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MODIFIED RING COMPRESSION TESTS ON
CORRUGATING MEDIUM

✓ Project 1108-33

Preliminary

Report

to

TECHNICAL COMMITTEE

FOURDRINIER KRAFT BOARD INSTITUTE, INC.

September 3, 1963

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THE INSTITUTE OF PAPER CHEMISTRY

Appleton, Wisconsin

MODIFIED RING COMPRESSION TESTS ON
CORRUGATING MEDIUM

INTRODUCTION

As requested by the Technical Committee, modified ring compression tests in the cross-machine direction are currently being made on corrugating medium sampled from each roll submitted for evaluation in connection with the base-line study on corrugating medium, Project 1108-17. This testing program was initiated on the rolls of medium received during July. The current report presents a bi-monthly summation of the results obtained during July and August.

PROCEDURE

The procedure followed in evaluating each roll of corrugating medium for cross-machine direction modified ring compression has involved a number of steps which are described subsequently in this paragraph in the order of their performance. From each roll of medium, several wraps were taken for test purposes after the outer layers had been removed. The sample taken for test purposes was cut into sheets twelve inches in length which were then preconditioned for at least 24 hours in an atmosphere at 73°F. and less than 35% R.H. followed by conditioning for at least 48 hours in an atmosphere at 73°F. and 50% R.H., the latter atmosphere also being the environment in which subsequent specimen preparation and testing were carried out. From each of five of the conditioned sheets, two 6 by 0.5 inch specimens (the 6-inch dimension being parallel to the machine direction) were cut with a Concora cutter, the 6-inch dimension of one specimen from each of these pairs being subsequently trimmed to 2 inches with a card cutter for the modified ring compression test, whereas the other specimen was used for the Concora test for Project 1108-17. The loading edges of each specimen for the modified ring compression test were touched against a sheet of wax-saturated paper toweling lying on a hot plate set at 170 to 175°F. (Mobilwax D was used to saturate the paper toweling.) The loading edges of each specimen were held in contact with the paper toweling long enough to permit the wax to migrate into the specimen to a depth of approximately 1/16-inch. The next step involved applying a 3/16 to 1/4-inch wide stripe of Weldwood contact cement by means of a brush to each end of the specimen to permit overlapping and adhering the ends together. Prior to this, however, the contact cement was given time to become visibly dry so that when the ends were overlapped and joined, their bonding was immediate and secure. The overlapping and joining of the ends of each specimen was accomplished by wrapping the specimen around a Plexiglas cylinder having a height of 1/2-inch and a diameter of 0.579

inch. This cylinder dimension limited the overlapping of the ends to a minimum of 1/8-inch and maximum of 3/16-inch. The Plexiglas cylinder was also helpful in achieving parallel loading edges.

After being prepared as described above, each specimen was conditioned in the test atmosphere for at least 12 hours and then tested using the conventional ring holder (ASTM) but substituting a 1/4-inch high Plexiglas cylinder (of the same diameter as the cylinder on which the specimen was formed) for the conventional island. The testing was carried out on an H. and D. compression tester at a loading rate of approximately 900 lb./min. measured with the platens in contact with each other. The modified ring compression strength was recorded to the nearest pound for each of the five specimens prepared from a given roll, the average of the five specimens being expressed on a unit width basis (lb./in.) by dividing the average maximum load (pounds) sustained by the five specimens by their average length which was two inches.

RESULTS

During July and August, 146 rolls representing the production of 22 machines were evaluated for cross-machine modified ring compression. The results obtained for each machine are given in Tables I through XXII for Machine A through V, respectively. It may be noted from the results for each machine given in Tables I through XXII that in addition to maximum, minimum, and average data for each roll, a composite average is also given, having been obtained by determining the arithmetic mean of the averages for the individual rolls. This composite average for each machine is referred to as the "current machine average." In Table XXIII the current machine averages and number of rolls evaluated are summarized for each machine. In addition a "current F.K.I. average" is shown, having been calculated by determining the arithmetic mean of the current machine averages. A graphical representation of the current machine averages and the current F.K.I. average is shown in Fig. 1.

