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MATERIALS, SURFACING, FOR BUILT-UP BITUMINOUS ROOFING

I. GENERAL SPECIFICATIONS

There are no general specifications applicable to this specification.

II. TYPES

Surfacing materials for bituminous built-up roofing shall be of the following types, and the type desired shall be stated in invitation for bids:

- Type I. Roofing Gravel.
- Type II. Roofing Slag.

III. MATERIAL

Material shall be as specified under Detail Requirements, section V hereof.

IV. GENERAL REQUIREMENTS

There are no general requirements applicable to this specification.

V. DETAIL REQUIREMENTS

1. *Type I. Roofing Gravel.*—Shall be hard, durable, waterworn, dry, and free from clay, loam, sand, and other foreign substances. It shall preferably be within the following limits with respect to size:

	Percent
Passing a $\frac{3}{4}$ -inch sieve.....	100
Passing a $\frac{5}{8}$ -inch sieve and retained on a $\frac{1}{4}$ -inch sieve, not less than.....	80
Retained on a $\frac{1}{8}$ -inch sieve.....	100

2. *Type II. Roofing Slag.*—Shall be crushed, hard, blast-furnace slag, dry, and free from sand, dirt, clay, or other foreign substances. It shall preferably be within the following limits with respect to size:

	Percent
Passing a $\frac{3}{4}$ -inch sieve.....	100
Passing a $\frac{5}{8}$ -inch sieve and retained on a $\frac{1}{4}$ -inch sieve, not less than.....	80
Retained on a $\frac{1}{8}$ -inch sieve.....	100

VI. METHODS OF SAMPLING AND TESTING

1. Roofing gravel and slag shall be sampled by the methods given in A.S.T.M. Standards, 1930, part II, p. 622, "Sampling Stone, Slag, Gravel, Sand and Stone Block for use as Highway Materials", D-75-22, which are essentially as follows:

a. Samples of the materials shall be taken from the bins or storage piles of the screening or washing plant, preferably while the material is being loaded from these supplies. Samples shall be taken from different parts of the stock pile, care being taken to avoid sampling a segregated area of coarse-grained material which is likely to exist at the base of the pile. In sampling from a bin, separate samples shall be taken from the top of the bin and at the outlet of the loading chute. At the latter place at least one half cubic yard of material shall be run off and representative samples taken from it. These samples shall be well mixed in a composite sample and a 25-pound sample for test obtained by the quartering method shall be plainly marked and transmitted to the laboratory for examination.

b. Where it is not practical to visit the plant, samples shall be taken from different parts of the car, boat, or wagon during unloading. Separate samples shall be taken from the top, middle, and bottom of the car, boat, wagon, etc. These samples shall be well mixed into a composite sample and a 25-pound sample obtained by the quartering method shall be plainly marked and transmitted to the laboratory for mechanical analysis.

2. Laboratory Examination.—Sieve Analysis of Roofing Gravel or Slag:

a. A representative test sample of the surfacing material, which in an air-dry condition weighs about 5 pounds, shall be selected from the sample submitted to the laboratory by quartering or by the use of a sampler.

b. The sieves shall be of square-mesh wire cloth in the following sizes: $\frac{1}{8}$ -inch, $\frac{1}{4}$ -inch, $\frac{5}{8}$ -inch, and $\frac{3}{4}$ -inch, these being the widths of the clear openings.

c. The sample shall be separated by means of the sieves, sifting being continued until not more than 1 percent by weight of the sample passes any sieve during one minute.

d. Each size shall be weighed on a balance or scale which is sensitive to 0.1 ounce (approximately 3 grams).

e. The percentage by weight of the total sample passing each of the sieves shall be determined, and the percentage reported to the nearest whole number.

VII. PACKING AND MARKING

Not applicable to this specification.

VIII. NOTES

1. This specification applies to surfacing materials intended for surfacing built-up bituminous roofing. Materials may be used interchangeably, but must be applied in the manner described in the specifications for application of the particular surfacing material.

2. Materials shall be purchased by weight or volume as specified in the contract.

3. The use of this specification for the commodity covered herein is mandatory on all procuring agencies of the Army.

NOTICE.—When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Gov-

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ernment thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

NOTE.—Unless otherwise specified in invitation for bids, bidders may obtain copies of this specification at the following points:

New York General Depot, First Avenue and Fifty-eighth Street, Brooklyn, N.Y.

Chicago Quartermaster Depot, 1819 West Pershing Road, Chicago, Ill.

San Francisco General Depot, Fort Mason, San Francisco, Calif.

Eighth Corps Area General Depot, Fort Sam Houston, Tex.

[No. 81-7A]

AUGUST 22, 1933

SUPERSEDING

No. 81-13

July 10, 1924

ROOFING, BUILT-UP, TYPE 4AWS, CONSTRUCTION OF

I. GENERAL SPECIFICATIONS.

The latest issues of the following Federal and United States Army specifications, basic numbers as indicated, form a part of this specification insofar as the terms are applicable:

Federal specifications:

Felt, rag, asphalt-saturated, for roofing and water-

proofing-----

Number

HH-F-191

Asphalt for mineral-surfaced roofing-----

SS-A-666

United States Army specifications:

Flashings, metal, installation of, with bituminous
built-up roofing-----

81-23

Flashings, plastic, installation of, with bituminous
built-up roofing-----

81-24

Materials, surfacing, for bituminous built-up roofing--

81-7

II. GRADE.

Not applicable to this specification.

III. MATERIAL.

Roofing of type 4AWS shall contain not less than the following quantities of materials per 100 square feet:

Pounds

Four layers asphalt-saturated rag felt-----

60

Asphalt for mineral-surfaced roofing-----

105

Roofing gravel-----

400

or

Roofing slag-----

300

IV. GENERAL REQUIREMENTS.

Not applicable to this specification.

V. DETAIL REQUIREMENTS.

1. This roofing shall consist of four layers or plies of asphalt-saturated rag felt cemented together with asphalt and surfaced with slag, gravel, or similar surfacing material as called for in the invitation for bids.

2. Flashings of the type required under the specification for the building shall be included and shall conform to United States Army Specifications Nos. 81-23 or 81-24, referred to in section I hereof.

3. Roofing of type 4AWS shall be laid in the following manner:

(a) The asphalt shall not be heated above 400° F. and shall be hot when the felts are laid.

(b) The layers of felt shall be laid so as to be free from wrinkles and buckles.

(c) The surfacing material shall always be dry when applied, and in addition shall be heated in cold weather.

(d) The board-roof surface installed by other contractors, before being considered satisfactory for laying the roof covering, shall be smooth and free from loose boards, large cracks, or projecting ends which might injure the roofing. All dirt and foreign material shall be removed. Precast gypsum slabs shall be firmly set, well pointed, and free from any unevenness which might injure the roofing.

4. (a) Lay two layers of 32-inch asphalt-saturated felt over the entire roof surface, lapping each sheet 17 inches over the preceding sheet. Lap the ends of the sheets not less than 4 inches. When 36-inch felt is used, lap the sheets 19 inches.

(b) Carry these layers of felt up abutting vertical surfaces at least 4 inches.

(c) Nail the sheets along the edges sufficiently to hold them in place until the remaining felts are laid with nails driven through flat tin disks.

5. Mop the entire surface of this felt with a uniform coating of hot asphalt, using not less than 25 pounds per 100 square feet.

6. (a) Over this coating of asphalt lay two additional layers of 32-inch asphalt-saturated felt over the entire roof surface, lapping each sheet 17 inches over the preceding sheet. Lap the ends of the sheets not less than 6 inches. When 36-inch felt is used lap the sheets 19 inches.

(b) Cut off these layers of felt at abutting vertical surfaces.

(c) Mop each of these sheets the full width of the lap with hot asphalt, using not less than 20 pounds per 100 square feet in each mopping.

7. Over the entire surface apply a uniform coating of hot asphalt, using not less than 60 pounds per 100 square feet.

8. Into this asphalt, while hot, embed the surfacing material.

VI. METHODS OF INSPECTION, SAMPLING, AND TESTING.

The necessary inspection shall be made to determine compliance with the specification.

VII. PACKING AND MARKING.

Not applicable to this specification.

VIII. NOTES.

1. Roofing of type 4AWS is adapted to board sheathing with inclines not exceeding 3 inches to the foot or precast gypsum slabs with inclines not exceeding 1 inch to the foot and shall not be used on inclines steeper than these.

2. Roofing constructed in the manner specified is durable and should not require repairs or renewals on account of the action of the elements for a period of 10 years.

NOTICE.—When Government drawings, specifications, or other data are used for any purpose, other than in connection with a definitely related Government procurement operation, the United States Gov-

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ernment thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded, by implication or otherwise, as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

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New York general depot, First Avenue and Fifty-eighth Street, Brooklyn, N. Y.
Chicago quartermaster depot, 1819 West Pershing Road, Chicago, Ill.
San Francisco general depot, Fort Mason, San Francisco, Calif.
Eighth Corps Area general depot, Fort Sam Houston, Tex.
[No. 81-13A]

AUGUST 22, 1933

SUPERSEDING

No. 81-14

July 10, 1924

ROOFING, BUILT-UP, TYPE 5AWS, CONSTRUCTION OF

I. GENERAL SPECIFICATIONS

The latest issues of the following Federal and United States Army Specifications, basic numbers as indicated, form a part of this specification insofar as the terms are applicable:

Federal Specifications:

Felt, Rag, Asphalt-saturated, for Roofing and Water-proofing	No. HH-F-191
Asphalt for Mineral-surfaced Roofing	SS-A-666

United States Army Specifications:

Flashings, Metal, Installation of, with Bituminous Built-up Roofing	81-23
Flashings, Plastic, Installation of, with Bituminous Built-up Roofing	81-24
Materials, Surfacing, for Bituminous Built-up Roofing	81-7

II. GRADE

Not applicable to this specification.

III. MATERIAL

Roofing of type 5AWS shall contain not less than the following quantities of materials per 100 square feet:

	Pounds
Five layers asphalt-saturated rag felt	76
Asphalt for mineral-surfaced roofing	125
Roofing gravel	400
or	
Roofing slag	300

IV. GENERAL REQUIREMENTS

Not applicable to this specification.

V. DETAIL REQUIREMENTS

1. This roofing shall consist of five layers or plies of asphalt saturated rag felt, cemented together with asphalt and surfaced with slag, gravel, or similar surfacing material as called for in the invitation for bids.

2. Flashings of the type required under the specification for the building shall be included and shall conform to United States Army Specifications Nos. 81-23 or 81-24, referred to in section I hereof.

3. Roofing of type 5AWS shall be laid in the following manner:

(a) The asphalt shall not be heated above 400° F. and shall be hot when the felts are laid.

(b) The layers of felt shall be laid so as to be free from wrinkles and buckles.

(c) The surfacing material shall always be dry when applied and in addition shall be heated in cold weather.

(d) The board roof surface installed by other contractors before being considered satisfactory for laying the roof covering shall be smooth and free from loose boards, large cracks, or projecting ends which might injure the roofing. All dirt and foreign material shall be removed. Precast gypsum slabs shall be firmly set, well pointed, and free from any unevenness which might injure the roofing.

4 (a) Lay two layers of 32-inch asphalt-saturated felt over the entire roof surface, lapping each sheet 17 inches over the preceding sheet. Lap the ends of the sheets not less than 4 inches. When 36-inch felt is used lap the sheets 19 inches.

(b) Carry these layers of felt up abutting vertical surfaces at least 4 inches.

(c) Nail the sheets along the edges sufficiently to hold them in place until the remaining felts are laid with nails driven through flat tin disks.

5. Mop the entire surface of this felt with a uniform coating of hot asphalt, using not less than 25 pounds per 100 square feet.

6. (a) Over this coating of asphalt lay three additional layers of 32-inch asphalt saturated felt over the entire roof surface, lapping each sheet 22 inches over the preceding sheet, and nailing each sheet approximately 6 inches from its upper edge with nails driven through flat tin disks. Lap the ends not less than 6 inches. When 36-inch felt is used, lap the sheets 24½ inches.

(b) Cut off these layers of felt at abutting vertical surfaces.

(c) Mop each of these three sheets the full width of the lap with hot asphalt using not less than 20 pounds per 100 square feet in each mopping.

7. Over the entire surface apply a uniform coating of hot asphalt, using not less than 60 pounds per 100 square feet.

8. Into this asphalt, while hot, embed the surfacing material.

VI. METHODS OF INSPECTION, SAMPLING, AND TESTING

The necessary inspection shall be made to determine compliance with the specification.

VII. PACKING AND MARKING

Not applicable to this specification.

VIII. NOTES

1. Roofing of type 5AWS is adapted to board sheathing with inclines not exceeding 3 inches to the foot or precast gypsum slabs or blocks with inclines not exceeding 1 inch to the foot, and shall not be used on inclines greater than these.

2. Roofing constructed in the manner specified is durable and should not require repairs or renewals on account of the action of the elements for a period of 20 years.

[No. 81-14A]

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San Francisco General Depot, Fort Mason, San Francisco, Calif.

Eighth Corps Area General Depot, Fort Sam Houston, Tex.

[No. 81-14A]

**U. S. ARMY
SPECIFICATION**

No. 81-15A

AUGUST 22, 1933

SUPERSEDING

No. 81-15

July 10, 1924

**ROOFING, BUILT-UP, TYPE 3ACS,
CONSTRUCTION OF**

I. GENERAL SPECIFICATIONS.

The latest issues of the following Federal and United States Army specifications, basic numbers as indicated, form a part of this specification insofar as the terms are applicable:

Federal specifications:

Primer, Asphalt, for Roofing and Waterproofing----	<i>No.</i> SS-A-701
Felt, Rag, Asphalt-saturated, for Roofing and Water- proofing -----	HH-F-191
Asphalt, for mineral-surfaced roofing-----	SS-A-666

United States Army specifications:

Flashings, Metal, Installation of, With Bituminous Built-up Roofing -----	81-23
Flashings, Plastic, Installation of, With Bituminous Built-up Roofing -----	81-24
Materials, Surfacing, for Bituminous Built-up Roofing -----	81-7

II. GRADE.

Not applicable to this specification.

III. MATERIAL.

Roofing of type 3ACS shall contain not less than the following quantities of materials per 100 square feet:

	Over/con- crete	Over gyp- sum
	<i>Pounds</i>	<i>Pounds</i>
Asphalt primer-----	7.5	15
3 layers asphalt-saturated rag felt-----	45	45
Asphalt for mineral-surface roofing-----	130	130
Roofing gravel-----	400	400
Or		
Roofing slag-----	300	300

IV. GENERAL REQUIREMENTS.

Not applicable to this specification.

V. DETAIL REQUIREMENTS.

1. This roofing shall consist of three layers or plies of asphalt-saturated rag felt cemented together with asphalt and surfaced with slag, gravel, or similar surfacing material, as called for in invitation for bids.

2. Flashings of the type required under the specification for the building shall be included and shall conform to United States Army Specifications Nos. 81-23 or 81-24, referred to in section I hereof.

3. Roofing of type 3ACS shall be laid in the following manner:

a. The asphalt shall not be heated above 400° F. and shall be hot when the felts are laid.

b. The layers of felt shall be laid so as to be free from wrinkles and buckles.

c. When the roof surface is of gypsum, each sheet of felt shall be nailed at approximately 6 inches from its upper edge with nails driven through flat tin disks.

d. The surfacing material shall always be dry when applied and in addition shall be heated in cold weather.

e. Concrete and gypsum surfaces installed by other contractors before being considered satisfactory for laying the roof covering shall be smooth, firm, dry, and free from high spots, depressions, and all loose and foreign material. Precast slabs shall be firmly set and well pointed.

f. When the roof surface is of gypsum, apply a second coat of primer after the first coat has dried, using not less than 1 gallon per 100 square feet.

4. Coat the roof surface uniformly with asphalt primer, using not less than 1 gallon per 100 square feet, and allow to dry.

5. Over this apply a uniform coating of hot asphalt, using not less than 30 pounds per 100 square feet.

6. a. Over this coating of asphalt lay three layers of 32-inch asphalt-saturated felt over the entire roof, lapping each sheet 22 inches over the preceding sheet. Lap the ends of the sheets not less than 6 inches. When 36-inch felt is used, lap the sheets 24½ inches.

b. Mop each of these three sheets the full width of the lap with hot asphalt, using not less than 20 pounds per 100 square feet in each mopping.

c. Cut off the felts at abutting vertical surfaces.

7. Over the entire surface apply a uniform coating of hot asphalt, using not less than 60 pounds per 100 square feet.

8. Into this asphalt, while hot, embed the surfacing material.

VI. METHODS OF INSPECTION, SAMPLING, AND TESTING.

The necessary inspection shall be made to determine compliance with the specification.

VII. PACKING AND MARKING.

Not applicable to this specification.

[No. 81-15A]

VIII. NOTES.

1. Roofing of type 3ACS is adapted to concrete and poured-gypsum surfaces with inclines not exceeding 3 inches to the foot and shall not be used on inclines greater than this.

2. Roofing constructed in the manner specified is durable and should not require repairs or renewals on account of the action of the elements for a period of 10 years.

[No. 81-15A]

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[No. 81-15A]

ROOFING, BUILT-UP, TYPE 4ACS, CONSTRUCTION OF

I. GENERAL SPECIFICATIONS.

The latest issues of the following Federal and United States Army specifications, basic numbers as indicated, form a part of this specification insofar as the terms are applicable:

Federal specifications:

	<i>Number</i>
Primer, asphalt, for roofing and waterproofing-----	SS-A-701
Asphalt for mineral-surfaced roofing-----	SS-A-666
Felt, rag, asphalt-saturated, for roofing and water- proofing-----	HH-F-191

U. S. Army specifications:

Flashings, metal, installation of, with bituminous built-up roofing-----	81-23
Flashings, plastic, installation of, with bituminous built-up roofing-----	81-24
Materials, surfacing, for bituminous built-up roof- ing-----	81-7

II. GRADE.

Not applicable to this specification.

III. MATERIALS.

Roofing of type 4ACS shall contain not less than the following quantities of materials per 100 square feet:

	Over concrete	Over gypsum
	<i>Pounds</i>	<i>Pounds</i>
Asphalt primer-----	7.5	15
Four layers asphalt-saturated rag felt-----	60	60
Asphalt for mineral-surfaced roofing-----	150	150
Roofing gravel-----	400	400
Or		
Roofing slag-----	300	300

IV. GENERAL REQUIREMENTS.

Not applicable to this specification.

V. DETAIL REQUIREMENTS.

1. This roofing shall consist of four layers or plies of asphalt-saturated rag felt cemented together with asphalt and surfaced with slag, gravel, or similar surfacing material, as called for in the invitation for bids.

2. Flashings of the type required under the specification for the building shall be included and shall conform to United States Army Specifications Nos. 8-23 or 8-24, referred to in section I hereof.

3. Roofing of type 4ACS shall be laid in the following manner:

a. The asphalt shall not be heated above 400° F. and shall be hot when the felts are laid.

b. The layers of felt shall be laid so as to be free from wrinkles and buckles.

c. When the roof surface is of gypsum, each sheet of felt shall be nailed at approximately 6 inches from its upper edge with nails driven through flat tin disks.

d. The surfacing material shall always be dry when applied, and in addition shall be heated in cold weather.

e. Concrete and gypsum surfaces installed by other contractors, before being considered satisfactory, for laying the roof covering, shall be smooth, firm, dry, and free from high spots, depressions, and all loose and foreign material. Precast slabs shall be firmly set and well pointed.

f. When the roof surface is of gypsum, apply a second coat of primer after the first coat has dried, using not less than 1 gallon per 100 square feet.

4. Coat the roof surface uniformly with asphalt primer, using not less than 1 gallon per 100 square feet, and allow to dry.

5. Over this apply a uniform coating of hot asphalt, using not less than 30 pounds per 100 square feet.

6. a. Over this coating of asphalt lay four layers of 32-inch asphalt-saturated felt over the entire roof surface, lapping each sheet 24½ inches over the preceding sheet. Lap the ends of the sheets not less than 6 inches. When 36-inch felt is used, lap the sheets 27½ inches.

b. Mop the full width of each lap with hot asphalt, using not less than 20 pounds per 100 square feet in each mopping.

c. Cut off these layers of felt at abutting vertical surfaces.

7. Mop the entire surface of this felt with a uniform coating of hot asphalt, using not less than 60 pounds per 100 square feet.

8. Into this asphalt, while hot, embed the surfacing material.

VI. METHODS OF INSPECTION, SAMPLING, AND TESTING.

The necessary inspection shall be made to determine compliance with the specification.

VII. PACKING AND MARKING.

Not applicable to this specification.

[No. 81-16A]

[No. 81-16A]

VIII. NOTES.

1. Roofing of type 4ACS is adapted to concrete and poured-gypsum roof surfaces with inclines not exceeding 3 inches to the foot and shall not be used on inclines greater than this.

2. Roofing constructed in the manner specified is durable and should not require repairs or renewals on account of the action of the elements for a period of 20 years.

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New York General Depot, First Avenue and Fifty-eighth Street, Brooklyn, N. Y.

Chicago Quartermaster Depot, 1819 West Pershing Road, Chicago, Ill.

San Francisco General Depot, Fort Mason, San Francisco, Calif.

Eighth Corps Area General Depot, Fort Sam Houston, Tex.

[No. 81-16A]

AUGUST 22, 1933

SUPERSEDING

No. 81-17

July 10, 1924

ROOFING, BUILT-UP, TYPE 5ACS, CONSTRUCTION OF

I. GENERAL SPECIFICATIONS

The latest issues of the following Federal and United States Army specifications, basic numbers as indicated, form a part of this specification insofar as the terms are applicable:

Federal specifications:

	Number
Primer, asphalt, for roofing and waterproofing-----	SS-A-701
Asphalt, for mineral-surfaced roofing-----	SS-A-666
Felt, rag, asphalt-saturated, for roofing and water- proofing-----	HH-F-191

United States Army specifications:

Flashings, metal, installation of, with bituminous built- up roofing-----	81-23
Flashings, plastic, installation of, with bituminous built- up roofing-----	81-24
Materials, surfacing, for bituminous built-up roofing----	81-7

II. GRADE

Not applicable to this specification.

III. MATERIAL

Roofing of type 5ACS shall contain not less than the following quantities of materials per 100 square feet:

	Over con- crete	Over gypsum
	Pounds	Pounds
Asphalt primer-----	7.5	15
5 layers asphalt-saturated rag felt-----	76	76
Asphalt for mineral-surfaced roofing-----	170	170
Roofing gravel-----	400	400
or Roofing slag-----	300	300

IV. GENERAL REQUIREMENTS

Not applicable to this specification.

V. DETAIL REQUIREMENTS

1. This roofing shall consist of five layers or plies of asphalt-saturated rag felt cemented together with asphalt and surfaced with

slag, gravel, or similar surfacing material, as called for in the invitation for bids.

2. Flashings of the type required under the specification for the building shall be included and shall conform to United States Army Specifications Nos. 81-23 or 81-24, referred to in section I hereof.

3. Roofing of type 5ACS shall be laid by either the shingle or the two and three method. The shingle method is preferred and shall be used when no choice is specified.

4. The asphalt shall not be heated above 400° F. and shall be hot when the felts are laid.

5. The layers of felt shall be laid so as to be free from wrinkles and buckles.

6. When the roof surface is of gypsum each sheet of felt shall be nailed at approximately 6 inches from its upper edge with nails driven through flat tin disks.

7. The surfacing material shall always be dry when applied and in addition shall be heated in cold weather.

8. Concrete and gypsum surfaces installed by other contractors before being considered satisfactory for laying the roof covering shall be smooth, firm, dry, and free from high spots, depressions, and all loose and foreign material. Precast slabs shall be firmly set and well pointed.

9. When the roof surface is of gypsum apply a second coat of primer after the first coat has dried, using not less than 1 gallon per 100 square feet.

10. *Shingle method.*—(1) Coat the roof surface uniformly with asphalt primer, using not less than 1 gallon per 100 square feet, and allow to dry.

(2) Over this apply a uniform coating of hot asphalt, using not less than 30 pounds per 100 square feet.

(3) Over this coating of asphalt lay five layers of 32-inch asphalt-saturated felt over the entire roof surface, lapping each sheet 26 inches over the preceding sheet. Lap the ends of the sheets not less than 6 inches. When 36-inch felt is used lap the sheets 29 inches.

Mop each of these five sheets the full width of the lap with hot asphalt, using not less than 20 pounds per 100 square feet in each mopping.

Cut off these layers of felt at abutting vertical surfaces.

(4) Over the entire surface apply a uniform coating of asphalt, using not less than 60 pounds per 100 square feet.

(5) Into this asphalt, while hot, embed the surfacing material.

11. *Two and three method.*—(1) Coat the roof surface uniformly with asphalt primer, using not less than 1 gallon per 100 square feet, and allow to dry.

(2) Over this apply a uniform coating of hot asphalt, using not less than 30 pounds per 100 square feet.

(3) Over this coating of asphalt lay two layers of 32-inch asphalt-saturated felt over the entire roof surface, lapping each sheet 17 inches over the preceding sheet. Lap the ends of the sheets not less than 4 inches. When 36-inch felt is used lap the sheets 19 inches.

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Mop the full width of each lap with hot asphalt, using not less than 20 pounds per 100 square feet in each mopping.

Cut off these layers of felt at abutting vertical surfaces.

(4) Mop the entire surface of this felt with a uniform coating of hot asphalt, using not less than 20 pounds per 100 square feet.

(5) Over this coating of asphalt lay three additional layers of 32-inch asphalt-saturated felt over the entire roof surface, lapping each sheet 22 inches over the preceding sheet. Lap the ends of the sheets not less than 6 inches. When 36-inch felt is used, lap the sheets 24½ inches.

Mop each of these three sheets the full width of the lap with hot asphalt, using not less than 20 pounds per 100 square feet, in each mopping.

Cut off these layers of felt at abutting vertical surfaces.

(6) Over the entire surface apply a uniform coating of hot asphalt, using not less than 60 pounds per 100 square feet.

(7) Into this asphalt, while hot, embed the surfacing material.

VI. METHODS OF INSPECTION, SAMPLING, AND TESTING

The necessary inspection shall be made to determine compliance with the specification.

VII. PACKING AND MARKING

Not applicable to this specification.

VIII. NOTES

1. Roofing of type 5ACS is adapted to concrete and poured-gypsum surfaces with inclines not exceeding 3 inches to the foot and shall not be used on inclines greater than this.

2. Roofing constructed in the manner specified above is durable and should not require repairs or renewals on account of the action of the elements for a period of 20 years. While the surface of this type of roofing will require some attention in about the same time as roofing of type 4ACS, if the roofing is allowed to stand until complete failure, longer life can be expected from type 5ACS than from type 4ACS.

NOTICE.—When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever, and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

NOTE.—Unless otherwise specified in invitation for bids, bidders on Government supplies may obtain copies of this specification at the following points:
New York General Depot, First Avenue and Fifty-eighth Street, Brooklyn, N.Y.

Chicago Quartermaster Depot, 1819 West Pershing Road, Chicago, Ill.

San Francisco General Depot, Fort Mason, San Francisco, Calif.

Eighth Corps Area General Depot, Fort Sam Houston, Tex..

[No. 81-17A]

ROOFING, BUILT-UP, TYPE 3TCS, CONSTRUCTION OF

I. GENERAL SPECIFICATIONS.

The latest issues of the following Federal and United States Army specifications, basic numbers as indicated, form a part of this specification insofar as the terms are applicable:

Federal specifications:

Felt, rag, coal-tar saturated, for roofing and waterproofing-----	No. HH-F-201
Pitch, coal-tar, for roofing-----	R-P-381

United States Army specifications:

Flashings, metal, installation of, with bituminous built-up roofing-----	81-23
Flashings, plastic, installation of, with bituminous built-up roofing-----	81-24
Material, surfacing, for bituminous built-up roofing-----	81-7

II. GRADE.

Not applicable to this specification.

III. MATERIAL.

Roofing of type 3TCS shall contain not less than the following quantities of materials per 100 square feet:

	Pounds
Three layers coal-tar saturated rag felt-----	45
Coal-tar pitch-----	160
Roofing gravel-----	400
or	
Roofing slag-----	300

IV. GENERAL REQUIREMENTS.

Not applicable to this specification.

V. DETAIL REQUIREMENTS.

1. This roofing shall consists of three layers or plies of coal tar saturated rag felt cemented together with coal-tar pitch and surfaced with slag, gravel, or similar surfacing materials, as called for in the invitation for bids.

2. Flashings of the type required under the specification for the building shall be included and shall conform to United States Army specifications nos. 81-23 or 81-24, referred to in section I hereof.

3. Roofing of type 3TCS shall be laid in the following manner:

a. The coal-tar pitch shall not be heated above 375° F. and shall be hot when the felts are laid.

b. The layers of felt shall be laid so as to be free from wrinkles and buckles.

c. When the roof surface is of gypsum, each sheet of felt shall be nailed at approximately 6 inches from its upper edge, with nails driven through flat tin disks.

d. The surfacing material shall always be dry when applied and in addition shall be heated in cold weather.

e. Concrete and gypsum roof surfaces installed by other contractors before being considered satisfactory for laying the roof covering shall be smooth, firm, dry, and free from high spots, depressions, and all loose and foreign material. Precast concrete slabs shall be firmly set and well pointed.

4. Mop the roof slab uniformly with hot coal-tar pitch, using not less than 40 pounds per 100 square feet.

5. Over this coating of coal-tar pitch lay three layers of 32-inch coal-tar-saturated felt over the entire roof surface, lapping each sheet 22 inches over the preceding sheet. Lap the ends not less than 6 inches. When 36-inch felt is used, lap the sheets 24½ inches.

Cut off these layers of felt at abutting vertical surfaces.

Mop each of these three sheets the full width of the lap with hot coal-tar pitch, using not less than 25 pounds per 100 square feet in each mopping.

6. Over the entire surface apply a uniform coating of hot coal-tar pitch, using not less than 70 pounds per 100 square feet.

7. Into this pitch, while hot, embed the surfacing material.

VI. METHODS OF INSPECTION, SAMPLING, AND TESTING.

The necessary inspection shall be made to determine compliance with the specification.

VII. PACKING AND MARKING.

Not applicable to this specification.

VIII. NOTES.

1. Roofing of type 3TCS is adapted to concrete and poured gypsum roof surfaces with inclines not exceeding 1 inch to the foot and shall not be used on inclines greater than this.

2. Roofing constructed in the manner specified is durable and should not require repairs or renewals on account of the action of the elements for a period of 10 years.

Notice.—When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever, and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell, any patented invention that may in any way be related thereto.

NOTE.—Unless otherwise specified in invitation for bids, bidders on Government supplies may obtain copies of this specification at the following points:

New York general depot, First Avenue and Fifty-eighth Street, Brooklyn, N. Y.

Chicago quartermaster depot, 1819 West Pershing Road, Chicago, Ill.

San Francisco general depot, Fort Mason, San Francisco, Calif.

Eighth Corps Area general depot, Fort Sam Houston, Tex.

[No. 81-18A]

AUGUST 22, 1933

SUPERSEDING

No. 81-19

July 10, 1924

ROOFING, BUILT-UP, TYPE 4TCS, CONSTRUCTION OF

I. GENERAL SPECIFICATIONS.

The latest issues of the following Federal and United States Army Specifications, basic numbers as indicated, form a part of this specification insofar as the terms are applicable:

Federal specifications:

	<i>Number</i>
Felt, rag, coal-tar saturated, for roofing and water-proofing-----	HH-F-201
Pitch, coal-tar, for roofing-----	R-P-381

U. S. Army specifications:

Flashings, metal, installation of, with bituminous built-up roofing-----	81-23
Flashings, plastic, installation of, with bituminous built-up roofing-----	81-24
Material, surfacing, for bituminous built-up roofing--	81-7

II. GRADE.

Not applicable to this specification.

III. MATERIAL.

Roofing of type 4TCS shall contain not less than the following quantities of materials per 100 square feet:

	<i>Pounds</i>
Four layers coal-tar saturated rag felt-----	60
Coal-tar pitch-----	185
Roofing gravel-----	400
Or	
Roofing slag-----	300

IV. GENERAL REQUIREMENTS.

Not applicable to this specification.

V. DETAIL REQUIREMENTS.

1. This roofing shall consist of four layers or plies of coal-tar saturated rag felt cemented together with coal-tar pitch and surfaced with slag, gravel, or similar surfacing materials, as called for in invitation for bids.

2. Flashings of the type required under the specification for the building shall be included and shall conform to United States Army Specifications Nos. 81-23 or 81-24, referred to in section I hereof.

3. Roofing of type 4TCS shall be laid in the following manner:

(a) The coal-tar pitch shall not be heated above 375° F. and shall be hot when the felts are laid.

(b) The layers of felt shall be laid so as to be free from wrinkles and buckles.

(c) When the roof surface is of gypsum, each sheet of felt shall be nailed at approximately 6 inches from its upper edge with nails driven through flat tin disks.

(d) The surfacing material shall always be dry when applied and in addition shall be heated in cold weather.

(e) Concrete and gypsum roof surfaces installed by other contractors before being considered satisfactory for laying the roof covering, shall be smooth, firm, dry, and free from high spots, depressions, and all loose and foreign material. Precast concrete slabs shall be firmly set and well pointed.

4. Mop the roof slab uniformly with hot coal-tar pitch, using not less than 40 pounds per 100 square feet.

5. (a) Over this coating of coal-tar pitch lay four layers of 32-inch coal tar saturated felt over the entire roof surface, lapping each sheet 24½ inches over the preceding sheet. Lap the ends of the sheets not less than 6 inches. When 36-inch felt is used, lap the sheets 27½ inches.

(b) Mop each of these four sheets the full width of the lap with hot coal-tar pitch, using not less than 25 pounds per 100 square feet in each mopping.

(c) Cut off these layers of felt at abutting vertical surfaces.

6. Over the entire surface apply a uniform coating of hot coal-tar pitch, using not less than 70 pounds per 100 square feet.

7. Into this pitch, while hot, embed the surfacing material.

VI. METHODS OF INSPECTION, SAMPLING, AND TESTING.

The necessary inspection shall be made to determine compliance with the specification.

VII. PACKING AND MARKING.

Not applicable to this specification.

VIII. NOTES.

1. Roofing of type 4TCS is adapted to concrete and poured gypsum surfaces with inclines not exceeding 1 inch to the foot and shall not be used on inclines greater than this.

2. Roofing constructed in the manner specified is durable and should not require repairs or renewals on account of the action of the elements for a period of 20 years.

NOTICE.—When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever, and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise as in any

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manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell, any patented invention that may in any way be related thereto.

NOTE.—Unless otherwise specified in invitation for bids, bidders on Government supplies may obtain copies of this specification at the following points:

New York General Depot, First Avenue and Fifty-eighth Street, Brooklyn, N. Y.

Chicago Quartermaster Depot, 1819 West Pershing Road, Chicago, Ill.

San Francisco General Depot, Fort Mason, San Francisco, Calif.

Eighth Corps Area General Depot, Fort Sam Houston, Tex.

[No. 81-19A]

AUGUST 22, 1933

SUPERSEDING

No. 81-20

July 10, 1924

ROOFING, BUILT-UP, TYPE 5TCS CONSTRUCTION OF

I. GENERAL SPECIFICATIONS.

The latest issues of the following Federal and United States Army Specifications, basic numbers as indicated, form a part of this specification insofar as the terms are applicable:

Federal Specifications:

Felt, Rag, Coal-Tar Saturated, for Roofing and Water-proofing	No. HH-F-201
Pitch, Coal-Tar, for Roofing	R-P-381

United States Army Specifications:

Flashings, Metal, Installation of, with Bituminous Built-Up Roofing	81-23
Flashings, Plastic, Installation of, with Bituminous Built-Up Roofing	81-24
Material, Surfacing, for Bituminous Built-Up Roofing	81-7

II. GRADE.

Not applicable to this specification.

III. MATERIAL.

Roofing of type 5TCS shall contain not less than the following quantities of materials per 100 square feet:

	Pounds
Five layers coal-tar saturated rag felt	76
Coal-tar pitch	210
Roofing gravel	400
or	
Roofing slag	300

IV. GENERAL REQUIREMENTS.

Not applicable to this specification.

V. DETAIL REQUIREMENTS.

1. This roofing shall consist of five layers or plies of coal-tar saturated rag felt cemented together with coal-tar pitch and surfaced with slag, gravel, or similar surfacing materials, as called for in invitation for bids.

2. Flashings of the type required under the specification for the building shall be included and shall conform to United States Army Specifications Nos. 81-23 or 81-24, referred to in section I hereof.

3. Roofing of type 5TCS shall be laid either by the shingle method or by the two-and-three method. The shingle method is preferred and shall be used when no choice is specified.

4. The coal-tar pitch shall not be heated above 375° F. and shall be hot when the felts are laid.

5. The layers of felt shall be laid so as to be free from wrinkles and buckles.

6. When the roof surface is of gypsum, each sheet of felt shall be nailed at approximately 6 inches from its upper edge with nails driven through flat tin disks.

7. The surfacing material shall always be dry when applied, and in addition shall be heated in cold weather.

8. Concrete and gypsum roof surfaces installed by other contractors before being considered satisfactory for laying the roof covering shall be smooth, firm, dry, and free from high spots, depressions, and all loose and foreign material. Precast concrete slabs shall be firmly set and well pointed.

9. *Shingle method.*—*a.* Coat the roof slab uniformly with hot coal-tar pitch, using not less than 40 pounds per 100 square feet.

(*b*) (1) Over this coating of coal-tar pitch lay five layers of 32-inch coal-tar saturated felt over the entire roof, lapping each sheet 26 inches over the preceding sheet. Lap the ends of the sheets not less than 6 inches. When 36-inch felt is used, lap the sheets 29 inches.

(2) Mop each of these five sheets the full width of the lap with hot coal-tar pitch, using not less than 25 pounds per 100 square feet in each mopping.

(3) Cut off these layers of felt at abutting vertical surfaces.

(*c*) Over the entire surface apply a uniform coating of hot coal-tar pitch, using not less than 70 pounds per 100 square feet.

(*d*) Into this pitch, while hot, embed the surfacing material.

10. *Two-and-three method.*—*a.* Coat the roof slab uniformly with hot coal-tar pitch, using not less than 40 pounds per 100 square feet.

(*b*) (1) Over this coating of coal-tar pitch lay two layers of 32-inch coal-tar saturated felt over the entire roof, lapping each sheet 17 inches over the preceding sheet. Lap the ends of the sheets not less than 4 inches. When 36-inch felt is used, lap the sheets 19 inches.

(2) Mop the full width of each lap with hot coal-tar pitch, using not less than 25 pounds per 100 square feet in each mopping.

(3) Cut off these layers of felt at abutting vertical surfaces.

(*c*) Mop the entire surface of this felt with a uniform coating of hot coal-tar pitch, using not less than 25 pounds per 100 square feet.

(*d*) (1) Over this coating of coal-tar pitch lay three additional layers of 32-inch coal-tar saturated felt over the entire roof, lapping each sheet 22 inches over the preceding sheet. Lap the ends of the sheets not less than 6 inches. When 36-inch felt is used, lap the sheets 24½ inches.

(2) Mop each of these three sheets the full width of the lap with hot coal-tar pitch, using not less than 25 pounds per 100 square feet in each mopping.

(*e*) Over the entire surface apply a uniform coating of hot coal-tar pitch, using not less than 70 pounds per 100 square feet.

(*f*) Into this pitch, while hot, embed the surfacing material.

[No. 81-20A]

VI. METHODS OF INSPECTION, SAMPLING, AND TESTING.

The necessary inspection shall be made to determine compliance with the specification.

VII. PACKING AND MARKING.

Not applicable to this specification.

VIII. NOTES.

1. Roofing of type 5TCS is adapted to concrete and poured-gypsum surfaces with inclines not exceeding 1 inch to the foot and shall not be used on inclines greater than this.

2. Roofing constructed in the manner above specified is durable and should not require repairs or renewals on account of the action of the elements for a period of 20 years. While the surface of this type of roofing will require some attention in about the same time as roofing of type 4TCS, if the roofing is allowed to stand without attention, until complete failure, longer life can be expected of type 5TCS than from type 4TCS.

NOTICE.—When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever, and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell, any patented invention that may in any way be related thereto.

NOTE.—Unless otherwise specified in invitation for bids, bidders on Government supplies may obtain copies of this specification at the following points:

New York general depot, First Avenue and Fifty-eighth Street, Brooklyn, N. Y.

Chicago quartermaster depot, 1819 West Pershing Road, Chicago, Ill.

San Francisco general depot, Fort Mason, San Francisco, Calif.

Eighth Corps Area general depot, Fort Sam Houston, Tex.

[No. 81-20A]

**U. S. ARMY
SPECIFICATION**

**NO. 81-21B.
25 September 1943**

C-1a. Roofing of type 4TWS shall contain not less than the following quantities of material per 100 square feet:

One layer sheathing paper	5 lbs.
Four layers coal-tar saturated rag felt	60 "
Coal-tar pitch	125 "
Roofing gravel	400 "

or

Roofing slag	300 "
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C-2. Workmanship.--Workmanship shall be of the highest grade throughout.

D. GENERAL REQUIREMENTS.

D-1. See Section E.

E. DETAIL REQUIREMENTS.

E-1. This roofing shall consist of four layers or plies of coal-tar saturated rag felt cemented together with coal-tar pitch and surfaced with slag, gravel, or similar surfacing materials, as called for in invitation for bids.

E-2. Flashings of the type required under the specification for the building shall be included and shall conform to U. S. Army Specifications Nos. 81-23 or 81-24, as applicable.

E-3. Roofing of type 4TWS shall be laid in the following manner:

E-3a. The coal-tar pitch shall not be heated above 375 degrees F. and shall be hot when the felts are laid.

E-3b. The layers of felt shall be laid so as to be free from wrinkles and buckles.

E-3c. When the roof surface is of gypsum plank or precast gypsum, the sheathing paper may be omitted.

E-3d. The surfacing material shall always be dry when applied, and in addition shall be heated in cold weather.

92-5115A620

**U. S. ARMY
SPECIFICATION**

**NO. 81-21B.
25 September 1943**

E-3e. The roof surface installed by other contractors before being considered satisfactory for laying the roof covering shall be smooth, dry and free from loose material, large cracks, or projecting ends or nails which might injure the roofing. All dirt and foreign material shall be removed. Precast slabs shall be firmly set, and properly grouted. Roof decks shall be properly graded to outlets.

E-4. Lay one layer of sheathing paper over the entire surface, lapping the sheets at least one inch and nailing along the edges to hold the sheathing paper in place until the felt is laid.

E-5. Over the entire sheathing paper surface, lay two dry layers of coal-tar saturated felt, lapping each sheet 17 inches over the preceding sheet for 32-inch wide felt, and 19 inches for 36-inch wide felt. Lap ends of sheets not less than 4 inches. Carry each layer of felt up abutting vertical surfaces not less than 4 inches. Nail the sheets along the edges sufficiently to hold them in place until the remaining felts are laid, using nails driven through flat tin disks.

E-6. Mop the entire surface of this felt with a uniform coating of hot coal-tar pitch, using not less than 30 pounds per 100 square feet.

E-7. Over this coating of coal-tar pitch, lay two additional layers of 32-inch coal-tar saturated felt over the entire roof surface, lapping each sheet 17 inches over the preceding sheet and nailing each sheet approximately one inch from its upper edge with nails driven through flat tin disks on 12 inch centers. Lap the ends not less than 6 inches. When 36-inch felt is used, lap the sheets 19 inches. Cut off these layers of felt at abutting vertical surfaces. Mop each of these two sheets the full width of the lap with hot coal-tar pitch, using not less than 25 pounds per 100 square feet.

E-8. Over the entire felted surface, apply a uniform coating of hot coal-tar pitch, using not less than 70 pounds per 100 square feet.

E-9. Into this pitch, while hot, embed the surfacing material.

F. METHODS OF INSPECTION.

F-1. Inspection.--Material furnished under this specification will be subject to inspection, during and after the process of manufacture, by authorized Government Inspectors, who shall be afforded proper facilities for determining compliance with the specification.

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25 September 1943**

G. PACKING AND MARKING.

G-1. Not applicable to this specification.

H. NOTES.

H-1. Roofing of type 4TWS is adapted to wood sheathing with inclines not exceeding 3 inches to the foot or precast gypsum slabs or gypsum plank with inclines not exceeding 2 inches to the foot, and shall not be used on inclines greater than these.

H-2. Roofing constructed in the manner specified is durable and should not require repairs or renewals on account of the action of the elements for a period of 10 years.

H-3. Copies of this specification may be obtained from the Office of the Chief of Engineers, Administrative Division, Office Service Branch, Washington, D.C.

H-4. The use of this specification, whenever applicable, is mandatory on all procuring agencies of the Army.

NOTICE.--When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever, and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications or other data, is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

92-5115ABCD

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U.S. ARMY
SPECIFICATION

Revised
9/25/43 with 21b

No. 81-21A

SEPTEMBER 1, 1933

SUPERSEDING

No. 81-21

July 10, 1924

**ROOFING, BUILT-UP, TYPE 4TWS,
CONSTRUCTION OF**

I. GENERAL SPECIFICATIONS

The latest issues of the following Federal and U.S. Army Specifications, basic numbers as indicated, form a part of this specification insofar as the terms are applicable:

Federal specifications:

	<i>Number</i>
Felt, rag, coal-tar saturated, for roofing and water-proofing-----	HH-F-201
Pitch, coal-tar, for roofing-----	R-P-381

U.S. Army specifications:

Flashings, metal, installation of, with bituminous built-up roofing-----	81-23
Flashings, plastic, installation of, with bituminous built-up roofing-----	81-24
Material, surfacing, for bituminous built-up roofing---	81-7

II. GRADE

Not applicable to this specification.

III. MATERIAL

Roofing of type 4TWS shall contain not less than the following quantities of materials per 100 square feet:

	<i>Pounds</i>
One layer sheathing paper or unimpregnated felt-----	5
Four layers coal-tar saturated rag felt-----	60
Coal-tar pitch-----	120
Roofing gravel-----	400
or	
Roofing slag-----	300

IV. GENERAL REQUIREMENTS

Not applicable to this specification.

V. DETAIL REQUIREMENTS

1. This roofing shall consist of four layers or plies of coal-tar saturated rag felt cemented together with coal-tar pitch and surfaced with slag, gravel, or similar surfacing materials, as called for in invitation for bids.

2. Flashings of the type required under the specification for the building shall be included and shall conform to U.S. Army Specifications Nos. 81-23 or 81-24, referred to in Section I hereof.

3. Roofing of type 4TWS shall be laid in the following manner:

(a) The coal-tar pitch shall not be heated above 375° F. and shall be hot when the felts are laid.

(b) The layers of felt shall be laid so as to be free from wrinkles and buckles.

(c) When the roof surface is of gypsum block, the sheathing paper may be omitted.

(d) The surfacing material shall always be dry when applied, and in addition shall be heated in cold weather.

(e) The board roof surface installed by other contractors before being considered satisfactory for laying the roof covering shall be smooth and free from loose boards, large cracks, or projecting ends which might injure the roofing. All dirt and foreign material shall be removed. Precast gypsum slabs shall be firmly set, well pointed, and free from any unevenness which might injure the roofing.

4. Lay one layer of sheathing paper over the entire roof surface, lapping the sheets at least 1 inch and nailing along the edges to hold them in place until the felt is laid.

5. Lay two layers of 32-inch coal-tar saturated felt over the sheathing paper over the entire roof surface, lapping each sheet 17 inches over the preceding sheet. Lap the ends of the sheets not less than 4 inches. Carry these layers of felt up abutting vertical surfaces at least 4 inches. When 36-inch felt is used, lap the sheets 19 inches.

Nail the sheets along the edges sufficiently to hold them in place until the remaining felts are laid using nails driven through flat tin disks.

6. Mop the entire surface of this felt with a uniform coating of hot coal-tar pitch, using not less than 25 pounds per 100 square feet.

7. Over this coating of coal-tar pitch, lay two additional layers of 32-inch coal-tar saturated felt over the entire roof surface, lapping each sheet 17 inches over the preceding sheet and nailing each sheet approximately 6 inches from its upper edge with nails driven through flat tin disks. Lap the ends not less than 6 inches. When 36-inch felt is used, lap the sheets 19 inches.

Cut off these layers of felt at abutting vertical surfaces. Mop each of these two sheets the full width of the lap with hot coal-tar pitch, using not less than 25 pounds per 100 square feet in each mopping.

8. Over the entire surface apply a uniform coating of hot coal-tar pitch, using not less than 70 pounds per 100 square feet.

9. Into this pitch, while hot, embed the surfacing material.

VI. METHODS OF INSPECTION, SAMPLING, AND TESTING

The necessary inspection shall be made to determine compliance with the specification.

VII. PACKING AND MARKING

Not applicable to this specification.

VIII. NOTES

1. Roofing of type 4TWS is adapted to board sheathing with inclines not exceeding 3 inches to the foot or precast gypsum slabs or blocks with inclines not exceeding 1 inch to the foot and shall not be used on inclines greater than these.

[No. 81-21A]

2. Roofing constructed in the manner specified is durable and should not require repairs or renewals on account of the action of the elements for a period of 10 years.

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NOTE.—Unless otherwise specified in invitation for bids, bidders on Government supplies may obtain copies of this specification at the following points:

New York General Depot, First Avenue and 58th Street, Brooklyn, N.Y.
Chicago Q.M. Depot, 1819 West Pershing Road, Chicago, Ill.
San Francisco General Depot, Fort Mason, San Francisco, Calif.
Eighth Corps Area General Depot, Fort Sam Houston, Tex.

