10.0

NATIONAL BUREAU OF STANDARDS REPORT

2683

TESTS OF FLASHING MATERIALS

by
Thomas H. Boone

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

U. S. DEPARTMENT OF COMMERCE

Sinclair Weeks, *Secretary*

NATIONAL BUREAU OF STANDARDS

A. V. Astin, *Director*

THE NATIONAL BUREAU OF STANDARDS

The scope of activities of the National Bureau of Standards is suggested in the following listing of the divisions and sections engaged in technical work. In general, each section is engaged in specialized research, development, and engineering in the field indicated by its title. A brief description of the activities, and of the resultant reports and publications, appears on the inside of the back cover of this report.

Electricity. Resistance Measurements. Inductance and Capacitance. Electrical Instruments. Magnetic Measurements. Applied Electricity. Electrochemistry.

Optics and Metrology. Photometry and Colorimetry. Optical Instruments. Photographic Technology. Length. Gage.

Heat and Power. Temperature Measurements. Thermodynamics. Cryogenics. Engines and Lubrication. Engine Fuels. Cryogenic Engineering.

Atomic and Radiation Physics. Spectroscopy. Radiometry. Mass Spectrometry. Solid State Physics. Electron Physics. Atomic Physics. Neutron Measurements. Infrared Spectroscopy. Nuclear Physics. Radioactivity. X-Rays. Betatron. Nucleonic Instrumentation. Radiological Equipment. Atomic Energy Commission Instruments Branch.

Chemistry. Organic Coatings. Surface Chemistry. Organic Chemistry. Analytical Chemistry. Inorganic Chemistry. Electrodeposition. Gas Chemistry. Physical Chemistry. Thermochemistry. Spectrochemistry. Pure Substances.

Mechanics. Sound. Mechanical Instruments. Aerodynamics. Engineering Mechanics. Hydraulics. Mass. Capacity, Density, and Fluid Meters.

Organic and Fibrous Materials. Rubber. Textiles. Paper. Leather. Testing and Specifications. Polymer Structure. Organic Plastics. Dental Research.

Metallurgy. Thermal Metallurgy. Chemical Metallurgy. Mechanical Metallurgy. Corrosion.

Mineral Products. Porcelain and Pottery. Glass. Refractories. Enameled Metals. Concreting Materials. Constitution and Microstructure. Chemistry of Mineral Products.

Building Technology. Structural Engineering. Fire Protection. Heating and Air Conditioning. Floor, Roof, and Wall Coverings. Codes and Specifications.

Applied Mathematics. Numerical Analysis. Computation. Statistical Engineering. Machine Development.

Electronics. Engineering Electronics. Electron Tubes. Electronic Computers. Electronic Instrumentation.

Radio Propagation. Upper Atmosphere Research. Ionospheric Research. Regular Propagation Services. Frequency Utilization Research. Tropospheric Propagation Research. High Frequency Standards. Microwave Standards.

Ordnance Development.
Electromechanical Ordnance.
Ordnance Electronics.

These three divisions are engaged in a broad program of research and development in advanced ordnance. Activities include basic and applied research, engineering, pilot production, field testing, and evaluation of a wide variety of ordnance matériel. Special skills and facilities of other NBS divisions also contribute to this program. The activity is sponsored by the Department of Defense.

Missile Development. Missile research and development: engineering, dynamics, intelligence, instrumentation, evaluation. Combustion in jet engines. These activities are sponsored by the Department of Defense.

- Office of Basic Instrumentation
- Office of Weights and Measures.

NATIONAL BUREAU OF STANDARDS REPORT

NBS PROJECT		NBS REPORT
1000-30-4801	July 21, 1953	2683

TESTS OF FLASHING MATERIALS

by
Thomas H. Boone

Floor, Roof and Wall Coverings Section
Building Technology Division

Sponsored by
Office of the Chief of Engineers
Department of the Army

The publication, re ' In part, is prohibited
unless permission i tandards, Washington
25, D. C. Such pe eport has been specifi-
cally prepared if t 'eport for its own use.

