## EXPERIMENTAL INVESTIGATION OF PRESSURE DROP IN HELICAL COILS

Thesis by

Lt. Comdr. A. H. Clancy Jr., U.S.N.

In Partial Fulfillment of the Requirements

For the Degree of

Aeronautical Engineer

California Institute of Technology

Pasadena, California

1949

### ACKNOWLEDGMENTS

The author is indebted to Mr. R. F. Rose and the staff of the Hydraulics Laboratory, Jet Propulsion Laboratory, California Institute of Technology, for their guidance and assistance in the preparation of this thesis.

Acknowledgment is also accorded Lieutenant Commander R. A. Weatherup, U. S. Navy, with whom the author conducted the experimental part of this investigation.

#### ABSTRACT

The purpose of this study was to begin an investigation of the pressure drop in flow through helical coils. In general, the procedure followed was to define the governing paremeters and then to isolate the effect of each on the pressure drop. The pressure drop was assumed to depend upon the length of the tube, the inside diameter of the tube, the diameter of the helix, the roughness of the inside of the tube, and Reynolds number. Variation of pressure drop with change in diameter of the tube was not investigated. Five different lengths of plastic tubing were tested separately on five helices of different diameters at Reynolds numbers from 3,000 to 100,000 to study the effects of length and helix diameter. Twelve steel coils of different inside roughnesses were tested over the same Reynolds number range to obtain the effect of roughness on pressure drop.

The results of the investigation indicated that pressure drop in a helical coil is linearly dependent on length, is only slightly affected by roughness, and is a function of both Reynolds number and diameter of helix as indicated in the attached curves. These conclusions, of course, hold only for the limited field covered by the investigation.

#### SYMBOLS

d, - Inside diameter of test tubing, ft.

DH - Mean diameter of helix, ft.

f - Friction factor for straight circular pipe.

f - Friction factor for coiled circular pipe. (=fhe)

h<sub>c</sub> - Ratio of friction factor for helical coil and friction

factor for equivalent straight pipe.

g - Acceleration of gravity, ft./sec.<sup>2</sup>

L - Length of test tubing, ft.

m - Mass flow rate, slugs/sec.

n - Number of turns in helix.

Δp - Pressure drop, lbs./ft.2

r - Roughness of tube, microinches.

Re - Reynolds number.

v - Flow velocity, ft./sec.

— Fluid absolute viscosity, slugs/ft.-sec.

ρ - Fluid mass density, slugs/ft.3

#### INTRODUCTION

The use of regenerative cooling in rocket motors has emphasized the lack of experimental data concerning the pressure drop in helical coils. All standard texts in Fluid Mechanics deal at length with pressure drop through straight conduits and pressure drop for flow around bends. The existing data on flow around bends, however, normally covers only bends up to 90 degrees and pipe sizes many times the diameter of the tubing for which information is desired in connection with rocket cooling.

The present investigation was undertaken as the beginning of the detailed collection of information concerning the pressure drop in helical coils in the hope of providing a concrete basis upon which the design engineer could make intelligent estimates of the pressure losses.

An attempt was made to isolate all the variables involved in order to discover quantitatively the factors contributing to the increase in pressure drop in a helical coil over that in a straight tube.

#### EQUIPMENT

In this investigation it was assumed that the pressure drop in a helical coil was some function depending on the length of the tube, L, the inside diameter of the tube,  $d_t$ , the diameter of the helix,  $D_H$ , the inside roughness, r, and the Reynolds number, Re.

The first series of tests was designed to investigate the effects of roughness on pressure drop in a helical coil. To this end, twelve ten foot lengths of stainless steel tubing, one half inch nominal outside diameter, were sandblasted to various inside roughnesses. These tubes were tested straight and then bent into helices of the same diameter and tested at various Reynolds numbers. (See Table I for test configurations). In this manner all of the variables with the exception of r and Re were held as constant as the fabrication technique would allow. As indicated in Table I there was some variation in d<sub>t</sub> because of the fact that the tubes were out of stock and not machined, and some variation in D<sub>H</sub> because of the springback in the helices after they were bent.

The tubes were sandblasted by "The Sandblaster's Studio" of
Los Angeles. A special nozzle was designed by this company for a
hose small enough to fit inside the steel tubing. The hose was inserted through the steel tube and then withdrawn at a steady rate
during the blasting operation. The direction of withdrawal was then
reversed in order to make the roughness as uniform as possible
throughout the length of the tubing. Different size grit was used
for different roughnesses. It was desired to vary the roughness
between the tubes as uniformly as possible from 10 to 100 microinches.

The values obtained, as measured on a profilometer, are listed in Table I. The distribution was not very uniform; however, it was decided to test the specimens anyway, inasmuch as there was an appreciable roughness spread between the smoothest and roughest tube.

The technique for bending the steel tubing into helices was as follows. The inner surface of the tubing was coated with light machine oil and the entire tube was heated in boiling water. The tube was then filled with a molten, low-boiling point metal, "Cerrosafe", while still in the heating bath. After the tube cooled, it was formed by hand into a helix, using a cylinder of the desired diameter for the coiling process. The helix was then emptied of the Cerrosafe by heating with a blowtorch. Remnants of the Cerrosafe were then further removed by a steam jet. The tubes were weighed before and after the coiling operation to insure that no particles of Cerrosafe remained in the helices. There were no evidences of residual Cerrosafe.

The second set of tests was designed to hold roughness constant and to vary the remaining parameters. For these tests a plastic tubing called "Jescolite" was chosen. This tubing had a nominal one-half inch outside diameter and about a 0.05 inch wall thickness. By using the same piece of tubing for the remaining tests the roughness and inside diameter of the tubing were held constant while length, diameter of helix, and Reynolds number were varied. For the purpose of varying helix diameter, five wooden mandrels were constructed of different diameters, each having a one-half inch wide

by one-half inch deep helix cut into them. (Fig. 1). Twenty-five runs were made using the five helix diameters and five different lengths. (See Table II for test configurations).

Before the Jescolite was accepted for use it was statically tested to determine to what extent it would expand under pressure. This was quite an important consideration when it is remembered that pressure loss in a straight conduit is inversely proportional to the product of the hydraulic diameter and the square of the cross sectional area. The tubing was wound in an unsupported helix of four inches diameter and then statically tested up to a pressure of 200 p.s.i. With the pressure at 125 p.s.i. or less the expansion was negligible. The maximum static pressure during the runs was 120 p.s.i. at the upstream end of the tubing. To investigate the distortion in the shape of the tubing due to winding, the ratio of the major and minor axes (assuming the tube to be in the shape of an ellipse) was recorded with no pressure on the four inch helix. This ratio was found to be 1.10. Using this ratio, the error between hydraulic radius of the ellipse and radius of a circle of equal perimeter was computed to be only four tenths of one per cent. With pressure in the Jescolite and with the tubing wound in the helical grooves this error should be even less. Thus the plastic tubing was considered to be circular in cross section and rigid in dimensions throughout the tests.

The inside diameter of the plastic tubing was measured by measuring the outside diameter of a piece of aluminum rod machined to fit snugly in the Jescolite. This dimension was checked at both ends of the tubing after each cut was made and did not vary throughout the tests.

#### PROCEDURE

The test setup is shown schematically in Fig. 2, while photographs of the equipment are shown in Figs. 3, 4, and 5. Standard equipment was used with the exception of the test specimens and the wooden helices previously described. The test fluid was water.

In general, the test procedure was as follows: (1) Establish a flow rate, (2) Measure and record a differential pressure, (3) Simultaneously obtain flow rate by weighing a mass of water during a specific time interval, (4) Measure and record temperature of water. From these recorded data and specimen dimensions, the quantities Re and f<sub>c</sub> were calculated.

Three methods of pressure measurement were used to obtain maximum accuracy over all ranges of pressure drop. The first pressure measurements at low flow rates were made on a ten foot water manometer. Measurements were then shifted to a ten foot mercury manometer. At high rates of flow, above the range of the two manometers, two pressure gauges were used. In all runs, overlapping readings of the pressure measuring devices were made to insure continuity in the data when a shift of instrument was made. In all cases the agreement at the shift point was excellent.

The test procedure was designed to furnish a curve of friction factor, f, versus Re for a straight section of test tubing which could be compared with a curve of  $f_c$  versus Re for the corresponding coiled tube.

In both the steel and the plastic tests it was desired to isolate the pressure drop through the coiled portion of the test specimens in order to obtain greater accuracy in the comparison of results. This required the subtraction of the pressure drop in the straight sections of tubing leading in and out of the coil from the total pressure drop measured. For each steel specimen and for the single plastic specimen a one foot straight length was tested and curves obtained of pressure drop versus mass flow rate. In every helical configuration, both steel and plastic, six inch leads were allowed at each end of the coil for connection to the pressure taps. In the calculations, the pressure drop of the one foot length was subtracted from the total measured pressure drop of the corresponding helical specimen for the same mass flow rate. In subsequent calculations, a new length was used, one foot shorter than the original tap to tap length. In this manner, the end effects of leads and taps were removed. This method is not entirely accurate because the flow pattern in the tested one foot lengths was probably not the same as the flow pattern in the leads during the helical tests. However, the magnitude of the correction was small compared to the overall pressure drop and thus the resultant error would be negligible.

Fach steel sample was run straight before it was coiled, to get the corresponding straight pipe curve. Inasmuch as the same

parison runs were made with the plastic straight. One was made at the beginning and the other after the first reduction in length.

They checked within one per cent.

#### PRESENTATION OF RESULTS

The direct results of the investigation are values of friction factor versus Reynolds number. For the steel tubing, tabulated results are found in Tables III to VIII inclusive. Plotted results for the steel are found in Figs. 6-9. For the plastic test specimens, tabulated data appears in Tables IX to XV inclusive. Figs. 10-19 show the plotted results for the plastic tubing.

The following dimensionless parameters are used in the discussion of the results:

h<sub>c</sub> - Ratio of friction factor for coiled specimen to that of same specimen run straight

 $D_{
m IP}/d_{
m t}$  - Ratio of helix diameter to tube diameter

L/d. - Ratio of length of tube to tube diameter

r/d<sub>t</sub> - Ratio of roughness (microinches) to tube diameter

Re - Reynolds number

The Darcy equation, shown below, was used to calculate f.

$$\Delta p = f \frac{L}{dt} \frac{1}{2} \rho v^2$$

Δp - pressure drop, lbs/ft<sup>2</sup>

f - friction factor, dimensionless

 $L/d_t$  - ratio of length to diameter of tube

/ - mass density of fluid, slugs/cu.ft.

v - velocity, ft/sec.

There was some question as to whether the number of turns in the helical coil should have been used as one of the parameters of the discussion, but it was felt that the use of  $L/d_t$  and  $D_H/d_t$  was more logical and convenient inasmuch as the former parameter appears directly in the Darcy equation. Note, however, that when  $L/d_t$  and  $D_H/d_t$  are given, the number of turns is defined.

References are made throughout the report to curves of f versus Re, for different relative roughnesses, published by Moody (Ref. 1). In this work Moody defines relative roughness as  $\mathcal{E}/d_t$  where  $\mathcal{E}$  is a length proportional to the internal roughness of the pipe. He then correlates this ratio with different types of commercial grade pipes. In this investigation the question of the relation between  $r/d_t$  and  $\mathcal{E}/d_t$  arises. When the steel samples and the plastic tubing were tested straight, it was found that their curves of f versus Re coincided very closely with Moody's curves for a straight pipe where  $r/d_t$  was set equal to  $\mathcal{E}/d_t$ . This fact was used as justification for relating Moody's results to results obtained in this study.

On each curve of f versus Re, for both the steel and the plastic tubing, there appears a plot of  $h_c$  versus Re. A compilation of these curves is shown for the steel in Fig. 20, and for the plastic in Fig. 22.

For the plastic tubing, crossplots of  $h_c$  versus L/d<sub>t</sub> appear in Figs. 23, 24, and 25 for Reynolds numbers of 8,000, 20,000, and 60,000 respectively. Crossplots of  $h_c$  versus  $D_H/d_t$  appear for the plastic in Figs. 26 and 27 for the Reynolds numbers indicated. A compilation of the curves from Figs. 26 and 27 appear in Fig. 28.

#### DISCUSSION

In evaluating the results of this investigation no attempt was made to express any of the variations in analytic form. The relationship of  $\mathbf{h}_{\mathbf{c}}$  with either Re or  $\mathbf{D}_{\mathbf{H}}$  seemed to follow no simple law.

Fig. 20 is a plot of  $h_c$  versus Re for representative values of  $r/d_t$  for the steel coils. Fig. 21 shows a crossplot of  $h_c$  versus  $r/d_t$  for fixed values of Re. Note that in these crossplots and in subsequent ones, the plotted points are used to identify the source of data and not to indicate experimental points.

A study of Fig. 21 indicates that h<sub>c</sub> shows very little dependence on r/d<sub>t</sub> over the range of relative roughnesses covered in this report. No definite statement can be made concerning the trend of the variation because of the scatter of the points. The smoothness of the curves through the original experimental points justifies the belief that the random nature of the points was not caused by errors in pressure measuring technique. It is felt that the eimless distribution was caused by ignorance of the overall physical characteristics of the steel test specimens. Although extreme care was taken in measuring the diameters of the tubing, the measurements could naturally only be taken at the ends of the tubes and no account could be made of the variation of d<sub>t</sub> along the length. Similarly, the profilometer roughness readings were taken on samples cut off the ends of the specimens and had to be taken as representative of the entire tube. The fact that the variation of h<sub>c</sub> with r/d<sub>t</sub> was small can be

somewhat justified by noting that for similar ranges of Re and relative roughnesses, Moody obtained only slight differences of friction factor from that of a smooth straight pipe. It must be borne in mind that the small variation obtained applies only to the narrow limits of this investigation. Again looking at Moody's curves, and assuming that the overall behaviour of the coiled tubes will be generally similar, it can be expected that, for higher values of relative roughness or higher values of Re, the effect of relative roughness on the pressure drop will be more pronounced.

The use of the plastic tubing in the investigation was very effective in cutting down the number of parameters upon which the pressure loss depended. By using the same piece of tubing for the runs involving different helix diameters and different lengths, the factors of relative roughness and tube diameter were held constant. The effects of the remaining three parameters,  $L/d_t$ ,  $D_H/d_t$ , and Re, could then be easily separated.

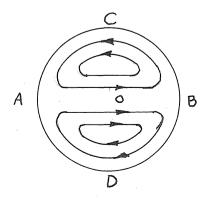
Fig. 22 shows the variation of  $h_{\rm c}$  with Re for the plastic coils. A very distinct minimum was recorded in every case in the Re range between 7,000 and 11,000. There appears to be no obvious explanation for this phenomenon.

Figs. 23. 24, and 25 indicate the variation of  $h_c$  with  $L/d_t$ . The results confirm what might have been suspected; that is, there is no variation of  $h_c$  for different lengths of the same tubing. This linearity of pressure drop with length is the same as is found in straight pipe theory and experiment. This conclusion might be

expected to hold for higher values of L/d, than used in this study, but there is doubt as to its validity for lower values of  $L/d_{_{\pm}}$  which involve a fraction of a turn. It is reasonable to assume that, after a secondary flow has been established in a uniformly coiled tube, it will continue unchanged and that the pressure loss will be linear with length. However, the mechanism of establishing the flow in the first turn or turns is unknown and the probability of a variation of  $h_c$  with  $L/d_t$  in the lower range must be considered. There was a definite limitation to the lower value of  $L/d_{+}$  in this experiment. This was brought about by the technique of removing the end effects as previously described. As the length of the tubing was decreased, the correction factor became a greater and greater percentage of the total pressure drop, thus decreasing the accuracy of the results. A more refined technique for tapping the test specimen itself for static pressure measurement might allow an investigation of the distance required for secondary flow development.

The secondary flow referred to above may be described as follows.

Consider the cross section of a coiled tube.



In the sketch, point "A" is the inside of the turn and point "B" is the outside of the turn. The velocity of the fluid at points "C" and "D" is lower than the velocity at point "O" because of the friction of the walls of the tube. Because the velocities in the center section "OB" are higher than those in the regions "BC" and "BD", the centrifugal force and thus the pressure in region "OB" is higher and the fluid tends to take up a spiral motion from "B" towards "C" and "D". By continuity it then continues to "A" and back up the center. This spiral flow is superimposed on the axial flow.

Figs. 26 and 27 show the results of  $h_c$  vs.  $D_H/d_t$  for various Reynolds numbers. Here again, crossplot points indicate the source of the data and not experimental points. The curves indicating the variation were drawn through the mean of the  $L/d_t$  points. These curves were collected in Fig. 28 to show their relative positions more clearly. For further clarity in emphasizing both the minimum with respect to Re and the observed inflection with respect to  $D_H/d_t$ , a three dimensional plot of  $h_c$  vs.  $D_H/d_t$  and Re is shown in Fig. 29. The widest variation of the points in Figs. 26 and 27 appeared at Re 3,000. This might be expected because of the low flow rates used to obtain this Re. The values of  $\Delta p$  corresponding to the low flow rates were themselves so small that an error in reading the manometer would be a much higher percentage of the total than would be the case at a higher flow rate.

