

CONTINUOUS BASELINE STUDY

Project 1108-B

Summary Report

to

FOURDRINIER KRAFT BOARD INSTITUTE, INC.

October 1, 1954

Forest Products Division
Reference Room - Tech Center

DEC 27 1957

THE INSTITUTE OF PAPER CHEMISTRY

Appleton, Wisconsin

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This report presents a summary of the results obtained in conjunction with the Continuous Baseline Study from April 1, 1954, to September 30, 1954--a period of six months--and is supplementary to a similar report dated April 1, 1954. The duration of each reported period as well as the total number of samples submitted is given in Table I, and the number of samples submitted by each mill for each of the reported periods is shown in Table II. Also shown in Table II is the total and average number of samples submitted by each mill for the six periods; the average is also given for the previous six periods.

As mentioned above, previous summary reports have presented data for the first 81 periods of the Continuous Baseline Study. It may be recalled that during the first 81 periods, the current F.K.I. averages for basis weight oscillated near the 43-lb. level. It may be seen in Table III and Figure 1 that during the interim from periods 82 to 87, basis weight values have remained close to the 43-lb. level also.

The current F.K.I. caliper averages exhibited a definite trend downward during the first 81 periods. This trend was especially evident for approximately the first 40 periods. Since then caliper has maintained a low level near 13 points. The current F.K.I. caliper average is 12.8 points.

The first 36 periods of the Continuous Baseline Study witnessed a substantial rise in bursting strength results. A decline was

noted during periods 37 to 49. It may be seen in Table II and Figure 1 that bursting strength values maintained a higher level during periods 50 to 81. Since then, this higher level has been maintained.

TABLE I
DURATION OF REPORTED PERIODS--NUMBER OF 42-LB.
KRAFT LINERBOARD SAMPLES PER PERIOD

Reported Period	Duration	Number of Samples
Average for previous 6 periods October 1, 1953, through March 31, 1954		102
82	April 1 through April 30, 1954	117
83	May 1 through May 31, 1954	97
84	June 1 through June 30, 1954	104
85	July 1 through July 31, 1954	96
86	August 1 through August 31, 1954	97
87	September 1 through September 30, 1954	86
Average of Periods 82 to 87		100

TABLE II

TABULATION BY PERIODS OF THE NUMBER OF SAMPLES OF 42-LB. KRAFT
LINERBOARD SUBMITTED BY EACH MILL

Period	Mills														
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
82	6	20	8	12	1	15	4	6	11	4	3	8	7	8	4
83	10	16	8	8	2	4	6	6	3	4	4	8	5	9	4
84	7	12	8	6	1	9	6	6	7	4	4	8	6	8	12
85	9	16	6	7	4	4	7	6	9	4	4	3	6	9	2
86	8	16	8	10	1	9	7	8	6	2	2	6	7	5	2
87	9	4	8	5	3	9	9	1	10	4	3	8	4	5	4
Totals	49	84	46	48	12	50	39	33	46	22	20	41	35	44	28
Average	8.2	14.0	7.7	8.0	2.0	8.3	6.5	5.5	7.7	3.7	3.3	6.8	5.8	7.3	4.7
Average for previous six periods:															
	8.5	16.0	8.0	8.5	2.0	10.5	7.0	3.7	7.7	5.0	2.0	7.7	4.5	6.3	4.8

TABLE III
TABULATION OF CURRENT F.K.I. AVERAGES BY PERIODS

Period	Basis Weight, lb.	Caliper, points	Bursting Strength, p.s.i. g.	G. E. Puncture, units	Elmendorf Tear g./sheet	
					In	Across
Average for previous six periods	43.0	13.0	108	34	350	383
82	43.0	12.9	109	34	354	383
83	43.0	13.1	111	34	351	381
84	42.7	12.9	111	33	344	377
85	43.1	12.9	114	34	352	383
86	42.9	12.8	112	34	351	378
87	42.9	12.8	112	34	347	379

COMPARISON OF CURRENT F.K.I. AVERAGES BY PERIODS

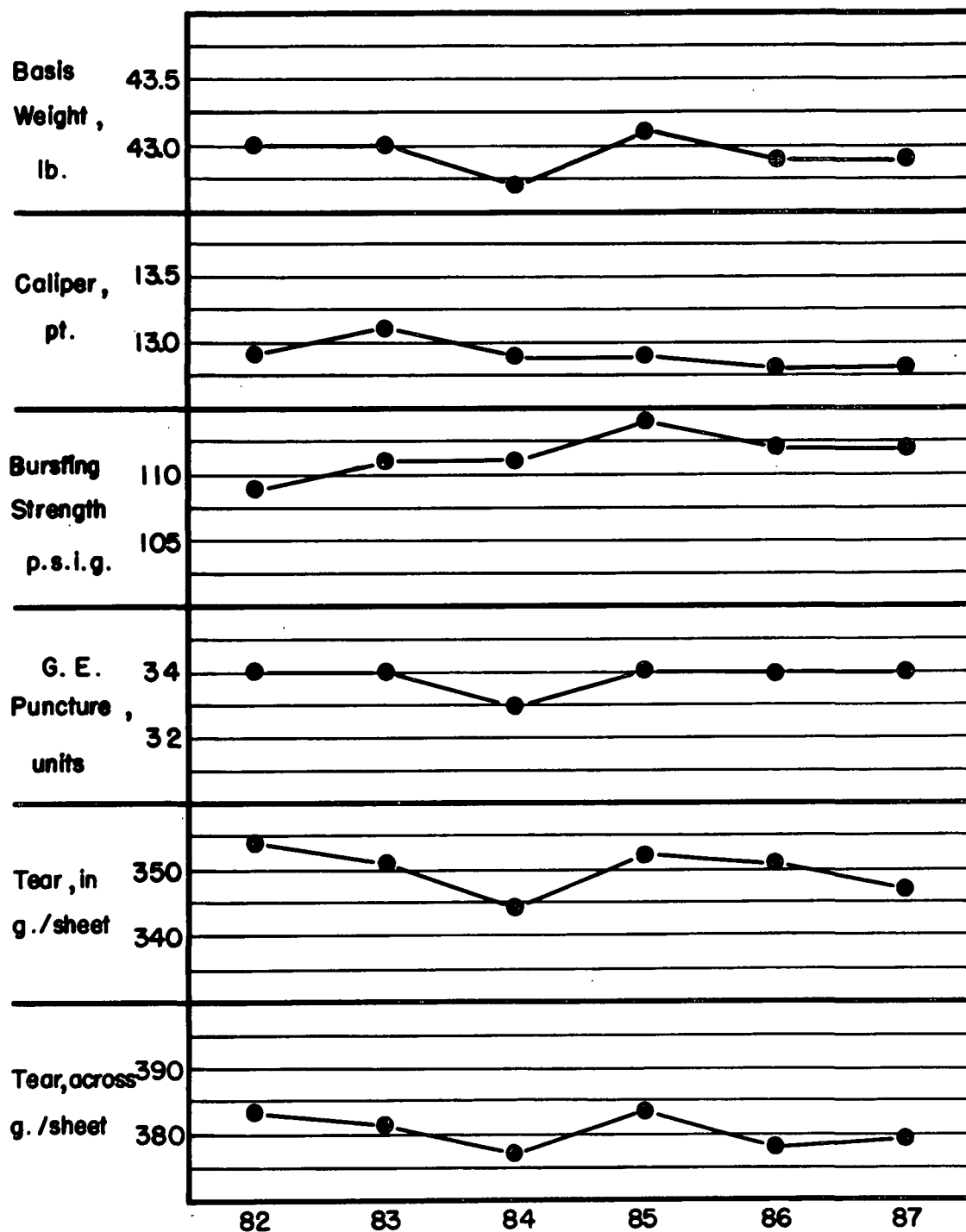


FIGURE 1

G. E. puncture values have exhibited a gradual decline from the inception of the Continuous Baseline Study to the present time. It may be noted in Figure 1 that the current G. E. puncture average is 34 units as compared with the average at the beginning of the study of 40 units.

Tearing strength during the first thirty periods was at a high level. However, since that time, there has been a gradual decline. It may be seen in Figure 1 that both machine and cross-machine direction tearing strength are currently at low levels.

Thus, the trends for the interim covered by periods 82 to 87 are the following:

1. Basis weight has remained relatively constant near the 43-lb. level.
2. Caliper has maintained a low level, generally below 13 points.
3. Bursting strength has held a strong level.
4. G. E. puncture has remained at a low level.
5. Elmendorf tear has remained at a low level.

Table IV presents the current mill averages for Mill A for periods 82 to 87. The averages are shown graphically in Figure 2. In general, the trends outlined above for the current monthly F.K.I. averages apply also to the results for Mill A.

The current mill averages for Mill B, shown in Table V and graphically illustrated in Figure 3, indicate that the basis weight results have varied above and below a 43-lb. level. Caliper has been

TABLE IV

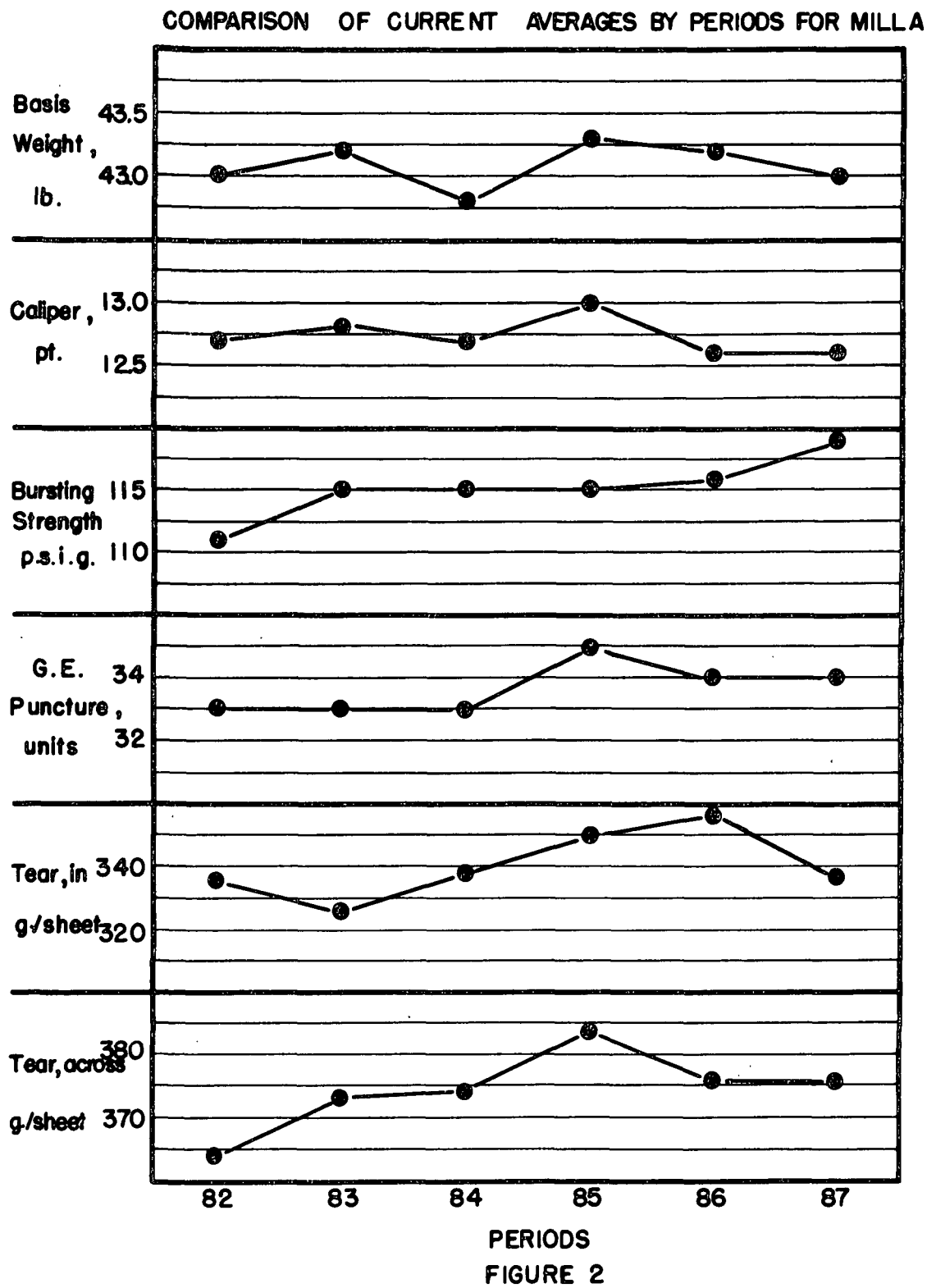
TABULATION OF CURRENT AVERAGES BY PERIODS FOR MILL A

