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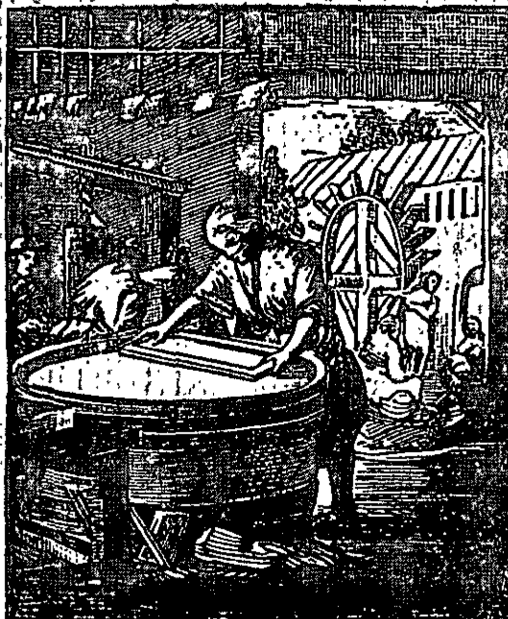

INSTITUTE OF
PAPER CHEMISTRY
Appleton Wisconsin

SUPPLEMENTARY REPORT ON CALIPER OF SINGLE-FACED BOARD

Project 1108-17

Progress Report 82

to

FOURDRINIER KRAFT BOARD INSTITUTE, INC.

January 1, 1961

THE INSTITUTE OF PAPER CHEMISTRY

Appleton, Wisconsin

This report is supplementary to Progress Report 81 of the baseline study on corrugating medium entitled, "Continuous evaluation of corrugating medium" which provides a program whereby participating mills have the opportunity to submit rolls of medium on a regular weekly schedule for evaluation with regard to physical characteristics of the medium and of the single-faced board made from the medium. Specifically, each medium is evaluated for caliper, basis weight, and Concora flat crush. In addition each medium is fabricated into A-flute single-faced corrugated board on the Institute's corrugator to determine its runability in terms of speed and tension, and the single-faced board obtained at maximum speed with minimum tension is evaluated for its flat crush strength.

This report is an extension of the baseline study described above and is concerned specifically with the caliper and uniformity of caliper of the single-faced board fabricated from each roll of medium. Uniformity of caliper is generally considered to be another facet of the criteria used to evaluate the runability of corrugating medium, and the Technical Committee of the Fourdrinier Kraft Board Institute, Inc., has requested that a measurement of the uniformity of caliper be included as a part of the evaluation given each roll of corrugating medium.

The evaluation of the caliper and uniformity of caliper of the single-faced board made from each roll of corrugating medium was carried out using the five circular specimens that were subsequently tested for flat crush strength. Each specimen was five square inches in area. They were cut at intervals of approximately two feet along the central portion of a strip of the single-faced board fabricated at maximum speed and minimum tension. On each of these five specimens, caliper measurements were made on five consecutive flutes and the caliper difference between consecutive flutes was calculated, there being four calculations of differences for each specimen. The twenty-five caliper measurements (five calipers on each of the five specimens) were averaged and are reported as the caliper for each sample of medium. Likewise, the twenty caliper differences between consecutive flutes (four caliper differences on each of the five specimens) were averaged, and the maximum, minimum, and average values are reported for each sample of corrugating medium.

The instrument for measuring the caliper of individual flutes of single-faced board consists of a bench-type thickness gage with a pressure foot 3/8 inch in diameter and an anvil consisting of a plane circular surface 2 inches in diameter. The pressure foot is attached to a dial indicator which can be read to 0.0001 inch. The load on the pressure foot is 100 $\pm$ 10 grams. A caliper determination is made by inserting each five-square-inch circular specimen between the pressure foot and the anvil so that the foot rests on the second flute from one end of the specimen without touching either of the adjacent flutes. The 3/8-inch diameter of the pressure foot permits it to contact only one flute with ease. The specimen is pressed gently against the anvil, and the reading is then recorded. As mentioned previously, five consecutive flutes through the center of each specimen are calipered in this way. It should be emphasized that these calipers may not necessarily correspond to regular caliper measurements because of differences in load and other variables.

