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API
BULLETIN
containing

CURVES FOR SELECTING BEAM PUMPING UNITS

OFFICIAL PUBLICATION



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AMERICAN PETROLEUM INSTITUTE
New York, N. Y.

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Dallas, Texas 75201

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Foreword

- a. This bulletin is under the jurisdiction of the API Committee on Standardization of Production Equipment.
- b. The purpose of this bulletin is to present a set of master curves for use in selecting beam pumping units. The curves were derived from the application of a computer program to portions of the material in API RP 11L: *Design Calculations for Pumping Systems* (First Edition, March 1967).

Introduction

The Table of Contents on page iii outlines the range of values for each group of curves having the same peak torque rating. This page also includes a notation of the conditions assumed for the curve calculations.

Three composite curves are included on pages iv, v, and vi that plot capacity in barrels per day with depth in thousands of feet, based on rod stress limits of 25,000 psi, 30,000 psi, and 35,000 psi respectively.

The curves in this book may be used to select a unit for purchase. They will also be helpful to field personnel having the responsibility of transferring pumping units from one location to another because of changing well potentials.

Example

Required: Design a sucker rod pumping installation that will provide a pump displacement of 550 barrels per day at a depth of 4,000 feet and limit the rod stress to 30,000 psi.

Procedure: Refer to COMPOSITE — 30,000 PSI STRESS LIMIT curves, page v.

Extend a line horizontally at 550 barrels per day to intersect a line drawn vertically from the 4000-foot point on the depth axis. Note that the intersect point is between curves 18 and 14. From the tabulation at the right side of page v, note that the unit corresponding to the higher curve (curve 14) is a 320,000 in.-lb peak torque unit, utilizing a 74-inch stroke and a No. 76 string design, see the table titled "Rod and Pump Data", in the current edition of API RP 11L: *Recommended Practice for Design Calculations for Sucker Rod Pumping Systems*.

To determine further design details, locate the proper set of curves from the tabulated data on the right side of each page in the book. Curves for a 320,000 in.-lb unit, utilizing a 74-inch

NOTE: This is the first edition of this bulletin. It was authorized for publication at the 1969 standardization conference as reported in Circ PS-1382, and as subsequently approved by letter ballot.

stroke and a No. 76 rod string may be found on page 82. Extend a line vertically upward from the 4,000-foot point on the depth axis to intersect with a line extended horizontally from 550 barrels per day gross production. Note that the intersect point is above the 1-3/4-inch pump plunger curve and below the 2-inch pump plunger curve in the series of curves titled PROD., extending generally from the upper left to the lower right portion of the graph. Since the requirement is for a pump displacement of 550 barrels per day, the 2-inch pump plunger will be needed. By extending a line horizontally from the intersect of 4000-foot depth vertical line and the 2-inch pump plunger curve to the GROSS BARRELS PER DAY vertical axis, it is determined that this size plunger will provide a pump displacement of 590 barrels per day (or produce 590 barrels per day at 100% pump volumetric efficiency). To determine if the 30,000 psi maximum stress limitation will be exceeded, extend a line upward from the 4,000-foot depth point to intersect the 2-inch pump plunger curve in the series of curves titled STRESS, extending generally from the lower left to the upper right portion of the graph. From the intersect point, extend a line horizontally to the ROD STRESS, 1000 PSI vertical axis. This value is found to be 29,100 psi and is below the maximum limitation. Now extend a line downward from the 4000-foot depth point until it intersects the 2-inch pump plunger-strokes per minute curve. From this intersect point, extend a line horizontally to the STROKES/MINUTE vertical axis and read 20 strokes per minute. It will therefore require 20 strokes per minute to displace 590 barrels per day with a 2-inch diameter pump plunger, a maximum rod stress of 29,100 psi, and the unit described in the tabulation on page 82.

Note that this unit has a 24,600 lb beam rating and will require a rod stress of 40,900 psi to load the beam to capacity. (Rod stress equal to limit of beam loading may be determined by reading the rod stress opposite the heavy line under the beam limit rating. See NOTE below TABLE OF CONTENTS, page iii).

There are nineteen pages of curves for the 320,000 in.-lb peak torque units, with various beam ratings, stroke lengths, and rod designs. Data from these curves may be compared with the above to determine if the same production may be obtained with less rod stress, fewer strokes per minute, different rod design, etc.

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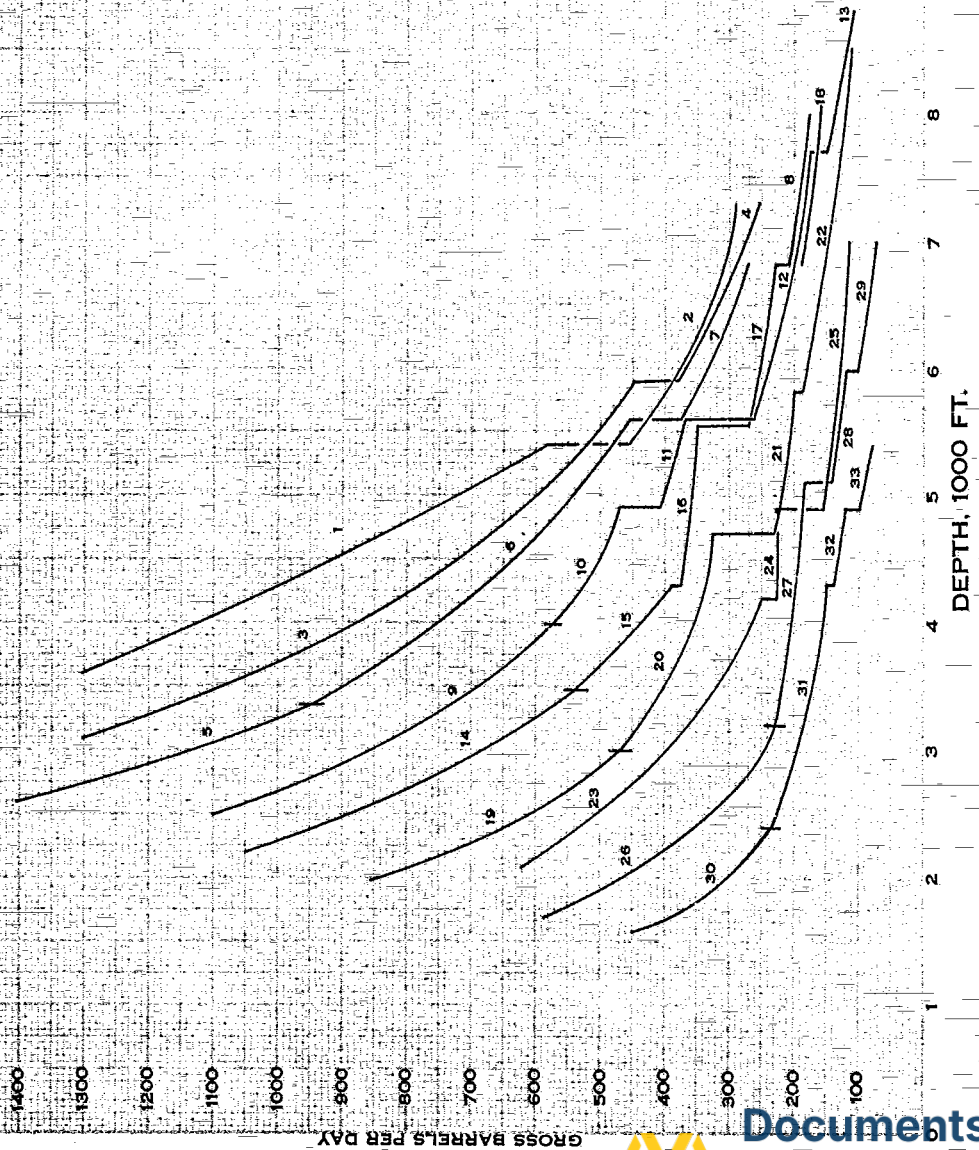
PROD. B/D MIN. MAX.	DEPTH FT.		PEAK TORQUE LB. IN.	STROKE LENGTH		STRESS PSI		PAGE	
	MIN.	MAX.		MIN.	MAX.	MIN.	MAX.	FROM	TO
70	455		57,000	36	42	13,000	35,200	1	11
72	590		80,000	42	48	14,400	39,600	12	25
73	660		114,000	48	54	12,200	39,400	26	43
94	890		160,000	54	64	13,800	39,000	44	61
114	1,045		228,000	64	74	15,100	40,000	62	80
112	1,170		320,000	74	86	15,100	39,600	81	99
125	1,380		456,000	86	100	17,300	40,000	100	119
145	2,015		640,000	85	100	20,000	40,000	120	142
155	2,280		912,000	106	120	22,500	40,000	143	160

NOTE: Curves are plotted in accordance with API RP 11L, 1st Edition, March 1967. Assumed conditions: anchored tbg, fluid gravity of 1.0, pump volumetric efficiency 100%, net lift equal to pump depth, and properly counterbalanced units. Generally, limiting factor on curve is peak torque rating of the unit. Rod stress equal to limit of beam loading may be determined by reading the rod stress opposite the line under the beam limit rating. If beam limit and equivalent rod stress are above the maximum rod stress plotted on the vertical axis, the beam limit and equivalent rod stress are recorded at the top of the sheet (see page 6 for example).

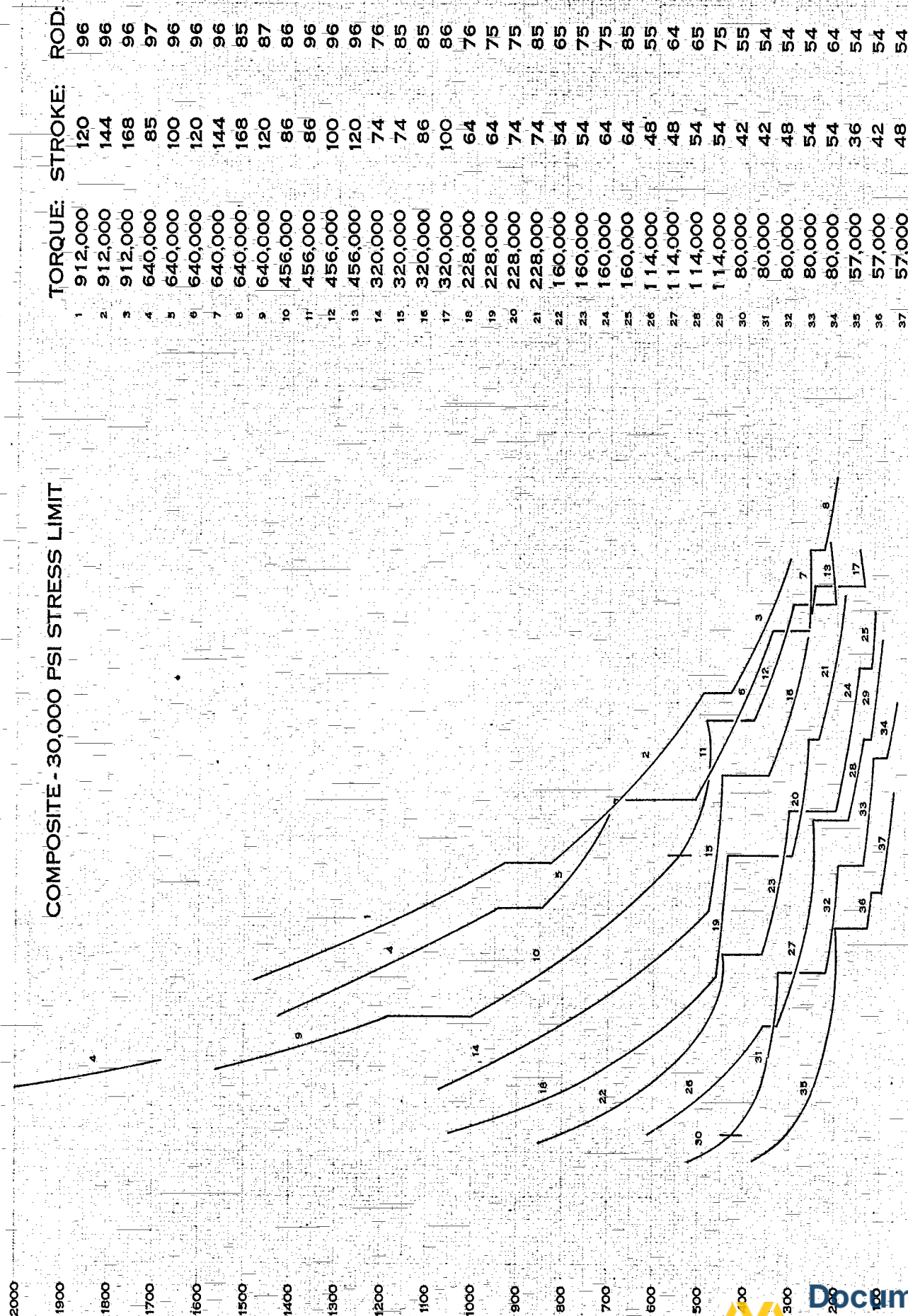


COMPOSITE - 25,000 PSI STRESS LIMIT

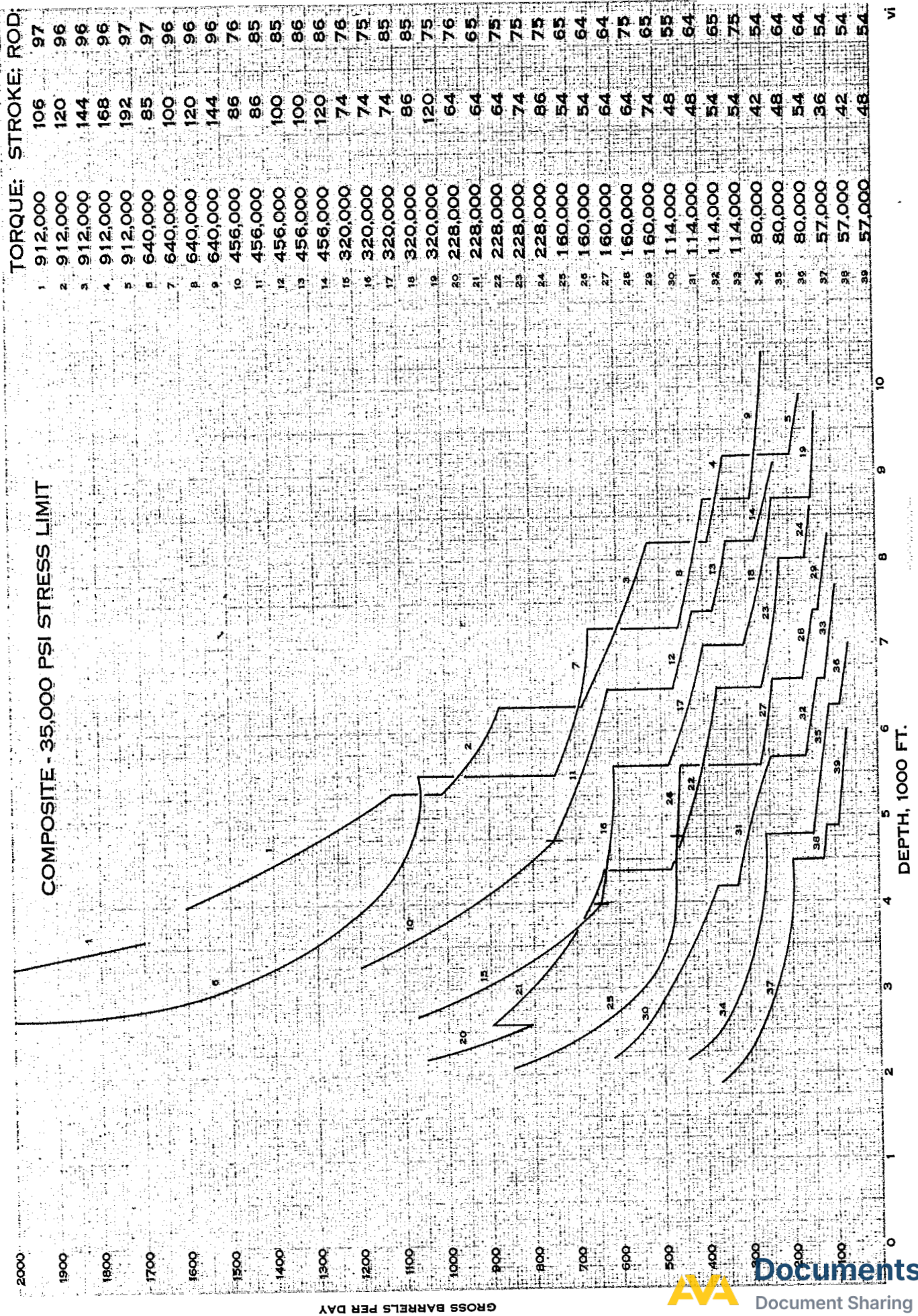
	TORQUE:	STROKE:	ROD:
1	912,000	168	96
2	640,000	144	96
3	640,000	120	96
4	640,000	186	85
5	456,000	86	97
6	456,000	86	96
7	456,000	100	96
8	456,000	120	96
9	320,000	74	86
10	320,000	74	85
11	320,000	74	96
12	320,000	86	96
13	320,000	100	96
14	228,000	64	76
15	228,000	64	75
16	228,000	64	85
17	228,000	74	85
18	228,000	86	85
19	160,000	54	76
20	160,000	54	75
21	160,000	64	75
22	160,000	64	85
23	114,000	48	65
24	114,000	54	64
25	114,000	54	75
26	80,000	42	65
27	80,000	42	64
28	80,000	48	64
29	80,000	54	64
30	57,000	36	65
31	57,000	36	64
32	57,000	42	54
33	57,000	48	54



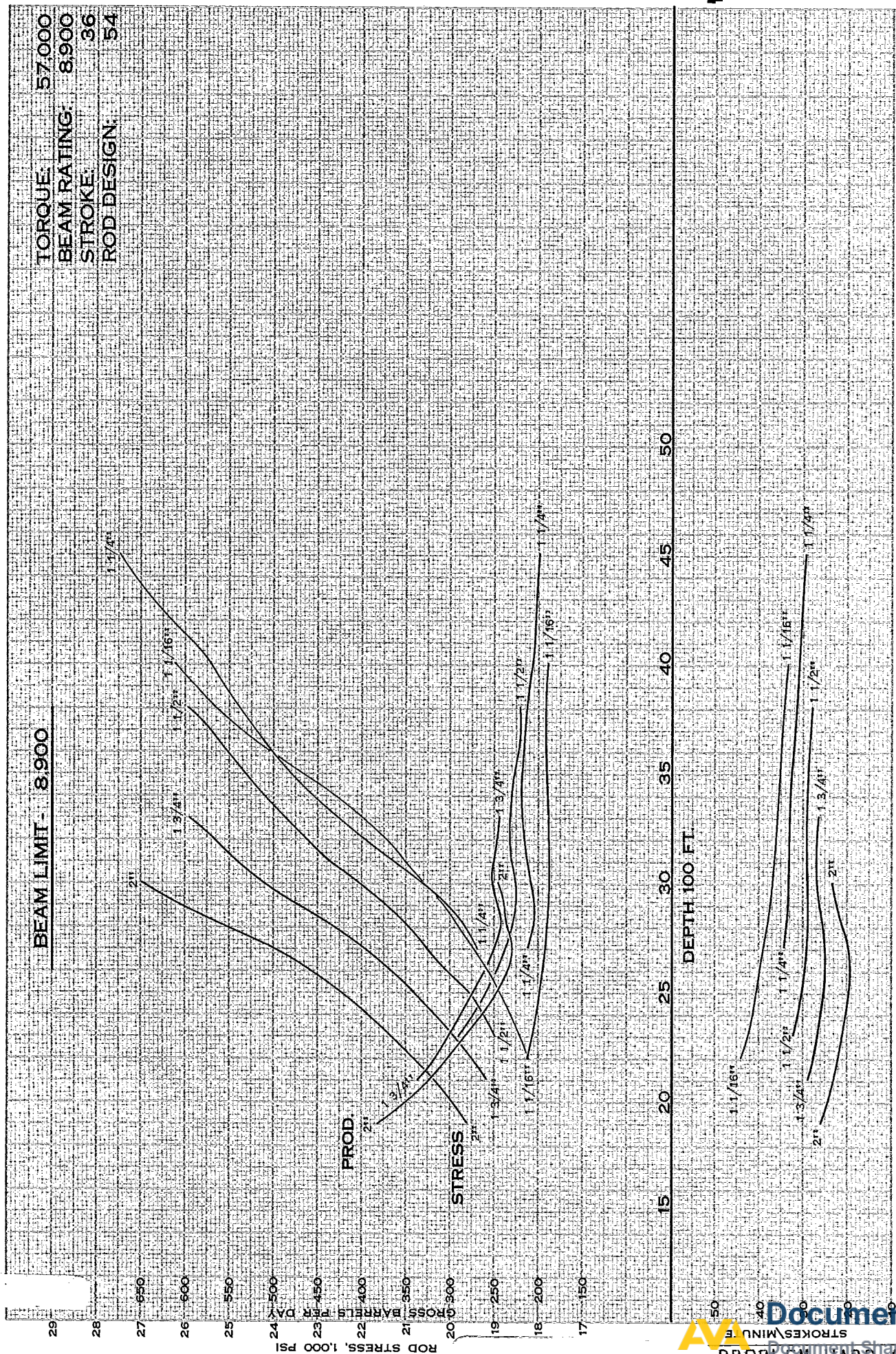
COMPOSITE - 30,000 PSI STRESS LIMIT



DEPTH, 1000 FT.