TABLE I

SUMMARY OF DATA FOR MACHINE A
 July and August, 1963
 (Type of Medium: Semichemical)

I.P.C. K-No.	Code	Date Made	Date Received	Mill Roll Number	Cross-Machine		lb./in. Av.
					Modified Max.	Ring Compression, Min.	
K-7927	A-1	6-18-63	6-26-63	548	13.5	12.0	12.8
K-7989	A-2	7-11-63	7-22-63	549	14.5	13.0	14.0
K-7990	A-3	7-13-63	7-22-63	550	12.5	10.0	11.4
K-7991	A-4	7-13-63	7-22-63	551	12.0	10.5	11.3
K-8012	A-5	7-18-63	7-26-63	552	14.0	12.5	13.3
K-8035	A-6	7-19-63	8-7-63	553	13.5	11.5	12.5
K-8036	A-7	7-30-63	8-7-63	554	13.0	11.5	12.4
K-8047	A-8	7-31-63	8-12-63	555	13.5	12.5	13.0
K-8052	A-9	8-9-63	8-16-63	556	14.5	12.5	<u>13.6</u>
Current Machine Average							12.7

TABLE II

SUMMARY OF DATA FOR MACHINE B
 July and August, 1963
 (Type of Medium: Semichemical)

I.P.C. K-No.	Code	Date Made	Date Received	Mill Roll Number	Cross-Machine		lb./in. Av.
					Modified Max.	Ring Compression, Min.	
K-7930	B-1	6-19-63	6-27-63	--	12.5	11.5	12.1
K-8007	B-2	7-12-63	7-25-63	--	13.5	11.5	12.3
K-8008	B-3	7-13-63	7-25-63	--	13.5	12.0	13.0
K-8009	B-4	7-15-63	7-25-63	--	13.5	12.0	12.5
K-8010	B-5	7-20-63	7-25-63	--	12.5	12.0	12.4
K-8071	B-6	8-14-63	8-22-63	--	12.5	11.0	11.6
K-8072	B-7	8-16-63	8-22-63	--	12.5	11.5	<u>12.1</u>
Current Machine Average							12.3

TABLE III

SUMMARY OF DATA FOR MACHINE C
July and August, 1963
(Type of Medium: Semichemical)

I.P.C. K-No.	Code	Date Made	Date Received	Mill Roll Number	Cross-Machine			
					Modified Max.	Ring Min.	Compression, lb./in. Av.	
K-7966	C-1	7-2-63	7-12-63	357	13.5	11.5	12.9	
K-7981	C-2	7-12-63	7-18-63	358	13.5	11.5	12.5	
K-8014	C-3	7-20-63	7-29-63	359	14.0	12.5	13.3	
K-8033	C-4	7-30-63	8-5-63	360	12.5	11.0	<u>12.1</u>	
							Current Machine Average	12.7

TABLE IV

SUMMARY OF DATA FOR MACHINE D
July and August, 1963
(Type of Medium: Semichemical)

I.P.C. K-No.	Code	Date Made	Date Received	Mill Roll Number	Cross-Machine			
					Modified Max.	Ring Min.	Compression, lb./in. Av.	
K-7934	D-1	6-24-63	7-1-63	72	14.0	12.5	13.1	
K-7954	D-2	7-1-63	7-8-63	73	14.5	14.0	14.2	
K-7968	D-3	7-8-63	7-12-63	74	14.0	13.0	13.5	
K-7997	D-4	7-17-63	7-23-63	75	13.5	11.5	12.8	
K-8016	D-5	7-23-63	7-29-63	76	14.0	12.0	12.8	
K-8039	D-6	8-4-63	8-8-63	77	13.5	10.5	12.7	
K-8061	D-7	8-13-63	8-19-63	78	12.5	11.0	<u>11.4</u>	
							Current Machine Average	12.9