Period	Basis Weight, lb.	Caliper, points	Bursting Strength, p.s.i. g.	G. E. Puncture, units	Elmendorf Tear g./sheet	
					In	Across
Average for previous six periods	43.3	12.8	111	33	331	371
82	43.0	12.7	111	33	336	364
83	43.2	12.8	115	33	326	373
84	42.8	12.7	115	33	338	374
85	43.3	13.0	115	35	350	384
86	43.2	12.6	116	34	357	376
87	43.0	12.6	119	34	337	376

TABLE V

TABULATION OF CURRENT AVERAGES BY PERIODS FOR MILL B

Average for previous six periods	43.1	12.5	111	29	296	349
82	42.5	12.4	115	28	286	344
83	43.0	12.6	117	28	280	336
84	43.1	12.6	119	28	280	338
85	43.5	12.7	121	29	281	346
86	42.6	12.6	116	28	268	322
87	43.3	12.9	109	30	292	341



COMPARISON OF CURRENT AVERAGES BY PERIODS FOR MILL B

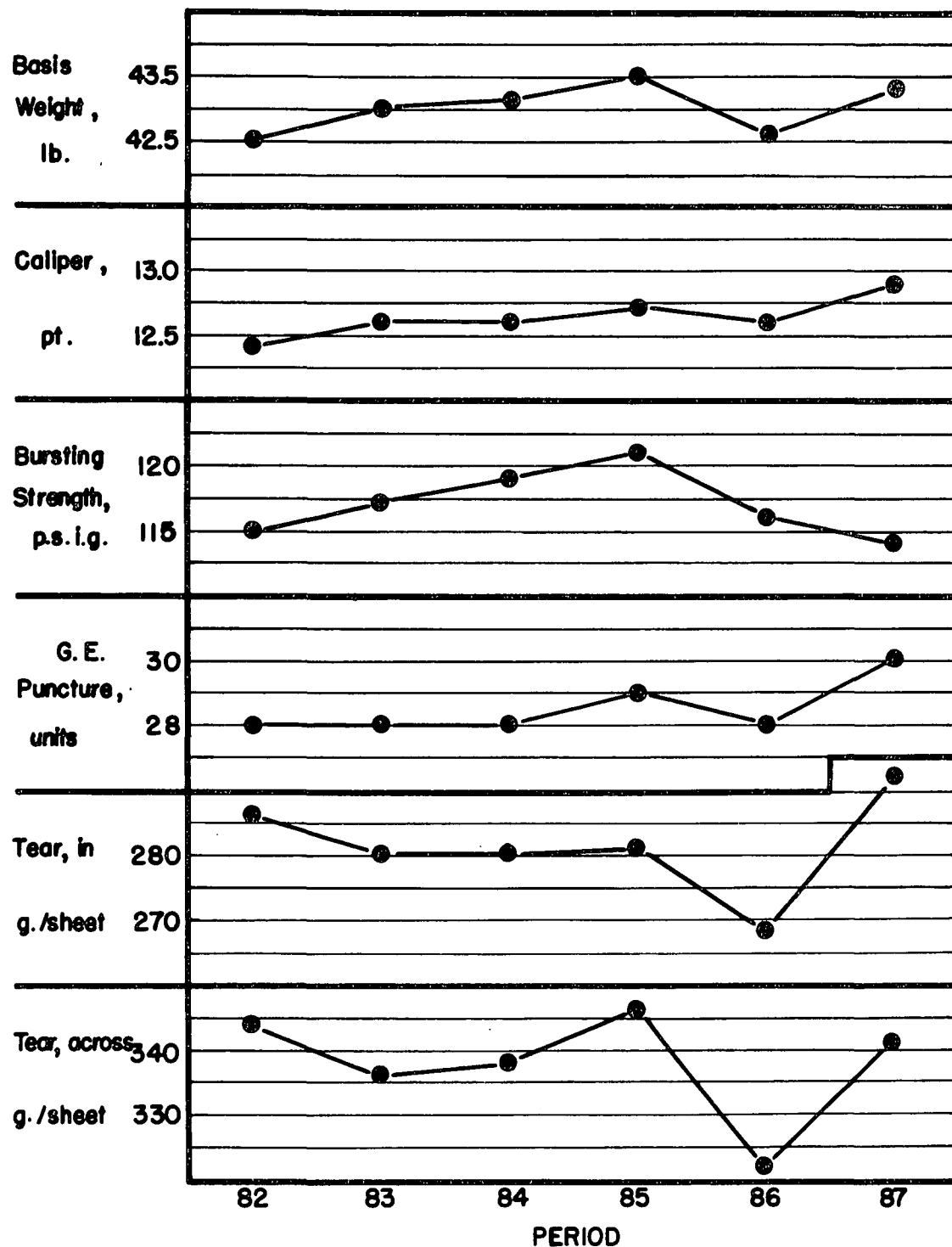


FIGURE 3

under 13 points whereas the other tests have exhibited trends similar to those for the current F.K.I. averages--i.e., high bursting strength, low G. E. puncture and Elmendorf tear.

The current mill averages for the 82nd to 87th periods are presented in Table VI for Mill C. A graphical presentation is given in Figure 4. It may be noted that basis weight has fluctuated near 43 and 44 lb.; caliper has maintained a level near 14 points; bursting strength has held a high level, while the other tests, G. E. puncture and Elmendorf tear, have remained at levels very near the F.K.I. averages.

Presented graphically in Figure 5 are the current mill averages shown in Table VII for Mill D. The following trends are evident from the data shown in Figure 5: (1) Basis weight has maintained a level between 43 and 44 lb.; (2) caliper has been near the 12-point level; (3) bursting strength has maintained a high level; (4) G. E. puncture averages have been strong but currently are pointing toward a weaker level; and (5) tear values also appear to be on the downgrade currently.

The current mill averages for Mill E are shown in Table VIII, and a graphic presentation is given in Figure 6. It may be noted that the basis weight results have varied between 40-lb. and 45-lb. levels. Caliper results have fluctuated near the 13-point level. Bursting strength has maintained a relatively strong level. G. E. puncture results have varied between 30 and 36 units, and tearing strength results have also varied randomly over a considerable range.

TABLE VI

TABULATION OF CURRENT AVERAGES BY PERIODS FOR MILL C

Period	Basis Weight, lb.	Caliper, points	Bursting Strength, p.s.i.g.	G. E. Puncture, units	Elmendorf Tear g./sheet In Across	
Average for previous six periods	43.6	14.1	108	34	344	385
82	43.1	13.6	112	33	340	385
83	43.1	13.9	112	35	354	386
84	42.8	14.1	112	35	349	389
85	43.7	13.4	120	35	342	392
86	42.7	13.6	112	34	336	379
87	42.7	14.3	111	35	340	378

TABLE VII

TABULATION OF CURRENT AVERAGES BY PERIODS FOR MILL D

Average for previous six periods	43.3	12.6	107	36	369	393
82	43.6	12.5	109	36	362	390
83	43.9	13.1	109	37	373	399
84	43.0	12.3	111	35	362	384
85	43.4	12.1	116	36	365	394
86	43.1	12.3	110	36	352	390
87	42.5	11.9	113	34	330	373

TABLE VIII

TABULATION OF CURRENT AVERAGES BY PERIODS FOR MILL E

Average for previous six periods	43.2	13.8	102	32	366	367
82	41.6	12.5	106	30	355	346
83	42.7	13.0	108	33	370	355
84	40.2	12.6	107	30	313	341
85	43.8	12.9	115	35	369	379
86	45.2	13.3	109	36	356	374
87	43.0	12.5	113	33	345	354

