

O T T A W A

July 23, 1945.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1909.

Effect of Salt Spray and Ordinary Atmospheric
Corrosion on Coated Steel Strapping.

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Report of Investigation
No. 1909, July 23, 1945.

RRR:LB.

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Background:

Letters dated May 23 and May 29, 1945, from Mr. H. B. Percival of the Office of the Ministry of War Transport of the United Kingdom, Windsor Station, Montreal 3, Canada, requested that samples of steel strapping, of different kinds and having different protective coatings, be tested to determine the effect of corrosion on them.

The letters state that strapping materials are used on crates for transporting hatch covers which go with barges. Further information supplied is:

"The crates for this equipment are quite heavy and there is a considerable amount of strain placed on the strap itself when the crates are being handled during transport. The steel strap is for reinforcement purposes

(Background, cont'd) -

and where it can be used allows for much lighter type of crates or cases to be used and results in considerable saving of lumber crating material. Therefore it is important that the strap maintain its strength and elasticity under all the various conditions."

"The cases or crates on which the strap is used will, in many cases, be exposed to the weather elements for a considerable length of time when in transit on railway cars, or while lying in outside storage."

"The cases and crates will be in fresh water air and salt water air areas."

"The temperature conditions will likely vary from 30° below zero up to at least 115° F. above."

"The humidity in some areas will be relatively high, probably up to 100 per cent."

Undoubtedly the information obtained in this investigation will be useful in other wartime purposes and also in peacetime purposes.

EXPERIMENTS PERFORMED:

The various samples of steel strapping received, together with their designations, are listed in Table I.

The following experiments were performed:

(1) Two samples of each kind of strap were submitted to mechanical test to determine the breaking load, maximum stress, 0.2 per cent proof stress, and elongation. The results are given in Table II.

The load strength of the sealed joint on each of the straps also was determined. The results are given in Table IV.

(2) Three samples of each kind of strap, with sealed joints attached, were placed in the Salt Spray Cabinet, in which 20 per cent salt (sodium chloride) solution and a temperature of about 95° F. were used. After removal from the cabinet

(Experiments Performed, cont'd) -

the samples were subjected to mechanical test.

(3) Three samples of each kind of strap, with sealed joints attached, were placed in the Weather-Ometer. Here they were exposed for the whole time to light resembling sunlight produced by an electric arc, also to a spray of ordinary tap water for three minutes out of every twenty. The temperature was about 125° F. At the end of the time in the Weather-Ometer the samples were removed and subjected to mechanical test.

(4) The thickness of the zinc coatings on the galvanized straps was determined.

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TABLE I. - Samples of Steel Strap and Sealed Joints Submitted.

1. - Salt Spray Test.

<u>TYPE OF STRAP</u>	<u>EXHIBIT NO.</u>
Acme - 1 $\frac{1}{4}$ " .035 - painted	A
do	AA
do	AAA
Signode - 1 $\frac{1}{4}$ " .035 - unpainted	B
do	BB
do	BBB
Acme - $\frac{3}{4}$ " .035 - painted	C
do	CC
do	CCC
Signode - $\frac{3}{4}$ " .035 - painted	D
do	DD
do	DDD
Acme - 5/8" .020 - painted	E
do	EE
do	EEE
Signode - 5/8" .020 - painted	F
do	FF
do	FFF
Acme - 5/8" .018 - galvanized	G
do	GG
do	GGG
Signode - 5/8" .020 - galvanized	H
do	HH
do	HHH

(Experiments Performed, cont'd) -

TABLE I (cont'd)

2. - Humidity Test

<u>TYPE OF STRAP</u>	<u>EXHIBIT NO.</u>
Acme - 1 $\frac{1}{4}$ ".035 - painted	J
do	JJ
do	JJJ
Signode - 1 $\frac{1}{4}$ ".035 - unpainted	K
do	KK
do	KKK
Acme - $\frac{3}{4}$ ".035 - painted	L
do	LL
do	LLL
Signode - $\frac{3}{4}$ ".035 - painted	M
do	MM
do	MMM
Acme - 5/8".020 - painted	N
do	NN
do	NNN
Signode - 5/8".020 - painted	O
do	OO
do	OOO
Acme - 5/8".018 - galvanized	P
do	PP
do	PPP
Signode - 5/8".020 - galvanized	Q
do	QQ
do	QQQ

3. - Mechanical Test

Acme - 1 $\frac{1}{4}$ ".035 - painted	R
do	RR
Signode - 1 $\frac{1}{4}$ ".035 - unpainted	S
do	SS
Acme - $\frac{3}{4}$ ".035 - painted	T
do	TT
Signode - $\frac{3}{4}$ ".035 - painted	U
do	UU
Acme - 5/8".020 - painted	V
do	VV
Signode - 5/8".020 - painted	W
do	WW
Acme - 5/8".018 - galvanized	X
do	XX
Signode - 5/8".020 - galvanized	Y
do	YY

TABLE II. - Mechanical Properties of Steel Strapping Prior to Corrosion.

Sample Designation	: Size of Strap, (in. x in.) : A = Acme : S = Signode:	: Strap Gauged to - (in. x in.)	: Area of Section, Sq. in.	: Breaking Load, pounds	: Max. Stress, p.s.i.	: 0.2% Proof Stress, p.s.i.	: Elongation in 2 inches, per cent
R	: 1 1/4 x 0.035 A	: 1.248 x 0.036	: 0.0449	: 4,840	: 107,700	: 71,200	: 18.0
RR	: do	: 1.247 x 0.036	: 0.0449	: 4,600	: 102,500	: 67,000	: 21.0
S	: 1 1/4 x 0.035 S	: 1.254 x 0.037	: 0.0463	: 5,100	: 110,000	: 59,400	: 10.0
SS	: do	: 1.250 x 0.037	: 0.0462	: 5,300	: 114,700	: 65,800	: 15.0
T	: 3/4 x 0.035 A	: 0.74 x 0.036	: 0.0271	: 3,050	: 112,500	: 70,200	: 18.0
TT	: do	: 0.749 x 0.035	: 0.0262	: 2,810	: 110,700	: 62,400	: 17.5
U	: 3/4 x 0.035 S	: 0.747 x 0.035	: 0.0261	: 2,640	: 101,000	: 61,300	: 20.0
UU	: do	: 0.750 x 0.035	: 0.0262	: 2,560	: 97,400	: 55,400	: 20.5
V	: 5/8 x 0.020 A	: 0.625 x 0.020	: 0.0125	: 996	: 79,600	: 73,000	: 8.0
VV	: do	: 0.625 x 0.0195	: 0.0125	: 920	: 73,600	: 70,800	: 7.0
W	: 5/8 x 0.020 S	: 0.626 x 0.020	: 0.0125	: 1,200	: 96,000	: 87,200	: 4.0
WW	: do	: 0.626 x 0.020	: 0.0125	: 1,204	: 96,200	: 90,000	: 2.0
X	: 5/8 x 0.018 A	: 0.625 x 0.0165	: 0.0106	: 1,190	: 112,200	: --	: 5.0
XX	: do	: 0.625 x 0.0165	: 0.0103	: 1,170	: 113,500	: 113,500	: 4.5
Y	: 5/8 x 0.020 S	: 0.630 x 0.021	: 0.0132	: 1,414	: 107,100	: 107,000	: 3.5
YY	: do	: 0.630 x 0.021	: 0.0132	: 1,424	: 108,000	: 107,500	: 3.5

(Experiments Performed, cont'd) -

(Experiments Performed, cont'd) -

LOG OF SALT SPRAY TEST.

After 2
days:

All A, B, D and F samples were badly corroded on the surface of straps and sealed joints.

All C and E samples were not quite so badly corroded on straps and sealed joints.

All G and H samples were covered with white corrosion product from the zinc coatings. In many spots iron rust was visible. The early failure of the zinc coatings was not unexpected in view of their thinness. The thickness varied between 0.00006 inch and 0.00032 inch as measured by the Aminco-Brenner Magne-Gage. See Table VII.

After 19
days:

All samples designated by double letter (AA, BB, etc.) were removed from the Salt Spray Cabinet and the straps and sealed joints were submitted to mechanical test. The results are given in Tables III and IV and Figures 1 to 8 inclusive.

After 21
days:

All remaining samples, i.e., samples designated by single and triple letters, were removed from the cabinet and the straps and sealed joints were submitted to mechanical test. The results are given in Tables III and IV and Figures 1 to 8 inclusive.

(Continued on next page)

(Experiments Performed, cont'd) -

It should be noted that in the case of all corroded samples the maximum stress and 0.2 per cent proof stress were calculated on the basis of the cross-sectional area of the corresponding uncorroded samples.

In Figure 17 the breaking load of the various straps is plotted against the number of days of corrosion in the Salt Spray Cabinet.

(Tables III and IV
follow, on Pages 8 to 11.)
(Text is resumed on Page 12.)

TABLE III. - Data on Corrosion of Straps Before and After Treatment in the Salt Spray Cabinet.

Sample Designation	Size of Strap (in. x in.) A = Acme S = Signode	Breaking Load, pounds			Maximum Stress, p.s.i.			0.2% Proof Stress, p.s.i.			Elongation in 2 inches, per cent			Condition of strap. See Fig. No.
		Uncor- roded	After 19 days	After 21 days	Uncor- roded	After 19 days	After 21 days	Uncor- roded	After 19 days	After 21 days	Uncor- roded	After 19 days	After 21 days	
R RR	1½ x 0.035 A	4,840 4,600			107,700 102,500			71,200 67,000			18.0 21.0			
AA A AAA	" " "		4,200	5,100 4,540		93,500	113,500 101,000		61,300	72,200 67,900		7.5	11.5	1 1
S S	" S	5,100 5,300			110,000 114,700			59,400 65,800			10.0 15.0			
BB B BBB	" " "		4,500	4,580 4,440		97,400	99,200 96,200		65,000	61,900 60,600		4.0	10.5	2 2
T TT	¾ x 0.035 A	3,050 2,810			112,500 110,700			70,200 62,400			18.0 17.5			
CC C CCC	" " "		2,700	2,620 2,740		103,000	100,000 104,500		65,000	55,400 65,600		6.0	13.0	3 3
U UU	" S	2,640 2,560			101,000 97,400			61,300 55,400			20.0 20.5			
DD D DDD	" " "		2,500	1,980 2,220		95,400	75,600 84,600		N.D.	N.D. 49,600		10.5	- 9.0	4 4

Experiments Performed, cont'd.

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(Continued on next page)

TABLE III (cont'd) - Data on Corrosion of Straps Before and After Treatment in the Salt Spray Cabinet.

Sample Designation	Size of Strap (in. x in.) A = Acme S = Signode	Breaking Load, pounds			Maximum Stress, p.s.i.			0.2% Proof Stress, p.s.i.			Elongation in 2 inches, per cent			Condition of trap, See Fig. No.
		Uncor- roded	After 19 days	After 21 days	Uncor- roded	After 19 days	After 21 days	Uncor- roded	After 19 days	After 21 days	Uncor- roded	After 19 days	After 21 days	
V	5/8 x 0.020 A	996			79,600			73,000			8.0			
VV	"	920			73,600			70,800			7.0			
EE	"		780			61,600			61,600		1.5			
E	"			710			56,800			N.D.		3.0		5
EEE	"			760			60,800			"		-		5
W	" S	1,200			96,000			87,200			4.0			
WW	"	1,204			96,200			90,000			2.0			
FF	"		1,080			86,400			85,600		1.0			
F	"			1,030			82,400			N.D.		4.0		6
FFF	"			940			75,200			"		-		6
X	5/8 x 0.018 A	1,190			112,200			-			5.0			
XX	"	1,170			113,500			113,500			4.5			
GG	"		1,080			105,000			105,000		1.0			
G	"			986			95,800			N.D.		3.5		7
GGG	"			990			96,100			"		-		7
Y	5/8 x 0.020 S	1,414			107,100			107,000			3.5			
YY	"	1,424			108,000			107,500			3.5			
HH	"		1,344			102,000			91,600		2.0			
H	"			1,340			101,500			97,800		10.0		8
HHH	"			1,314			99,600			95,500		-		8

N.D. = Not determined.

(Experiments Performed, cont'd)

(Page 3)

TABLE IV. - Breaking Load of Sealed Joints Before and After Treatment in the Salt Spray Cabinet.

Sample Designation	Size of Strap (in. x in.) A = Acme S = Signode	Breaking Load, pounds			75% of Breaking Load of Strap, pounds	REMARKS	Condition of Joint. See Figure No.
		Uncor- roded	After 19 days	After 21 days			
R	1 1/4 x 0.035 A	3,200			3,630	Pulled out of clamp.	
RR		3,210			3,450	" " "	
AA	"		3,440			Broke in clamp.	1(c)
A	"			4,140		" " "	1(d)
AAA	"			3,360		Sheared in clamp.	1(e)
S	" S	3,580			3,825	Broke in clamp.	
SS		4,050			3,970	" " "	
BB	" "		2,940			Pulled out of clamp.	2(c)
B				2,900		" " " "	2(d)
BBB				3,160		" " " "	2(e)
T	5/4 x 0.035 A	2,300			2,290	Broke in clamp.	
TT		2,240			2,110	Pulled out of clamp.	
CC	" "		2,300			Broke in clamp.	3(c)
C				2,460		Sheared in clamp.	3(d)
CCC				2,240		Pulled out of clamp.	3(e)
U	" S	1,600			1,980	Clamp split.	
UU		1,620			1,920	" "	
DD	" "		1,660			Pulled out of clamp.	4(c)
D				1,660		" " " "	4(d)
DDD				1,800		" " " "	4(e)

Experiments Performed, cont'd

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(Continued on next page)

TABLE IV (cont'd) - Breaking Load of Sealed Joints Before and After Treatment in the Salt Spray Cabinet.

Sample Designation	Size of Strap (in. x in.) A = Acme S = Signode	Breaking Load, pounds			75% of Breaking Load of Strap, pounds	REMARKS	Condition of Joint. See Figure No.
		Uncor roded	After 19 days	After 21 days			
V	5/8 x 0.020 A	860			746	Broke in clamp.	
VV	"	880			690	" " "	
EE	"		740			Broke outside of clamp.	
E	"			700		" " " "	
EEE	"			790		" " " "	
W	" S	940			900	Broke in clamp.	
WW	"	944			903	" " "	
FF	"		954			" " "	6(c)
F	"			950		" " "	6(d)
FFF	"			860		" " "	6(e)
X	5/8 x 0.018 A	1,024			893	Broke in clamp.	
XX	"	1,080			878	" " "	
GG	"		1,084			Broke outside of clamp.	
G	"			1,004		" " " "	
GGG	"			860		" " " "	
Y	5/8 x 0.020 S	1,070			1,060	Broke in clamp.	
YY	"	1,058			1,068	" " "	
HH	"		1,076			" " "	8(c)
H	"			1,064		" " "	8(d)
HHH	"					" " "	8(e)

(Experiments Performed, cont'd) -

LOG OF WEATHER-OMETER TEST.

After 5 days:

- | | | |
|--|---|--|
| J, JJ, JJJ
K, KK, KKK
M, MM, MMM | - | Straps had some rust but none had appeared on the sealed joints. |
| L, LL, LLL
N, NN, NNN | - | Small amount of corrosion on the straps. Seal joints all had started to corrode. |
| O, OO, OOO | - | Straps were corroded over the entire surface. Seal joints were still unaffected. |
| P, PP, PPP | - | Straps still uncorroded. One seal joint had started to corrode. |
| Q, QQ, QQQ | - | Straps still uncorroded. All seal joints had started to corrode. |

After 16 days:

All samples designated by double letter (JJ, KK, etc.) were removed from the Weather-Ometer and the straps and sealed joints were submitted to mechanical test. The results are given in Tables V and VI and Figures 9 to 16 inclusive.

After 19 days:

All remaining samples, i.e., samples designated by single and triple letters, were removed from the Weather-Ometer and the straps and sealed joints were submitted to mechanical test. The results are given in Tables V and VI and Figures 9 to 16 inclusive.