[No. 81-21A]

ROOFING, BUILT-UP, TYPE 5TWS, CONSTRUCTION OF

I. GENERAL SPECIFICATIONS

The latest issues of the following Federal and United States Army specifications, basic numbers as indicated, form a part of this specification insofar as the terms are applicable.

Federal specifications:

Felt, rag, coal-tar saturated for roofing and water-proofing-----	<i>Pounds</i> HH-F-201
Pitch, coal-tar, for roofing-----	R-P-381

United States Army specifications:

Flashings, metal, installation of, with bituminous built-up roofing-----	81-23
Flashings, plastic, installation of, with bituminous built-up roofing-----	81-24
Materials, surfacing, for bituminous built-up roofing-----	81-7

II. GRADE

Not applicable to this specification.

III. MATERIAL

Roofing of type 5TWS shall contain not less than the following quantities of materials per 100 square feet:

	<i>Pounds</i>
One layer sheathing paper or unimpregnated felt-----	5
Five layers coal-tar saturated rag felt-----	76
Coal-tar pitch-----	145
Roofing gravel-----	400
or	
Roofing slag-----	300

IV. GENERAL REQUIREMENTS

Not applicable to this specification.

V. DETAIL REQUIREMENTS

1. This roofing shall consist of five layers or plies of coal-tar saturated rag felt cemented together with coal-tar pitch and surfaced with slag, gravel, or similar surfacing materials, as called for in invitation for bids.

2. Flashings of the type required under the specification for the building shall be included and shall conform to United States Army Specifications Nos. 81-23 or 81-24, referred to in section I hereof.

3. Roofing of type 5TWS shall be laid in the following manner:

(a) The coal-tar pitch shall not be heated above 375° F. and shall be hot when the felts are laid.

(b) The layers of felt shall be laid so as to be free from wrinkles and buckles.

(c) When the roof surface is of gypsum block, the sheathing paper may be omitted.

(d) The surfacing materials shall always be dry when applied and in addition shall be heated in cold weather.

(e) The board roof surface, installed by other contractors before being considered satisfactory for laying the roof covering shall be smooth, and free from loose boards, large cracks, or projecting ends which might injure the roofing. All dirt and foreign material shall be removed. Precast gypsum slabs shall be firmly set, well pointed, and free from any unevenness which might injure the roofing.

4. Lay one layer of sheathing paper over the roof surface, lapping the sheets at least 1 inch and nailing along the edges to hold them in place until the felt is laid.

5. (a) Lay two layers of 32-inch coal-tar saturated felt over the sheathing paper over the entire roof surface, lapping each sheet 17 inches over the preceding sheet. Lap the ends of the sheets not less than 4 inches. When 36-inch felt is used, lap the sheets 19 inches.

(b) Carry these layers of felt up abutting vertical surfaces at least 4 inches.

(c) Nail the sheets along the edges sufficiently to hold them in place until the remaining felts are laid, using nails driven through flat tin disks.

6. Mop the entire surface of this felt with a uniform coating of hot coal-tar pitch, using not less than 25 pounds per 100 square feet.

7. (a) Over this coating of coal-tar pitch, lay three additional layers of 32-inch coal-tar saturated felt over the entire roof surface, lapping each sheet 22 inches over the preceding sheet, and nailing each sheet approximately 6 inches from its upper edge, using nails driven through flat tin disks. Lap the ends not less than 6 inches. When 36-inch felt is used, lap the sheets 24½ inches.

(b) Cut off these layers of felt at abutting vertical surfaces.

(c) Mop each of these three sheets the full width of the lap with hot coal-tar pitch, using not less than 25 pounds per 100 square feet in each mopping.

8. Over the entire surface apply a uniform coating of hot coal-tar pitch, using not less than 70 pounds per 100 square feet.

9. Into this pitch, while hot, embed the surfacing material.

VI. METHODS OF INSPECTION, SAMPLING, AND TESTING

The necessary inspection shall be made to determine compliance with the specification.

VII. PACKING AND MARKING

Not applicable to this specification.

VIII. NOTES

1. Roofing of type 5TWS is adapted to board sheathing with inclines not exceeding 3 inches to the foot or precast gypsum slabs or [No. 81-22A]

blocks with inclines not exceeding 1 inch to the foot and shall not be used on inclines greater than these.

2. Roofing constructed in the manner specified is durable and should not require repairs or renewals on account of the action of the elements for a period of 20 years.

NOTICE.—When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever, and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

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New York General Depot, First Avenue and Fifty-eighth Street, Brooklyn, N.Y.

Chicago Quartermaster Depot, 1819 West Pershing Road, Chicago, Ill.

San Francisco General Depot, Fort Mason, San Francisco, Calif.

Eighth Corps Area General Depot, Fort Sam Houston, Tex.

[No. 81-22A]

FLASHINGS, METAL, INSTALLATION OF, WITH BITUMINOUS BUILT-UP ROOFING

I. GENERAL SPECIFICATIONS

The latest issue of Federal Specification TT-R-191, "Red Lead; Dry and Paste-in-Oil", forms a part of this specification insofar as the terms are applicable.

II. GRADE

Not applicable to this specification.

III. MATERIAL

Not applicable to this specification.

IV. GENERAL REQUIREMENTS

Not applicable to this specification.

V. DETAIL REQUIREMENTS

1. This specification covers the installation of all metal flashings and other metal fittings in connection with built-up bituminous roofing in the angles formed where the roof surface abuts walls, curbs, ventilators, pipe, and other vertical surfaces, and where required to make the roof covering water-tight. They shall be installed by the roofing contractor, or, at least, he shall be responsible for their proper installation.

2. The metal flashing sheets shall be 8 to 10 feet long, and the flashing sheets and hooks shall be of the weights, kinds, and shape specified for the particular job.

3. Unless otherwise specified before installation, both sides of flashings and counterflashings shall be given 2 coats of red lead and linseed-oil paint weighing not less than 25 pounds per gallon, conforming to Federal Specification No. TT-R-191, referred to in section I hereof.

4. The flashings shall be installed before the gravel, slag, tile, or other surfacing material or the top coating of asphalt or coal-tar pitch is applied to the roofing.

5. Parapet walls of concrete shall be constructed in such a manner so as to provide for a flashing groove or reglet $\frac{1}{2}$ inch wide and not less than $1\frac{1}{2}$ inches deep. The groove shall be at right angles to the wall except where a 45° cant is used, when it should be set or cut in the wall at that angle.

6. Brick parapet walls shall be provided with a groove $\frac{1}{4}$ to $\frac{3}{8}$ inch wide and not less than $1\frac{1}{2}$ inches deep either by the installation of a wooden strip between the courses of brick at the proper height which can be removed afterwards or by raking out the mortar.

7. The line on which the cap or counterflashings are installed shall be not more than 10 inches nor less than 6 inches above the roof level. Step flashings shall be used where vertical surfaces abut sloped roof surfaces.

8. Three layers of asphalt-saturated felt in the case of asphalt roofing or coal-tar saturated rag felt in the case of coal-tar pitch roofing shall be set in the angle. They shall be cemented together and to underlying surfaces and the top layer coated. The asphalt used in the roofing or asphalt plastic roofing cement shall be used with asphalt-saturated felt. The coal-tar pitch used in the roofing or coal-tar plastic roofing cement shall be used with coal-tar saturated rag felt.

9. These layers of felt shall extend at least 6 inches up, abutting vertical surfaces. They shall extend out over the roofing and lap as follows: The first layers of felt shall extend out over the roofing at least 6 inches, the second layer shall lap the first approximately 5 inches, and the third layer shall lap the second approximately 4 inches.

10. A strip of the metal of the required width shall be rounded, not bent at sharp angles, into the proper shape and set in the angle against these layers of felt which have been mopped or coated as above. This metal strip shall extend out at least 6 inches over the roofing and up to within 1 inch of the flashing groove.

11. The strip of metal shall be lapped at the ends over adjoining sheets 3 inches and shall be nailed to the roof boards in the case of board sheathing through the roofing with nails spaced approximately 6 inches apart and on a line about 1 inch from the edge of the sheet. Nailing shall also be done in the same manner in the case of gypsum. The upper edge of the flashing shall be secured when possible with flashing hooks spaced about 12 inches apart.

12. Over the portion of the metal-flashing strip lying on the roofing lay two plies of asphalt or coal-tar saturated rag felt at least 15 inches wide, cementing them to the flashing strip and roofing and to each other with either hot asphalt or coal-tar pitch, depending upon the kind of felt used. The first layer shall extend out over the roofing at least 2 inches beyond the second layer.

13. The top coating of hot asphalt or coal-tar pitch, as the case may be, shall then be applied and the slag or gravel embedded.

14. The cap or counterflashing shall then be installed. It shall be bent so as to fit into the reglet of flashing groove to a depth of $1\frac{1}{2}$ inches and shall extend down over the base flashing at least 3 inches. The counterflashing shall be in lengths not exceeding 10 feet and shall lap at ends at least 3 inches. Counterflashing shall be held in place by lead wedges spaced 18 inches apart.

15. After placing the counterflashing the grooves or reglets shall be filled with plastic roof cement. The ends shall also be cemented and coated with plastic roof cement.

16. Roof leaders, vent connections, outlet boxes, ventilators, or other fittings extending through the roofing, also gravel guards, shall be installed before the top coating of asphalt or coal-tar pitch or the slag, gravel, or other surfacing material is applied. These fittings shall be provided with the proper metal flanges for making a water-tight connection with the roofing.

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17. The flanges shall be set on top of the last layer of felt after a heavy mopping of asphalt or coal-tar pitch has been applied, depending upon the character of the bituminous material of which the roofing is composed. When possible they shall be nailed so as to be firmly held in place. They shall be covered with two layers of saturated felt not less than twice the width of the flange. These felts shall be cemented together and to the flange with hot asphalt or coal-tar pitch.

VI. METHODS OF INSPECTION, SAMPLING, AND TESTS

The necessary inspection shall be made to determine compliance with the specification.

VII. PACKING AND MARKING

Not applicable to this specification.

VIII. NOTES

None applicable to this specification.

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San Francisco general depot, Fort Mason, San Francisco, Calif.

Eighth Corps Area general depot, Fort Sam Houston, Tex.

[No. 81-20A]

0-100

AUGUST 22, 1933

SUPERSEDING

No. 81-24

July 10, 1924

FLASHINGS, PLASTIC, INSTALLATION OF, WITH BITUMINOUS BUILT-UP ROOFING

I. GENERAL SPECIFICATIONS

None applicable to this specification.

II. GRADE

Not applicable to this specification.

III. MATERIAL

Not applicable to this specification.

IV. GENERAL REQUIREMENTS

Not applicable to this specification.

V. DETAIL REQUIREMENTS

1. This specification covers the installation of plastic base flashings with or without appropriate cap or counterflashings in connection with built-up bituminous roofing in the angles formed where the roof surface abuts walls and similar vertical surfaces and where required to make the roof covering watertight. They shall be installed by the roofing contractor or he shall at least be responsible for their proper installation.

2. Plastic flashings shall be composed of either asphalt-saturated felt or coal-tar saturated rag felt cemented together, respectively, with asphalt plastic roofing cement or coal-tar plastic roofing cement.

3. The flashings shall be installed before the gravel, slag, or other surfacing material or the top coating of asphalt or coal-tar pitch is applied to the roofing.

4. Parapet walls of concrete shall be constructed in such a manner so as to provide for a flashing groove or reglet $\frac{1}{2}$ inch wide and not less than $1\frac{1}{2}$ inches deep. The groove or reglet shall be at right angles to the walls except where a 45° cant is used when it should be set or cut in the wall at that angle.

5. Brick parapet walls shall be provided with a groove $\frac{1}{4}$ inch to $\frac{3}{8}$ inch wide and not less than $1\frac{1}{2}$ inches deep either by the installation of a wooden strip between the courses of brick at the proper height, which can later be removed, or by raking out the mortar.

6. The line on which the cap or counterflashings are installed shall be not more than 10 inches nor less than 6 inches above the roof level. Step flashings shall be used where vertical surfaces abut sloped-roof surfaces.

7. Cant strips or fillings are recommended and shall be used wherever practicable for all flashings. They shall be at least 5 inches high unless otherwise indicated and shall be laid at an angle of 45° from the vertical.

8. (a) Three layers of asphalt-saturated felt in the case of asphalt roofing, or coal-tar saturated rag felt in the case of coal-tar pitch roofing shall be set in the angle. They shall be cemented together and to underlying surfaces with either asphalt plastic roofing cement or coal-tar plastic roofing cement, respectively.

(b) If the reglet is set at an angle of 45° and opens out directly on the cant strip, these layers of felt should be extended up into the reglet to its full depth.

(c) If the reglet is at right angles to the vertical surface, these layers of felt should extend only up to it.

(d) These layers of felt shall extend out over the roofing and lap as follows: The first layer of felt shall extend out over the roofing at least 6 inches, the second layer shall lap the first approximately 5 inches, and the third layer shall lap the second approximately 4 inches.

9. Over the last layer of felt a $\frac{1}{16}$ -inch to $\frac{1}{8}$ -inch coating of plastic roofing cement shall be applied by means of a trowel.

10. (a) The counterflashing shall then be installed. It shall consist of metal bent into proper shape or a combination of metal and a strip of 50 pounds prepared roofing. The metal portion of the latter shall be bent flat on itself along its upper edge so as to form a groove or lap $1\frac{1}{4}$ inches wide into which the prepared roofing shall be securely fastened.

(b) In installing metal counterflashing the metal strip shall be bent so as to fit in the reglet or flashing groove to a depth of $1\frac{1}{2}$ inches and shall extend down over the base flashing at least 3 inches.

(c) In installing a metal and prepared roofing combination counterflashing, the lapped portion in which the sheet of prepared roofing is held shall be inserted into the reglets or flashing grooves, the back of the prepared roofing strip shall be coated with plastic roofing cement and the projecting metal and prepared roofing shall be turned down over the base flashing at least 3 inches. The exposed face of the counterflashing, including the metal part, shall be coated uniformly with plastic roofing cement.

11. Strips for counterflashing shall not exceed 10 feet in length and the end joints shall be lapped not less than 3 inches and sealed with plastic roofing cement. The reglets or flashing grooves shall also be pointed up with plastic roofing cement.

VI. METHODS OF INSPECTION, SAMPLING, AND TESTING

The necessary inspection shall be made to determine compliance with the specification.

VII. PACKING AND MARKING

Not applicable to this specification.

[No. 81-24A]

VIII. NOTES

None applicable to this specification.

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San Francisco General Depot, Fort Mason, San Francisco, Calif.
Eighth Corps Area General Depot, Fort Sam Houston, Tex.

[No. 81-24A]

UU-W-101a

JULY 3, 1935

SUPERSEDING

Fed. Spec. UU-W-101

Sept. 20, 1932

FEDERAL STANDARD STOCK CATALOG

Section IV

(Part 5)

FEDERAL SPECIFICATION

FOR

WALLBOARD; COMPOSITION

This specification was approved by the Director of Procurement, for the use of all departments and establishments of the Government, and shall become effective not later than March 1, 1936. It may be put into effect, however, at any earlier date after promulgation.

A. APPLICABLE FEDERAL SPECIFICATIONS

A-1. There are no other Federal specifications applicable to this specification.

A-2. Any special requirements of the individual departments of the Government are noted under section H.

B. GRADE

B-1. Composition wallboard shall be furnished in but one grade.

C. MATERIAL

C-1. *Material.*—Composition wallboard shall be manufactured of vegetable fiber which has been thoroughly mixed with beater size.

D. GENERAL REQUIREMENTS

D-1. See section E.

E. DETAIL REQUIREMENTS

E-1. *Physical characteristics.*—Wallboard shall have the following physical characteristics.

E-1a. *Weight.*—Weight shall not exceed 45 pounds per cubic foot.

E-1b. *Transverse strength.*—Transverse strength shall be not less in any direction than shown in the following table when tested as described in paragraph F-2b:

Nominal thickness	Transverse strength
<i>Inches</i>	<i>Pounds</i>
$\frac{3}{16}$	7.00
$\frac{1}{4}$	12.00
$\frac{5}{16}$	18.00
$\frac{3}{8}$	27.00

E-1c. Linear expansion.—Linear expansion shall not exceed 0.75 percent when tested as described in paragraph F-2c.

E-2. Thickness.—Wallboard shall be furnished in the following thicknesses, as specified: $\frac{1}{16}$, $\frac{1}{4}$, $\frac{5}{16}$, or $\frac{3}{8}$ inch.

E-3. Finish.—Unless otherwise specified, at least one surface shall be finished with a varnish size to take paint and decorations. The other surface may be finished with a water-proof coating, provided such coating is at least as water resistant as varnish size.

E-4. Tolerances.—Unless otherwise specified in proposal tolerances shall be permitted as follows:

Length and width.....	plus none, minus $\frac{1}{8}$ inch.
Thickness.....	plus or minus 5 percent.

F. METHODS OF SAMPLING, INSPECTION, AND TEST

F-1. Sampling.—Samples shall be taken to give a fair representation of the entire shipment. Pieces from 5 boards of any carload, or one-half of 1 percent of the number of pieces in less-than-carload shipments, but not less than 3 boards of any shipment shall constitute the test sample. From each, a specimen 24 by 30 inches shall be cut, the longer dimension being crosswise the board as it is usually obtained.

F-2. Inspection and tests.—

F-2a. Atmospheric conditions.—Tests for transverse strength shall be made under prevailing atmospheric conditions except in the case of disputes. These tests shall then be made on samples conditioned for at least 24 hours at a relative humidity of 65 percent and at a temperature of 70° to 75° F.

F-2b. Transverse strength.—The transverse strength shall be determined as follows:

A specimen 3 inches wide and 18 inches long is taken for test. The transverse strength is determined by placing the specimen on horizontal parallel supports 12 inches apart and applying the load at mid-span on a bearing parallel to the end supports so that the deflection takes place at 12 inches plus or minus 2 inches per minute until the specimen breaks. The bearing and supports shall be rounded to a radius of approximately $\frac{3}{8}$ inch to prevent injury to the specimen. Three specimens from the long direction of the board and three at right angles thereto shall be tested. The transverse strength in each direction is the average of three specimens taken from that direction.

NOTE.—See Miscellaneous Publication Bureau of Standards No. 132, issued December 1, 1931.

F-2c. Linear expansion.—The maximum linear expansion shall be determined in the following manner from specimens 3 by 12 inches that have been cut parallel with the long direction of the board and from like specimens cut at right angles thereto:

At each of two points approximately 10 inches apart on the center line of each specimen a small area is coated by rubbing with a glass-marking pencil (or a wax crayon). A fine crossmark is made with a razor blade on the center line in each of these two areas as reference points for the length measurements. The specimens are then con-

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ditioned for 24 hours at 50 percent relative humidity and measurement; are then made of the distance between the two reference points. A scale graduated in hundredths of an inch is used and readings are made with a magnifying lens to the nearest 0.005 inch. The specimens are next conditioned for 24 hours at 97 percent relative humidity, after which the distance between the two reference points is again measured. The measurements shall be made in the conditioned air specified in each case, or as quickly as possible after each specimen is removed therefrom. The linear expansion shall be reported as the increase in the length between reference marks as a percentage of the length at 50 percent relative humidity. (In the absence of other facilities, a convenient means of conditioning the specimens at the specified humidity conditions is to expose them in an enclosed space immediately above saturated solutions of suitable salts—sodium dichromate ($\text{Na}_2\text{Cr}_2\text{O}_7 \cdot 2\text{H}_2\text{O}$) for 50 percent relative humidity, and potassium sulphate (K_2SO_4) for 97 percent relative humidity.)

G. PACKAGING, PACKING, AND MARKING

G-1. Packaging.—Unless otherwise specified, commercial packages are acceptable under this specification.

G-2. Packing.—

G-2a. Domestic shipments.—Unless otherwise specified the subject commodity shall be delivered in substantial commercial containers so constructed as to insure acceptance by common or other carriers for safe transportation at the lowest rate to the point of delivery.

G-2b. Export shipments.—For export or oversea shipment when specified the equivalent of approximately 500 square feet of $\frac{1}{4}$ -inch board shall be bundled, the ends and sides being suitably protected. Each bundle will be strapped with steel bands drawn tight and secured with metal clips at each end and intermediately every 3 feet. Each bundle shall then be securely wrapped with moisture-proof paper and sealed to make an airtight package. Each wrapped bundle shall be packed in a light-weight open crate. The crates shall be made of 2- by 2-inch lumber for the frame and be held together with cross slats of $\frac{1}{2}$ -inch or $\frac{5}{8}$ by 4-inch cross strips. One cross slat shall be placed on both sides at each end and intermediately every foot.

G-3. Marking.—Unless otherwise specified, shipping containers shall be marked with the name of the material, size, and the quantity contained therein, as defined by the contract or order under which the shipment is made, the name of the contractor, and the number of the contract or order.

H. REQUIREMENTS APPLICABLE TO INDIVIDUAL DEPARTMENTS

H-1. The following departmental specifications of the issue in effect on date of invitation for bids shall, insofar as applicable, form a part of this specification; and contractors should provide themselves with the necessary copies when submitting bids to the respective departments.

H-1a. Army.—United States Army Specification No. 100-2 (latest issue) Standard Specification for Marking Shipments.

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(Section IV, part 5)

H-1b. Navy.—Navy Department General Specifications for Inspection of Material, copies of which may be obtained without cost upon application to the Bureau of Supplies and Accounts, Navy Department, Washington, D. C.

I. NOTES

I-1. Purchasers should specify the thickness, width, length, and finish desired. Pebbled or tiled surfaces are commercially available and should be specified, if desired. Standard sizes are 32 and 48 inches wide and 6 to 16 feet long.

I-2. It is believed that this specification adequately describes the characteristics necessary to secure the desired material, and that normally no samples will be necessary prior to award to determine compliance with this specification. If, for any particular purpose, samples with bids are necessary, they should be specifically asked for in the invitation for bids, and the particular purpose to be served by the bid sample should be definitely stated, the specification to apply in other respects.

I-3. Copies of this specification may be obtained upon application, accompanied by cash or money order, to the Superintendent of Documents, Government Printing Office, Washington, D. C. Price 5 cents.

I-4. The Index of Federal Specifications is obtainable upon application, accompanied by cash or money order, to the Superintendent of Documents, Government Printing Office, Washington, D. C., price to be obtained from that office.

Notice.—When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related governmental procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever, and the fact that the Government may have formulated or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

U. S. GOVERNMENT PRINTING OFFICE: 1935

For sale by the Superintendent of Documents, Washington, D. C. Price 5 cents

SS-C-153

AUGUST 1, 1933

SUPERSEDING

F.S. No. 380

January 25, 1926

FEDERAL STANDARD STOCK CATALOG

Section IV

(Part 5)

FEDERAL SPECIFICATION

FOR

CEMENT; BITUMINOUS, PLASTIC

This specification was approved for promulgation by the Federal Specifications Board on August 1, 1933, for the use of the departments and independent establishments of the Government in the purchase of this commodity, and shall become mandatory for all departments and independent establishments of the Government not later than February 15, 1934. It may be put into effect, however, at any earlier date, after promulgation.

APPLICABLE FEDERAL SPECIFICATIONS

A-1. There are no other Federal specifications applicable to this specification.

A-2. Special requirements of individual departments of the Government are noted under section H.

TYPES

B-1. Bituminous plastic cement shall be of two types.

Type I. Asphaltic base.

Type II. Coal-tar base.

The type or types desired shall be specified in the invitation for bids.

MATERIAL

C-1. Bituminous plastic cement shall be composed of a suitable inorganic filler, a suitable solvent, and a nonvolatile bituminous binder. The binder in type I shall be mainly asphaltic, and in type II mainly coal tar, but the manufacturer may add other organic products to either of these binders to produce a cement of better working and lasting properties.

GENERAL REQUIREMENTS

D-1. Basis of purchase.—Material is to be purchased by net weight.

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FEDERAL STANDARD STOCK CATALOG

(Section IV, Part 5)

E. DETAIL REQUIREMENTS

E-1. Condition in container.—The plastic cement shall be a smooth uniform mixture, not thickened or livered, and showing no separation which cannot be easily overcome by stirring.

E-2. Nonvolatile matter.—The plastic cement shall yield not less than 70 percent of nonvolatile matter when 10 grams are heated in an oven at 105°–110° C. (221°–230° F.) for 24 hours.

E-3. Inorganic filler.—The plastic cement shall yield on ignition not less than 15 percent nor more than 45 percent of ash.

E-4. Workability.—The plastic cement shall spread readily without drawing or pulling when applied with a trowel to prepared roofing, asphalt-saturated felt, and to metal surfaces.

E-5. Behavior at 60° C. (140° F.).—Test pieces prepared as in E-4 on smooth-surfaced prepared roofing, asphalt-saturated flashing felt and steel, and exposed for 60 minutes in a well-ventilated room and then in an oven at 60° C. (140° F.) for 5 hours shall show no blistering and not more than one fourth inch sagging or slipping, and no appreciable absorption of the cement by the prepared roofing or saturated felt.

E-6. Behavior at 0° C. (32° F.).—Metal-test pieces from E-5 when bent quickly over a mandrel 1 inch in diameter, immediately after exposure to a temperature of 0° C. (32° F.) for 1 hour, shall show no cracking of the cement, and no separation of metal and cement.

F. METHODS OF SAMPLING AND TESTING

Deliveries will in general be sampled and tested by the following methods, but the purchaser reserves the right to use any additional information to ascertain whether the material meets the specification.

F-1. Sampling.—From each shipment the inspector shall take at random a number of packages equivalent to one half the cube root of the total number of packages in the lot. If this proves to be a fractional number it shall be expressed as the next higher whole number. The contents of each package selected shall be thoroughly stirred until a homogeneous mixture is obtained. One pint of the cement shall then be immediately drawn from each package and transferred to a clean receptacle of a suitable size which shall be kept tightly covered except while the cement is being introduced. After all the pint samples have been entered the contents of this container shall be thoroughly stirred and two 1-quart samples of the composite sample shall be transferred to clean dry containers, shall immediately be stoppered with new clean corks or well fitting covers or caps, sealed, and distinctly labeled. One sample shall be transmitted to the testing laboratory and the other retained for check analysis in case of dispute.

F-2. Laboratory examination.—

F-2a. Condition in container.—The plastic cement should be of a smooth uniform mixture, not thickened or livered, and showing no separation which cannot be easily overcome by stirring.

F-2b. Nonvolatile matter.—Weigh about 10 grams of the sample in a weighed flat-bottomed metal disc about 5 to 8 centimeters in diameter or a friction top can plug. Heat the dish with its contents

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in an oven maintained at 105°-110° C. (221°-230° F.) for 24 hours, cool and weigh. From the weight of the residue left in the dish and from the weight of the original sample taken compute the percentage of nonvolatile matter.

F-2c. Ash.—Transfer from 5 to 10 grams of the sample (accurately weighed) to a porcelain crucible and heat at a low temperature (not above a dull red) until all carbon is consumed, cool, weigh, and compute the percentage of ash.

F-2d. Workability.—Spread the cement with a trowel to a thickness of 1.5 to 3 millimeters ($\frac{1}{16}$ to $\frac{1}{8}$ inch) upon smooth-surfaced asphalt prepared roofing (heavyweight), asphalt-saturated flashing felt and a plate of clean steel. The steel plates should be about 0.4 millimeters (0.016 inch) thick. A convenient size for all the test pieces is 10 by 15 centimeters (4 by 6 inches). Note whether the cement spreads easily, at room temperature without drawing or pulling. Embed a thread in each coating extending across the coating at a distance of not more than 5 centimeters (2 inches) from the top of the test piece and measure its distance from the top.

F-2e. Behavior at 60° C. (140° F.).—After exposing the test pieces prepared in F-2d for 60 minutes in a horizontal position in a well ventilated room at a temperature not below 15° C. (59° F.), but not in the direct rays of the sun, suspend them vertically for 5 hours in an oven at 60° C. (140° F.). Remove the test pieces from the oven after 5 hour's heating and examine for blistering and absorption of cement and for slipping by comparing the distance of the thread from the top of the test piece with its distance at the beginning of the test.

F-2f. Behavior at 0° C. (32° F.).—Cool the metal test pieces from F-2e to room temperature and immerse them in a water bath at 0° C. (32° F.) for 1 hour. Immediately after their removal from the bath bend the panels at a uniform rate, in approximately 2 seconds time, over a mandrel 1 inch in diameter, with the metal next to the mandrel. Dry thoroughly and examine.

G. PACKAGING, PACKING, AND MARKING

G-1. Packaging.—Unless otherwise specified, commercial packages are acceptable under this specification.

G-2. Packing.—Unless otherwise specified, the subject commodity shall be delivered in standard commercial containers, so constructed as to insure acceptance by common carriers, for safe transportation, at the lowest rate, to the point of delivery.

G-3. Marking.—Each package shall be legibly marked with a description of the contents, the name of the manufacturer, the place of manufacture, the brand (if any), the net weight or net liquid measure of the contents, and some means of identification of "the particular contract on which purchase and shipment were made." Each shipment of the material shall be accompanied by printed directions for its use.

H. REQUIREMENTS APPLICABLE TO INDIVIDUAL DEPARTMENTS

H-1. The following departmental specifications, of the issue in effect on date of invitation for bids, shall respectively form a part of this specification.

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H-1a. Army.—United States Army Specification No. 100-2, Standard Specification for marking shipments.

H-1b. Navy.—Navy Department purchases will be made under the issue in effect on date of invitation for bids of Bureau of Yards and Docks Specification No. 7Y, roofing, siding, and sheet-metal work; dampproofing and membrane waterproofing, copies of which may be obtained without cost upon application to the Bureau of Yards and Docks, Navy Department, Washington, D.C.

I. NOTES

I-1. Bituminous plastic cement is intended for use in the construction of plastic flashings in conjunction with bituminous roofing, for the repair of asphalt and metal roofing and as an expansion joint material for concrete and masonry.

I-2. The inorganic filler in satisfactory plastic bituminous cement is generally wholly or in part asbestos.

I-3. Type I should be used with Federal specification flashing felt. Either type may be used on coal-tar pitch, for repair of metal roofing, or as expansion joint material for concrete and masonry.

I-4. It is believed that this specification adequately describes the characteristics necessary to secure the desired material, and that normally no samples will be necessary prior to award to determine compliance with this specification. If, for any particular purpose, samples with bids are necessary, they should be specifically asked for in the invitation for bids, and the particular purpose to be served by the bid sample should be definitely stated, the specification to apply in all other respects.

I-5. This specification governs all United States Government purchases of this commodity. Users are requested to retain this specification in permanent file until a revision is issued.

I-6. Interested parties are advised that an alphabetical index of Federal specifications may be obtained upon application as noted in paragraph next below, price to be obtained from the Superintendent of Documents.

I-7. Copies of this specification may be obtained upon application, accompanied by money order or coupon, or cash, to Superintendent of Documents, Government Printing Office, Washington, D.C. Price 5 cents.

Notice.—When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility or any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

U. S. GOVERNMENT PRINTING OFFICE: 1937

For sale by the Superintendent of Documents, Washington, D.C. ----- Price 5 cents

100-200

HH-F-191a

SEPTEMBER 29, 1942

SUPERSEDING

FED. SPEC. HH-F-191

August 1, 1933

FEDERAL STANDARD STOCK CATALOG

Section IV

(Part 5)

FEDERAL SPECIFICATION

FOR

**FELT; ASPHALT-SATURATED (FOR) FLASHINGS,
ROOFING, AND WATERPROOFING**

This specification was approved on the above date by the Director of Procurement for the use of all departments and establishments of the Government, and shall become effective not later than March 1, 1943. It may be put into effect, however, at any earlier date after promulgation.

A. APPLICABLE SPECIFICATIONS

A-1. There are no other Federal Specifications applicable to this specification.

A-2. Non-Governmental Specifications or Standards.

A-2a. *Underwriters' Laboratories, Inc.:*

Standard for Rag-Felt Roof Covering Materials for Use in Construction of Built-Up Roof Coverings.

List of Inspected Fire Protection Equipment and Materials. (See I-8.)

A-2a (1). The bidder shall submit to the purchasing agency proof that the material he proposes to supply under this specification conforms to the standards of the Underwriters' Laboratories for asphalt-saturated felt for use in the construction of built-up roof coverings, as regards fire and casualty hazards. The label or listing of the Underwriters' Laboratories will be accepted as conforming to this requirement.

A-2a (2). In lieu of the label or listing the bidder may submit independent proof satisfactory to the purchasing agency that his material conforms to the published standard, including methods of test, of the Underwriters' Laboratories.

A-2a (3). Compliance with the above preliminary requirements, as regards fire and casualty hazards, does not absolve the bidder from complete compliance with the other requirements of this specification in order to secure the acceptance of his material.

A-3. Any special requirements of the individual agencies of the Government are noted under Section H.

B. TYPES AND GRADE

B-1. Asphalt-saturated felt shall be of the following types (the type or types desired shall be stated in the invitation for bids):

Type I, 15-lb. Type—Asphalt-saturated felt for mineral-surfaced built-up roofing and for membrane water-proofing.

Type II, 30-lb. Type—Asphalt-saturated felt for built-up roofing and flashings.

B-2. Material shall be of but one grade.

C. MATERIAL AND WORKMANSHIP

C-1. *Material*.—Shall be composed of roofing felt made of organic fibers, impregnated with an asphaltic saturant.

C-2. *Workmanship*.—See paragraph E-1.

D. GENERAL REQUIREMENTS

D-1. See E, Detail Requirements.

E. DETAIL REQUIREMENTS

E-1. *Appearance*.—Asphalt-saturated felt of both types shall be free from visible external defects, such as holes, ragged or untrue edges, breaks, rents, cracks, or indentations, and shall be uniform throughout. The felt shall not crack or be so sticky as to cause injury when unrolled at temperatures of 50° and 90° F. The surface of the felt shall not be coated or covered with substances which would tend to interfere with the adhesion between the felt and the plying cement. The use of silica or wood flour will be permitted. The surface shall be uniformly smooth and shall be free from areas or patches of unabsorbed saturant and superficial dry spots.

E-2. *Physical and chemical requirements*.—Material shall meet the following requirements:

Width (inches) $36 \pm \frac{1}{4}$ or $32 \pm \frac{1}{4}$, as called for	Type I, 15-lb. type		Type II, 30-lb. type	
	Maximum	Minimum	Maximum	Minimum
Gross weight of roll (lbs.)	80	¹ 61	80	¹ 61
Weight of wrapping, packing, etc. (lb.)	$\frac{1}{2}$		$\frac{1}{2}$	
Weight per 100 square feet, exclusive of wrapping, packing, etc. (lbs.)		14		28
Pliability at 25° C. (77° F.). No cracking or bending 90° over a rounded corner of radius (inch)	$\frac{1}{2}$		$\frac{3}{4}$	
Average breaking strength:				
With fiber grain (lbs.)		30		40
Across fiber grain (lbs.)		15		20
Volatile matter at 105-110° C. (221-230° F.) (percent by weight)	4		4	
Weight of moisture-free desaturated felt per 100 square feet (lbs.)		5.2		10.4
Saturation of moisture-free felt (percent by weight)		140		150
Ash of desaturated felt (percent by weight)	10		10	

¹ The gross weight of roll is based on 432 square feet per roll of 15-pound felt and 216 square feet per roll of 30-pound felt. Where the production of rolls containing less than 432 square feet of 15-pound felt or 216 square feet of 30-pound felt is standard commercial practice, these will be acceptable under Government contracts. In such cases the minimum weight per roll shall be decreased proportionately.

F. METHODS OF SAMPLING, INSPECTION, AND TESTS

F-1. Sampling for inspection.—From each shipment of more than 1,000 rolls, take at random a number of rolls of felt equivalent to one-half the cube root of the total included in the lot. If this proves to be a fractional number, express it as the next higher digit. From each shipment of 1,000 rolls or less take five rolls at random.

F-2. Determination of weight, width, and appearance.—The weight per 100 square feet of material, and its variation in weight; the width and its variation must be determined by the inspector and the results transmitted to the testing laboratory with the sample. Material which does not conform to the specification in these respects shall be rejected by the inspector and only deliveries which conform in these respects sampled for laboratory tests.

F-2a. Remove wrappers, cores, and other packing material from each roll taken and weigh the roll and the packing material, etc., separately, to the nearest one-fourth pound. Then unwind each roll and measure the length of the roll and the width at each end of the roll to the nearest one-fourth inch, and reroll. Observe the appearance of the material while unrolling and rerolling.

F-2b. The finished material shall be free from visible external defects, such as holes, ragged or untrue edges, breaks, rents, cracks, or indentations. The surface shall be uniformly smooth and shall be free from areas or patches of unabsorbed saturant and superficial dry spots. The rolls shall be capable of being unrolled easily at 50° and 90° F. without cracking or sticking to such an extent as to cause injury. The surface of the felt shall not be coated or covered with substances which would tend to interfere with the adhesion between the felt and the plying cement. The use of silica or wood flour will be permitted.

F-2c. Compute the weight per 100 square feet of each roll examined, and from these weights compute the average weight of the shipment. If the calculated weight per 100 square feet of any roll examined is less than 14 pounds per 100 square feet for type I, 15-lb. type, and less than 28 pounds for type II, 30-lb. type, this shall be cause for the rejection of the whole shipment.

F-3. Sampling for laboratory examination.—From the rolls examined in sampling for inspection, select one the weight of which is nearest the average weight of the whole lot. Unroll, and at approximately 15 feet from one end cut two samples the full width of the roll and approximately 40 inches long. The sheet shall be cut at right angles to the edge of the roll. Measure and weigh the strips and calculate the weight per 100 square feet of each. Discard all strips whose weight varies by more than 0.5 pound from that obtained in F-2a. Divide each strip into four equal parts, marking the surface on the inside of the roll and the direction of the fiber grain on each section. (The direction of the fiber grain is always parallel to the edge of the sheet.) Label, and pack flat between supports wide enough to prevent crushing. Transmit one sample (four sections) to the testing laboratory and retain the other for check tests in case of dispute.

F-4. Laboratory Examination.—

F-4a. Appearance.—Examine both sides of the sheet of felt and note for uniformity of color and texture. The felt shall be thoroughly and

uniformly impregnated and shall show no unsaturated spots at any point.

F-4b. Weight.—Trim the sample so that it can be measured accurately, and weigh to the nearest gram (15 grains). From the measurements and weight so obtained compute the weight per 100 square feet. The weight so determined is only to be used in making the laboratory calculations and shall not be used as a basis for acceptance or rejection. (See F-2).

F-4c. Pliability.

F-4c (1). Type I, 15-lb. type.—At a point not less than 3 inches from the edge of the roll, cut 10 strips 1 inch wide and 6 inches long in the direction of the fiber grain and condition them for 10 to 15 minutes in a water bath at $25^{\circ} \pm 1^{\circ}$ C. Remove the strips from the water individually, and bend each strip immediately over the rounded corner of a block (rounded to a radius of $\frac{1}{2}$ inch) in approximately 2 seconds time. The surface of the test piece corresponding to the inside of the roll shall be uppermost when making the test. Dry thoroughly and examine. If one or more of these strips crack the material is reported as failing in the pliability test. Any crack less than $\frac{1}{4}$ inch in length originating at the edge of the test strip, or any slight lifting of the surface fibers, shall be disregarded.

F-4c (2). Type II, 30-lb. type.—Use the same procedure as described under F-4c (1), type I, 15-lb. type above, except that the corner of a block that has been rounded to a radius of $\frac{3}{4}$ inch shall be used.

F-4d. Breaking Strength.—At a point not less than 3 inches from the edge of the roll, cut 10 strips of the felt 1 inch by 6 inches with the fiber grain and 10 strips of the same size across the fiber grain. Condition both sets of strips at a temperature of 25° C. $\pm 1^{\circ}$ C for not less than 4 hours before testing.

F-4d (1). Test both sets of strips at 25° C. (77° F) $\pm 1^{\circ}$ C. in a Scott or similar testing machine of the inclination-balance type having a capacity of not less than 150 pounds. The test strip shall be gripped $1\frac{1}{2}$ inches on each end, leaving 3 inches between the clamps, and the lower jaw shall travel at the rate of 12 inches per minute. If any strip breaks nearer than one-half inch to either clamp, the reading shall be disregarded and an additional strip tested in its place. The average of the 10 readings from strips cut in one direction shall be taken as the breaking strength of the sample in that direction.

F-4e. Volatile matter.—Cut two strips of the asphalt-saturated felt 6 inches wide and 12 inches long, weigh the strips separately to the nearest 0.1 gram, and suspend them for 5 hours in an oven at 105° to 110° C. (221° to 230° F.). Remove from the oven, cool in a desiccator, and weigh. Compute the percentage loss in weight for each sample and report as volatile matter the average loss of the two samples.

F-4f. Weight of desaturated felt.—Cut a strip 2 inches wide representing the full width of the sample, measure accurately and weigh to the nearest milligram. From this data calculate the weight of 100 square feet of saturated felt. If this weight varies by more than 0.5 pound from that calculated in F-4b, discard and cut additional strips until a sample within the limit is obtained. Extract with benzol (carbon tetrachloride, chloroform, or carbon bisulfide will usually give the same results but benzol shall be used in case of dispute)

in a suitable extraction apparatus until the solvent runs through colorless. Remove the desaturated felt from the extraction apparatus, dry in air until free from the odor of solvent, and brush off any adhering particles of foreign matter. Place the desaturated felt in a tared weighing bottle and heat in an oven at 105° to 110° C. (221° to 230° F.) for one-half hour, cool in a desiccator, and weigh. Calculate the percentage of moisture-free felt in the sample taken for extraction and compute the weight of moisture-free desaturated felt per 100 square feet from the weight obtained in F-4b.

F-4g. Saturation of moisture-free felt.—The weight of saturant in the felt is the difference in weight between the original sample taken for extraction in F-4f and the weight of the desaturated felt (plus any surfacing material present). The percentage saturation of the moisture-free felt is obtained by the following formula:

$$\frac{\text{Weight of saturant}}{\text{Weight of moisture-free desaturated felt}} \times 100 = \text{percentage saturation}$$

F-4g (1). Nature of saturant.—Test to identify the saturant as asphalt.

F-4h. Ash of moisture-free desaturated felt.—Incinerate the felt obtained in F-4f in a weighed crucible in a muffle furnace or over an open flame until all of the organic matter is consumed. Cool, weigh, and compute the percentage ash of the moisture-free desaturated felt.

G. PACKAGING, PACKING AND MARKING FOR SHIPMENT

G-1. Packaging.—Unless otherwise specified, commercial packages are acceptable under this specification.

G-2. Packing.—The rolls of saturated felt shall be securely wrapped in a substantial grade of paper of the same width as the fabric. The wrapper shall completely encircle the roll and shall be pasted at the overlap in a manner which will prevent it shifting from position. The ends of the rolls need not be covered. No roll shall contain more than two pieces and there shall not be more than three percent of rolls containing two pieces in any shipment.

G-3. Marking.—Each package shall be legibly marked with a description of the contents, the name of the manufacturer, the place of manufacture, the brand (if any), the net weight of the contents, and some means of identification of "the particular contract on which purchase and shipment were made." Each shipment of the material shall be accompanied by printed directions for its use.

H. REQUIREMENTS APPLICABLE TO INDIVIDUAL DEPARTMENTS

H-1. The following departmental specifications of the issue in effect on date of invitation for bids, and special requirements, shall form a part of this specification, and shall be applicable to purchases made under this specification by the respective departments:

H-2. Army.—United States Army Specification No. 100-2, Standard Specification for Marking Shipments.

H-3. Navy.—For administrative reasons Navy purchases will be made under the issue in effect on date of invitation for bids of Bureau of Yards and Docks Specification No. 7Y—Roofing, Siding, Sheet-Metal Work; Dampproofing and Membrane Waterproofing, copies of which may be obtained, without cost, upon application to the Bureau

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of Yards and Docks, Navy Department, Washington, D. C. The technical requirements of the Bureau of Yards and Docks specification conform in detail with the technical requirements of this Federal specification.

I. NOTES

I-1. Type I, 15-lb. type, asphalt-saturated felt is intended for use with asphalt for mineral-surfaced roofing and asphalt for waterproofing and dampproofing in the construction of built-up roofing and membrane waterproofing respectively.

I-2. Type II, 30-lb. type, asphalt-saturated felt is intended for use in the construction of built-up roofing, for flashings, and as an underlay material under slate, tile, etc.

I-3. Basis of purchase should be by the roll of not less than 432 square feet for type I, 15-lb. type and of not less than 216 square feet for type II, 30-lb. type; or by the square (100 square feet); or by weight, according to agreement between the purchaser and the seller.

I-4. It is believed that this specification adequately describes the characteristics necessary to secure the desired material, and that normally no samples will be necessary prior to award to determine compliance with this specification. If, for any particular purpose, samples with bids are necessary, they should be specifically asked for in the invitation for bids, and the particular purpose to be served by the bid sample should be definitely stated, the specification to apply in all other respects.

I-5. Federal Specifications do not include all types, classes, grades, sizes, etc., of the commodities indicated by the titles of the specifications, or which are commercially available, but are intended to cover the types, etc., which are suitable for Federal Government requirements.

I-6. An index of Federal Specifications may be purchased as noted in the paragraph below, price to be obtained from the Superintendent of Documents.

I-7. Copies of this specification may be obtained upon application, accompanied by money order, coupon, or cash, to Superintendent of Documents, Government Printing Office, Washington, D. C. Price 5 cents.

I-8. Copies of the standard and listings of the Underwriters' Laboratories, Inc., referred to herein, may be obtained without cost from the Underwriters' Laboratories, Inc., 207 East Ohio Street, Chicago, Ill.

Notice.—When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

U. S. GOVERNMENT PRINTING OFFICE: 1942

For sale by the Superintendent of Documents, Washington, D. C. Price 5 cents

HH-F-201

JUNE 6, 1933

**SUPERSEDING
F.S. No. 81
December 29, 1923**

FEDERAL STANDARD STOCK CATALOG

Section IV

(Part 5)

FEDERAL SPECIFICATION

FOR

**FELT; COAL-TAR-SATURATED (FOR) ROOFING
AND WATERPROOFING**

This specification was approved for promulgation by the Federal Specifications Board on June 6, 1933, for the use of the departments and independent establishments of the Government in the purchase of this commodity, and shall become mandatory for all departments and independent establishments of the Government not later than December 1, 1933. It may be put into effect, however, at any earlier date after promulgation.

A. APPLICABLE FEDERAL SPECIFICATIONS

A-1. There are no other Federal specifications applicable to this specification.

A-2. Any special requirements of the individual departments of the Government are noted under section H.

B. TYPES

B-1. Coal-tar saturated felt shall be of but one type.

C. MATERIAL

C-1. Material shall be composed of roofing felt made of organic fibers, impregnated with a coal-tar saturant.

D. GENERAL REQUIREMENTS

D-1. Basis of purchase shall be by the roll or by the square (100 square feet) according to agreement between purchaser and the seller.

E. DETAIL REQUIREMENTS

E-1. Appearance.—Coal-tar saturated felt shall be free from visible external defects, such as holes, ragged or untrue edges, breaks, rents, cracks, or indentations, and shall be uniform throughout. When unrolled at temperatures between 50° and 90° F., it shall not stick to such an extent as to cause injury. The surface

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(Section IV, Part 5)

of the felt shall not be coated or covered with talc or other substances which might tend to interfere with the adhesion between the felt and the plying cement. The surface shall be uniformly smooth and shall be free from areas or patches of unabsorbed saturant and superficial dry spots.

E-2. Physical and chemical requirements shall meet the following requirements: ¹

	Maximum	Minimum
Gross weight of roll.....pounds.....	80	45
Weight of wrapping, packing, etc.....do.....	1/2	
Weight per 100 square feet, exclusive of wrapping, packing, etc.....do.....	15	13
Pliability at 25° C. (77° F.), (cracking on bending over a 1/16-inch mandrel, through an arc of 180°).....		None.
Average breaking strength:		
With the fiber grain.....pounds.....		30
Across the fiber grain.....do.....		15
Thickness of desaturated felt.....inch.....		0.025
Ash of desaturated felt.....percent.....	10	

F. METHODS OF INSPECTION, DETERMINATION OF WEIGHT AND WIDTH, SAMPLING, AND TESTING

Deliveries will, in general, be sampled and tested by the following methods, but the purchaser reserves the right to use any additional information to ascertain whether the material meets the specification.

F-1. *Sampling for inspection.*—From each shipment of more than 1,000 rolls take at random a number of rolls of felt equivalent to one half the cube root of the total included in the lot. If this proves to be a fractional number, express it as the next higher digit. From each shipment of 1,000 rolls or less take at random five in each case.

F-2. *Determination of weight and width.*—The weight per 100 square feet of material, and its variation in weight; the width and its variation must be determined by the inspector and the results transmitted to the testing laboratory with the sample. Material which does not conform to the specification in these respects should be rejected by the inspector and only deliveries which conform in these respects sampled for laboratory tests.

F-2a. Remove wrappers, cores, and other packing material from each roll selected and weigh the roll and the packing material, etc., separately to the nearest one fourth pound. Then unwind each roll and measure the length and the width of each end of the roll to the nearest one fourth inch and reroll. Observe also the appearance of the material while unrolling and rerolling.

The finished material should be free from visible external defects, such as holes, ragged or untrue edges, breaks, rents, cracks, or indentations. The rolls should be capable of being unrolled at temperatures between 50 and 90° F. without sticking to such an extent as to cause injury.

¹ Width (inches) 36+1/4 inch or 32+1/4 inch as called for.