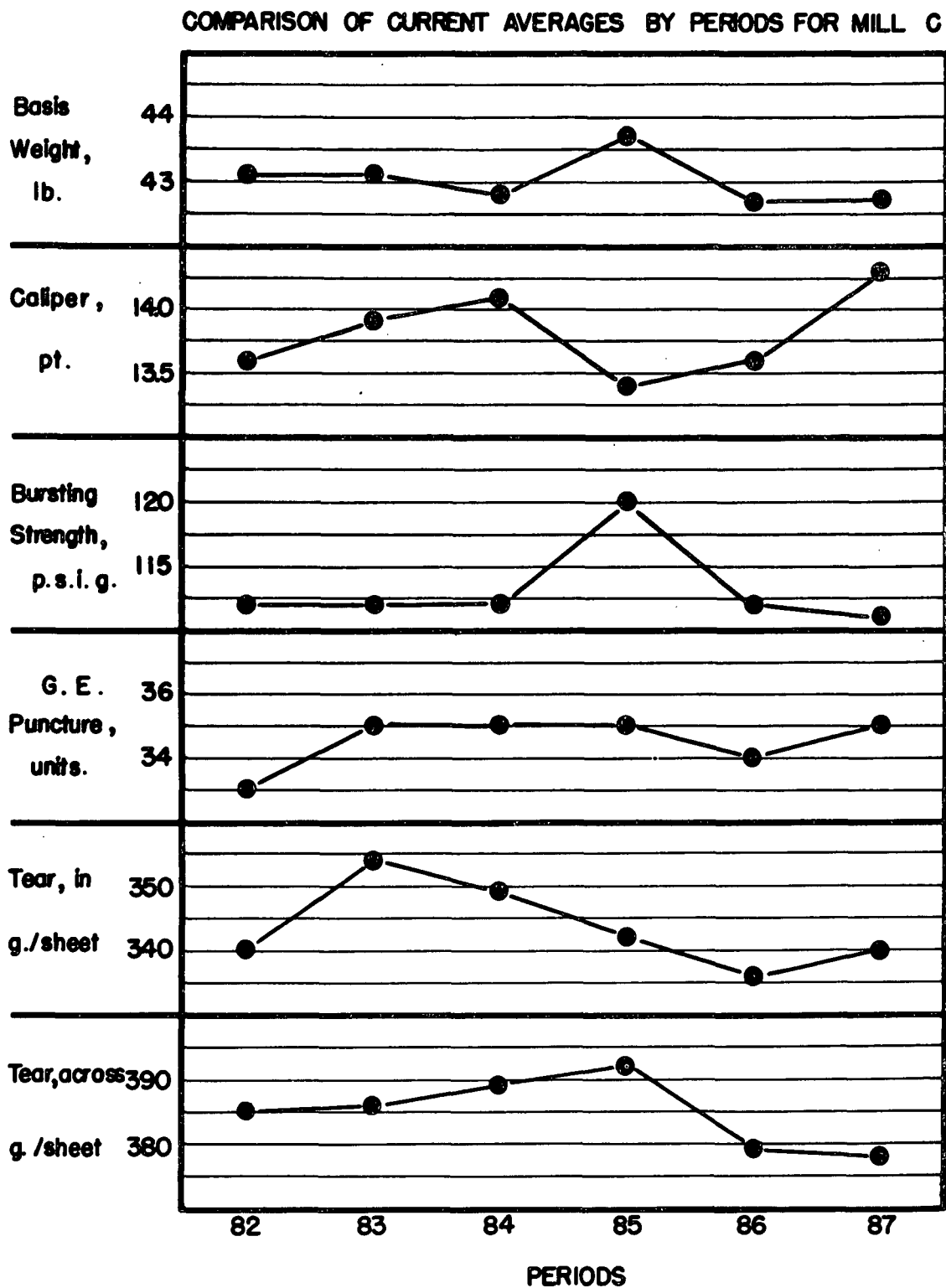


FIGURE 4

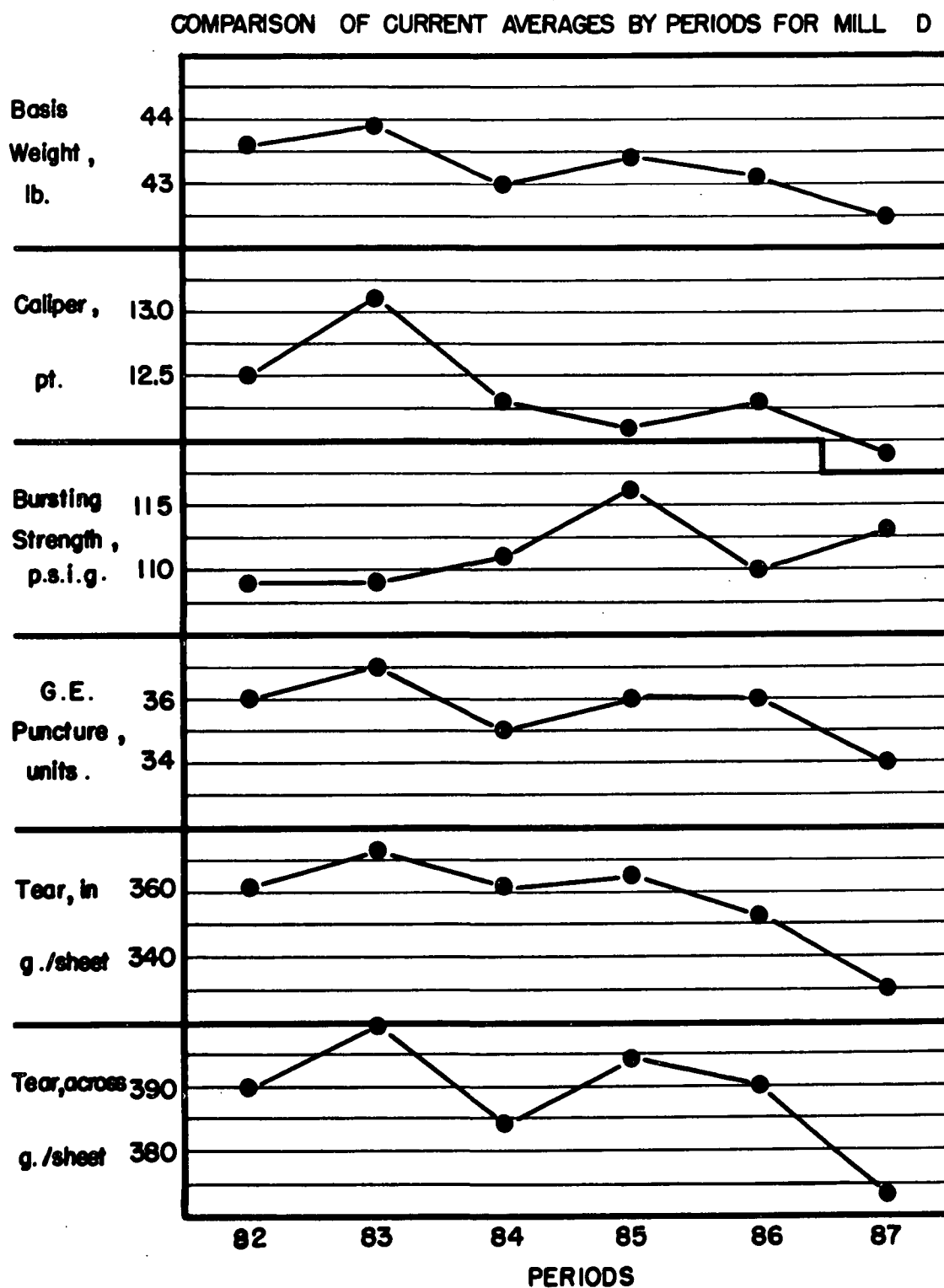


FIGURE 5

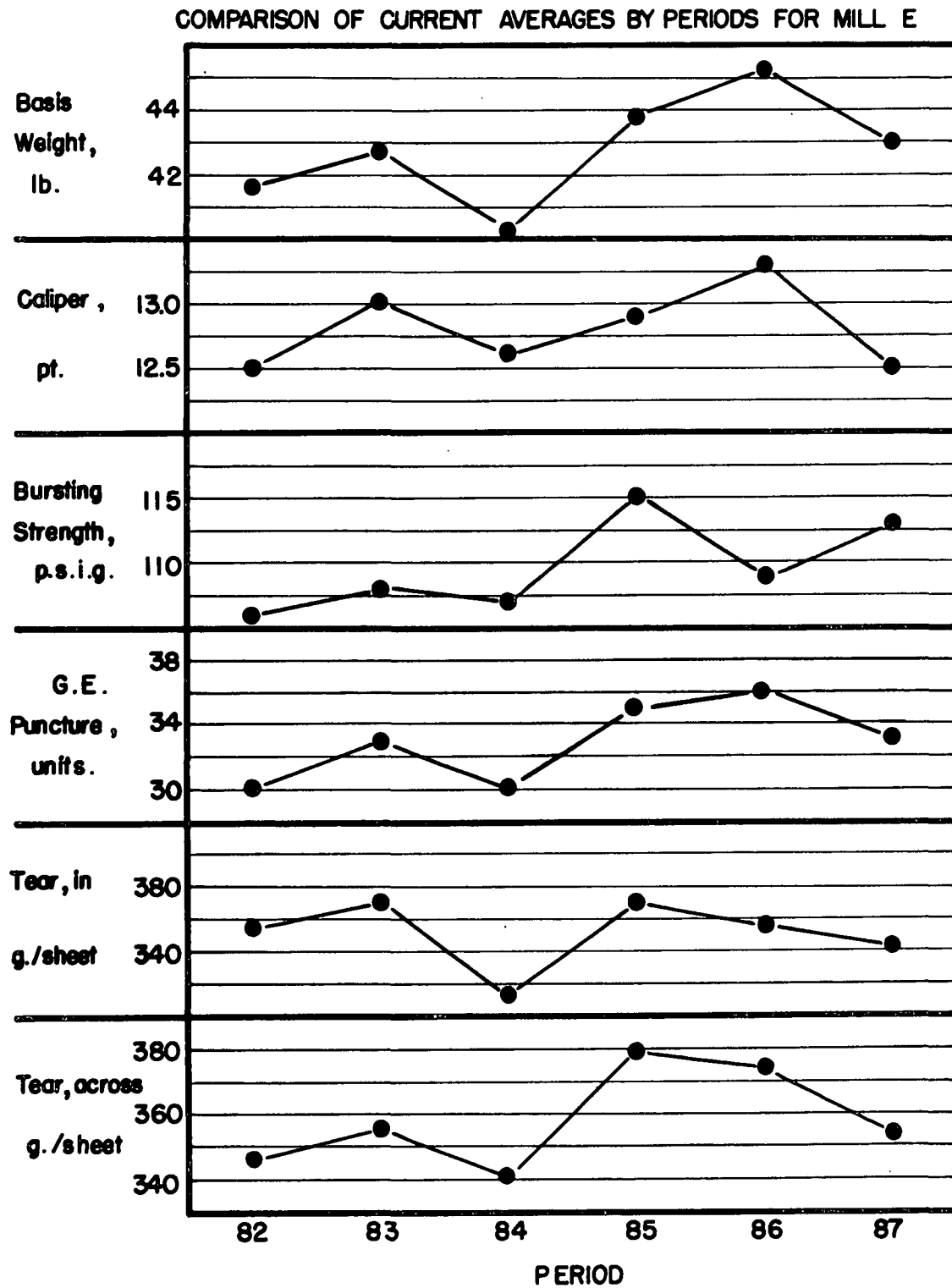


FIGURE 6

Illustrated graphically in Figure 7 are the current mill averages shown in Table IX for Mill F. It is evident from the results shown in Table IX and Figure 7 that basis weight has increased somewhat as has caliper; bursting strength has held a good level; G. E. puncture and Elmendorf tear have maintained levels considerably above the F.K.I. averages, especially during recent months.

The current mill averages for Mill G are shown in Table X and presented in graphic form in Figure 8. It may be seen in Figure 8 that a trend to lower basis weight values is evident at the present time. Caliper has maintained a level between 12 and 13 points. Bursting strength has decreased somewhat and G. E. puncture results have held a very low level. Elmendorf tear results have also maintained very low levels, especially during recent months.

The current mill averages for Mill H, which are shown in Table XI and presented graphically in Figure 9 exhibit the following trends: basis weight near 43 lb., a low caliper level (slightly above 12 points), bursting strength of greater magnitude, stronger G. E. puncture, and a tearing strength level which currently appears to be gaining strength.

The current mill averages for Mill I presented in Table XII and illustrated graphically in Figure 10 show a tendency to lower weight, a caliper level near 13 points for first five periods and currently near 12 points, stronger bursting strength currently in the area of 115 points, relatively constant G. E. puncture and fluctuating tear strength, both at low levels.

TABLE IX

TABULATION OF CURRENT AVERAGES BY PERIODS FOR MILL F

Period	Basis Weight, lb.	Caliper, points	Bursting Strength, p.s.i.g.	G. E. Puncture, units	Elmendorf Tear g./sheet	
					In	Across
Average for previous six periods	42.9	13.4	107	38	387	421
82	42.9	13.3	103	37	382	411
83	43.4	13.9	107	39	408	430
84	42.9	13.4	103	38	388	417
85	44.8	13.7	108	42	417	451
86	43.2	13.1	110	39	402	428
87	43.6	13.6	110	38	391	437

TABLE X

TABULATION OF CURRENT AVERAGES BY PERIODS FOR MILL G

Average for previous six periods	43.9	12.3	122	32	346	378
82	44.7	13.3	113	33	361	379
83	43.0	12.7	115	31	321	353
84	42.5	11.9	112	29	303	331
85	42.4	11.3	114	28	296	321
86	42.2	12.3	108	28	305	327
87	42.1	13.0	108	29	313	344

TABLE XI

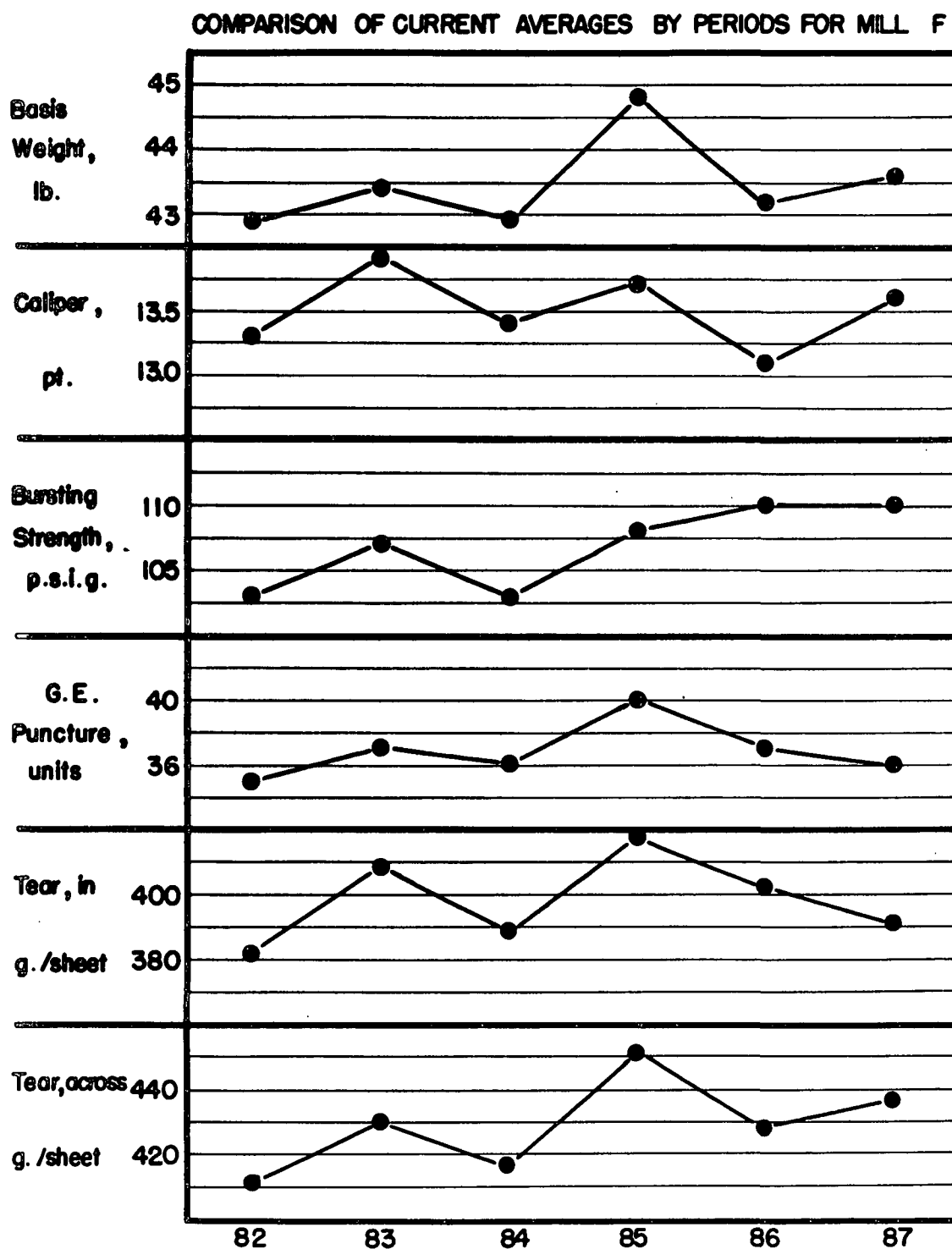
TABULATION OF CURRENT AVERAGES BY PERIODS FOR MILL H

