

B5 tunes for experiment 766

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June 1985

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U.S. Department of Energy

USDOE Office of Science (SC)

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EP&S Division Technical Note
No. 112

B5 Tunes for Experiment 766

Gerry M. Bunce

June 3, 1985

The following plots were made for a beam at the B-target which is (1.4 mm x 1 mrad)_x . (1.3 mm x 2 mrad)_y. These are half sizes, taken from calculations for the switchyard; however, they appear to be consistent with the observed spot size on B. After the beam traverses the target, the multiple-scattering blow-up should be ± 2 mrad. The plots do not have this additional spread folded in. A $\Delta p/p$ of $\pm .3\%$ was used and it is assumed the servo system holds the beam steady at B. These sizes are Transport half sizes, which nominally contain 90% of the beam.

Tune A This is the "standard" tune where the upstream quads are set for B1 at 10 GeV/c. The "wavy hole" aperture (vertical) is shown as $\pm 1/2$ ". This tune appears to give poor transmission, as is observed. Q6/7, however, are at opposite polarity from what is now used!

Tune B The polarities of the upstream quads remain the same and the beam is squeezed through the apertures.

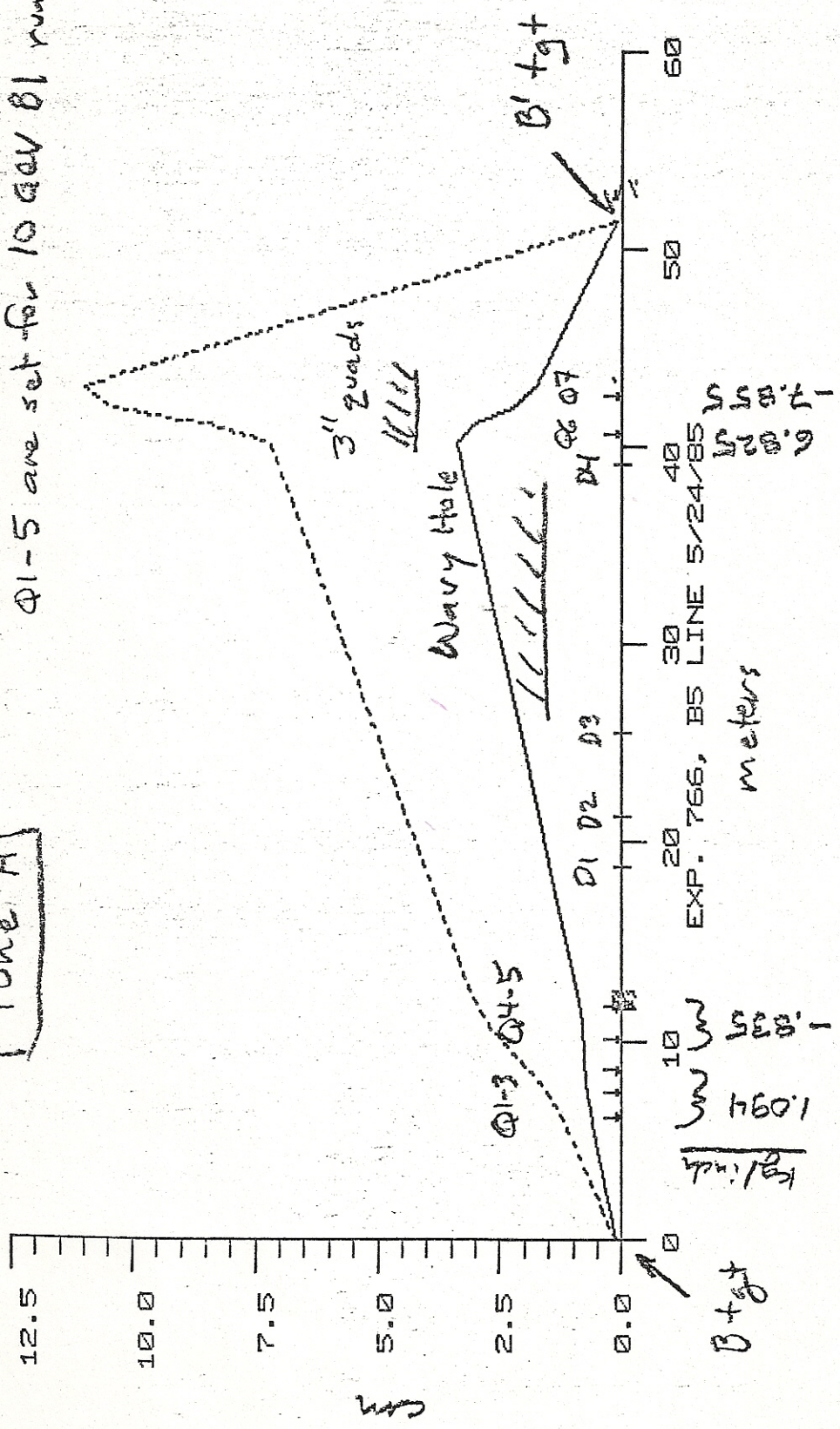
Tune C The upstream quad polarities are interchanged. The transmission should be quite high.

Tune D Again, the upstream quad polarities have been inverted, but with their settings chosen to get optimum (but poor compared with Tune A) momentum selection and transmission for B1. This solution would seem to have no better transmission for B5 than Tune A, so it has little going for it.

Note: B and C are not ideal for the B1 line! Tune A has been found to give more transmission (x1.5 to 2) and a smaller spot at B' than the previous E766 tune.

Tune A

June 5, 1985
 Q1-5 are set for 10 dBV B1 running.



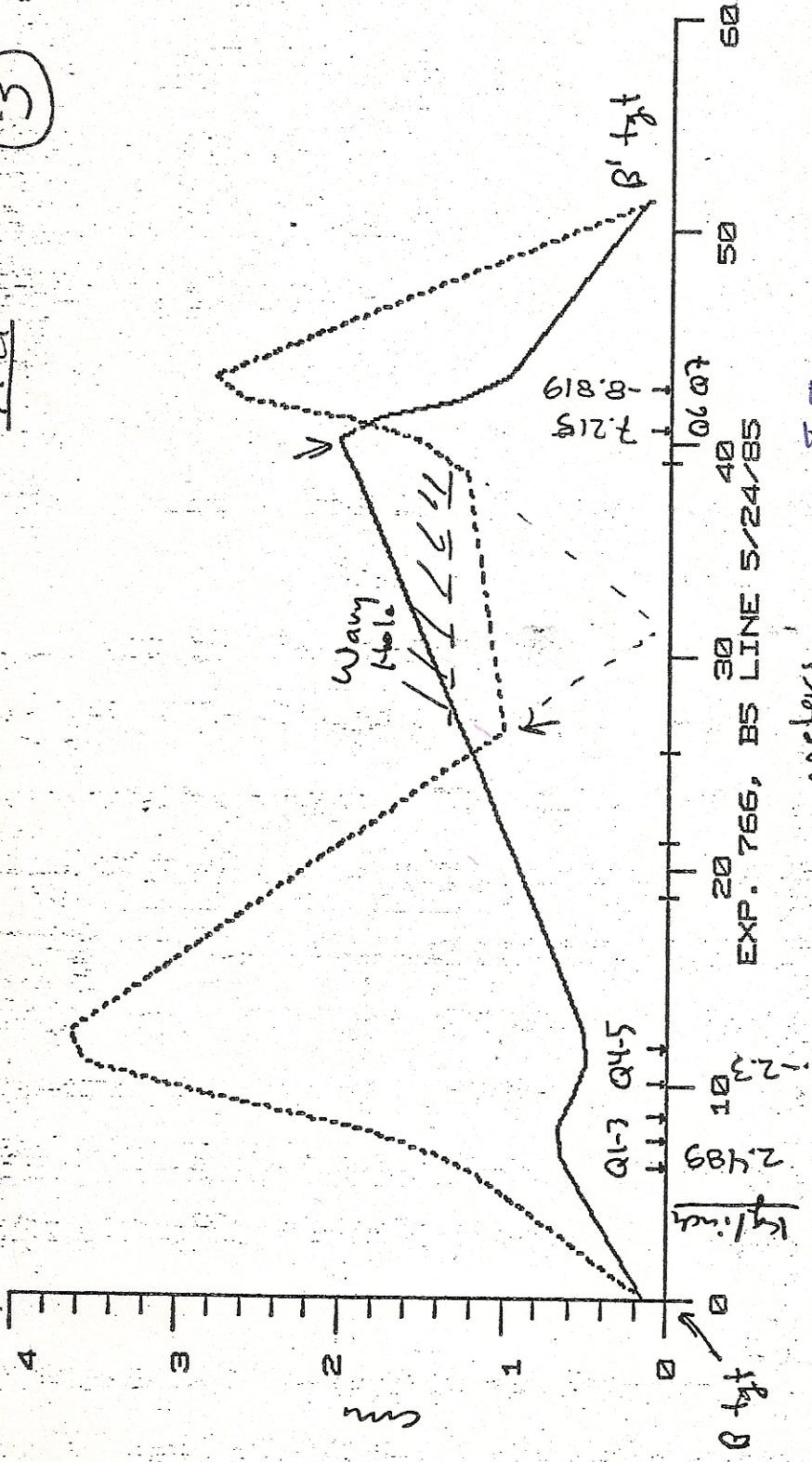
Distance (m)	Current (kA)	Pol.	D:bulk
10	1.094	A	950
10	1.835	B	1043
40	6.025	A	2560
40	7.855	B	2976
60	1.604	A	2560
60	1.86	B	2976

EXP. 766, B5 LINE 5/24/85
 meters

Tune B

3rd 2 wads
1/1cc

3



∴ 625 to get
d. bubble ch.