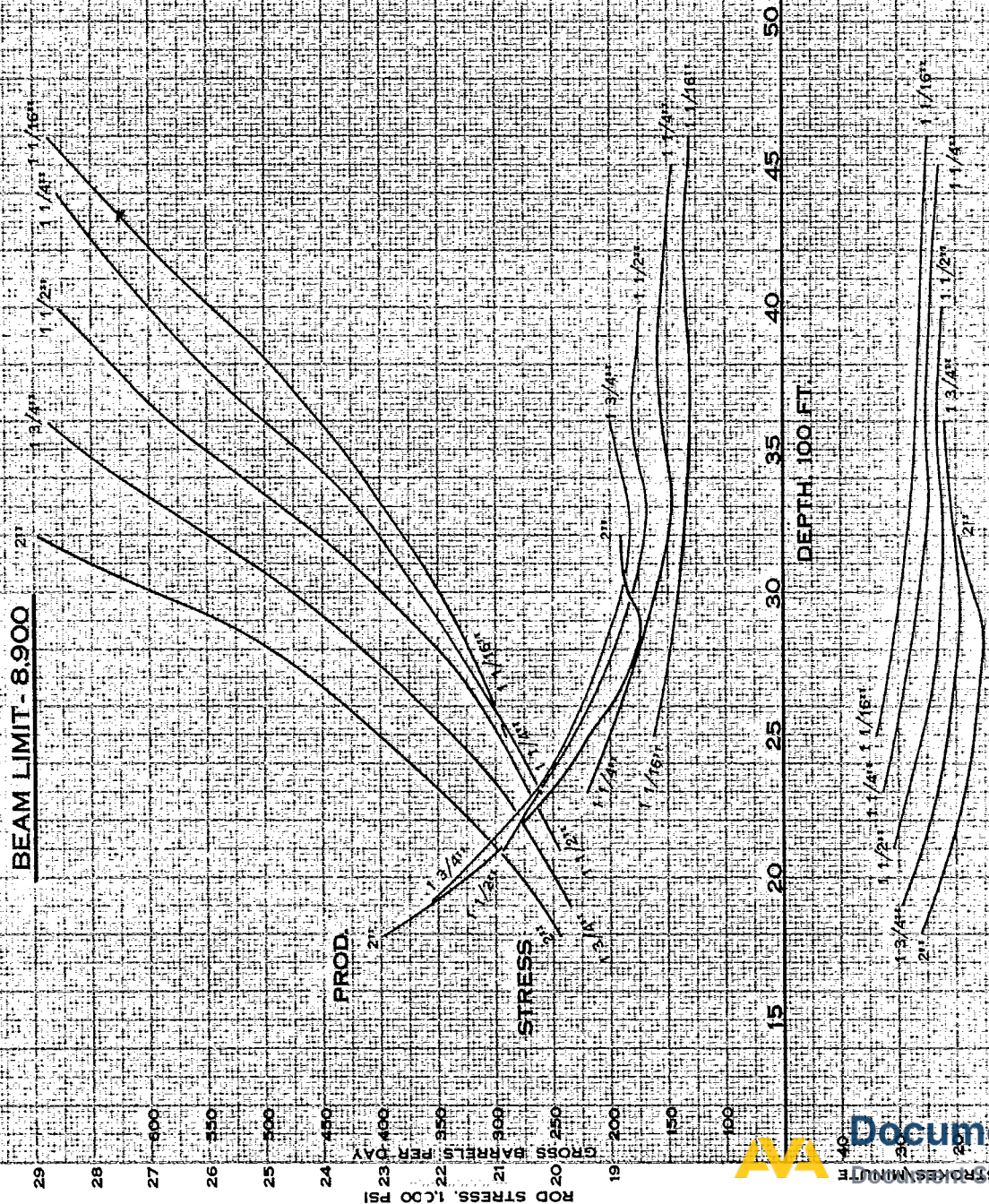


vi

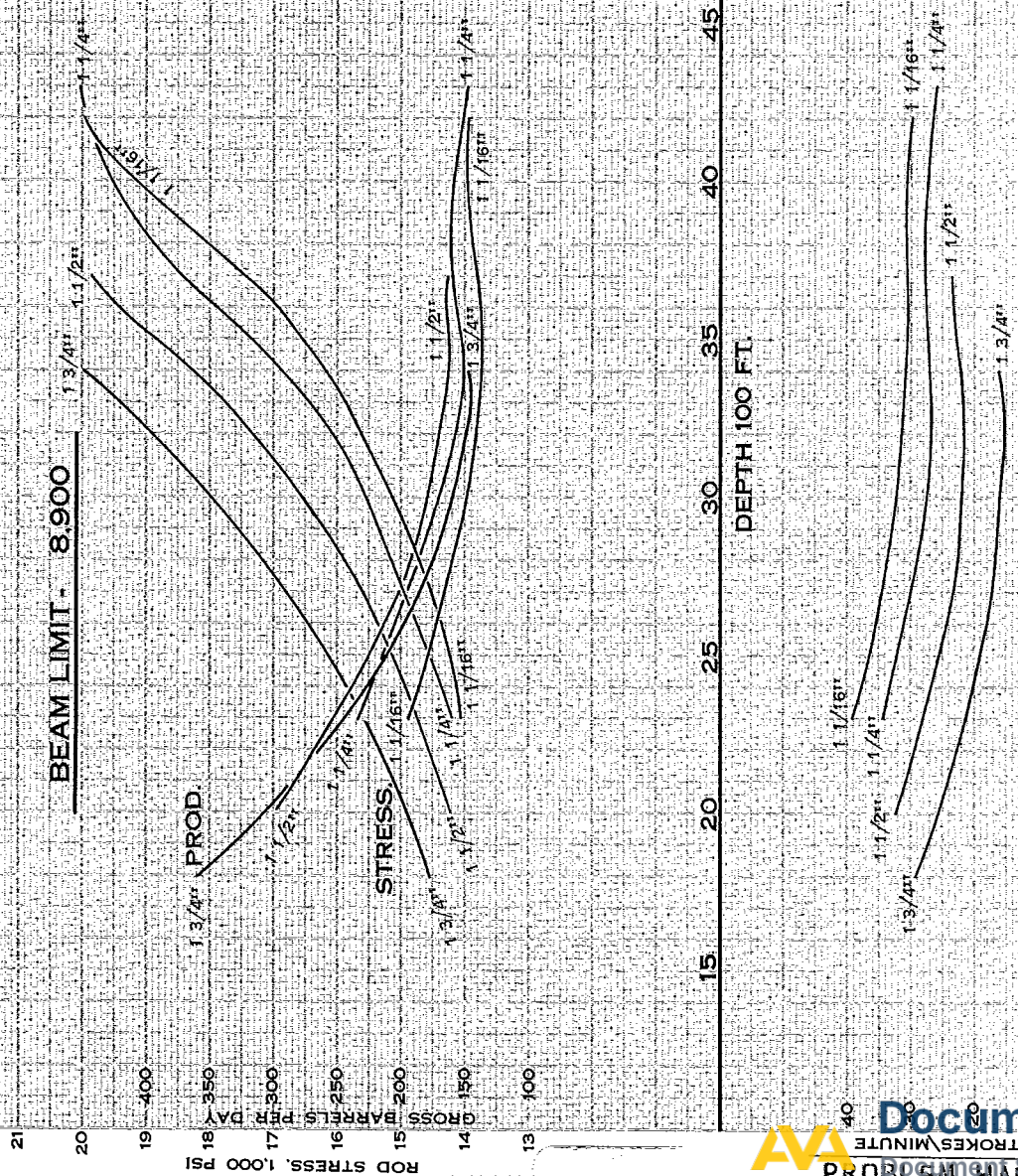


TORQUE: 57,000
 BEAM RATING: 8,900
 STROKE: 36
 ROD DESIGN: 55

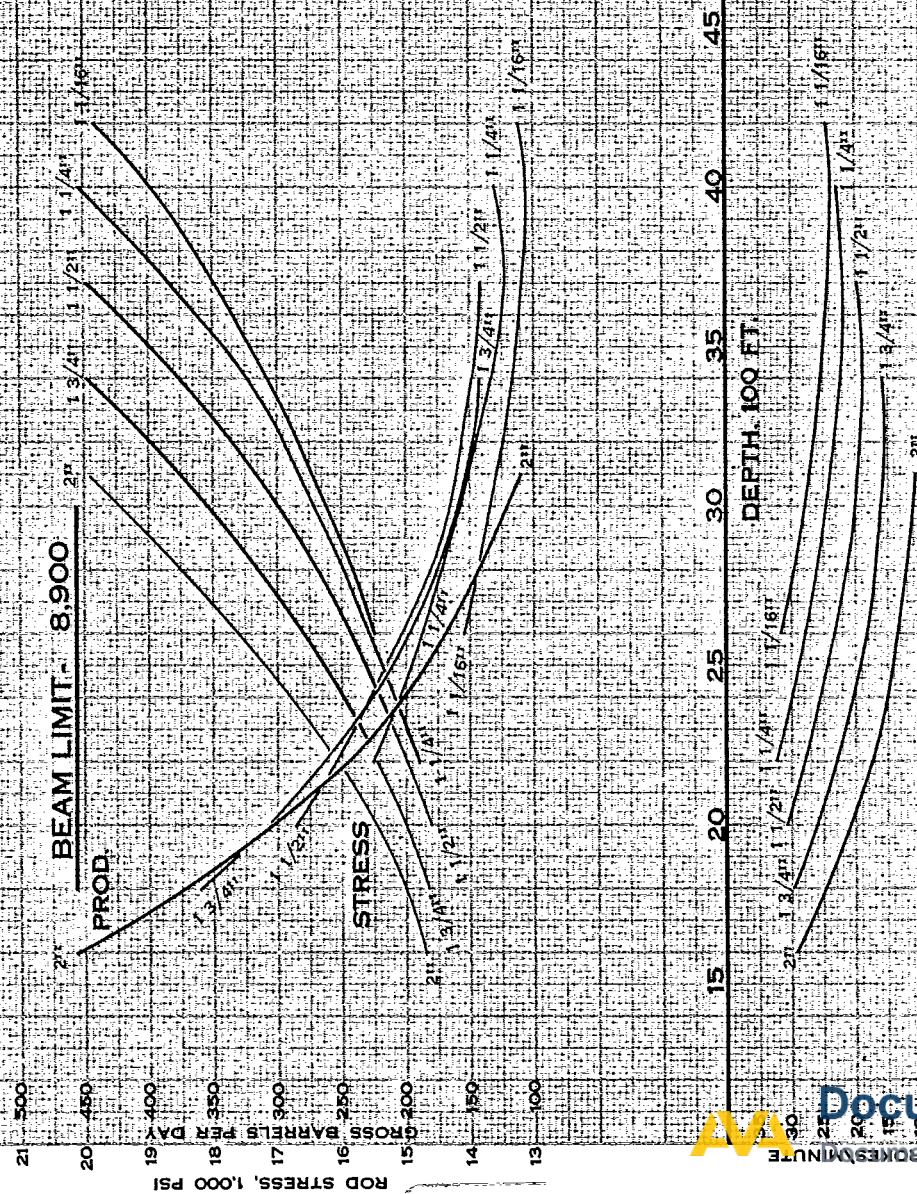
BEAM LIMIT - 8,900



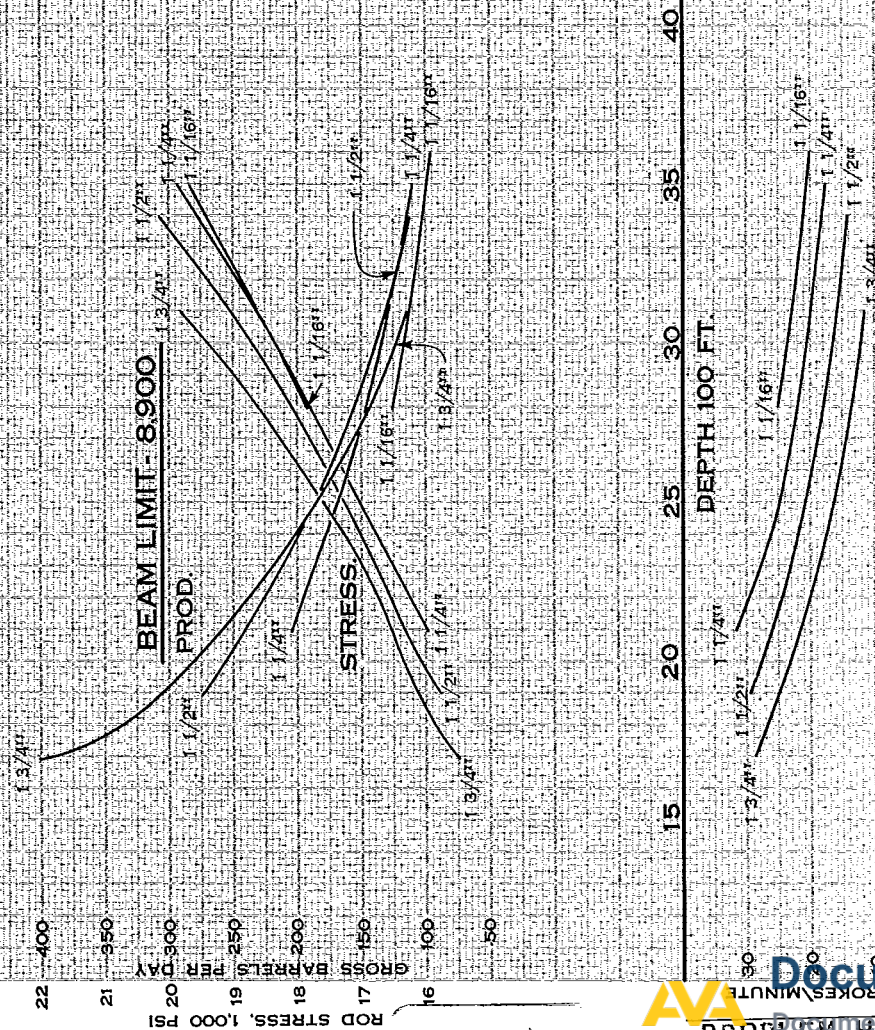
TORQUE: 57,000
 BEAM RATING: 8,900
 STROKE: 36
 ROD DESIGN: 64



TORQUE: 57,000
 BEAM RATING: 8,900
 STROKE: 36
 ROD DESIGN: 65



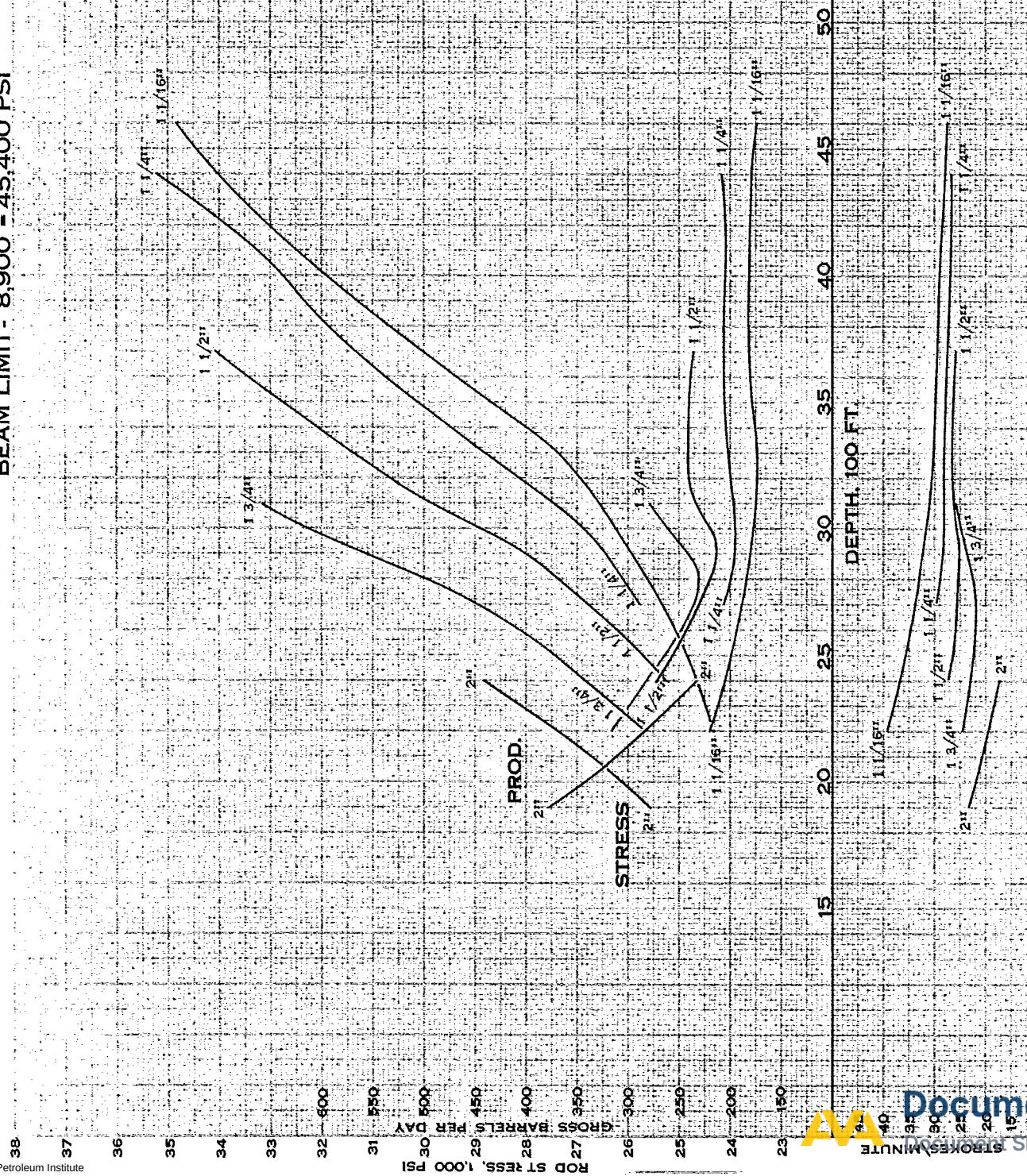
TORQUE: 57,000
 BEAM RATING: 8,900
 STROKE: 36
 ROD DESIGN: 66