It should be noted that in the case of all corroded samples the maximum stress and 0.2 per cent proof stress were calculated on the basis of the cross-sectional area of the

(Experiments Performed, cont'd) -

corresponding uncorroded samples.

In Figure 18 the breaking load of the various straps is plotted against the number of days of corrosion in the Weather-Ometer.

(Tables V and VI
(follow, on Pages 14)
(to 17. Text resumed)
(on Page 18.)

TABLE V. - Data on Corrosion of Straps Before and After Treatment in the Weather-Ometer.

Sample Designation	Size of Strap (in. x in.) A = Acme S = Signode	Breaking Load, pounds			Maximum Stress, p.s.i.			0.2% Proof Stress, p.s.i. :			Elongation in 2 inches, per cent			Condition of Strap. See Fig. No.
		Uncor-roded	After 16 days	After 19 days	Uncor-roded	After 16 days	After 19 days	Uncor-roded	After 16 days	After 19 days	Uncor-roded	After 16 days	After 19 days	
		R	1 1/4 x 0.035 A	4,840			107,700			71,200			18.0	
RR	"	4,600			102,500			67,000			21.0			
JJ	"		4,600			102,500			68,400			18.5		
J	"			4,500				100,100					12.0	9(a)
JJJ	"			4,420				98,400					16.5	9(b)
S	" S	5,100			110,000			59,450			10.0			
SS	"	5,300			114,700			65,800			15.0			
KK	"		4,960			107,300			64,000			6.5		
K	"			5,000				108,200					8.0	10(a)
KKK	"			5,060				109,500					11.0	10(b)
T	3/4 x 0.035 A	3,050			112,500			70,200			18.0			
TT	"	2,810			110,700			62,400			17.5			
LL	"		2,880			110,000			66,800			19.0		
L	"			2,800				106,900					10.0	11(a)
LLL	"			2,800				106,900					17.0	11(b)
U	" S	2,640			101,000			61,300			20.0			
UU	"	2,560			97,400			55,400			20.5			
MM	"		2,560			97,800			58,400			10.0		
M	"			2,600				99,300					20.0	12(a)
MMM	"			2,600				99,300					17.0	12(b)

Experiments Performed, cont'd

(Continued on next page)

TABLE V (cont'd) - Data on Corrosion of Straps Before and After Treatment in the Weather-Ometer.

Sample Designation	Size of strap (in. x in.) A = Acme S = Signode	Breaking Load, pounds			Maximum Stress, p.s.i.			0.2% Proof Stress, p.s.i.			Elongation in 2 inches, per cent			Condition of Strap. See Fig. No.
		Uncor- roded	After 16 days	After 19 days	Uncor- roded	After 16 days	After 19 days	Uncor- roded	After 16 days	After 19 days	Uncor- roded	After 16 days	After 19 days	
V VV	5/8 x 0.020 A "	996 920			79,600 73,600			73,000 70,800			8.0 7.0			
NN N NNN	" " "		920	936 960		73,600	74,900 76,800		72,300	72,000 N.D.		4.5	2.5 7.0	13(a) 13(b)
W WW	" S	1,200 1,204			96,000 96,200			87,200 90,000			4.0 2.0			
OO O OOO	" " "		1,154	1,070 1,164		92,300	85,600 93,000		92,000	N.D. 91,700		2.0	- 11.5	14(a) 14(b)
X XX	5/8 x 0.018 A "	1,190 1,170			112,200 113,500			- 113,500			5.0 4.5			
PP P PPP	" " "		1,210	1,204 1,160		117,500	116,800 112,600		117,500	N.D. N.D.		2.5	3.0 3.0	15(a) 15(b)
Y YY	5/8 x 0.020 S "	1,414 1,424			107,100 108,000			107,000 107,500			3.5 3.5			
QQ Q QQQ	" " "		1,410	1,410 1,432		106,700	106,800 108,500		101,500	103,700 106,000		5.5	3.0 5.5	16(a) 16(b)

N.D. = Not determined.

Experiments Performed, cont'd

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TABLE VI. - Breaking Load of Sealed Joints Before and After Treatment in the Weather-Ometer.

Sample Designation	Size of Strap (in. x in.) A = Acme S = Signode	Breaking Load, pounds			75% of Breaking Load of Strap, pounds	REMARKS	Condition of Joint. See Figure No.
		Uncor-roded	After 16 days	After 19 days			
R	1½ x 0.035 A	3,200			3,630	Pulled out of clamp.	
RR		3,210			3,450	" " " "	
JJ	" "		3,400			Broke in clamp.	9(c)
J				3,950		" " "	9(d)
JJJ					3,000	" " "	9(e)
S	" S	3,580			3,825	Broke in clamp.	
SS		4,050			3,970	" " "	
KK	" "		4,240			" " "	10(c)
K				3,800		" " "	10(d)
KKK					4,400	" " "	10(e)
T	¾ x 0.035 A	2,300			2,290	Broke in clamp.	
TT		2,240			2,110	Pulled out of clamp.	
LL	" "		2,300			Broke in clamp.	11(c)
L				2,500		" " "	11(d)
LLL					1,900	" " "	11(e)
U	" S	1,600			1,980	Clamp split.	
UU		1,620			1,920	" "	
MM	" "		1,900			Pulled out of clamp.	12(c)
M				2,000		" " " "	12(d)
MMM					1,800	" " " "	12(e)

Experiments Performed, cont'd

(Continued on next page)

TABLE VI (cont'd) - Breaking Load of Sealed Joints Before and After Treatment in the Weather-Ometer.

Sample Designation	Size of Strap (in. x in.) A = Acme S = Signode	Breaking Load, pounds			75% of Breaking Load of Strap, pounds	REMARKS	Condition of Joint. See Figure No.
		Uncor- roded	After 16 days	After 19 days			
V VV	5/8 x 0.020 A	860 880			746 690	Broke in clamp. " " "	
NN N NNN	"		946			" " "	13(c) 13(d) 13(e)
				890 890		" " "	
W WW	" S	940 944			900 903	Broke in clamp. " " "	
OO O OOO	"		958			" " "	14(c) 14(d) 14(e)
				960 1,000		" " "	
X XX	5/8 x 0.018 A	1,024 1,080			893 878	Broke in clamp. " " "	
PP P PPP	"		1,100			" " "	15(c) 15(d) 15(e)
				1,070 1,085		" " "	
Y YY	5/8 x 0.020 S	1,070 1,058			1,060 1,068	Broke in clamp. " " "	
QQ Q QQQ	"		1,080			" " "	16(c) 16(d) 16(e)
				1,080 1,090		" " "	

(Experiments Performed, cont'd)

(Experiments Performed, cont'd) -

NOTE ON ZINC COATINGS
ON STRAPPING.

Three thickness measurements were made on the zinc coating on each of the galvanized straps, using the Aminco-Brenner Magne-Gage. The average of the three results obtained in each case is given in Table VII.

TABLE VII. - Thickness of Zinc Coatings
on Strapping.

<u>Designation</u>	<u>Thickness, inch</u>	
P	0.00011)	Average thickness = 0.00008
PP	0.00006)	
PPP	0.00008)	
Q	0.00016)	Average thickness = 0.00025
QQ	0.00026)	
QQQ	0.00032)	

It will be noted that:

1. The zinc coatings were all quite thin.
2. The coatings on the P straps were much thinner than those on the Q straps.
3. The thickness of the coatings on the P straps was much more uniform than that on the Q straps.

CONCLUSIONS:

Many important conclusions can be drawn from this extensive investigation. Some of the more outstanding ones are as follows:

1. The deterioration of coated steel strapping is generally greater under seacoast and marine conditions than under ordinary inland conditions.

2. Comparatively thin zinc coatings are good protection under ordinary inland conditions but they fail badly

(Conclusions, cont'd) -

under seacoast and marine conditions.

3. In some cases, at least, the action of the corroding agent changes the nature of the failure in the sealed joints.

4. The breaking load of a number of the sealed joints is less than 75 per cent of the breaking load of the accompanying straps.

5. Unpainted samples are considerably less desirable than painted ones under marine conditions.

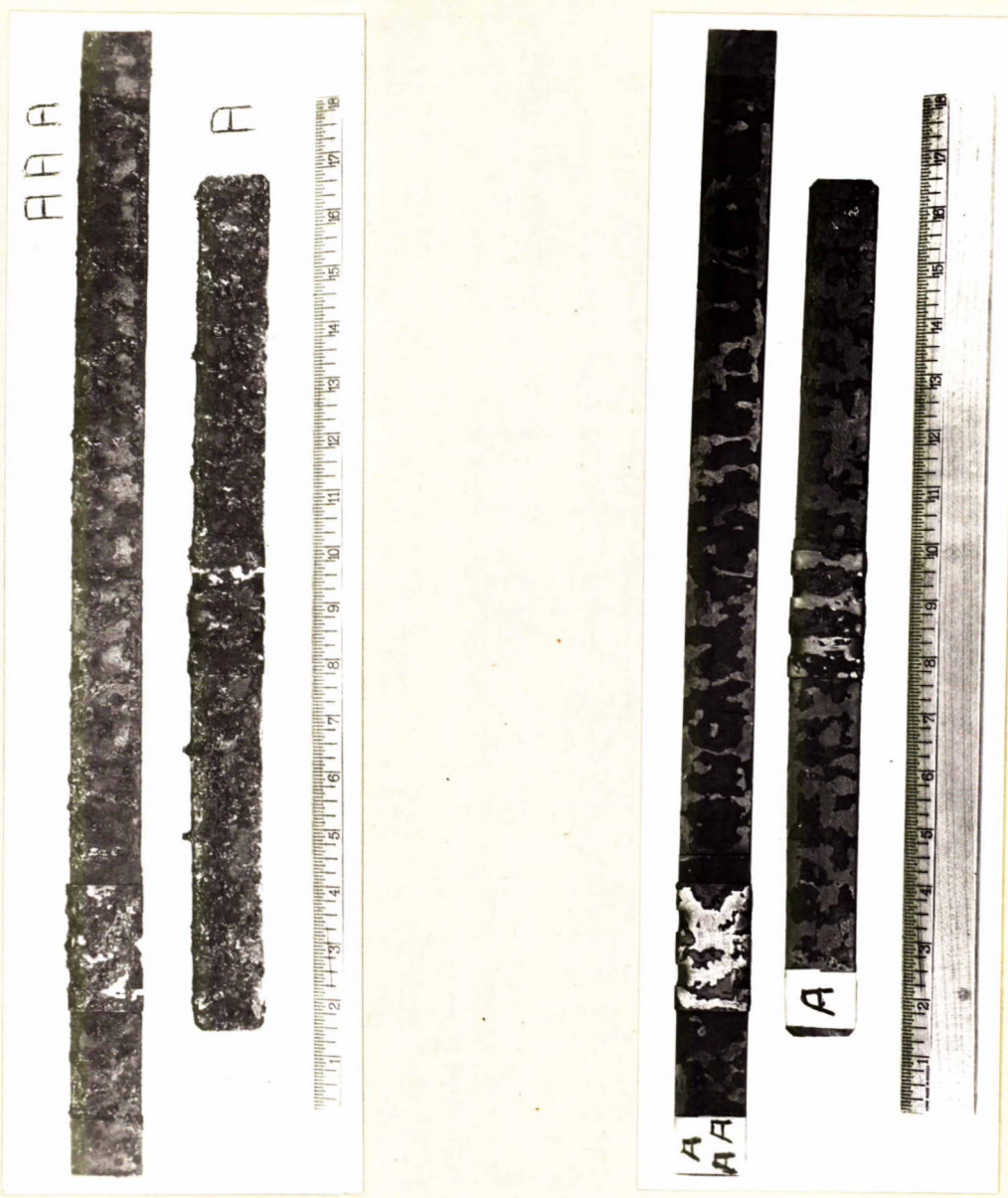
6. It is extremely important to note that none of these straps was bent. The corrosion can be expected to be much more severe at a sharp bend because the coating will be cracked or flaked off and also because the tendency of the metal to corrode will be greater. ✓

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12 cc

Figure 1.



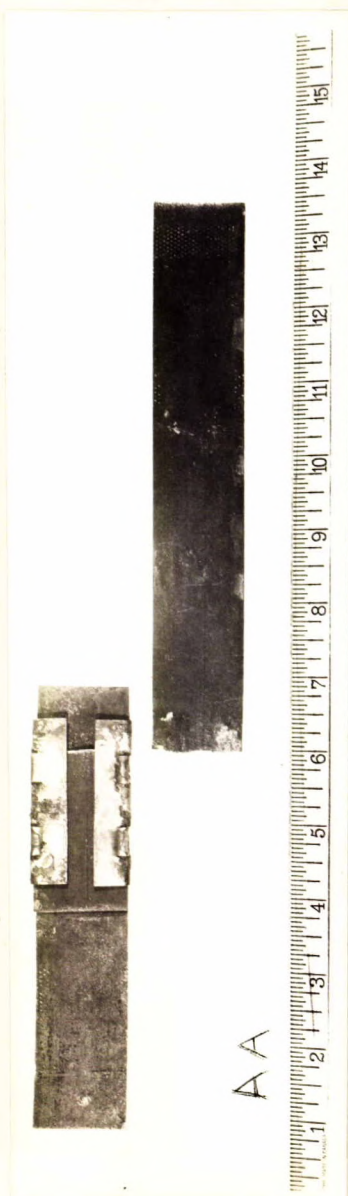
(a)

(b)

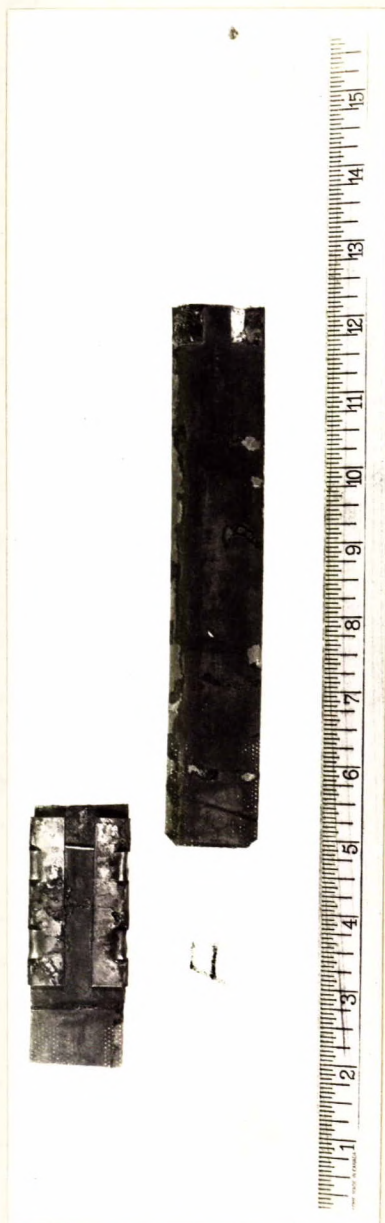
ACME $1\frac{1}{4}$ " X 0.035" PAINTED STRAPS WITH SEALED JOINTS,
AFTER 21 DAYS IN THE SALT SPRAY CABINET.

- (a) Before removal of corrosion product.
- (b) After removal of corrosion product.