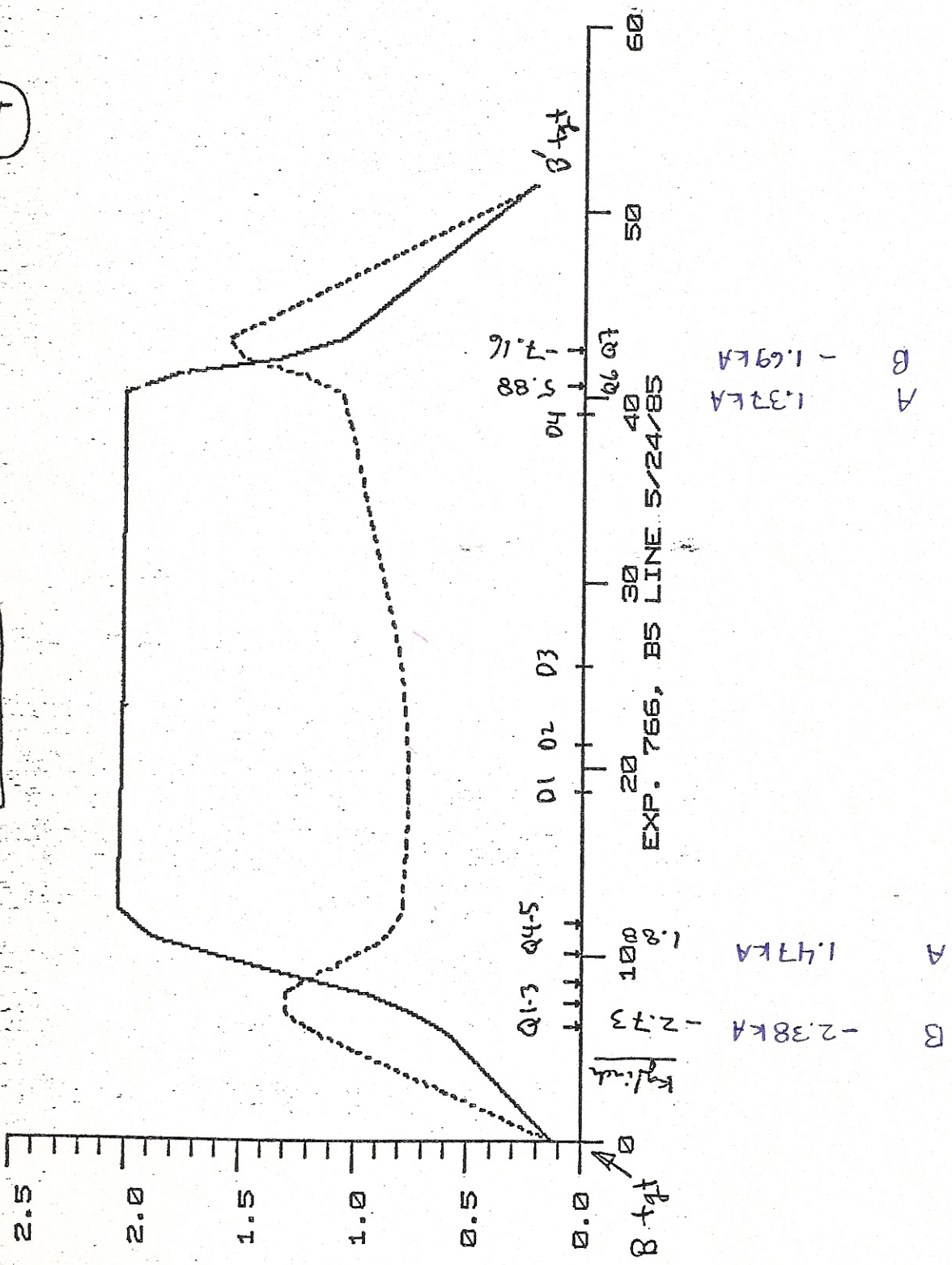
A 2.17KA
B -1.80KA

A 1.70KA
B -2.45KA

meters

4

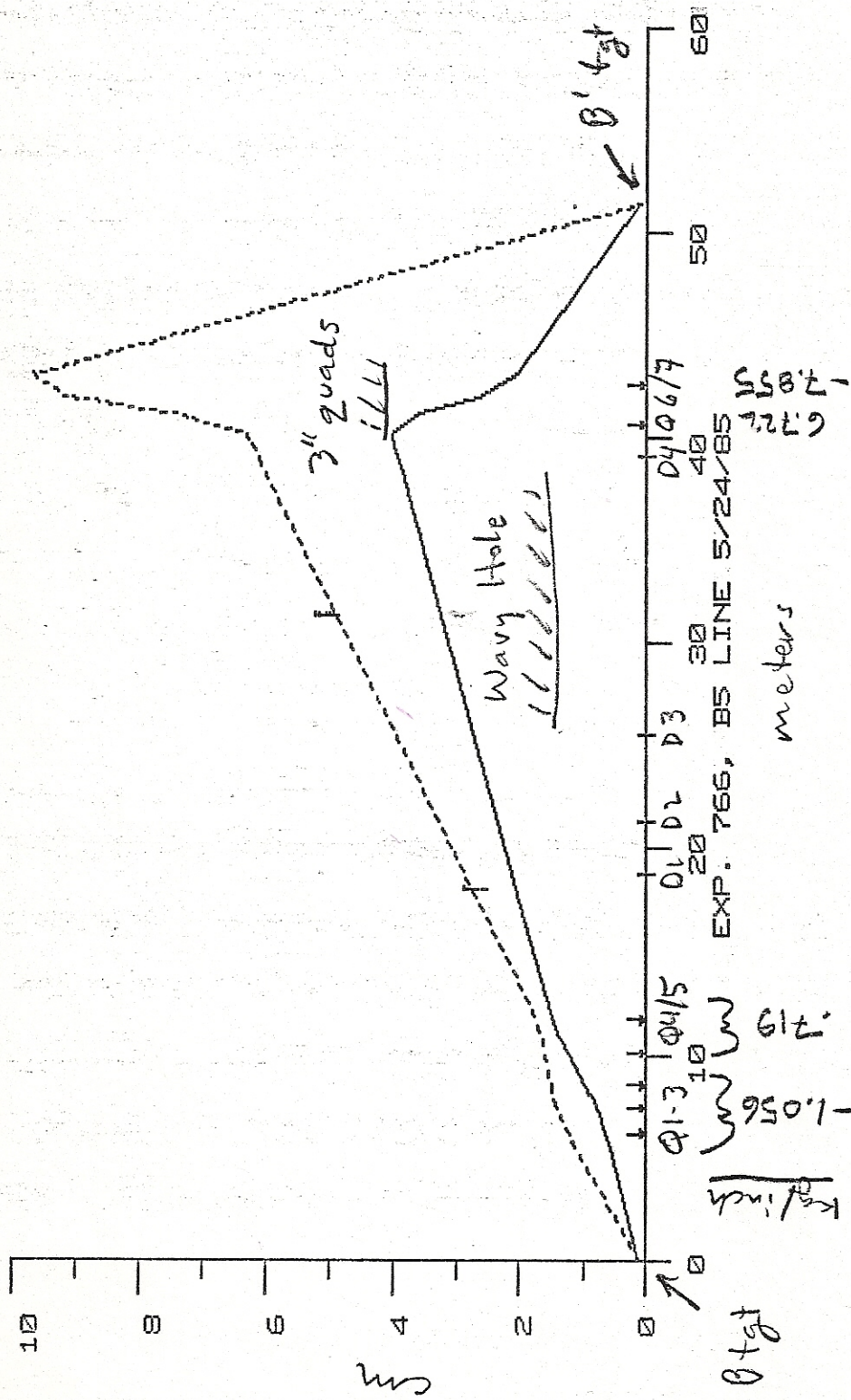
Tune C



REVERSED Q1-5, 10.69 GEV TUNE FOR B1

Tune D

11-Jun-85 09:28



D.66uk
 pd. 920
 current 920amps
 K/inch 1.056
 A 562
 B 920
 A 899

6.72%
 7.855
 1540
 1887
 A 2464
 B 3019

June A June 5, 1985

"EXP. 766, B5 LINE 5/24/85

DRIFT 3:	"D1	5.690000	0.000000	0.000000	0.000000	0.000000	0.000000
QUAD* 5:	"Q1	0.932000	1.009400	1.009400	2.540000	23.838800	0.000000
DRIFT 3:	"D2	0.249000	0.000000	0.000000	0.000000	0.000000	0.000000
QUAD* 5:	"Q2	0.932000	1.009400	1.009400	2.540000	23.838800	0.000000
DRIFT 3:	"L2	0.249000	0.000000	0.000000	0.000000	0.000000	0.000000
QUAD* 5:	"Q3	0.932000	1.009400	1.009400	2.540000	23.838800	0.000000
DRIFT 3:	"L3	0.435000	0.000000	0.000000	0.000000	0.000000	0.000000
QUAD* 5:	"Q4	1.321000	-0.835000	-0.835000	2.540000	-21.672000	0.000000
DRIFT 3:	"L4	1.321000	-0.835000	-0.835000	2.540000	-21.672000	0.000000
QUAD* 5:	"L5	5.480000	0.000000	0.000000	0.000000	0.000000	0.000000
DRIFT 3:	"D1	0.600000	0.000000	0.000000	0.000000	0.000000	0.000000
ROTAT 2:	"D1	1.981000	9.883000	9.883000	0.000000	1.179000	0.000000
BEND* 4:	"D1	0.600000	0.000000	0.000000	0.000000	0.000000	0.000000
ROTAT 2:	"D2	0.508000	0.000000	0.000000	0.000000	0.000000	0.000000
DRIFT 3:	"D2	0.600000	0.000000	0.000000	0.000000	0.000000	0.000000
ROTAT 2:	"D2	1.981000	9.883000	9.883000	0.000000	1.179000	0.000000
BEND* 4:	"D2	0.600000	0.000000	0.000000	0.000000	0.000000	0.000000
ROTAT 2:	"D3	0.350000	0.000000	0.000000	0.000000	0.000000	0.000000
DRIFT 3:	"D3	1.981000	0.000000	0.000000	0.000000	0.000000	0.000000
BEND* 4:	"D3	11.960000	0.000000	0.000000	0.000000	0.000000	0.000000
DRIFT 3:	"D4	1.070000	0.000000	0.000000	0.000000	0.000000	0.000000
BEND* 4:	"D4	1.500000	0.000000	0.000000	0.000000	0.000000	0.000000
DRIFT 3:	"Q6	1.000000	6.825000	6.825000	2.540000	3.709000	0.000000
QUAD* 5: 0 1	"Q6	0.910000	0.000000	0.000000	0.000000	0.000000	0.000000
DRIFT 3:	"Q7	1.000000	-7.855000	-7.855000	2.540000	-2.913000	0.000000
QUAD* 5: 0 1	"Q7	8.430000	0.000000	0.000000	0.000000	0.000000	0.000000
DRIFT 3:	"Q7	1.000010	0.100000	0.100000	0.000000	0.115000	0.000000
FIT 10:	"Q7	3.000030	0.100000	0.100000	0.000000	0.103900	0.000000
FIT 10:	"Q7	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