HH-F-201

AMENDMENT—1
SEPTEMBER 14, 1943

SUPERSÉDING EMERGENCY
ALTERNATE FED. SPEC.
E-HH-F-201
April 1, 1942

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Section IV

(Part 5)

FEDERAL SPECIFICATION

FOR

FELT; COAL-TAR-SATURATED, (FOR) ROOFING AND WATERPROOFING*

This amendment was approved on the above date by the Director of Procurement, for the use of all departments and establishments of the Government, and shall become effective not later than Nov. 15, 1943. It may be put into effect, however, at any earlier date after promulgation.

The following changes shall be made in Federal Specification HH-F-201, dated June 8, 1933:

Page 1:

Paragraph B-1. Delete paragraph and substitute:

B-1. Coal-tar-saturated felt shall be of the following types, as specified in the invitation for bids:

Type I, 15-lb. type.

Type II, 30-lb. type.

*Certain provisions of this amendment are intended to conserve critical or strategic materials. When the present emergency is over, this amendment will be considered for revision.

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Page HH-F-201-2:

Paragraph E-2. Delete paragraph in its entirety and substitute:

E-2. *Physical and chemical requirements:*

	Type I, 15-lb. type		Type II, 30-lb. type	
	Maximum	Minimum	Maximum	Minimum
(Width (inches) $36 \pm \frac{1}{4}$ inch or $32 \pm \frac{1}{4}$ inch as called for)				
Gross weight of roll..... pounds	80	45	80	56
Weight of wrapping, packing, etc..... do	$\frac{1}{2}$		$\frac{1}{2}$	
Weight per 100 square feet, exclusive of wrapping, packing, etc..... pounds	15	13		26
Pliability at 25° C. (77° F.) (cracking on bending, Type I, over a $\frac{1}{8}$ -inch mandrel, through an arc of 180°, and Type II, through an arc of 90° over a rounded corner of $\frac{1}{4}$ -inch radius, respectively).....		None		None
Average breaking strength:				
With the fiber grain..... pounds		30		
Across the fiber grain..... do		15		
Thickness of desaturated felt (Type I)..... inch		0.025		
Thickness of saturated felt (Type II)..... do				0.050
Ash of desaturated felt (Type I)..... percent	10			
Ash of saturated felt (Type II)..... do			4	

Page HH-F-201-3:

Paragraph F-2a:

Lines 8, 9, and 10. Delete sentence beginning "In no case," and substitute, "If the calculated weight per 100 square feet of any roll examined is less than 13 pounds for Type I, 15-pound type, or less than 26 pounds for Type II, 30-pound type, the whole shipment does not meet the specification and this may be made the cause for rejection."

Paragraph F-4c:

Line 1. After "Pliability" insert "Type I, 15-pound type." Insert subparagraph F-4c (1) as follows:

F-4c (1). *Pliability, Type II, 30-pound type.*—Use the same procedure as described under F-4c, except that the strips shall be bent through an arc of 90° over the rounded corner of a block (rounded to a radius of $\frac{3}{4}$ inch). The surface of the test piece corresponding to the inside of the roll shall be uppermost in making this test. If one or more of these strips crack, the material is reported as failing in the pliability test.

Paragraph F-4e:

Line 1. After "Thickness of desaturated felt," insert "Type I, 15-pound type."

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HH-F-201
Amend.-1-3
(Sept. 1943)

Page HH-F-201-4:

Paragraph F-4e: Insert subparagraph F-4e (1) as follows:

F-4e (1). *Thickness of saturated felt, Type II, 30-pound type.*—Cut a 2-inch strip the full width of the roll and caliper it at 15 equally spaced points through the center of the strip with a micrometer having flat bearing surfaces at each contact point. Average the readings.

Paragraph F-4f:

Line 1. After "*Ash of moisture-free desaturated felt,*" insert "*Type I, 15-pound type.*"

Insert subparagraph F-4f (1) as follows:

F-4f (1). *Ash of saturated felt, Type II, 30-pound type.*—Weigh accurately the 2-inch strip of saturated felt obtained in F-4e (1), and incinerate it in a weighed crucible in a muffle furnace or over an open flame until all of the organic matter is consumed. Cool, weigh and compute the percentage ash of the saturated felt.

Paragraph G-2a. Delete paragraph and substitute:

G-2a. The corners of the felt on the outside of each roll shall be turned in and the rolls shall be taped, or some other equally protective wrapping employed, which will insure acceptance and safe delivery by common or other carriers at the lowest rate to the point of delivery called for in the contract or purchase order. A standard label shall be attached to each roll to identify the material. The ends of the rolls need not be covered. No roll shall contain more than two pieces and there shall not be more than 3 percent of rolls containing two pieces in any shipment.

The surface of the felt should not be coated or covered with talc or other substances which might tend to interfere with the adhesion between the felt and the plying cement. The surface should be uniformly smooth and should be free from areas or patches of unabsorbed saturant and superficial dry spots.

Compute the weight per 100 square feet of each roll examined and from these weights compute the average weight of the shipment. In no case should this weight be less than 13 pounds per 100 square feet, and any roll examined whose weight per 100 square feet is less than 13 pounds shall be cause for the rejection of the whole shipment.

F-3. Sampling for laboratory examination.—From the rolls examined for sampling, select one the weight of which is near the average weight of the whole lot. Unroll and at approximately 25 feet from the end cut two samples the full width of the roll and approximately 40 inches long, label, roll carefully but do not crease, wrap, and transmit one to the testing laboratory. Retain the other sample for check analysis in case of dispute.

F-4. Laboratory examination.—

F-4a. Appearance.—Examine both sides of the sheet of felt and note for uniformity of color. The felt should be thoroughly and uniformly impregnated and should show no unsaturated spots at any point.

F-4b. Weight.—Trim the sample so that it is 36 inches long and the full width of the roll. Measure accurately and weigh to the nearest gram (15 grains). From the measurements and weight so obtained compute the weight per 100 square feet. The weight so determined is only to be used in making the laboratory calculations and shall not be used as a basis for acceptance or rejection. (See F-2.)

F-4c. Pliability.—Cut five strips 1 inch wide and 6 inches long in the direction of the fiber grain and immerse in water at 25° C. (77° F.) for 10 to 15 minutes. Remove the strips from the water and immediately bend each strip over a mandrel one-sixteenth inch in diameter through an arc of 180° at a uniform rate in approximately two seconds time. Dry thoroughly and examine. If one or more of these five strips crack on this test, cut ten strips from another part of the sample and repeat the test. If one or more of these strips crack the material is reported as failing on the pliability test.

F-4d. Breaking strength.—Cut 10 strips of the felt 1 inch by 6 inches with the fiber grain and 10 strips of the same size across the fiber grain. Test both sets of strips at 21° C. (70° F.) in a Scott or similar testing machine of the inclination balance type having a capacity of 100 to 150 pounds. The test strips shall be gripped 1½ inches on each end leaving 3 inches between the clamps, and the lower jaw shall travel at the rate of 12 inches per minute. If any strip breaks nearer than one-half inch to either clamp, the reading shall be disregarded and an additional strip tested in its place. The average of the 10 readings from strips cut in one direction shall be taken as the breaking strength of the sample in that direction.

F-4e. Thickness of desaturated felt.—Cut a 2-inch strip the full width of the sample and extract with carbon bisulphide or benzol in

a suitable extraction apparatus until the solvent contains not more than a trace of soluble matter. Remove the desaturated felt from the extractor, allow to stand in air until the odor of the solvent has disappeared, and brush off the carbonaceous matter and other insoluble matter adhering to the felt. Caliper the felt at 15 equally spaced points, at least three fourths inch from a cut edge, with a micrometer having flat bearing surfaces at each contact point. Average the readings.

In case an extraction apparatus of sufficient size to accommodate the whole strip is not available, the felt may be cut into squares approximately one inch on each side. In this case extract and air-dry as described above, mix thoroughly and take at random 15 pieces of felt. Caliper each piece at its center with a micrometer having flat bearing surfaces at each contact point. Average the readings.

F-4f. Ash of moisture-free desaturated felt.—Cut the desaturated felt obtained in F-4e into squares about 1 cm on each side and mix thoroughly. Take at random enough pieces to weigh about 10 grams, dry in an oven at 105 to 110° C. (221 to 230° F.) for one half hour, cool in a desiccator, weigh accurately, and incinerate in a weighed crucible in a muffle furnace or over an open flame until all of the carbon is consumed. Cool, weigh, and compute the percentage ash of the moisture-free desaturated felt.

G. PACKAGING, PACKING, AND MARKING

G-1. Packaging.—Unless otherwise specified, commercial packages are acceptable under this specification.

G-2. Packing.—

G-2a. The rolls of saturated felt shall be securely wrapped in a substantial grade of paper of the same width as the fabric. The wrapper shall completely encircle the roll and shall be pasted at the overlap in a manner which will prevent it shifting from position. The ends of the rolls need not be covered. No roll shall contain more than two pieces, and there shall not be more than three percent of rolls containing two pieces in any shipment.

G-3. Marking.—Each package shall be legibly marked with a description of the contents, the name of the manufacturer, the place of manufacture, the brand (if any), the net weight of the contents, and some means of identification of "the particular contract on which purchase and shipment were made." Each shipment of the material shall be accompanied by printed directions for its use.

H. REQUIREMENTS APPLICABLE TO INDIVIDUAL DEPARTMENTS

H-1. The following departmental specifications, of the issue in effect on date of invitation for bids, shall respectively form a part of this specification.

H-1a. Army.—United States Army Specification No. 100-2, standard specification for marking shipments.

H-1b. Navy department purchases will be made under the issue in effect on date of invitation for bids of Bureau of Yards and Docks Specification No. 7Y, Roofing, Siding, and Sheet Metal Work; Damp-

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proofing and Membrane Waterproofing, (copies of which may be obtained without cost upon application to the Bureau of Yards and Docks, Navy Department, Washington, D.C.

I. NOTES

I-1. Coal-tar saturated felt is intended for use with coal-tar pitch for roofing and coal-tar pitch for waterproofing and dampproofing in the construction of built-up roofing and membrane waterproofing, respectively.

I-2. It is believed that this specification adequately describes the characteristics necessary to secure the desired material, and that normally no samples will be necessary prior to award to determine compliance with this specification. If, for any particular purpose, samples with bids are necessary, they should be specifically asked for in the invitation for bids, and the particular purpose to be served by the bid sample should be definitely stated, the specification to apply in all other respects.

I-3. This specification governs all United States Government purchases of this commodity. Users are requested to retain this specification in permanent file until a revision is issued.

I-4. Interested parties are advised that an alphabetical index of Federal specifications may be obtained upon application, as noted in paragraph next below, price to be obtained from the Superintendent of Documents.

I-5. Copies of this specification may be obtained upon application, accompanied by money order or coupon, or cash, to Superintendent of Documents, Government Printing Office, Washington, D.C. Price 5 cents.

Notice.—When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility or any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use or sell any patented invention that may in any way be related thereto.

U. S. GOVERNMENT PRINTING OFFICE : 1933

For sale by the Superintendent of Documents, Washington, D.C. - - - Price 5 cents

UU-P-271a

MAY 7, 1943

SUPERSEDING
Fed. Spec. UU-P-271
Sept. 30, 1936, and
EMERGENCY ALTERNATE
E-UU-P-271
November 20, 1942

FEDERAL STANDARD STOCK CATALOG

Section IV

(Part 5)

FEDERAL SPECIFICATION

FOR

PAPER; KRAFT, WRAPPING, WATERPROOFED*

This specification was approved on the above date by the Director of Procurement, for the use of all departments and establishments of the Government, and shall become effective not later than July 15, 1943. It may be put into effect, however, at any earlier date after promulgation.

A. APPLICABLE SPECIFICATION.

A-1. The following Federal Specification of the issue in effect on date of invitation for bids shall form a part of this specification:

UU-P-31-Paper; General Specifications

B. TYPES AND GRADES.

Type designation:

Construction

A-----	Duplexed-creped one direction.
B-1-----	Duplexed-creped both directions, or creped in one direction and pleated or corrugated in the other direction.
B-2-----	
B-3-----	
B-4-----	
C-----	Duplexed-uncreped.
D-1-----	Duplexed-reinforced one direction, uncreped.
D-2-----	Duplexed-reinforced one direction, creped one direction.
E-1-----	Duplexed-reinforced any two directions, uncreped.
E-2-----	Duplexed-reinforced any two directions, creped one direction.
F-----	Coated, cotton scrim-lined, uncreped.
G-1A-----	Coated, 10 ounces burlap-lined, uncreped.
G-1B-----	Coated, 7½ ounces burlap-lined, uncreped.
G-1C-----	Coated, 40 inches, 2.05 yards Osnaburg-lined, uncreped.
G-1D-----	Coated, 40 inches, 7 ounces Osnaburg-lined, uncreped.

* Certain provisions of this specification are intended to conserve critical or strategic materials. When the present emergency is over, this specification will be considered for revision.

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Type designation:	Construction
G-2A-----	Coated, 10 ounces burlap-lined, creped one direction.
G-2B-----	Coated, 7½ ounces burlap-lined, creped one direction.
G-2C-----	Coated, 40 inches 2.05 yards Osnaburg-lined, creped one direction.
G-2D-----	Coated, 7 ounces 40 inches Osnaburg-lined, creped one direction.
G-3A-----	Coated, 10 ounces burlap-lined, creped in two directions, or creped in one direction and pleated or corrugated in the other direction.
G-3B-----	Coated, 7½ ounces burlap-lined, creped in two directions, or creped in one direction and pleated or corrugated in the other direction.
G-3C-----	Coated, 40 inches 2.05 yards Osnaburg, creped in two directions or creped in one direction and pleated or corrugated in the other direction.
G-3D-----	Coated, 7 ounces 40 inches Osnaburg, creped in two directions or creped in one direction and pleated or corrugated in the other direction.
H-1}-----	Triplexed-creped both directions, or creped one direction and pleated or corrugated in the other direction.
H-2}-----	
I-----	Triplexed-creped in one direction.
J-1}-----	Quadruplexed-creped in both directions, or creped in one direction and pleated or corrugated in the other direction.
J-2}-----	
K-1-----	Single sheet uncreped, coated, saturated or infused on one side with asphalt
K-2-----	Single sheet uncreped, coated, saturated or infused on both sides with asphalt.
K-3-----	Single sheet creped, coated, saturated or infused on one side with asphalt.
K-4-----	Single sheet creped, coated, saturated or infused on both sides with asphalt.
L-1}-----	Duplexed-uncreped, one sheet coated, saturated or infused with asphalt.
L-2}-----	
L-3-----	Duplexed-creped, one sheet coated, saturated or infused with asphalt.
L-4-----	Duplexed-creped, coated, saturated or infused on both sides with asphalt.
M-----	Triplexed-uncreped.

C. MATERIAL AND WORKMANSHIP

C-1. Shall be free from visible defects and have a uniform appearance. The paper shall not stick together to an extent that will cause tearing when unrolled.

D. GENERAL REQUIREMENTS.

D-1. Stock.—Shall be 100 percent unbleached sulphate fibers.

D-2. Purchase basis.—Shall be 100 square feet.

D-3. Cut.—Shall be in rolls or flat cuts as specified in invitation for bids.

D-4. Sizes.—Widths, 36, 48, 54, 60, 72, 84 and 96 inches or as specified in invitation for bids.

D-5. Bleeding.—When specified in the inquiry for bid or on procurement orders, all types of paper except types F and G, and except any types which are coated, saturated, or infused on an exposed surface, shall show no substantial bleeding of asphaltum when heated to 170° Fahrenheit for 5 hours under the conditions specified in paragraph F-6. (See par. I-1.)

E. DETAIL REQUIREMENTS.

E-1. Construction.—Shall be as follows:

E-1a. Type A.—Type A paper shall consist of two sheets of paper cemented together with asphaltum and creped in one direction.

E-1b. Type B-1, B-2, B-3, and B-4.—Types B-1, B-2, B-3, and B-4 papers shall consist of two sheets of paper cemented together with asphaltum and creped in both directions of the paper, or creped in one direction and pleated or corrugated in the other direction.

E-1c. Type C.—Type C paper shall consist of two sheets of paper cemented together with asphaltum.

E-1d. Type D-1.—Type D-1 paper shall consist of two sheets of paper cemented together with asphaltum in which are imbedded cords or strands of fiber running the long direction of the paper. The distance between the cords or strands shall be specified by the purchasing officer as either not more than $\frac{1}{2}$ inch or not more than $1\frac{1}{4}$ inches.

E-1e. Type D-2.—Type D-2 paper, same as type D-1, but with paper creped one direction.

E-1f. Type E-1.—Type E-1 paper shall consist of two sheets of paper cemented together with asphaltum in which are imbedded cords or strands of fiber running in any two directions of the paper as specified. The distance between the cords or strands shall be specified by the purchasing officer as either not more than $\frac{1}{2}$ inch or not more than $1\frac{1}{4}$ inches, unless otherwise specified.

E-1g. Type E-2.—Type E-2 paper, same as type 1, but with paper creped one direction.

E-1h. Type F.—Type F paper shall consist of a single sheet of paper, coated on one side with asphaltum in which is imbedded cotton scrim, having not less than eight strands to the inch in each direction.

E-1i. Types G-1A, G-1B, G-1C, and G-1D.—Types G-1A, G-1B, G-1C, and G-1D papers shall consist of a single sheet of uncreped paper, coated on one side with asphaltum in which is imbedded one of the types of burlap or osnaburg listed in paragraphs E-1k (1), E-1k (2), E-1k (3), and E-1k (4).

E-1j. Types G-2A, G-2B, G-2C and G-2D.—Types G-2A, G-2B, G-2C, and G-2D papers shall consist of a single sheet of paper, creped in one direction, coated on one side with asphaltum in which is imbedded one of the types of burlap or osnaburg listed in paragraphs E-1k (1), E-1k (2), E-1k (3), and E-1k (4).

E-1k. Types G-3A, G-3B, G-3C, and G-3D.—Types G-3A, G-3B, G-3C, and G-3D papers shall consist of a single sheet of paper, creped in two directions or creped in one direction and pleated or corrugated in the other direction, coated on one side with asphaltum in which is imbedded one of the types of burlap or osnaburg listed in paragraphs E-1k (1), E-1k (2), E-1k (3), and E-1k (4).

E-1k (1).—Grade A shall be burlap of 10 ounces per linear yard (40-inch basis) with commercial tolerance (other widths prorated to 40 inches).

E-1k (2).—Grade B shall be burlap of 7½ ounces per linear yard (40-inch basis) with commercial tolerance (other widths prorated to 40 inches).

E-1k (3).—Grade C shall be 40-inch 2.05-yard Osnaburg (other widths prorated to 40 inches) with commercial tolerance.

E-1k (4).—Grade D shall be 7-ounce 40-inch Osnaburg (other widths prorated to 40 inches) with commercial tolerance.

E-1l. Types H-1 and H-2.—Types H-1 and H-2 papers shall consist of three sheets of paper cemented together with asphaltum and creped in both directions of the paper, or creped in one direction and pleated or corrugated in the other direction.

E-1m. Type I.—Type I paper shall consist of three sheets cemented together with asphaltum and creped in one direction of the paper.

E-1n. Types J-1 and J-2.—Types J-1 and J-2 papers shall consist of four sheets of paper cemented together with asphaltum and creped in both directions of the paper, or creped in one direction and pleated or corrugated in the other direction.

E-1o. Type K-1.—Type K-1 paper shall consist of a single sheet of uncreped paper coated, saturated or infused on one side with asphalt.

E-1p. Type K-2.—Type K-2 paper shall consist of a single sheet of uncreped paper coated, saturated or infused on both sides with asphalt.

E-1q. Type K-3.—Type K-3 paper shall consist of a single sheet of creped paper coated, saturated, or infused on one side with asphalt.

E-1r. Type K-4.—Type K-4 paper shall consist of a single sheet of creped paper coated, saturated or infused on both sides with asphalt.

E-1s. Types L-1 and L-2.—Types L-1 and L-2 papers shall consist of two sheets of paper uncreped, cemented together with asphaltum and having one sheet coated, saturated, or infused with asphalt.

E-1t. Type L-3.—Type L-3 paper shall consist of two sheets of paper cemented together with asphalt, having one sheet coated, saturated, or infused with asphalt, and creped in one direction.

E-1u. Type L-4.—Type L-4 paper shall consist of two sheets of creped paper cemented together with asphalt coated, saturated or infused on both sides with asphalt.

E-1v. Type M.—Type M paper shall consist of three sheets of paper cemented together with asphaltum.

E-2. Average tensile strength, water resistance, and stretch.—Shall be as follows:

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Type	Tensile strength per inch width, minimum each direction	Water resistance, dry-indicator method (minimum)	Stretch in each creped or pleated direction (minimum)	Basis weight of asphaltum 24 x 36-500, per ply of paper before combining or creping ^{1 2 3} (minimum)	Basis weight of paper 24 x 36-500, per ply of paper before combining or creping ¹ (minimum)
	<i>Pounds</i>	<i>Hours</i>	<i>Percent</i>	<i>Pounds</i>	<i>Pounds</i>
A-----	15	10	30	15	30
B-1-----	12	8	30	15	30
B-2-----	12	8	15	15	30
B-3-----	12	48	20	50	30
B-4-----	15	48	15	50	60
C-----	20	15	none	15	30
D-1-----	20	24	none	30	30
D-2-----	15	12	10	30	30
E-1-----	30	24	none	30	30
E-2-----	30	12	10	30	30
F-----	20	4	none	30	30
G-1A-----	85	24	none	30	30
G-1B-----	65	24	none	30	30
G-1C-----	75	24	none	30	30
G-1D-----	65	24	none	30	30
G-2A-----	85	24	(4)	30	30
G-2B-----	65	24	(4)	30	30
G-2C-----	75	24	(4)	30	30
G-2D-----	65	24	(4)	30	30
G-3A-----	85	24	(5)	30	30
G-3B-----	65	24	(5)	30	30
G-3C-----	75	24	(5)	30	30
G-3D-----	65	24	(5)	30	30
H-1-----	18	48	20	50	30
H-2-----	25	48	15	50	60
I-----	20	24	15	20	30
J-1-----	24	48	20	50	30
J-2-----	35	48	15	50	60
K-1-----	13	4	none	5	40
K-2-----	13	12	none	10	40
K-3-----	8	4	30	5	40
K-4-----	8	4	30	10	40
L-1-----	20	24	none	20	30
L-2-----	40	48	none	27	60
L-3-----	15	12	10	20	30
L-4-----	20	24	10	20	40
M-----	30	48	none	20	30

¹ Wherever asphaltum is specified as a combining agent, any other combining agent equal in all respects to asphaltum may be substituted. Any of the papers specified herein may be additionally impregnated or coated with any suitable material. Any substitute material must meet all the requirements specified herein.

² This does not require that the double coating process be used. A single coat of asphaltum of double the weight specified may be used.

³ These are included as a matter of information only and are not requirements.

⁴ The papers of Types G-2A, G-2B, G-2C, and G-2D shall have sufficient stretch that when the tensile test is applied, in the creped direction, the paper shall not break before the burlap or osnaburg breaks.

⁵ The papers of Types G-3A, G-3B, G-3C and G-3D shall have sufficient stretch that when, the tensile test is applied in each direction parallel with the strands, the paper shall not break before the burlap or osnaburg breaks in either direction.

F. METHODS OF SAMPLING, INSPECTION, AND TESTS.

F-1. All tests not herein specified shall be made in accordance with Federal Specification UU-P-31, Paper; General Specifications.

F-2. Each sample shall consist of not less than five sheets, each not less than three square feet, and each taken from a different roll.

F-3. Water resistance shall be determined by the dry-indicator method as specified in T. A. P. I. standard method T-433-m-41 using the method specified in Paragraph 1 of Procedure B. The time for transudation shall be reported as the point for the appearance over the entire area of the indicator of an easily perceptible color change of the dry indicator particles when compared with a similar specimen prepared in the same way but not exposed to the water. Five tests shall be made on each side of the paper and the average time for the 10 specimens shall be reported.

F-4. The number of square feet in the shipment shall be calculated from the weight of the entire shipment, the net weight of the sample rolls, and the weight per foot of paper calculated from the weight of the sample sheets.

F-5. Tensile strength and stretch shall be determined simultaneously with a pendulum type of instrument having a device for indicating the amount of stretch. The stretch shall be recorded at the instant of rupture of the paper under the tensile stress. When stretch is to be determined, care must be taken to apply no more initial tension to the test strip before clamping it than is required to straighten it. Strips 2 inches wide and not less than 5½ inches between jaws, shall be used for these tests. The test values for tensile strength are divided by 2 to obtain the values per inch width.

F-6. The test for bleeding of the asphalt will be as follows: When specified in the inquiry for bid or on procurement orders, the paper shall show no substantial bleeding due to asphalt penetration when tested by suspension for 5 hours in air uniformly heated to 170° F.

G. PACKAGING, PACKING, AND MARKING FOR SHIPMENT.

G-1. Packaging.—Unless otherwise specified, paper shall be furnished in commercial rolls or containers.

G-2. Packing.—If containers are used for packing, they shall be of the type, size, and kind commonly used for the purpose, so constructed as to insure acceptance and safe delivery by common or other carriers, at the lowest rate, to point of delivery called for in the contract or purchase order.

G-3. Marking.—The rolls or containers shall be marked with the name of the material, size, type, and quantity contained therein as defined by the contract or order under which shipment is made, the name of the contractor, and the number of the contract or order.

H. REQUIREMENTS APPLICABLE TO INDIVIDUAL DEPARTMENTS.

H-1. The following departmental specifications of the issue in effect on date of invitation for bids, and special requirements, shall form a part of this specification, and shall be applicable to purchases made under this specification by the respective departments:

H-2. Army.—U. S. Army Specification No. 100-2, Standard Specification for Marking Shipments, insofar as the terms are applicable.

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copies of which may be obtained on application to the Quartermaster General, War Department, Washington, D. C.

H-3. Navy.—Navy Department General Specification for Inspection of Material, copies of which may be obtained without cost upon application to Bureau of Supplies and Accounts, Navy Department Washington, D. C.

H-4. Marine Corps.—Instructions issued by the Quartermaster's Department, U. S. Marine Corps, 1100 South Broad Street, Philadelphia, Pa.

I. NOTES.

I-1. For shipment in climates or for use under conditions where high temperatures are to be encountered, the requirement under paragraph D-5 is recommended. Wherever the product packed may be damaged by asphalt, an underwrap of suitable material should be used.

I-2. Federal Specifications do not include all types, classes, grades, sizes, etc., of the commodities indicated by the titles of the specifications, or which are commercially available, but are intended to cover the types, etc., which are suitable for Federal Government requirements.

I-3. An Index of Federal specifications may be purchased as noted in the paragraph below, price to be obtained from the Superintendent of Documents.

I-4. Copies of this specification and of UU-P-31 may be obtained upon application, accompanied by money order, coupon or cash, to Superintendent of Documents, Government Printing Office, Washington, D. C., Price 5 cents each.

Notice.—When Government drawings, specifications, or other data are used for any purpose, other than in connection with a definitely related Government Procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded, by implication or otherwise, as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use or sell any patented invention that may in any way be related thereto.

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FEDERAL STANDARD STOCK CATALOG

Section IV

(Part 5)

FEDERAL SPECIFICATION

FOR

SHINGLES; ROOFING, CEMENT-ASBESTOS

This specification was approved by the Director of Procurement for the use of all departments and establishments of the Government and shall become effective not later than December 1, 1935. It may be put into effect, however, at any earlier date after promulgation.

A. APPLICABLE FEDERAL SPECIFICATIONS

A-1. Federal Specification FF-N-101 for nails is applicable to this specification.

A-2. Any special requirements of individual departments of the Government are noted in section H.

B. TYPES

B-1. This specification covers four general types of cement-asbestos shingles determined by variations in thickness and method of laying:

Type A.—Shingles of type A are tapered in thickness from butt to head, rectangular in shape, have smooth or rough exposed surface and even or irregular edges, and are designed to be laid with head lap according to the "American" method.

Type B.—Shingles of type B are uniform in thickness from butt to head, rectangular in shape, have smooth or rough exposed surface and even or irregular edges, and are designed to be laid with head lap according to the "American" method.

Type C.—Shingles of type C are uniform in thickness, square in shape, have smooth, granular, or rough exposed surface and straight, square edges, and are designed to be laid with combined head and side lap according to the "Dutch" or "Scotch" method. They may have one clipped corner.

Type D.—Shingles of type D are uniform in thickness, square in shape, have smooth, granular, or rough exposed surface and straight, square edges, and are designed to be laid according to the "hexagonal" or "French" method. Not less than three corners shall be cut to give the desired pattern.

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C. MATERIAL AND WORKMANSHIP

C-1. Cement-asbestos shingles shall be made of portland cement and asbestos fibers or these with the addition of such pigments and/or mineral granules as may be necessary to produce specified colors. They shall have a dense, hard structure. They shall be thoroughly seasoned.

D. GENERAL REQUIREMENTS

D-1. Breakage.—Shingles shall be whole and clean. Not more than 2 percent of broken shingles will be accepted.

D-2. Supplementary shapes.—Starters and shapes and rolls used as hip and ridge finish shall be of the same materials as the shingles.

D-3. Holes for fastening and laps.—

D-3a. Shingles, starters, and rolls shall be furnished with holes for fastening. The holes in type A and type B shingles shall be located to give head laps in the range 1 to 3 inches.

D-3b. Holes in type C shingles shall be located to give overlap at the head of 3 inches and a side lap of one-fourth or one-third of the width of the shingles as specified.

D-3c. Holes in type D shingles shall be located so they will be laid with a 3-inch overlap on two edges to give a 13 by 13 inch exposed surface.

D-4. Nails and fastenings.—Nails for shingles and rolls ("needle-point") shall be furnished in proper quantity and length. They shall have flat heads and shall be long enough to properly secure the shingles to the sheathing. Nails shall be either hard copper, copper-clad, zinc-coated, or cadmium plated steel as specified, conforming with Federal specifications. Copper storm anchors or hooks shall be provided for type C and type D shingles. Copper clips shall be supplied for ridge rolls.

D-5. Color and finish.—

D-5a. The color or colors shall be as specified. Colors other than the normal gray shall be obtained by embedding lime-proof mineral pigments or mineral granules, or both, in the exposed face, or by chemical impregnation. The color shall cover butt edges that are $\frac{1}{4}$ inch or over in thickness. The colors shall not fade appreciably on exposure to light and atmospheric conditions.

D-5b. The exposed shingle surface may be smooth or slightly roughed by pits or ridges. Granular surfacing shall be obtained with mineral granules embedded to give a rough surface. Shingles having mineral granules embedded but presenting a smooth exposed surface, shall be considered as smooth-surfaced.

D-6. Sizes.—The standard sizes shall be as specified below. A plus tolerance of not more than $\frac{1}{16}$ inch and a minus tolerance of $\frac{1}{64}$ inch shall be allowed for individual shingles on all thicknesses. The average thickness of the butts for a given sample shall not be less than the specified thickness. For the rough-surfaced shingles, the thickness shall be taken as the average at projections and depressions. The thickness at the top of tapered shingles shall not be less than $\frac{1}{8}$ inch. A plus-or-minus tolerance of $\frac{1}{8}$ inch will be permitted in the widths and lengths supplied without requiring adjust-

ment in number of shingles or area covered. Type A and type B shingles exceeding the specified width by not more than $1\frac{1}{2}$ inches and the length by not more than $2\frac{1}{2}$ inches, and type C exceeding by not more than 1 inch in both dimensions, shall be accepted, but both the total area of the number of shingles supplied and the roof area that can be covered shall be not less than those for the number requisitioned of standard size.

D-6a. Type A shingles shall have butt thickness of either $\frac{1}{4}$ inch or $\frac{5}{16}$ inch, as specified. They shall be 8 inches in width by 16 inches in length.

D-6b. Type B shingles shall be $\frac{5}{32}$ or $\frac{1}{4}$ inch in thickness, as specified. They shall be 8 inches in width by 16 inches in length.

D-6c. Type C shingles shall be $\frac{5}{32}$ inch thick and 16 by 16 inches.

D-6d. Type D shingles shall be $\frac{5}{32}$ inch in thickness and 16 by 16 inches.

E. DETAIL REQUIREMENTS

E-1. *Absorption.*—The average absorption of the shingles shall be not more than $17\frac{1}{2}$ percent of their dry weight as determined by the test described in paragraph F-2.

E-2. *Strength.*—The average modulus of rupture of the shingles shall not be lower than 3,000 pounds per square inch as tested dry according to paragraph F-3a, 1,250 pounds per square inch as tested after immersion according to paragraph F-3b, and not lower than 3,000 pounds per square inch as tested dry after subjection to the heat test described in paragraph F-3c.

F. METHODS OF SAMPLING, INSPECTION, AND TESTS

F-1. *Sampling.*—Ten shingles selected so as to be representative of a quantity not exceeding 50,000 pieces shall constitute a sample. Additional samples representative of the material as delivered may be taken at any time or place at the discretion of the inspector. Immediately before test the sample shall be dried to constant weight at a temperature between 212° and 220° F.

F-2. *Absorption test.*—Three shingles or representative pieces thereof, previously dried, shall be weighed separately on scales sensitive to within one-half of 1 percent of their weight. Pieces from the modulus of rupture test on dry or saturated shingles may be used. They shall then be completely immersed in soft, distilled, or rain water at room temperature (60° to 80° F.) for 24 hours. They shall then be removed from the water and again weighed separately after wiping the surface with a damp cloth. The difference between the weight after immersion and the weight when dry, multiplied by 100 and divided by the dry weight shall be taken as the absorption in percent.

F-3. *Modulus of rupture test.*—The loads shall be applied without impact by means of equipment having accuracy and sensitivity within 1 pound or 2 percent of the minimum breaking load. The specimen for each type of transverse test shall consist of not less than 4 pieces 3 inches wide, taking 2 from each shingle at right angles, and shall be tested on a span of not less than 7 or more than 10 inches. The test piece shall be supported on 2 knife edges of

the rocker type adjusted perpendicular to its long dimension. The load, W , shall be applied through the third knife edge at the middle of the specimen along a line parallel to the supporting knife edges, the finished surface of the specimen to face downward. The modulus of rupture R is computed by the formula,

$$R = \frac{3WL}{2BD^2}$$

where L is the distance in inches between the lines of support, B is the width of the specimen, and D is the average thickness under the middle knife edges, both in inches. The average thickness shall be determined to the nearest 0.002 inch.

F-3a. Modulus of rupture test of dry shingles.—The specimen for this test shall be tested after cooling from the drying treatment specified in paragraph F-1.

F-3b. Modulus of rupture test after saturation.—The specimens for this test shall be tested after immersion in water for 24 hours as outlined in paragraph F-2. The samples from the absorption test may be used.

F-3c. Modulus of rupture test after heat exposure.—The specimens for this test shall be tested after cooling following heating for 4 hours in a muffle furnace maintained at an average temperature of 600° F. within $\pm 20^\circ$ F., for the space occupied by the samples. The specimens shall be shielded from direct radiation from heating element or flames.

G. PACKING AND MARKING

G-1. Any special requirements of the individual departments are noted under section H.

G-2. Packing.—Unless otherwise specified, the subject commodity shall be delivered in standard commercial containers, so constructed as to insure acceptance by common or other carriers, for safe transportation, at the lowest rate, to the point of delivery.

G-3. Marking.—Unless otherwise specified, shipping containers shall be marked with the name of the material and type as defined by the contract or order under which the shipment is made, the name of the contractor, and the number of the contract or order.

H. REQUIREMENTS APPLICABLE TO INDIVIDUAL DEPARTMENTS

H-1. The following departmental specifications of the issue in effect on date of invitation for bids shall form a part of this specification:

H-1a. Army.—United States Army Specification No. 100-2b, Standard Specification for Marking of Shipments.

H-1b. Navy.—Navy Department purchases will be made under the issue in effect on date of invitation for bids of Bureau of Yards and Docks Specification No. 7Y, Roofing, siding, and sheet metal work; dampproofing and membrane waterproofing, copies of which may be obtained without cost upon application to the Bureau of Yards and Docks, Navy Department, Washington, D. C.

FEDERAL STANDARD STOCK CATALOG
(Section IV, part 5)

SS-S-291-5
(May 1935)

I. NOTES

I-1. *Items to be specified.*—Purchasers should exercise all options specified herein and should specify type; method of laying; color; surface finish as smooth, granular, or rough, or at bidder's option, any one of the three; thickness; size as defined in paragraphs D-6a, D-6b, D-6c, and D-6d; the amount of side lap for Type C shingles; length and type of hip and ridge finish; and nails or other fastenings.

I-2. *Color and surface finish.*—Cement-asbestos shingles can be obtained in various shades of gray, red, brown, black, buff, purple, green, and mixtures of these colors. The depth of color penetration is in the range 0.005 to 0.02 inch. Manufacturers' lists should be consulted to avoid, where possible, the drafting of requirements in point of color or finish that would unduly restrict competition.

Efflorescence may appear on cement-asbestos shingles within a few months after application, but generally disappears within 2 years. This does not necessarily involve a permanent change in applied colors.

I-3. *Sizes.*—Shingles of each type are to be requisitioned in one width and length. Bidders are permitted to supply them in the range of sizes for each type indicated in Paragraph D-6. The limits are placed so as to enable the widest possible competition consistent with obtaining a desired design or appearance.

I-4. Copies of this specification may be obtained upon application, accompanied by money order or coupon, or cash, to the Superintendent of Documents, Government Printing Office, Washington, D. C. Price 5 cents.

I-5. An alphabetical index of Federal specifications may be purchased, as noted in paragraph above, price to be obtained from the Superintendent of Documents.

Notice: When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

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LLL-F-321a

MAY 21, 1935

**SUPERSEDING
Fed. Spec. LLL-F-321
Sept. 20, 1932**

FEDERAL STANDARD STOCK CATALOG

Section IV

(Part 5)

FEDERAL SPECIFICATION

FOR

FIBER-BOARD; INSULATING

This specification was approved by the Director of Procurement for use of all departments and establishments of the Government and shall become effective not later than November 15, 1935. It may be put into effect, however, at an earlier date after promulgation.

A. APPLICABLE FEDERAL SPECIFICATIONS

A-1. There are no other Federal specifications applicable to this specification.

A-2. Any special requirements of the individual departments of the Government are noted under section H.

B. CLASSES AND USES

B-1. Fiber insulating board shall be furnished in three classes and in various thicknesses, as specified (see par. I-2).

Class A. Building board.

Class B. Lath (for plaster base).

Class C. Roof board.

C. MATERIALS

C-1. Material.—Boards shall be manufactured from wood or other vegetable fiber, by a felting or molding process, suitable sizing material being incorporated in the product to render it water-resistant. The material shall be subjected to such drying temperature as to effect complete destruction of rot-producing fungi (see par. D-5).

D. GENERAL REQUIREMENTS

D-1. Construction.—The finished board may be either single or multiple-ply. When multiple-ply boards are supplied, a suitable moisture-resistance cement shall be used to join the plies.

D-2. Surfaces.—For plaster base, roof boards, and similar applications surfaces shall be natural and shall be free from cracks, lumps,

excessive departure from planeness, or other defects. For interior finish, partitions, and similar applications where the board is exposed, surfaces shall be finished and shall be smooth and flat and reasonably free from coarse or hairy fibers.

D-3. Dimensions.—Dimensions shall be as specified, subject to the following tolerances:

Length and width: Tolerance, minus $\frac{1}{4}$ inch, plus none.

Thickness: Tolerance, plus or minus $\frac{1}{16}$ inch.

D-4. Edge finish.—

D-4a. Class A.—Edges shall be square.

D-4b. Class B.—Edges shall be either shiplapped, beveled-and-shiplapped, tongue-and-grooved, beveled-and-tongue-and-grooved, V-jointed, or shiplapped-and-grooved.

D-4c. Class C.—Edges shall be square unless shiplapped or offset are specified.

D-5. Destruction of rot-producing fungi.—Each bidder shall state in his proposal the temperature and humidity and the time insulating fiber-board is held at this condition during the process of manufacture. The temperature necessary to sterilize insulating board varies with the humidity during the heating process. For example, 10 minutes at 100° C. and 100 percent humidity will sterilize, while at 90° C. and 70 percent humidity 1 hour is required. At lower temperatures a longer time is required.

E. DETAIL REQUIREMENTS

E-1. Physical properties.—Fiber insulating board shall have the properties shown in table I when tested according to methods hereinafter described:

TABLE I

	Class A	Class B	Class C
Maximum thermal conductivity B. t. u. per hour per square foot per degree F. per inch thickness (note 1)---	0.36	0.36	0.36
Minimum transverse strength, (Lengthwise (note 2)-----	14	14	7
pounds----- (Crosswise (note 2)-----	12	12	7
Minimum deflection at ultimate load, inches-----	0.25	0.25	0.25
Maximum deflection at ultimate load, inches-----	.85	.85	1.25
Minimum tensile strength, pounds per square inch (note 3)-----	175	175	100
Water absorption, percent-----	5	5	10
Maximum linear expansion, percent-----	$\frac{1}{2}$	$\frac{1}{2}$	-----

Note 1. No board of any class having a conductance greater than 0.72 B. t. u. per hour, per square foot per degree F. irrespective of thickness will be acceptable under this specification.

Note 2. This requirement is based upon specimens $\frac{1}{2}$ -inch thick. For specimens of other thicknesses the requirement shall be increased in direct proportion, that is, for a thickness of 1 inch, it shall be doubled, etc.

Note 3. Tensile strength requirements shall be applicable only on thicknesses up to and including 1 inch.

LLL-F-321a

AMENDMENT—1
MAY 21, 1937

FEDERAL STANDARD STOCK CATALOG

Section IV

(Part 5)

FEDERAL SPECIFICATION

FOR

FIBER-BOARD; INSULATING

This Amendment was approved on the above date, by the Director of Procurement, for the use of all departments and establishments of the Government, and shall become effective not later than November 15, 1937. It may be put into effect, however, at any earlier date after promulgation.

The following corrections should be made in Federal Specification LLL-F-321a, dated May 21, 1935:

Page 1:

Paragraph D-1. Delete paragraph in its entirety and substitute:

D-1. *Construction.*—The finished board may be either single or multiple-ply. When multiple-ply boards $\frac{3}{4}$ -inch or less in thickness are supplied, a suitable moisture-resistance cement shall be used to join the plies. Multiple-ply boards 1-inch and over in thickness may be stapled, stitched, or thoroughly cemented, as specified.

Page LLL-F-321a—12:

Paragraph D-4c. Delete paragraph in its entirety and substitute:

D-4c. *Class C.*—Edges shall be square unless shiplapped or offset are specified. When offset boards $1\frac{1}{2}$ inches and over in thickness are specified the offset shall be one-half the thickness of the board.

Page LLL-F-321a—10:

Paragraph I-1. Delete paragraph in its entirety and substitute:

I-1. Purchasers should specify the class, purpose for which used, dimensions and kind of surface desired; also whether cemented, stapled, or stitched joining of plies is desired in boards 1-inch in thickness and over. Under class C when other than square-edge finish is desired the kind desired shall be specified. (See par. D-4c.)

Paragraph 1-2. Insert subparagraph 1-2 as follows:

1-2. The width and length dimensions listed in paragraphs 1-2a, 1-2b, and 1-2c are the overall dimensions of the finished board.

F. METHOD OF SAMPLING, INSPECTION, AND TESTS

F-1. Sampling.—Samples shall be taken at random so as to give a fair representation of the entire shipment. Pieces from 5 boards of any carload, or one-half of 1 percent of the number of pieces in less than carload shipments, but not less than 3 boards of any shipment, shall constitute the test sample. From each, a specimen 24 by 30 inches shall be cut, the longer dimension being cross-wise of the longer dimension of the board as it is usually obtained. When a shipment consists of more than 1 car or carrier load a sample shall be selected from each car or carrier.

F-2. Inspection and tests.—

F-2a. Atmospheric conditions.—Tests for tensile strength, transverse strength, and deflection shall be made under prevailing atmospheric conditions except in the case of disputes. These tests shall then be made on samples conditioned for at least 24 hours at a relative humidity of 65 percent and at a temperature of 70° to 75° F.

F-2b. Thermal conductivity.—The guarded hot plate shall be the standard method for determination of thermal conductivity. The temperature of the surfaces of the material shall be regarded as that of the plates on each side. The test specimen shall be at least 8 by 8 inches and the plates must be applied in such a manner that the density and other physical characteristics of the material under test is not altered. The standard method of making tests shall be at a mean temperature of 75° F. and upon dry material. The material shall be dried at a temperature of 160° F. for a sufficient time to eliminate all moisture before the test is made. The percentage of moisture driven off, together with the atmospheric conditions, and the density of the material, shall be reported with the test. The temperature of the surfaces of the material shall be regarded as that of the plates on each side. The construction of the apparatus, and the procedure recommended by the United States Bureau of Standards (Journal of the American Society of Heating and Ventilating Engineers, vol. 26, no. 7, Oct. 1920), are as follows:

F-2b (1). Figure 1 shows a diagrammatic sketch of the assembled apparatus. The copper plates, four in number, are suspended from the frame by means of small piano wires. The middle plates enclose an electric heating element, details of construction of the 12-inch square heating plates being shown in figure 2. The heating grid, having a resistance of about 20 ohms, is built of $\frac{1}{8}$ -inch no. 36 constantan ribbon, wound diagonally on a sheet of fiber board, 11 inches square, so that the winding is distributed uniformly over the entire surface. It is insulated with m'canite sheets and placed between two $\frac{1}{8}$ -inch copper plates which are then held together tightly by means of a number of copper screws passing through holes in the fiber board. Each plate has a $\frac{3}{4}$ -inch saw cut isolating an 8-inch square in the center, as shown in the figure. This arrangement tends to minimize the heat conduction between the center square and the outer guard ring. The two outer

cold plates (fig. 3) are identical in construction and consist merely of $\frac{1}{8}$ -inch copper plates with water or brine circulating tubes soldered to the backs.

F-2b (2). Thermocouples are used to measure the difference in temperature between the hot and cold plates. A fine (no. 32 B. & S. gage) constantan wire is soldered directly to the center of the surface of each plate in contact with the insulating material, the outer

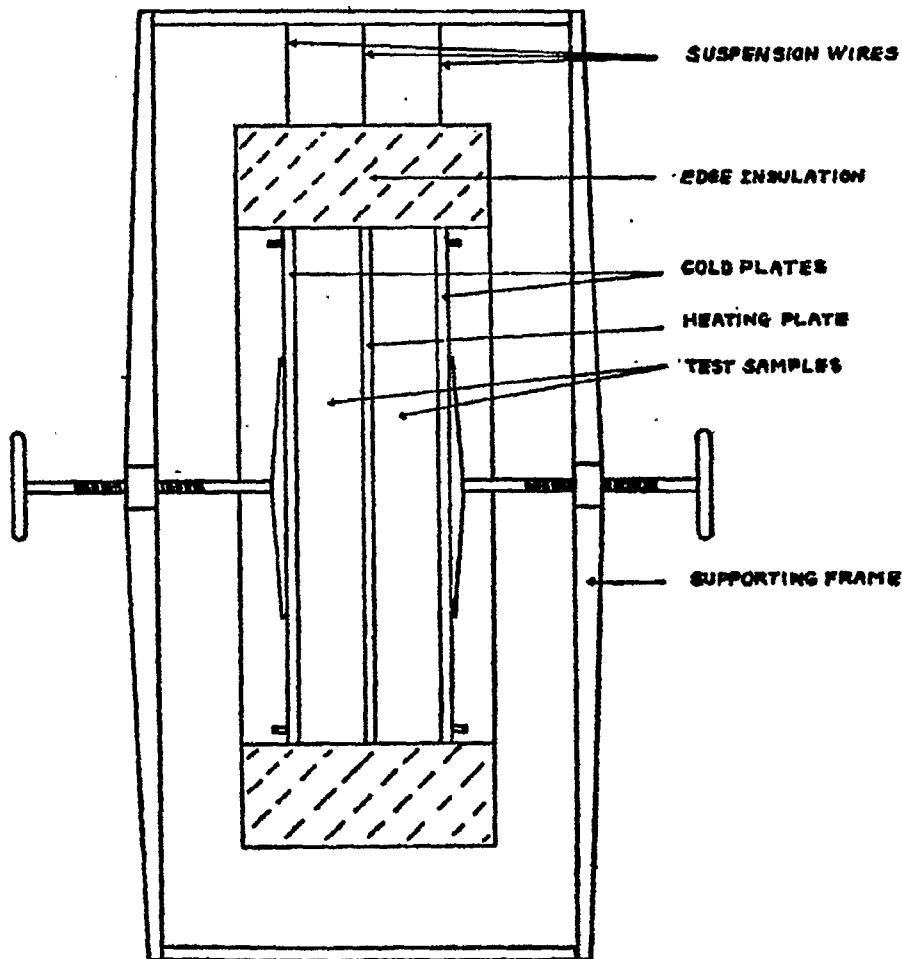


FIGURE 1.

plates serving as cold junctions and the two surfaces of the center plates as the corresponding hot junctions. The temperatures of the plates, as will be shown later, are sensibly the same as the temperatures of the surfaces of the test material in contact with them, providing the test material is not too good a conductor of heat. Each wire is led off from the center in a small groove cut in the surface of each plate. The copper leads to the measuring instrument are connected directly to the middle plates and to each of the outer

plates as shown in figure 4. In this way the copper plates themselves form the thermojunctions with the constantan wires. Since no appreciable temperature gradient will be present in the heating plates, the junctions on those plates may be placed on the inside next to the heating grid. This eliminates the necessity of cutting grooves on the outside surfaces to accommodate the wires, but, on the other hand, the junctions are not conveniently accessible.

