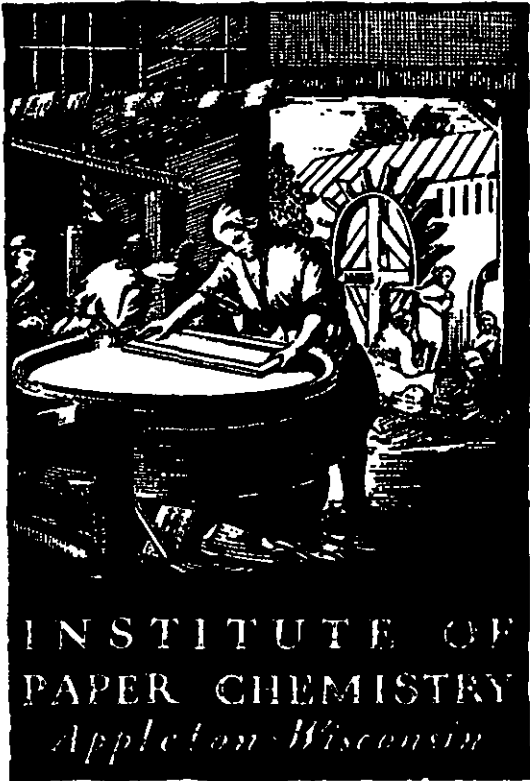


Institute of Paper Science and Technology  
Central Files



CONTINUOUS BASE LINE STUDY  
✓ Project 1108-B  
Progress Report Five  
to  
FOURDRINIER KRAFT BOARD INSTITUTE  
December 1, 1947

THE INSTITUTE OF PAPER CHEMISTRY

APPLETON, WISCONSIN

CONTINUOUS BASE LINE STUDY

Project 1108-B

Progress Report 5

to

FOURDRINIER KRAFT BOARD INSTITUTE

December 1, 1947

---

THE INSTITUTE OF PAPER CHEMISTRY

APPLETON, WISCONSIN

In conjunction with the F.K.I. Continuous Baseline Study, fifty-four different sample lots of 42-lb. Fourdrinier kraft linerboard were submitted by nine different F.K.I. mills to The Institute of Paper Chemistry for testing during the period November 1 through November 30. In addition to the 42-lb. kraft linerboard, three samples of special drum stock were also submitted for evaluation. The results on the special stock are reported separately in this report. A tabulation of the number of samples classified according to mill may be seen in Table I.

TABLE I

DISTRIBUTION OF 42-lb. LINERBOARD SAMPLES

Mill Code	Samples Submitted
A	8
B	12
C	4
D	5
E	1
F	6
G	8
H	5
J	5
	<hr/>
	54

The above sample lots were tested for basis weight, caliper, bursting strength, G. E. puncture, and Elmendorf tear. A comparison

---

of the average strength results for each mill may be seen in Table II and graphically presented in Figures 1 to 6, inclusive. In addition to a comparison of the mill averages, Table II also shows the cumulative F.K.I. averages as well as the F.K.I. index. The cumulative F.K.I. averages include all the results up to but not including the current period; the current period in the case of this report is November 1 through November 30. The F.K.I. index is obtained as follows:

$$\frac{\text{current F.K.I. average}}{\text{cumulative F.K.I. average}} \times 100 = \text{F.K.I. index (\%)}$$

The F.K.I. index furnishes a ready means of comparing the current quality with previous results. For example, the current F.K.I. average basis weight is 43.2 lb. and the cumulative F.K.I. average basis weight is 43.0. Determining the index in per cent as indicated above, the resulting index for basis weight is 100.5%. This signifies that the current average basis weight is approximately 0.5% higher than the cumulative average which, in this case, covered the period July 25 up to November 1.

A comparison of the results in Table II and Figure 1 shows that the average basis weight for all mills was above the 42-lb. specification set forth in Rule 41. Mill E had the highest average basis weight, it being approximately 4.8% higher than the specified 42-lb. The amount by which the mills exceeded the 42-lb. specification is as follows:

Mill Code	Per cent
A	0.7
B	2.4
C	1.4
D	4.3
E	4.8
F	3.6
G	2.4
H	3.8
J	2.6

A comparison of the average basis weight data for the previous period with the current F.K.I. average indicates that, the basis weight has remained approximately the same.

A comparison of the average calipers for the various mills (see Figure 2) shows that the mill averages varied from a low of 14.2 for Mill A to 17.2 for Mill E, the average being 15.4.

The average bursting strength values obtained for each mill are graphically shown in Figure 3. It may be observed that the average bursting strength for the various mills ranged from a low of 99 for Mill D to a high of 110 for Mill J. The current F.K.I. average bursting strength was the same as the cumulative average.

The data of Table II and Figure 4 show that the average G. E. puncture for all mills was 39 units, with Mill E having the highest

---

TABLE II

SUMMARY OF COMPOSITE MILL AVERAGES--NOVEMBER 1 THROUGH NOVEMBER 30, 1947

Code No.	Basis Weight lb.	Caliper, points	Bursting Strength, points	G. E Puncture, units	In Direction	Elmendorf Tear, g /sheet	Across Direction
A	42.3	14.2	100	39	379	419	
B	43.0	15.2	102	36	367	395	
C	42.6	14.0	107	39	362	400	
D	43.8	17.0	99	39	396	441	
E	44.0	17.2	101	42	405	463	
F	43.5	15.2	108	41	378	443	
G	43.0	15.3	107	39	373	411	
H	43.6	15.2	104	39	391	411	
J	43.1	14.9	110	35	351	390	
Current FKI Average:	43.2	15.4	104	39	378	419	
Cumulative FKI Average:	43.0	15.4	104	39	384	416	
FKI Index, %	100.5	100.0	100.0	100.0	98.4	100.7	

and Mill J the lowest. In connection with Mill J, it may be observed that this mill had the lowest G. E. puncture during the last period.