Tune B

DRIFT	3:	"D1	5:	690000	0:	000000	0:	000000	0:	000000
QUAD*	5:	"Q1	0:	932000	2:	489000	2:	489000	10:	566000
DRIFT	3:	"D2	0:	249000	0:	000000	2:	540000	0:	000000
QUAD*	5:	"Q2	0:	932000	2:	489000	2:	540000	10:	566000
DRIFT	3:	"L2	0:	249000	0:	000000	0:	000000	0:	000000
QUAD*	5:	"Q3	0:	932000	2:	489000	2:	540000	10:	566000
DRIFT	3:	"L3	0:	435000	0:	000000	0:	000000	0:	000000
QUAD*	5:	"Q4	1:	321000	-2:	101000	2:	540000	-8:	483000
DRIFT	3:	"L4	0:	253000	0:	000000	0:	000000	0:	000000
QUAD*	5:	"Q5	1:	321000	-2:	549000	2:	540000	-6:	955000
DRIFT	3:	"L5	5:	480000	0:	000000	0:	000000	0:	000000
ROTAT	2:	"D1	0:	600000	0:	000000	0:	000000	0:	000000
BEND*	4:	"D1	1:	981000	9:	883000	0:	000000	1:	179000
ROTAT	2:	"D2	0:	600000	0:	000000	0:	000000	0:	000000
DRIFT	3:	"D2	0:	508000	0:	000000	0:	000000	0:	000000
ROTAT	2:	"D2	0:	600000	0:	000000	0:	000000	0:	000000
BEND*	4:	"D2	1:	981000	9:	883000	0:	000000	1:	179000
ROTAT	2:	"D3	0:	600000	0:	000000	0:	000000	0:	000000
DRIFT	3:	"D3	2:	350000	0:	000000	0:	000000	0:	000000
BEND*	4:	"D3	1:	981000	9:	883000	0:	000000	0:	000000
DRIFT	3:	"D4	11:	960000	0:	000000	0:	000000	0:	000000
BEND*	4:	"D4	1:	070000	0:	000000	0:	000000	0:	000000
DRIFT	3:	"Q6	0:	500000	0:	000000	0:	000000	0:	000000
QUAD*	5:	"Q6	1:	000000	7:	215000	2:	540000	3:	519000
DRIFT	3:	"Q7	0:	910000	0:	000000	0:	000000	0:	000000
QUAD*	5:	"Q7	1:	000000	-8:	819000	2:	540000	-2:	578000
DRIFT	3:	"Q7	8:	430000	0:	000000	0:	000000	0:	000000
FIT	10:	"Q7	1:	00010	0:	100000	0:	010000	0:	150000
FIT	10:	"Q7	3:	000030	0:	100000	0:	010000	0:	127000
	0:	"Q7	0:	000000	0:	000000	0:	000000	0:	000000

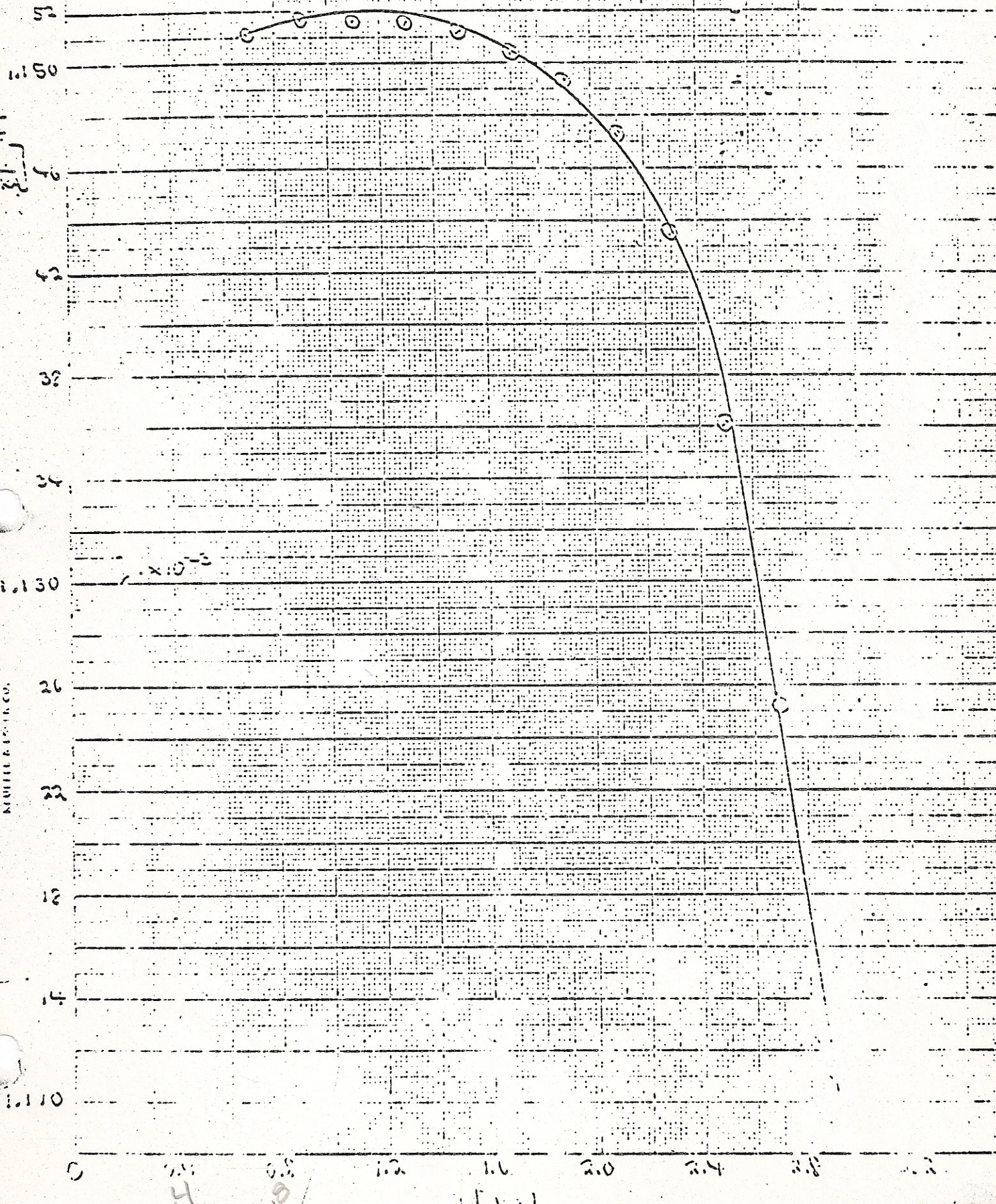
Tune C

"EXP: 766, B5 LINE 5/24/85

DRIFFT	3:	"D1	5.690000	0.000000	0.000000	0.000000
QUAD*	5:	"Q1	0.932000	-2.733000	2.540000	0.000000
DRIFFT	3:	"D2	0.249000	0.000000	0.000000	0.000000
QUAD*	5:	"Q2	0.932000	-2.733000	2.540000	0.000000
DRIFFT	3:	"L2	0.249000	0.000000	0.000000	0.000000
QUAD*	5:	"Q3	0.932000	-2.733000	2.540000	0.000000
DRIFFT	3:	"L3	0.435000	0.000000	0.000000	0.000000
QUAD*	5:	"Q4	1.321000	1.884000	2.540000	0.000000
DRIFFT	3:	"L4	0.253000	0.000000	0.000000	0.000000
QUAD*	5:	"Q5	1.321000	1.884000	2.540000	0.000000
DRIFFT	3:	"L5	5.480000	0.000000	0.000000	0.000000
ROTAT	2:	"D1	0.600000	0.000000	0.000000	0.000000
BEND*	4:	"D1	1.981000	9.883000	0.000000	1.179000
ROTAT	2:	"D2	0.508000	0.000000	0.000000	0.000000
DRIFFT	3:	"D2	0.600000	0.000000	0.000000	0.000000
ROTAT	2:	"D2	0.600000	0.000000	0.000000	0.000000
BEND*	4:	"D2	1.981000	9.883000	0.000000	1.179000
ROTAT	2:	"D3	0.600000	0.000000	0.000000	0.000000
DRIFFT	3:	"D3	2.350000	0.000000	0.000000	0.000000
BEND*	4:	"D3	1.981000	0.000000	0.000000	0.000000
DRIFFT	3:	"D4	1.960000	0.000000	0.000000	0.000000
BEND*	4:	"D4	1.070000	0.000000	0.000000	0.000000
DRIFFT	3:	"Q6	0.500000	0.000000	0.000000	0.000000
QUAD*	5: 0 1	"Q6	1.000000	5.883000	2.540000	4.275000
DRIFFT	3:	"Q7	0.910000	0.000000	0.000000	0.000000
QUAD*	5: 0 1	"Q7	1.000000	-7.163000	2.540000	-3.209000
DRIFFT	3:		8.430000	0.000000	0.000000	0.000000
FIT	10:		1.000010	0.100000	0.010000	0.000000
FIT	10:		3.000030	0.100000	0.010000	0.000000