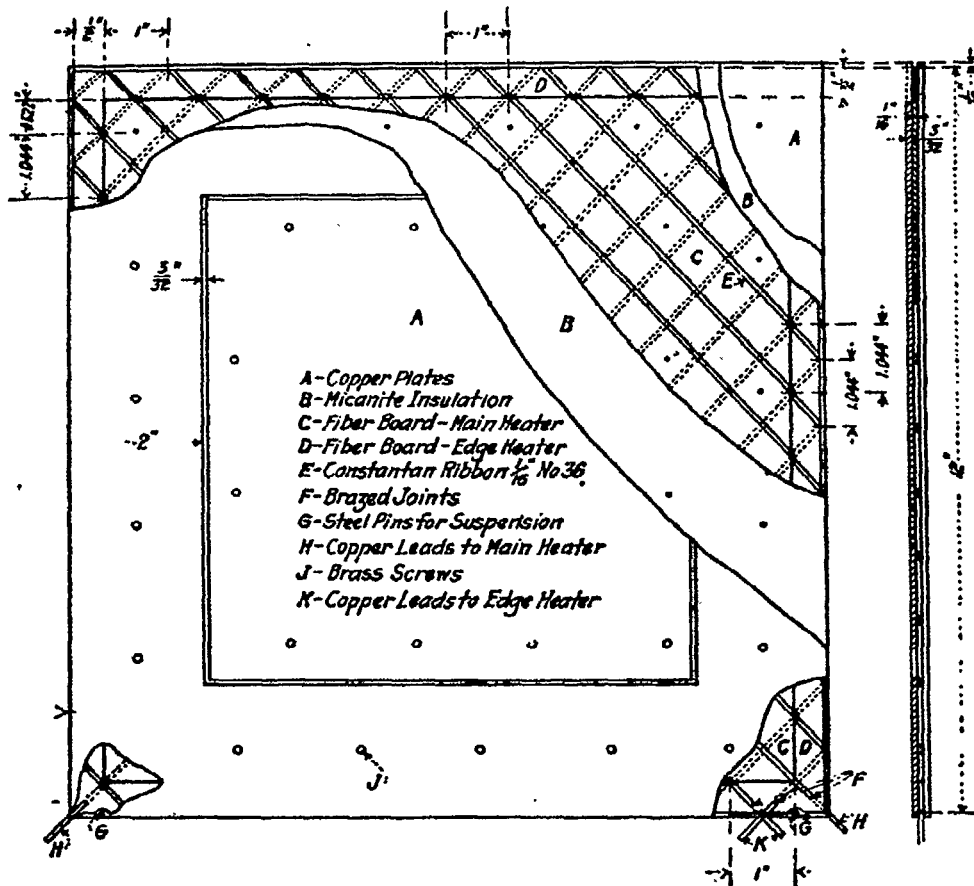


FIGURE 2.—Details of heating plate for thermal conductivity apparatus.

F-2b (3). To compensate for heat loss from the edges of the heating plate, an auxiliary heating element consisting of ribbon similar to the main heating grid is wound, as shown in figure 2 on a hollow square of fiber board $\frac{1}{2}$ -inch wide around the edges of the plates. A small auxiliary current can be regulated in this heater in order to maintain the guard ring at the temperature of the inner square. Auxiliary thermocouples, the junctions of which are placed on each side of the saw cut at the corners of the inner square, enable this adjustment to be effected. When the auxiliary thermocouples indicate a zero temperature difference across the saw cut no lateral

flow of heat can take place either in the central square or the hollow square surrounding it.

F-2b (4). Figure 4 gives a diagram of the electrical connections. A reliable ammeter is used to measure the current supplied to the main heating grid and some form of potentiometer outfit to measure the electromotive forces of the thermocouples. The galvanometer used with the potentiometer can also be used as a direct deflection instrument, but this requires that all the couples have the same resistance. Furthermore, the galvanometer calibration is subject to change so that it is desirable to use a null method of measure-

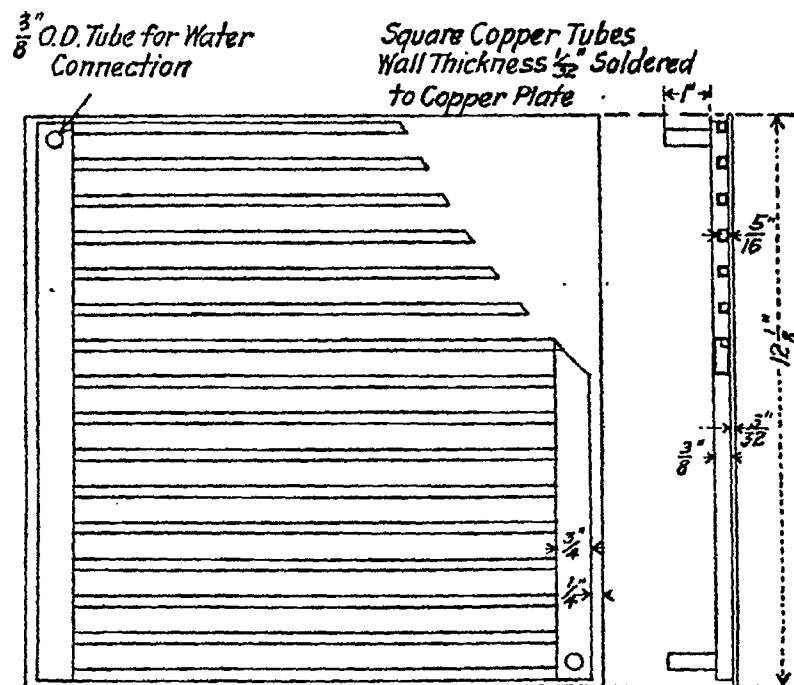


FIGURE 3.—Details of one of the outer cold plates.

ment. The relation between the thermal electromotive force of the thermocouples and the temperature is taken from a calibration of a thermocouple of the same material, i. e. no. 32 constantan wire against pure copper wire.

F-2b (5). To determine the actual rate of energy supply per unit area to the inner squares of the heating plates, the resistance per unit area of the heating grid in that region is computed from the measured resistance of the metallic ribbon per unit length, its width and spacing. This is equivalent to determining the length of ribbon over the center square and one-half the area of the saw cut, multiplying this length by the resistance of the ribbon per unit length, and dividing the product by the area of the center plus one-half the saw cut. The rate of electrical energy supply per unit area to each slab of test material is evidently equal to one-half the ordinary expression for power in electrical unit, viz I^2R , provided the effective

insulation on each side of the heating plate is the same. The quantity R in this case is not the total resistance of the heating grid, but its resistance per unit area of surface covered. The temperature coefficient of resistance of the constantan ribbon used for the heating grid is so small that R remains practically constant throughout the range of temperature in which the apparatus can be used.

F-2b (6). The two outer cold plates are kept at constant temperature by allowing water or brine to flow through them in sufficient quantity to carry off all the heat supplied without becoming appreciably heated. The cooling liquid must be kept at a fairly constant temperature during an experiment otherwise a condition of equilibrium is never reached. If water is used an apparatus for

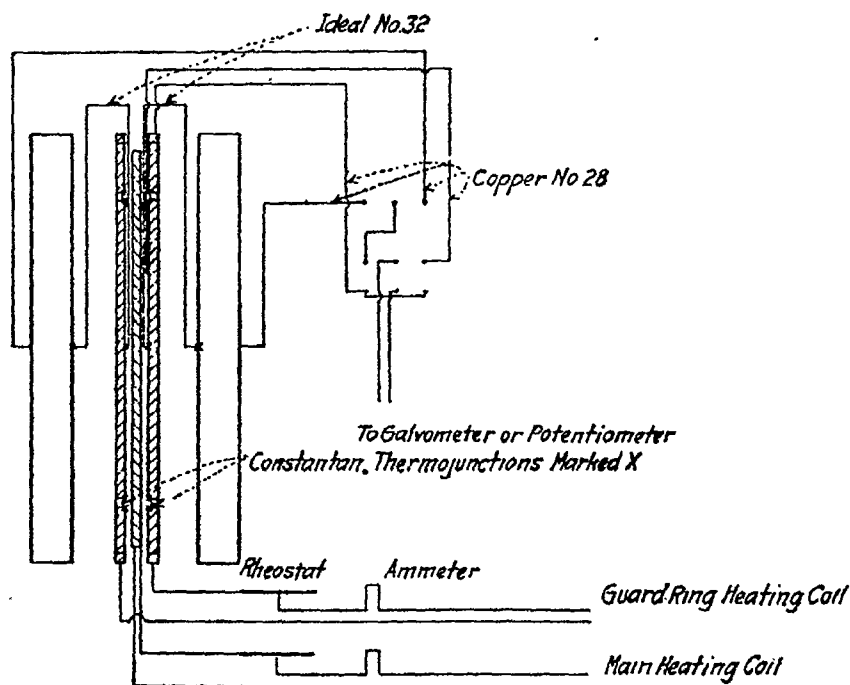


FIGURE 4.—Arrangement of electrical connections to thermojunctions.

automatically mixing hot and cold water in the proper proportions will be found convenient to furnish a constant temperature supply, but in a great many places the tap water has a fairly constant temperature and no thermostatic devices need be employed.

F-2b (7). Two identical flat samples of insulating material previously dried to constant weight (see par. F-2b) are placed in the apparatus, one on each side of the central heating plate. Enough pressure is applied to insure a good contact between the specimens and the copperplates, but not enough to cause an appreciable diminution in the thickness of the samples. The heating plates are then heated up rapidly with a fairly large current to a temperature somewhat above the final equilibrium temperature desired. The

current is then reduced to a value which will maintain the hot plate at about the desired temperature. This value of the current is calculated from the estimated conductivity and the thickness of the samples being tested. When a condition of approximate equilibrium has been established a small current is regulated in the auxiliary guard-ring heating coil until the thermocouples between the inner squares and the guard-rings of the heating plate give no deflection of the galvanometer. This current must be adjusted from time to time during the experiment since the temperature of the hot plate is slowly changing as equilibrium is being approached.

F-2b (8). Under equilibrium conditions, the average thermal conductivity of the two specimens is given by the following expression:

$$K = \frac{I^2 R d}{JT}$$

where

K =thermal conductivity;

I =current;

R =resistance per unit area of surface;

d =average thickness of sample;

T =average temperature difference between hot and cold plates;

J =electrical equivalent of heat (4.183 joules=1 calorie).

F-2c. Transverse strength.—The transverse strength shall be determined as follows:

A specimen 3 inches wide and 18 inches long is taken for test. The transverse strength is determined by placing the specimen on horizontal parallel supports 12 inches apart and applying the load at midspan on a bearing parallel to the end supports, so that the deflection takes place at 12 inches plus or minus 2 inches per minute until the specimen breaks. The bearing and supports shall be rounded to a radius of approximately $\frac{3}{8}$ inch to prevent injury to the specimen. Three specimens from the long direction of the board and three at right angles thereto shall be tested. The transverse strength in each direction is the average of three specimens taken from that direction.

NOTE.—See Miscellaneous Publication Bureau of Standards No. 132, issued Dec. 1, 1931.

F-2d. Deflection test.—Ultimate deflection shall be determined at the time each specimen breaks in the test under paragraph F-2c. Each specimen shall meet the minimum and maximum requirements of table I.

F-2e. Tensile strength.—The test for tensile strength shall be as follows: From each sample, specimens 2 inches wide and not less than 10 inches long shall be clean-cut parallel to the longest direction of the board and at right angles thereto. The distance between clamps shall be not less than 6 inches. Results on specimens under test that break within $\frac{1}{2}$ inch of the jaws shall be disregarded. The machine speed shall be set for the openings between the clamps at the rate of 2 inches per minute.

The specimens before being placed in the testing machine shall be measured for width and thickness to the nearest 0.01 inch. The tensile strength shall be taken as the average of three specimens from each direction of the board.

F-2f. Water absorption.—A specimen 12 by 12 inches shall be dried at 160° F. for 24 hours and cooled to room temperature in a dry atmosphere. The thickness of the sample shall be measured and the volume calculated therefrom. The sample shall then be carefully weighed and submerged horizontally under 1 inch of distilled water maintained at a temperature of 70° F. plus or minus 5° F. After 2 hours of submerision, the sample shall be stood on end to drain for 10 minutes at the end of which time the excess surface water shall be removed by hand with a blotting paper or paper towel and immediately weighed. The volume of absorbed water calculated, and the water absorption expressed in percent by volume based on the initial volume.

F-2g. Linear expansion.—The maximum linear expansion shall be determined in the following manner from a specimen 3 by 12 inches that has been cut parallel with the long direction of the board and from a like specimen cut at right angles thereto. At each of two points approximately 10 inches apart on the center line of each specimen a small area is coated by rubbing with a glass marking pencil (or a wax crayon). A fine cross mark is made with a razor blade on the center line in each of these two areas as reference points for the length measurements. The specimens are then conditioned for 24 hours at 50 percent relative humidity and measurements are then made of the distance between the two reference points. A scale graduated in hundredths of an inch is used and readings are made with a magnifying lens to the nearest 0.005 inch. The specimens are next conditioned for 24 hours at 97 percent relative humidity after which the distance between the two reference points is again measured. The measurements shall be made in the conditioned air specified in each case, or as quickly as possible after each specimen is removed therefrom. The linear expansion shall be reported as the increase in the length between reference marks as a percentage of the length at 50 percent relative humidity. (In the absence of other facilities, a convenient means of conditioning the specimens at the specified humidity conditions is to expose them in an enclosed space immediately above saturated solutions of suitable salts—sodium dichromate ($\text{Na}_2\text{Cr}_2\text{O}_7 \cdot 2 \text{H}_2\text{O}$) for 50 percent relative humidity and potassium sulphate (K_2SO_4) for 97 percent relative humidity).

G. PACKAGING, PACKING, AND MARKING

G-1. Packaging.—Unless otherwise specified, commercial packages are acceptable under this specification.

G-2. Packing.—Unless otherwise specified, the subject commodity shall be delivered in standard commercial containers, so constructed as to insure acceptance by common or other carriers for safe transportation at the lowest rate to the point of delivery.

G-3. Marking.—Unless otherwise specified, shipping containers shall be marked with the name of the material, class size, and quantity contained therein, as defined by the contract or order under which shipment is made, the name of the contractor, and the number of the contract or order.

LLL-F-321a-10 FEDERAL STANDARD STOCK CATALOG
(May 1935)
(Section IV, part 5)

H. REQUIREMENTS APPLICABLE TO INDIVIDUAL DEPARTMENTS

H-1. The following departmental specifications of the issue in effect on date of invitation for bids shall, insofar as applicable, form a part of this specification, and contractors should provide themselves with the necessary copies when submitting bids to the respective departments.

H-1a. Army.—United States Army Specification No. 100-2, latest issue Standard Specifications for Marking Shipments.

H-1b. Navy.—Navy Department General Specification for Inspection of Material, copies of which may be obtained without cost upon application to the Bureau of Supplies and Accounts, Navy Department, Washington, D. C.

I. NOTES

I-1. Purchasers should specify the class, purpose for which used, dimensions and kind of surface desired. Under class C when other than square-edge finish is desired the kind desired shall be specified (see par. D-4c).

I-2. Commercial sizes.—

I-2a. Class A.—4 feet wide by 5, 6, 7, 8, 9, 10, or 12 feet long by $\frac{1}{2}$ inch, $\frac{3}{4}$ inch, and multiples of $\frac{1}{2}$ inch thick.

I-2b. Class B.—48 inches long by 16, 18, or 24 inches wide by $\frac{1}{2}$ inch, $\frac{3}{4}$ inch, and multiples of $\frac{1}{2}$ inch thick.

I-2c. Class C.—22 by 47 inches and 24 by 48 inches by $\frac{1}{2}$ inch and multiples of $\frac{1}{2}$ inch thick.

I-3. It is believed that this specification adequately describes the characteristics necessary to secure the desired material, and that normally no samples will be necessary prior to award to determine compliance with this specification. If for any particular purpose, samples with bids are necessary they should be specifically asked for in the invitation for bids, and the particular purpose to be served by the bid samples should be definitely stated, the specification to apply in all other respects.

I-4. Copies of this specification may be obtained upon application, accompanied by cash or money order, to the Superintendent of Documents, Government Printing Office, Washington, D. C. Price 5 cents.

I-5. The Index of Federal Specifications is obtainable upon application, accompanied by cash or money order, to the Superintendent of Documents, Government Printing Office, Washington, D. C. Price to be obtained from that office.

Notice.—When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related governmental procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever, and the fact that the Government may have formulated or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or other person or corporation or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

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R-P-381

JUNE 6, 1933

**SUPERSEDING
F.S. Nos. 80 and 83
December 29, 1923**

FEDERAL STANDARD STOCK CATALOG

Section IV

(Part 5)

FEDERAL SPECIFICATION

FOR

**PITCH; COAL-TAR (FOR) MINERAL-SURFACED BUILT-
UP ROOFING, WATERPROOFING AND DAMP-
PROOFING**

This specification was approved for promulgation by the Federal Specifications Board on June 6, 1933, for the use of the departments and independent establishments of the Government in the purchase of this commodity, and shall become mandatory for all departments and independent establishments of the Government not later than February 15, 1934. It may be put into effect, however, at any earlier date, after promulgation.

A. APPLICABLE FEDERAL SPECIFICATIONS

A-1. There are no other Federal specifications applicable to this specification.

A-2. Any special requirements of the individual departments of the Government are noted under section H.

B. TYPES

B-1. Coal-tar pitch shall be of the following types: (the type (or types) desired shall be stated in the invitation for bids).

Type I. Coal-tar pitch for built-up roofing.

Type II. Coal-tar pitch for waterproofing and damp-proofing.

C. MATERIAL

C-1. Material shall be as specified under detail requirements.

D. GENERAL REQUIREMENTS

D-1. Basis of purchase.—Material shall be purchased by weight.

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E. DETAIL REQUIREMENTS

E-1. *Appearance.*—Freshly melted material of both types shall be uniformly glossy, and on aging one week its surface shall not become dull or show any separation of oily constituents. Freshly fractured material shall present a satiny black surface.

E-2. *Physical and chemical requirements.*—

	Type I		Type II	
	Maximum	Minimum	Maximum	Minimum
Softening point (cube in water method).....	66° C. (150° F.)	60° C. (140° F.)	60° C. (140° F.)	52° C. (125° F.)
Ductility (c.m.).....		50		50
Specific gravity at 25°/25° C. (77°/77° F.).....	1.34	1.22	1.34	1.22
Insoluble in carbon bisulphide (percent).....	30	15	30	15
Ash (percent).....	1		1	
DISTILLATION TEST				
Distillate under 300° C. (572° F.) (percent).....	12		12	
Specific gravity of distillate at 38°/15.5° C. (100°/60° F.).....		1.03		1.03

F. METHODS OF SAMPLING, AND TESTS

Deliveries will, in general, be sampled and tested by the following methods, but the purchaser reserves the right to use any additional information to ascertain whether the material meets the specification.

F-1. *Sampling.*—From each shipment select at random a number of packages equivalent to the cube root of the total number of packages included in the lot. If the cube root as calculated proves to be a fractional number, express it as the next higher digit.

A sample shall be taken at least 3 inches below the surface and at least 3 inches from the side of each container selected. A clean hatchet may be used if the material is hard enough to shatter and a broad, stiff putty knife if the material is soft. An auger, or brace and three-fourths-inch bit, or other suitable means may also be used. Avoid contamination with superficial water, wooden slivers, or foreign matter.

The samples so taken shall be combined by melting together with constant stirring to prevent overheating at a temperature not exceeding 121° C. (250° F.). When thoroughly melted, two 1-quart friction-top cans shall be filled with the well-mixed material, allowed to cool, tightly sealed, marked for identification with the manufacturer's name and brand, etc., and one transmitted to the testing laboratory. The other shall be retained for use in case of dispute.

F-2. Laboratory examination.—

F-2a. Appearance.—Carefully melt about 10 g of the coal-tar pitch at a temperature not exceeding 121° C. (250° F.) and pour it into a small tin box or other suitable container provided with a cover. At least one half the surface shall be free from froth or bubbles. Allow the coal-tar pitch to cool in a place free from drafts and dust. When cool, examine the surface, then cover the box with the lid and set aside for one week, after which period examine again. Immediately after cooling, the surface shall be glossy black, and after standing one week the surface shall not show any dulling or the separation of greasy or oily material when compared with a freshly prepared sample.

F-2b. Softening point (cube in water method).—The softening point shall be determined by the "Standard Method of Test for Softening Point of Tar Products (Cube in Water Method)", D-61-24, A.S.T.M., Standards 1930, part II, page 655. This method is essentially as follows:

F-2b (1). Apparatus.—(See fig. 1.)

F-2b (1) a. A mold suitable for forming a 12.7 mm $\pm$ 0.1 mm (one half inch) cube of pitch.

F-2b (1) b. An L-shaped hook made from no. 12 gage copper wire, the foot of which shall be 2½ cm (1 inch) long.

F-2b (1) c. A glass vessel capable of being heated, not less than 8½ cm (3½ inches) in diameter by 10½ cm (4 inches) in depth measured from the bottom of the flare. (A 600-ml beaker, low form.)

F-2b (1) d. A total immersion thermometer meeting the following specification:

Type.—Etched stem, glass.

Liquid.—Mercury.

Range and subdivision.—Minus 4° to +104° C. in 0.2°.

Total length.—454 to 460 mm.

Stem.—Plain front, enamel back, suitable thermometer tubing. Diameter 6.0 to 7.0 mm.

Bulb.—Corning normal or equally suitable thermometric glass. Length, 20 to 30 mm. Diameter, not greater than stem.

Distance to -4° line from bottom of bulb.—50 to 70 mm.

Distance to +104° line from top of thermometer.—20 to 50 mm.

Filling above mercury.—Nitrogen gas.

Top finish.—Glass ring.

Graduation.—All lines, figures, and letters clear cut and distinct. Lines corresponding to even degree marks to be longer than the remaining lines. Graduations to be numbered at each multiple of 2°.

Immersion.—Total.

Scale error.—The error at any point of the scale, when the thermometer is standardized at total immersion, shall not exceed 0.3°.

Special marking.—A serial number and the manufacturer's name or trade mark shall be etched on the stem.

Case.—The thermometer shall be supplied in a suitable case, on which shall appear "-4° to +104° C. in 0.2°, total immersion."

The A.S.T.M. low S.P. -2° to +80° C. thermometer (see A.S.T.M. Standards D 36-26 or D 61-24) gives within its range readings identical with the -4° to +104° C. thermometer specified above.

F-2b (2). *Preparation of sample.*—The pitch shall be molded into a 12.7 mm (one half inch) cube, truly shaped and with sharp edges, either by melting and pouring or softening and pressing into a mold.

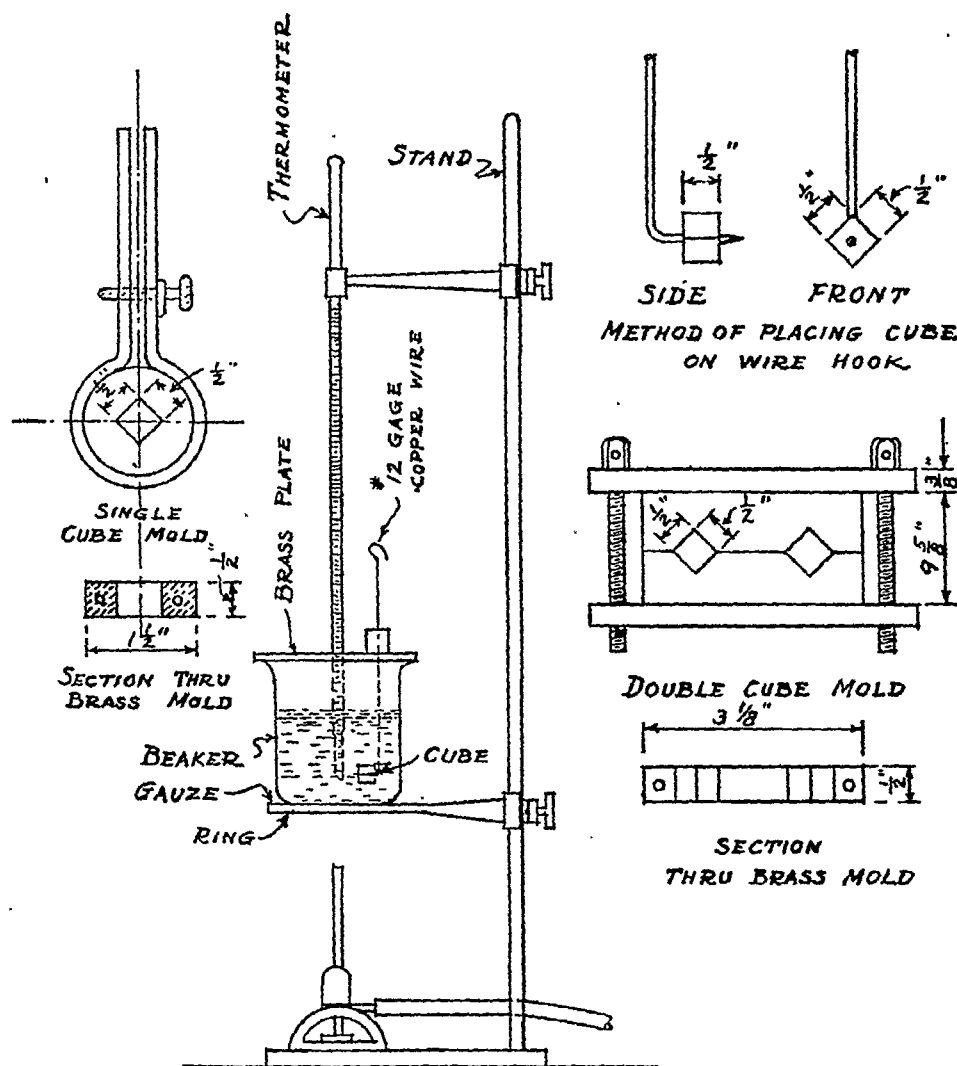


FIGURE 1.

(Two satisfactory molds are shown in fig. 1.) In all cases an excess of pitch shall be used and the surplus material shall be cut off cleanly with a slightly heated knife. If the pitch is melted, it should be thoroughly stirred to avoid incorporating air bubbles in the mass and then poured into the mold so as to leave an excess on cooling. The mold should rest on a brass plate, and the surface of the plate and the interior surfaces of the mold should be amalgamated to prevent the pitch from adhering to them.

Determine the softening point within three hours after the sample has been prepared.

F-2b (3). Procedure.—Assemble the apparatus as shown in figure 1. Fill the glass container to a depth of approximately 9½ cm (3¾ inches) with freshly boiled, distilled water that has been cooled to not less than 45° C. below the softening point of the material under test. Place the cube of pitch on the wire as shown in figure 1 and suspend it in the water so that its lower edge is 2.5 ± 0.1 cm (1 inch) above the bottom of the beaker and its upper edge is not less than 5 cm (2 inches) below the surface of the water. Allow it to remain in the water for 15 minutes before applying heat. Suspend the thermometer so that the bottom of the bulb is level with the bottom edge of the cube of pitch and within 6 mm (¼ inch), but not touching the cube.

Apply the heat in such a manner that the temperature of the water after the first three minutes of heating is raised uniformly 5° C. (9° F.) $\pm 0.5^\circ$ C. (1° F.) each minute. Report as the softening point the temperature indicated by the thermometer (adding or subtracting any certified corrections but making no emergent stem corrections) at the instant the sample touches the bottom of the container.

F-2c. Ductility.—The ductility shall be determined by the "Tentative Method of Test for Ductility of Bituminous Materials" D 113-26 T, Proceedings A.S.T.M. 1926, vol. 26, part 1, p. 886. This method is essentially as follows:

F-2c (1). Apparatus.—

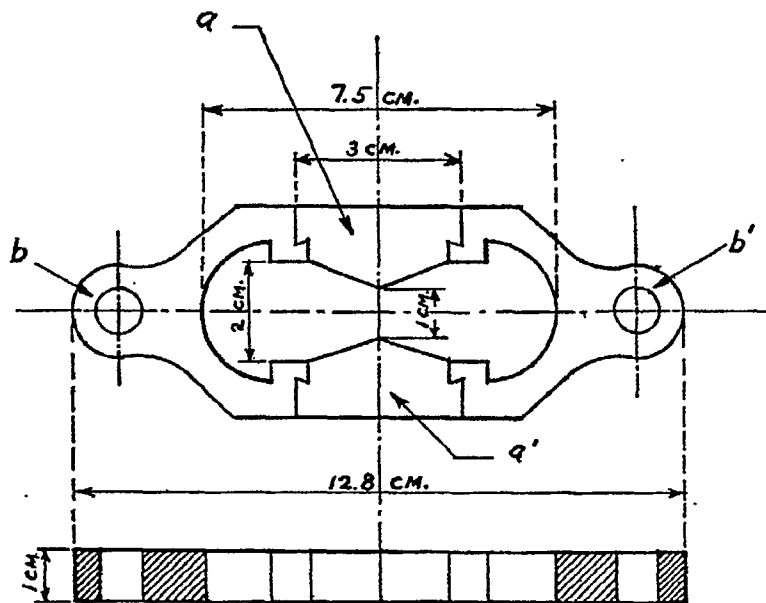


FIGURE 2.

FEDERAL STANDARD STOCK CATALOG

(Section IV, Part 5)

F-2c (1) a. Mold.—The mold shall be of the shape shown in figure 2. It shall be made of brass, the ends B and B' being known as clips and the parts A and A' as sides of the mold. The dimensions of the mold shall be as follows:

	CM
Total length (internal).....	7.45-7.55
Distance between clips.....	2.97-3.06
Width of clips at mouth.....	1.98-2.02
Width of briquet at minimum cross section (halfway between clips).....	0.99-1.01
Thickness of briquet throughout.....	0.99-1.01

F-2c (1) b. Water bath.—A water bath shall be maintained at a temperature varying not more than 0.1° C. from 25° C. (77° F.). The volume of water shall be not less than 10 liters, and the sample shall be immersed to a depth of not less than 10 cm and shall be supported on a perforated shelf not less than 5 cm from the bottom of the bath.

F-2c (1) c. Testing machine.—Any apparatus may be used for pulling the briquets of pitch apart which is so constructed that the briquet will be continuously immersed in water and the two clips pulled apart at a uniform rate of 5 cm per minute.

F-2c (2). Procedure.—The coal-tar pitch shall be completely melted at the lowest temperature at which it will be thoroughly fluid and then poured into the standard mold. The mold shall be assembled on a brass plate, and the surface of the plate and the interior surfaces of the side pieces A and A' of the mold shall be thoroughly amalgamated so as to prevent the pitch from sticking. In filling the mold care shall be taken not to disarrange the parts and thus distort the briquet. In filling, the pitch shall be poured in a thin stream back and forth from end to end of the mold until it is more than level full. After cooling at room temperature for 30 minutes the excess pitch shall be cut off by means of a hot putty knife, so that the mold will be just level full.

The brass plate and mold containing the briquet shall then be placed in the water bath and kept at a temperature of 25° C. (77° F.) for at least one and one half hours, when the briquet shall be removed from the plate and the side pieces A and A' detached.

The rings at each end of the clip shall then be attached to the pins or hooks in the ductility machine and the two clips pulled apart at a uniform rate of 5 cm per minute (± 5 percent). While the test is being made, the water in the tank of the ductility machine shall cover the briquet by at least 2.5 cm and shall be kept continuously at a temperature of 25° C. (77° F.) $\pm 0.5^\circ$ C. (1.0° F.). When the briquet of pitch breaks, the distance from the original position of the clip before pulling to its present position shall be measured and shall be taken as the ductility. The average of three tests shall be taken, excepting that any obviously abnormal result shall be rejected.

F-2d. Specific gravity at 25°/25° C. (77°/77° F.).—The specific gravity may be determined by any approved method, but some method similar to the following is recommended:

A small platinum pan or crucible supported in a wire sling shall be accurately weighed in air and the weight designated by (A). It

shall then be weighed in a similar manner suspended in freshly distilled water at 25° C. (77° F.) but immersed except for the fine platinum wire used for suspension and this weight designated by (B). The crucible shall then be dried and poured almost full of coal-tar pitch which has been melted at the lowest possible temperature. It shall then be allowed to cool to 25° C. (77° F.) and weighed in the sling in air. This weight shall be designated as (C). Then it shall be weighed in water and the weight shall be designated as (D). From these weights the specific gravity shall be computed according to the following formula:

$$\text{Sp. gr.} = \frac{C - A}{(C - A) - (D - B)}$$

F-2e. Insoluble in carbon bisulphide.—Approximately one g of coal-tar pitch, accurately weighed, shall be placed in a beaker of 100 to 150 ml capacity, covered with cold carbon bisulphide and set aside for about 15 minutes, the liquid being stirred every few minutes until the lumps break up and the bitumen goes into solution. The solid particles shall be allowed to settle, and the carbon bisulphide solution of the bitumen shall be decanted through a weighed Gooch crucible prepared with a mat of asbestos fiber of a thickness that will scarcely transmit light.

The sediment remaining in the beaker shall be crushed with a stirring rod and a little more carbon bisulphide added. The sides of the beaker also shall be washed down with carbon bisulphide. The contents of the beaker shall then be poured into the crucible and all sediment washed from the beaker into the crucible with carbon bisulphide. Suction may be used to aid in filtering. The sediment on the filter shall be washed with carbon bisulphide until the washings run through colorless. The crucible shall then be set in a place free from dust until the carbon bisulphide evaporates and then placed in an oven at 105 to 110° C. (221 to 231° F.) for one hour. It shall then be cooled and weighed, the increase giving the total insoluble matter.

F-2f. Ash.—Place approximately one gram of the pitch, accurately weighed, in a previously ignited and weighed crucible of about 30 ml capacity and incinerate until all of the carbon is consumed. Cool, weigh, and calculate the percentage ash.

F-2g. Distillation test.—The coal-tar pitch shall be distilled by the "Standard Method of Test for Distillation of Bituminous Materials Suitable for Road Treatment" D 20-30, A.S.T.M. Standards 1930, part II, p. 642. This method is essentially as follows:

F-2g (1). Apparatus.—

F-2g (1) a. Flask.—The distillation flask, fig. 3, shall be a side neck distilling flask, having the following dimensions:

Diameter of bulb, outside.....	86 mm± 1.5 mm
Diameter of neck, inside.....	22 mm± 1.0 mm
Diameter of tubulature, inside.....	10 mm± 0.5 mm
Height of flask, outside.....	131 mm± 1.5 mm
Vertical distance bottom of bulb, outside, to horizontal tangent at tubulature, inside.....	93 mm± 1.5 mm
Length of tubulature.....	220 mm± 5.0 mm
Angle of tubulature.....	73 dec.± 2 dec.
Thickness of tubulature wall.....	1.0 to 1.5 mm

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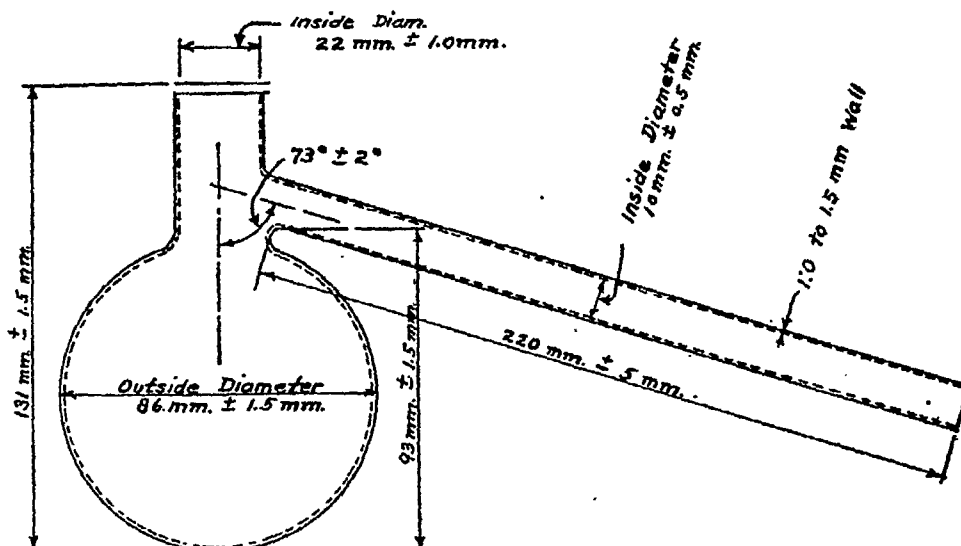


FIGURE 3.

F-2g (1) b. Condenser tube.—The condenser tube shall be a suitable form of tapered glass tubing of the following dimensions:

Outside diameter of small end, 12.5 mm permissible variation ± 1.5 mm.

Outside diameter of large end, 28.5 mm permissible variation ± 3.0 mm.

Length, 360.0 mm permissible variation ± 4.0 mm.

Length of tapered part, 100.0 mm permissible variation ± 5.0 mm.

F-2g (1) c. Shield.—A galvanized iron shield, lined with $\frac{1}{8}$ inch asbestos, of the form and dimensions shown in fig. 4 shall be used to protect the flask from air currents and to prevent radiation. The cover (top) may be of asbestos cement board made in two parts, or it may be of galvanized iron lined with $\frac{1}{8}$ inch asbestos.

F-2g (1) d. Receiver.—Any satisfactory receiver may be used for collecting the distillate. An Erlenmeyer flask having a capacity of 25 ml has been found convenient.

F-2g (1) e. Thermometer.—The thermometer shall conform to the following requirements. These specifications cover a total immersion thermometer graduated in either Centigrade or Fahrenheit degrees as specified, the range being from 0 to 400° C. or 30 to 760° F., respectively.

Type.—Etched stem, glass.

Liquid.—Mercury.

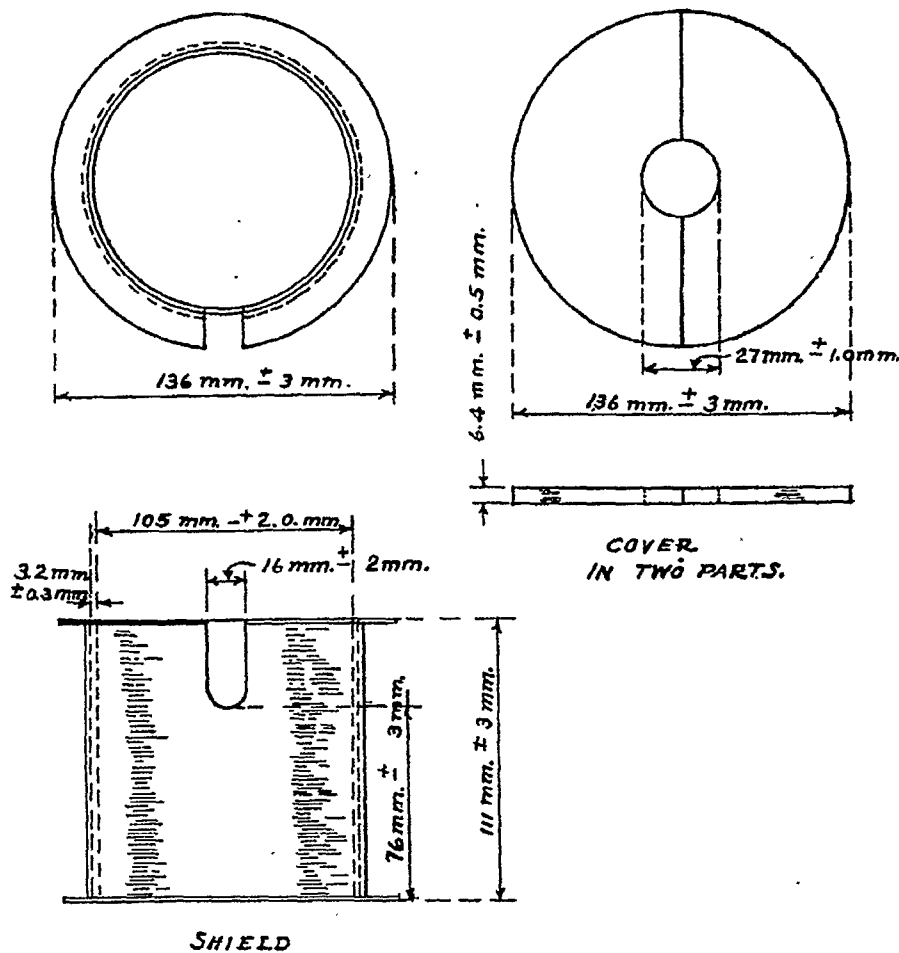
Range and subdivision.—0 to 400° C. in 1° C. or 30 to 760° F. in 2° F.

Total length.—378 to 384 mm (14.88 to 15.12 in.).

Stem.—Plain front, enamel back, suitable thermometer tubing. Diameter, 6.0 to 7.0 mm (0.24 to 0.28 in.).

FEDERAL STANDARD STOCK CATALOG
(Section IV, Part 5)

R-P-381-9
(June 1935)



FLANGED OPEN END CYLINDER,
MADE OF 22 GAGE GALVANIZED
IRON WITH $\frac{1}{8}$ IN. ASBESTOS LINING
RIVETED TO METAL

FIGURE 4.

Bulb.—Corning normal or equally suitable thermometric glass.
Length, 10 to 15 mm (0.39 to 0.59 in.). Diameter, 5.0 to 6.0 mm
(0.20 to 0.24 in.).

Distance to 0° C. or 32° F. line from bottom of bulb: 25 to 35 mm
(0.98 to 1.38 in.).

Distance to 400° C. or 752° F. line from top of thermometer:
30 to 45 mm (1.18 to 1.77 in.).

Filling above mercury.—Nitrogen gas.

Top finish.—Glass ring.

Graduation.—All lines, figures, and letters clear cut and distinct.

The first and each succeeding 5° C. or 10° F. line to be longer than the remaining lines. Graduations to be numbered at each multiple of 10° C. or 20° F.

Immersion.—Total.

Special marking.—"A.S.T.M. High Distillation", a serial number, and the manufacturer's name or trade mark shall be etched on the stem.

Scale error.—The error at any point of the scale up to 370° C. or 700° F. when the thermometer is standardized as provided below shall not exceed 1° C. or 2° F.

Standardization.—The thermometer shall be standardized immersed in the testing bath to the top of the mercury column, at the ice point and at temperature intervals of approximately 50° C. or 100° F. up to 370° C. or 700° F.

Test for permanency of range.—After being subjected to a temperature between 360 and 370° C. or 680 and 700° F. for 24 hours, the accuracy shall be within the limit specified.

Case.—The thermometer shall be supplied in a suitable case on which shall appear the marking: "A.S.T.M. High Distillation, 0 to 400° C.", or "A.S.T.M. High Distillation, 30 to 760° F.", according to the type of thermometer.

Note.—For the purpose of interpreting these specifications the following definitions apply:

The total length is the over-all length of the finished instrument.

The diameter is that measured with a ring gage.

The length of the bulb is the distance from the bottom of the bulb to the beginning of the enamel backing.

The top of the thermometer is the top of the finished instrument.

F-2g (1) f. *Burner and shield.*—A Bunsen burner and a suitable shield or chimney to protect the burner from draughts.

F-2g (2). *Procedure.*—

F-2g (2) a. *Assembly of apparatus.*—The flask shall be supported on a tripod or rings over two sheets of 20 mesh gauze, 150 mm

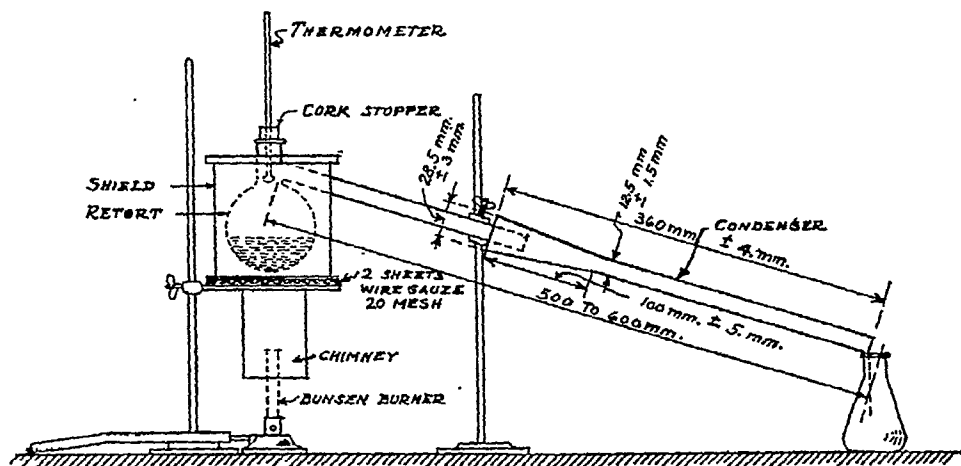


FIG-5-DISTILLATION APPARATUS ASSEMBLY.

FIGURE 5.

square, as shown in fig. 5. It shall be connected to the condenser tube by a tight cork joint. The thermometer shall be inserted through a cork in the neck with the top of the bulb level with the lowest point of juncture of the tubulature and neck of the flask.

The axis of the flask through the neck shall be vertical.

The distance from the bulb of the thermometer to the outlet end of the condenser tube shall be not more than 600 nor less than 500 mm.

F-2g (2) b. Distillation.—Place 100 grams ± 0.1 gram of the pitch in the flask and apply heat so that the first drop comes over in from 5 to 15 minutes. Conduct the distillation at the rate of between 50 and 70 drops per minute, collecting the distillate in the weighed receiver and stopping the distillation when the thermometer registers 300° C. (572° F.). During the distillation the condenser tube shall be warmed whenever necessary to prevent the accumulation of solid distillates. Weigh the distillate and calculate the percentage of distillate under 300° C. (572° F.).

F-2h. Specific gravity of distillate at 38°/15.5° C. (100°/60° F.)—Any approved method that gives results accurate to the third decimal place may be used for determining the specific gravity of the distillate, but the Westphal balance is recommended for small amounts. The specific gravity is not determined on distillates weighing less than five grams.

G. PACKAGING, PACKING, AND MARKING

G-1. Packaging.—Unless otherwise specified, commercial packages are acceptable under this specification.

G-2. Packing.—Unless otherwise specified the subject commodity shall be delivered in standard commercial containers, so constructed as to insure acceptance by common or other carriers, for safe transportation, at the lowest rate, to the point of delivery.

G-3. Marking.—Each package shall be legibly marked with a description of the contents, the name of the manufacturer, the place of manufacture, the brand (if any), the net weight of net liquid measure of the contents, and some means of identification of "the particular contract on which purchase and shipment were made". Each shipment of the material shall be accompanied by printed directions for its use.

H. REQUIREMENTS APPLICABLE TO INDIVIDUAL DEPARTMENTS

H-1. The following departmental specifications, of the issue in effect on date of invitation for bids, shall respectively form a part of this specification:

H-1a. Army.—United States Army Specification No. 100-2, Standard Specification for Marking Shipments.

H-1b. Navy Department purchases will be made under the issue in effect on date of invitation for bids of Bureau of Yards and Docks Specification No. 7Y, roofing, siding, and sheet metal work; damp-proofing and membrane waterproofing, copies of which may be obtained without cost upon application to the Bureau of Yards and Docks, Navy Department, Washington, D.C.

I. NOTES

I-1. Type I coal-tar pitch is intended for use with coal-tar saturated felt for roofing and waterproofing in the construction of built-up roofing over board sheathing with inclines not exceeding 3 inches to the foot and over concrete surfaces with inclines not exceeding 1 inch per foot.

I-2. Type II coal-tar pitch is intended for use with coal-tar saturated felt for roofing and waterproofing, as a plying cement in the construction of membrane waterproofing, or alone as a damp proofing coating.

This coal-tar pitch may be used for damp proofing and waterproofing tanks, retaining walls, dams, conduits, foundations of buildings, tunnels, subways, pools, reservoirs, etc., where not exposed except during installation to temperatures exceeding 38° C. (100° F.) and where not subject to vibration.

I-3. It is believed that this specification adequately describes the characteristics necessary to secure the desired material, and that normally no samples will be necessary prior to award to determine compliance with this specification. If, for any particular purpose, samples with bids are necessary, they should be specifically asked for in the invitation for bids, and the particular purpose to be served by the bid sample should be definitely stated, the specification to apply in all other respects.

I-4. This specification governs all United States Government purchases of this commodity. Users are requested to retain this specification in permanent file until a revision is issued.

I-5. Interested parties are advised that an Alphabetical Index of Federal Specifications may be obtained upon application as noted in paragraph next below, price to be obtained from the Superintendent of Documents.

I-6. Copies of this specification may be obtained upon application, accompanied by money order or coupon, or cash, to Superintendent of Documents, Government Printing Office, Washington, D.C. Price, 5 cents.

Notice.—When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use or sell any patented invention that may in any way be related thereto.

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AUGUST 1, 1933

SUPERSEDING

F.S. No. 424

July 9, 1926

FEDERAL STANDARD STOCK CATALOG

Section IV

(Part 5)

FEDERAL SPECIFICATION

FOR

**ROOF-COATING; ASPHALT, BRUSHING-
CONSISTENCY**

This specification was approved for promulgation by the Federal Specifications Board on August 1, 1933, for the use of the departments and independent establishments of the Government in the purchase of this commodity, and shall become mandatory for all departments and independent establishments of the Government not later than February 15, 1934. It may be put into effect, however, at any earlier date after promulgation.

A. APPLICABLE FEDERAL SPECIFICATIONS

A-1. There are no other Federal specifications applicable to this specification.

A-2. Any special requirements of the individual departments of the Government are noted under section H.