Caliper data have been obtained on the single-faced board fabricated from each of the eighty-nine rolls of corrugating medium which were submitted for evaluation during the month of December. Also included for purposes of convenient reference are the single-face flat crush and runability data. The current machine averages for each test are summarized in Table I for Machines A through U. A graphical presentation of the current machine caliper averages on single-faced board is shown in Figure 1, and a similar presentation of the current machine averages for the caliper difference between consecutive flutes is given in Figure 2. The test results obtained on the individual rolls of medium submitted by each company are given in Tables II through XXII for machines A through U, respectively.

It may be seen in Figure 1 and Table I that the average caliper results for the single-faced boards varied from a low value of 193.1 points for Machine Q to a high value of 198.7 points for Machine A. Likewise, from the results given in Table I and Figure 2, it may be noted that the average caliper difference between consecutive flutes ranged from a minimum of 1.3 points for Machines D, H, and K to a maximum of 3.0 points for Machine B. The majority of the machines were associated with average caliper differences of two points or less.

TABLE I

SUMMARY OF CURRENT MACHINE AVERAGES
December, 1960

Machine	Number of Rolls	Caliper, points	Caliper Difference Between Consecutive Flutes, points	Single-Face Flat Crush, p.s.i.
A	4	198.7	1.4	30.6
B	4	198.1	3.0	31.0
C	6	196.6	1.7	25.4
D	4	196.4	1.3	35.4
E	4	196.2	1.6	34.2
F	5	197.4	1.7	35.5
G	5	195.4	1.8	35.6
H	4	196.8	1.3	33.1
I	2	195.7	1.9	34.0
J	5	196.3	2.0	31.2
K	1	195.7	1.3	35.2
L	2	196.6	2.0	32.9
M	5	194.6	1.8	35.7
N	4	194.6	2.0	34.8
O	4	198.4	2.2	33.3
P	4	196.0	1.8	33.4
Q	8	193.1	2.2	32.2
R	6	196.8	2.5	30.9
S	6	196.6	1.9	33.1
T	5	195.9	2.5	32.3
U	1	Note a	Note a	Note a
Total	89			

[a] Single-face flat crush and caliper could not be determined because the medium fractured at less than 100 f.p.m.

