Research Record No. 212

EVALUATION OF THE NEW TWIST LIVELINESS TESTER

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KEY WORDS: YARN TESTING, TWIST LIVELINESS, APPARATUS

INTRODUCTION

On the basis of preliminary trials carried out in 1979 (Research Record No. 103) on a prototype twist liveliness apparatus a new piece of equipment was built by a professional instrument engineer (1984).

As in the earlier trials, the method and apparatus were evaluated using a selection of yarns, test lengths and loop loading weights.

METHOD OF TEST

1. Principle

Twist liveliness is determined by clamping a known length of yarn under tension and suspending a known weight from the centre of the yarn. The ends of the yarn are brought together and the loop formed is allowed to twist on itself. The number of turns in the loop are counted and expressed in turns/metre, based on the known length.

2. Yarn samples

The yarns used in the evaluation were from IIC old stock and were as follows:

1. 34'scc 734 tpm, 3.2 twist factor, dyed - source, Caulier Freres
2. 42'scc, 880 tpm, 3.4 twist factor combed - source, Carrington Viyella
3. 60'scc, 1415 tpm, 4.7 twist factor, Dixie mercerised yarn, source Dixie Yarns.
4. 34'scc, 829 tpm, 3.6 twist factor, combed - source, Carrington Viyella
5. 24'scc, 912 tpm, open end - source Courtaulds
6. 28'scc, 731 tpm, 3.5 twist factor - source, Mars Mill
7. 20'scc source, Pear New Mill (tpm and twist factor not available)
8. 20'scc, 632 tpm, 3.6 twist factor, reverse twist - source, Mars Mill

All yarns were allowed to condition for a minimum of 24 hours prior to testing.

3. Effect of Test Length

The apparatus was graduated at 100cm, 80cm, 60cm, 40cm, 20cm intervals. The previous trials indicated that shorter test lengths below 40cm were to be avoided. On this basis, test lengths of 40, 60, 80, 100cm were evaluated.

A pretension of 2g/Tex was applied to the yarn before clamping and this remained constant throughout the trial.

Ten measurements were taken for each yarn at all test lengths, using different loop loading weights. The number of turns in the loop was counted after rotation had ceased. The mean of the 10 measurements, 95% confidence limits and % Accuracy were calculated and are shown in Tables 1-3.

The mean values were converted to turns/metre (T/L) and the values plotted in Figures 1-5. From these figures, there appears to be no consistent influence of the test length. The confidence limits of the actual number of turns in the loop were plotted in Figures 6-10. They appear to vary more or less in line with the mean values, ranging from about 2% to about 6% of the mean with no obvious indication of either preferred test length or a preferred loop loading weight.

4. Effect of Loop Loading Weight

For each test length evaluated, a range of loop loading weights were used. On the evidence of previous work a 10g weight gave good correlation and weights below 5g gave a lower %CV. Therefore the range of weights selected were 6, 8, 10, 12, 14g.

All yarns were measured using these weights. The mean of all the test lengths for each yarn at each of the weights used is shown in Table 4 and plotted in

Figure 11. The mean of all 95% confidence limits for the above data are also shown in Table 4 and plotted in Figure 12.

Least squares regression analysis was performed on these data using a simple linear model, $y = a + bx$. The regression coefficients are given in Table 5 and the resulting lines are shown in Figure 11. The slope of these lines is mainly a function of yarn stiffness (actually the ratio of torsional rigidity to bending rigidity - reference 1), whereas the intercept (i.e. the value at zero load) indicates the basic twist liveliness.

Thus the dyed combed yarn shows a similar slope to the grey yarns but has a much lower intercept than the corresponding 34Ne grey yarn.

The mercerised yarn has the lowest intercept even though it is the finest (i.e. the highest level of twist). However, it has a relatively very steep slope suggesting a relatively high stiffness ratio.

The rotor yarn has a "normal" slope but a relatively high intercept for its count, presumably due to its relatively high twist level.

Ideally, for a routine lab test, we would like to be able to choose a single loop load and use it for all yarns. These results indicate that, for normal yarns (i.e. grey and dyed, ring or rotor) any load within the range investigated would rank the yarns in the correct order since the slopes of T/L versus load are not very different.

In the case of spectacularly different yarns however, e.g. mercerised yarns or synthetic fibre blends, erroneous rankings would almost certainly be obtained.

Figure 12 shows that there is no reason to prefer any of the five chosen loop weights over any other, although in the previous study (Research Record No. 103) it was found that lower loads than these should be avoided.

CONCLUSIONS

1. For the testing of normal cotton yarns there is no reason to change our present test method from a test length of 100cm and a loop loading weight of 10g.

2. However, when practical limitations demand it, the test length may be reduced to 40cm without the need for additional specimens to be tested.

3. Confidence limits for 10 specimens range between about 2% and about 6% of the mean.

4. For the testing of non-normal cotton yarns, or for comparisons with synthetic fibre blends, the test method will have to include tests made with at least four different loop loading weights in order to establish the slope and the intercept of the T/L vs weight line.

REFERENCE

1. J.M. Bennett & R. Postle: J. Text. Inst., 1979 pp 142-151.

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NUMBER OF TURNS IN LOOP - TABLE 1

	1	2	3	4	5	6	7	8
100/6	25.4	58.45	39.2	46.6	48.75	45.75	33.6	37.4
100/8	27.65	55.05	41.2	40.1	48.55	44.1	35.1	39
100/10	37.4	66.65	56.15	55.4	59	53.8	35.7	45.5
100/12	39.3	75	63.1	61.9	67.5	57.1	43.15	48.75
100/14	41.25	75.25	68.7	65.15	65.7	62.35	45.65	53.85
80/6	22.35	45.95	33.65	38	38.5	34.65	25.75	30.6
80/8	22.2	47.85	33.55	36.95	39	32.9	27.05	31.65
80/10	28.45	52.55	45.05	46	46	40.45	31.05	36.65
80/12	30.1	57.85	48.85	47.9	50.55	46.1	32.4	38
80/14	33.35	60.65	55.5	49.65	53.65	47	33.8	46.65
60/6	16.45	33.5	21.6	25.1	27.05	25	18.7	20.85
60/8	17.6	36.2	25.7	28.95	29.65	25.7	20.15	24.85
60/10	22.15	43.05	31.55	31.45	34.45	30.75	22.7	27.7
60/12	24.35	44.4	37.2	33.95	37.1	33.55	25.35	30.25
60/14	25.4	48.5	44.7	39.3	41.4	38.55	27.05	35.35
40/6	10.75	21.65	14.6	17.25	19.1	16.6	12.8	14.7
40/8	11.75	23.8	17.35	20.3	20.6	18.45	13.8	17.65
40/10	14.95	29	23.05	23.15	24.7	21.95	15.1	19.1
40/12	15.75	30.5	26.55	23.65	24.85	21.7	16.55	19.65
40/14	17.15	32.1	29.7	25.65	28.95	26.6	17.95	21.85