B. TYPE

B-1. Asphalt roof coating shall be of one type only.

C. MATERIAL

C-1. The coating shall consist of asphaltic materials, with or without fatty oils, thinned with a volatile solvent to a heavy brushing consistency, and mineral filler.

D. GENERAL REQUIREMENTS

D-1. Basis of purchase.—The material shall be purchased by weight or volume, as specified in the contract.

E. DETAIL REQUIREMENTS

E-1. Condition in container.—The material shall not liver in the container and after slight stirring shall be a smooth homogeneous mixture.

E-2. Consistency.—It shall be of a heavy brushing consistency to insure a film of appreciable thickness and yet not so stiff as to prevent easy application with a 3-knot roof brush at the rate of approximately 1 gallon per 50 square feet over asphalt roofing.

to aid filtration. Wash the residue in the crucible with cold carbon bisulphide until the washings are colorless, dry the crucible with its contents in air at room temperature until the odor of carbon bisulphide has almost disappeared, and then for 1 hour in an oven at 105° to 110° C. (221° to 230° F.), cool, and weigh. From the weight of the insoluble matter in the crucible and the weight of the sample taken compute the percentage of the matter insoluble in carbon bisulphide and consider it as mineral filler. Ignite a weighed portion of the insoluble matter to a red heat for one-half hour, cool, and weigh.

F-2d. Behavior at 60° C. 140° (F.).—Brush the coating at a rate of approximately 1 gallon to 50 square feet on smooth-surfaced asphalt prepared roofing (heavy weight), and clean steel. The steel plates should be about 0.4 mm (0.016 inch) thick. A convenient size for the test pieces is 10 by 15 cm (4 by 6 inches). Note whether the cement spreads easily at room temperature without drawing or pulling. Embed a thread in each coating extending across the coating at a distance of not more than 5 cm (2 inches) from the top of the test piece and measure its distance from the top. After exposing these test pieces for 60 minutes in a horizontal position in a well-ventilated room at a temperature not below 15° C. (59° F.), but not in the direct rays of the sun, suspend them vertically for 5 hours in an oven at 60° C. (140° F.). Remove the test pieces from the oven after 5 hours' heating and examine for blistering and absorption of the coating and for slipping by comparing the distance of the thread from the top of the test piece with its distance at the beginning of the test.

F-2e. Behavior at 0° C. (32° F.).—Cool the metal test pieces from F-2d to room temperature and immerse them in a water bath at 0° C (32° F.) for 1 hour. Immediately after their removal from the bath bend the panels in approximately 2 seconds' time, over a mandrel 1 inch in diameter, with the metal next to the mandrel, dry thoroughly, and examine.

G. PACKAGING, PACKING, AND MARKING

G-1. Packaging.—Unless otherwise specified, commercial packages are acceptable under this specification.

G-2. Packing.—Unless otherwise specified, the subject commodity shall be delivered in standard commercial containers, so constructed as to insure acceptance by common or other carriers for safe transportation at the lowest rate to the point of delivery.

G-3. Marking.—Each package shall be legibly marked with a description of the contents, the name of the manufacturer, the place of manufacture, the brand (if any), the net weight or net liquid measure of the contents, and some means of identification of "the particular contract on which purchase and shipment were made." Each shipment of the material shall be accompanied by printed directions for its use.

H. REQUIREMENTS APPLICABLE TO INDIVIDUAL DEPARTMENTS

H-1. The following departmental specifications, of the issue in effect on date of invitation for bids, shall respectively form a part of this specification.

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H-1a. Army: United States Army Specification No. 100-2, Standard Specification for Marking Shipments.

H-1b. Navy: Navy Department purchases will be made under the issue in effect on date of invitation for bids of Bureau of Yards and Docks Specification No. 7Y, Roofing, Siding, and Sheet Metal Work; Dampproofing and Membrane Waterproofing, copies of which may be obtained without cost upon application to the Bureau of Yards and Docks, Navy Department, Washington, D.C.

I. NOTES

I-1. Asphalt roof coating is intended for use in the repair and coating of asphalt and metal roofing and for application to concrete, masonry, and steel structures as a dampproofing and protective coating. In the application of this material on concrete and masonry it is advisable to apply a priming coat of asphalt primer.

I-2. While the exact nature of the mineral filler to be used in this coating is not specified, asbestos fiber is considered one of the most suitable mineral fillers.

I-3. It is believed that this specification adequately described the characteristics necessary to secure the desired material and that normally no samples will be necessary prior to award to determine compliance with this specification. If, for any particular purpose, samples with bids are necessary, they should be specifically asked for in the invitation for bids, and the particular purpose to be served by the bid sample should be definitely stated, the specification to apply in all other respects.

I-4. This specification governs United States Government purchases of this commodity. Users are requested to retain this specification in permanent file until a revision is issued.

I-5. Interested parties are advised that an alphabetical index of Federal specifications may be obtained upon application as noted in paragraph next below, price to be obtained from the Superintendent of Documents.

I-6. Copies of this specification may be obtained upon application, accompanied by money order or coupon, or cash, to Superintendent of Documents, Government Printing Office, Washington, D.C., Price 5 cents.

Notice.—When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility or any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

U. S. GOVERNMENT PRINTING OFFICE: 1937

For sale by the Superintendent of Documents, Washington, D.C. . . . Price 5 cents

OCTOBER 21, 1941

FEDERAL STANDARD STOCK CATALOG

SECTION IV

(PART 5)

EMERGENCY ALTERNATE FEDERAL SPECIFICATION

FOR

ROOFING; ASPHALT-PREPARED, SMOOTH-SURFACED

IN THE INTEREST OF THE CONSERVATION OF CERTAIN STRATEGIC MATERIALS AND WITH THE PURPOSE OF SPECIFYING A PRODUCT THAT WILL BETTER SERVE THE NEEDS OF THE GOVERNMENT, THIS SPECIFICATION WAS APPROVED ON THE ABOVE DATE BY THE DIRECTOR OF PROCUREMENT, FOR THE USE OF ALL DEPARTMENTS AND ESTABLISHMENTS OF THE GOVERNMENT, AND SHALL BECOME EFFECTIVE IMMEDIATELY AS AN EMERGENCY ALTERNATE SPECIFICATION IN THE PURCHASE OF THE COMMODITY COVERED BY IT, WHERE IT MAY BE CONSIDERED A SUITABLE ALTERNATE FOR MATERIAL COVERED BY FEDERAL SPECIFICATION SS-R-501, ROOFING, ASPHALT-PREPARED, SMOOTH-SURFACED.

THE REQUIREMENTS OF THIS EMERGENCY ALTERNATE SPECIFICATION ARE COVERED BY FEDERAL SPECIFICATION SS-R-501, ROOFING; ASPHALT-PREPARED, SMOOTH-SURFACED, DATED AUGUST 1, 1933, WITH THE FOLLOWING CHANGES:

GRADES

SMOOTH-SURFACED PREPARED ROOFING SHALL BE OF THE FOLLOWING GRADES. (THE GRADE OR GRADES DESIRED SHALL BE SPECIFIED IN THE INVITATION FOR BIDS.)

65-LB. GRADE

55-LB. GRADE (SEE NOTE 2)

MATERIAL

THIS ASPHALT-PREPARED ROOFING SHALL BE COMPOSED OF ROOFING FELT MADE OF ORGANIC FIBERS, SATURATED AND COATED ON BOTH SIDES WITH ASPHALTIC COMPOUNDS AND SURFACED WITH FINELY POWDERED TALC OR MICA, WHICH MUST PREVENT STICKING IN THE ROLLS.

GENERAL REQUIREMENTS

BASIS OF PURCHASE SHALL BE BY THE ROLL (TO COVER 100 OR 200 SQUARE FEET, ACCORDING TO AGREEMENT BETWEEN PURCHASER AND THE SELLER).

DETAIL REQUIREMENTS

1. APPEARANCE. - THE SURFACE IN BOTH GRADES OF ROOFING SHALL BE SMOOTH OR FINELY VEINED IN APPEARANCE. DEEPLY RIBBED ROOFING WILL NOT BE ACCEPTABLE. THE COATING SHALL BE UNIFORMLY APPLIED ON BOTH SIDES AND UP TO THE EDGE OF THE SHEET, AND NO UNCOATED SPOTS OR DEFECTS - SUCH AS BLISTERS OR LARGE LUMPS OF COATING - SHALL BE PERCEPTIBLE.

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ROOFING; ASPHALT-PREPARED, SMOOTH-SURFACED

Em. A1+ - 35.R-501

2. PHYSICAL AND CHEMICAL REQUIREMENTS.

DESIGNATION	65-POUND GRADE		55-POUND GRADE	
	MAX.	MIN.	MAX.	MIN.
1/ WIDTH, INCHES, $36 \pm 1/4$ OR $32 \pm 1/4$, AS SPECIFIED				
AREA OF ROLL, SQUARE FEET		(108 216)		(108 216)
AVERAGE GROSS WEIGHT PER 108 SQUARE FEET, POUNDS		65		55
WEIGHT PER ROLL OF WRAPPING, PACKING, NAILS, AND CEMENT, POUNDS	3	60	3	50
WEIGHT PER 108 SQUARE FEET OF ROOFING, POUNDS				
PLIABILITY AT 250° C (770° F) (CRACKING ON BENDING 90° OVER A ROUNDED EDGE OF 3/4-INCH RADIUS)		NONE		NONE
HEAT TEST AT 800° C (1760° F) (SLIDING, BLISTERING, OR ABSORPTION OF THE SURFACE COATING)		NONE		NONE
WEIGHT OF MOISTURE-FREE DESATURATED FELT PER 108 SQUARE FEET, POUNDS		13.5		10.8
ASH OF MOISTURE-FREE DESATURATED FELT, PERCENT BY WEIGHT	10		10	
THICKNESS OF DESATURATED FELT, INCH		0.060		0.048
SATURATION OF FELT, PERCENT		160		160
WEIGHT OF MINERAL-FILLED COATING PER 108 SQUARE FEET, POUNDS		18		18
MINERAL FILLER PASSING NO. 100-SIEVE IN COATING, PERCENT BY WEIGHT (WILL INCLUDE MINERAL SURFACING MATERIAL)	40	45	40	15
NAILS (ZINC-COATED) (SEE NOTE 3):				
GAGE OF WIRE	12	10 1/2	12	10 1/2
DIAMETER OF HEADS, INCH		3/8		3/8
THICKNESS OF HEADS, INCH		0.025		0.025
LENGTH OF SHANK, INCH	1	3/4	1	3/4
NUMBER PER 108 SQUARE FEET OF 36-INCH ROOFING		250		250
NUMBER PER 108 SQUARE FEET OF 32-INCH ROOFING		275		275

1/ REQUIREMENTS FOR WIDTH AND AREA OF ROLL; WEIGHT PER ROLL OF WRAPPING, PACKING, NAILS, AND CEMENT; PLIABILITY; HEAT TEST; WEIGHT AND THICKNESS OF DESATURATED FELT FOR THE 65- AND 55-POUND GRADES ARE IDENTICAL WITH THOSE FOR GRADES A AND B, RESPECTIVELY, UNDER FEDERAL SPECIFICATION SS-R-501.

2/ THE SHEET OF FELT SHALL BE THOROUGHLY AND UNIFORMLY SATURATED.

3. LAP CEMENT. (SEE NOTE 3).

THE LAP CEMENT SHALL BE OF SUCH NATURE AS TO BIND THE LAPS FIRMLY WITHOUT INJURIOUS EFFECT UPON THE ROOFING. IT SHALL CONSIST OF A SUITABLE BITUMINOUS MATERIAL DISSOLVED IN A VOLATILE SOLVENT. NOT LESS THAN THREE FOURTHS OF A PINT PER 108 SQUARE FEET SHALL BE FURNISHED FOR 36-INCH ROOFING AND NOT LESS THAN ONE PINT PER 108 SQUARE FEET FOR 32-INCH ROOFING. NOTES TO PURCHASING OFFICERS AND SPECIFYING ENGINEERS:

NOTE 1. THE PURPOSE OF THIS EMERGENCY ALTERNATE SPECIFICATION IS TO PROVIDE A ROOFING THAT IS BETTER BALANCED AS REGARDS THE WEIGHT OF FELT AND COATING. THIS IS ACCOMPLISHED BY INCREASING THE WEIGHT FOR BOTH GRADES OF FINISHED ROOFING AND LEAVING THE FELT WEIGHTS UNCHANGED. THE USE OF MINERAL FILLER IN THE ASPHALT COATINGS IS OPTIONAL UNDER FEDERAL SPECIFICATION SS-R-501. MINERAL-FILLED COATINGS ARE MANDATORY IN THE PRESENT SPECIFICATION.

NOTE 2. THE 55-POUND GRADE OF ROOFING UNDER THIS SPECIFICATION IS SIMILAR TO THAT COVERED BY GRADE A IN FEDERAL SPECIFICATION NO. SS-R-501 EXCEPT THAT THE WEIGHT OF FELT REQUIRED PER 108 SQUARE FEET IS 2.7 POUNDS LESS.

NOTE 3. NAILS AND LAP CEMENT MAY BE FURNISHED IN BULK AS AGREED BETWEEN BUYER AND SELLER.

NOTE. TO SAVE TIME, IT IS SUGGESTED THAT THE VARIOUS DEPARTMENTS DUPLICATE WITHOUT CHANGE THE NECESSARY COPIES OF THIS SPECIFICATION IN THEIR OWN OFFICES.

(40459)

FEDERAL STANDARD STOCK CATALOG**Section IV****(Part 5)****FEDERAL SPECIFICATION****FOR****ROOFING; ASPHALT-PREPARED, SMOOTH-SURFACED**

This specification was approved for promulgation by the Federal Specifications Board on August 1, 1933, for the use of the departments and independent establishments of the Government in the purchase of this commodity, and shall become mandatory for all departments and independent establishments of the Government not later than February 1, 1934. It may be put into effect, however, at any earlier date after promulgation.

A. APPLICABLE FEDERAL SPECIFICATIONS

A-1. There are no other Federal specifications applicable to this specification.

A-2. Special requirements of individual departments of the Government are noted under section H.

B. GRADES

B-1. Smooth-surfaced prepared roofing shall be of the following grades. (The grade or grades desired shall be specified in the invitation for bids.)

Grade A.—Heavy weight.

Grade B.—Medium weight.

C. MATERIAL

C-1. This asphalt-prepared roofing shall be composed of roofing felt made of organic fibers, saturated and coated on both sides with asphaltic compounds and surfaced with finely powdered talc or mica, which must prevent sticking in the rolls.

D. GENERAL REQUIREMENTS

D-1. Basis of purchase shall be by the roll (to cover 100 or 200 square feet, according to agreement between purchaser and the seller).

E. DETAIL REQUIREMENTS

E-1. Appearance.—The surface in both grades of roofing shall be smooth or finely veined in appearance. Deeply ribbed roofing will

not be acceptable. The coating shall be uniformly applied on both sides and up to the edge of the sheet, and no uncoated spots or defects—such as blisters or large lumps of coating—shall be perceptible.

E-2. Physical and chemical requirements.—

Width, inches, $36\pm\frac{1}{4}$ or $32\pm\frac{1}{4}$, as specified	Grade A		Grade B	
	Max.	Min.	Max.	Min.
Area of roll.....square feet.....		{ 108 216 }		{ 108 216 }
Average gross weight per 108 square feet.....pounds.....		55		45
Weight per roll of wrapping, packing, nails, and cement.....pounds.....	3		3	
Weight per 108 square feet of roofing.....pounds.....		50		40
Pliability at 25° C. (77° F.) (cracking on bending 90° over a rounded edge of $\frac{3}{4}$ -inch radius).....		None		None
Heat test at 80° C. (176° F.) (sliding, blistering, or absorption of the surface coating).....		None		None
Weight of moisture-free desaturated felt per 108 square feet.....pounds.....		13.5		10.8
Thickness of desaturated felt.....inch.....		0.060		0.048
Weight of total ash of roofing per 108 square feet.....pounds.....	9		9	
Saturation of felt.....percent.....		¹ 160		¹ 150
Nails (zinc-coated):				
Gage of wire.....	12	10½	12	10½
Diameter of heads.....inch.....		$\frac{3}{8}$		$\frac{3}{8}$
Thickness of heads.....do.....		0.025		0.025
Length of shank.....do.....	1	$\frac{3}{4}$	1	$\frac{3}{4}$
Number per 108 square feet of 36-inch roofing.....		250		250
Number per 108 square feet of 32-inch roofing.....		275		275

¹ The sheet of felt shall be thoroughly and uniformly saturated.

E-3. Lap cement.—The lap cement shall be of such nature as firmly to bind the laps without injurious effect upon the roofing. It shall consist of a suitable bituminous material dissolved in a volatile solvent. Not less than three fourths of a pint per 108 square feet shall be furnished for 36-inch roofing and not less than one pint per 108 square feet for 32-inch roofing.

F. METHODS OF INSPECTION, DETERMINATION OF WEIGHT AND WIDTH, SAMPLING, AND TESTING

Deliveries will, in general, be sampled and tested by the following methods, but the purchaser reserves the right to use any additional information to ascertain whether the material meets the specification.

F-1. Sampling for inspection.—From each shipment take at random rolls of roofing equivalent to the cube root of the total number included in the lot. If the cube root is a fractional number, express it as the next higher digit.

F-2. Determination of weight and width.—The weight per 108 square feet of material, and its variation in weight: The width and its variation must be determined by the inspector and the results transmitted to the testing laboratory with the sample. Material

which does not conform to the specification in these respects should be rejected by the inspector and only deliveries which conform in these respects sampled for laboratory tests.

F-2a. Remove the wrappers, other packing material, nails, and cement from each roll selected and weigh the roll and the packing material, etc., separately to the nearest one-fourth pound. Then unwind each roll and measure the length and width of the rectangular portion of the roll to the nearest one fourth inch, and reroll. Observe the appearance of the roofing while unrolling and rerolling. Satisfactory roofing will not stick and will be free from visible external defects, such as holes, ragged or untrue edges, breaks, rents, cracks, indentations, or lumps of coating. Unless the coating covers both sides and extends to the edge of the sheet, the material should be rejected.

Compute the area and weight per 108 square feet of each roll selected, and from these weights compute the average weight of the shipment. Should the weight of any 108 square feet be less than the minimum weight specified (40 pounds for medium and 50 pounds for heavy) it shall be cause for the rejection of the whole shipment. Compute also the average weight of the packing materials, nails, and cement.

F-3. Sampling for laboratory examination.—From the rolls examined for sampling, select one, the weight of which is near the average weight of the lot. Unroll, and at approximately 10 feet from the end cut two samples the full width of the roll and approximately 40 inches long, label, roll carefully, but do not crease, wrap, and transmit one to the testing laboratory. Retain the other for use in case of dispute.

F-4. Laboratory examination.—

F-4a. Weight.—Trim the sample so that it is 36 inches long and the full width of the roll. Measure accurately and weigh to the nearest gram (15 grains). From the measurements and weight so obtained compute the weight per 108 square feet. The weight so determined is only to be used in making the laboratory calculations and shall not be used as a basis for acceptance or rejection. (See F-2.)

F-4b. Appearance.—Examine both sides of the sample and note the appearance. The coating should extend to the edge of the sheet, which should not be ragged. No uncoated spots or defects, such as blisters or large lumps of coating, should be perceptible.

F-4c. Pliability.—Cut five strips 1 inch wide and 6 inches long in the direction of the fiber grain and immerse them in water at 25° C. (77° F.) for 10 to 15 minutes. Remove the strips from the water and immediately bend each strip, with the exposure side up, 90° over the edge of a block (which has been rounded to a radius of ¼ inch) at a uniform speed, in approximately 2 seconds' time. Dry thoroughly and examine. If one or more of these five strips crack on this test, cut 10 strips from another part of the sample and repeat the test. If one or more of these strips crack, the material is reported as failing on the pliability test.

F-4d. Behavior on heating at 80° C. (176° F.) for five hours.—Cut a strip of the roofing approximately 8 by 8 inches and suspend it vertically for five hours in an oven maintained at 80° C. (176° F.)

plus or minus 3° C. (5° F.). Remove at the end of this period, and note any flowing, sagging, blistering, or absorption of the surface coating.

F-4e. Weight of moisture-free, desaturated felt.—Cut two strips approximately 2 inches wide and 8 inches long from the roofing, weigh accurately, and extract with benzol (carbon tetrachloride, chloroform or carbon bisulphide will usually give the same results, but benzol should be used in case of dispute) in a suitable extraction apparatus until the benzol runs through colorless and contains no soluble material. The roofing may be cut into squares approximately 1 inch on each side in case an extraction apparatus of sufficient size to accommodate the whole strips is not available. Remove the desaturated felt from the extractor, dry in air until free from the odor of benzol, and brush off any adhering mineral matter. Place the desaturated felt in a tared weighing bottle, dry in an oven at 105° to 110° C. (221° to 230° F.) for one half hour, cool in a desiccator, and weigh. Calculate the percentage of moisture-free desaturated felt in the sample taken for extraction and compute the weight of moisture-free desaturated felt per 108 square feet from the weight obtained in F-4a.

F-4f. Thickness of desaturated felt.—Cut one of the strips of felt obtained in F-4e into four equal portions and caliper each piece at four equally spaced points at least three quarters of an inch from a cut edge with a micrometer having flat bearing surfaces, or if the strips were cut into pieces in F-4e take at random 16 pieces of the felt and caliper each piece at its center. Average the readings.

F-4g. Total ash of roofing.—Cut two strips of the roofing approximately 2 inches wide and 8 inches long into squares about 1 cm on each side and mix thoroughly. Take at random enough pieces to weigh about 10 grams, dry in an oven at 105° to 110° C. (221° to 230° F.) for one half hour, cool in a desiccator, weigh accurately, and incinerate in a weighed crucible in a muffle furnace or over an open flame until all of the carbon is consumed. Cool, weigh, and calculate the percentage ash of the roofing and compute the weight per 108 square feet from the weight obtained in F-4a.

F-4h. Saturation of felt.—Cut two strips of the original roofing approximately 2 inches wide and 8 inches long and warm them in an oven at about 80° C. (176° F.). Strip off the surfacing and coatings, taking care that as little as possible of the saturated felt is removed with the coatings and that none of the coatings adhere to the felt. Weigh the saturated felt obtained and extract in a suitable extractor with benzol (see F-4e) until the benzol runs through colorless and contains no soluble material.

Remove the desaturated felt from the extractor and dry in air until free from the odor of benzol. Place in a tared weighing bottle, dry at 105° to 110° C. (221° to 230° F.) for one half hour, and weigh. From the weight obtained and the original weight compute the percentage saturation of the moisture-free felt as follows:

$$\frac{\text{Weight of saturated felt} - \text{weight of desaturated felt}}{\text{Weight of desaturated felt}} \times 100$$

=percentage saturation of moisture-free felt

Cut three 2-inch strips of the roofing at random across the entire sheet and split them open for their full length. The felt so exposed shall be uniformly saturated, showing no gray or unsaturated spots.

G. PACKAGING, PACKING, AND MARKING

G-1. Packaging.—Unless otherwise specified, commercial packages are acceptable under this specification.

G-2. Packing.—The asphalt-prepared roofing shall be put up in rolls of 108 or 216 square feet as specified in the order. No roll shall contain more than two pieces of roofing nor shall there be more than 3 percent of such rolls in a shipment. The rolls shall be tightly wound and their ends shall be protected with metal caps, scrap roofing cloth, or other suitable means. The wrapper shall be of a substantial grade of paper of the same width of the fabric and shall completely encircle the roll.

G-3. Marking.—Each package shall be legibly marked with a description of the contents, the name of the manufacturer, the place of the manufacture, the brand (if any), the net weight of the contents, and some means of identification of "the particular contract on which purchase and shipment were made." Each roll shall contain printed directions for laying. Nails and lap cement shall be furnished either in each roll or in bulk, as specified in the contract.

H. REQUIREMENTS APPLICABLE TO INDIVIDUAL DEPARTMENTS

H-1. The following departmental specifications, of the issue in effect on date of invitation for bids, shall respectively form a part of this specification.

H-1a. ARMY: United States Army Specification No. 100-2, Standard Specification for Marking Shipments.

H-1b. NAVY DEPARTMENT purchases will be made under the issue in effect on date of invitation for bids of Bureau of Yards and Docks Specification No. 7Y, Roofing, Siding, and Sheet-metal Work; dampproofing and membrane waterproofing; copies of which may be obtained without cost upon application to the Bureau of Yards and Docks, Navy Department, Washington, D.C.

I. NOTES

I-1. It is believed that this specification adequately describes the characteristics necessary to secure the desired material, and that normally no samples will be necessary prior to award to determine compliance with this specification. If, for any particular purpose, samples with bids are necessary, they should be specifically asked for in the invitation for bids, and the particular purpose to be served by the bid sample should be definitely stated, the specification to apply in all other respects.

I-2. This material is intended primarily for use on temporary buildings.

I-3. This specification governs all United States Government purchases of this commodity. Users are requested to retain this specification in permanent file until a revision is issued.

I-4. Interested parties are advised that an alphabetical Index of Federal Specifications may be obtained upon application as noted

FEDERAL STANDARD STOCK CATALOG

(Section IV, Part 5)

in paragraph next below, price to be obtained from the Superintendent of Documents.

I-5. Copies of this Specification may be obtained upon application, accompanied by money order, coupon, or cash, to Superintendent of Documents, Government Printing Office, Washington, D.C. Price 5 cents.

Notice.—When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility or any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use or sell any patented invention that may in any way be related thereto.

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AUGUST 1, 1933

SUPERSEDING

F.S. No. 423

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FEDERAL STANDARD STOCK CATALOG

Section IV

(Part 5)

FEDERAL SPECIFICATION

FOR

**ROOFING; ASPHALT AND ASBESTOS-PREPARED,
MINERAL-SURFACED**

This specification was approved for promulgation by the Federal Specifications Board on August 1, 1933, for the use of the departments and independent establishments of the Government in the purchase of this commodity, and shall become mandatory for all departments and independent establishments of the Government not later than February 15, 1934. It may be put into effect, however, at any earlier date after promulgation.

A. APPLICABLE FEDERAL SPECIFICATIONS

A-1. There are no other Federal specifications applicable to this specification.

A-2. Any special requirements of the individual departments of the Government are noted under section H.

B. TYPE

B-1. Mineral-surfaced, asphalt, and asbestos-prepared roofing shall be of one type only.

C. MATERIAL

C-1. This prepared roofing shall be composed of asbestos roofing felt, containing at least 85 percent of asbestos fiber, saturated and coated with asphaltic compounds. One side shall be surfaced with mineral granules. The other side may be dusted with talc or mica to prevent sticking in the rolls.

D. GENERAL REQUIREMENTS

D-1. *Basis of purchase.*—

D-1a. Basis of purchase shall be by the roll or by the square (to cover 100 or 200 square feet) according to agreement between purchaser and the seller.

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E. DETAIL REQUIREMENTS

E-1. Color and appearance.—The mineral granules shall be uniformly distributed over the entire surface (except as noted below) and when so specified the color shall substantially match a sample mutually agreed upon by buyer and seller. The coating and mineral surfacing must extend to the edge of the sheet on one side and may have an unsurfaced lapping edge approximately 2 inches wide on the other side. The edges of the sheet shall not be ragged.

E-2. Physical and chemical requirements.—

Width, inches, $36 \pm \frac{1}{4}$ or $32 \pm \frac{1}{4}$, as called for

	Maxi- mum	Mini- mum
Area of roll.....square feet.....		108
Weight per roll of wrapping, packing, nails, and cement.....pounds.....	5	
Weight per 108 square feet of roofing.....pounds.....		80
Heat test at 80° C. (176° F.) (sliding, blistering, absorption of the surface coating, or loss of mineral granules).....		None
Volatile matter at 80° C. (176° F.).....percent.....	$1\frac{1}{2}$	
Weight of moisture-free desaturated felt per 108 square feet.....pounds.....		18
Thickness of desaturated felt.....inch.....		0.045
Ash of desaturated felt.....percent.....		70
Composition of felt: Asbestos fiber, percent (remainder may be hair, cotton rags or lint, starch or other suitable binding materials).....		85
Saturation of felt.....percent.....		60
Weight of material other than mineral surfacing, and mineral matter in the coating per 108 square feet.....pounds.....		45
Nails (zinc-coated):		
Gage of wire.....	12	10
Diameter of heads.....inch.....		$\frac{3}{16}$
Thickness of heads.....inch.....		0.025
Length of shank.....inch.....	1	$\frac{3}{4}$
Number per 108 square feet of 36-inch roofing.....		250
Number per 108 square feet of 32-inch roofing.....		275

E-3. Lap cement.—The lap cement shall be of such nature as to firmly bind the laps without injurious effect upon the roofing. It shall consist of a suitable bituminous material dissolved in a volatile solvent. Not less than three fourths of a pint per 108 square feet shall be furnished for 36-inch roofing and not less than one pint per 108 square feet for 32-inch roofing.

F. METHODS OF INSPECTION, DETERMINATION OF WEIGHT AND WIDTH, SAMPLING, AND TESTING

Deliveries will, in general, be sampled and tested by the following methods, but the purchaser reserves the right to use any additional information to ascertain whether the material meets the specification.

F-1. Sampling for inspection.—From each shipment select at random rolls of roofing equivalent to the cube root of the total number included in the lot. If the cube root is a fractional number, express it as the next higher digit.

F-2. Determination of weight and width.—The weight per 108 square feet of material and its variation in weight: The width and its variation must be determined by the inspector and the results

transmitted to the testing laboratory with the sample. Material which does not conform to the specification in these respects should be rejected by the inspector and only deliveries which conform in these respects sampled for laboratory tests.

F-2a. Remove the wrappers, other packing material, nails and cement from each roll selected and weigh the roll and the packing material, etc., separately to the nearest one fourth pound. Then unwind each roll and measure the length and width of the rectangular portion of the roll to the nearest $\frac{1}{4}$ inch and reroll. Observe the appearance of the roofing while unrolling and rerolling. Satisfactory roofing will not stick and will be free from visible external defects, such as holes, ragged or untrue edges, breaks, rents, cracks, indentations, or lumps of coating. The mineral granules should be uniformly distributed over the entire surface (except as noted below), and when so specified the color should substantially match the mutually agreed-upon sample. The coating and surfacing may extend to the edge of the sheet of roofing, but an unsurfaced lapping edge approximately 2 inches wide along one side is permissible. The edges of the sheet should not be ragged. Compute the area and weight per 108 square feet of each roll taken. Should the weight of any roll per 108 square feet be less than the minimum weight specified, 80 pounds, it shall be cause for the rejection of the whole shipment. Compute also the average weight of the packing materials, nails, and cement.

F-3. Sampling for laboratory examination.—From the rolls examined for sampling, select one, the weight of which is near the average weight of the lot. Unroll and, at approximately 10 feet from the end, cut two samples the full width of the roll and approximately 40 inches long, label, roll carefully but do not crease, wrap, and transmit one to the testing laboratory. Retain the other for use in case of dispute.

F-4. Laboratory examination.—

F-4a. Color and appearance.—Examine both sides of the roofing and note the color and general appearance and compare them with the mutually agreed upon sample.

F-4b. Weight.—Trim the sample so that it is 36 inches long and the full width of the roll (except that material having an unsurfaced lapping edge shall have that edge trimmed off). Measure accurately and weigh to the nearest gram (15 grains). From the measurements and weights so obtained compute the weight per 108 square feet. The weight so determined is only to be used in making the laboratory calculations and shall not be used as a basis for acceptance or rejection.

F-4c. Behavior on heating at 80° C. (176° F.) for 2 hours.—Cut two strips from the roofing approximately 8 by 8 inches, weigh, and suspend vertically for 2 hours in an oven at 80° C. (176° F.) plus or minus 3° C. (5° F.). Remove at the end of this period and note any flowing, sagging, blistering, or absorption of the surface coating. Cool, weigh, and compute the loss in weight.

F-4d. Weight of moisture-free, desaturated felt.—Cut two strips approximately 2 inches wide and 8 inches long from the roofing,

weigh accurately, and extract with benzol¹ in a suitable extraction apparatus until the benzol runs through colorless and contains no soluble material. The roofing may be cut into squares approximately one inch on each side in case an extraction apparatus of sufficient size to accommodate the whole strip is not available. Retain the extract for any mineral matter it may contain. Remove the desaturated felt from the extractor, dry in air until free from the odor of benzol and brush off any adhering mineral matter, retaining it with the mineral matter in the extractor. Place the desaturated felt in a tared weighing bottle, dry in an oven at 105° to 110° C. (221° to 230° F.) for one half hour, cool in a desiccator, and weigh. Calculate the percentage of moisture-free, desaturated felt in the sample taken for extraction and compute the weight of moisture-free desaturated felt per 108 square feet from the weight obtained in F-4b.

F-4e. Thickness of desaturated felt.—Cut one of the strips of felt obtained in F-4d into four equal portions and caliper each piece at four equally spaced points at least three fourths of an inch from a cut edge with a micrometer having flat bearing surfaces or, if the strips were cut into pieces in F-4d, take at random 16 pieces of the felt and caliper each piece at its center. Average the readings.

F-4f. Ash of moisture-free desaturated felt.—Cut the desaturated felt obtained in F-4d into squares about 1 cm on each side and mix thoroughly. Take at random enough pieces to weigh about 10 grams, dry in an oven at 105° to 110° C. (221° to 230° F.) for one half hour, cool in a desiccator, weigh accurately, and incinerate in a weighed crucible in a muffle furnace or over an open flame until all of the carbon is consumed. Cool, weigh, and compute the percentage ash of the moisture-free desaturated felt.

F-4g. Material other than mineral surfacing and mineral matter in the coating per 108 square feet.—Combine the mineral matter from the extractor and from the surface of the desaturated felt with that obtained by the filtration or evaporation and ignition of the benzol extract from F-4d, dry in air until free from the odor of benzol, heat for one half hour in an oven at 105° to 110° C. (221° to 230° F.), cool, and weigh. Calculate the percentage of mineral matter other than in the felt in the sample taken for extraction and compute this total mineral matter per 108 square feet from the weight obtained in F-4b. This weight, plus the weight of moisture-free desaturated felt subtracted from the weight obtained in F-4b, is the weight of material other than mineral matter in 108 square feet of roofing.

F-4h. Saturation of felt.—Cut two strips of the original roofing approximately 2 inches wide and 8 inches long and warm them in an oven at about 80° C. (176° F.). Strip off the surfacing and coatings, taking care that as little as possible of the saturated felt is removed with the coatings and that none of the coatings adhere to the felt. Weigh the saturated felt obtained and extract in a suitable extractor with benzol¹ until the benzol runs through colorless and contains no soluble material.

¹ Carbon tetrachloride, chloroform, or carbon bisulphide will usually give the same results, but benzol should be used in case of dispute.

Remove the desaturated felt from the extractor and dry in air until free from the odor of benzol. Place in a tared weighing bottle, dry at 105° to 110° C. (221° to 230° F.) for one half hour, and weigh. From the weight obtained and the original weight compute the percentage saturation of the moisture-free felt as follows:

$$\frac{\text{Weight of saturated felt} - \text{Weight of desaturated felt}}{\text{Weight of desaturated felt}} \times 100 \\ = \text{Percentage saturation of moisture-free felt}$$

G. PACKAGING, PACKING, AND MARKING

G-1. Packaging.—Unless otherwise specified, commercial packages are acceptable under this specification.

G-2. Packing.—The prepared roofing shall be put up in rolls of 108 square feet. No rolls shall contain more than two pieces of roofing nor shall there be more than 3 percent of such rolls in a shipment. The rolls shall be tightly wound and their ends shall be protected with metal caps, scrap roofing cloth, or other suitable means. The wrapper shall be of a substantial grade of paper of the same width of the fabric and shall completely encircle the roll.

G-3. Marking.—Each package shall be legibly marked with a description of the contents, the name of the manufacturer, the place of manufacture, the brand (if any), the net weight of the contents, and some means of identification of "the particular contract on which purchase and shipment were made." Each roll shall contain printed directions for laying. Nails and lap cement shall be furnished either in each roll or in bulk, as specified in the contract. Roofing for export shipment shall be packed as mutually agreed upon by purchaser and seller.

H. REQUIREMENTS APPLICABLE TO INDIVIDUAL DEPARTMENTS

H-1. The following departmental specifications, of the issue in effect on date of invitation for bids, shall respectively form a part of this specification.

H-1a. ARMY: United States Army Specification No. 100-2, standard specification for marking shipments.

H-1b. NAVY DEPARTMENT PURCHASES will be made under the issue in effect on date of invitation for bids of Bureau of Yards and Docks Specification No. 7Y, Roofing, Siding, and Sheet-Metal Work; Damp-proofing and Membrane Waterproofing, copies of which may be obtained without cost upon application to the Bureau of Yards and Docks, Navy Department, Washington, D.C.

I. NOTES

I-1. It is believed that this specification adequately describes the characteristics necessary to secure the desired material, and that normally no samples will be necessary prior to award to determine compliance with this specification. If, for any particular purpose, samples with bids are necessary, they should be specifically asked for in the invitation for bids, and the particular purpose to be served by the bid sample should be definitely stated, the specification to apply in all other respects.

FEDERAL STANDARD STOCK CATALOG
(Section IV, Part 5)

I-2. This specification governs all United States Government purchases of this commodity. Users are requested to retain this specification in permanent file until a revision is issued.

I-3. An alphabetical index of Federal Specifications may be obtained upon application as noted in paragraph next below, price to be obtained from the Superintendent of Documents.

I-4. Copies of this Specification may be obtained upon application, accompanied by money order, coupon, or cash, to Superintendent of Documents, Government Printing Office, Washington, D.C. Price 5 cents.

Notice.—When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation or conveying any rights or permission to manufacturer, use, or sell any patented invention that may in any way be related thereto.

U. S. GOVERNMENT PRINTING OFFICE: 1933

For sale by the Superintendent of Documents, Washington, D.C. - - - Price 5 cents

FEDERAL STANDARD STOCK CATALOG**Section IV****(Part 5)****FEDERAL SPECIFICATION****FOR****ROOFING AND SHINGLES; ASPHALT-PREPARED,
MINERAL-SURFACED**

This specification was approved for promulgation by the Federal Specifications Board on August 1, 1933, for the use of the departments and independent establishments of the Government in the purchase of this commodity, and shall become mandatory for all departments and independent establishments of the Government not later than February 1, 1934. It may be put into effect, however, at any earlier date, after promulgation.

A. APPLICABLE FEDERAL SPECIFICATIONS

A-1. There are no other Federal specifications applicable to this specification.

A-2. Any special requirements of the individual departments of the Government are noted under section H.

B. TYPES

B-1. Mineral-surfaced prepared roofing shall be of the following types. (The type or types desired shall be specified in the invitation for bids.)

Type I. Mineral-surfaced asphalt prepared, ready or roll roofing.

Type II. Mineral-surfaced asphalt shingles.

C. MATERIAL

C-1. Mineral-surfaced asphalt prepared roofing and shingles shall be composed of roofing felt made of organic fibers saturated and coated on both sides with asphalt and surfaced on the side to be exposed to the weather with mineral granules. The other side may be dusted with talc or mica to prevent sticking in the package.

D. GENERAL REQUIREMENTS

D-1. *Basis of purchase.*

D-1a. Basis of purchase shall be by the roll or by the square (to cover 100 square feet) according to agreement between purchaser and seller.

D-2. Color and appearance.—The mineral granules shall be distributed uniformly over the entire surface (except as noted below) and when so specified the color shall substantially match a sample mutually agreed upon by buyer and seller. The coating and surfacing must extend to the edge of the sheet of roofing or of the shingles, except that roll roofing may have an unsurfaced lapping edge approximately 2 inches wide along one side of the sheet. The edges of the sheet of roofing or of the shingle shall not be ragged. Satisfactory roofing will not stick and will be free from visible external defects, such as holes, ragged or untrue edges, rents, cracks, indentations, or lumps of coating.

D-3. Trimmings.—If desired, trimmings shall be as specified in order -----.

D-4.—Physical and chemical requirements applicable to both types of roofing.

	Maximum	Minimum
Heat test at 80° C. (176° F.) (sliding, blistering, absorption of the surface coating or loss of mineral granules) -----		None
Volatile matter at 80° C. (176° F.) (percent) -----	1½	-----
Weight of moisture-free desaturated felt per 108 square feet (pounds) -----		10.8
Thickness of desaturated felt (inch) -----		0.05
Total weight of organic fibers and bitumen per 108 square feet (pounds) -----		45

E. DETAIL REQUIREMENTS

E-1. Requirements applicable to type I roofing.—Width (inches), 36 ($\pm \frac{1}{4}$ inch), or 32 ($\pm \frac{1}{4}$ inch), as called for.

	Maximum	Minimum
Area of roll ----- square feet -----		108
Weight per roll of wrapping, packing, nails, and cement ----- pounds -----	5	-----
Weight per 108 square feet of roofing ----- do -----		80
Pliability at 25° C. (77° F.). (cracking on bending 90 degrees over a rounded edge of $\frac{3}{4}$ -inch radius) -----	None	-----
Saturation of felt ----- percent -----		160
Nails (zinc coated):		
Gauge of wire -----	12	10
Diameter of heads ----- inch -----		$\frac{3}{16}$
Thickness of heads ----- do -----		0.025
Length of shank ----- do -----		$\frac{3}{4}$
Number per 108 square feet of 36-inch roofing -----		250
Number per 108 square feet of 32-inch roofing -----		275

Lap cement.—The lap cement shall be of such nature as to firmly bind the laps without injurious effect upon the roofing. It shall consist of a suitable bituminous material dissolved in a volatile

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solvent. Not less than three fourths of a pint per 108 square feet shall be furnished for 36-inch roofing and not less than 1 pint per 108 square feet for 32-inch roofing.

E-2. Requirements applicable to type II roofing.—The size and form of the shingles shall be as specified in the invitation for bids and they shall also meet the following requirements:

	Maximum	Minimum
Weight per 108 square feet.....pounds.....		83
Saturation of felt.....percent.....		175

Nails.—Nails shall be as specified for type I roofing except that they shall be 1 inch long when the shingles are laid on solid sheathing and 1½ to 1¾ inches long when laid over old shingles. Nails for shingles shall be purchased separately and the number required will depend upon the size and form of the shingles and shall be agreed upon by the purchaser and seller.

F. METHODS OF INSPECTION, DETERMINATION OF WEIGHT AND WIDTH, SAMPLING AND TESTING

Deliveries will, in general, be sampled and tested by the following methods, but the purchaser reserves the right to use any additional information to ascertain whether the material meets the specification.

F-1. Sampling for inspection.—From each shipment select at random rolls of roofing or packages of shingles equivalent to the cube root of the total number included in the lot. If the cube root is a fractional number, express it as the next higher digit.

F-2. Determination of weight and width.—The weight per 108 square feet of material, and its variation in weight: The width of roll roofing and its variation must be determined by the inspector and the results transmitted to the testing laboratory with the sample. Material which does not conform to the specification in these respects should be rejected by the inspector and only deliveries which conform in these respects sampled for laboratory tests.

F-2a. Type I mineral-surfaced asphalt prepared roofing.—Remove the wrappers, other packing material, nails, and cement from each roll selected and weigh the roll and the packing material, etc., separately to the nearest one-fourth pound. Then unwind each roll and measure the length and width of the rectangular portion of the roll to the nearest one-fourth inch and reroll. Observe the appearance of the roofing while unrolling and rerolling. The mineral granules should be uniformly distributed over the entire surface (except as noted below) and when so specified the color shall substantially match the sample mutually agreed upon by buyer and seller. The coating and surfacing may extend to the edge of the sheet of roofing, but an unsurfaced lapping edge approximately 2 inches wide along one side is permissible. The edges of the sheet should not be ragged. Compute the area, and the weight per 108 square feet of each roll taken. Should the weight of any roll per 108

square feet be less than the minimum weight specified, 80 pounds, it shall be cause for rejection of the whole shipment. Compute also the weight of the packing materials, nails, and cement.

F-2b. Type II mineral-surfaced asphalt shingles.—Remove the wrappers and other packing material from each package of shingles taken and weigh the shingles and also the packing material to the nearest one-fourth pound. Count the number of shingles or strips in each package taken, compute the area, and from these results and the weight compute the weight per 108 square feet. A minimum weight of less than 83 pounds shall be cause for rejection of the whole shipment. Observe the color and general appearance of the shingles while counting them and compare with the mutually agreed upon sample. The mineral granules should be uniformly distributed over the entire surface of the shingles. The coating and surfacing should extend to the edge of each shingle. The edges should not be ragged. No patches of coating should show through the mineral surfacing nor should the coating be broken from the edges. The shingles should be of the specified shape and should not stick together in the package to such an extent as to injure the coating when unpacked.

F-3. Sampling for laboratory examination.—

F-3a. Type I mineral-surfaced asphalt prepared roofing.—From the rolls examined for sampling, select one, the weight of which is near the average weight of the lot. Unroll, and at approximately 10 feet from the end cut two samples the full width of the roll and approximately 40 inches long, label, roll carefully, but do not crease, wrap, and transmit one to the testing laboratory. Retain the other for use in case of dispute.

F-3b. Type II mineral-surfaced asphalt shingles.—For sampling take, in the case of individual shingles, two shingles from each package examined or, in the case of strip shingles, one strip from each two packages examined. Carefully wrap, label, and transmit to the testing laboratory. The sample submitted to the laboratory shall contain at least six individual shingles or two strips. Samples similar to those transmitted to the testing laboratory should be taken and retained for use in case of dispute.

F-4. Laboratory examination.—

F-4a. Color and appearance.—Examine both sides of the roofing or shingles and note the color and general appearance and compare them with the mutually agreed upon sample.

F-4b. Weight.—

F-4b (1). Type I mineral-surfaced asphalt prepared roofing.—Trim the sample so that it is 36 inches long and the full width of the roll (except that material having an unsurfaced lapping edge shall have that edge trimmed off). Measure accurately and weigh to the nearest gram (15 grains). From the measurements and weight so obtained compute the weight per 108 square feet. The weight so determined is only to be used in making the laboratory calculations and shall not be used as a basis for acceptance or rejection (see F-2).

F-4b (2). Type II mineral-surfaced asphalt shingles.—Weigh each shingle or strip submitted to the nearest gram (15 grains); measure

to the nearest one sixteenth inch and from the weights and area so obtained compute the weight per 108 square feet. The weight so determined is only to be used in making laboratory calculations and shall not be used as a basis for acceptance or rejection (see F-2).

F-4c. Pliability (type I only).—Cut five strips 1 inch wide and 6 inches long in the direction of the fiber grain and immerse them in water at 25° C. (77° F.) for 10 to 15 minutes.

Remove the strips from the water and immediately bend each strip with the exposure side up, 90 degrees over the edge of a block (which has been rounded to a radius of $\frac{3}{4}$ inch), at a uniform speed, in approximately 2 seconds time. Dry thoroughly and examine.

If 1 or more of these 5 strips crack on this test, cut 10 strips from another part of the sample and repeat the test. If one or more of these strips crack, the material is reported as failing on the pliability test.

F-4d. Behavior on heating at 80° C. (176° F.) for two hours.—Cut two strips from the roofing or shingles approximately 8 inches by 8 inches, weigh, and suspend vertically for two hours in an oven at 80° C. (176° F.), plus or minus 3° C. (5° F.). Remove at the end of this period and note any flowing, sagging, blistering, or absorption of the surface coating. Cool, weigh, and compute the loss in weight.

F-4e. Weight of moisture-free, desaturated felt.—Cut two strips approximately 2 inches wide and 8 inches long from the roofing, weigh accurately and extract with benzol¹ in a suitable extraction apparatus until the benzol runs through colorless and contains no soluble material. The roofing may be cut into squares approximately 1 inch on each side in case an extraction apparatus of sufficient size to accommodate the whole strips is not available. Retain the extract for any mineral matter it may contain. Remove the desaturated felt from the extractor, dry in air until free from the odor of benzol, and brush off any adhering mineral matter, retaining it with the mineral matter in the extractor. Place the desaturated felt in a tared weighing bottle, dry in an oven at 105° to 110° C. (221° to 230° F.) for one half hour, cool in a desiccator, and weigh. Calculate the percentage of moisture-free desaturated felt in the sample taken for extraction and compute the weight of moisture-free desaturated felt per 108 square feet from the weight obtained in F-4b.

F-4f. Thickness of desaturated felt.—Cut one of the strips of felt obtained in F-4d into four equal portions and caliper each piece at four equally spaced points at least three quarters of an inch from a cut edge with a micrometer having flat bearing surfaces, or if the strips were cut into pieces in F-4d take at random 16 pieces of the felt and caliper each piece at its center. Average the readings.

F-4g. Total weight of organic fiber and bitumen.—Combine the mineral matter from the extractor and from the surface of the desaturated felt with that obtained by the filtration or evaporation and ignition of the benzol extract from F-4e, dry in air until free from the odor of benzol, heat for one half hour in an oven at 105° to 110° C. (221° to 230° F.), cool and weigh. Calculate the percentage of mineral

¹ Carbon tetrachloride, chloroform or carbon bisulphide will usually give the same results but benzol should be used in case of dispute.

matter in the sample taken for extraction and compute the total mineral matter per 108 square feet from the weight obtained in F-4b. Subtract this weight from the weight computed in F-4b.

F-4h. Saturation of felt.—Cut two strips of the original roofing or shingle approximately 2 inches wide and 8 inches long and warm them in an oven at about 80° C. (176° F.). Strip off the surfacing and coatings, taking care that as little as possible of the saturated felt is removed with the coatings, and that none of the coatings adhere to the felt. Weigh the saturated felt obtained and extract in a suitable extractor with benzol² until the benzol runs through colorless and contains no soluble material.