Average for previous six periods	42.9	12.4	106	32	346	387
82	43.3	12.2	111	35	383	402
83	42.6	12.2	108	35	373	386
84	42.5	12.2	110	34	373	391
85	42.1	12.1	112	34	358	385
86	43.0	12.4	112	35	368	393
87	43.1	12.1	116	35	384	407

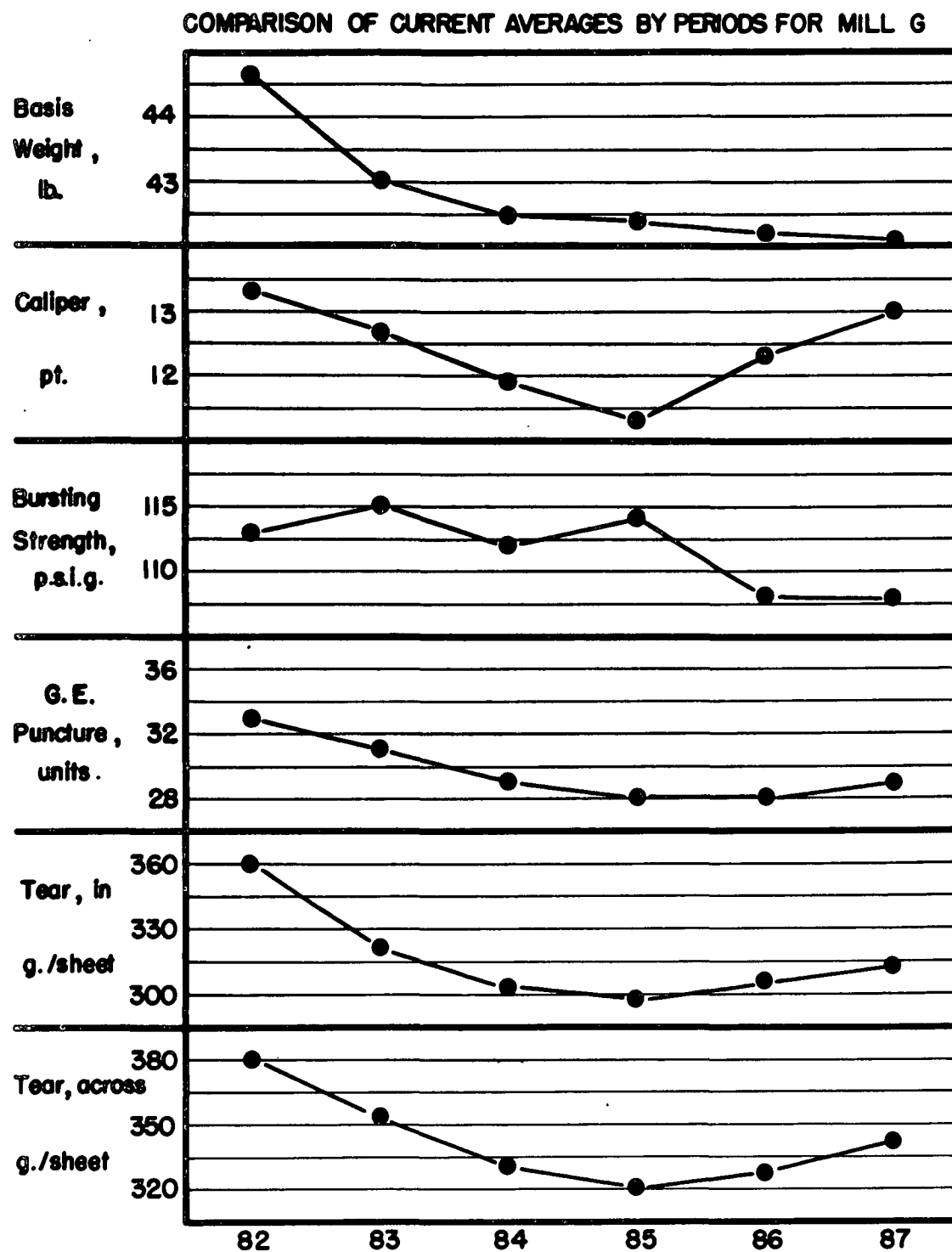
TABLE XII

TABULATION OF CURRENT AVERAGES BY PERIODS FOR MILL I

Period	Basis Weight, lb.	Caliper, points	Bursting Strength, p.s.i.g.	G. E. Puncture, units	Elmendorf Tear	
					g./sheet In	Across
Average for previous six periods	42.6	13.2	106	32	330	388
82	42.4	13.1	105	31	318	379
83	43.3	13.4	110	33	332	390
84	42.7	13.3	109	32	330	390
85	42.6	12.8	112	32	330	387
86	42.0	12.8	115	32	325	383
87	42.4	12.2	115	31	316	381