A graphic comparison of the Elmendorf tear results for the various mills is given in Figures 5 and 6. The results indicate that the current F.K.I. machine direction tear results were approximately 1.6% lower than the cumulative average. Similarly, the across-machine tear index was approximately 0.7% higher

A comparison of the F.K.I. indexes indicates that, for the current period, basis weight, caliper, bursting strength, G. E. puncture and across-direction tear were approximately the same as the cumulative averages. The machine direction tear was slightly lower than the cumulative period.

In order to compare the variation within a given mill, the test results for each particular mill have been tabulated in Tables III to XI for Mills A to J, respectively. In addition to the current averages, cumulative averages for each mill, together with the mill factor and the mill index, are given for each mill. The cumulative mill average is the average test results obtained on the samples submitted by the particular mill up to but not including the current averages. The mill factor and the mill index are obtained as follows:

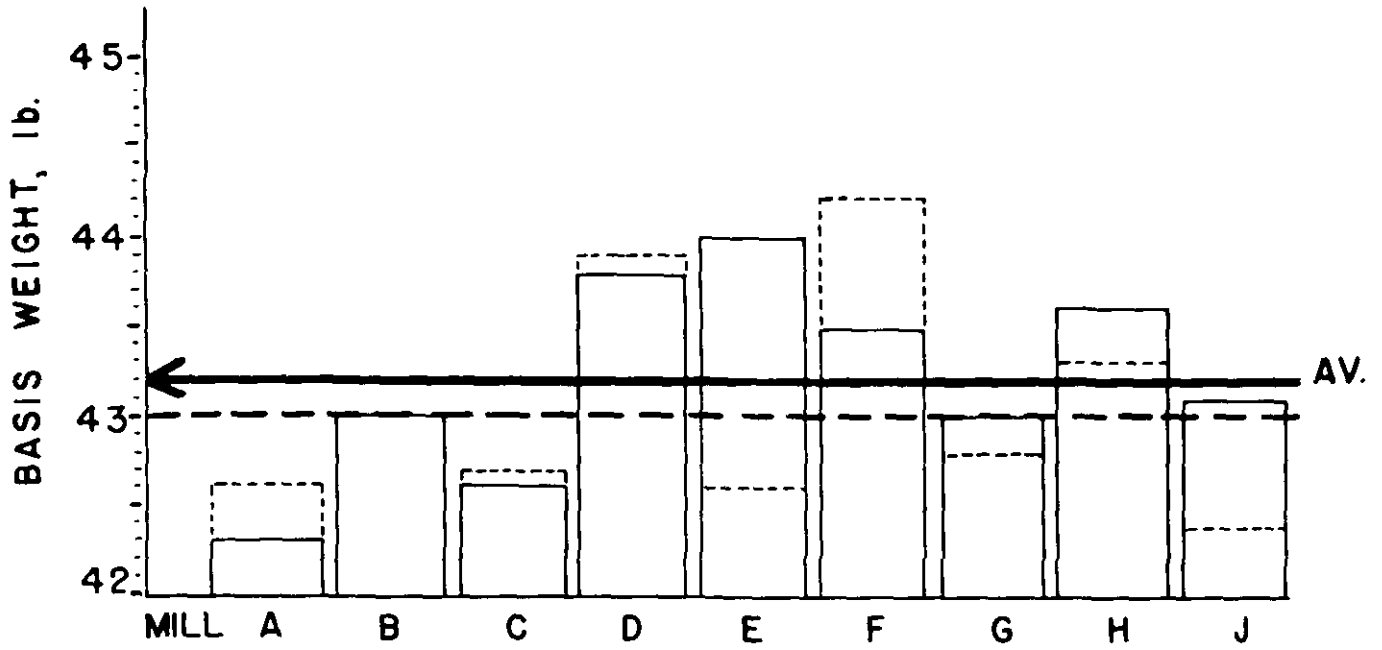
$$\frac{\text{current mill average}}{\text{cumulative mill average}} \times 100 = \text{mill factor (\%)}$$

$$\frac{\text{current mill average}}{\text{cumulative F.K.I. average}} \times 100 = \text{mill index (\%)}$$

The mill factor and the mill index serve as a ready means for comparing the current mill results with either the previous result for that particular mill or with the cumulative F.K.I. results. As more samples are included and as the test data accumulate, the factors and indexes will have added significance. Starting with the report for December, the reports will contain a comparison of the test data obtained at both the mills and at Appleton.