TABLE V

SUMMARY OF DATA FOR MACHINE E
 July and August, 1963
 (Type of Medium: Semichemical)

I.P.C. K-No.	Code	Date Made	Date Received	Mill Roll Number	Modified Max.	Cross-Machine Ring Compression, lb./in.		Av.
						Min.		
K-7935	E-1	6-9-63	7-2-63	262	13.5	12.5		12.9
K-7936	E-2	6-14-63	7-2-63	425	13.5	13.0		13.2
K-7982	E-3	6-25-63	7-19-63	770	15.0	11.5		13.1
K-7969	E-4	7-2-63	7-12-63	36	14.0	13.5		13.7
K-7983	E-5	7-10-63	7-19-63	254	14.0	12.0		12.9
K-8030	E-6	7-15-63	8-2-63	518	13.0	12.5		12.7
K-8031	E-7	7-23-63	8-2-63	659	14.5	11.5		13.2
K-8048	E-8	8-5-63	8-14-63	124	15.0	14.0		<u>14.3</u>
Current Machine Average								13.2

TABLE VI

SUMMARY OF DATA FOR MACHINE F
 July and August, 1963
 (Type of Medium: Kraft)

I.P.C. K-No.	Code	Date Made	Date Received	Mill Roll Number	Modified Max.	Cross-Machine Ring Compression, lb./in.		Av.
						Min.		
K-7939	F-1	6-4-63	7-3-63	13	12.5	10.5		12.0
K-7940	F-2	6-4-63	7-3-63	14	14.0	12.0		12.7
K-7941	F-3	6-4-63	7-3-63	15	13.5	11.5		12.5
K-7942	F-4	6-4-63	7-3-63	16	13.5	11.5		12.4
K-7992	F-5	7-17-63	7-23-63	17	13.0	11.5		12.0
K-7993	F-6	7-17-63	7-23-63	18	14.0	11.5		12.9
K-7994	F-7	7-17-63	7-23-63	19	14.0	11.5		13.1
K-7995	F-8	7-17-63	7-23-63	20	13.5	10.5		<u>12.2</u>
Current Machine Average								12.5

TABLE VII

SUMMARY OF DATA FOR MACHINE G
July and August, 1963
(Type of Medium: Semichemical)

I.P.C. K-No.	Code	Date Made	Date Received	Mill Roll Number	Modified Max.	Cross-Machine Ring Compression, lb./in.		Av.
						Min.		
K-7943	G-1	--	7-3-63	84	13.0	12.5		12.9
K-7944	G-2	--	7-3-63	85	14.0	12.5		12.8
K-8067	G-3	7-21-63	8-22-63	86	12.5	11.5		12.1
K-8068	G-4	--	8-22-63	87	12.5	11.0		11.9
K-8069	G-5	8-12-63	8-22-63	88	12.5	11.0		<u>11.5</u>
Current Machine Average								12.2

TABLE VIII

SUMMARY OF DATA FOR MACHINE H
July and August, 1963
(Type of Medium: Semichemical)

I.P.C. K-No.	Code	Date Made	Date Received	Mill Roll Number	Modified Max.	Cross-Machine Ring Compression, lb./in.		Av.
						Min.		
K-7945	H-1	5-24-63	7-5-63	536	14.5	11.5		13.1
K-7946	H-2	6-17-63	7-5-63	537	14.5	12.5		13.3
K-7964	H-3	6-23-63	7-10-63	538	14.5	13.5		13.8
K-7970	H-4	6-29-63	7-15-63	539	14.0	12.5		13.0
K-8018	H-5	7-1-63	7-30-63	540	14.0	12.5		13.3
K-8019	H-6	7-9-63	7-30-63	541	13.0	11.5		12.2
K-8034	H-7	7-15-63	8-6-63	542	13.5	12.0		<u>13.0</u>
Current Machine Average								13.1

TABLE IX

SUMMARY OF DATA FOR MACHINE I
July and August, 1963
(Type of Medium: Semichemical)

I.P.C. K-No.	Code	Date Made	Date Received	Mill Roll Number	Cross-Machine Modified Ring Compression, lb./in.		Av.
					Max.	Min.	
K-7947	I-1	6-7-63	7-5-63	17	10.0	8.5	9.4
K-7948	I-2	6-13-63	7-5-63	18	11.5	9.5	10.7
K-7949	I-3	6-20-63	7-5-63	19	11.0	9.5	10.2
K-7950	I-4	6-26-63	7-5-63	20	13.0	9.0	<u>11.0</u>
Current Machine Average							10.3

TABLE X

SUMMARY OF DATA FOR MACHINE J
July and August, 1963
(Type of Medium: Semichemical)

I.P.C. K-No.	Code	Date Made	Date Received	Mill Roll Number	Cross-Machine Modified Ring Compression, lb./in.		Av.
					Max.	Min.	
K-7931	J-1	6-18-63	6-27-63	3760	12.5	11.0	11.6
K-7932	J-2	6-20-63	6-27-63	4090	13.5	11.5	12.6
K-7937	J-3	6-21-63	7-2-63	4365	12.5	11.5	12.1
K-7938	J-4	6-22-63	7-2-63	4684	13.0	11.5	12.4
K-8026	J-5	7-10-63	7-31-63	2400	12.5	9.5	11.5
K-8027	J-6	7-18-63	7-31-63	4502	12.5	11.5	12.0
K-8028	J-7	7-19-63	7-31-63	4727	12.5	11.0	11.8
K-8029	J-8	7-21-63	7-31-63	5046	12.5	11.0	<u>11.8</u>
Current Machine Average							12.0

TABLE XI

SUMMARY OF DATA FOR MACHINE K
July and August, 1963
(Type of Medium: Semichemical)

I.P.C. K-No.	Code	Date Made	Date Received	Mill Roll Number	Cross-Machine Modified Ring Compression, lb./in.		Av.
					Max.	Min.	
K-7951	K-1	6-25-63	7-8-63	955	12.5	10.0	11.7
K-7952	K-2	6-25-63	7-8-63	956	12.5	11.0	12.0
K-7979	K-3	7-8-63	7-17-63	963	13.5	12.5	12.9
K-7980	K-4	7-8-63	7-17-63	964	13.0	11.5	12.6
K-8040	K-5	8-1-63	8-8-63	971	12.5	12.0	12.3
K-8041	K-6	8-1-63	8-8-63	972	13.0	10.0	11.7
K-8063	K-7	8-8-63	8-20-63	979	12.5	10.0	10.9
K-8064	K-8	8-8-63	8-20-63	980	12.5	10.5	11.4
K-8065	K-9	8-13-63	8-20-63	982	14.5	13.5	13.8
K-8066	K-10	8-13-63	8-20-63	983	15.0	13.0	<u>14.0</u>

Current Machine Average 12.3

TABLE XII

SUMMARY OF DATA FOR MACHINE L
July and August, 1963
(Type of Medium: Semichemical)

I.P.C. K-No.	Code	Date Made	Date Received	Mill Roll Number	Modified Ring Compression, lb./in.		Av.
					Max.	Min.	
K-7955	L-1	7-2-63	7-9-63	19	12.5	11.5	11.2
K-7998	L-2	7-17-63	7-25-63	20	13.5	11.5	12.6
K-8011	L-3	7-17-63	7-26-63	21	13.5	11.5	12.6
K-8017	L-4	7-25-63	7-29-63	22	13.5	11.5	12.3
K-8037	L-5	7-30-63	8-8-63	23	13.5	11.0	12.1
K-8046	L-6	8-7-63	8-12-63	24	11.5	11.5	11.5
K-8062	L-7	8-13-63	8-19-63	25	11.5	10.5	<u>11.1</u>

Current Machine Average 11.9

TABLE XIII
 SUMMARY OF DATA FOR MACHINE M

July and August, 1963
 (Type of Medium: Bogus)

I.P.C. K-No.	Code	Date Made	Date Received	Mill Roll No.	Cross-Machine Ring Compression, lb./in.		
					Modified Max.	Min.	Av.
K-7956	M-1	6- 6-63	7-10-63	176	8.5	7.5	7.8
K-7957	M-2	6-13-63	7-10-63	177	8.0	7.5	7.9
K-7958	M-3	6-17-63	7-10-63	178	9.0	7.0	8.2
K-7959	M-4	6-21-63	7-10-63	179	9.5	7.5	8.7
K-7984	M-5	7- 1-63	7-22-63	180	10.5	7.0	8.3
K-7985	M-6	7- 6-63	7-22-63	181	9.0	6.0	<u>8.0</u>
Current Machine Av.							8.2

TABLE XIV
 SUMMARY OF DATA FOR MACHINE N

July and August, 1963
 (Type of Medium: Semichemical)

K-7928	N-1	6-20-63	6-27-63	--	12.5	11.5	11.9
K-7929	N-2	6-23-63	6-27-63	--	12.0	11.5	11.8
K-8003	N-3	7-13-63	7-25-63	--	12.5	10.5	11.5
K-8004	N-4	7-15-63	7-25-63	--	12.0	10.5	11.3
K-8005	N-5	7-16-63	7-25-63	--	12.0	10.5	11.4
K-8006	N-6	7-17-63	7-25-63	--	12.0	11.0	11.5
K-8056	N-7	8- 8-63	8-19-63	--	12.5	11.0	11.5
K-8057	N-8	8-13-63	8-19-63	--	12.0	11.5	<u>11.7</u>
Current Machine Av.							11.6

TABLE XV
SUMMARY OF DATA FOR MACHINE O
July and August, 1963
(Type of Medium: Semichemical)

I.P.C. K-No..	Code	Date Made	Date Received	Mill Roll No.	Cross-Machine Modified Ring Compression, lb./in.		
					Max.	Min.	Av.
K-7965	O-1	7- 1-63	7-12-63	692	13.0	11.5	12.3
K-8013	O-2	7-23-63	7-29-63	693	13.5	10.5	12.5
K-8032	O-3	7-30-63	8- 5-63	694	13.0	11.5	<u>12.1</u>
Current Machine Av.							12.3

TABLE XVI
SUMMARY OF DATA FOR MACHINE P
July and August, 1963
(Type of Medium: Semichemical)

K-7971	P-1	7-10-63	7-15-63	957	13.0	12.0	12.3
K-7972	P-2	7-10-63	7-15-63	958	12.5	10.5	11.6
K-8020	P-3	7-25-63	7-30-63	965	13.5	11.0	12.2
K-8021	P-4	7-25-63	7-30-63	966	13.0	11.5	12.2
K-8058	P-5	8-12-63	8-19-63	973	12.5	11.0	11.7
K-8059	P-6	8-12-63	8-19-63	974	11.5	10.0	<u>10.8</u>
Current Machine Av.							11.8

TABLE XVII
 SUMMARY OF DATA FOR MACHINE Q
 July and August, 1963
 (Type of Medium: Bogus)

I.P.C. K-No.	Code	Date Made	Date Received	Mill Roll No.	Cross-Machine Modified Ring Compression, lb./in.		
					Max.	Min.	Av.
K-7960	Q-1	6- 5-63	7-10-63	179	8.5	7.5	8.2
K-7961	Q-2	6-12-63	7-10-63	180	8.5	7.5	7.8
K-7962	Q-3	6-17-63	7-10-63	181	9.5	8.5	8.8
K-7963	Q-4	6-22-63	7-10-63	182	10.0	8.5	9.2
K-7986	Q-5	7- 1-63	7-22-63	183	8.5	7.5	7.9
K-7987	Q-6	7- 6-63	7-22-63	184	8.5	7.0	7.8
K-7988	Q-7	7- 6-63	7-22-63	185	7.0	5.5	<u>6.6</u>
Current Machine Av.							8.0

TABLE XVIII
 SUMMARY OF DATA FOR MACHINE R
 July and August, 1963
 (Type of Medium: Semichemical)

K-7973	R-1	6-20-63	7-15-63	413	14.5	12.0	13.2
K-7974	R-2	6-24-63	7-15-63	414	14.5	12.5	13.2
K-7975	R-3	7- 1-63	7-15-63	415	14.0	13.0	13.5
K-8022	R-4	7-12-63	7-31-63	416	13.5	10.0	12.3
K-8023	R-5	7-18-63	7-31-63	417	13.0	12.0	12.4
K-8024	R-6	7-18-63	7-31-63	418	14.0	11.5	12.8
K-8025	R-7	7-22-63	7-31-63	419	12.5	10.0	<u>11.5</u>
Current Machine Av.							12.7

TABLE XIX
SUMMARY OF DATA FOR MACHINE S
July and August, 1963
(Type of Medium: Semicheical)

I.P.C. K-No.	Code	Date Made	Date Received	Mill Roll No.	Cross-Machine Ring Compression, lb./in.		
					Modified Max.	Min.	Average
K-7976	S-1	6-12-63	7-15-63	235	14.5	13.5	13.8
K-7977	S-2	6-16-63	7-15-63	236	13.0	12.0	12.5
K-7978	S-3	--	7-15-63	237	13.0	12.0	12.5
K-8049	S-4	7-31-63	8-16-63	238	14.5	13.5	13.9
K-8050	S-5	7-31-63	8-16-63	239	14.5	14.0	14.1
K-8051	S-6	7-31-63	8-16-63	240	13.0	11.5	<u>12.1</u>
Current Machine Av.							13.2

TABLE XX
SUMMARY OF DATA FOR MACHINE T
July and August, 1963
(Type of Medium: Semicheical)

K-7933	T-1	6-24-63	7- 1-63	72	13.5	12.0	12.8
K-7953	T-2	7- 1-63	7- 8-63	73	14.0	12.5	13.5
K-7967	T-3	7- 8-63	7-12-63	74	14.5	13.0	13.7
K-7996	T-4	7-17-63	7-23-63	75	14.0	11.5	12.8
K-8015	T-5	7-22-63	7-29-63	76	14.5	12.0	13.4
K-8038	T-6	8- 4-63	8- 8-63	77	13.5	11.5	12.5
K-8060	T-7	8-13-63	8-19-63	78	12.5	11.5	<u>12.3</u>
Current Machine Av.							13.0

TABLE XXI
 SUMMARY OF DATA FOR MACHINE U
 July and August, 1963
 (Type of Medium: Semichemical)

I.P.C. K-No.	Code	Date Made	Date Received	Mill Roll No.	Cross-Machine Modified Ring Compression, lb./in.		
					Max.	Min.	Av.
K-8042	U-1	7- 5-63	8- 9-63	B-1	13.0	11.0	12.1
K-8043	U-2	7-17-63	8- 9-63	G-1	14.0	12.5	13.5
K-8044	U-3	7-23-63	8- 9-63	G-3	14.0	13.0	13.7
K-8045	U-4	7-24-63	8- 9-63	G-4	15.5	12.5	<u>13.6</u>
Current Machine Av.							13.2

TABLE XXII
 SUMMARY OF DATA FOR MACHINE V
 July and August, 1963
 (Type of Medium: Semichemical)

K-7999	V-1	7-12-63	7-25-63	--	12.5	11.5	12.0
K-8000	V-2	7-13-63	7-25-63	--	13.5	12.0	12.6
K-8001	V-3	7-16-63	7-25-63	--	12.0	11.5	11.8
K-8002	V-4	7-19-63	7-25-63	--	13.0	11.5	12.2
K-8053	V-5	8- 8-63	8-19-63	--	12.5	11.0	11.5
K-8054	V-6	8- 9-63	8-19-63	--	11.5	10.0	10.9
K-8055	V-7	8-14-63	8-19-63	--	12.5	11.5	11.9
K-8070	V-8	8-16-63	8-22-63	--	12.5	11.0	<u>11.7</u>
Current Machine Av.							11.8

TABLE XXIII
SUMMARY OF CURRENT MACHINE AVERAGES
July and August, 1963

Machine Code	Type of Medium	No. of Rolls	Cross-Machine Modified Ring Compression, lb./in.
A	Semichemical	9	12.7
B	Semichemical	7	12.3
C	Semichemical	4	12.7
D	Semichemical	7	12.9
E	Semichemical	8	13.2
F	Kraft	8	12.5
G	Semichemical	5	12.2
H	Semichemical	7	13.1
I	Semichemical	4	10.3
J	Semichemical	8	12.0
K	Semichemical	10	12.3
L	Semichemical	7	11.9
M	Bogus	6	8.2
N	Semichemical	8	11.6
O	Semichemical	3	12.3
P	Semichemical	6	11.8
Q	Bogus	7	8.0
R	Semichemical	7	12.7
S	Semichemical	6	13.2
T	Semichemical	7	13.0
U	Semichemical	4	13.2
V	Semichemical	8	11.8
	Total	146	
	Current F. K. I. Average		12.0

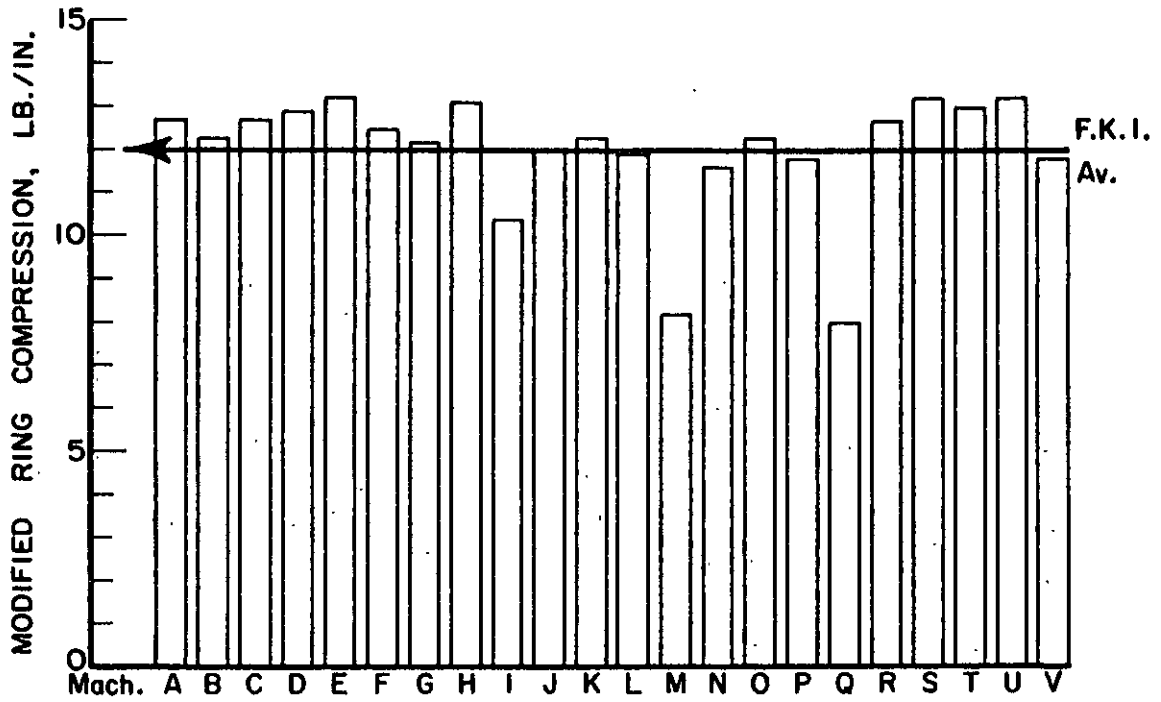


Figure 1. Comparison of Cross-Machine Direction Modified Ring Compression Results