.0	21.75	31.75	
S	2.	5.25	18.75	31.25	44.25	2.	3.75	13.25	22.0	31.5	
	3.	5.5	18.75	31.0	44.25	3.	4.25	13.5	22.5	32.0	
i	4.	5.25	19.0	31.0	44.5	4.	4.0	13.5	23.0	31.75	
n											
Unpainted Steel Surface-						Stainless Steel Surface-					
p	1.	4.5	14.5	23.5	32.5	1.	4.5	18.25	30.5	41.0	
o	2.	4.25	14.25	23.25	32.25	2.	4.25	18.75	30.25	40.75	
u	3.	4.75	14.25	23.25	31.5	3.	4.75	18.75	30.75	40.75	
n	4.	4.5	14.25	23.5	32.75	4.	4.5	19.0	30.25	41.0	
d											
s											

POWER REQUIREMENTS OF SLIDER BED BELT CONVEYOR

TYPE OF BELT--SILVER DUCK CANVAS TOP, RUBBER BASE

Observer - Mr. Goldman

August 3, 1951

<u>LOAD</u> in Pounds						<u>LOAD</u> in Pounds					
		0	200	400	600			0	200	400	600
Enameled Steel Surface-						Fir Wood Surface-					
S	1.	5.0	26.75	40.25	56.0	1.	5.75	17.5	30.5	42.5	
C	2.	4.75	27.75	40.0	56.25	2.	6.0	17.75	30.25	42.25	
A	3.	5.25	27.5	40.5	55.5	3.	5.5	17.75	30.25	42.25	
L	4.	5.5	27.5	40.25	56.0	4.	5.75	18.0	30.25	42.5	
E											
Stainless Steel Surface-						Maple Wood Surface-					
R	1.	5.50	19.5	31.5	45.25	1.	5.5	17.75	31.75	44.0	
E	2.	5.25	19.25	31.75	45.5	2.	5.25	18.0	31.5	43.75	
A	3.	5.75	19.25	32.0	44.25	3.	5.75	18.25	31.5	43.75	
D	4.	5.5	19.5	31.75	45.75	4.	5.5	18.25	31.5	44.0	
I											
Aluminum Surface-						Recheck-Enameled Steel Surface-					
G	1.	5.0	18.75	31.5	44.0	1.	5.0	21.5	39.75	55.5	
S	2.	5.25	18.75	31.25	44.25	2.	4.75	22.0	39.5	56.0	
	3.	4.75	19.25	31.75	44.25	3.	5.5	22.5	39.5	56.25	
i	4.	5.25	19.0	31.75	44.0	4.	5.25	22.0	39.75	56.0	
n											
Unpainted Steel Surface-						Aluminum Surface-					
p	1.	5.25	17.25	28.0	40.5	1.	5.0	16.75	27.5	40.0	
o	2.	5.5	17.5	28.5	40.5	2.	4.75	16.25	28.0	40.25	
u	3.	5.75	17.5	28.75	40.75	3.	4.5	16.5	27.75	40.75	
n	4.	5.5	17.75	28.75	40.75	4.	4.75	16.5	28.0	40.5	
d											
s											

POWER REQUIREMENTS OF SLIDER BED BELT CONVEYOR

TYPE CF BELT--CHEMIGUM

Observer - Mr. Goldman

August 7, 1951

<u>LOAD</u> in Pounds						<u>LOAD</u> in Pounds				
		0	200	400	600		0	200	400	600
Enameled Steel Surface-						Fir Wood Surface-				
S	1.	5.0	20.0	33.75	47.0	1.	5.0	15.25	25.75	35.5
C	2.	5.25	20.25	34.0	47.25	2.	5.25	15.5	25.	35.0
A	3.	4.75	19.75	34.25	47.0	3.	5.5	15.5	25.25	35.25
L	4.	5.0	19.75	34.25	46.75	4.	5.25	15.25	25.0	34.75
E										
Stainless Steel Surface-						Maple Wood Surface-				
R	1.	4.75	16.5	27.75	39.75	1.	5.0	15.25	24.75	34.5
E	2.	4.5	16.25	27.5	39.75	2.	5.25	14.75	25.0	34.75
A	3.	5.0	16.75	27.5	37.75	3.	4.75	15.0	25.0	34.75
D	4.	4.75	16.5	27.75	37.75	4.	5.0	15.25	24.75	35.0
I										
Aluminum Surface-						Recheck C. K.-				
G	1.	4.75	15.75	25.0	36.25					
S	2.	5.0	15.0	25.25	35.25					
	3.	5.24	15.25	25.5	36.0					
i	4.	5.0	15.5	25.5	36.25					
n										
Unpainted Steel Surface-										
p	1.	4.75	15.0	24.75	34.75					
o	2.	5.0	15.0	25.0	34.5					
u	3.	5.0	14.75	24.75	35.0					
n	4.	4.75	15.0	25.0	34.75					
d										
s										

SAMPLE COMPUTATIONS

1. Average Scale -- (Rough top rubber belt on enameled steel surface)

$$\begin{aligned}\text{Av. Scale} &= \frac{\text{Reading 1} - \text{Reading 2} - \text{Reading 3} - \text{Reading 4}}{\text{Number of Readings}} \\ &= 19 - 18.5 - 21 - 20 / 4 \\ &= \underline{19.6 \text{ Pounds}}\end{aligned}$$

2. Horsepower to Chain

$$\text{H.P.} = 2 \quad T N / 33,000$$

where N = Revolutions per minute of motor

$$= 59 \text{ R.P.M.}$$

T = Torque on motor in foot pounds

$$= (\text{Average Scale})(\text{Lever Arm to scale})$$

$$= (19.6) \frac{(10)}{12}$$

$$= 16.33 \text{ Ft.Lb.}$$

$$\text{H.P.} = 2 \frac{(16.33)(59)}{33,000}$$

$$= \underline{0.1835 \text{ HP}}$$

RESULTS OF COMPUTATIONS OF POWER REQUIREMENTS OF SLIDER

BED BELT CONVEYOR ON ROUGH TOP RUBBER BELT

Observer - Mr. Goldman

Revolutions per Minute of

Motor - 59

July 30, 1951

Lever Arm to Scale - 10"

LOAD in Pounds

0 200 400 600

Enameled Steel Surface-

Av. Scale	4.13	19.6	35.06	46.6
Horsepower	.0387	.1835	.3282	.4362

Stainless Steel Surface-

Av. Scale	4.0	17.81	31.75	46.44
Horsepower	.0375	.1667	.2972	.4347

Aluminum Surface-

Av. Scale	4.25	16.94	28.94	40.0
Horsepower	.0398	.1586	.2709	.3745

Unpainted Steel Surface-

Av. Scale	3.31	14.0	24.4	34.5
Horsepower	.0310	.1311	.2284	.3230

Fir Wood Surface-

Av. Scale	3.75	13.5	22.5	33.0
Horsepower	.0351	.1264	.2106	.3090

Maple Wood Surface-

Av. Scale	4.0	13.37	25.0	35.31
Horsepower	.0374	.1251	.2340	.3306

Recheck

Enameled Steel Surface-

Av. Scale	4.0	13.37	25.0	35.31
Horsepower	.0374	.1251	.2340	.3306

RESULTS OF COMPUTATIONS OF POWER REQUIREMENTS OF SLIDER
BED BELT CONVEYOR ON INNER BOUND CANVAS BELT

Observer - Mr. Goldman

July 31, 1951

		<u>LOAD</u> in Pounds			
		0	200	400	600
Enameled Steel Surface-					
Av. Scale		4.0	18.25	34.06	45.94
Horsepower		.0375	.1709	.3189	.4301
Stainless Steel Surface-					
Av. Scale		4.44	21.13	35.69	49.1
Horsepower		.0416	.1979	.3341	.4596
Aluminum Surface-					
Av. Scale		5.25	18.75	31.19	44.25
Horsepower		.0492	.1755	.2920	.4142
Unpainted Steel Surface-					
Av. Scale		4.5	14.31	23.26	32.25
Horsepower		.0421	.1340	.2180	.3020
Fir Wood Surface-					
Av. Scale		4.75	16.44	26.75	37.0
Horsepower		.0445	.1539	.2504	.3464
Maple Wood Surface-					
Av. Scale		4.75	17.81	30.25	42.81
Horsepower		.0445	.1667	.2832	.4008
Recheck					
Enameled Steel Surface					
Av. Scale		4.0	13.31	22.31	31.75
Horsepower		.0375	.1246	.2089	.2972
Stainless Steel Surface-					
Av. Scale		4.5	18.69	30.44	40.9
Horsepower		.04213	.1750	.2850	.3829

RESULTS OF COMPUTATIONS OF POWER REQUIREMENTS OF SLIDER
BED BELT CONVEYOR ON SMOOTH TOP RUBBER BELT

Observer - Mr. Goldman

August 1, 1951

LOAD in Pounds

0 200 400 600

Enameled Steel Surface-

Av. Scale	4.25	19.25	33.06	46.63
Horsepower	.0398	.1802	.3094	.4365

Stainless Steel Surface-

Av. Scale	4.0	16.06	27.06	38.0
Horsepower	.0375	.1503	.2533	.3557

Aluminum Surface-

Av. Scale	4.0	14.56	25.13	34.75
Horsepower	.0375	.1363	.2353	.3253

Unpainted Steel Surface-

Av. Scale	3.5	13.94	23.69	33.38
Horsepower	.0328	.1305	.2218	.3215

Fir Wood Surface-

Av. Scale	4.0	14.63	24.31	34.31
Horsepower	.0375	.1370	.2276	.3195

Maple Wood Surface-

Av. Scale	3.75	14.0	23.88	33.94
Horsepower	.0351	.1311	.2236	.3177

Recheck

Aluminum Surface-

Av. Scale	3.63	13.31	23.19	32.69
Horsepower	.0340	.1246	.2171	.3060

RESULTS OF COMPUTATIONS OF POWER REQUIREMENTS OF SLIDER
BED BELT CONVEYOR ON SILVER DUCK CANVAS BELT

Observer - Mr. Goldman

August 3, 1951

LOAD in Pounds

0 200 400 600

Enameled Steel Surface-

Av. Scale	5.12	27.37	40.25	55.94
Horsepower	.0479	.2562	.3768	.5237

Stainless Steel Surface-

Av. Scale	5.5	19.38	31.75	45.56
Horsepower	.0515	.1814	.2972	.4265

Aluminum Surface-

Av. Scale	5.06	18.94	31.56	44.13
Horsepower	.0474	.1773	.2955	.4131

Unpainted Steel Surface-

Av. Scale	5.5	17.5	28.5	42.38
Horsepower	.0515	.1638	.2668	.3804

Fir Wood Surface-

Av. Scale	5.75	17.75	30.31	42.38
Horsepower	.0538	.1662	.2337	.3967

Maple Wood Surface-

Av. Scale	5.5	18.06	31.56	43.88
Horsepower	.0515	.1691	.2955	.4108

Recheck

Enameled Steel Surface-

Av. Scale	5.12	22.0	39.63	55.94
Horsepower	.0479	.2060	.3710	.5237

Aluminum Surface-

Av. Scale	4.75	16.5	27.81	40.38
Horsepower	.0445	.1545	.2603	.3780

RESULTS OF COMPUTATIONS OF POWER REQUIREMENTS OF SLIDER
BED BELT CONVEYOR ON IMPREGNATED CANVAS (RED GANDY 32) BELT

Observer - Mr. Goldman

August 6, 1951

		<u>LOAD</u> in Pounds			
		0	200	400	600
Enameled Steel Surface-					
Av. Scale		8.88	36.56	59.63	83.06
Horsepower		.0831	.3423	.5582	.7776
Stainless Steel Surface-					
Av. Scale		7.5	22.31	33.56	44.75
Horsepower		.0702	.2089	.3142	.4189
Aluminum Surface-					
Av. Scale		7.88	20.63	31.75	44.25
Horsepower		.0738	.1931	.2972	.4142
Unpainted Steel Surface-					
Av. Scale		7.81	20.13	30.0	41.0
Horsepower		.0731	.1834	.2808	.3838
Fir Wood Surface-					
Av. Scale		7.5	20.06	31.25	42.0
Horsepower		.0702	.1878	.2925	.3932
Maple Wood Surface-					
Av. Scale		7.5	20.56	31.63	42.69
Horsepower		.0702	.1925	.2961	.3996
Recheck -- C. K.					



RESULTS OF COMPUTATIONS OF POWER REQUIREMENTS OF SLIDER
BED BELT CONVEYOR ON CHEMIGUM BELT

Observer - Mr. Goldman

August 7, 1951

		<u>LOAD</u> in Pounds			
		0	200	400	600
Enameled Steel Surface-					
Av. Scale		5.0	19.94	34.06	47.0
Horsepower		.0468	.1867	.3139	.4400
Stainless Steel Surface-					
Av. Scale		4.75	16.5	27.63	39.75
Horsepower		.0445	.1545	.2587	.3721
Aluminum Surface-					
Av. Scale		5.0	15.38	25.31	35.94
Horsepower		.0468	.1440	.2369	.3365
Unpainted Steel Surface-					
Av. Scale		4.88	14.94	24.88	34.75
Horsepower		.0457	.1399	.2329	.3253
Fir Wood Surface-					
Av. Scale		5.25	15.38	25.38	35.19
Horsepower		.0492	.1440	.2376	.3294
Maple Wood Surface-					
Av. Scale		5.0	15.06	24.88	34.75
Horsepower		.0468	.1411	.2329	.3253
Recheck -- C. K.					

RESULTS OF COMPUTATIONS OF POWER REQUIREMENTS OF SLIDER
BED BELT CONVEYOR ON NEOPRENE BELT

Observer - Mr. Goldman

August 9, 1951

LOAD in Pounds

0 200 400 600

Enameled Steel Surface-

Av. Scale	4.25	22.56	40.13	57.38
Horsepower	.0398	.2119	.3757	.5418

Stainless Steel Surface-

Av. Scale	3.88	15.38	26.83	37.88
Horsepower	.0363	.1487	.2516	.3546

Aluminum Surface-

Av. Scale	4.13	14.06	23.81	33.88
Horsepower	.0387	.1316	.2229	.3172

Unpainted Steel Surface-

Av. Scale	3.88	14.63	26.33	36.88
Horsepower	.0363	.1370	.2470	.3453

Fir Wood Surface-

Av. Scale	4.25	14.88	24.94	34.94
Horsepower	.0398	.1393	.2335	.3271

Maple Wood Surface-

Av. Scale	4.25	14.69	25.19	35.44
Horsepower	.0398	.1375	.2353	.3318

Recheck -- C. K.

SUMMARY AND CONCLUSION

It is difficult to make any definite statements as to the power required to run the various belts because each belt had its own characteristics which made it act differently on the different surfaces. However certain generalizations can be made regarding the belts which required the least power, as well as the comparative qualities of the surfaces.

Running surfaces. With the exception of the inner-bound canvas belt on the stainless steel surface, all of the belts required more power on the enameled steel surface. The stainless steel and aluminum surfaces were very close together and required just a little less power than the enameled steel surface. The running surfaces requiring the least power seemed to be the maple wood, the fir wood, and the unpainted hot rolled steel.

During the testing of the first three belts, the enameled surface was used as the initial surface tested. It was found that after all of the surfaces had been tested and a recheck made of the enamel, the power required to drive the belt was quite a bit lower than the original readings. The first explanation of this was that the tension in the belt had changed. However, after

reversing the order of the surfaces it was proven that this marked difference could only be due to the wearing away of the enamel during the run. As the enamel wore thin, the unpainted metal of the slider-bed became exposed. The belts running on this unpainted steel naturally gave a lower power reading. The curves of the rechecks were included mainly to show that after a short period of running, the enamel disappears and that it is of little value to paint the slider-bed originally.

Belts. The belts which required the most power to run over all of the surfaces were the impreganted canvas, the innerbound canvas, and the silver duck canvas. The neoprene, chemigum, smooth-top rubber, and rough-top rubber belts required less power than did the canvas belts. However, each of these belts performed differently on the different surfaces and no definite order of least to most power could be established.

Power. These generalizations were made on the basis of the conveyor load vs. horsepower required curves found in the appendix of this thesis. These curves show that there was a straight line relationship between the power required to drive the conveyor belts and the load which the conveyor carried. It was also noted that none of these curves started from the origin at the zero load.

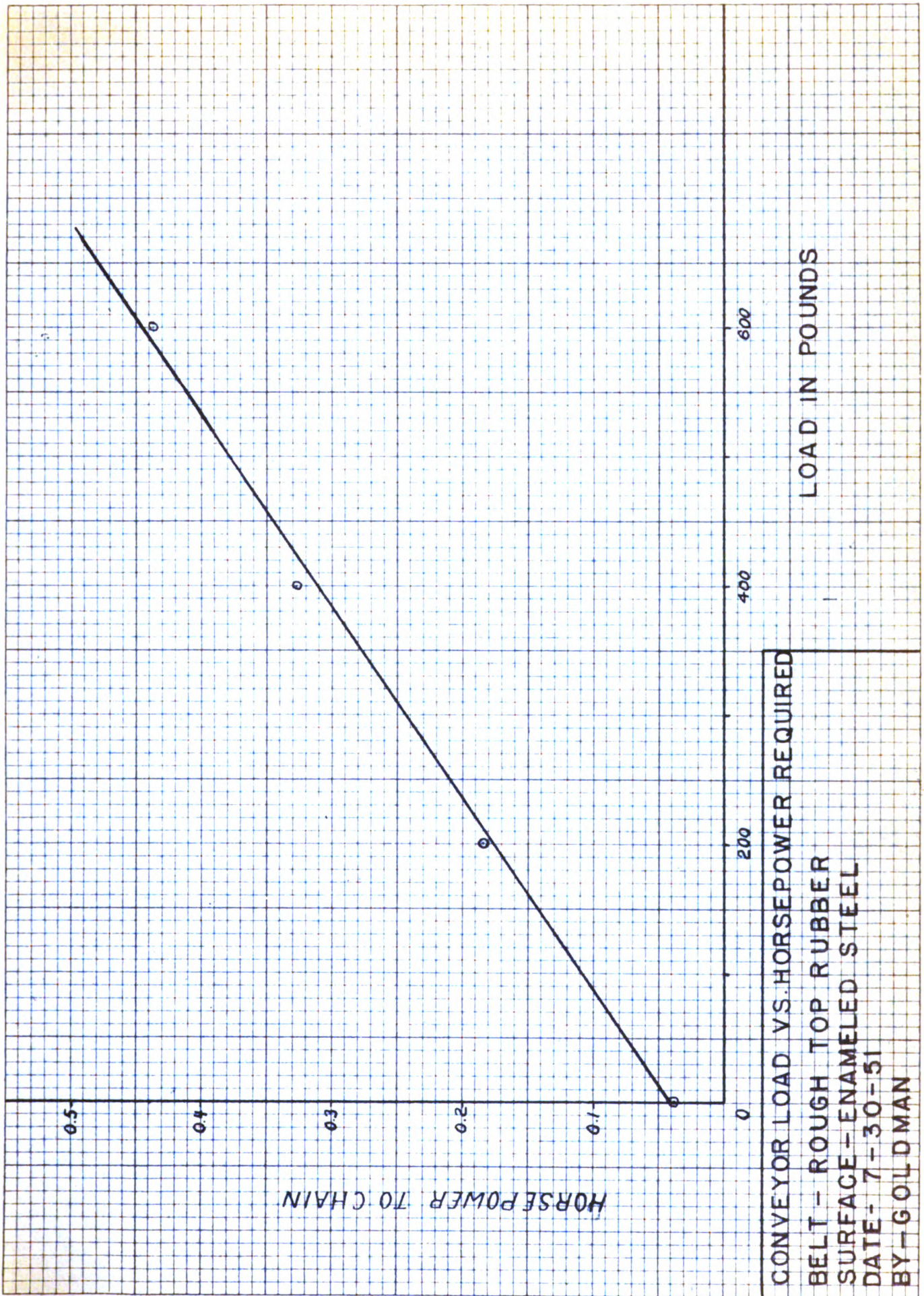
Thus it is evident that the power required to drive the conveyor was broken down into two components: first was the power required to drive the belt when there was no load on it; and the second was the power required to drive the load from one location to another.

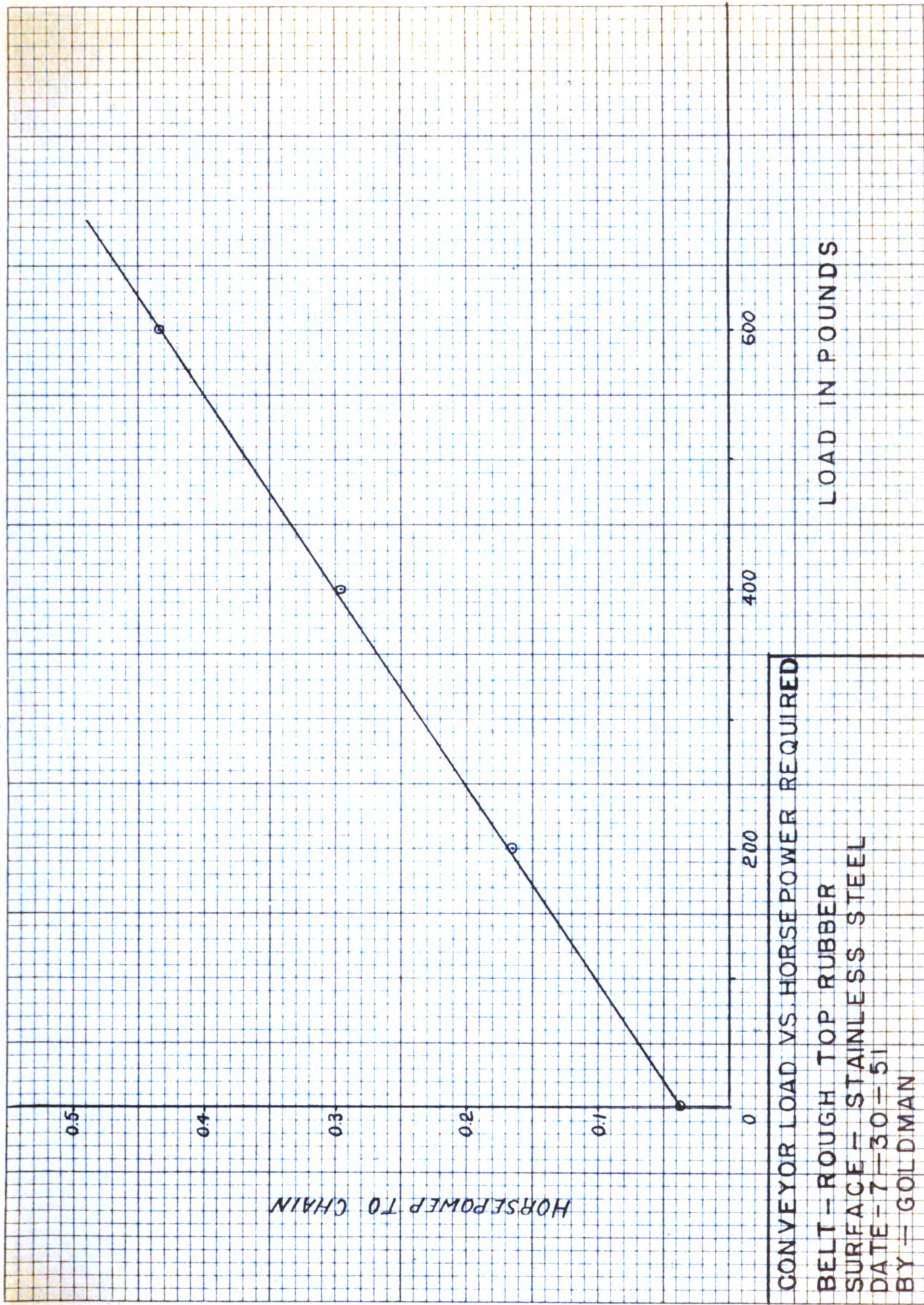
The power required to drive the belt at zero load could be further broken down into the power required to overcome the friction of the pulleys, to pull the unloaded belt across the slider-bed and to make the belt bend to conform to the design of the conveyor. When the belt was loaded, each of these factors was increased and to them was added the increased frictional drag due to the weight of the load, plus the power required to bring the load from its initial contact up to the speed of the moving belt. This last power requirement accounted for the increase in torque on the dynamometer when the load was added to the belt.

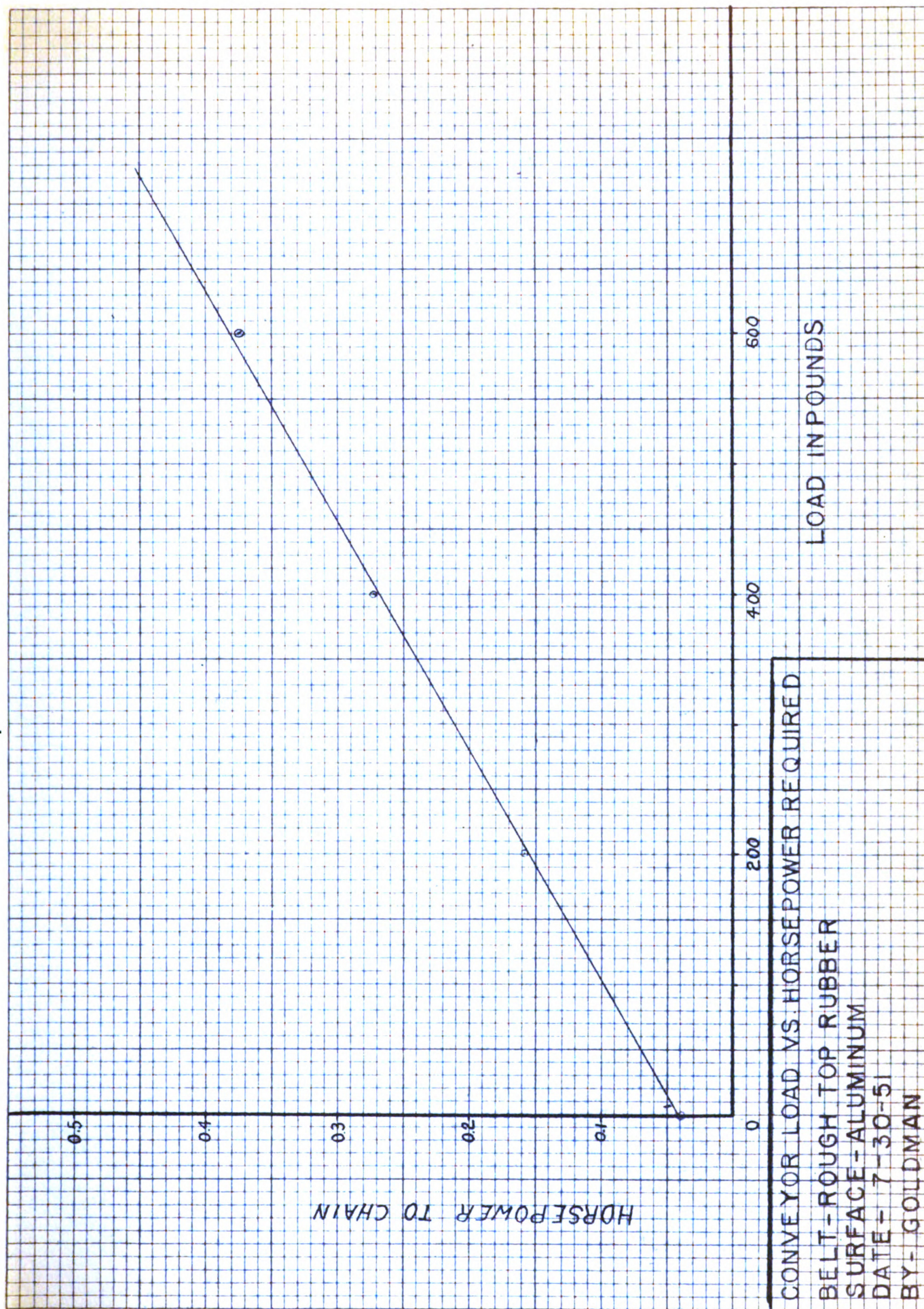
General. In conclusion, it should be remembered that this test was conducted using one specific make of conveyor with definite brands of belts and under the conditions present in the laboratory. The results of such a test may or may not coincide with results obtained under any other given set of conditions. It should be emphasized at this time that all of the variable factors

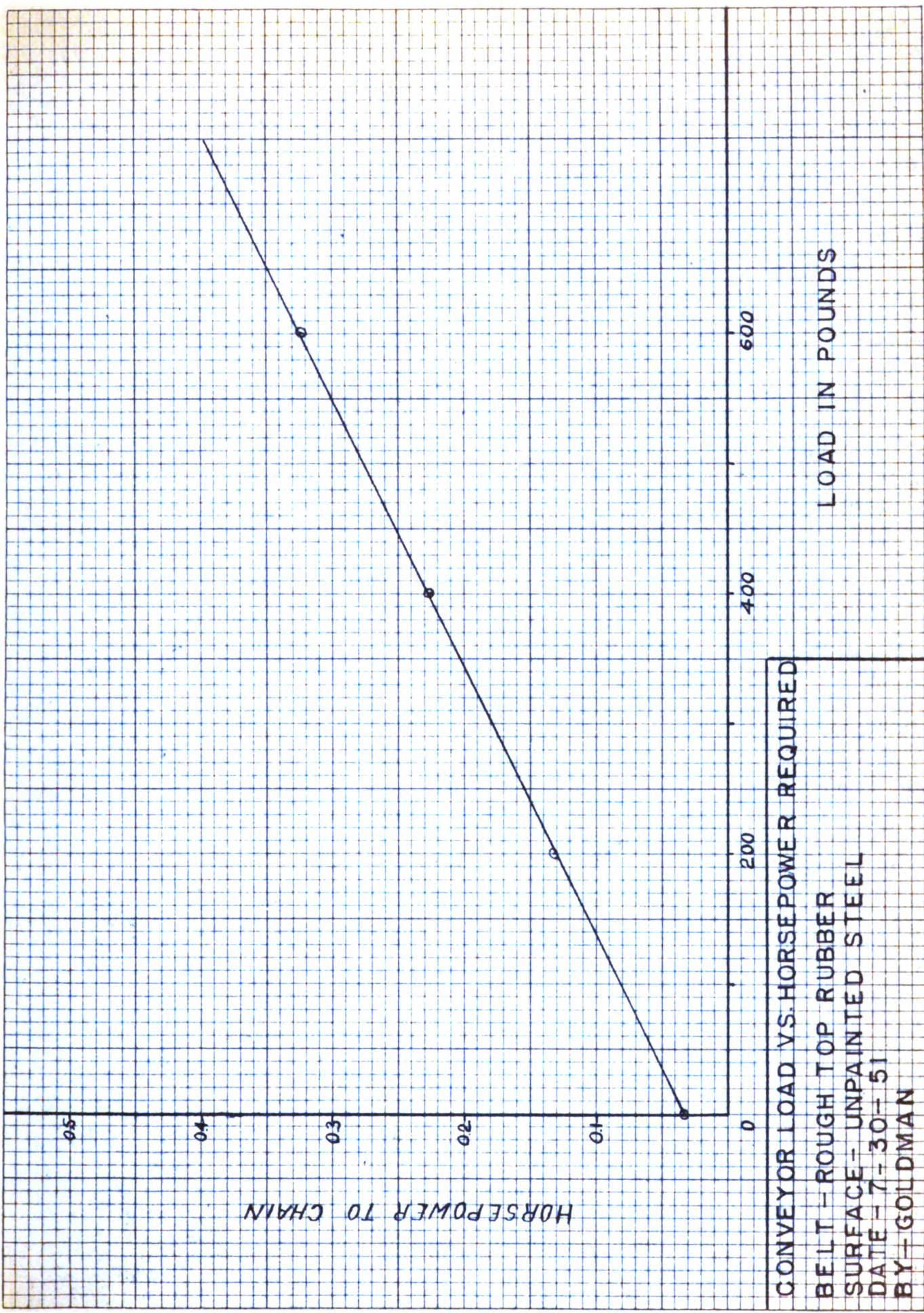
mentioned in this thesis play a very important part in the performance of a conveyor. The figures obtained in this study are the results of an attempt to cancel out as many of the variables as possible and varying remaining factors under controlled conditions, in order to make a comparison of a number of belts and slider-beds.