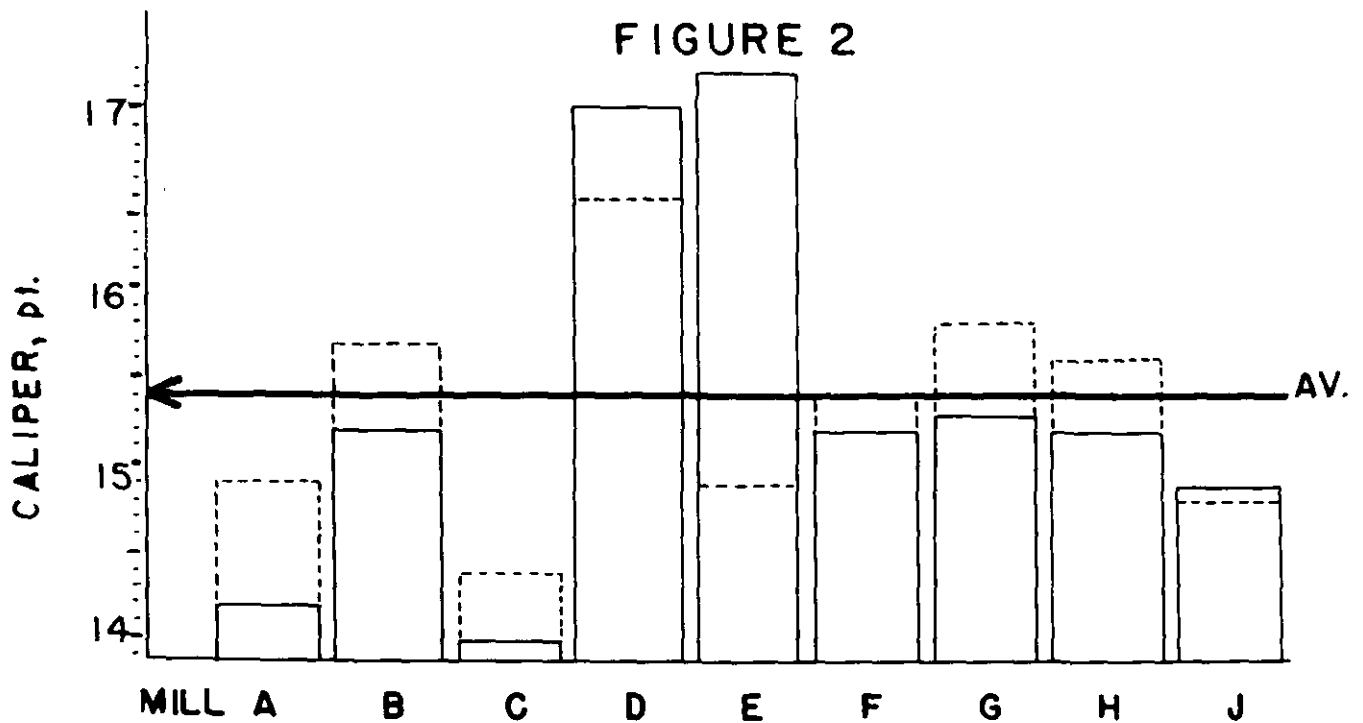
The results obtained on the special drum stock may be seen in Table XII.

FIGURE 1



COMPARISON OF BASIS WEIGHT RESULTS  
(PERIOD NOV. 1 - NOV. 30)