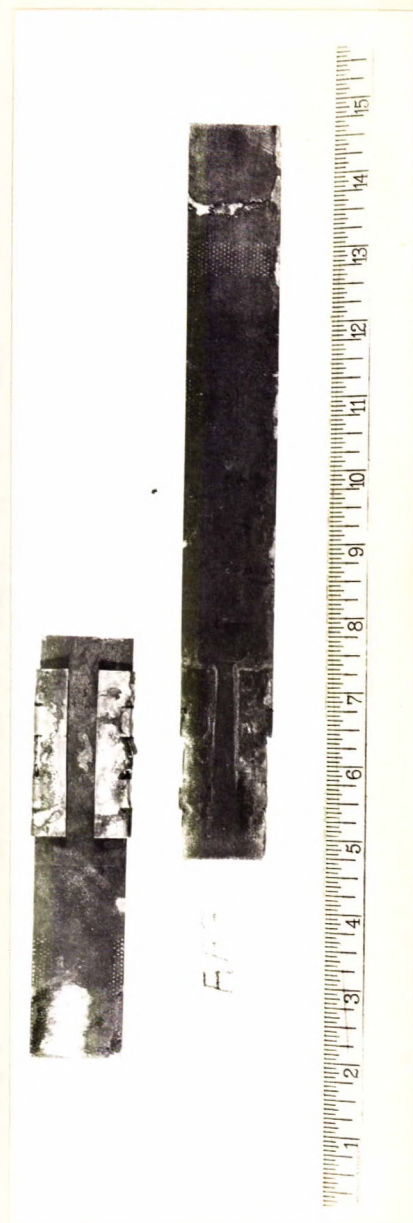
Figure 1 (cont'd)



(c)



(d)

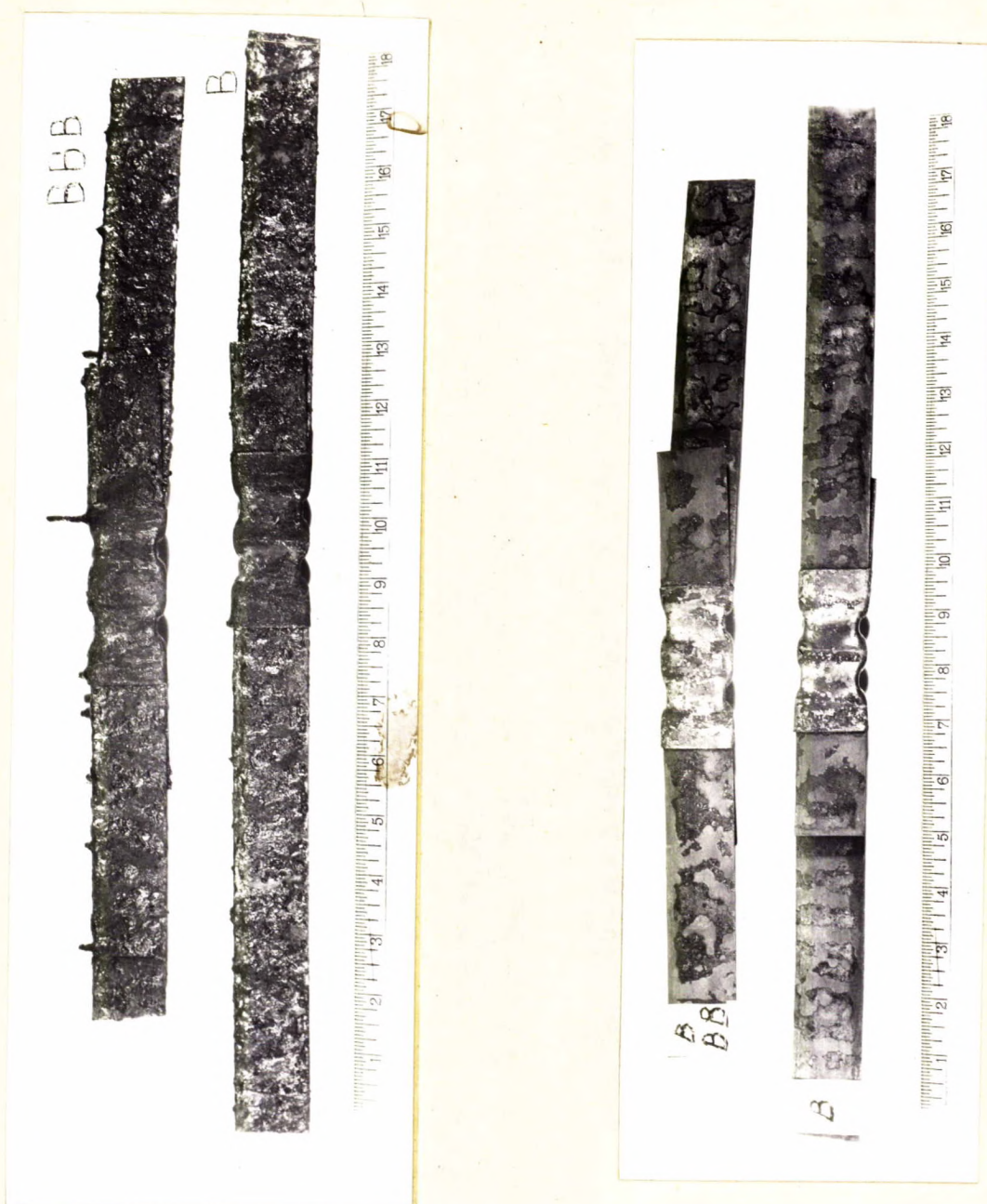


(e)

SEALED JOINTS ON ACME $1\frac{1}{4}$ " X 0.035" PAINTED STRAPS
AFTER REMOVAL FROM THE SALT SPRAY CABINET AND UNDER-
GOING BREAKING LOAD TEST.

- (c) Strap AA after 19 days in the cabinet.
- (d) Strap A) after 21 days in the cabinet.
- (e) Strap AAA)

Figure 2.



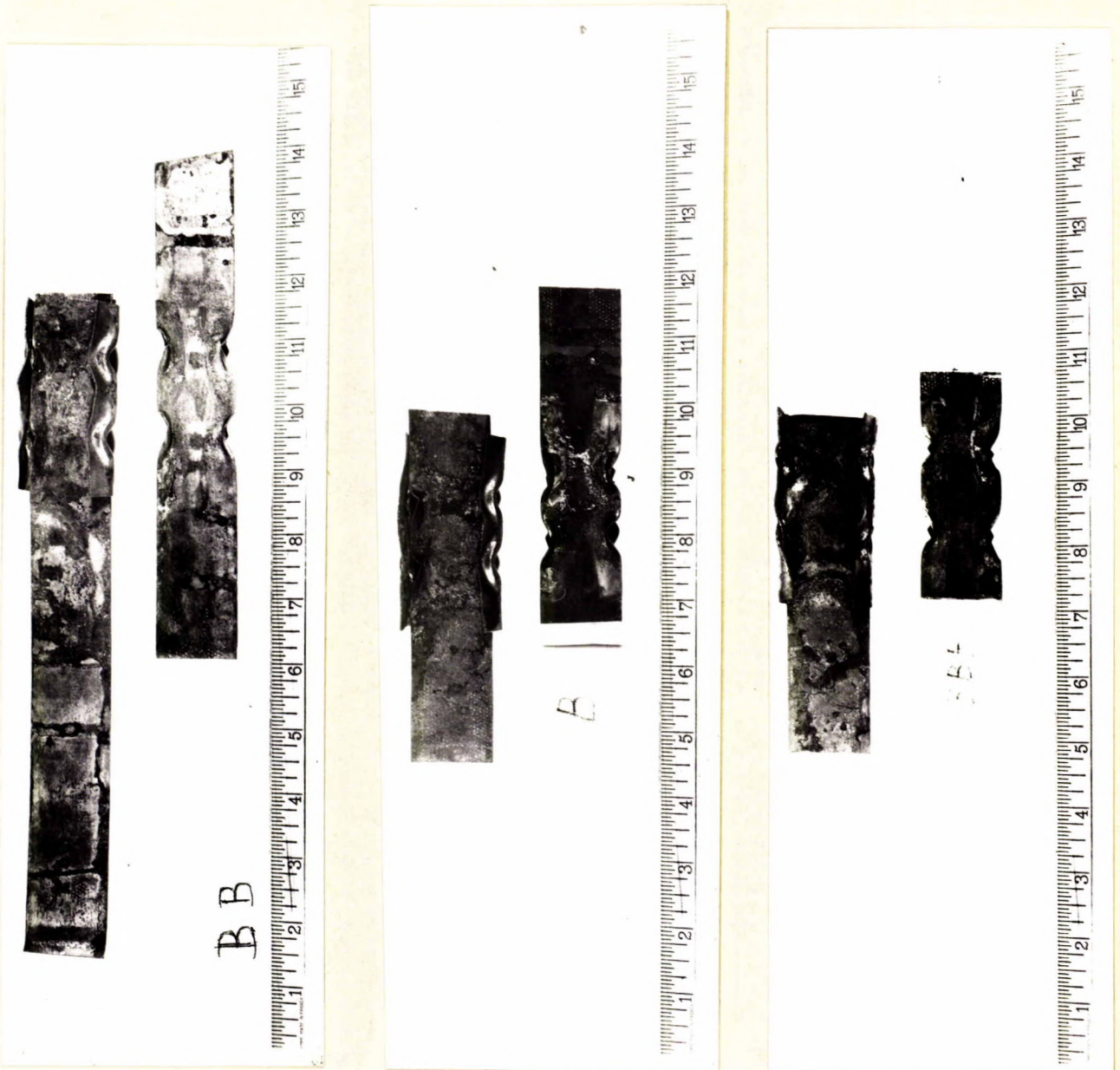
(a)

(b)

SIGNODE $1\frac{1}{4}$ " X 0.035" UNPAINTED STRAPS WITH SEALED JOINTS, AFTER 21 DAYS IN THE SALT SPRAY CABINET.

- (a) Before removal of corrosion product.
- (b) After removal of corrosion product.

Figure 2 (cont'd)



(c)

(d)

(e)

SEALED JOINTS ON SIGNODE $1\frac{1}{4}$ " X 0.035" UNPAINTED STRAPS
AFTER REMOVAL FROM THE SALT SPRAY CABINET AND UNDERGO-
ING BREAKING LOAD TEST.

- (c) Strap BB after 19 days in the cabinet.
- (d) Strap B)
- (e) Strap BBB) after 21 days in the cabinet.

Figure 3.



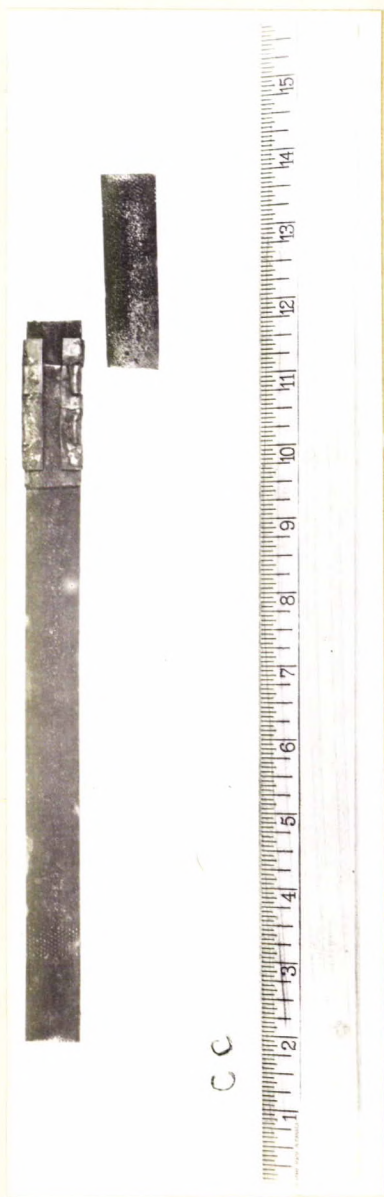
(a)

(b)

ACME $3/4$ " x 0.035" PAINTED STRAPS WITH SEALED JOINTS,
AFTER 21 DAYS IN THE SALT SPRAY CABINET.

- (a) Before removal of corrosion product.
- (b) After removal of corrosion product.

Figure 3 (cont'd)



(c)



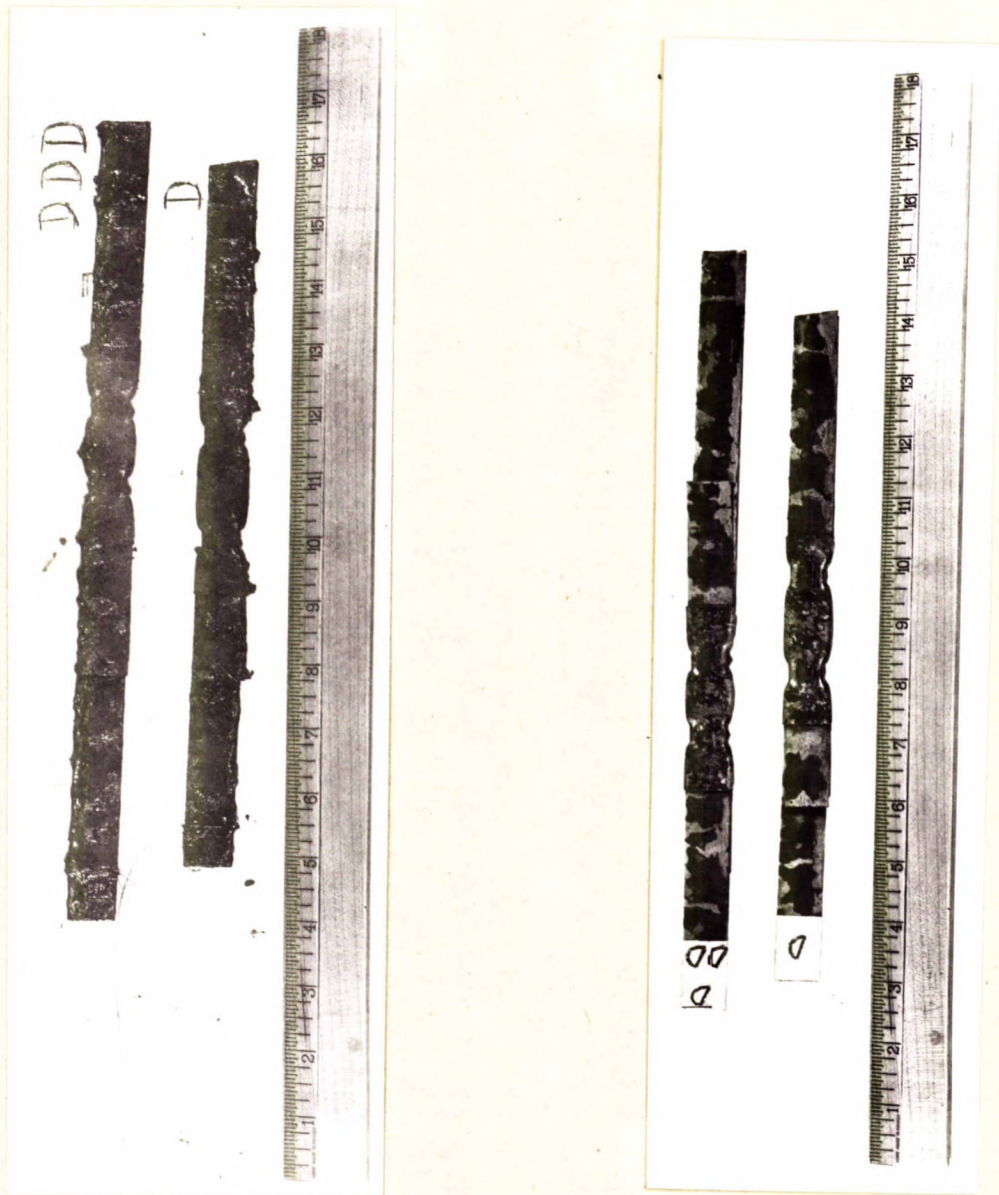
(d)



(e)

SEALED JOINTS ON ACME 3/4" X 0.035" PAINTED STRAPS AFTER REMOVAL FROM THE SALT SPRAY CABINET AND UNDERGOING BREAKING LOAD TEST.

- (c) Strap CC after 19 days in the cabinet.
- (d) Strap C)
- (e) Strap CCC) after 21 days in the cabinet.

Figure 4.