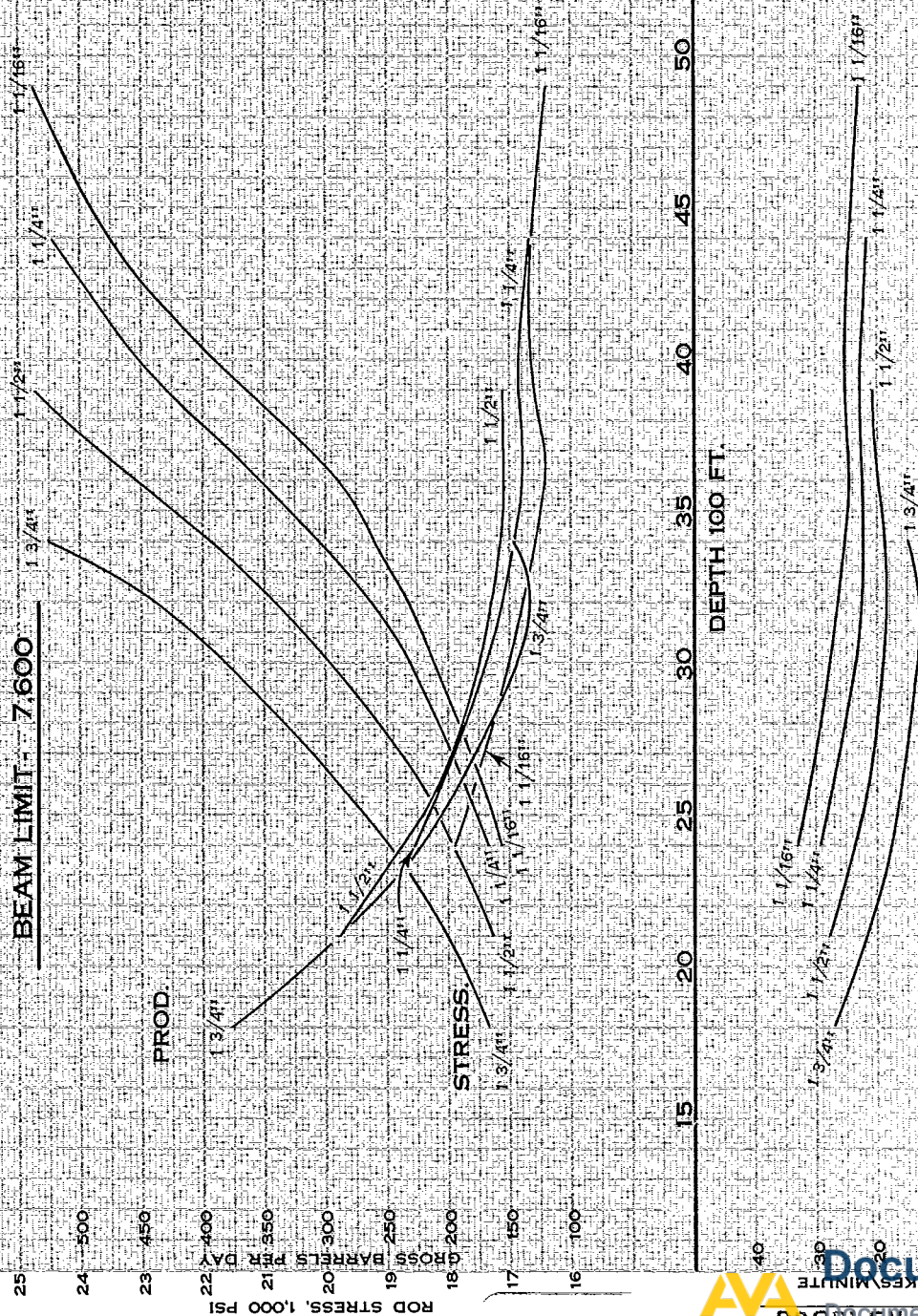
Documents
 PROBLEM HARD COPY

BEAM LIMIT - 8,900 - 45,400 PSI

TORQUE: 57,000
 BEAM RATING: 8,900
 STROKE: 42
 ROD DESIGN: 44



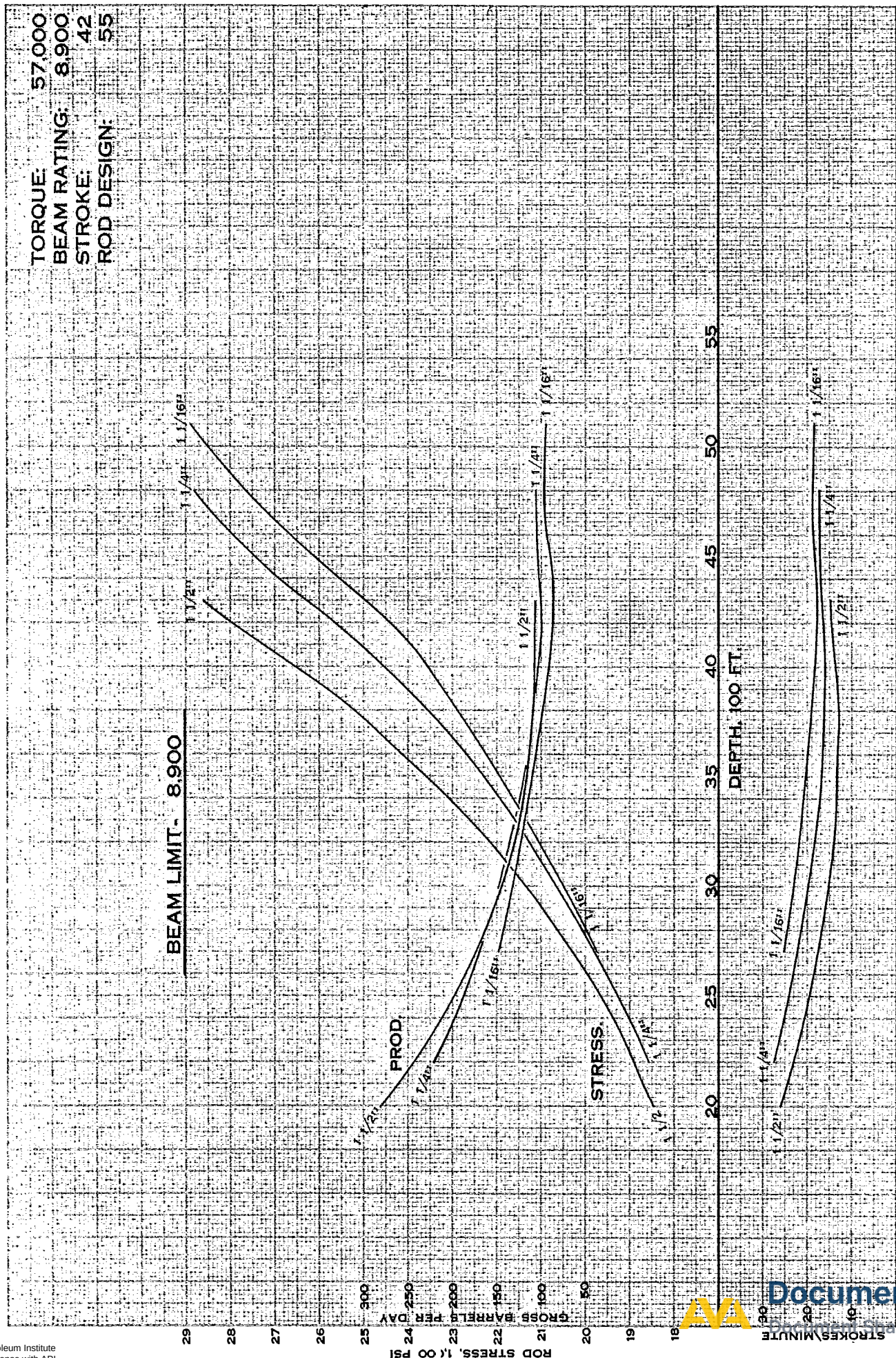
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 ROD DESIGN: 54



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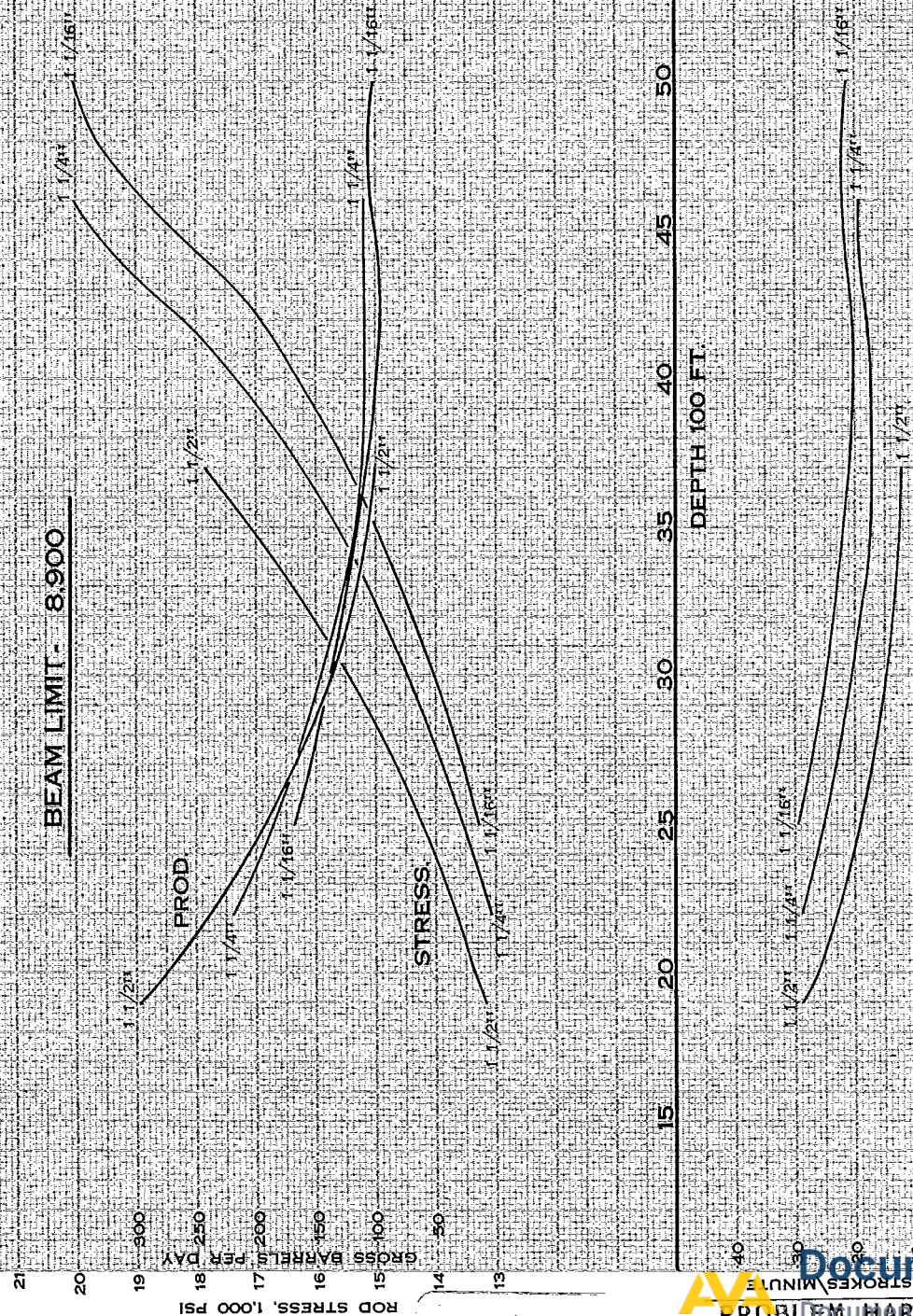
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 BEAM RATING: 8,900
 STROKE: 42
 ROD DESIGN: 55

BEAM LIMIT - 8,900



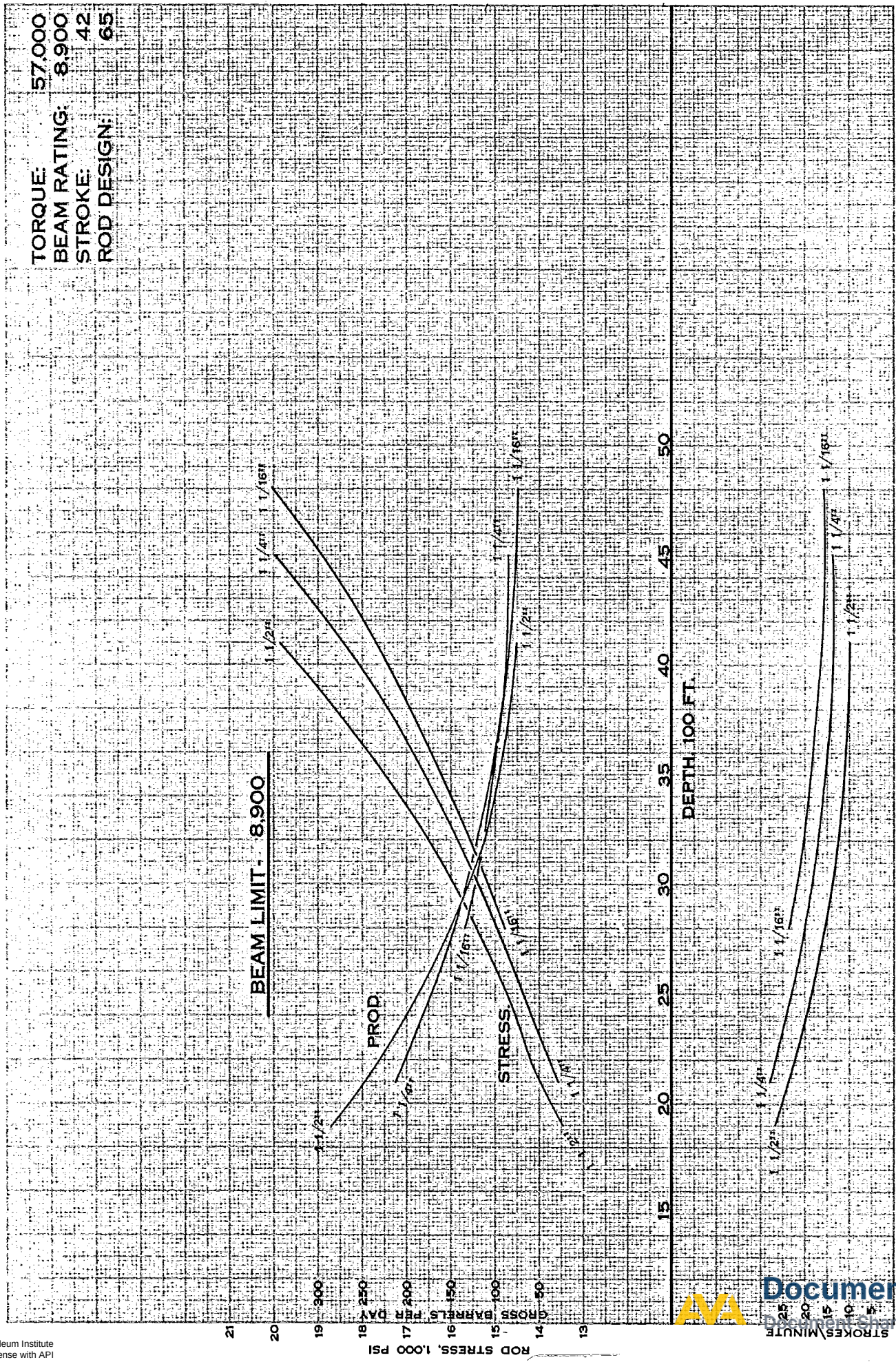
TORQUE: 57,000
 BEAM RATING: 8,900
 STROKE: 42
 ROD DESIGN: 64

BEAM LIMIT - 8,900



Documents
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TORQUE: 57,000
 BEAM RATING: 8,900
 STROKE: 42
 ROD DESIGN: 65

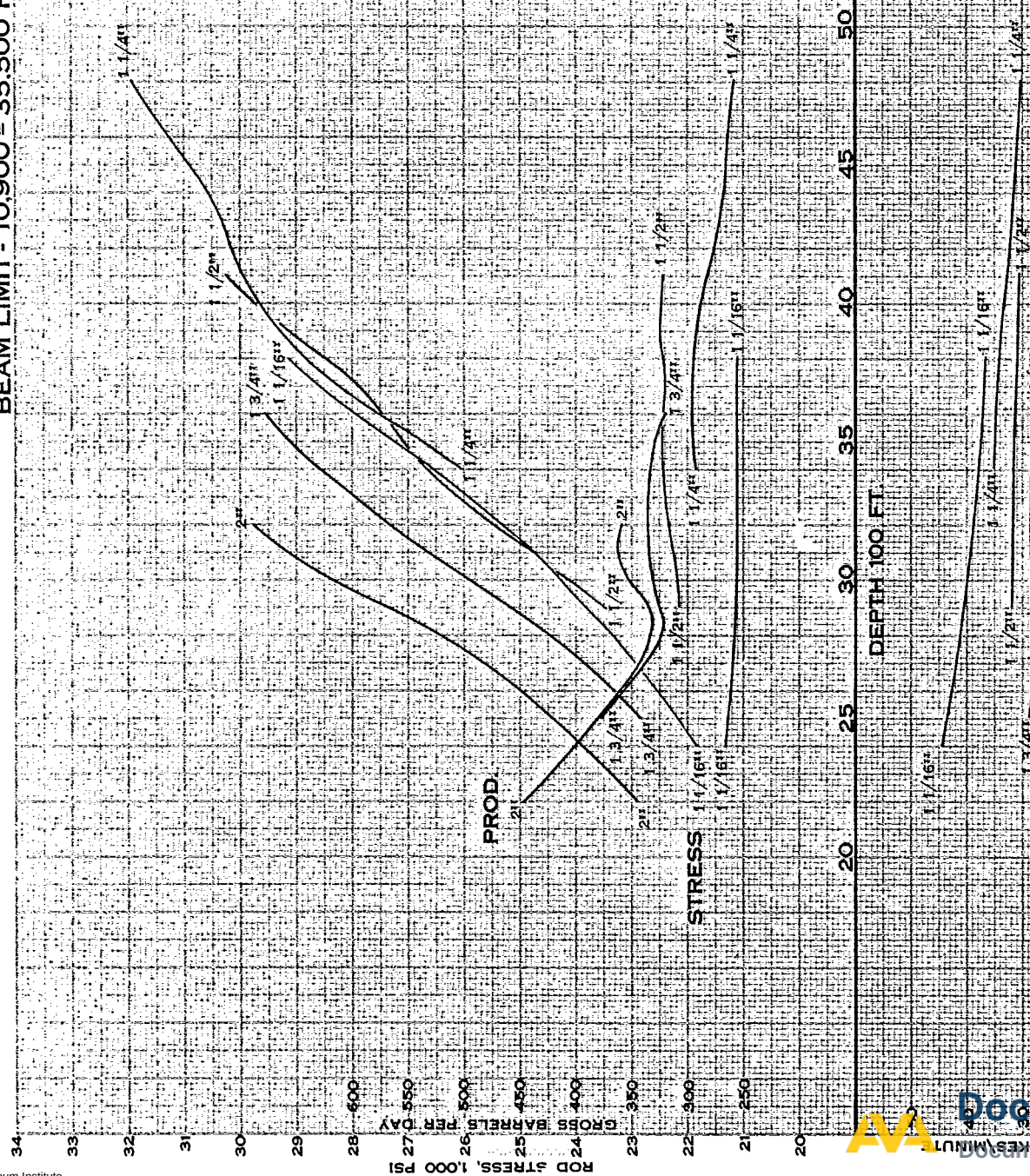


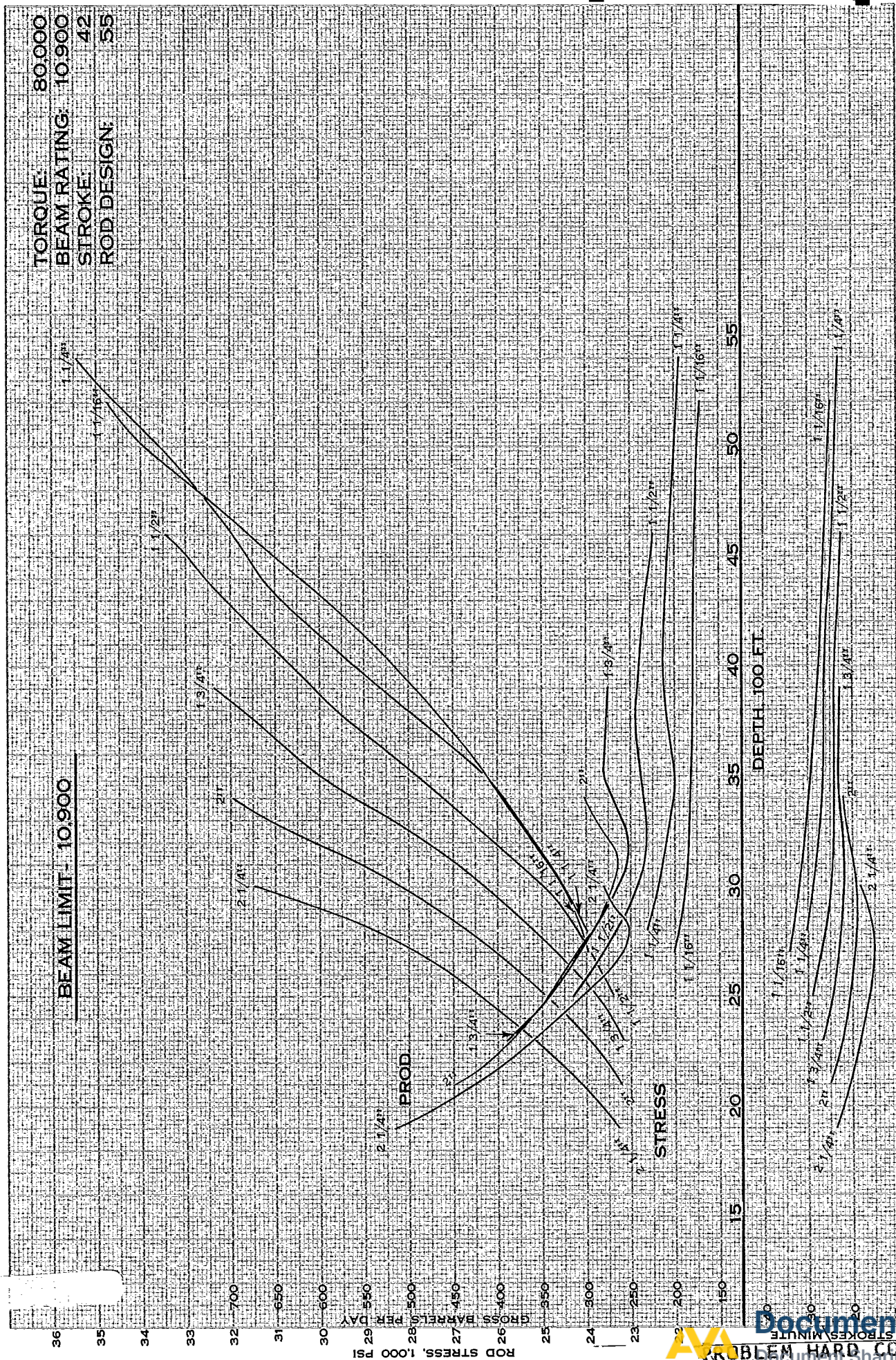
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DEPTH 100 FT.