TABLE 1

95% CONFIDENCE LIMITS - TABLE 2

	1	2	3	4	5	6	7	8
100/6	0.82	2.93	1.38	2.34	1.83	3.02	1.74	1.57
100/8	0.88	3.27	1.93	3.01	1.66	1.68	1.28	1.84
100/10	1.71	2.93	1.34	1.84	1.75	2.17	1.52	1.69
100/12	1.17	1.44	2.2	1.81	4.65	2.33	1.91	1.63
100/14	1.6	1.54	2.7	3.31	2.26	3.81	1.74	1.86
80/6	1.34	2.94	1.47	1.84	1.82	1.71	1.11	1.26
80/8	0.79	2.3	1.31	1.05	1.28	1.14	1.03	0.48
80/10	1.03	1.78	1.34	2.41	2.01	2.02	1.12	0.83
80/12	0.94	1.74	1.41	2.93	3.61	2.7	2.36	2.32
80/14	1.12	2.34	3.15	1.78	1.36	2.7	1.32	2.44
60/6	1.14	1.98	1.18	1.53	1.44	1.55	1.83	1.23
60/8	1.12	1.98	1.12	1.37	1.04	1.6	1.58	1.71
60/10	1.34	2.76	1.41	1.53	0.66	1.24	1.91	1.3
60/12	1.62	1.49	1.48	0.92	1.4	1.45	2	1.78
60/14	0.69	2.01	2.57	1.5	1.92	1.9	1.1	1.43
40/6	0.66	1.39	1.06	0.9	1.19	0.89	0.59	1.32
40/8	0.85	1.44	1.45	1.35	0.89	0.99	0.86	1.37
40/10	0.78	1.38	1.11	1.44	1.58	1.47	1.18	0.94
40/12	0.66	2.12	1.6	1.19	1.01	1.13	0.43	0.79
40/14	0.76	1.49	1.23	1.32	1.59	1.48	1.22	0.94

TABLE 2

% ACCURACY - TABLE 3

	1	2	3	4	5	6	7	8
100/6	2.81	4.35	3.06	4.34	3.26	5.72	4.49	3.64
100/8	2.75	5.15	4.06	6.49	2.96	3.31	3.16	4.09
100/10	3.96	3.8	2.07	2.87	2.57	3.49	3.69	3.21
100/12	2.58	1.66	3.02	2.53	5.97	3.53	3.83	2.89
100/14	3.36	1.77	3.41	4.4	2.98	5.3	3.31	3
80/6	5.19	5.54	3.79	4.19	4.09	4.28	3.73	3.57
80/8	3.1	4.16	3.39	2.45	2.85	3.01	3.31	1.31
80/10	3.14	2.93	2.58	4.55	3.78	4.33	3.14	1.95
80/12	2.69	2.6	2.5	5.31	6.19	5.07	6.31	5.3
80/14	2.91	3.35	4.92	3.1	2.2	4.97	3.38	4.53
60/6	5.99	5.12	4.72	5.26	4.6	5.36	8.46	5.1
60/8	5.49	4.73	3.78	4.11	3.04	5.4	6.8	5.97
60/10	5.24	5.56	3.86	4.22	1.67	3.5	7.29	4.06
60/12	5.76	2.9	3.45	2.34	3.27	3.76	6.82	5.09
60/14	2.36	3.59	4.98	3.31	4.02	4.28	3.52	3.51
40/6	5.31	5.57	6.31	4.5	5.4	4.64	3.99	7.77
40/8	6.25	5.25	7.25	5.77	3.74	4.65	5.42	6.73
40/10	4.53	4.12	4.18	5.39	5.55	5.82	6.76	4.24
40/12	3.62	6.02	5.23	4.37	3.53	4.53	2.24	3.49
40/14	3.81	4.01	3.59	4.45	4.77	4.81	5.89	3.73

TABLE 3

MEAN OF ALL TEST LENGTHS FOR T/L - TABLE 4

	6g.	8g.	10g.	12g.	14g.
1	26.91	28.53	36.81	39.22	42
2	56.46	58.67	69.15	74.39	78.04
3	38.44	42.34	55.67	63.14	71.71
4	44.77	46.32	55.8	59.37	64.21
5	47.43	49.56	58.92	63.66	68.53
6	43.06	43.54	52.62	56.23	62.96
7	32.24	34.25	37.52	41.82	44.46
8	36.79	41.03	46.31	48.95	56.43

MEAN OF ALL 95% CONFIDENCE LIMITS FOR T/L

	6g.	8g.	10g.	12g.	14g.
1	0.99	0.91	1.22	1.1	1.04
2	2.31	2.25	2.14	1.57	1.85
3	1.27	1.45	1.3	1.67	2.41
4	1.65	1.7	1.81	1.71	1.98
5	1.57	1.22	1.5	2.67	1.78
6	1.79	1.35	1.73	1.9	2.47
7	1.32	1.19	1.43	1.68	1.15
8	1.35	1.35	1.19	1.63	1.63

TABLE 5

REGRESSION COEFFICIENTS FOR y = a + bx

YARN	INTERCEPT(a)	SLOPE(b)	r^2
34'scc-1	14.26	2.04	0.944
42'scc-2	37.90	2.94	0.960
60'scc-3	10.59	4.37	0.981
34'scc-4	28.13	2.60	0.961
24'scc-5	29.47	2.81	0.972
28'scc-6	25.44	2.62	0.952
20'scc-7	22.05	1.60	0.987
20'scc-8	22.30	2.36	0.981