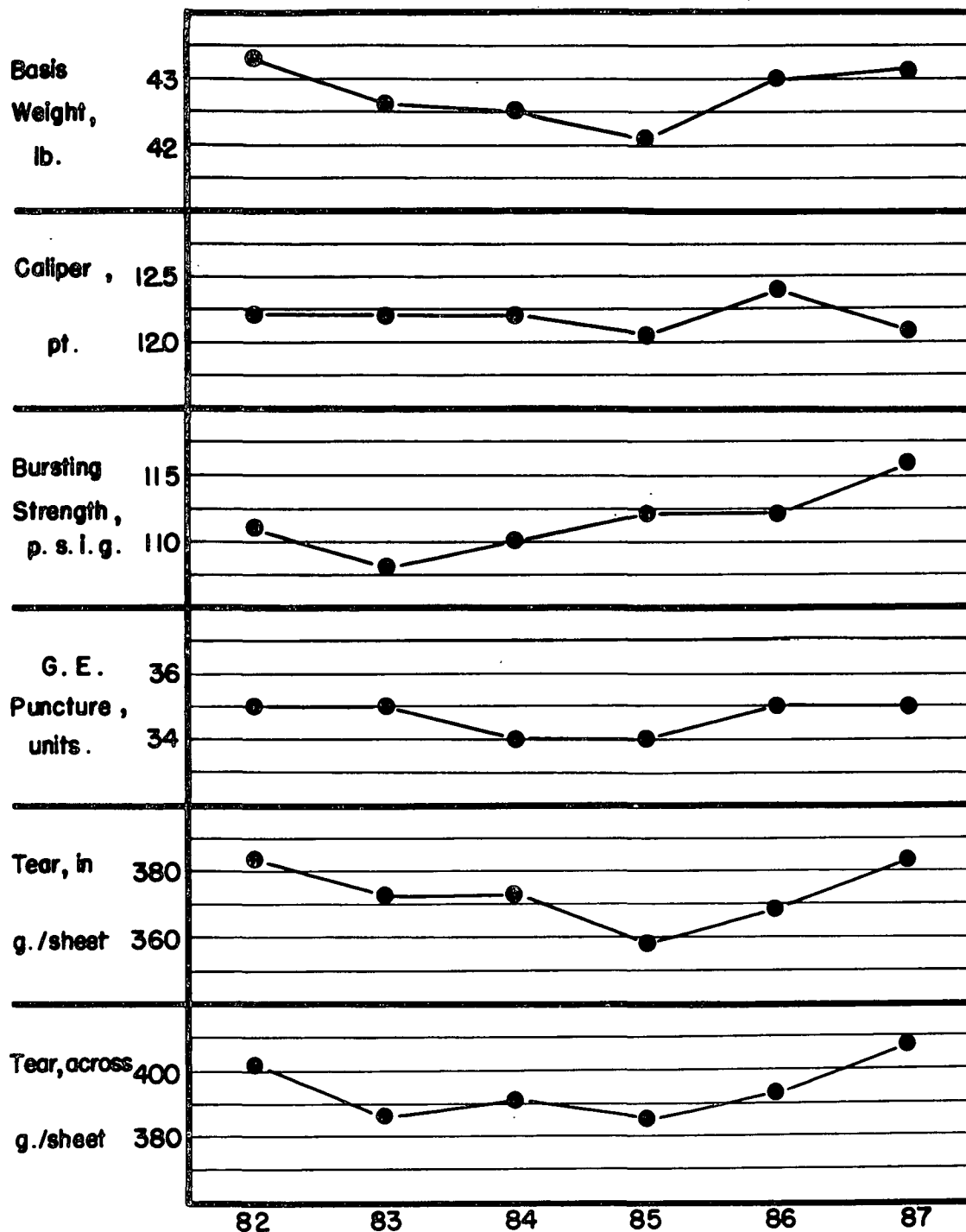


PERIOD
FIGURE 7



PERIOD
FIGURE 8

COMPARISON OF CURRENT AVERAGES BY PERIODS FOR MILL H



PERIODS
FIGURE 9

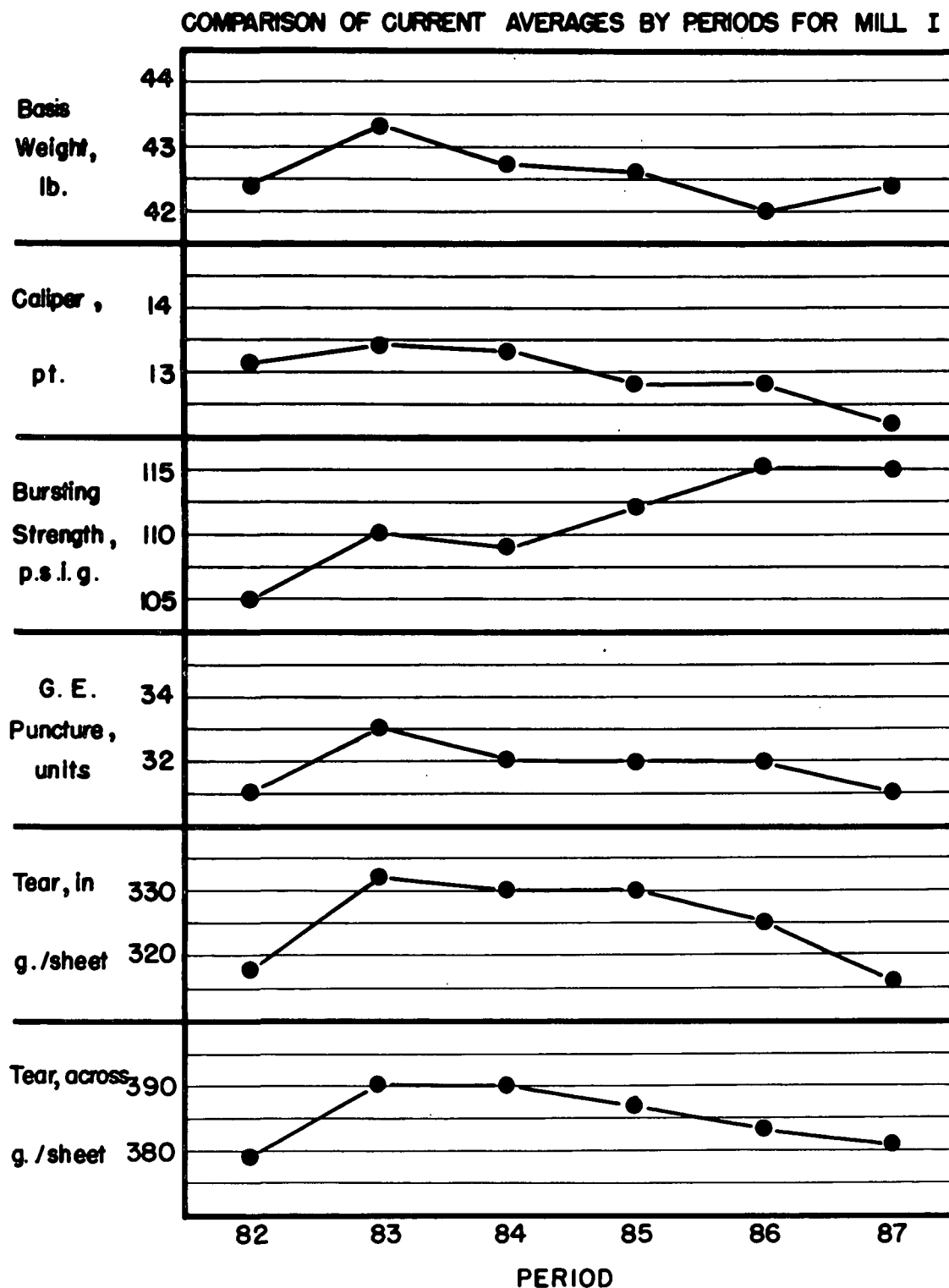


FIGURE 10

Pictured graphically in Figure 11 are the current mill averages shown in Table XIII for Mill J. It may be noted in Figure 11 that weight has fluctuated between 42 and 43 lb.; caliper has been slightly above 13 points; bursting strength has maintained a strong level; G. E. puncture has also maintained a strong level and Elmendorf tear has maintained a relatively constant level.

The test averages for Mill K are shown in Table XIV and are plotted in Figure 12. It may be noted that weight and caliper have moved downward; bursting strength has fluctuated considerably and is currently 103; G. E. puncture and Elmendorf tear have maintained strong levels up to the current period when both decreased somewhat.

The current mill averages for Mill L are presented in Table XV and pictured graphically in Figure 13. The following trends are evident; weight between 43 lb. and 44 lb.; caliper has been near 14 points; bursting strength has been close to 110 p.s.i.g. most of the time; G. E. puncture values have varied between 33 and 38 units whereas tearing strength values have apparently increased slightly.

Shown graphically in Figure 14 are the current mill averages given in Table XVI for Mill M. It may be seen in Figure 14 that weight, caliper, and bursting strength have maintained relatively constant levels. G. E. Puncture values have also held a steady level. Tearing strength has decreased somewhat.

The current mill averages for Mill N are shown in Table XVII and presented graphically in Figure 15. It may be seen in Figure 15 that

TABLE XIII

TABULATION OF CURRENT AVERAGES BY PERIODS FOR MILL J

Period	Basis Weight, lb.	Caliper, points	Bursting Strength, p.s.i.g.	G. E. Puncture, units	Elmendorf Tear, g./sheet	
					In	Across
Average for previous six periods	42.6	13.5	110	31	347	377
82	43.3	13.5	113	32	355	384
83	42.4	13.6	114	31	341	378
84	42.6	13.8	110	31	332	378
85	42.7	13.4	117	32	348	380
86	41.9	13.2	111	33	370	370
87	43.5	13.0	117	34	353	376

TABLE XIV

TABULATION OF CURRENT AVERAGES BY PERIODS FOR MILL K

Average for previous six periods						
	42.9	12.9	104	35	360	377
82	44.2	13.4	99	38	396	408
83	44.3	13.2	109	37	380	407
84	43.6	13.0	106	38	387	396
85	42.7	13.2	110	37	391	395
86	42.9	13.0	112	36	398	410
87	42.0	12.7	103	34	357	373

TABLE XV

TABULATION OF CURRENT AVERAGES BY PERIODS FOR MILL L

Period	Basis Weight, lb.	Caliper, points	Bursting Strength, p.s.i.g.	G. E. Puncture, units	Elmendorf Tear, g./sheet	
					In	Across
Average for previous six periods	43.1	13.6	106	35	349	384
82	43.2	13.7	110	33	326	363
83	43.4	13.7	113	34	339	370
84	43.1	14.0	106	35	338	373
85	44.5	14.7	104	38	338	371
86	43.7	13.8	111	37	355	388
87	43.6	14.2	109	36	358	394

TABLE XVI

TABULATION OF CURRENT AVERAGES BY PERIODS FOR MILL M

Average for previous six periods	43.5	13.9	106	36	388	401
82	43.2	13.4	108	34	383	402
83	43.4	13.6	108	34	374	395
84	43.8	13.7	111	35	386	389
85	42.8	13.6	107	35	369	384
86	43.5	13.7	108	34	383	380
87	43.0	13.6	105	35	373	369

TABLE XVII

TABULATION OF CURRENT AVERAGES BY PERIODS FOR MILL N

Average for previous six periods	42.9	12.4	106	35	347	392
82	42.7	12.3	109	36	355	397
83	42.2	12.4	113	36	352	387
84	42.6	12.0	111	37	347	394
85	42.2	11.9	111	36	367	392
86	42.9	12.0	110	37	349	392
87	43.3	12.2	115	39	364	395