Fig. 28 shows not only the minimum found before with respect to Re, but also indicates an inflection of  $h_c$  with respect to  $D_H/d_t$ . This inflection is not evident in the curves corresponding to Reynolds numbers of 3,000 and 8,000, but is quite clear in the curves drawn for Re 15,000 and higher. The inflection occurs at a value of  $D_H/d_t$  of about 22.5. Hughes and Sefford, (Ref. 2, p. 233), quote some results from experiments by Brightmore, (Ref. 3), in which inflections with respect to  $D_H/d_t$  were found, but at different values of  $D_H/d_t$ . Brightmore's experiments were made with elbows instead of full coils. It is interesting to note that in Fig. 28, for Reynolds numbers of 15,000 and above, there is practically no variation of  $h_c$  with  $D_H/d_t$  values from 20.0 to 28.0.

In Fig. 30 a comparison is made between a plastic coil and two steel coils whose configurations were most nearly the same as the plastic coil. The anomalous result followed that there was a greater pressure drop in the plastic coil than in the steel coil, the latter assumed to be the rougher. A possible explanation, discussed previously with regard to the variation of  $h_c$  with  $r/d_t$ , might lie in the fact that the dimensions of the steel tubing were not known exactly and that the plastic tubing was more uniform in its physical properties than the steel. The agreement between the plastic and the steel was within ten per cent. The inconsistency seen in Fig. 30 coupled with the scatter of points in Fig. 21 seems to indicate that reproducibility of results with the stainless steel tubing technique is poor. On the other hand, all of the results in this experiment

using the plastic tubing are quite consistent. This fact further justifies the use of the plastic tubing in these tests.

It must be remembered that this study covered only a limited field, and thus it is difficult to extend any of the conclusions which were reached. This, of course, suggests further investigation over a wider range of the independent parameters. Other vital concerns of the racket motor designer are the questions of pressure drop in coils of varying  $D_{\rm H}/d_{\rm t}$  which would be found around the throat of a rocket, and pressure drop in helical coils whose cross section is not circular.

### CONCLUSIONS

Recalling that  $h_c = \oint (L/d_t, D_H/d_t, r/d_t, Re)$ , the conclusions reached in this investigation are enumerated below. In each case where  $h_c$  is considered as a function of one of the variables, it is implied that the other variables are held constant.

- l.  $h_{\rm c}$  varies only slightly with  $r/d_{\rm t}$  over the range of  $r/d_{\rm t}$  from 0.00005 to 0.00030, and follows no consistent trend.
- 2. h is independent of  $L/d_t$  over the range of  $L/d_t$  from 77.8 to 628.0.
- 3.  $h_c$  is dependent on Re over the Re range of 3,000 to 100,000 and has a minimum between the Reynolds numbers of 7,000 and 11,000. The position of the minimum moves from the lower to the higher value of Re as  $D_p/d_\pm$  decreases from 31.3 to 10.9.
- 4.  $h_c$  is dependent on  $D_H/d_t$  as the latter parameter varies from 10.9 to 31.3, decreasing generally as  $D_H/d_t$  increases. For values of Re of 15,000 and above, however, an inflection occurs at  $D_H/d_t$  equal to approximately 22.5. After a very slight increase,  $h_c$  begins its downward trend again at  $D_H/d_t$  equal to about 28.0. Over the range of  $D_H/d_t$  from 20.0 to 28.0,  $h_c$  can be considered constant (15,000  $\leq$  Re  $\leq$  100,000).
- 5. The independence of  $h_c$  with  $L/d_t$  can be extended to values of  $L/d_t$  greater than those tested but not to  $L/d_t$  values less than those tested.
  - 6. The plastic tubing, "Jescolite", was found to be quite

satisfactory for use in experiments of this type if caution is used to keep the expansion within allowable limits.

7. The range of roughnesses tested in this study was not great enough to establish the dependence of  ${\bf h}_c$  with  $r/{\bf d}_t.$ 

## REFERENCES

- 1. MOODY, L. F., "Friction Factors for Pipe Flow", Transactions of the A.S.M.E., Vol. 66, November, 1944, pp. 671-684.
- 2. HUGHES, H. J. and SAFFORD, A. T., Hydraulics, rev. edit.,
  MacMillan, 1926.
- 3. BRIGHTMORE, A. W., "Proceedings Institute of Civil Engineers",
  Vol. 169, pp. 315 et seq.

#### BIBLIOGRAPHY

- 1. ADLER, M., "Strömung in gekrämmten Rohren", Zeitschrift Für Angewandte Mathematik und Mechanik, Vol. 14, October, 1934
- 2. BINDER, R. C., Fluid Mechanics, 1st edit., Prentice-Hall, Inc., 1943
- 3. GOLDSTEIN, S., Modern Development in Fluid Dynamics, 1st edit.,
  Oxford at the Clarendon Press, 1938.
- 4. WESKE, J. R., N.A.C.A. Technical Notes #1471, January, 1948.
- 5. WHITE, C. M., "Streamline Flow Through Curved Pipes", Proceedings of the Royal Society of London", Vol. 123, 1929

-20-

## That feel has been I

## DIMENSIONS OF STAINLESS STEEL SPECIMENS

SPECIMEN NUMBER ->	1	2	3	4	5	6
Lan. FT.	7.66	7.69	7.70	7.70	7.70	7.695
dx IN.	.470	.440	.432	.433	. 438	.434
dx FT.	.0367	.0367	.0359	.0358	. 0365	.0361
MICRO/NOMES	2 3.	36.	40.	29.	23,	20
D <sub>rs</sub> FT.	. 590	.590	.590	. 590	,590	,590
Dm/gx	1.6.06	16.06	14.22	14.27	13,75	14.10
L/dx	208.5	209.0	214.0	215.	211	2/3.
m(APPRIX)	Landy	kuf	kumfs	Lufa	Sounfie	L

form approximate of	SPECIMEN NUMBER	7	8	9	10	11	/2
ode meritika en samben	Lucian F. T.	7.68	7.5/5	7.695	7.69	7. 496	7.695
lands of Sand Garden Commission of the	dr IN	.436	. 397	.432	.436	. 437	.433
per antigogen in the contraction of the	dr FT.	.0363	. 0331	.0360	,0363	.0364	.036/
harmonic of 4022 (chambride	J.C. MICROINCAES	3 /.	93	3 <i>0</i> .	24,	21.	62
MATERIAL PROPERTY.	D <sub>H</sub> FT.	.585	,585	.590	.590	.585	,580
Species of the 2009	DH/dr	16.11	15.75	16.39	16.25	16.09	16.08
Province contraction of the cont	L/dx	211.5	227.0	2/3.5	212.	206.	
Oliver State	~ (APPROX.)	+	4	4	4	4	4

TABLE IIa

## PLASTIC TUBE TEST CONFIGURATIONS

MATERIAL PROPERTY.	TEST No.	/	2	3	4		6
Personal Contraction of the Cont	L FT.	24.26	20.2	20.2	20.2	20.2	20.2
the second	dt IN.	0.386	0.386	0.386	0.386	0.386	0.386
- commonstrator - as	dt FT	0.0322	0.0322	0,0322	0.0322	0.0322	0.0322
Periodicus Periodicus	DH FT.	STRAIGHT	1.005	0.84	0,64	0.51	0.35
A CONTRACTOR OF THE PARTY OF TH	PH/de	STRAIGHT	31.3	26.1	21.1	15.86	10.9
St. Capper Str. Lynn, St.	L/dt	754.0	628.0	628.0	628.0	628.0	628.0
-	n (approv)	0	6.5	7.7	9.6	13.0	19.5

Southborness and the state of t	TEST No.	g mana anggagai at the kanana inggan at shanggagai at gagi in thagay na a ya jala in manana a		rojanja ana o jemnikoje rivaka je i gazi se vistanjiho nod	G		//
desir passing canal	L FT.		12.085	12,085	12.085	12.085	12.085
Company of the Contract of the	de in		0.386	0.386	0.386	0.386	0.386
Contraction of the	de FT.		0.0322	0,0322	0.0322	0,0322	0,0322
	DH FT.		1.005	0.84	0.64	0.51	0.35
	DH/dt		313	26.1	21.1	15.86	10.9
	L/d=		37570	37570	3750	375.0	375.0
and the second	n (approx.)		3.7	4.7	5. 7		11.7

T	EST NO.	en kontrologiskopiskopiskopiskopiskopiskopiskopiskop	12	/3	14	15	16
	L FT.	Contract to the second	8.065	8.065	8.06,5	6.065	8,065
The state of the s	de 14.		0.386	0. <i>38</i> 6	0.386	0.386	0.386
	dt FT.		0.0322	0.0322	0.0322	0,6322	0.0322
Service of the service of	DH FT.		1,005	0.84	0.64	0.5%	0.35
and the second	DH/dt		31.3	26.1	21.1	15.86	10.9
	4/dt	ing Thereof is the Attenues Abia accommod a bomber a com-	251.0	251.0	251.0	251.0	257.0
In	(opprox)		2.6	3.0.	4,0	5.1	7.7

PLASTIC TUBE TEST CONFIGURATIONS

Bearing and Comment of the Comment	TEST No.		the second secon	19.	Sonny (b)	Zer 1	yradinig design o en
Contract of the contract of th	Lancon por symm	5.555	5.555	5,555	5.555	5.555	рановинову ст. На тичнования у выд инф тоцироз но - К.
The Contract of the Contract o	dt IN.	0.386	0.386	0.386	0.386	0,386	
officione quipma	dt FT.	0.6322	0.0322	0.0322	0.0322	0.0322	
- ACCEPTATION OF THE PARTY OF T	DH FT.	1.005	0.84	0.64	0,51	0.35	
- Contraction and	DH/dt	31,3	26.1	21.1	15.86	10.9	
Control of the Contro	L/de	172.5	172.5	172.5	172.5	172.5	The state of the s
SC CARGO CONTRACTOR	nlapprox	1.7	2,1	2,6	3.5	5,2	

A CONTRACTOR OF THE PROPERTY O	TEST	No.	22	2.3	24	To Sure	26	
P. Sandalan, among S.	L	FT.	2.505	2.505	2.505	2.505	2,505	
Gridgest Spatished	de	/W.	0,386	0.386	0.386	0.386	0.386	
Brothers Wilders Park	de	FT.	0.0322	0,0372	0.0322	0.0322	0.0322	grans in constitutional Education and in Professional Services
Sharing Street Say of	DH	FT,	1.005	0.84	0.64	0.51	0.35	g.
Andread Report of Charles	DH/d-	t-	31,3	26.1	21.1	15.86	10.9	
and palestocked	L/d+		77.8	77.8	77.8	77.8	77.5	Stranovick on Colonial and the Stranovick of the Colonial Stranovick of the
Section Control	n lapp	rox.)	0.8	1,0	1, 1	1,5	2.2	

-23-TABLE III

## STEEL TUBING TEST RESULTS

	SPE	CIMEN N	le. 1 - 5r	RAIGHT		MEN NO		
	P=1,936	SLUGS 1/	u = 2,21×10	5 3LUGS FF-3EC	P=1.93	7 500GS	p= 2.42	×10-53LVGS FT-5EC
EPOPE POPULAÇÃO DE CARACITA DE	LBS/FT2	m slugs/sec	1	F	1 p 185/FT?	199 31-1165/5EC	Re	×10 SLUGS. FT-SEC fhe
mand Common and		0.00219	i .	0.0416	11.7	0.00176	2,525	0.0778
identification of	15.9	0.00292	4,590	0.0387	29.6	0.00341	4,890	0.0524
- Annual Control	31.2	0.00424	6,660	0.0361	42.3	0.60436	6,250	0.0458
-	43.2	0.00511	8,040	0.0341	55.5	0.00523	7,500	0.0418
	102.0	0.00845	13,250	0.0297	93.4	0.00712	10,220	0.0378
and the special series	226.0	0.0133	20,900	0.0263	224.5	0.0114	16,370	0.0355
-	3 74.0	0.0176	27,700	0.0249	406.0	0.0158	22,750	0.0333
- Tanana	627.0	0.0238	37,400	0.0229	677.0	0.0212	30,400	0.0310
- Contraction of the Contraction	1148.0	0.0337	52,900	0.0209	1297.0	0.0302		0.0294
estaturates disc	2990.0	0.0578	90,900	0.0185	2385.0	0.0423	60,700	0.0275
	5290.0	0.0791	124,100	0.0175	5370.0	0.0665	95,300	0.0250
Part (Percental) (Co. A.)	6640.0	0.0894	140,400	0.0172	7420,0	0.0784	112,300	0.0248

٠,	and the second s	***************************************					CONTRACTOR OF THE PROPERTY OF		
-	SPEC	IMEN N	10.2-ST	RAIGHT	SPECIMEN No. 2 - COILED				
	P=1,936	5LUGS FT3 )/	L= 2.2/×/0	55 51065 FT-SEC	P=1,937 56065 ; H = 2,325 × 10 5 3665 FT-5EC				
e) andere (displaying the W		M SLUGS/SEC	Re	F	AP LBS/FT2	sives/sec	Re	fhe	
		0.00301		0.0408	1	0.00272	4,060	0.0568	
	27.	0.00389	6,110	0,0368	131.8	0.00867	12,920	0.0362.	
-	42.7	0.00504	7,890	0.0348	420.0	0.0165	24,660	0.0317	
The second second	53,1	0.00576	9,040	0.0328	838,0	0.0243	36,200	0.0293	
	92.3	0.00798	12,530	0.0298	2490,0	0.0448	66,800	0.0256	
	20110	0.01248	19,620	0.0265	5010.0	0.0659	98,200	0.0238	
	354.0	0.0172	27,100	0.0244					
	616,0	0.0236	37,100	0.0277					
	1144.0	0.0333	52,400	0.0212			hare <u>sellukitationsus (musik</u> usit <u>suu Miteset</u> tausitausitation)	and the second	
	2075.0	0.0473	74,500	0.0190	A CONTRACTOR OF THE PROPERTY O	garanara ana animah gang ay 17.77 kabupatan makasi kemena kabupatan ka	TOTAL COLVER TO THE STATE OF TH		
	4340.0	0,0713	112,000	0.0176	elle sol un vitta ergunaturische zeite "deutschreiben einzumengezeiten.	Constitution of the Consti	enter 150°0 en European propriet Palante en European en European en European en European Euro	english with compact that the compact to the compact that the compact to the comp	
		0.0790	1	0,0170			na combabble të Shringishi në shringishi në shringishi ka	lagacy on principle of the design of the following products as the control of the	

## TABLE IV STEEL TUBING TEST RESULTS

				SPECIMEN No. 3 - COILED			
P=1.936	54U675	H= 2,21×10	STLUGS ET-SEC	P= 1.937	54.00 S	U = 2,325	×16 336065
AP LBS/FT2	5WG3/5EC	Re	F	165/FT2	sivers/sec	Re	Fhe
Commence of the Commence of th	0.00316		0.0377	1	0.00204		0.0616
32.7	0.004/3	6,580	0.0362	30.6	0.00339	55/50	0.0498
44.1	0.00484	7,750	0.0353	55.0	0.00505	7,720	0,0402
87.4	0.00728	11,660	0.0309	93,9	0.00687	10,480	0.0373
214.0	0.01232	19,750	0.0263	428.0	0.0159	24,200	0.0317
376.0	0.0169	27,100	0,0245	1267.0	0.0291	44,400	0.0280
646.0	0.0229	36,700	0,0231	2355.0	0.0412	62,800	0.0260
1183.0	0.0325	52,100	0.0210	7660,0	0.0783	119,400	0.0234
2140.0	0.0457	73,100	0.0192	Control of the Contro			a management of the state of th
4510.0	0.0693	110,800	0.0176				
5650.0	0.0793	126,800	0.0168				
	iging commence complete the first handle could a proof of the first country to the reservation in a second country to the coun	المنطق المنط والمنطق المنطق المنطق والمنطق المنطق الم	To the second se	e gegettermingen som det ste et et en ste et en st Ste et en ste et en		ga muura aannan oo	