Approved for public release by the Director of the National Institute of Standards and Technology (NIST) on October 9, 2015.

TESTS OF FLASHING MATERIALS

TESTS OF FLASHING MATERIALS

1. PURPOSE OF INVESTIGATION

Laboratory tests were made to obtain physical and analytical data to substantiate the suitability of selected flashing materials for use in building construction.

2. SCOPE OF THE INVESTIGATION

Laboratory tests were made on two organic, and two organic-metallic flashing materials. Data on durability, water permeability, resistance to puncture, flexibility, resistance to corrosion (alkali and acid), and resistance to mildew and elevated temperatures were obtained.

No attempt was made to obtain data on sample variability of the four materials studied and all test specimens were taken from the first few yards of a single roll of each material.

3. MATERIALS

The names of the manufacturers, sample numbers, types, trade names, and brief descriptions of materials tested are given in Table 1.

4. RESULTS OF TESTS

4.1 Composition

Table 2 gives the physical characteristics of the flashing materials with analytical data obtained on each.

TABLE 1. MATERIALS

Sample No.	Manufacturer	Type	Designation or Trade Name	Description
1	Rubber & Plastic Compound Co., Inc.	Reinforced rubber sheet	Nerva-Clad	Compounded rubber sheet reinforced with woven glass fabric.
2	Rubber & Plastic Compound Co., Inc.	Plastic sheet	Nervastral Seal-Pruf Type H-D	Compounded organic sheet.
3	Wasco Flashing Co.	Copper coated with asphalt-saturated fabric	Wasco Copper-Fabric Flashing	Three-ounce copper foil bonded to and between two layers of asphalt-saturated cotton fabric with asphalt mastic. Fabric was hemmed on all edges. The material was corrugated the width of the sheet.
4	Phoenix Buildings Products, Inc.	Copper sheet backed with bituminized paper.	Cop-R-Flash	One-ounce copper foil bonded to a lamina of lead foil which was bonded to asphalt-saturated & reinforced creped paper.

TABLE 2. COMPOSITION AND PHYSICAL CHARACTERISTICS

SAMPLE No. 1	
Total weight, oz/sq.yd	28.5
Total thickness, in.	0.027
Glass reinforcing fibers	
Weight, oz/sq.yd	1.9
Threads per in.	16 and 16
SAMPLE No. 2	
Total weight, oz/sq.yd	21.7
Total thickness, in.	0.019
SAMPLE No. 3	
Total weight, oz/sq.yd	88.9
Total thickness, in.	0.07 (approx.)
Sheet copper	
Weight, oz/sq.yd	26.1
Thickness, in.	0.0035
Desaturated fabric	
Weight, oz/sq.yd	8.3[1/]
Threads per in.	28 and 33
Mineral matter, oz/sq.yd	11.1
Total bitumen, oz/sq.yd	43.4
SAMPLE No. 4	
Total weight, oz/sq.yd	52.9
Total thickness, in.	0.036
Sheet copper	
Weight, oz/sq.yd	10.4
Thickness, in.	0.002
Sheet lead	
Weight, oz/sq.yd	20.3
Thickness, in.	0.002
Desaturated paper	
Weight, oz/sq.yd	4.1[1/]
Glass reinforcing fibers	
Weight, oz/sq.yd	0.024
Total bitumen, oz/sq.yd	18.0

1/ Combined weight of two layers.

4.2 Accelerated Aging

Specimens of the flashings were exposed to four different aging tests as follows: (a) exposure to air at high pressure, (b) exposure to oxygen at high pressure, (c) extremes of temperature and humidity, and (d) weatherometer test. The visual change of each follows: For effect of these aging tests on waterproofness, see paragraph 4.3, and for effect on flexibility, see paragraph 4.5.

(a) Air pressure, 40 hours at 80 psi and 70 ±1°C (158°F), in accordance with Section II, 4 of Federal Specification ZZ-R-601a.

Sample No.	Appearance of Specimens
1	No visual changes.
2	No visual changes.
3	Darkening of surface.
4	Slight shrinkage of paper.

