

## B5 tunes for experiment 766

G. M. Bunce

June 1985

Collider Accelerator Department  
**Brookhaven National Laboratory**

**U.S. Department of Energy**

USDOE Office of Science (SC)

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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)<sub>x</sub> . (1.3 mm x 2 mrad)<sub>y</sub>. 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  $\pm 2$  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.

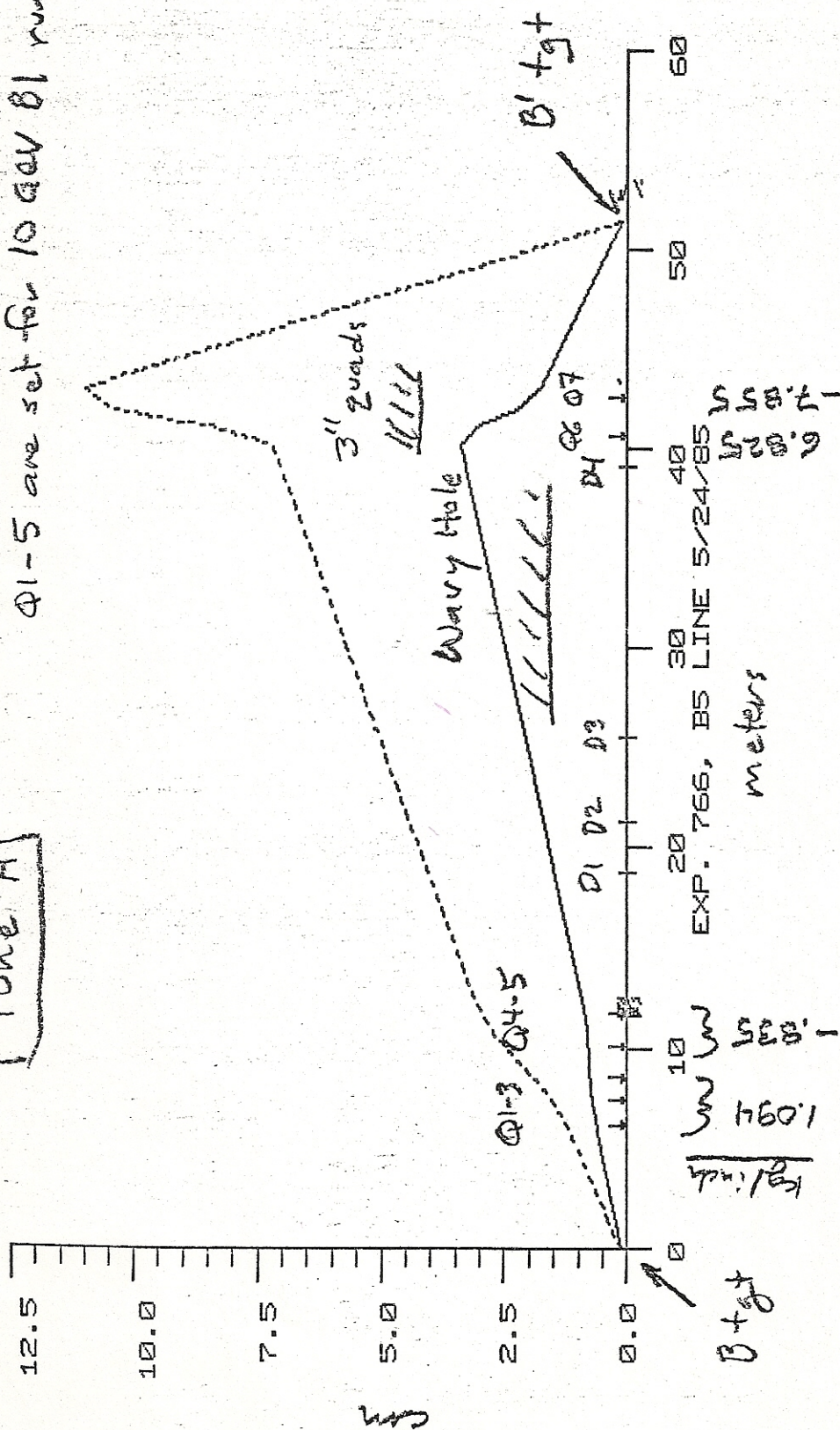
Note: B and C are not ideal for the B1 line! Tune A has been found to give more transmission (x1.5 to 2) and a smaller spot at B' than the previous E766 tune.



Tune A

June 5, 1985

Q1-5 are set for 10 gaw 81 running.



D:bulk	Pol.	A	B
950		1.094	1.094
1043		1.835	1.835

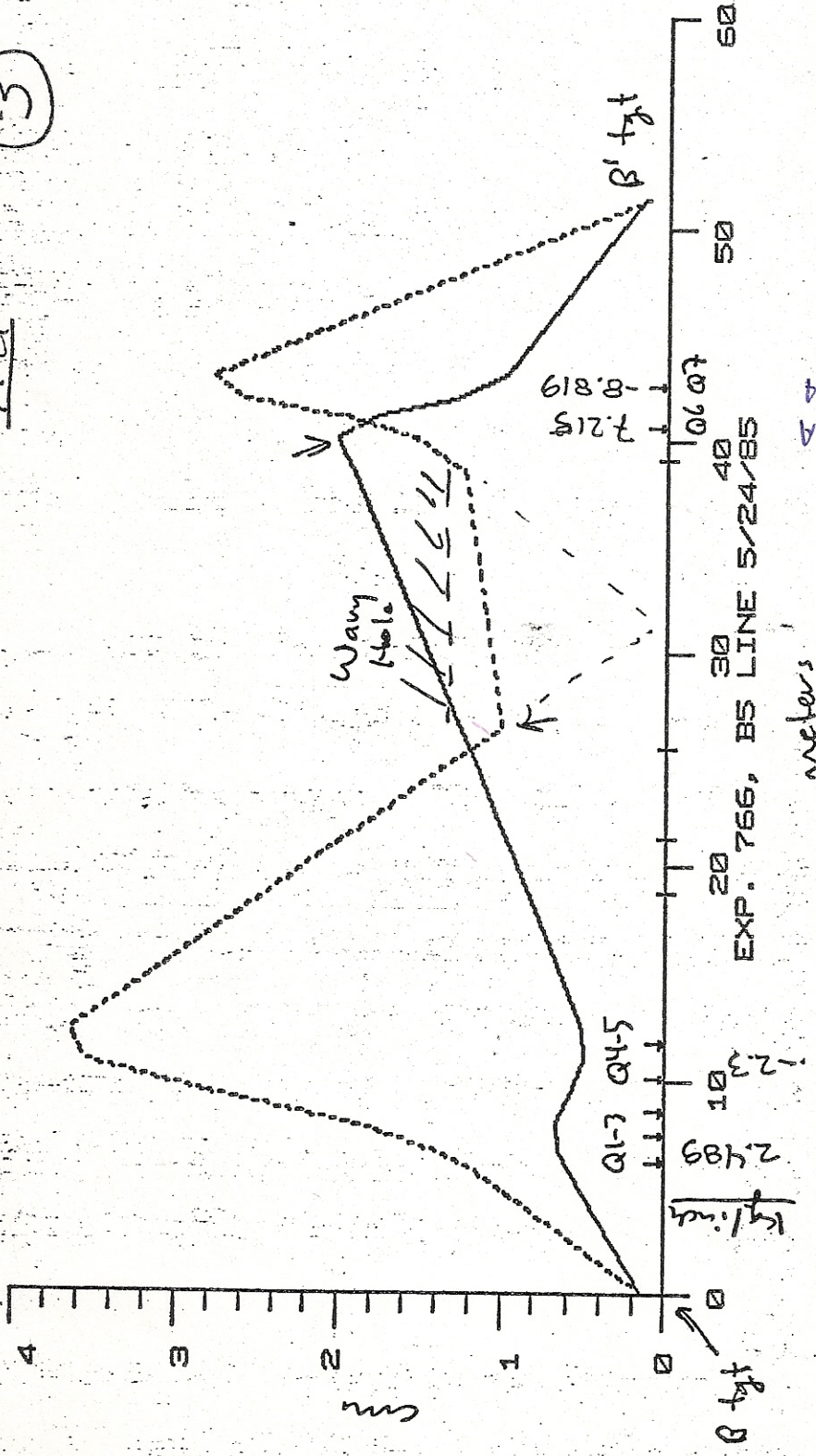
D:bulk	Pol.	A	B
2560		1.60 kA	1.60 kA
2976		7.855	7.855



Tune B

3" 2wads  
11cc

(3)



÷ 625 to get  
d.buck off.

A 2.17kA  
B -1.80kA

A 1.70kA  
B -2.45kA

7.215  
-8.819

kg/inch

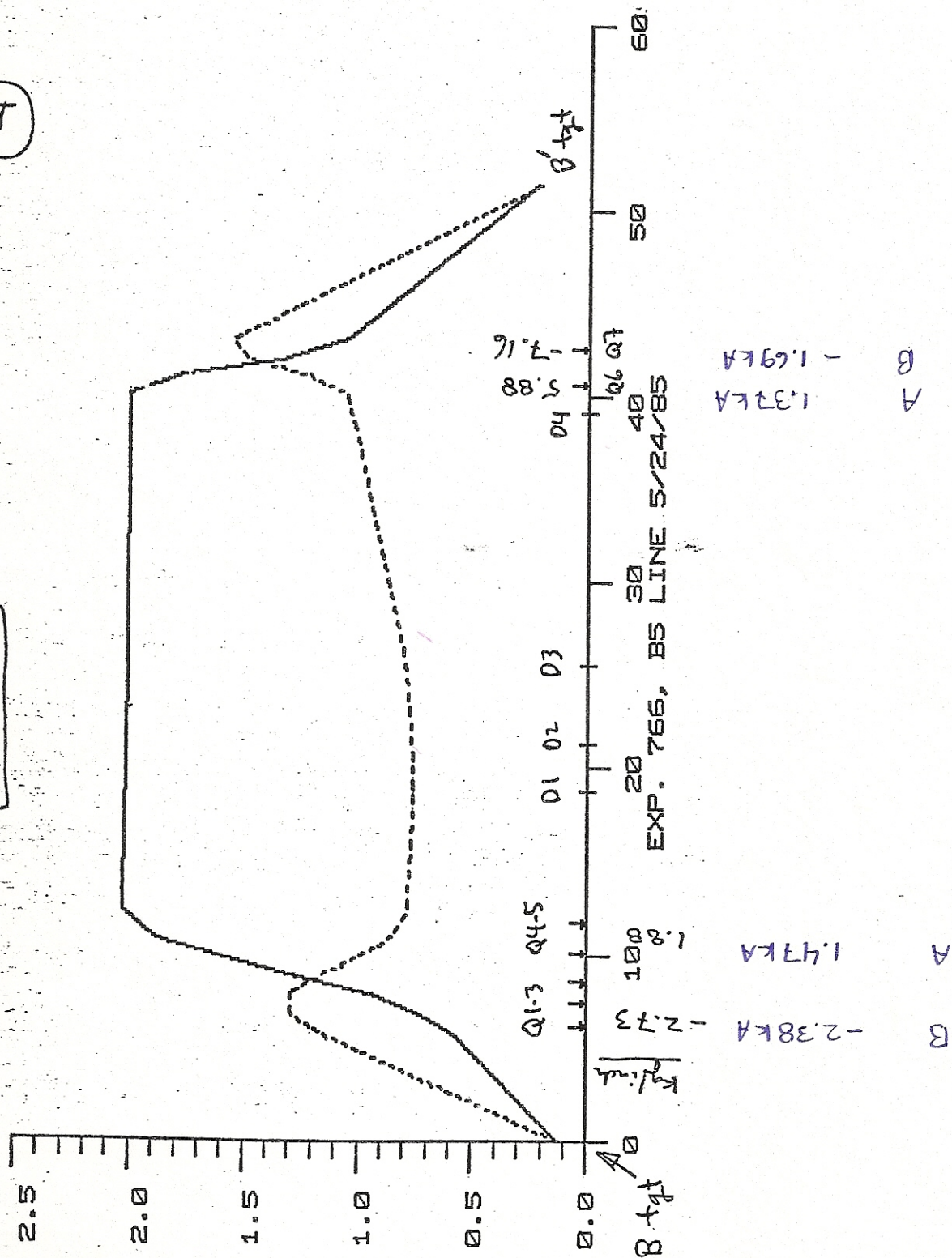
01-7 04-5

2.489  
-2.3



Tune C

4

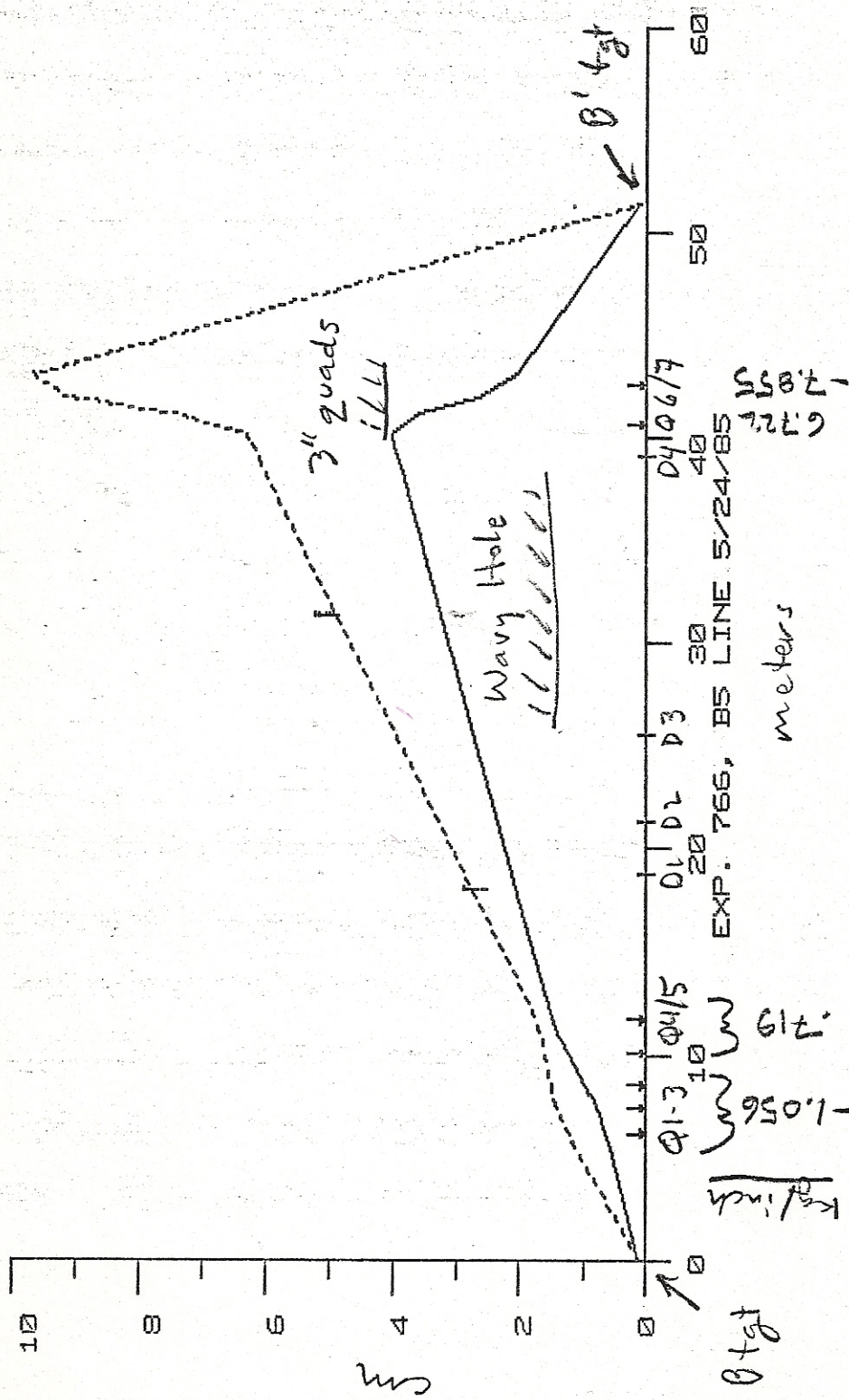




REVERSED Q1-5, 10.69 GEV TUNE FOR B1

**Tune D**

11-Jun-85 09:28



Dibuk pd. current  
 920 B 920amps -1.056  
 899 A 562  
 .719

2464 3019  
 A B  
 1540 1887  
 6.726 -7.855



Tune A June 5, 1985

"EXP. 766, B5 LINE 5/24/85					
DRIFFT 3:	"D1	5.690000	0.000000	0.000000	0.000000
QUAD* 5:	"Q1	0.932000	1.009400	2.540000	23.838000
DRIFFT 3:	"D2	0.249000	0.000000	0.000000	0.000000
QUAD* 5:	"Q2	0.932000	1.009400	2.540000	23.838000
DRIFFT 3:	"L2	0.249000	0.000000	0.000000	0.000000
QUAD* 5:	"Q3	0.932000	1.009400	2.540000	23.838000
DRIFFT 3:	"L3	0.435000	0.000000	0.000000	0.000000
QUAD* 5:	"Q4	1.321000	-0.835000	2.540000	-21.672000
DRIFFT 3:	"L4	0.253000	-0.835000	2.540000	-21.672000
QUAD* 5:	"Q5	1.321000	0.000000	2.540000	0.000000
DRIFFT 3:	"L5	5.480000	0.000000	0.000000	0.000000
ROTAT 2:		0.600000	0.000000	0.000000	0.000000
BEND* 4:	"D1	1.981000	9.883000	0.000000	1.179000
ROTAT 2:		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:	"D2	1.981000	9.883000	0.000000	1.179000
ROTAT 2:		0.600000	0.000000	0.000000	0.000000
DRIFFT 3:		2.350000	0.000000	0.000000	0.000000
BEND* 4:	"D3	1.981000	0.000000	0.000000	0.000000
DRIFFT 3:		11.960000	0.000000	0.000000	0.000000
BEND* 4:	"D4	1.070000	0.000000	0.000000	0.000000
DRIFFT 3:		0.500000	0.000000	0.000000	0.000000
QUAD* 5: 0 1	"Q6	1.000000	6.825000	2.540000	3.709000
DRIFFT 3:		0.910000	0.000000	0.000000	0.000000
QUAD* 5: 0 1	"Q7	1.000000	-7.855000	2.540000	-2.913000
DRIFFT 3:		8.430000	0.000000	0.000000	0.000000
FIT 10:		1.000010	0.100000	0.010000	0.115000
FIT 10:		3.000030	0.100000	0.010000	0.103900
0:		0.000000	0.000000	0.000000	0.000000



# Tune B

D1	5.690000	0.000000	0.000000	0.000000	0.000000	0.000000
Q1	0.932000	0.489000	2.489000	2.489000	2.540000	10.566000
D2	0.249000	0.932000	0.000000	2.489000	2.540000	10.566000
Q2	0.249000	0.932000	0.000000	2.489000	2.540000	10.566000
L2	0.249000	0.932000	0.000000	2.489000	2.540000	10.566000
Q3	0.435000	0.932000	0.000000	2.489000	2.540000	10.566000
L3	0.435000	0.932000	0.000000	2.489000	2.540000	10.566000
Q4	1.321000	0.253000	2.101000	2.101000	2.540000	0.483000
L4	0.253000	1.321000	0.000000	2.540000	2.540000	0.000000
Q5	1.321000	0.253000	2.101000	2.101000	2.540000	0.000000
L5	0.253000	1.321000	0.000000	2.540000	2.540000	0.000000
D1	1.981000	0.600000	0.000000	0.000000	0.000000	1.179000
Q1	0.600000	1.981000	0.000000	0.000000	0.000000	0.000000
D2	0.508000	0.600000	0.000000	0.000000	0.000000	0.000000
Q2	0.508000	0.600000	0.000000	0.000000	0.000000	0.000000
L2	0.508000	0.600000	0.000000	0.000000	0.000000	0.000000
Q3	1.981000	0.600000	0.000000	0.000000	0.000000	1.179000
L3	0.600000	1.981000	0.000000	0.000000	0.000000	0.000000
D3	2.350000	1.981000	0.000000	0.000000	0.000000	0.000000
Q3	1.981000	2.350000	0.000000	0.000000	0.000000	0.000000
D4	1.070000	1.981000	0.000000	0.000000	0.000000	0.000000
Q4	1.070000	1.981000	0.000000	0.000000	0.000000	0.000000
Q6	1.000000	1.000000	7.215000	7.215000	2.540000	3.519000
Q7	0.910000	1.000000	0.000000	0.000000	2.540000	0.000000
Q1	1.000000	0.910000	0.819000	0.819000	2.540000	0.000000
Q2	0.430000	0.430000	0.000000	0.000000	0.000000	0.000000
Q3	1.000100	1.000100	0.100000	0.100000	0.010000	0.150000
Q4	3.000300	3.000300	0.100000	0.100000	0.010000	0.127000
Q5	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000



Tune C

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

DRIFT	3:	"D1	5.690000	0.000000	0.000000	0.000000
QUAD*	5:	"Q1	0.932000	-2.733000	2.540000	-9.326000
DRIFT	3:	"D2	0.249000	0.000000	0.000000	0.000000
QUAD*	5:	"Q2	0.932000	-2.733000	2.540000	-9.326000
DRIFT	3:	"L2	0.249000	0.000000	0.000000	0.000000
QUAD*	5:	"Q3	0.932000	-2.733000	2.540000	-9.326000
DRIFT	3:	"L3	0.435000	0.000000	0.000000	0.000000
QUAD*	5:	"Q4	1.321000	1.884000	2.540000	9.925000
DRIFT	3:	"L4	0.253000	0.000000	0.000000	0.000000
QUAD*	5:	"Q5	1.321000	1.884000	2.540000	9.925000
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:	"D3	0.508000	0.000000	0.000000	0.000000
ROTAT	2:	"D2	0.600000	0.000000	0.000000	0.000000
BEND*	4:	"D3	1.981000	9.883000	0.000000	1.179000
ROTAT	2:	"D4	0.600000	0.000000	0.000000	0.000000
DRIFT	3:	"D4	2.350000	0.000000	0.000000	0.000000
BEND*	4:	"D4	1.981000	9.883000	0.000000	1.179000
DRIFT	3:	"Q6	1.070000	0.000000	0.000000	0.000000
BEND*	4:	"Q6	1.070000	0.000000	0.000000	0.000000
DRIFT	3:	"Q7	0.500000	0.000000	0.000000	0.000000
QUAD*	5: 0 1	"Q7	1.000000	5.883000	2.540000	4.275000
DRIFT	3:	"Q7	0.910000	0.000000	0.000000	0.000000
QUAD*	5: 0 1	"Q7	1.000000	-7.163000	2.540000	-3.209000
DRIFT	3:	"Q7	8.430000	0.000000	0.000000	0.000000
FIT	10:	"Q7	1.000100	0.100000	0.010000	0.000000
FIT	10:	"Q7	3.000300	0.100000	0.010000	0.227000





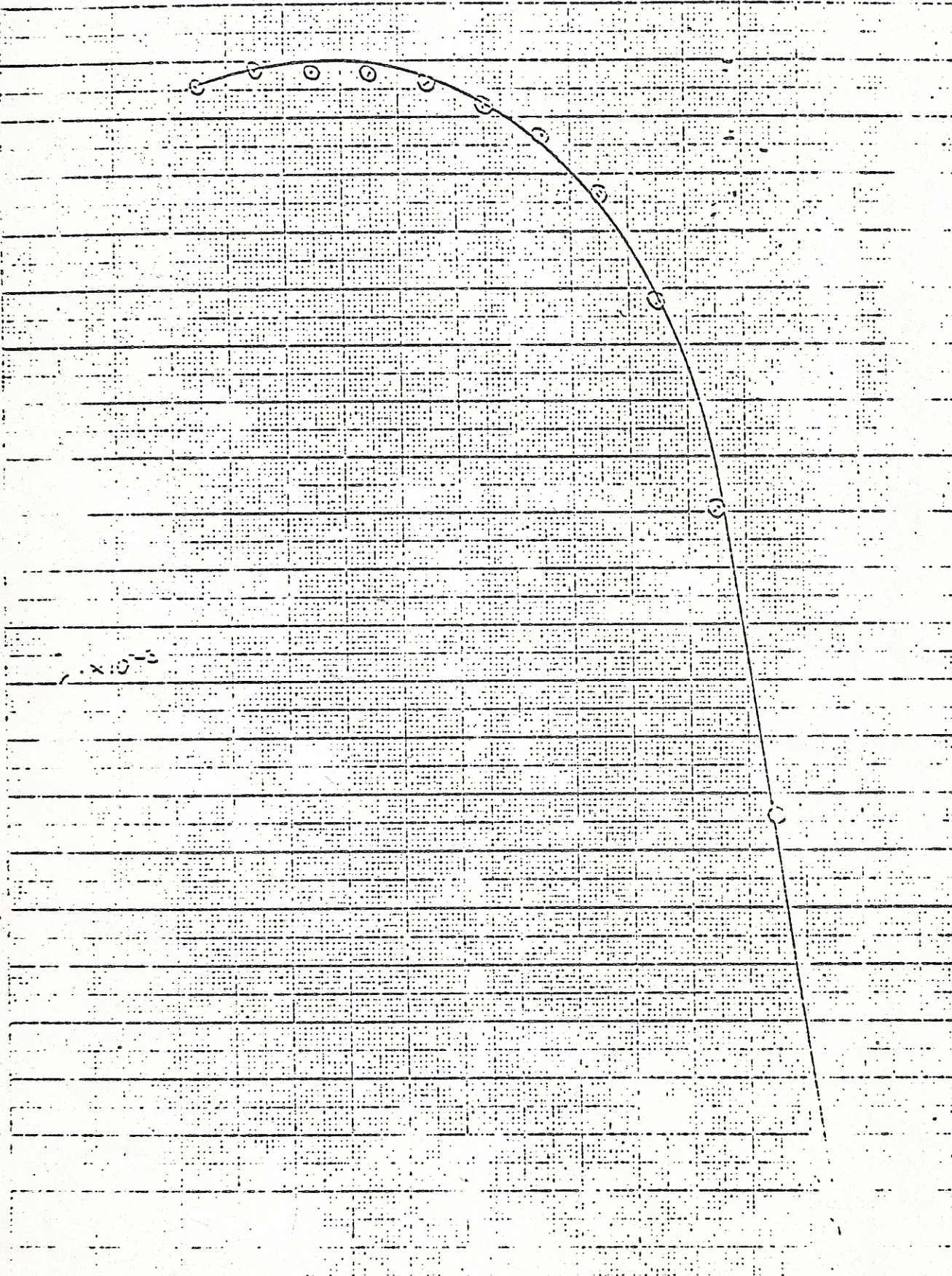


$\frac{G}{I}$   
 $\times 10^{-3}$

16 X 10 TO THE CUBED PER AG 1510  
 10 X 25 CM  
 KIMBLE & CO. CO.

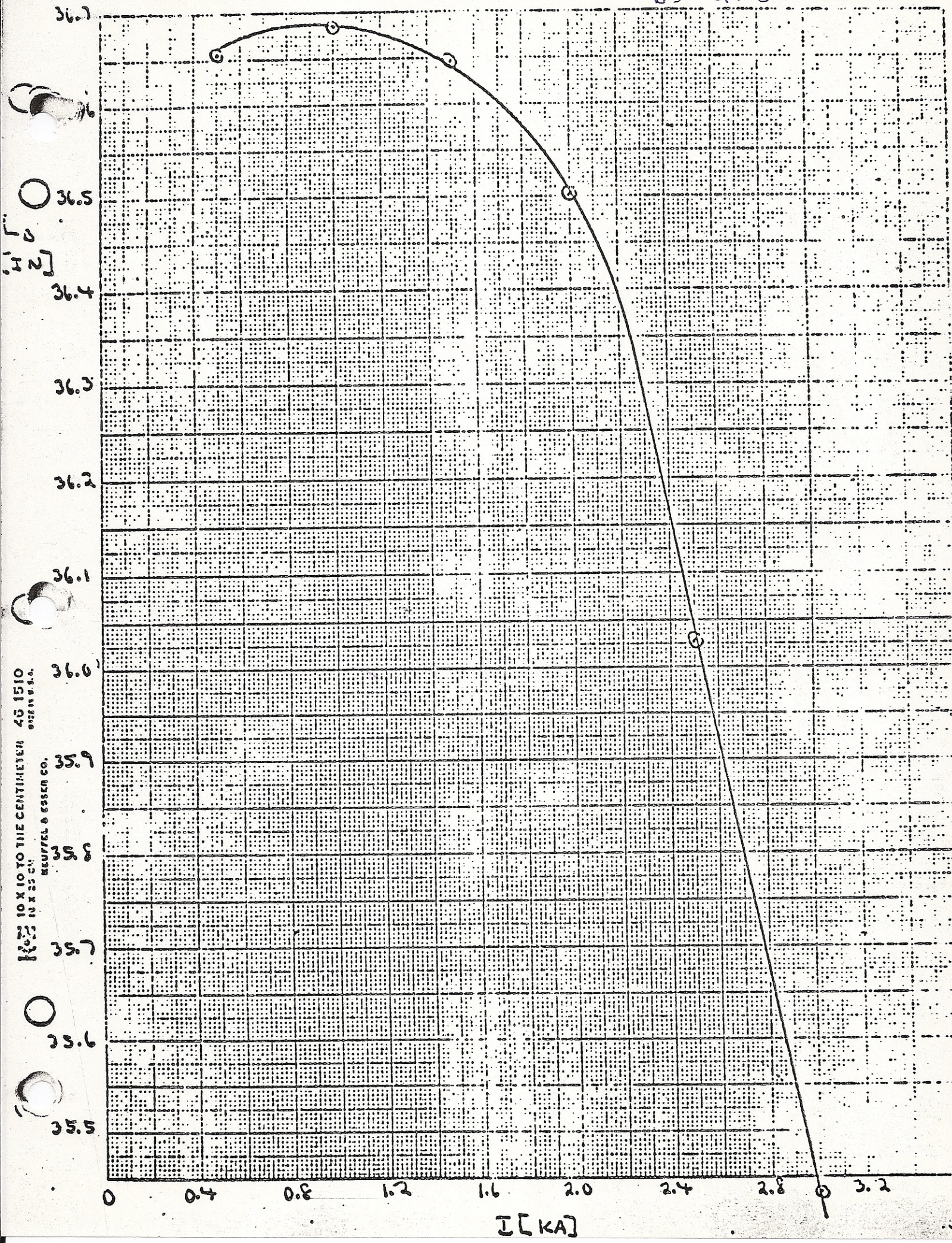
1.150  
 1.130  
 1.110

0 0.4 0.8 1.2 1.6 2.0 2.4 2.8 3.2





B5 Q1-3 N8Q52



RESISTANCE TO THE CENTIMETER 45 1510  
HUFFEL & ESSER CO.



Panby

B5 Q4-5

Multiply by kamps to get gradient

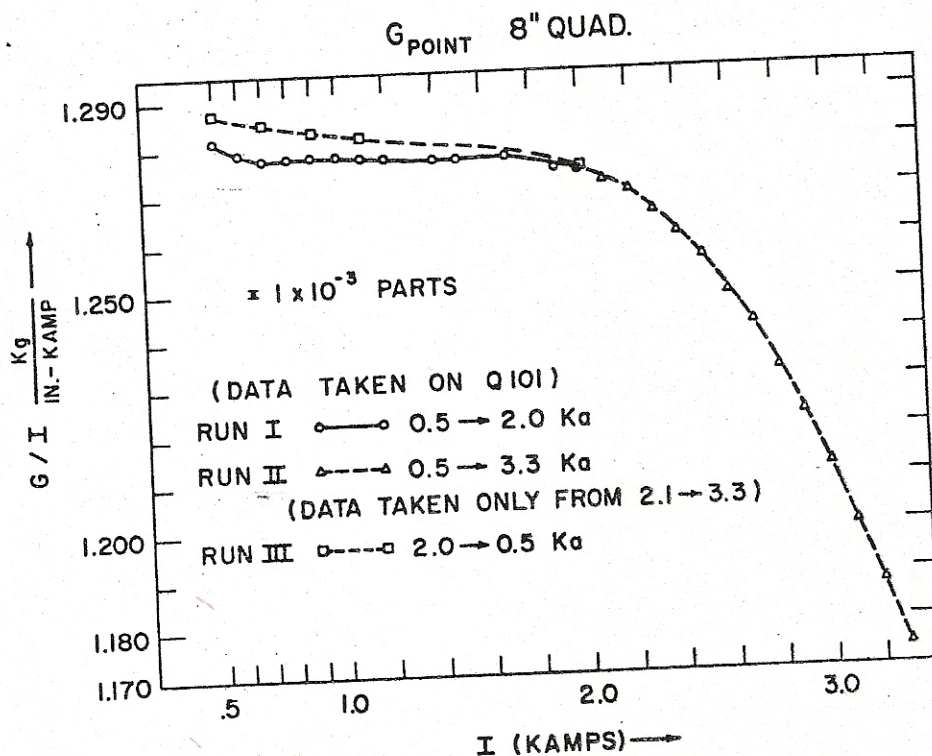


Fig. 6. Gradient, G point, vs I for 8 inch quadrupoles.



Dawby

B5 Q4-5

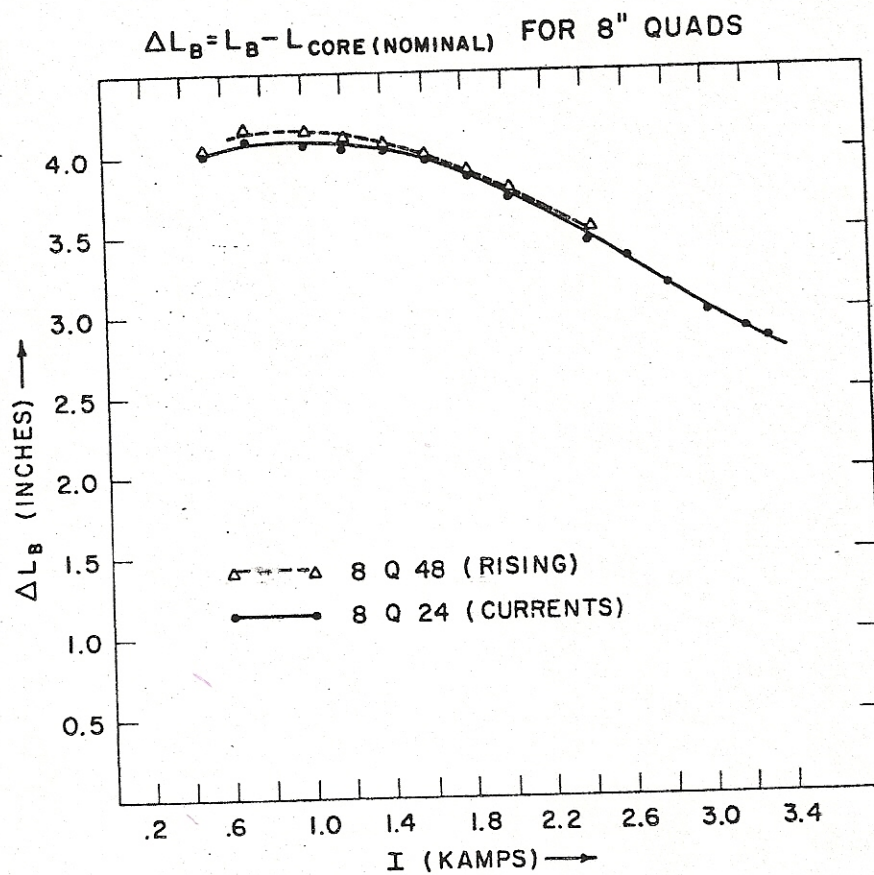


Fig. 7. Magnet length,  $L_B$ , vs I for 8 inch quadrupoles. ( $L_B = \Delta L_B + L_{\text{core}}$ ).



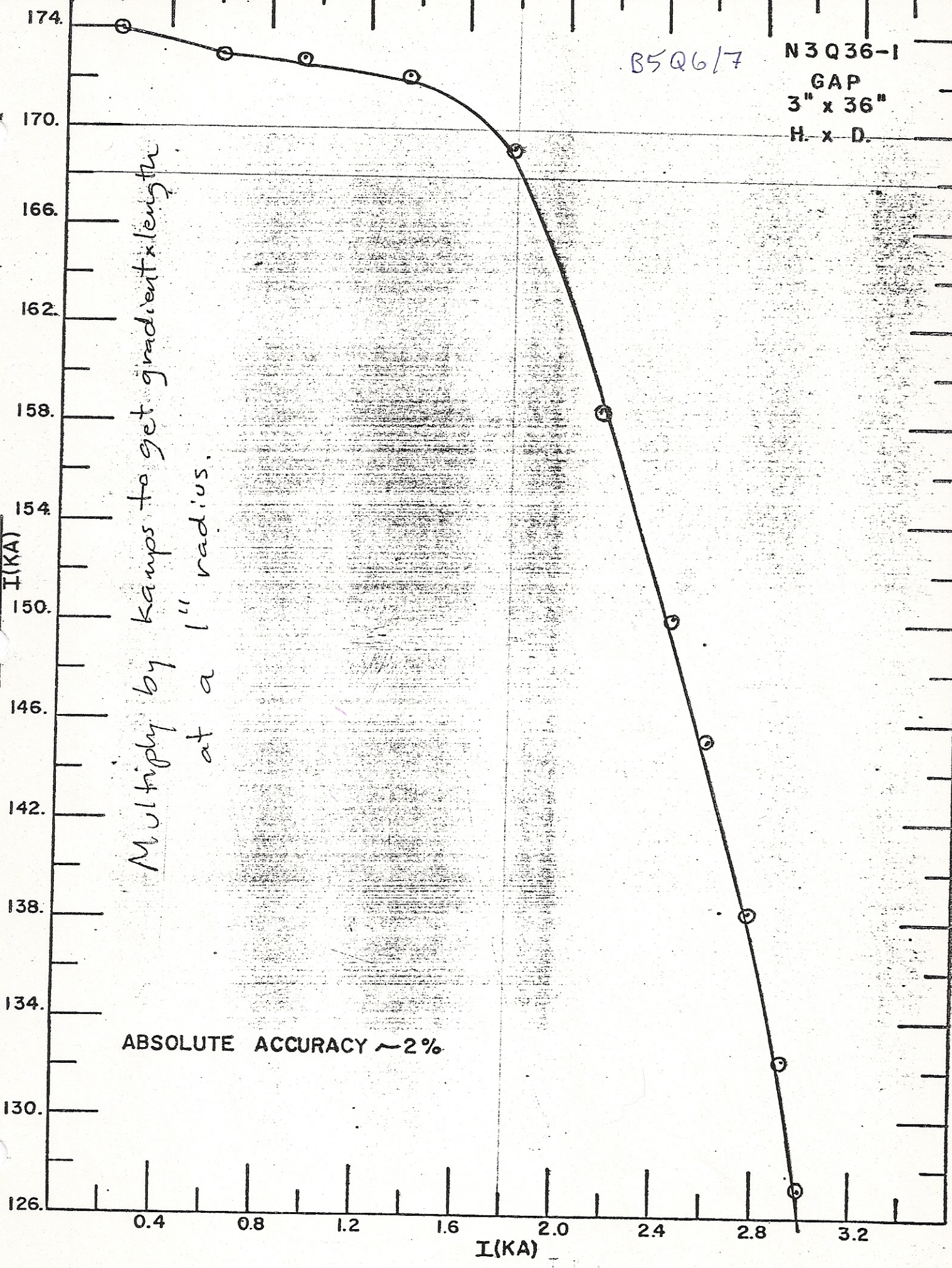
B5Q6/7

N3Q36-1

GAP  
3" x 36"  
H. x D.

$G\left(\frac{KG}{IN}\right) \times Lb (IN)$   
 $I(KA)$   
Multiply by kamps to get gradient x length  
at a 1" radius.

ABSOLUTE ACCURACY ~2%





B5D1

Danby

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

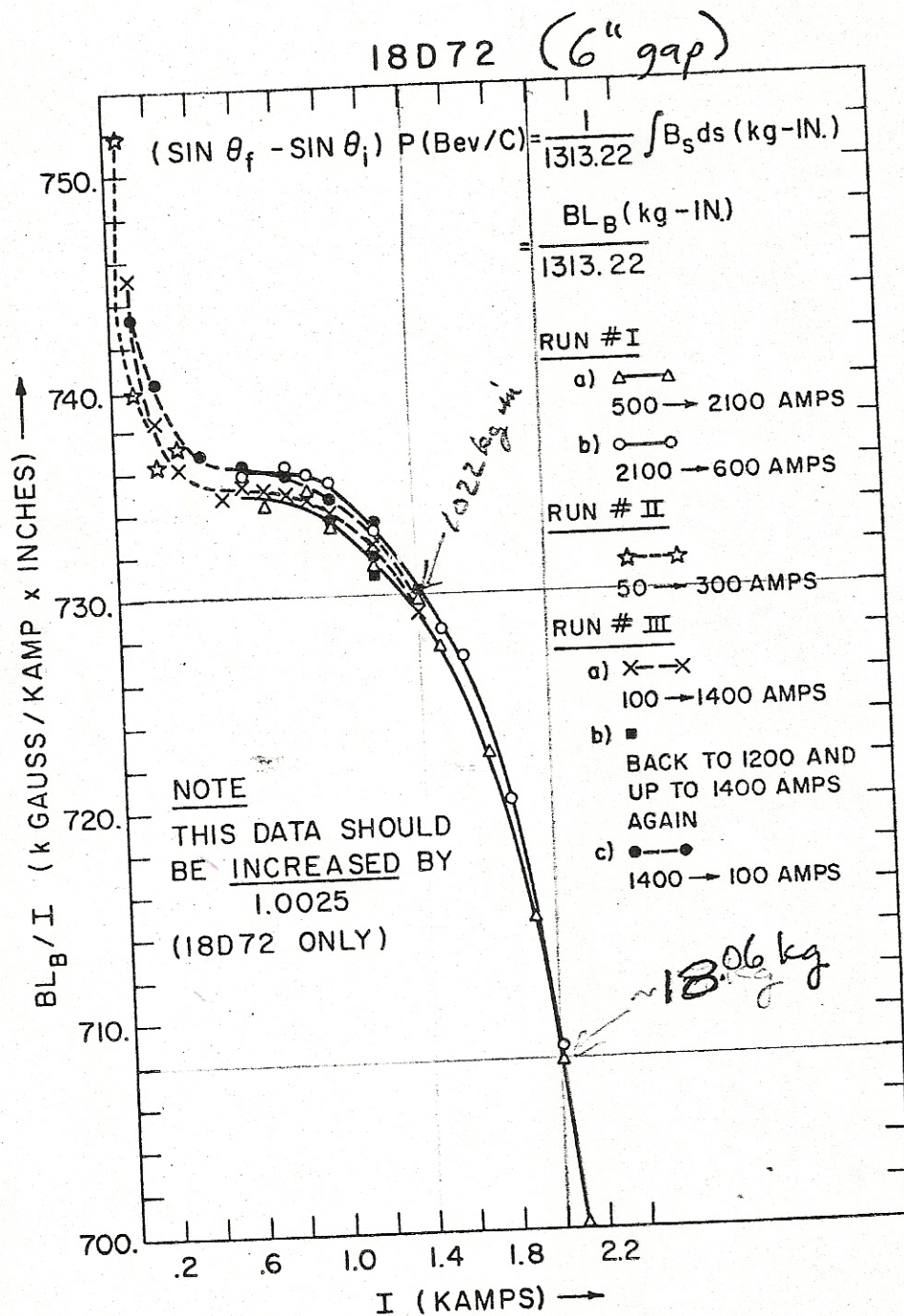


Fig. 2.  $\int B_s ds$  vs I for 18D72 magnets.



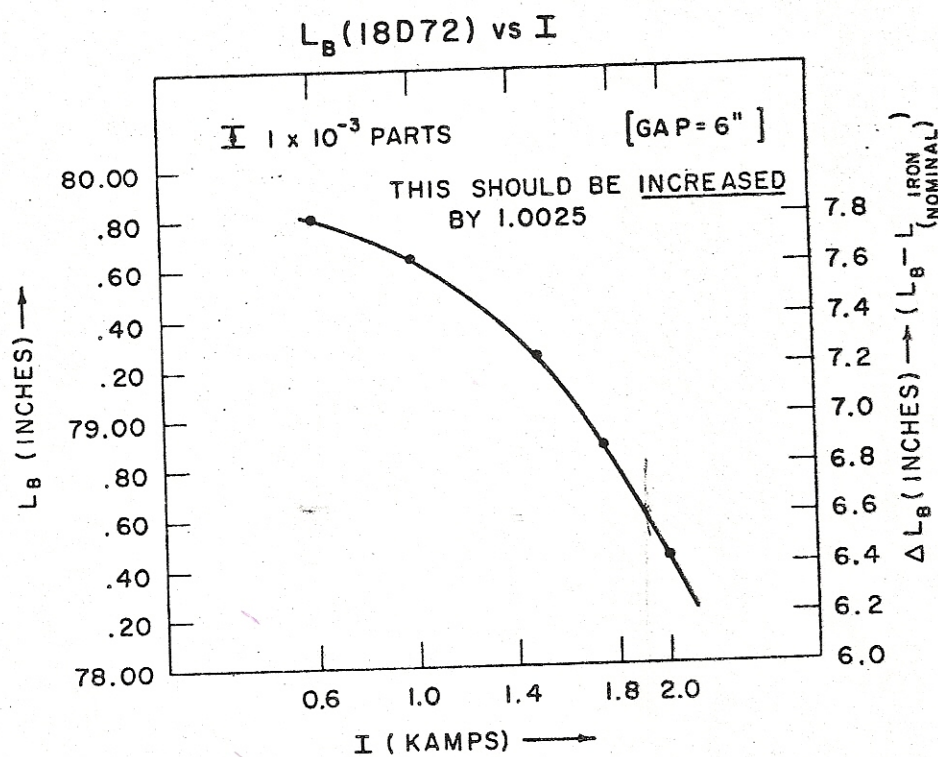


Fig. 3. Magnet length,  $L_B$ , vs  $I$  for 18D72 magnets.



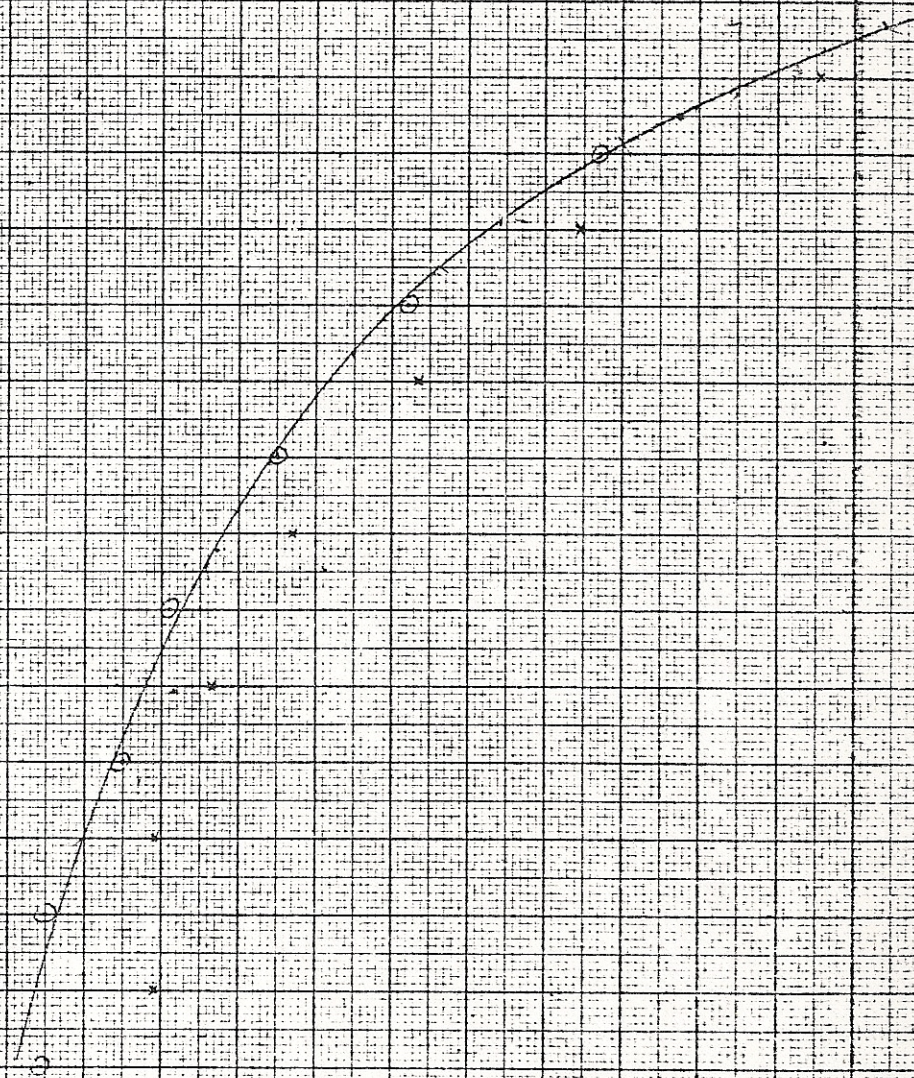
300-162

$$\begin{aligned}
 (\sin \theta_0 - \sin \theta_1) \times \left[ \frac{\text{Bew/c}}{1} \right] &= \frac{(B_{15}) - B_0 [KG-IN]}{313.22} \\
 &= \frac{B_{15} [KG-IN]}{313.22}
 \end{aligned}$$

746.0  
742.0  
738.0  
734.0  
730.0  
726.0  
722.0

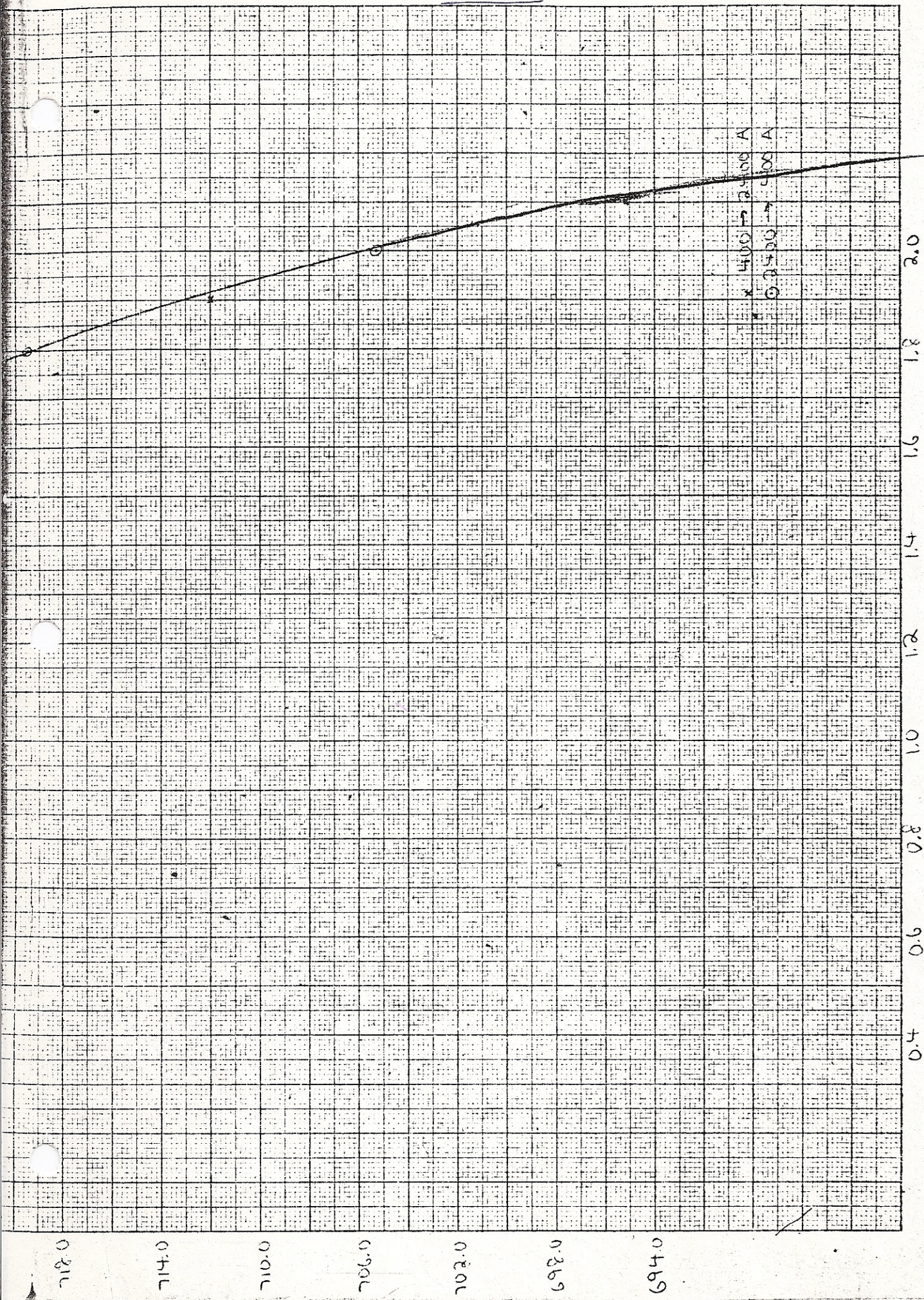
$\frac{B_{15}}{I} \left[ \frac{KG-IN}{KA} \right]$

$\downarrow \times 10^{-3}$





B502



4000 2500 A  
3000 2000 A  
2000 1500 A  
1000 1000 A

30D72

K&E 10 X 10 TO THE CM. 359-14L  
KLUFFEL & FISHER CO. NAT'L IN. 1 A

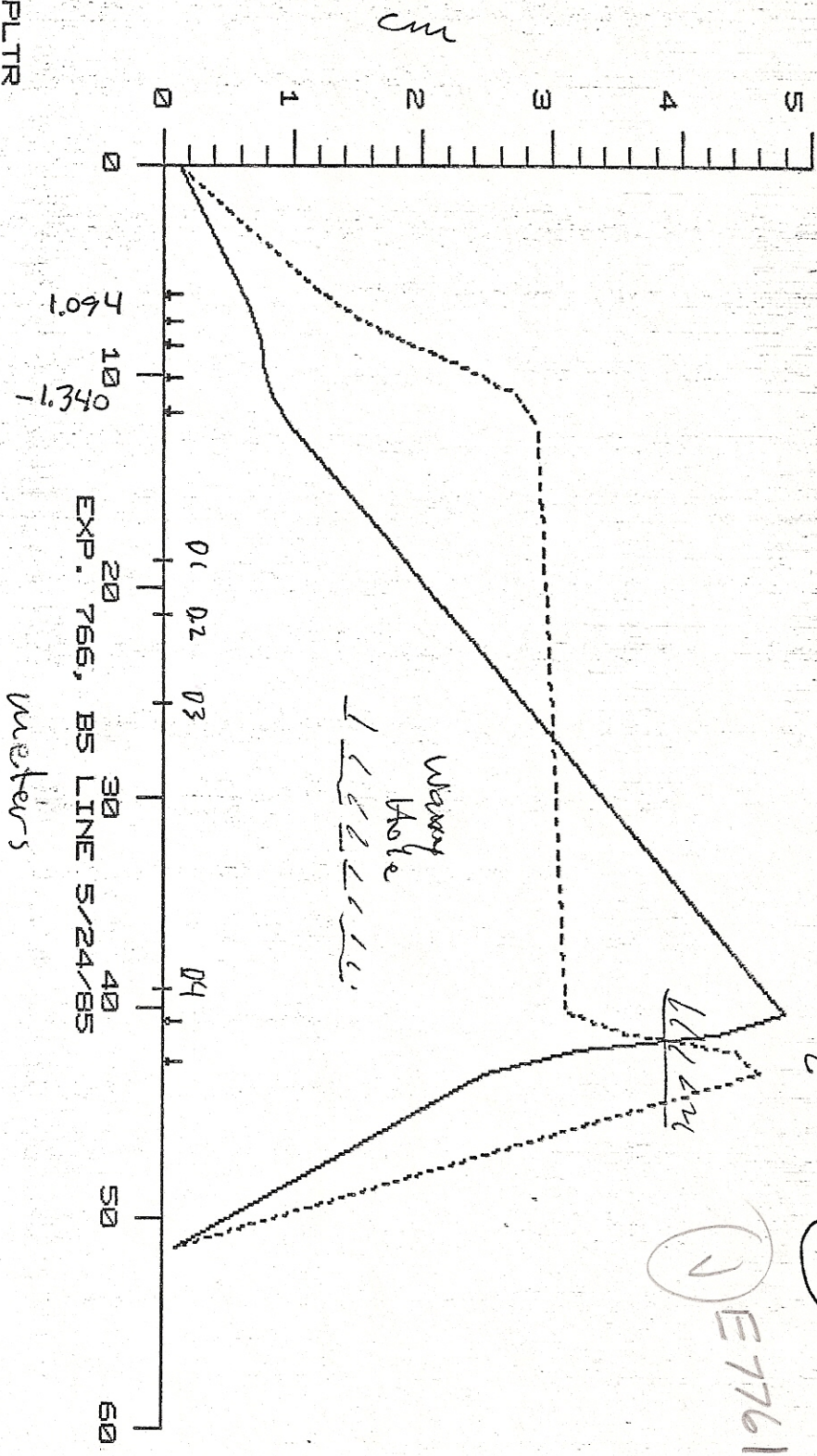
I [KA]



3<sup>u</sup> quadrants

(2)

① E7761.201





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

2

DRI FT	3.	"D1	5.690000	0.000000	0.000000	0.000000
QUAD*	5.	"Q1	0.932000	1.094000	2.540000	0.000000
DRI FT	3.	"D2	0.249000	0.000000	0.000000	23.838000
QUAD*	5.	"Q2	0.932000	1.094000	2.540000	0.000000
DRI FT	3.	"L2	0.249000	0.000000	0.000000	23.838000
QUAD*	5.	"Q3	0.932000	1.094000	2.540000	0.000000
DRI FT	3.	"L3	0.435000	0.000000	0.000000	0.000000
QUAD*	5.	"Q4	1.321000	-1.340000	2.540000	-13.423000
DRI FT	3.	"L4	0.253000	0.000000	0.000000	0.000000
QUAD*	5.	"Q5	1.321000	-1.340000	2.540000	-13.423000
DRI FT	3.	"L5	5.480000	0.000000	0.000000	0.000000
ROTAT	2.	"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
DRI FT	3.		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
DRI FT	3.	"D3	2.350000	0.000000	0.000000	0.000000
BEND*	3.		1.981000	0.000000	0.000000	0.000000
DRI FT	3.	"D4	1.960000	0.000000	0.000000	0.000000
BEND*	4.		1.070000	0.000000	0.000000	0.000000
DRI FT	3.		0.500000	0.000000	0.000000	0.000000
QUAD*	5.	"Q6	1.000000	6.817000	2.540000	3.714000
DRI FT	3.		0.910000	0.000000	0.000000	0.000000
QUAD*	5.	"Q7	1.000000	-7.630000	2.540000	-3.003000
DRI FT	3.		8.430000	0.000000	0.000000	0.000000
FIT	10.		1.000100	0.100000	0.010000	0.100300
FIT	10.		3.000300	0.100000	0.010000	0.106300

RUN PLTR

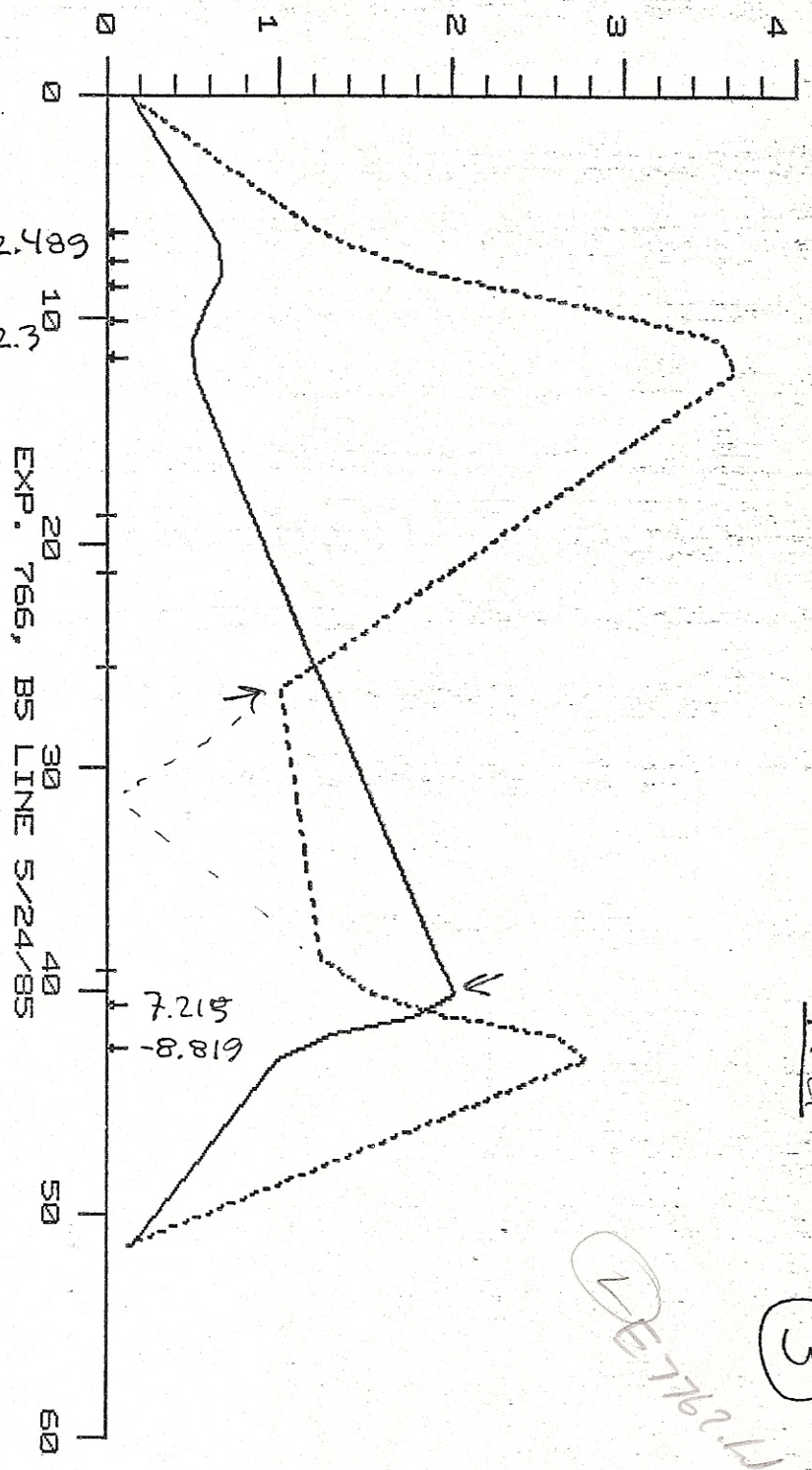
ENTER UP TO 55 CHARACTERS OF DESCRIPTION:



3" 2x4s  
11x

(3)

DE 766.71



5.01 1.0 6. 2.54 '06' ;  
.^C##

.TECO FOR05.DAT4HARACTERS OF DESCRIPTION:

→ : requested sizes

L2K Core1  
\*S04#0LT##  
5.0 1.321 -1.395 2.54 '04' ;  
\*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 '01' ;  
3.0 .249 'D2' \*  
5.0 .932 2.489 2.54 '02' ;  
3.0 .249 'L2' \*



DRIFF 3. "D1 5.690000 0.000000 0.000000 0.000000 0.000000  
 QUAD\* 5. "Q1 0.932000 2.489000 2.540000 10.566000  
 DRIFF 3. "D2 0.249000 0.000000 0.000000 0.000000  
 QUAD\* 5. "Q2 0.932000 2.489000 2.540000 10.566000  
 DRIFF 3. "L2 0.249000 0.000000 0.000000 0.000000  
 QUAD\* 5. "Q3 0.932000 2.489000 2.540000 10.566000  
 DRIFF 3. "L3 0.435000 0.000000 0.000000 0.000000  
 QUAD\* 5. "Q4 1.321000 -2.101000 2.540000 -8.483000  
 DRIFF 3. "L4 0.253000 0.000000 0.000000 0.000000  
 QUAD\* 5. "Q5 1.321000 -2.549000 2.540000 -6.955000  
 DRIFF 3. "L5 5.480000 0.000000 0.000000 0.000000  
 ROTAT 2. "D1 0.600000 9.883000 0.000000 0.000000  
 BEND\* 4. 1.981000 0.000000 0.000000 1.179000  
 ROTAT 2. "D2 0.600000 0.000000 0.000000 0.000000  
 DRIFF 3. 2.350000 0.000000 0.000000 0.000000  
 ROTAT 2. "D3 1.981000 0.000000 0.000000 0.000000  
 BEND\* 4. 11.960000 0.000000 0.000000 0.000000  
 DRIFF 3. "D4 1.070000 0.000000 0.000000 0.000000  
 BEND\* 4. 0.500000 0.000000 0.000000 0.000000  
 DRIFF 3. 5.0 1 "Q6 1.000000 7.215000 2.540000 3.519000  
 QUAD\* 5.0 1 "Q7 0.910000 0.000000 0.000000 0.000000  
 DRIFF 3. 8.430000 -8.819000 2.540000 -2.578000  
 QUAD\* 5.0 1 1.000000 0.000000 0.000000 0.000000  
 DRIFF 10. 1.000100 0.100000 0.010000 0.150800  
 FIT 10. 3.000300 0.100000 0.010000 0.127000  
 FIT 0. 0.000000 0.000000 0.000000 0.000000

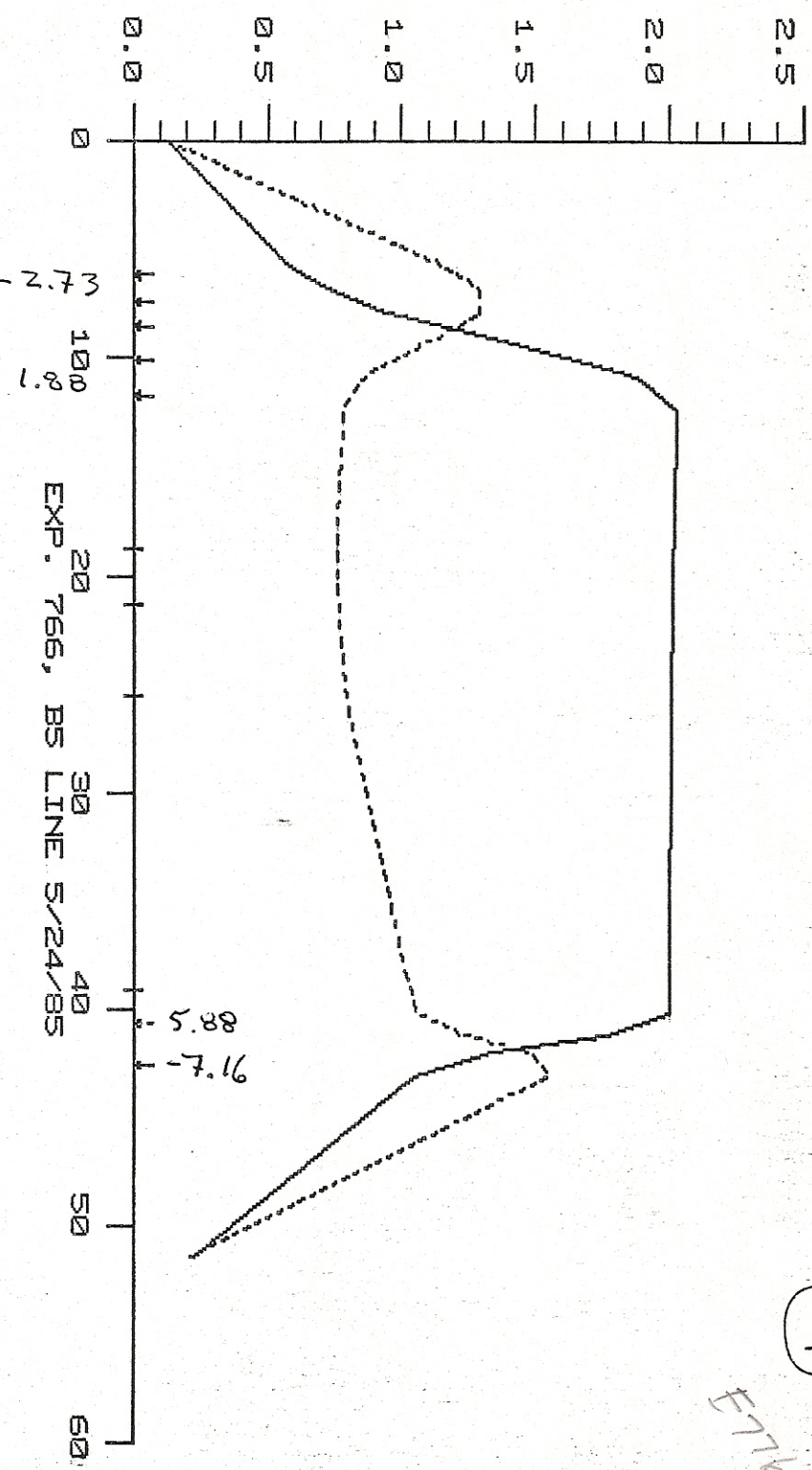
5.01 1.0 6. 2.54 'Q6' ;  
 .^C\$\$\$

. TECO FOR05.DAT4CHARACTERS OF DESCRIPTION:

LEK Core1  
 \*SQ4\$0LT\$#  
 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  
F7763.20



\*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\TRANS125,64

STOP

END OF EXECUTION  
 CPU TIME: 3.88 ELAPSED TIME: 12.13  
 EXIT

.RUN PLTR

ENTER UP TO 55 CHARACTERS OF DESCRIPTION:



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

DRIFT	3.	"D1	5.690000	0.000000	0.000000	0.000000
QUAD*	5.	"Q1	0.932000	-2.733000	2.540000	-9.326000
DRIFT	3.	"D2	0.249000	0.000000	0.000000	0.000000
QUAD*	5.	"Q2	0.932000	-2.733000	2.540000	-9.326000
DRIFT	3.	"L2	0.249000	0.000000	0.000000	0.000000
QUAD*	5.	"Q3	0.932000	-2.733000	2.540000	-9.326000
DRIFT	3.	"L3	0.435000	0.000000	0.000000	0.000000
QUAD*	5.	"Q4	1.321000	1.884000	2.540000	9.925000
DRIFT	3.	"L4	0.253000	0.000000	0.000000	0.000000
QUAD*	5.	"Q5	1.321000	1.884000	2.540000	9.925000
DRIFT	3.	"L5	0.480000	0.000000	0.000000	0.000000
ROTAT	2.	"D1	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
DRIFT	3.		0.508000	0.000000	0.000000	0.000000
ROTAT	2.	"D2	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
DRIFT	3.	"D3	2.350000	0.000000	0.000000	0.000000
BEND*	4.		1.981000	0.000000	0.000000	0.000000
DRIFT	3.	"D4	11.960000	0.000000	0.000000	0.000000
BEND*	4.		1.070000	0.000000	0.000000	0.000000
DRIFT	3.	"Q6	0.500000	0.000000	0.000000	0.000000
QUAD*	5.	"Q6	1.000000	5.883000	2.540000	4.275000
DRIFT	3.	"Q7	0.910000	0.000000	0.000000	0.000000
QUAD*	5.		1.000000	-7.163000	2.540000	-3.209000
DRIFT	3.		8.430000	0.000000	0.000000	0.000000
FIT	10.		1.000100	0.100000	0.010000	0.000000
FIT	10.		3.000300	0.100000	0.010000	0.227000

\*S884\$I \$0TT\$

5.0 1.321 1.884 2.54 'Q4' ;

\*S10. \$0LT\$

10. 1. 1. 2. .1 ;RACTERS OF DESCRIPTION:

\*\*4K\$EX\$

.RUN TT\TRANS125,64

STOP

END OF EXECUTION

CPU TIME: 3.88 ELAPSED TIME: 12.13

EXIT

.RUN PLTR

ENTER UP TO 55 CHARACTERS OF DESCRIPTION:

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