	SPECIA	YEN NO.	4 - STR	416147	SPECI	MEN NO	6.4-G	1 ha 6 ha
-	P=1.956	SLUGS /	L=2.21×10	FT-SEC	P=1.937	SLUGS ;/	4-2,325	10 SLUGS
***************************************	1 p LBS/=T2	M SLUGS/SEC	Re	F	AP LBS/FT2	SLUGS/SEC	Re	fhe
-		0.00237		0.04-16		0.00179		0.0759
	26,2	0.00387	6,170	0.0332	28.7	0.00332	5,040	0.0495
-	38.7	0.00469	7,360	0.0346	63,4	0,00559	8,470	0.0386
	52,4	0.00553	8,810	0.0326	99.6	0.00724	10,950	0,0362
	81.8	0.00715	11,460	0.0305	330.0	0.0140	21,200	0.0322
The second second	208.0	0.0119	18,970	0.0280	1260.0	0.0296	44,900	0.0273
· · · · · · · · · · · · · · · · · · ·	344.0	0.0165	26,300	0.0241	45400	0.0605	91,800	0.0236
	630,0	0.0230	36,600	0,0228	7360,0	0.0782	118,600	0,0229
	1180.0	0.0341	54,400	0.0194		The second of the second secon		a and origin consequently
	2150.0	0.0466	74,300	0.0189				
	4480.0	0.0700	111,700	0.0174				Charles and showed parts and the charge transport
	5570.0	0.0786	125,400	0.0172		The state of the s	E CONTRACTOR CONTRACTO	

# TABLE IL STEEL TUBING TEST RESULTS

					SPECIMEN No. 5- COLLED				
P=	1,936	SLUGS j	L=2,325	×10 31.065 FT-586	P=1.937 SLUGS ; /1 = 2.325-10 SLUGS FT3 ; /1 = 2.325-10 SLUGS				
LBS	1 p	m 51095/5€€	Re	fu	AP LBS/FT2	m swaspec	Re	fhe	
1		0.ccz84		0.0390		0.00191		0.0794	
3	36.6	0.00447	6,700	0,0368	32.6	0,00358	5,300	0,05/3	
7	79,5	0.00733	10,990	0.0299	50.8	0.00497	7,440	0.04-14	
3	89,0	0.6178	26,600	0.0198	94.6	0.00720	10,780	0.0369	
11	63.0	010335	50,100	0.0209	411.0	0,0161	24,050	0.0321	
49	110.0	0.0736	110,300	0.0182	1267.0	0,0303	45,400	0.0278	
					233570	0.0422	63,200	0.0264	
		7			7225.0	0.0787	117,800	0,0235	
		- MANUFACTURE OF THE STATE OF T						Company of the compan	
- Whatermouter	TOTAL THE STATE OF	AND THE RESIDENCE AND THE PARTY OF THE PARTY			South the second		egyegyőzőkédőköntérhedődák –ki Podymant O'Ardos az k		
And bearing the state of the st		and the same	place value of the state of the	AT BOOK OF THE STATE OF THE STA	The second secon	And a street of the street of			
							The second secon	20 MANAGEMENT 12 WITTE No. 66 Tax Section 12 Tax	

SPECIMEN NO. 6 - STRAIGHT SPECIMEN	1 No. 6-61000
P=1.937 SLU45 ; h= 2.42×10 SLU45 P=1.937 SLUG.	5; fr=2.325×16 51165
AP M Re F AP M LBS/FT2 SLUGS/SEE Re F LBS/F72 SLUGS	ske Re the
16.0 0.00277 4,040 0.0399 13.9 0.00	
33.4 0.00426 6,200 0.0354 31.9 0.00	388 5,860 0.0408
88.3 0.00734 10,680 0.0315 51.0 0.00	501 7,570 0,0391
333.0 0.0158 23,100 0.0254 92.9 0.00	697 10,510 0.0367
1138.0 0.0337 49,100 0.0193 426.0 0.01	61 24,400 0,0314
5/40.0 0.0736 107,200 0.0/82 1274.0 0.02	97 44,800 0.0278
2370.00.04	117 63,000 0.0261
7600.0 0.07	780 117,800 0.0240
The second secon	and an angular part of the court of the property of the court of the c
The second distance of	
	na wakiliwani kata a galaya esha ayanga aktif baga kata baka a salah falamaka da baka 2000 kili 2000 kili baka

## TABLE VI

## STEEL TUBING TEST RESULTS

and the second	SPEC	IMEN 1	Vo. 7- 5	RAIGHT	SPECIMEN No. 7 - COILED				
	P=1,937.	51065 FT3 1/	U=2,42×	10 3LUGS FT-3EC	P=1,937 50065 , LL = 2,325 × 10 5 5006.				
	AP LBS/FT2	ห้า ระบรร/ระ	Re	-fran	ABS/FT2	ระบลร/ระอ	Re	f he	
	12.4	0.00234	3,390	0.0449	10.9	0.00157	2,360	0.0875	
	46.2	0.00501	7,240	0.0365	32.2	0.00361	5,430	0.0489	
	97.9	0.00 775	11,190	0,0322	49,4	0.00485	7,290	0,0415	
	346.0	0.01597	23,100	0.0269	434.0	0.0165	24,750	0.0316	
	1315.0	0.0353	51,100	0,0209	1272.0	0.0300	45,200	0.0279	
	4970.0	0.0737	106,500	0.0182	2335.0	0.0418	62,800	0.0265	
					5380.0	0,0664	99,800	0.0241	
					7350.0	0.0781	117,200	0.0239	
			of the same of the same and the						
-		Policial						Account of the control of the contro	
Page Wassacakier			200 mm - 200	manananan kelebah kelanti dan kelanti d	A CONTRACTOR OF THE PROPERTY O	former invocation philosophistic collections of		The form to the property of the second secon	
- Lance		And the second s							

			-	-	Kanada kanada mada kanada k	Matingan despitation in process and a surface of the con-	allerina and the same and the same of the	
SPEC	IHEN N	lo. 8 - 57	KAIG HT	SPECT	MEN NO	B-6,	1250	
P=1.936	5LU45 ; h	.= 2.325×1	O SLUGS FT-SEC	P=1.937 SLUGS ; h= 2.35 × 10 536465				
	SLUGS/SEC							
	0,00263			13,5			0,0810	
30.5	0,00317	5,250	0.0380	25,2	0.00230		0.0573	
42.7	0.00384	6,370	0.0364	18	0.00295	4,830	0.0513	
56.9	0,00462		0.0334	56.2	0,00406		0,0426	
93.6	0.00613	10,160	0.0312	97.3	0,00571	9,300	0.0377	
228.0	0,0102	16,990	0.0272	221.0	0.00894		0.0347	
383,0	0.0138	)	010250				0,0319	
637.0	0,0184	30,550	0,0235	681,0	0.0168	1	0.0303	
12.54.0	0.0272	45,100	0.02/2	1358.0	0.0244	39,800	0.0277	
2390,0	0.0391			2490,0	I manufacture the second secon	55,600	0.0270	
4740.0	0,0575		1	4710.0	*	79,100	0.0246	
8070.0	0.0771		Assessment and the contract of	7360,0	Area con a series of the serie	101,600	0.0239	
			1	1	0.0717	į.	0.0229	

# TABLE VIII STEEL TUBING TEST RESULTS

· Comments	SPEC	IMEN 1	10:9-57	RAIGHT	SPECIMEN No. 9-COILED				
	P=1,937	52.045 pet3 1/	W= 2.45=	10 53LUGS	P=1.937	51.11/95 PT 3 )	16=2.29	FT - 5 FT	
	4 /2 / LB5/FT2	5LU65/55C	R	4	AP LBS/FT2	swas/sec	Re	fle	
	14.8	0,00259	3,730	0.0417	16.9	0.00227	3,500	0.0616	
2.	47.2	0.00505	7,270	0.0349	31:4	0,00351	5,420	0,0478	
0.0000000000000000000000000000000000000	96.8	0.00760	10,930	0.0316	55.2	0.00.516	7,970	0,0389	
And and an arrange	308.0	0.01486	21,400	0.0263	128.4	0.00828	12,810	0,0351	
1	1220.0	0.0329	47,400	0.02/2	402.0	0.0156	24,000	0,0312	
- Political	4670.0	0.0695	100,000	0.0182	1284,0	0.0296	45,700	0.0275	
,					2310.0	0.0410	63,200	0,0258	
			TOTAL CONTRACTOR CONTR	TABLE STREET, MANAGES INC.	5590,0	0.0667	103,100	0,0235	
						-			
			The state of the s		A STATE OF THE PROPERTY OF THE	The second secon	der Armen der Der gegengerigt, sie zie zie gelaust Auffügsseich zu der		

-		and the second s	and the second s	· ·	ngo musika apakata kasasa kata maka karasa ka	with the second control of the second contro	as Subustinian and Proceedings of the State	
	SPEC	MEN X	10. 10-ST	RAIGHT	SPECIMEN No. 10 - COILED			
P	-1,937	SLUGS .	4=2.45=1	0 51065 FT-5EC	P=1.936 SLUGS; h=2.25×10 SLUGS FT= SEC Ap m/s Re fhe			
LB	4 p 5/FT2	M SLUGS/SEC	Re	+ F	Ap LBS/FT2	SLUAS/SEC	Re	fhe
			4,560			0.00221		0.0624
	59.5	0.00580	8,260	0.0344	31.1	0,00366	5,700	0,0457
/	109,5	0.00834	11,860	0.0312	5516	0,00535	8,330	0.0383
3	64.0	0.0167	23,850	0.0258	123,1	0.00831	12,940	0.0352
12	220,0	0.0330	47,100	0.0221	384,5	0.0155	24,100	0.0316
4	680.0	0.0715	102,000	0.0182	12430	0.0295	46,000	0,0281
					22850	0.0416	64,800	0.0260
-contra	e nemonana anno ana marina	Provincial and construction construction of the pro-			5530,0	0.0674	105,000	0,0239
Transmitted De								
10.52090	E No. in such that the comment of th		The state of the s		AND THE BOOK AND	a majorita suma minera mana mana mana mana mana mana mana ma		
					December of the property of the second	Section Control of the Section	THE REAL PROPERTY OF THE PROPE	
	-	Supplied (Charles)	- And and a second a second and					

## TABLE VIII STEEL TUBING TEST RESULTS

SPECI	YEN No.	11-5TA		SPECIMEN No. 11-COILED				
P=1.937	SLUGS )	pr=2,47%	10 31.065 FT-36C	P=1.936 SLUGS ; /L=2.375=10 SLUGS				
1 / LB5/FT2	52063/SEC	Re	- Arresi	AP LBS/FT2	ni swaspse	Re	fhe "	
1 .	0.00328			15.5	0.00225	3,380	0,6625	
63.0	0.00615	8,690	0:0340	28.9	0.00347	5,220	0,0490	
111.3	0.00867	12,250	0.0302	54.9	0.00537	8,690	0,0387	
358,0	0.0172	24,300	0.0248	126.9	0.00860	12,910	0.0350	
1235.0	0.0350	49,500	0.0205	399,0	0.0162	24,300	0.03/1	
4620.0	0.0730	103,100	0.0178	1279,0	0,0309	46,500	0.0272	
				2305,0	0.0428	64,400	0.0256	
and the same of th				5370.0	0.0681	102,400	0,0236	
				7210.0	0.0791	119,000	0.0234	
				A CONTRACTOR OF THE PARTY OF TH	A STATE OF THE PARTY OF THE PAR	And the second s	gger er von der wie eine die gehalt der die die der der der der der der der der der de	
	The control of the state of the control of the control of the state of	Gammania gammania ang mangalan ang ang ang ang ang ang ang ang ang a	and the second of the second o		And the second s	and and the second		
	THE RESERVE AND A STATE OF THE PARTY OF THE		Bahwari accessorbarrasuatis (ascentity mayor Ranso	The second secon				

		MEN NO							
	P=1.936	SLUGS j	4=2,325	10 Stables Free Stables	P=1,937_56045 / 16=2,37 56045				
	Ab LBS/FT2	SLUGS/SEC	Re	£	AP LBS/FT2	ทำ รเบคร/รฮ	Re	FAC	
-		0.00389		0.0371	17,6	0.00216	3,210	0.0715	
-	46.2	0.00510	7,720	0,0339	32.3	0.00362	5,410	0.0466	
-	86.1	0.00722	10,920	0.0314	48.4	0,00474	7,080	0.0406	
-	218.5	0.0126	19,130	0.0261	86.0	0.00676	10,100	0,0356	
deline and the same	366.0	0.0169	25,600	0.0244	207.0	0,0108	16,120	0.0335	
	612.0	0,0226	34,400	0.0227	425,0	0.0160	23,850	0,03 KL	
	1.178.0	0.0328	49,700	0.0208	658.0	0.0204	30,400	0.0299	
	2/50,0	0,0465	70,500	0,0188	1261.0	0.0293	43,800	0.0277	
	4490.0	0.0695	105,200	0,0176	2340,0	0.0414	61,800	0.0258	
	6340.0	0.0838	126,800	0.0171	4300.0	0.0578	86,400	0,0242	
	And the Control of th		The second secon	Alle Sules and the Committee of the Sules Sules and Sule	5670.0	0.0675	100,900	0.0234	
		Control of the Contro		and the second seco	mercegan Chapter Size Lander Art 2 College		erryge generalistic derrees. The commission between		

# TABLE IX PLASTIC TEST RESULTS

	TEST	No. 1		TEST No. 2				
P= 1.93	7 510G5 F7 3	; µ= 2.9	12×10 5LOG	P=1.936	51065 ; M	= 2.735	10-5 52 U4S 157-560 fho	
1/5 135/FT2	ћ 51.045/sEC	Re	f	LBS/FT 2	ที่ก 5LL45/5EC	Re	f ho	
49.8	0.00196	3,220	0.0436	50.7	0.00182	3,230	0.0621	
64.6	0.00222	3,640	0.0433	7.4.4	0.60247	4,380	0.0494	
	0.00258	22200 1200 1000 1000 1000 1000 1000 100	0.0418	110,6	0.00328		0.0416	
1	0.00307	5,010	0.0397	210.5	0.00483	8,550	0.0367	
245.0	0.00483	7,920	0.0353	474.0	0.00742	13,150	0.0348	
499.0	0.00734	12,030	0.0311	718.0	0.00927	16,450	0.0339	
622.0	0.00823	13,450	0.0310	1505.0	0,0139-	24,700	0.0312	
916.0	0.01040	17,040	0.0285	3035,0	0.0206	36,600	0.0289	
1820.0	0.01552	25,500	0,0253	5480.0	0,0290	51,400	0.0264	
3610.0	0.0233	38,200	0.0223	1-68800	0.0333	59,100	0.0251	
5820.0	0.0312	51,100	0.0201			The state of the s		
						E CONTROL CONT		

		THE STATE OF THE S		riget Procurement, anning my and record recitation (Madel Market States of	a production of a test of the contract of the	the form the property of the first person of the contract of the property of the first person of the first	Specification of the second second second second second
	TEST N	6, 3	The state of the s		TEST No	. 4	
P=1.937	51.065 ; M	= 2.335=1	6 SLUGS FT-SEC	P=1.937	51.065 ; H	= 2.335×1	6-5 SLU(15) FT-36C
1 LBS/FT 2	199 5445/5EC	R	the	Ap LBS/FTZ	m 3LUG5/SEC	Re	Fhe
	0.00232		0.0590	48.6	0.00164	2,790	0.0729
117.8	0.00312	5,310	0.0488	74.4	0.00218	3,695	0.6638
224.5	0.00475	8,0 <i>50</i>	0.0404	106.9	0.00288	4,890	0.0525
455.0	0.00689	11,680	0.0390	211.5	0.00459	7,800	0.0399
744.0	0.00900	15,280	0.0373	494.0	0,00742	12,600	0.0365
1463.0	0.01309	22,200	0.0347	761.0	0.00935	15,850	0.0355
2940.0	0.0194	32,900	0.0318	1450.0	0.0132		0.0335
5120.0	0.0266	45,200	0.0293	2930.0	0.0196	33,300	0.0309
6540.C	0.6310	52,700	0.0276	5260.0	0,0270	45,900	0.0292
		And the second s		6670.0	0,0309	52,500	0.0283
Service of Service Ser	angeres, again shake milata 1977 to 1974 to 19	The second of th	Marco Tal Care Character per a specie carbonic al cis none Sis	gaggar managar sa umusa (jinakilita citti, a suna citti kitari finna B			
		The second secon			Address of the Control of the Contro		