FIGURE 1

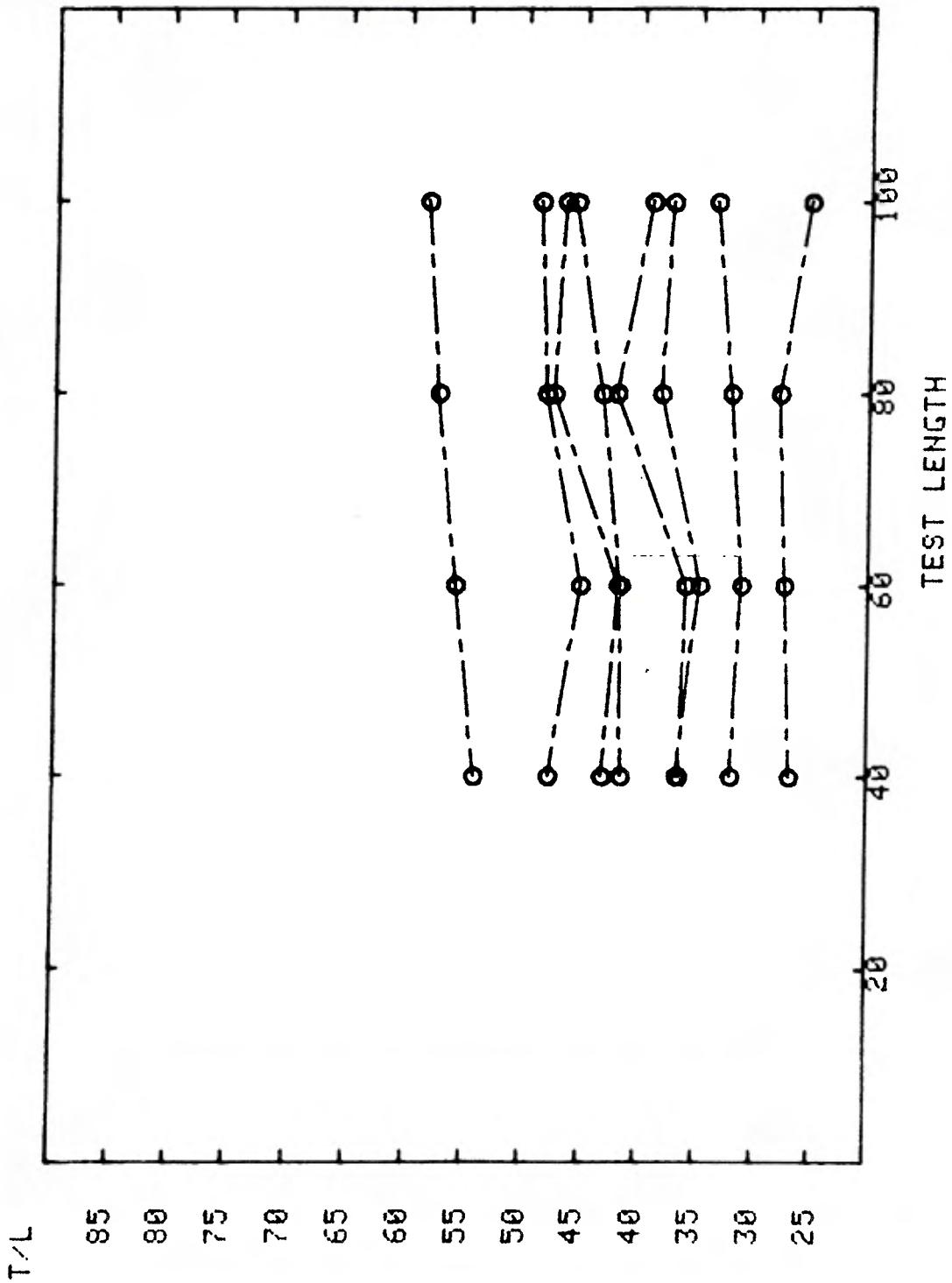
TWIST LIVELINESS - WEIGHT 6g.
T/L
85
80
75
70
65
60
55
50
45
40
35
30
25
20
40
60
80
100
TEST LENGTH

FIGURE 2

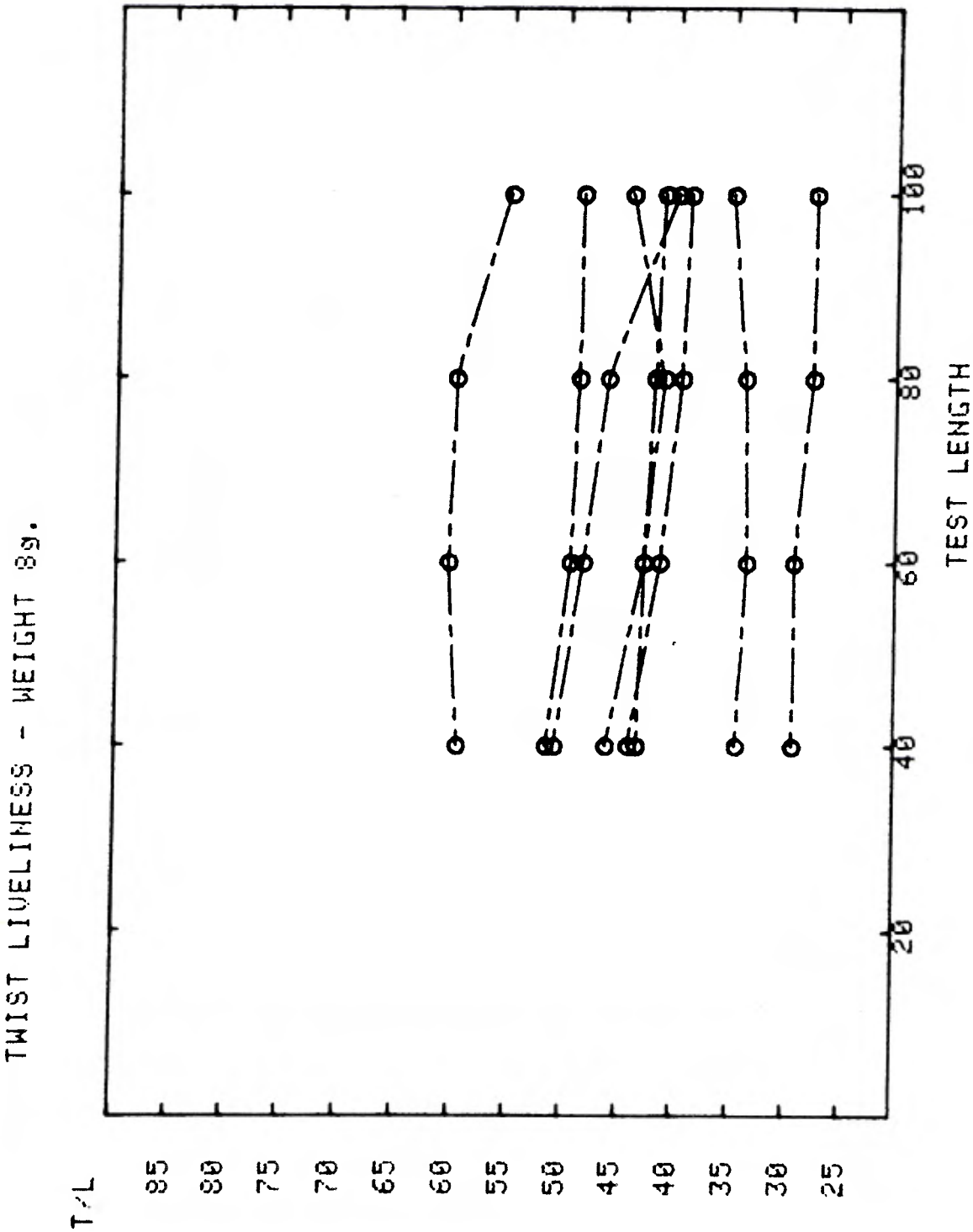
TWIST LIVELINESS - WEIGHT 8g.
T/L
85
80
75
70
65
60
55
50
45
40
35
30
25
20
40
60
80
100
TEST LENGTH