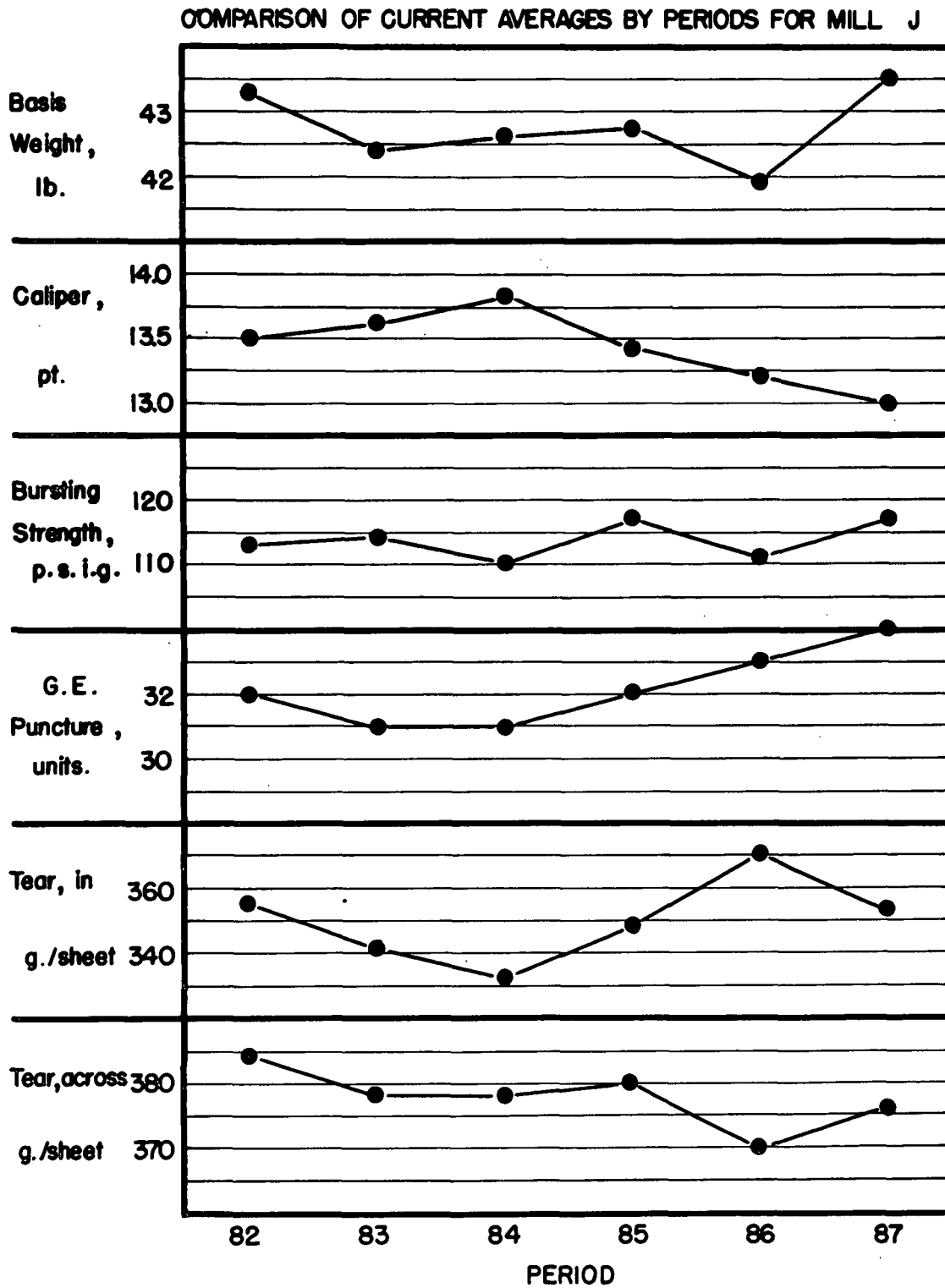


FIGURE II

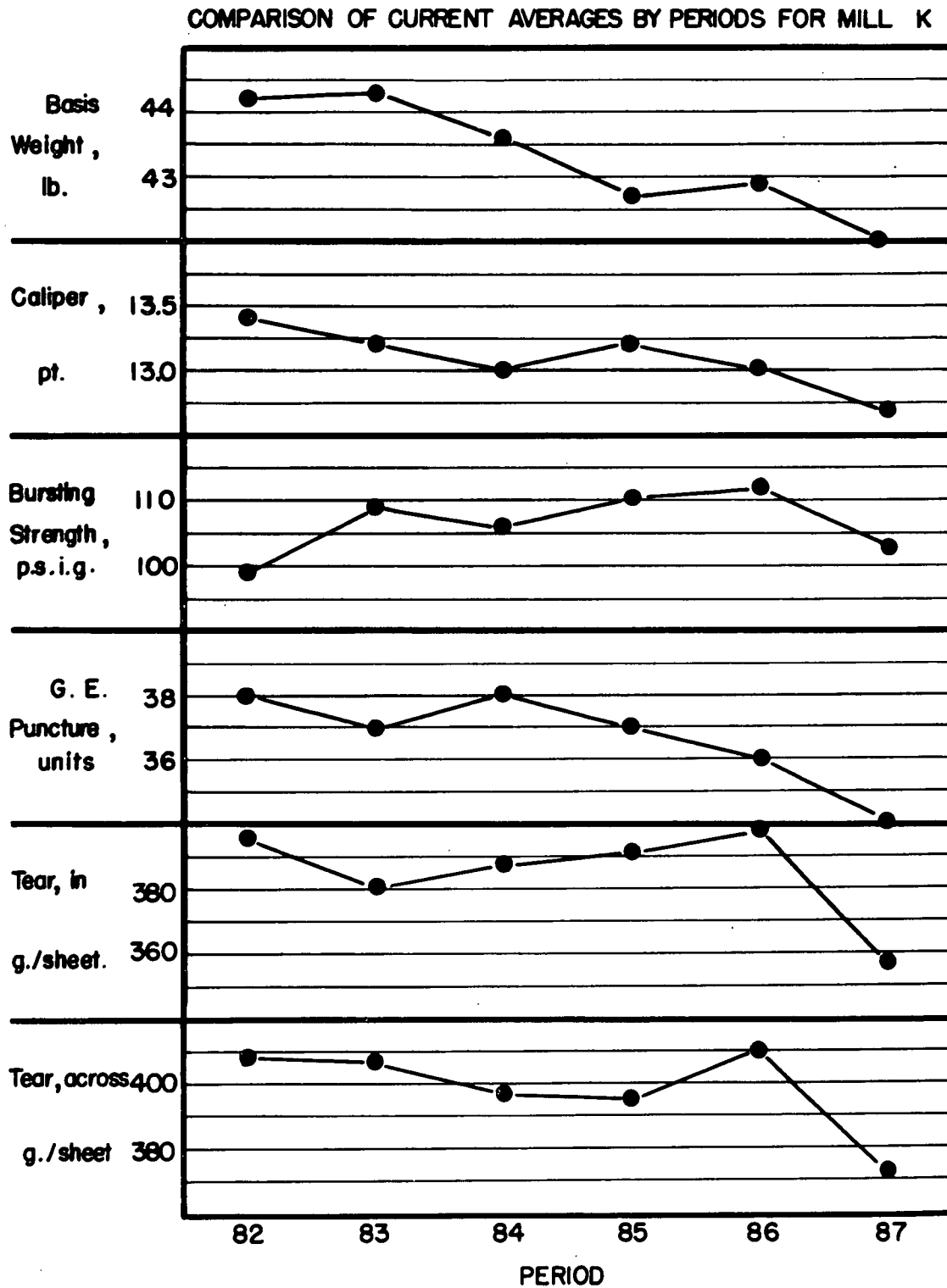
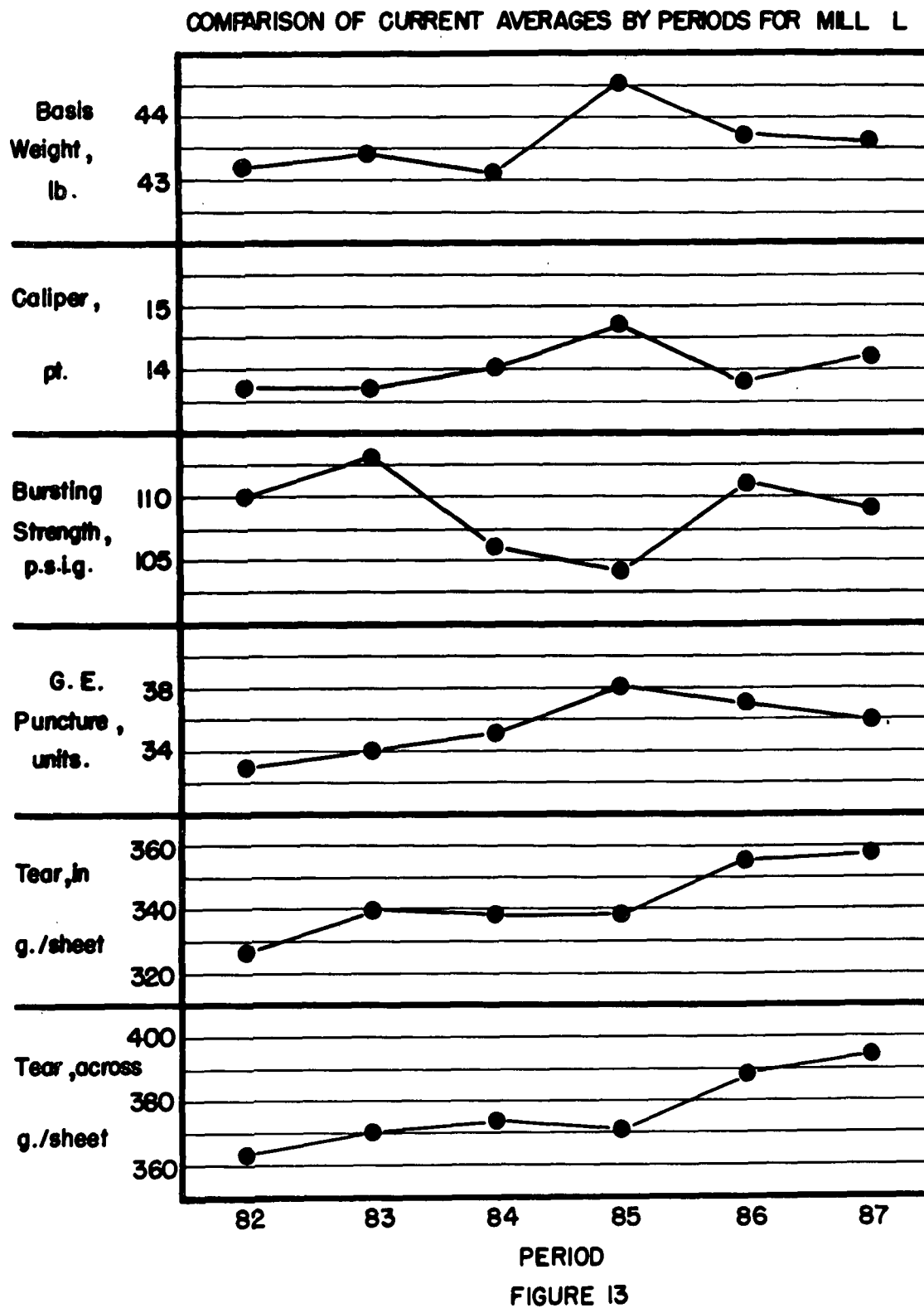
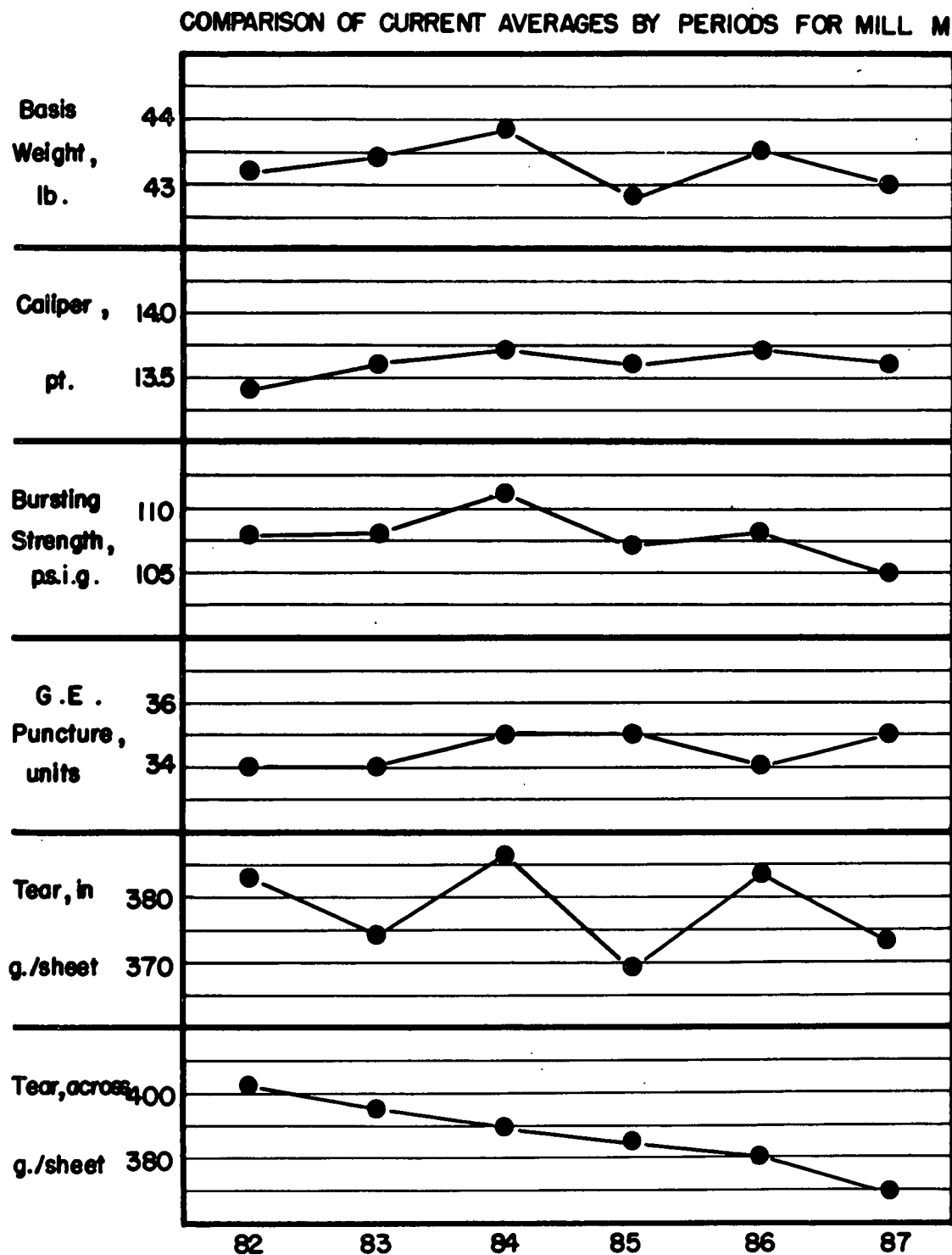


FIGURE 12





PERIOD
FIGURE 14

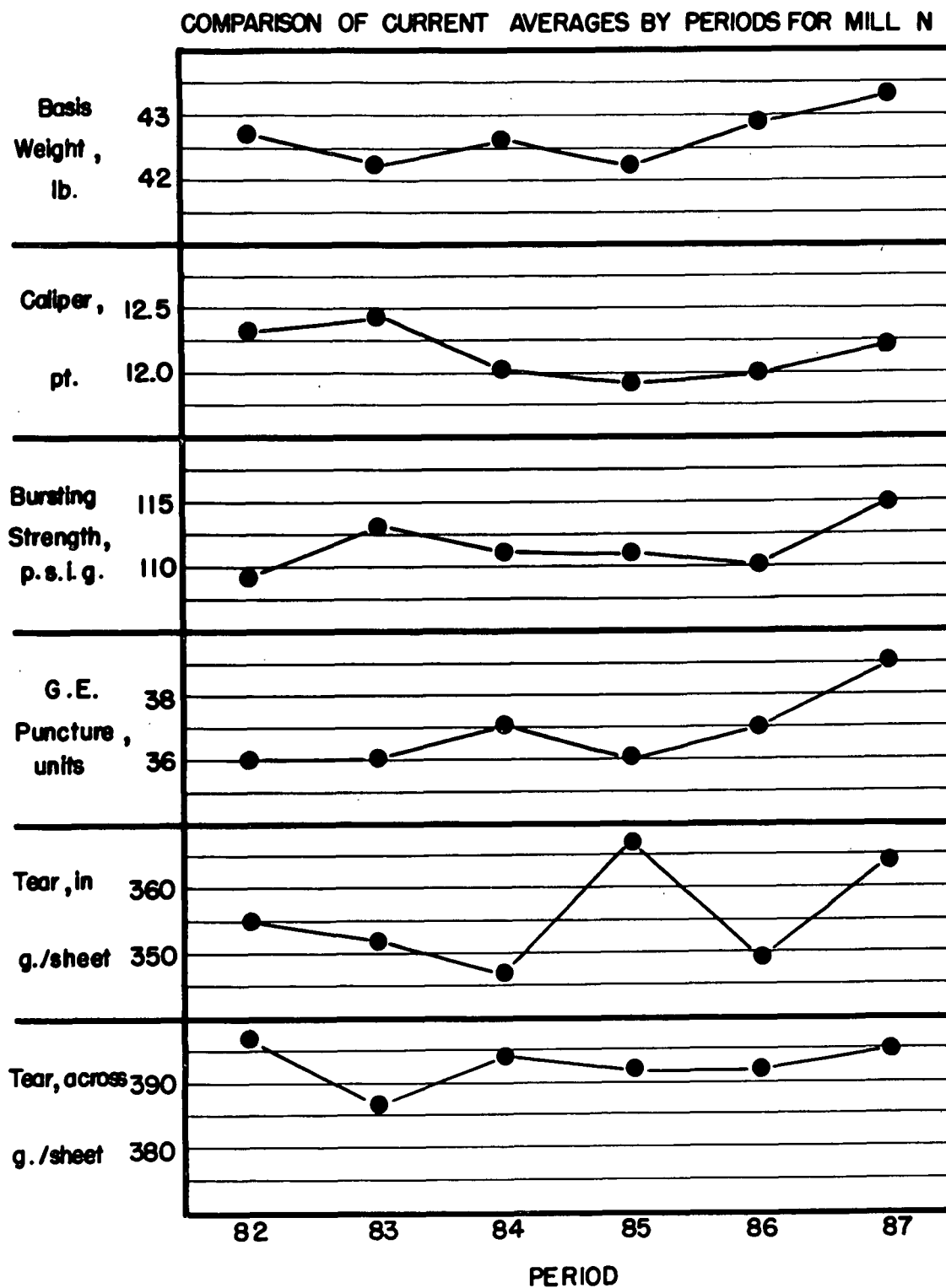


FIGURE 15

basis weight has varied between the 42 and 43-lb. levels; caliper has maintained a low level near 12 points; bursting strength has been relatively constant at a strong level; G. E. puncture has increased whereas the tearing strength results have not changed substantially.