# -30-TABLE X

## PLASTIC TEST RESULTS

	TEST A	Vo. 5		negative and the second	. 7557	No. 6	Part of the state	
P=1.937	5LUGS ) /	U=2.335×	10 5 32.065 FT-SEC	P=1,9375LUGS; \( \mu = 2.335 \times 10^5 3LUGS \\ \mu \tag{FT.3} \\ \mu \tag{FT.5RC}				
185 185 1872	sings slugs sec	Re	fhc	AP LBS/FT2	100 5 / SEU 65/ SEC	Re	fhe	
1	0.00210	3,565	0.0705	138,9	0.00264	4480	0.0809	
113.4	0.00282	4,790	0.0580	221.0	0.00424	7,200	0.0500	
203.0	0.00420	7,130	0.0468	537.0	0.00701	11,910	0.0443	
448.0	0.00675	11,460	0.0400	800.0	0.00884	15,020	0.0416	
752.0	0.00896	15, Z10	0.0380	1475.0	0.0126	21,460	0.0375	
1480.0	0.0130	22,100	0.0356	2957.0	0.0183	31,100	0.0358	
2950.0	0.0192	32,500	0,0327	5300.0	0.0254	43,000	0.0336	
5250.0	0.0264	44,800	0.0306	6725.0	0.0290	49,200	0.0325	
6690.0	0.0302	51,300	0.0298					
		\$45 P. S.						
							The state of the s	
	gamman menenementen kalanda kendulan di kendulan da selembah di kelebah di kelebah di kelebah di kelebah di ke Berapakan di kelebah d Berapakan di kelebah d		er og en					

		وراء والمراجعة و	en ar en handrier er en	Agricio de Anglairo de Antonio de	name product in a subsequent programme and the second process region.	The transfer of the second se		
	TEST A	10. 7			TEST 1	Vo. 8	The state of the s	
P=1.937	SLUGS it	1:2.29×10	FT-SEC	P=1.937 SLUGS; $\mu = 2.29 \times 10^{-5} \text{ SLUG}$ $F73$ ; $\mu = 2.29 \times 10^{-5} \text{ SLUG}$ $AP_{LBS/F7} = \frac{\hat{S}}{5000}  _{SEC}$ Re fhe				
AP LB3/F72	SLUGS/SEC	Re	fhe	183/FT2	SLUGS/SEC	Re	fhe	
	0.00103				0.00111	1,923	0.0934	
1	0.00190		0.0621	A	0.00208	3,610	0.0607	
1 . 1	0.00240		0.0526		0.00244	4,220	0.0564	
4	0,00302		0.0450	62.4	0.00291	5,040	0.0499	
115.1	0.00451	7,800	0,0385	116,9	0.00448	7,750	0.0395	
255.0	0.00689	11,910	0.0365	265,0	0.00689	11,910	0.0380	
464.0	0.00946	16,380	0.0352	Special section and an experience of the second section and the section and the second section and the	0,00926	16,010	0.0366	
	0.0121	20,900	0.0336	1	0.0119		0.03.51	
1390.0	0.0176	30,400	0.0305	1400.0	0.0171	29,500	0.0327	
2630.0	0.0248	42,900	0.0291	2600.0	0.0740	41,700	0.0305	
A CONTRACTOR OF THE PROPERTY O	0.0351	60,800	0.0268	4710.0	c.c336	58,000	0.0284	
6450.0	0.0412	71,400	0.0258	6410.0	0.0401	2	0.0271	

## TABLE XI

## PLASTIC TEST RESULTS

/EST /	Vo. 9		TEST No. 10					
P=1.937 SLUGS;	M=2.29x	15 SLUGS FTSEC	TEST No. 10 P=1.937 SLUGS ; μ= 2.29×10 SLUGS FT-SEC					
165/FT 2 SLUGS/SEC	Re	fhc	LBS/FT2	seum/sec	Re	fhc		
20.3 0.60124		0.0900	21.1	0.00124	2,140	0.0937		
42.4 0.00209	3,620	0.0659	45.9	0.00215	3,730	0,0672		
52.5 0.00250	4,320	0.0571	57.9	0.00253	4,380	0.0613		
72.1 0.00312	5,400	0.0504	79.5	0:00316	5,470	0.0542		
132.1 0.00455	7,270	0.0434	141.7	0.00467	8,090	0.0440		
270.0 0.00693	12,000	0.0381	277.0	0.00673	11,610	0.0417		
452.00.00914	15,800	0.0368	January and the second second second	0.60889	15,400	0.0396		
740.00.0119	20,650	0.0352	766.0	0.0119	20,600	0.0366		
1400.0 0.0171	29,500	0.0326	1460,0	0.0171	29,500	0.034/		
2687.0 0.0246	42,500	0.0302	2690,0	0.0241	41,700	0.0315		
4675.0 0.0336	58,200	0.0280	4710.0	0.0331	57,200	10.0292		
6340,0 0.0401	69,400	0.0268	6460.0	0.0396	68,500	0.0280		

TEST No. 11				TEST NO. 12			
P=1.937	SLUGS ;	M= 2.285	×10 536065 FTSEC	P=1.937_	51063 jpl	= 2.29 × 10	FTSEC
LBS/FT2	SLUGS/SEC	Re	fhc	135/FTZ	SLUGS/SE	Re	fhe
17.8	0.000998	1,730	0.122	1	0.00/38	2,395	
5	0.00194	,	0.0836	31.7	0,00852	4,360	0.0506
56.9	0.00227	3,940	0.0746	39.9	0,00298	5,150	0.0457
72.0	0.00265	4,590	0.0696	50.0	0.00349	6,040	0.0417
124.8	0.00388	6,730	0.0562	100.0	0.00522	9,025	0.0373
269.0	0.00624	10,790	0.0472	225.5	0.00807	13,980	0.0351
	0.00870	15,070	0.0431	443,0	0.0116	20,150	0.0333
1	0.0109		0.0413	7	0,0148	25,700	0.0318
	0.0160	27,800	0.0379	1330.0	0.0214	37,000	0.0296
Section of the second section of the section of the second section of the section of the second section of the	0.0226	T	0.0350	ACTION MANAGEMENT OF THE PROPERTY OF THE PROPE	0.0305	52,800	0.0272
	0.0315		0,0326	4450,0	0.0424	73,300	0.0253
6520.0	0.0376	65,300	0.0313	6080.0	0.0508	\$ ·	0.0240

PLASTIC TEST RESULTS

TEST No. 13				TEST No. 14				
P=1,937 5LUGS; H= 2.29×10 5SLUGS FT-SEC				P=1.937 3665; H= 2.25×10 5 5665				
4 p LB5/FT2	m SLUGS/SEC	Re	fhc	Ab LBS/FT2	TLUGS/SEC	Re	fhe	
	0.00156		0.0728	1	0.00/06		0.0814	
27.6	0.00215	3,720	0.0608	183	0.00164	2,880	0.0695	
38.8	0.00278	4,800	0.0512	25.8	0.00204	3,585	0,0633	
77.2	0.00444	7,690	0.0398	37.6	0.00266	4,680	0.0541	
187.7	0.00714	12,340	0.0375	77.5	0.00444	7,800	0.6400	
330.5	0,00969	16,750	0.0358	188,0	0.00720	12,660	0,0369	
581.0	0.0132	22,900	0.0284	566.0	0.0131	23,000	0,0336	
1083.0	0.0187	32,400	0.0315	11280	0.0193	33,900	0.0308	
1995.0	0.0264	45,600	0.0292	2004.0	0.0266	46,760	0.0289	
4390.0	0.0402	69,600	0.0276	4190.0	0,0405	71,300	0,0259	
6040.0	0.0495	85,600	0.0250	6040.0	0.0497	87,400	0.0249	
						gergere en		

		-		ragge or a first contract resource and a second of the contract of the contrac		ranti (managara angaran na arawa kangapangan) ya sistembala ngaraka nga	t Name a 1998 (Salan Salan Sa
TEST No 15				TEST No. 16			
TEST NO 15 P=1.937 SLUGS FT3; M= 2.285×10-5 SLUGS FT-SEC				P=1.936 SLUGS; H=2.22×10 SLUGS			
LBS/FT2	m SLUGS/SEC	Re		Ab LBS/FT2	m SLUGS/SEC		fhe
8.6	0.00089	1,540	0.112	16.7	0.00/08	A STATE OF THE PROPERTY OF THE PARTY OF THE	0.145
18.1	0.00152	2,640	0.0793		0.00147		0,0949
30.4	0.00216	3,740	0.0664	28.0	0.00184	3,300	0.0838
39.4	0.00259	4,500	0.0597		0.00230		0.0736
75.2	0.00406		0.0464		0.00381	6,820	0.0552
190.0	0.00700	12,110	0.0396	191.0	0.00663	11,860	0.0441
335.5	0.00952	16,500	0.0378	333.0	0.00893	15,960	0.0426
566.0	0.0128	22,100	0,0354	580.0	0.0124	22,300	0.0381
1150.0	0.0189	32,800	0.0328	1125.0	0.0178	31,900	0.0360
2010.0	0.0259	45,000	0.0304	2030.0	0.0249	44,600	0.0335
4260.0	0.0396	65,600	0.0276	Control of the second of the s	0.0378	67,700	0.0304
6050.0	0.0485	84,000	0.0262	6120.0	0.0467	83,500	0.0286

# TABLE XIII

	TEST	No. 17			TEST	No. 18	
P=1.936	SLUGS 3/	L = 2.25×10	5-5-51.065 FT-SEC	P=1,936	51.045 ; L	= 2.24×10	5 36665 FT-386
4/2 435/FT2	in swas/sec	Re	fhe	Ab LOSS/FT2	ห์ 3LV6S/SEC	Re	the
9.3	0.00135	2,390	0.0754	9.6	0,00135		0.0784
16.9	0.00206	3,630	0.0591	16.2	0.00191	3,380	0.0658
25.1	0.00280	4,940	0.0473	26.9	0.00269	4,750	0.0550
34.0	0.00347	6,120	0.0417	35.8	0.00354	6,250	0.0423
69.4	0.06527	9,310	0.0368	71.0	0.00519	9,175	0.0390
180.1	0.00871	15,390	0.0351	185.2	0,00860	15,210	0.0370
303.0	0.0116	20,300	0.0337	315.5	0.01153	20,430	0.0349
550.0	0.0163	28,600	0.0308	545.5	0.01578	27,900	0.0324
1036.0	0.0228	40,100	0.0296	1059.0	0.0226	39,980	0.0306
1880.0	0.0320	56,400	0.0272	1898.0	0.0314	55,500	0.0284
4/20.0	0.0501	88,400	0.0242	4/35.0	0.0505	89,200	0.0240
5630.0	0.0578	105,500	0.0232	5710.0	0.0590	104,200	0.0243

and the state of t	TEST	No. 19			TEST	No. 20	2.
P=1.936	56.065 ; pe	.= 2.25×10	555465 FF7-5EC	P=1.936	52065 ; f	c= 2,72×1	55665 FT-366
ABS/FTZ	# FT3 ; /u m SLUGS/SEC	Re	Fhe	LBS/FT2	SLUG 3/SEC	Re	fha
	0.00125		0.0900	11.7	0.00115	}	
16.2	0.00186	3,270	0.0693	18.2	0.00182	2,960	0.0971
27.6	0.00277	4,870	0.0532	26.9	0.00255	4,540	0.0611
35.8	0.00355	5,890	0.0473	36.8	0.00317	5,650	0.0542
69.9	0.00511	9,000	0,0396	73.0	0.00502	8,950	0.0427
191,5	0.00875	15,400	0-0370	189.3	0.00854	15,200	0.0384
315.5	0.0116	20,400	0.0346	312.5	0.0113	20,050	0.0364
536.0	0.0156	27,350	0,0328	527.0	0.0150		0.0344
1044.0	0.0225	39,600	0.0306	1060,0	0.0222	<b>?</b>	0.0318
1909.0	0.0316	55,600	0.0282	1923,0	0.6311	55,400	0.0294
4160.0	0.0496	87,400	0.0249	4205.0	0.0483	86,000	0.0267
5720.0	0.0595	104,700	0.0240	5720.0	0.0579	103000	0.0252

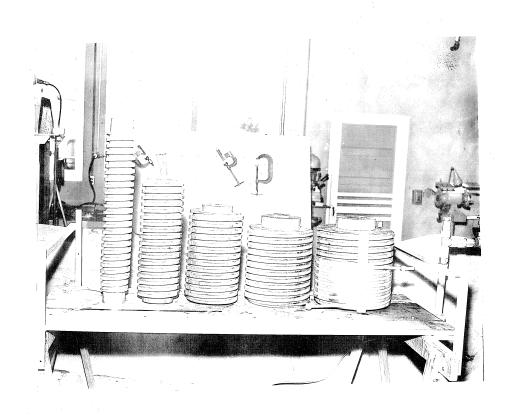
## TABLE XIV

	TEST	No. 2,	/ .		TEST		
P=1.9365	1095 ; M	= 2.25×10	5 5 LUGS FT-56C	P=1.936	51.063 j	4. m. 2. 2 2. x.	10 536.0 GG FT- SEC
AP LBS/FTZ	1063 ; fl 54065/sec	Re	fhe	LBS/FT2	1045 1/ 1/ 1/ 1/ 1/ 1/ 1/ 1/ 1/ 1/ 1/ 1/ 1/	Re	the
13.0	1		0.0960		1		0.0694
18.9	0.00182	3,210	0.0839	9,7	0,00251	4,490	0.0502
30:0	0.00255	4,490	0.0682	12.6	0,00305	5,450	0.0442
38,4	0,00304	5,350	0,0616	25.2	0,00464	8,290	0.0384
73.8	0.00467	8,210	0.0500	67.3	0.00776	13,880	0.0366
190.0	0.00811	14,280	0.0426	111.1	0.0103	18,370	0,0345
311.0	0.0107	18,880	0,0400	218.5	0.0148	26,400	0.0328
549.0	0.0147	25,920	0,0374	386.0	0.0203	36,300	0,0306
1089.0	0.0215	37,800	0.0348	700.0	0.0283	50,600	0.0286
1925.0	0.0297	52,300	0.0322	1465,0	0.0433	77,300	0.0257
4260.0	0.0466	82,000	0.0290	3690.0	0.0735	131,200	0.0224
5810.0	0.0560	98,400	0.0274			and the state of t	

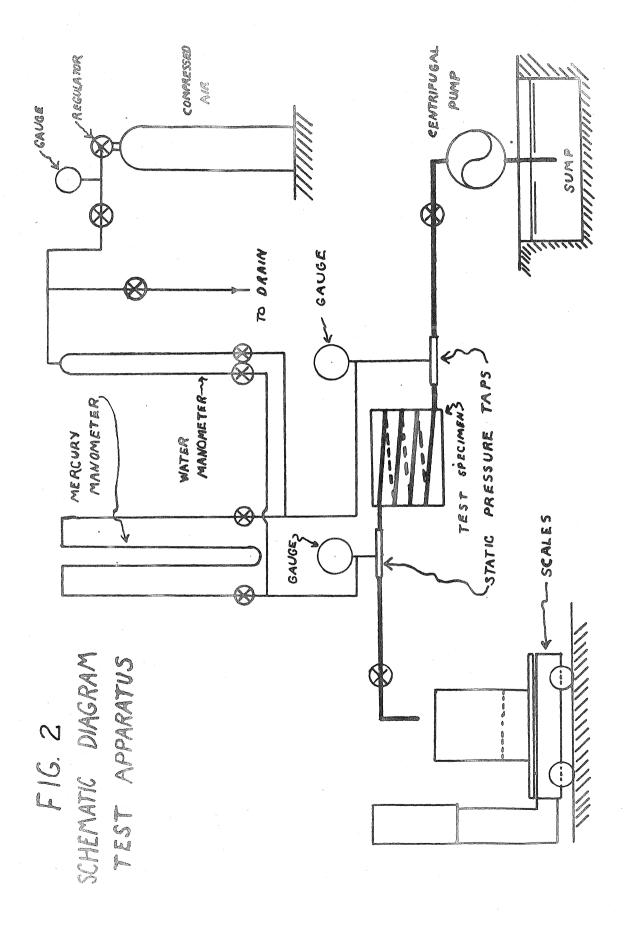
	maken person managan pengangan pengangan pengan mengan bangan pengan pengan pengan pengan pengan pengan pengan		er i dendre van de Vina van de stade de vande forderheese van de van de spring	påraghtenahtenanten mantenanga ganamatenana	To an all the state of the stat		
	TEST	No. 25	?	A CONTRACTOR OF THE CONTRACTOR	TEST	No. 2	June
P=1.936.	5LUG5 j/	u=2.22×	10 SLUGS FT-5EC	P=1.936	51.065 ju	, = 2.27×1	6 556 1/65 page 5 556
Ab LBS/FTZ	#1 5LUG5/5EC	Re	fhe	LES/FTZ	5LUGS / LL FT3 / LL PM SLUGS/SEC	Re	$fh_c$
	0,00/33		0.0811		0.00128	2,280	0.106
6.4	0.00171	3,055	0.0711	6.7	0.00168	3,000	0.0785
9.8	0.00244	4,360	0.0537	10.2	0.00234	4,190	0.0609
/3,3	0.00299	5,340	0,0488	14.4	0.00308	5,570	0.0498
26.7	0.00459	8,210	0.0415	25.4	0.00454	8,130	0.0404
63.0	0,00763	13,620	0.0355	65.4	0.00759	13,560	0,0373
112.6	0.0101	18,020	0.0363	111.8	0.0102	18,180	0.0355
224,0	0,0147	26,300	0,0339	217.5	0.0146	26,200	0.0333
391.0	0.0200	35,900	0.0319	315.5	0.0180	32,200	0.0319
704,0	0.0280	50,000	0.0295	708.0	0.0283	50,600	0.0290
1462.0	0.0424	A second second second second second second	0.0267	the charge and provide the second of the sec	0.0427	76,400	0.0262
3740.0	0.0728	130,100	0.0232	3700.0	0.0733	131,000	0.0226

