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THE INSTITUTE OF PAPER CHEMISTRY

Appleton, Wisconsin

EFFECT OF DIAPHRAGM PRESSURE ON BURSTING STRENGTH

Project 1108-26S

Preliminary Report Three

to

Technical Committee

FOURDRINIER KRAFT BOARD INSTITUTE, INC.

June 6, 1961

TABLE OF CONTENTS

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SUMMARY

Because of the importance of the bursting strength tester to the paperboard industry, a subcommittee of the Fourdrinier Kraft Board Institute was set up to enlist the co-operation of B. F. Perkins and Son, Inc. in diaphragm and tester standardization. As a result it was decided to pursue a research program for the general purpose of (a) identifying diaphragm characteristics which govern diaphragm life and contribution to bursting strength readings and (b) to develop specifications for diaphragms.

As one phase of the program, the manufacturer endeavored to supply a series of diaphragms having widely different pressure characteristics in order that the effect of diaphragm pressure on test readings might be re-evaluated. While the desired pressure ranges could not be attained, five sets of diaphragms were evaluated. The diaphragm pressure at 1.8 cm. ranged from about 15 p.s.i. gage to about 100 p.s.i.g.; however, the three middle range sets of diaphragms exhibited approximately equal diaphragm pressures near 60 to 70 p.s.i.g.

The diaphragms were evaluated to determine the effect of diaphragm pressure on

a. The bursting strength of both 42-lb. kraft liner and 200-lb. series combined board, and

b. The apparent diaphragm contribution as measured by pressure *versus* distention and pressure *versus* time methods.

On the basis of the limited and somewhat erratic results obtained, the following conclusions might be drawn for the kraft liner results:

a. The pressure-distention method of estimating apparent diaphragm contribution appeared to yield results which were in approximate agreement with the bursting strength test results.

b. The pressure-distention method gave lower values for the apparent diaphragm contribution than the pressure-time method. In view of (a) above, it was concluded that the pressure-distention estimates were possibly more realistic.

c. Present diaphragm pressure specifications of 23 to 30 p.s.i.g. at 3/8-inch distention appear to permit about two p.s.i.g. differences in bursting strength of kraft linerboard. A comparable figure for the 40 to 45-p.s.i.g. specification at 1.8 cm. would be about 0.5 p.s.i.g.

The data for the combined board evaluation was less satisfactory--in part because the low pressure diaphragms gave premature failures. Additional data and possibly refinement of methods may be required to permit similar conclusions for combined board.

INTRODUCTION

Because of the importance of the bursting strength tester to the paperboard industry, a subcommittee of the Fourdrinier Kraft Board Institute was set up to enlist the co-operation of B. F. Perkins and Son, Inc. in diaphragm and tester standardization. As a result of the various meetings, it was decided to pursue a research program at the Institute for the general purpose of (a) identifying diaphragm characteristics which govern diaphragm life and contribution, and (b) to develop specifications for diaphragms.

In two previous reports to the Technical Committee a comparative evaluation of two diaphragm types (305A and 305B) was made with regard to bursting strength results and diaphragm life (1, 2). Type 305B differs from the older design 305A in that the thickness is gradually tapered from the center to the inner edge of the run. In reference (1) kraft liner was used as the test material; in reference (2) a 200-lb. test combined board was used as the test material. In general, the studies indicated that the two diaphragm types gave approximately equivalent results--implying that the differences in diaphragm contribution between types were not sufficient to cause marked differences in test.

Methods for evaluating the apparent diaphragm contribution to the bursting strength test were also investigated. One method consisted of (a) obtaining pressure versus distention (p-d) curves during sample tests, (b) reading the distention at failure from the curves, and (c) reading the apparent diaphragm pressure at the failure distention from a p-d curve for the diaphragm alone. A complete description of the apparatus may be found in reference (1). The method was extended to corrugated board in reference (2) and an alternative approach involving pressure versus time (p-t) curves was also investigated. The latter approach required that p-t curves be obtained during sample testing, the time to failure could then be read from the curves and used to estimate the apparent diaphragm pressure at failure by reading the pressure at the failure time from a p-t curve for the diaphragm alone.

The above methods were developed to assist in meeting one of the goals of the study--i.e., the development of suitable diaphragm specifications to maintain the diaphragm contribution within permissible tolerances. For this purpose it was felt that diaphragms exhibiting widely different diaphragm pressures should be evaluated to determine their effect on

a. Test readings using both liner and combined board,

b. Apparent diaphragm contribution.

The B. F. Perkins and Son, Inc. furnished four lots of special diaphragms for the study and one additional lot was selected from those evaluated in the previous reports. The diaphragm pressures at 1.8-cm. distention were intended to vary over a range from about 10 to 100 p.s.i.g. The evaluation of these diaphragms and their effect on test readings is summarized herein.

MATERIALS

A. DIAPHRAGMS

The following type 305B diaphragms were evaluated:

Desired Diaphragm Pressure Range at 1.8 cm., p.s.i.g.	Composition
10 to 15	Sirvene No. 9643
40 to 50	Sirvene No. 3356
50 to 70	Sirvene No. 3356
70+	Sirvene No. 403113
50 to 80[a]	Sirvene No. 409641

[a] See Reports 1 and 2. This lot was included after it was found that the Sirvene 3356 diaphragms intended to have pressures in the range of 50 to 70 p.s.i.g. actually gave considerably higher pressures.

B. LINER

One sample of 42-lb. kraft liner was obtained and divided into two portions--one of which was carefully randomized, preconditioned, and conditioned. The other portion was used for the "waste" tests in the life evaluation. This sample was essentially the same as that used in reference (1) except that it was taken from nearer the center of the parent roll. All tests were performed with the wire side down.

C. COMBINED BOARD

One sample of 200-lb. series A-flute combined board was divided into two portions--one of which was carefully randomized, preconditioned and conditioned. The other portion was used for the "waste" tests in the life evaluation. This sample was not the board used in reference (2). All tests were performed with the single-face side down.

GENERAL PROCEDURE

A. PREWORKING DIAPHRAGMS

Each diaphragm used in the study was preworked using the exact procedure specified in Preliminary Report One, dated September 21, 1960.