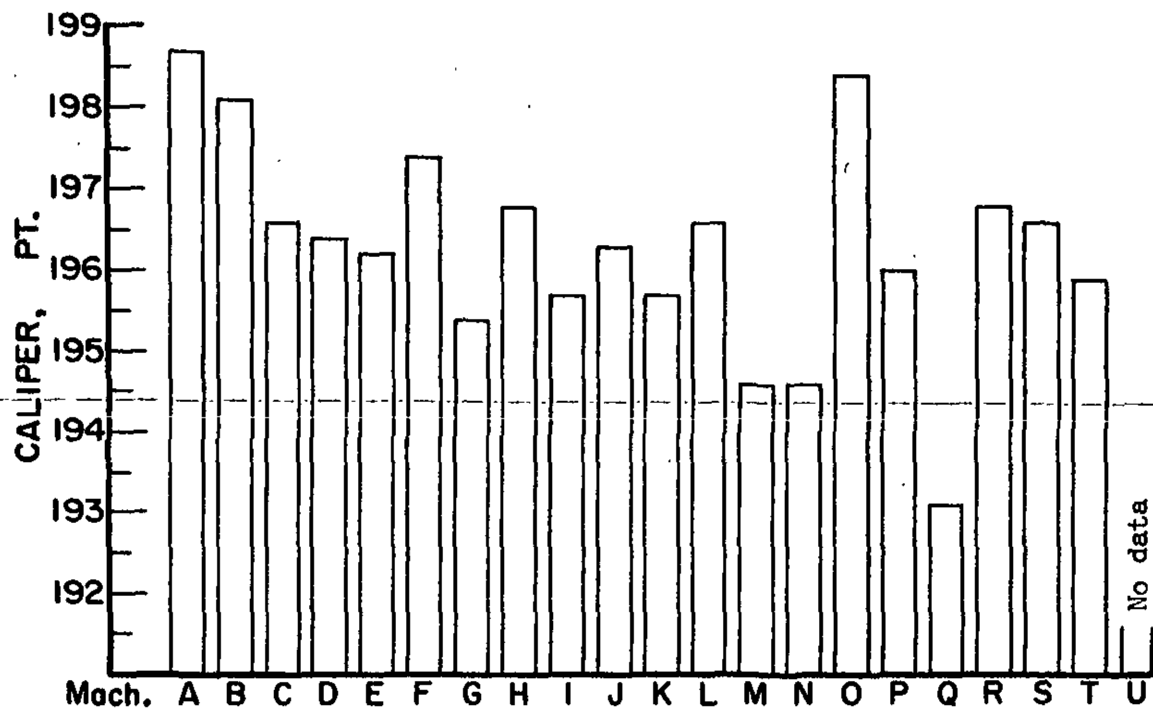

Figure 1. Comparison of Caliper Results on Single-Faced Board
December, 1960

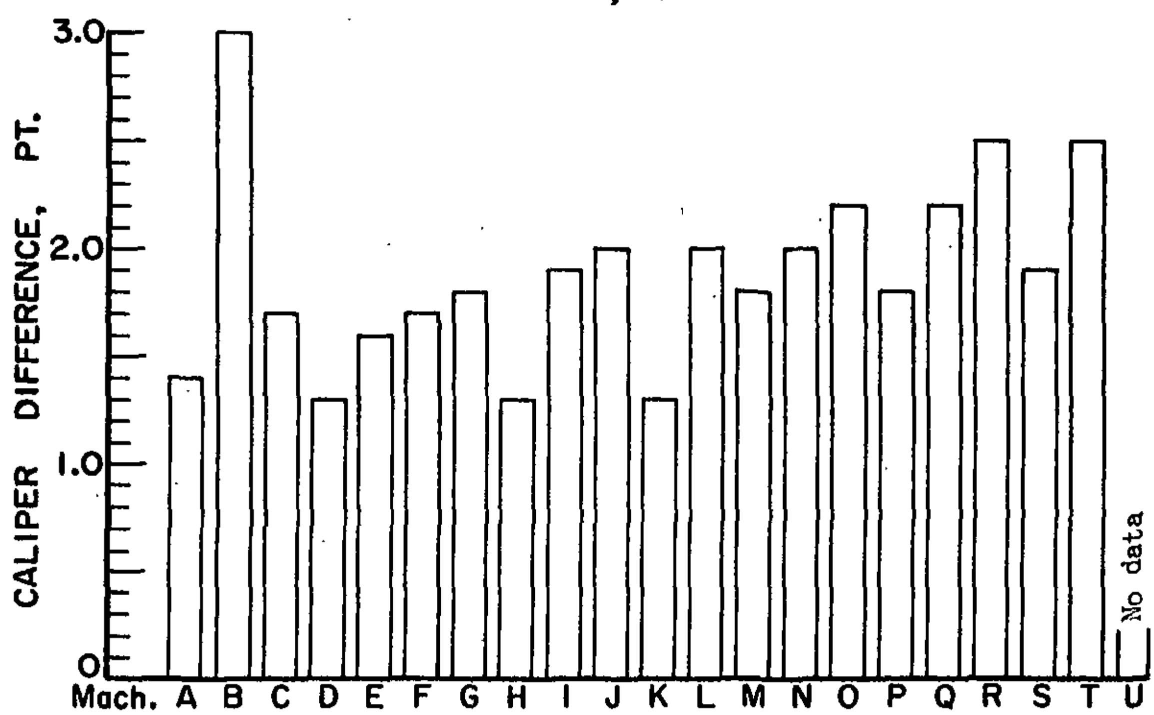

Figure 2. Comparison of the Caliper Differences Between Consecutive
Flutes of Single-Faced Board, December, 1960

TABLE II

SUMMARY OF TEST RESULTS FOR MACHINE A
December, 1960

Code	Date Made	Mill Roll No.	Caliper, pt.	Caliper Difference Between Consecutive Flutes, pt. Max.	Min.	Av.	Single-Face Flat Crush, p.s.i.	Runability (Maximum Tension at 600 f.p.m.), lb./in.
A-1	11-30-60	423	197.9	3.5	0.1	1.1	31.5	1
A-2	11-30-60	424	198.0	3.8	0.0	1.5	30.9	1
A-3	12- 7-60	431	199.3	3.8	0.2	1.6	30.4	1-1/2
A-4	12- 7-60	432	199.5	3.7	0.0	1.4	29.8	1
Current Machine Av.			198.7			1.4	30.6	

TABLE III

SUMMARY OF TEST RESULTS FOR MACHINE B
December, 1960

B-1	11-29-60	355	197.8	6.9	0.7	3.5	33.6	1
B-2	11-29-60	356	199.4	6.7	0.4	3.0	28.1	1
B-3	12- 7-60	357	197.1	5.2	0.0	2.7	33.9	1-1/2
B-4	12-14-60	358	198.2	5.9	0.0	2.7	28.5	1-1/2
Current Machine Av.			198.1			3.0	31.0	

TABLE IV

SUMMARY OF TEST RESULTS FOR MACHINE C
December, 1960

C-1	12- 5-60	46	196.7	3.5	0.5	2.0	25.1	1-1/2
C-2	12- 5-60	47	196.1	3.7	0.0	1.7	26.8	1-1/2
C-3	12- 6-60	48	196.8	2.4	0.3	1.3	24.6	1-1/2
C-4	12- 6-60	49	196.1	3.1	0.0	1.0	26.1	1-1/2
C-5	12- 7-60	50	196.7	4.0	0.4	1.9	25.7	1-1/2
C-6	12- 7-60	51	197.3	7.8	0.5	2.5	24.4	1-1/2
Current Machine Av.			196.6			1.7	25.4	

TABLE V

SUMMARY OF TEST RESULTS FOR MACHINE D
December, 1960

Code	Date Made	Mill Roll No.	Caliper, pt.	Caliper Difference Between Consecutive Flutes, pt.			Single-Face Flat-Crush, p.s.i.	Runability (Maximum Tension at 600 f.p.m.), lb./in.
				Max.	Min.	Av.		
D-1	11-22-60	421	195.1	2.9	0.1	1.3	37.5	1-1/2
D-2	11-22-60	422	195.4	2.5	0.2	1.2	36.5	1-1/2
D-3	12- 6-60	429	198.2	4.2	0.1	1.8	32.0	1-1/2
D-4	12- 6-60	430	197.0	2.9	0.1	1.0	35.5	1-1/2
Current Machine Av.			196.4			1.3	35.4	

TABLE VI

SUMMARY OF TEST RESULTS FOR MACHINE E
December, 1960

E-1	11-24-60	--	196.4	3.1	0.0	1.3	35.3	1
E-2	12- 6-60	--	195.9	5.4	0.2	2.5	34.0	1/2
E-3	12- 7-60	--	195.9	5.0	0.0	1.5	33.4	1/2
E-4	12-13-60	--	196.4	3.2	0.0	1.0	34.0	1
Current Machine Av.			196.2			1.6	34.2	

TABLE VII

SUMMARY OF TEST RESULTS FOR MACHINE F
December, 1960

F-1	11- 9-60	292	196.6	4.4	0.0	1.7	37.8	1/2
F-2	11-17-60	293	198.6	3.8	0.0	1.5	35.9	1/2
F-3	11-23-60	294	196.6	4.7	0.0	1.9	34.2	1/2
F-4	12- 1-60	295	197.2	5.8	0.5	1.9	35.9	1
F-5	12- 5-60	296	197.8	2.0	0.0	1.3	33.7	1
Current Machine Av.			197.4			1.7	35.5	

TABLE VIII

SUMMARY OF TEST RESULTS FOR MACHINE G
December, 1960

Code	Date Made	Mill Roll No.	Caliper, pt.	Caliper Difference Between Consecutive Flutes, pt. Max.	Min.	Av.	Single-Face Flat Crush, p.s.i.	Runability (Maximum Tension at 600 f.p.m.), lb./in.
G-1	10-11-60	426	192.9	2.5	0.0	1.2	33.7	Min.
G-2	11-27-60	427	196.0	4.8	0.0	1.5	37.3	Min.
G-3	11-28-60	428	196.4	5.8	0.0	2.4	35.7	Min.
G-4	12- 1-60	429	195.8	4.0	0.2	2.1	35.5	1-1/2
G-5	12- 5-60	430	195.8	5.6	0.1	1.7	35.6	1-1/2
Current Machine Av.			195.4			1.8	35.6	

TABLE IX

SUMMARY OF TEST RESULTS FOR MACHINE H
December, 1960

H-1	11-23-60	--	197.8	3.9	0.0	1.6	33.7	1-1/2
H-2	12- 6-60	--	196.5	4.0	0.3	1.7	31.6	1-1/2
H-3	12- 9-60	--	196.5	2.4	0.0	1.0	33.9	1-1/2
H-4	12-14-60	--	196.5	2.8	0.2	0.9	33.2	1
Current Machine Av.			196.8			1.3	33.1	

TABLE X

SUMMARY OF TEST RESULTS FOR MACHINE I
December, 1960

I-1	11-29-60	427	195.5	6.5	0.0	2.0	34.6	1-1/2
I-2	11-29-60	428	195.9	4.0	0.0	1.8	33.3	1-1/2
Current Machine Av.			195.7			1.9	34.0	

TABLE XI

SUMMARY OF TEST RESULTS FOR MACHINE J
December, 1960

Code	Date Made	Mill Roll No.	Caliper, pt.	Caliper Difference Between Consecutive Flutes, pt. Max.	Min.	Av.	Single-Face Flat Crush, p.s.i.	Runability (Maximum Tension at 600 f.p.m.), lb./in.
J-1	11-16-60	124	196.2	2.0	0.0	0.9	31.8	1/2
J-2	11-18-60	125	196.2	7.5	0.2	3.2	32.4	1
J-3	11-20-60	126	195.9	3.7	0.1	1.7	31.4	1/2
J-4	11-24-60	127	195.8	5.6	0.6	3.0	30.0	Min.
J-5	12- 8-60	128	197.5	3.5	0.0	1.2	30.5	1-1/2
Current Machine Av.			196.3			2.0	31.2	

TABLE XII

SUMMARY OF TEST RESULTS FOR MACHINE K
December, 1960

K-1	11-23-60	80	195.7	3.9	0.2	1.3	35.2	1-1/2
Current Machine Av.			195.7			1.3	35.2	

TABLE XIII

SUMMARY OF TEST RESULTS FOR MACHINE L
December, 1960

L-1	10-30-60	4934	196.2	4.0	0.4	2.2	33.6	Min.
L-2	11- 3-60	314	197.0	5.3	0.5	1.9	32.2	1/2
Current Machine Av.			196.6			2.0	32.9	

TABLE XIV

SUMMARY OF TEST RESULTS FOR MACHINE M
December, 1960

M-1	11- 4-60	96	193.1	5.7	0.0	1.4	34.6	Min.
M-2	11-10-60	296	195.3	3.5	0.0	1.1	36.0	1/2
M-3	11-17-60	512	195.8	4.3	0.0	1.2	36.5	Min.
M-4	11-28-60	840	193.4	5.4	0.0	2.1	36.1	Min.
M-5	11-30-60	911	195.4	6.5	0.0	3.0	35.4	Min.
Current Machine Av.			194.6			1.8	35.7	

TABLE XV

SUMMARY OF TEST RESULTS FOR MACHINE N
December, 1960

Code	Date Made	Mill Roll No.	Caliper, pt.	Caliper Difference Between Consecutive Flutes, pt. Max.	Min.	Av.	Single-Face Flat Crush, p.s.i.	Runability (Maximum Tension at 600 f.p.m.), lb./in.
N-1	11-23-60	599	195.6	3.4	0.0	1.4	35.4	1
N-2	12- 7-60	600	192.0	6.0	0.3	2.6	33.3	1/2
N-3	12- 9-60	601	195.1	4.0	0.2	1.6	35.9	1/2
N-4	12-14-60	602	195.8	4.5	0.2	2.5	34.7	1
Current Machine Av.			194.6			2.0	34.8	

TABLE XVI

SUMMARY OF TEST RESULTS FOR MACHINE O
December, 1960

O-1	11-16-60	417	197.4	6.0	0.1	2.5	33.1	1/2
O-2	11-16-60	418	196.9	5.1	0.1	1.8	33.9	1/2
O-3	11-30-60	425	200.7	5.7	0.0	2.0	32.0	Min.
O-4	11-30-60	426	198.8	4.1	0.0	2.4	34.2	Min.
Current Machine Av.			198.4			2.2	33.3	

TABLE XVII

SUMMARY OF TEST RESULTS FOR MACHINE P
December, 1960

P-1	11-22-60	--	196.2	4.0	0.0	1.5	36.3	1-1/2
P-2	12- 6-60	--	195.9	5.6	0.3	2.2	32.3	1/2
P-3	12- 9-60	--	195.4	2.5	0.0	1.1	32.0	1/2
P-4	12-16-60	--	196.3	5.3	0.5	2.4	32.8	1-1/2
Current Machine Av.			196.0			1.8	33.4	

TABLE XVIII

SUMMARY OF TEST RESULTS FOR MACHINE Q
December, 1960

Code	Date Made	Mill Roll No.	Caliper, pt.	Caliper Difference Between Consecutive Flutes, pt. Max.	Min.	Av.	Single-Face Flat Crush, p.s.i.	Runability (Maximum Tension at 600 f.p.m.), lb./in.
Q-1	11-21-60	45	192.2	2.0	0.1	0.8	33.5	1
Q-2	11-21-60	46	191.3	5.1	0.0	2.4	31.9	1
Q-3	11-21-60	47	191.8	3.8	0.2	1.7	29.4	1/2
Q-4	11-21-60	48	192.3	3.4	0.1	1.2	31.6	1/2
Q-5	12- 5-60	49	194.2	9.5	1.0	3.9	33.2	1-1/2
Q-6	12- 5-60	50	194.2	6.0	0.4	2.8	32.5	1-1/2
Q-7	12- 6-60	51	194.3	6.9	0.0	2.3	32.5	1-1/2
Q-8	12- 6-60	52	194.4	4.9	0.6	2.8	32.6	1-1/2
Current Machine Av.			193.1			2.2	32.2	

TABLE XIX

SUMMARY OF TEST RESULTS FOR MACHINE R
December, 1960

R-1	11-11-60	49	195.4	4.9	0.5	3.0	31.9	1-1/2
R-2	11-11-60	50	195.6	3.3	0.0	1.2	31.7	1-1/2
R-3	11-29-60	51	197.6	8.2	0.0	3.9	29.6	1/2
R-4	11-29-60	52	197.2	6.8	0.0	2.8	29.7	1/2
R-5	11-29-60	53	196.9	4.5	0.1	1.7	31.9	1-1/2
R-6	11-29-60	54	197.8	5.0	0.4	2.5	30.9	1-1/2
Current Machine Av.			196.8			2.5	30.9	

TABLE XX

SUMMARY OF TEST RESULTS FOR MACHINE S
December, 1960

S-1	11-19-60	407	196.8	2.8	0.0	1.4	36.5	Min.
S-2	11-19-60	408	196.4	4.4	0.0	1.4	33.2	1/2
S-3	11-20-60	409	197.8	7.2	0.1	2.7	31.6	Note a
S-4	11-22-60	410	197.0	2.8	0.1	1.0	33.0	1
S-5	11-23-60	411	195.9	4.3	0.2	2.1	34.8	Note a
S-6	12- 1-60	412	195.9	4.8	0.5	2.6	29.4	Min.
Current Machine Av.			196.6			1.9	33.1	

[a] Maximum speed at which this roll could be corrugated with minimum tension was 575 f.p.m.

TABLE XXI

SUMMARY OF TEST RESULTS FOR MACHINE T
December, 1960

Code	Date Made	Mill Roll No.	Caliper, pt.	Caliper Difference Between Consecutive Flutes, pt. Max.	Min.	Av.	Single-Face Flat Crush, p.s.i.	Runability (Maximum Tension at 600 f.p.m.), lb./in.
T-1	11-30-60	K-1	196.4	5.4	0.8	2.7	32.9	1-1/2
T-2	11-30-60	K-2	195.8	7.6	0.0	3.1	32.0	1-1/2
T-3	11-30-60	K-3	195.4	4.1	0.0	1.6	33.7	1-1/2
T-4	11-30-60	K-4	195.7	5.0	0.0	1.7	31.3	1/2
T-5	11-30-60	K-5	196.0	5.7	0.3	3.2	31.6	1
Current Machine Av.			195.9			2.5	32.3	

TABLE XXII

SUMMARY OF TEST RESULTS FOR MACHINE U
December, 1960

U-1	11-21-60	7	Note a		Note a		Note a	Note a
Current Machine Av.			--			--	--	

[a] Single-face flat crush and caliper could not be determined because the medium fractured at less than 100 f.p.m.

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