(a)

(b)

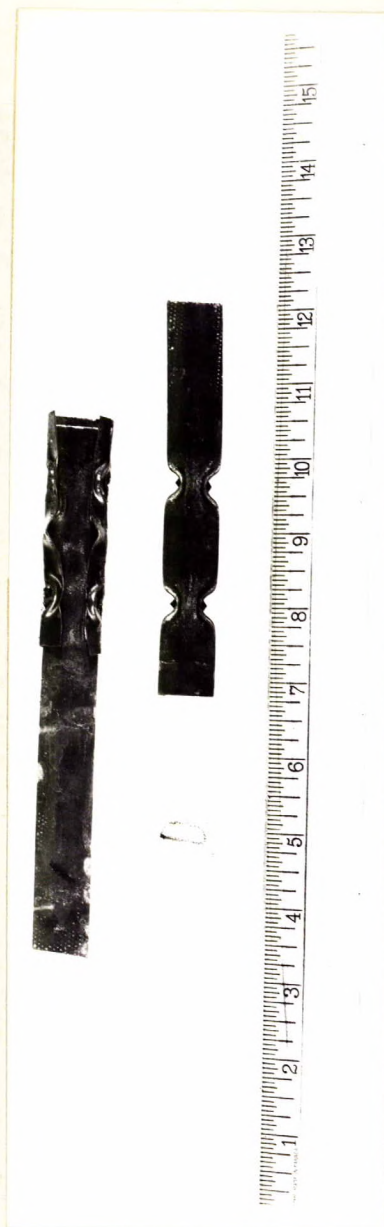
SIGNODE $3/4''$ x $0.035''$ PAINTED STRAPS WITH SEALED JOINTS, AFTER 21 DAYS IN THE SALT SPRAY CABINET.

- (a) Before removal of corrosion product.
(b) After removal of corrosion product.

Figure 4 (cont'd)



(c)



(d)



(e)

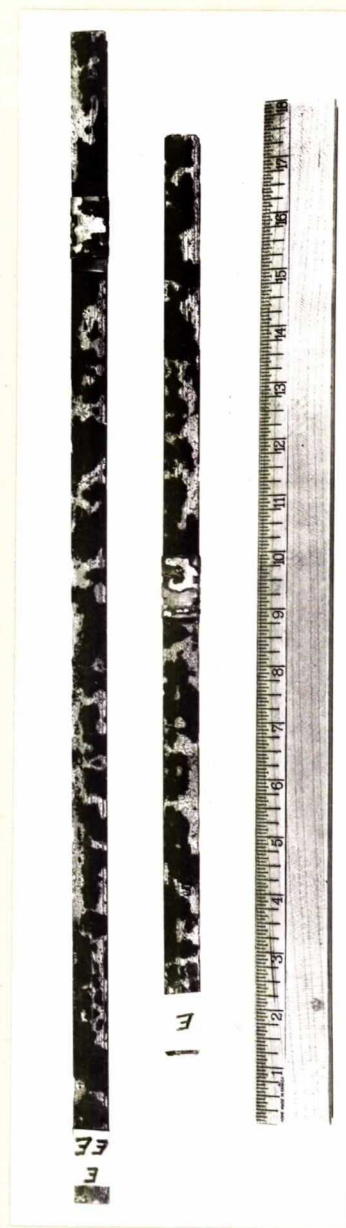
SEALED JOINTS ON SIGNODE 3/4" X 0.035" PAINTED STRAPS AFTER
 REMOVAL FROM THE SALT SPRAY CABINET AND UNDERGOING BREAKING
 LOAD TEST.

- (c) Strap DD after 19 days in the cabinet.
- (d) Strap D)
- (e) Strap DDD) after 21 days in the cabinet.

Figure 5.



(a)



(b)

ACME 5/8" X 0.020" PAINTED STRAPS WITH SEALED JOINTS, AFTER 21 DAYS IN THE SALT SPRAY CABINET.

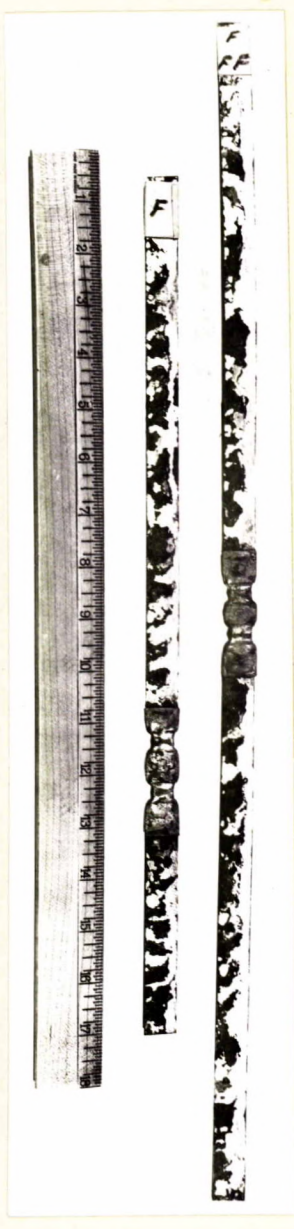
- (a) Before removal of corrosion product.
- (b) After removal of corrosion product.

Note: In the case of Samples E, EE and EEE, the straps broke before the sealed joints in the breaking load test.

Figure 6.



(a)

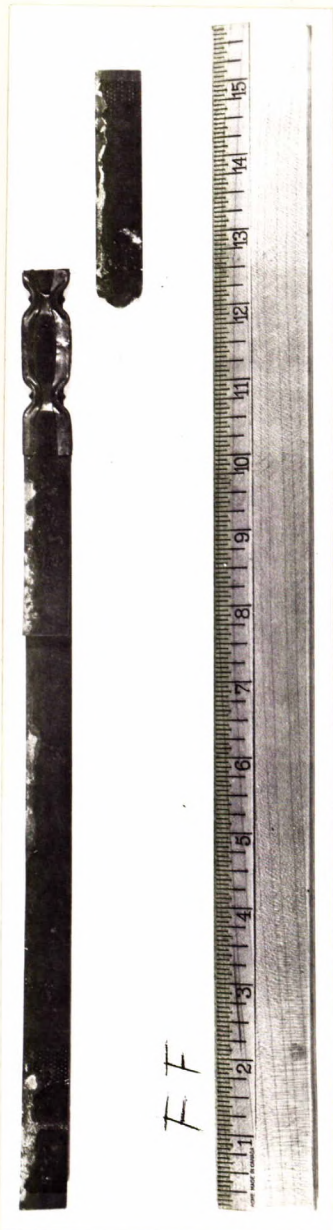


(b)

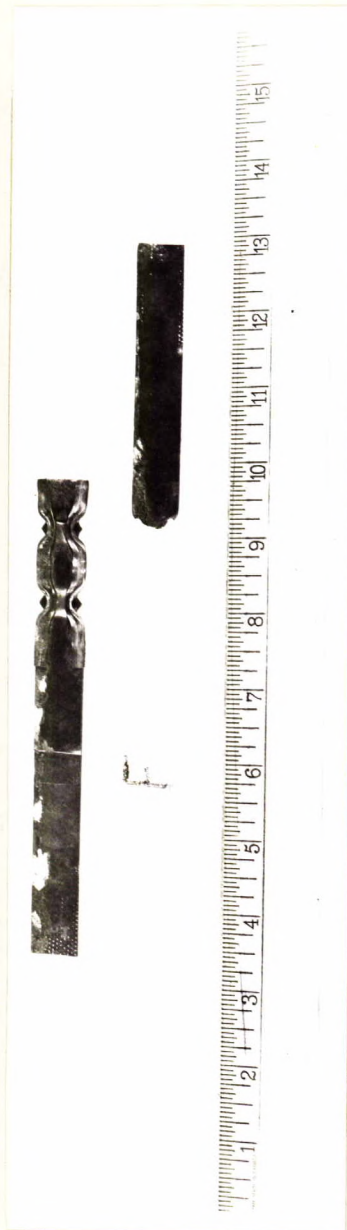
SIGNODE 5/8" X 0.020" PAINTED STRAPS WITH SEALED JOINTS, AFTER 21 DAYS IN THE SALT SPRAY CABINET.

- (a) Before removal of corrosion product.
- (b) After removal of corrosion product.

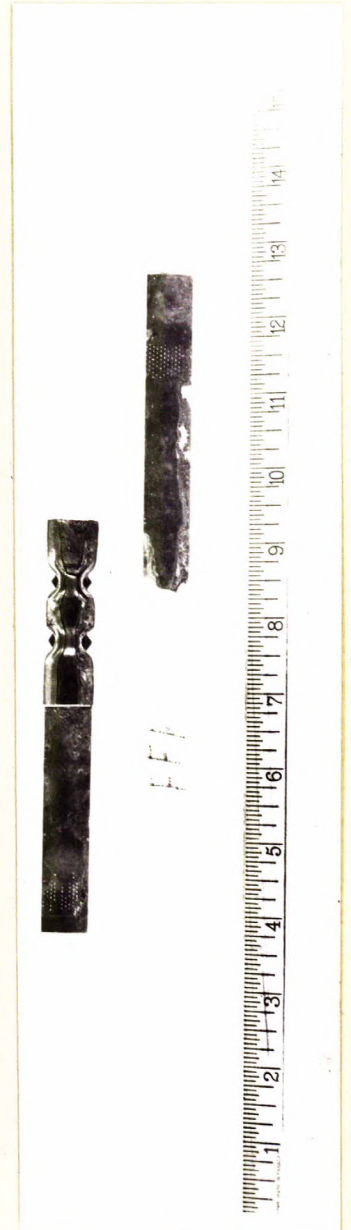
Figure 6 (cont'd)



(c)



(d)



(e)

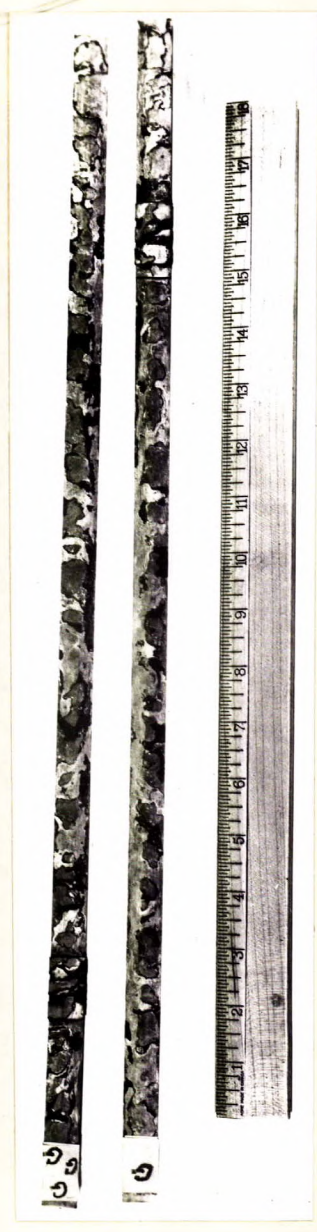
SEALED JOINTS ON SIGMODE 5/8" X 0.020" PAINTED STRAPS AFTER REMOVAL FROM THE SALT SPRAY CABINET AND UNDERGOING BREAKING LOAD TEST.

- (c) Strap FF after 19 days in the cabinet.
- (d) Strap F)
- (e) Strap FFF) after 21 days in the cabinet.

Figure 7.



(a)



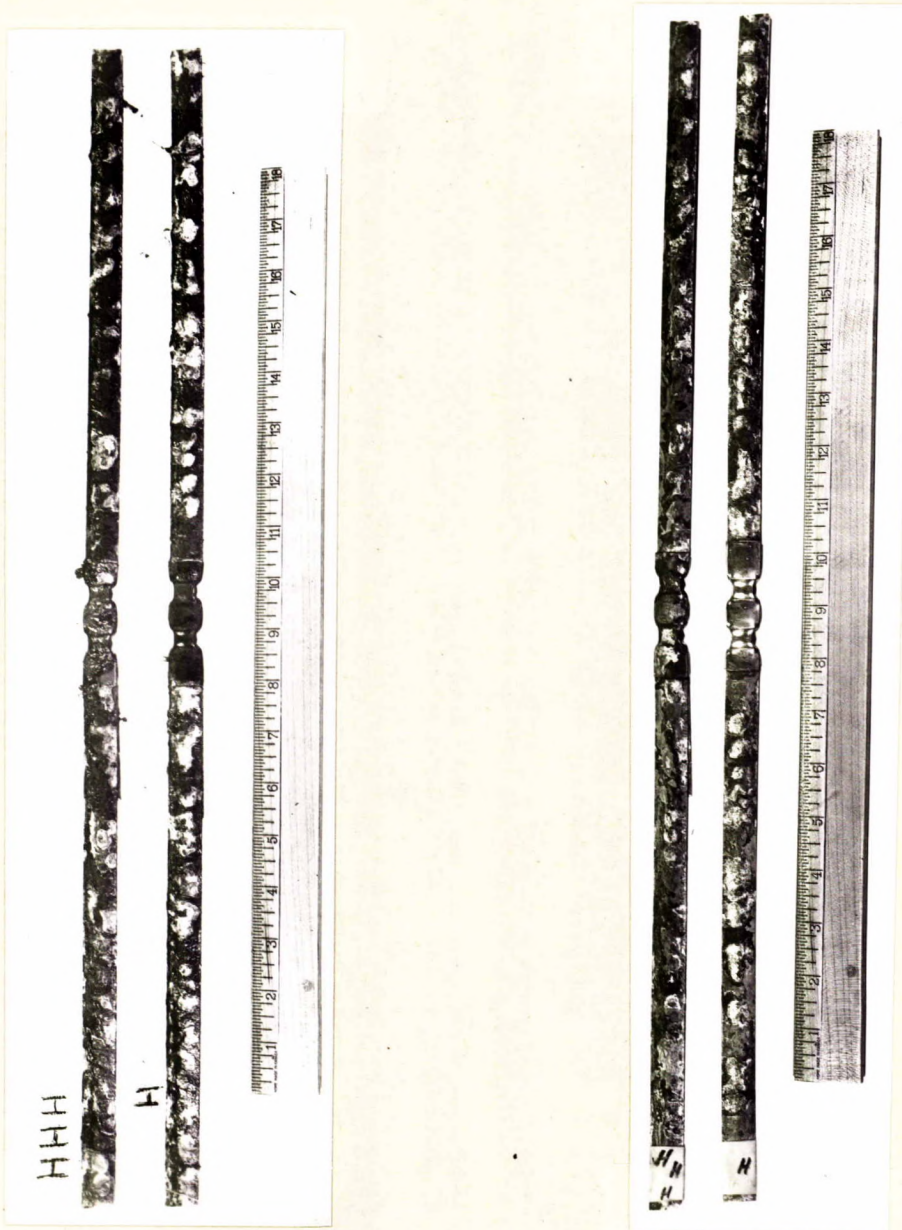
(b)

ACME 5/8" X 0.018" GALVANIZED STRAPS WITH SEALED JOINTS, AFTER 21 DAYS IN THE SALT SPRAY CABINET.

- (a) Before removal of corrosion product.
- (b) After removal of corrosion product.

Note: In the case of Samples G, GG and GGG, the straps broke before the sealed joints in the breaking load test.

Figure 8.