The current mill averages for Mill O are given in Table XVIII and pictorially illustrated in Figure 16 where it may be noted that basis weight has maintained a very low level near 42-lb.; caliper also has been very low varying between 11.9 and 12.7 points; bursting strength has held a strong level, while G. E. puncture and Elmendorf tear have maintained somewhat weaker levels until the current period where greater strength is evident.

The current mill averages (drum linerboard) for Mill E are given in Table XIX and illustrated graphically in Figure 17 where it may be noted that basis weight has decreased somewhat as has caliper. Bursting strength has increased whereas G. E. puncture and Elmendorf tear have decreased.

A composite summary of the current F.K.I. averages from the inception of the Continuous Baseline Study to the present time is given in Table XX. These results are illustrated graphically in Figure 18. It may be noted in Figure 18 that basis weight has remained relatively constant, being near the 43-lb. level at all times. A very definite trend to lower caliper has been evident and, at the present time, caliper values have leveled off at approximately 13 points. Bursting strength values for the eighty-seven periods have exhibited no constant long-range

TABLE XVIII

TABULATION OF CURRENT AVERAGES BY PERIODS FOR MILL O

Period	Basis Weight, lb.	Caliper, points	Bursting Strength, p.s.i.g.	G. E. Puncture, units	Elmendorf Tear, g./sheet	
					In	Across
Average for previous six periods	41.6	12.3	111	34	341	373
82	41.8	12.2	112	35	365	395
83	41.3	12.7	108	33	339	365
84	42.0	12.0	124	32	338	373
85	42.3	12.2	122	34	355	384
86	42.0	11.9	120	31	341	360
87	42.6	11.9	118	36	355	388

TABLE XIX

TABULATION OF CURRENT AVERAGES BY PERIODS FOR MILL E
(Drum Linerboard)

Period	Basis Weight, lb.	Caliper, points	Bursting Strength, p.s.i.g.	G. E. Puncture, units	Elmendorf Tear, g./sheet	
					In	Across
Average for previous six periods	48.0	14.8	102	39	406	408
82	48.5	14.5	104	41	451	425
83	46.6	13.8	106	38	417	403
84	47.0	13.8	104	40	412	398
85	46.4	13.6	104	39	408	396
86	47.4	13.6	107	37	387	382
87	45.6	12.9	114	37	349	353

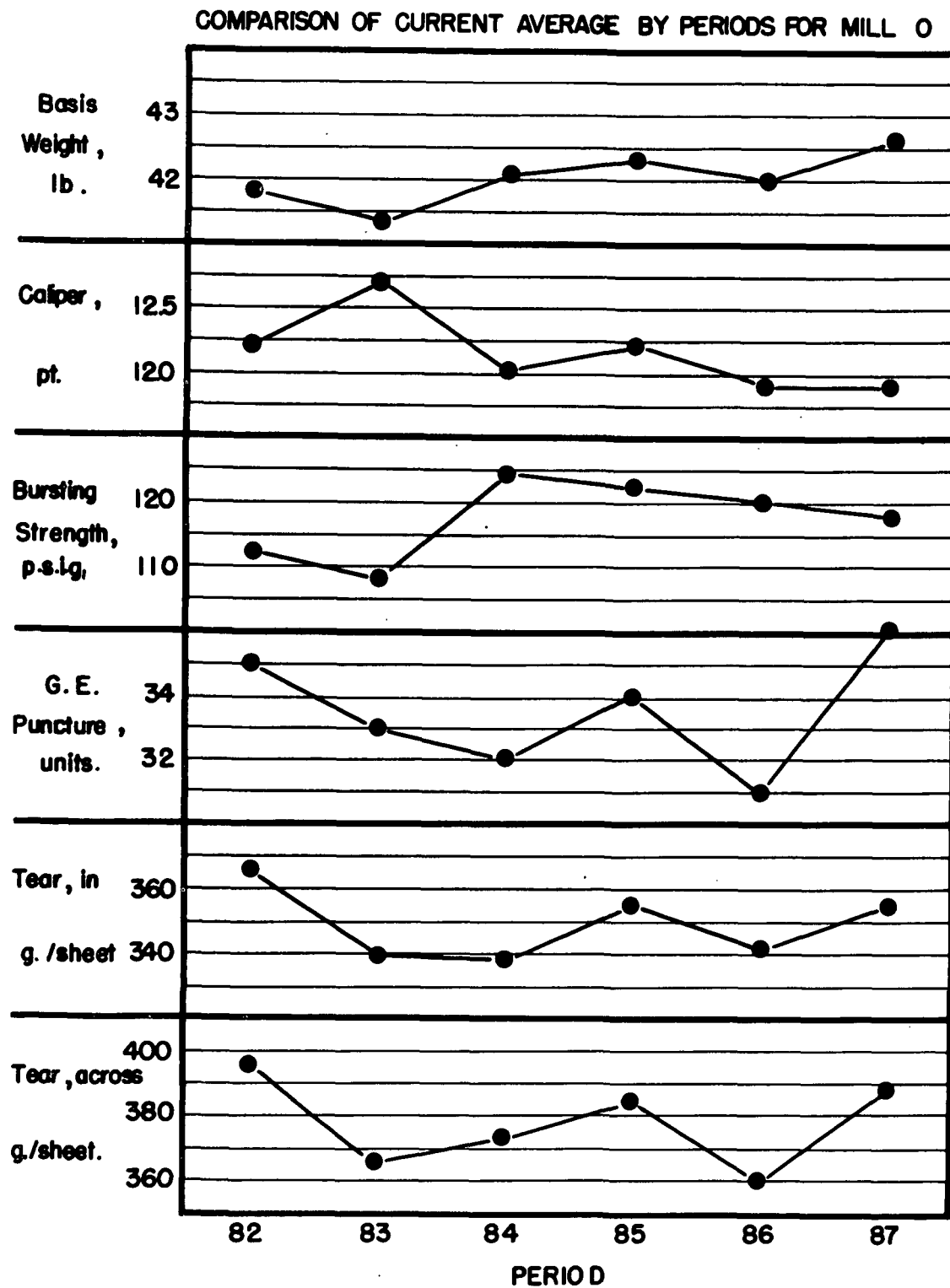


FIGURE 16

COMPARISON OF CURRENT AVERAGES BY PERIODS FOR MILL E
(DRUM LINERBOARD)