	7E 57	- No. Z	5	The state of the s	TEST	No. 2	6
P=1.936	SLUGS ;	U=2.25×1	O-SSLUGS FT-SEC	P=1.936	51063 3/	U= 2.27×1	5 31 65 FT-38C
1 /5 LB5/FT2	5LUGS. FT3 1/ M SLUGS/SEC	Re	Pha	135/FTZ	51.065 FT3 )/ M 51.065/SEC	Re	fhe
3.80	0.00108	1,900		7.6	0.00172		0.0844
7,1	0,00170	3,010	0.0801	11.1	0.00220		0,0755
9.8	0.00224	3,940	0.0637	14,6	0.00269	4,690	0.0663
14.1	0,00290	5,110	0.0547	27.8	0.00422	7,360	0.6512
26.4	0.00447	7,880	0.0434	70.8	0.00736		0.0429
63.5	0.00753	13,250	0.0367	115.3	0.00972	16,960	0.0401
111.9	0.00994	17,500	0.0371	ZZ5.0	0.0142	24,800	0.0366
220.5	0.0145	25,550	0.0344	388,5	0,0192	33,400	0.0348
382.0	0.01966	34,650	0.0323	723.0	0.0269	46,900	0,0328
701.0	0.0275	48,400	0.0304	1530,0	0.0413	72,000	0.0295
1481.0	0.0422	79,800	0.0274	3860,0	0.0705	123,000	0.0255
3830,0	0.6722	127,000	0.0241				decrease possession and a second

					Littrachelegen i sactor tract to prove the part of the control of the control of the control of the control of	and the second of the second o	s assessment to the control of the c
	hari palaminin ng mahalan ng ang ang ang ang ang ang ang ang an	an Theorem and a first grass of the entire the control of the entire the control of the control		Control of the contro	a om a sinaa fire-i moombu, saari juga nigif salah kaspusi ar	gaart verschen geven de die Fernement verbere CVV de 4 Gener en Freih	e Symposium de Lance (Marie Santon) (1965) (1964) (1964) (1964) (1964) (1964) (1964) (1964) (1964) (1964) (1964)
l.	(d) (0.000 d) (4.000 d)	erne poerni lilitz (in eta prikimet pretinazione) p me	jeroja - atri minja Marad Gri 19. ga majirakinga agu kuma ting jerokata paga	general mena until di danci until mangrapi panca i tragma C	a ngunang manda mandalaga ini ayan mang mang mang mang manani ayan gayan man a	and community of the co	(Signature) and make the second of the secon
	a nama a mana katan da San ada manggaran na katan da an aya meng	and the simple production of the simple produc	- Epic - All Francis - Et A. Lak Stranger Francis comm		program plantetivele megantiljudikle ver omale ver beste med i	n contraction of a seminary of general particles with the series of the	and afficial service distribution of the service of
	and the second s	indire. In the property of the control of the contr	in puga Jagaban dankana ya jiya efini mamamada ili Tariyen (a.u) e. 15.2		i	тайнардан орология чэгээ 2005,000 он 180 оно ньо	produce objects page in the combined the investigation
The state of the s	f	dal dalam proposati transpira ang Aryingga ung mengambal privin	amaning gan ting yang gan pilonomini kina Piraner Mari Kunasi Majir kana Salamini.		ten aj en tilligen maganit elle tre pellega av ter til 1900 och til 1900 och til 1900 och til 1900 och til 190	and the family of the first state of the first stat	er, bedeustrætter for forske var fersom i se
and the second of the second s	er kinnet i semili deni ilmini del madiki ima del elektrologi (harri 1864 () 20 panon i basa)	uman nga pang gagaman nga pang mang mang pangga pang bandah di mang pang sa mang bandah di mang pang sa mang b	a to the second property or contract the second sec		bayak, ya asimpatataka ari permelika karimakin kuli hisiologia	and an action of the action of	and the second s
	Ann Lichtengannstaurum den ritheregali servicion Westerleiten Pro-	an alternative across of the Worlds Polygo-1900/3 Language	And the second s	The state of the s		and the state of t	
	general to confirm that the department plants are the confirm and the last an inflant (the last as in the last	Annual (1997) in the residence of the second	And the state to which the state of the stat	AND THE PROPERTY OF THE PROPER	Baser (B. Marian (All 1994) - 1994 (B. M. M. 1944) - 1944 (B. 1994) - 1944 (B. 1994)	1957, the Strippe will be a till 1957 to by another teams of project	were regarded and the control of the
	have help agent the market to Beer and a to Bee " for " ) and he " provided " ( to be of a b' ) ( ) and		The contract of the contract o		And the Control of th		
		an and and a complete and an analysis and make the first of the first		egy of a set of the contract o	Beginsperingersperings Province (Spirit Library) of Anolysis of Anolysis	See all American and any charles and response from place of the complete of th	Mary specification of the control of
and the second control of the lates provided	hatterpressure transcription and the second section of the con-	gen a standard southwall and arrest on some growth southwall some or on	it komp <sub>erit</sub> e i proprio presidente di membrio dell'informa	and the Professional American Processing States on the States of the Sta	HONOR AND	State of the state	eger of the control o
			gage to the man committee of the state of Manager State and the state of the state		See galler and the second and the se	the translation of the state of	47.
Secretarian and the optimist of the company of the secretarian	geographen agent from him. Stable hill Million of 100 to 100 to 100 to	igas internasional disconversation of the representation of the second o	en in weggen en waard te waste en water een ween internet	killer (ministration) (sch. (sch. committe) (ministration) (sch. sch. committee) (sch. sch. sch. sch. sch. sch. sch. sch.	Approximation and the second of the second o	et realiza guardiaren errora eta ego errora guardiaren duta. Esta eta esta esta esta esta esta esta es	See and an owner of the See and the second s



FTG. 1
Wooden mandrels for forming plastic tubing into helices.



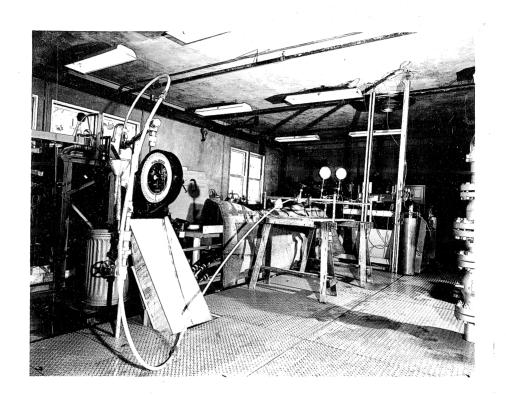


FIG. 3
Test setup.

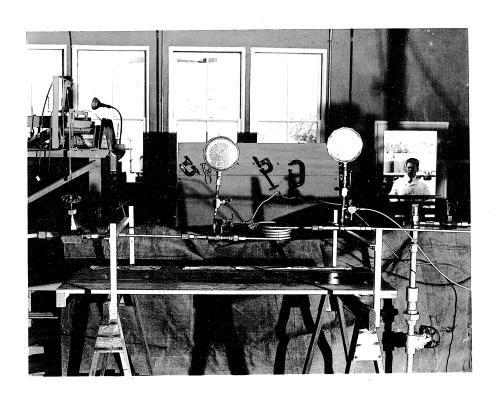


FIG. 4
Steel coil in test position.

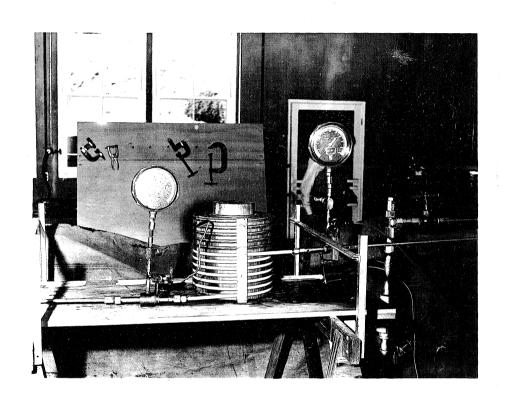
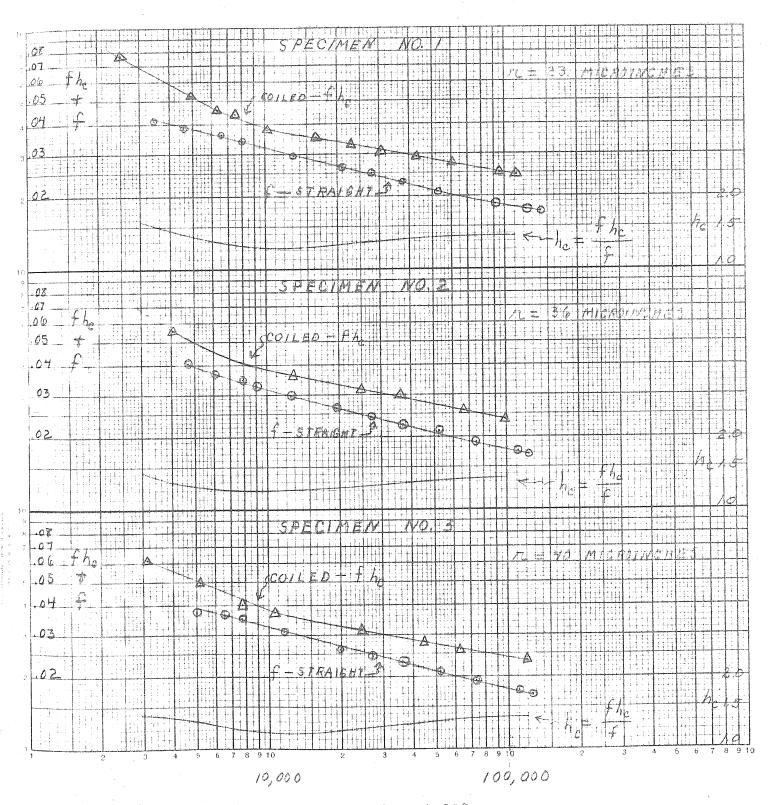


FIG. 5
Plastic coil in test position.