Remove the desaturated felt from the extractor and dry in air until free from the odor of benzol. Place in a tared weighing bottle, dry at 105° to 110° C. (221° to 230° F.) for one half hour and weigh. From the weight obtained and the original weight compute the percentage saturation of the moisture-free felt as follows:

$$\frac{\text{Weight of saturated felt} - \text{Weight of desaturated felt}}{\text{weight of desaturated felt}} \times 100 = \text{percentage saturation of moisture-free felt.}$$

G. PACKAGING, PACKING, AND MARKING

G-1. Packaging.—Unless otherwise specified, commercial packages are acceptable under this specification.

G-2. Packing.

G-2a. The roofing shall be put up in rolls of 108 square feet. No roll shall contain more than two pieces of roofing, nor shall there be more than 3 percent of rolls containing two pieces in any shipment. The rolls shall be tightly wound and securely wrapped in a substantial grade of paper. The wrapper shall completely encircle the roll and shall be pasted at the overlap in a manner which will prevent it shifting from position. The ends of the roll shall be protected with metal caps, cloth, or other suitable means. The nails and lap-cement shall be furnished either in each roll or in bulk, as specified in the order. When furnished in bulk, the cloth or metal ends may be omitted. Rolls for export shipment shall be packed as agreed upon by the purchaser and seller.

G-2b. Shingles shall be packed in bundles weighing not more than 135 pounds gross. The bundles shall either be packed in cardboard cartons or between wooden or cardboard ends and tied with rope, wire or steel bands so as to make a substantial package, as may be agreed upon by the purchaser and seller.

G-3. Marking.—Each package or roll shall be legibly marked with a description of the contents, the name of the manufacturer, the place of manufacture, the brand (if any), the net weight of the contents, and some means of identification of "the particular contract on which purchase and shipment were made". Each shipment of the material shall be accompanied by printed directions for its use.

² See note under F-4e.

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H. REQUIREMENTS APPLICABLE TO INDIVIDUAL DEPARTMENTS

H-1. The following departmental specifications, of the issue in effect on date of invitation for bids, shall respectively form a part of this specification.

H-1a. Army.—United States Army Specification No. 100-2, Standard Specification for Marking Shipments.

H-1b. Navy.—Navy Department purchases will be made under the issue in effect on date of invitation for bids of Bureau of Yards and Docks Specification No. 7Y, roofing, siding, and sheet metal work; dampproofing, and membrane waterproofing, copies of which may be obtained without cost upon application to the Bureau of Yards and Docks, Navy Department, Washington, D.C.

I. NOTES

I-1. It is believed that this specification adequately describes the characteristics necessary to secure the desired material, and that normally no samples will be necessary, prior to award to determine compliance with this specification. If, for any particular purpose, samples with bids are necessary, they should be specifically asked for in the invitation for bids, and the particular purpose to be served by the bid sample should be definitely stated, the specification to apply in all other respects (see D-2).

I-2. This specification governs all United States Government purchases of this commodity. Users are requested to retain this specification in permanent file until a revision is issued.

I-3. An alphabetical index of Federal specifications may be obtained upon application as noted in paragraph next below, price to be obtained from the Superintendent of Documents.

I-4. Copies of this specification may be obtained upon application, accompanied by money order or coupon, or cash, to Superintendent of Documents, Government Printing Office, Washington, D.C. Price 5 cents.

Notice.—When Government drawings, specifications, or other data, are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility or any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

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For sale by the Superintendent of Documents, Washington, D.C. . . . Price 5 cents

HH-I-521b

AUGUST 27, 1937

SUPERSEDING
Fed. Spec. HH-I-521a
August 19, 1936

FEDERAL STANDARD STOCK CATALOG

Section IV

(Part 5)

FEDERAL SPECIFICATION

FOR

**INSULATION; BAT OR STRIP-FORM AND
LOOSE-FILL**

This specification was approved on the above date by the Director of Procurement, for the use of all departments and establishments of the Government, and shall become effective not later than April 1, 1938. It may be put into effect, however, at any earlier date after promulgation.

A. APPLICABLE FEDERAL SPECIFICATION.

A-1. Federal Specification LLL-F-321, Fiberboard, insulating, of the issue in effect on date of invitation for bids, shall form a part of this specification.

B. TYPES AND CLASSES.

B-1. Insulation, in accordance with this specification, shall be furnished in the following types and classes, as specified:

Type I. Bat or strip form.

Class (A) Light weight.

Class (B) Medium weight.

Type II. Loose-fill form.

Class (A) Light weight.

Class (B) Medium weight.

Class (C) Heavy weight.

C. MATERIALS.

C-1. Materials.—Insulation shall be composed of mineral matter in fibrous form, in granular form, in fibrous form granulated into nodules, in powdered form mixed with cellulose fiber, or in bat form, as specified.

D. GENERAL REQUIREMENTS.

D-1. Sulphur.—The sulphur content shall not exceed 0.75 percent.

D-2. Oil content.—When fibrous material is furnished, the material shall contain not less than 0.35 percent of mineral oil which shall be added while the material is being fiberized.

E. DETAIL REQUIREMENTS.

E-1. Type I, bat or strip form.—Bats or strips shall be composed of mineral wool fibers felted and bound together in such a manner as to

produce a semirigid spongy block of uniform thickness. If a supporting member is required it shall be on one side only and shall be waterproof kraft paper unless a fireproof paper is specified. Bonding materials shall be of such character as to be practically insoluble in water.

E-2. Thickness.—The thickness of type I insulation shall not be more than $\frac{1}{4}$ inch less than the specified thickness. (See par. F-2c.)

E-3. Type II, loose-fill form.—This form shall be composed of mineral matter in fibrous form, in granular form or in fibrous form granulated into nodules, as specified. All particles except the fibrous form shall pass a 1-inch mesh screen and not more than 5 percent shall be retained on a $\frac{3}{4}$ -inch screen.

E-4. Class A, light weight.—

E-4a. Conductivity.—The conductivity shall not exceed 0.30 B. t. u. per hour per square foot per degree F. per inch thickness at a mean temperature of 75° F.

E-4b. Density.—Type I material shall weigh not more than 8 pounds per cubic foot, type II material shall weigh not more than 12 pounds per cubic foot.

E-5. Class B, medium weight.—

E-5a. Conductivity.—The conductivity shall not exceed 0.50 B. t. u. per hour per square foot per degree F. per inch thickness at a mean temperature of 75° F.

E-5b. Density.—Type I material shall weigh not more than 12 pounds per cubic foot, type II material shall weigh not more than 15 pounds per cubic foot.

E-6. Class C, heavy weight.—

E-6a. Conductivity.—The conductivity shall not exceed 0.50 B. t. u. per hour per square foot per degree F. per inch thickness at a mean temperature of 75° F.

E-6b. Density.—Type II material shall not weigh more than 24 pounds per cubic foot.

E-6c. The cellulose fiber content of Class C type II material shall not exceed 15 percent by weight.

F. METHODS OF SAMPLING, INSPECTION, AND TESTS.

F-1. Sampling.—Samples shall be taken from unbroken packages.

F-1a. Type I.—Three pieces shall be taken at random from each lot of 1,000 pieces, or less.

F-1b. Type II.—At least three packages shall be selected at random from each lot of 2,000 pounds or less. The contents shall be dumped, thoroughly mixed and quartered down to provide a 25-pound sample.

F-2. Inspection and tests.—

F-2a. Conductivity.—This shall be made as described in paragraphs F-2b to F-2b (8) inclusive of Federal Specification LLL-F-321, referred to in section A.

F-2b. Density.—

F-2b (1). Type I.—Each of three bats or strips shall be measured and weighed separately. The average weight shall be reduced to pounds per cubic foot. (See par. F-2c.)

F-2b (2). Type II.—A cubical box of 1 cubic foot capacity and of known weight shall be filled loosely with the material which shall be screeded flush with the top of the box. The box shall be dropped

HH-I-521b

AMENDMENT—1

JUNE 8, 1938

FEDERAL STANDARD STOCK CATALOG

Section IV

(Part 5)

FEDERAL SPECIFICATION

FOR

INSULATION; BAT OR STRIP-FORM AND LOOSE-FILL

This amendment was approved on the above date by the Director of Procurement, for the use of all departments and establishments of the Government, and shall become effective not later than February 15, 1939. It may be put into effect, however, at any earlier date after promulgation.

The following changes should be made in Federal Specification HH-I-521b, dated August 27, 1937:

Page 1:

Paragraph C-1. Delete paragraph in its entirety and substitute:

C-1. Insulation shall be composed of mineral matter in fibrous form, in granular form, in nodulated fibrous form, in powdered form mixed with cellulose fiber, or in bat form, as specified.

Page HH-I-521b—2:

Paragraph E-3:

3d line—delete "All particles except the fibrous form" and substitute "All particles in granulated form or nodulated form."

from a height of about 6 inches to the floor. This operation shall be repeated three times. The settled space shall be filled loosely with the material, after each drop, and again screeded flush with the top of the box. After the third drop, the box with its contents shall be weighed. The weight of the box and contents minus the weight of the box is the weight of the insulation in pounds per cubic foot.

F-2c. Thickness.—A full size bat or strip is laid face down on a flat surface and then covered with a lightweight cardboard or shipping carton top. A direct scale reading from the flat surface on which the bat or strip rests to the underside of the cardboard shall then be made at six points equally spaced around the periphery of the bat or strip. The average of these six readings is the thickness of the bat or strip.

G. PACKAGING, PACKING, AND MARKING.

G-1. Packaging.—Unless otherwise specified, commercial packages are acceptable under this specification.

G-2. Packing.—Unless otherwise specified, the subject commodity shall be delivered in standard commercial containers so constructed to insure acceptance by common or other carriers, for safe transportation at the lowest rate to the point of delivery.

G-3. Marking.—Unless otherwise specified, shipping containers shall be marked with the name of the material, class, and the quantity contained therein, as defined by the contract or order under which shipment is made, the name of the contractor, and the number of the contract or order.

H. REQUIREMENTS APPLICABLE TO INDIVIDUAL DEPARTMENTS.

H-1. The following departmental specifications of the issue in effect on date of invitation for bids shall respectively form a part of this specification:

H-1a. Army.—United States Army Specification No. 100-2, Standard Specification for Marking Shipments.

United States Army Specification No. 22-42, Supplies Subsistence for United States Army, Conditions Governing the Purchase of.

H-1b. Navy.—Navy Department General Specifications for Inspection of Material, copies of which may be obtained without cost, upon application to the Bureau of Supplies and Accounts, Navy Department, Washington, D. C.

I. NOTES.

I-1. Purchasers should exercise all options desired and should specify type and class required. (See secs. B-1 and C-1.)

I-2. Insulation should be purchased by the square foot. Purchasers should specify the thickness required.

I-3. Commercial sizes are as follows:

Bats—15 by 18, 15 by 11½, and 15 by 23 inches.

Strips—15 by 8½, 15 by 9, 23 by 9, and 23 by 36 inches.

Thicknesses—4, 3½, 3, and 2 inches.

I-4. It is believed that this specification adequately describes the characteristics necessary to secure the desired material and that normally samples will not be necessary prior to award to determine compliance with this specification. If, for any particular purpose,

FEDERAL STANDARD STOCK CATALOG

(Section IV, part 5)

in all other respects.

I-5. Copies of this specification and LLL-F-321 may be obtained upon application, accompanied by cash or money order, to the Superintendent of Documents, Government Printing Office, Washington, D. C. Price, 5 cents each.

I-6. An Index of Federal Specifications is obtainable upon application accompanied by cash or money order, to the Superintendent of Documents, Government Printing Office, Washington, D. C. Price 10 cents.

Notice.—When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

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FEDERAL STANDARD STOCK CATALOG

Section IV

(Part 5)

FEDERAL SPECIFICATION

FOR

PAPER; SHEATHING, WATERPROOF

This specification was approved by the Director of Procurement for the use of all departments and establishments of the Government and shall become effective not later than August 15, 1935. It may be put into effect, however, at any earlier date after promulgation.

A. APPLICABLE FEDERAL SPECIFICATIONS

A-1. The following Federal specification of the issue in effect on date of invitation for bids shall form a part of this specification:

Federal Specification UU-P-31, General Specifications for Paper.

A-2. Any special requirements of the individual departments are noted under section H.

B. GRADES AND USES

B-1. Sheathing paper shall be furnished in two grades:

Grade A. For permanent structures or for other uses where long-continued exposure to dampness may occur (see I-1).

Grade B. For temporary structures, or other uses where long service is not required.

C. MATERIAL AND WORKMANSHIP

C-1. Shall be free from visible defects and have a uniform appearance. The paper shall not stick together to an extent that will cause tearing when unrolling.

D. GENERAL REQUIREMENTS

D-1. Shall be waterproofed with asphalt.

D-2. Purchase shall be on a basis of 100 square feet.

E. DETAIL REQUIREMENTS

Grade A Grade B

E-1. Tensile breaking strength each direction not less than (pounds per inch width)----- 40 20

E-2. *Water resistance*.—Not less than (hours)----- 120 24

E-3. *Pliability*.—Shall not crack when bent.

E-4. *Size*.—Width, 36, 48, 60, 72, or 84 inches, as specified in invitation for bids, with a plus or minus tolerance of ¼ inch.

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F. METHODS OF SAMPLING, INSPECTION, AND TESTS

F-1. Any requirements applicable to individual departments are noted under section H.

F-2. All tests not herein specified shall be made in accordance with Federal Specification UU-P-31, General Specifications for Paper.

F-3. Each sample shall consist of not less than 5 sheets, each not less than 3 square feet, and each taken from a different roll.

F-4. Water resistance shall be determined by the ground-glass method as follows:

F-4a. Five specimens, 6 by 6 inches in size, shall be folded to form boxes 2 inches square and 2 inches high, open at the top, the tabs formed by folding being held by convenient fasteners, such as paper clips. The paper boxes shall be placed on the ground surface of a piece of ground glass resting on black paper or other suitable dark surface. The boxes shall be filled to within $\frac{1}{2}$ inch of the top with water at 65 to 90° F. temperature. They shall be lifted at the end of the time period corresponding to the specification requirement in paragraph E-2, and the ground glass under them observed for transuded moisture, this being visible as a dark film on the surface of the glass.

F-5. The number of square feet in the shipment shall be calculated from the weight of the entire shipment, the net weight of the sample rolls, and the weight per foot of paper calculated from the weight of the sample sheets.

F-6. A strip 1 inch wide shall be used in the tensile breaking strength test.

F-7. Cut five strips, 6 inches by 1 inch, in the machine direction of the paper. Bend them over a $\frac{1}{16}$ -inch mandrel at 32° F. through an arc of 180° at a uniform rate in 2 seconds. All strips shall remain uncracked.

G. PACKAGING, PACKING, AND MARKING

G-1. Unless otherwise specified, shall be furnished in commercial rolls.

G-2. The grade and the contents in square feet shall be plainly marked on the outside of each roll.

H. REQUIREMENTS APPLICABLE TO INDIVIDUAL DEPARTMENTS

H-1. The following departmental specifications of the issue in effect on date of invitation for bids shall respectively form a part of this specification, in so far as the activities noted are concerned:

H-1a. Army: United States Army Specification No. 100-2, Standard Specification for Marking Shipments.

H-1b. Navy: Navy Department General Specifications for Inspection of Material, copies of which may be obtained upon application to the Bureau of Supplies and Accounts, Navy Department, Washington, D. C.

H-1c. Marine Corps: Instructions issued by the quartermaster.

UU-P-536

AMENDMENT-1
OCTOBER 18, 1943

FEDERAL STANDARD STOCK CATALOG

Section IV

(Part 5)

FEDERAL SPECIFICATION

FOR

PAPER; SHEATHING, WATERPROOF*

This amendment was approved on the above date by the Director of Procurement, for the use of all departments and establishments of the Government, and shall become effective not later than Dec. 15, 1943. It may be put into effect, however, at any earlier date after promulgation.

The following changes shall be made in Federal Specification UU-P-536, dated February 5, 1935:

Page 1:

Paragraph E-1. Column "Grade A" delete "40" and substitute "32".

*Certain provisions of this amendment are intended to conserve critical or strategic materials. When the present emergency is over, this amendment will be considered for revision.

FEDERAL STANDARD STOCK CATALOG UU-P-536-3
(February 1935)

(Section IV, part 5)

I. NOTES

I-1. Grade A is intended for sheathing permanent structures, and for other construction uses where long-continued exposure to dampness may occur, the curing and protecting of concrete and terrazzo, covering sand cushions, the protection of membrane waterproofing, and the protection of floor finishing materials following their installation.

I-2. It is believed that this specification adequately describes the characteristics necessary to secure the desired material, and that normally no samples will be necessary prior to award to determine compliance with this specification. If, for any particular purpose, sample with bids are necessary, they should be specifically asked for in the invitation for bids, and the particular purpose to be served by the bid sample should be definitely stated, the specification to apply in all other respects.

I-3. An alphabetical index of Federal specifications may be purchased as noted in paragraph next below, price to be obtained from the Superintendent of Documents.

I-4. Copies of this specification may be obtained upon application, accompanied by money order or coupon or cash, to Superintendent of Documents, Government Printing Office, Washington, D. C., price 5 cents.

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HH-I-571

OCTOBER 29, 1938

SUPERSEDING Fed. Specs.:

HH-B-421, Sept. 20, 1932

and

HH-F-211, Sept. 20, 1932

FEDERAL STANDARD STOCK CATALOG

Section IV

(Part 5)

FEDERAL SPECIFICATION

FOR

**INSULATION (VEGETABLE OR WOOD-FIBER);
BLANKET, FELT, AND LOOSE-FILL**

This specification was approved on the above date by the Director of Procurement for the use of all departments and establishments of the Government and shall become effective not later than May 15, 1939. It may be put into effect, however, at any earlier date after promulgation.

A. APPLICABLE SPECIFICATION.

A-1. The following Federal Specification, of the issue in effect on date of invitation for bids, shall form a part of this specification.

LLL-F-321. Fiberboard; Insulating.

B. CLASSES.

B-1. Insulation shall be furnished in the following classes as specified in the invitation for bids:

Class A. Flexible Blanket.

Class B. Semi-Rigid Felt.

Class C. Loose-Fill.

C. MATERIAL.

C-1. Insulation shall be manufactured from cleaned and sterile wood or other vegetable fiber; or a mixture of animal hair and wood-bark fiber.

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D. GENERAL REQUIREMENTS.

D-1. Thermal conductivity.—The thermal conductivity of the insulation material shall not be more than 0.32 b. t. u./hr./sq. ft./inch thickness/deg. F. temperature difference at a mean temperature of 75° F.

D-2. Density.—The insulation material shall weigh not more than 7 pounds per cubic foot.

E. DETAIL REQUIREMENTS.

E-1. Class A. Flexible blanket.—

E-1a. Construction.—Material shall be effectively confined between sheets of strong durable paper or suitable textile, unless it is of such a nature as to obviously make the use of confining members unnecessary. When specified, the paper shall be waterproofed.

E-1b. Flexibility.—This type shall be flexible enough to bend easily around a rod 3 inches in diameter without breaking.

E-1c. Thickness.—Flexible blanket shall be furnished in nominal thickness of $\frac{1}{2}$ inch and 1 inch, as specified. No minus tolerance in thickness shall be permitted.

E-2. Class B. Semi-rigid felt.—

E-2a. Construction.—Unless otherwise specified, both surfaces shall be either natural felt or reinforced with paper or burlap sewed with cord. When specified, one or both surfaces may be reinforced with enameled or copper screen wire, galvanized wire mesh, or metal lath.

E-2b. Thickness.—Semirigid felt shall be furnished in nominal thicknesses of $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, 1, $1\frac{1}{2}$, and 2 inches, as specified. A minus tolerance in thickness of 2 percent will be permitted.

E-3. Class C. Loose-fill.—

E-3a. Composition.—Class C insulation shall be composed of loose fibers of wood bark or other vegetable matter.

F. METHOD OF SAMPLING, INSPECTION, AND TESTS.

F-1. Sampling.—Samples shall be taken from unbroken packages.

F-1a. Classes A and B.—At least 1 percent of the number of classes A and B insulation in a shipment, but not more than five blankets or felts shall be selected at random to be representative of the shipment. From each sample a specimen 12 by 12 inches shall be cut.

F-2. Inspection and tests.—

F-2a. Thermal conductivity.—The thermal conductivity test shall be conducted as described in Federal Specification LLL-F-321 mentioned in section A.

F-2b. Thickness—Classes A and B.—Approximately 6 inches aggregate thickness shall be obtained by piling up samples not less than 8 inches square. The aggregate thickness shall be measured between flat rigid plates subjecting the specimens to a pressure of 3 pounds per square foot. The aggregate thickness thus obtained shall be divided by the number of samples to determine the average thickness of the material as furnished. Density shall be computed using this thickness, the length, width, and weight.

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(Oct. 1938)

F-2c. Density—Class C.—A cubical box of 1 cubic foot capacity and of known weight shall be filled loosely with the material, which shall be screeded flush with the top of the box. The box shall be dropped from a height of about 6 inches to the floor. This operation shall be repeated three times. The settled space shall be filled loosely with the material, after each drop, and again screeded flush with the top of the box. After the third drop, the box with its contents shall be weighed. The weight of the box and contents minus the weight of the box is the weight of the insulation in pounds per cubic foot.

G. PACKAGING, PACKING, AND MARKING FOR SHIPMENT.

G-1. Packaging.—Unless otherwise specified, commercial packages are acceptable under this specification.

G-2. Packing.—Unless otherwise specified, the subject commodity shall be delivered in standard commercial containers so constructed to insure acceptance by common or other carriers, for safe transportation at the lowest rate to the point of delivery.

G-3. Marking.—Unless otherwise specified, shipping containers shall be marked with the name of the material, class, and the quantity contained therein, as defined by the contract or order under which shipment is made, the name of the contractor, and the number of the contract or order.

H. REQUIREMENTS APPLICABLE TO INDIVIDUAL DEPARTMENTS.

H-1. The following departmental specifications of the issue in effect on data of invitation for bids shall respectively form a part of this specification:

H-1a. Army.—United States Army Specification No. 100-2, Standard Specification for Marking Shipments.

United States Army Specification No. 22-42, Supplies Subsistence for United States Army, Conditions Governing the Purchase of.

H-1b. Navy.—Navy Department General Specifications for Inspection of Material, copies of which may be obtained without cost, upon application to the Bureau of Supplies and Accounts, Navy Department, Washington, D. C.

I. NOTES.

I-1. Purchasers should exercise any desired options and should specify class desired.

I-2. It is believed that this specification adequately describes the characteristics necessary to secure the desired material, and that normally no samples will be necessary prior to award to determine compliance with this specification. If, for any particular purpose, samples with bids are necessary, they should be specifically asked for in the invitation for bids, and the particular purpose to be served by the bid sample should be definitely stated, the specification to apply in all other respects.

I-3. This specification covers only the types, classes, grades, sizes, etc., of the commodity as generally purchased by the Federal Government, and is not intended to include all of the types, etc., which are commercially available.

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(Oct. 1938) (Section IV, part 5)

I-4. An index of Federal specifications may be obtained upon application as noted in paragraph next above, price to be obtained from the Superintendent of Documents.

I-5. Copies of this specification and of LLL-F-321 may be obtained upon application, accompanied by money order or coupon, or cash, to the Superintendent of Documents, Government Printing Office, Washington, D. C. Price 5 cents each.

Notice.—When Government drawings, specifications, or other data are used for any purposes other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

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BIRD 004841

500-600

HH-C-581a

DECEMBER 18, 1935

**SUPERSEDING
Fed. Spec. HH-C-581
September 5, 1933**

FEDERAL STANDARD STOCK CATALOG

Section IV

(Part 5)

FEDERAL SPECIFICATION

FOR

COTTON FABRIC; WOVEN, ASPHALT-SATURATED

This specification was approved by the Director of Procurement, for the use of all departments and establishments of the Government, and shall become effective not later than July 15, 1936. It may be put into effect, however, at any earlier date after promulgation.

A. APPLICABLE FEDERAL SPECIFICATIONS.

A-1. Federal Specification CCC-T-191—Textiles; Test Methods—of the issue in effect on date of invitation for bids, shall form a part of this specification.

A-2. Any special requirements of the individual departments of the Government are noted under section H.

B. TYPES.

B-1. Asphalt-saturated woven cotton fabric shall be of but one type.

C. MATERIAL.

C-1. Material shall be composed of woven cotton fabric impregnated with an asphaltic saturant.

D. GENERAL REQUIREMENTS.

D-1. See Detail Requirements.

E. DETAIL REQUIREMENTS.

E-1. Appearance.—It must be free from visible external defects, such as ragged or untrue edges, breaks, and rents. The meshes of the fabric shall not be completely closed or sealed by the asphalt saturant. There shall be sufficient porosity to allow the moppings of asphalt plying cement to come through. The fabric shall not stick when unrolled at temperatures between 10° C. (50° F.) and 32° C. (90° F.) to such an extent as to cause injury. The surface of the fabric shall be uniformly smooth and free from irregularities, folds, and knots. It shall not be coated with talc, portland cement, or other substance which would tend to interfere with the adhesion between the fabric

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and the plying cement. The use of powdered silica or wood flour shall be permitted.

E-2. *Physical and chemical requirements.*—

	Maxi- mum	Mini- mum
Width.....inches.....	38	30
Selvage.....inch.....	1/4	
Weight per roll. To be mutually agreed upon by buyer and seller but in no case more than 80 pounds.		
Weight per square yard.....ounces.....	✓ 15	11
Average strength (grab method):		
Direction of the warp.....pounds.....		50
Direction of the filling.....do.....		40
Volatile matter at 105° C. (221° F.).....percent.....	2	
Pliability at 0° C. (32° F.). (Cracking on bending over a 1/2-inch mandrel through an arc of 180° in one direction and then through 360° over the same mandrel in the opposite direction).....		None
Average weight of moisture-free desaturated fabric per square yard		
ounces.....		3 1/2
Saturation of moisture-free fabric.....percent.....		200
Ash of moisture-free desaturated fabric.....do.....	1	
Thread count per inch. (Both in the direction of the warp and the filling).....	36	18
Cotton fiber content.....percent.....		100

¹ This shall not exclude the customary sizing materials in amounts not exceeding 8 percent by weight of the moisture-free cotton.

F. METHODS OF INSPECTION, DETERMINATION OF WEIGHTS AND WIDTH SAMPLING AND TESTING.

Deliveries will, in general, be sampled and tested by the following methods, but the purchaser reserves the right to use any additional information to ascertain whether the material meets the specification.

F-1. *Sampling for inspection.*—From each shipment of more than 1,000 rolls taken at random a number of rolls of fabric equivalent to one-half the cube root of the total included in the lot. If this proves to be a fractional number, express it as the next higher digit. From each shipment of 1,000 rolls or less take at random 5 in each case.

F-2. *Determination of weight and width.*—The weight per square yard of material, and its variation in weight; the width and its variation must be determined by the inspector and the results transmitted to the testing laboratory with the sample. Material which does not conform to the specification in these respects should be rejected by the inspector and only deliveries which conform in these respects sampled for laboratory tests.

F-2a. Remove wrappers and other packing material from each roll selected and weigh the roll and the packing materials, etc., separately to the nearest one-quarter pound, then unwind each roll and measure the length and width to the nearest one-quarter inch and observe the appearance of the material. (See E-1.) Compute the area of each roll and the weight per square yard of each roll of fabric examined.

F-3. Sampling for laboratory examination.—From the rolls examined for sampling, select one the weight of which is near the average weight of the whole lot. Unroll and at approximately 25 feet from the end cut two samples the full width of the roll and approximately 40 inches long, label, carefully wrap, and transmit one to the testing laboratory. Retain the other sample for check analysis in case of dispute.

F-4. Laboratory examination.—

F-4a. Appearance.—Examine both sides of the sheet of saturated fabric and note the color and general appearance.

F-4b. Weight.—Trim the sample so that it is 36 inches long and the full width of the roll, measure accurately to one-sixteenth inch, and weigh to the nearest gram (15 grains). From the measurements and weight so obtained compute the weight per square yard. The weight so determined is only to be used in making the laboratory calculations and shall not be used as a basis for acceptance or rejection. (See F-2.)

F-4c. Pliability.—Cut five strips 1 inch wide and 6 inches long in the direction of the warp and immerse in a cooling mixture of ice and water at 0° C. (32° F.) for 10 to 15 minutes. The strips shall then be removed from the water and each strip bent over a 1/32-inch mandrel through an arc of 180° at a uniform speed in approximately 2 seconds and then through 360° over the same mandrel in the opposite direction. Dry thoroughly and examine. If 1 or more of these 5 strips crack on this test, cut 10 strips from another part of the sample and repeat the test. If one or more of these strips crack the material is reported as failing on the pliability test.

F-4d. Breaking strength.—(Grab method.) Follow method given in section VI, Federal Specification CCC-T-191.

F-4e. Volatile matter.—Cut two strips of asphalt-saturated fabric 6 inches wide and 12 inches long. Weigh the strips separately and suspend them for 5 hours in an oven at 105° to 110° C. (221° to 230° F.), remove from the oven, cool in a desiccator, and weigh. Compute the percentage loss in weight and average the two results.

F-4f. Weight of desaturated fabric.—Cut a strip approximately 2 inches wide and the full width of the sample, weigh, and extract with benzol (carbon tetrachloride, chloroform, or carbon bisulphide will usually give the same results but benzol should be used in case of dispute) in a suitable extraction apparatus until the solvent runs through colorless. The saturated fabric may be cut into squares approximately 1 inch on each side in case an extraction apparatus of sufficient size to accommodate the whole strip is not available. Remove the desaturated fabric from the extraction apparatus, dry in air until free from the odor of benzol, and brush off any adhering particles of foreign matter. Place the desaturated fabric in a tared weighing bottle and heat in an oven at 105° to 110° C. (221° to 230° F.) for one half hour, cool in a desiccator and weigh. Calculate the percentage of moisture-free fabric in the sample taken for extraction and compute the weight of moisture-free desaturated fabric per square yard from the weight obtained in F-4b.

F-4g. Saturation of moisture-free fabric.—The weight of saturant in the fabric is the difference in weight between the original sample taken for extraction in F-4f and the weight of the desaturated fabric (plus any surfacing material present). The percentage saturation of the moisture-free fabric is obtained by the following formula:

$$\frac{\text{Weight of saturant}}{\text{Weight of moisture-free desaturated fabric}} \times 100 = \frac{\text{percentage}}{\text{saturation}}$$

F-4h. Thread count.—Count the number of threads to the inch in both the warp and filling at five different places. The average of these shall be taken as the threads per inch or thread count.

F-4i. Character of fiber.—From a piece of the desaturated fabric (from which any sizing has been removed by bringing to a boil in a 0.5 percent sodium hydroxide solution), take at random 5 threads in the direction of the warp and 5 in the direction of the filling and separate the fibers in water on a microscope slide, so that the fibers are uniformly distributed. Dry the slides so prepared until all the water is removed, cool and add a drop of zinc-chloriodide solution (Herzberg solution).¹

Cover the stained fibers with a cover glass, draw off the excess stain, and examine under a microscope with a magnification of about 100 diameters. The fibers should all be stained a wine-red color, and shall have the characteristic shape of cotton fiber.

G. PACKAGING, PACKING, AND MARKING.

G-1. Packaging.—Unless otherwise specified, commercial packages are acceptable under this specification.

G-2. Packing.

G-2a. The rolls of treated cotton fabric shall be wound on mandrels² not less than 2 inches in diameter and extending 2 to 4 inches beyond the end of the rolls. They shall be securely tied or wrapped in a manner which will prevent unrolling in transit.

G-3. Marking.—Each package shall be legibly marked with a description of the contents, the name of the manufacturer, the place of manufacture, the brand (if any), the net weight of the contents, and some means of identification of "the particular contract on which the purchase and shipment were made." Each shipment of the material shall be accompanied by printed directions for its use.

H. REQUIREMENTS APPLICABLE TO INDIVIDUAL DEPARTMENTS.

H-1. The following departmental specifications, of the issue in effect on date of invitation for bids, shall respectively form a part of this specification.

¹ The Herzberg stain is made according to the following formula:

Solution A	{ 20 g zinc chloride,
	{ 10 ml distilled water.
Solution B	{ 2.1 g potassium iodide,
	{ 0.1 g iodine,
	{ 5.0 ml distilled water.

Dissolve solutions A and B separately, then mix and allow to stand several hours, or until all sediment has settled out. The clear liquid is then decanted into a dark-colored bottle and is ready for use. The stain shall be kept in the dark and should be tested before use on known fibers.

² The mandrel may be either round, square or polygonal.

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(Section IV, Part 5) (Dec. 1935)

H-1a. Army.—United States Army Specification No. 100-2, Standard Specification for Marking Shipments.

H-1b. Navy.—Navy Department purchases will be made under the issue in effect on date of invitation for bids of Bureau of Yards and Docks Specification No. 7Y, Roofing, Siding, and Sheet Metal Work; Dampproofing and Membrane Waterproofing, copies of which may be obtained without cost upon application to the Bureau of Yards and Docks, Navy Department, Washington, D. C.

I. NOTES.

I-1. Basis of purchase shall be by the roll or by the square (100 square feet) according to agreement between purchaser and the seller.

I-2. Asphalt-saturated fabric is intended for use with asphalt for waterproofing and dampproofing in the construction of membrane waterproofing.

I-3. It is believed that this specification adequately describes the characteristics necessary to secure the desired material, and that normally no samples will be necessary prior to award to determine compliance with this specification. If, for any particular purpose, samples with bids are necessary, they should be specifically asked for in the invitation for bid, and the particular purpose to be served by the bid sample should be definitely stated, the specification to apply in all other respects.

I-4. An alphabetical index of Federal specifications may be obtained upon application as noted in paragraph next below, price to be obtained from the Superintendent of Documents.

I-5. Copies of this specification may be obtained upon application, accompanied by money order or coupon, or cash, to Superintendent of Documents, Government Printing Office, Washington, D. C. Price 5 cents.

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JULY 3, 1935**FEDERAL STANDARD STOCK CATALOG****Section IV****(Part 5)****FEDERAL SPECIFICATION****FOR****COTTON-FABRIC; WOVEN, COAL-TAR-SATURATED**

This specification was approved by the Director of Procurement, for the use of all departments and establishments of the Government, and shall become effective not later than January 15, 1936. It may be put into effect, however, at any earlier date after promulgation.

A. APPLICABLE FEDERAL SPECIFICATIONS

A-1. The following Federal Specification, of the issue in effect on date of invitation for bids, shall form a part of this specification:
CCC-T-191—Textiles; test-methods.

A-2. Any special requirements of the individual departments of the Government are noted under section H.

B. TYPES

B-1. Coal-tar-saturated woven cotton fabric shall be of but one type.

C. MATERIAL

C-1. Material shall be composed of woven cotton fabric impregnated with a coal-tar saturant.

D. GENERAL REQUIREMENTS

D-1. See Detail Requirements.

E. DETAIL REQUIREMENTS

E-1. Appearance.—It must be free from visible external defects, such as ragged or untrue edges, breaks, and rents. The meshes of the fabric shall not be completely closed or sealed by the coal-tar saturant. There shall be sufficient porosity to allow the moppings of coal-tar-pitch plying cement to come through. The fabric shall not stick when unrolled at temperatures between 10° C. (50° F.) and 32° C. (90° F.) to such an extent as to cause injury. The surface of the fabric shall be uniformly smooth and free from irregularities, folds, and knots. It shall not be coated with talc, portland cement, or other substance which would tend to interfere with the adhesion between the fabric and the plying cement. The use of powdered silica or wood flour shall be permitted.

FEDERAL STANDARD STOCK CATALOG

(Section IV, part 5)

E-2. Physical and chemical requirements.

	Maxi- mum	Mini- mum
Width.....inches.....	38	30
Selvaqe.....inch.....	34	
Weight per roll. To be mutually agreed upon by buyer and seller but in no case more than 80 pounds.....		
Weight per square yard.....ounces.....	15	11
Average strength (grab method):		
Director of the warp.....pounds.....		50
Director of the filling.....do.....		40
Pliability at 0° C. (32° F.). (Cracking on bending over a 1/2-inch man- drel through an arc of 180° in one direction and then through 360° over the same mandrel in the opposite direction).....		None
Fabric:		
Thread count per inch. (Both in the direction of the warp and the filling).....	36	18
Cotton fiber content.....percent.....		100

F. METHODS OF INSPECTION, DETERMINATION OF WEIGHTS AND WIDTH SAMPLING, AND TESTING

Deliveries will, in general, be sampled and tested by the following methods, but the purchaser reserves the right to use any additional information to ascertain whether the material meets the specification.

F-1. Sampling for inspection.—From each shipment of more than 1,000 rolls take at random a number of rolls of fabric equivalent to one-half the cube root of the total included in the lot. If this proves to be a fractional number, express it as the next higher digit. From each shipment of 1,000 rolls or less take at random 5 in each case.

F-2. Determination of weight and width.—The weight per square yard of material, and its variation in weight; the width and its variation must be determined by the inspector and the results transmitted to the testing laboratory with the sample. Material which does not conform to the specification in these respects should be rejected by the inspector and only deliveries which conform in these respects sampled for laboratory tests.

F-2a. Remove wrappers and other packing material from each roll selected and weigh the roll and the packing materials, etc., separately to the nearest one-quarter pound, then unwind each roll and measure the length and width to the nearest one-quarter inch and observe the appearance of the material. See paragraph E-1. Compute the area of each roll and the weight per square yard of each roll of fabric examined.

F-3. Sampling for laboratory examination.—From the rolls examined for sampling, select one the weight of which is near the average weight of the whole lot. Unroll and at approximately 25 feet from the end cut two samples the full width of the roll and approximately 40 inches long, label, carefully wrap, and transmit one to the testing laboratory. Retain the other sample for check analysis in case of dispute.

F-4. Laboratory examination.—

F-4a. Appearance.—Examine both sides of the sheet of saturated fabric and note the color and general appearance.

F-4b. Pliability.—Cut five strips 1 inch wide and 6 inches long in the direction of the warp and immerse in a cooling mixture of ice and water at 0° C. (32° F.) for 10 to 15 minutes. The strips shall then be removed from the water and each strip bent over a 1/32-inch mandrel through an arc of 180° at a uniform speed in approximately 2 seconds and then through 360° over the same mandrel in the opposite direction. Dry thoroughly and examine. If 1 or more of these 5 strips crack on this test, cut 10 strips from another part of the sample and repeat the test. If one or more of these strips crack the material is reported as failing on the pliability test.

F-4c. Breaking strength.—(Grab method.) Follow method given in section VI of Federal Specification CCC-T-191.

F-4d. Character of fiber.—Cut a strip approximately 2 inches wide and the full width of the sample, and extract with benzol (carbon tetrachloride, chloroform, or carbon bisulphide will usually give the same results but benzol should be used in case of dispute) in a suitable extraction apparatus until the solvent contains not more than a trace of soluble matter. The saturated fabric may be cut into squares approximately 1 inch on each side in case an extraction apparatus of sufficient size to accommodate the whole strip is not available. Remove the desaturated fabric from the extraction apparatus, dry in air until free from the odor of benzol, and brush off any adhering particles of foreign matter. From a piece of the desaturated fabric (from which any sizing has been removed by bringing to a boil in a 0.5 percent sodium hydroxide solution), take at random 5 threads in the direction of the warp and 5 in the direction of the filling and separate the fibers in water on a microscope slide, so that the fibers are uniformly distributed. Dry the slides so prepared until all the water is removed, cool, and add a drop of zinc-chlor-iodide solution.¹

Cover the stained fibers with a cover glass, draw off the excess stain, and examine under a microscope with a magnification of about 100 diameters. The fibers should all be stained a wine-red color and should have the characteristic shape of cotton fiber.

F-4e. Thread count.—Count the number of threads to the inch in both the warp and filling at five different places. The average of these shall be taken as the threads per inch or thread count.

G. PACKAGING, PACKING, AND MARKING

G-1, Packaging.—Unless otherwise specified, commercial packages are acceptable under this specification.

G-2, Packing.—The rolls of treated cotton fabric shall be wound on mandrels not less than 2 inches in diameter and extending 2 to 4 inches beyond the ends of the rolls. They shall be securely tied or wrapped in a manner which will prevent unrolling in transit.

G-3. Marking.—Each package shall be legibly marked with a description of the contents, the name of the manufacturer, the place

¹ The Herzberg stain is made according to the following formula:

Solution A: 20 grams zinc chloride, 10 milliliters distilled water.

Solution B: 2.1 grams potassium iodide, 0.1 gram iodine, 5 milliliters distilled water.

of manufacture, the brand (if any), the net weight of the contents, and some means of identification of "the particular contract on which the purchase and shipment were made." Each shipment of the material shall be accompanied by printed directions for its use.

Dissolve solutions A and B separately, then mix and allow to stand several hours, or until all sediment has settled out. The clear liquid is then decanted into a dark-colored bottle and is ready for use. The stain shall be kept in the dark and should be tested before use on known fibers.

H. REQUIREMENTS APPLICABLE TO INDIVIDUAL DEPARTMENTS

H-1. The following departmental specifications, of the issue in effect on date of invitation for bids, shall respectively form a part of this specification.

H-1a. *Army*.—United States Army Specification No. 100-2, Standard Specification for Marking Shipments.

H-1b. *Navy*.—Navy Department purchases will be made under the issue in effect on date of invitation for bids of Bureau of Yards and Docks Specification No. 7 Y, Roofing, Siding, and Sheet Metal Work; Dampproofing and Membrane Waterproofing, copies of which may be obtained without cost upon application to the Bureau of Yards and Docks, Navy Department, Washington, D. C.

I. NOTES

I-1. Basis of purchase should be by the roll or by the square (100 square feet) according to agreement between purchaser and the seller.

I-2. Coal-tar-saturated fabric is intended for use with coal-tar pitch for waterproofing and dampproofing in the construction of membrane waterproofing.

I-3. It is believed that this specification adequately describes the characteristics necessary to secure the desired material, and that normally no samples will be necessary prior to award to determine compliance with this specification. If, for any particular purpose, samples with bids are necessary, they should be specifically asked for in the invitation for bid, and the particular purpose to be served by the bid sample should be definitely stated, the specification to apply in all other respects.

I-4. An alphabetical index of Federal Specifications may be obtained upon application as noted in paragraph next below, price to be obtained from the Superintendent of Documents.

I-5. Copies of this specification may be obtained upon application, accompanied by money order or coupon, or cash, to Superintendent of Documents, Government Printing Office, Washington, D. C. Price 5 cents.

Notice.—When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever, and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

U. S. GOVERNMENT PRINTING OFFICE : 1942

For sale by the Superintendent of Documents, Washington, D. C. Price 5 cents

SS-A-666

JUNE 6, 1933

SUPERSEDING

F.S. Nos. 84, 85

December 29, 1923

and

F.S. No. 85

June 1, 1934

FEDERAL STANDARD STOCK CATALOG

Section IV

(Part 5)

FEDERAL SPECIFICATION

FOR

ASPHALT; (FOR) BUILT-UP ROOFING,
WATERPROOFING, AND DAMP-PROOFING

This specification was approved for promulgation by the Federal Specifications Board on June 6, 1933, for the use of the departments and independent establishments of the Government in the purchase of this commodity, and shall become mandatory for all departments and independent establishments of the Government not later than December 1, 1933. It may be put into effect, however, at any earlier date, after promulgation.

A. APPLICABLE FEDERAL SPECIFICATIONS.

A-1. There are no other Federal Specifications applicable to this specification.

A-2. Any special requirements of the individual departments of the Government are noted under section H.

B. TYPES, CLASSES, AND GRADES

B-1. Asphalt shall be of the following types, classes and grades as specified in the invitation for bids.

Type I. Asphalt for surfaced, built-up roofing which may be of the following classes:

Class A, free from inorganic matter.

Class B, containing finely divided mineral matter.

Type II. Asphalt for unsurfaced built-up roofing, which shall be one of two grades as specified in the contract, as follows:

Grade 1. For use on inclines not exceeding 3 inches to the foot over boards and 1½ inches to the foot over concrete.

Grade 2. For use on inclines not exceeding 6 inches to the foot over boards and 3 inches to the foot over concrete.

Asphalt under either grade may be of the following classes:

Class A, free from inorganic matter.

Class B, containing finely divided mineral matter.

Type III. Asphalt for waterproofing and damp-proofing shall be free from inorganic matter.

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(Section IV, Part 5)

C. MATERIAL
C-1. Material shall be as specified under detail requirements.

D. GENERAL REQUIREMENTS
D-1. Basis of purchase.—Material is to be purchased by weight.

E. DETAIL REQUIREMENTS
E-1. Appearance.—Freshly melted material of both types shall be uniformly glossy, and on aging one week its surface shall not become dull or show any separation of oil, grease, paraffin scale, or similar material.

E-2. Physical and chemical requirements.—

	Type I		Type II		Type III	
	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
Softening point.....	74° C. (165° F.)	60° C. (140° F.)	74° C. (165° F.), grade 1. 88° C. (190° F.), grade 2.	86° C. (180° F.), grade 1. 74° C. (165° F.), grade 2.	77° C. (171° F.)	60° C. (140° F.)
Penetration (hundredths of a centimeter) at 0° C. (32° F.).....		10		10		10
Penetration (hundredths of a centimeter) at 25° C. (77° F.).....	50	25	50	20	50	25
Penetration (hundredths of a centimeter) at 46° C. (115° F.).....			100		100	
Ductility (centimeters) at 25° C. (77° F.).....		5		5		15
Volatile matter (percent) at 163° C. (325° F.).....	1.5		1.0		1.0	
Decrease in penetration (percent) at 25° C. (77° F.) after heating.....	40		40		40	
Ash (percent): ¹						
Class A.....	1		1		1	
Class B.....	35	10	35	10		
Coarse particles (inorganic matter retained on a no. 100 sieve) expressed as percentage of ash, class B only.....	2		2			

¹ The ash shall be mainly silica or silicates.

F. METHODS OF SAMPLING, INSPECTION, AND TESTS

Deliveries will, in general, be sampled and tested by the following methods, but the purchaser reserves the right to use any additional information to ascertain whether the material meets the specifications.

F-1. Sampling.—From each shipment select at random a number of packages equivalent to the cube root of the total number of pack-

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AMENDMENT-1
NOVEMBER 4, 1943

FEDERAL STANDARD STOCK CATALOG

Section IV

(Part 5)

FEDERAL SPECIFICATION

FOR

**ASPHALT; (FOR) BUILT-UP ROOFING, WATER-
PROOFING, AND DAMP-PROOFING***

This amendment was approved on the above date by the Director of Procurement, for the use of all departments and establishments of the Government, and shall become effective not later than Jan. 15, 1944. It may be put into effect, however, at any earlier date after promulgation.

The following change shall be made in Federal Specification SS-A-666, dated June 6, 1933:

Page SS-A-666-2:

Paragraph E-2:

Table: Type II, Ductility (centimeters) at 25° C. (77° F.),
Minimum: Delete "5" and substitute "4" for Grade 1 and
"3" for Grade 2.

*This amendment is intended to conserve critical or strategic materials. When the present emergency is over, this amendment will be considered for revision.

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U. S. GOVERNMENT PRINTING OFFICE: 1943

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(Section IV, Part 5)

SS-A-44-3
(June 1935)

ages included in the lot. If the cube root as calculated proves to be a fractional number, express it as the next higher digit.

Samples shall be taken at least 3 inches below the surface and at least 3 inches from the side of each container selected. A clean hatchet may be used if the material is hard enough to shatter and a broad, stiff putty knife if the material is soft. An auger, or brace and three fourths inch bit, or other suitable means may also be used. Avoid contamination with superficial water, wood slivers, or foreign matter.

The samples so taken shall be combined by melting together with constant stirring to prevent overheating, but the temperature must not exceed 200° C. (392° F.). When thoroughly melted, two 1-quart friction-top cans shall be filled with the well-mixed material, allowed to cool, tightly sealed, marked for identification with the manufacturer's name and brand, etc., and one transmitted to the testing laboratory. The other shall be retained for use in case of dispute.

F-2. Laboratory examination.—

F-2a. Appearance.—Carefully melt about 10 g of the asphalt at a temperature not exceeding 200° C. (392° F.) and pour it into a small tin box or other suitable container provided with a cover. At least one half the surface shall be free from froth or bubbles. Allow the asphalt to cool in a place free from drafts and dust. When cool, examine the surface, then cover with the lid and set aside for one week, after which period examine again. Immediately after cooling the surface shall be glossy black, and after standing one week the surface shall not show any dulling or the separation of paraffin scale or greasy or oily material.

F-2b. Softening point.—Determine the softening point by the method given in Bureau of Standards Research Paper No. 142, "The Ring and Ball Method of Test for Softening Point of Bituminous Materials, Resins, and Similar Substances", Bureau of Standards Journal of Research, Vol. 4, February 1930. Reprints of this paper are for sale by the Superintendent of Documents, Government Printing Office, Washington, D.C. Price 5 cents. This method is essentially as follows:

F-2b (1). Apparatus.—

F-2b (1) a. Ring.—A brass ring of the following dimensions:

Depth.— 6.35 ± 0.10 mm ($\frac{1}{4}$ inch).

Inside diameter at bottom.— 15.88 ± 0.10 mm ($\frac{5}{8}$ inch).

Inside diameter at top.—Not less than inside diameter at bottom nor more than 17.6 mm, preferably 17.46 mm ($1\frac{1}{8}$ inch).