APPENDIX

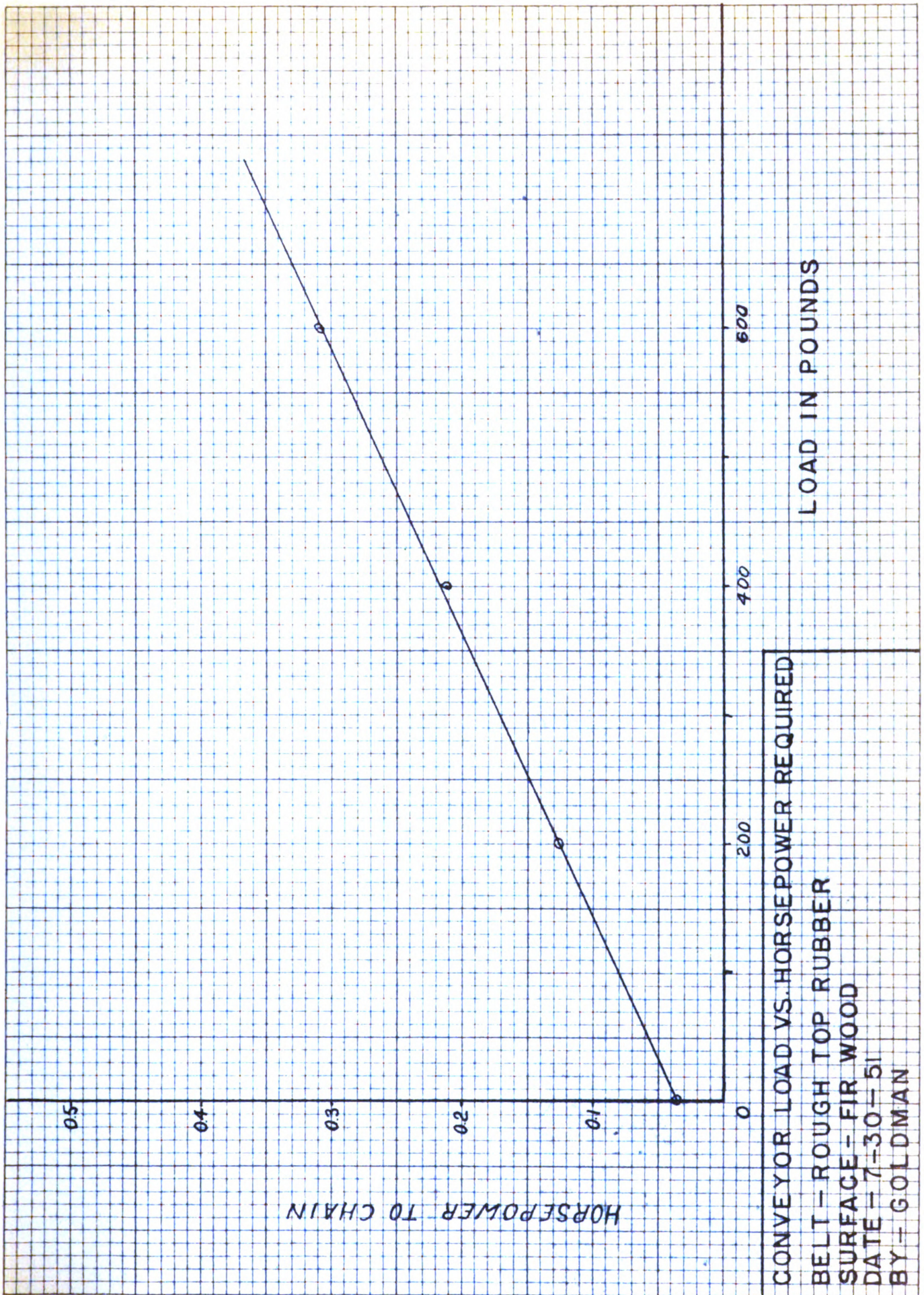


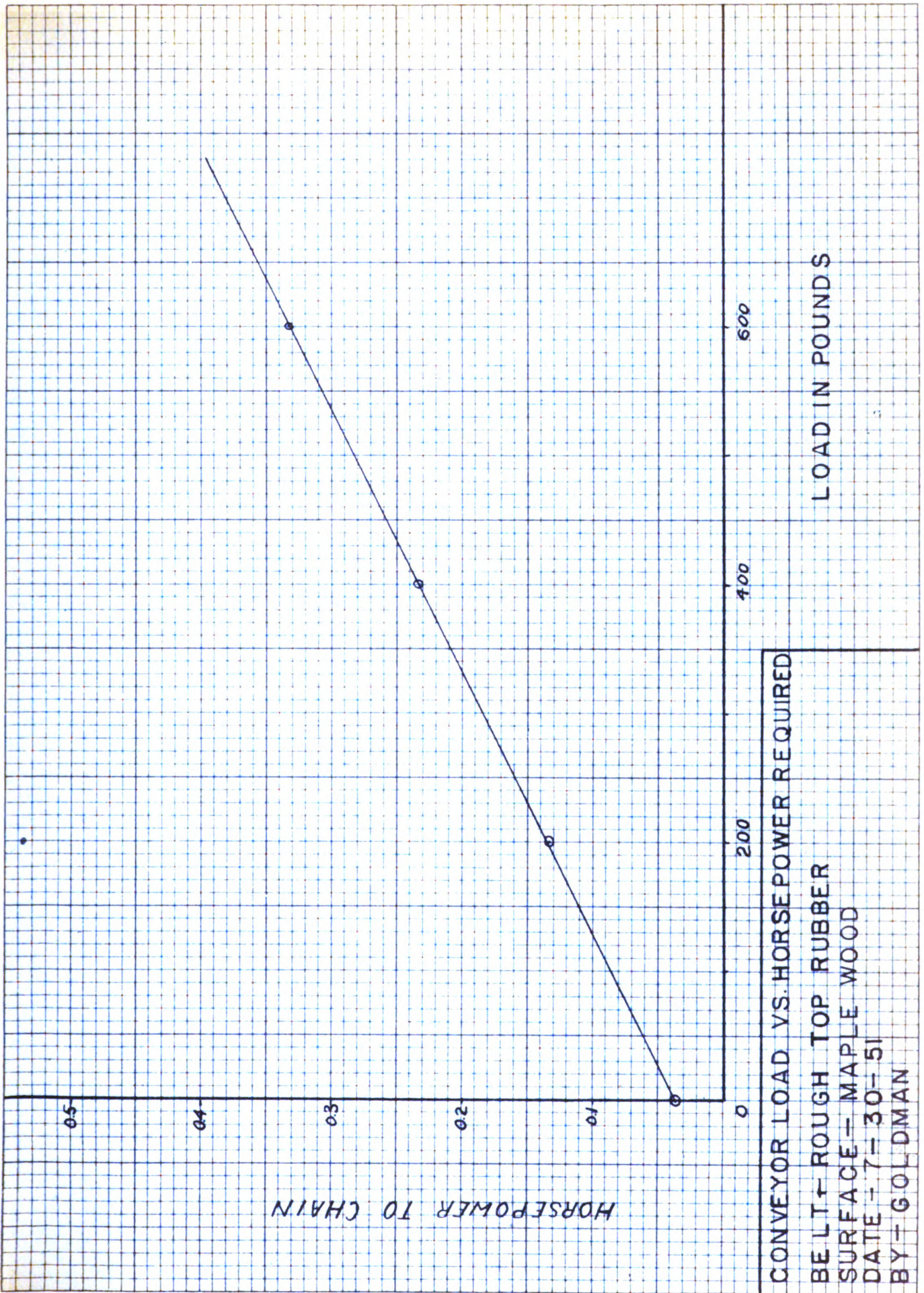


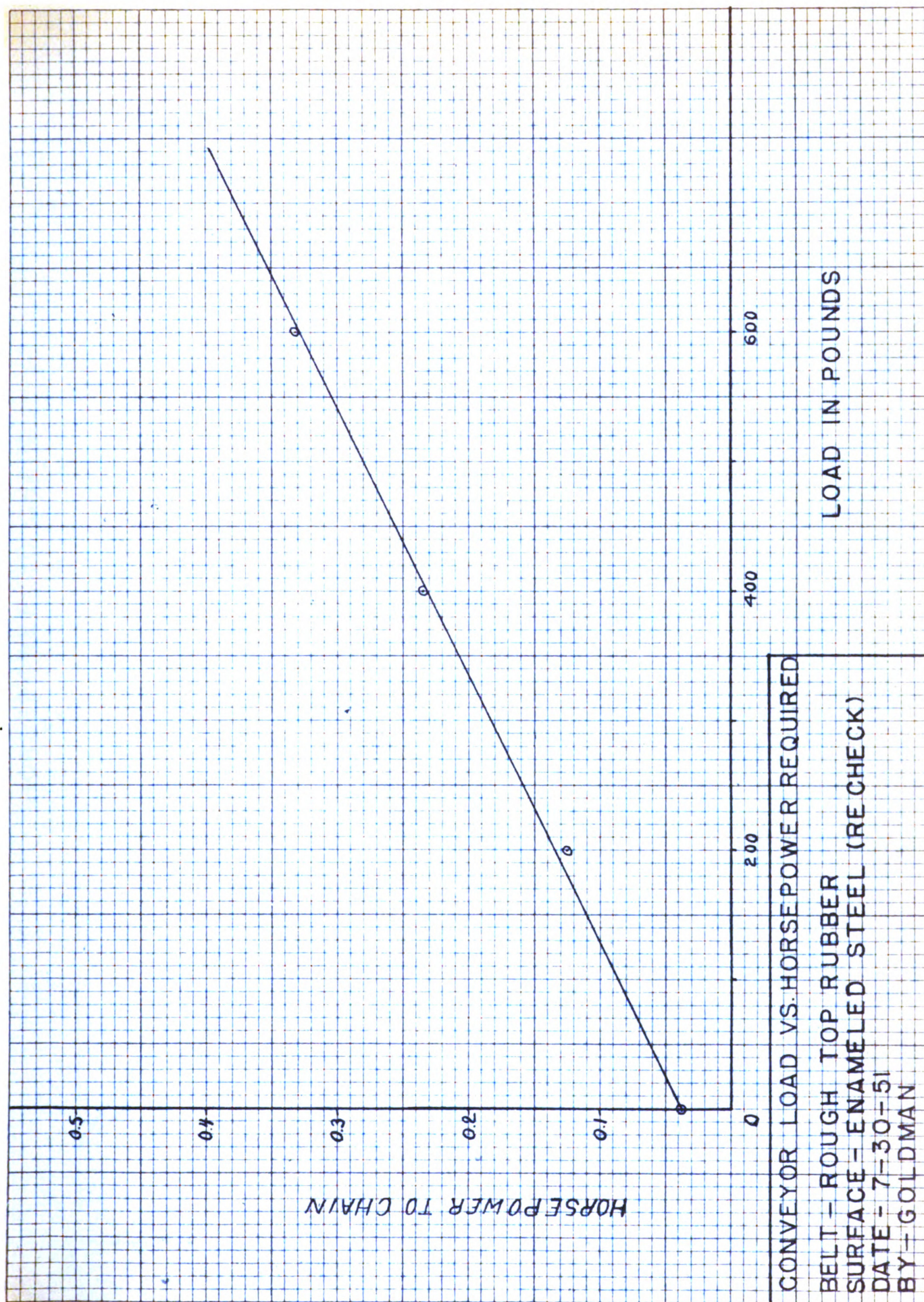


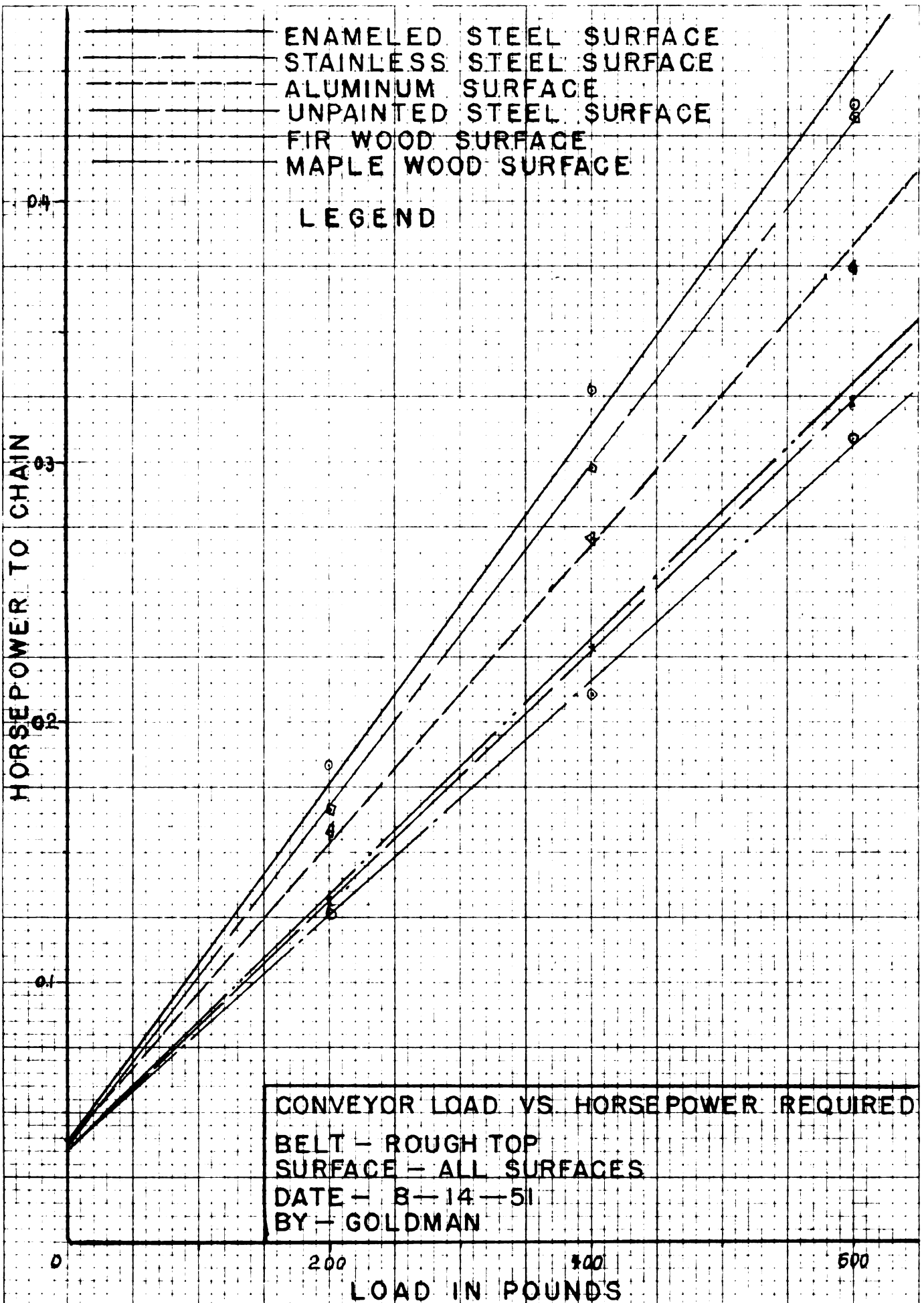


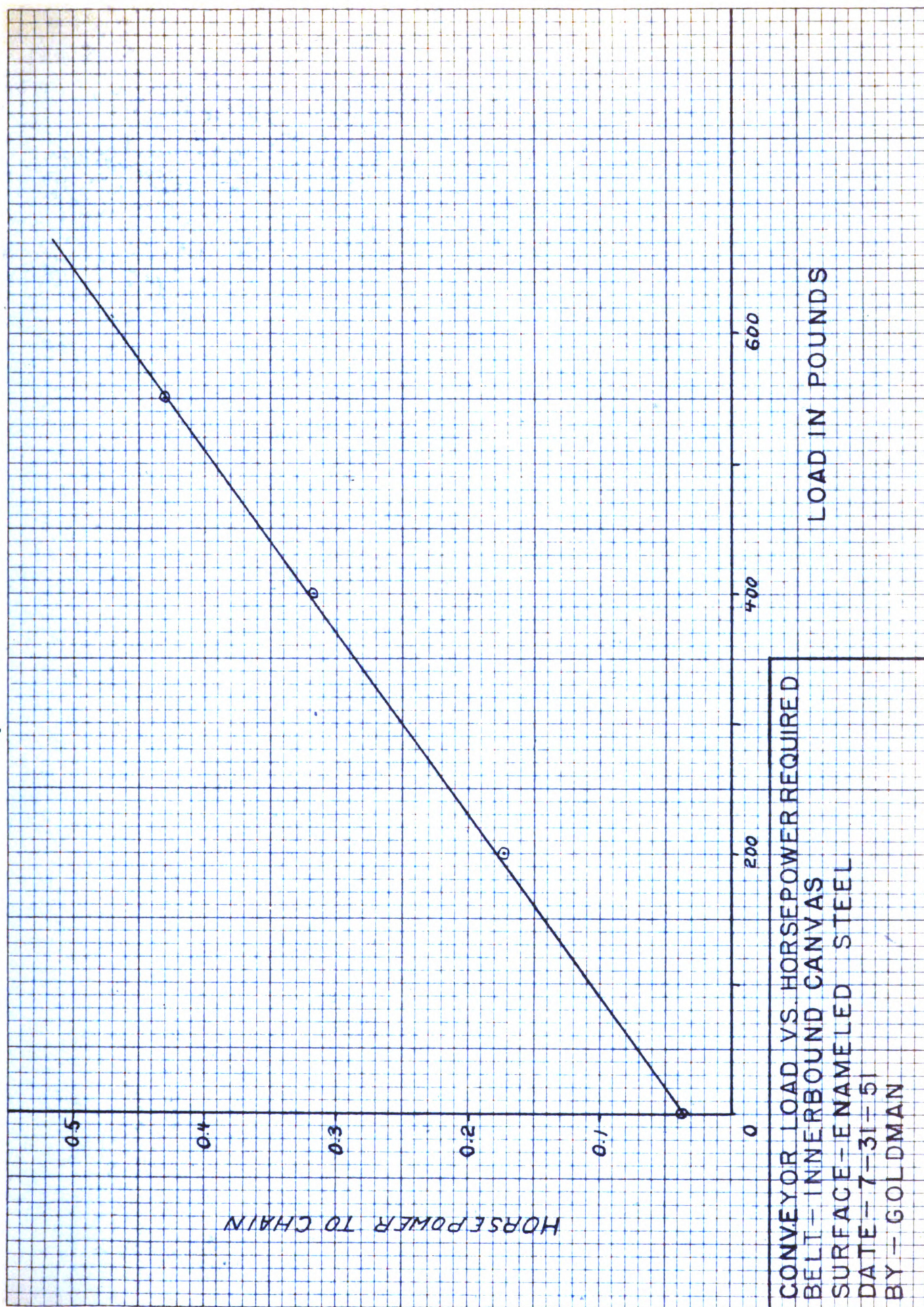
CONVEYOR LOAD VS. HORSEPOWER REQUIRED
BELT - ROUGH TOP RUBBER
SURFACE - UNPAINTED STEEL
DATE - 7-30-51
BY - GOLDMAN