(b) Oxygen pressure, 8 days at 300 psi and 70 ±1°C (158°F), in accordance with Section II, 4 of Federal Specification ZZ-R-601a.

Sample No.	Appearance of Specimens
1	No visual changes.
2	No visual changes.
3	Darkening of surface.
4	No visual changes.

(c) Exposure to extremes of temperature and humidity, cold, hot, and high humidity cycle test. The following cycle was repeated three times.

24 hours at 120°F, dry air
24 hours at -20°F
24 hours at 120°F and 90 ±3% relative humidity

Sample No.	Appearance of Specimens
1	No visual changes.
2	No visual changes.
3	Slight shrinkage of cotton fabric.
4	Shrinkage of paper, approximately 1/16 in. in length direction, separation of copper sheet from asphalt bond.

(d) Weatherometer, 300 hours exposure to National Carbon Lamp Type XIA, in accordance with paragraph 5b(2), Section IV, Federal Specification CCC-T-191b.

Sample No.	Appearance of Specimens
1	Surface dulled.
2	Gray-white discoloration.
3	Slight shrinkage and leaching of cotton fabric.
4	Wrinkling and extreme shrinkage of surface ply of paper, slight shrinkage and edge separation of intermediate ply.

4.3 Water Permeability

Specimens 8 by 8-inch were tested for water permeability before and after aging, and after bending to 45° over a straight edge having a 1/16-inch radius edge, and then flattened.

The specimens were clamped over a circular opening 4-1/2 inches in diameter forming the bottom of a reservoir. Water was introduced into the reservoir and maintained for one hour at a depth of 20 inches over the specimen. The water that leaked through the specimen was collected and its volume measured.

There was no leakage on any of the specimens as indicated in the table below:

	Specimen No. 1	Specimen No. 2	Specimen No. 3	Specimen No. 4
Original	None	None	None	None
After 45° bend	None	None	None	None
After 8 days oxygen pressure	None	None	None	None
After 40 hrs air pressure	None	None	None	None
After cycle test	None	None	None	None
After 300 hrs weather-ometer	None	None	None	None

4.4 Resistance to Puncture

For this test, the General Electric Puncture Tester was used. This device has been in use for some time in testing paperboard shipping containers (Tentative Method of Test for Puncture and Stiffness of Paperboard, Corrugated and Solid Fiberboard, A.S.T.M. Designation D781-44T).

In making this test, specimens of all samples were punctured 10 times each, at least 4 inches apart, in both length and cross directions, and from both sides. In the following results, the average of 10 tests is given for each direction and for each side, except for samples that showed no marked directional or

side differences, in which case the average of all results is given.

Puncture Test

Sample No.	Orientation of Specimen	Results, in. - oz. Avg.	Max.	Min.
1	1/ Length direction	130	140	130
	Cross direction	170	180	160
2	2/ Length direction	1300+	---	---
	Cross direction	1290	1300	1280
3	Length direction	890	1270	650
	Cross direction	1270	1300	1200
4	No marked directional or side effects	170	190	140

1/ Length direction indicates that the lengthwise direction of the flashing was oriented in the same direction as the swing of the pendulum.

2/ Beyond the capacity of the instrument to rupture the specimen.

4.5 Adaptability to Forming and Bending

The flexibility of the samples was determined by means of an apparatus described in JAN-P-125, Specification on Packaging and Packing for Overseas Shipment Barrier and Material, Waterproof, Flexible, dated 31 October 1944. This consisted of two parallel brass tubes, 1-1/2 in. in diameter and 9 in. long, fastened 1 in. apart, forming a 1-in. slot with both ends of each tube mounted on ball bearings. The test specimens, 8 in. long by 2, 4, or 8 in. in width, were

placed so that the 1-in. wide slot was centered under the specimens and so that the width of the specimen was centered between the ends of the slot. A rod, 1/2 in. in diameter, was then positioned gently upon the specimen at the center of and parallel to the slot. Attached to the rod and underneath the specimen was suspended a bucket into which the load was introduced at a uniform rate of 4.0 ±0.2 lb per minute. The amount of load required to pull the specimen through the slot was recorded and calculated to pounds per inch of width of the specimen. The number of specimens tested is noted in parenthesis.