Outside diameter at bottom.—Not less than 18.0 mm nor more than 21.0 mm.

Outside diameter at top.—Not less than outside diameter at bottom nor more than 21.0 mm.

The interior of the ring may be either tapered, within the tolerances given above, or cylindrical. (The tapered ring is to be preferred, as it can be used with all kinds of materials to which the ring and ball method is applicable. The cylindrical ring, while suitable for asphalts, cannot be used with materials that shrink away from the ring, such as resins and pitches.)

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The outside of the ring may be either uniformly cylindrical or smaller at the bottom provided the above dimensions are complied with. For convenience in mounting it is advisable to have it smaller at the bottom. (See fig. 1.)

F-2b (1)b. Ball.—A steel ball, such as used in ball bearings, 9.53 mm ($\frac{3}{8}$ inch) in diameter, weighing between 3.45 and 3.55 g.

F-2b (1)c. Container.—A glass vessel, capable of being heated, not less than 8.5 cm ($3\frac{1}{2}$ inches) in diameter and not less than 10.5 cm ($4\frac{1}{4}$ inches) in depth from the bottom of the flare. (A 600 ml beaker, low form.)

F-2b (1)d. Thermometer.—A total immersion thermometer meeting the following specification:

Type.—Etched stem, glass.

Liquid.—Mercury.

Ring and subdivision.—Minus 4° to $+104^{\circ}$ C. in 0.2° .

Total length.—454 to 460 mm.

Stem.—Plain front, enamel back, suitable thermometer tubing.

Diameter, 6.0 to 7.0 mm.

Bulb.—Corning normal or equally suitable thermometer glass.

Length, 20 to 30 mm. Diameter, not greater than stem.

Distance to -4° line from bottom of bulb.—50 to 70 mm.

Distance to $+104^{\circ}$ line from top of thermometer.—20 to 50 mm.

Filling above mercury.—Nitrogen gas.

Top finish.—Glass ring.

Graduation.—All lines, figures, and letters clear cut and distinct. Lines corresponding to even degree marks to be longer than the remaining lines. Graduations to be numbered at each multiple of 2° .

Immersion.—Total.

Scale error.—The error at any point of the scale, when the thermometer is standardized at total immersion, shall not exceed 0.3° .

Special marking.—A serial number and the manufacturer's name or trade mark shall be etched on the stem.

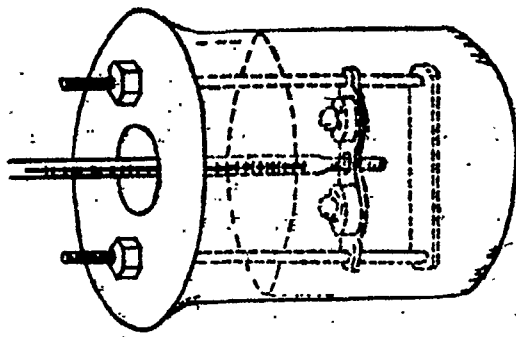
Case.—The thermometer shall be supplied in a suitable case, on which shall appear " -4° to $+104^{\circ}$ C. in 0.2° , total immersion."

The A.S.T.M. low softening point, -2° to $+80^{\circ}$ C. thermometer (see A.S.T.M. D-36-26) gives within its range readings identical with the -4° to $+104^{\circ}$ C. thermometer specified above.

F-2b (1)e. Support for ring and thermometer.—Any convenient method for supporting the ring may be used provided it meets the following requirements: The ring must be supported in a substantially horizontal position; the top of the ring must be at least 8 cm below the top of the container and the bottom of the ring 2.54 ± 0.02 cm (1 inch) above a horizontal plate or the bottom of the container; the distance from the center of the ring to thermometer bulb must be not more than 16.5 mm.

A device for centering the ball is desirable, but not essential.

F-2b (2). Preparation of sample.—Melt the sample and stir it thoroughly, avoiding incorporating air bubbles in the mass, and then pour it into the ring so as to leave an excess on cooling. The ring while being filled should rest on a brass plate that has been



ASSEMBLY
WITHOUT BALL CENTERING
DEVICE

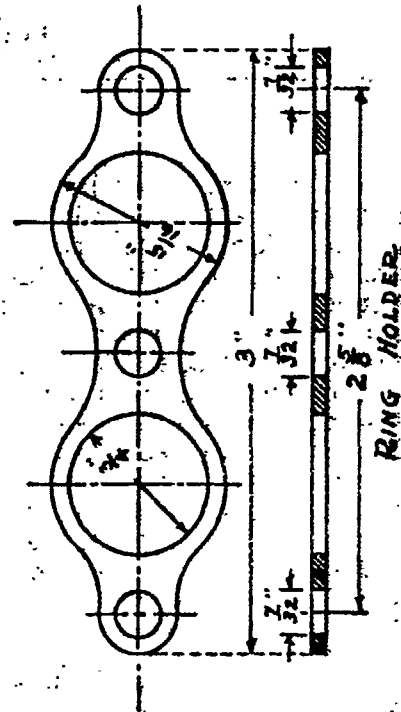
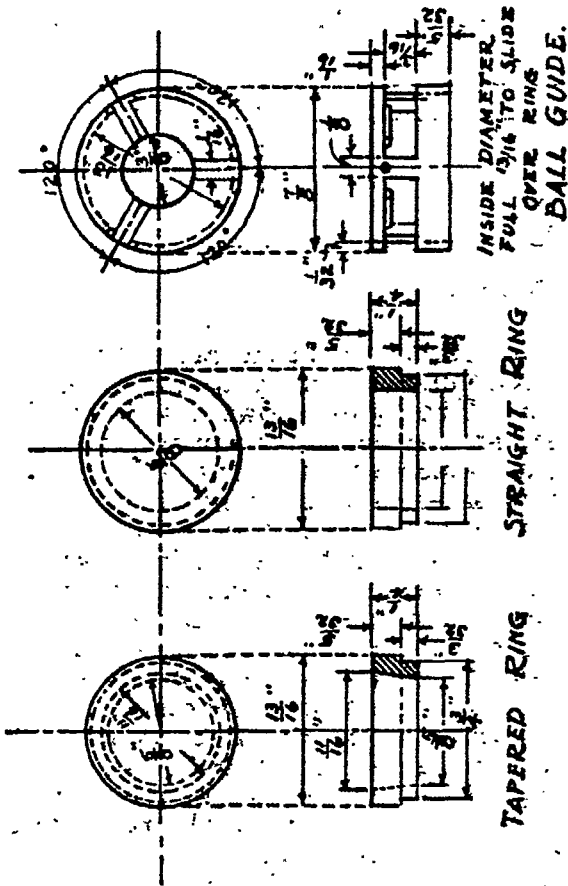
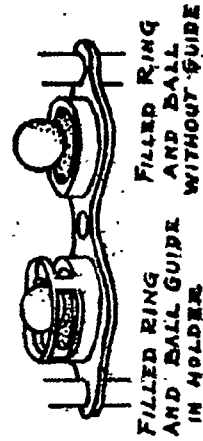


FIGURE 1.

amalgamated to prevent the sample from adhering to it. After cooling, cut off the excess material cleanly with a slightly heated knife. Determine the softening point within three hours after the sample is prepared.

F-2b (3). Procedure.—

F-2b (3) a. Asphalts having softening points 80° C. (176° F.) or lower.—Fill the glass container to a depth of not less than 9 cm with freshly boiled distilled water that has been cooled to not less than 45° C. (81° F.) below the softening point of the material under test, provided such softening point is not below 50° C. (122° F.). If the softening point is below 50° C. the water shall be cooled to not above 5° C. (41° F.). Place the filled ring and ball, but not in contact, in the bath and maintain the initial temperature for 15 minutes. Then place the ball in the center of the upper surface of the material in the ring, and at once suspend the support carrying the ring, ball (ball guide if used), and horizontal plate so that the

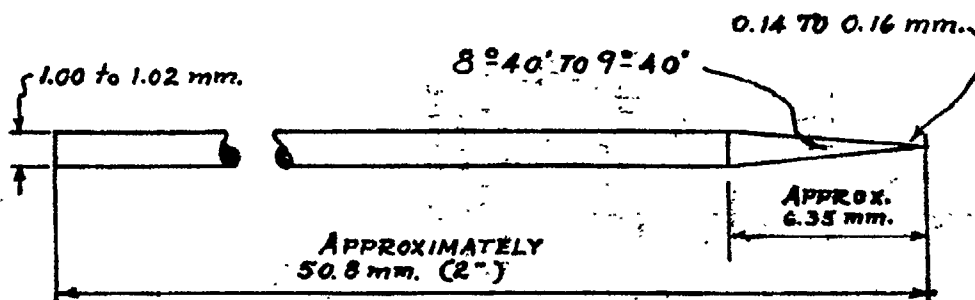


FIGURE 2.

top of the ring is not less than 5.1 cm below the surface of the water and the -4.0° to $+104^{\circ}$ C. thermometer is hanging approximately in the middle of the container. The figure shows details of ring, ball guide, support, container, and assembly of apparatus except tripod and burner. Apply heat in such a manner that the temperature of the water after the first three minutes of heating is raised uniformly 5° C. (9° F.) $\pm 0.5^{\circ}$ C. (1° F.) per minute. To facilitate uniform heating, it is advisable to place the burner midway between the center and the edge of the beaker away from the specimen. Report as the softening point the temperature indicated by the thermometer (adding or subtracting any certified corrections, but making no emergent stem corrections) at the instant the sample touches the horizontal plate or the bottom of the container.

F-2b (3) b. Asphalts having softening points higher than 80° C. (176° F.).—Use same method as given under F-2b(3)a except that instead of water U.S.P. glycerine shall be used as the bath.

F-2c. Penetration at 25° C. (77° F.).—Determine the penetration by the "Standard Method of Test for Penetration of Bituminous Materials", D-5-25, A.S.T.M. Standards, 1930, part II, p. 647, which is essentially as follows:

F-2c (1). Apparatus.—

F-2c (1)a. Container.—The container for holding the asphalt to be tested shall be a flat-bottomed cylindrical dish approximately 55 mm ($2\frac{1}{8}$ inches) in diameter and 35 mm ($1\frac{1}{4}$ inches) deep.¹

F-2c (1)b. Needle.—The needle (fig. 2) shall be a cylindrical steel rod approximately 50.8 mm (2 inches) long, having a diameter of 1.00 to 10.2 mm. This shall be symmetrically tapered at one end to a cone approximately 6.35 mm ($\frac{1}{4}$ inch) in height and whose angle shall be within the range of 8 degrees 40 minutes and 9 degrees 40 minutes. After tapering, the point shall be blunted by grinding off to a truncated cone, the smaller base of which shall be from 0.14 to 0.16 mm in diameter. The finished needle shall be hardened and highly polished.

F-2c (1)c. Water bath.—The water bath shall be maintained at a temperature not varying more than 0.1° C. from 25° C. (77° F.). The volume of the water shall be not less than 10 liters, and the sample shall be immersed to a depth of not less than 10 cm (4 inches) and shall be supported on a perforated shelf not less than 5 cm (2 inches) from the bottom of the bath.

F-2c (1)d. Penetration machine.—Any apparatus which will allow the needle to penetrate without appreciable friction and which is accurately calibrated to read in hundredths of a centimeter.

F-2c (1)e. Transfer dish.—The transfer dish for the container shall be a small dish or tray of such capacity as will insure complete immersion of the container during the test. It shall be provided with some means which will insure a firm bearing and prevent rocking of the container.

F-2c (2). Preparation of sample.—The sample shall be completely melted at the lowest possible temperature and stirred thoroughly until it is homogeneous and free from air bubbles. It shall then be poured into the sample container to a depth of not less than 15 mm (five eighths inch). The sample shall be protected from dust and allowed to cool in air at a temperature not lower than 18° C. (65° F.) for 1 hour. It shall then be placed in the water bath along with a transfer dish and allowed to remain 1 hour.

F-2c (3). Procedure.—In making the test the sample shall be placed in the transfer dish which has been filled with water from the water bath to a depth sufficient to completely cover the container. The transfer dish containing the sample shall then be placed upon the stand of the penetration machine. The needle, loaded with the specified weight (100 g) shall be adjusted to make contact with the surface of the sample and the dial adjusted to zero or its reading noted. The needle is then released for the specified period of time (5 seconds), after which its penetration is measured.

At least three tests shall be made at points on the surface of the sample not less than 1 cm (three eighths inch) from the side of the container, and not less than 1 cm (three eighths inch) apart. After each test, the sample and transfer dish shall be returned to the water bath, and the needle shall be carefully wiped toward its point with a clean dry cloth to remove all adhering asphalt. The penetration

¹ Gill style ointment box, deep pattern, made by the American Can Co., and of 3-ounce capacity, meets this requirement.

FEDERAL STANDARD STOCK CATALOG

(Section IV, Part 5)

reported shall be the average of at least three tests whose values shall not differ more than four hundredths of a centimeter between maximum and minimum.

F-2d. Penetration at 0° C. (32° F.).—This shall be determined as in F-2c at a temperature of 0° C. (32° F.) $\pm 0.2^\circ$ C. (0.4° F.), a 200 g load, and a period of 60 seconds instead of a temperature of 25° C. (77° F.), a load of 100 g, and a period of 5 seconds.

F-2e. Penetration at 46° C. (115° F.).—This shall be determined as in F-2c at a temperature of 46° C. (115° F.) $\pm 0.5^\circ$ C. (1° F.), a 50 g load and for a period of 5 seconds, instead of a temperature of 25° C. (77° F.), a load of 100 g, and a period of 5 seconds.

F-2f. Ductility.—The ductility shall be determined by "Tentative method of test for ductility of bituminous materials," D-113-26T, proceedings A.S.T.M., 1926, vol. 26, part I, page 886. This method is essentially as follows:

F-2f (1). Apparatus.—

F-2f (1)a. Mold.—The mold shall be of the shape shown in figure 3. It shall be made of brass, the ends b and b' being known as clips, and the parts a and a' as sides of the mold. The dimensions of the mold shall be as follows:

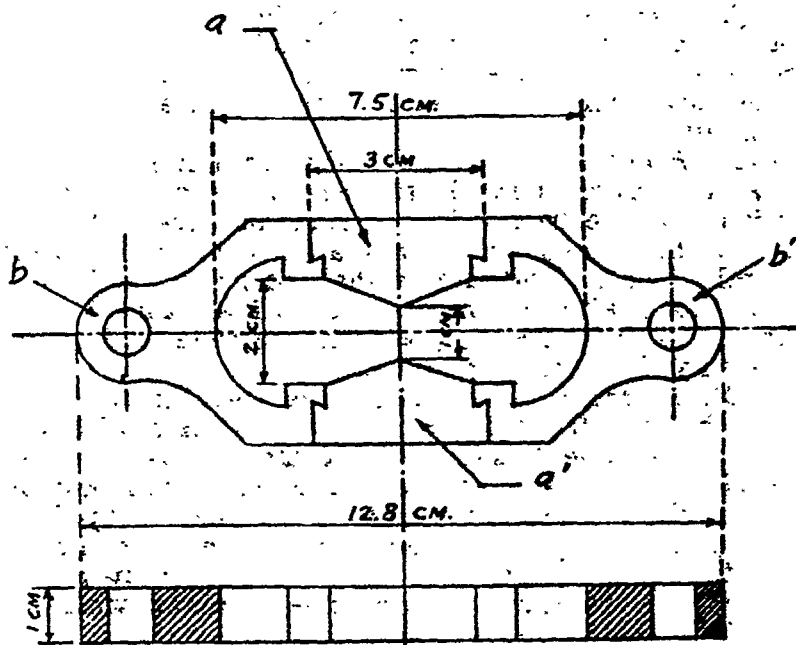


FIGURE 3.

	Cm
Total length (internal).....	7.45-7.55
Distance between clips.....	2.97-3.06
Width of clips at mouth.....	1.98-2.02
Width of briquet at minimum cross section (half way between clips).....	.99-1.01
Thickness of briquet throughout.....	.99-1.01

F-2f (1)b. Water bath.—Same as F-2c (1)c.

F-2f (1)c. Testing machine.—Any apparatus may be used for pulling the briquet of asphalt apart that is so constructed that the briquet will be continuously immersed in water and the two clips pulled apart at a uniform rate of 5 cm per minute.

F-2f (2). Procedure.—The mold shall be assembled on a brass plate, and the surface of the plate and the interior surfaces of the side pieces *A* and *A'* of the mold shall be thoroughly amalgamated, so as to prevent the asphalt from sticking. The asphalt shall be completely melted at the lowest temperature at which it will be thoroughly fluid and then poured into the standard mold. In filling, the asphalt shall be poured in a thin stream back and forth from end to end of the mold until it is more than level full. After cooling to room temperature for 30 minutes the excess asphalt shall be cut off by means of a hot putty knife, so that the mold will be just level full.

The brass plate and mold containing the briquet shall then be placed in the water bath and kept at a temperature of 25° C. (77° F.) for at least one and one half hours, when the briquet shall be removed from the plate and the side pieces *A* and *A'* detached.

The rings at each end of the clip shall then be attached to the pins or hooks in the ductility machine and the two clips pulled apart at a uniform rate of 5 cm per minute (± 5 percent). While the test is being made the water in the tank of the ductility machine shall cover the briquet by at least 2.5 cm and shall be kept continuously at a temperature of 25° C. (77° F.) ± 0.5 ° C. (1° F.). When the briquet of asphalt breaks, the distance from the original position of the clip before pulling to its present position shall be measured and shall be taken as the ductility. The average of three tests shall be taken, except that any obviously abnormal result shall be rejected.

F-2g. Volatile matter.—The volatile matter shall be determined by the "Standard Method of Test of Loss on Heating of Oil and Asphaltic Compounds", D-6-30, A.S.T.M. Standards, 1930, part II, page 638, which is essentially as follows:

F-2g (1) Apparatus—

F-2g (1)a. Oven.—A constant temperature oven so constructed that the temperature in all parts of the oven will not vary more than 1° C. An oven with a revolving shelf is recommended. The oven shall be well ventilated, and shall be provided with a window so that the thermometer can be read without opening the door. The source of heat shall be either gas or electricity.

F-2g (1)b. Thermometer.—Use either the thermometer specified in A.S.T.M. D-6-30 or any short accurate thermometer having a range including 155° to 175° C. graduated in $\frac{1}{2}$ ° C. or smaller subdivisions (an Anschutz thermometer is convenient.)

F-2g (1)c. Container.—Same as F-2c (1)a.

F-2g (2). Preparation of sample.—The sample as received shall be melted and thoroughly stirred to insure a complete mixture before the portion for test is removed.

F-2g (3). Procedure.—Place approximately 50 g of the asphalt, accurately weighed, in a tarred container and place in the constant-temperature oven, which has previously been heated to 163° C.

FEDERAL STANDARD STOCK CATALOG

(Section IV, Part 4)

(325° F.) $\pm 0.5^\circ$ C. (1° F.). Maintain this temperature for 5 hours, then remove the sample from the oven, cool, weigh and compute the loss as volatile matter.

Place the thermometer so that it will record the actual temperature to which the asphalt is exposed. If an oven of the revolving-shelf type is used, the thermometer may be laid on the shelf which shall be rotated five to six revolutions per minute.

F-2h. Penetration at 25° C. (77° F.) after heating.—The sample from test F-2g shall be melted at a temperature not exceeding 200° C. (392° F.) until fluid and thoroughly mixed. It shall then be allowed to cool to room temperature and tested for penetration as in F-2c at a temperature of 25° C. (77° F.), a load of 100 g, and for a period of 5 seconds.

F-2i. Ash.—About 1 g of asphalt accurately weighed shall be placed in a crucible of about 30 ml capacity and incinerated until the carbon is consumed and only mineral matter remains. Cool in a desiccator, and weigh. From the weights of the original sample and the ash obtained compute the percentage of ash. Determine nature of ash by usual methods of qualitative analysis.

F-2j. Coarse particles (inorganic matter retained on a no. 100 sieve) expressed as percentage of ash, class B, only. Weigh accurately into a 400 ml beaker an amount of sample, calculated from the percentage ash that will yield about 1 gram of mineral matter. Add a suitable organic solvent (benzol, carbon tetrachloride or chloroform are suitable solvents but benzol must be used in case of dispute) and warm until the asphalt is dissolved. Pour the solution through a weighed no. 100 sieve, wash all residue on to the sieve and wash sieve (with organic solvent) until free from asphalt. Dry and weigh sieve and contents.

From the weight of sample taken, the percentage ash and the weight of the residue retained on the sieve, compute the percentage of coarse particles in the mineral matter.

G. PACKAGING, PACKING, AND MARKING

G-1. Packaging.—Unless other wise specified, commercial packages are acceptable under this specification.

G-2. Packing.—Unless otherwise specified, the subject commodity shall be delivered in standard commercial containers, so constructed as to insure acceptance by common or other carriers for safe transportation; at the lowest rate, to the point of delivery.

G-3. Marking.—Each package shall be legibly marked with a description of the contents, the name of the manufacturer, the place of manufacture, the brand (if any), the weight of the contents, and some means of identification of the particular contract on which purchase and shipment were made. Each shipment of the material shall be accompanied by printed directions for its use.

H. REQUIREMENTS APPLICABLE TO INDIVIDUAL DEPARTMENTS

H-1. The following departmental specifications, of the issue in effect on date of invitation for bids, shall, respectively, form a part of this specification:

FEDERAL STANDARD STOCK CATALOG

(Section IV, Part 5)

SS-A-606-11
(June 1937)

H-1a. Army.—United States Army Specification No. 100-2, Standard Specification for Marking Shipments.

H-1b. Navy.—Navy Department purchases will be made under the issue in effect on date of invitation for bids of Bureau of Yards and Docks Specification No. 7Y, roofing, siding, and sheet-metal work; dampproofing and membrane waterproofing, copies of which may be obtained without cost upon application to the Bureau of Yards and Docks, Navy Department, Washington, D.C.

I. NOTES

I-1. It is believed that this specification adequately describes the characteristics necessary to secure the desired material, and that normally no samples will be necessary prior to award to determine compliance with this specification. If, for any particular purpose, samples with bids are necessary, they should be specifically asked for in the invitation for bids, and the particular purpose to be served by the bid sample should be definitely stated, the specification to apply in all other respects.

I-2. This specification governs all United States Government purchases of this commodity. Users are requested to retain this specification in permanent file until a revision is issued.

I-3. Interested parties are advised that an Alphabetical Index of Federal Specifications may be obtained upon application as noted in paragraph next below, price to be obtained from the Superintendent of Documents.

I-4. Copies of this specification may be obtained upon application, accompanied by money order or coupon, or cash, to Superintendent of Documents, Government Printing Office, Washington, D.C. Price, 5 cents.

Notice.—When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility or any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

U. S. GOVERNMENT PRINTING OFFICE : 1941

For sale by the Superintendent of Documents, Washington, D. C. - Price 5 cents

BIRD 004863

600-700

SS-A-696

JUNE 23, 1931

**SUPERSEDING
F. S. B. No. 277
May 8, 1925.**

FEDERAL STANDARD STOCK CATALOGUE

Section IV

(Part 5)

FEDERAL SPECIFICATION

FOR

ASPHALT; PETROLEUM, TYPE PAF-1-25 (FOR) JOINT-FILLER (SQUEEGEE OR POURING METHOD)

This specification was approved for promulgation by the Federal Specifications Board on June 23, 1931, for the use of the departments and independent establishments of the Government in the purchase of this commodity, and shall become mandatory for all departments and independent establishments of the Government not later than March 1, 1932. It may be put into effect, however, at any earlier date, after promulgation.

A. APPLICABLE FEDERAL SPECIFICATIONS.

A-1. There are no other Federal specifications applicable to this specification.

A-2. Any special requirements of the individual departments of the Government are noted under section H.

B. GRADE.

B-1. This specification covers one grade only.

C. MATERIAL.

C-1. Material supplied under this specification shall be asphalt prepared from suitable asphaltic petroleum.

D. GENERAL REQUIREMENTS.

D-1. The petroleum asphalt shall be homogeneous, free from water, and shall not foam when heated to 200° C. (392° F.).

E. DETAIL REQUIREMENTS.

E-1. *Physical and chemical properties.*—The petroleum asphalt shall meet the following requirements:

E-1a. Flash point, not less than 200° C. (392° F.).

E-1b. Softening point, 65° C. (149° F.) to 110° C. (230° F.).

E-1c. Penetration at 25° C. (77° F.), 100 grams, 5 seconds, 30 to 50. Penetration at 0° C. (32° F.), 200 grams, 1 minute, not less than 10.

Penetration at 46.1° C. (115° F.), 50 grams, 5 seconds, not more than 110.

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FEDERAL STANDARD STOCK CATALOGUE

(Section IV, Part 5)

E-1d. Ductility at 25° C. (77° F.), not less than 2 centimeters.

E-1e. Loss at 163° C. (325° F.), 5 hours, not more than 1 per cent.

E-1e(1). Penetration of residue at 25° C. (77° F.), 100 grams, 5 seconds, as compared to penetration before heating, not less than 60 per cent.

E-1f. Bitumen (soluble in carbon disulphide), not less than 99 per cent.

E-1g. Proportion of bitumen soluble in carbon tetrachloride, not less than 99 per cent.

F. METHODS OF TESTS.

F-1. Tests of the physical and chemical properties of the petroleum asphalt shall be made in accordance with the following methods:

F-1a. *Flash point*.—A.S.T.M. Standard Method D92-24.

F-1b. *Softening point*.—A.S.T.M. Standard Method D36-26.

F-1c. *Penetration*.—A.S.T.M. Standard Method D5-25.

F-1d. *Ductility*.—A.S.T.M. Tentative Standard Method D113-26T.

F-1e. *Loss on heating*.—A.S.T.M. Standard Method D6-30.

F-1f. *Bitumen (soluble in carbon disulphide)*.—A.S.T.M. Standard Method D4-27.

F-1g. *Proportion of bitumen soluble in carbon tetrachloride*.—A.S.T.M. Standard Method D165-27.

G. PACKING AND MARKING.

G-1. Packaging, packing, and marking shall be in accordance with commercial practice unless otherwise specified.

G-2. Any special requirements of the individual departments are noted under section H.

H. REQUIREMENTS APPLICABLE TO INDIVIDUAL DEPARTMENTS.

H-1. The following departmental specifications of the issue in effect on date of invitation for bids shall respectively form a part of this specification:

H-1a. Army: U. S. Army Specification No. 100-2, Standard Specification for Marking Shipments.

H-1b. Navy: Navy Department General Specifications for Inspection of Material, copies of which may be obtained without cost upon application to the Bureau of Supplies and Accounts, Navy Department, Washington, D. C.

I. NOTES.

I-1. The material covered by this specification is intended for use in filling the joints of brick pavements. It may also be used to fill expansion joints or the wider cracks in concrete pavements.

I-2. It is believed that this specification adequately describes the characteristics necessary to secure the desired material, and that normally no samples will be necessary prior to award to determine compliance with this specification. If, for any particular purpose, samples with bids, are necessary, they should be specifically asked for in the invitation for bids, and the particular purpose to be served by the bid sample should be definitely stated, the specification to apply in all other respects.

SS-A-696
AMENDMENT—1
JUNE 17, 1937

FEDERAL STANDARD STOCK CATALOG

Section IV

(Part 5)

FEDERAL SPECIFICATION

FOR

**ASPHALT; PETROLEUM, TYPE PAF-1-25 (FOR)
JOINT-FILLER (SQUEEGEE OR POURING METH-
OD)**

This Amendment was approved on the above date by the Director of Procurement, for the use of all departments and establishments of the Government, and shall become effective, not later than January 1, 1938. It may be put into effect, however, at any earlier date after promulgation.

The following correction should be made in Federal Specification SS-A-696, dated June 23, 1931:

Page 1:

Paragraph E-1c:

Line 1—delete "30 to 50" and substitute "25 to 40".

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FEDERAL STANDARD STOCK CATALOGUE
(Section IV, Part 5)

SS-A-696-3
(June, 1931)

I-3. This specification governs all United States Government purchases of this commodity. Users are requested to retain this specification in permanent file until a revision is issued.

I-4. Interested parties are advised that an Alphabetical Index of Federal Specifications may be obtained upon application as noted in paragraph next below, price to be obtained from the Superintendent of Documents.

I-5. Copies of this specification may be obtained upon application, accompanied by money order or coupon or cash to Superintendent of Documents, Government Printing Office, Washington, D. C. Price 5 cents.

Notice.—When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use or sell any patented invention that may in any way be related thereto.

U. S. GOVERNMENT PRINTING OFFICE: 1931

For sale by the Superintendent of Documents, Washington, D. C. Price 5 cents.

BIRD 004868

700-800

SS-A-701

AUGUST 1, 1933

SUPERSEDING
F. S. No. 87
December 29, 1923

FEDERAL STANDARD STOCK CATALOG

Section IV

(Part 5)

FEDERAL SPECIFICATION

FOR

**ASPHALT-PRIMER; (FOR) ROOFING AND
WATERPROOFING**

This specification was approved for promulgation by the Federal Specifications Board on August 1, 1933, for the use of the departments and independent establishments of the Government in the purchase of this commodity, and shall become mandatory for all departments and independent establishments of the Government not later than March 15, 1934. It may be put into effect, however, at any earlier date, after promulgation.

A. APPLICABLE FEDERAL SPECIFICATIONS

A-1. There are no other Federal Specifications applicable to this specification.

A-2. Special requirements of individual departments of the Government are noted under section H.

B. TYPE

B-1. Asphalt primer shall be of but one type.

C. MATERIAL

C-1. Asphalt primer shall consist of an asphaltic base thinned to suitable brushing consistency with a volatile solvent.

D. GENERAL REQUIREMENTS

D-1. Material is to be purchased by weight or volume as specified in the contract.

E. DETAIL REQUIREMENTS

E-1. Asphaltic base.—The asphaltic base separated as in F-2b shall be not less than 35 percent by weight and shall have the following characteristics:

	Maximum	Minimum
Softening point (ring and ball method).....	77° C. (170° F.)	55° C. (131° F.)
Penetration (hundredths of a centimeter) at 25° C. (77° F.).....	50	15

FEDERAL STANDARD STOCK CATALOG

(Section IV, part 5)

E-2. Solvent.—The solvent separated as in F-2b shall be a hydrocarbon distillate, having the following characteristics when distilled according to the method given in F-2d:

	Maximum	Minimum
Distillate under 120° C. (248° F.)	(%) 20	
End point	200° C. (500° F.)	

F. METHODS OF SAMPLING AND TESTING

Deliveries will, in general, be sampled and tested by the following methods, but the purchaser reserves the right to use any additional information to ascertain whether the material meets the specification.

F-1. Sampling.—

F-1a. From each shipment or portion thereof, the inspector shall select at random a number of packages equivalent to the cube root of the total number of packages in the lot. If the cube root as calculated proves to be a fractional number, it shall be expressed as the next higher whole number.

By means of a paddle, the contents of each package selected shall be thoroughly stirred so as to get a homogenous mixture. One pint of the primer shall then be immediately drawn from each package and transferred to a clean receptacle of suitable size, which, in turn, shall be kept tightly covered except when samples are being introduced. After all the pint samples have been added, the contents of the container shall be thoroughly stirred, and two 1-quart samples of the composite sample shall be transferred to a clean, dry container which shall immediately be stoppered with a new clean cork or well-fitting cover or cap, sealed, and distinctly labeled. One sample shall be transmitted to the testing laboratory, the other shall be retained for check analysis in case of dispute.

F-2. Laboratory examination.—

F-2a. Weight of asphaltic base.—A portion of the sample shall be placed in a stoppered bottle or weighing pipette and weighed. About 1.5 g of the sample shall be transferred to a flat-bottomed metal dish about 8 cm in diameter (a friction top can plug). The container shall be weighed again and the exact weight of the portion of the sample transferred to the weighed dish shall be computed by difference. The dish with its contents shall be heated in an oven at 105 to 110° C. (221 to 230° F.) for 3 hours, cooled, and weighed. From the weight of the residue left in the dish and the weight of the sample taken, the percentage of nonvolatile residue (asphaltic base) shall be computed.

F-2b. Separation of asphaltic base and solvent for examination.—About 250 grams of the primer shall be distilled with steam until no appreciable amount of solvent distills over. Heat the residue, with constant stirring, until all of the water is expelled and there is no further danger of foaming. The distillation is best carried out in a cylindrical copper still in which the water may be removed from the residue by heating with a ring burner; starting with the burner placed near the top and gradually lowering it. The temperature must not exceed 150° C. (300° F.). Transfer the residue to an oven

at 105° to 110° C. (221° to 230° F.) until any remaining solvent is removed.

F-2c. Examination of asphaltic base.—Test the asphaltic base separated in F-2b for softening point and penetration as follows:

F-2c (1). Softening point.—Determine the softening point by the method given in Bureau of Standards Research Paper No. 142, The Ring and Ball Method of Test for Softening Point of Bituminous Materials, Resins, and Similar Substances, Bureau of Standards Journal of Research, vol. 4, February 1930. (Reprints of this paper are for sale by the Superintendent of Documents, Government Printing Office, Washington, D.C. Price 5 cents).

This method is essentially as follows:

F-2c (1) a. Apparatus.—

F-2c (1) a (1). Ring.—

A brass ring of the following dimensions:

Depth.— 6.35 ± 0.10 mm ($\frac{1}{4}$ inch).

Inside diameter at bottom.— 15.88 ± 0.10 mm ($\frac{5}{8}$ inch).

Inside diameter at top.—Not less than inside diameter at bottom nor more than 17.6 mm, preferably 17.46 mm ($1\frac{1}{16}$ inch).

Outside diameter at bottom.—Not less than 18 mm nor more than 21 mm.

Outside diameter at top.—Not less than outside diameter at bottom nor more than 21 mm.

The interior of the ring may be either tapered, within the tolerances given above, or cylindrical. (The tapered ring is to be preferred as it can be used with all kinds of materials to which the ring and ball method is applicable. The cylindrical ring, while suitable for asphalts, cannot be used with materials that shrink away from the ring, such as resins and pitches.)

The outside of the ring may be either uniformly cylindrical or smaller at the bottom provided the above dimensions are complied with. For convenience in mounting it is advisable to have it smaller at the bottom. (See fig. 1.)

F-2c (1) a (2). Ball.—

A steel ball, such as used in ball bearings, 9.53 mm ($\frac{3}{8}$ inch) in diameter weighing between 3.45 and 3.55 g.

F-2c (1) a (3). Container.—

A glass vessel, capable of being heated, not less than 8.5 cm ($3\frac{3}{4}$ inches) in diameter and not less than 10.5 cm ($4\frac{1}{8}$ inches) in depth from the bottom of the flare. (A 600 ml beaker, low form.)

F-2c (1) a (4). Thermometer.—

A total immersion thermometer meeting the following specification:

Type.—Etched stem, glass.

Liquid.—Mercury.

Range and subdivision.—Minus 4° to $\pm 104^\circ$ C. in 0.2°

Total length.—454 to 460 mm.

Stem.—Plain front, enamel back, suitable thermometer tubing. Diameter, 6 to 7 mm.

Bulb.—Corning normal or equally suitable thermometric glass. Length 20 to 30 mm. Diameter, not greater than stem.

Distance to.—4° line from bottom of bulb—50 to 70 mm.

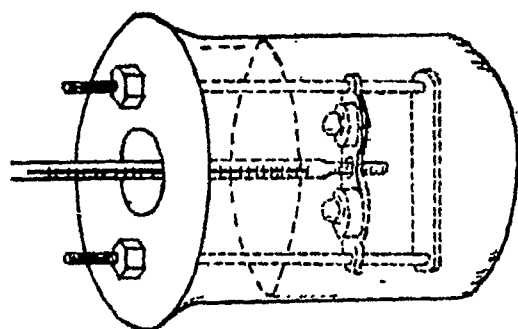
Distance to.—104° line from top of thermometer—20 to 50 mm.

Filling above mercury.—Nitrogen gas.

Top finish.—Glass ring.



FEDERAL STANDARD STOCK CATALOG
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ASSEMBLY
WITHOUT BALL CENTERING
DEVICE

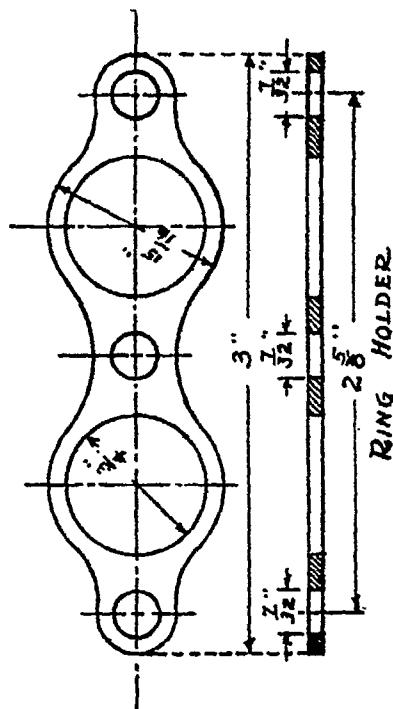
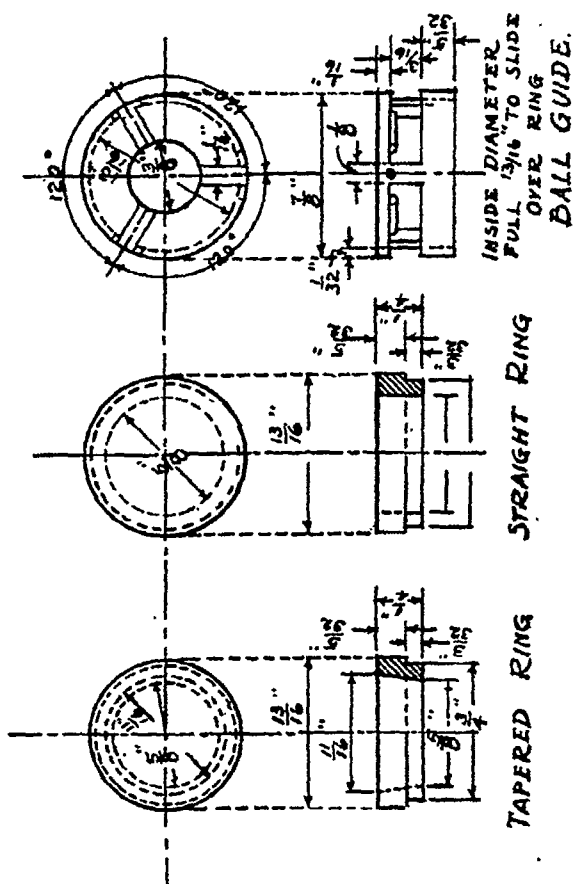
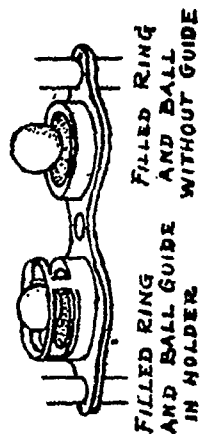


FIGURE 1.

Graduation.—All lines, figures, and letters clear cut and distinct. Lines corresponding to even degree marks to be longer than the remaining lines. Graduations to be numbered at each multiple of 2° .

Immersion.—Total.

Scale error.—The error at any point of the scale, when the thermometer is standardized at total immersion, shall not exceed 0.3° .

Special marking.—A serial number and the manufacturer's name or trade mark shall be etched on the stem.

Case.—The thermometer shall be supplied in a suitable case, on which shall appear " -4° to $+104^{\circ}$ C. in 0.2° , total immersion."

The A.S.T.M. low S.P., -2° to $+80^{\circ}$ C. thermometer (see A.S.T.M. D-36-26) gives within its range readings identical with the -4° to $+104^{\circ}$ C. thermometer specified above.

F-2c (1) a (5). Support for ring and thermometer.—

Any convenient method for supporting the ring may be used provided it meets the following requirements: The ring must be supported in a substantially horizontal position; the top of the ring must be at least 8 cm below the top of the container and the bottom of the ring 2.54 ± 0.02 cm (1 inch) above a horizontal plate or the bottom of the container; the distance from the center of the ring to thermometer bulb must be not more than 16.5 mm.

A device for centering the ball is desirable, but not essential.

F-2c (1) b. Preparation of sample.—

Melt the sample and stir it thoroughly, avoiding incorporating air bubbles in the mass, and then pour it into the ring so as to leave an excess on cooling. The ring while being filled should rest on a brass plate that has been amalgamated to prevent the sample from adhering to it. After cooling, cut off the excess material cleanly with a slightly heated knife. Determine the softening point within 3 hours after the sample is prepared.

F-2c (1) c. Procedure.—

Fill the glass container to a depth of not less than 9 cm with freshly boiled distilled water that has been cooled to not less than 45° C. (81° F.) below the softening point of the material under test, provided such softening point is not below 50° C. (122° F.). If the softening point is below 50° C. the water shall be cooled to not above 5° C. (41° F.). Place the filled ring and ball, but not in contact, in the bath and maintain the initial temperature for 15 minutes. Then place the ball in the center of the upper surface of the material in the ring, and at once suspend the support carrying the ring, ball (ball guide if used), and horizontal plate so that the top of the ring is not less than 5.1 cm below the surface of the water and the -4.0° to $+104^{\circ}$ C. thermometer is hanging approximately in the middle of the container. The figure shows details of ring, ball guide, support, container, and assembly of apparatus except tripod and burner. Apply heat in such a manner that the temperature of the water after the first 3 minutes of heating is raised uniformly 5° C. (9° F.) $\pm 0.5^{\circ}$ C. (1° F.) per minute. To facilitate uniform heating, it is advisable to place the burner midway between the center and the edge of the beaker away from the specimen. Report as the softening point the temperature indicated by the thermometer (adding or subtracting any certified corrections, but making no emergent stem corrections) at the instant the sample touches the horizontal plate or the bottom of the container.

F-2c (2). Penetration at 25° C. (77° F.).—Determine the penetration by the "Standard Method of Test for Penetration of Bituminous Materials", D5-25, A.S.T.M. Standards, 1930, Part 11, p. 647, which is essentially as follows:

F-2c (2) a. Apparatus.—

F-2c (2) a (1). Container.—The container for holding the asphalt to be tested shall be a flat-bottomed cylindrical dish approximately 55 mm ($2\frac{1}{16}$ inches) in diameter and 35 mm ($1\frac{3}{8}$ inches) deep.¹

F-2c (2) a (2). Needle.—The needle (fig. 2) shall be a cylindrical steel rod approximately 50.8 mm (2 inches) long, having a diameter of 1.00 to 1.02 mm. This shall be symmetrically tapered at one end to a cone approximately 6.35 mm ($\frac{1}{4}$ inch) in height and whose angle shall be within the range of 8° 40' and 9° 40'. After tapering, the point shall be blunted by grinding off to a truncated cone, the smaller base of which shall be from 0.14 to 0.16 mm in diameter. The finished needle shall be hardened and highly polished.

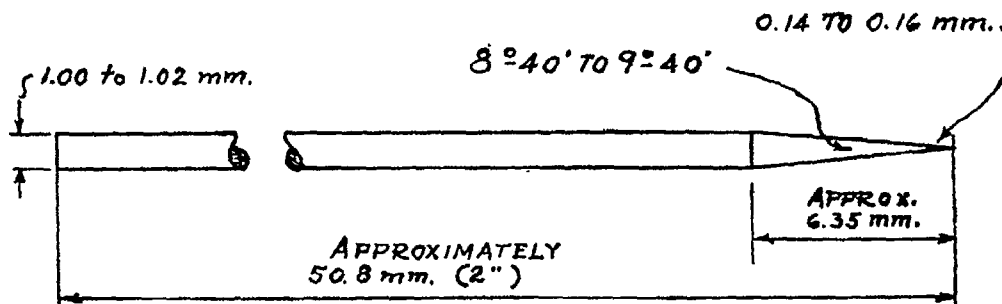


FIGURE 2.

F-2c (2) a (3). Water bath.—The water bath shall be maintained at a temperature not varying more than 0.1° C. from 25° C. (77° F.). The volume of the water shall be not less than 10 liters, and the sample shall be immersed to a depth of not less than 10 cm (4 inches) and shall be supported on a perforated shelf not less than 5 cm (2 inches) from the bottom of the bath.

F-2c (2) a (4). Penetration machine.—Any apparatus which will allow the needle to penetrate without appreciable friction and which is accurately calibrated to read in hundredths of a centimeter.

F-2c (2) a (5). Transfer dish.—The transfer dish for the container shall be a small dish or tray of such capacity as will insure complete immersion of the container during the test. It shall be provided with some means which will insure a firm bearing and prevent rocking of the container.

F-2c (2) a (6). Preparation of sample.—The sample shall be completely melted at the lowest possible temperature and stirred thoroughly until it is homogeneous and free from air bubbles. It shall then be poured into the sample container to a depth of not less than 15 mm ($\frac{5}{8}$ inch). The sample shall be protected from dust and allowed to cool in air at a temperature not lower than 18° C. (65° F.) for 1 hour. It shall then be placed in the water bath along with a transfer dish and allowed to remain 1 hour.

¹ A Gill style ointment box, deep pattern, made by the American Can Co., and of 3-ounce capacity, meets this requirement.

FEDERAL STANDARD STOCK CATALOG

(Section IV, part 5)

SS-A-701-7
(Aug. 1935)

F-2c (2) b. Procedure.—In making the test the sample shall be placed in the transfer dish, which has been filled with water from the water bath to a depth sufficient to completely cover the container. The transfer dish containing the sample shall then be placed upon the stand of the penetration machine. The needle, loaded with the specified weight (100 g) shall be adjusted to make contact with the surface of the sample and the dial adjusted to zero or its reading noted. The needle is then released for the specified period of time (5 seconds), after which its penetration is measured.

At least 3 tests shall be made at points on the surface of the sample not less than 1 cm ($\frac{3}{8}$ inch) from the side of the container, and not less than 1 cm ($\frac{3}{8}$ inch) apart. After each test, the sample and transfer dish shall be returned to the water bath, and the needle shall be carefully wiped toward its point with a clean dry cloth to remove all adhering asphalt. The penetration reported shall be the average of at least three tests whose values shall not differ more than $\frac{1}{100}$ centimeter between maximum and minimum.

F-2d. Examination of solvent.—The solvent separated in F-2b shall be distilled according to the Standard Method for Test for Distillation of Gasoline, Naphtha, Kerosene, and Similar Petroleum Products, D 86-30, A.S.T.M.; Standards, 1930, part II, p. 491. This method is also described in Federal Specification TT-T-291 for Volatile Mineral Spirits for Thinning Paints.

G. PACKAGING, PACKING, AND MARKING

G-1. Packaging.—Unless otherwise specified, commercial packages are acceptable under this specification.

G-2. Packing.—Unless otherwise specified, the subject commodity shall be delivered in standard commercial containers, so constructed as to insure acceptance by common or other carriers, for safe transportation, at the lowest rate, to the point of delivery.

G-3. Marking.—Each package shall be legibly marked with a description of the contents, the name of the manufacturer, the place of manufacture, the brand (if any), the net weight or net liquid measure of the contents, and some means of identification of "the particular contract on which purchase and shipment were made." Each shipment of the material shall be accompanied by printed directions for its use.

H. REQUIREMENTS APPLICABLE TO INDIVIDUAL DEPARTMENTS

H-1. The following departmental specifications, of the issue in effect on date of invitation for bids, shall respectively form a part of this specification.

H-1a. Army.—United States Army Specification No. 100-2, Standard Specification for Marking Shipments.

H-1b. Navy Department purchases will be made under the issue in effect on date of invitation for bids of Bureau of Yards and Docks Specification No. 7Y, Roofing, Siding, and Sheet Metal Work; Damp-proofing and Membrane Waterproofing, copies of which may be obtained without cost upon application to the Bureau of Yards and Docks, Navy Department, Washington, D.C.

FEDERAL STANDARD STOCK CATALOG

(Section IV, part 5)

I. NOTES

I-1. This specification applies to asphalt primer intended for use, when specified, as a priming coat for concrete, gypsum, and other masonry surfaces over which asphalt built-up roofing, waterproofing, or dampproofing are to be applied.

I-2. It is believed that this specification adequately describes the characteristics necessary to secure the desired material, and that normally no samples will be necessary prior to award to determine compliance with this specification. If, for any particular purpose, samples with bids are necessary, they should be specifically asked for in the invitation for bids, and the particular purpose to be served by the bid sample should be definitely stated, the specification to apply in all other respects.

I-3. This specification governs all United States Government purchases of this commodity. Users are requested to retain this specification in permanent file until a revision is issued.

I-4. An alphabetical Index of Federal Specifications may be obtained upon application as noted in paragraph next below; price to be obtained from the Superintendent of Documents.

I-5. Copies of this specification may be obtained upon application, accompanied by money order or coupon, or cash, to Superintendent of Documents, Government Printing Office, Washington, D.C.

Notice.—When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

U. S. GOVERNMENT PRINTING OFFICE : 1938

For sale by the Superintendent of Documents, Washington, D.C. . . . Price 5 cents

NAVY DEPARTMENT
BUREAU OF YARDS AND DOCKS

NO. 611
SUPERSEDING
No. 7Y
DECEMBER 1, 1924

SPECIFICATION
FOR
ROOFING,
SIDING, AND SHEET METAL WORK;
DAMPPROOFING AND MEMBRANE
WATERPROOFING



UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1933

In the paragraphs so noted the technical requirements of this specification conform in detail to the Federal specifications (as approved by the Federal Specifications Board), the numbers of which are given. Copies of Federal specifications are not necessary and are not available for distribution by the Navy Department.