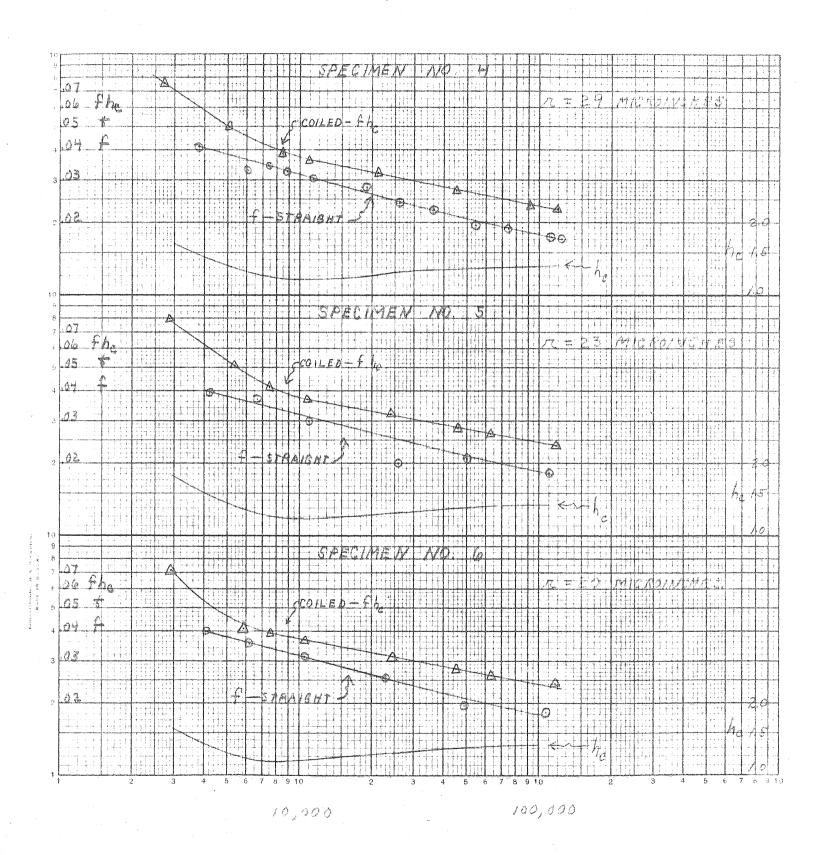
6

STEEL TUBING TEST RESULTS



REYNOLD'S NUMBER

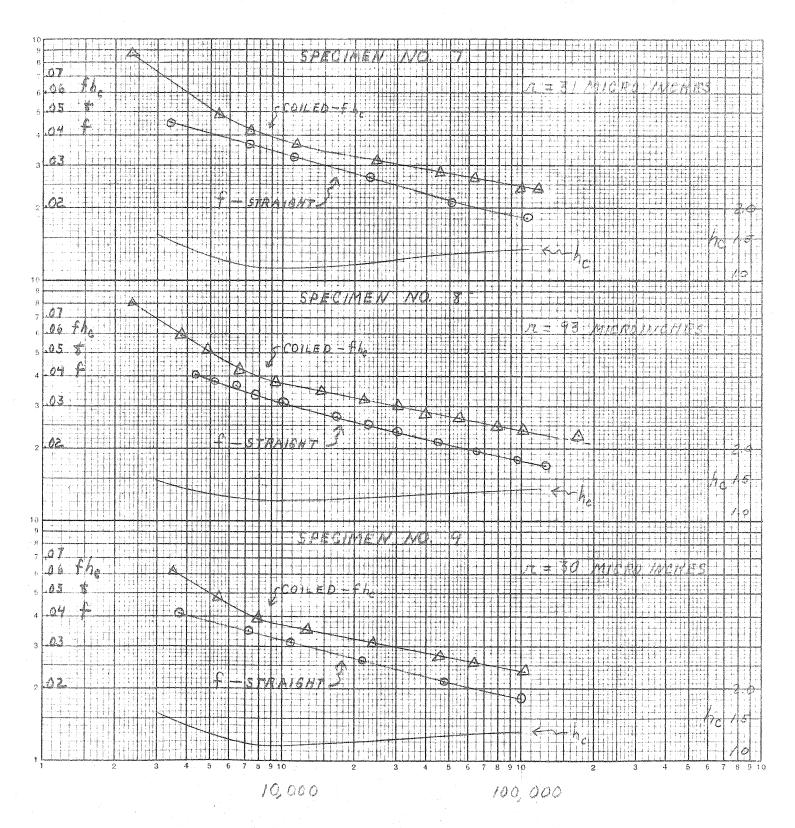
STERL CORRECTEST RESULTS



REYNOLD'S NUMBER

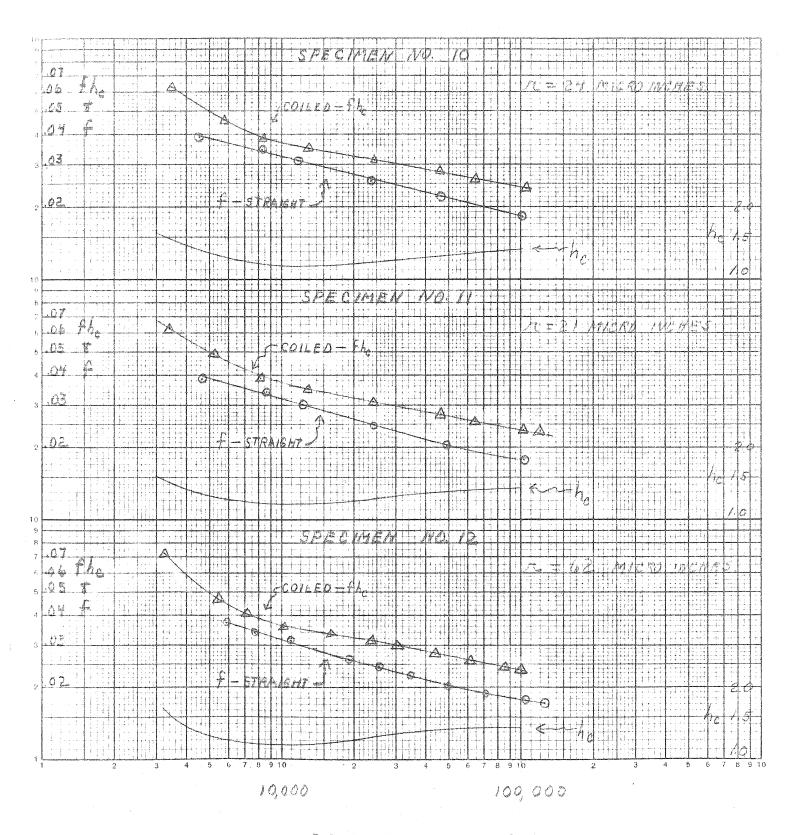
F16.8

#### STEEL TUBING TEST RESULTS



REYNOLD'S NUMBER

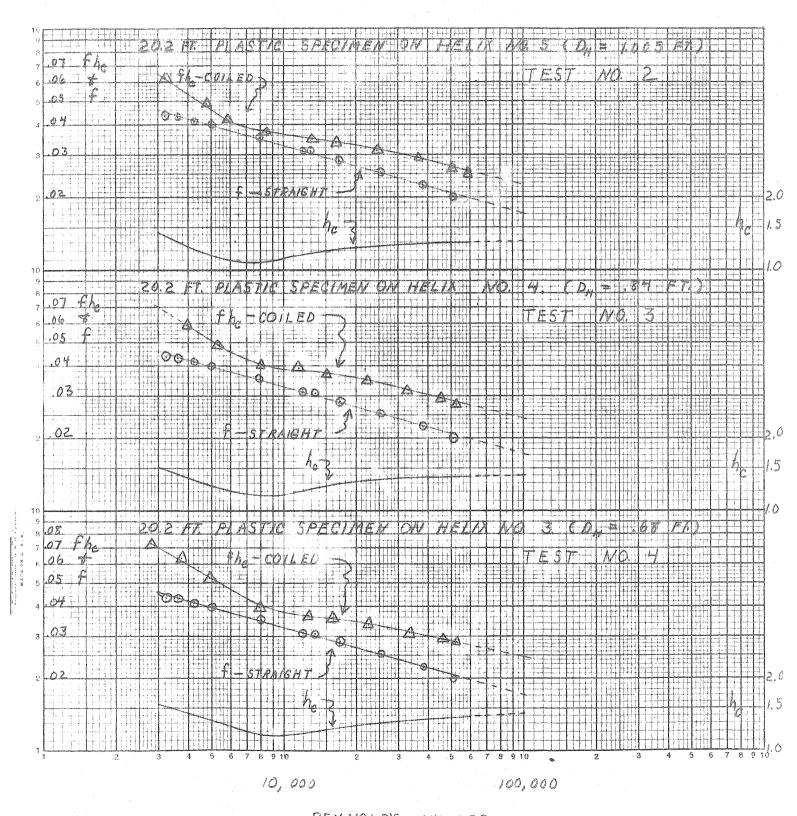
STEEL TURING TEST REVULTS



REYNOLD'S NUMBER

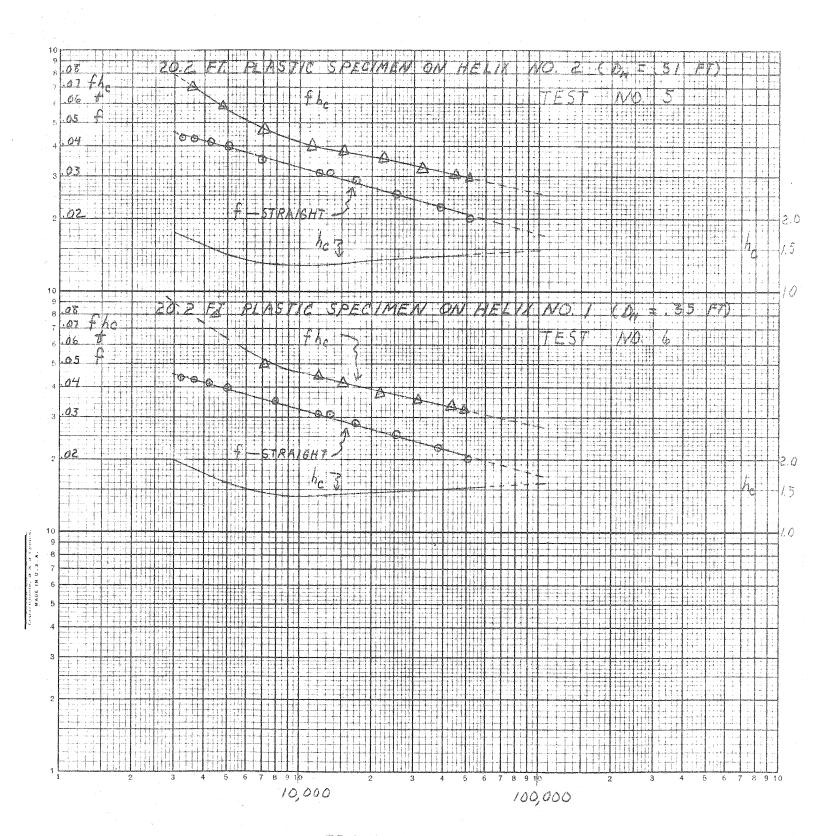
## from 10 10

#### PLASTIC TEST RESULTS



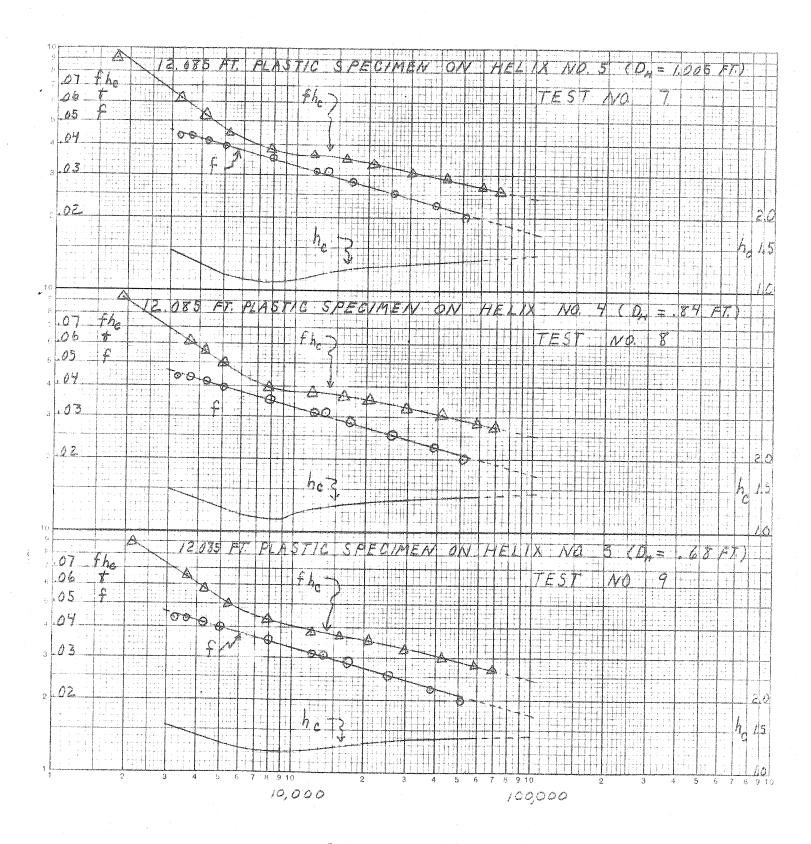
REYNOLD'S NUMBER

## 7/6, 11



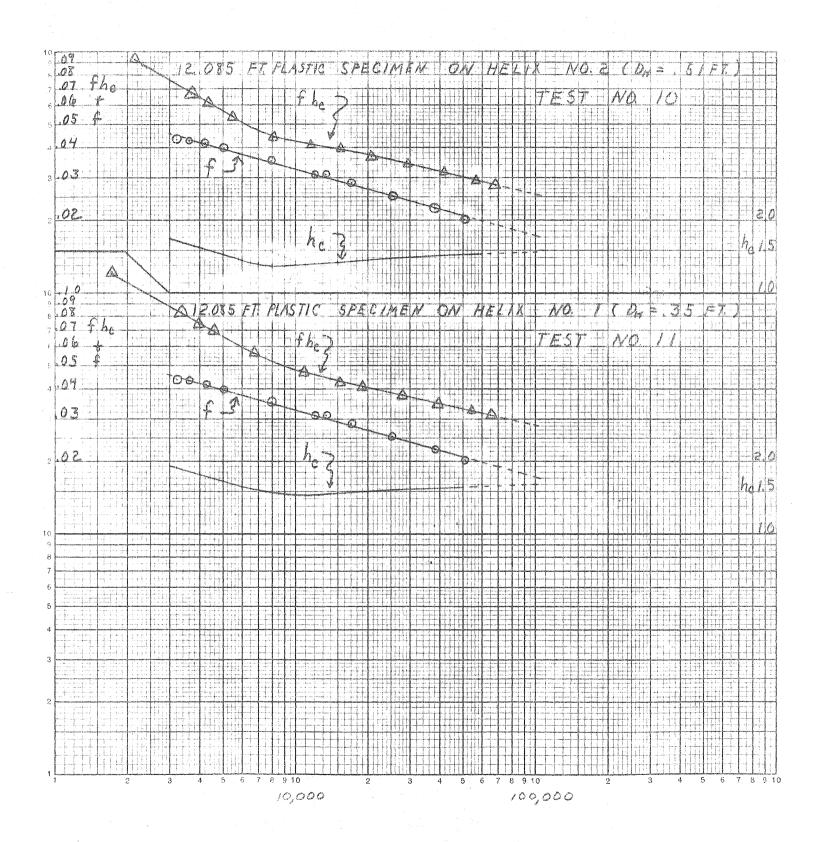
REYNOLD'S NUMBER

F/G. 12



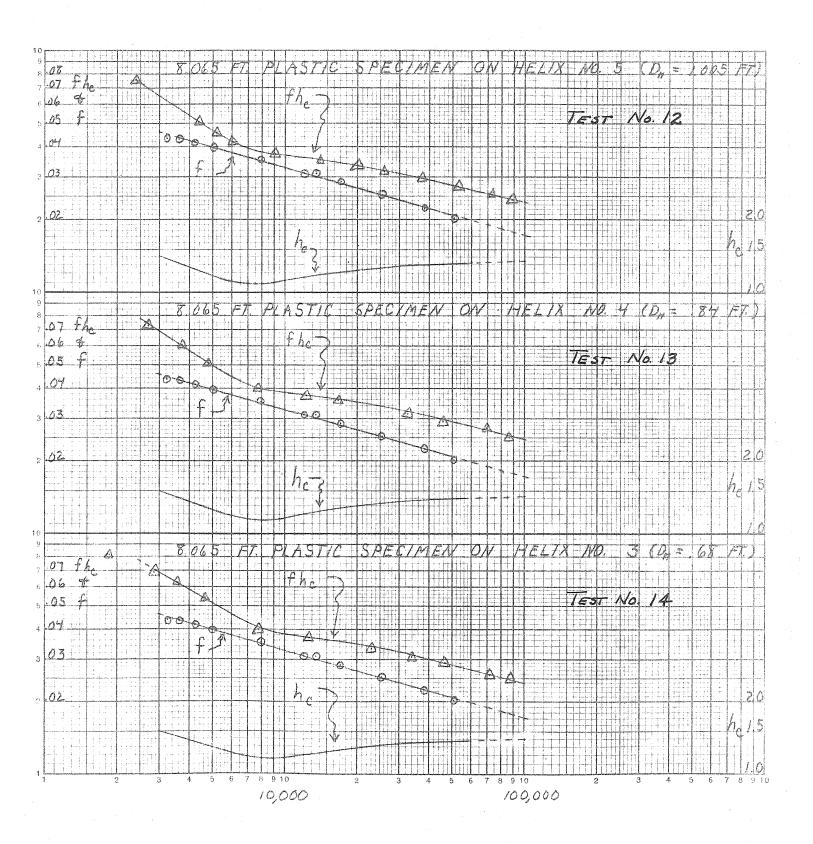
REYNOLD'S NUMBER

FLASTIC TEST RESULTS

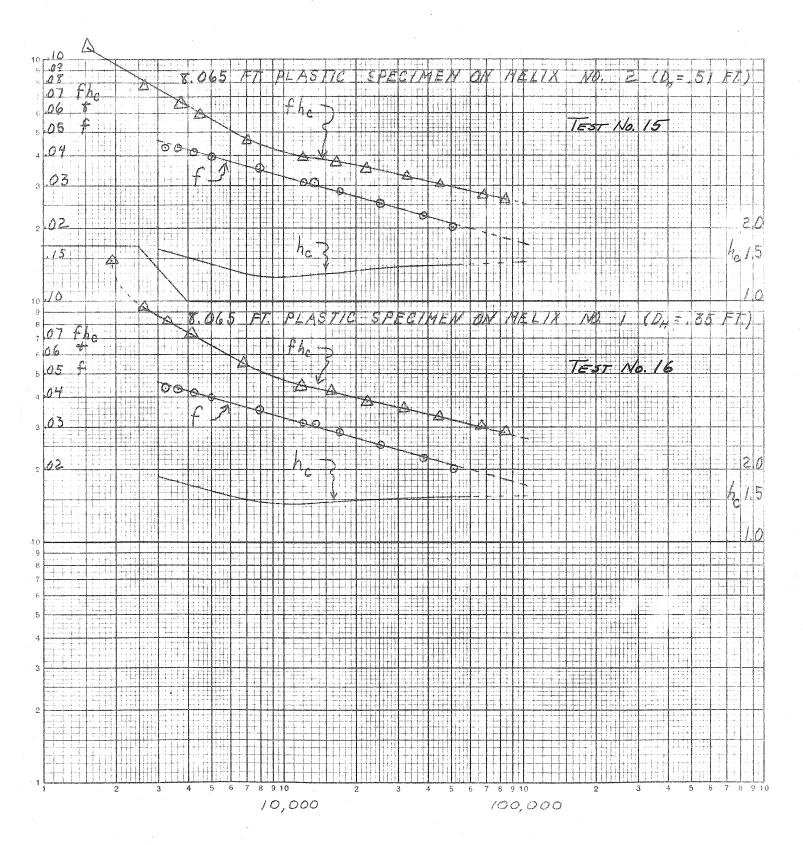


REYNOLD'S NUMBER

### F16.14

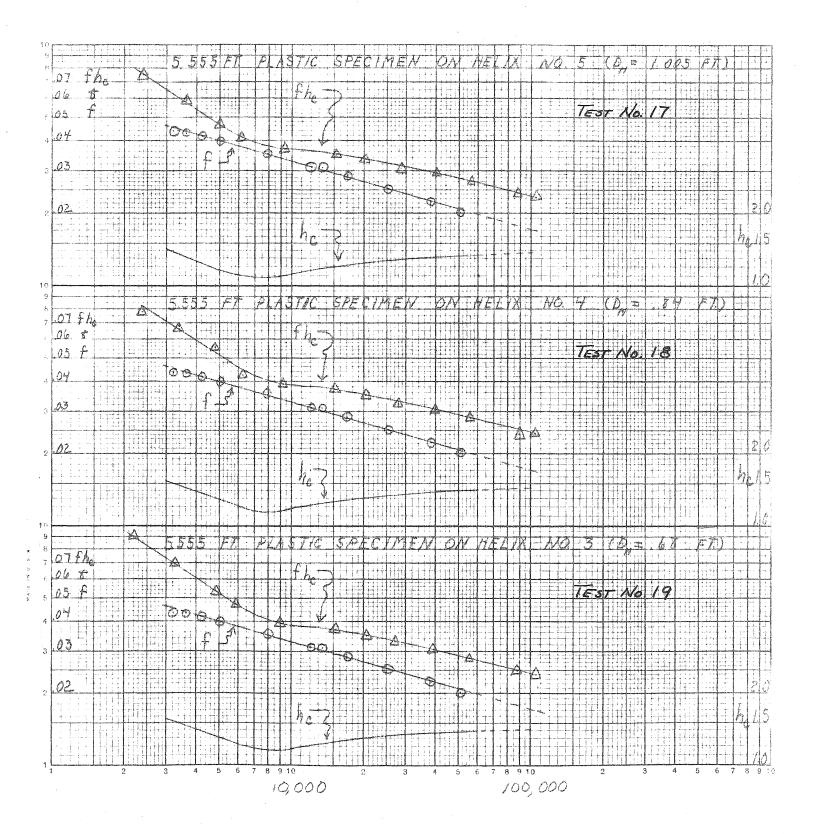


REYNOLD'S NUMBER



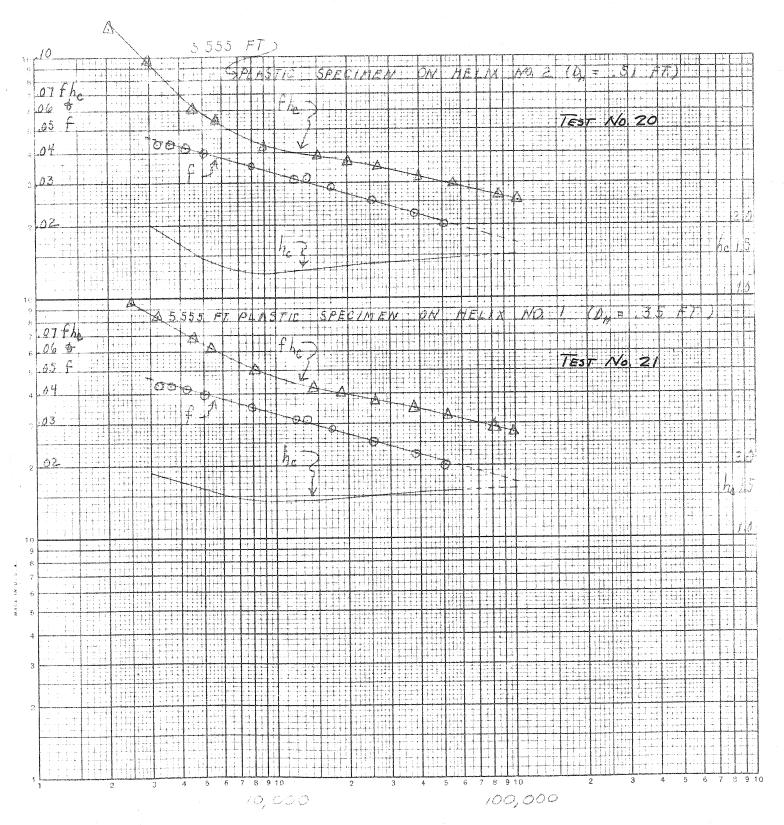
REYNOLD'S NUMBER

F/6. 16



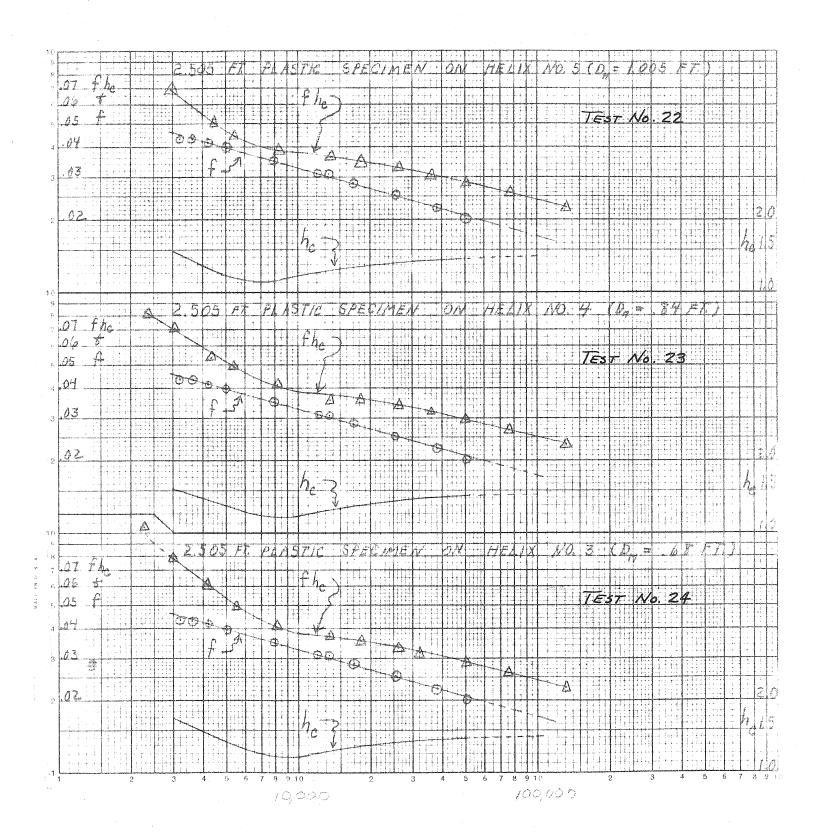
REYNOLD'S NUMBER

## 16.17

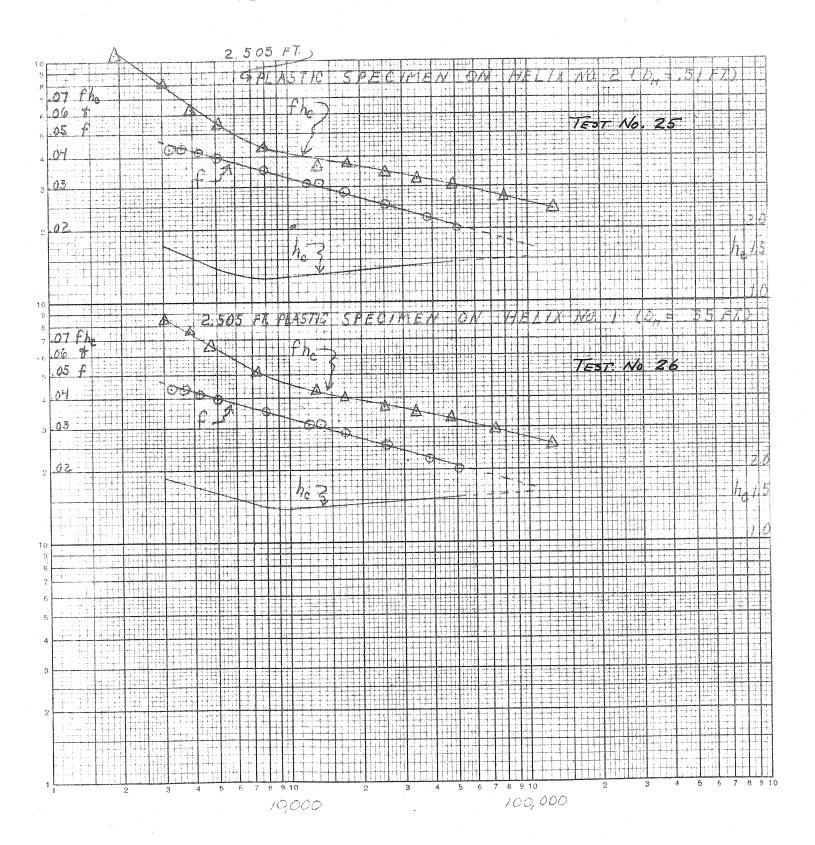


REYNOLD'S NUMBER

### F 16. 18



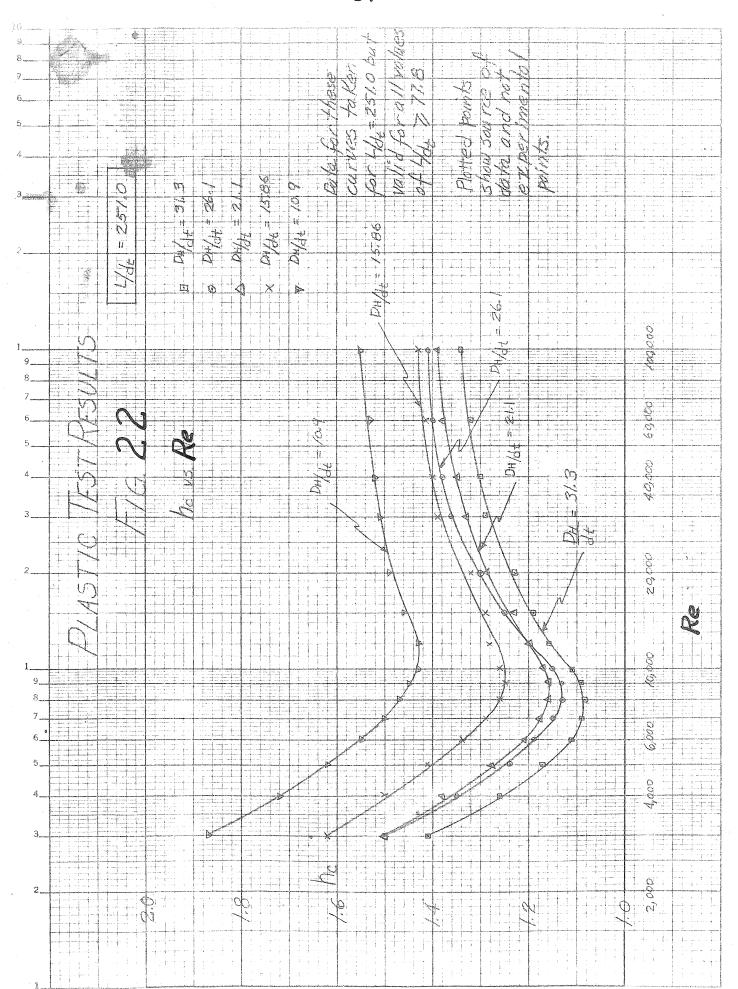
/ J. 19



REYNOLD'S NUMBER

			13	~			- german									
			W.	4	4	18.	1. 19%			4	<b>.</b>					
		1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	0119	4	1	2	2	4								
			S.P.E.	.01	3	9	5		1 1 2 1	1 20	4 6				to the state of th	
			4)	K	71 m	R	- 11 E-1	25.6 25.63	- 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1		生工					
			14		- t	2000	5	26	12:	T.V.	12 3					
			K	X4	\$ L	* Y	100		H)	3,5						
			<b>S</b>	EN	2	1.3	NEWDE				2 2	i i				
			8	CV	1/4/6	3	112	\$ 4			9 7	) \ \( \)		1::::		
			12.1	SPECIMEN	374.5	SPECIMEN	- 0	23	3 18 2	25	Sou			111		
			1	0	d	15	. ×	1 100	-\ <u>\</u> \\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\		-1-1					-
			STA		- 70	77.00			111							
											1	1-1-1-				ļ
										1		111		1		
							1-1-							+	l ë	
										TH				The second second second	3,	
										推挂						
											##				15	
	0	- A.								中					3°	
	<b>A</b>	_D9				111				$H^{\pm 1}$	-#-					
			1-1-1-		11	1				$++\lambda$	111			###	1 8	
	- 0	\( \sigma \)									7/17	\ iii			3	
	V	> =							###		M					
		2									A d	1 1				
	1						111		###			171			Higi	
											116	<b>张</b> 图			1 8	
											111	1	<b>\</b>	++++	H N	
			+++		444	111					+	1	<b>初</b> 一			