This test was made on original and aged specimens to determine the effect of aging. The results follow:

A. Flexibility, lb/in. width

Sample No.	Orientation of Specimen		Original	After 40 Hrs. Air Pressure	After 8 Days Oxygen Pressure
1	1/	Avg.	0.03	0.03	0.03
2	1/	Avg.	0.03	0.03	0.03
3	Length direction	Avg.	0.6	1.3 (5)	1.3 (5)
		Max.	0.9	1.4	1.4
		Min.	0.5	1.2	1.2
	Cross direction	Avg.	0.8	1.4 (5)	1.4 (5)
		Max.	0.9	1.5	1.4
		Min.	0.7	1.3	1.3

(Continued on next page)

Sample No.	Orientation of Specimen		Original	After 40 Hrs. Air Pressure		After 8 Days Oxygen Pressure	
4	Length direction (Copper face up)	Avg.	1.0	1.1	(5)	1.2	(5)
		Max.	1.0	1.2		1.2	
		Min.	0.8	1.0		1.1	
	(Copper face down)	Avg.	0.7	0.8	(5)	0.8	(5)
		Max.	0.7	0.8		0.8	
		Min.	0.7	0.7		0.7	
	Cross direction (Copper face up)	Avg.	0.8	0.9	(5)	0.8	(5)
		Max.	0.8	0.9		0.9	
		Min.	0.7	0.8		0.8	
	(Copper face down)	Avg.	0.5	0.6	(5)	0.6	(5)
		Max.	0.5	0.7		0.7	
		Min.	0.4	0.5		0.5	

1/ Measurement below accuracy of apparatus.

B. Flexibility at 10°F

All samples were bent 45° in both length and cross directions and from both sides. Each bend was made on a different specimen. The specimens (8 X 8 in.) were held at a temperature of 10°F for 24 hours before bending and bent at the same temperature.

Sample No.	Results
1	No cracks or other injuries.
2	No cracks or other injuries.
3	Slight separation of cotton fabric from copper. No cracks.
4	Slight separation of copper sheet from asphalt bond. No cracks.

4.6 Acid and Alkali Tests

The surfaces of the flashing samples were exposed to 5% solutions of sulfuric acid, hydrochloric acid, acetic acid, sodium hydroxide, and a saturated lime solution for 10 days. The solutions were placed on the side opposite the copper on the sample that contained an outside ply of copper foil. The apparent effects of the samples are noted below and are based on visual examination and on hand-tearing or plucking to estimate degradation.

Effects of Acids and Alkalis

	1	2	3	4
Sulfuric Acid 5%	None	None	Fabric weakened	Slight weakening of paper
Hydrochloric Acid 5%	None	None	Fabric weakened	Slight weakening of paper
Acetic Acid 5%	None	None	None	None
Lime Solution Saturated	None	None	None	None
Sodium Hydroxide 5%	Slight etching of top surface	None	Solution penetrated thru fabric; copper slightly corroded	Paper weakened

4.7 Resistance to Mildew

Approximately 30 ml of a sterile culture medium consisting of

Sodium nitrate	3.00 grams
Dipotassium hydrogen phosphate	1.00 "
Magnesium sulphate	0.25 "
Potassium chloride	0.25 "
Agar	10 "
Distilled water	1000 "

were poured into 10 cm Petrie dishes and allowed to cool. A piece of No. 2 Whatman (7 cm) sterilized filter paper was moistened and placed on the medium in each dish.

An inoculum was prepared by scraping a fruiting culture of Chaetomium globosum 1042.4 into 100 ml of sterile water. This spore suspension was used to inoculate the filter paper in the Petrie dishes by pipetting a few ml of the suspension into the middle of each piece of filter paper.

The plates were then incubated at 28°C for 48 hours at which time a mycelial mat was formed over the substrate. Specimens of flashing (2" x 2") were then placed on the mats and incubated for 14 days. They were then examined visually and by hand-tearing or plucking to estimate degradation. The results are as follows:

Sample No.

1 Heavy mycelial growth; no evidence of degradation or loss of strength.

2 Sample showed a 1/4-inch border of mycelial growth; no loss of strength. Sample considered resistant to mildew attack.

3 Heavy reproductive growth; asphalt saturated cotton was considerably weakened and bond of material to copper sheet weakened so that it could be easily scraped off.

4 The asphalt-saturated kraft paper was heavily covered with reproductive growth. Tear strength of the paper lessened and bond of paper to asphalt was weakened. This sample exhibited as much mildew growth as sample No. 3 but the residual strength was greater.

4.8 Resistance to Staining and Bleeding

The samples were exposed for three days in an air oven at 180°F. There was no evidence of dripping, bleeding or severe tackiness as would be indicated on white bond paper placed in contact with samples.

5. EVALUATION OF RESULTS

Table 3 is a rough evaluation of the results of tests using 5-ounce copper sheet as the standard. In using this table, it should be remembered that any attempt to achieve a strict grading of dissimilar materials by series of tests may result in erroneous conclusions. For example, the ratings on samples Nos. 3 and 4 are ratings of the coatings on the copper rather than of the copper itself.

TABLE 3. COMPARATIVE RATINGS
(STANDARD 5-OUNCE COPPER SHEET)*

Sample No.	1	2	3	4
Resistance to Aging	=	=	-	-
Waterproofness	=	=	=	=
Resistance to Puncture	=	+	+	=
Flexibility	+	+	=	=
Resistance to Acids and Alkalis	+	+	-	-
Resistance to Mildew Growth	=	=	-	-

\+ ..... Greater than 5-ounce copper.
\- ..... Less than 5-ounce copper.
= ..... In the same range as 5-ounce copper.

*For physical data of 5-ounce copper sheet, see sample designation no. 17 in National Bureau of Standards Report on Housing and Home Finance Agency Project 1950-STR-10A, Acceptance Testing - Flashings Only, a copy of which is enclosed with this report.

THE NATIONAL BUREAU OF STANDARDS

Functions and Activities

The functions of the National Bureau of Standards are set forth in the Act of Congress, March 3, 1901, as amended by Congress in Public Law 619, 1950. These include the development and maintenance of the national standards of measurement and the provision of means and methods for making measurements consistent with these standards; the determination of physical constants and properties of materials; the development of methods and instruments for testing materials, devices, and structures; advisory services to Government Agencies on scientific and technical problems; invention and development of devices to serve special needs of the Government; and the development of standard practices, codes, and specifications. The work includes basic and applied research, development, engineering, instrumentation, testing, evaluation, calibration services, and various consultation and information services. A major portion of the Bureau's work is performed for other Government Agencies, particularly the Department of Defense and the Atomic Energy Commission. The scope of activities is suggested by the listing of divisions and sections on the inside of the front cover.

Reports and Publications

The results of the Bureau's work take the form of either actual equipment and devices or published papers and reports. Reports are issued to the sponsoring agency of a particular project or program. Published papers appear either in the Bureau's own series of publications or in the journals of professional and scientific societies. The Bureau itself publishes three monthly periodicals, available from the Government Printing Office: The Journal of Research, which presents complete papers reporting technical investigations; the Technical News Bulletin, which presents summary and preliminary reports on work in progress; and Basic Radio Propagation Predictions, which provides data for determining the best frequencies to use for radio communications throughout the world. There are also five series of nonperiodical publications: The Applied Mathematics Series, Circulars, Handbooks, Building Materials and Structures Reports, and Miscellaneous Publications.

Information on the Bureau's publications can be found in NBS Circular 460, Publications of the National Bureau of Standards ($1.00). Information on calibration services and fees can be found in NBS Circular 483, Testing by the National Bureau of Standards (25 cents). Both are available from the Government Printing Office. Inquiries regarding the Bureau's reports and publications should be addressed to the Office of Scientific Publications, National Bureau of Standards, Washington 25, D. C.


NBS