B. TESTING

Two diaphragms of each type were evaluated in this phase according to the following:

1. 42-lb. kraft liner.
    a. Obtain the diaphragm pressure at 3/8-inch and 1/8 cm.
    b. Obtain one p-d and one p-t curve for the diaphragm alone.
    c. Perform 50 tests and obtain four p-d and four p-t curves during the testing.
    d. Repeat (a) and (b)
    e. Repeat (a) through (d) after performing 200 waste tests.
2. 200-lb. test combined board
    a. Repeat (a) through (e) using the combined board sample.

C. SPECIAL TECHNIQUES

a. p-d curves: For the combined board tests the p-d curves were obtained by using the pin technique described in Preliminary Report 1, November 29, 1960; that is, a blunt tack was inserted through the top liner to rest against the top surface of the lower liner. The probe of the deflection apparatus rested in the top surface of the tack as shown in Figure 1 which illustrates the test setup for combined board. All testing was performed with a pin in place, consequently, the test averages are lower than would normally be attained with 200-lb. test board.

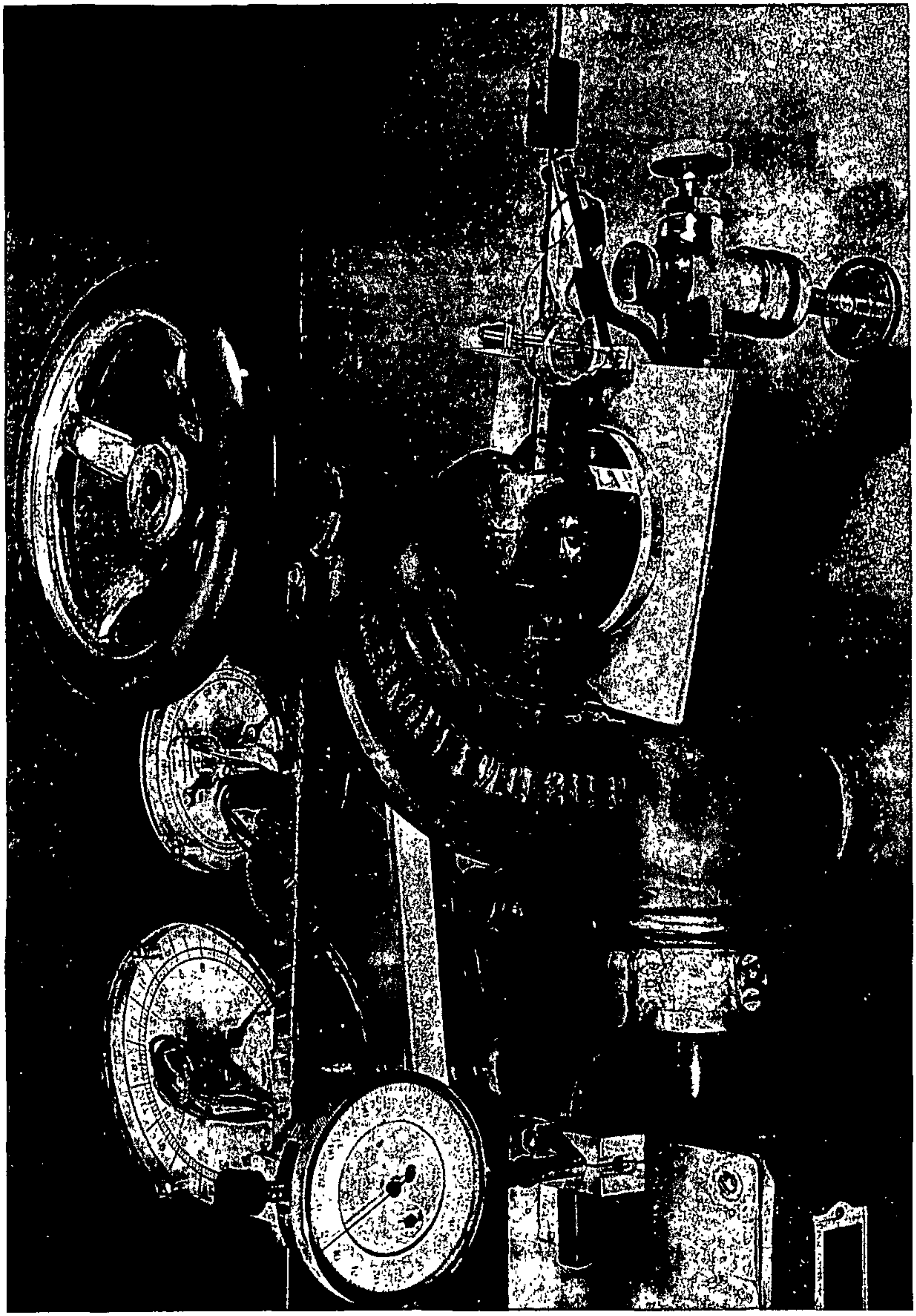

Figure 1. Pressure Distention Apparatus with Combined Board Specimen in Place on Bursting Strength Tester

b. p-t curves: To avoid uncertainty in determining the time to failure, a microswitch was installed so that operation of test switch activated the sweep on the oscilloscope.

DISCUSSION OF RESULTS

The results obtained for each of the diaphragm types are tabulated in Tables I through V and summarized in Table VI on the basis of composite averages. Referring to Table I for the relatively weak diaphragms identified as Sirvene 9643, it may be noted that it proved impossible to carry out the planned program of tests with combined board because of premature failure of the diaphragms. It also may be mentioned that the type of failure in the bursting strength tests appeared to be somewhat different for these diaphragms. In particular it appeared that the diaphragm sought out a weak point in the test area and "punched" a hole in that area to produce failure.

With the above in mind, reference to Table VI indicates, for the 42-lb. kraft liner tests, that

1. The diaphragm types may be separated into three groups on the basis of diaphragm pressure, test reading or apparent diaphragm contribution. Thus diaphragm type 9643 gave the lowest diaphragm pressures, test readings, and apparent diaphragm contribution. Diaphragm types 3356 (40 to 50), 409641 and 3356 (50 to 70) gave approximately equivalent diaphragm pressures, test readings and apparent diaphragm contributions. Diaphragm type 403113 gave the highest diaphragm pressure, test readings, and apparent diaphragm contributions. In this respect, the effort to obtain a series of diaphragms giving approximately equispaced differences in diaphragm pressure was not successful.