												1				Q
										1111		1-11			l 8	
													199			
												11	4#			
						114					1					
												N D			-6	
			and where the same properties								and the same of the same of the same of				4-6	
	144		1 + + +							4++1		1-1-1-			1 8	11:
										17	111					
										4						
					<b>G</b> <sup>‡</sup>	1-1-1-				ÌЩ				_   _   _   _		
				12				,								
			. 4 . 5			1+	-5					##		1	7 8	
1-				00	++++		4.1	-31				$111^{\circ}$	Y		The Man	
	E							***				111				
							4	اار		4	-11-1	11-		-1-1-1-		
			1			****	manufacture of the same									

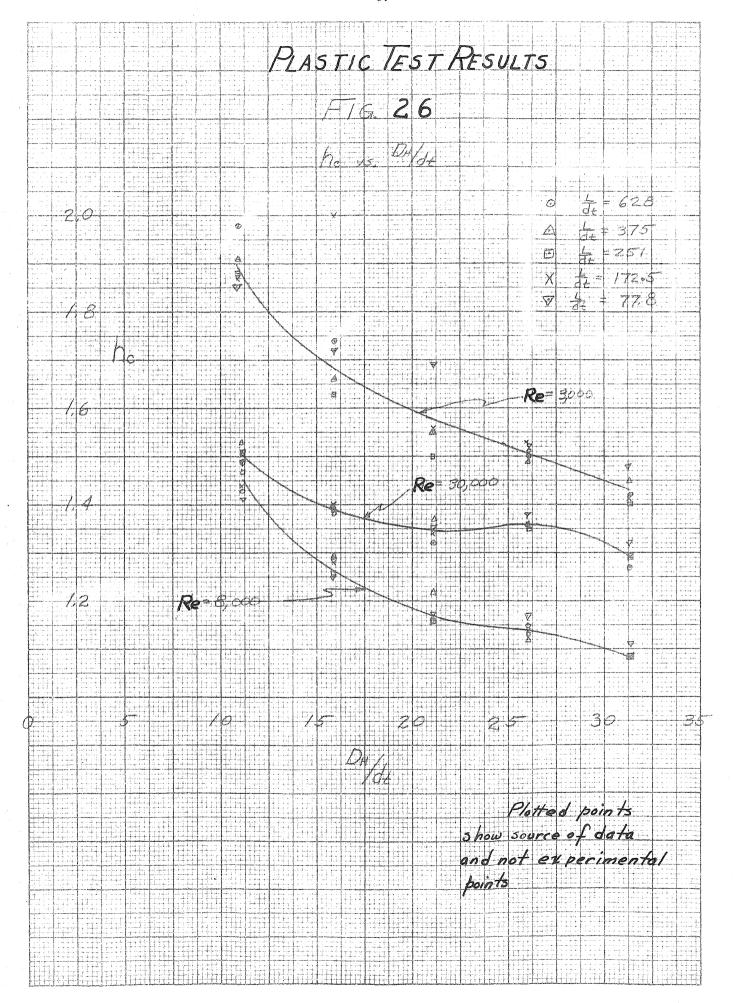
			1	4								1	P	Y	4		Q)					-5476
											4111	4			and the second		7		\$			1
			H												and the second		2000		200			Ŀ
000										2 (	) ) )						797	7	1			2
\$								1 8	4	}{t-{{ }	)				ame of positions		6)		1000	ď		
3 8										0 1							10			Ž.		
~ a	3 8							- Q	1115	\$ 0	3						ĝ	3	- e- Y			
	1 4				Ħ		H	H	, ,	(-Y	× =						7	7	<i>#</i>			
Na Carlo					H	H				,							Plo 1720	2 P S	<i>b</i>			
																						-
M							H															1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -
3					Ш											Ħ						
8									8													
Y		<b>4</b>							Š				1		ij							
						Hi			8													-
Y .									70					Ш								1
								13	*	Ш								Щ				-
F 6	J					HH								H		Ш						1
ļu \									Ų.													-
									3													11111
53.5								1.3	N													ļ-
777								12	8									Ш				11111
3									,					4 1 1 6 1 1								I
27.72		I	1	<b>*</b> 0 <b>5</b>			1.to	1 8	3						A							
		/	imali	1	<b>.</b>	1		1 1 1 1	12	0 n n					13	to be foregoned	Ш			14	Angline for	1
			<b>*</b>	ζ <sup>4</sup> 9 Ε				固		<b>7</b>			14/4	xx  K								
				HH						1:11			1			Ш						-
	•   e/		4	Ø 13	ETI-							1	19.00	*	×							
		0 3			捕								Al <sub>a</sub>	k						1.19		-
				1441 14	144						144			Hilli				H		进用进		1
																	American Commercial					
			THEF			Ш	H															
		الما الما الماما ا	4											Ų						T V		1
					to francisco de																	
					1:11		0.7				1		6		\$	1			7.0			LIL
					4114		TITTI															L
	- Indiani - Lagradiani may any five														HHH							-
			ШЫП		ШII		ШÌ		Щ	Ш	HH	Ш	ШÏ			Ш井		HH	Hiil	<u> </u>	ШШ	j