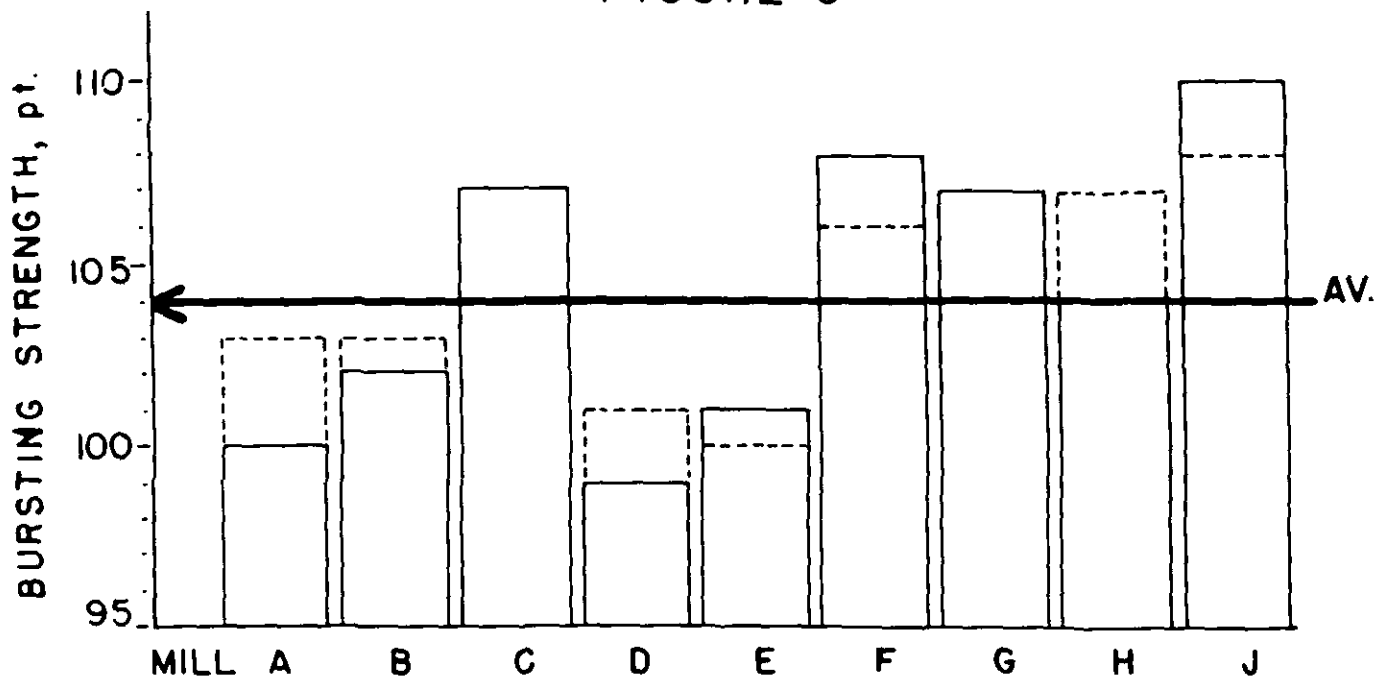
FIGURE 2



COMPARISON OF CALIPER RESULTS  
(PERIOD NOV. 1 - NOV. 30)

— CURRENT MILL AVERAGE  
- - - CUMULATIVE MILL AVERAGE

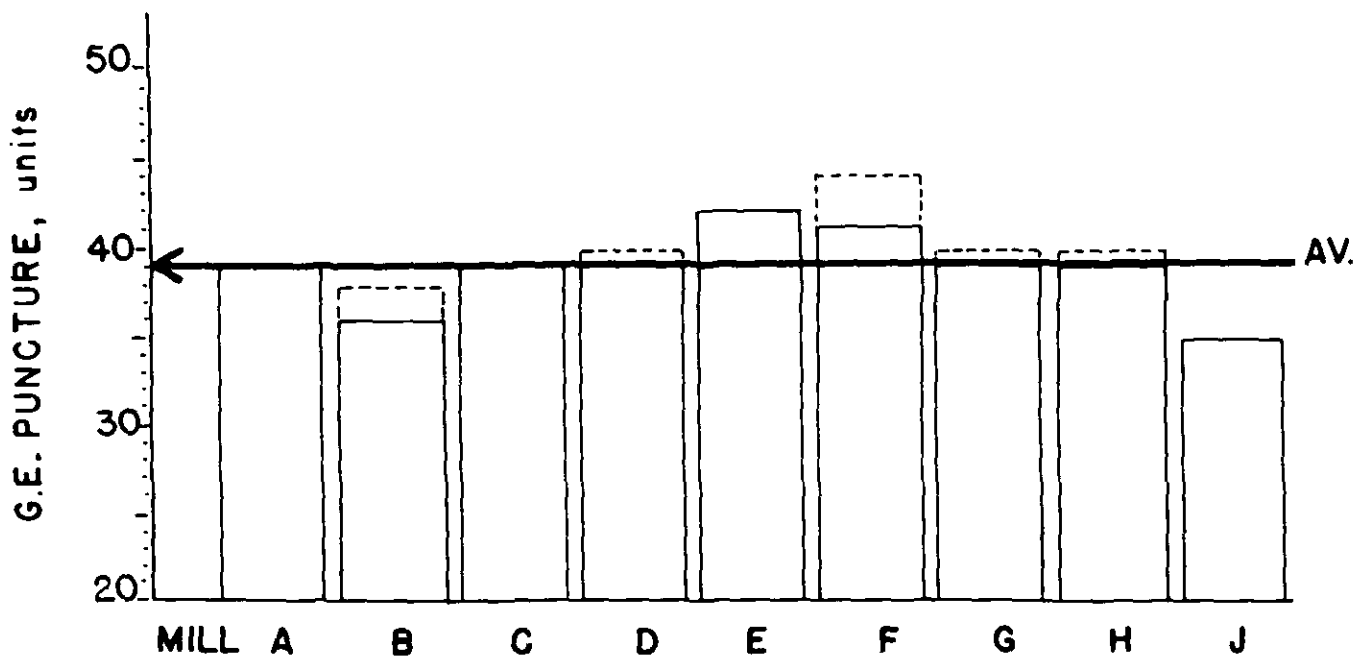
FIGURE 3



COMPARISON OF BURSTING STRENGTH RESULTS

(PERIOD NOV. 1 - NOV. 30)