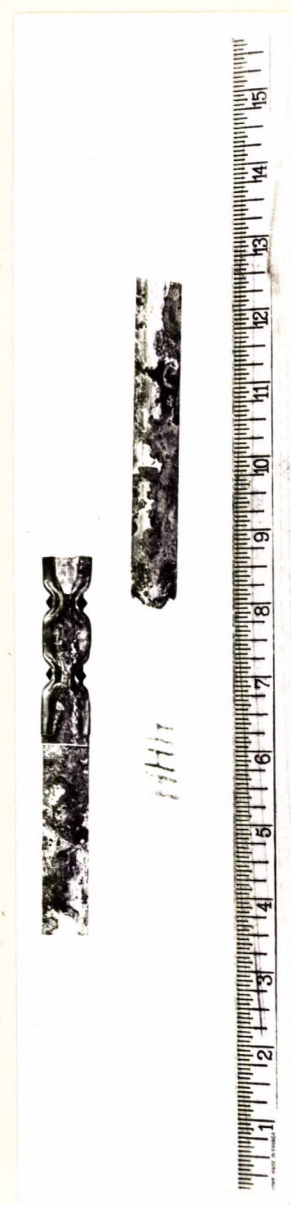
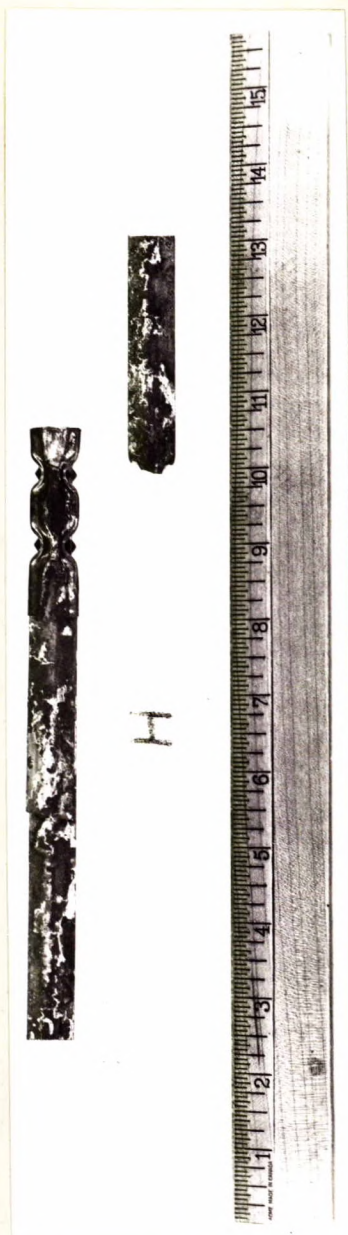
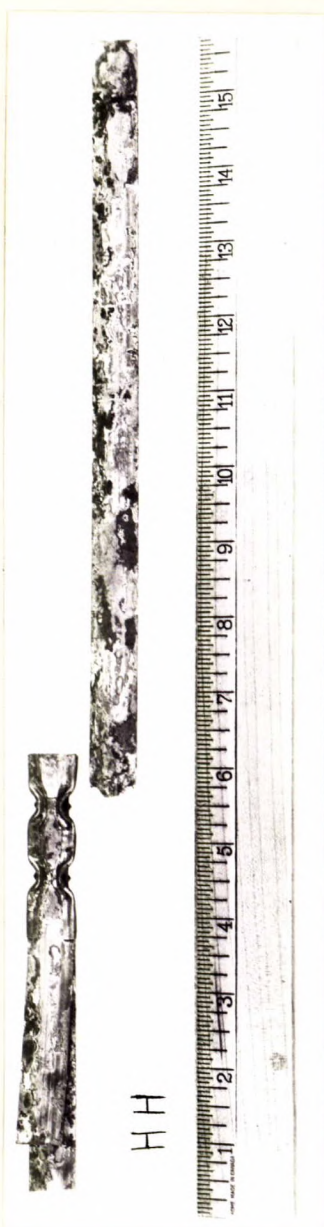
(a)

(b)

SIGNODE 5/8" X 0.020" GALVANIZED STRAPS WITH SEALED JOINTS, AFTER 21 DAYS IN THE SALT SPRAY CABINET.

- (a) Before removal of corrosion product.
- (b) After removal of corrosion product.

Figure 8 (cont'd)



(c)

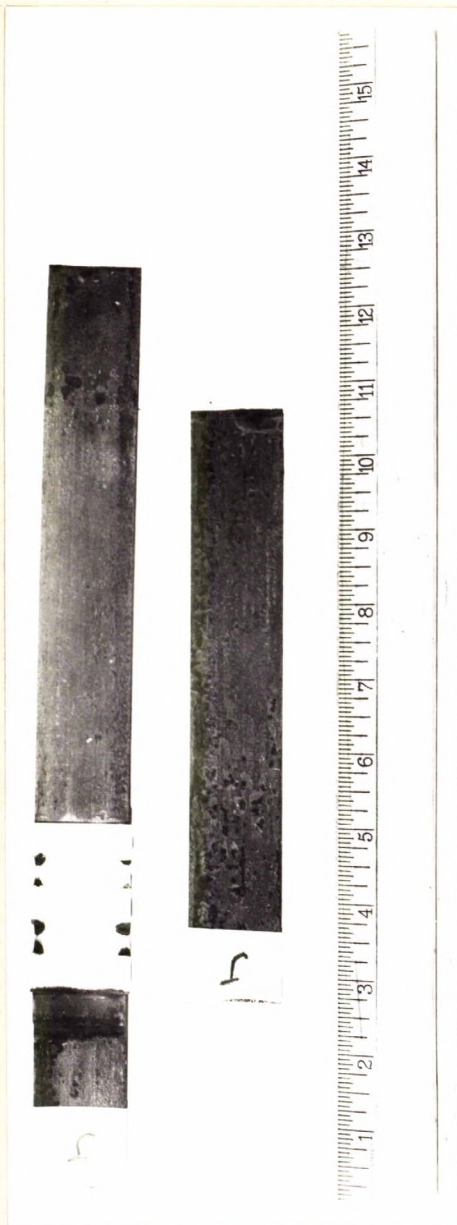
(d)

(e)

SEALED JOINTS ON SIGNODE 5/8" X 0.020" GALVANIZED STRAPS
AFTER REMOVAL FROM THE SALT SPRAY CABINET AND UNDERGOING
BREAKING LOAD TEST.

- (c) Strap HH after 19 days in the cabinet.
- (d) Strap H) after 21 days in the cabinet.
- (e) Strap HHH)

Figure 9.



(a)

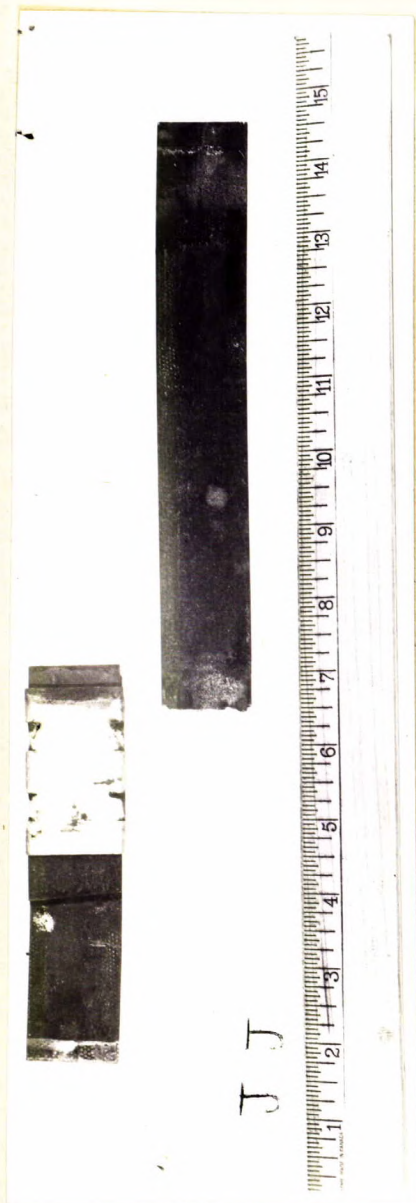


(b)

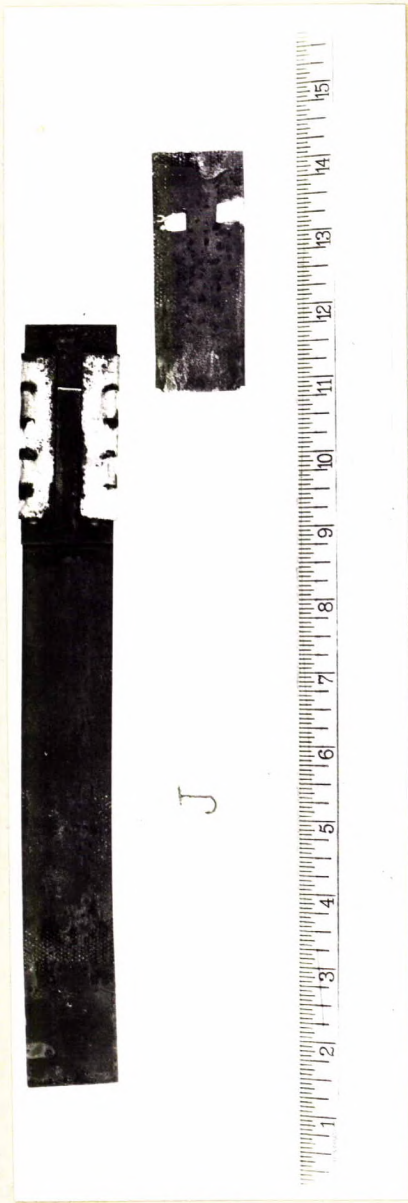
ACME 1 $\frac{1}{4}$ " X 0.035" PAINTED STRAPS WITH SEALED JOINTS, AFTER 19 DAYS IN THE WEATHER-OMETER.

No corrosion product was removed.

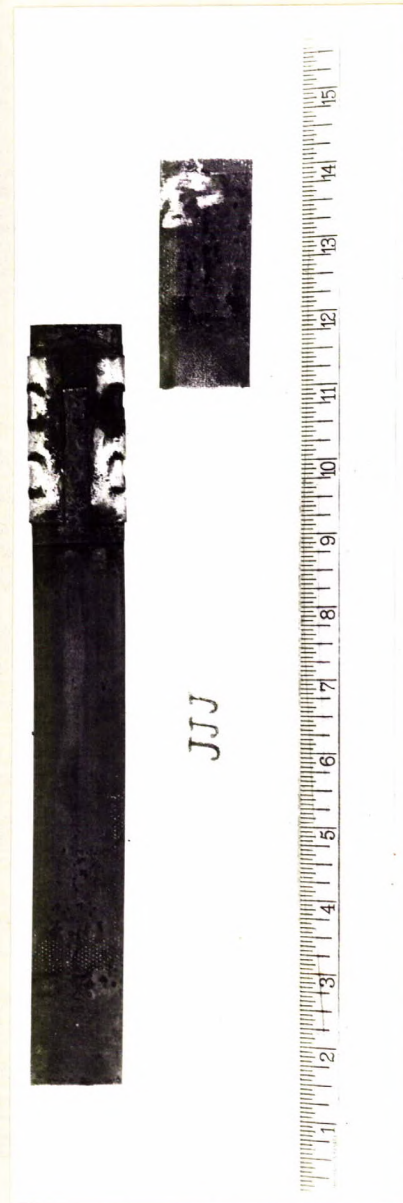
Figure 9 (cont'd)



(c)



(d)

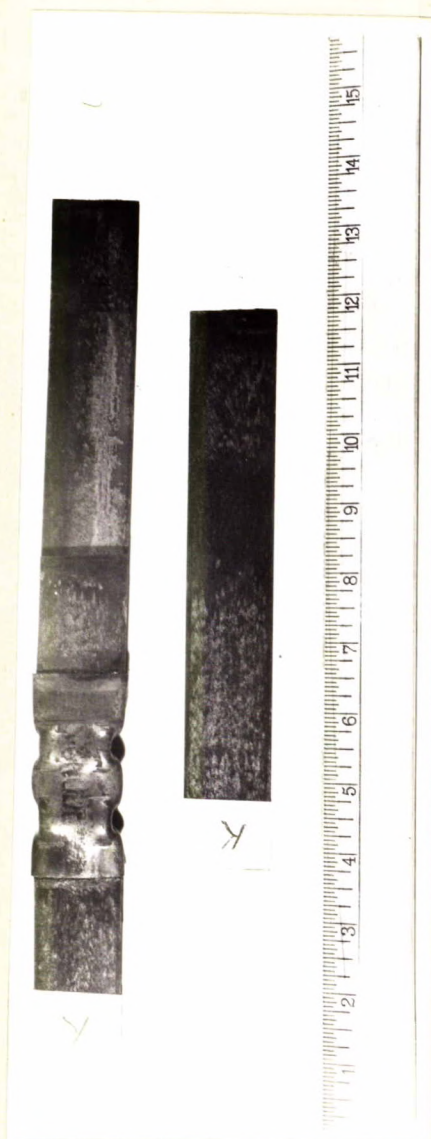


(e)

SEALED JOINTS ON ACME $1\frac{1}{4}$ " X 0.035" PAINTED STRAPS AFTER REMOVAL FROM THE WEATHER-OMETER AND UNDERGOING BREAKING LOAD TEST.

- (c) Strap JJ after 16 days in the Weather-Ometer.
- (d) Strap J) after 19 days in the Weather-Ometer.
- (e) Strap JJJ

Figure 10.



(a)

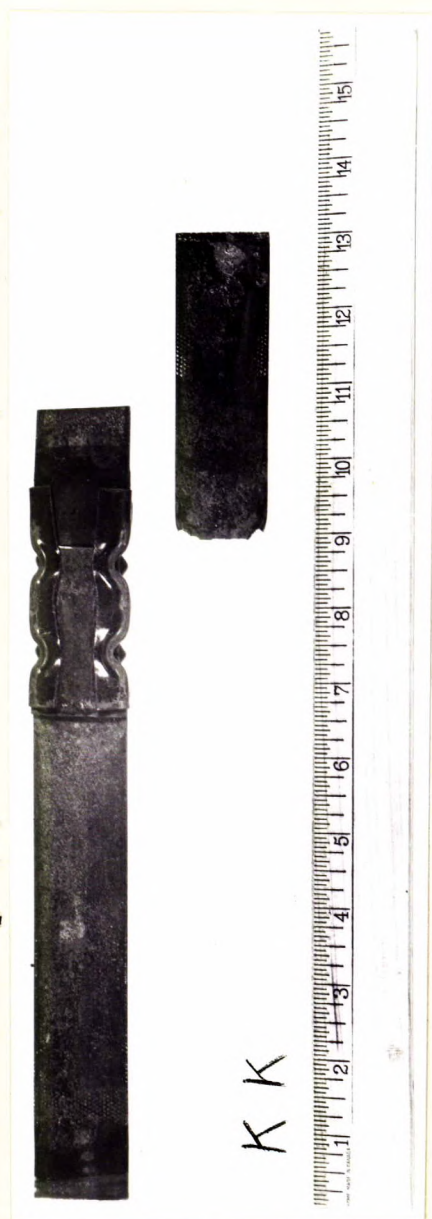


(b)

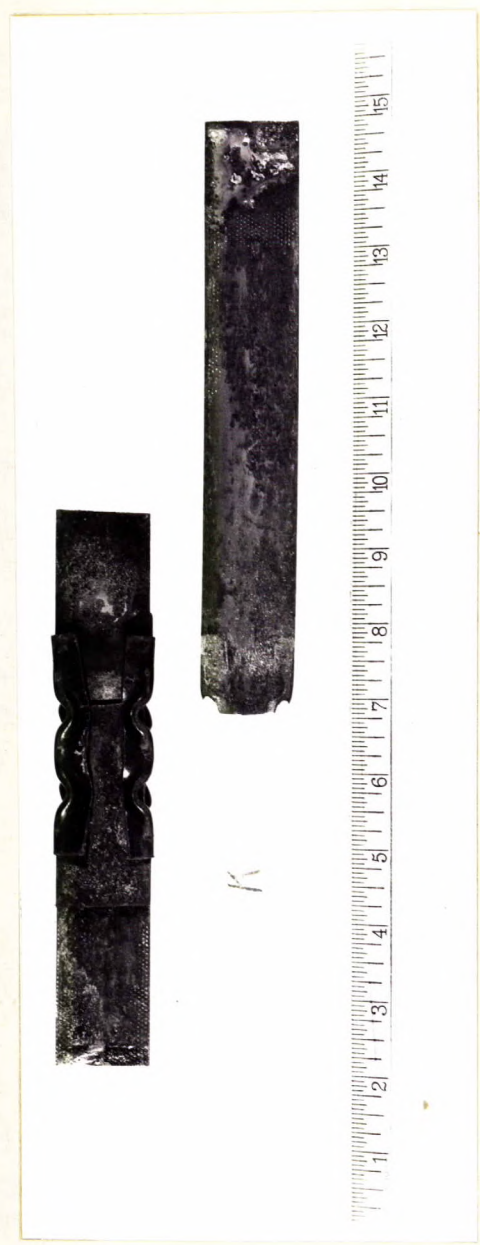
SIGNODE $1\frac{1}{8}$ " X 0.035" UNPAINTED STRAPS WITH SEALED JOINTS, AFTER 19 DAYS IN THE WEATHER-OMETER.

No corrosion product was removed.