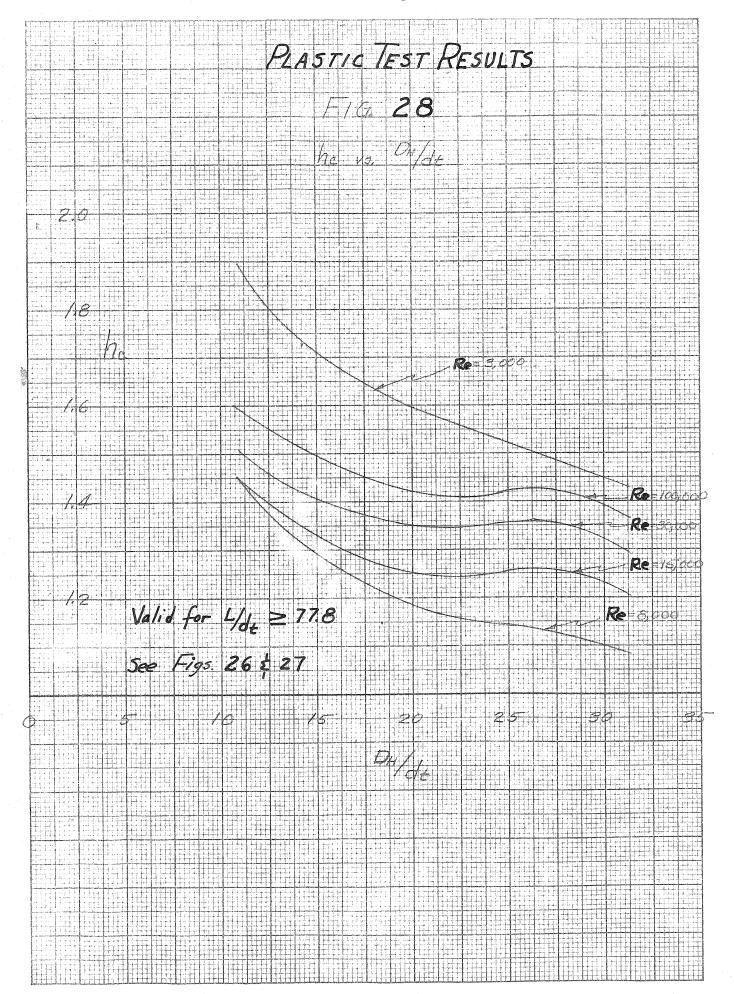
		Commence of the Commence of th								#24 \$400 PC					)						/			-	<b>)</b>				er promouveger			1		
					-	1			+			-		/	1/	4.	5	$\mathcal{T}$	C	1	E	5	T	/1	$\mathcal{F}_{\mathcal{E}}$	$SU_{i}$	LT	5						
		-		·					-	1		1			-		_		G.		>	. 7				-			1					
														animan an				Lini.	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	_	-				AF Samuel					Amazar				
																r	lc_	LV	5.	1	1						1							
																	İ	-				d <sub>e</sub>							ļ					
	2		)			+				17,						-	RE	9 =	6	5		24	2						-	-	-			
-	-	-   -			ļ.,										1			-											-					
		+				+			-	41. 41. j					1:-1					-						E	D,	Vde		3/	3			
						1				1-4											-					0		Vat Vat	1	1				
	7	1	3-						1	17																A	D	-		and	-			
					h	3				. 1						1			F	H	-					×	L	1/1				5		
			-						Ŀ	1													111			₩.	1.4	7+/,	lt =	10.	:9			
		16					111			1						1													1				1000 mm	
	1 T	16	14 [			1			H		+1					1			ЕЩ				Ш			D <sub>i</sub>		6.9						
		1							#							- -					1		H			dŧ								
			:::: :::::	 	H	4		777	0				1	7 	-				-	Y		4	A					<b>.</b>						
	-/		1	V		+						1														===	-	36			4			
	1 . 1					- 1															H			1	(*/di	<b>.</b>								
1		+				+	H	Ξ,	N I		111		1							X.	J.										X			
1	ļ.,			X			1-4-1		Ī		1						1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -			<b>A</b>			المر	74/1	= 2	le l								
		1	1	۵						11			4							معط		7,-					-	-			A			
	mayoun order			d					1				é						-						Ш				DH	WE.	# é	26	; / !	
1					1111	1		1				##	1					Ш								<b>1</b>	Щ,	0.7		ij	40			
-		H	111			- 1					-		1	Terrespond	meenne	-	production								Palin (DSID) an	- Animas			OE.					
				-74	0			111	· • • • •	2.4	70)					4				4	15.7				57	97)	inii Jii		16	¢0			1-1-1	7.6
								71-1	1									1,11				11								-				
									H				-			T		4	di			1						E						
						***			11:		Hil		44			1											113							
					-						措		1													H							17:-	
			H						F	-41					1									111										
						4			1			H	Ħ												蒀									
-									1		拼		4								H											詌		
		1				A 200			1																					ļi.				
									ļ.,		111	Hi	H								H	Щ								E				1444
		Ш	100	Ш	Lin	Ш		Hill	Ш	Ш	نظا	£Ц		Ш	H		لند			لنتنا		Ш					<u> Hit</u>	Hille	4 1 1 1 1		$\mathbf{I}$		لتا	

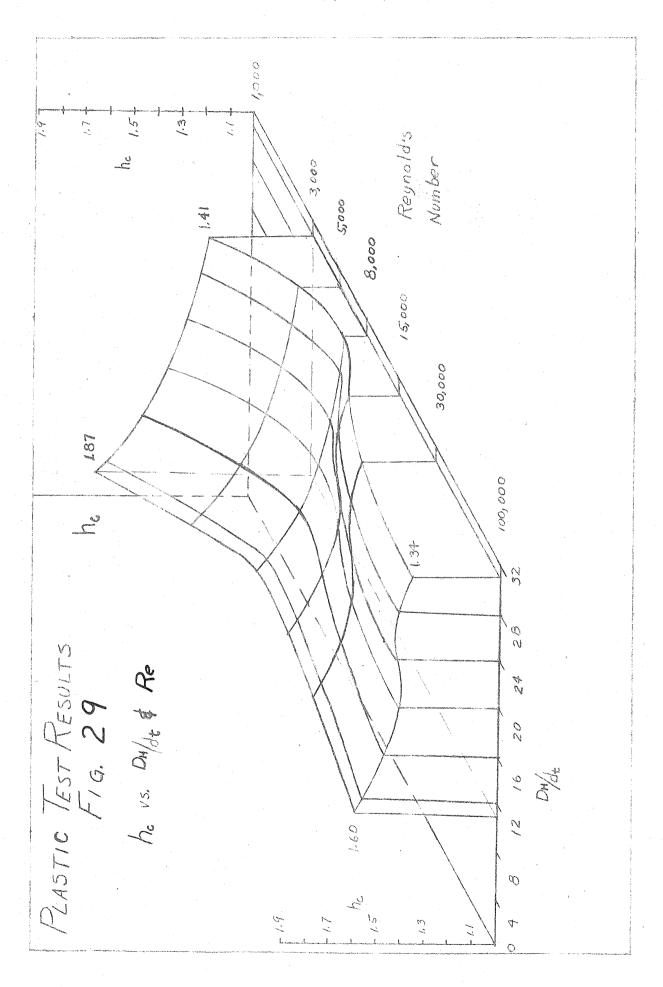
													HH					HF.					Tomas and							H
				H						1114		F	) /	15	$\mathcal{T}_{I}$	C		TE	5	7	R	F5	UI	T5						
				H						Ħ																				
														F	1	6		2	4			I								
						1				İ.	İ	ij			<del>                                      </del>															
				h	1					Ħ			盟	h		1		1/	4										Œ	
		1				7				H						Ï			d 6,,,,,,			1		TE						
							itu.							D	<b>9</b> =	1	2	701	المورد				-							
	-2	.0												/ X.			)		المعادلة			1								-
							-			H											1								E	
		1												Hi										E A			3), 3	1		
		+									i										Ħ	擂	0	D	17.		1			H
	.7	48		1						#	#									HH		lщ					21.	1		
			1	H			11															ĦĦ			144 747					
			110	H												=									1	1	-	7 <b>0</b>		
i - +   I	141			H							#					+		and a second						Ħ	7.77c	le =	70,	1		
##	1	6				-									Ш	#							Hid	H				H		
	14						H							H		#						H		4/3	i ic		H			
			- I			toque					37.		-					7		maker		1		-						
			Ť				+ V					Ш		Ш										Hiii				$\nabla$		
	1	1						Щ			H	Щ				#						D	1/4:	315	86					
					Ш	Ш		<u> </u>	<u> </u>				H				ξ.	<b>(</b>							H		H			
4		H															-/	2									190	B		. Z
H				Ш	Ш		Ш					Ш															2		c#	
	1	1							H		þ														\$					F
	-/-	- 4-1	Ħ									Ш									1		HH			13		34	\$	
			Ш	11::	H	Н			H					H						Ш							11111			
				Ш												1 1					++++	4111		4.11			1::	H		
						111			Ш			H			++++					114							1777		H	
+								TITL		Ш															Hi	6	++++		11111	X
$\circ$												Ш	- 5	4	+1!+1	-11	HT	7	po	1111		150	767			1203			H	
			++++		Ш		##		Hi			#					1	7		Ш										
			HH	بنباجة	H	+			Ш		111						7	d		拙				Ė					抽	
H			111					11.1.1.1	Ш		11	111	HH		11111		H				1-1-1-1-1						Ħ		HH	
					扭				崖	! ! ! ! ! i	-1-1-1	H		抽	Ш	11		4-4-4-4-												
					詌	Ħ					$\parallel$	Ħ			Hill	Ħ	Ш							-	H					
Ħ		HH		Hii	111				1		+	H			###	#						1	1 1 1 1 2			4-1-1	抽	HH		
- Sup		##	Ħi	1	-						Н	444.		1:11			#						1							
Ħ			卌	Hiii	$\mathbb{H}$				HH			+++			1111		#					i - I - I - I - I				1111		1-1-1-1	HE	##
11	Hi	11:11	1445	1111							+++			1		1	111										mframmeni	-	H	H
		11:12	11:11:			771			1+++		-1-			1111		H		tttt		#	11:17-			+++++						1
HL	Ш	Ш	Щі	Ш	Ш	Ш		Ш	Ш		Ш	Ш		Ш	Ш	Ш	H				ШЕ		Ш	ШШ						Ш

	USE				H		Production Options of	programme in		HI			Topason In-					ereces poster.				**************************************		maa-ratamin v		* 4	
										F	), 1	57	-/ (	^ -	TF.	57	A	$\mathcal{I}_{F}$	511	17	:5						
												<i>57</i>				e				l							
										ne Angere		_	7 G		2	5			L								
	+		b								L.	/		6		U		**************************************									
				1 1 1 1				H			$h_{c}$			1/	/ <sub>4</sub> -											1	
											f (C	V															
											R		60		00												- [
	-2:	0		1					H		CXE				محدية الن									-			
				1 1 1 1														en emendendenden			П	D⊭	<i>t</i> i.:	= 7	1.2		
				1111		7 5			##												Ø	$D_{t}$	00 171	- S			
													1:1:1:	lilian Line							Δ	··Dı	10= 11:t=	= 5	7 1		
	/.	8									HH										X	$D_t$	171.	.a /	67.6	Z	
			1											dan jan							\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	D,	101 111,		4. C		1
			//c								1							111					703				
																			P	/die		9.9					
	1.	6				5									2		[اسمعاد				Fil						
	111,		7		H				1	7									D:# /		15	ЕИ					
						×			H								سايس		V.## /	111		140					
			Χ			i i i i i i i i i i i i i i i i i i i	espelator (a											Dμy		过	.7				<b>X</b>		
1	1	4				-6															1, 121			1	Δ :	1.1.	
	411				-	Z Z														]"/a		4/+!					
					Hii														ħ.			\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \		21	<del> </del>		
17.			1-1-1						11111	11111									1		1	74	in.	37.	<b>D</b>	1	
	-/,	2	11-14			1			11111		11111				詌	1111											
															<del>                                     </del>		讎								H		
								Hiii					1444		HH		H		Hi							11.11	
1	11111 13711					1415	1:1:::		Titl														1111			1111	
					1	1	And Albert	A Carlot		-	+++++	HH													-		
			A	10	H	Hil	20	9,31		1111	130	20			1/1	ko:		1111		90			6	10	+		72
			17 11	1==	###		111111		11	liii:	抽				ĦH	HH	++	H	Hi				11.				
		Ti i i	H		HH.			HH							44,44												
			Link		1111	HH		1::::		1111	Thi	$\pm\pm\pm$		1/6	1										1 1 1 1	1	11.7
H			1111		1111	1.17		Ш		4 4	41114			1 1-9 1 1							1111					diri	
-1-				l III		E	HH	1																		1	4444
				1		1													1				t::::		H	i (. i	and the state of
		#:	1		1::::::		HШ			1::::					-		H				11:::	H			1-4-		L
	1114		1	1	-	H	閸													1	-1				+	Hii	
III		1	Hii				Hi															1 + + +		1			
11.		1:::	11.77		11111	11:11							profession bear			EII	Ħ		4	1			J		-		



									Щ											)									
											H	1/	15	7	10		ES	T	K	ES	U	LT	5						
							1						111			1	11,5	1., 1											
		-11, /													-//		2	7	1.1.7					4		7			
								+				H		/	1	da	-	-											
				13.1.1			H	#						7		H	Du	4											
										111			1	7c	V.	\$		12			1								
							135									H	111		+++										
	77	<i>~</i>			1.11	;																							
	2							ŀ		H		L	1				Hi.					ĺЪ	0	L	14	= 6	28		
					1.77			#		Hi						E	H						Œ.	1	1/1	3	376	Line:	
															H							1	19		1/1.	1	2		
							H			ᆵ			#			#=	扭				H			1 1	11:	- 7			
	-/.	8			-		-		Ш				#			1		144	HH				F		/ de	-	L. Kon E.	2	
	ent de la landa de la landa de landa de landa de landa de la						1			##				4	Шŧ		H				<u> </u>		V		7di		77.	8	
	İ	-2	lh.							H				111															
				+ 1						111		H		++1		E		H										1	
重			Ш							Ħ	圃					1					Ш		H		H				
	1.	6				Ħ			\$		H							ĦĦ				Zaza	1		##				
									a					##	뻐					/50	•	100	100		ĦĦ	HE		H	1
							#			1		$\geq$	$\downarrow$	<u> </u>		H			H										-
					H	1			A D	剒				D D							Hi			#			111		ЬE
7	7	1				Ш			¥	X				11					Ш		4				1		¥	扭	凵
	LA								Ш	Ħi	h			111							1				Щ				Ш
	111			ļ	Ħ	Ħ							7	\$							Hil	Īi:					6		描
				Ē		Ħ			#					Ā		$\downarrow \downarrow$		Ħij			Ш		alli				Ħ	1	#
	1				11							HE				1				H					+		17	Hii	抽
	-1.	2	1			11		A	œ:	- /4	100	4	4					HH						<u> </u>			十二		卌
																				144			-		14		###	掛	##
									111							Ш			1111				Ш			111			
		1	1			H	Ħ				掛				H			Ш	Ħij			H							
11	Ħ	<b> </b>				$\mathbb{H}$																							##
	, , , , ,									H	Ш							텖	HIII			H		甘井					
				5		H		16	1		H	H	14					P	Ħi		2	\$			13	9			#3
							H	$\mathbb{H}$			H															+#			
<b>4</b> + 1				<u>l</u>			H				Ħ	111		Ш	Ш	114	٧,	4	抽描			##		117		H	Hi		
		扭进					Ш	11	Ш		蒀		Ш			Ш			譁			Ш							
		#		#::		掛		#		肼							壨						1			##			#
Ħ		H						$\blacksquare$		H		H					HH			PI	646	ed!	Dois	2/3	ta en	hou	<u>,                                    </u>		
								Ħ	Ħ			Ħij			描		##				مرمد و و		, /	Ja.	fo	an	1		텚
		FE					##		H	H		##		H			肼			100	1		1		14	1		ĦĒ	
			1111			HH	##	11					$\mathbb{H}$		H				HI	no	1 0	21	per	IN	en	la	/	肼	#
			Шi		14	Ш	H							H	Ш					po	in	5.	1				H		H
	Ħ						H			Ш					trit	11:						Щ							
							#		##														HI				Ш		atom from the region of
Hil	H	İ	111	描		Hill	#	Ħ	H	Ħ			$\mathbb{H}$	H	H			Hil						Ш	Ш	Hill	HH	Hiii	





								N	- S						
								13	9	* * * * * * * * * * * * * * * * * * *					1
								8	B	1-1-1					1
								9	W			-			
							1	7	2	_					1
								N X	3	M		1		-	1
										7					
		1 2			EE			48 6 6 6	. 6	la i		11	Hii		1
		113							- 4	70		++-			
4:::::		1 2					1	2	3						-
		1 8 -	1-1-1-1-				11	N	- 2	الثب	N				-
									- 17		1				-
		Z.					-	1/2	+4	<u>a</u> –	7/2				
							1	5						8	
								N	8		- (e			18	
					<b>#</b>			19	10		15 I				
				<b> </b>	40		1		IJ		7			1-8-	
				<b> </b>	40			\$ 64	3	D 6	3 4			18	-
	m	2									4			<u> </u>	
		3	<b>!</b>							1	1	+		38	
	Kr				1 410	and the second second		7	*					2,	
		1 24						*							
	HL	2			4			3	IEN.						1
		\ \			+++	<b>\</b>		3							E D
	LEITE	l 👸			h !			276	8. 8					88	3
					= 7=			5	13	1411				20,	
					Щ <u>ф</u> _	40		1			A)				SQ
		10						FE	Leaf	1					10%
		14			þ	40		A.	27.2			1 1		00	70
					1	14								1-0-	Ž,
		20 03 20 32			7	II -		47)	5	131				18	1
		Andrews				(Zin		<b>N</b>	- 44		6.3				
		\$			did			3	>		5			\$_	
		Š						. " " L	57.4%		3			1/9	H
					and the state of				441						
				1-1-1	8A			9	-	1 1 1	7		111	1-8-	
			I I I	V IX											
			H	04						+1					
								ar also see he made a comp				111			ļ
						arakankan kara			+1+					00	
	TIT C	be	2	1 5	<del>نمشنسسسس</del> و ، احجاج						***	al		N	
	7						1								
											111				
						-	+ ب	rite berkent			1				Ι .