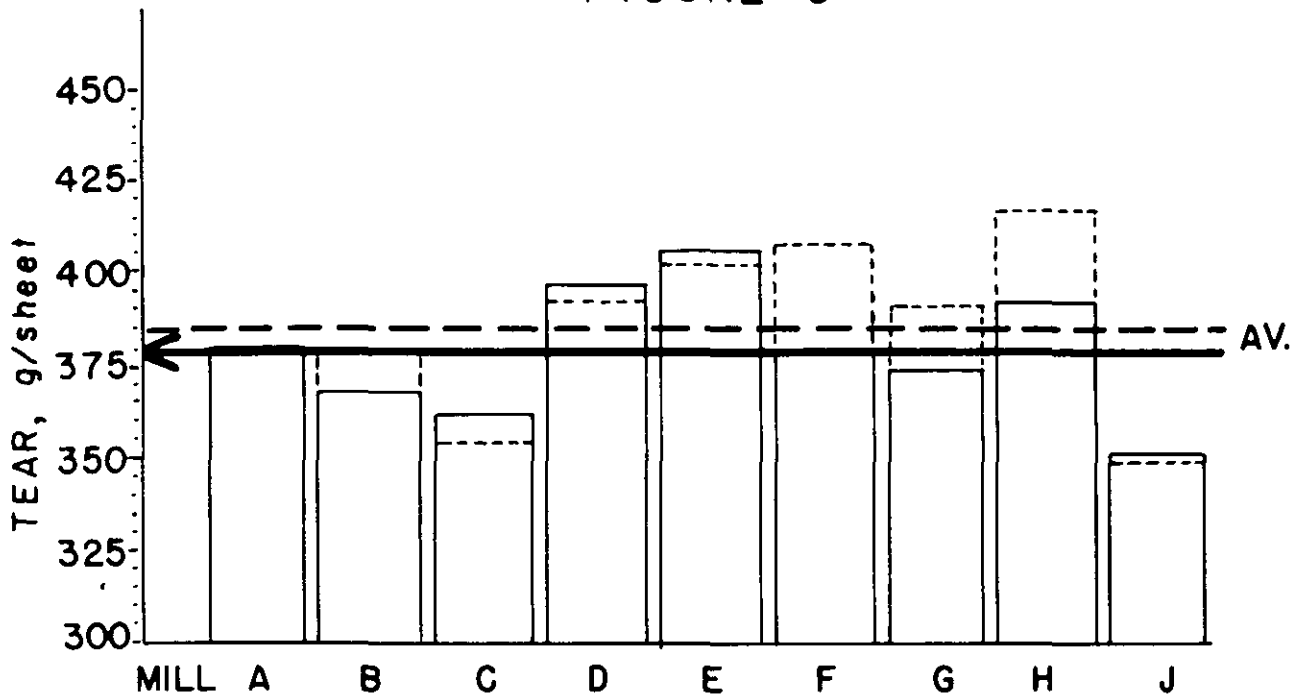
FIGURE 4



COMPARISON OF G.E. PUNCTURE RESULTS

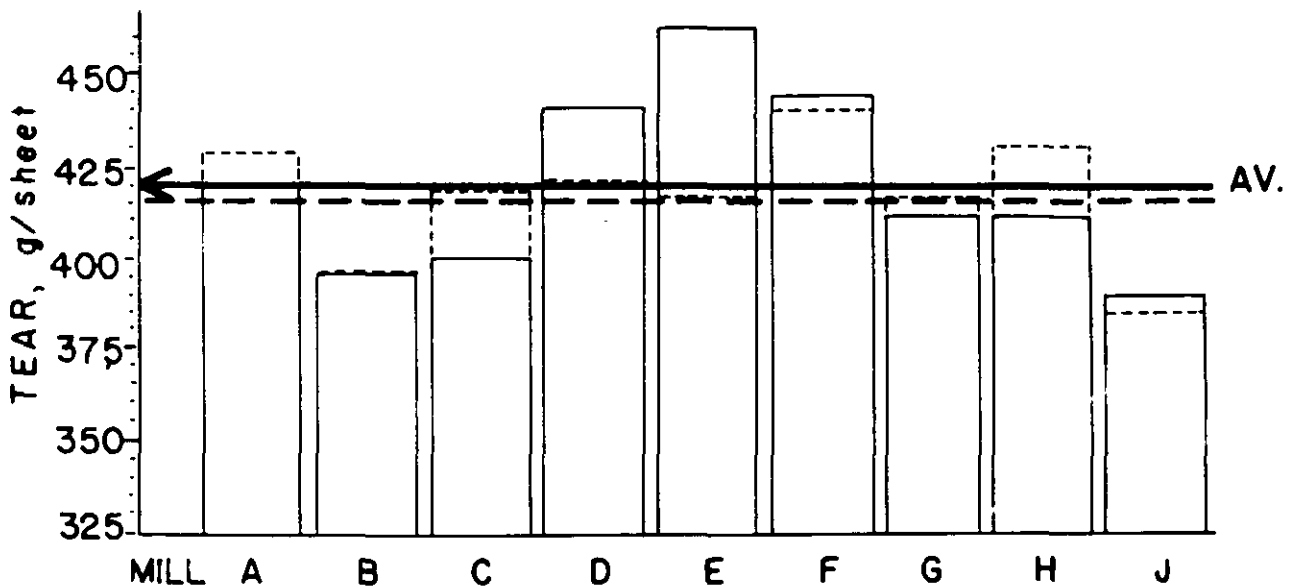
(PERIOD NOV. 1 - NOV. 30)

FIGURE 5



COMPARISON OF TEAR RESULTS, machine direction  
(PERIOD NOV. 1 - NOV. 30)

FIGURE 6



COMPARISON OF TEAR RESULTS, across machine direction  
(PERIOD NOV. 1 - NOV. 30)