2. A correlation between bursting strength and either diaphragm pressure at fixed distention or apparent diaphragm contribution was evident.

3. The p-t and p-d methods of evaluating the apparent diaphragm contribution gave quite different magnitudes. In relation to the absolute differences

TABLE I

SUMMARY OF RESULTS FOR DIAPHRAGM TYPE 9643

	Diaphragm No. 1					Diaphragm No. 2					Composite				
	Diaphragm Pressure, p.s.i.g.		Bursting Strength, p.s.i.g.	Apparent Diaphragm Contribution p.s.i.g.		Diaphragm Pressure, p.s.i.g.		Bursting Strength, p.s.i.g.	Apparent Diaphragm Contribution p.s.i.g.		Diaphragm Pressure, p.s.i.g.		Bursting Strength, p.s.i.g.	Apparent Diaphragm Contribution, p.s.i.g.	
	3/8 inch	1.8 cm.		p-t Method	p-d Method	3/8 inch	1.8 cm.		p-t Method	p-d Method	3/8 inch	1.8 cm.		p-t Method	p-d Method
42-lb. Kraft Liner															
Initial															
Start	11.5	15.0	127.2	8.3	3.2	11.5	15.2	120.6	--	2.9	11.5	15.1	123.9	8.3	3.0
End	11.8	15.2		8.4	3.1	11.8	15.4		9.2	2.0	11.8	15.3		8.8	2.6
Av.	11.6	15.1		8.4	3.2	11.6	15.3		9.2	2.4	--	--		--	--
After Washing Tests															
Start	10.5	14.5	130.0	7.0	3.1	11.2	15.0	122.2	7.4	2.9	10.8	14.8	126.1	7.2	3.0
End	11.3	15.0		8.0	3.7	11.8	15.1		7.2	2.8	11.6	15.0		7.6	3.2
Av.	10.9	14.8		7.5	3.4	11.5	15.0		7.3	2.8	--	--		--	--
Composite	11.2	15.0	128.6	7.9	3.3	11.6	15.2	121.4	8.2	2.6	11.4	15.0	125.0	8.0	3.0
200-lb. Test Combined Board															
Initial[a]															
Start	11.3	15.0	187.0(46)	12.7	8.2	11.6	15.0	196.2(18)	10.5	7.2	11.2	15.0	191.6	11.6	7.7

[a] Diaphragm failed before completion of test; the figure in parenthesis gives the number of tests included in the average.

TABLE II

SUMMARY OF RESULTS FOR DIAPHRAGM TYPE 3356 (40-50)

	Diaphragm No. 1					Diaphragm No. 2					Composite				
	Diaphragm Pressure, p.s.i.g.		Bursting Strength, p.s.i.g.	Apparent Diaphragm Contribution, p.s.i.g.		Diaphragm Pressure, p.s.i.g.		Bursting Strength, p.s.i.g.	Apparent Diaphragm Contribution, p.s.i.g.		Diaphragm Pressure, p.s.i.g.		Bursting Strength, p.s.i.g.	Apparent Diaphragm Contribution, p.s.i.g.	
	3/8 inch	1.8 cm.		p-t Method	p-d Method	3/8 inch	1.8 cm.		p-t Method	p-d Method	3/8 inch	1.8 cm.		p-t Method	p-d Method
42-lb. Kraft Liner															
Initial Start	33	86		23.0	12.3	31	81		17.3	9.1	32	84		20.2	10.7
			131.6					127.1					129.4		
End	34	85		22.7	11.3	31	76		21.1	9.8	32	80		21.9	10.6
Average	34	86		22.8	11.8	31	78		19.2	9.4	—	—		—	—
After "Waste" Tests— Start	34	74		22.9	9.4	31	59		19.1	7.6	32	66		21.0	8.5
			131.3					125.8					128.6		
End	34	71		21.4	10.6	31	56		17.7	9.1	32	64		19.6	9.8
Average	34	72		22.2	10.0	31	58		18.4	8.4	—	—		—	—
Composite	34	79	131.4	22.5	10.9	31	68	126.4	18.8	8.9	32	74	129.0	20.7	9.9
200-lb. Test Combined Board															
Initial Start	34	71		32.2[a]	22.5	32	63		31.5	20.8	33	67		31.8	21.6
			208.4					204.2					206.3		
End	32	71		31.5[a]	20.7	30	54		31.3	21.1	31	62		31.4	20.9
Average	33	71		31.8	21.6	31	58		31.4	21.0	—	—		—	—
After "Waste" Tests—Start	33	61		30.0	20.8	30	52		29.8	17.1	32	56		29.9	19.0
			210.5					203.7					207.1		
End	33	59		31.9	20.2	30	52		27.8	17.1	32	56		29.8	18.6
Average	33	60		31.0	20.5	30	52		28.8	17.1	—	—		—	—
Composite	33	66	209.4	31.4	21.0	30	55	204.0	30.1	19.0	32	60	206.7	30.7	20.0

[a] A small extrapolation of the p-t curves for the diaphragm was required to determine these values.

TABLE III

SUMMARY OF RESULTS FOR DIAPHRAGM TYPE 409641

	Diaphragm No. 1					Diaphragm No. 2					Composite				
	Diaphragm Pressure, p.s.i.g.		Bursting Strength, p.s.i.g.	Apparent Diaphragm Contribution, p.s.i.g.		Diaphragm Pressure, p.s.i.g.		Bursting Strength, p.s.i.g.	Apparent Diaphragm Contribution, p.s.i.g.		Diaphragm Pressure, p.s.i.g.		Bursting Strength, p.s.i.g.	Apparent Diaphragm Contribution, p.s.i.g.	
	3/8 inch	1.8 cm.		p-t Method	p-d Method	3/8 inch	1.8 cm.		p-t Method	p-d Method	3/8 inch	1.8 cm.		p-t Method	p-d Method
42-lb. Kraft Liner															
Initial--Start	31	87	125.8	19.6	8.8	30	83	127.4	21.8	9.4	30	85	126.6	20.7	9.1
End	33	83		26.2	9.5	32	81		21.6	10.0	32	82		23.9	9.8
Average	32	85		22.9	9.2	31	82		21.7	9.7	—	—		—	—
After "waste" tests-- Start	30	73	126.6	23.9	8.5	30	70	130.1	24.0	10.3	30	72	128.4	24.0	9.4
End	32	69		23.3	10.0	31	71		24.8	9.6	32	70		24.0	9.8
Average	31	71		23.6	9.2	30	70		24.4	10.0	—	—		—	—
Composite	32	78	126.2	23.2	9.2	30	76	128.8	23.0	9.8	31	77	127.5	23.2	9.5
200-lb. Test Combined Board															
Initial--Start	29	73	207.4	29.7	19.8	29	72	206.3	32.6	22.0	29	72	206.8	31.2	20.9
End	31	67		29.9	20.4	30	68		33.0	20.5	30	68		31.4	20.4
Average	30	70		29.8	20.1	30	70		32.8	21.2	—	—		—	—
After "waste" tests---Start	28	57	205.1	29.0	19.9	28	64	203.5	31.9	17.8	28	60	204.3	30.4	18.8
End	29	58		23.9	21.9	29	67		27.8	17.0	29	62		25.8	19.4
Av.	28	58		26.4	20.9	28	66		29.8	17.4	—	—		—	—
Composite	29	64	206.2	28.1	20.5	29	68	204.4	31.3	19.3	29	66	205.6	29.7	19.9

TABLE IV

SUMMARY OF RESULTS FOR DIAPHRAGM TYPE 3356 (55-70)

	Diaphragm No. 1					Diaphragm No. 2					Composite				
	Diaphragm Pressure, p.s.i.g.		Bursting Strength, p.s.i.g.	Apparent Diaphragm Contribution, p.s.i.g.		Diaphragm Pressure, p.s.i.g.		Bursting Strength, p.s.i.g.	Apparent Diaphragm Contribution, p.s.i.g.		Diaphragm Pressure, p.s.i.g.		Bursting Strength, p.s.i.g.	Apparent Diaphragm Contribution p.s.i.g.	
	3/8 inch	1.8 cm.		p-t Method	p-d Method	3/8 inch	1.8 cm.		p-t Method	p-d Method	3/8 inch	1.8 cm.		p-t Method	p-d Method
42-lb. Kraft Liner															
Initial—Start	34	92	130.5	23.8	12.1	33	95	126.2	22.0	10.1	34	94	128.4	22.9	11.1
End	33	86		22.8	11.6	34	82		23.8	11.1	34	84		23.3	11.4
Av.	34	89		23.3	11.8	34	88		22.9	10.6	—	—		—	—
After "waste" tests -- Start	33	76	130.0	19.8	10.6	32	69	129.2	21.6	11.1	32	72	129.6	20.7	10.8
End	33	74		21.2	9.1	33	79		23.8	10.7	33	72		22.5	9.9
Av.	33	75		20.5	9.8	32	70		22.7	10.9	—	—		—	—
Composite	34	82	130.2	21.9	10.8	33	79	127.7	22.8	10.8	33	80	129.0	22.4	10.8
200-lb. Test Combined Board															
Initial--Start	33	74	215.4	31.1	18.2	32	68	207.1	33.6 [a]	22.4	32	71	211.2	32.4	20.3
End	33	75		34.0	21.9	33	68		33.6 [a]	21.0	33	72		33.8	21.4
Av.	33	74		32.6	20.0	32	68		33.6	21.7	—	—		—	—
After "waste" tests -- Start	31	64	211.8	34.0 [a]	21.5	31	61	205.2	33.5 [a]	18.8	31	62	208.5	33.8	20.2
End	31	64		31.4 [a]	19.5	32	64		33.5 [a]	20.3	32	64		32.4	19.9
Av.	31	64		32.7	20.5	32	62		33.5	19.6	—	—		—	—
Composite	32	69	213.6	32.6	20.2	32	65	206.2	33.6	20.6	32	67	209.8	33.1	20.4

[a] A small extrapolation of the p-t curves for the diaphragm was required to determine these values.

TABLE V

SUMMARY OF RESULTS FOR DIAPHRAGM TYPE 403113

	Diaphragm No. 1					Diaphragm No. 2					Composite				
	Diaphragm Pressure, p.s.i.g.		Bursting Strength, p.s.i.g.	Apparent Diaphragm Contribution, p.s.i.g.		Diaphragm Pressure, p.s.i.g.		Bursting Strength, p.s.i.g.	Apparent Diaphragm Contribution, p.s.i.g.		Diaphragm Pressure, p.s.i.g.		Bursting Strength, p.s.i.g.	Apparent Diaphragm Contribution, p.s.i.g.	
	3/8 inch	1.8 cm.		p-t Method	p-d Method	3/8 inch	1.8 cm.		p-t Method	p-d Method	3/8 inch	1.8 cm.		p-t Method	p-d Method
42-lb. Kraft Liner															
Initial--Start	44	112	135.9	34.7	16.7	41	100	134.0	32.0	16.5	42	106	135.0	33.4	16.6
End	51	106		32.7	19.0	45	102		33.0	18.0	48	104		32.8	18.5
Av.	43	109		33.7	17.8	43	101		32.5	17.2	—	—		—	—
After "waste" tests-- Start	44	88	134.5	36.0	16.9	40	87	134.9	35.7	15.5	42	88	134.7	35.8	16.2
End	45	84		36.0	16.0	44	84		34.4	15.4	44	84		35.2	15.7
Av.	44	86		36.0	16.4	42	86		35.0	15.4	—	—		—	—
Composite	46	98	135.2	34.8	17.1	42	94	134.4	33.8	16.3	44	96	134.8	34.3	16.8
200-lb. Test Combined Board															
Initial--Start	45	84	216.5	42.3	31.9	40	84	205.1	42.5	28.6	42	84	210.8	42.4	30.2
End	46	86		44.2	31.6	42	88		39.7	34.8	44	87		42.0	33.2
Av.	46	85		43.2	31.8	41	86		41.1	51.7	—	—		—	—
After "waste" Tests-- Start	42	72	211.6	41.5	30.0	41	76	208.4	40.5	28.0	42	74	210.0	41.0	29.0
End	45	77		42.2	31.2	42	77		40.5	30.8	44	77		41.4	31.0
Av.	44	74		41.8	30.6	42	76		40.5	29.4	—	—		—	—
Composite	45	80	214.0	42.5	31.2	42	81	206.8	40.8	30.6	43	80	210.4	41.7	30.8

TABLE VI

SUMMARY OF COMPOSITE RESULTS

Diaphragm Identification	Diaphragm Pressure, p.s.i.g. 3/8 in.	Diaphragm Pressure, p.s.i.g. 1.8 cm.	Bursting Strength, p.s.i.g.	Apparent Diaphragm Contribution, p.s.i.g. p-t	Apparent Diaphragm Contribution, p.s.i.g. p-d
			42-lb. Kraft Liner		
9643	11	15	125.0	8.0	3.0
3356(40-50)	32	74	129.0	20.7	9.9
409641	31	77	127.5	23.2	9.5
3356(50-70	33	80	129.0	22.4	10.8
403113	44	96	134.8	34.3	16.8
			200-lb. Series Combined Board		
9643[a]	11	15	191.6	11.6	7.7
3356(40-50)	32	60	206.7	30.7	20.0
409641	29	66	205.6	29.7	19.9
3356(50-70)	32	67	209.8	33.1	20.4
403113	43	80	210.4	41.7	30.8

[a] Based on the number of tests before diaphragm failure.

in bursting strength, the p-d method appears superior. For example, compare the results for diaphragm types 3356 (55 to 70) and 403113. The difference in bursting strength was 5.8 p.s.i.g. The apparent diaphragm contributions for the p-t and p-d methods were 11.9 p.s.i.g. and 6.8 p.s.i.g. respectively. Thus the p-d method appeared to more closely predict the actual difference in bursting strength obtained with the two diaphragm types. A similar comparison could be made between diaphragm types 9643 and 3356 (40 to 50).

To illustrate the above in another manner the composite averages for each diaphragm used in evaluating the 42-lb. kraft linerboard are plotted in Figures 2 through 4. In Figure 2 the bursting strength of the 42-lb. liner sample has been plotted _versus_ the apparent diaphragm contribution as measured by the p-t and p-d methods. (Note: The lines shown on the chart were fitted by "eye".) Keeping in mind the _limited_ nature of the data it may be noted that the slope of the p-d relationship was apparently near unity--i.e., one p.s.i.g. difference in apparent diaphragm contribution was about equal to one p.s.i.g. difference in bursting strength. In contrast, for the p-t method, the slope was near 0.5--i.e., one p.s.i.g. difference in apparent diaphragm contribution was about equal to 0.5 p.s.i.g. difference in bursting strength. The above suggests that the p-d method gives the more realistic estimates of the apparent diaphragm contribution to the bursting strength test.

In Figure 3 diaphragm pressure at 3/8-in. and 1/8-cm. distention is plotted _versus_ the bursting strength of the 42-lb. kraft liner sample (Note: The curvilinear lines were fitted by "eye"). Referring to the figure, it may be noted that diaphragm specifications of 23 to 30 p.s.i.g.

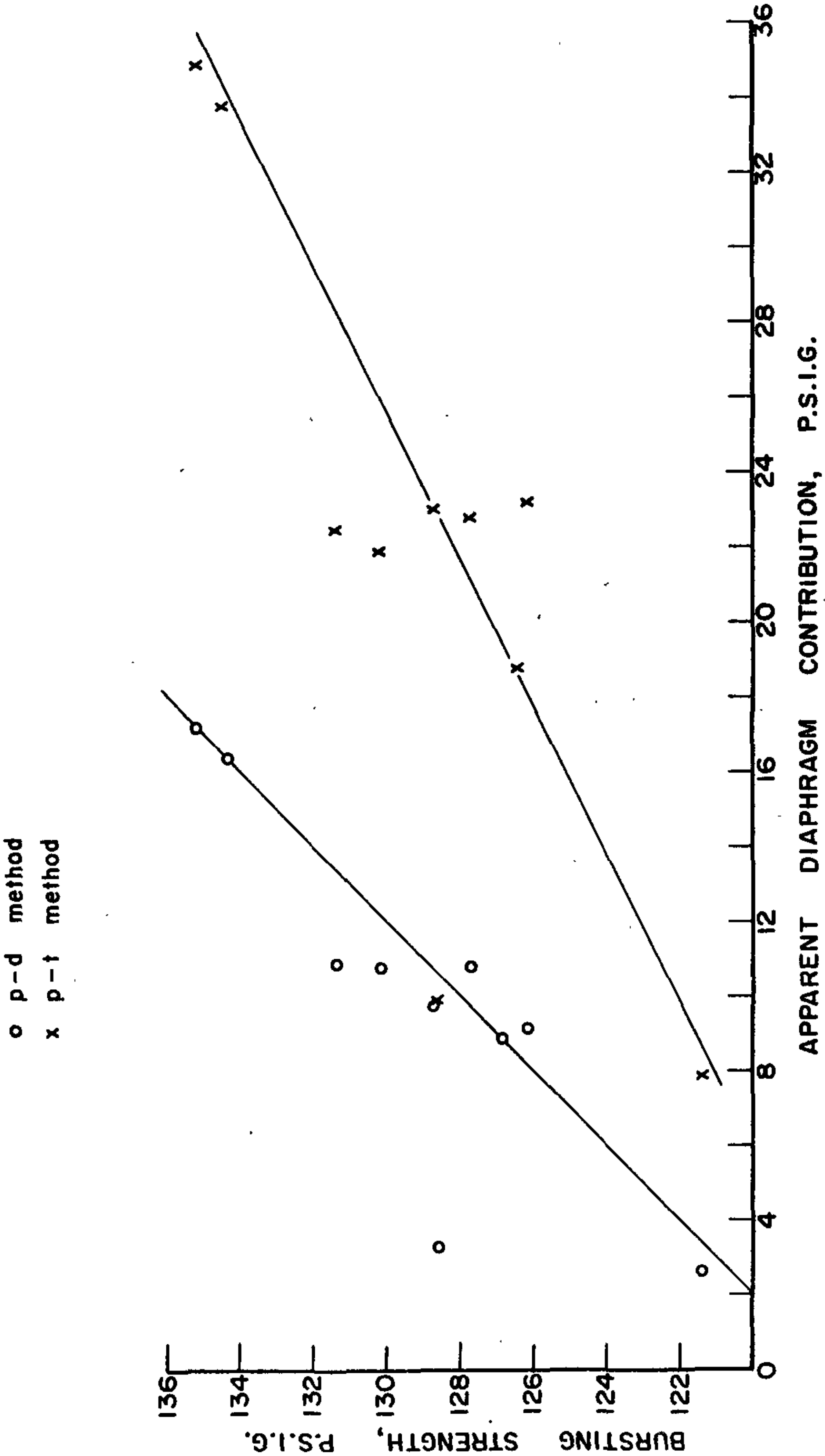

Figure 2. Relationship Between Bursting Strength of 42-lb. Kraft Liner and the Apparent Diaphragm Contribution

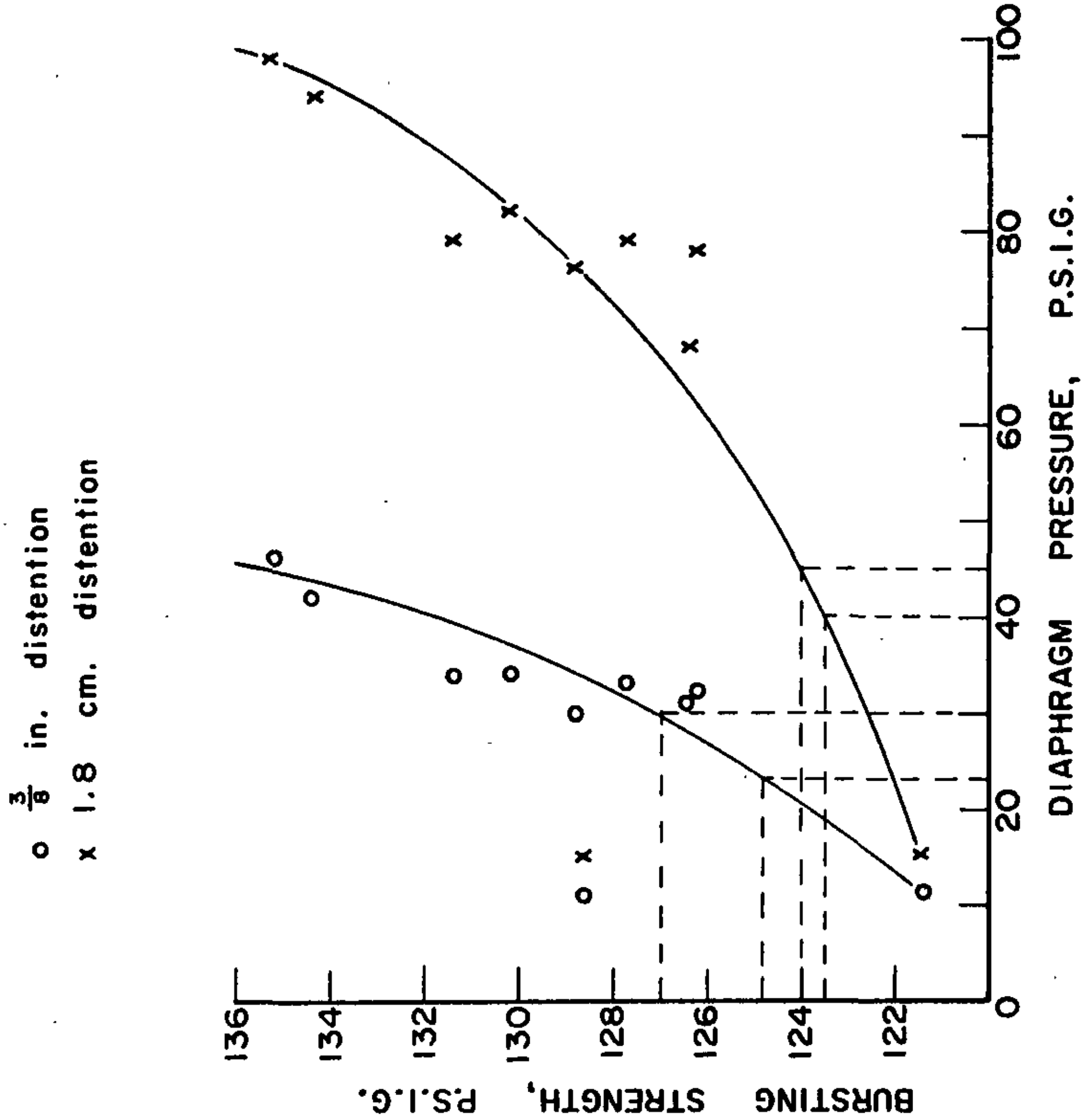

Figure 3. Relationship Between Bursting Strength of 42-lb. Kraft Liner and the Diaphragm Pressure

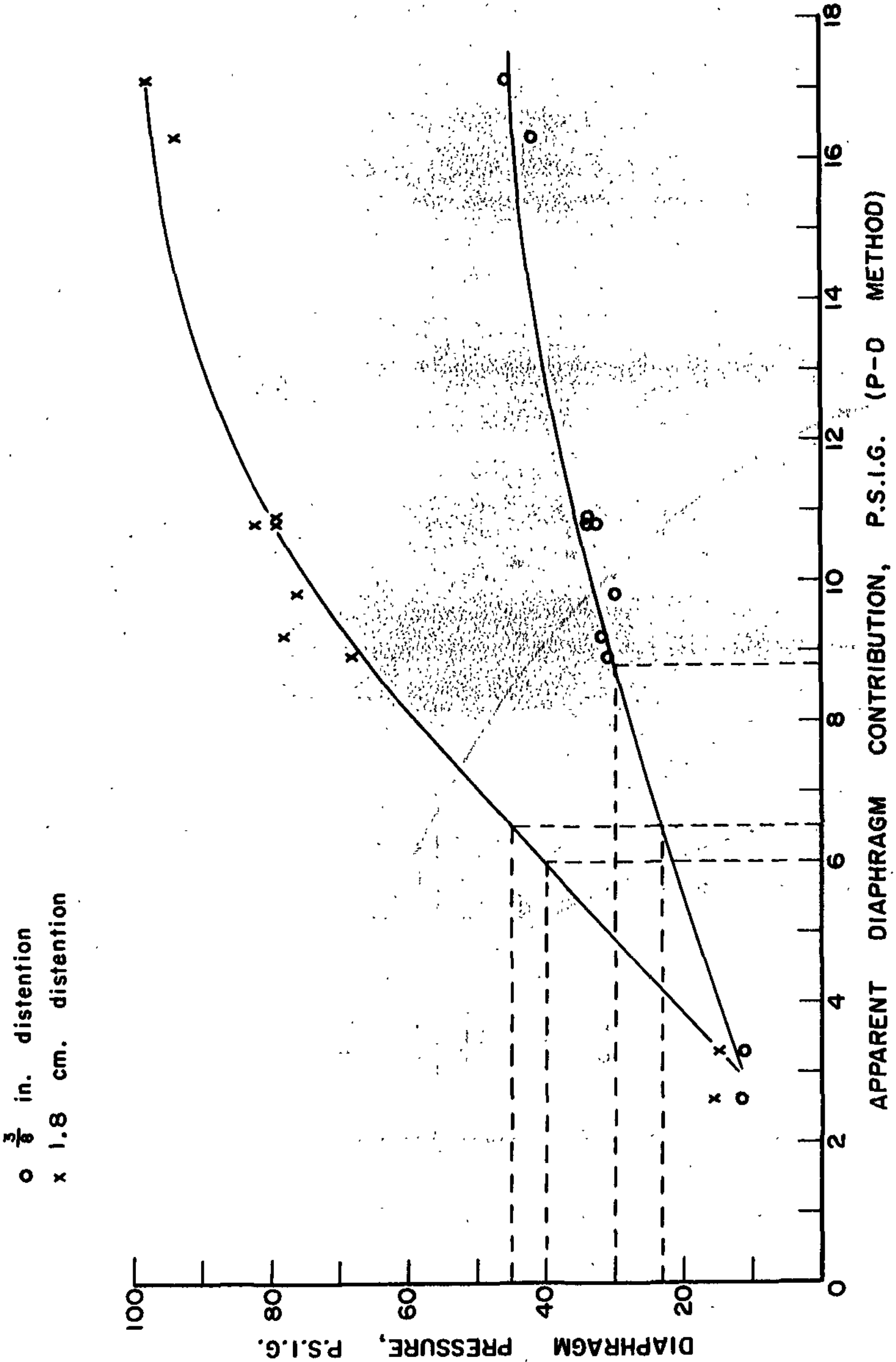

Figure 4. Relationship Between Bursting Strength of 42-lb. Kraft Liner and Apparent Diaphragm Contribution

at 3/8-inch distention corresponded to a difference in bursting strength of about 2.2 p.s.i.g.--i.e., about ±1 p.s.i.g. In contrast the 40 to 45 p.s.i.g. diaphragm specification at 1.8 cm. corresponded to a bursting strength difference of about 0.5 p.s.i.g.

In Figure 4 the diaphragm pressure at 3/8 inch and 1.8 cm. is plotted _versus_ the apparent diaphragm contribution as measured by the p-d method. As may be noted, the present diaphragm specifications at 3/8-in. distention apparently may permit deviations in apparent diaphragm contribution of about 2 p.s.i.g.

The above figures emphasize the scanty and somewhat erratic nature of the data. This is probably inevitable in view of the rather small differences in bursting strength that must be detected. However, taken at face value, the method appears to permit re-evaluation of present methods of diaphragm specification in terms of their effect on bursting strength level or variability.

The preceding discussion has centered attention on the results obtained using a 42-lb. kraft linerboard as the test material. The combined board results were, however, less favorable. For example, reference to Table VI indicates that diaphragm type 403113 with the highest diaphragm pressure gave test results not materially higher than for the other diaphragm types.

The above coupled with the premature failure of the low-pressure diaphragms resulted in unsatisfactory relationships between combined board bursting strength and diaphragm pressure or apparent diaphragm contribution.

These relationships are shown in Figures 5 and 6. It is concluded that additional data coupled possibly with a change in procedure will be required to produce results equivalent to those obtained with linerboard.

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2. An investigation of diaphragm characteristics. Part II. Comparison of diaphragm types 305A and 305B in a simulated life test using combined board and additional exploration of means of measuring diaphragm contribution. Project 1108-26S, Preliminary Report Two to the FKBI, Nov. 29, 1960.

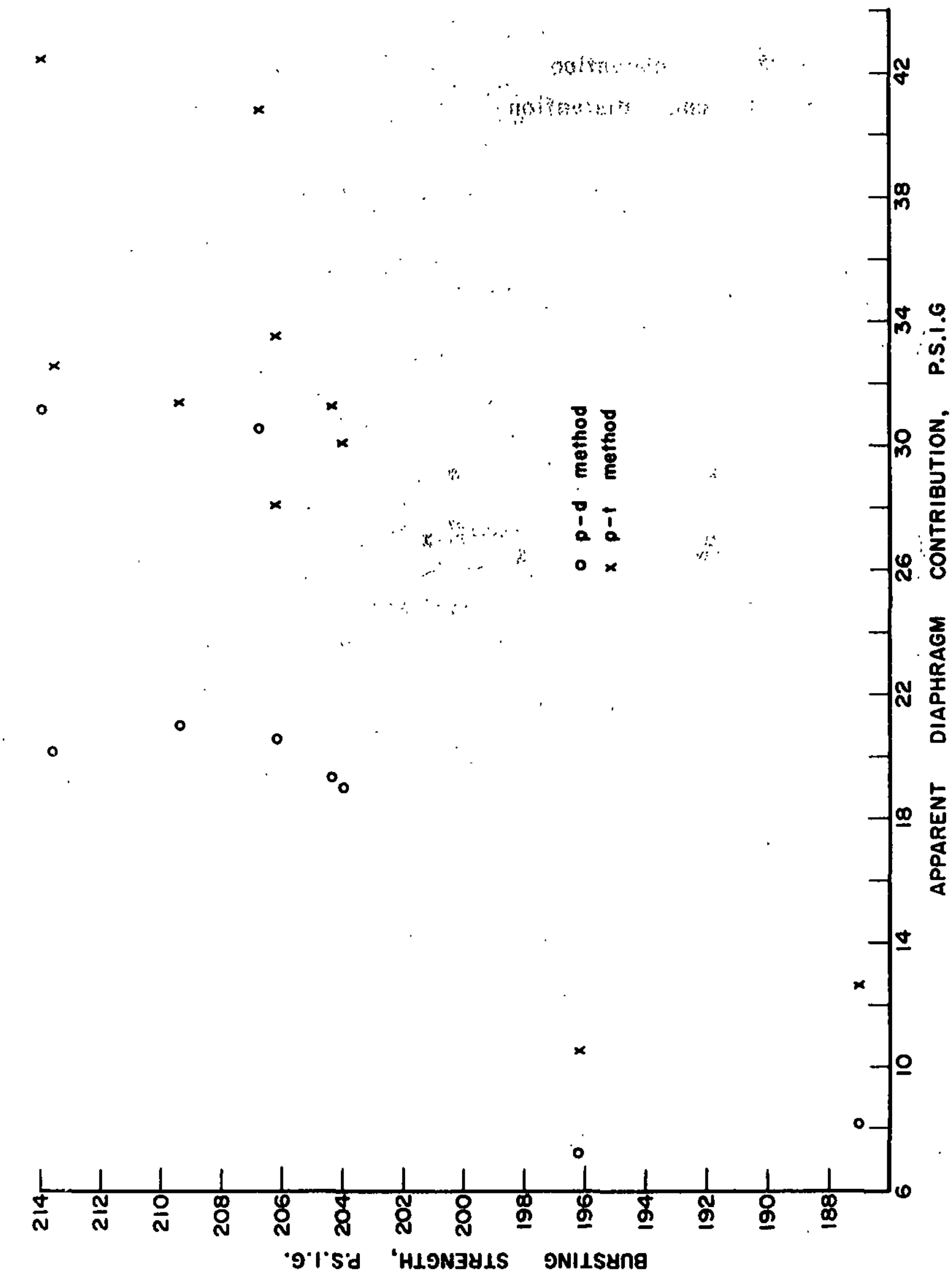

Figure 5. Relationship Between Bursting Strength of Combined Board and the Apparent Diaphragm Contribution

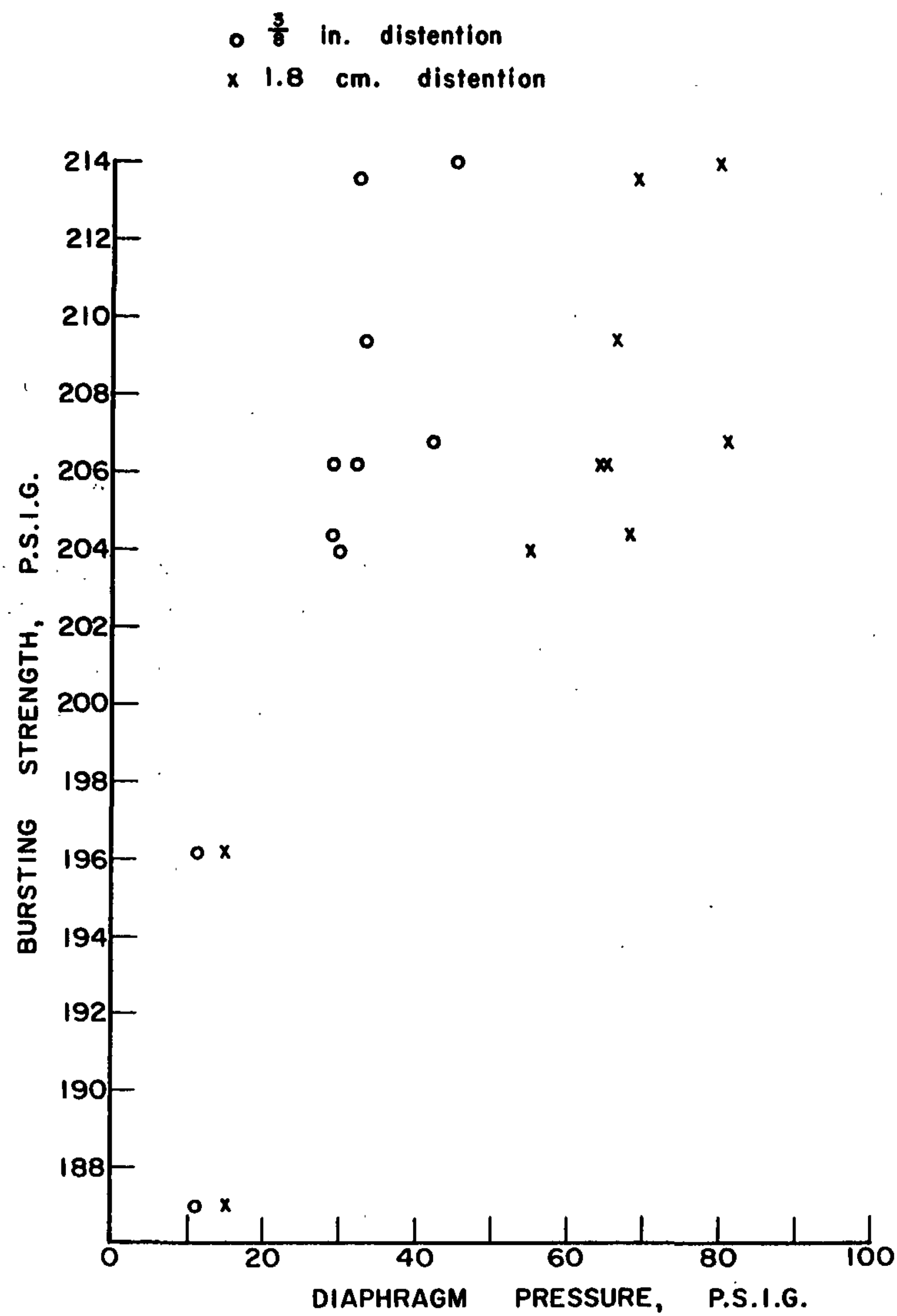

Figure 6. Relationship Between Bursting Strength of Combined Board