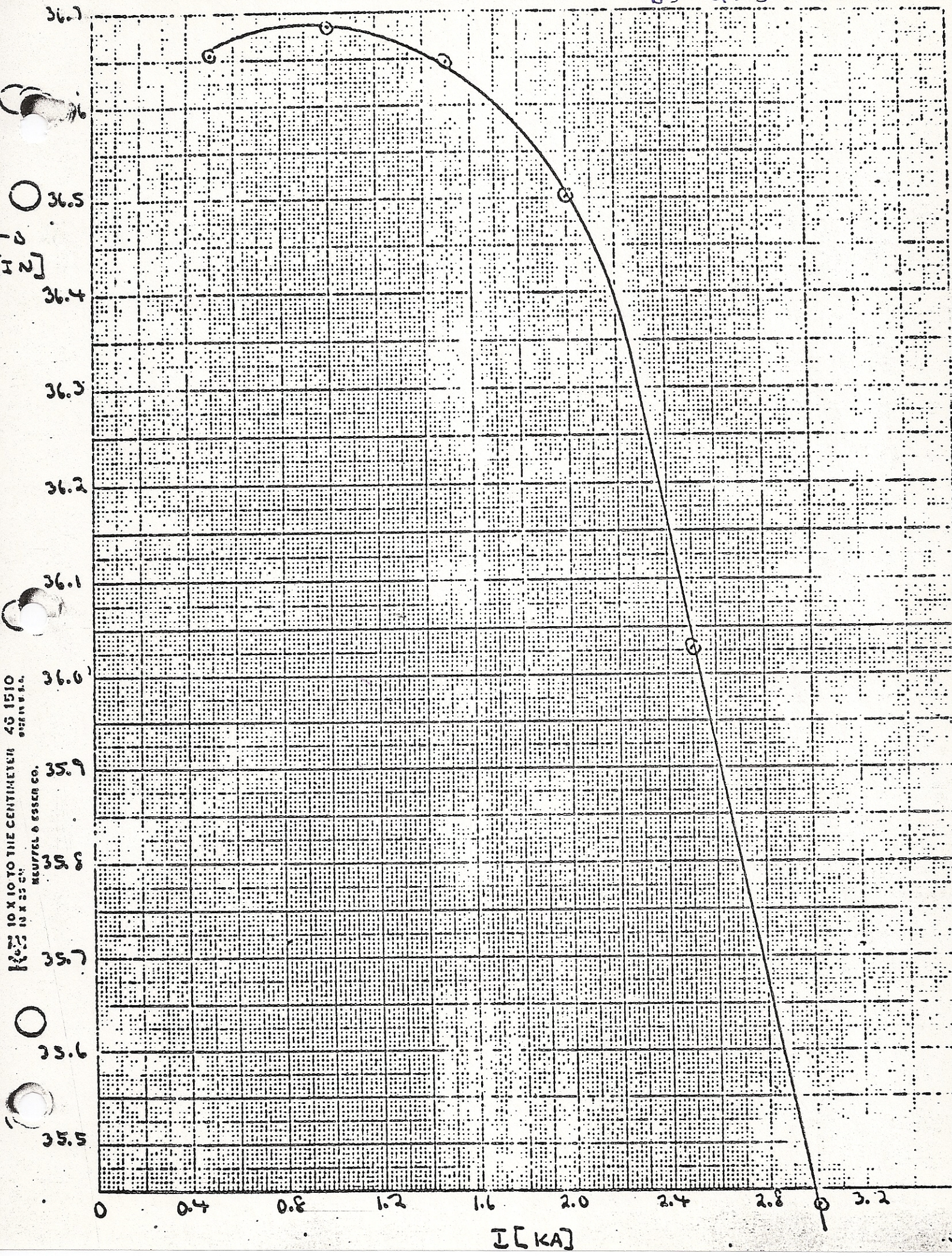
$\frac{G}{H}$
 $\frac{K \cdot G}{H}$

16 X 10 TO THE CENTER 40 1510
 10 X 25 CO.
 KATHLEEN & SONS CO.



H 9/ 11/11

B5 Q1-3 N8Q52



10 X 10 TO THE CENTIMETER 45 1510
HEUFFEL & ESSER CO.

Parby

B5 Q4-5

Multiply by kamps to get gradient

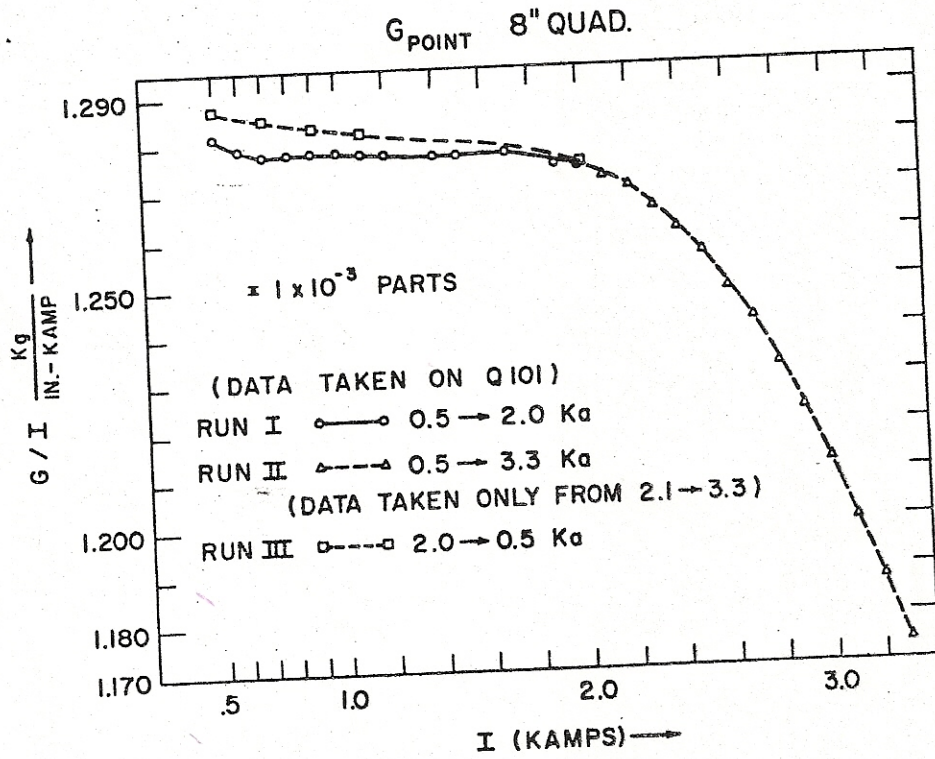


Fig. 6. Gradient, G point, vs I for 8 inch quadrupoles.

Dawby

B5 Q4-5

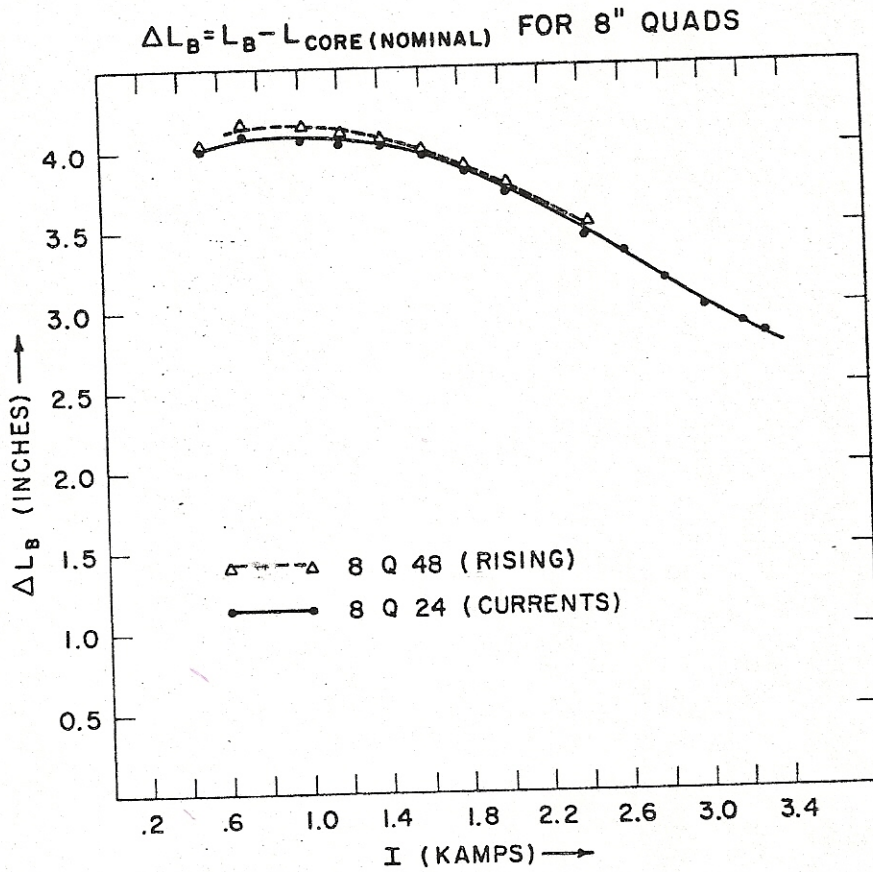
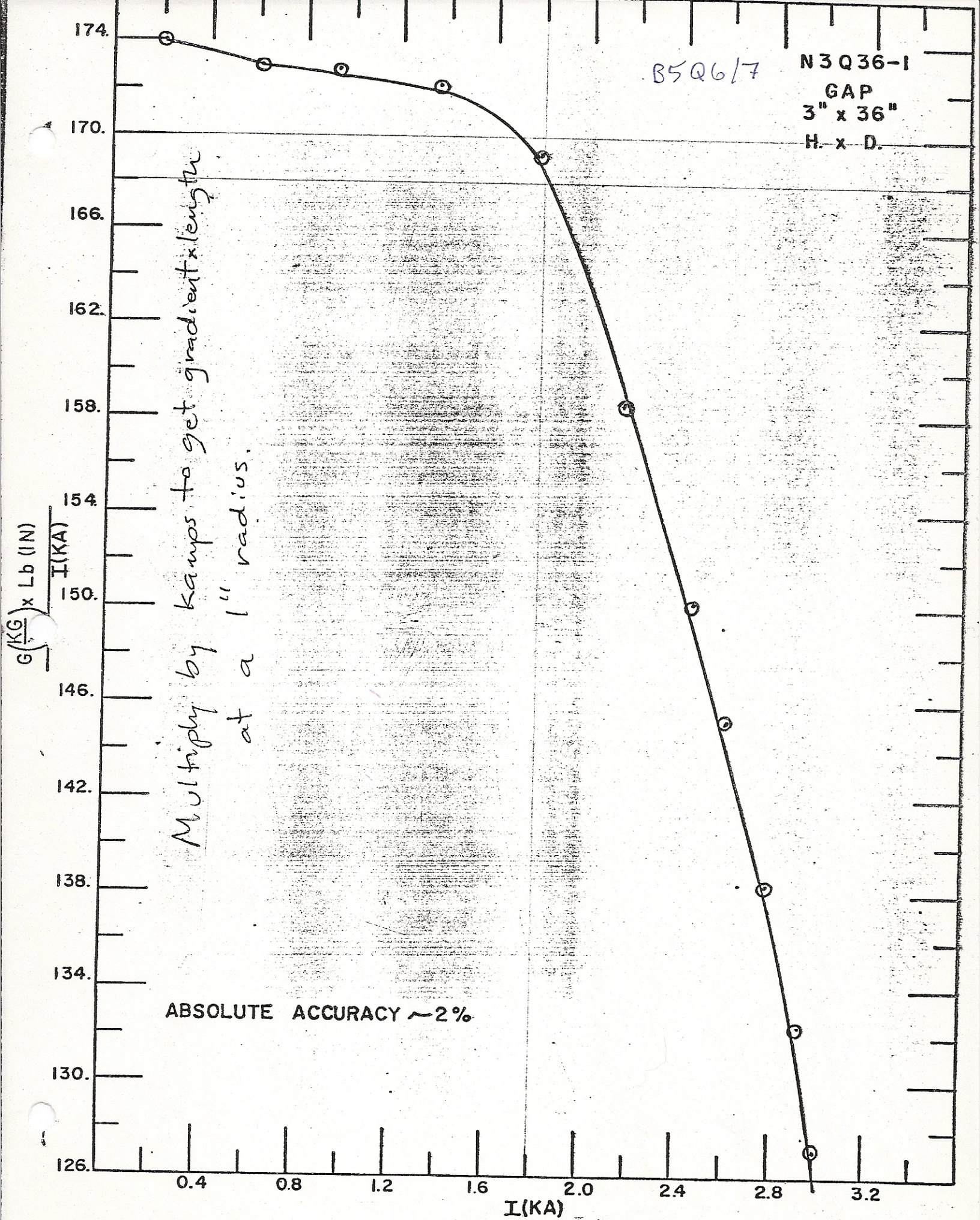