TABLE III  
SUMMARY OF INDIVIDUAL TEST LOTS--NOVEMBER 1 THROUGH NOVEMBER 30, 1947

File No.	Date Recd.	Date Made	Mch.	Basis Weight, lb.		Caliper, points		Bursting Strength, points		G. E. Puncture, units		Elmendorf Tear, g./sheet									
				No.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.					
<u>Mill A -- 42-lb. Liner Board</u>																					
129199	11/ 6/47	11/ 3/47	1	43.8	41.8	42.5	15.2	13.7	14.6	123	79	102	42	36	39	448	320	375	452	368	414
129200	11/ 6/47	11/ 3/47	2	44.2	41.6	43.2	15.1	13.9	14.4	120	81	100	38	32	36	464	344	377	456	320	391
129226	11/12/47	11/10/47	1	43.6	40.6	42.1	15.5	13.0	14.2	107	77	94	43	37	41	400	320	371	488	352	411
129231	11/13/47	11/11/47	1	43.8	40.4	42.0	16.4	13.0	14.0	116	79	97	42	34	37	428	333	379	476	362	417
129290	11/20/47	11/17/47	2	44.0	42.0	43.1	15.2	13.0	14.2	130	75	100	46	40	42	440	320	378	480	368	440
129291	11/20/47	11/18/47	2	42.0	41.0	41.6	15.0	13.0	13.9	112	82	97	41	36	39	472	344	381	480	352	429
129366	11/28/47	11/26/47	1	44.0	41.8	42.8	15.0	13.1	14.0	127	82	103	42	37	39	452	368	399	440	384	421
129370	11/28/47	11/25/47	1	42.4	40.0	41.5	14.9	13.0	14.0	139	95	109	40	36	37	408	328	370	480	400	434
Current Mill Average:				42.3		42.3	14.2		14.2	100		100	39		39	379		379	419		419
Cumulative Mill Average:				42.6		42.6	14.9		14.9	103		103	39		39	380		380	428		428
Mill Factor, %				99.3		99.3	95.3		95.3	97.1		97.1	100.0		100.0	99.7		99.7	97.9		97.9
Mill Index, %				98.4		98.4	92.2		92.2	96.2		96.2	100.0		100.0	98.7		98.7	100.7		100.7

TABLE IV  
SUMMARY OF INDIVIDUAL TEST LOTS--NOVEMBER 1 THROUGH NOVEMBER 30, 1947 (continued)

File No.	Date Recd.	Date Made	Mch. No.	Basis Weight, lb.		Caliper, points		Bursting Strength, points		G. E. Puncture, units		Elmendorf Tear, g./sheet									
				Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.						
<u>Mill B -- 42-lb. Liner Board</u>																					
129195	11/5/47	10/26/47	3	43.8	41.2	42.2	15.8	13.7	14.5	116	90	106	40	34	37	424	320	369	456	336	403
129196	11/5/47	11/1/47	1	44.8	42.0	43.6	17.7	15.0	16.5	119	78	104	42	37	40	440	352	399	520	360	424
129204	11/7/47	11/5/47	3	44.2	42.0	43.2	15.8	14.2	15.1	120	89	106	40	34	38	384	320	362	416	352	390
129205	11/7/47	11/5/47	1	45.8	41.8	43.0	16.9	15.1	16.3	124	92	103	43	35	39	416	320	370	464	320	392
129209	11/8/47	11/3/47	1	43.0	40.0	41.9	16.7	15.0	15.8	117	80	101	40	36	38	376	320	351	480	360	395
129210	11/8/47	11/3/47	3	43.6	41.0	42.1	15.0	13.5	14.2	120	90	106	40	35	37	396	324	364	464	384	416
129277	11/19/47	11/11/47	1	45.8	42.0	43.8	17.5	14.8	16.0	125	87	102	38	32	35	440	344	381	448	368	407
129278	11/19/47	11/13/47	3	45.0	42.0	43.7	15.6	14.2	14.7	122	80	101	37	32	35	420	336	374	424	352	393
129326	11/22/47	11/14/47	3	43.6	40.2	42.0	15.0	13.6	14.5	107	79	96	39	33	35	440	336	379	448	344	382
129329	11/24/47	11/20/47	3	44.2	42.2	43.3	14.8	13.3	14.2	118	83	104	33	29	31	376	312	335	400	344	373
129330	11/24/47	11/21/47	3	45.0	42.0	43.4	15.0	13.3	14.1	117	92	104	35	29	32	376	328	344	388	344	370
129354	11/26/47	11/21/47	1	45.8	42.0	43.8	17.6	16.0	16.9	117	77	97	40	33	36	408	336	371	440	344	391
Current Mill Average:				43.0		43.0	15.2		15.2	102		102	36		36	367		367	395		395
Cumulative Mill Average:				43.0		43.0	15.7		15.7	103		103	38		38	378		378	396		396
Mill Factor, %				100.0		100.0	96.8		96.8	99.0		99.0	94.7		94.7	97.1		97.1	99.7		99.7
Mill Index, %				100.0		100.0	98.7		98.7	98.1		98.1	92.3		92.3	95.6		95.6	95.0		95.0

TABLE V  
SUMMARY OF INDIVIDUAL TEST LOTS--NOVEMBER 1 THROUGH NOVEMBER 30, 1947 (continued)

File No.	Date Recd.	Date Made	Mch. No.	Basis Weight, lb.		Caliper, points		Bursting Strength, points		G. E. Puncture, units		Elmendorf Tear, g./sheet										
				Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.							
129191	11/4/47			44.8	42.0	43.0	14.8	12.7	14.0	133	88	108	44	37	40	412	336	366	448	352	409	
129221	11/10/47			44.0	42.0	42.6	14.7	13.0	14.0	140	87	111	44	36	40	392	320	358	400	328	363	
129242	11/17/47			43.8	41.8	42.4	14.6	12.1	13.6	131	91	106	41	34	37	464	312	373	488	376	418	
129327	11/22/47			43.6	42.0	42.5	15.1	13.0	14.4	121	80	104	40	35	38	392	328	351	464	376	409	
Current Mill Average:				42.6			14.0			107			39			362			400			
Cumulative Mill Average:				42.7			14.4			107			39			353			418			
Mill Factor, %				99.8			97.2			100.0			100.0			102.5			95.7			
Mill Index, %				99.1			90.9			102.9			100.0			94.3			96.2			