FIGURE 3

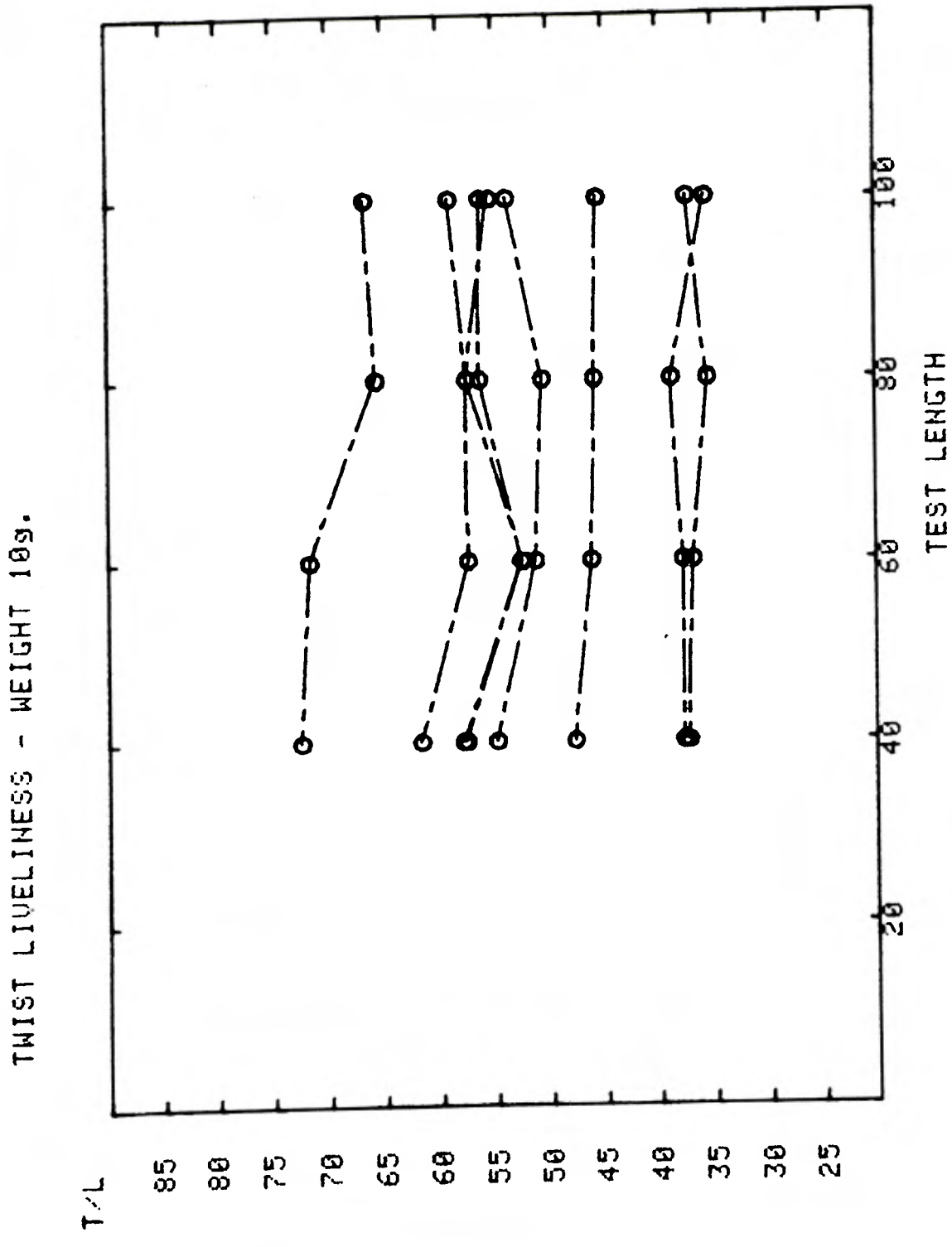
TWIST LIVELINESS - WEIGHT 10g.
T/L
85
80
75
70
65
60
55
50
45
40
35
30
25
20
40
60
80
100
TEST LENGTH

FIGURE 4

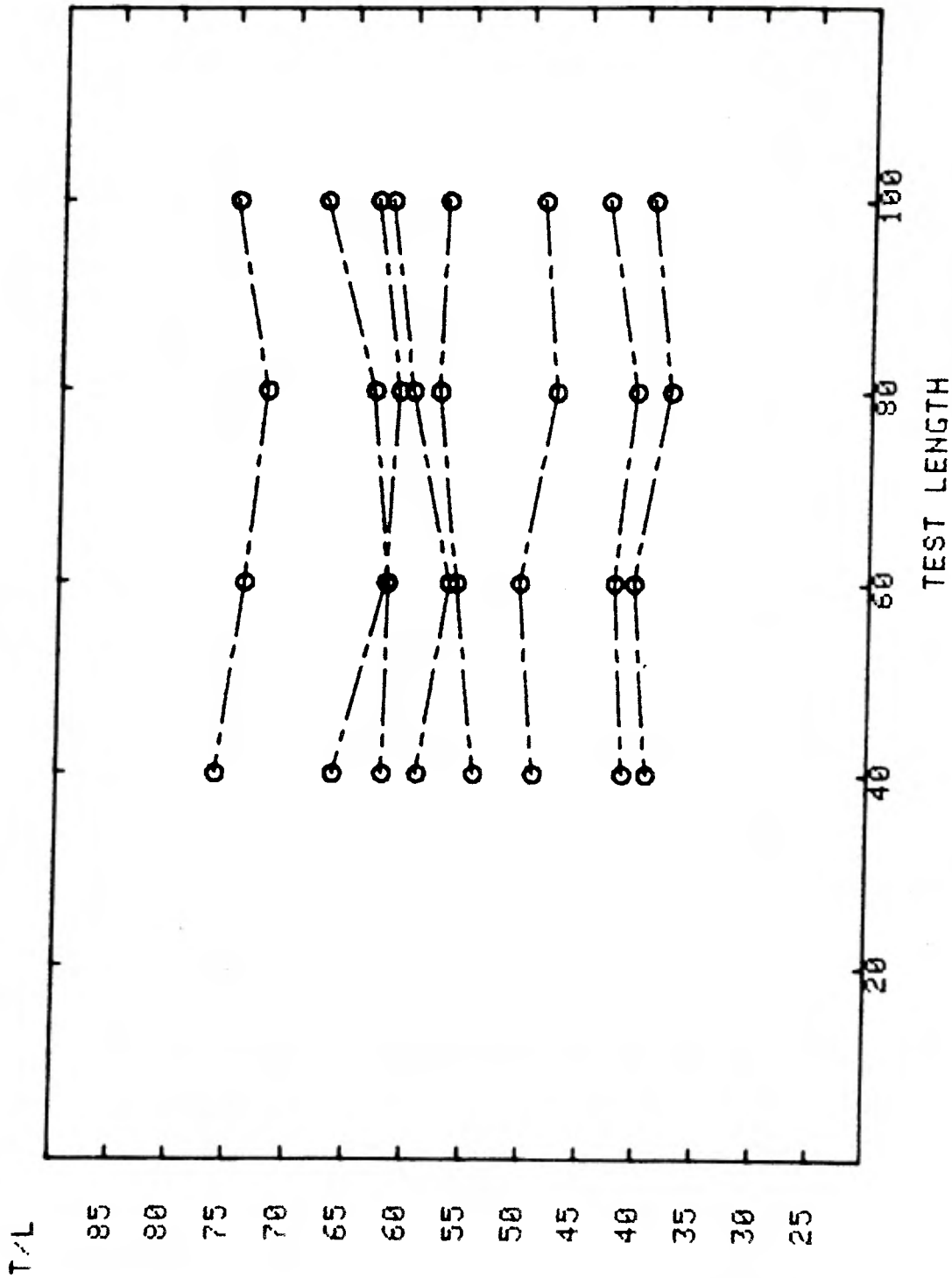
TWIST LIVELINESS - WEIGHT 12g.
T/L
85
80
75
70
65
60
55
50
45
40
35
30
25
20
40
60
80
100
TEST LENGTH