Fig. 7. Magnet length, L_B , vs I for 8 inch quadrupoles. ($L_B = \Delta L_B + L_{core}$).

B5Q6/7

N3Q36-1

GAP
3" x 36"
H. x D.



Multiply by kamps to get gradient x length
at a 1" radius.

ABSOLUTE ACCURACY ~ 2%

Danby

Multiply by kamps to get $\int B ds$ in kgauss-inches

18D72 (6" gap)

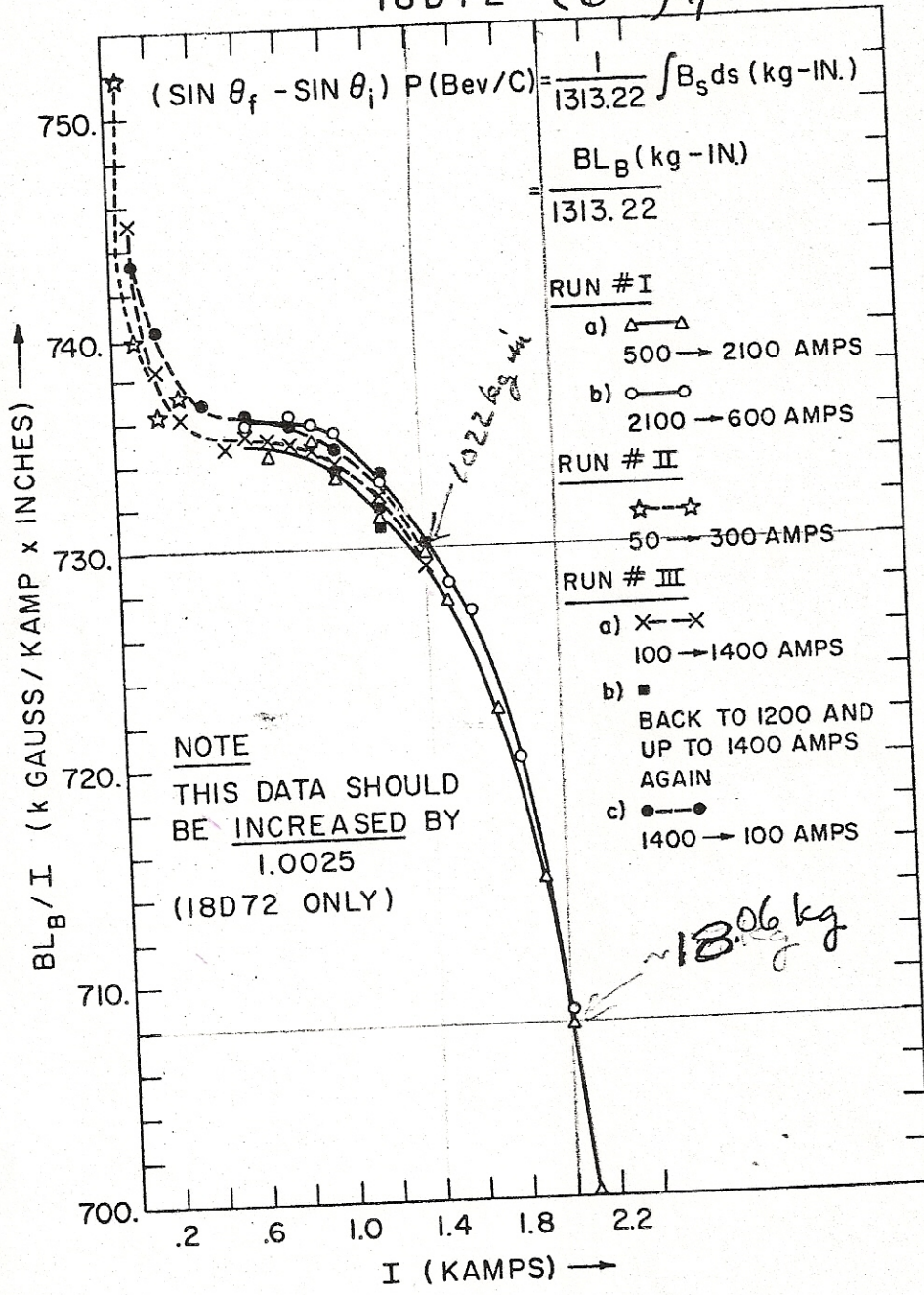


Fig. 2. $\int B_s ds$ vs I for 18D72 magnets.

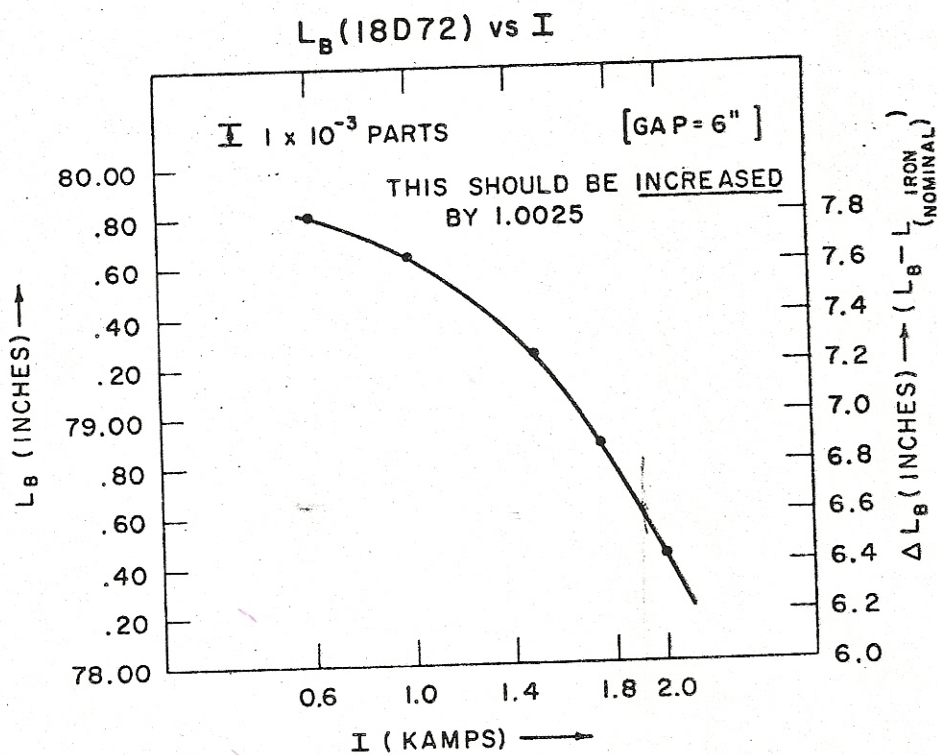


Fig. 3. Magnet length, L_B , vs I for 18D72 magnets.

300 1/2

$$\begin{aligned} (\sin \theta_1 - \sin \theta_2) \lambda &= \left[\frac{B_{12} \cdot \lambda_1}{B_{12} \cdot \lambda_2} \right] \lambda_2 \\ &= \left[\frac{B_{12}}{B_{12}} \right] \lambda_2 \\ &= \lambda_2 \end{aligned}$$