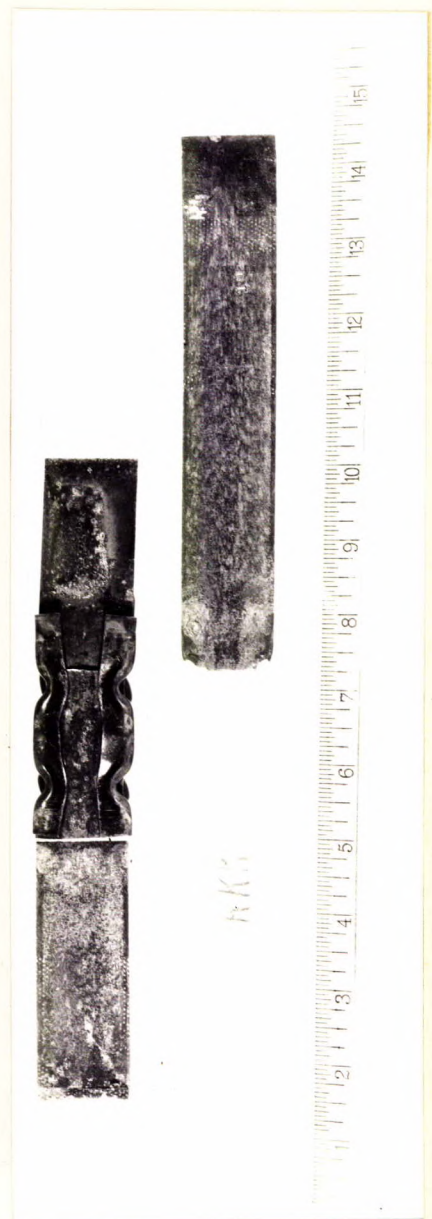
Figure 10 (cont'd)



(c)



(d)



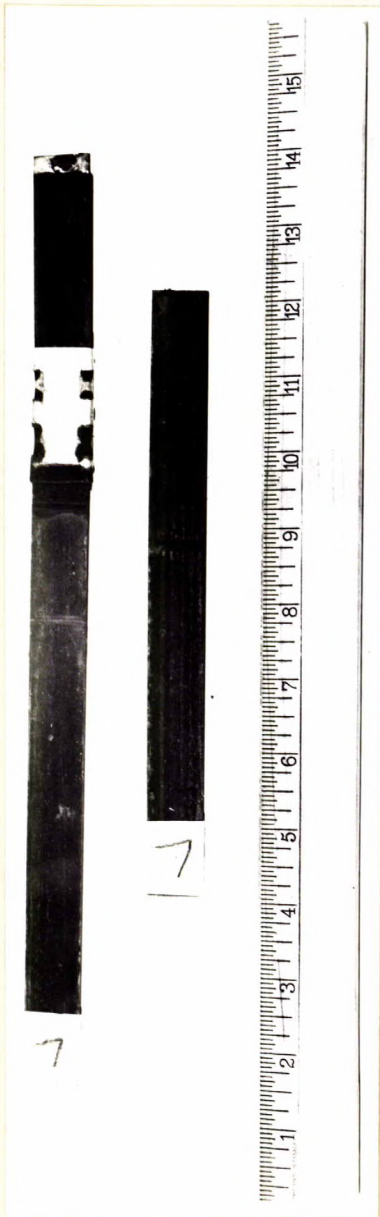
(e)

SEALED JOINTS ON SIGNODE $1\frac{1}{4}$ " X 0.035" UNPAINTED STRAPS
 AFTER REMOVAL FROM THE WEATHER-OMETER AND UNDERGOING
 BREAKING LOAD TEST.

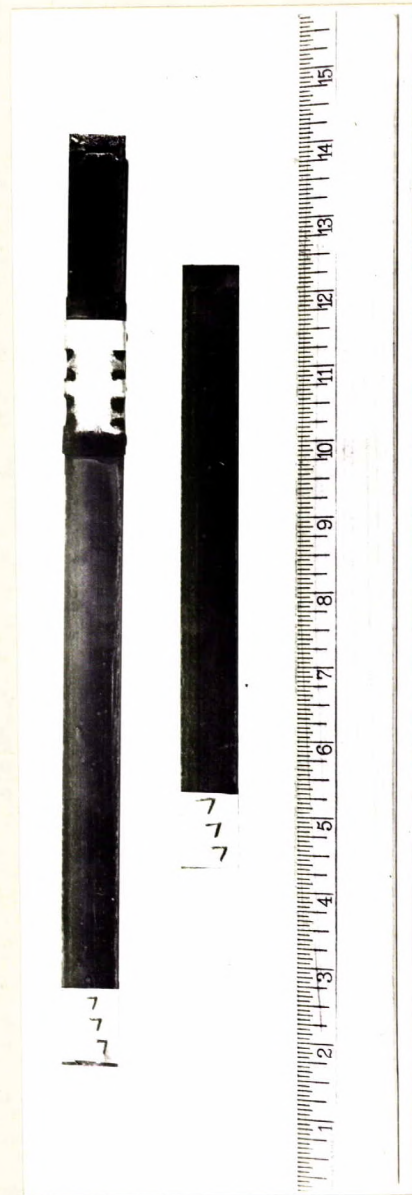
- (c) Strap KK after 16 days in the Weather-Ometer.
- (d) Strap K)
- (e) Strap KKK) after 19 days in the Weather-Ometer.

—

Figure 11.



(a)



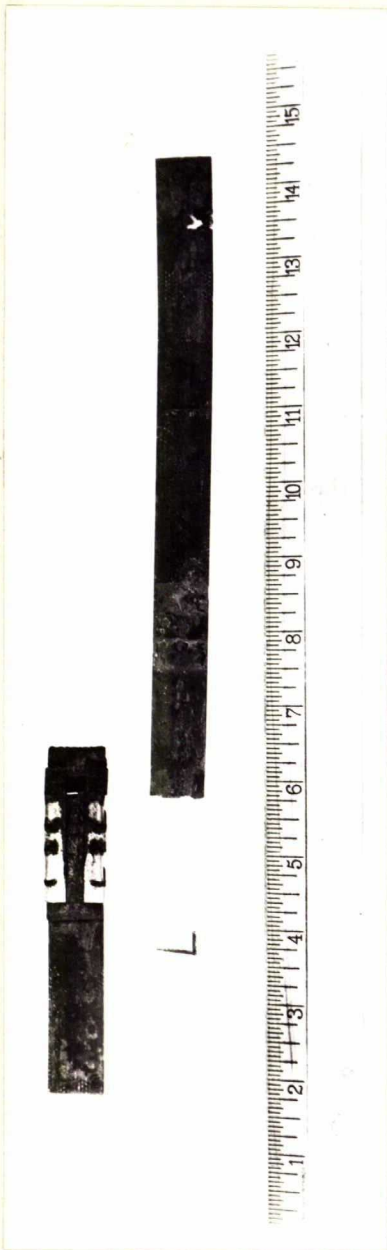
(b)

ACME 3/4" X 0.035" PAINTED STRAPS WITH SEALED JOINTS, AFTER 19 DAYS IN THE WEATHER-OMETER.

No corrosion product was removed.

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Figure 11 (cont'd)



(c)



(d)



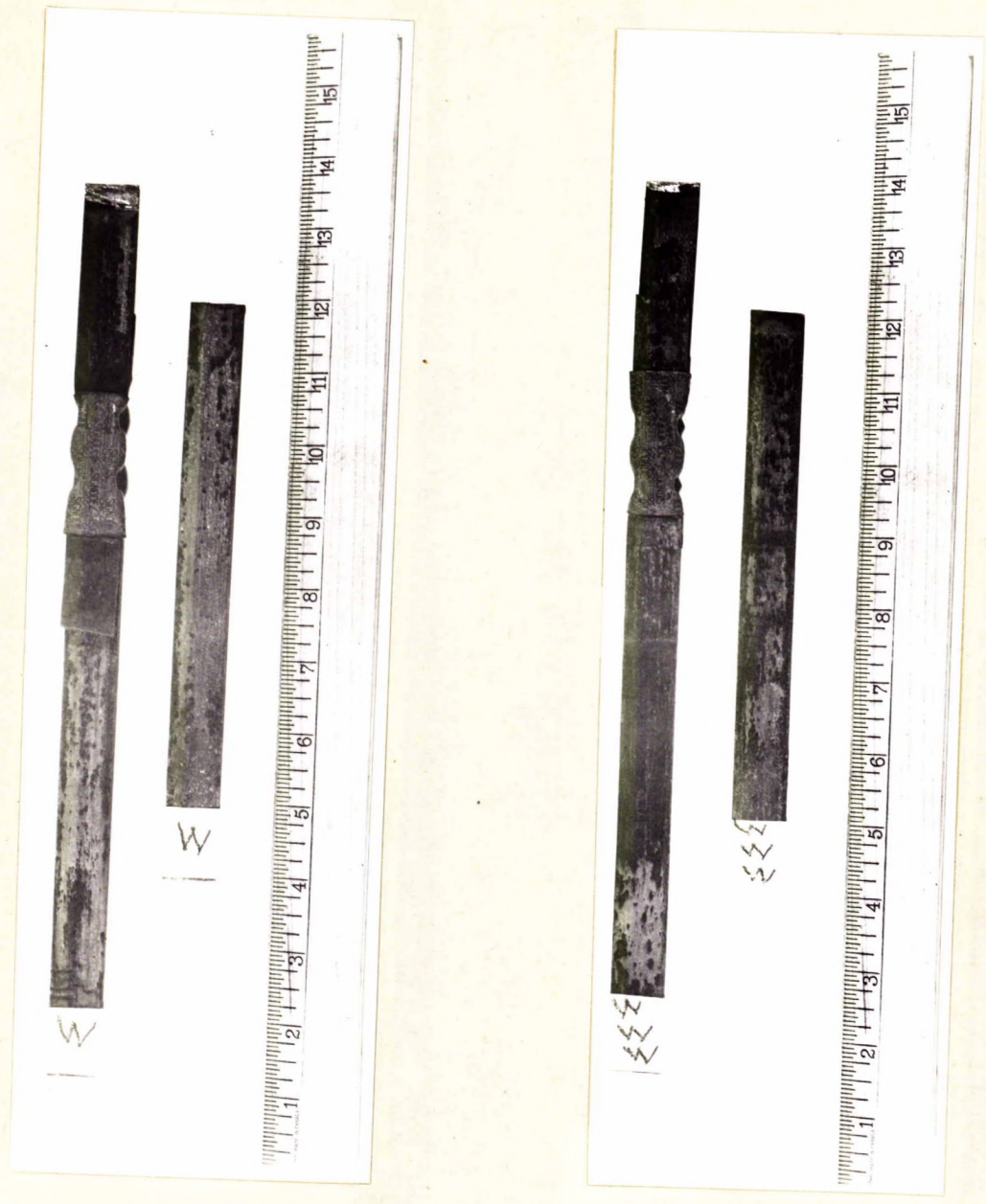
(e)

SEALED JOINTS ON ACME 3/4" X 0.035" PAINTED STRAPS
 AFTER REMOVAL FROM THE WEATHER-OMETER AND UNDERGO-
 ING BREAKING LOAD TEST.

- (c) Strap LL after 16 days in the Weather-Ometer.
- (d) Strap L) after 19 days in the Weather-Ometer.
- (e) Strap LLL)

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Figure 12.



(a)

(b)

SIGNODE $3/4''$ X $0.035''$ PAINTED STRAPS WITH SEALED JOINTS, AFTER 19 DAYS IN THE WEATHER-OMETER.

No corrosion product was removed.

Figure 12 (cont'd)



(c)



(d)

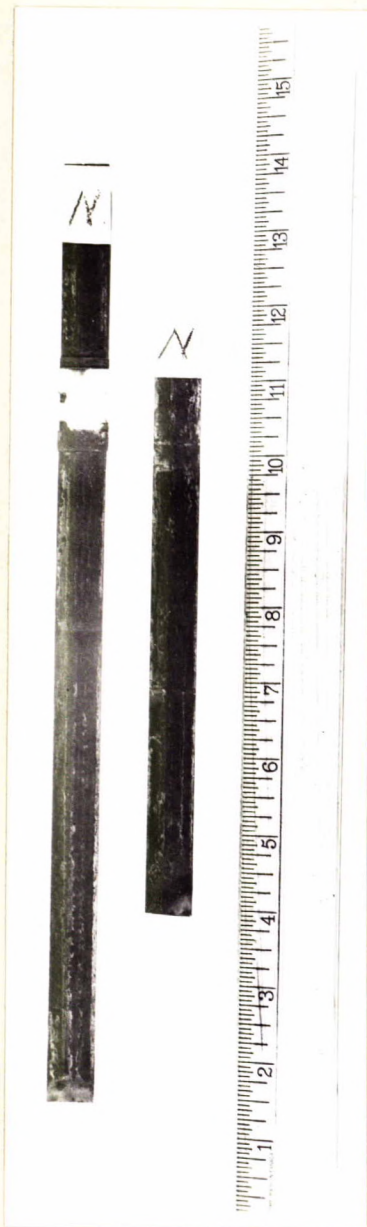


(e)

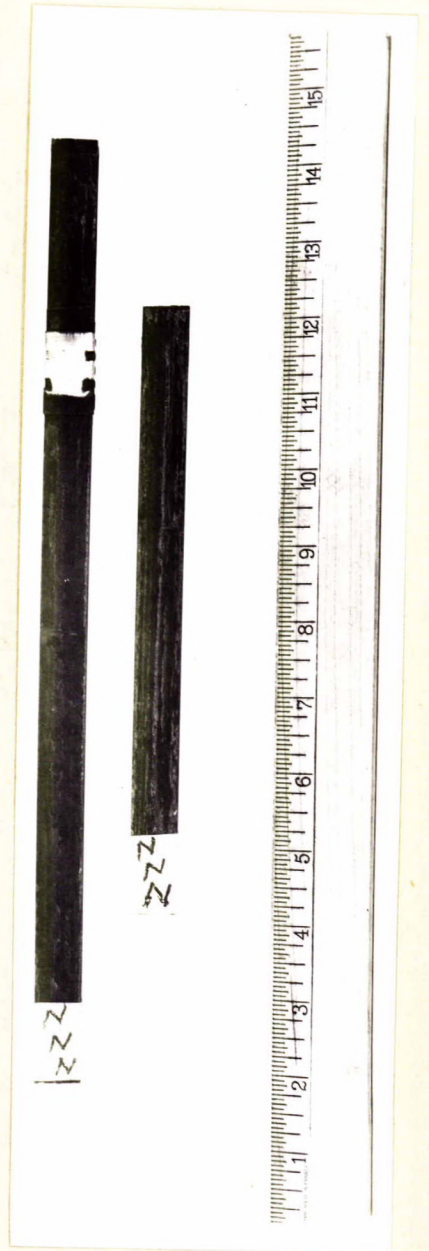
SEALED JOINTS ON SIGNODE 3/4" X 0.035" PAINTED STRAPS
 AFTER REMOVAL FROM THE WEATHER-OMETER AND UNDERGOING
 BREAKING LOAD TEST.

- (c) Strap MM after 16 days in the Weather-Ometer.
- (d) Strap M)
- (e) Strap MMM) after 19 days in the Weather-Ometer.

Figure 13.



(a)



(b)

ACME 5/8" X 0.020" PAINTED STRAPS WITH SEALED JOINTS, AFTER 19 DAYS IN THE WEATHER-OMETER.

No corrosion product was removed.