FIGURE 5

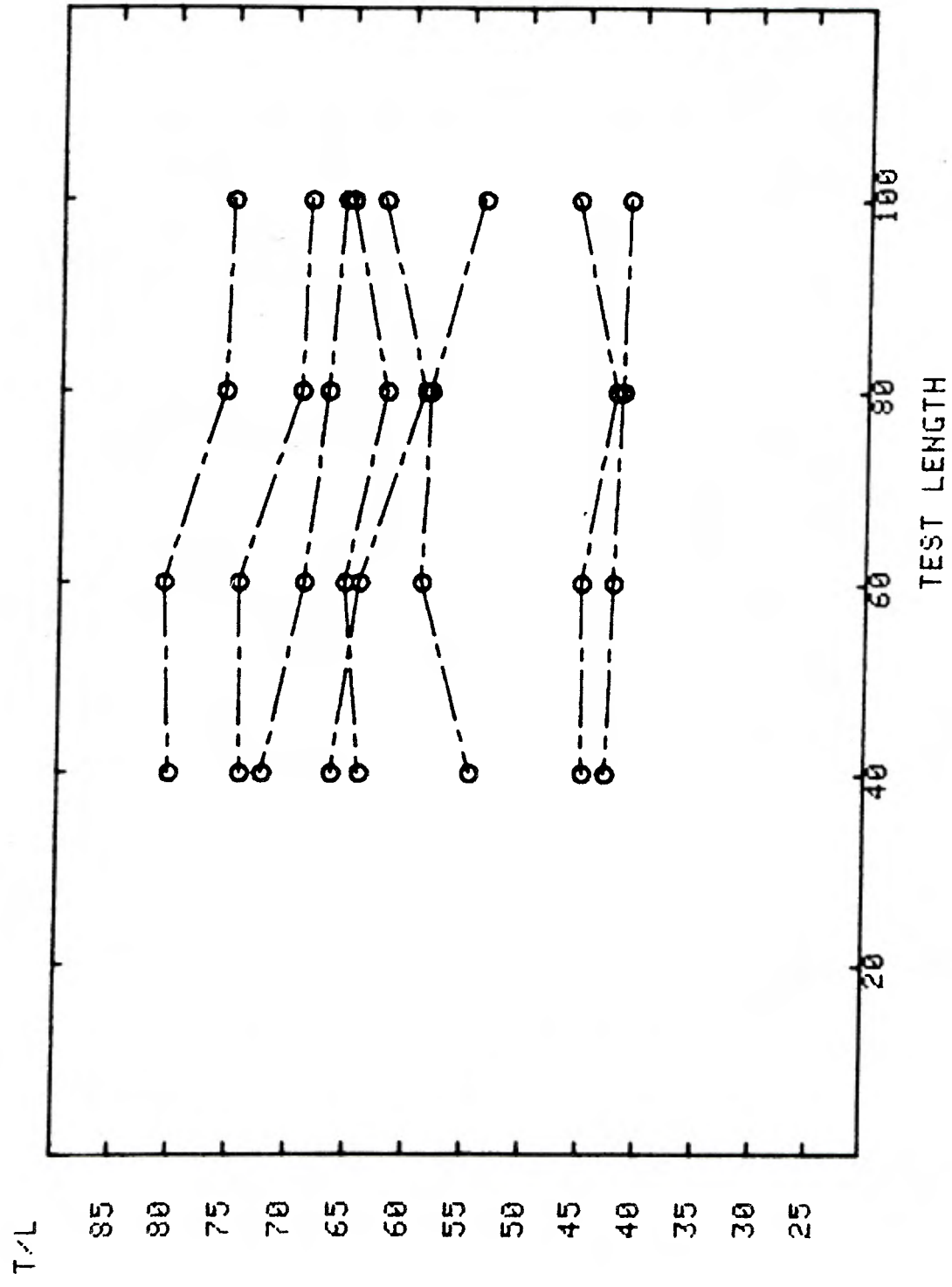
TWIST LIVELINESS - WEIGHT 14g.
T/L
85
80
75
70
65
60
55
50
45
40
35
30
25
20
40
60
80
100
TEST LENGTH

FIGURE 6

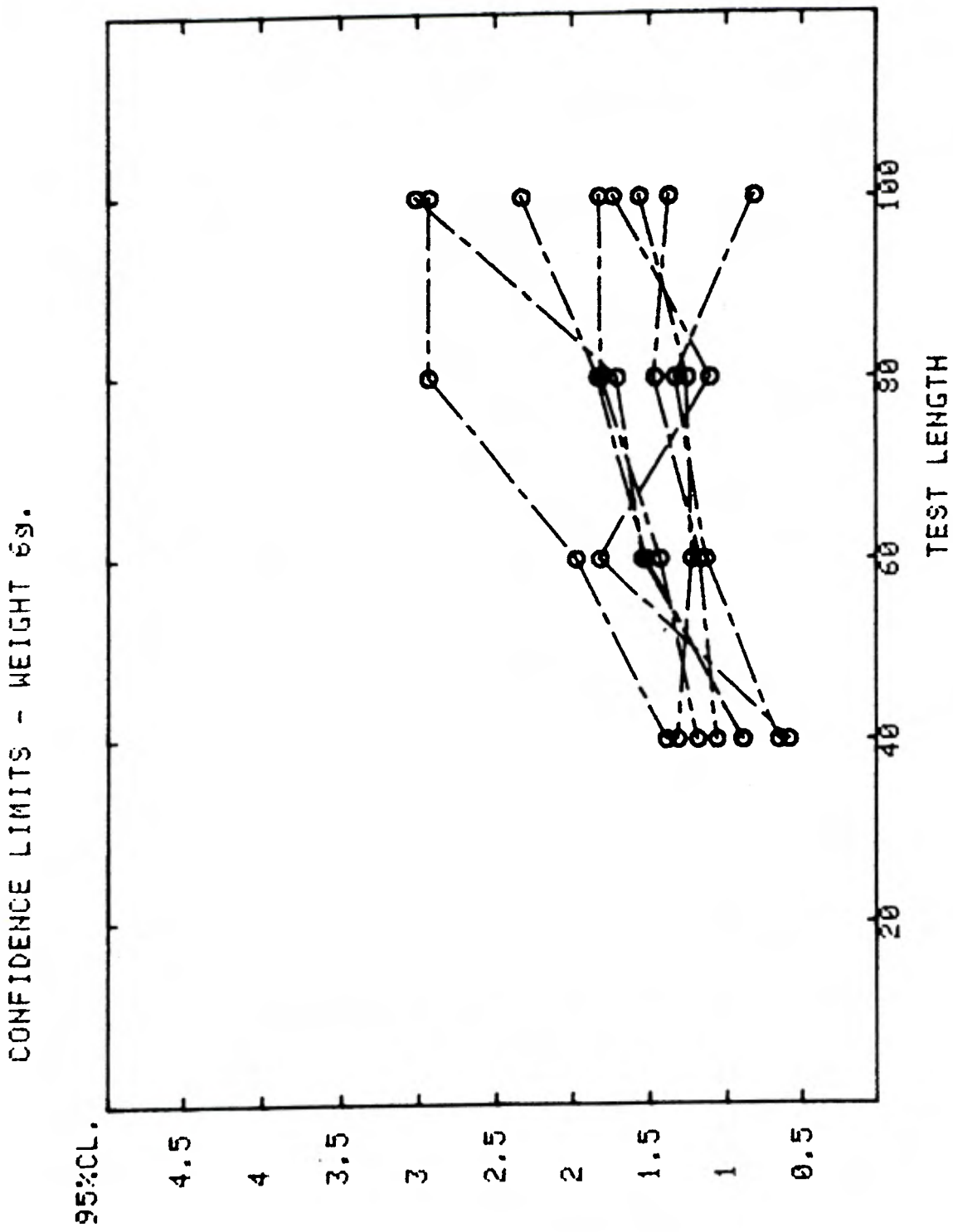
CONFIDENCE LIMITS - WEIGHT 6g.
95%CL.
4.5
4
3.5
3
2.5
2
1.5
1
0.5
20
40
60
80
100
TEST LENGTH