746.0

742.0

738.0

734.0

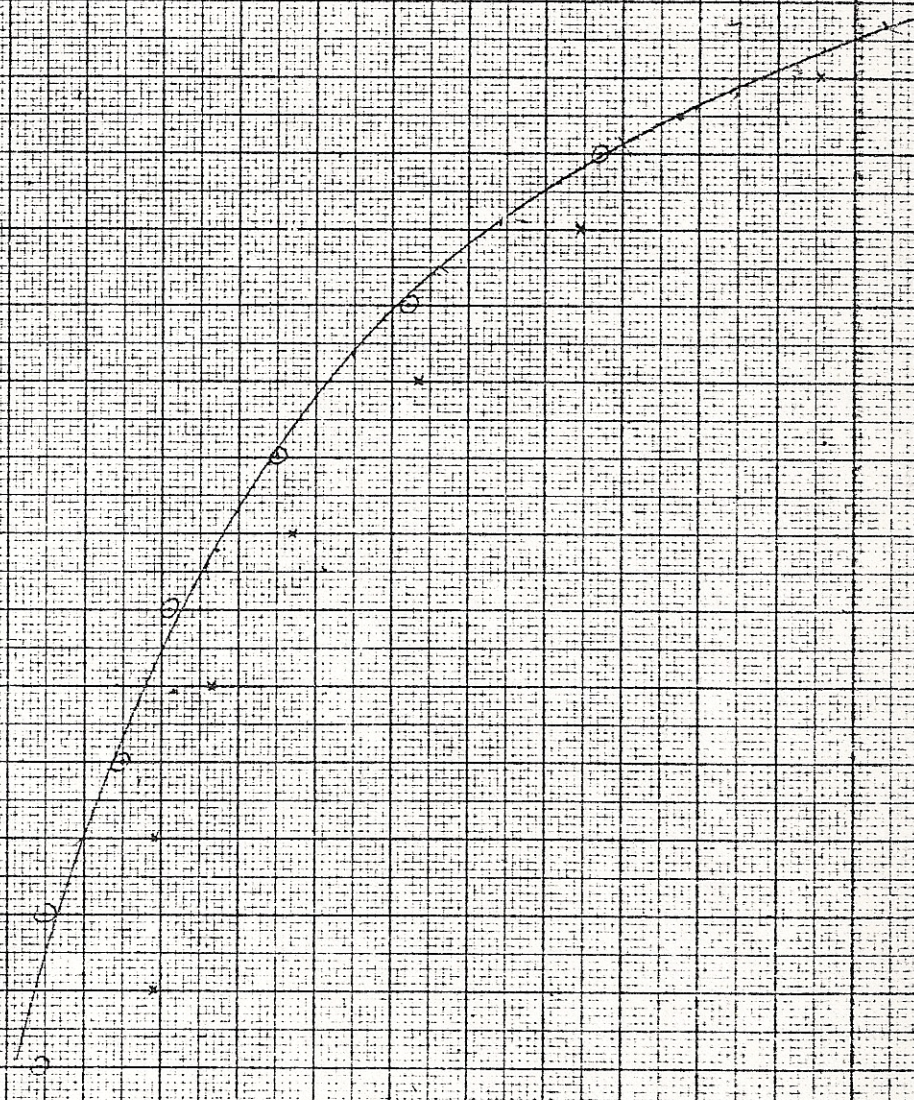
730.0

$$\frac{B_{12} \lambda}{I} \left[\frac{KG \cdot IN}{L \cdot KA} \right]$$

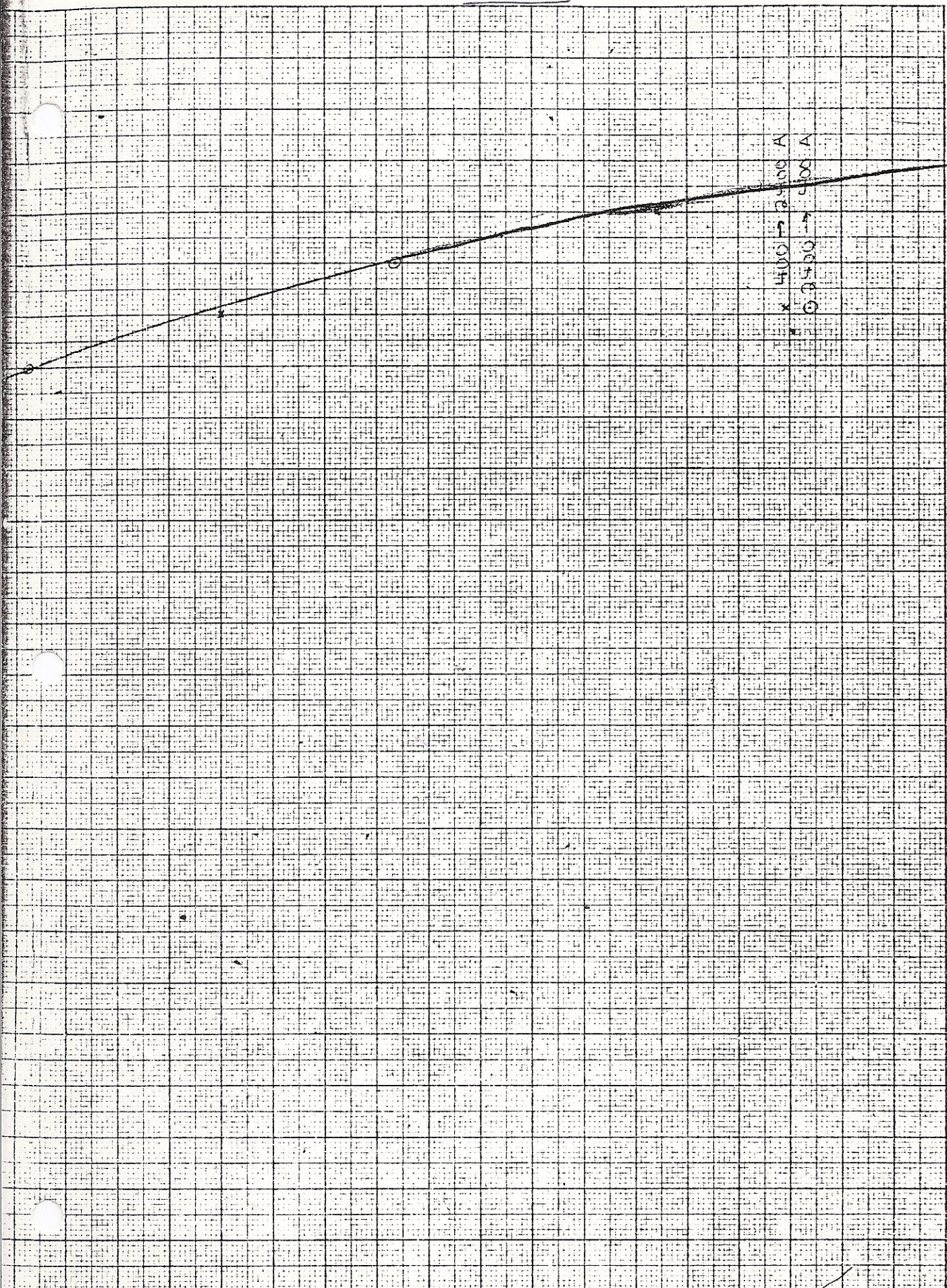
726.0

722.0

$\downarrow \times 10^3$



B502



I [KA]

2.0

1.8

1.6

1.4

1.2

1.0

0.8

0.6

0.4

30D7Z

x 4000 → 2500 A
o 2500 → 500 A

0.210

0.410

0.610

0.810

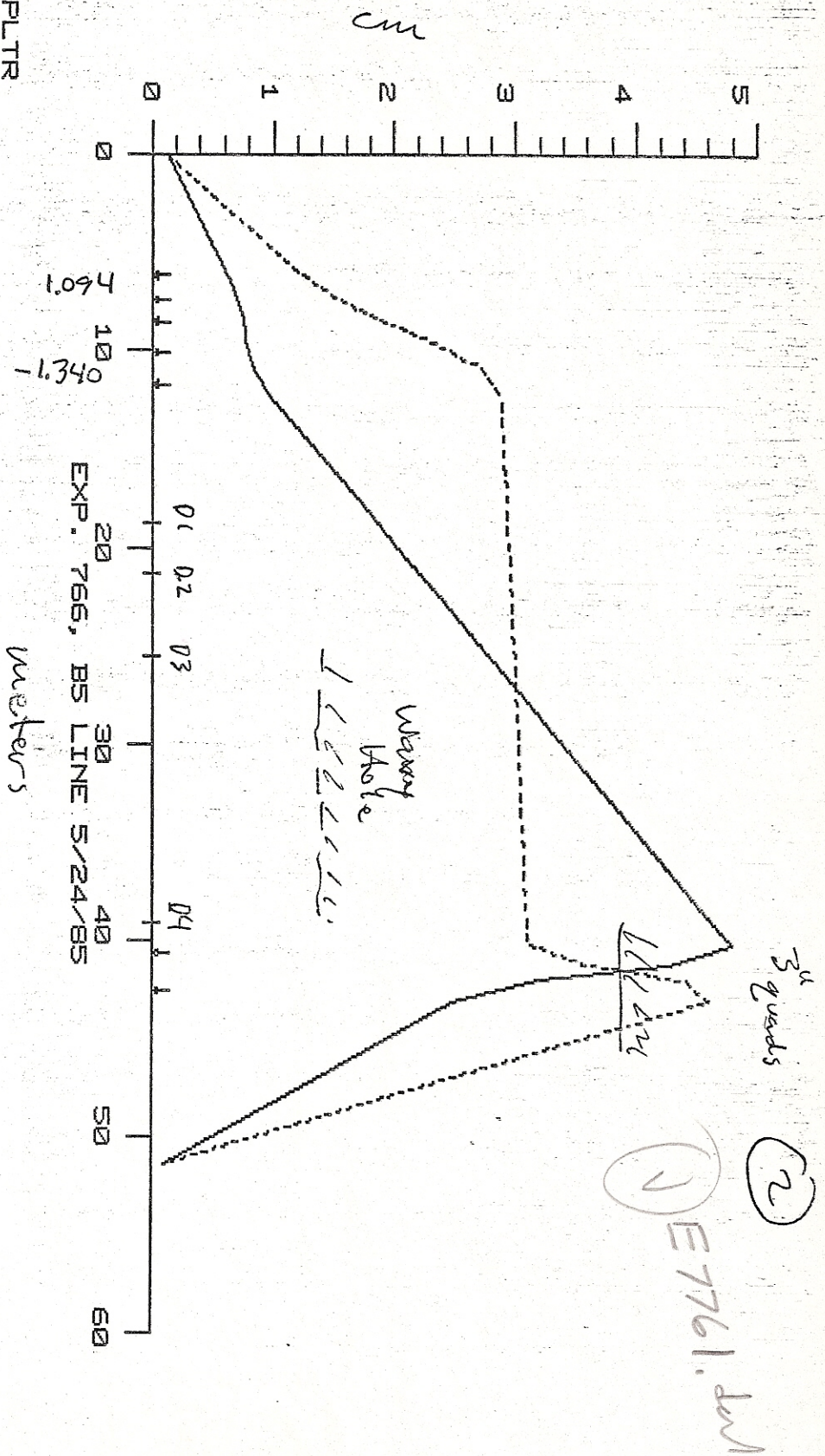
1.010

1.210

1.410

ENTER UP TO 55 CHARACTERS OF DESCRIPTION:

RUN PLTR



3 1/4 grads

(2)