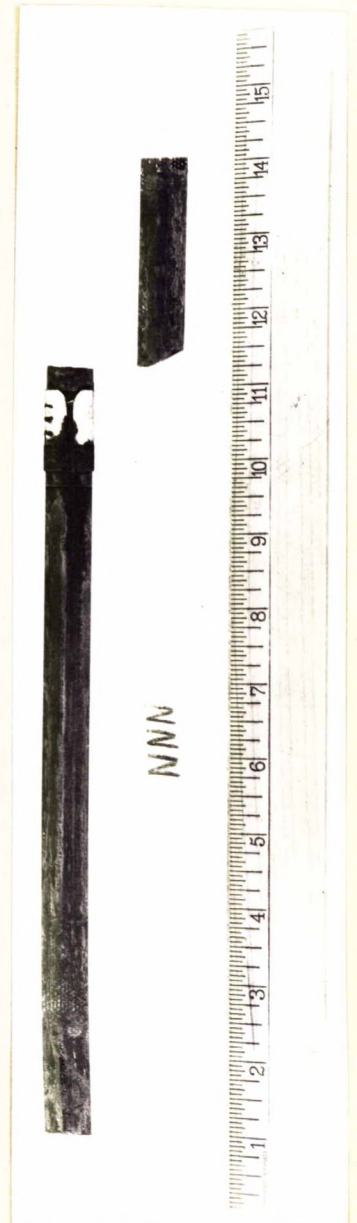
Figure 13 (cont'd)



(c)



(d)

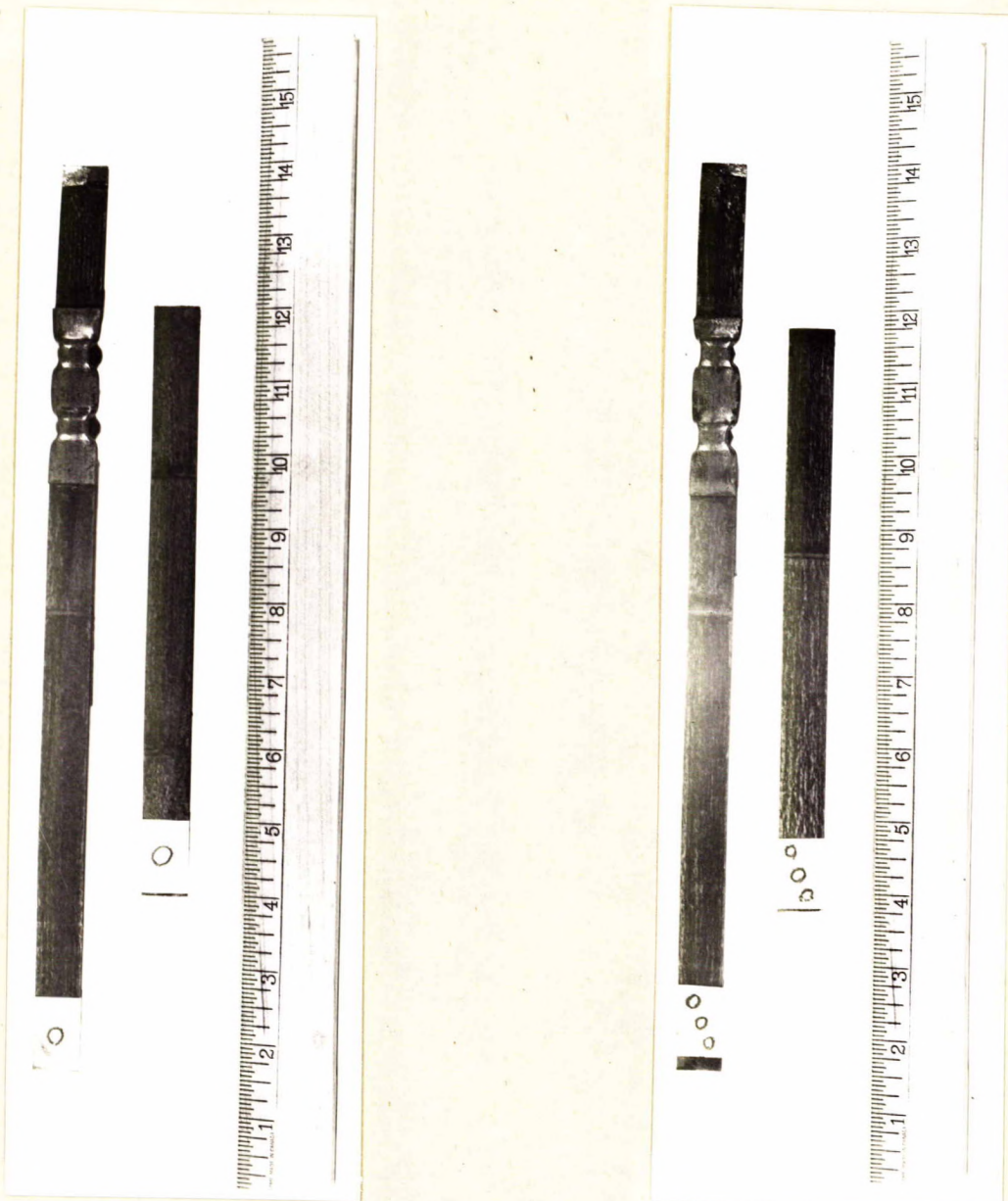


(e)

SEALED JOINTS ON ACME 5/8" X 0.020" PAINTED STRAPS
AFTER REMOVAL FROM THE WEATHER-OMETER AND UNDERGO-
ING BREAKING LOAD TEST.

- (c) Strap NN after 16 days in the Weather-Ometer.
- (d) Strap N)
- (e) Strap NNN) after 19 days in the Weather-Ometer.

Figure 14.



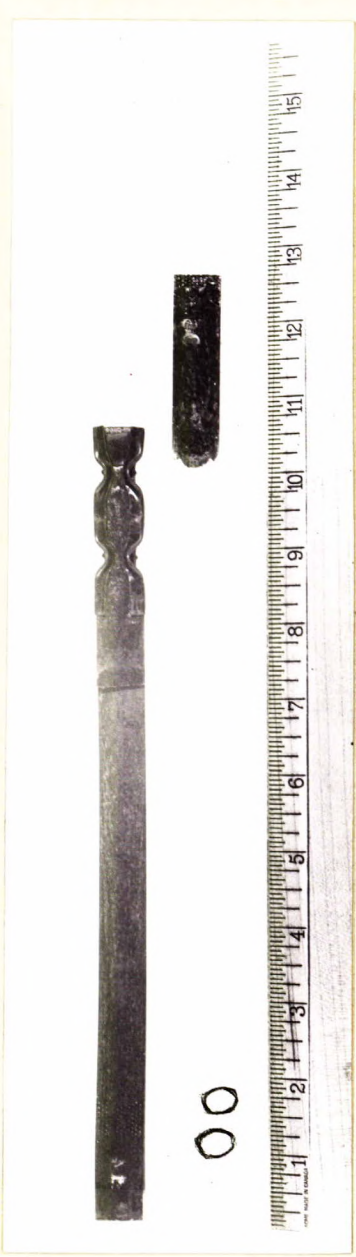
(a)

(b)

SIGNODE 5/8" X 0.020" PAINTED STRAPS WITH SEALED JOINTS, AFTER 19 DAYS IN THE WEATHER-OMETER.

No corrosion product was removed.

Figure 14 (cont'd)



(c)



(d)

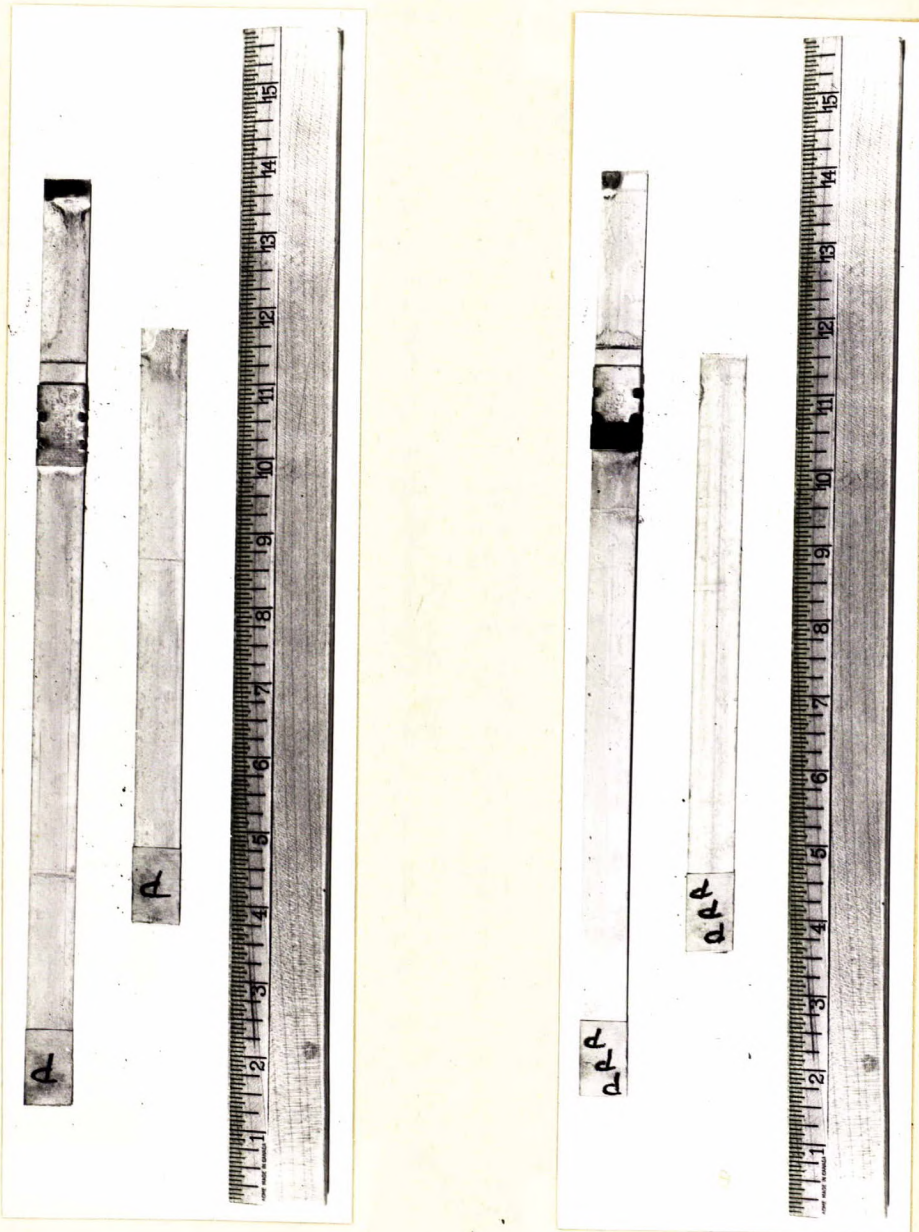


(e)

SEALED JOINTS ON SIGNODE 5/8" X 0.020" PAINTED STRAPS
 AFTER REMOVAL FROM THE WEATHER-OMETER AND UNDERGOING
 BREAKING LOAD TEST.

- (c) Strap 00 after 16 days in the Weather-Ometer.
- (d) Strap 0) after 19 days in the Weather-Ometer.
- (e) Strap 000)

Figure 15.



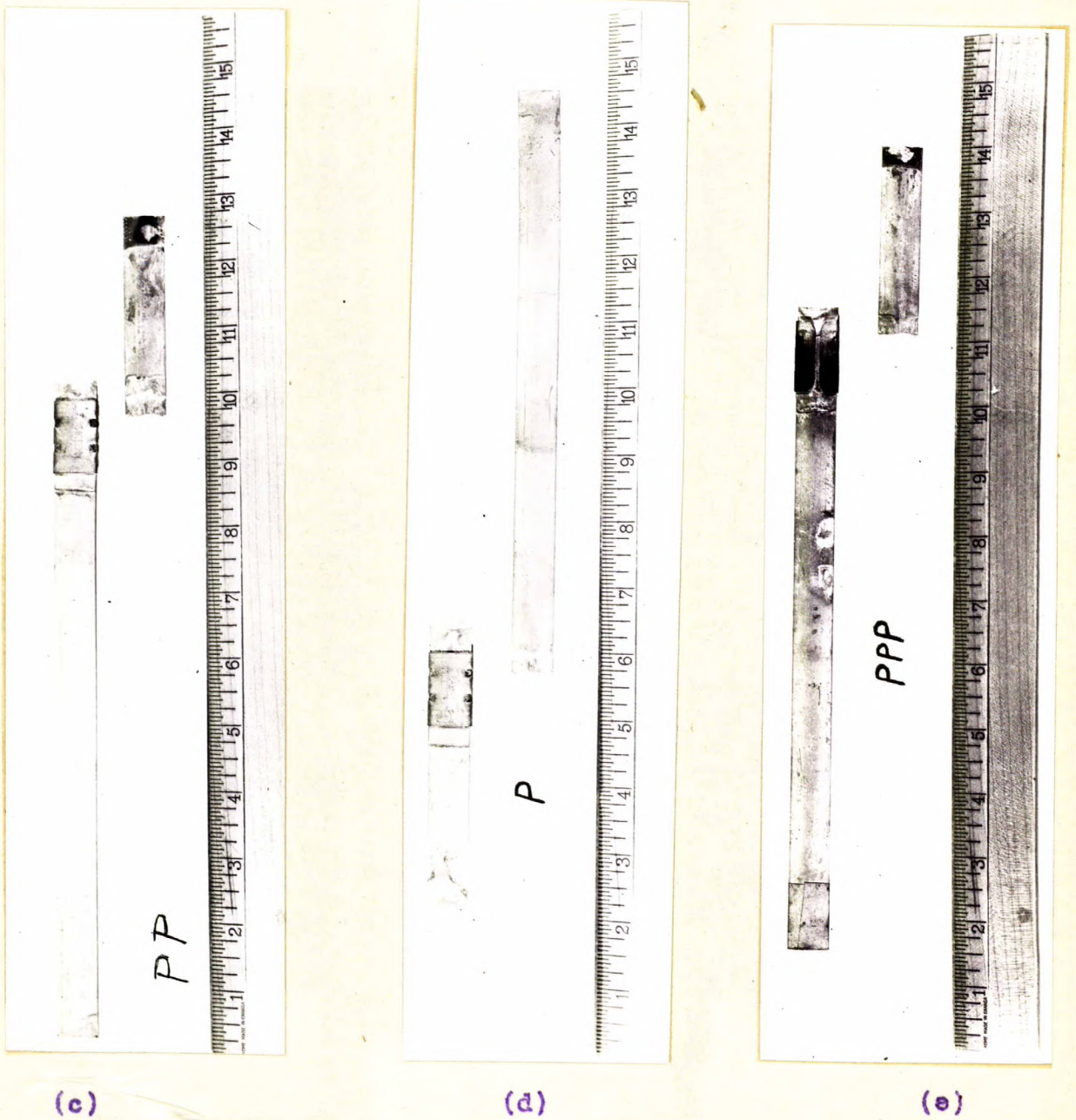
(a)

(b)

ACME 5/8" X 0.018" GALVANIZED STRAPS WITH SEALED JOINTS, AFTER 19 DAYS IN THE WEATHER-OMETER.

No corrosion product was removed.