BEAM LIMIT - 10,900 = 35,500 PSI

TORQUE: 80,000
 BEAM RATING: 10,900
 STROKE: 42
 ROD DESIGN: 54





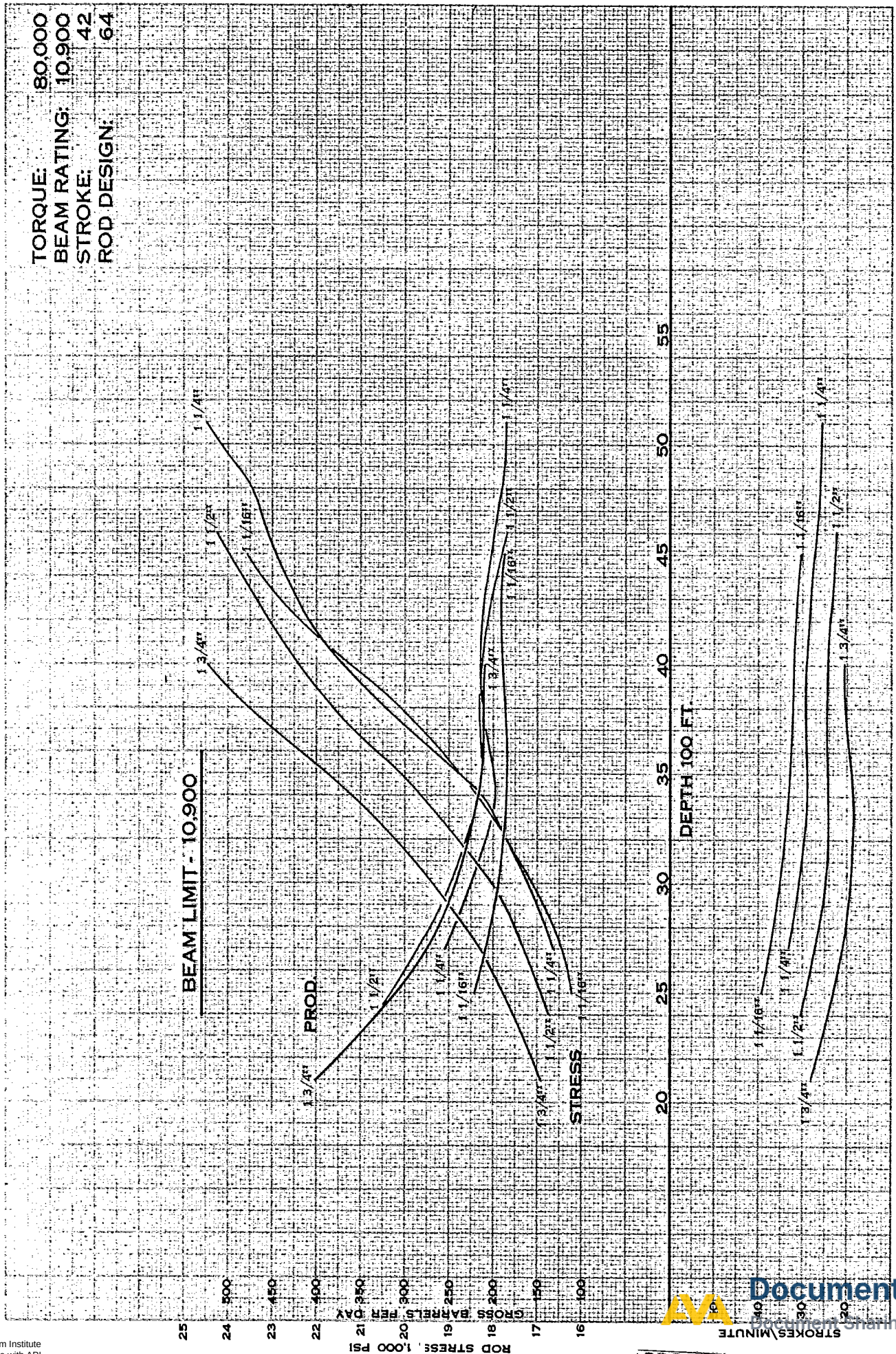
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 BEAM RATING: 10,900
 STROKE: 42
 ROD DESIGN: 64

BEAM LIMIT - 10,900

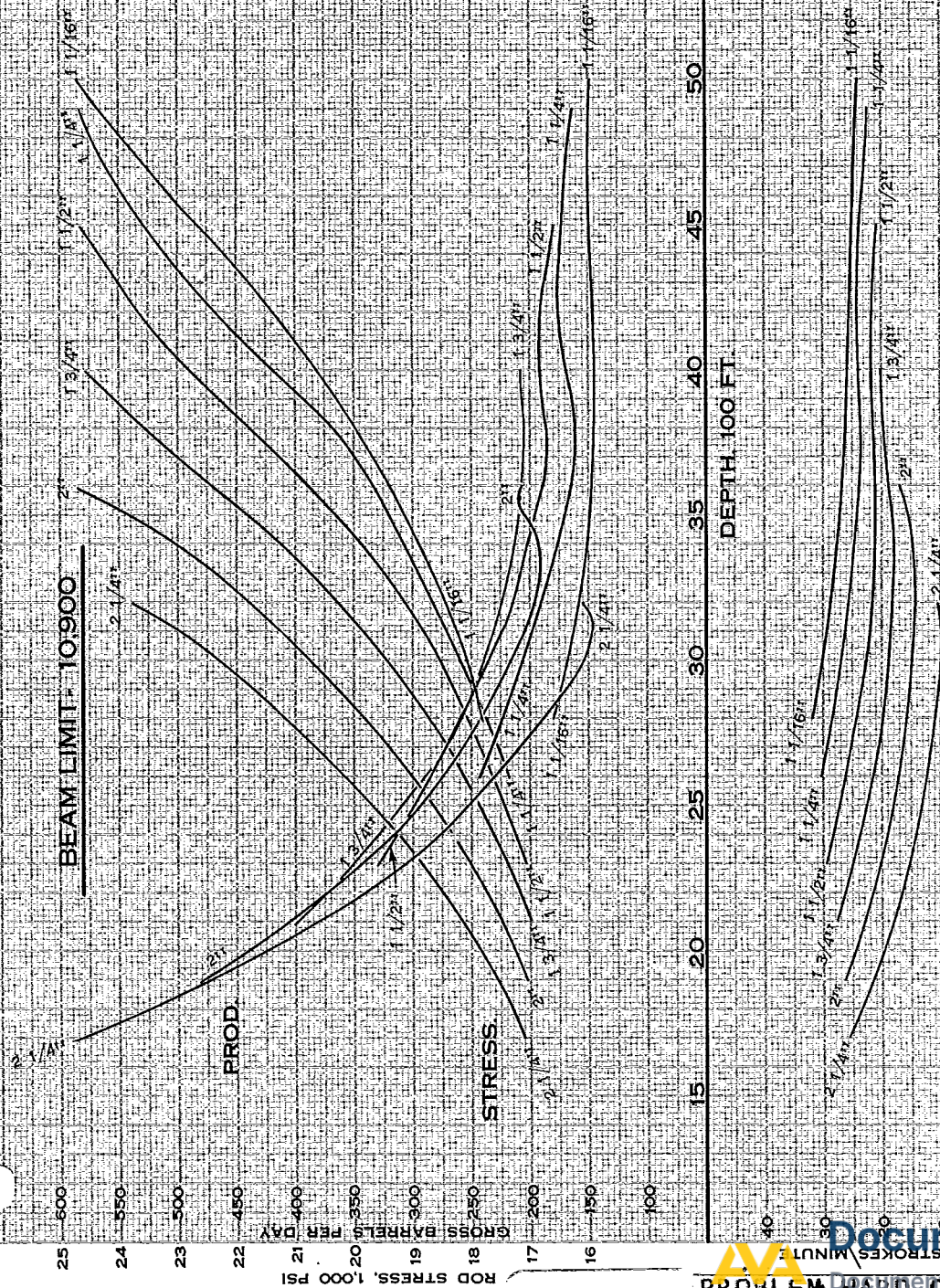
PROD

STRESS

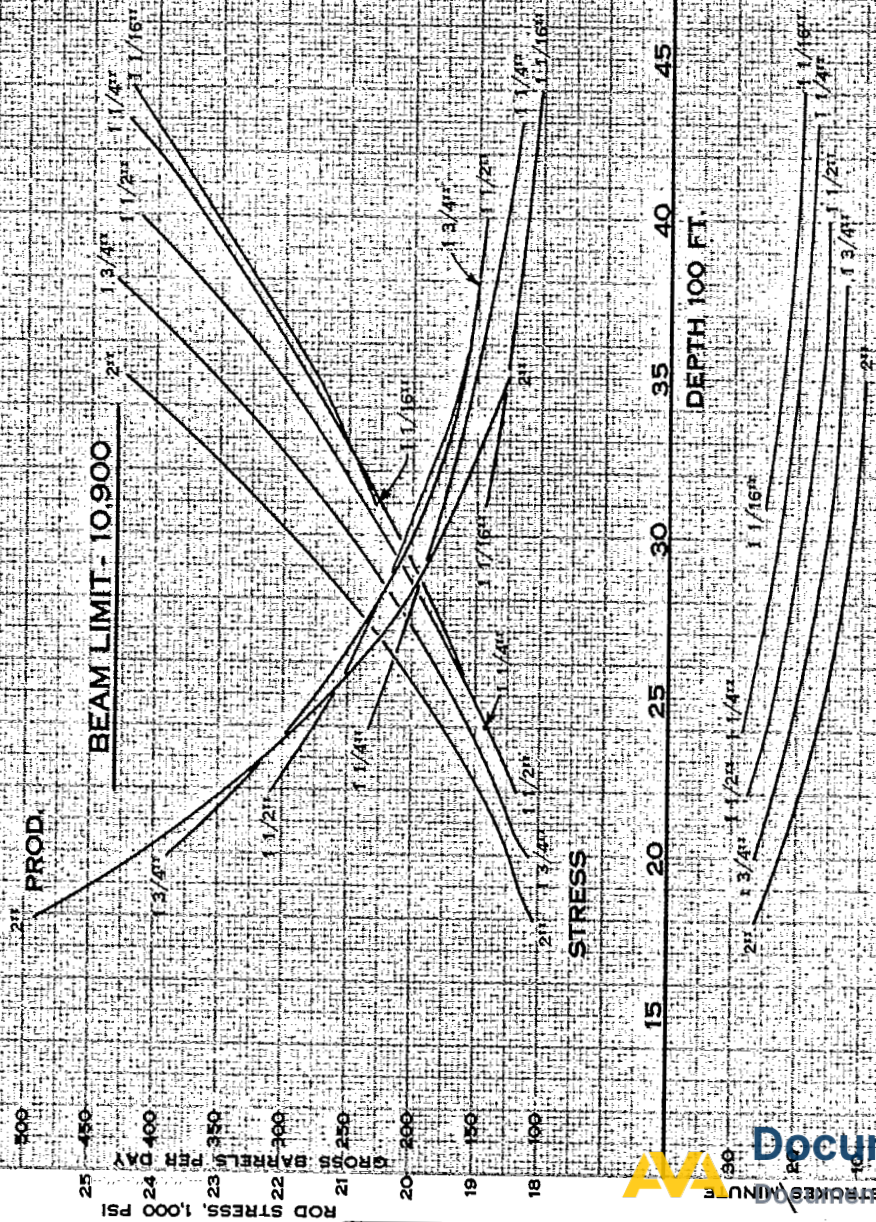
DEPTH 100 FT



TORQUE: 80,000
 BEAM RATING: 10,900
 STROKE: 42
 ROD DESIGN: 65

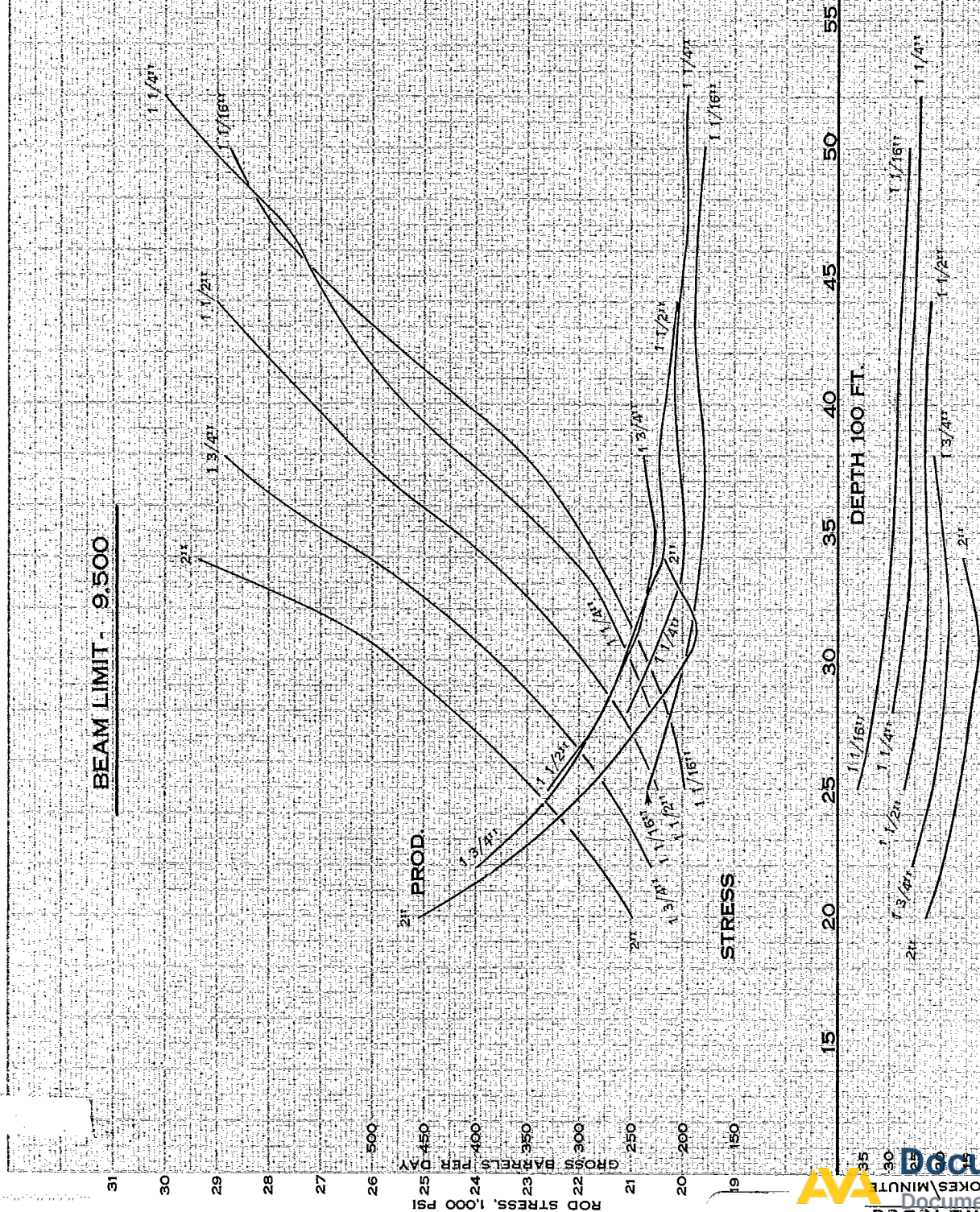


TORQUE: 80,000
 BEAM RATING: 10,900
 STROKE: 42
 ROD DESIGN: 66



TORQUE: 80,000
 BEAM RATING: 9,500
 STROKE: 48
 ROD DESIGN: 54

BEAM LIMIT - 9,500

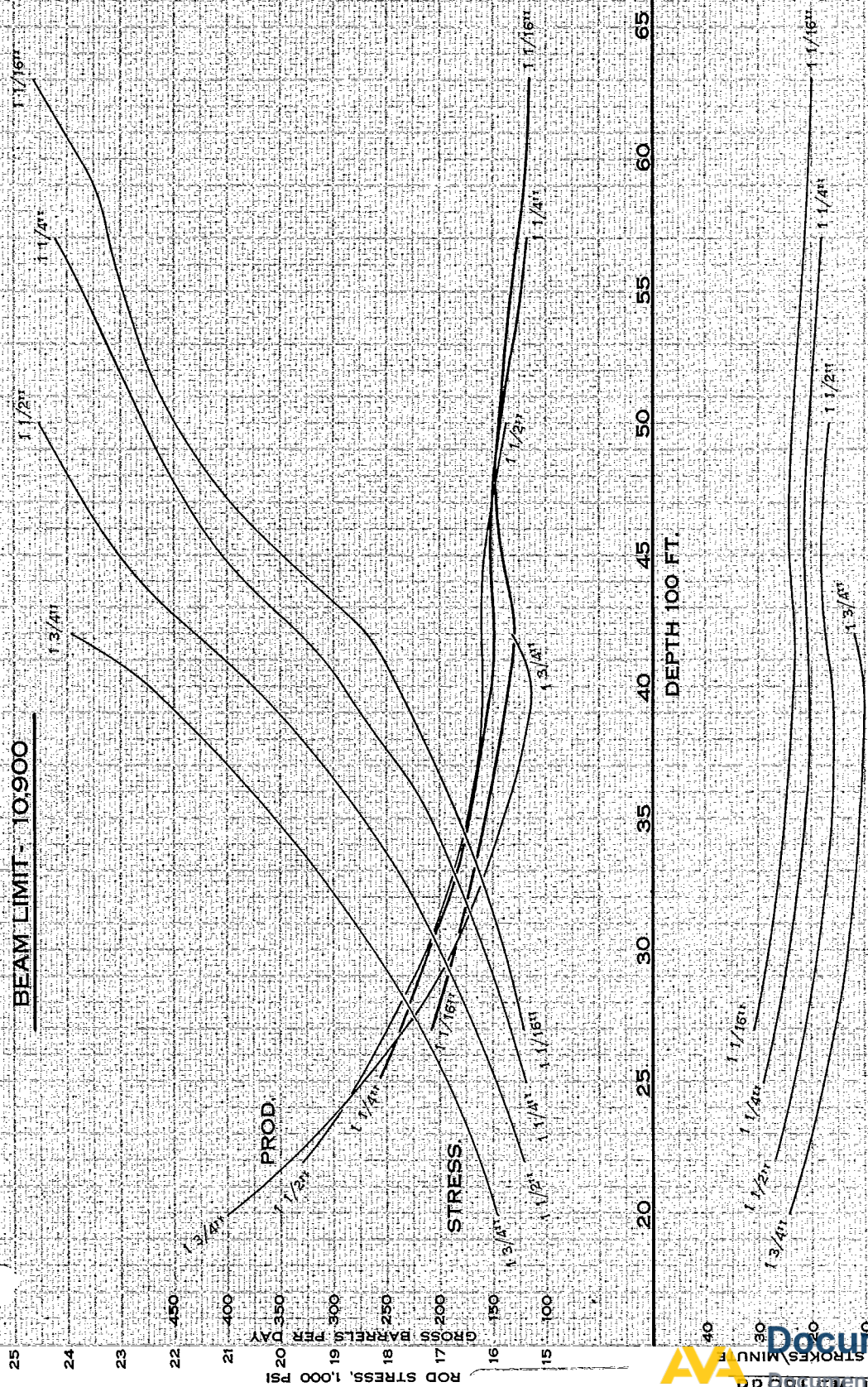


BEAM LIMIT - 9,500



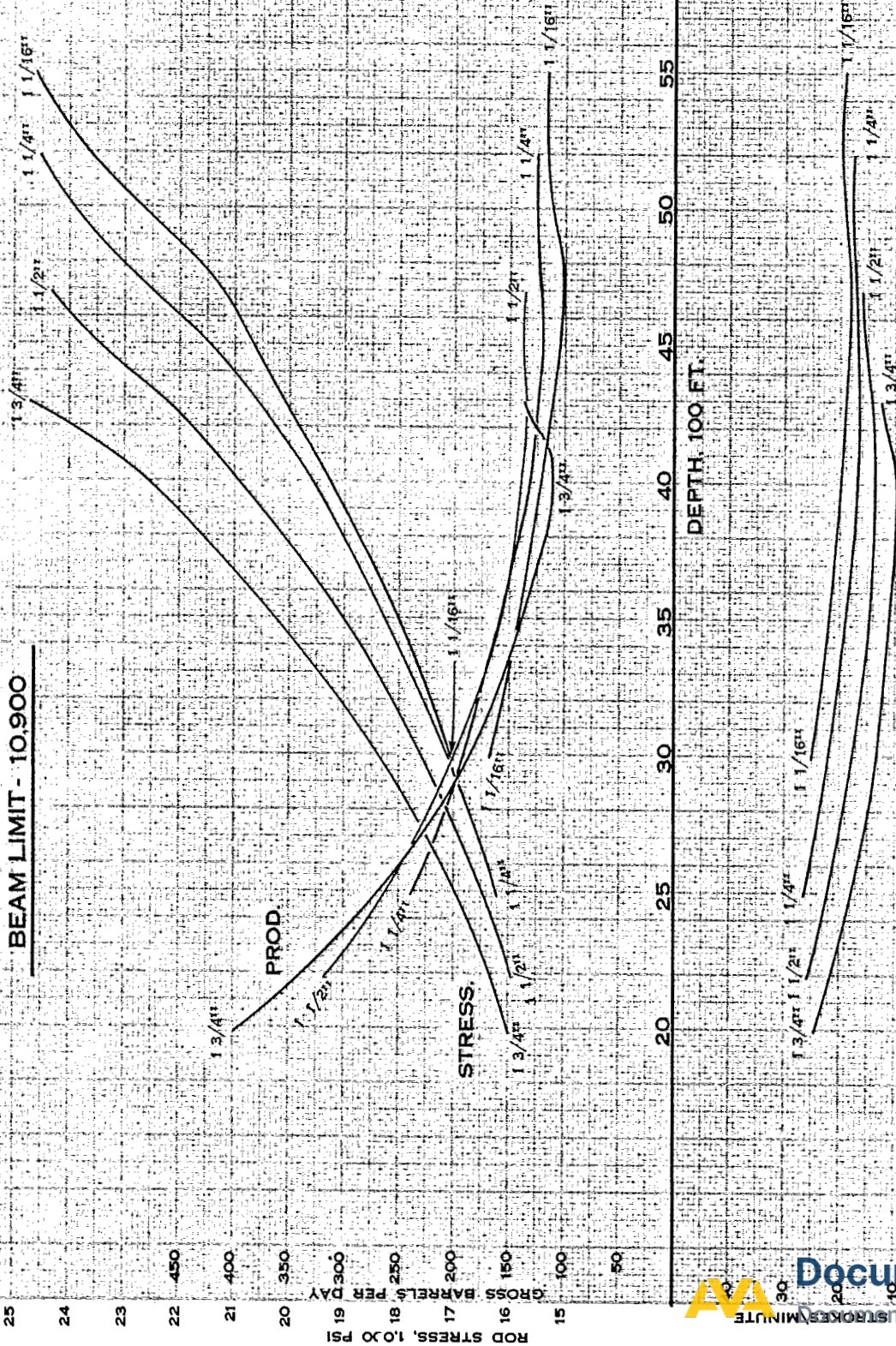
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 STROKE: 48
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BEAM LIMIT - 10,900