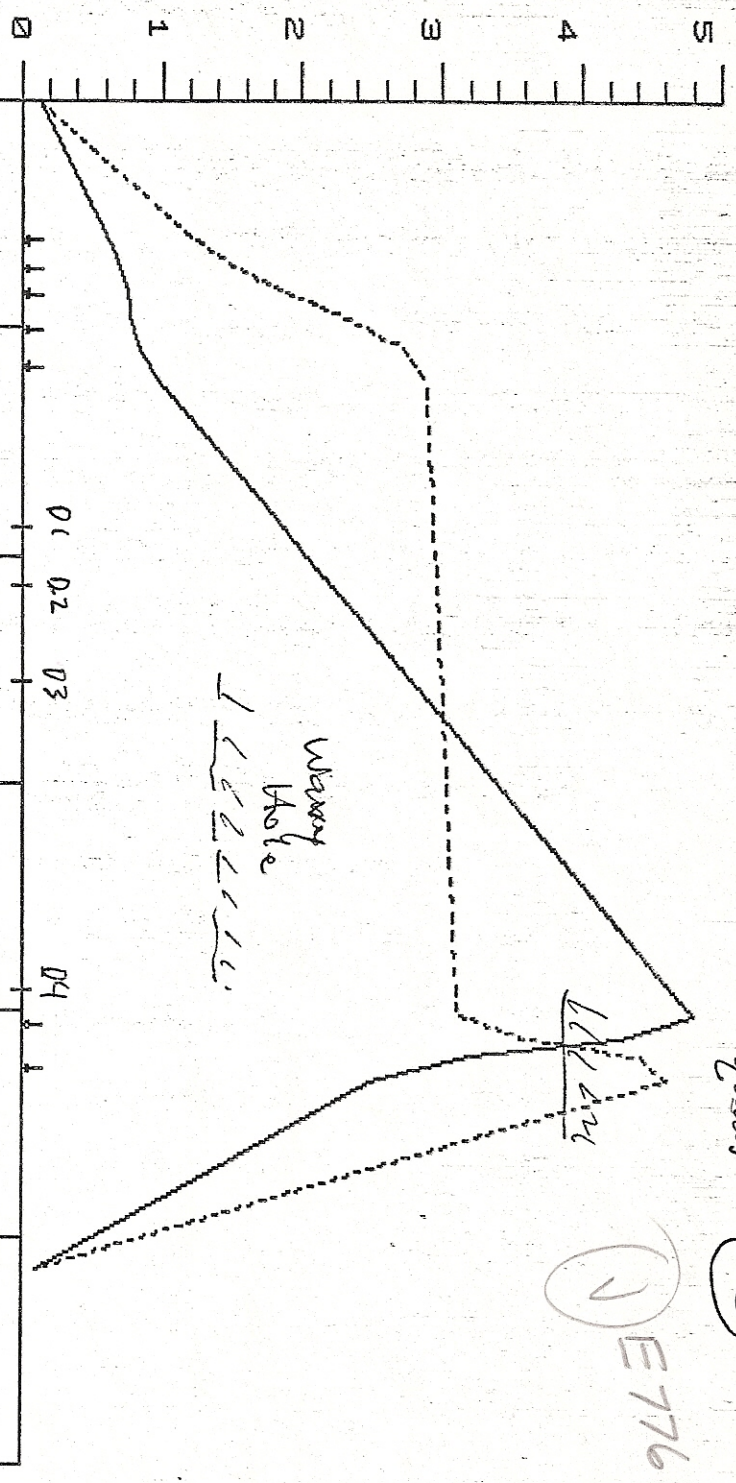
(1) E 7761. dm

cm

meters

EXP. 766, BS LINE 5/24/85

1.0
1.340



(2)

DRIFT	3.	"D1	5.690000	0.000000	0.000000	0.000000	0.000000
QUAD*	3.	"Q1	0.932000	1.094000	2.540000	23.838000	
DRIFT	3.	"D2	0.249000	0.000000	0.000000	0.000000	
QUAD*	3.	"Q2	0.932000	1.094000	2.540000	23.838000	
DRIFT	3.	"L2	0.249000	0.000000	0.000000	0.000000	
QUAD*	3.	"Q3	0.932000	1.094000	2.540000	23.838000	
DRIFT	3.	"L3	0.435000	0.000000	0.000000	0.000000	
QUAD*	3.	"Q4	1.321000	-1.340000	2.540000	-13.423000	
DRIFT	3.	"L4	0.253000	0.000000	0.000000	0.000000	
QUAD*	3.	"Q5	1.321000	-1.340000	2.540000	-13.423000	
DRIFT	3.	"L5	5.480000	0.000000	0.000000	0.000000	
ROTAT	3.	"D1	0.600000	0.000000	0.000000	0.000000	
BEND*	2.		1.981000	9.883000	0.000000	1.179000	
ROTAT	2.		0.600000	0.000000	0.000000	0.000000	
DRIFT	2.		0.508000	0.000000	0.000000	0.000000	
ROTAT	2.		0.600000	0.000000	0.000000	0.000000	
BEND*	2.	"D2	1.981000	9.883000	0.000000	1.179000	
ROTAT	2.		0.600000	0.000000	0.000000	0.000000	
DRIFT	2.		2.350000	0.000000	0.000000	0.000000	
BEND*	2.	"D3	1.981000	0.000000	0.000000	0.000000	
DRIFT	2.		11.966000	0.000000	0.000000	0.000000	
BEND*	2.	"D4	1.070000	0.000000	0.000000	0.000000	
DRIFT	2.		0.500000	0.000000	0.000000	0.000000	
QUAD*	2.	"Q6	1.000000	6.817000	2.540000	3.714000	
DRIFT	2.		0.910000	0.000000	0.000000	0.000000	
QUAD*	2.	"Q7	1.000000	-7.630000	2.540000	-3.003000	
DRIFT	2.		8.430000	0.000000	0.000000	0.000000	
FIT	10.		1.000010	0.100000	0.010000	0.100000	
FIT	10.		3.000030	0.100000	0.010000	0.100000	

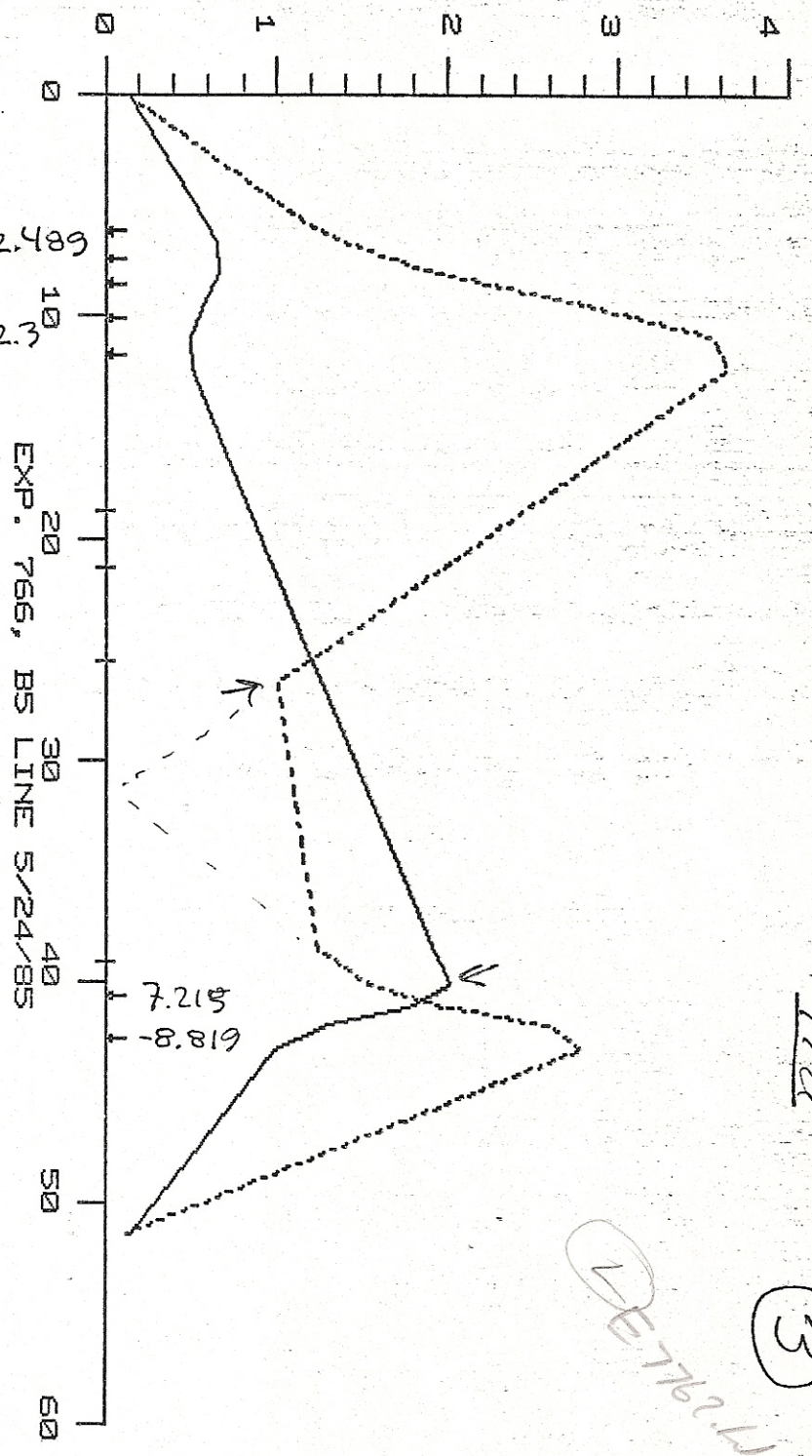
RUN PLTR

ENTER UP TO 55 CHARACTERS OF DESCRIPTION:

3" Quads
L1C

(3)

DE 766



→ : requested sizes

.TECO FORØS.DAT4HARACTERS OF DESCRIPTION:

L2K Core1
 *S04#0LT#
 S.Ø 1.321 -1.395 2.54 'Q4' ;
 *FS1.395#2.1Ø1#EX#
 CPU TIME: 4.36 ELAPSED TIME: 6.63
 .TY FORØS.DAT
 .EXP. 766, BS LINE 5/24/85'
 ØRUN PLTR
 1. .13 1. .13 2. .Ø. .3 28.5 ;
 16. .3 1836.15 ;
 3.Ø 5.69 'D1' *CTERS OF DESCRIPTION:
 5.Ø .932 2.489 2.54 'Q1' ;
 3.Ø .249 'D2' *
 5.Ø .932 2.489 2.54 'Q2' ;
 3.Ø .249 'L2' *

```

DRIFFT 3. 5. "D1 5.690000 0.000000 0.000000 0.000000 0.000000
QUAD* 5. 0. "Q1 0.932200 2.489000 2.540000 10.566000
DRIFFT 3. 0. "D2 0.249000 0.000000 0.000000 0.000000
QUAD* 5. 0. "Q2 0.932200 2.489000 2.540000 10.566000
DRIFFT 3. 0. "L2 0.249000 0.000000 0.000000 0.000000
QUAD* 5. 0. "Q3 0.932200 2.489000 2.540000 10.566000
DRIFFT 3. 0. "L3 0.435000 0.000000 0.000000 0.000000
QUAD* 5. 0. "Q4 1.321000 -2.101000 2.540000 -9.483000
DRIFFT 3. 0. "L4 0.253000 0.000000 0.000000 0.000000
QUAD* 5. 0. "Q5 1.321000 -2.549000 2.540000 -9.955000
DRIFFT 3. 0. "L5 5.480000 0.000000 0.000000 0.000000
ROTAT 2. 0. "D1 0.600000 9.883000 0.000000 1.000000
BEND* 2. 1.981000 0.000000 0.000000 0.000000
ROTAT 4. 0.600000 0.000000 0.000000 0.000000
DRIFFT 3. 0.508000 0.000000 0.000000 0.000000
ROTAT 2. 0.600000 0.000000 0.000000 0.000000
BEND* 4. 1.981000 9.883000 0.000000 1.179000
ROTAT 2. 0.600000 0.000000 0.000000 0.000000
DRIFFT 3. 0.350000 0.000000 0.000000 0.000000
BEND* 4. 1.981000 0.000000 0.000000 0.000000
DRIFFT 3. 0.500000 0.000000 0.000000 0.000000
BEND* 4. 1.070000 0.000000 0.000000 0.000000
DRIFFT 3. 0.500000 0.000000 0.000000 0.000000
QUAD* 5. 0 1 "Q6 0.910000 7.215000 2.540000 3.519000
DRIFFT 3. 0 1 "Q7 1.000000 0.000000 0.000000 0.000000
QUAD* 5. 0 1 "Q7 8.430000 2.540000 2.540000 -2.578000
DRIFFT 3. 0.430000 0.000000 0.000000 0.000000
FIT 10. 1.000000 0.100000 0.010000 0.150800
FIT 10. 3.000000 0.100000 0.010000 0.127000
FIT 10. 0.000000 0.000000 0.000000 0.000000

```

```

5.01 1.0 5. 2.54 'Q6' ;
.^C##

```

.TECO FOR05.DAT4HARACTERS OF DESCRIPTION:

```

L2K Core1
*SQ4#QLT##
5.0 1.321 -1.395 2.54 'Q4' ;
*FS1.395#2.101#EX##
CPU TIME: 4.36 ELAPSED TIME: 6.63
TY FOR05.DAT
'EXP. 766, BS LINE 5/24/85'
ORUN PLTR

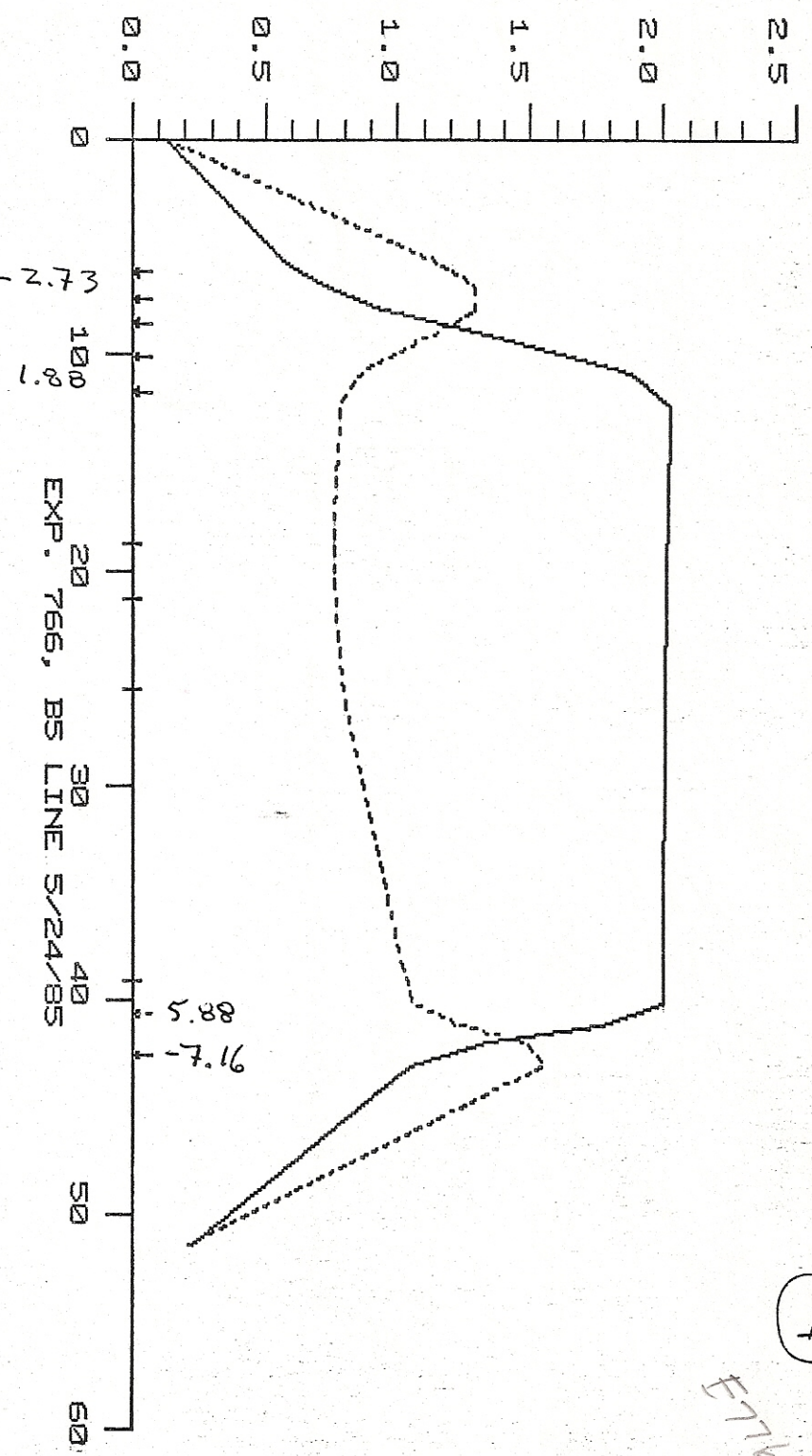
```

```

1. 13 1. 13 2. 0. .3 28.5 ;
16. 3. 1836.15 ;
3.0 5.69 'D1' *CTERS OF DESCRIPTION:
5.0 .932 2.489 2.54 'Q1' ;
3.0 .249 'D2' *
5.0 .932 2.489 2.54 'Q2' ;
3.0 .249 'L2' *
5.0 .932 2.489 2.54 'Q3' ;

```


(4)
F7763.205



*S884\$I \$0TT\$\$
5.0 1.321 1.884 2.54 'Q4' ;
*S10. \$0LT\$\$
10. 1. 1. 2. .1 ;ARACTERS OF DESCRIPTION:
*4K\$EX\$\$

Q1-3 } reversed polarity
Q4.5 }

.RUN TT\TRANSI25,64

STOP

END OF EXECUTION
CPU TIME: 3.98 ELAPSED TIME: 12.13
EXIT

.RUN PLTR

ENTER UP TO 55 CHARACTERS OF DESCRIPTION:

(4)

DRIFT	3.	"D1	5.690000	0.000000	0.000000	0.000000	0.000000
QUAD*	5.	"Q1	0.932000	-2.733000	2.540000	0.000000	-9.326000
DRIFT	3.	"D2	0.249000	0.000000	0.000000	0.000000	0.000000
QUAD*	5.	"Q2	0.932000	-2.733000	2.540000	0.000000	-9.326000
DRIFT	3.	"L2	0.249000	0.000000	0.000000	0.000000	0.000000
QUAD*	5.	"Q3	0.932000	-2.733000	2.540000	0.000000	-9.326000
DRIFT	3.	"L3	0.495000	0.000000	0.000000	0.000000	0.000000
QUAD*	5.	"Q4	1.321000	1.884000	2.540000	0.000000	9.925000
DRIFT	3.	"L4	0.253000	0.000000	0.000000	0.000000	0.000000
QUAD*	5.	"Q5	1.321000	1.884000	2.540000	0.000000	9.925000
DRIFT	3.	"L5	5.480000	0.000000	0.000000	0.000000	0.000000
ROTAT	2.	"D1	0.600000	0.000000	0.000000	0.000000	0.000000
ROTAT	4.	"D1	1.981000	9.883000	0.000000	0.000000	1.179000
ROTAT	2.	"D2	0.600000	0.000000	0.000000	0.000000	0.000000
ROTAT	4.	"D2	1.981000	9.883000	0.000000	0.000000	1.179000
DRIFT	3.	"D3	2.350000	0.000000	0.000000	0.000000	0.000000
BEND*	4.	"D3	1.981000	0.000000	0.000000	0.000000	0.000000
DRIFT	3.	"D4	11.960000	0.000000	0.000000	0.000000	0.000000
BEND*	4.	"D4	1.070000	0.000000	0.000000	0.000000	0.000000
DRIFT	3.	"Q5	0.500000	0.000000	0.000000	0.000000	0.000000
QUAD*	5.	"Q5	1.000000	5.883000	2.540000	0.000000	4.275000
DRIFT	3.	"Q7	0.910000	0.000000	0.000000	0.000000	0.000000
QUAD*	5.	"Q7	1.000000	-7.163000	2.540000	0.000000	-3.209000
DRIFT	3.		8.490000	0.000000	0.000000	0.000000	0.000000
FIT	10.		1.000100	0.100000	0.000000	0.000000	0.000000
FIT	10.		3.000030	0.100000	0.000000	0.000000	0.227000

*S884\$I \$0TT\$\$
 5.0 1.321 1.884 2.54 'Q4' ;
 *S10. \$0LT\$\$
 10. 1. 1. 2. .1 ;RRACTERS OF DESCRIPTION:
 **4K\$EX\$

.RUN TT\T\TRANSI25,64

STOP

END OF EXECUTION
 CPU TIME: 3.98 ELAPSED TIME: 12.13
 EXIT

.RUN PLTR

ENTER UP TO 55 CHARACTERS OF DESCRIPTION: