CHAPTER V

RESULTS

SERIES I Dynamometer calibration

Vertical force calibration

(Horizontal force was kept constant at 11.5lbs)

Vertical load (lbs.)	Vert. strain gauge bridge reading (% strain X 10^4)
12.00	29.0
23.02	56.5
34.04	82.5
45.06	108.5
56.08	134.0
67.10	158.5
78.12	184.5
89.14	208.5
100.16	233.5
111.18	258.5
122.20	283.0
133.22	307.0
144.24	332.0

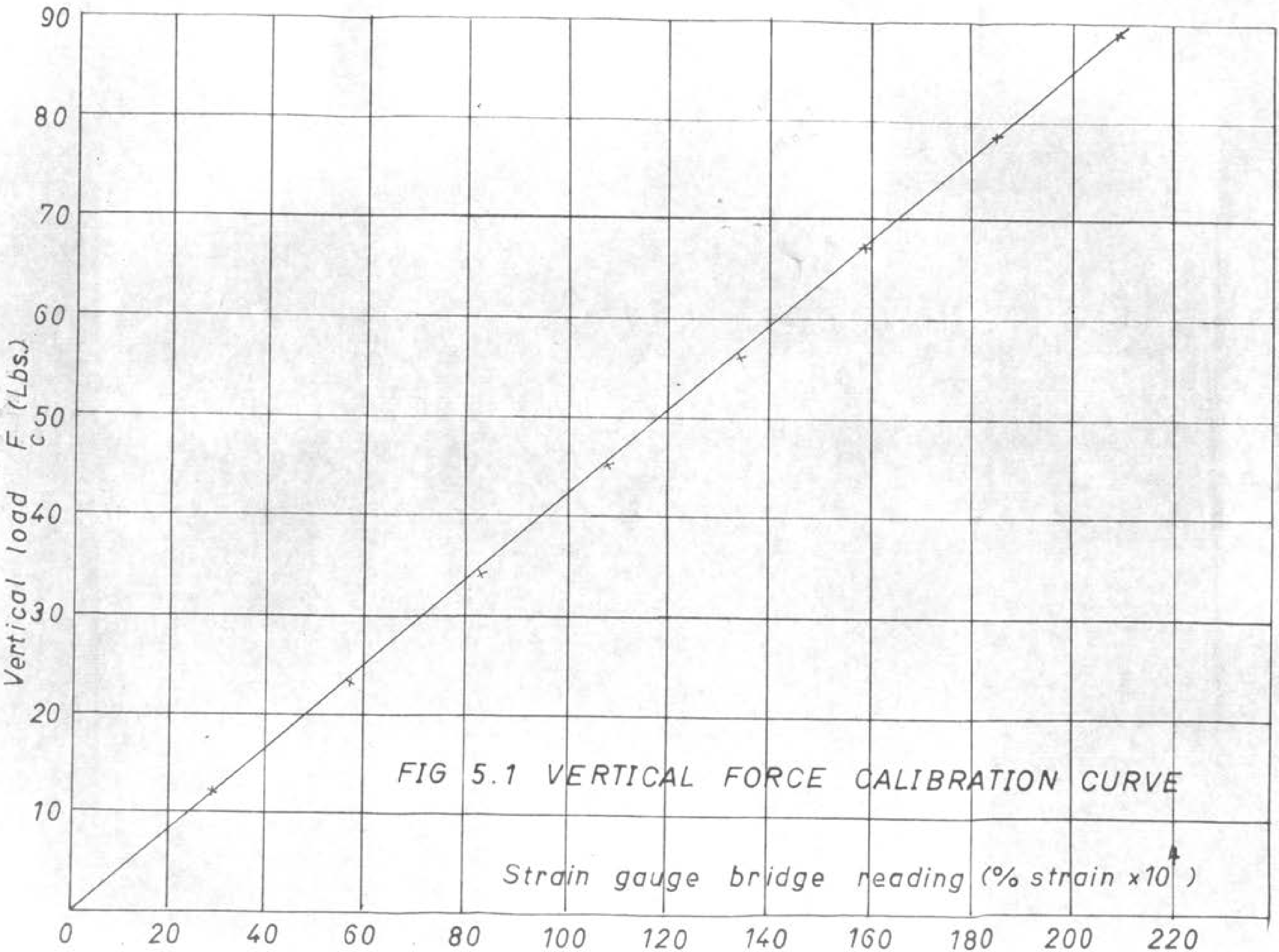

FIG 5.1 VERTICAL FORCE CALIBRATION CURVE

Horizontal force calibration

(Vertical force was kept constant at 12 lbs.)

Horisotal load (lbs.)	Hor. strain gauge bridge reading (% strain x 10^4)
11.50	30.0
22.52	56.0
33.54	82.5
44.56	108.0
55.58	133.5
66.60	157.5
77.62	181.0
88.64	206.5
99.66	230.0
110.68	253.0
121.70	278.0

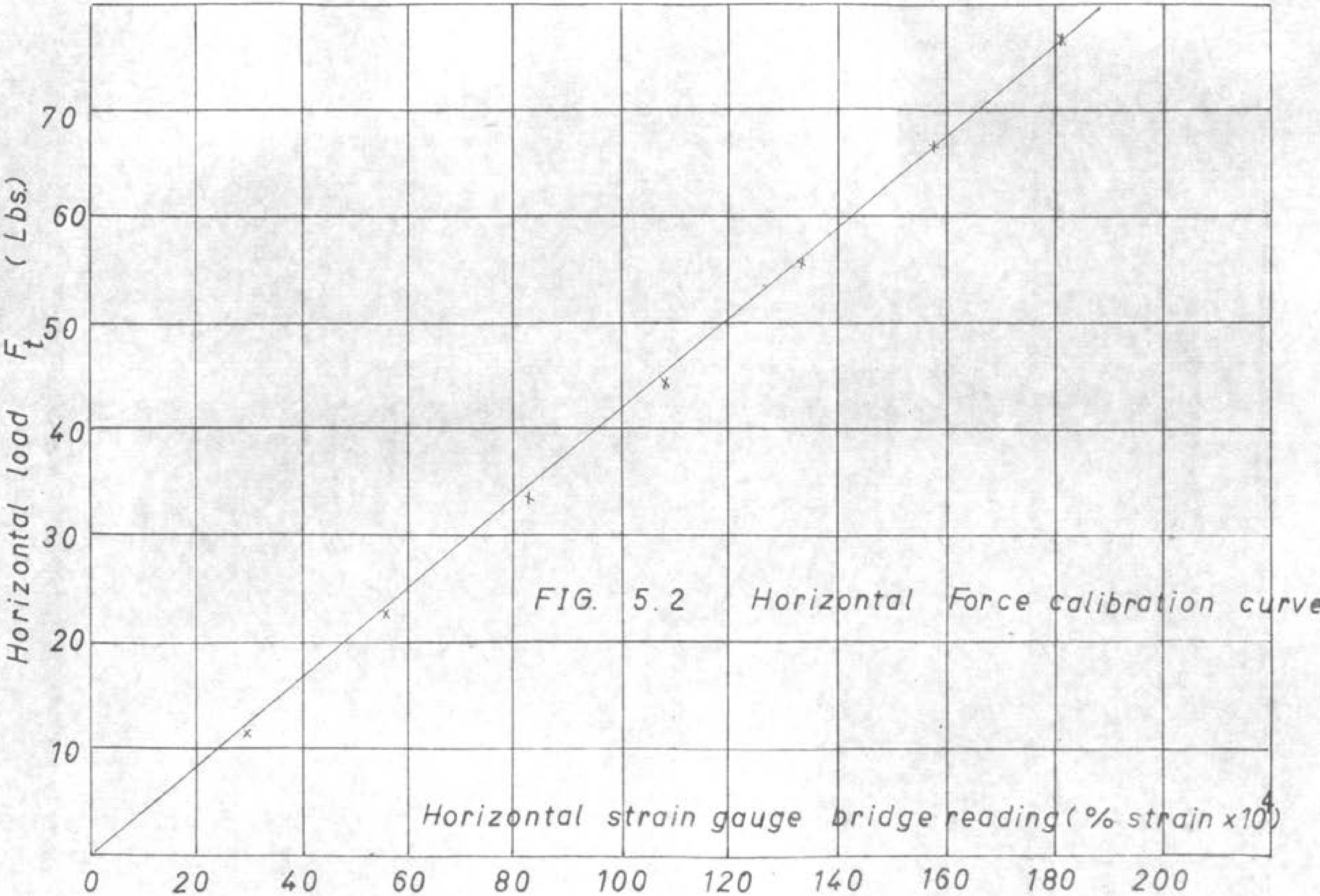

FIG. 5.2 Horizontal Force calibration curve

SERIES II Test for cross coupling

(Horizontal force was kept constant at 22.5 lbs.)

Vertical load (lbs.)	Hor. strain gauge bridge reading (% strain X 10^4)
12.00	57.0
22.00	57.0
32.00	57.5
43.02	58.0
54.04	58.0
65.06	59.0
76.08	59.0
87.10	59.0
98.12	60.0
109.14	61.0

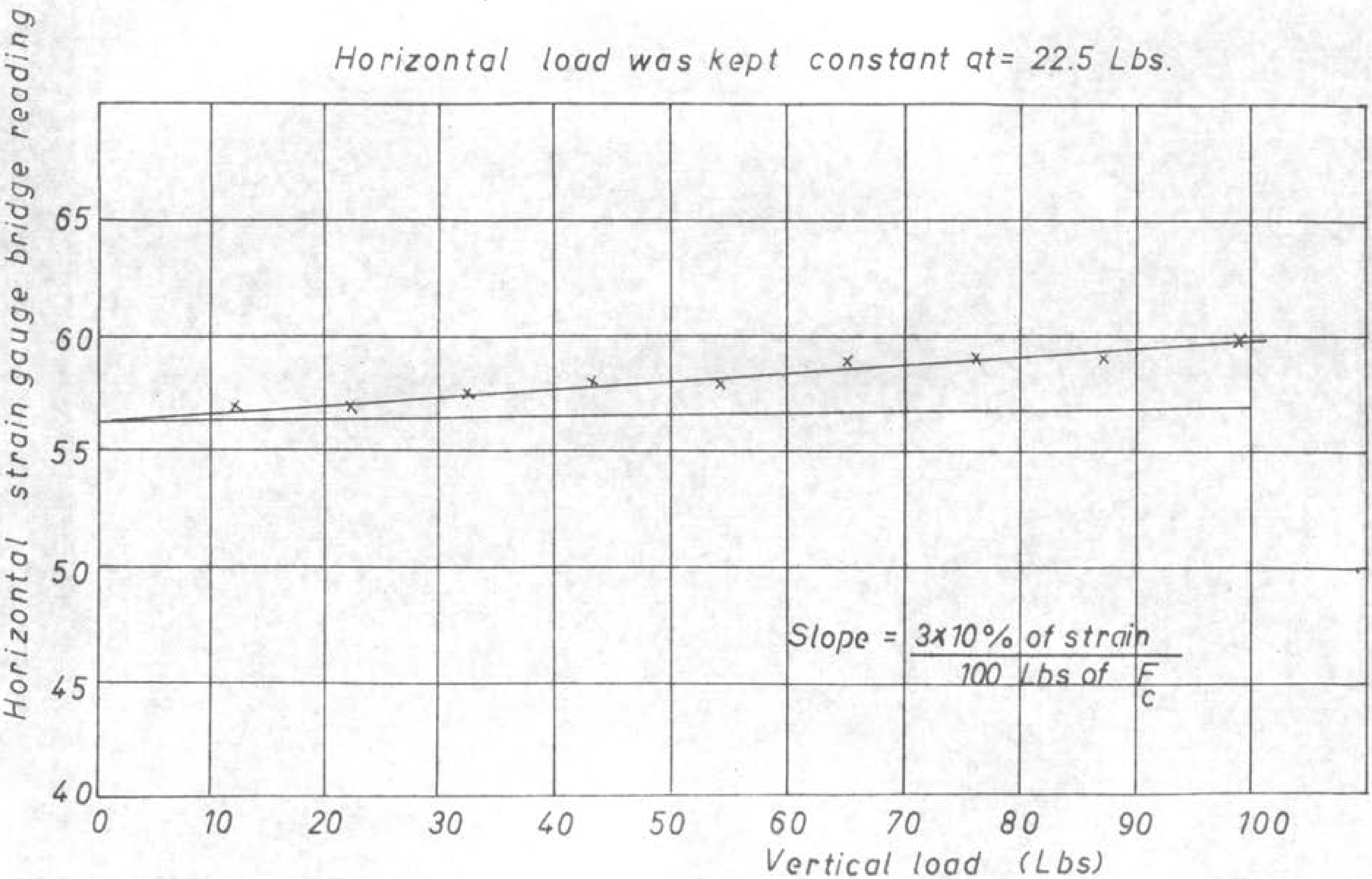

FIG 5.3 Cross coupling curve

SERIES IIIa Constant feed test

STEEL SPECIMEN A (WITHOUT CUTTING FLUID)

cutting speed ft./min.	depth of cut inX10^3	feed/rev. inX10^3	strain gauge bridge reading (%X10^4)		force(lbs)	
			vert.	Hor.	F_c	F_t
15	15	7.8	210	67.0	89.25	28.0
30	"	"	189	51.0	80.00	21.0
60	"	"	156	52.5	66.00	21.8
120	"	"	154	56.0	65.00	23.0
240	"	"	146	67.0	61.70	28.0
300	-	-	-	-	-	-
400	"	"	132	69.5	55.80	29.0

STEEL SPECIMEN B (WITHOUT CUTTING FLUID)

cutting speed ft./min.	depth of cut inX10^3	feed/rev. inX10^3	strain gauge bridge reading (%X10^4)		force(lbs)	
			vert.	Hor.	F_c	F_t
15	15	7.8	124	45	52.5	16.5
30	"	"	123	36	52.0	15.0
60	"	"	121	41	51.0	17.0
120	"	"	108	40	46.0	16.5
240	"	"	110	45	46.5	23.5
300	"	"	114	61	48.0	25.5
400	"	"	117	67	49.5	28.0

Specimen "A"

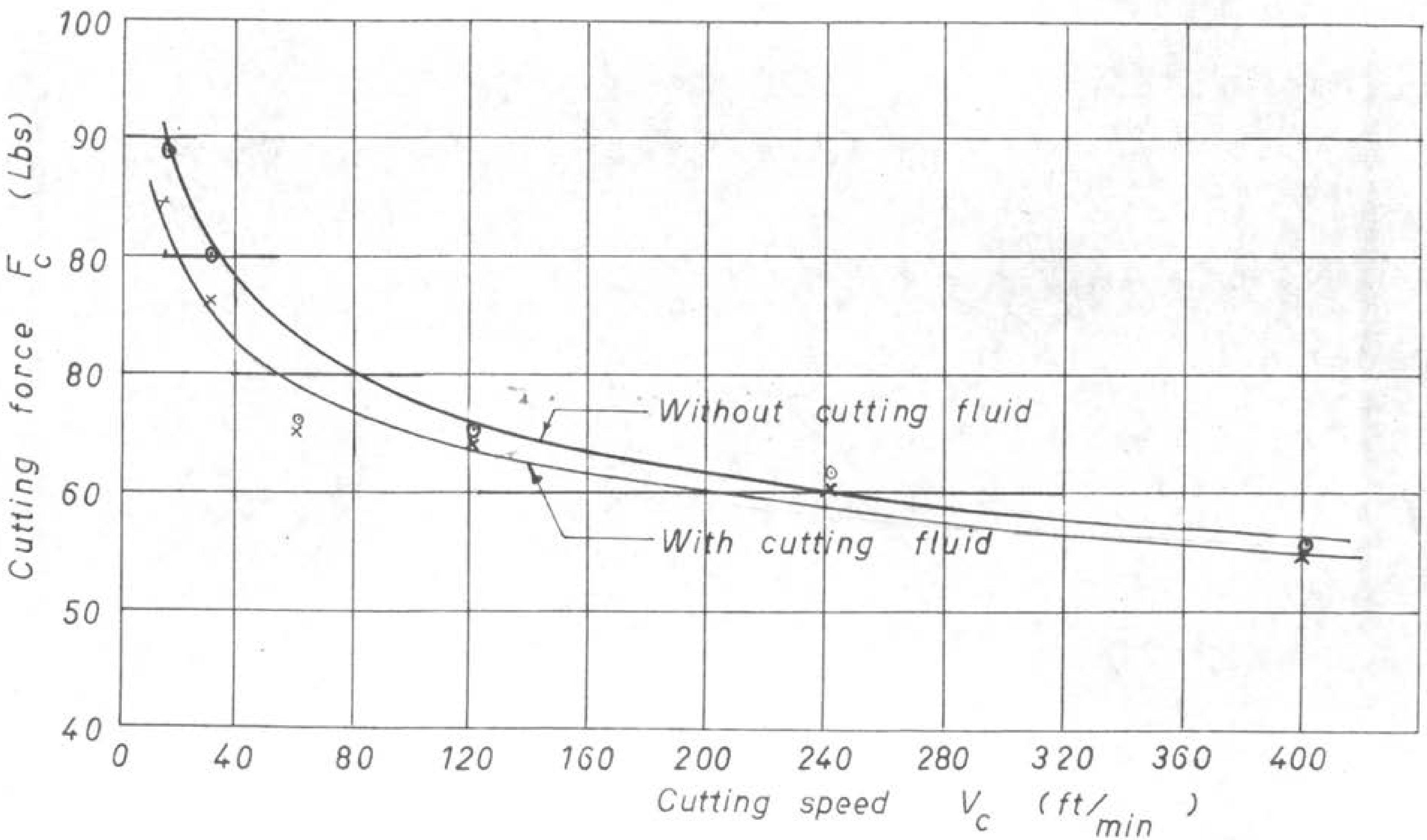

FIG 5.4 A RELATIONSHIP BETWEEN F_c & V_c

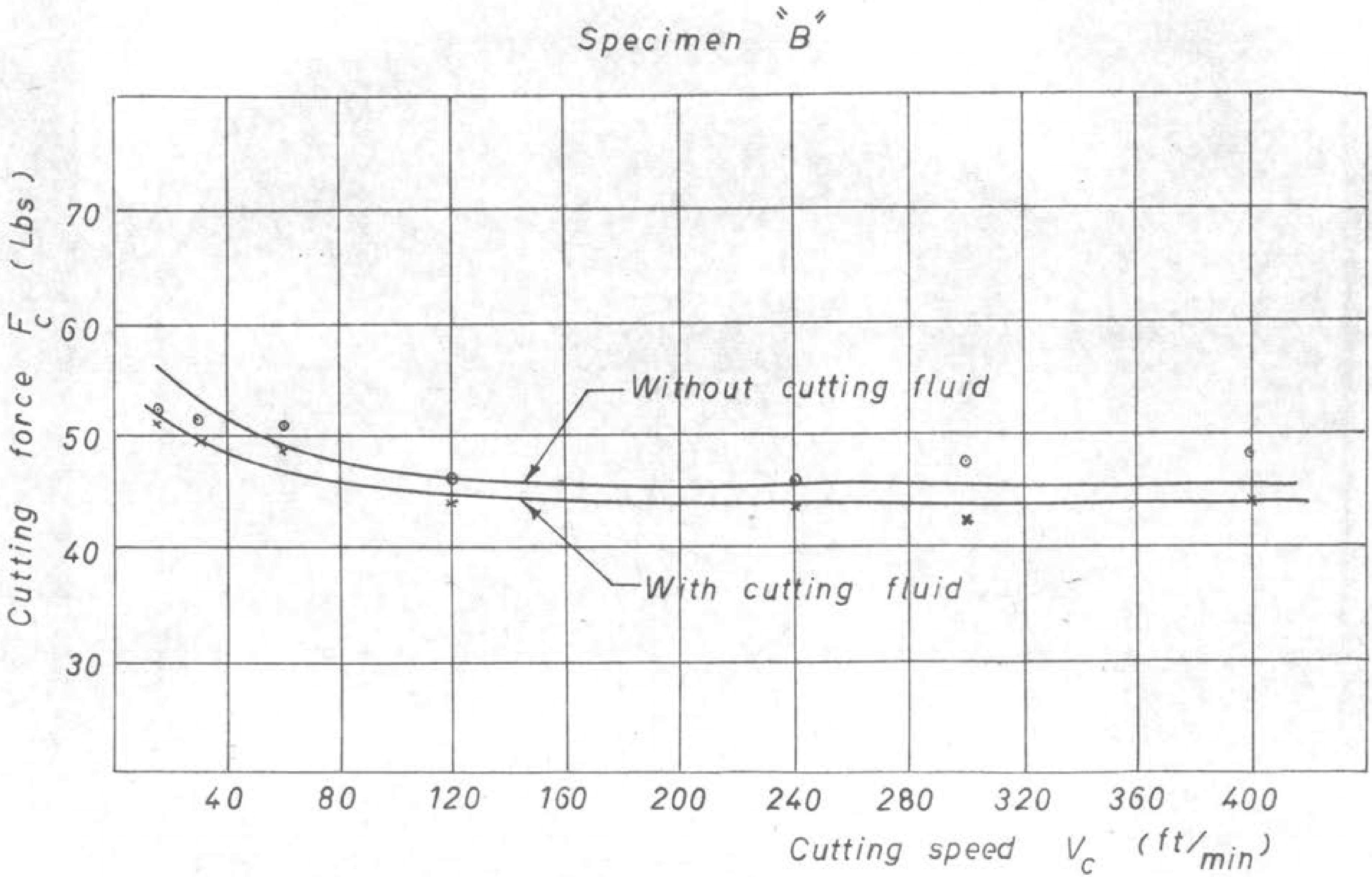

FIG 5.4 B RELATIONSHIP BETWEEN F_c & V_c

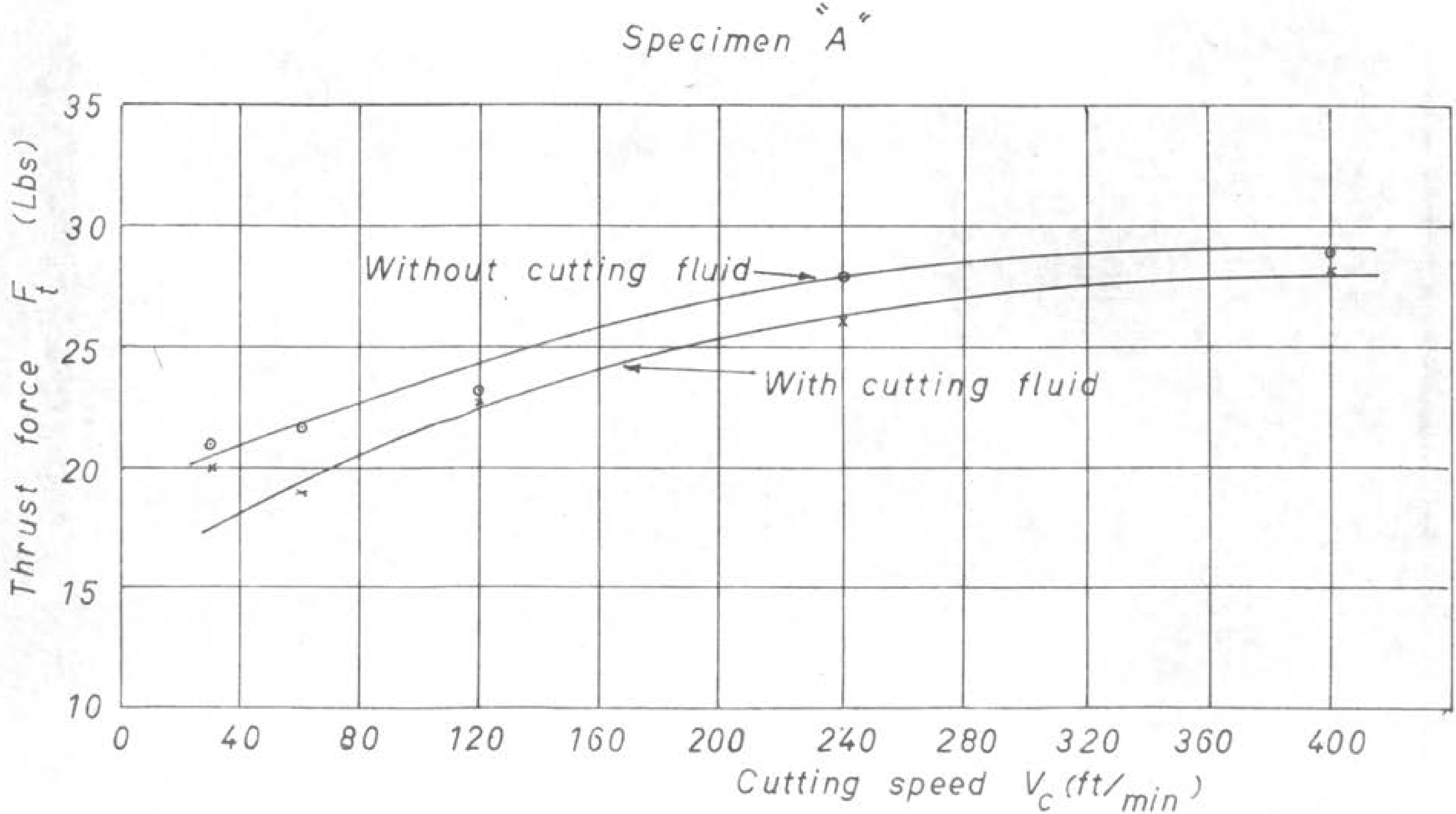

FIG 5.5 A RELATIONSHIP BETWEEN F_t & V_c

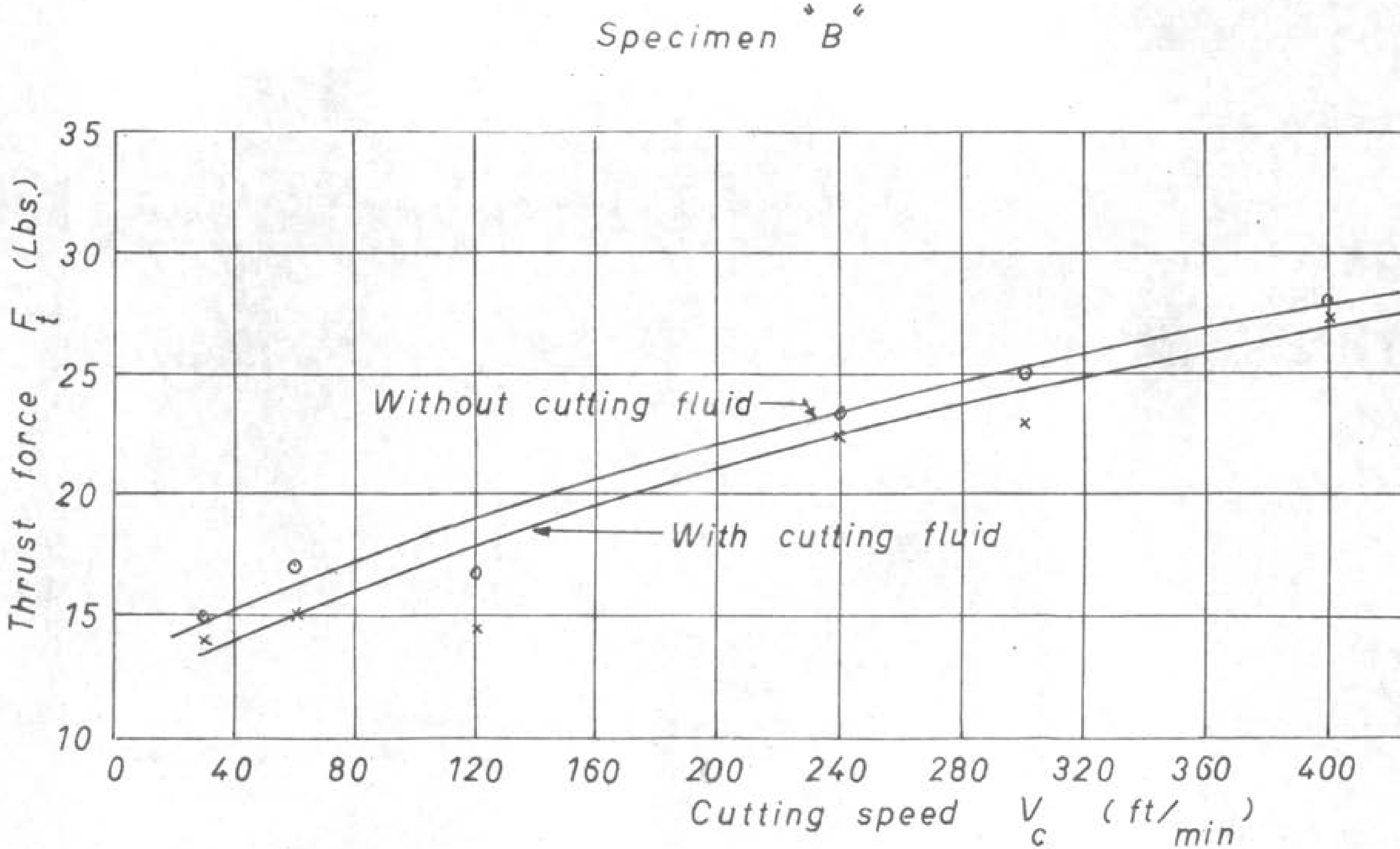

FIG 5.5 B. RELATIONSHIP BETWEEN F_t & V_c

SERIES IIIb Constant speed test

Steel specimen A (without cutting fluid)

cutting speed ft./min.	depth of cut inX10^3	feed/rev. inX10^3	strain gauge bridge reading (%X10^4) vert.	hor.	force(lbs) F_c	F_t
250	15	4.5	99.0	56.0	41.5	23.0
"	"	5.7	114.0	59.0	48.0	24.5
"	"	6.6	126.5	63.5	53.5	26.5
"	"	7.8	129.0	67.5	54.5	28.0
"	"	8.9	144.0	70.0	61.0	29.0
"	"	10.4	163.0	70.0	69.0	29.0
"	"	12.4	177.5	73.0	75.0	30.5

Steel specimen B (without cutting fluid)

cutting speed ft./min.	depth of cut inX10^3	feed/rev. inX10^3	strain gauge bridge reading (%X10^4) vert.	hor.	force(lbs) F_c	F_t
250	15	4.5	69	28	29.0	11.50
"	"	5.7	84	32	35.5	13.00
"	"	6.6	92	33	38.5	13.50
"	"	7.8	113	34	48.0	14.00
"	"	8.9	127	38	54.0	15.50
"	"	9.6	132	42	56.0	17.25
"	"	10.4	142	43	60.0	17.75
"	"	11.3	149	48	63.0	20.00
"	"	12.4	155	50	65.5	21.00

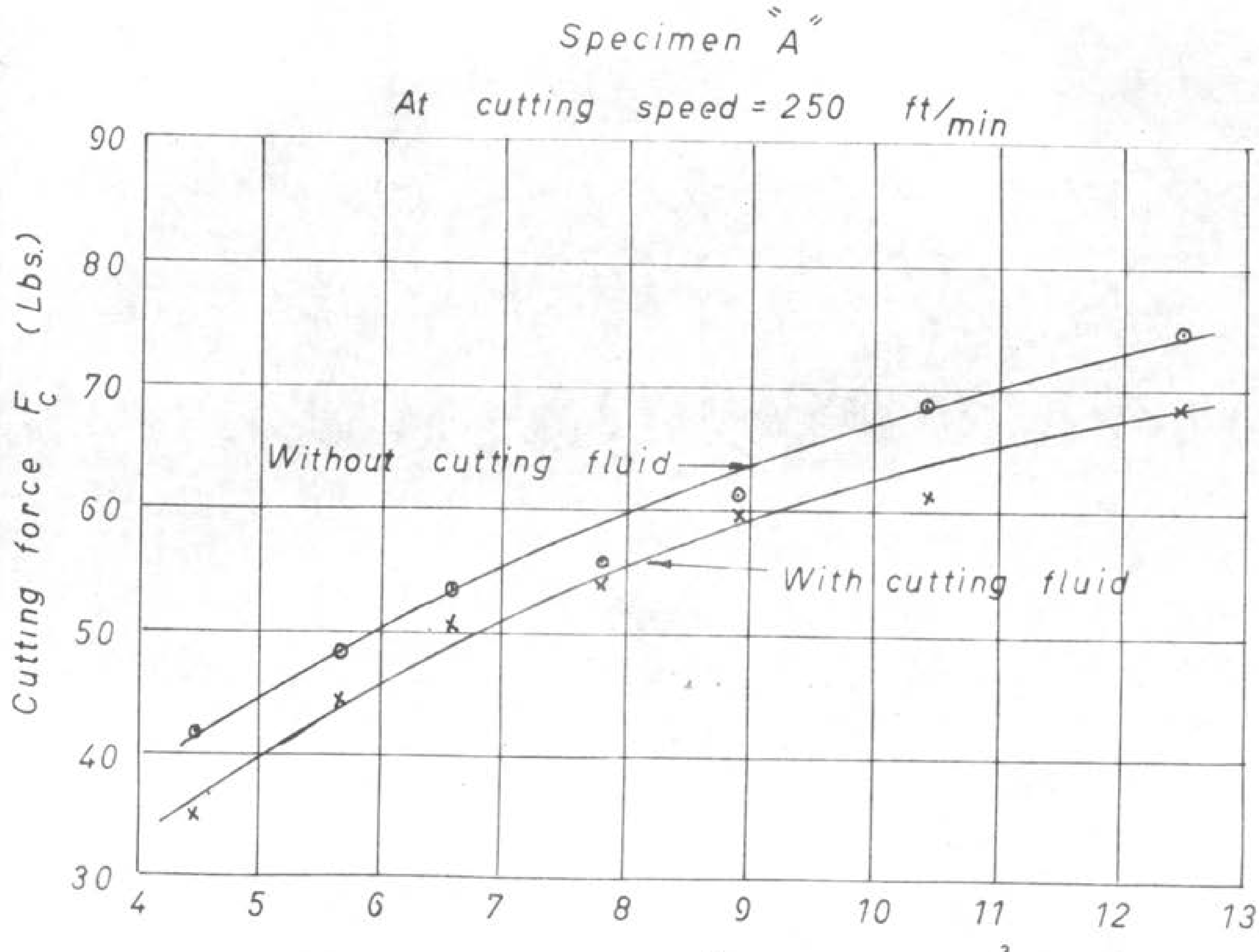

FIG 5.6 A. RELATIONSHIP BETWEEN F_c & Feed/rev.

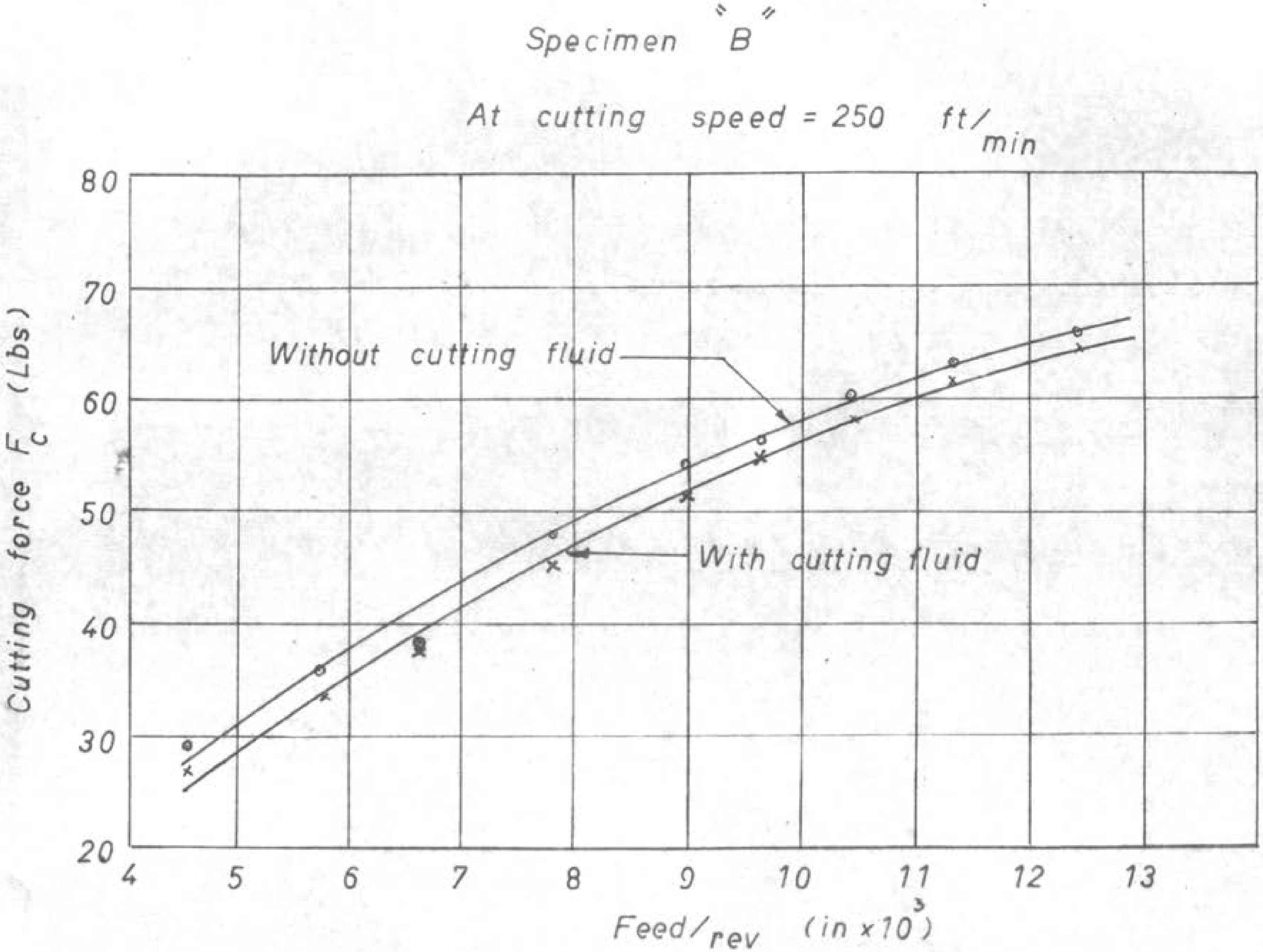

FIG 5.6 B RELATIONSHIP BETWEEN F_c & Feed/rev

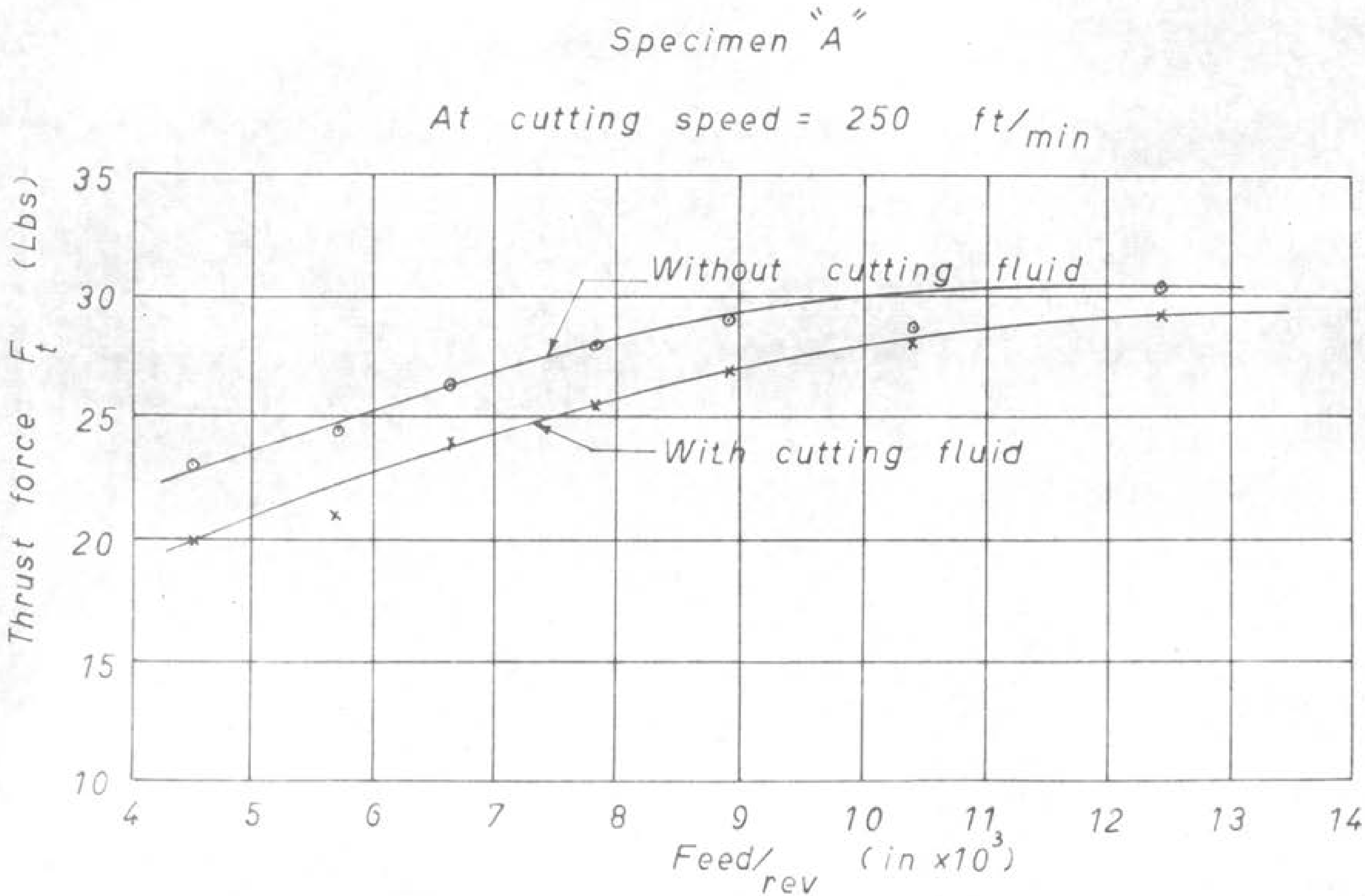

FIG 5.7 A. RELATIONSHIP BETWEEN F_t & Feed/rev

Specimen "B"

At cutting speed = 250 ft/min

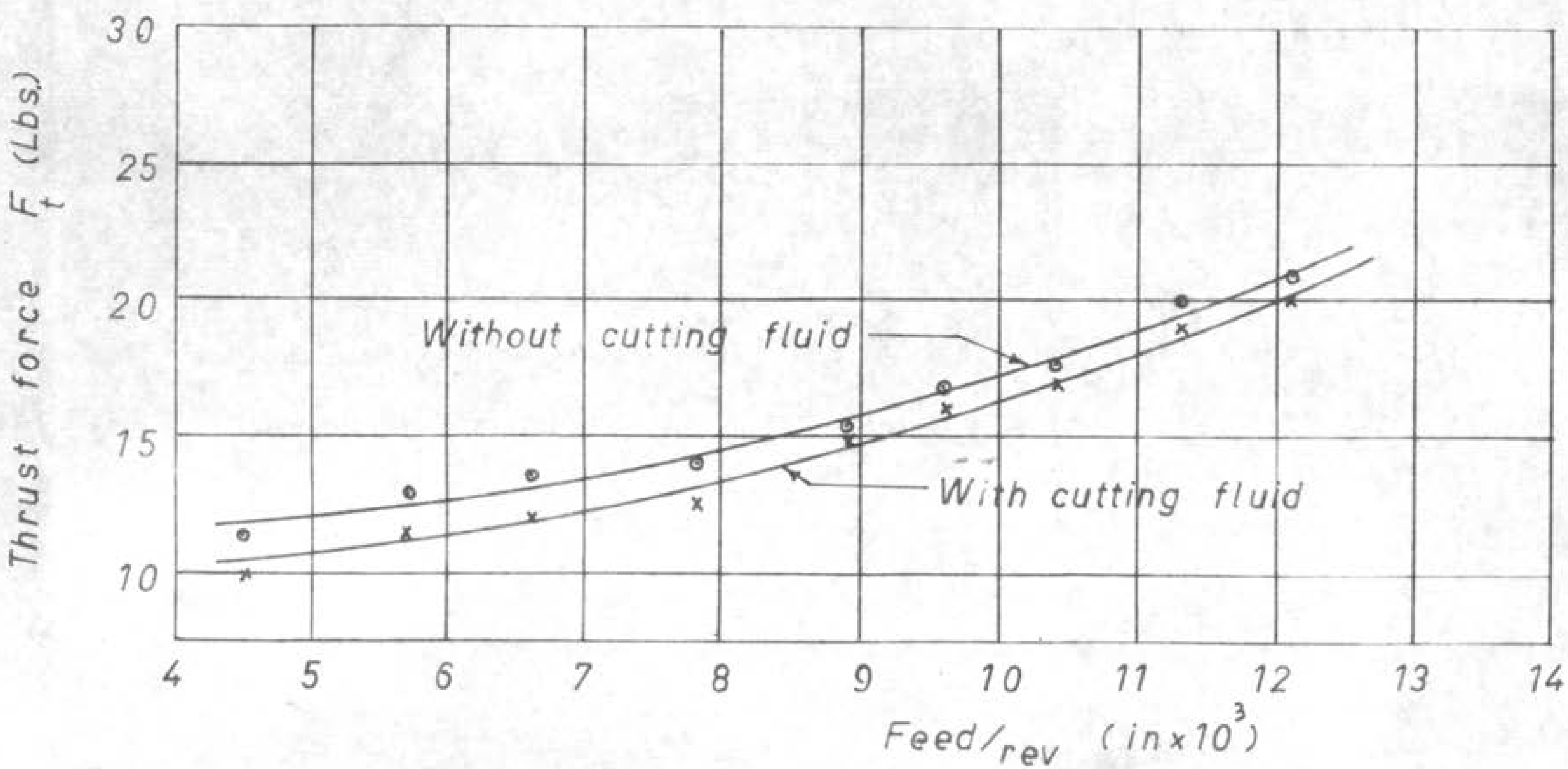

FIG 5.7 B RELATIONSHIP BETWEEN F_c & Feed/rev

SERIES IVa Constant feed test

Steel Specimen A (with cutting fluid)

cutting speed ft./min.	depth of cut inX10³	feed/rev. inX10³	strain gauge bridge reading (X10⁴) vert.	hor.	force(lbs) F_c	F_t
15	15	7.8	199.0	59.0	84.5	24.5
30	"	"	180.0	49.0	76.0	20.0
60	"	"	155.0	46.0	65.5	19.0
120	"	"	153.5	55.5	65.0	23.0
240	"	"	145.5	62.0	61.7	26.0
400	"	"	130.0	68.0	55.0	28.5

Steel specimen B (with cutting fluid)

cutting speed ft./min.	depth of cut inX10³	feed/rev. inX10³	strain gauge bridge reading (X10⁴) vert.	hor.	force(lbs) F_c	F_t
15	15	7.8	121.5	41.0	51.5	17.0
30	"	"	117.0	34.5	49.5	14.0
60	"	"	116.0	37.5	49.0	15.5
120	"	"	104.0	35.0	44.0	14.3
240	"	"	103.0	49.0	43.5	22.5
300	"	"	100.0	56.0	42.0	23.0
400	"	"	115.0	66.0	4[illegible].5	27.5

SERIES IVb Constant speed test

Steel specimen A (with cutting fluid)

cutting speed ft./min.	depth of cut in$\times10^3$	feed/rev. in$\times10^3$	strain gauge bridge reading (%$\times10^4$) vert.	hor.	force(lbs) F_c	F_t
250	15	4.5	81.0	48.5	34.0	20.0
"	"	5.7	105.0	51.0	44.5	21.0
"	"	6.6	120.5	57.0	51.0	23.8
"	"	7.8	126.5	61.5	53.6	25.5
"	"	8.9	142.0	65.0	60.0	27.0
"	"	10.4	160.0	69.0	60.0	28.8
"	"	12.4	176.0	70.0	68.0	29.2

Steel specimen B (with cutting fluid)

cutting speed ft./min.	depth of cut in$\times10^3$	feed/rev. in$\times10^3$	strain gauge bridge reading (%$\times10^4$) vert.	hor.	force(lbs) F_c	F_t
250	15	4.5	65.0	24.5	27.0	10.0
"	"	5.7	79.5	28.0	33.5	11.5
"	"	6.6	89.5	29.0	38.5	12.0
"	"	7.8	107.0	30.0	45.0	12.5
"	"	8.9	120.0	36.0	51.0	15.0
"	"	9.6	128.0	39.0	54.0	16.0
"	"	10.4	139.0	41.0	58.0	17.0
"	"	11.3	146.0	46.0	62.5	19.0
"	"	12.4	152.0	49.0	64.5	20.0

HARDNESS OF THE SPECIMENS

(2 ins. diam.)

Radii (in.)	(Average) degree of Rockwell hardness	
	Specimen A	Specimen B
0.1250	87.73	78.00
0.2500	89.33	78.20
0.3750	90.30	80.20
0.5000	91.00	80.95
0.6250	90.74	77.70
0.7500	90.87	76.80
0.8750	91.50	75.72
0.9375	90.00	73.00

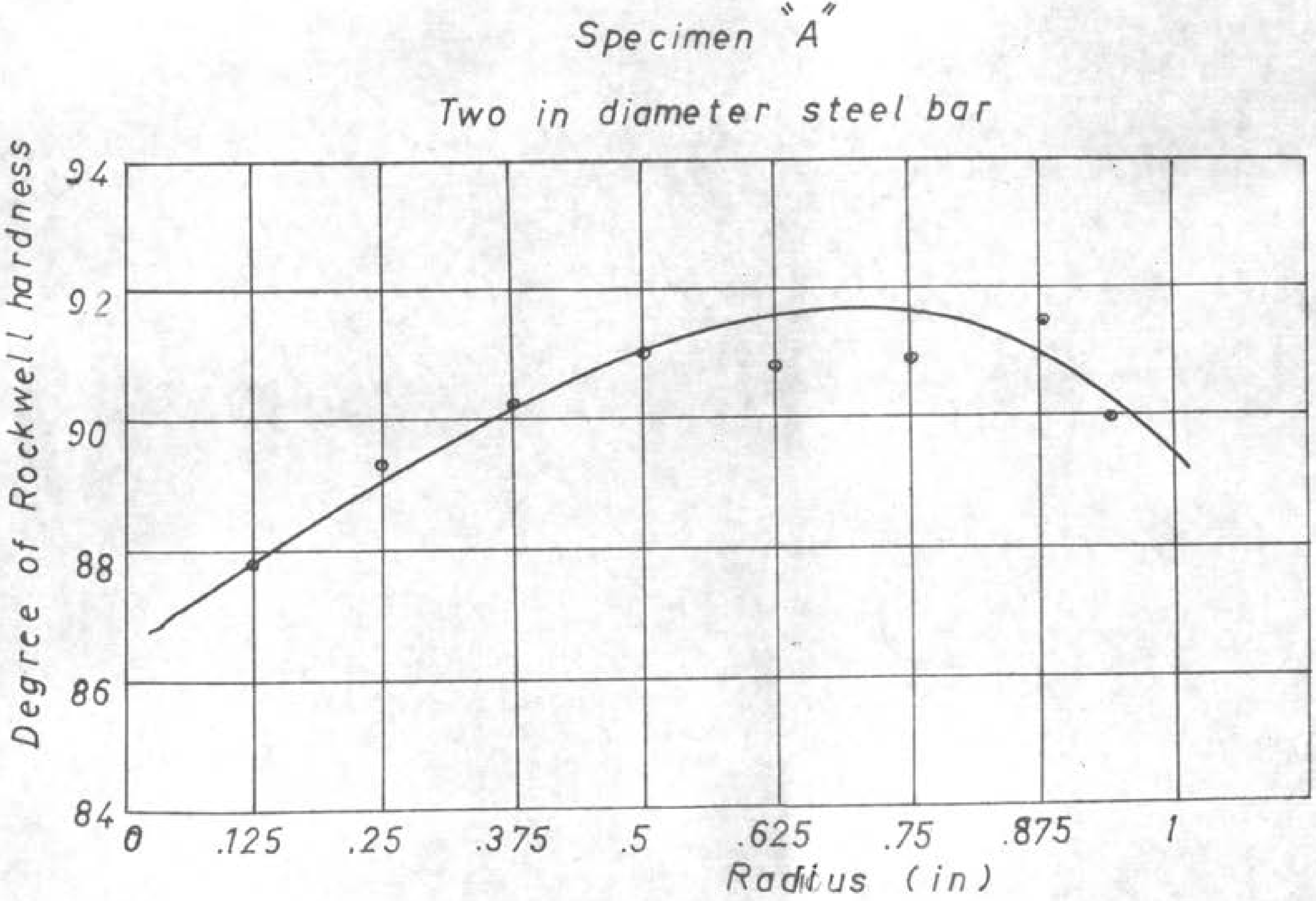

FIG 5.8 A. HARDNESS AT DIFFERENT RADII

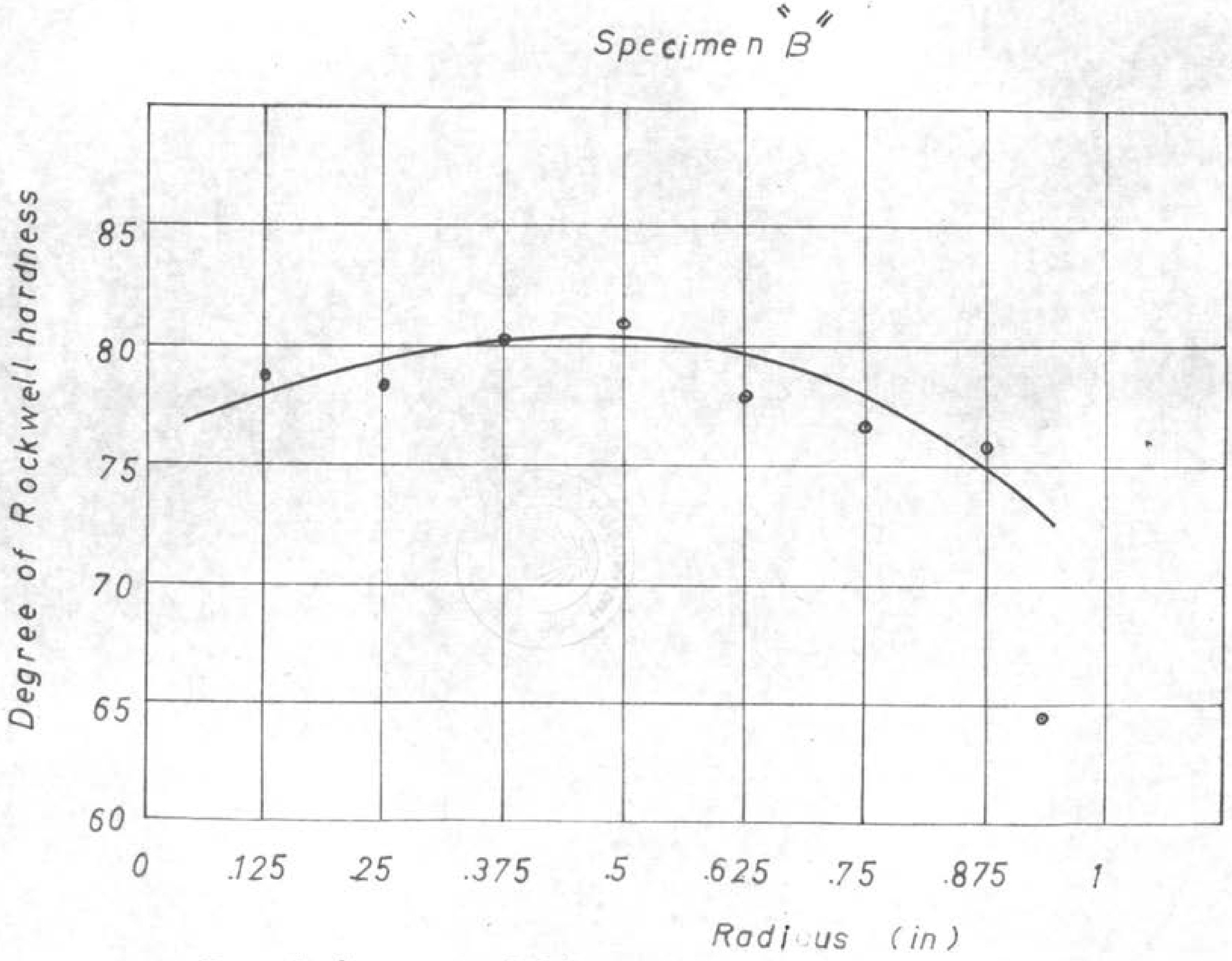

FIG. 5.8 B. HARDNESS AT DIFFERENT RADII

SERIES V Cutting ratio measurement

Steel specimen A (without cutting fluid)

At constant depth of cut = .015 in., feed = .0078 in/rev.

cutting speed ft./min.	mean Diam. (in.)	Length of chip (in.) before cut L_1	Length of chip (in.) after cut L_2	$\frac{A_1}{A_2} = \frac{L_2}{L_1}$
30	1.40	4.275	0.71	0.1661
60	1.88	5.775	1.20	0.2080
120	1.71	5.245	1.50	0.2833
240	1.55	4.895	1.60	0.3270
300	1.94	5.945	2.00	0.3370
400	1.75	5.375	1.80	0.3500

Steel specimen A (with cutting fluid)

At constant depth of cut = .015 in., feed = .0078 in./rev.

cutting speed ft./min.	mean Diam. (in.)	Length of chip (in.) before cut L_1	Length of chip (in.) after cut L_2	$\frac{A_1}{A_2} = \frac{L_2}{L_1}$
30	1.40	4.275	0.8	0.187
60	1.88	5.775	1.3	0.225
120	1.71	5.245	1.6	0.330
240	1.55	4.895	1.7	0.340
300	1.94	5.945	2.3	0.388
400	1.75	5.375	2.1	0.391

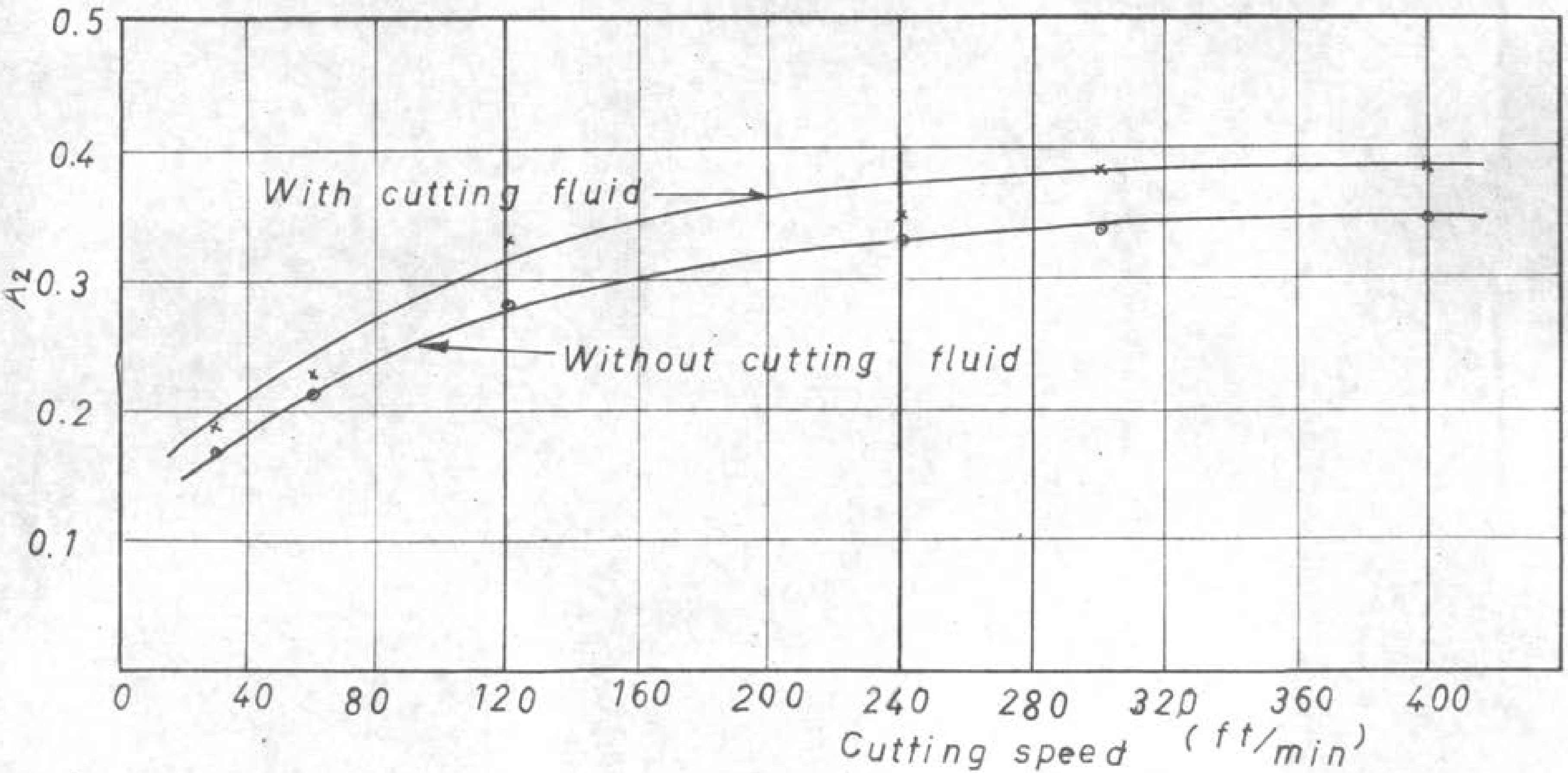

FIG 5.9 RELATIONSHIP BETWEEN $\frac{A_1}{A_2}$ & V_c

SERIES VI Vibration tests

a. Amplitude measurement

cutting speed ft./min.	depth of cut in. X 10^3	feed/rev. in.X 10^3	amplitude in.X 10^3
25.1	15	7.8	0.26
34.4	"	"	0.30
51.0	"	"	0.34
75.4	"	"	0.32
112.0	"	"	0.36
166.0	"	"	0.44
248.0	"	"	0.46
366.0	"	"	0.60

b. Check for natural frequency of the measuring bar

The natural frequency obtained from this test was 980 c/s

To determine the correct value of natural frequency

.

Dynamometer equivalent end weight W_d = 0.87 lb.

Weight of connecting link W_1 = 0.64 lb.

Weight of vibrator core W_v = 0.18 lb.

∴ Total weight = 0.74+0.18+0.87

= 1.69

$$N = \frac{1}{2\pi}\left(\frac{g\,E}{W}\right)^{\frac{1}{2}}$$

reduce the constant terms to $K = \frac{1}{2\pi}(g\,E)^{\frac{1}{2}}$

$$\therefore \quad N = \frac{K}{(W)^{\frac{1}{2}}}$$

for measuring value of $N = 980$ c.s

$$\therefore \quad 980 = \frac{K}{(v)^{1/2}}$$

$$K = 980 \times v^{1/2}$$

$$= 980 \times (1.69)^{1/2}$$

$\therefore$ N of the dynamometer

$$= \frac{K}{(v_d)^{1/2}}$$

$$= \frac{980(1.69)^{1/2}}{(.87)^{1/2}}$$

$$\therefore \quad = 1{,}290 \quad c/s$$

This value is in good agreement with the theoretical value of 1,230 c/s

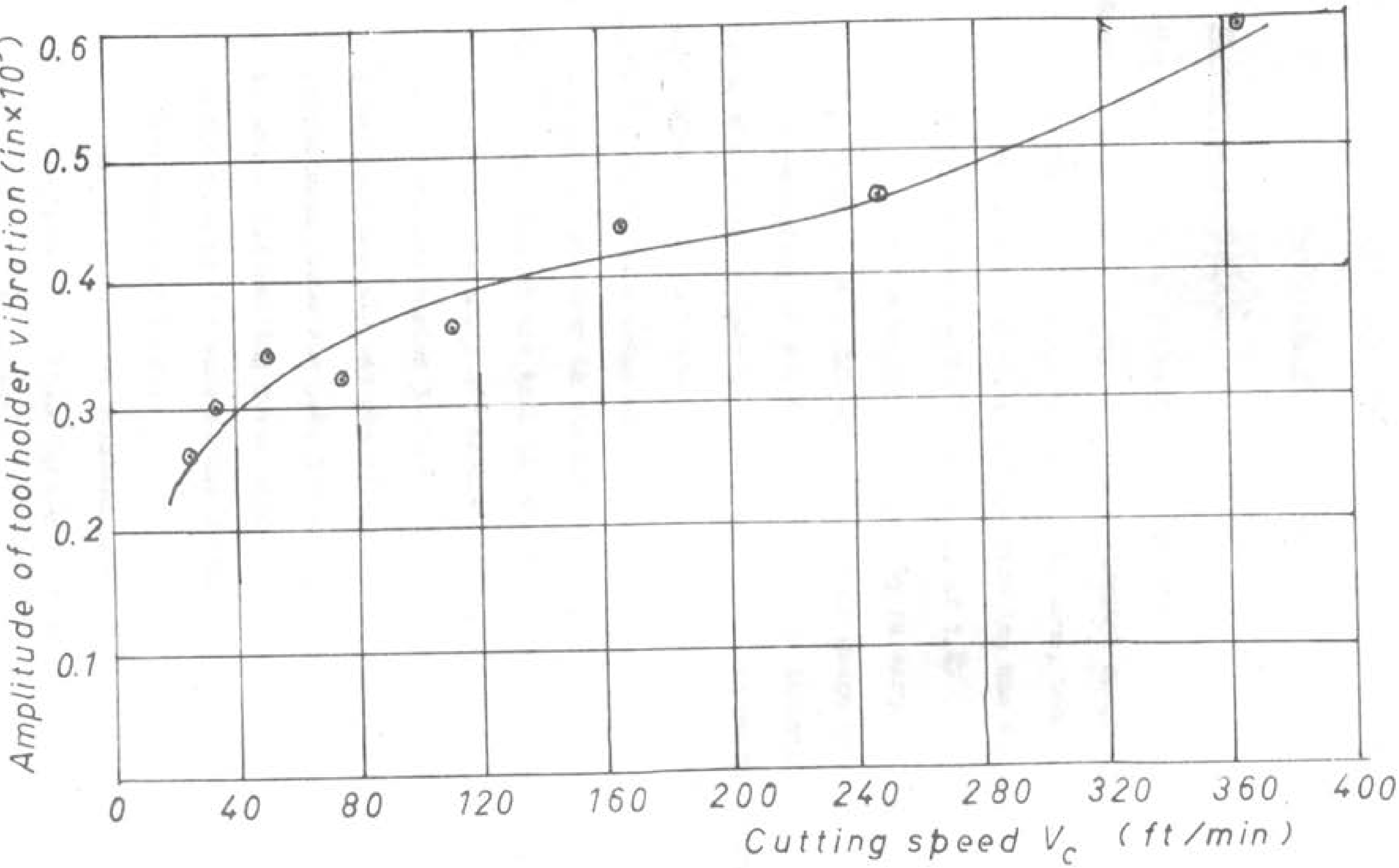

FIG. 5.10 RELATIONSHIP BETWEEN AMPLITUDE & V_c