FIGURE 7

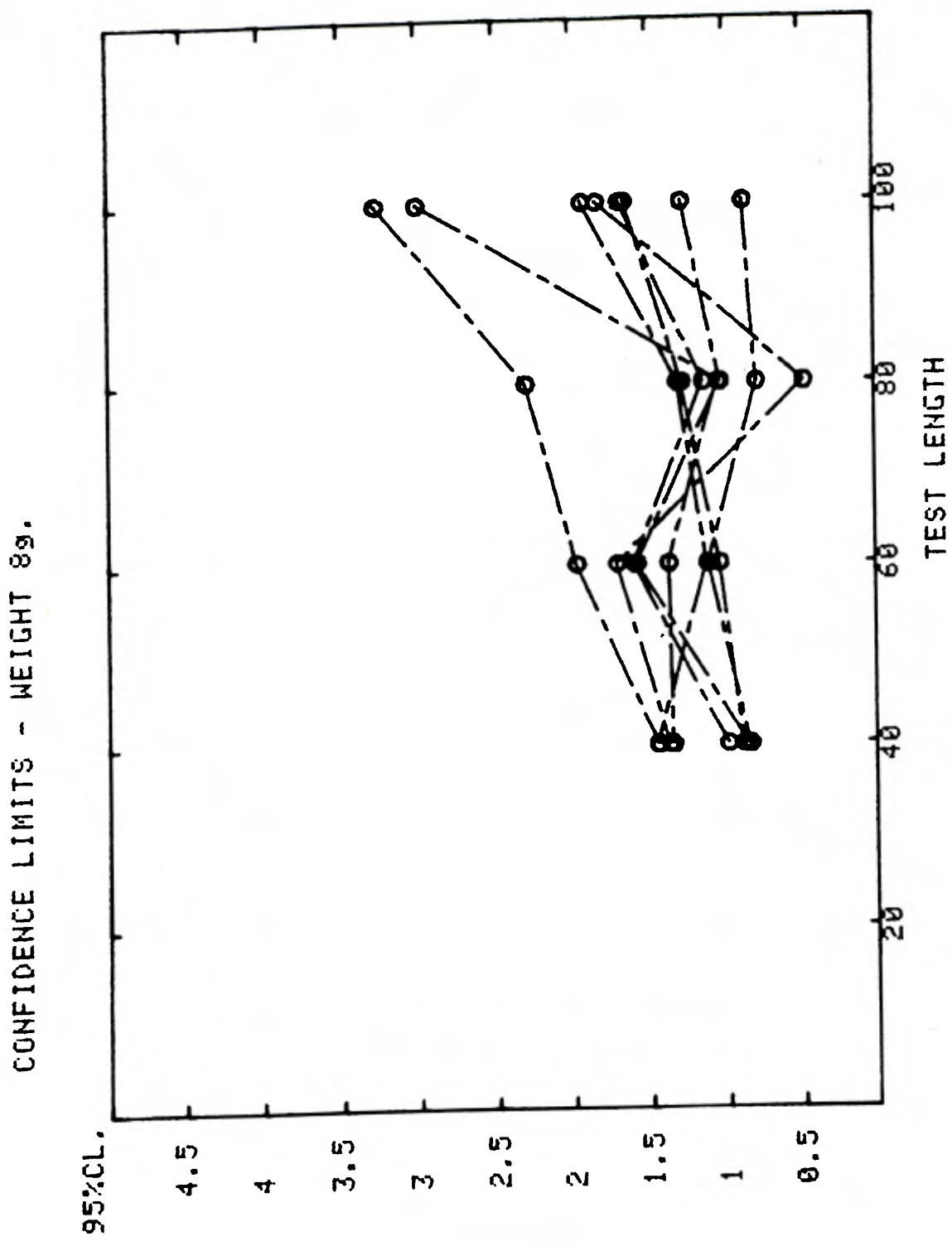
CONFIDENCE LIMITS - WEIGHT 8g.
95%CL.
4.5
4
3.5
3
2.5
2
1.5
1
0.5
20
40
60
80
100
TEST LENGTH

FIGURE 8

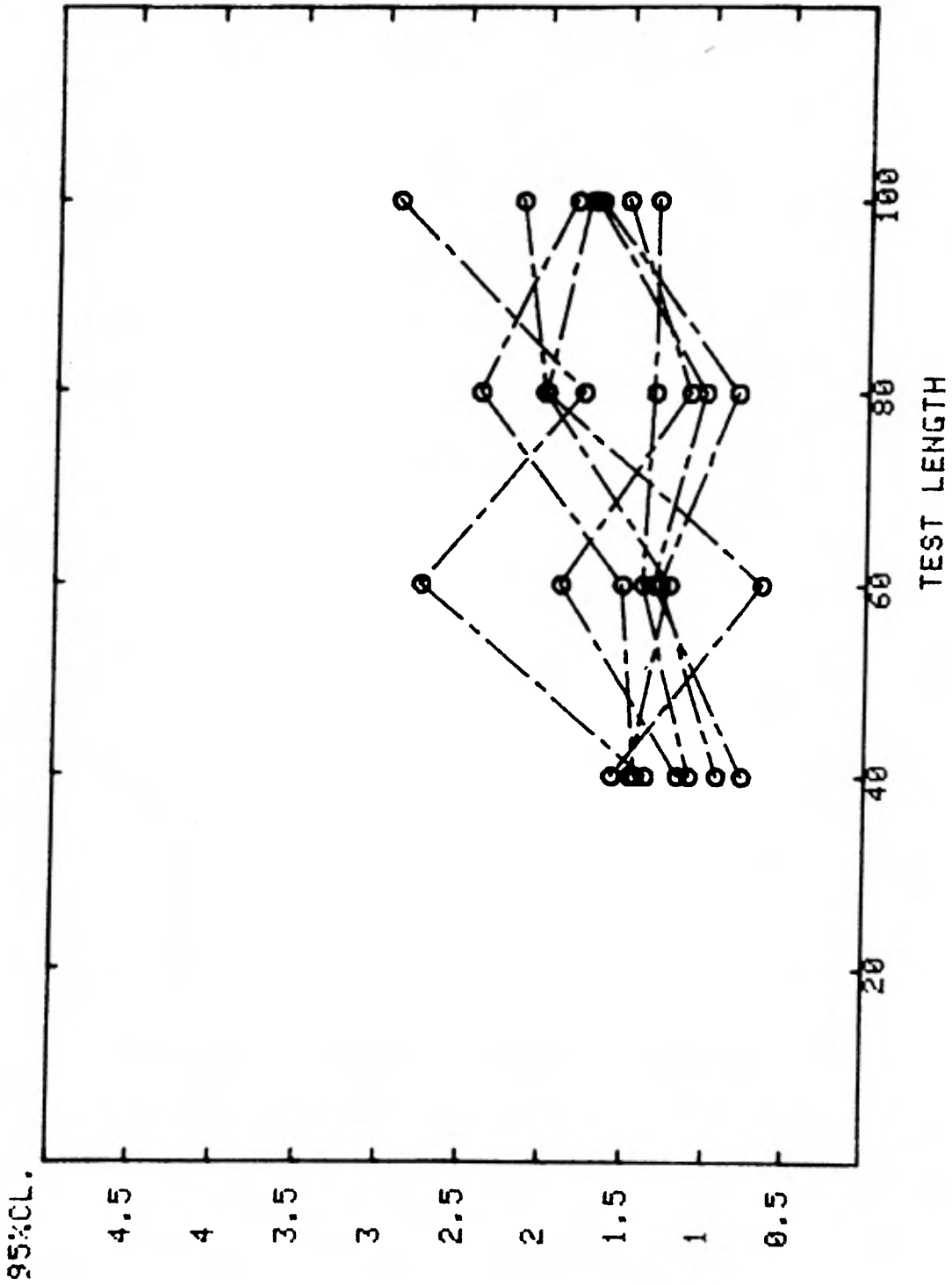
CONFIDENCE LIMITS - WEIGHT 10g.
95%CL.
4.5
4
3.5
3
2.5
2
1.5
1
0.5
20
40
60
80
100
TEST LENGTH

FIGURE 9

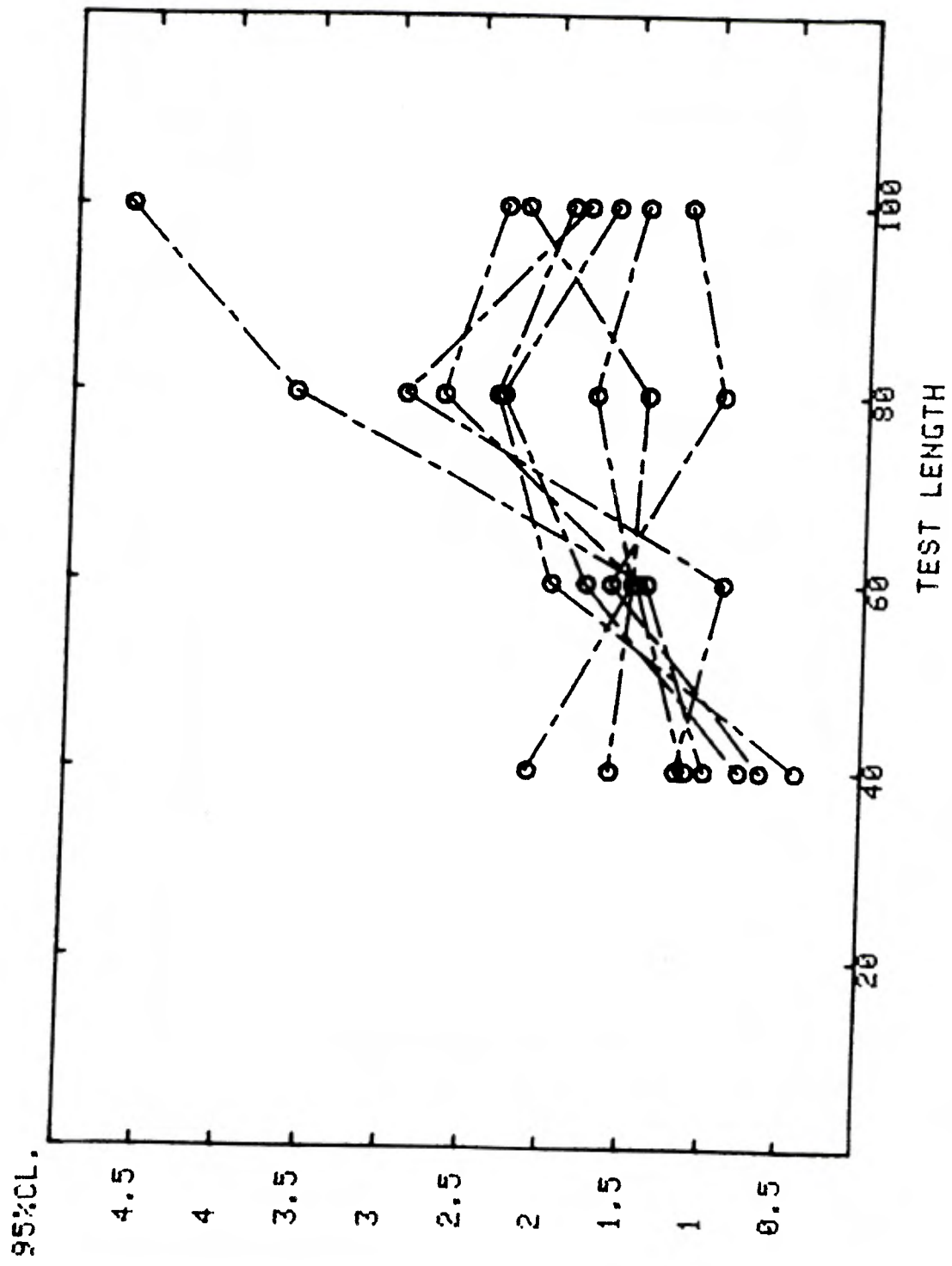
CONFIDENCE LIMITS - WEIGHT 12g.
95%CL.
4.5
4
3.5
3
2.5
2
1.5
1
0.5
20
40
60
80
100
TEST LENGTH

FIGURE 10

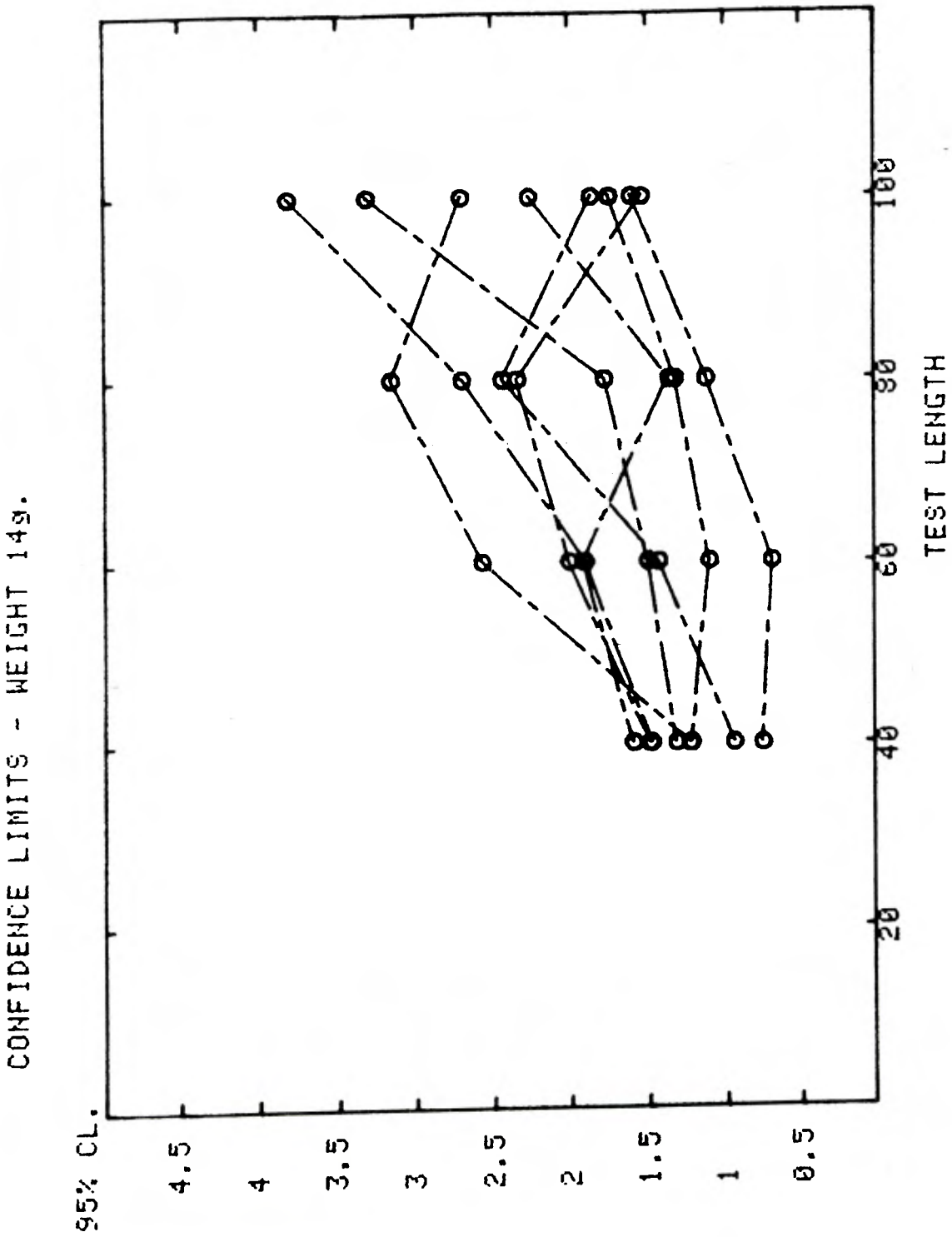
CONFIDENCE LIMITS - WEIGHT 14g.
95% CL.
4.5
4
3.5
3
2.5
2
1.5
1
0.5
20
40
60
80
100
TEST LENGTH

FIGURE 11

EFFECT OF LOOP WEIGHT ON MEAN T/L AVERAGED OVER TEST LENGTHS

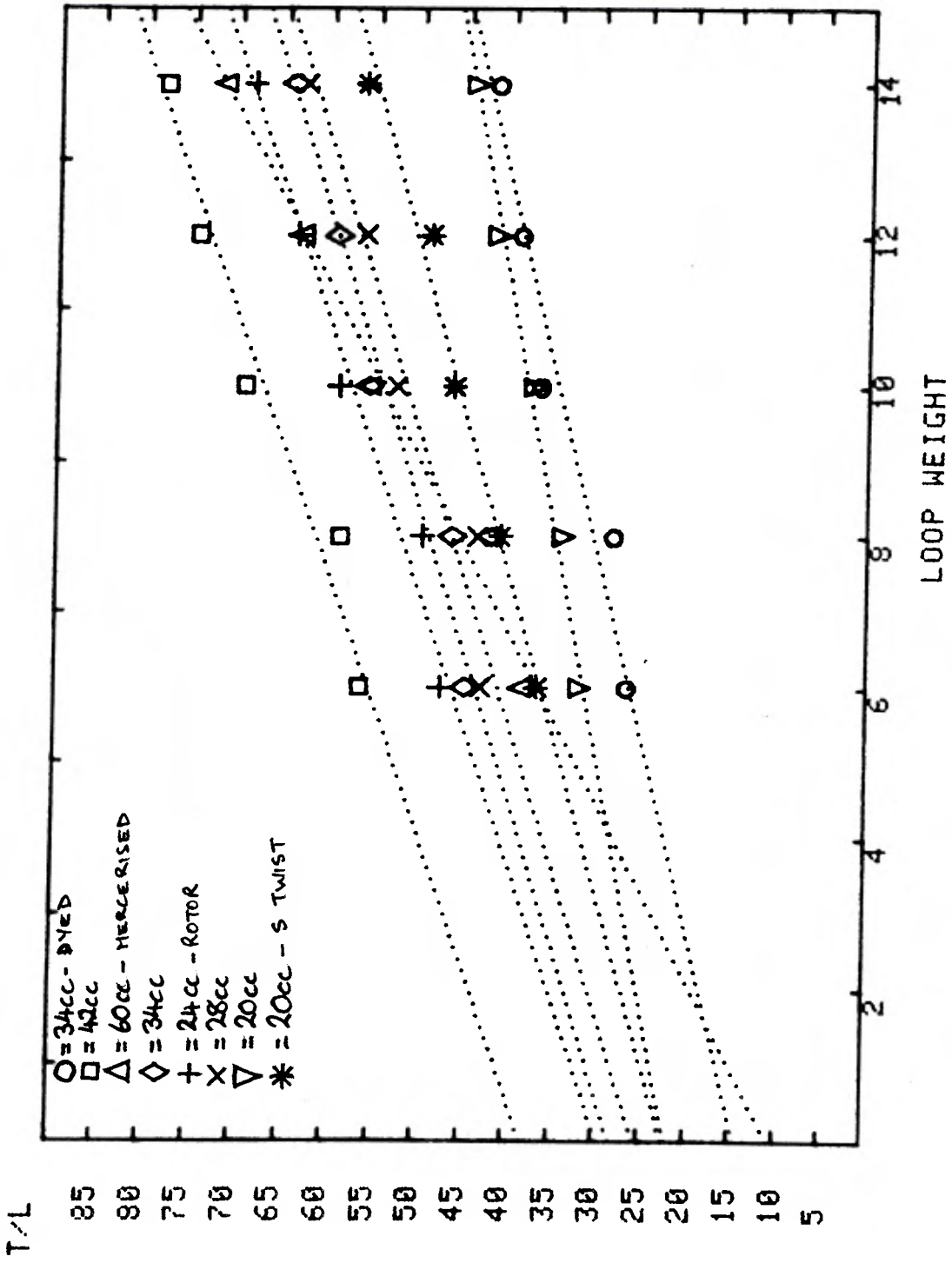

FIGURE 12

EFFECT OF LOOP WEIGHT ON CONFIDENCE LIMITS OF T/L AVERAGED OVER TEST LENGTHS