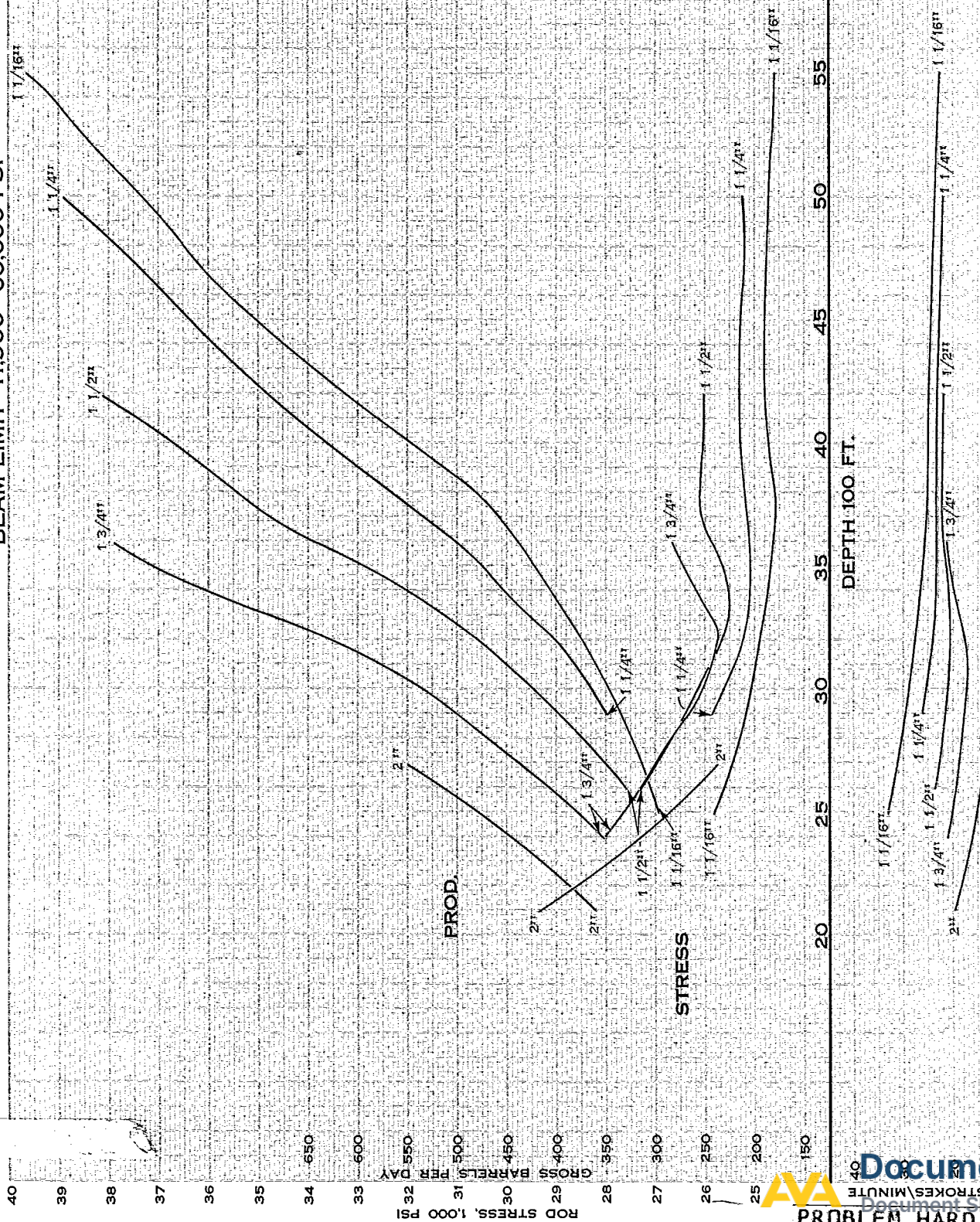
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 BEAM RATING: 10,900
 STROKE: 48
 ROD DESIGN: 65

BEAM LIMIT - 10,900



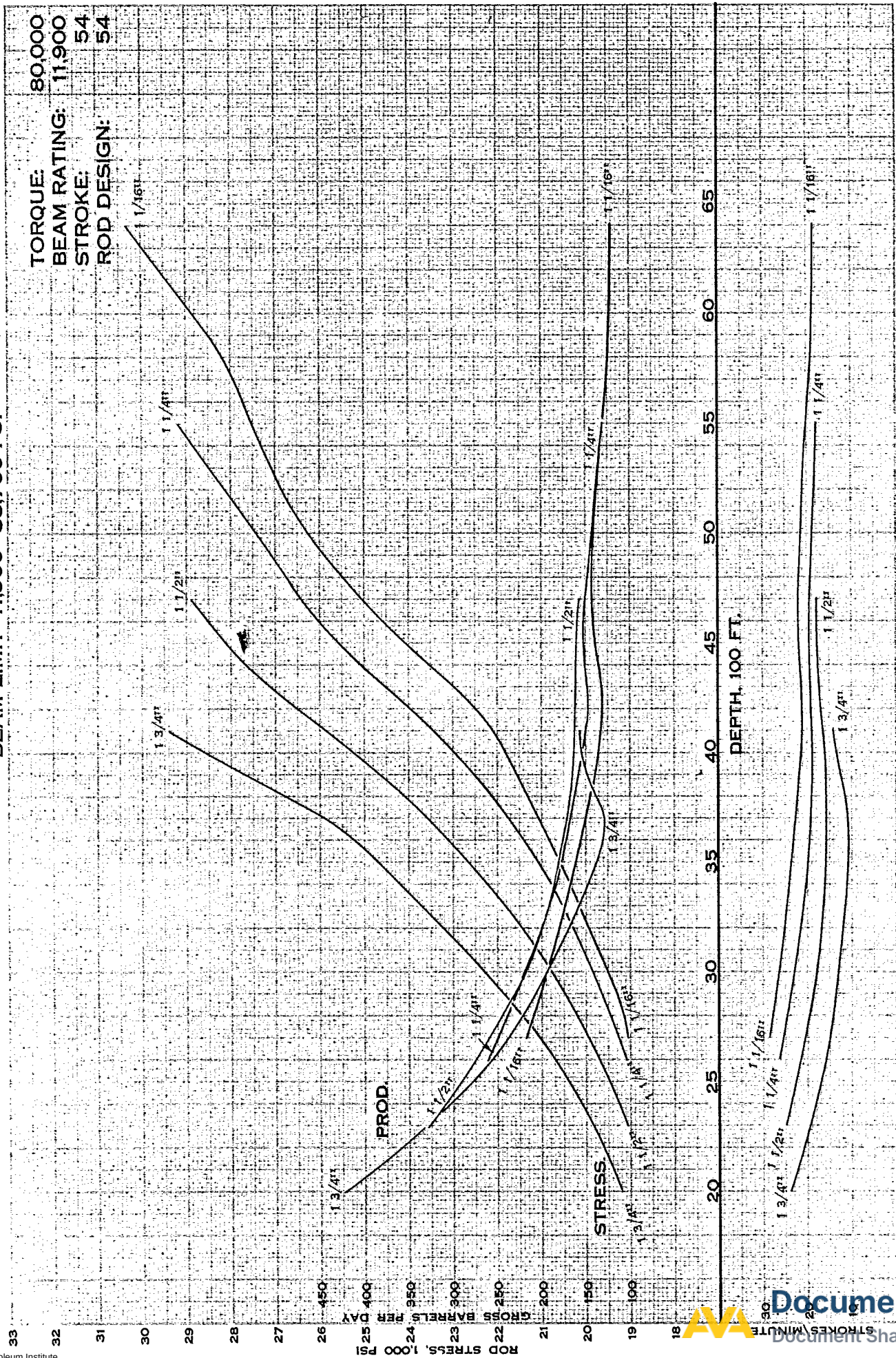
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TORQUE: 80,000
 BEAM RATING: 11,900
 STROKE: 54
 ROD DESIGN: 44



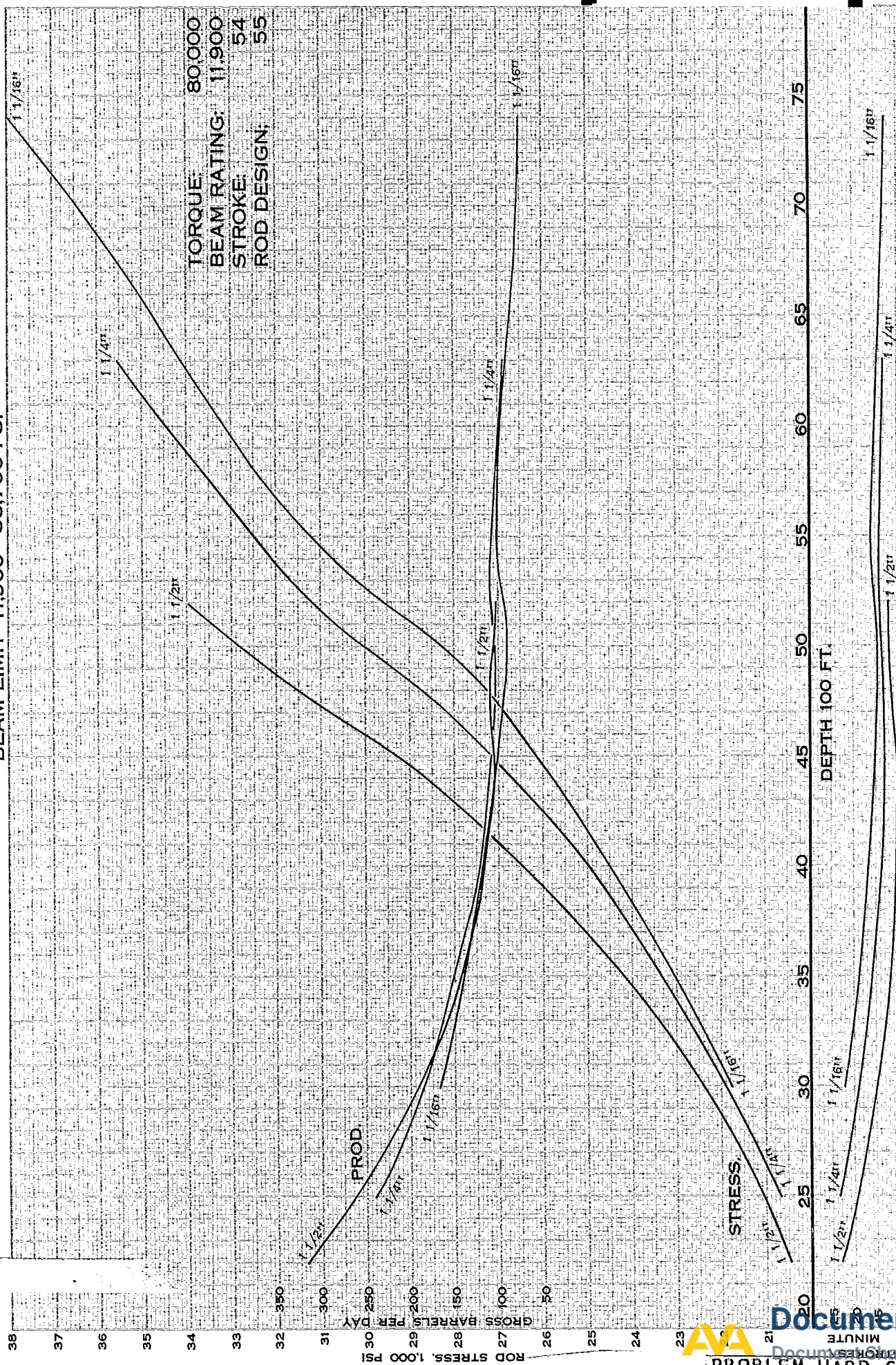
BEAM LIMIT - 11,900 = 38,700 PSI

TORQUE: 80,000
 BEAM RATING: 11,900
 STROKE: 54
 ROD DESIGN: 54



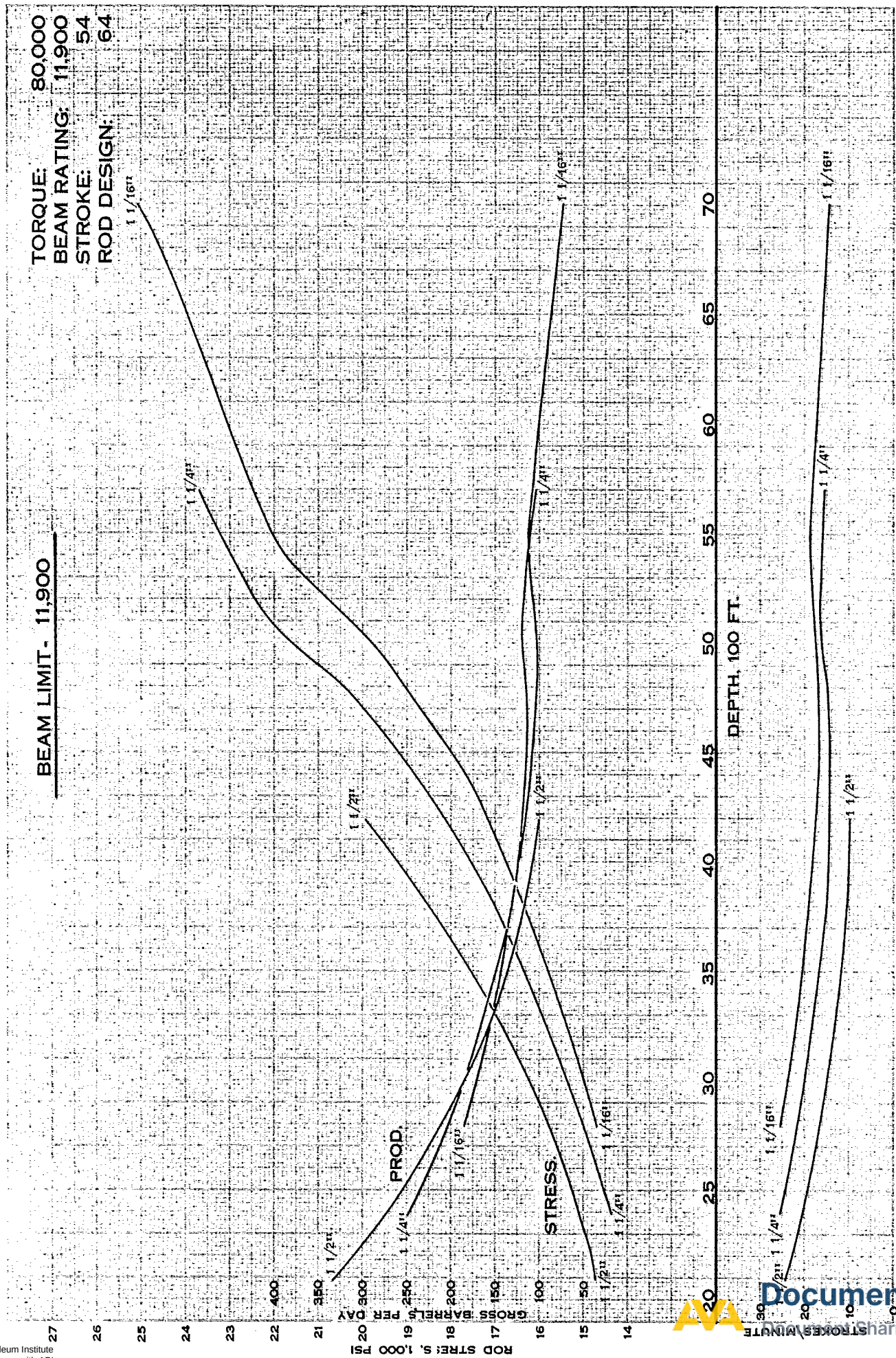
BEAM LIMIT - 11,900 = 38,700 PSI

TORQUE: 80,000
 BEAM RATING: 11,900
 STROKE: 54
 ROD DESIGN: 55



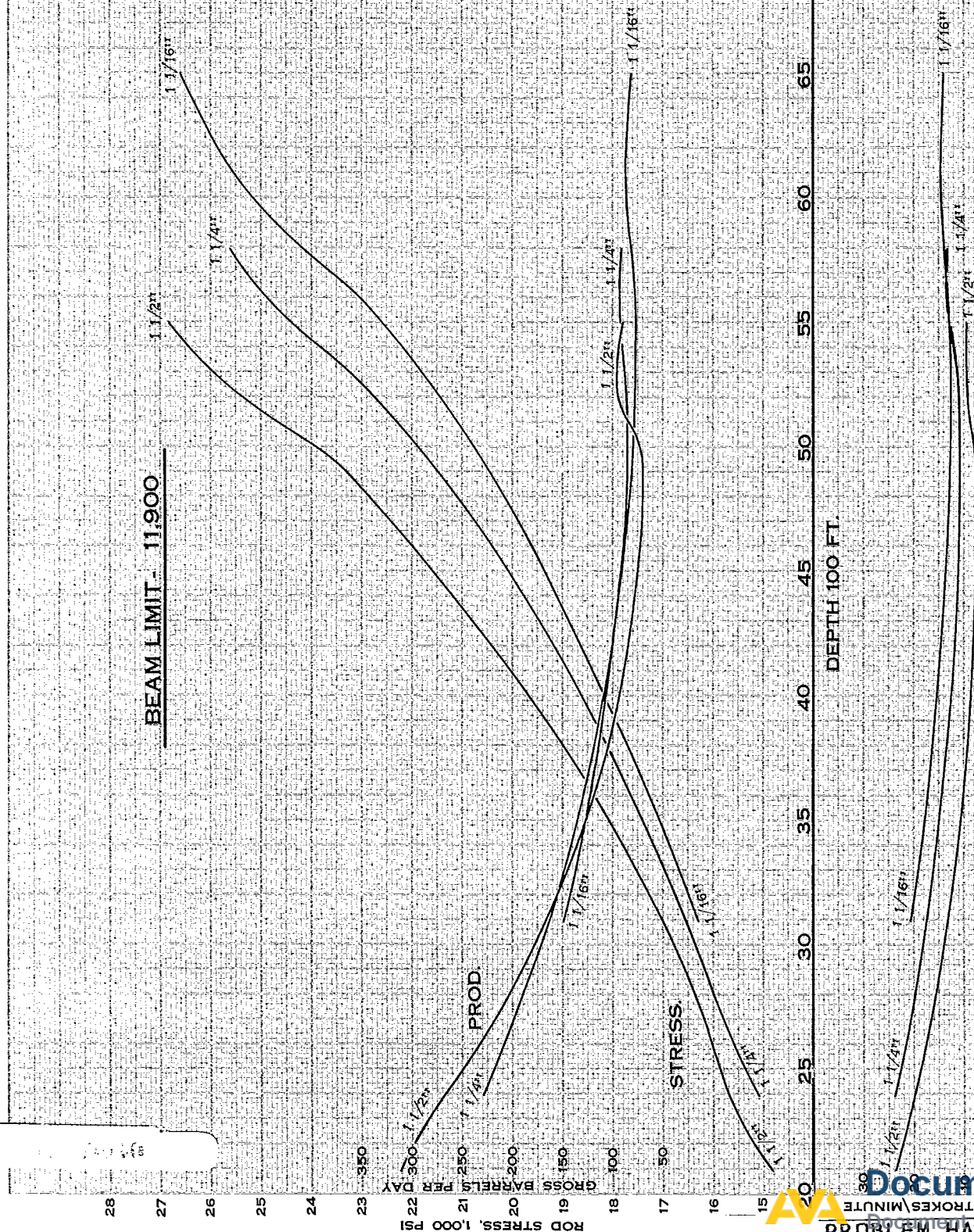
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 BEAM RATING: 11,900
 STROKE: 54
 ROD DESIGN: 64

BEAM LIMIT - 11,900



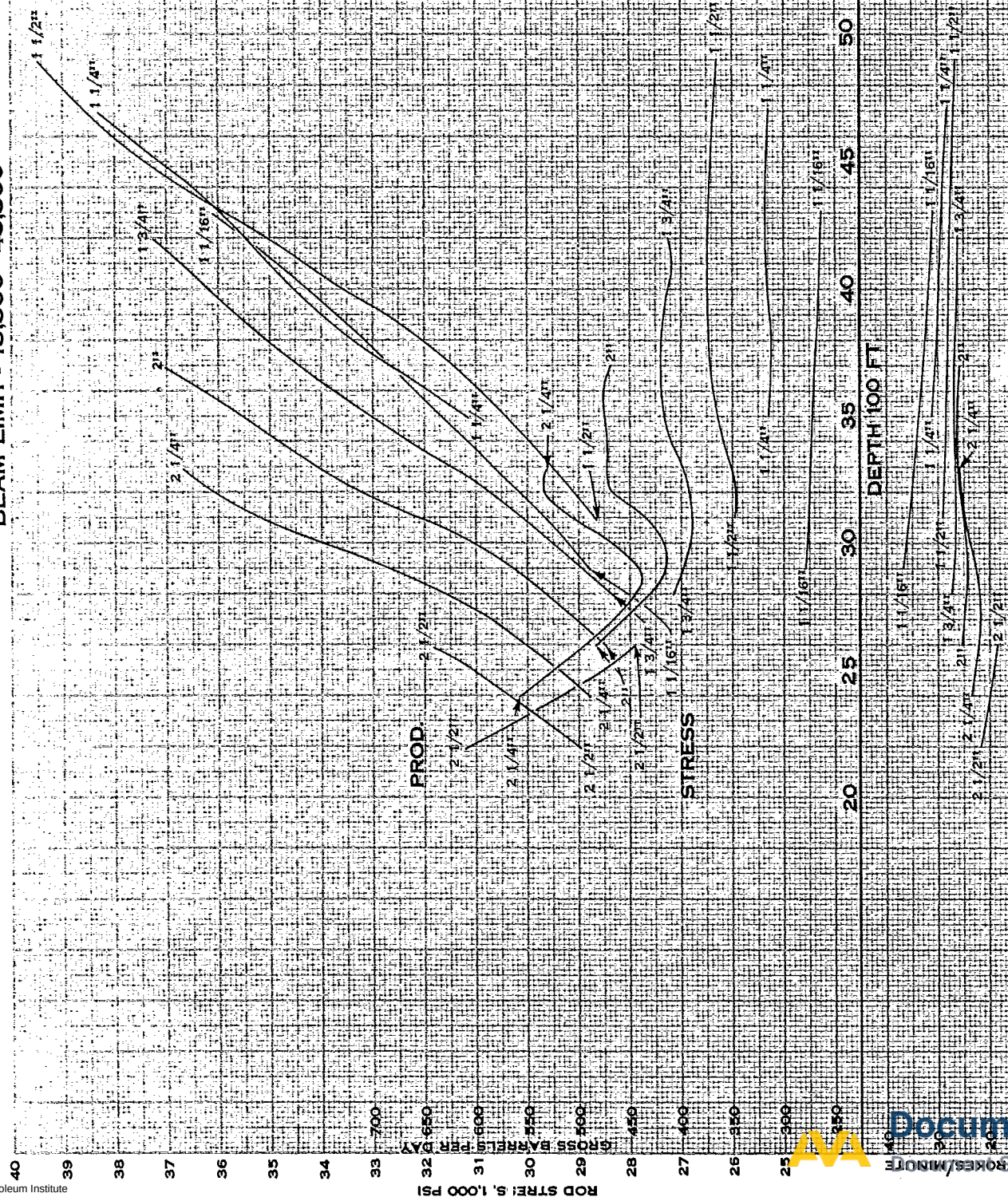
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 BEAM RATING: 11,900
 STROKE: 54
 ROD DESIGN: 65

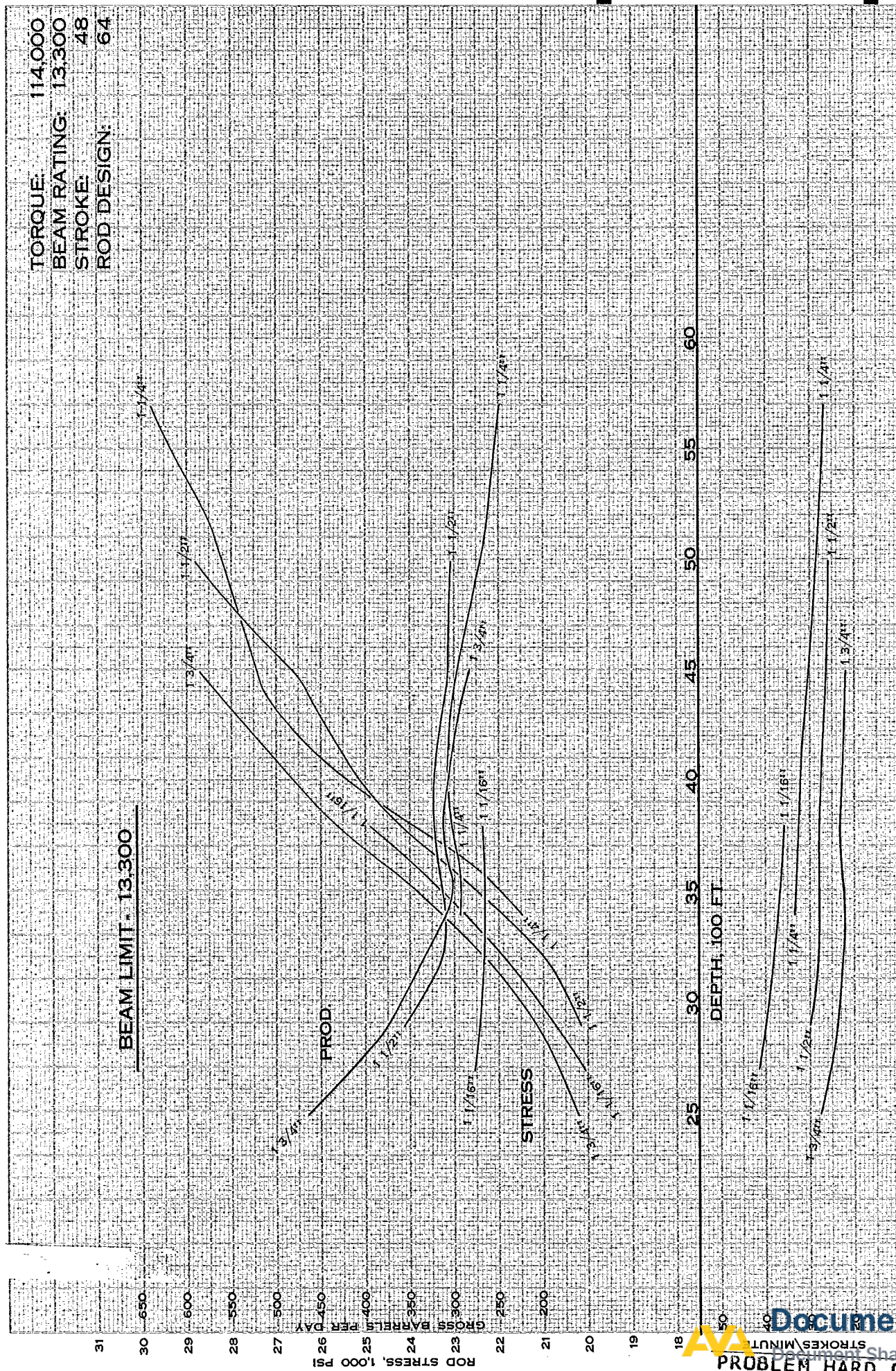
BEAM LIMIT - 11,900



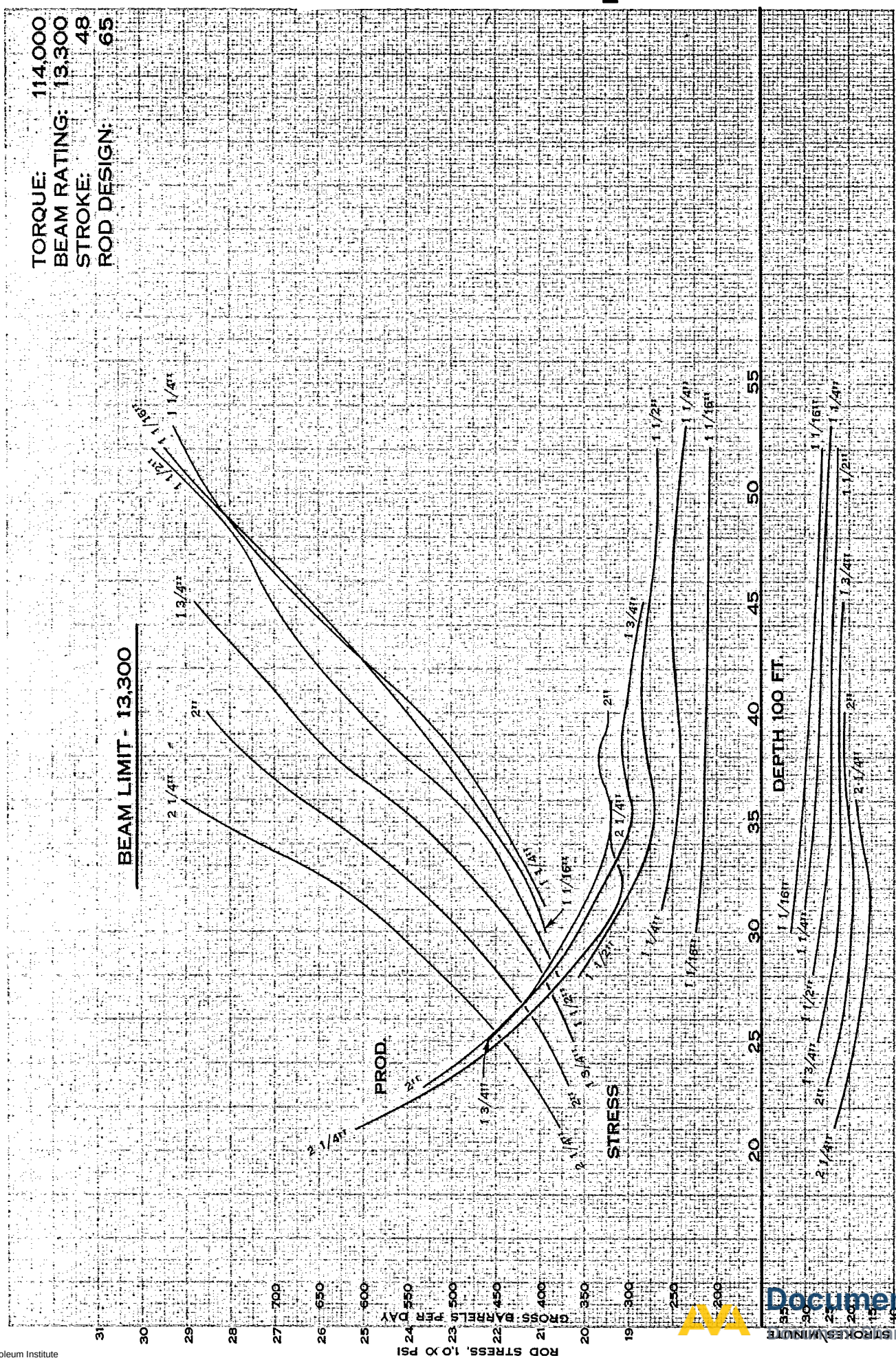
BEAM LIMIT - 13,300 = 43,300

TORQUE:	114,000
BEAM RATING:	13,300
STROKE:	48
ROD DESIGN:	55

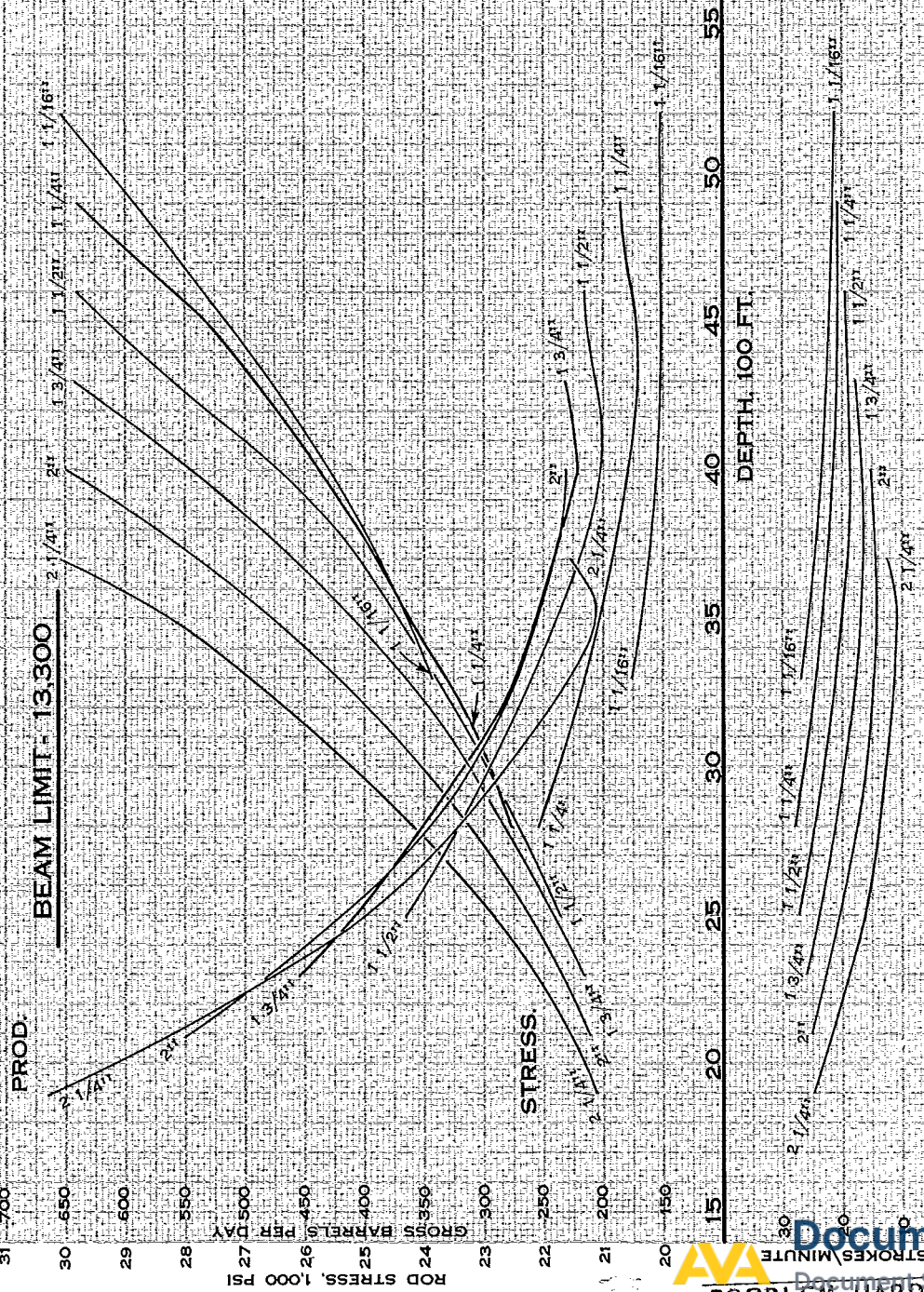




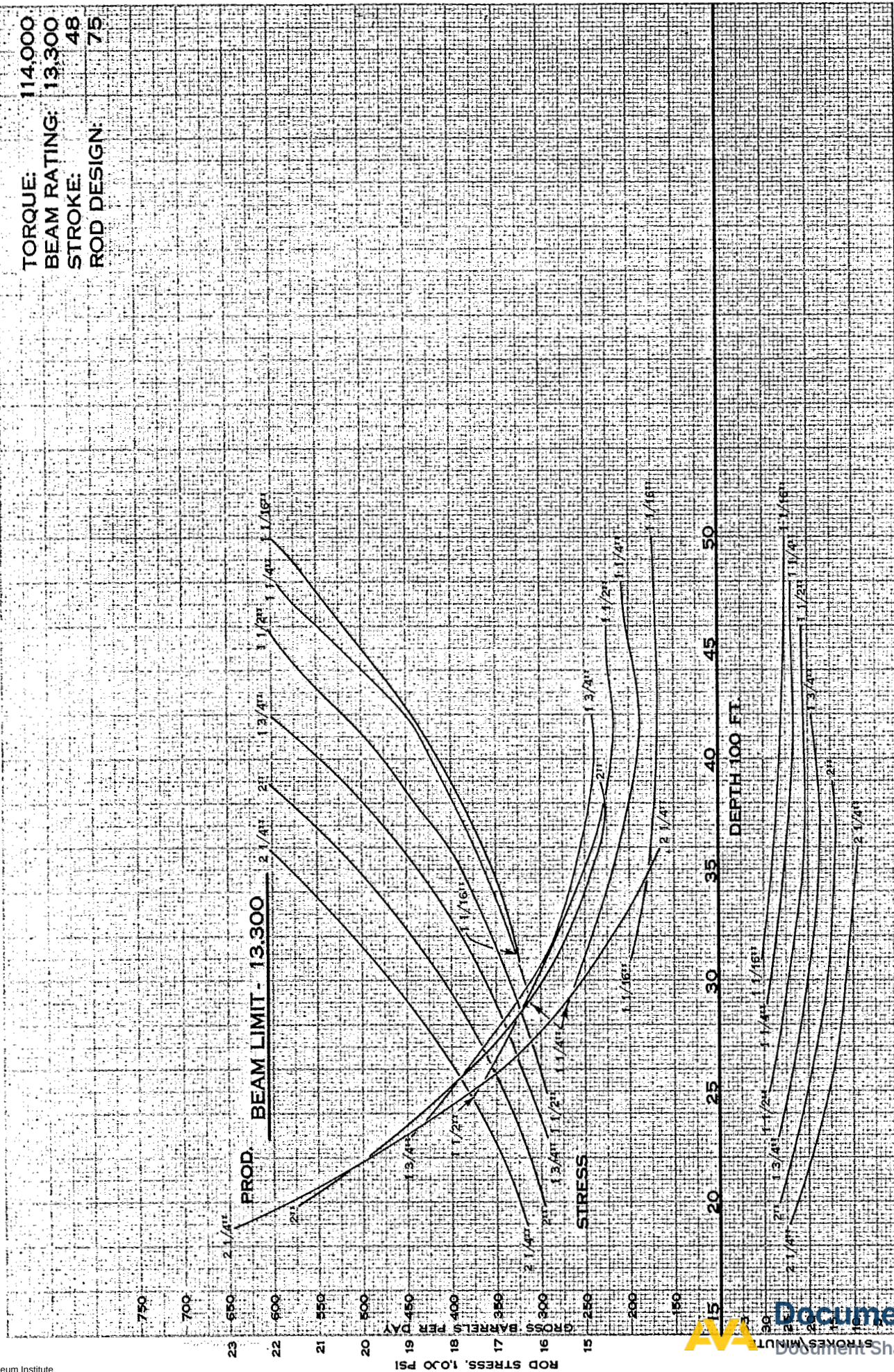
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 BEAM RATING: 13,300
 STROKE: 48
 ROD DESIGN: 65



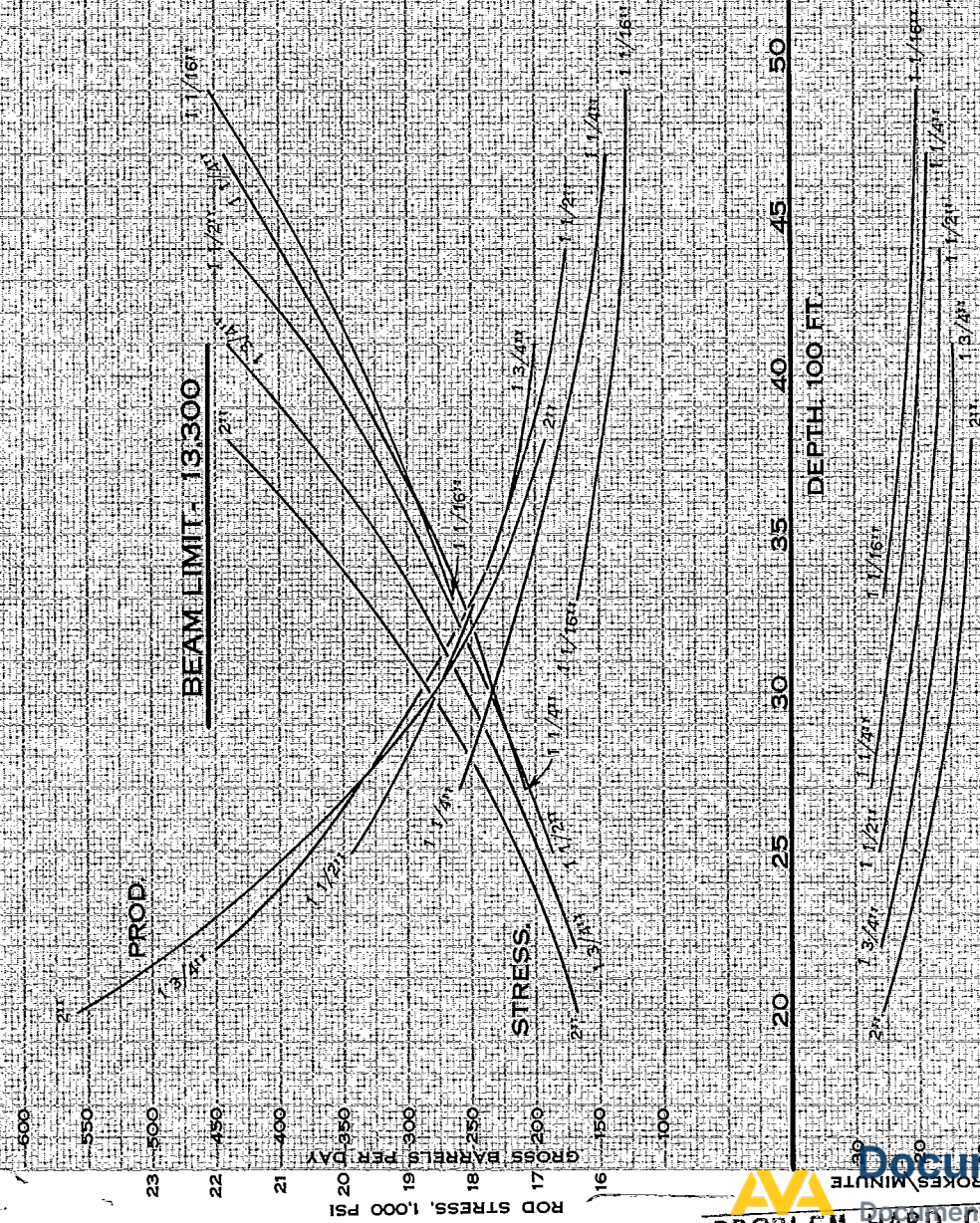
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 BEAM RATING: 13,300
 STROKE: 48
 ROD DESIGN: 66



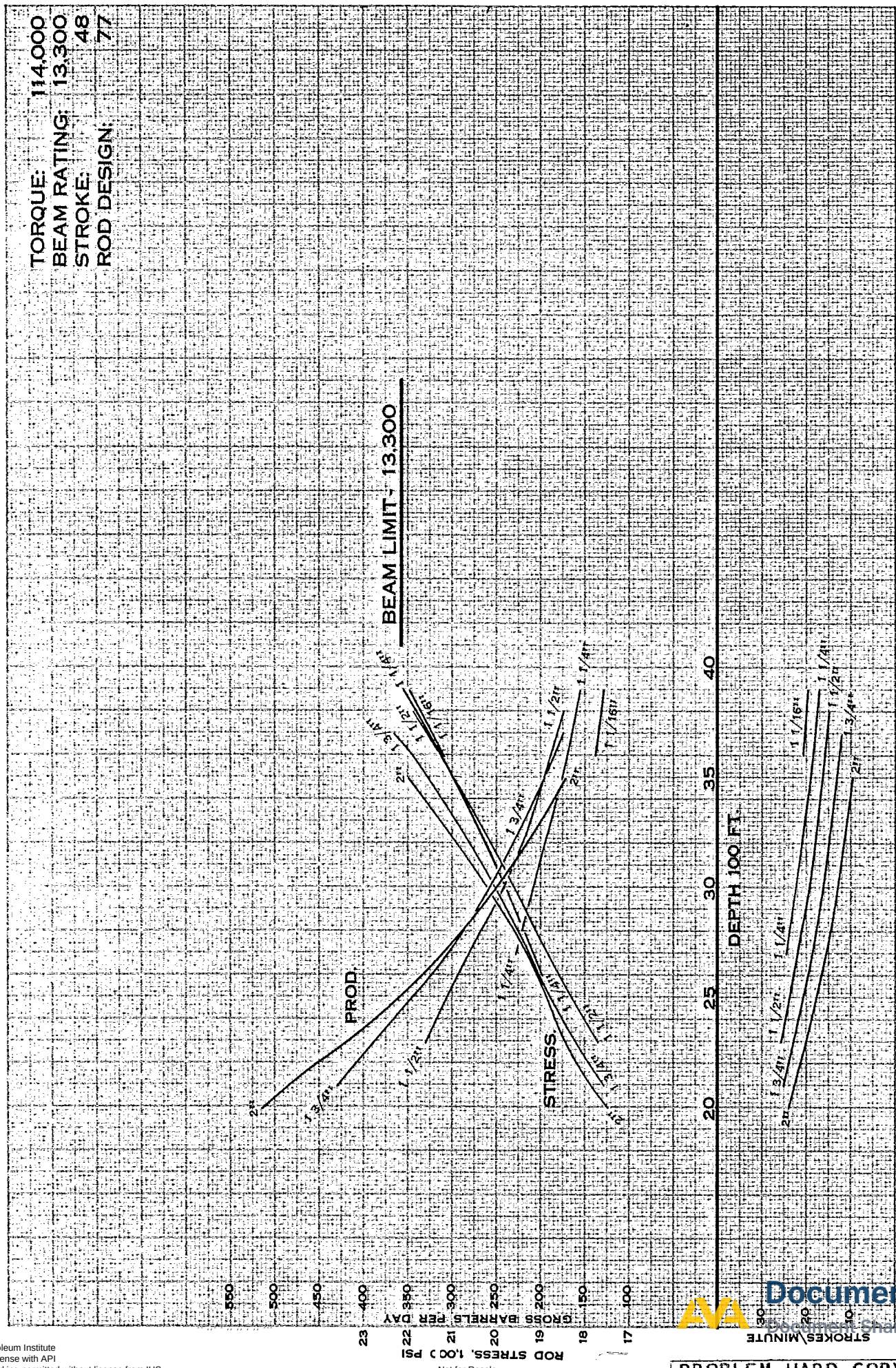
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 ROD DESIGN: 75



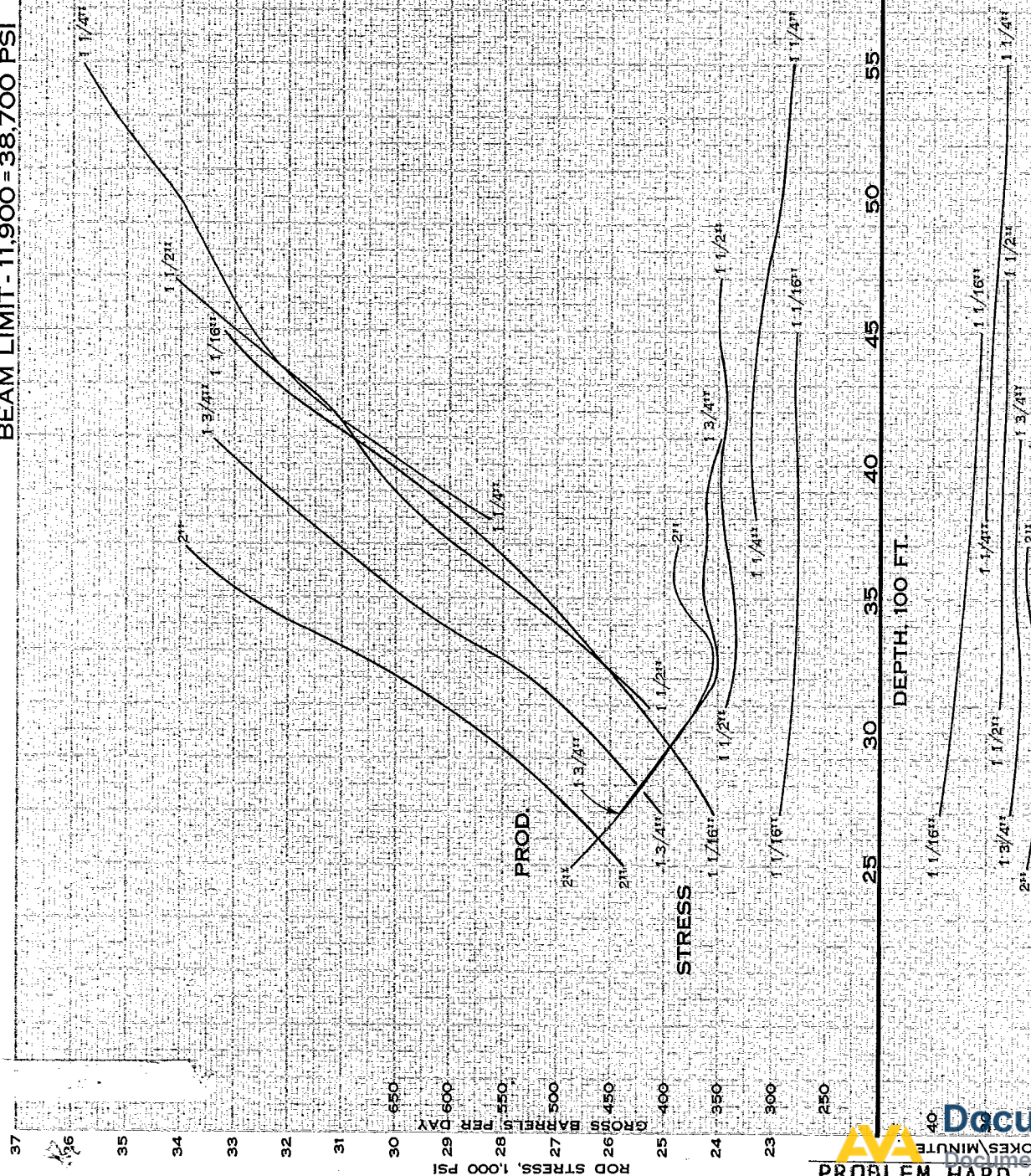
TORQUE: 114,000
 BEAM RATING: 13,300
 STROKE: 48
 ROD DESIGN: 76



TORQUE: 114,000
 BEAM RATING: 13,300
 STROKE: 48
 ROD DESIGN: 77

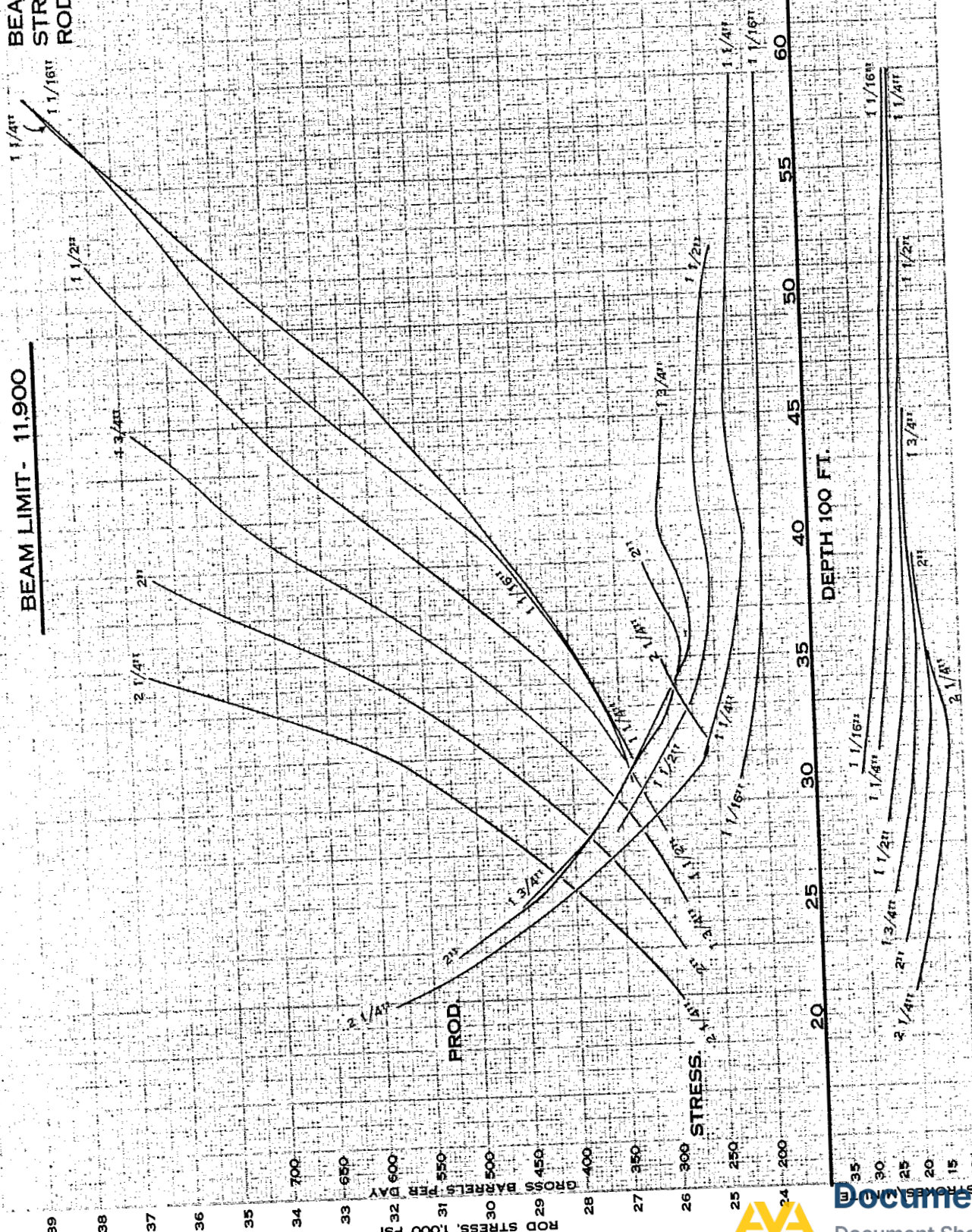


TORQUE:	114,000
BEAM RATING:	11,900
STROKE:	54
ROD DESIGN:	54



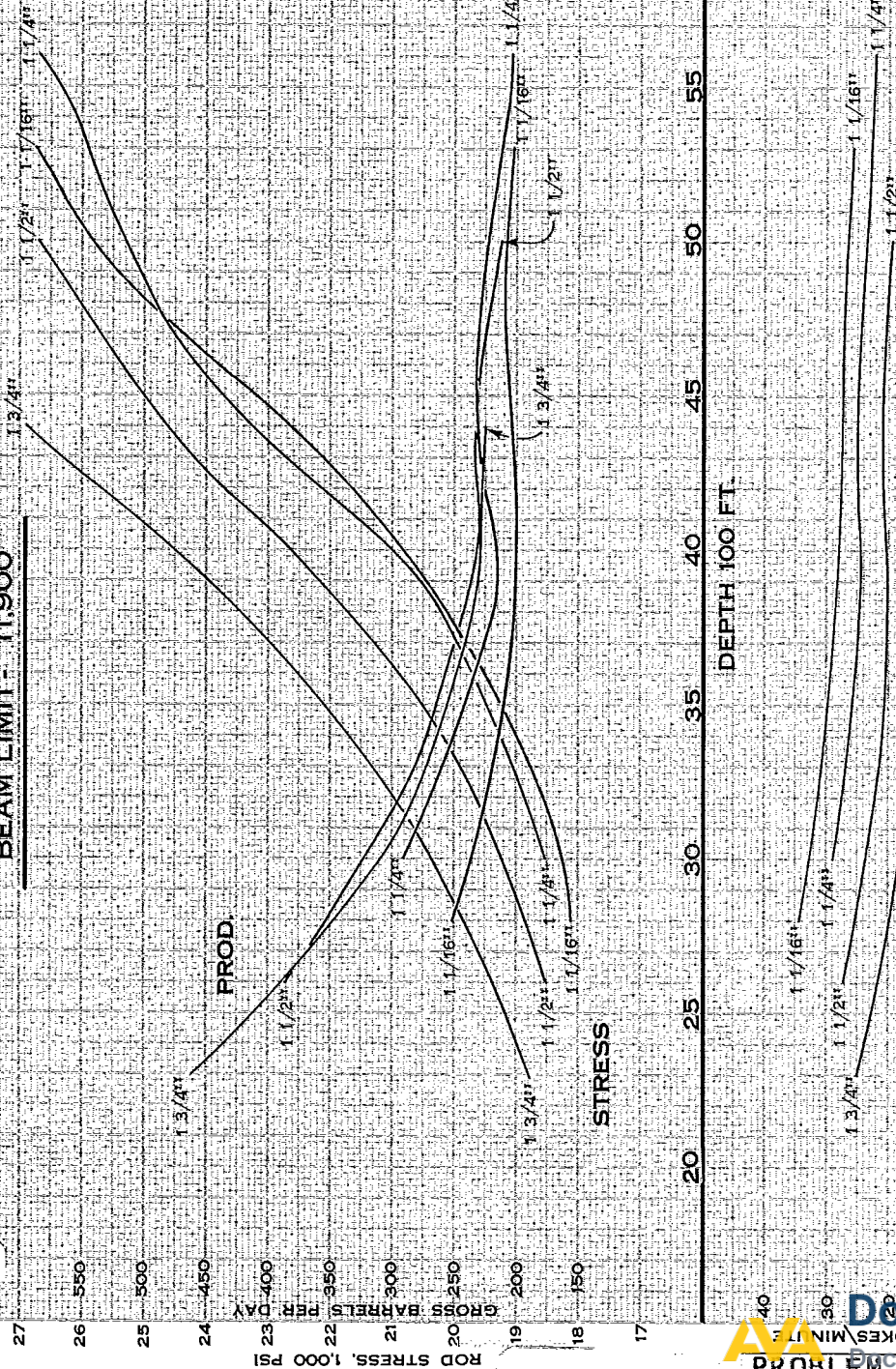
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 BEAM RATING: 11,900
 STROKE: 54
 ROD DESIGN: 55

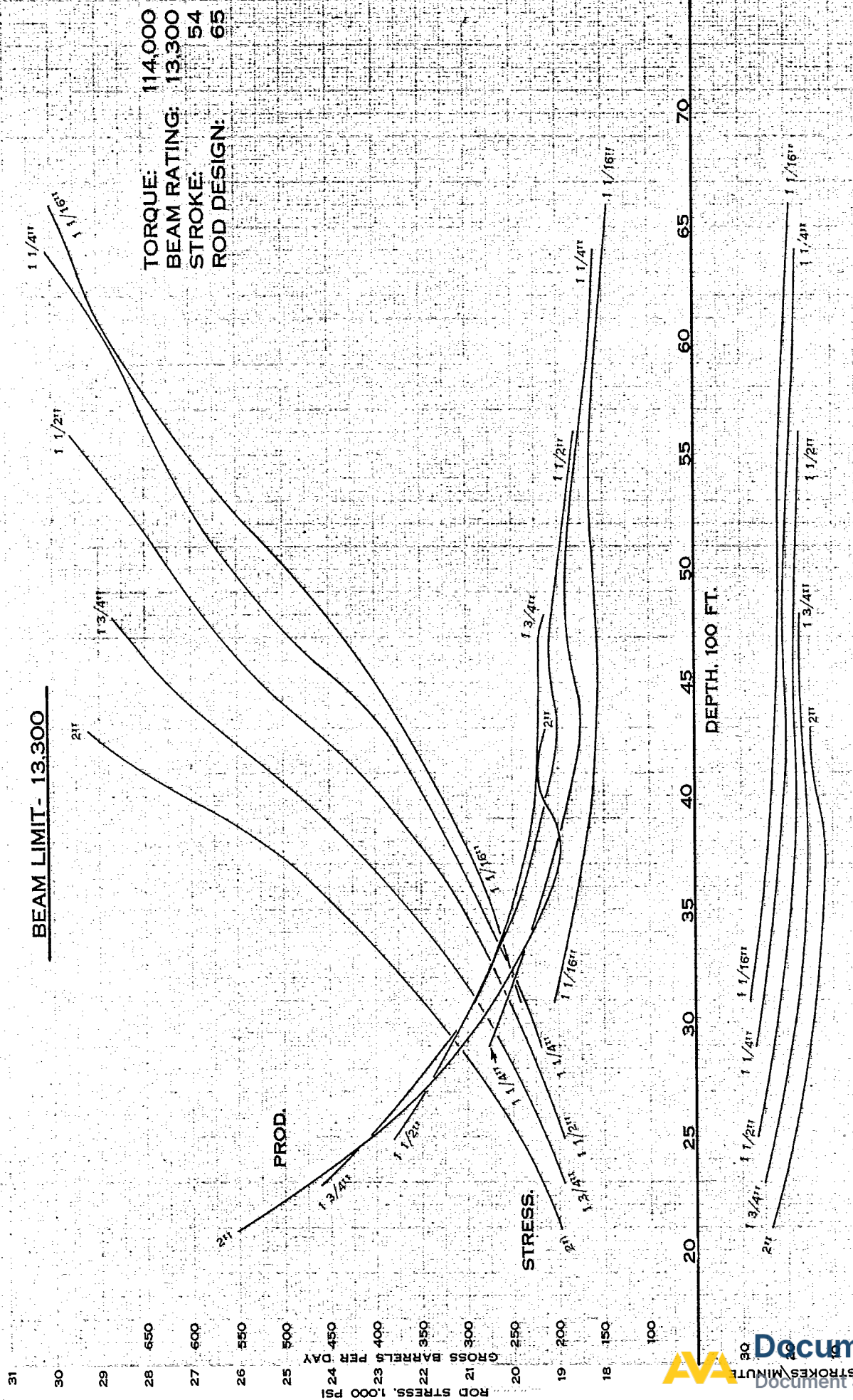
BEAM LIMIT - 11,900



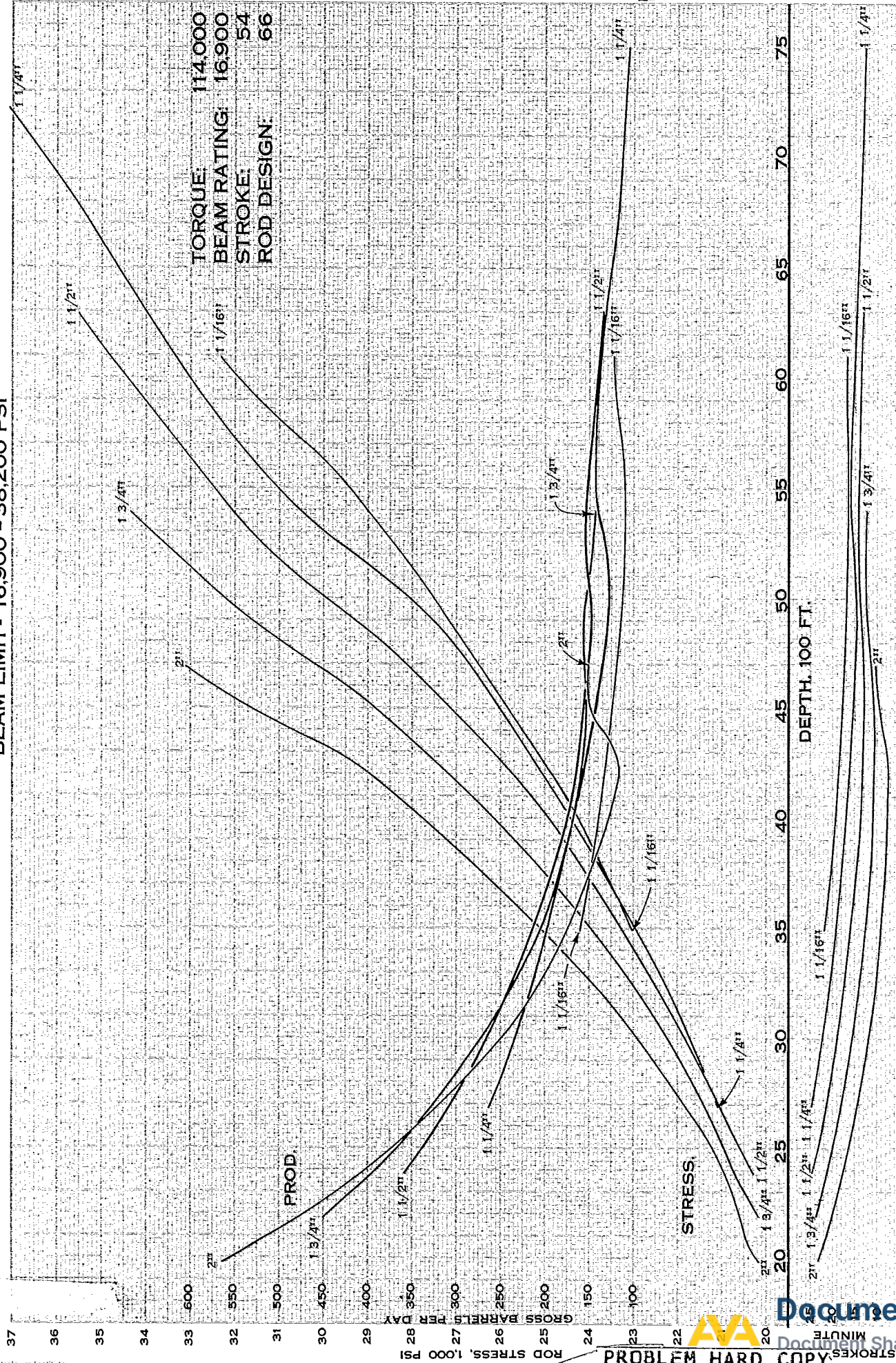
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 BEAM RATING: 11,900
 STROKE: 54
 ROD DESIGN: 64

BEAM LIMIT - 11,900



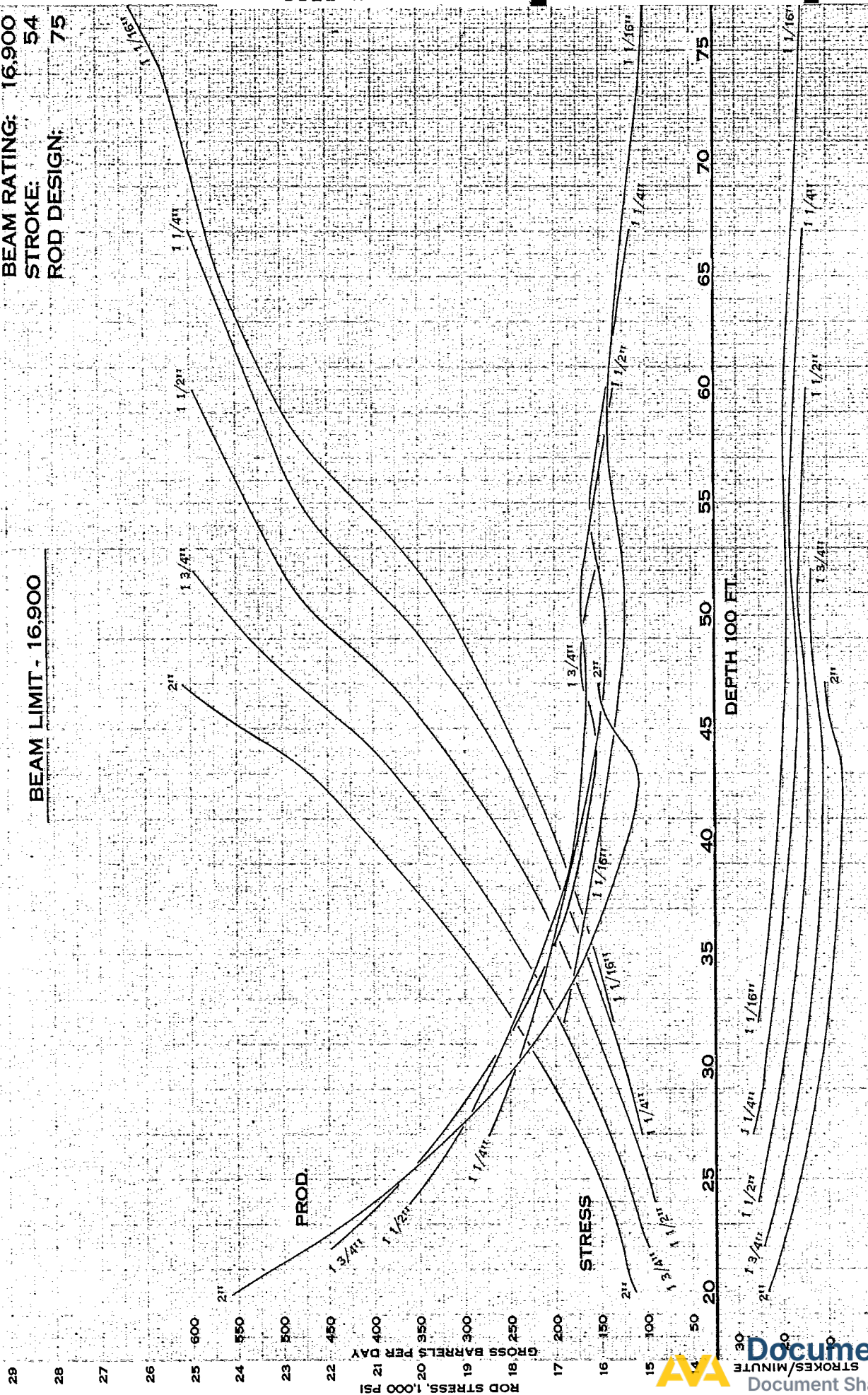


BEAM LIMIT - 16,900 = 38,200 PSI

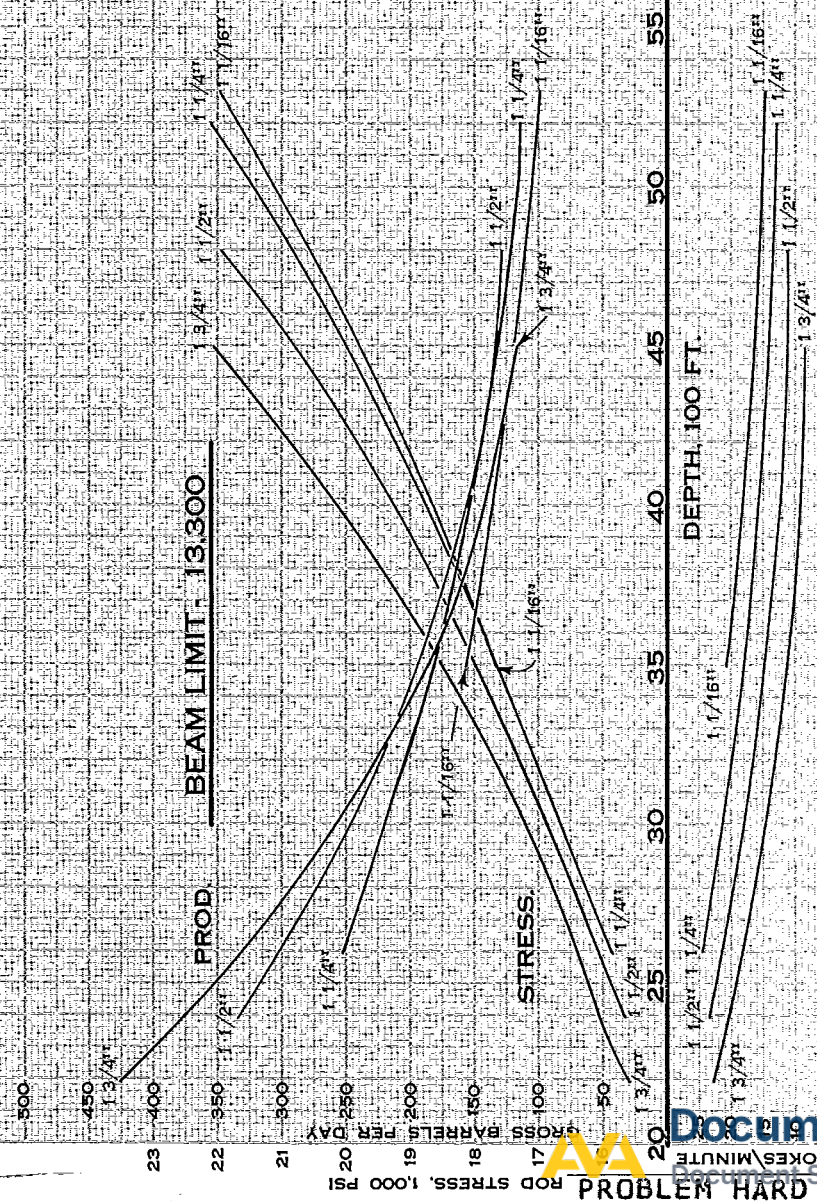


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 BEAM RATING: 16,900
 STROKE: 54
 ROD DESIGN: 75

BEAM LIMIT - 16,900

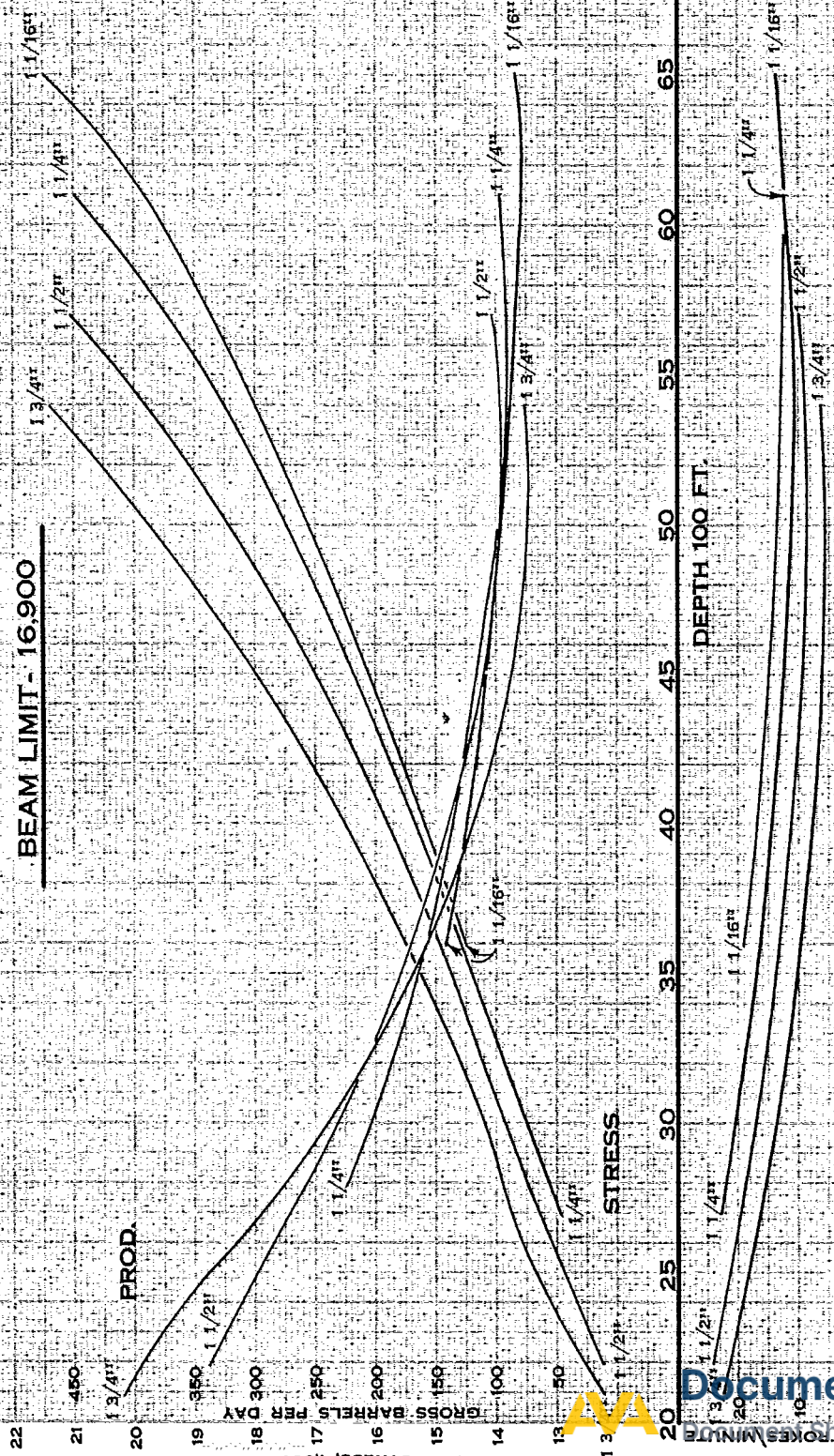


TORQUE: 114,000
 BEAM RATING: 13,300
 STROKE: 54
 ROD DESIGN: 76

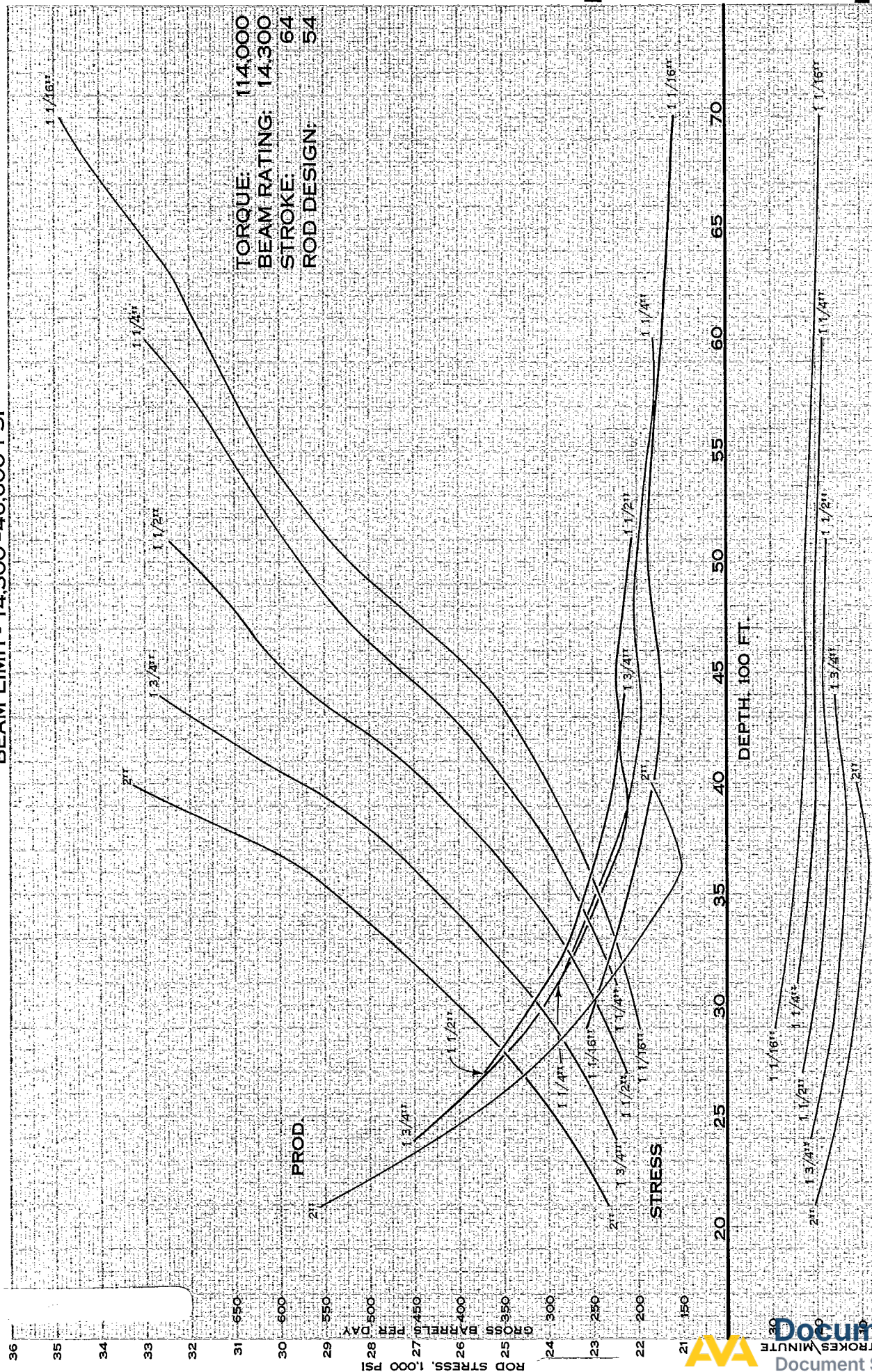


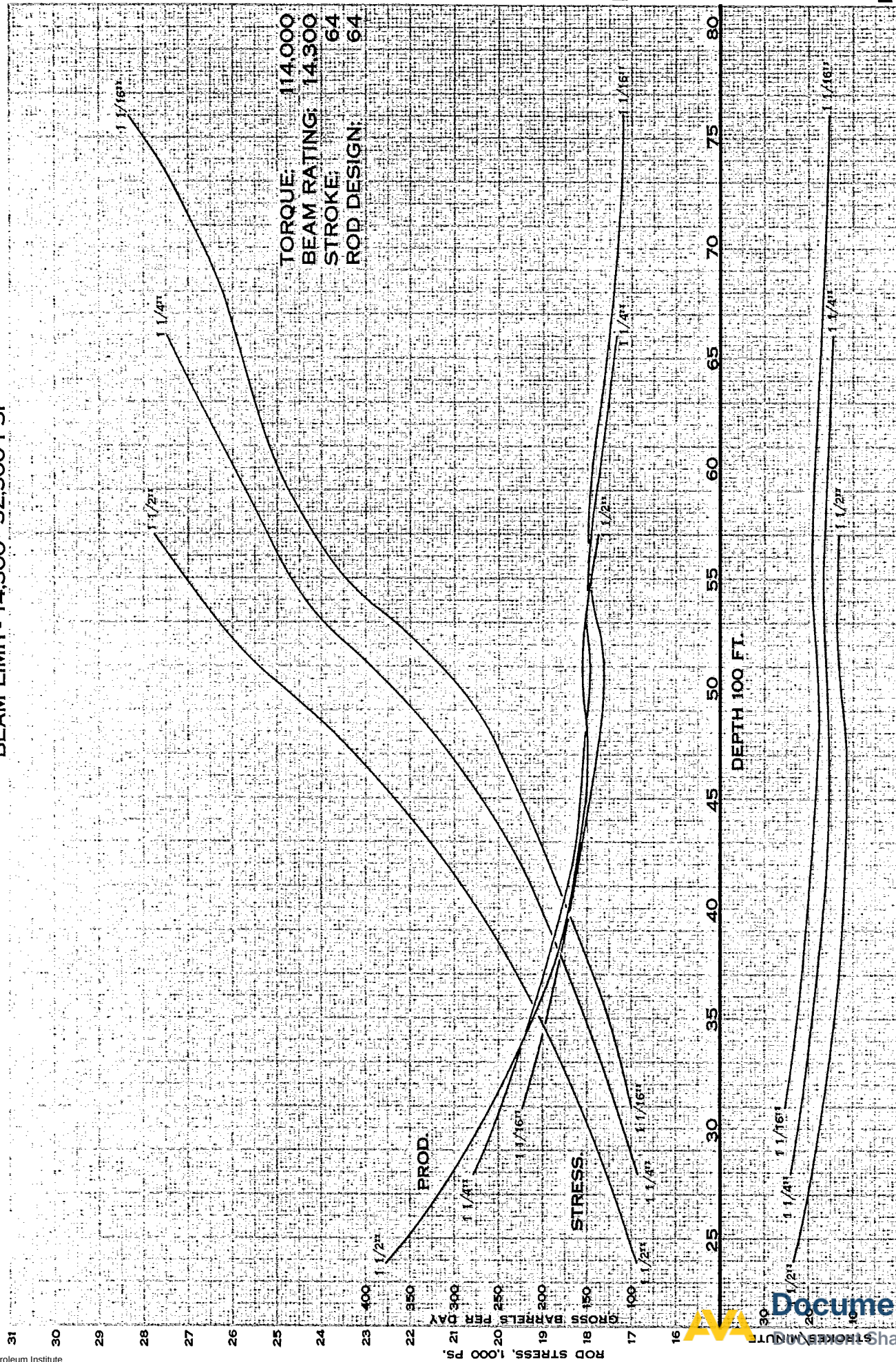
TORQUE: 114,000
 BEAM RATING: 16,900
 STROKE: 54
 ROD DESIGN: 86

BEAM LIMIT - 16,900



BEAM LIMIT - 14,300 = 46,600 PSI





BEAM LIMIT - 14,300 = 32,300 PSI

TORQUE: 114,000
 BEAM RATING: 14,300
 STROKE: 64
 ROD DESIGN: 65

1 1/4"

1 1/2"

1 1/16"

75

70

65

60

55

50

45

40

35

30

25

20

15

10

5

0

DEPTH 100 FT.

PROD.

STRESS.

ROD STRESS, 1,000 PSI

GROSS BARRELS PER DAY

Not for Resale

STROKES/MINUTE

Documents

Document Sharing Hub

TORQUE:	160,000
BEAM RATING:	16,900
STROKE:	54
ROD DESIGN:	64