Mill C -- 42-lb. Liner Board

TABLE VI

Mill D -- 42-lb. Liner Board

129230	11/13/47	11/11/47	4	44.2	43.4	43.8	18.0	16.5	17.2	120	89	107	43	36	39	472	352	417	496	400	450	
129240	11/17/47	11/13/47	4	44.2	42.0	43.0	17.5	15.4	16.6	118	83	99	43	36	39	448	320	388	472	392	422	
129325	11/22/47	11/19/47	4	45.6	42.6	44.1	18.2	16.1	17.2	112	72	92	42	36	39	488	352	399	496	360	446	
129333	11/24/47	11/21/47	4	46.0	43.0	44.6	19.0	16.0	17.3	115	83	96	43	35	39	440	320	385	528	376	455	
129369	11/28/47	11/25/47	4	44.4	42.4	43.4	17.4	16.0	16.6	111	75	100	43	38	40	440	352	389	488	376	434	
Current Mill Average:				43.8			17.0			99			39			396			441			
Cumulative Mill Average:				43.9			16.6			101			40			392			421			
Mill Factor, %				99.8			102.4			98.0			97.5			101.0			104.8			
Mill Index, %				101.9			110.4			95.2			100.0			103.1			106.0			

**TABLE VII**  
**SUMMARY OF INDIVIDUAL TEST LOTS--NOVEMBER 1 THROUGH NOVEMBER 30, 1947 (continued)**

File No.	Date Recd.	Date Made	Mch. No.	Basis Weight, lb.		Caliper, points	Bursting Strength, points		G. E. Puncture, units	Elmendorf Tear, g./sheet											
				Max	Min.		Max	Min.		In	Across										
129367	11/28/47	11/26/47		44.8	43.2	44.0	17.9	16.2	17.2	127	82	101	45	40	42	440	352	405	520	384	463
Current Mill Average:				44.0		44.0	17.2		17.2	101		101	42		42	405		402	415		463
Cumulative Mill Average:				42.6		42.6	14.9		14.9	100		100	39		39	402		402	415		463
Mill Factor, %				103.3		103.3	115.4		115.4	101.0		101.0	107.7		107.7	100.7		100.7	111.6		111.6
Mill Index, %				102.3		102.3	111.7		111.7	97.1		97.1	107.7		107.7	105.5		105.5	111.3		111.3

Mill E -- 42-lb. Liner Board

**TABLE VIII**

Mill F -- 42-lb. Liner Board

129194	11/5/47	46.0	44.0	45.1	17.4	15.6	16.5	127	92	109	49	42	46	448	360	399	536	392	453	
129208	11/8/47	44.2	42.2	43.4	16.3	14.9	15.6	121	85	106	46	40	43	448	360	392	520	408	453	
129236	11/15/47	43.8	40.0	42.4	14.6	12.5	13.7	134	98	114	39	33	36	396	324	362	424	376	399	
129238	11/17/47	44.6	42.4	43.8	15.9	14.5	15.2	118	88	107	46	41	43	504	328	380	640	416	495	
129315	11/21/47	44.0	42.4	43.3	15.0	13.1	14.4	122	79	108	41	36	39	416	320	363	456	360	401	
129331	11/24/47	44.0	41.8	42.9	16.8	14.6	15.9	117	84	106	42	34	39	448	336	371	512	408	458	
Current Mill Average:				43.5		43.5	15.2		15.2	108		108	41		378		378	443		443
Cumulative Mill Average:				44.2		44.2	15.4		15.4	106		106	44		406		406	441		441
Mill Factor, %				98.4		98.4	98.7		98.7	101.9		101.9	93.2		93.2		93.2	100.5		100.5
Mill Index, %				101.2		101.2	98.7		98.7	103.8		103.8	105.1		105.1		105.1	106.5		106.5

TABLE IX

SUMMARY OF INDIVIDUAL TEST LOTS - NOVEMBER 1 THROUGH NOVEMBER 30, 1947 (continued)

File No.	Date Recd.	Date Made	Mch. No.	Basis Weight, lb.		Caliper, points		Bursting Strength, points		G. E. Elmendorf Tear, g./sheet		Across									
				Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	In	Av.	Max.	Min.						
Mill G -- 42-lb. Liner Board																					
129197	11/ 5/47	10/30/47		44.2	42.6	43.5	14.4	13.0	13.8	128	91	112	40	35	38	412	348	372	448	384	411
129198	11/ 5/47	10/31/47		44.0	42.6	43.4	15.0	12.0	14.0	136	77	108	42	38	40	432	320	357	464	344	395
129207	11/ 7/47	11/ 5/47		43.4	42.0	42.7	16.7	15.0	15.8	129	90	112	45	39	41	480	336	391	488	352	418
129228	11/12/47	11/ 8/47		43.8	41.6	42.6	15.6	14.0	14.9	126	86	112	41	36	39	424	336	331	426	358	401
129237	11/15/47	11/13/47		44.2	42.2	43.0	16.9	15.2	16.2	118	90	102	40	35	38	400	328	352	504	368	409
129241	11/17/47	11/14/47		43.8	42.2	42.6	16.8	15.5	16.1	115	82	101	41	35	38	408	328	357	512	376	423
129332	11/24/47	11/21/47		43.6	41.8	42.7	16.7	15.2	15.8	115	84	104	41	35	37	392	320	338	456	352	408
129355	11/26/47	11/22/47		44.6	42.0	43.7	16.5	14.3	15.6	123	90	106	41	36	38	408	344	379	456	384	420

Current Mill Average: 43.0 15.3 107 39 373 411

Cumulative Mill Average: 42.8 15.8 104 40 339 416

Mill Factor, % 100.5 96.8 102.9 97.5 95.9 988

Mill Index, % 100.0 99.4 102.9 100.0 97.1 98.8

TABLE I  
SUMMARY OF INDIVIDUAL TEST LOTS- NOVEMBER 1 THROUGH NOVEMBER 30, 1947 (continued)

File No.	Date Recd.	Date Made	Mch.	Basis Weight, lb.		Caliper, points		Bursting Strength, points		G. E. Puncture, units		Elmendorf Tear, g /sheet											
				Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	In	Across										
129190	11/ 4/47	10/27/47	2	43.6	40.8	42.0	15.8	14.6	15.4	121	88	105	42	36	38	432	352	383	488	352	398		
129227	11/12/47	11/ 5/47	2	46.2	43.6	45.0	16.1	14.3	15.1	132	82	107	45	37	41	472	368	423	472	384	427		
129234	11/15/47	11/10/47	2	45.8	42.2	44.2	16.2	14.9	15.6	119	71	99	41	36	38	440	368	407	440	368	417		
129239	11/17/47	11/11/47	2	44.2	41.8	42.8	16.2	14.4	15.3	112	71	99	38	34	36	368	320	339	464	352	410		
129368	11/28/47	11/24/47	2	45.6	42.0	44.0	16.1	14.2	14.8	127	79	110	43	36	40	464	336	404	480	352	401		
Current Mill Average:				43.6		43.6	15.2		15.2	104		104	39		39		391		391		411		411
Cumulative Mill Average:				43.3		43.3	15.6		15.6	107		107	40		40		417		417		430		430
Mill Factor, %				100.7		100.7	97.4		97.4	97.2		97.2	97.2		97.2		93.8		93.8		95.6		95.6
Mill Index, %				101.4		101.4	98.7		98.7	100.0		100.0	100.0		100.0		101.8		101.8		98.8		98.8

TABLE XI  
Mill J - 42-lb. Liner Board

129185	11/ 1/47	10/28/47	44.4	41.0	42.9	15.9	15.0	15.3	131	102	120	40	33	37	400	320	367	520	344	420			
129186	11/ 1/47	10/30/47	44.2	40.4	42.7	16.1	15.1	15.7	127	76	109	40	34	37	392	320	362	472	368	415			
129222	11/10/47	11/ 7/47	43.8	41.0	42.6	15.0	13.2	14.1	131	88	110	36	31	33	408	276	335	400	312	360			
129248	11/17/47	11/14/47	44.6	42.2	43.5	15.4	13.4	14.4	118	74	96	38	34	35	392	320	349	456	336	373			
129348	11/25/47	11/21/47	45.4	42.4	43.8	16.2	14.9	15.3	132	98	113	35	30	32	376	288	339	456	344	382			
Current Mill Average:				43.1		43.1	14.9		14.9	110		110	35		35		351		351		390		390
Cumulative Mill Average:				42.4		42.4	14.8		14.8	108		108	35		35		348		348		385		385
Mill Factor, %				101.7		101.7	100.7		100.7	101.9		101.9	100.0		100.0		100.9		100.9		101.3		101.3
Mill Index, %				100.2		100.2	96.8		96.8	105.8		105.8	89.7		89.7		91.4		91.4		93.8		93.8

TABLE XII

SUMMARY OF INDIVIDUAL TEST LOTS--NOVEMBER 1 THROUGH NOVEMBER 30, 1947 (continued)

File No.	Date Recd.	Date Made	Mch.	Basis Weight, lb.		Caliper, points		Bursting Strength, points		G. E. Puncture, units		Elmendorf Tear, g./sheet										
				Max.	Min.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.					
129189	11/3/47	10/31/47		45.0	43.8	44.2	14.9	13.7	14.2	120	88	103	44	40	42	504	384	440	504	400	447	
129206	11/7/47	11/6/47		46.0	44.4	45.4	14.9	14.0	14.5	108	78	90	49	42	45	480	384	440	488	416	453	
129324	11/22/47	11/19/47		47.2	45.2	46.2	14.3	13.5	13.9	116	66	93	47	40	42	472	352	411	488	400	462	
<u>Mill E -- 44/46-lb. Drum Liner Board</u>																						
Current Mill Average:					45.3		14.2		14.2	96	96	43	43	43	43	430		430		454		454
Cumulative Mill Average:					45.4		14.1		14.1	99	99	41	41	41	41	409		409		434		434
Mill Factor, %					99.8		100.7		100.7	97.0	97.0	104.9	104.9	104.9	104.9	105.1		105.1		104.6		104.6