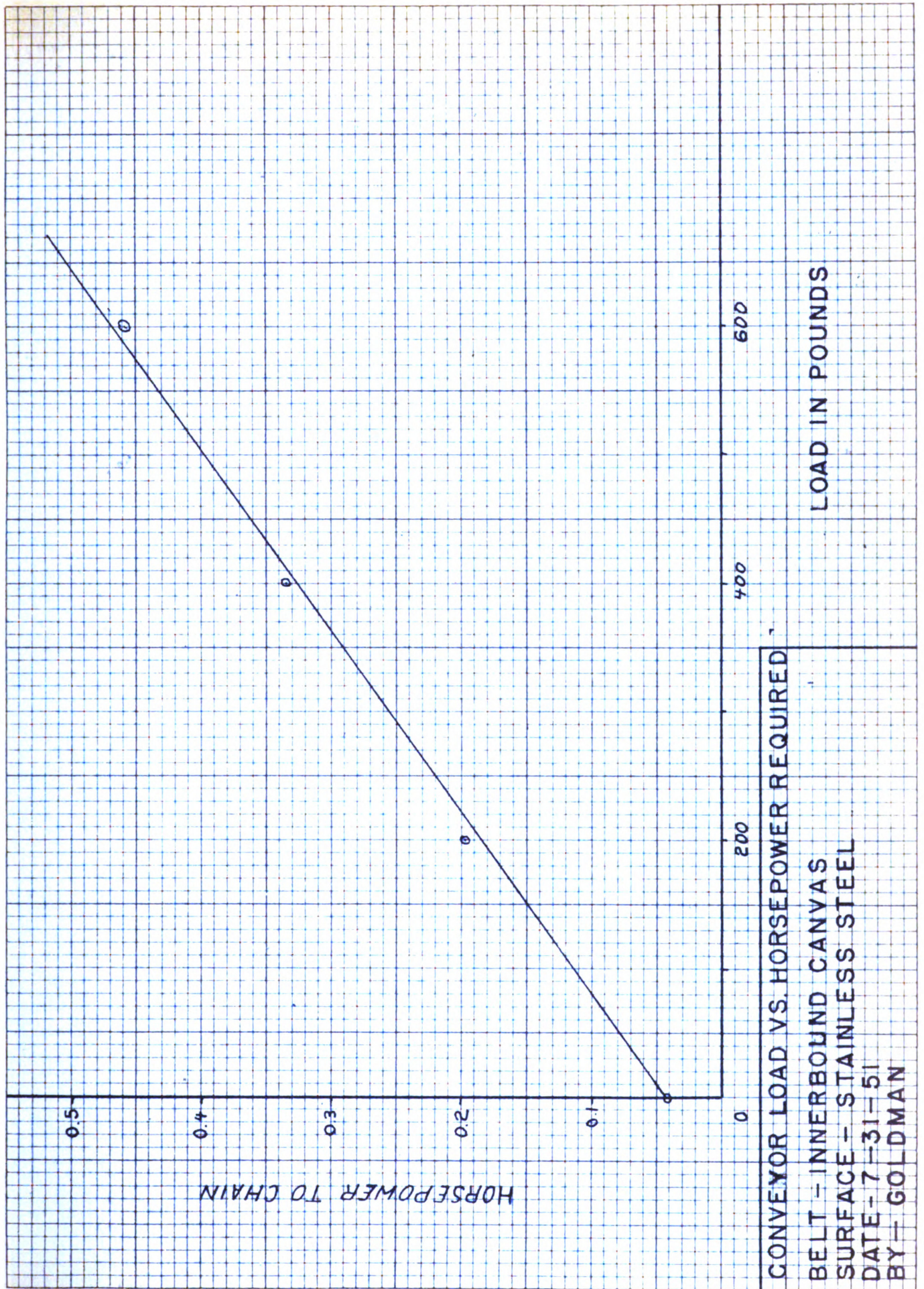






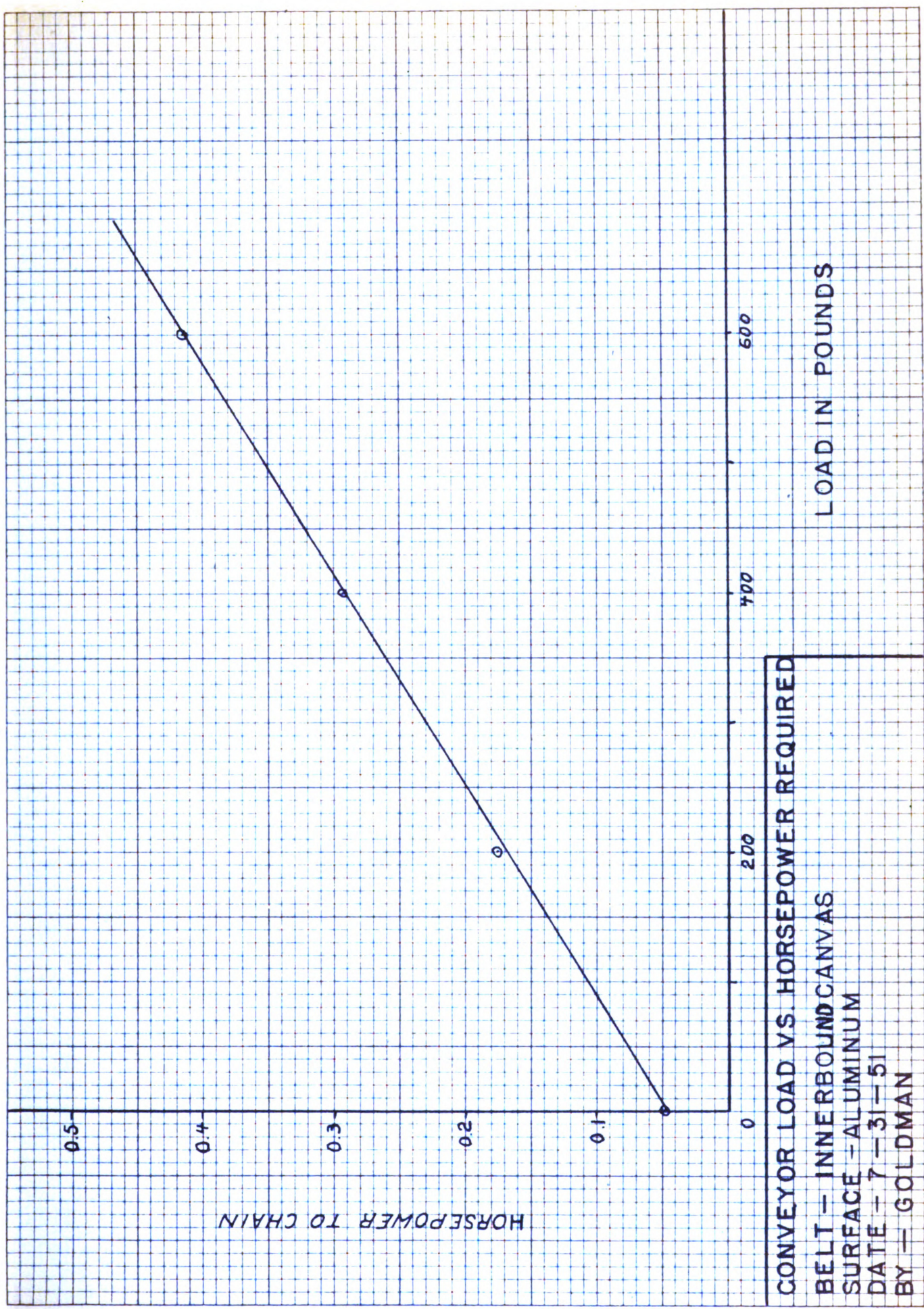




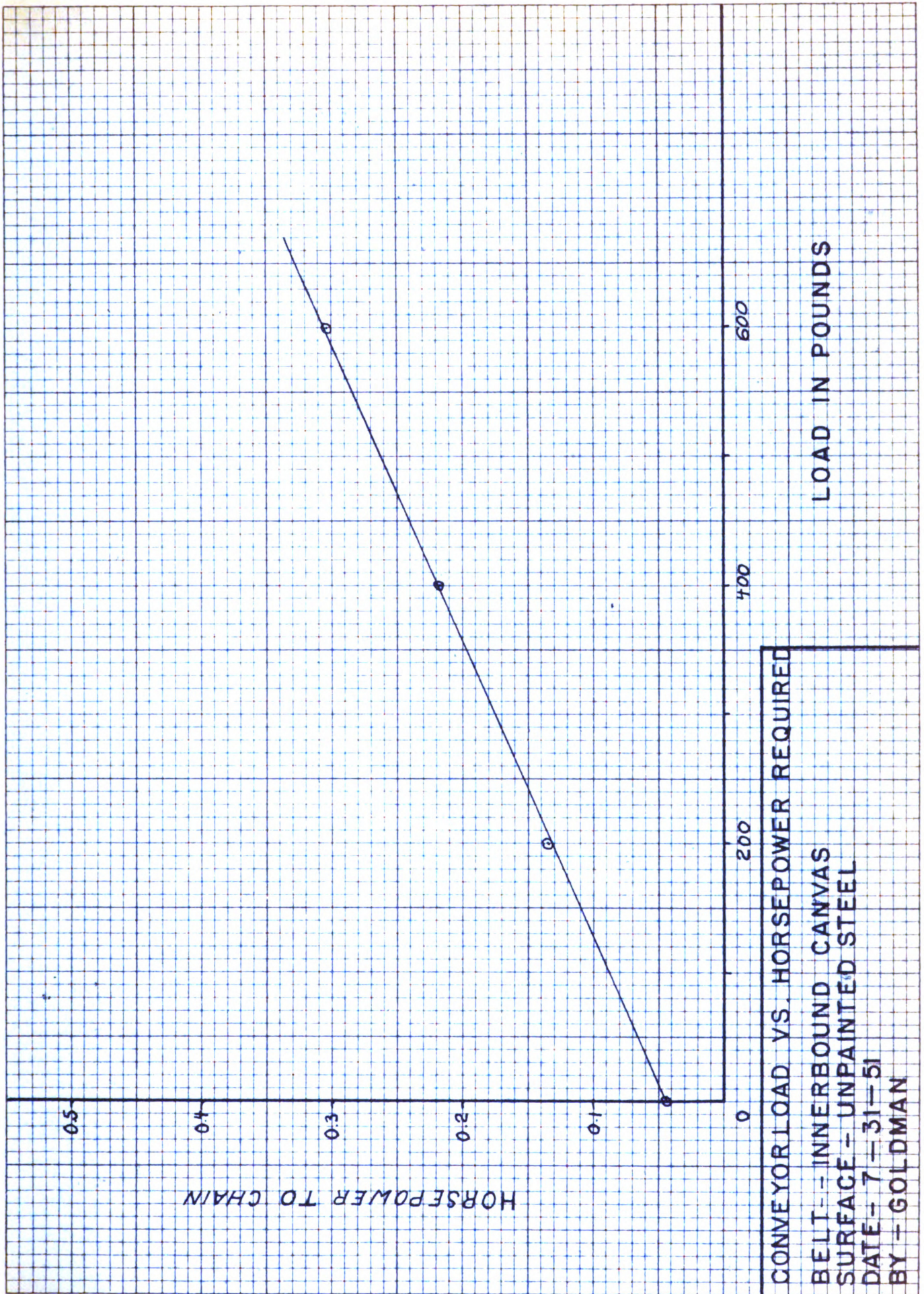


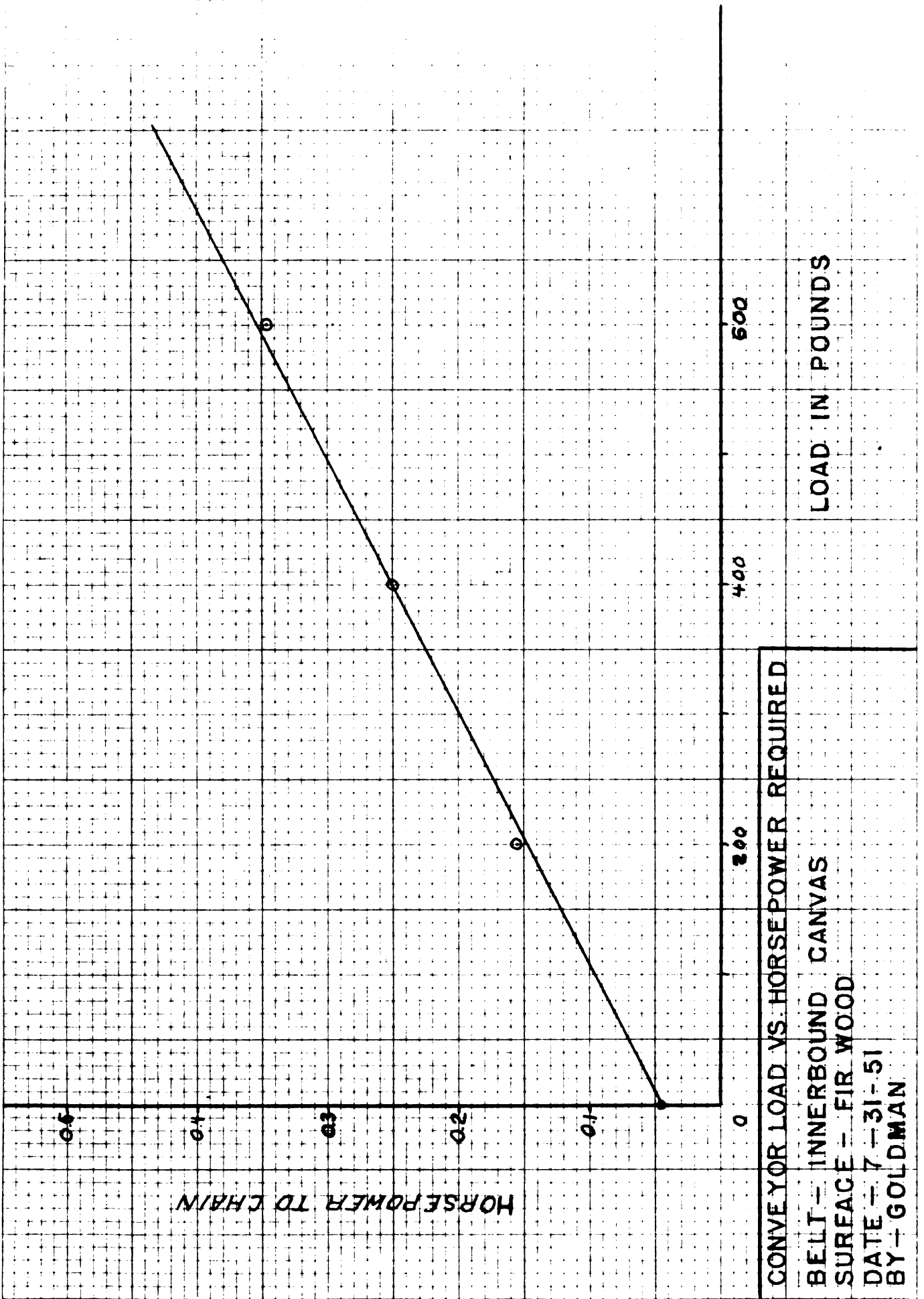
CONVEYOR LOAD VS. HORSEPOWER REQUIRED

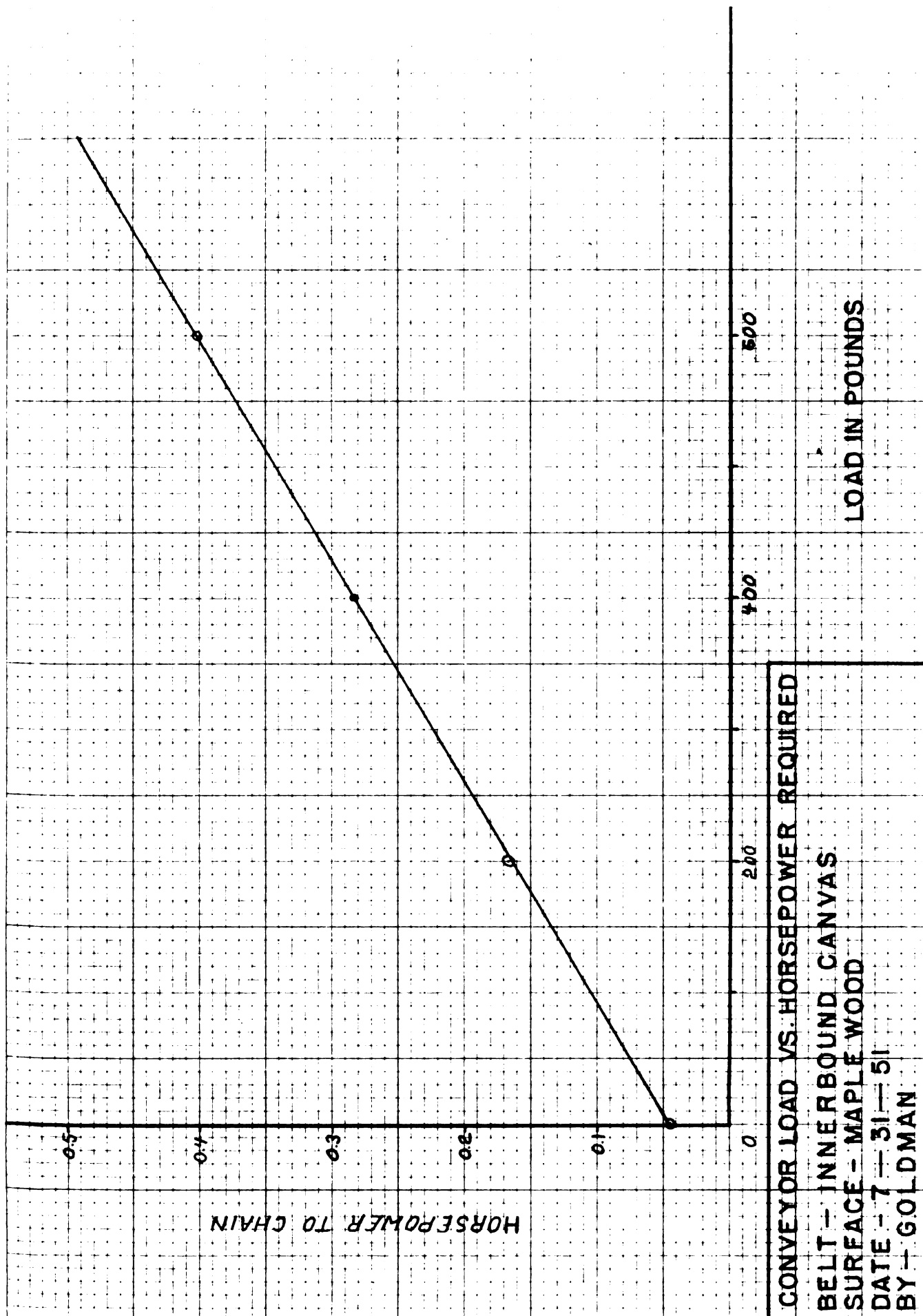
BELT - INNERBOUND CANVAS
SURFACE - STAINLESS STEEL
DATE - 7-31-51
BY - GOLDMAN



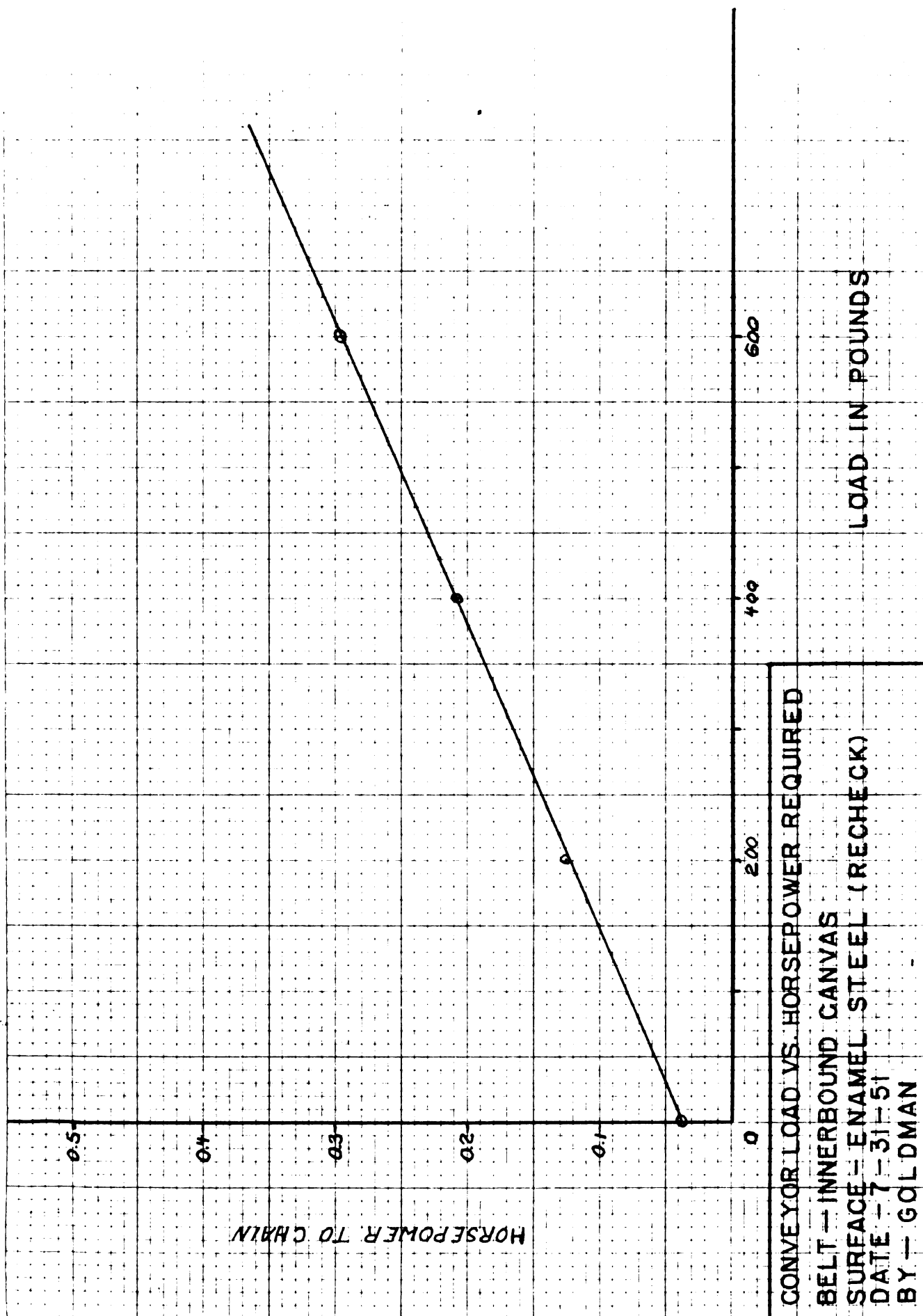
CONVEYOR LOAD VS. HORSEPOWER REQUIRED
BELT - INNERBOUND CANVAS
SURFACE - ALUMINUM
DATE - 7-31-51
BY - GOLDMAN

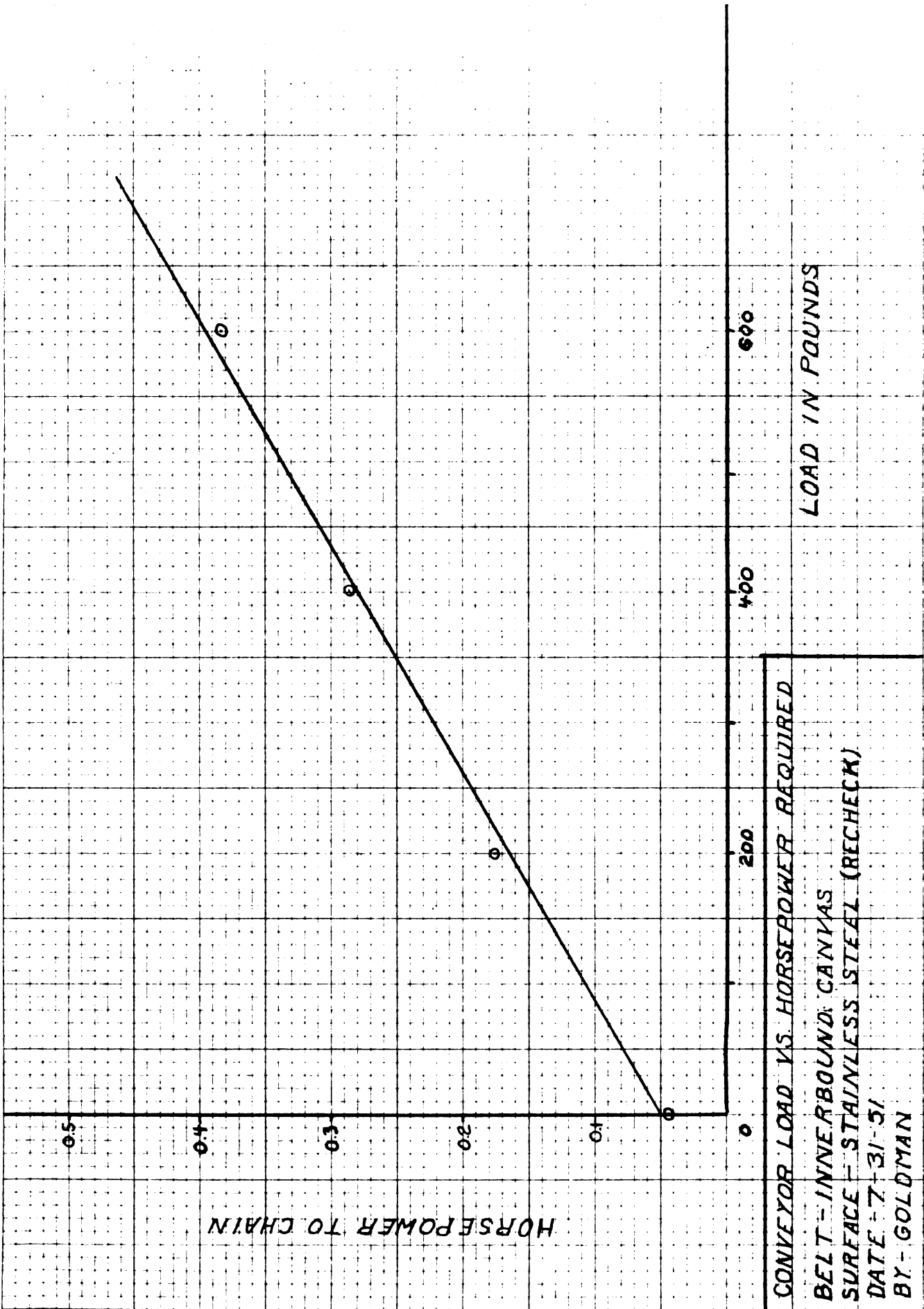


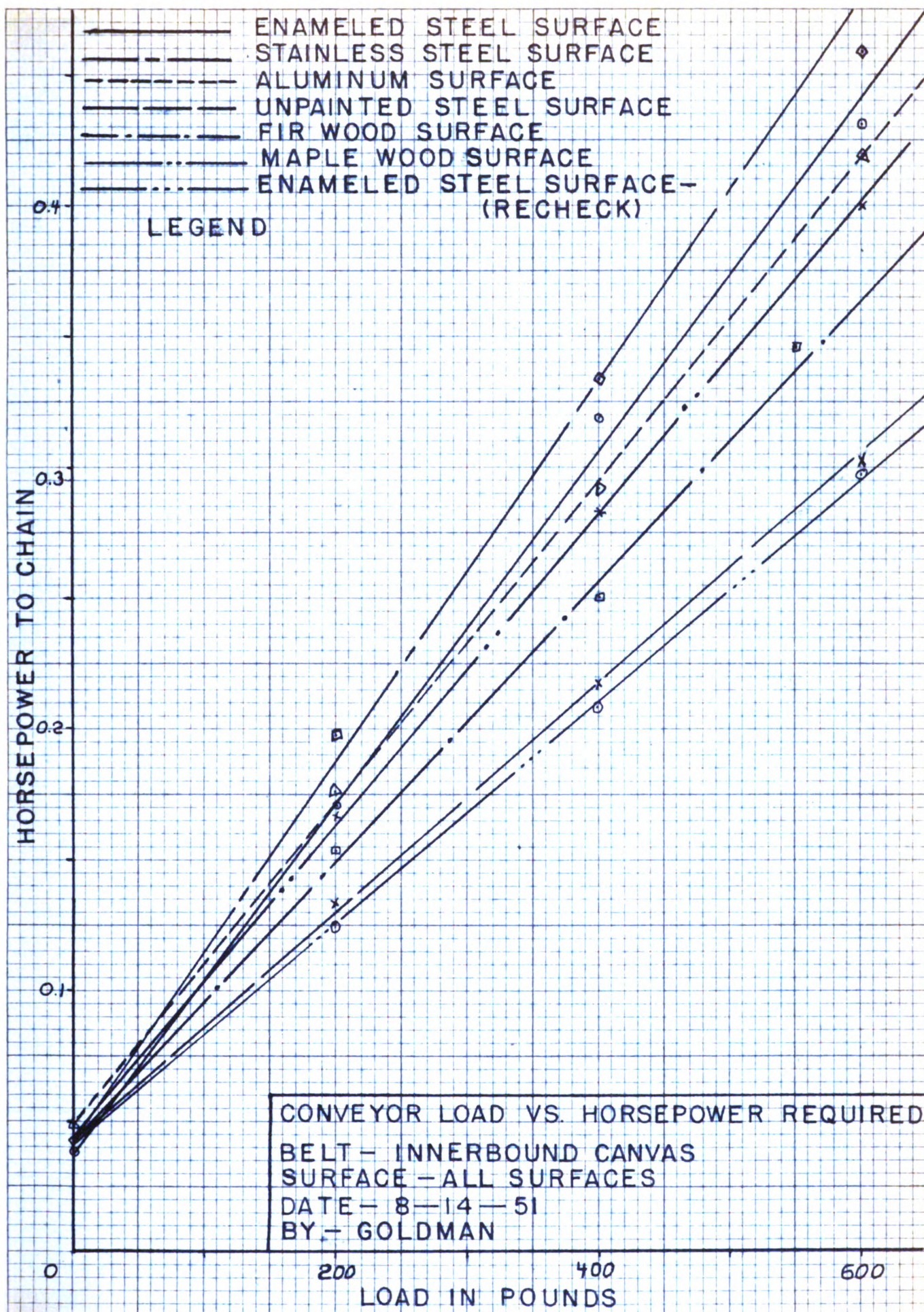


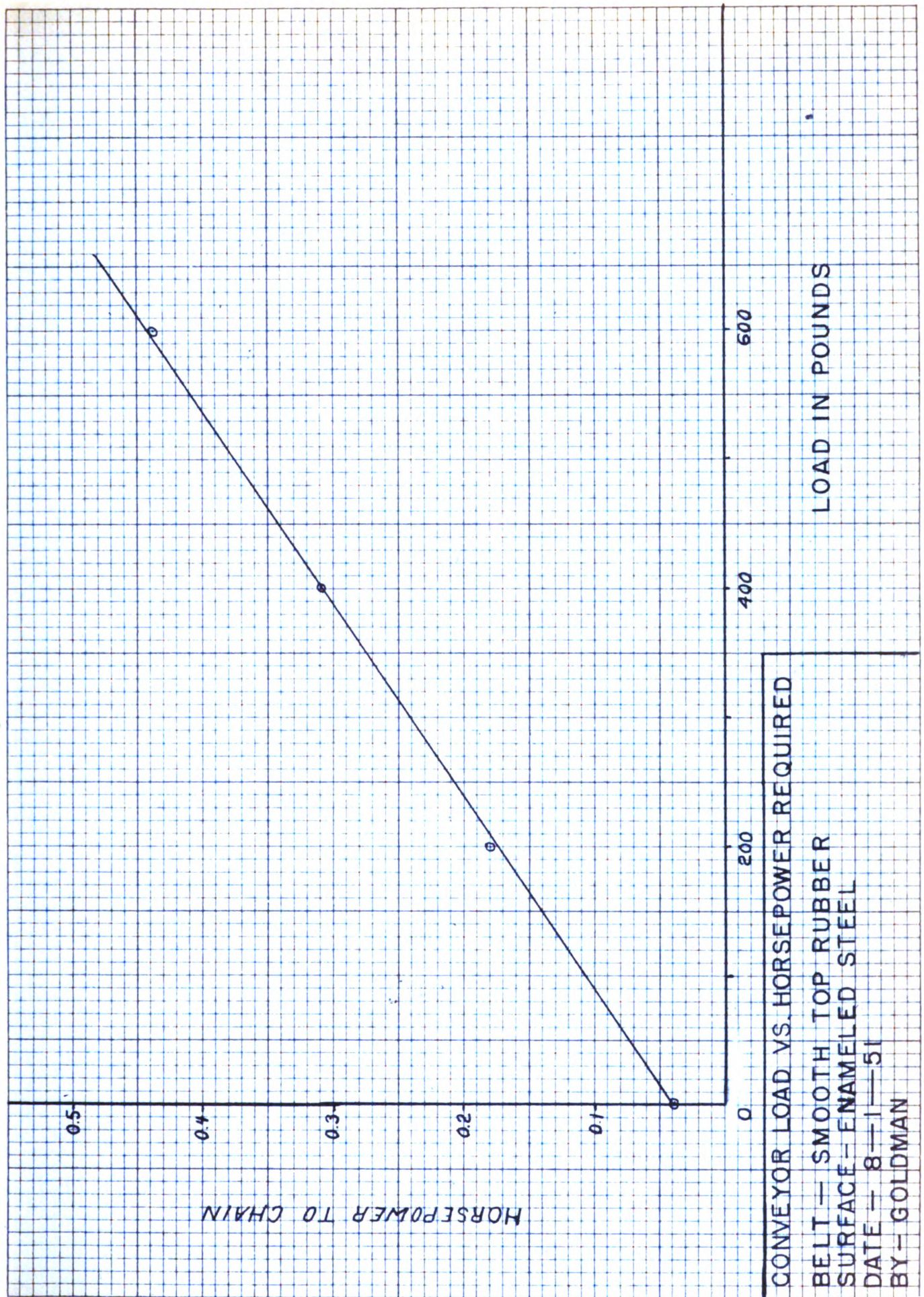


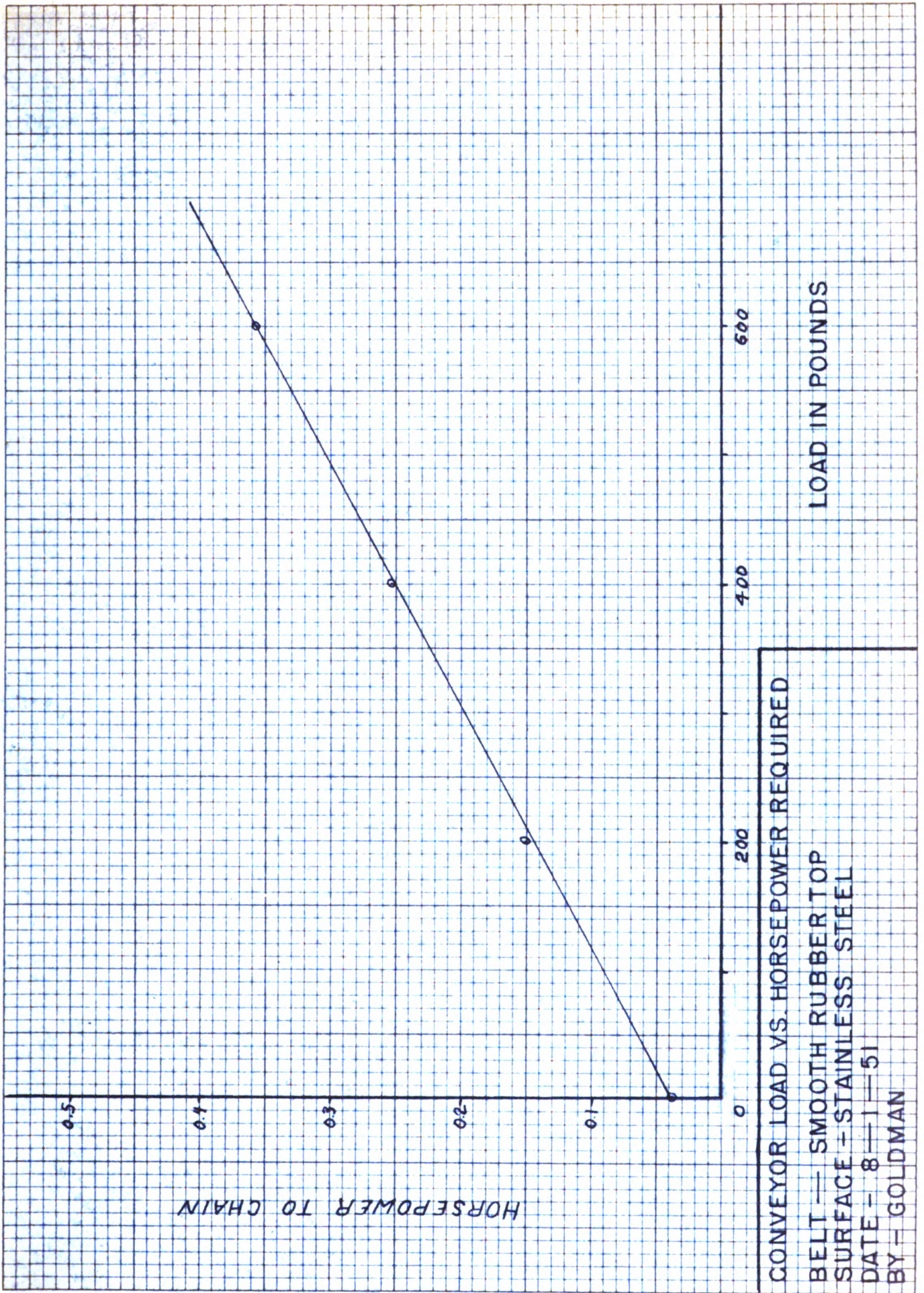
CONVEYOR LOAD VS. HORSEPOWER REQUIRED
BELT - INNERBOUND CANVAS
SURFACE - MAPLE WOOD
DATE - 7 - 31 - 51
BY - GOLDMAN

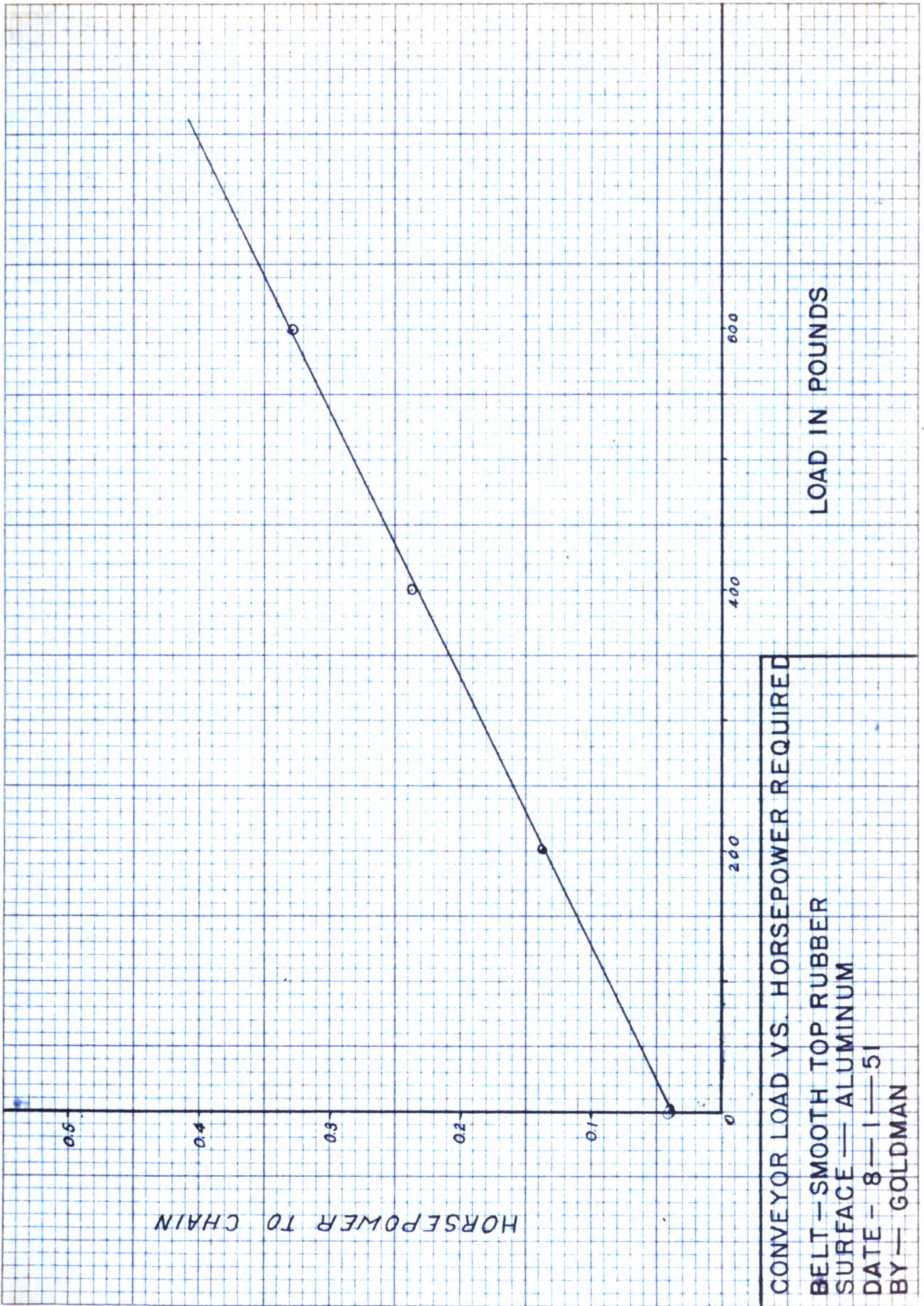


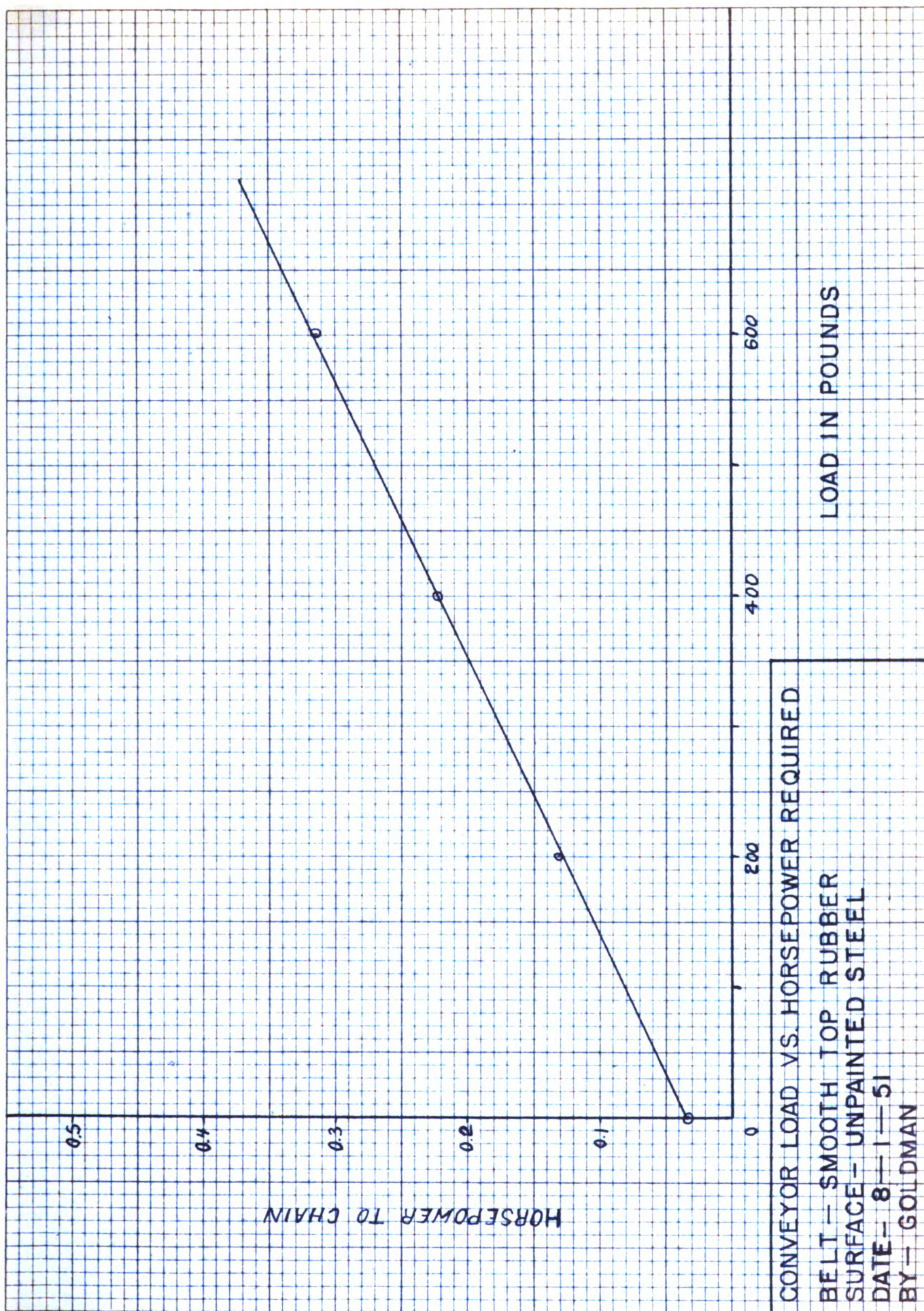


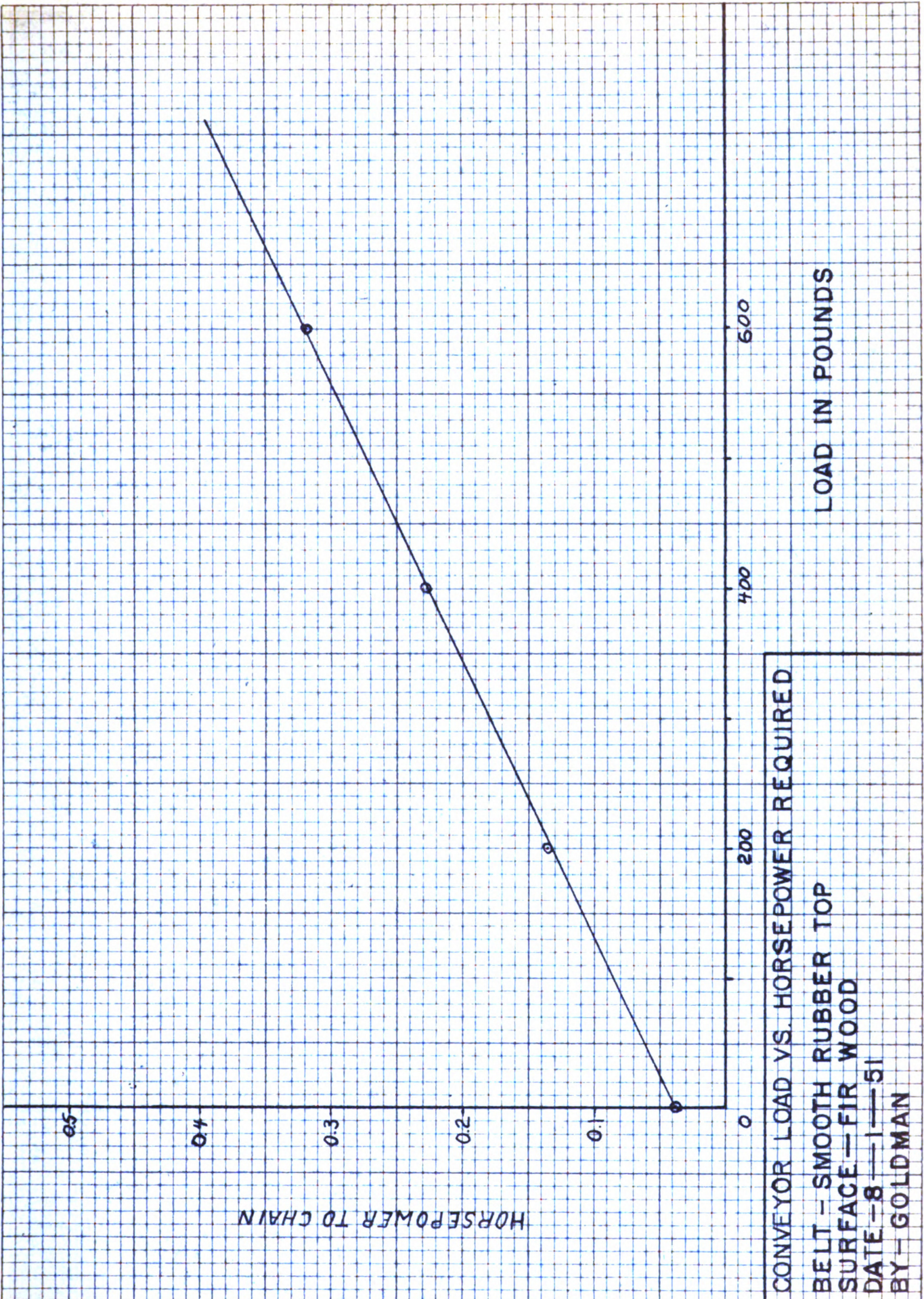


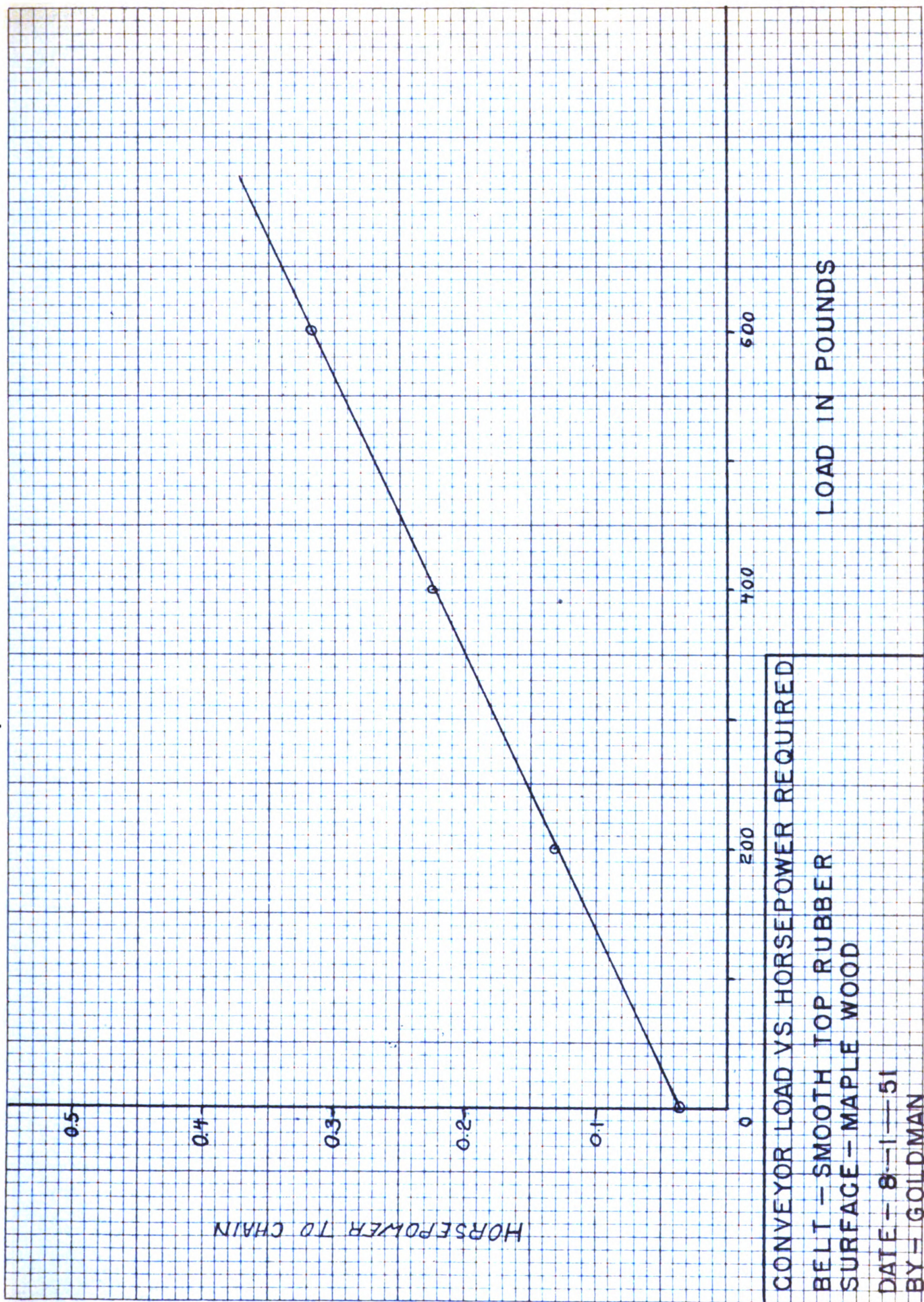


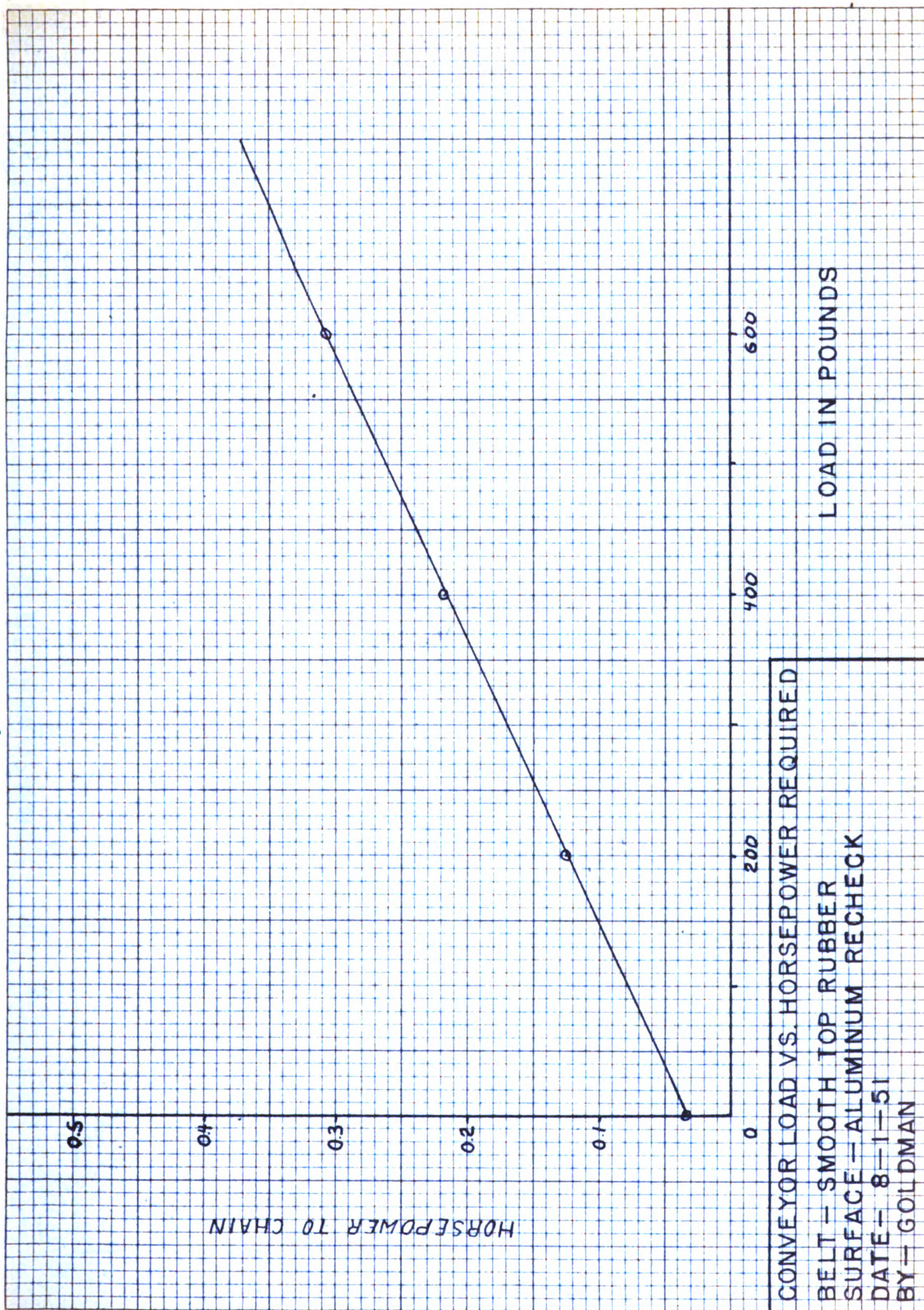


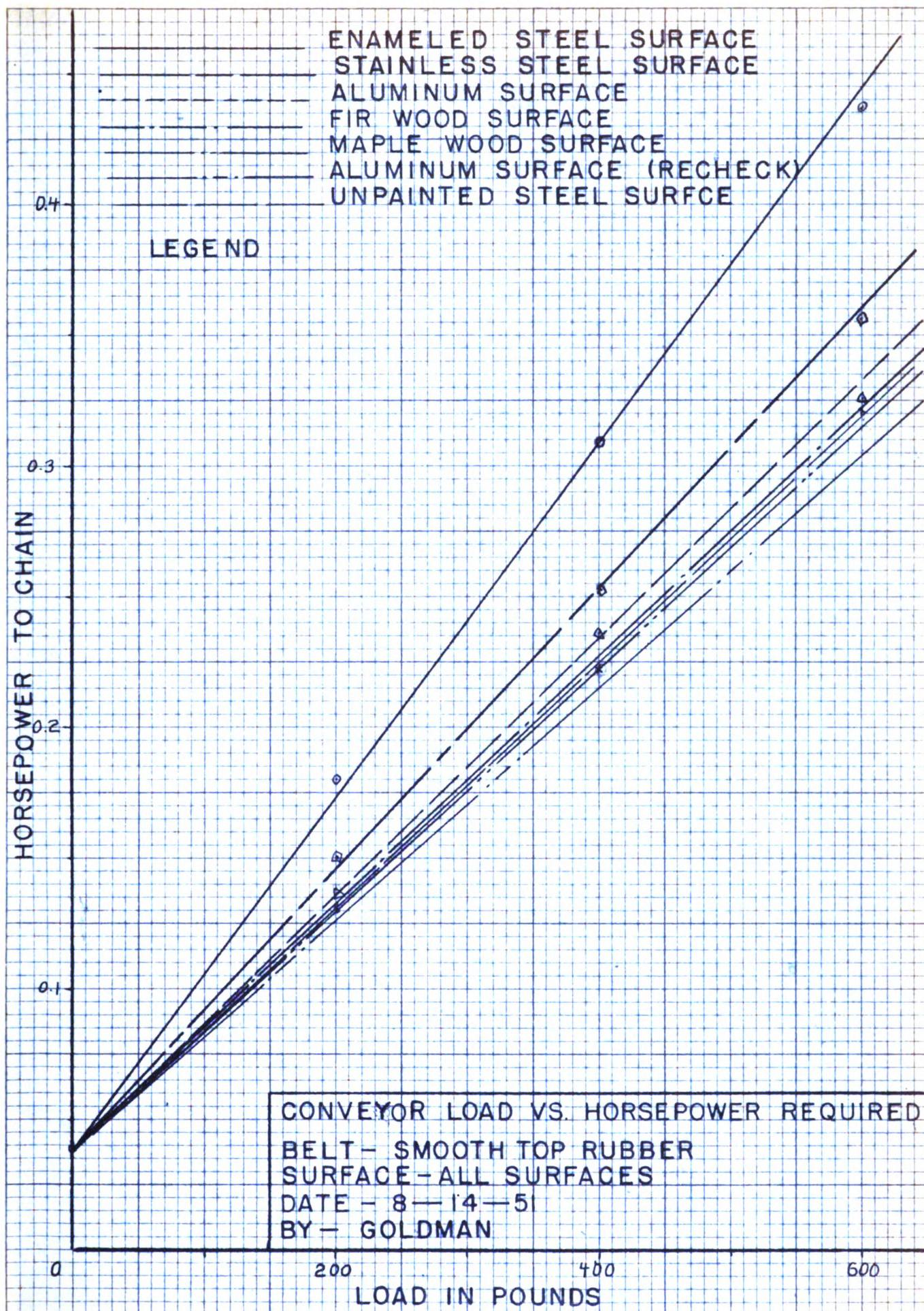


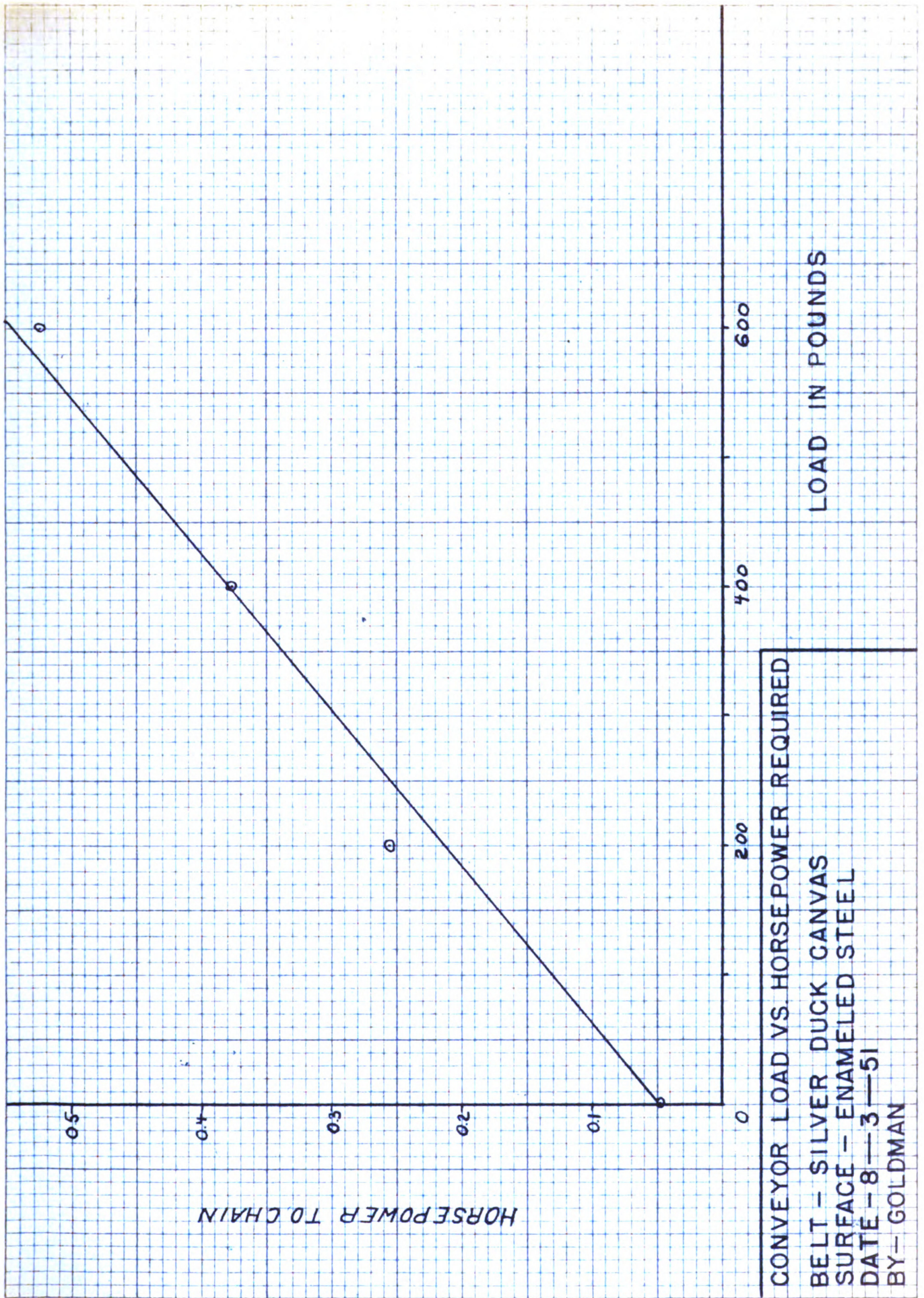


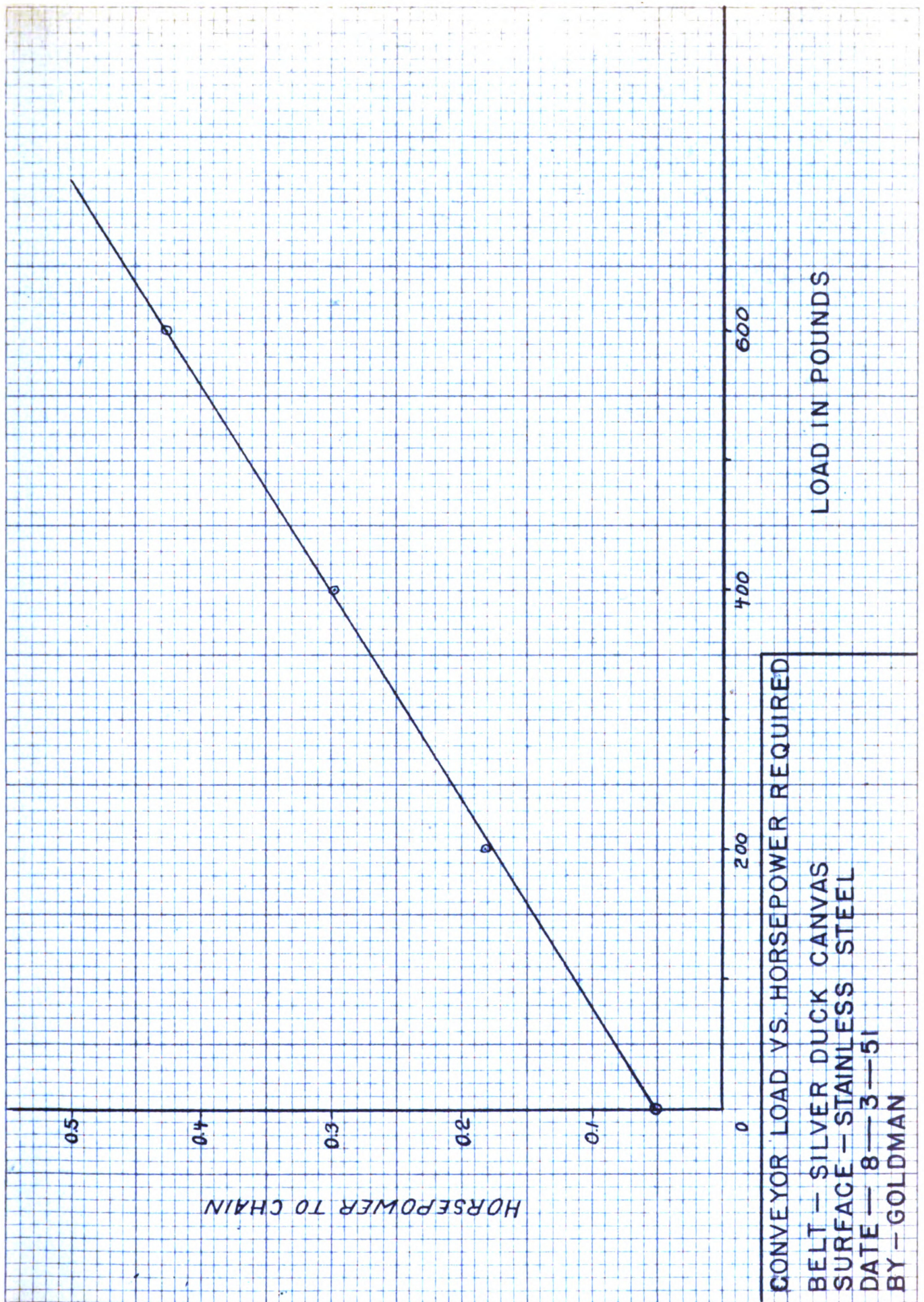


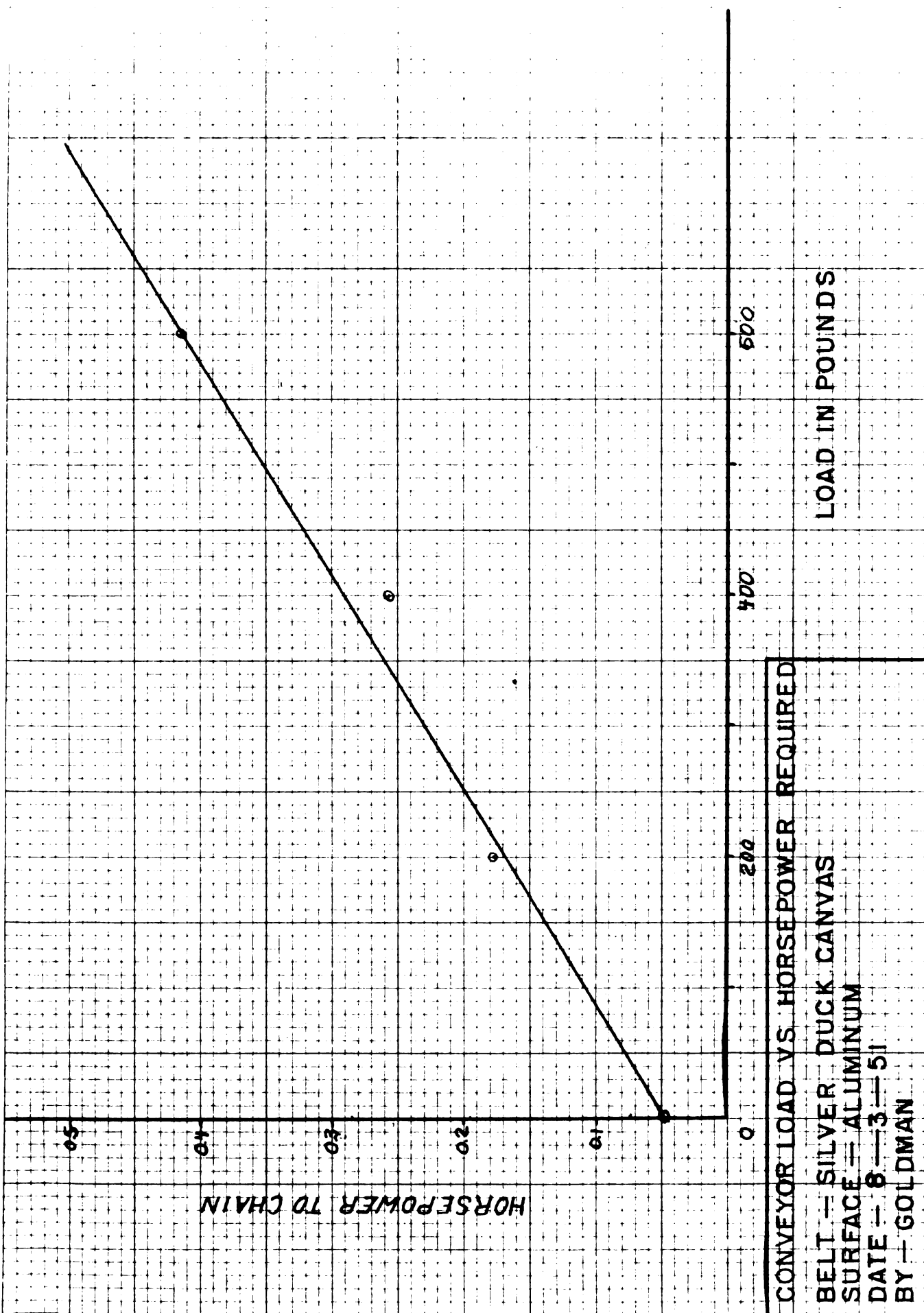




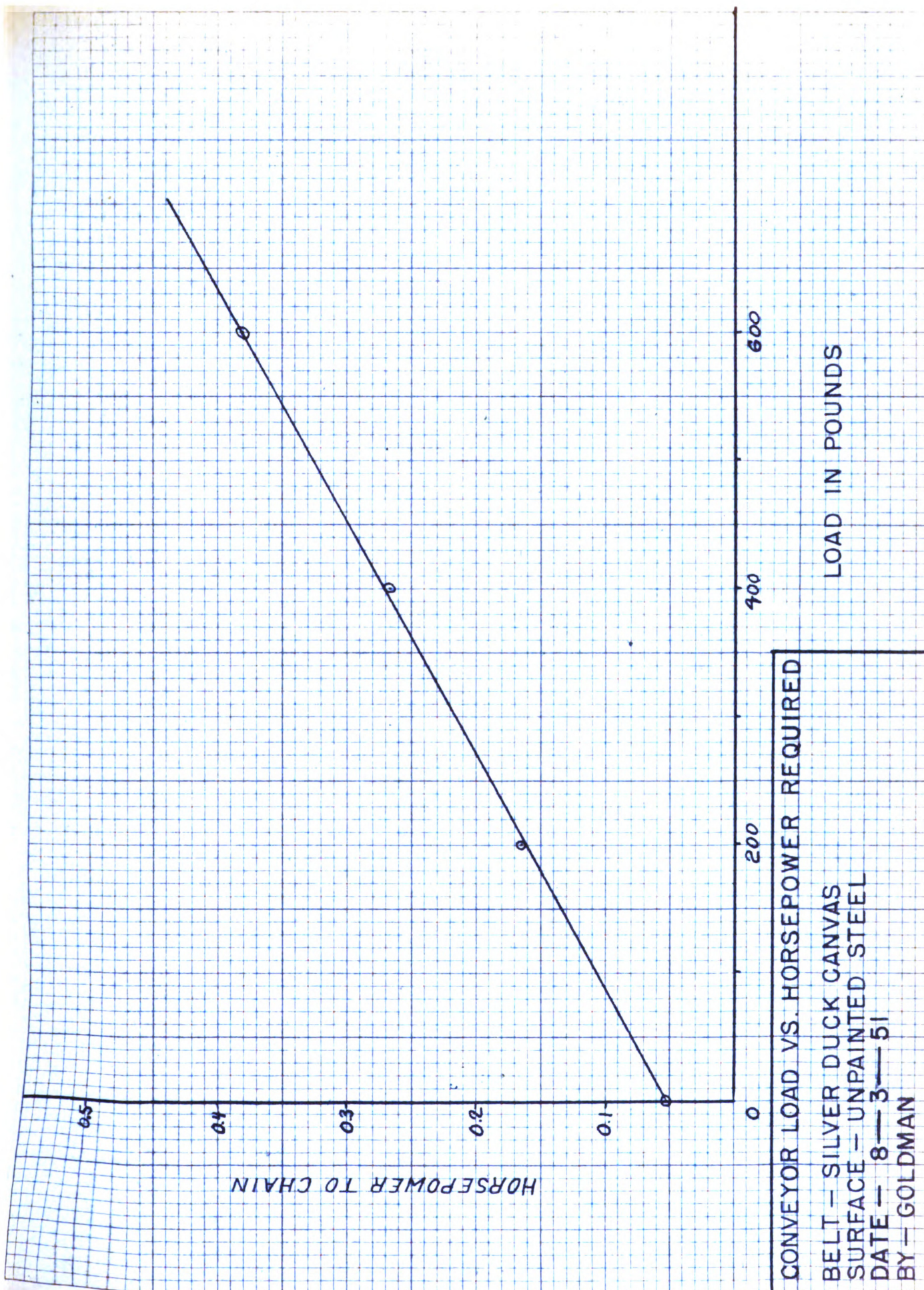


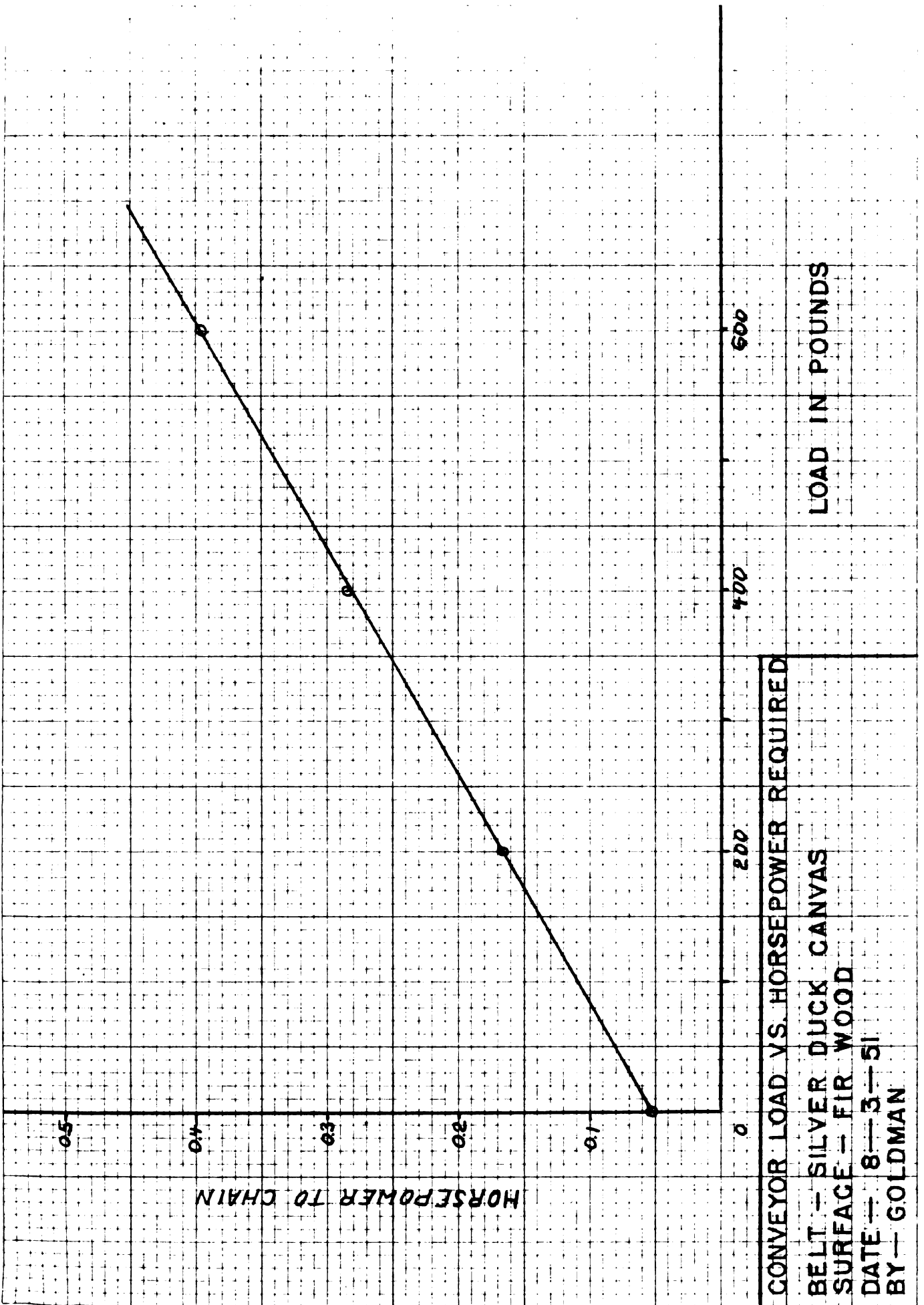


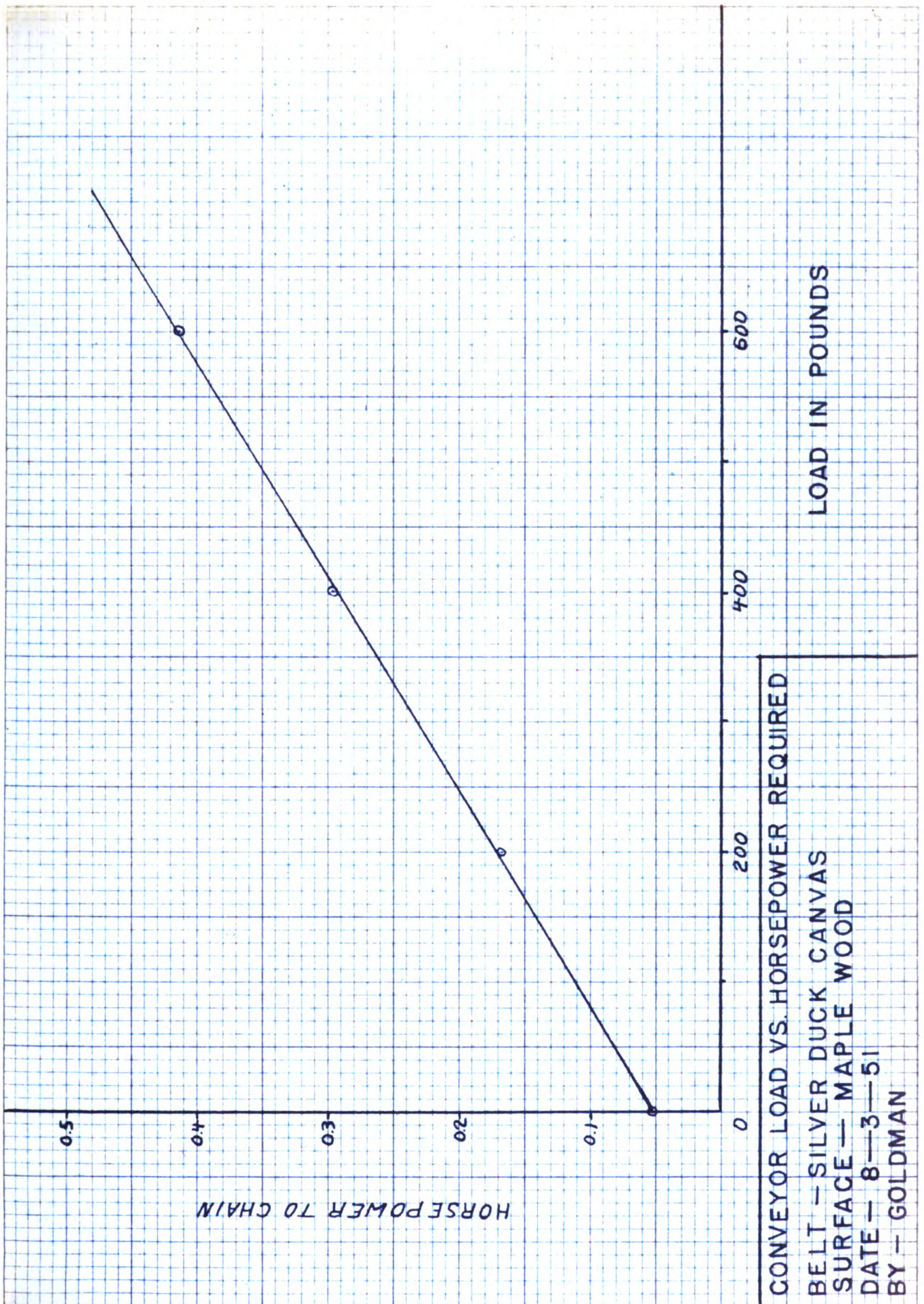


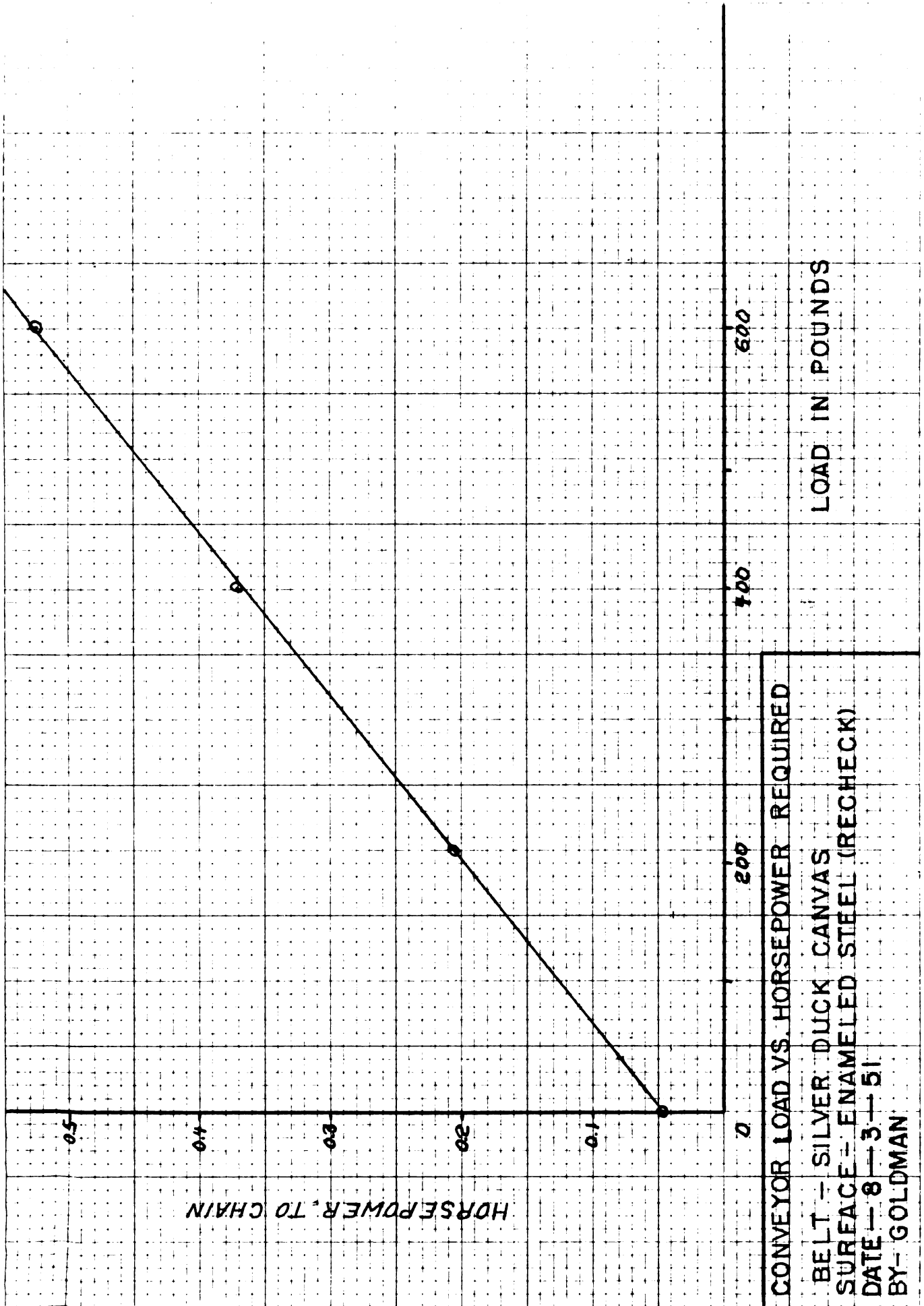


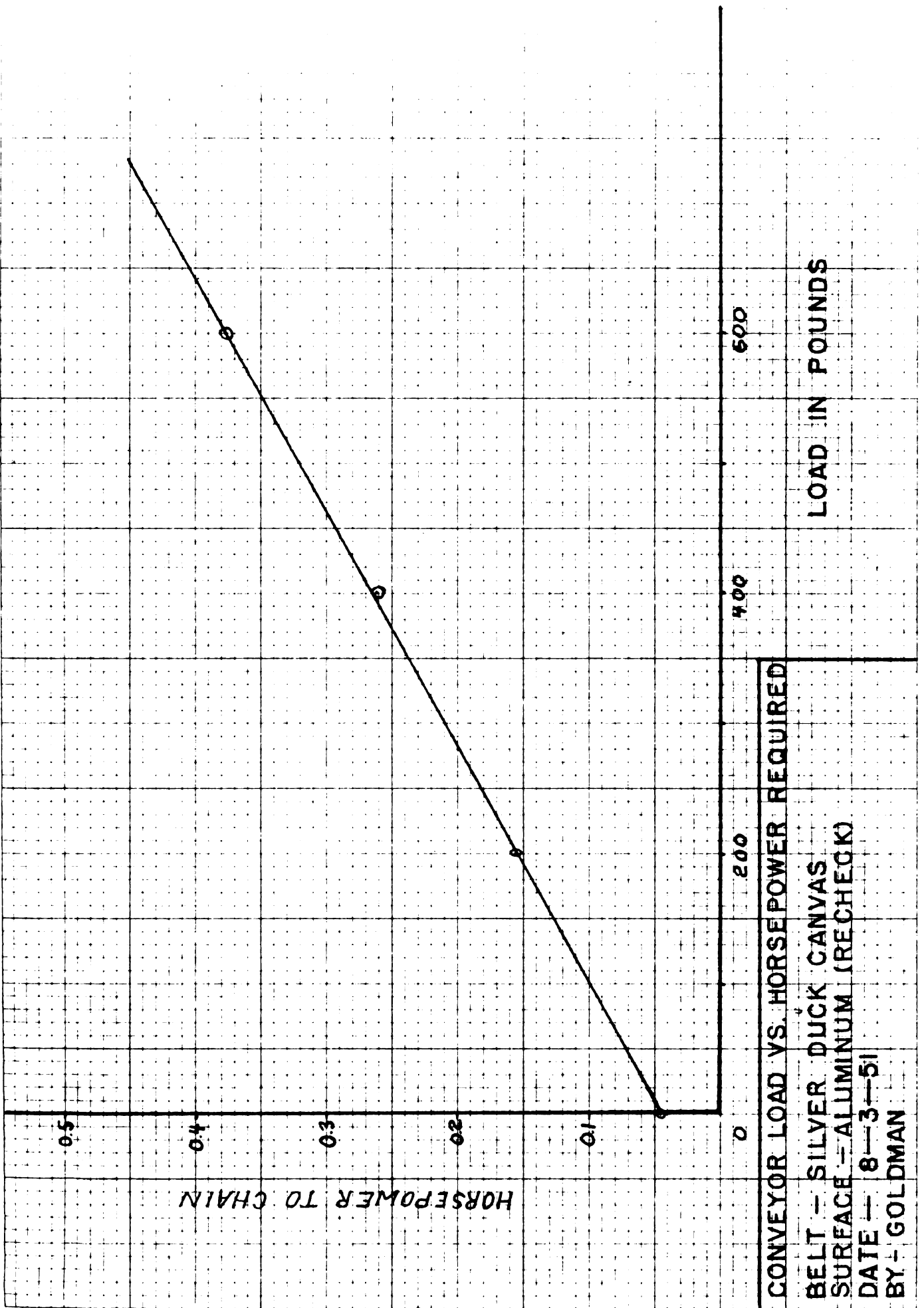
CONVEYOR LOAD VS. HORSEPOWER REQUIRED
BELT -- SILVER DUCK CANVAS
SURFACE -- ALUMINUM
DATE -- 8-3-51
BY -- GOLDMAN

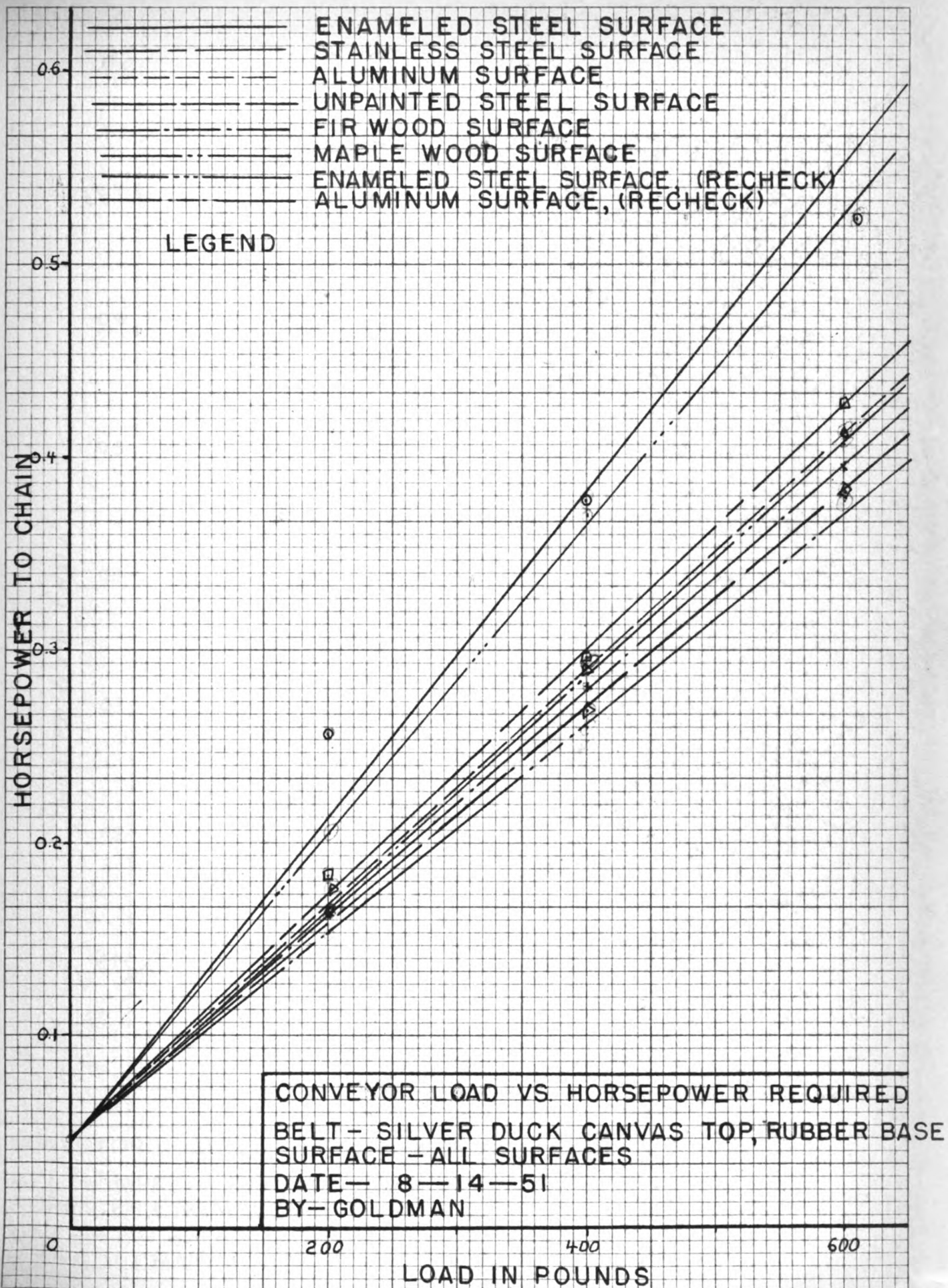


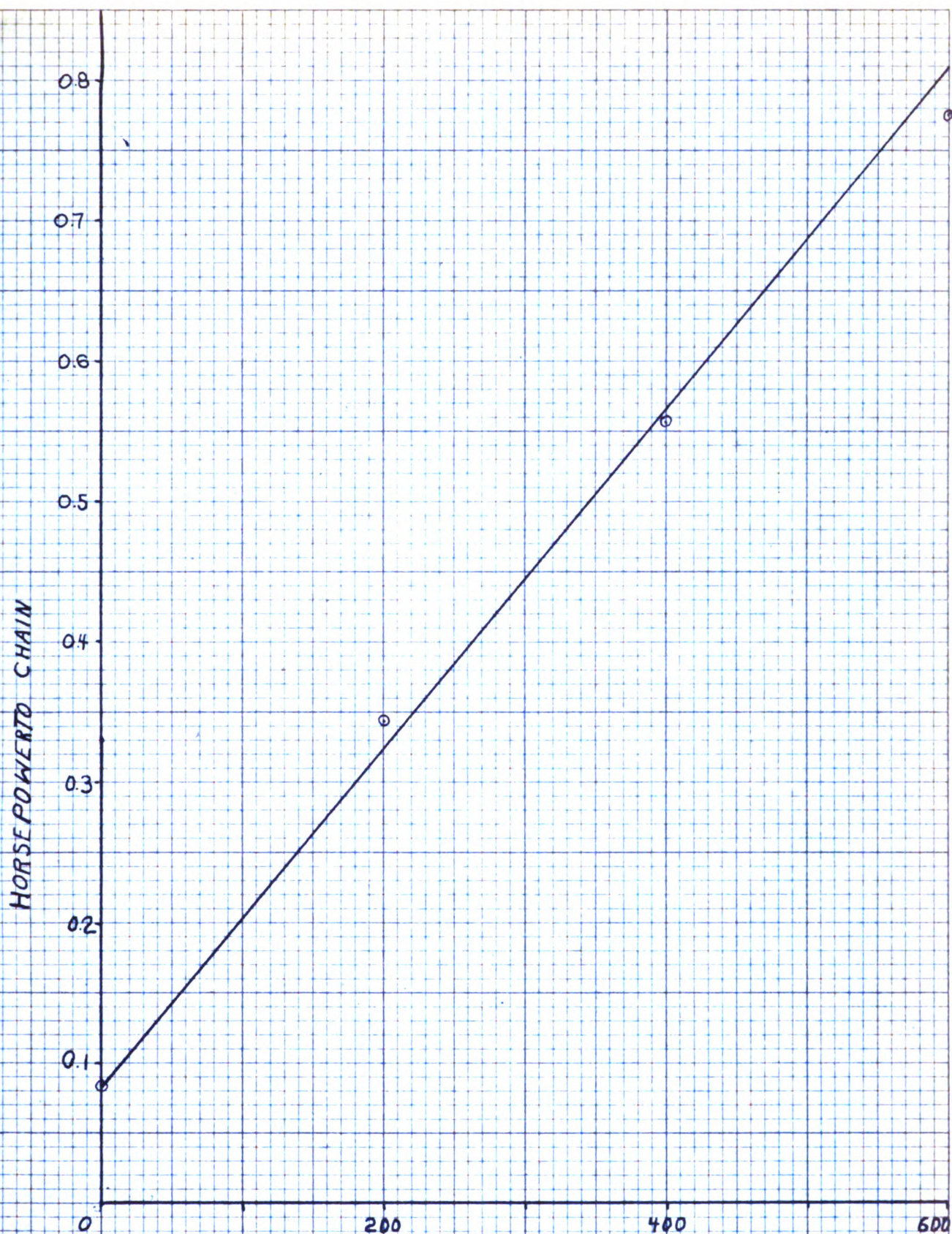












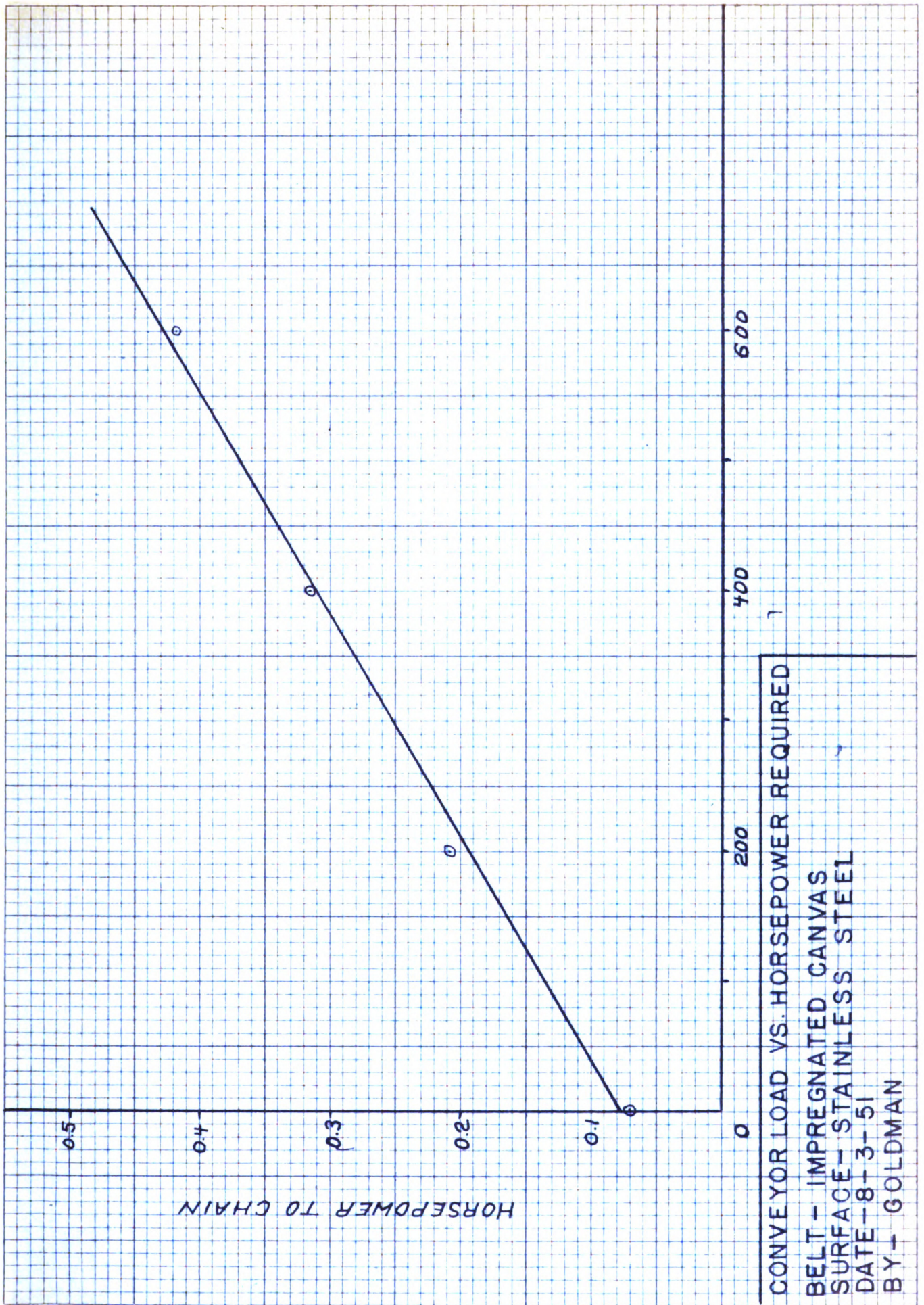
CONVEYOR LOAD VS. HORSEPOWER REQUIRED

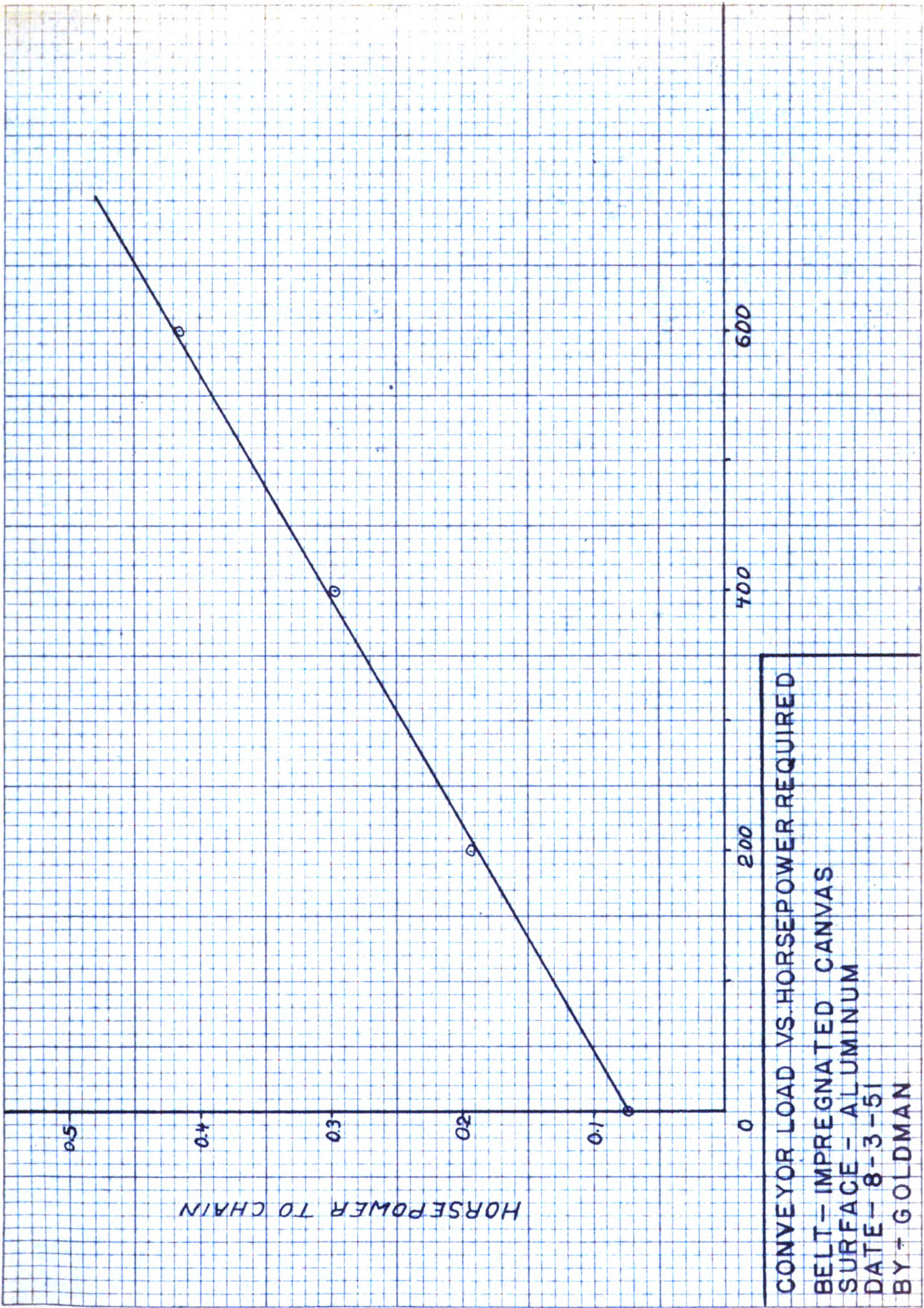
BELT-IMPREGNATED CANVAS

SURFACE-ENAMELED STEEL

DATE-8-6-51

BY-GOLDMAN





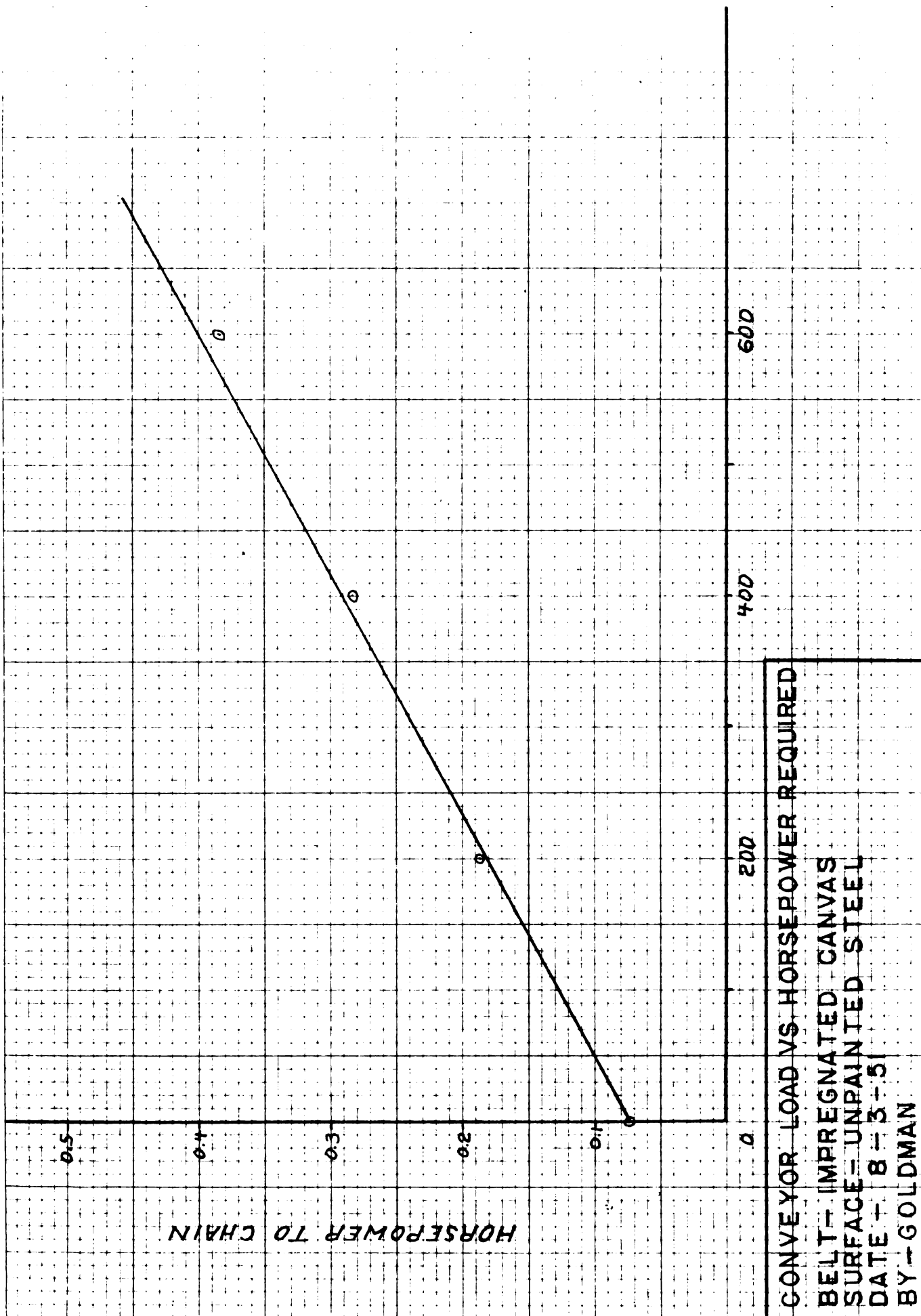
CONVEYOR LOAD VS. HORSEPOWER REQUIRED

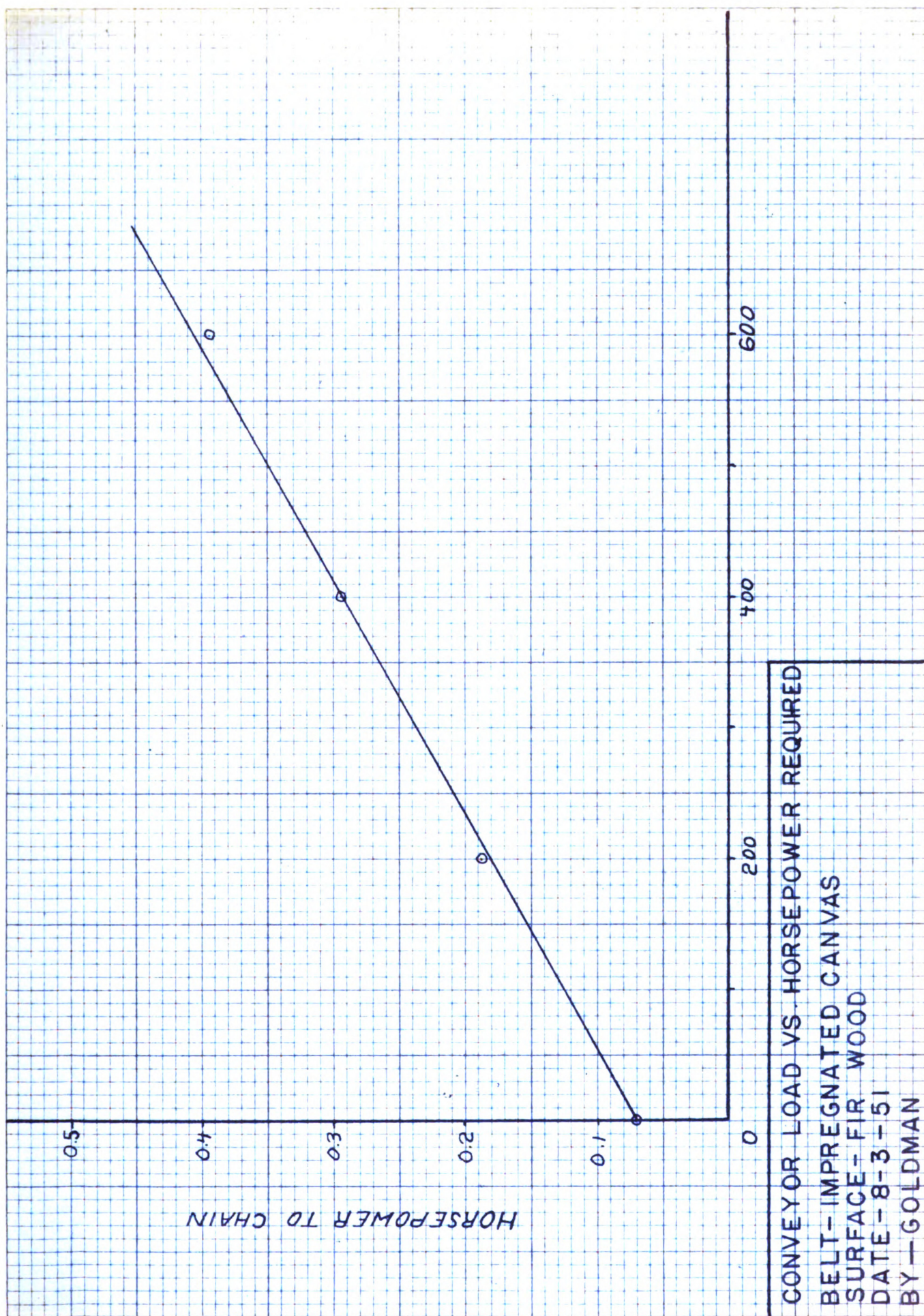
BELT - IMPREGNATED CANVAS

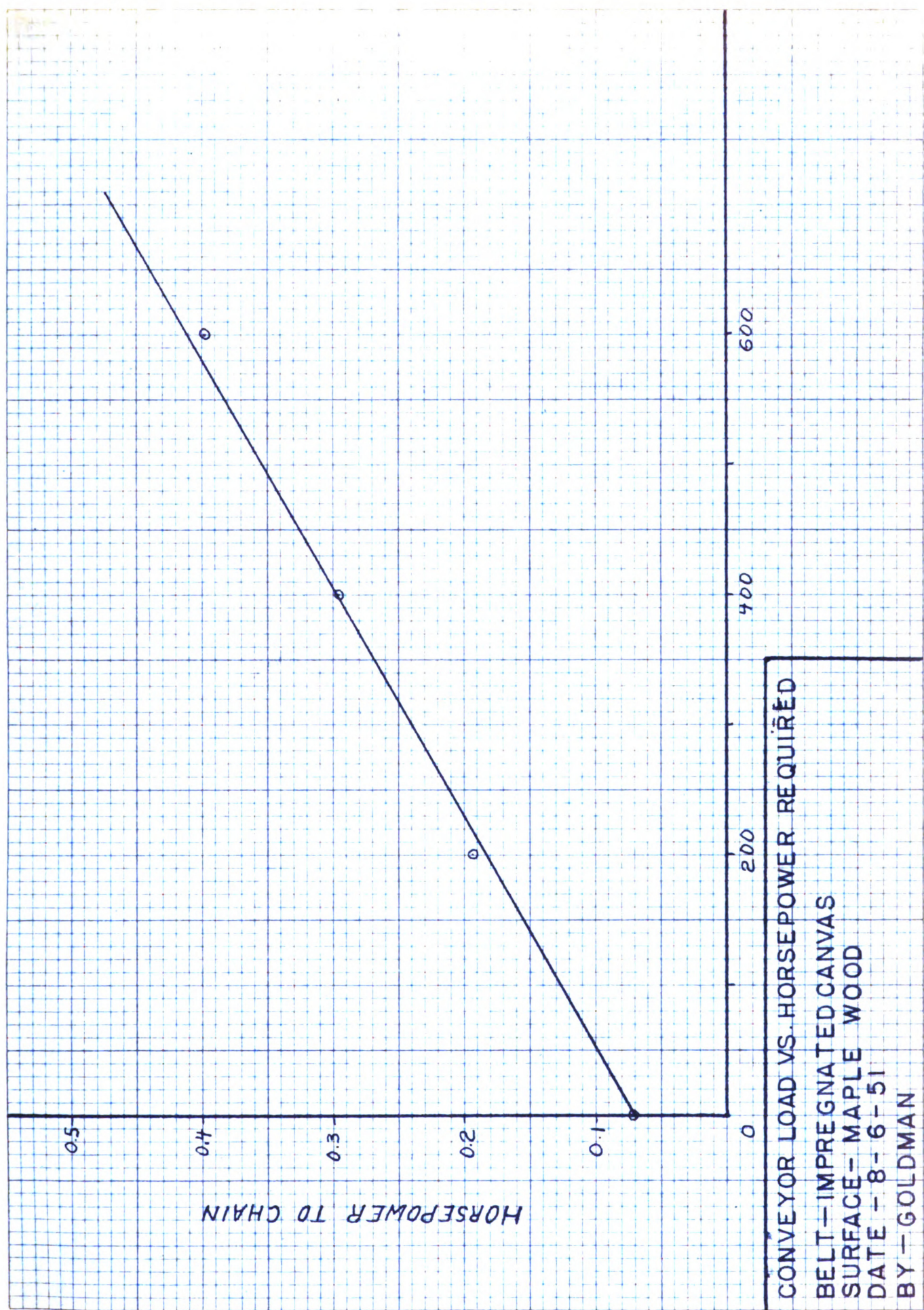
SURFACE - ALUMINUM

DATE - 8-3-51

BY - GOLDMAN







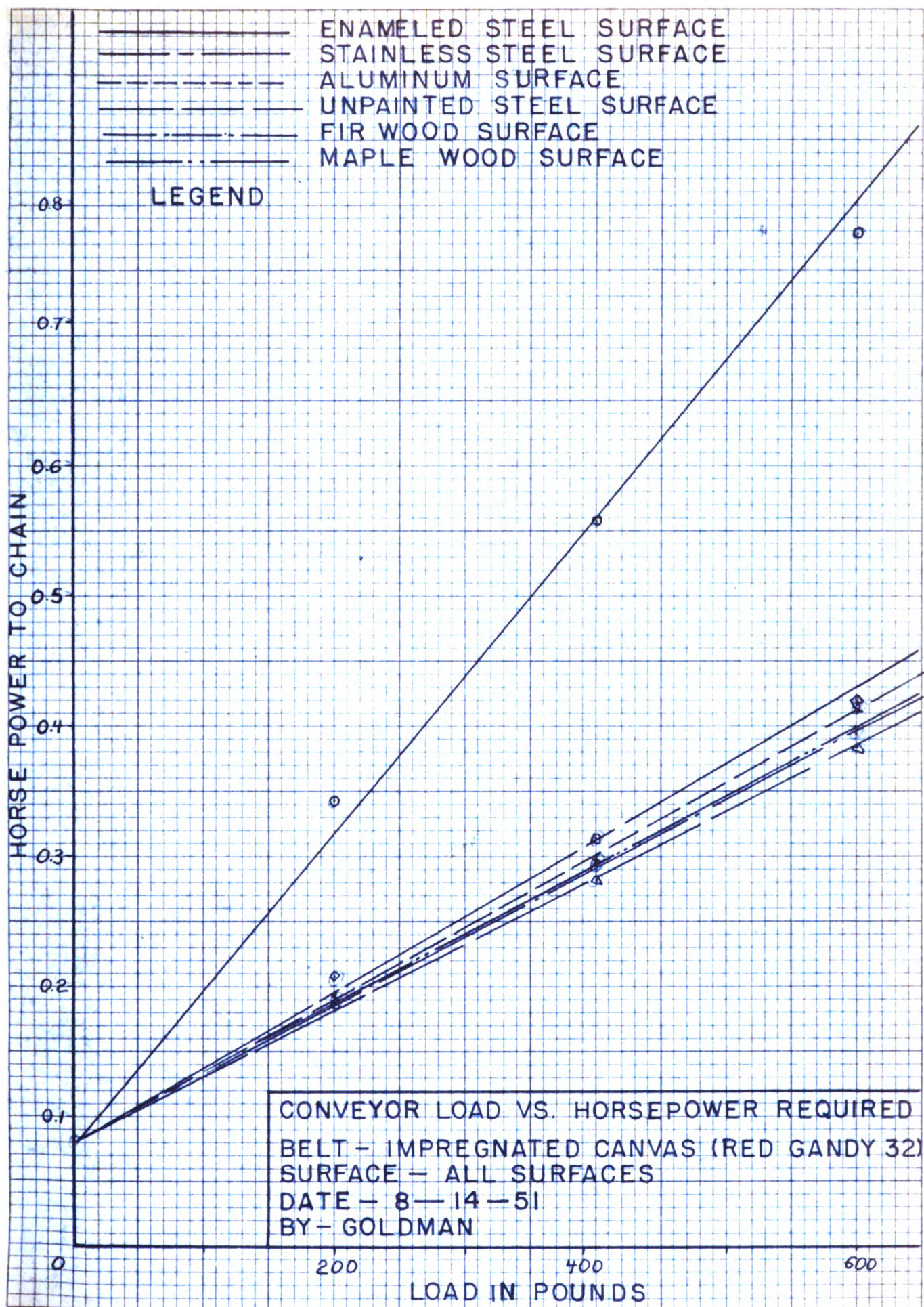
CONVEYOR LOAD VS. HORSEPOWER REQUIRED

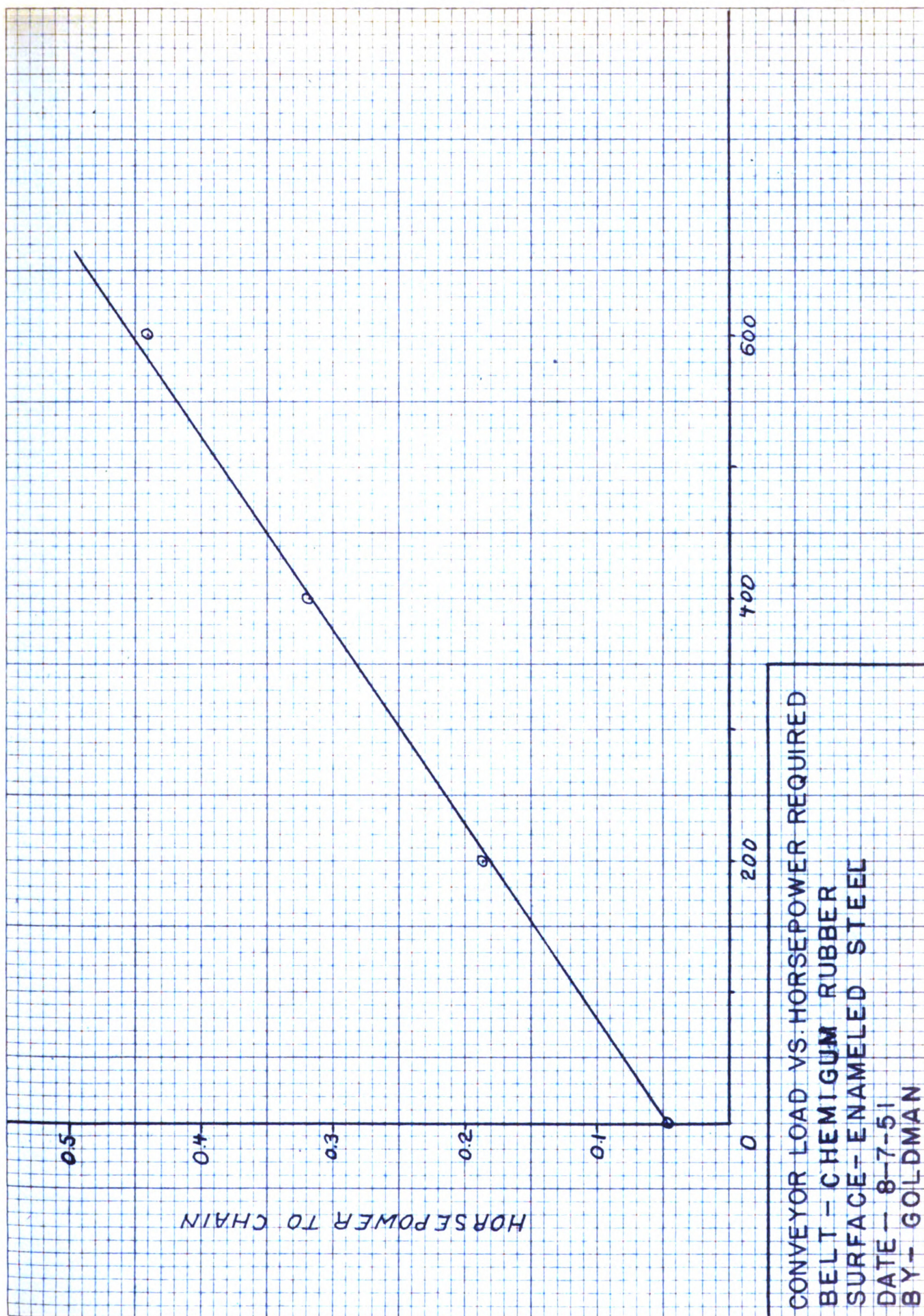
BELT-IMPREGNATED CANVAS

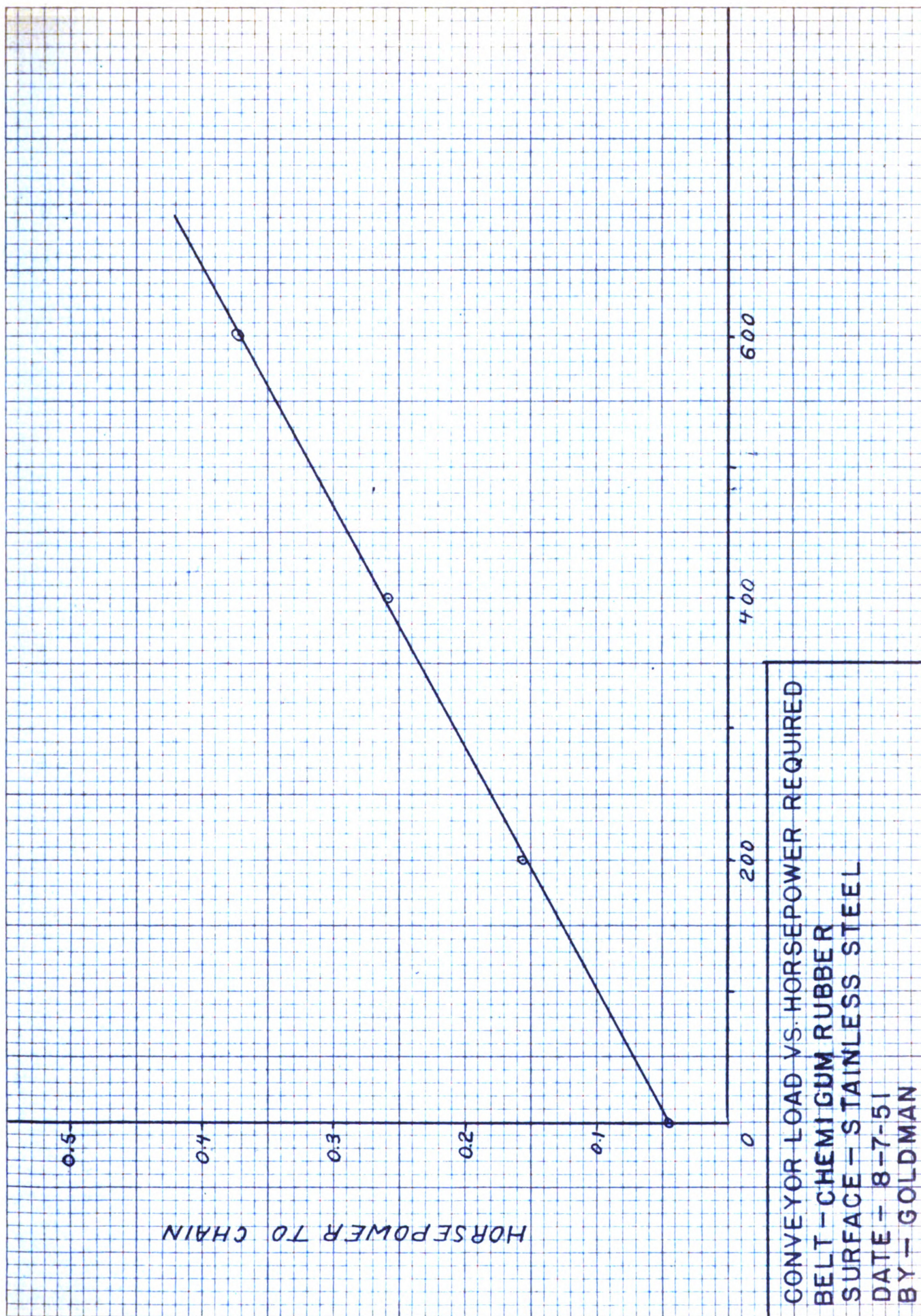
SURFACE- MAPLE WOOD

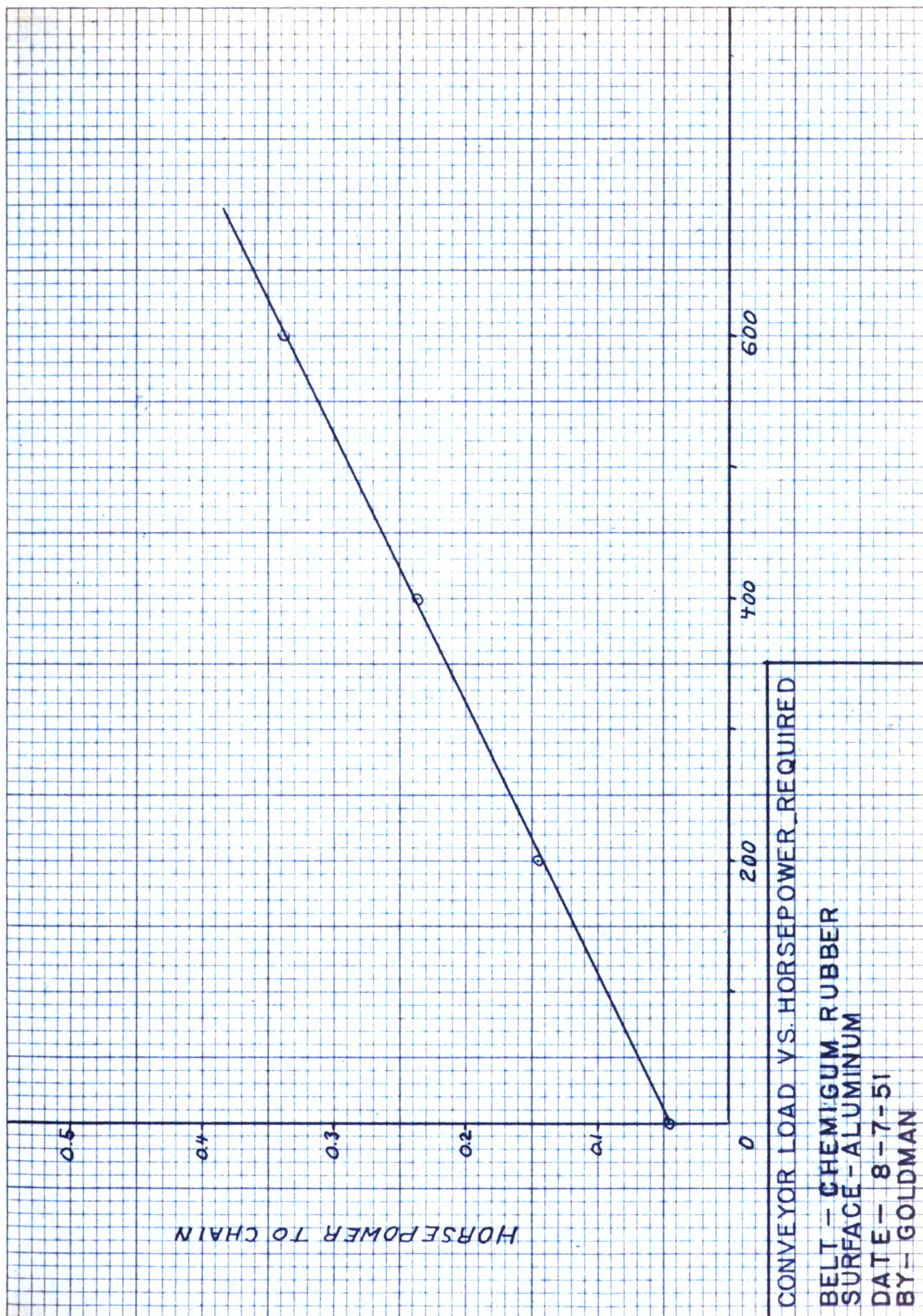
DATE - 8-6-51

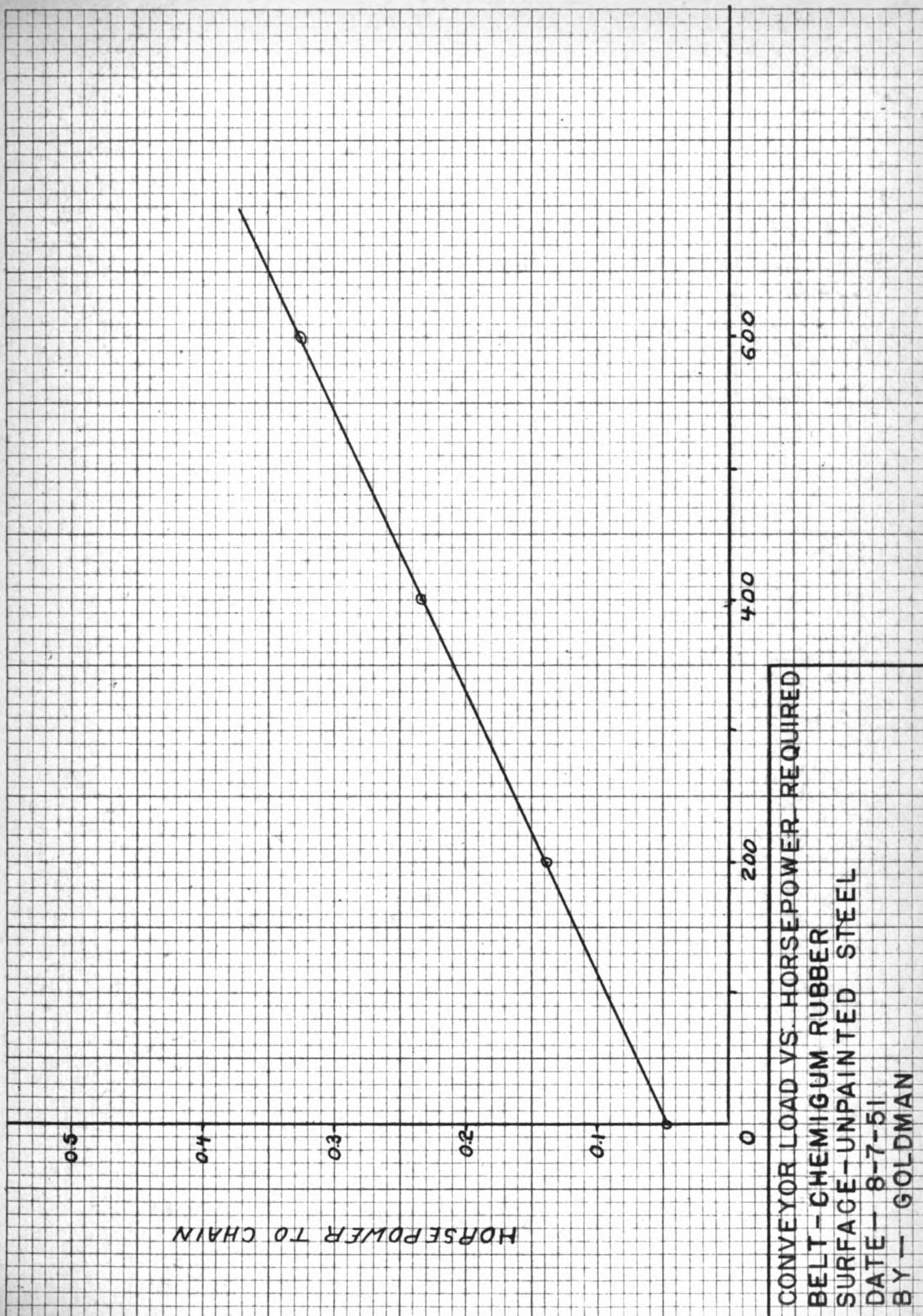
BY - GOLDMAN

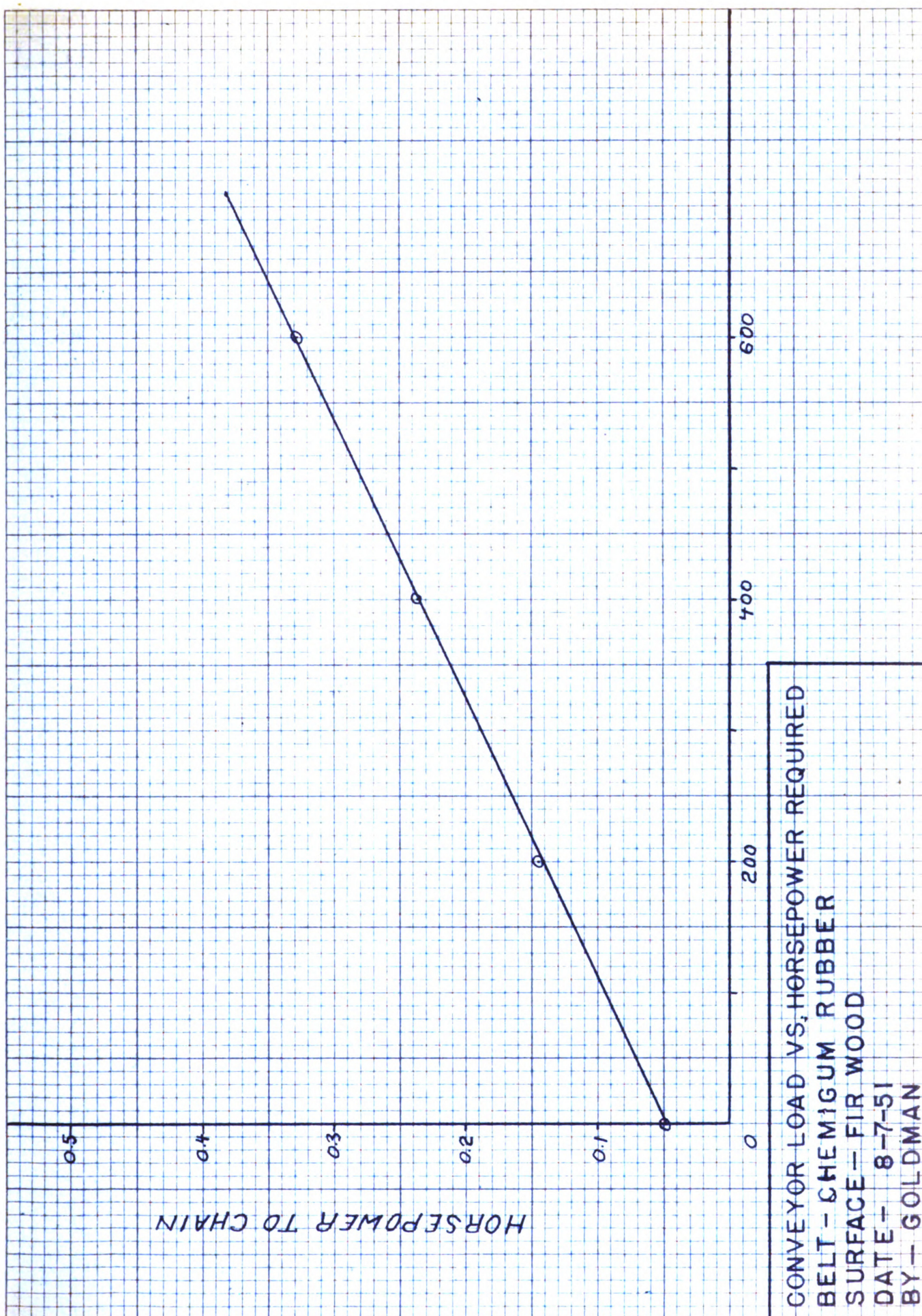


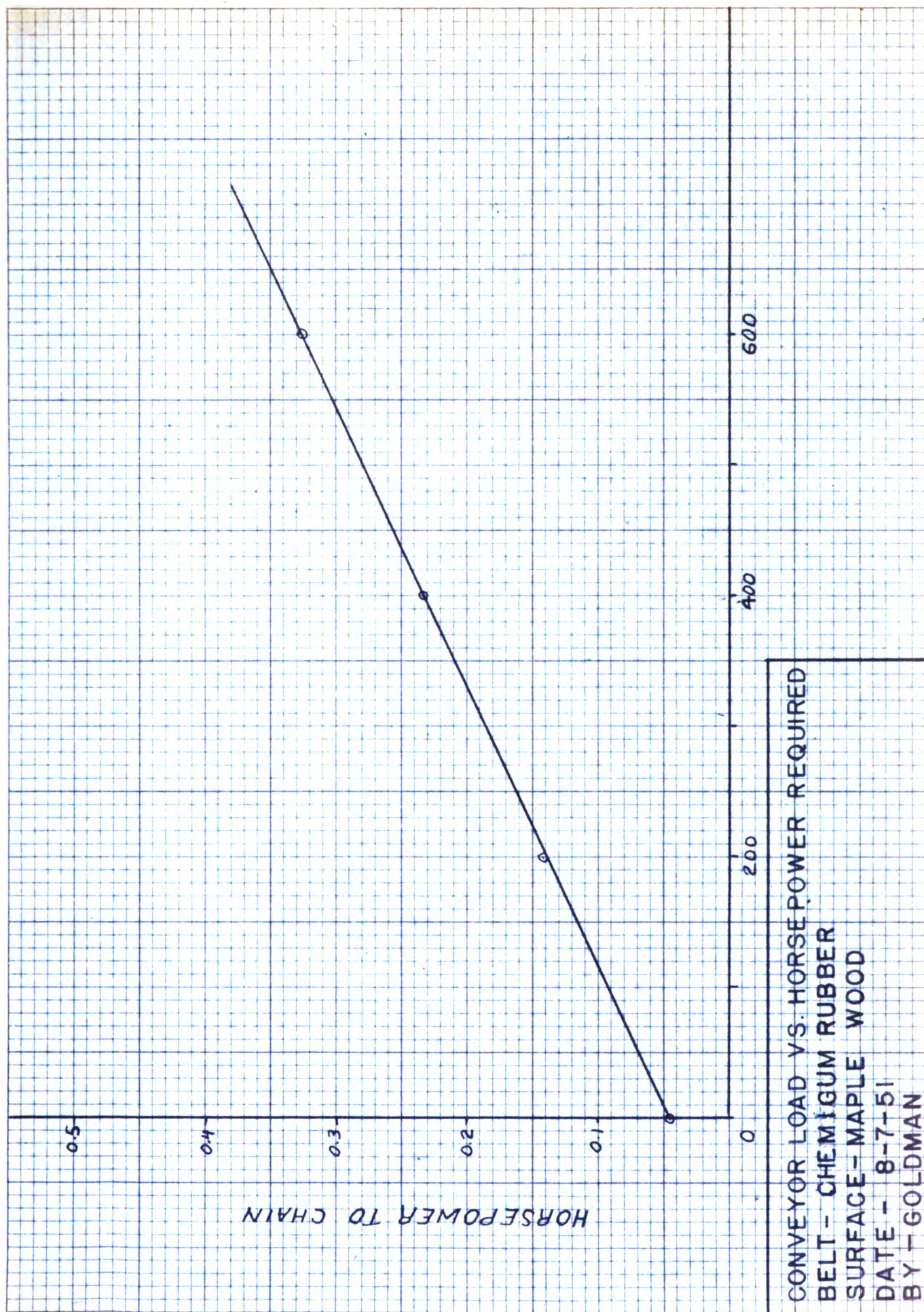


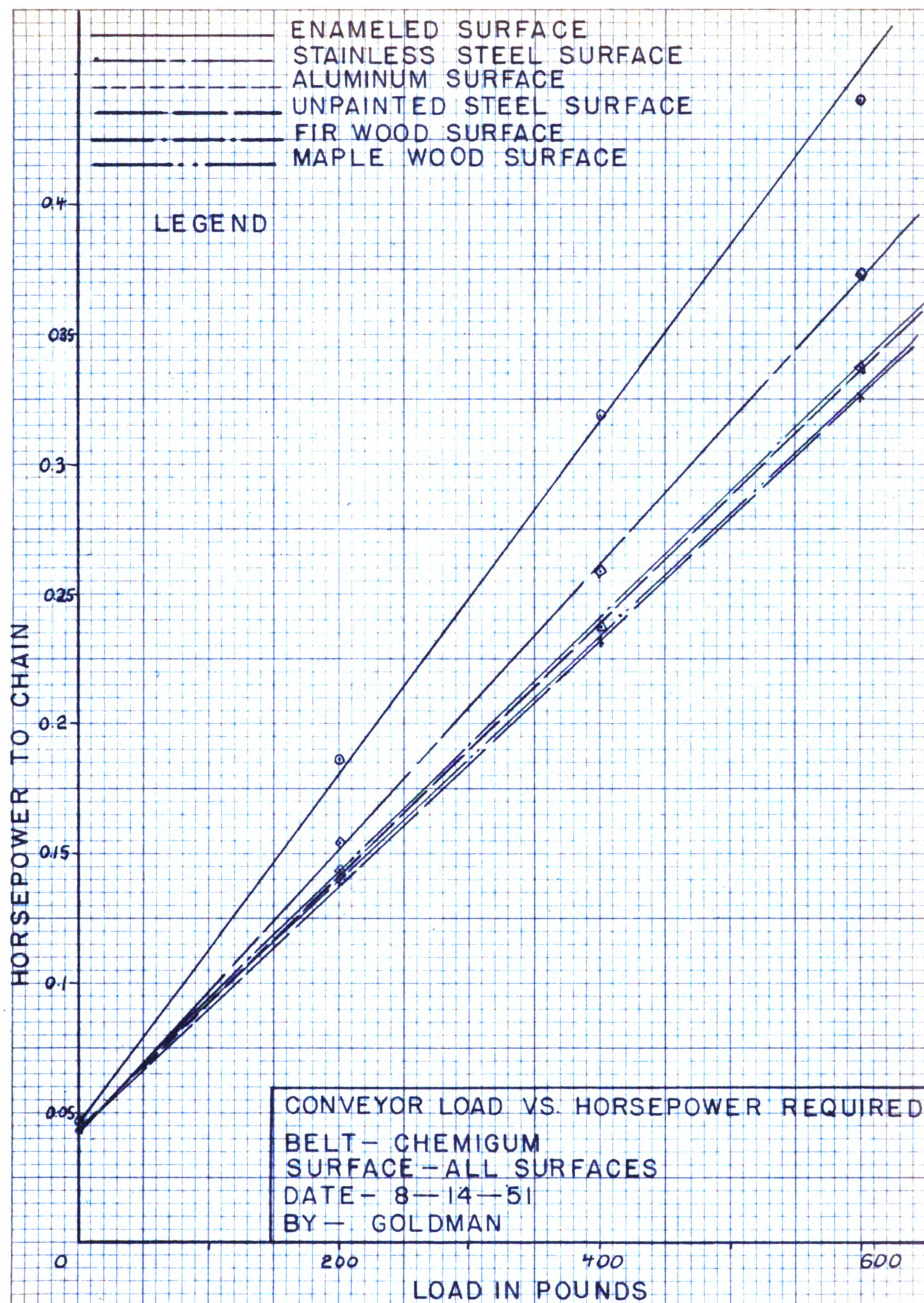


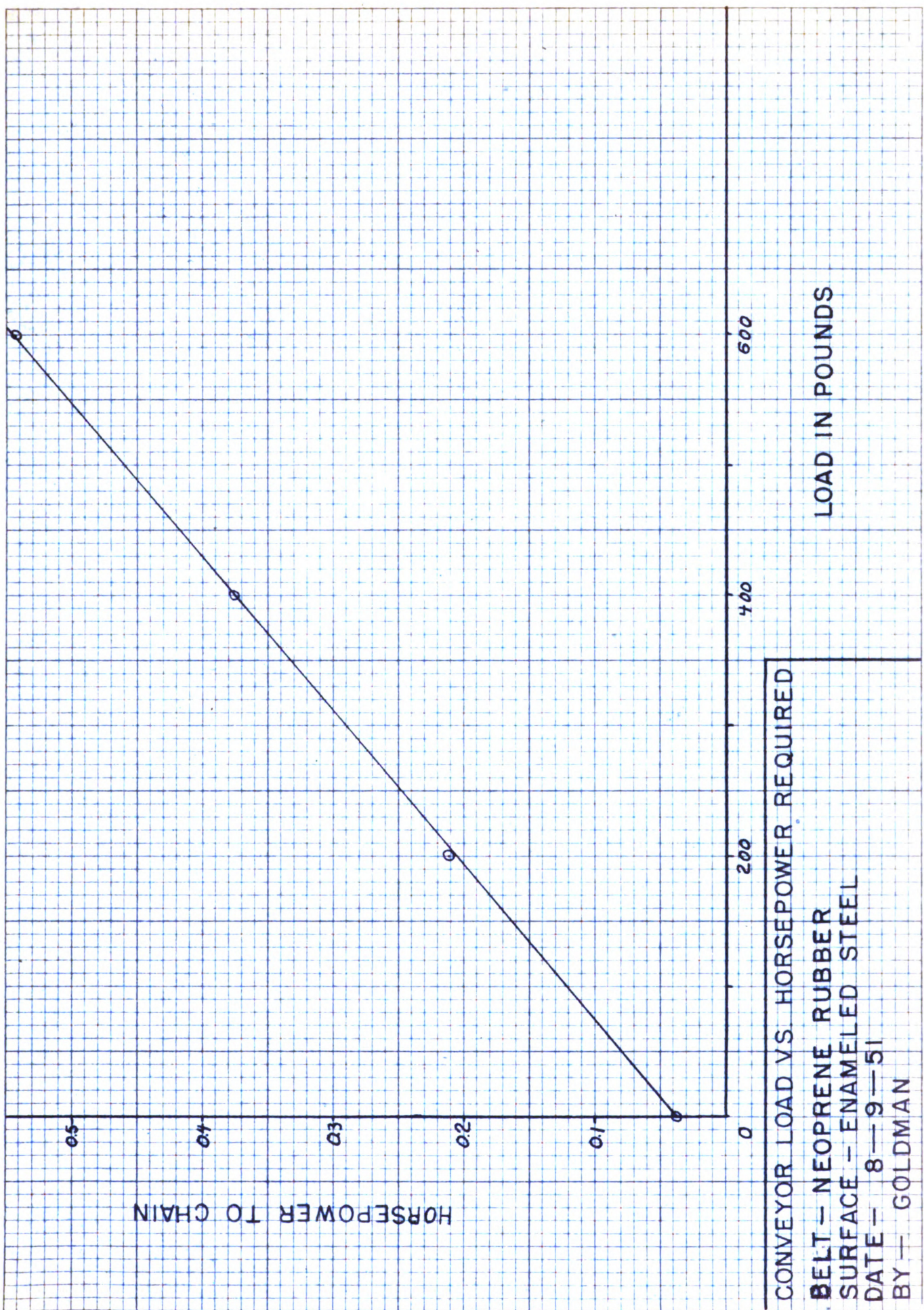






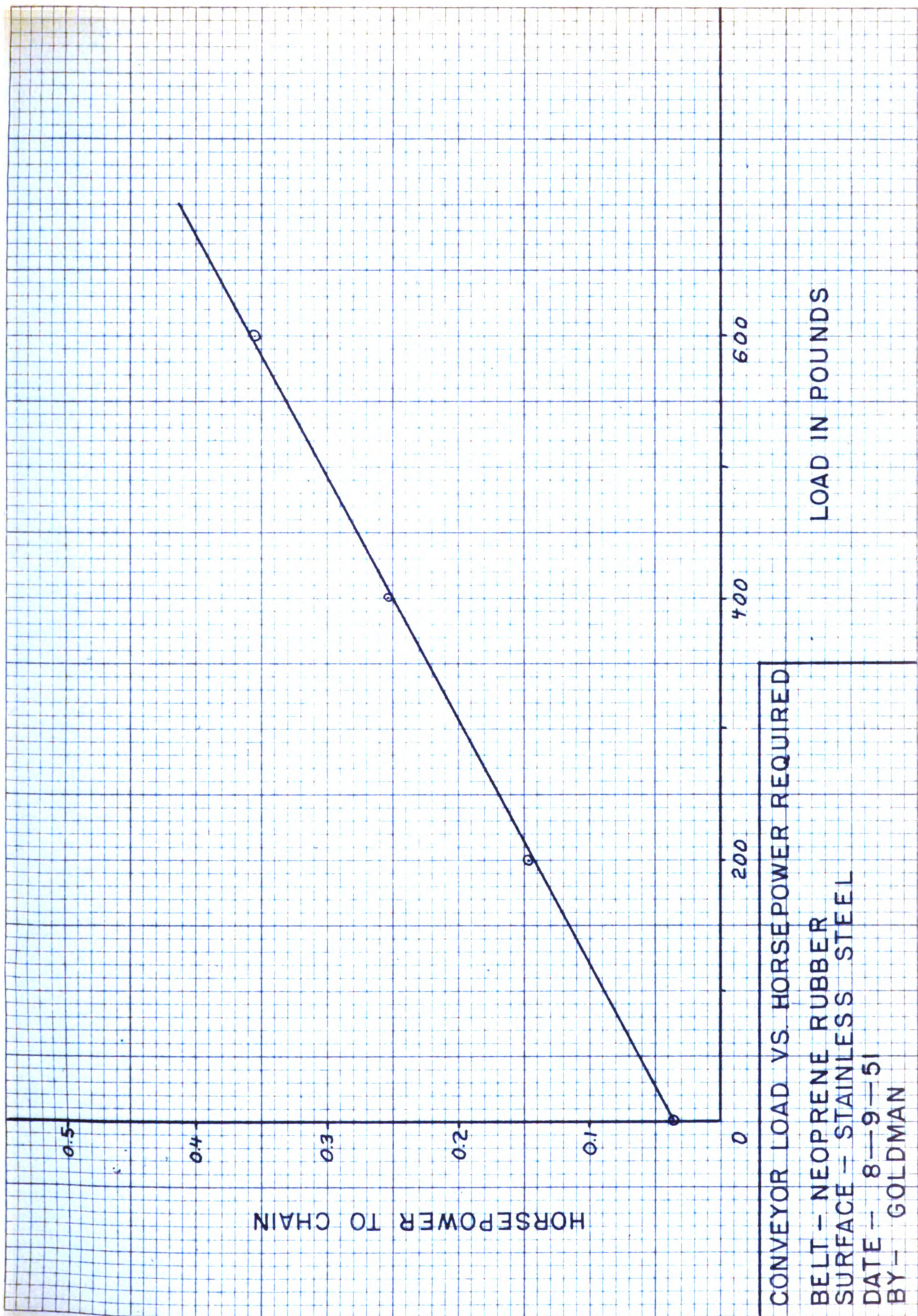


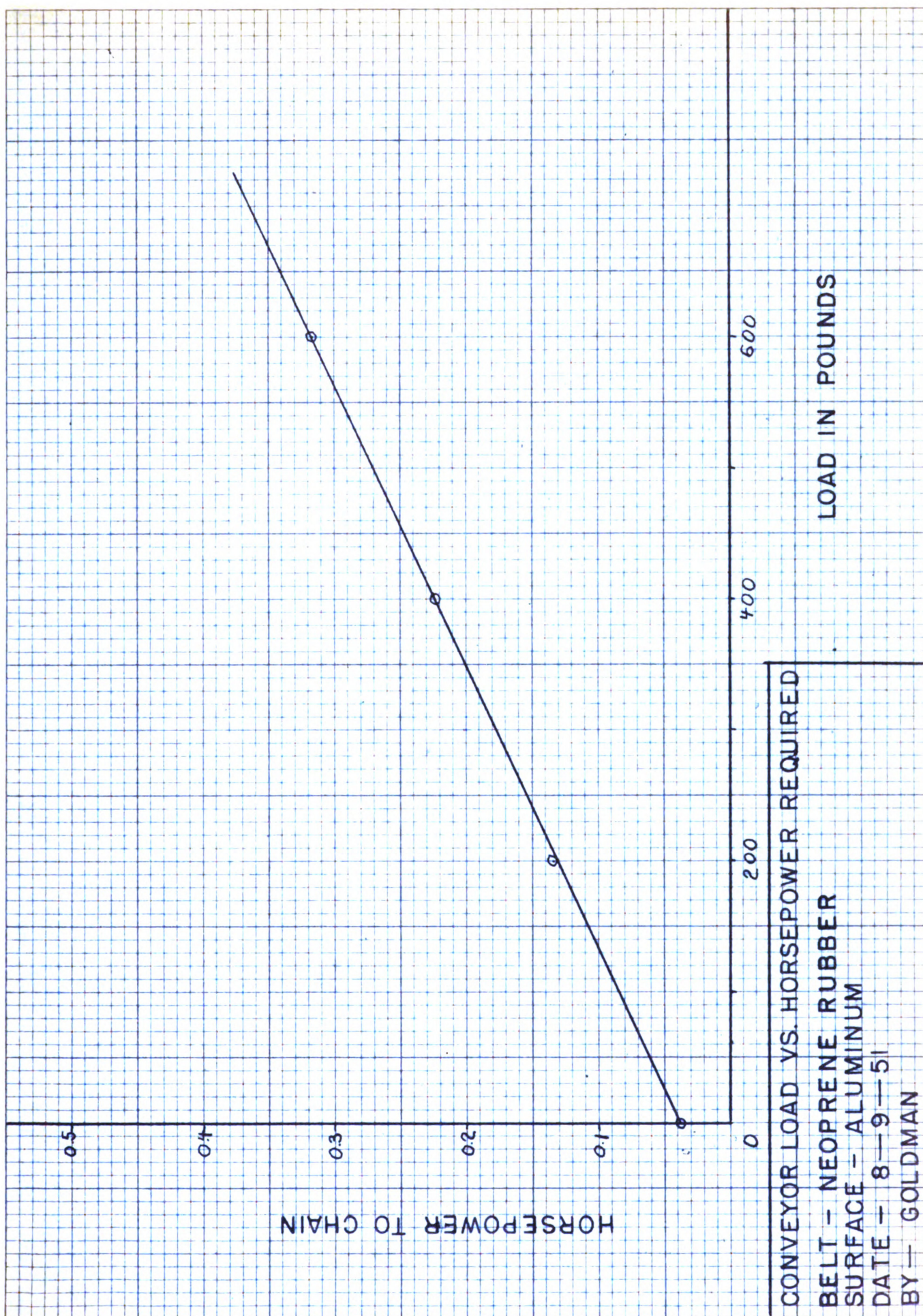


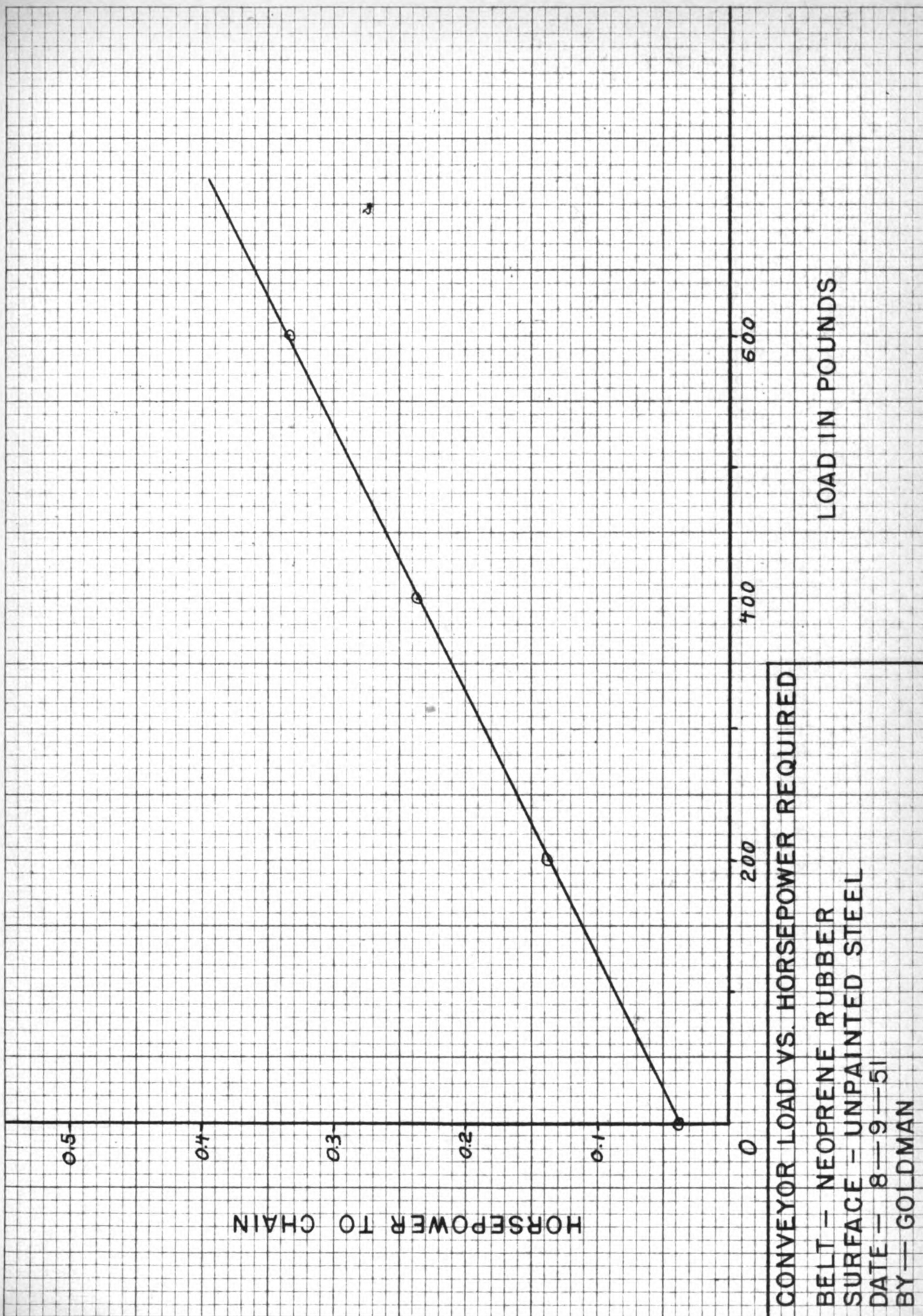


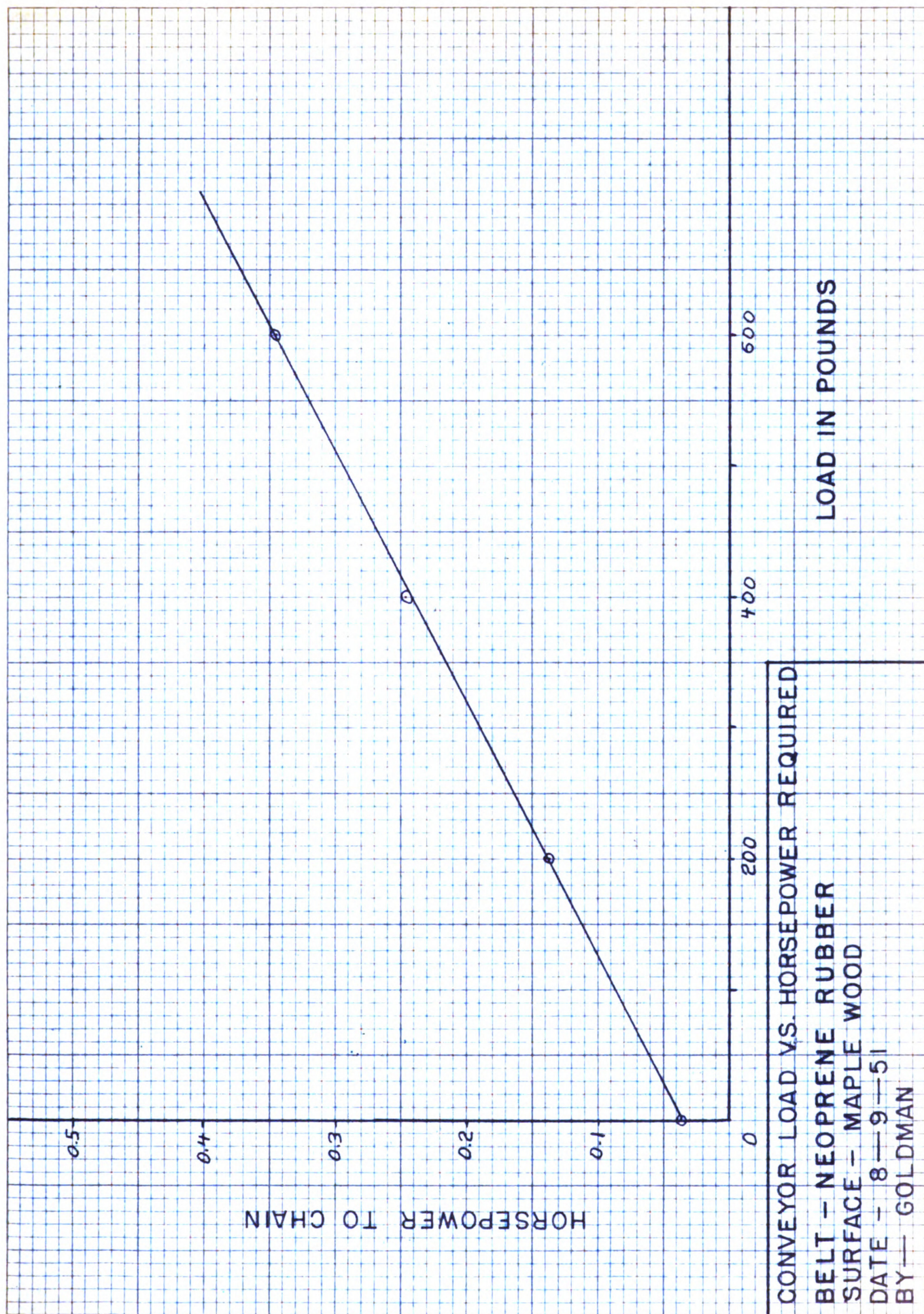
CONVEYOR LOAD VS. HORSEPOWER REQUIRED

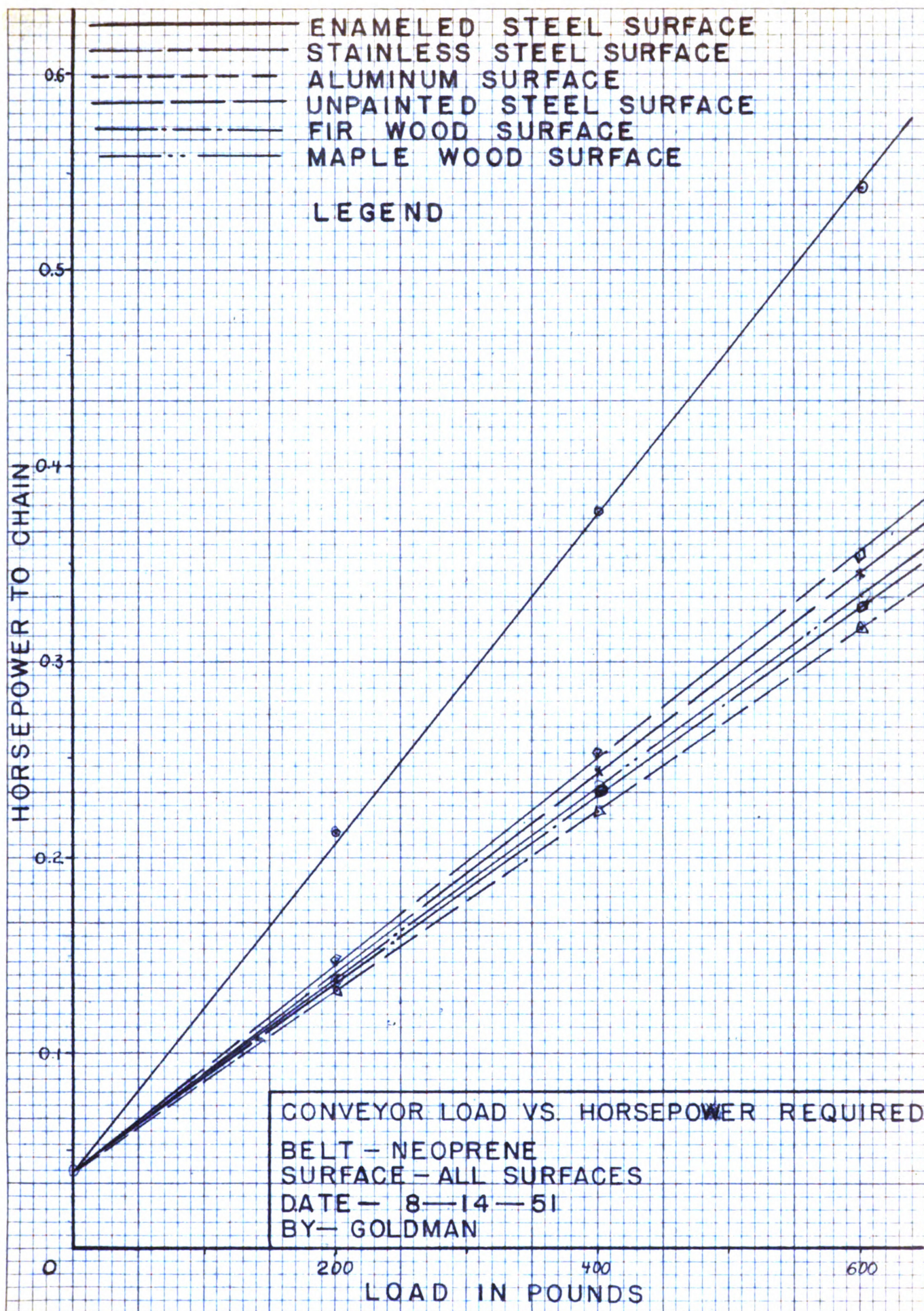
BELT - NEOPRENE RUBBER
SURFACE - ENAMELED STEEL
DATE - 8-9-51
BY - GOLDMAN

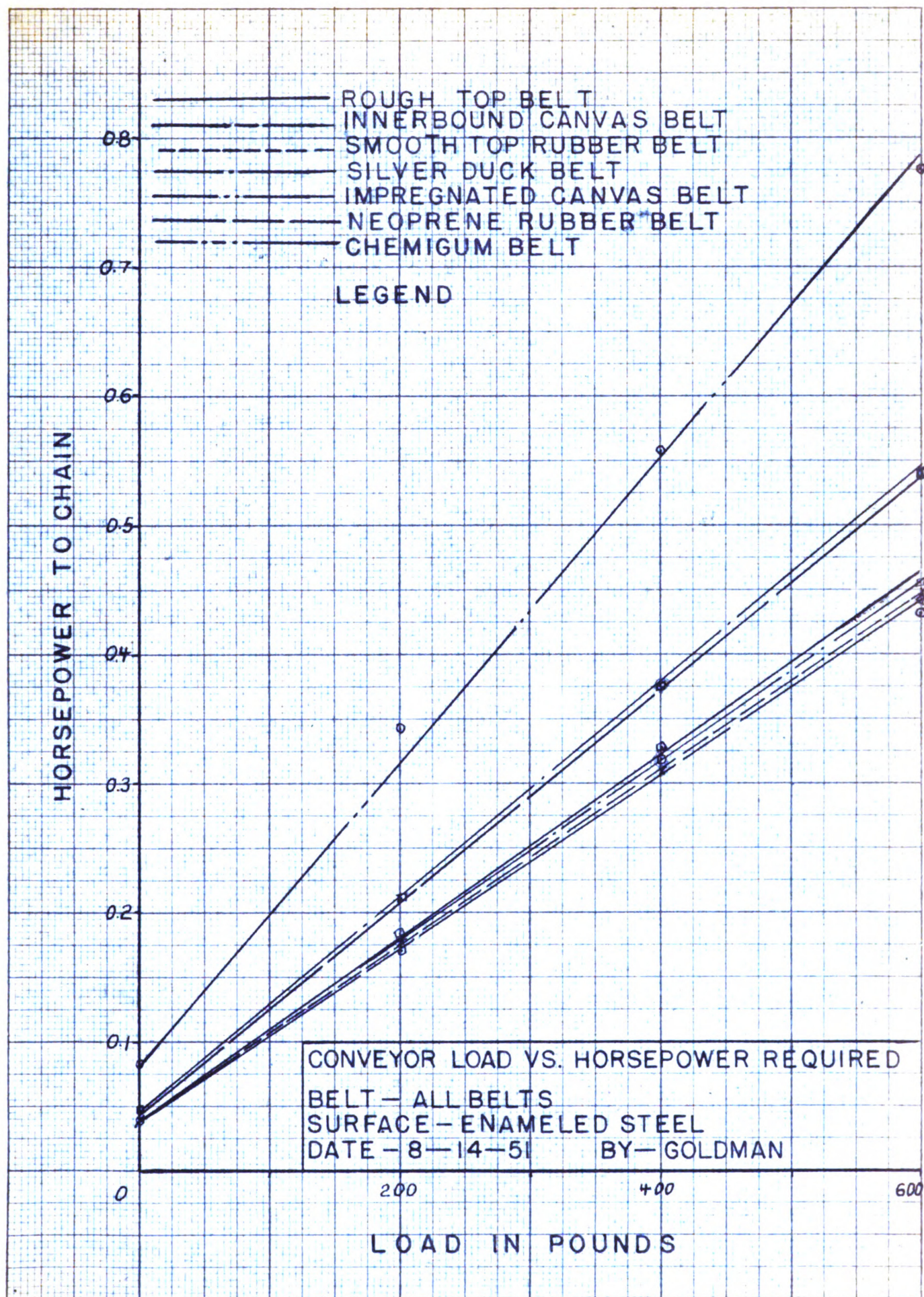


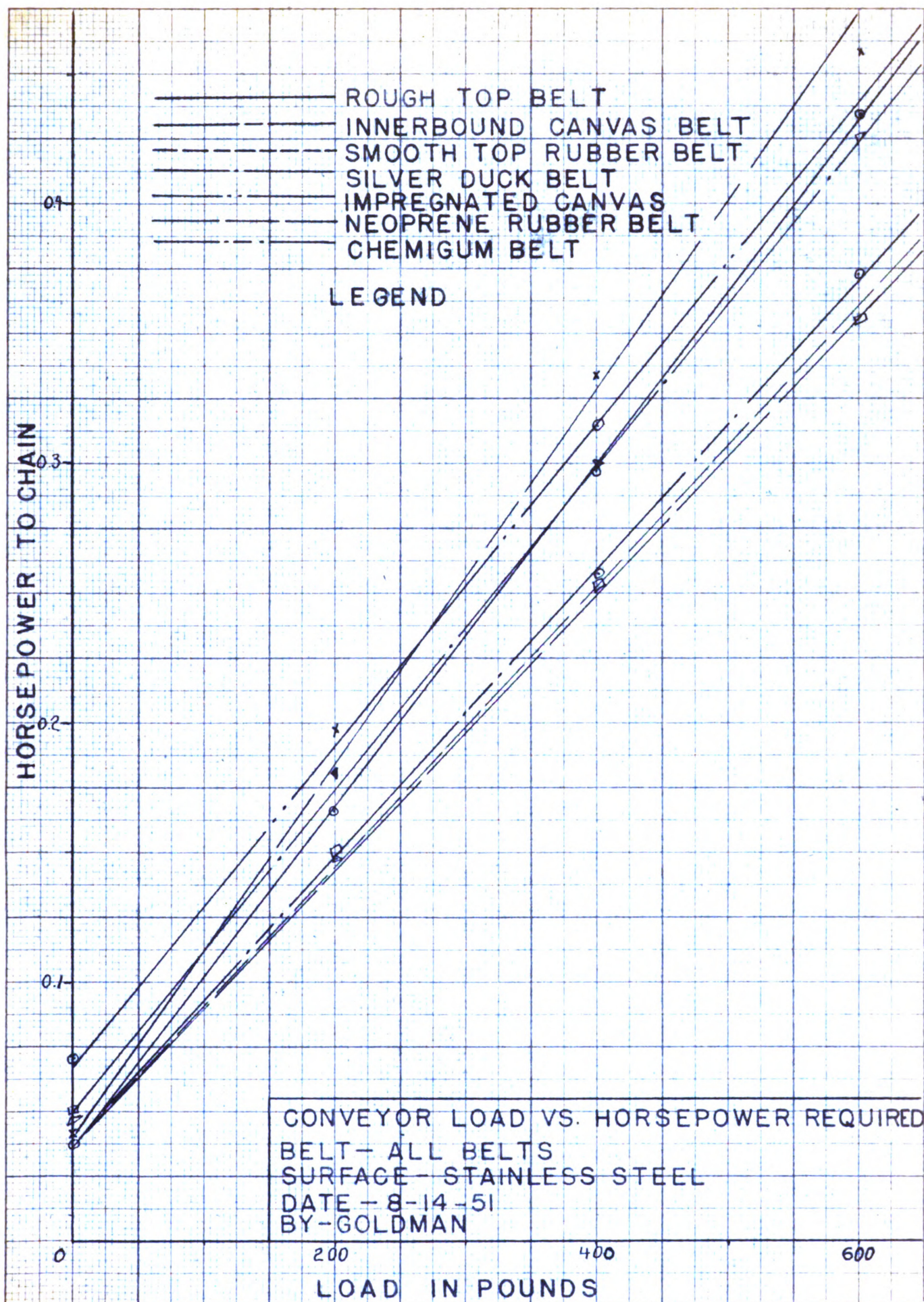


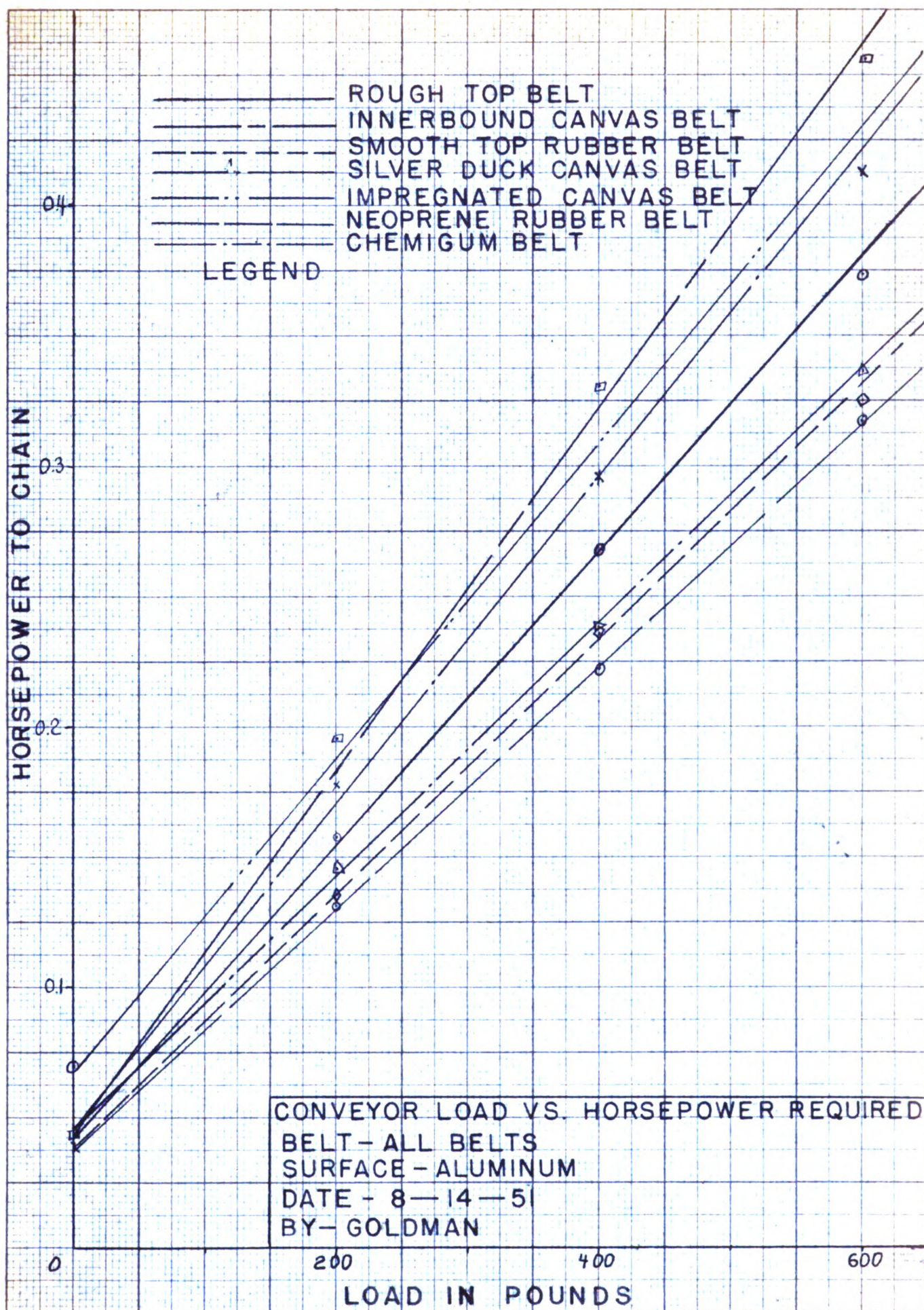












HORSEPOWER TO CHAIN

_____ ROUGH TOP BELT
 _____ INNERBOUND CANVASBELT
 _____ SMOOTH TOP RUBBER BELT
 _____ SILVER DUCK BELT
 _____ IMPREGNATED CANVAS BELT
 _____ NEOPRENE RUBBER BELT
 _____ CHEMIGUM BELT

LEGEND

0.1

0.2

0.3

0.4

CONVEYOR LOAD VS. HORSEPOWER REQUIRED
 BELT - ALL BELTS
 SURFACE - UNPAINTED STEEL
 DATE - 8-14-51
 BY - GOLDMAN

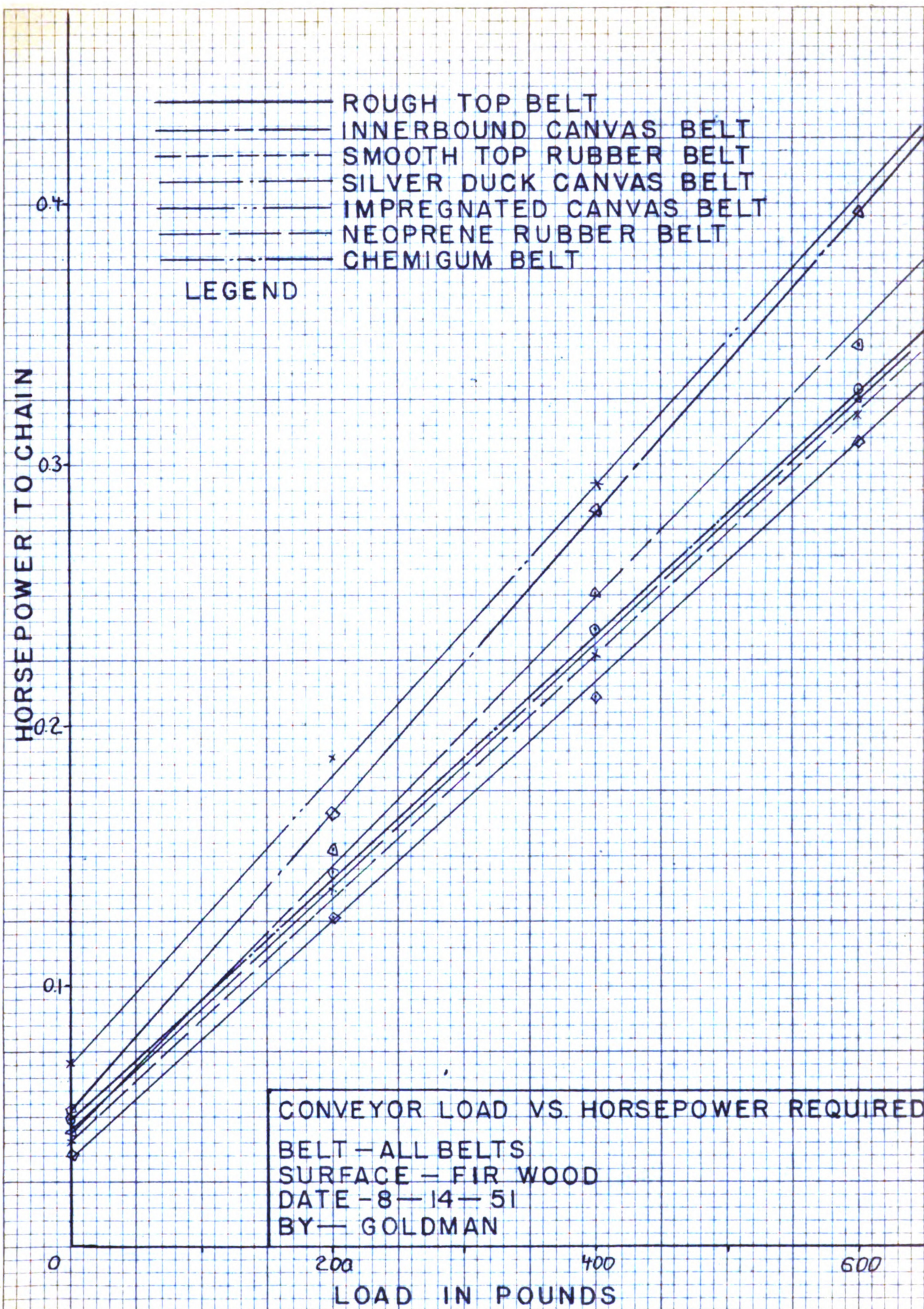
0

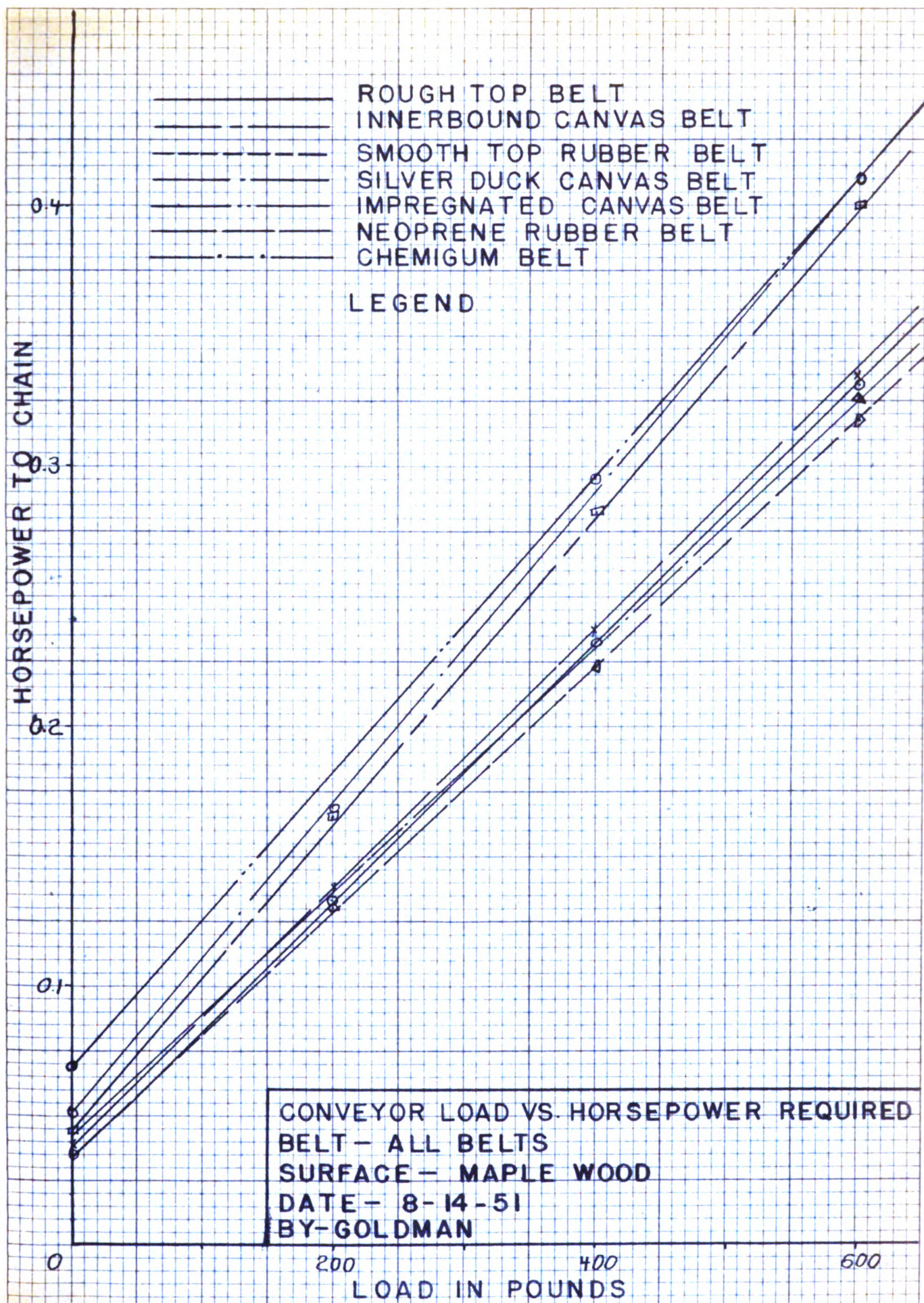
200

400

600

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