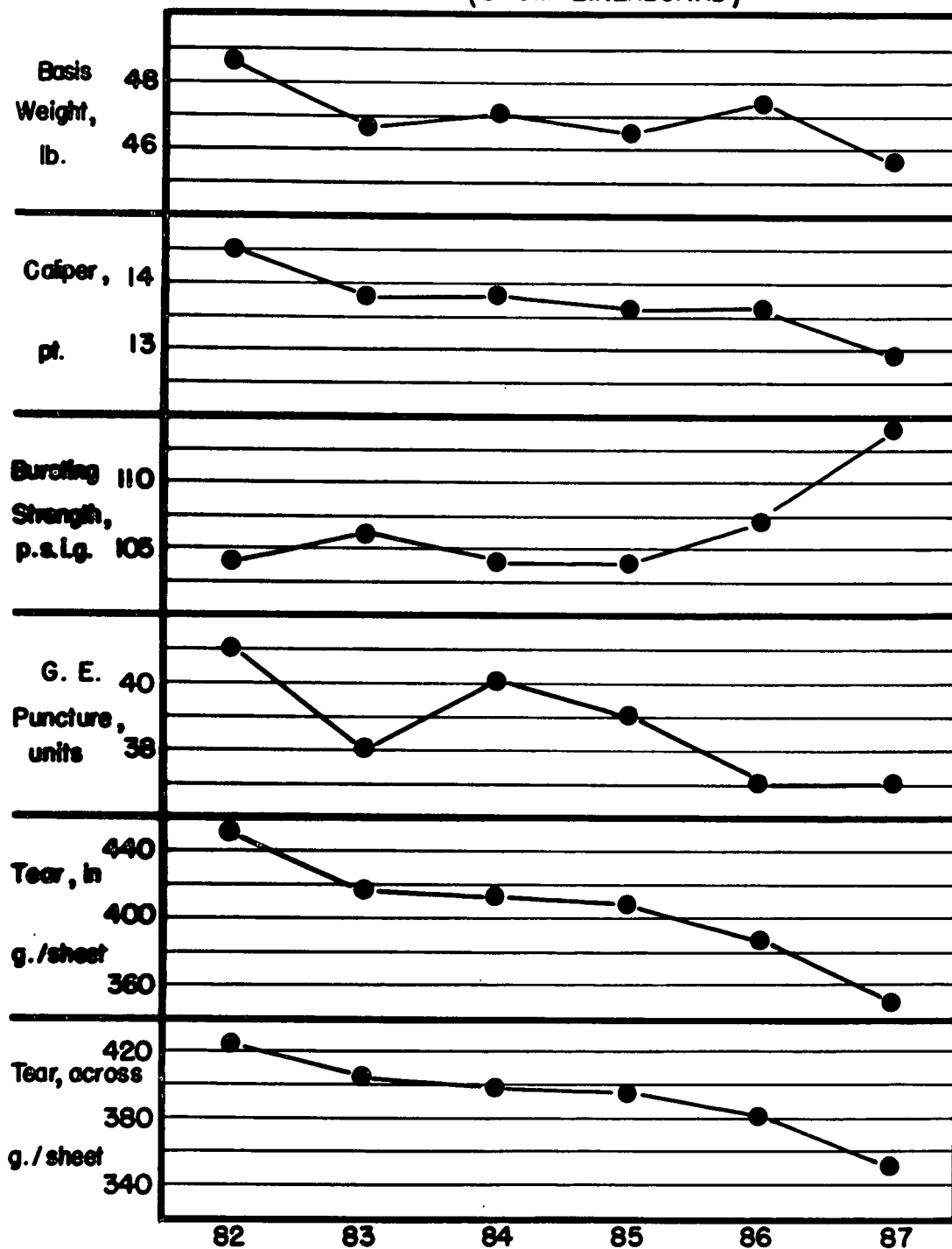


FIGURE 17

TABLE XX

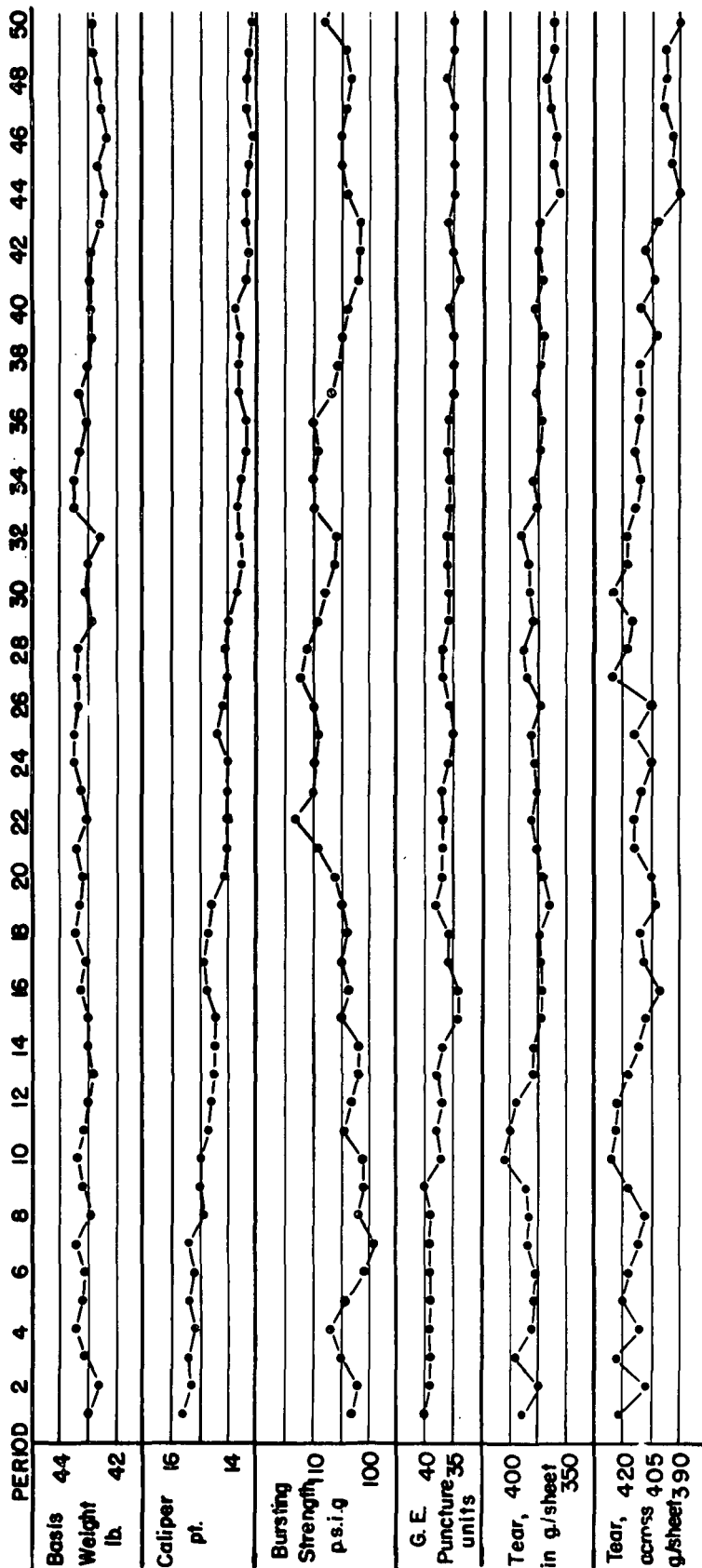
TABULATION OF CURRENT F.K.I. AVERAGES BY PERIODS

Period	Basis Weight, lb.	Caliper, points	Bursting Strength, p.s.i.g.	G. E. Puncture, units	Elmendorf Tear, g./sheet	
					In	Across
1	42.9	15.6	103	40	389	422
2	42.6	15.3	102	39	373	408
3	43.1	15.4	105	39	395	423
4	43.4	15.2	107	39	381	412
5	43.2	15.4	104	39	378	419
6	43.1	15.2	101	39	377	416
7	43.4	15.4	99	39	384	411
8	42.9	14.9	102	39	383	409
9	43.2	15.0	101	40	387	416
10	43.4	15.0	101	37	403	426
11	43.2	14.7	104	38	400	423
12	43.0	14.6	103	37	394	423
13	42.9	14.5	102	38	379	416
14	43.0	14.5	102	37	379	411
15	43.0	14.5	105	34	372	409
16	43.3	14.8	104	34	370	400
17	43.1	14.9	105	36	372	408
18	43.5	14.8	104	36	374	411
19	43.3	14.6	105	38	364	401
20	43.2	14.2	106	37	372	406
21	43.4	14.1	109	37	376	415
22	43.0	14.1	113	37	381	414
23	43.3	14.1	110	37	377	410
24	43.5	14.1	110	36	379	405
25	43.5	14.4	109	35	382	414
26	43.4	14.2	110	36	374	404
27	43.4	14.0	112	37	385	425
28	43.4	14.1	111	37	388	417
29	42.9	14.0	109	36	379	415
30	43.1	13.7	108	36	383	425
31	43.0	13.6	106	36	384	418
32	42.6	13.6	106	36	390	418
33	43.6	13.7	110	36	376	413
34	43.5	13.5	110	36	379	410
35	43.3	13.4	109	36	374	414
36	43.2	13.4	110	36	372	411
37	43.3	13.7	107	35	379	412
38	43.0	13.7	106	35	372	411
39	42.9	13.6	105	35	369	402
40	42.9	13.8	104	36	379	412
41	42.9	13.4	102	34	371	403
42	42.9	13.3	102	35	374	408
43	42.6	13.4	102	36	373	401
44	42.5	13.4	104	35	357	390
45	42.7	13.3	105	35	362	395

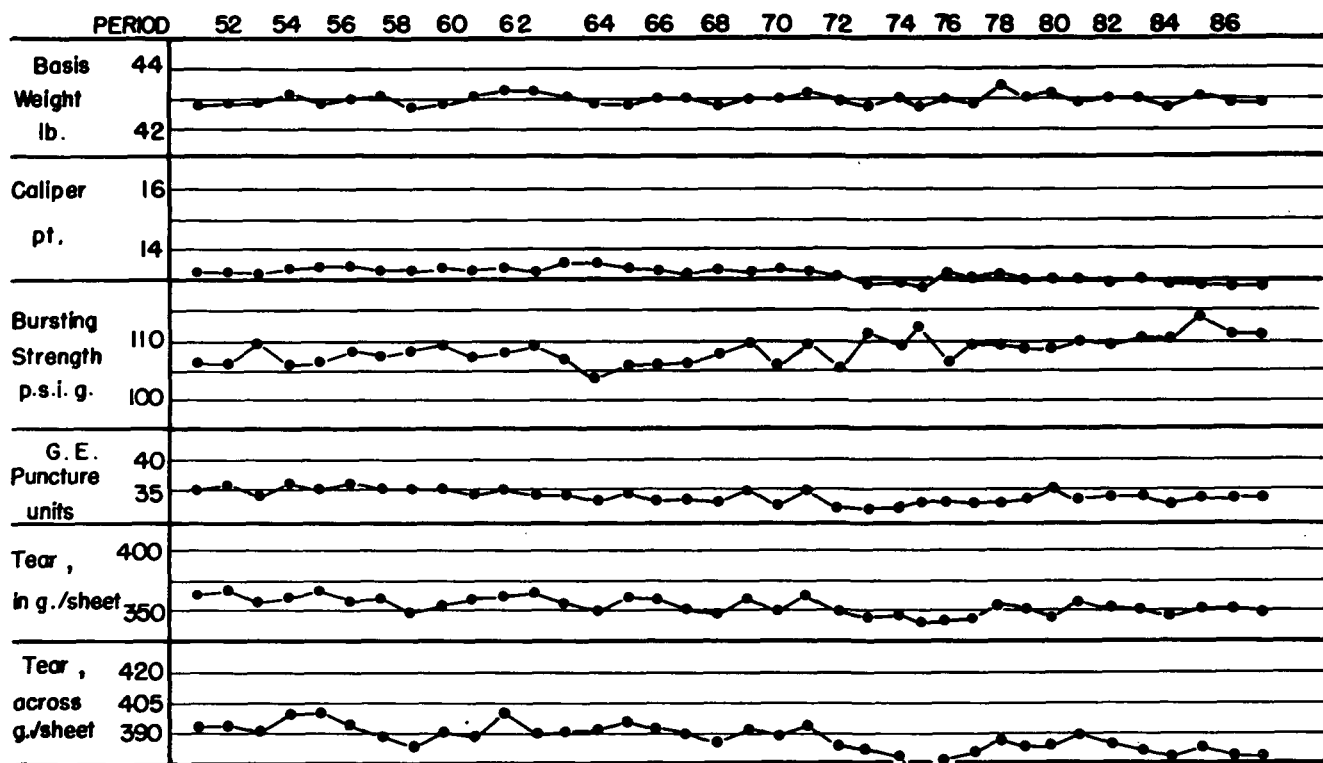
TABLE XX (Cont.)

TABULATION OF CURRENT F.K.I. AVERAGES BY PERIODS

Period	Basis Weight, lb.	Caliper, points	Bursting Strength, p.s.i. g.	G. E. Puncture, units	Elmendorf Tear, g./sheet	
					In	Across
46	42.4	13.2	105	35	359	393
47	42.6	13.4	104	35	365	399
48	42.6	13.3	103	36	367	397
49	42.8	13.3	104	35	362	397
50	42.9	13.2	108	35	362	389
51	42.8	13.3	106	35	363	393
52	42.9	13.2	106	36	367	395
53	42.9	13.2	109	34	357	391
54	43.2	13.4	106	36	362	398
55	42.9	13.4	106	35	365	398
56	43.0	13.4	108	36	358	394
57	43.1	13.3	107	35	359	388
58	42.7	13.3	108	35	348	382
59	42.9	13.4	109	35	354	390
60	43.1	13.3	107	34	360	388
61	43.3	13.4	108	35	363	400
62	43.2	13.3	109	34	364	390
63	43.1	13.5	107	34	356	390
64	42.9	13.5	107	34	353	391
65	42.9	13.4	108	35	364	400
66	43.0	13.2	108	34	360	394
67	43.0	13.1	108	34	353	390
68	42.9	13.3	109	34	350	388
69	43.0	13.2	110	35	363	397
70	43.0	13.4	108	34	358	390
71	43.2	13.4	110	35	364	399
72	43.0	13.1	108	33	351	387
73	42.9	12.9	111	33	349	385
74	43.1	13.0	110	33	347	382
75	42.7	12.8	112	33	341	374
76	43.0	13.2	107	33	342	375
77	42.9	13.0	109	33	347	380
78	43.4	13.1	109	33	353	387
79	43.0	13.0	108	34	351	384
80	43.1	13.0	108	35	348	384
81	42.9	13.0	110	34	356	389
82	43.0	12.9	109	34	354	383
83	43.0	13.1	111	34	351	381
84	42.7	12.9	111	33	344	377
85	43.1	12.9	114	34	352	383
86	42.9	12.8	112	34	351	378
87	42.9	12.8	112	34	347	379



COMPARISON OF CURRENT F.K.I. AVERAGES BY PERIODS
FIGURE 18



COMPARISON OF CURRENT F.K.I. AVERAGES BY PERIODS
FIGURE 18 CONTINUED

trend. During the first thirty-six periods, bursting strength showed an upward trend; then, to period forty-three, a downward trend. Since then, bursting strength has maintained a high level. G. E. puncture values have exhibited a gradual decline throughout the eighty-seven periods as have the machine and cross-machine direction tearing strength values. Thus, briefly summarized, the trends for the eighty-seven periods have been the following:

1. Weight has remained relatively constant at approximately 43 lb.
2. Caliper has decreased from a high level of nearly 16 points and levelled off at approximately 13 points.
3. Bursting strength has exhibited upward and downward trends, and is currently maintaining a high level near 112 points.
4. G. E. puncture has gradually declined from a high of 40 units for the first period to a low of 34 units at the present time.
5. Machine direction tearing strength has declined from 400 units at the start of the program to about 350 units currently.
6. Cross-machine direction tearing strength has slowly declined from a high value of more than 420 units at the inception of the study to approximately 380 units at the present time.