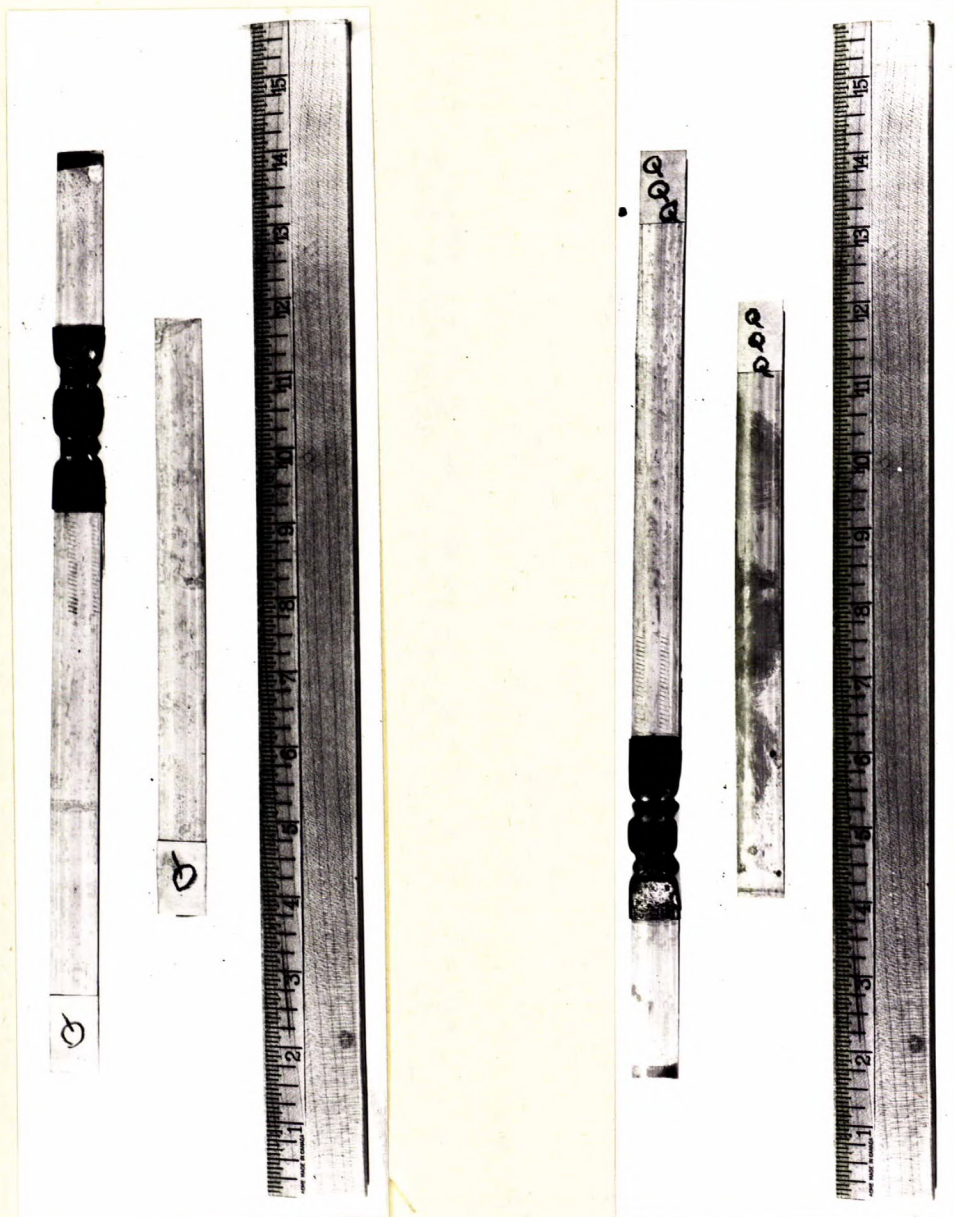
Figure 15 (cont'd)



SEALED JOINTS ON ACME 5/8" X 0.018" GALVANIZED STRAPS
AFTER REMOVAL FROM THE WEATHER-OMETER AND UNDERGOING
BREAKING LOAD TEST.

- (c) Strap PP after 16 days in the Weather-Ometer.
- (d) Strap P) after 16 days in the Weather-Ometer.
- (e) Strap PPP)

Figure 16.



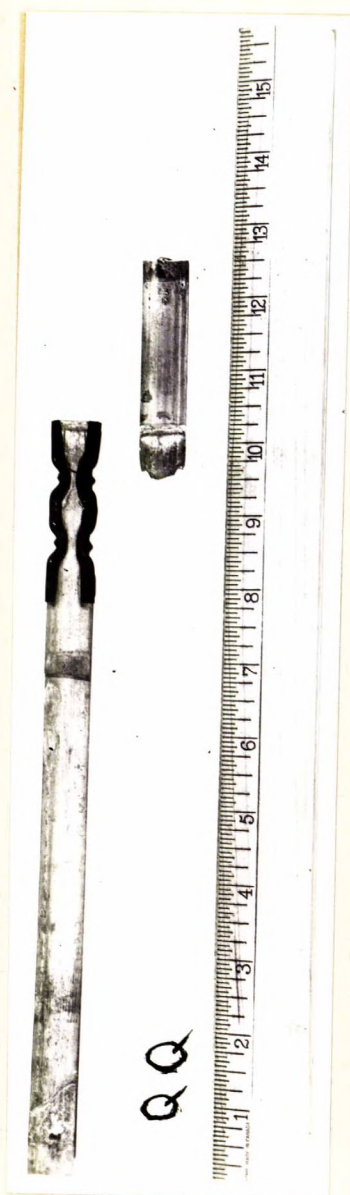
(a)

(b)

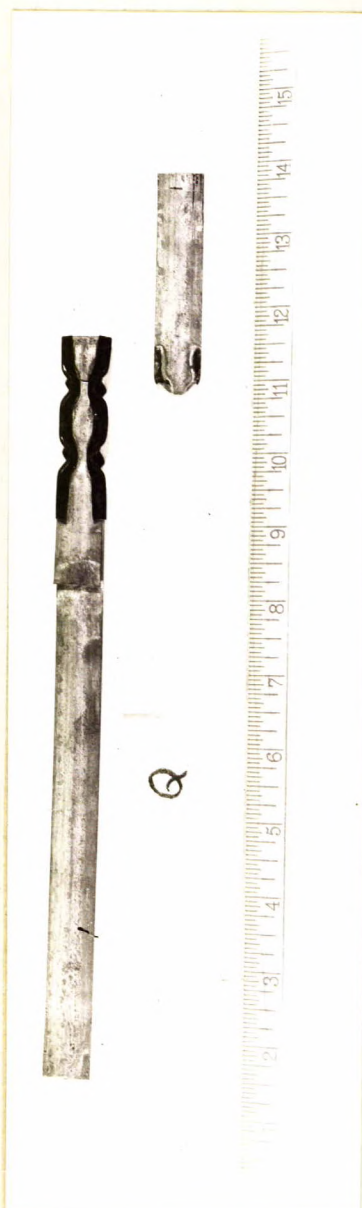
SIGNODE 5/8" X 0.020" GALVANIZED STRAPS WITH SEALED JOINTS, AFTER 19 DAYS IN THE WEATHER-OMETER.

No corrosion product was removed.

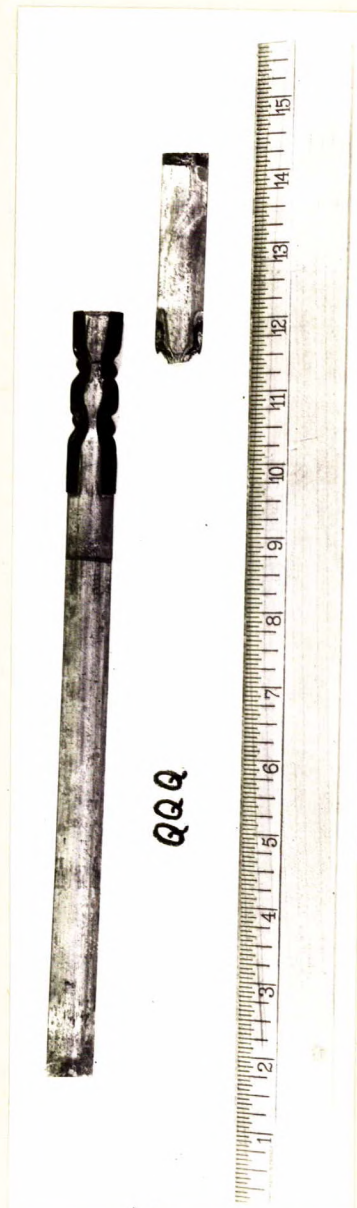
Figure 16 (cont'd)



(c)



(d)

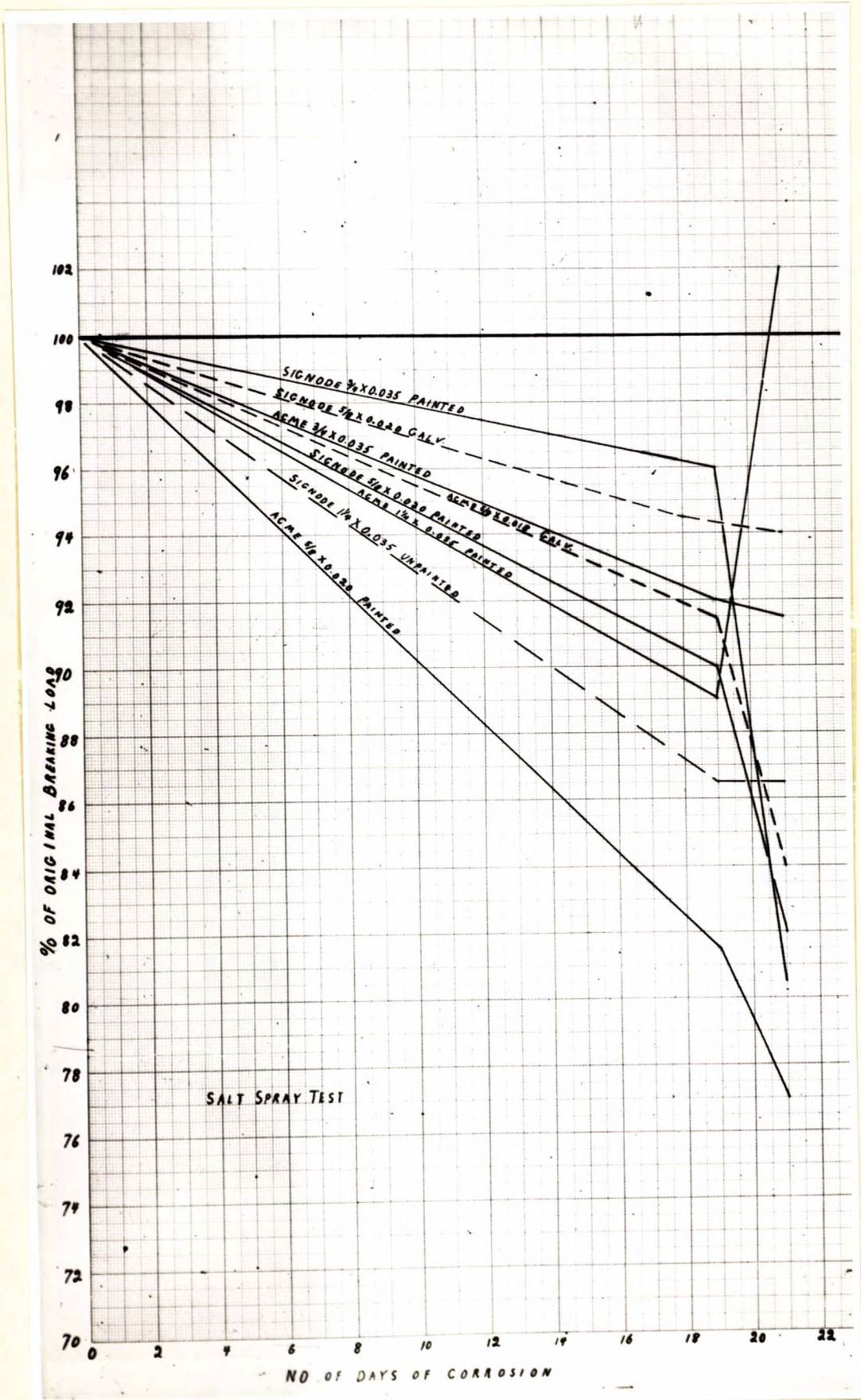


(e)

SEALED JOINTS ON SIGNODE 5/8" X 0.020" GALVANIZED STRAPS
AFTER REMOVAL FROM THE WEATHER-OMETER AND UNDERGOING
BREAKING LOAD TEST.

- (c) Strap QQ after 16 days in the Weather-Ometer.
- (d) Strap Q)
- (e) Strap QQQ) after 16 days in the Weather-Ometer.

Figure 17.

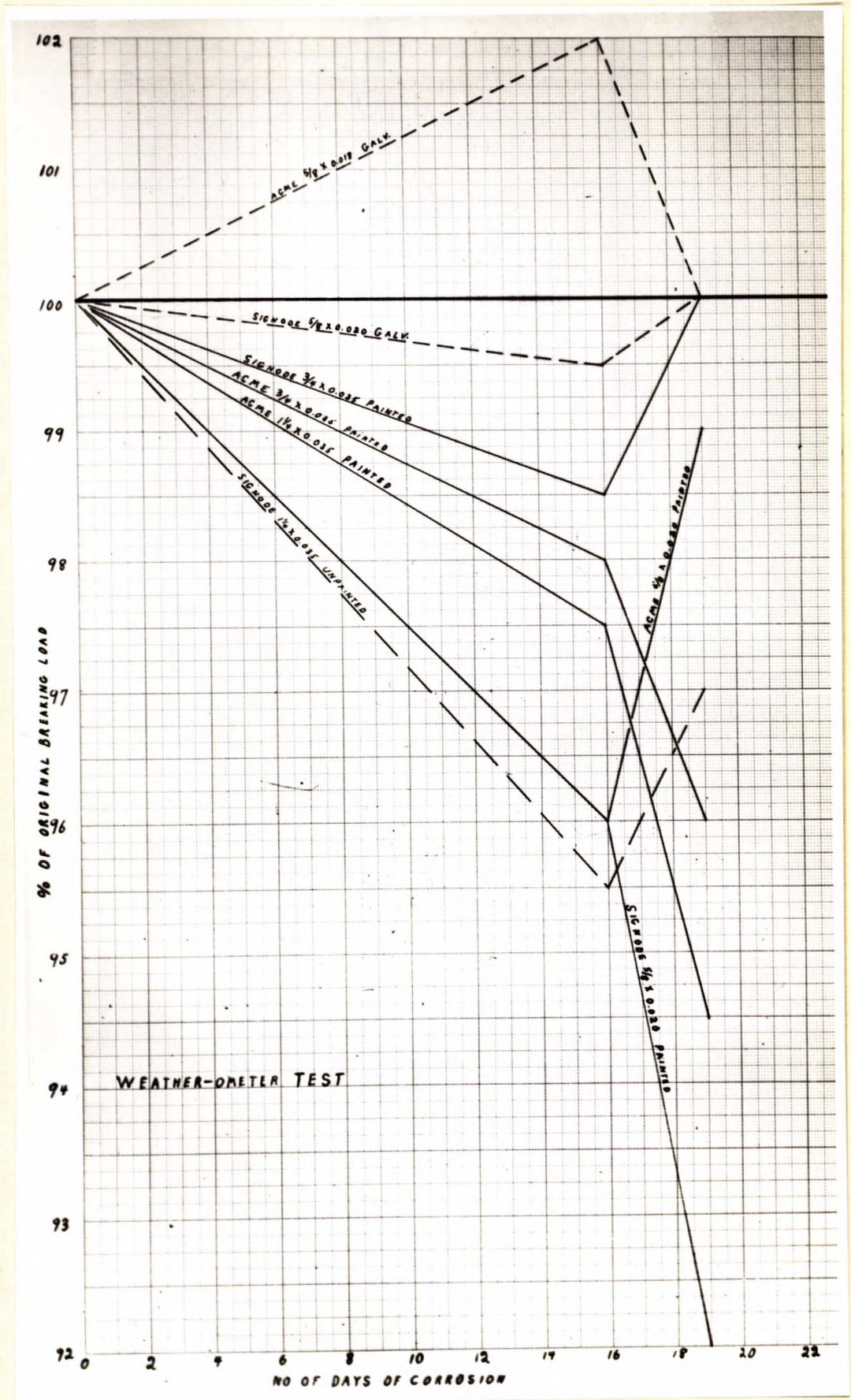


EFFECT OF SALT SPRAY CORROSION ON THE BREAKING LOAD OF VARIOUS TYPES OF COATED STEEL STRAPPING.

The breaking load of the uncorroded straps is taken to be 100 per cent.

Note: The values of "% of Original Breaking Load" at 0 and 21 days are more likely to be accurate than those at 19 days, because the former are averages based on two individual measurements while the latter are based on single measurements only.

Figure 18.



EFFECT OF WEATHER-OMETER CORROSION ON THE BREAKING LOAD OF VARIOUS TYPES OF COATED STEEL STRAPPING.

The breaking load of the uncorroded straps is taken to be 100 per cent.

Note: The values of "% of Original Breaking Load" at 0 and 19 days are more likely to be accurate than those at 16 days, because the former are averages based on two individual measurements while the latter are based on single measurements only.