No. 7Yg

JANUARY 2, 1934

Addendum No. 1

OCTOBER 1935

NAVY DEPARTMENT

BUREAU OF YARDS AND DOCKS

SPECIFICATION

FOR

ROOFING, SIDING, AND SHEET METAL WORK; DAMPPROOFING AND MEMBRANE WATERPROOFING

SECTION 1. MATERIALS.

1-10. Felts for built-up roofing, flashing, and waterproofing, etc.—At the end of the paragraph, change “HH-F-241” to “HH-F-201”.

Table III. Under class RT14, change “HH-F-F-241” to “HH-F-201”.

1-14. Asbestos shingles and ridge and hip rolls, etc.—Delete the entire paragraph and substitute the following:

“1-14x. Asbestos shingles and ridge and hip rolls shall be made of portland cement and asbestos fibers or these with the addition of pigments and/or mineral granules as necessary to produce the specified colors. They shall have a dense, hard structure and shall be seasoned thoroughly. Shingles shall be uniform or tapered in thickness from butt to head, rectangular; and designed to be laid with a 2-inch head lap according to the American method. Shingles, except those for starter courses, shall be 8 by 16 inches and shall have minimum thicknesses of $\frac{1}{2}$ inch for uniform-thickness shingles, and $\frac{1}{4}$ inch at the butt and $\frac{1}{8}$ inch at the head for tapered shingles; starter shingles for first courses shall be 9 by 18 inches and shall have a minimum thickness of $\frac{1}{4}$ inch. A plus tolerance of not more than $\frac{1}{16}$ inch and a minus tolerance of $\frac{1}{4}$ inch will be allowed for individual shingles on all thicknesses. The average thickness of the butts of a sample consisting of 10 shingles shall be not less than the specified thickness. The thickness of rough-surface shingles shall be taken as the average at projections and depressions. A plus or minus tolerance of $\frac{1}{8}$ inch will be permitted in the widths and lengths. Shingles exceeding the specified width by not more than $1\frac{1}{2}$ inches and the specified length by not more than $2\frac{1}{2}$ inches will be accepted, provided that the total area of the shingles and the roof area that they will cover will be not less than those for the number of standard size

requisitioned. Asbestos ridge and hip rolls shall be the arc of a circle in cross section, about 5 inches wide. The shingles and rolls shall be furnished with holes ready for fastening. Shingles shall be whole and clean; not more than 2 percent of broken shingles will be accepted. Shingles and rolls shall have smooth or rough exposed surface and even or irregular edges, and shall be in various shades of gray, red, brown, black, buff, purple, green, and mixtures of these colors, all as required by the special specification. Colors other than the normal gray shall be obtained by embedding lime-proof mineral pigments or mineral granules, or both, in the exposed face, or by chemical impregnation. The color shall cover butt edges $\frac{1}{4}$ inch and over in thickness. The colors shall not fade appreciably on exposure to light and atmospheric conditions. The average absorption of the shingles after immersion in water for 24 hours shall be not more than $17\frac{1}{2}$ percent of their dry weight. The average modulus of rupture of the shingles in pounds per square inch shall not be less than 3,000 when tested dry, 1,250 when tested after immersion in water for 24 hours, and 3,000 when tested after cooling following heating for 4 hours at an average temperature of 600 degrees F. Nails for securing the shingles and rolls to sheathing shall be furnished in the proper quantity. They shall be $1\frac{1}{4}$ -inch zinc-coated iron or copper slating nails; nails which come in contact with copper work shall be copper. Copper clips shall be furnished for securing rolls. (*F. S. no. SS-S-291, types A and B*)."

1-15. Wood shingles, etc.—Delete the first sentence and substitute the following: "Wood shingles shall be red cedar shingles, no. 1 grade, in accordance with the latest grading and packing rules of the Red Cedar Shingle Bureau; or cypress shingles, grade bests, in accordance with the latest rules of the Southern Cypress Manufacturers' Association."

1-22. Tin, etc.—At the end of the paragraph, add "Sheets shall be 20 by 28 inches for standing-seam work and 14 by 20 inches for flat-seam work."

1-26. Insulating board for roof decks, etc.—Delete the entire paragraph and substitute the following:

"1-26x. Insulating board for roof decks shall be $\frac{1}{2}$ - or 1-inch thick as required by the special specification and/or its accompanying drawings. A tolerance in thickness of plus or minus $\frac{1}{16}$ inch will be permitted. It shall be manufactured from wood or other vegetable fiber by a felting or molding process, suitable sizing material being incorporated to render it water resistant. The material shall be subjected to drying temperatures that will effect complete destruction of rot-producing fungi. The finished boards may be single or multiple ply. A suitable moisture-resistant cement shall be used to join the plies of multiple-ply boards. The surfaces shall be natural and shall be free from cracks, lumps, excessive departures from planeness, and other defects. Edges shall be square. Insulating board shall have a thermal conductivity of not more than 0.36 B. t. u. per hour per

square foot per inch of thickness per degree F. difference in temperature; the conductance of any board irrespective of thickness shall not be greater than 0.72 B. t. u. per hour per square foot per degree F. The transverse strength both lengthwise and crosswise of the boards for a 3-inch width and at a 12-inch span shall be not less than 7 pounds for $\frac{1}{2}$ -inch thickness and 14 pounds for 1-inch thickness. The deflection at the ultimate load in the transverse-strength test shall be not less than $\frac{1}{4}$ inch nor more than $1\frac{1}{4}$ inches. Insulating boards shall have an average tensile strength of not less than 100 pounds per square inch and a water absorption after 2 hours submersion of not more than 10 percent. (F. S. no. LLL-F-321a, class C.)"

After paragraph 1-27, insert the following:

"1-28x. Nails shall be in accordance with the edition of Federal specification no. FF-N-101 in effect on the date of invitation for bids."

SECTION 2. APPLICATION.

2-10. **Shingle (asbestos and wood) and slate roofing.**—Delete the fourth sentence and substitute therefor the following: "For a distance of 12 inches from the edges of gables and vertical surfaces, and 12 inches on each side of ridges, hips, and valleys, asbestos shingles and slates shall be laid in plastic cement, and all exposed nail heads shall be covered with plastic cement."

2-13. **Corrugated asbestos sheets.**—Add the following: "Laps in roofing shall be cemented with a suitable roof putty or cement."

2-17. **Insulation for roof decks, etc.**—

(1) After the first sentence, insert the following: "One-inch thick insulation may consist of two layers of $\frac{1}{2}$ -inch thick boards or of a single layer of 1-inch thick boards."

(2) At the end of the fourth sentence, add "; concrete decks shall be coated uniformly with asphalt primer, allowing it to dry before mopping."

2-18. **Flashing, etc.**—After the first sentence, add the following: "Felt flashing shall be class RA29 or RT29."

2-19. **Counterflashing, etc.**—

I. *Type C1.*—In the second sentence, delete "shall cover completely the exposed surface of the felt portion, and it".

SECTION 3. SHEET METAL WORK.

3-03. **Hung gutters, etc.**—In the fourth sentence, change "4 feet" to "30 inches."

3-17. **Miscellaneous flashing and counterflashing.**—

(1) In the next to the last sentence, change "not less than 4 inches" to "to extend not less than 3 inches".

(2) Delete the last sentence and substitute the following: "At sills, the wall flashing shall extend not less than 4 inches beyond each end of the sill."

3-18. Lead pans, etc.—(1) Delete the first sentence and substitute the following:

"3-18x. Copper and lead pans.—Copper pans shall be an approved type and construction, formed of sheet copper weighing 16 ounces per square foot. They shall have sides not less than 6 inches high; corners shall be reinforced. The copper sheets shall be shaped to provide flat dovetail corrugations or a series of ribs of an undercut saw-tooth design and shall be keyed or interlocked to prevent seepage at joints. Dovetails or ribs shall be approximately $\frac{3}{16}$ inch high and not more than 3 inches apart; they shall provide a mechanical key-bond for mortar. The sheets shall not be drawn or stretched in the formation of the pans. The corrugations or ribs shall be flattened to provide a valley 10 inches wide along the full length of the pan to conduct moisture to the floor drain. Connections of pans with floor drains shall be waterproof. The bottoms of the copper pans shall be bedded on a 1 to 4 cement mortar bed approximately $\frac{1}{2}$ inch thick, while the mortar is plastic. Lead pans shall consist of waterproofing, pans, and coating."

(2) II. *Pans*, etc.—In the first sentence, change "*pans*" to "*Lead pans*".

Notes to officers in charge of design. Delete Note 2.

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ROOFING, SIDING, AND SHEET METAL WORK; DAMPPROOFING AND MEMBRANE WATER- PROOFING

SECTION 1. MATERIALS

1-01. Manufactured roofing materials shall be delivered at the site in the original sealed packages or containers of the manufacturer and shall be wrapped and labeled with the manufacturer's name and brand. Roll roofing shall be wrapped in paper and labeled to indicate the grade, weight, area of roll, and type of saturant. Rolls of prepared roofing shall be wound tightly, and the ends of rolls shall be protected by metal caps, scrap roofing, or by other adequate means. Where the special specifications do not include laying the roofing, directions for applying shall be furnished.

1-02. Coal-tar pitch shall be a uniformly glossy black when freshly melted, and upon ageing 1 week its surface shall not become dull or show any separation of oily constituents. Freshly fractured material shall present a satiny black surface. Pitch shall have the characteristics given in table I. (*F.S. No. R-P-381.*)

TABLE I

Characteristic	Grade TR, for built-up roofing ¹	Grade TW, for waterproofing
Softening point.....	60° to 66° C.....	52° to 60° C.
Ductility, minimum.....	50 cm.....	50 cm.
Specific gravity at 25°/25° C.....	1.22 to 1.34.....	1.22 to 1.34.
Insoluble in carbon bisulphide.....	15 to 30 percent.....	15 to 30 percent.
Distillation by weight below 300° C., maximum.....	12 percent.....	12 percent.
Specific gravity of distillate at 38°/15.5° C.....	1.03.....	1.03.
Ash, maximum.....	1 percent.....	1 percent.

¹ Inclines not exceeding 3 inches per foot for wood and precast gypsum decks or 1 inch per foot for concrete and cast in place gypsum decks.

1-03. Asphalt primer for concrete and cast in place gypsum decks shall consist of an asphaltic base thinned to a suitable brushing consistency with a volatile solvent. It shall have the following characteristics: Asphaltic base, minimum 35 percent by weight; softening point of asphaltic base, 55° to 77° C.; penetration of asphaltic base at 25° C., 15 to 50. The solvent shall be a hydrocarbon distillate having an end point on distillation not exceeding 260° C., of which not more than 20 percent shall distill under 120° C. The solvent shall be removed completely in the test for separating the asphaltic base for examination. (*F.S. No. SS-A-701.*)

1-04. Asphalt shall be uniformly glossy when freshly melted and upon ageing 1 week its surface shall not become dull or show any

separation of oil, grease, paraffin, scale, or similar material. Asphalt shall have the characteristics given in table II. (F.S. No. SS-A-666.)

TABLE II

Characteristic	Grade AR1, ¹ for surfaced built-up roofing	Grade AR2, ² for unsurfaced built-up roofing	Grade AR3, ³ for unsurfaced built-up roofing	Grade AW for water-proofing
Softening point.....	60° to 74° C.....	66° to 74° C.....	74° to 88° C.....	60° to 77° C.....
Penetration at 0° C., minimum.....	10.....	10.....	10.....	10.....
Penetration at 25° C.....	25 to 50.....	20 to 50.....	20 to 50.....	25 to 50.....
Decrease in penetration at 25° C. after heating, maximum.....	40 percent.....	40 percent.....	40 percent.....	40 percent.....
Ductility at 25° C., minimum.....	5 cm.....	5 cm.....	5 cm.....	15 cm.....
Penetration at 46° C., maximum.....	100.....	100.....	100.....	100.....
Volatile matter at 163° C., maximum.....	1.5 percent.....	1 percent.....	1 percent.....	1 percent.....
Ash ⁴				
Asphalt free from inorganic matter, maximum.....	1 percent.....	1 percent.....	1 percent.....	1 percent.....
Asphalt containing finely divided mineral matter.....	10 to 35 percent.....	10 to 35 percent.....	10 to 35 percent.....	
Coarse particles ⁵ expressed as percentage of ash for asphalt containing finely divided mineral matter, maximum.....	2.....	2.....	2.....	

¹ Inclines not exceeding 3 inches per foot.

² Inclines not exceeding 3 inches per foot for wood and precast gypsum decks, or 1½ inches per foot for concrete and cast in place gypsum decks.

³ Inclines not exceeding 6 inches per foot for wood and precast gypsum decks, or 3 inches per foot for concrete and cast in place gypsum decks.

⁴ The ash shall be mainly silica or silicates.

⁵ Inorganic matter retained on a no. 100 sieve.

1-05. Plastic cement shall be composed entirely of a suitable inorganic filler, a suitable solvent, and a nonvolatile bituminous binder. The binder shall be mainly asphaltic or coal tar to which other organic products may be added if necessary to produce a cement of better working and lasting properties. The plastic cement shall be a smooth uniform mixture, not thickened or livered, and showing no separation which cannot be easily overcome by stirring. It shall yield not less than 70 percent of nonvolatile matter when 10 grams are heated in an oven at 105° to 110° C. for 24 hours, and from 15 to 45 percent of ash on ignition. The plastic cement shall spread readily without drawing or pulling when applied with a trowel to prepared and saturated felts, and to metal surfaces. Test pieces, prepared by troweling plastic cement on smooth-surfaced prepared felt, flashing felt, and metal, exposed in a well-ventilated room for 1 hour and then in an oven at 60° C. for 5 hours shall show no blistering, not more than ¼-inch sagging or slipping, and no appreciable absorption of the cement by the prepared or flashing felt. Metal test pieces from the previous test when bent quickly over a mandrel 1 inch in diameter immediately after exposure to a temperature of 0° C. for 1 hour shall show no cracking of the cement and no separation of metal and cement. (F.S. No. SS-C-153.)

1-06. Liquid cement required in connection with prepared roofing shall consist of an asphalt or coal-tar pitch base dissolved in a volatile solvent and shall be of a nature such as to bind firmly together the laps without injurious effect. (F.S. Nos. SS-R-501, SS-R-511, and SS-R-521.)

1-07. Asphalt roof coating shall be composed of asphaltic materials, with or without fatty oils, and a volatile solvent, and shall have

incorporated in it 5 to 25 percent of a suitable mineral filler. The material shall be smooth and homogeneous after slight stirring and shall not liver in the container. It shall be of a heavy brushing consistency, insuring a film of appreciable thickness but not too stiff to prevent easy application at the rate of approximately 1 gallon per 50 square feet when using a 3-knot roof brush over asphalt roofing. When 10 grams are heated for 24 hours in an oven at 105° C. the material shall yield not less than 60 percent of nonvolatile matter. On ignition of the mineral filler, the residue obtained shall be not less than 85 percent. Test pieces, prepared by brushing the coating on smooth-surfaced prepared felt and metal at the rate of one gallon to 50 square feet, exposed for 1 hour in a well-ventilated room and then in an oven at 60° C. for 5 hours shall show no blistering, not more than ¼ inch sagging or slipping, and no appreciable absorption of the coating by the prepared felt. Metal test pieces from the previous test when bent quickly over a mandrel 1 inch in diameter immediately exposure to a temperature of 0° C. for 1 hour shall show no cracking of the coating and no separation of metal and coating. (*F.S. No. SS-B-451.*)

1-08. Surfacing materials for built-up roofings shall be hard, durable, and dry, and free from clay, loam, sand, dirt, and other foreign substances. They shall be preferably within the following limits: Passing ¼-inch sieve, 100 percent; passing ⅜-inch sieve and retained on ½-inch sieve, not less than 80 percent; and retained on ¾-inch sieve, 100 percent. Gravel shall be water-worn; crushed stone shall be any hard, durable rock, except limestone, which can be crushed to particles approximating cubical and not long, thin, flat splinters; and slag shall be crushed blast furnace slag.

1-09. Unsaturated felt, or rosin-sized building paper which may be used in lieu thereof, shall weigh not less than 5 pounds per 100 square feet.

1-10. Felts for built-up roofing, flashing, and waterproofing, classes RA14, RT14, AA14, AA30, AA53, RA29, and RT29, shall have the characteristics given in table III. Felts shall be 32 or 36 inches wide plus or minus ¼ inch. The roofing shall be in not more than two pieces per roll, but not more than 3 percent of the rolls in any shipment shall be in more than one piece. They shall be uniform throughout and shall be free from visible external defects such as holes, ragged or untrue edges, breaks, rents, cracks, indentations, areas or patches of unabsorbed saturant, superficial dry spots, lack of uniform smoothness, and from the presence on the surface of talc or other substances which might tend to interfere with the adhesion of the bituminous compound or cement. The use of silica or wood flour will be permitted in the cases of felts saturated with asphalt. When unrolled at temperatures between 10° and 32° C., felt shall not stick to an extent such as to cause injury. (*F.S. Nos. HH-F-191 and HH-F-241.*)

1-11. Prepared roofing felts, classes PR42, PR52, PA53, PR80, and PA80, shall have the characteristics given in table III. It shall not stick and shall be free from visible external defects such as holes, ragged or untrue edges, rents, cracks, indentations, and lumps of coating. Felt shall be 32 or 36 inches wide plus or minus ¼ inch. The roofing shall be in rolls of 108 or 216 square feet in not more than two pieces per roll, but not more than 3 percent of the rolls in any

shipment shall be in more than one piece. Nails and cement shall be packed in each roll or in bulk as may be required. Where the special specification includes delivery only, the contractor shall furnish 250 nails and $\frac{3}{4}$ pint of liquid cement (see par. 1-06) with each 108 square feet of 36-inch felt, and 275 nails and 1 pint of cement with each 108 square feet of 32-inch felt. Nails shall be zinc-coated wire nails with heads not less than $\frac{3}{8}$ inch in diameter and not less than 0.025 inch thick, and with pointed shanks between $\frac{3}{4}$ and 1 inch long and from 0.105 to 0.135 inch in diameter. (*F.S. Nos. SS-R-501, SS-R-511, and SS-R-521.*) Where the special specification includes application, nails and cement sufficient to complete the laying of the roofing shall be furnished and installed in accordance with the requirements given elsewhere herein.

I. *Rag felts*, classes PR42 and PR52, shall be the smooth-surface type, saturated thoroughly and uniformly, and coated on both sides with an asphaltic compound, and surfaced with finely powdered talc or mica which shall prevent sticking in the rolls. The surface shall be smooth or finely veined; deeply ribbed roofing will not be accepted. The coating shall be applied uniformly on both sides and to the edges. The roofing shall be free from uncoated spots and blisters. No sliding, blistering, or absorption of the surface coating shall occur upon heating to 80° C. for 5 hours. (*F.S. No. SS-R-501.*) Material for flashing shall be similar and specially prepared for that purpose.

II. *Asbestos felt*, class PA53, shall be saturated with an asphaltic compound and shall be made in a single layer or shall be composed of three layers cemented together at the factory with an asphaltic compound so as to form a single thickness ready for application. Material for flashing shall be similar and shall be prepared especially for that purpose.

III. *Slate surfaced felts*, classes PR80 and PA80, shall be saturated and coated on both sides with an asphaltic compound and surfaced on the weather side with mineral granules which shall be uniform in color and distribution, red or green as required by the special specifications; the other side of the roll may be dusted with talc or mica. The coating and surfacing shall extend to the edge of the sheet except that an unsurfaced lapping edge about 2 inches wide may be provided along one edge. There shall be no flowing, sagging, blistering, or absorption of the coating nor shall the slate become detached and fall off when heated to 80° C. for 2 hours. (*F.S. SS-R-511 and SS-R-521.*) Material for flashing shall be similar but without slate surfacing, and shall be specially prepared for that purpose.

TABLE III

Use	Built-up roofing and waterproofing					Flashing		Prepared roofing				
	RA14, F.S.HH- F-191	RT14, F.S. HH-F- F-241	AA14	AA30	AA63	RA29, F.S.HH- F-191	RT29	PR42, F.S.SS- R-501	PR52, F.S.SS- R-501	PA63	PR80, F.S.SS- R-521	PA80, F.S.SS- R-511
Class	RA14, F.S.HH- F-191	RT14, F.S. HH-F- F-241	AA14	AA30	AA63	RA29, F.S.HH- F-191	RT29	PR42, F.S.SS- R-501	PR52, F.S.SS- R-501	PA63	PR80, F.S.SS- R-521	PA80, F.S.SS- R-511
Felt, kind of	Rag Asphalt	Rag Tar	Asbestos Asphalt	Asbestos Asphalt	Asbestos Asphalt	Rag Asphalt	Rag Tar	Rag Asphalt	Rag Asphalt	Asbestos Asphalt	Rag Asphalt	Asbestos Asphalt
Saturant, kind of												
Surface, mineral, weight per 108 square feet, pounds, maximum												
Weight, net, per 100 square feet, pounds:												
Maximum	15	15	15			30 1/4	30 1/4	3	3	3	35	35
Average	13	13	13			27 1/4	27 1/4	1 50	1 50	1 50	1 80	1 80
Minimum	1/16-inch mandrel	1/16-inch mandrel	1/16-inch mandrel	1/4-inch mandrel	1 1/4-inch mandrel	1/16-inch mandrel	1/16-inch mandrel	1/16-inch mandrel	1/16-inch mandrel	3/4-inch mandrel	1/4-inch mandrel	1/4-inch mandrel
Breaking strength, per inch width, pounds:												
With fiber grain	30	30	25	50		40	40	10 pounds	10 pounds	10 pounds	10 pounds	10 pounds
Across fiber grain	15	15	12	25		20	20	10 pounds	10 pounds	10 pounds	10 pounds	10 pounds
Ash of desaturated felt	10%	10%	70%	70%	65%	10%	10%	10%	10%	70%	70%	70%
Moisture-free desaturated felt:												
Weight per 100 square feet, minimum, pounds	5.2	0.025	8.5	20	17 1/2	10.4	10.4	10.8	13.5	25.5	10.8	18.0
Thickness, minimum, inch	4%		0.020	0.040	0.045	4%	4%	0.045	0.060	0.065	0.050	0.045
Loss in heating at 105° C. for 5 hours, maximum			2%	2%								
Weight of saturant compared to weight of mois- ture-free felt, minimum	140%		40%	50%	55%	150%		150%	160%	40%	160%	60%
Weight of comminuted surface, per 100 square feet, maximum, pound	1											
Weight of sand per 100 square feet, maximum, pounds												
Asbestos fiber, minimum					12 1/4							
Volatiles matter at 80° C., 2 hours, maximum			85%	85%	85%							85%
Weight of wrapping, packing, nails, and cement, pounds, maximum	1/2	1/2	1/2	1/2	1/2	1/2	1/2	8	8	7	5	5

1 Weight per 108 square feet.

2 Maximum.

3 Minimum.

4 Bending 90°.

5 Weight of total ash of roofing per 108 square feet.

1-12. Slate surfaced shingles shall conform to the requirements for prepared, slate surfaced, rag felt roofing, class PR80, except that the saturation of the moisture-free felt shall be 175 percent minimum and the weight shall be not less than 83 pounds per 108 square feet. Shingles shall be blue-black, red, or green, and individual or strip, as required by the special specification. They shall be of sizes which, when laid, will have a 4-inch exposure, not less than a 2-inch headlap, and exposed widths of 8 to 8½ inches. (*F.S. No. SS-R-521.*)

1-13. Slate shall be of reasonably smooth cleavage and shall be free from knots or knurls that would lessen the durability or weather-tightness of the finished work. It shall be rectangular, with straight cut edges. Corners shall be reasonably full on exposed edges, with no broken corners on covered ends that would diminish the nailing strength or weathertightness. Thickness shall be approximately ⅜ inch, measuring 22 to 25 inches per 100 pieces when piled closely. If rough surface slate is required by the special specification, it shall measure 25 to 30 inches per 100 pieces. For flatness, the maximum bend in any slate shall not exceed ⅜ inch in 12 inches. Slate, if curved, shall be made so that it can be laid with the convex side up. Holes shall be machine punched for 3-inch double (head) laps. Slate shall be whole and clean. Not more than 2 percent of broken slate will be accepted. The size and color shall be as required by the special specification. The average modulus of rupture across the grain shall be not less than 9,000 pounds per square inch. The average absorption shall be not more than 0.35 percent. The slate shall, under a 7-day submergence in a 1 percent by weight solution of sulphuric acid, show no softening to an average depth greater than 0.008 inch. (*F.S. No. SS-S-451, grade B.*)

1-14. Asbestos shingles and ridge and hip rolls shall be made of portland cement and pure asbestos fiber, with no other fibrous material, formed under pressure. They shall be of compact and uniform texture, tough and resilient, and shall be deep red, brown, gray, or slate color (black), as required by the special specification. Shingles, except those for starter courses, shall be 8 by 16 inches and shall have a minimum thickness of ⅜ inch; starter shingles for first courses shall be 9 by 18 inches and shall have a minimum thickness of ¼ inch. Asbestos ridge and hip rolls shall be the arc of a circle in cross section, about 5 inches wide. The shingles and rolls shall be delivered punched or drilled ready for application.

1-15. Wood shingles shall be red cedar shingles, A grade, in accordance with the latest domestic rules of the West Coast Lumbermen's Association; or cypress shingles, grade bests, in accordance with the latest rules of the Southern Cypress Manufacturers' Association. They shall be 16 inches long and of random widths. Shingles shall be dipped twice to within 3 inches of their upper ends in an approved creosote shingle stain.

1-16. Promenade tile shall be first quality, vitrified shale tile; shall be square-edged, sound, and unwarped; and shall be free from blisters, chipped edges, and other surface defects. The tile shall be grooved on the back so as to afford an ample bond. Promenade tile for the field shall be 6 by 9 by not less than ¾ inch. Half tile and special shapes shall be provided where required. No dimension shall vary more than 2 percent from that specified. The tiles shall be of varied shades of red and brown.

1-17. Pan and cover tile, including ridge and hip rolls, terminals, closures, and other shapes, shall be of shale, hard burned and unwarped, and free from fire cracks and other defects. The tile shall be of varied shades of red, brown, and purple. The pans and rolls for the field shall be about $7\frac{1}{2}$ inches wide and 18 inches long, and the arc of a circle in cross section. Valley tiles shall be cut to the proper angle and the valley roll patterns shall be filled before burning. The other shapes required shall be made to fit accurately and shall be of a section and design such as to insure watertight construction and a complete installation.

1-18. Corrugated asbestos sheets shall be made of asbestos fiber and portland cement, formed into dense, tough, structurally strong sheets, light gray, smooth on the weather side, and not less than $\frac{1}{2}$ inch thick at the crests of the corrugations and not less than $\frac{3}{8}$ inch thick at the minimum section. The inside and outside radii of corrugations shall be the same and sheets shall fit tightly at the laps. The product shall not warp, crack, peel, or be affected by temperature changes. Ridge and corner rolls and gable trim shall be of approved shapes with provision for excluding weather. Corners of sheets shall be clipped to secure butt joints and to eliminate overlapping of the sheets at the intersection of the vertical and horizontal joints.

1-19. Copper shall conform to the edition of Navy Department Specification No. 47C2 in effect on the date of invitations for bids. Sheets shall be 20 by 28 inches for standing seam work and 14 by 20 inches for flat seam work. Minimum weights per square foot and thicknesses shall be as follows:

Use	Weight	Thickness
	Ounces	Inch
Flat surfaces.....	16	.0215
Flashing and counterflashing.....	14	.0183
Louver slats.....	20	.0269
Ventilators:		
Up to 12 inches in diameter.....	14	.0183
18 to 24 inches in diameter.....	16	.0215
30 to 36 inches in diameter.....	18	.0242
Material not specified otherwise.....	16	.0215

1-20. Lead shall be grade B conforming to the edition of Navy Department Specification No. 47L1 in effect on the date of invitations for bids.

1-21. Zinc sheets shall conform to the edition of Navy Department Specification No. 47Z6 in effect on the date of invitations for bids. Corrugations shall be not less than $2\frac{1}{2}$ inches wide and not less than $\frac{5}{8}$ inch deep. Material, both corrugated and flat, shall be not less than 0.032 inch thick (1.2 pounds per square foot) except for ventilators and for flashing, which shall be not less than 0.036 and 0.024 inch thick (1.35 and 0.90 pounds per square foot), respectively.

1-22. Tin shall be IX terneplate roofing tin of 11.47 ounces per foot nominal weight (40-pound coating) conforming to the edition of Federal Specification No. QQ-T-201 in effect on the date of invitations for bids.

1-23. Sheet steel shall conform to the edition of Navy Department Specification No. 47S10 in effect on the date of invitations for bids, except that the steel shall contain not less than 0.2 percent of copper.

Minimum thicknesses, on the basis of the black sheets before galvanizing, shall be as follows:

Roofing and siding, galvanized, corrugated, type B:

Spacing center to center of purlins or girts (inches)	Roofing (inch)	Siding (inch)
Up to 42.....	0.025	0.025
Over 42 to 48.....	.031	.025
Over 48 to 54.....	.038	.025
Over 54 to 60.....	.050	.031
Over 60 to 66.....	.063	.038
Lower slats, flat, galvanized.....	0.031 inch.	
Ventilators, flat, galvanized:		
Up to 12 inches in diameter.....	0.019 inch.	
Over 12 to 24 inches in diameter.....	0.025 inch.	
Over 24 to 36 inches in diameter.....	0.031 inch.	
Material not specified otherwise above or by the special specifications.....	0.025 inch.	

1-24. Asbestos-covered metal shall be smooth surfaced, corrugated, and shall have a core of solid black sheet steel which shall be hermetically inclosed and sealed at the factory with the following impervious protective coatings and covering: (a) Asphalt coating, (b) asphalt saturated asbestos felt covering, and (c) weatherproof bituminous coating, using not less than 14 pounds per 100 square feet. The steel core shall be black sheets conforming to the edition of Navy Department Specification No. 47S10 in effect on the date of invitations for bids; corrugations shall be type B. The surfaces of the steel shall be cleaned thoroughly to remove all grease, moisture, oxides, and other impurities which might interfere with its proper protection or with the bonding of the protective coatings. The steel shall be immersed in a bath of an approved asphaltic compound, maintained at a proper temperature, and in a manner such that the surface of the steel will be inclosed completely by a thick, elastic, and gas and moisture proof shield. Over this a protective covering of commercially pure asbestos felt saturated with an approved asphaltic compound shall be laid, covering both sides of the steel, and it shall be forced into the coating by pressure and heating in a manner such that the asphalt and asbestos will intermingle and will be bonded thoroughly. The surface of the asbestos felt on both sides of the sheets shall be covered with an approved, uniform, water-repellant, and corrosion-proof coating. Coatings, when set, shall not be affected by ordinary temperature changes, with chipping or cracking in cold weather, or with becoming soft and running in hot weather. Asbestos-covered metal, when it leaves the factory, shall have no unprotected exposed edges, and the surface on both sides shall be of a permanent color, black, red, or aluminum, as required by the special specification. The minimum thicknesses of the steel core shall conform to the requirements given in the preceding paragraph.

1-25. Steel roof decks shall be of sheet steel having a nominal thickness of not less than 0.038 inch and conforming to the edition of Navy Department Specification No. 47S10 in effect on the date of invitations for bids, except that it shall contain not less than 0.2 percent copper. The sheets shall be painted or heavily galvanized and shall be in lengths necessary to form a continuous roof surface suitable for the proper application of the insulation and to permit end joints to occur over bearings only. The sheets shall have integral webs of a size and shape providing rigidity and strength sufficient to meet the more severe of the following conditions without exceeding

a fiber stress of 16,000 pounds per square inch, and without deflecting more than $\frac{1}{200}$ of the span: (a) The total dead load plus a live load of 20 pounds per square foot, or (b) the total dead load plus a concentrated load of 200 pounds. The 200-pound load shall be considered as being applied on a knife edge across the width of one sheet. The sheet shall be considered as extending over one span only and supported on knife edges spaced a distance equal to the spacing of purlins center to center. If the individual sheets are less than 24 inches wide, the effective width for the concentrated load shall be considered as 18 inches, provided the individual sheets are interlocked in a manner such that no sheet can deflect without carrying with it the sheet adjoining it on each side.

1-26. Insulating board for roof decks shall be not less than $\frac{1}{8}$ inch thick and shall be manufactured from wood or other vegetable fiber by a felting process wherein no extraneous binders are used. The finished boards may be either single or multiple ply. A suitable moisture-resistant cement shall be used to join the plies of multiple-ply boards. The boards shall be subjected to such drying temperatures as to effect complete sterilization. Suitable sizing material shall be incorporated in the product during manufacture to render it water resistant. The surfaces shall be natural and shall be free from cracks, lumps, excessive departure from planeness, or other defects. Edges shall be square. Insulating board shall have a thermal conductivity of not more than 0.36 B.t.u., per hour per square foot per inch of thickness per degree F., difference in temperature; a water absorption of not more than 10 percent; and an average tensile strength of not less than 100 pounds per square inch. (*F.S. No. LLL-F-321, grade B.*)

1-27. Metal covered insulation shall consist of a core 1 inch thick faced on both sides with sheet steel having a nominal thickness of not less than 0.025 inch. The sheet steel shall be heavily galvanized and shall conform to the edition of Navy Department Specification No. 47S10 in effect on the date of invitation for bids, except that it shall contain not less than 0.2 percent copper. The core shall be of an approved fibrous material cemented or felted to form a homogeneous mass and shall have an insulation value of at least 0.33 B.t.u. per hour per square foot per inch of thickness per 1° F. difference in temperature. The insulation shall consist of panels having sufficient stiffness to permit handling and erection. The insulation material shall be vermin proof and under all conditions shall not develop nor absorb odors. The galvanized sheets shall be cemented to the core with an adhesive that will not support corrosive action in the glue line at the metal facing and will have sufficient flexibility to allow expansion and contraction between rapid temperature change from minus 17 to plus 155° C. without destroying the bond between the core and metal facing or deterioration in the cement. The metal facing shall be cemented to the core under sufficient pressure to produce perfectly smooth panels without any flexibility of light reflections caused by buckling in the facing or core materials. The four corners of each sheet shall have a rivet securing the steel covering to the core. Thickness of panels shall not vary more than $\frac{1}{32}$ inch at any point. All vertical joints shall be of the cover plate type; all horizontal joints shall be of the interlocking type. All extruded or special rolled sections and all accessories required for structural connections along edges of panels shall be furnished.

SECTION 2. APPLICATION

2-01. Scope of work.—The contractor shall provide and install all material necessary to cover the roofs and sides, or to install the membrane waterproofing, or to apply the dampproofing with the particular type or types required by the special specifications, and for which the detail requirements are included herein.

2-02. Roof decks, floor slabs, and walls shall be clean, smooth, thoroughly dry, and free from projections which might injure the roofing or waterproofing which shall be laid smoothly, without wrinkles or buckles.

2-03. Special requirements for built-up and prepared roofing.—The methods of application given herein are based upon the use of 32-inch felts. If 36-inch widths are used the laps specified shall be increased as follows: 17 inches to 19 inches, 21½ and 22 inches to 24½ inches, 24½ inches to 27½ inches, and 26 inches to 29 inches. Where roofing is to be applied over wood decks, all loose knots and other flaws shall be removed, and knot holes and large cracks shall then be covered with tin or other sheet metal nailed in place. Mortar in joints between slabs forming precast gypsum decks shall be tight and flush with the top surfaces of the decks, and all loose and missing mortar shall be replaced with new gypsum mortar before the roofing is applied. Care shall be taken that the roofing is not installed over ragged or sharp corners. Pitch and asphalt shall be heated—pitch not above 190° C. and asphalt not above 205° C.—and shall be hot when applying the felts. Gravel or slag shall be heated just before it is used.

2-04. Felt valley lining.—Where valleys occur in connection with built-up, prepared, and slate surfaced shingle roofing, one layer of felt lining shall be applied in the valleys before the first layer of saturated felt is laid. On concrete and gypsum slabs the valley lining shall be mopped into place with the same material as used for laying the roofing sheets, and on wood sheathing it shall be nailed in place along the edges with a limited number of galvanized roofing nails. It shall extend the full length of valleys and 12 inches on each side. Valley lining shall be the same as the first layer of saturated felt, except that for prepared roofings classes PR80 and PA80 and for slate surfaced shingles it shall have a smooth surface.

2-05. Metal valley lining.—Where valleys occur in connection with slate, asbestos shingle, corrugated asbestos, wood shingle, and pan and cover tile roofing, the valleys shall be lined with metal. If the sheet metal work of the building is of sheet steel, the valley lining shall be of terneplate roofing tin; if the sheet metal work is of copper, the valley lining shall be of copper. Valleys shall be laid open and along true lines, with the metal exposed at the top about 2 inches on each side of the center line of the valley and widening out at the rate of ½ inch in 8 feet toward the bottom of the valley. Valley metal shall extend on each side of the center line of the valleys, at least 10 inches on short valleys where the conditions are favorable, and farther where necessary. Valley metal shall have no longitudinal seams. Cross seams shall be flat, and locked and soldered. Valley metal shall be laid on one layer of class RT29 or RA29 felt extending the full length of the valleys and 12 inches on each side. Both edges of valley metal shall be folded ½ inch and secured with 1½ by 3-inch cleats of the same metal as the valley metal. One end of each

cleat shall be locked to the valley metal and the opposite end shall be secured to the sheathing with two nails. The cleats shall be spaced not more than 30 inches on centers and the roof ends shall be folded over the nail heads after being fixed. Copper cleats shall be secured with copper roofing nails and terneplate cleats with tinned roofing nails. Where nail holes in slates and shingles come over the metal of valleys, new holes shall be provided in each piece so that it will be secured outside the metal lines by not less than two nails. Where nail holes of roofing tiles come over the metal of valleys, the tiles shall be fastened with copper or approved noncorrodible nails, or with copper wire attached to similar nails driven into the sheathing outside the metal lines, and enough plastic cement shall be applied to hold the wired pieces of tile firmly in place.

2-06. Built-up roofing.—

I. *Type 5TWS.*—Five layers of rag felt class RT14 and pitch grade TR, surfaced with gravel or slag, over wood sheathing or precast gypsum.

(a) If of wood sheathing, the decks shall be covered with one layer of unimpregnated felt or of resin-sized building paper, the sheets lapping at least 1 inch and being nailed along the edges to hold them in place until the succeeding layers are laid. If the decks are of precast gypsum, this layer shall be omitted.

(b) Over this there shall be laid two layers of the saturated felt, and each sheet of each layer shall be lapped 17 inches over the preceding sheet and end laps shall be not less than 4 inches. The sheets shall be fastened along the edges with nails driven through flat tin caps spaced as close as necessary to hold them in place until the remaining felt is laid. These layers shall be turned up vertical surfaces not less than 4 inches.

(c) Then the entire surface shall be coated uniformly with hot pitch, using not less than 25 pounds per 100 square feet.

(d) Upon this there shall be laid three layers of the saturated felt, and each sheet of each layer shall be lapped 22 inches over the preceding sheet and end laps shall be not less than 6 inches. Hot pitch shall be mopped the full 22 inches on each sheet, so that in no place will felt touch felt, using not less than 25 pounds of pitch per 100 square feet between successive layers. Each layer shall be fastened, approximately 6 inches from the upper edge, with nails driven through flat tin caps. These layers shall be cut off at vertical surfaces.

(e) Then the entire surface shall be coated uniformly with hot pitch, poured from a dipper, using not less than 70 pounds per 100 square feet.

(f) Into this, while hot, there shall be embedded to each 100 square feet not less than 400 pounds of gravel or 300 pounds of slag.

NOTE.—The total quantities of saturated felt and of pitch per 100 square feet of roof area shall be not less than 76 and 145 pounds, respectively.

II. *Type 5TCS.*—Five layers of rag felt class RT14 and pitch grade TR, surfaced with gravel or slag, over concrete or poured gypsum.

(a) The slabs shall be coated uniformly with hot pitch, using not less than 40 pounds per 100 square feet.

(b) Over this there shall be laid two layers of the saturated felt, and each sheet of each layer shall be lapped 17 inches over the preceding sheet and end laps shall be not less than 4 inches. Hot pitch shall be mopped the full 17 inches on each sheet, so that in no place

will felt touch felt, using not less than 25 pounds of pitch per 100 square feet between successive layers. If the decks are of poured gypsum, each layer, in addition to the above, shall be fastened, approximately 6 inches from the upper edge, with nails driven through flat tin caps. These layers shall be cut off at vertical surfaces.

(c) Then the entire surface shall be coated uniformly with hot pitch, using not less than 25 pounds per 100 square feet.

(d) Upon this there shall be laid three layers of the saturated felt, and each sheet of each layer shall be lapped 22 inches over the preceding sheet and end laps shall be not less than 6 inches. Hot pitch shall be mopped the full 22 inches on each sheet, so that in no place will felt touch felt, using not less than 25 pounds of pitch per 100 square feet between successive layers. If the decks are of poured gypsum each layer, in addition to the above, shall be fastened, approximately 6 inches from the upper edge, with nails driven through flat tin caps. These layers shall be cut off at vertical surfaces.

Optional for (b), (c) and (d).—Over this there shall be laid five layers of the saturated felt, and each sheet of each layer shall be lapped 26 inches over the preceding sheet and end laps shall be not less than 6 inches. Hot pitch shall be mopped the full 26 inches on each sheet, so that in no case will felt touch felt, using not less than 25 pounds of pitch per 100 square feet between successive layers. These layers shall be cut off at vertical surfaces. Nailing shall be as specified hereinbefore.

(e) Then the entire surface shall be coated uniformly with hot pitch, poured from a dipper, using not less than 70 pounds per 100 square feet.

(f) Into this, while hot, there shall be embedded to each 100 square feet not less than 400 pounds of gravel or 300 pounds of slag.

NOTE.—The total quantities of saturated felt and of pitch per 100 square feet of roof area shall be not less than 76 and 210 pounds, respectively.

III. Type 5AWS.—Five layers of rag felt class RA14 and asphalt grade AR1, surfaced with gravel or slag, over wood sheathing or precast gypsum.

(a) If of wood sheathing, the decks shall be covered with one layer of unimpregnated felt or rosin-sized building paper, the sheets lapping at least 1 inch and being nailed along the edges to hold them in place until the succeeding layers are laid. If the decks are of precast gypsum, this layer shall be omitted.

(b) Over this there shall be laid two layers of the saturated felt, and each sheet of each layer shall be lapped 17 inches over the preceding sheet and end laps shall be not less than 4 inches. The sheets shall be fastened along the edges with nails driven through flat tin caps spaced as closely as necessary to hold them in place until the remaining felt is laid. These layers shall be turned up vertical surfaces not less than 4 inches.

(c) Then the entire surface shall be coated uniformly with hot asphalt, using not less than 25 pounds per 100 square feet.

(d) Upon this there shall be laid three layers of the saturated felt, and each sheet of each layer shall be lapped 22 inches over the preceding sheet and end laps shall be not less than 6 inches. Hot asphalt shall be mopped the full 22 inches on each sheet, so that in no place will felt touch felt, using not less than 20 pounds of asphalt per 100 square feet between successive layers. Each layer shall be fastened approximately 6 inches from the upper edge with nails

driven through flat tin caps. These layers shall be cut off at vertical surfaces.

(e) Then the entire surface shall be coated uniformly with hot asphalt, poured from a dipper, using not less than 60 pounds per 100 square feet.

(f) Into this, while hot, there shall be embedded to each 100 square feet not less than 400 pounds of gravel or 300 pounds of slag.

NOTE.—The total quantities of saturated felt and of asphalt per 100 square feet of roof area shall be not less than 76 and 125 pounds, respectively.

IV. *Type 5ACS*.—Five layers of rag felt class RA14 and asphalt grade AR1, surfaced with gravel or slag, over concrete or poured gypsum.

(a) If of concrete, the decks shall be coated uniformly with asphalt primer, using not less than 1 gallon (7.5 pounds) per 100 square feet and allowing it to dry. If of poured gypsum, the decks shall be given two such coats. Upon this there shall be applied a uniform coat of hot asphalt, using not less than 30 pounds per 100 square feet.

(b) Over this there shall be laid two layers of the saturated felt, and each sheet of each layer shall be lapped 17 inches over the preceding sheet and end laps shall be not less than 4 inches. Hot asphalt shall be mopped the full 17 inches on each sheet, so that in no place will felt touch felt, using not less than 20 pounds of asphalt per 100 square feet between successive layers. If the decks are of poured gypsum, each layer, in addition to the above, shall be fastened approximately 6 inches from the upper edge with nails driven through flat tin caps. These layers shall be cut off at vertical surfaces.

(c) Then the entire surface shall be coated uniformly with hot asphalt, using not less than 25 pounds per 100 square feet.

(d) Upon this sheet there shall be laid three layers of the saturated felt, and each sheet of each layer shall be lapped 22 inches over the preceding sheet and end laps shall be not less than 6 inches. Hot asphalt shall be mopped the full 22 inches on each sheet, so that in no place will felt touch felt, using not less than 20 pounds of asphalt per 100 square feet between successive layers. If the decks are of poured gypsum, each layer, in addition to the above, shall be fastened approximately 6 inches from the upper edge, with nails driven through flat tin caps. These layers shall be cut off at vertical surfaces.

Optional for (b), (c), and (d).—Over this there shall be laid five layers of the saturated felt, and each sheet of each layer shall be lapped 26 inches over the preceding sheet and end laps shall be not less than 6 inches. Hot asphalt shall be mopped the full 26 inches on each sheet, so that in no case will felt touch felt, using not less than 20 pounds of asphalt per 100 square feet between successive layers. These layers shall be cut off at vertical surfaces. Nailing shall be as specified hereinbefore.

(e) Then the entire surface shall be coated uniformly with hot asphalt, poured from a dipper, using not less than 60 pounds per 100 square feet.

(f) Into this, while hot, there shall be embedded to each 100 square feet not less than 400 pounds of gravel or 300 pounds of slag.

NOTE.—The total quantities of saturated felt and of asphalt, exclusive of the primer, per 100 square feet of roof area shall be not less than 76 and 170 pounds, respectively.

V. *Type 4TWS*.—Four layers of rag felt class RT14 and pitch grade TR, surfaced with gravel or slag, over wood sheathing or precast gypsum.

(a) If of wood sheathing, the decks shall be covered with one layer of unimpregnated felt or of rosin-sized building paper, the sheets lapping at least 1 inch and being nailed along the edge to hold them in place until the succeeding layers are laid. If the decks are of precast gypsum, this layer shall be omitted.

(b) Over this there shall be laid two layers of the saturated felt, and each sheet of each layer shall be lapped 17 inches over the preceding sheet, and end laps shall be not less than 4 inches. Sheets shall be fastened along the edges with nails driven through flat tin caps spaced as closely as necessary to hold them in place until the remaining felt is laid. These layers shall be turned up vertical surfaces not less than 4 inches.

(c) Then the entire surface shall be coated uniformly with hot pitch, using not less than 25 pounds per 100 square feet.

(d) Upon this there shall be laid two layers of the saturated felt, and each sheet of each layer shall be lapped 17 inches over the preceding sheet, and end laps shall be not less than 6 inches. Hot pitch shall be mopped the full 17 inches on each sheet, so that in no place will felt touch felt, using not less than 25 pounds of pitch per 100 square feet between successive layers. Each layer shall be fastened, approximately 6 inches from the upper edge, with nails driven through flat tin caps. These layers shall be cut off at vertical surfaces.

(e) Then the entire surface shall be coated uniformly with hot pitch, poured from a dipper, using not less than 70 pounds per 100 square feet.

(f) Into this, while hot, there shall be embedded to each 100 square feet not less than 400 pounds of gravel or 300 pounds of slag.

NOTE.—The total quantities of saturated felt and of pitch per 100 square feet of roof area shall be not less than 60 and 120 pounds, respectively.

VI. *Type 4TCS*.—Four layers of rag felt, class RT14, and pitch, grade TR, surfaced with gravel or slag, over concrete or poured gypsum.

(a) The slabs shall be coated uniformly with hot pitch, using not less than 40 pounds per 100 square feet.

(b) Over this there shall be laid four layers of the saturated felt; each sheet of each layer shall be lapped 24½ inches over the preceding sheet, and end laps shall be not less than 6 inches. Hot pitch shall be mopped the full 24½ inches on each sheet, so that in no place will felt touch felt, using not less than 25 pounds of pitch per 100 square feet between successive layers. If the decks are of poured gypsum, each layer, in addition to the above, shall be fastened, approximately 6 inches from the upper edge, with nails driven through flat tin caps. These layers shall be cut off at vertical surfaces.

(c) Then the entire surface shall be coated uniformly with hot pitch, poured from a dipper, using not less than 70 pounds per 100 square feet.

(d) Into this, while hot, there shall be embedded to each 100 square feet not less than 400 pounds of gravel or 300 pounds of slag.

NOTE.—The total quantities of saturated felt and of pitch per 100 square feet of roof area shall be not less than 60 and 185 pounds, respectively.

VII. *Type 4AWS*.—Four layers of rag felt class RA14 and asphalt grade AR1, surfaced with gravel or slag, over wood sheathing or precast gypsum.

(a) If of wood sheathing, the decks shall be covered with one layer of unimpregnated felt or of rosin-sized building paper, the sheets lapping at least 1 inch and being nailed along the edges to hold them in place until the succeeding layers are laid. If the decks are of precast gypsum, this layer shall be omitted.

(b) Over this there shall be laid 2 layers of the saturated felt, and each sheet of each layer shall be lapped 17 inches over the preceding sheet and end laps shall be not less than 4 inches. Sheets shall be fastened along the edges with nails driven through flat tin caps spaced as closely as necessary to hold them in place until the remaining felt is laid. These layers shall be turned up vertical surfaces not less than 4 inches.

(c) Then the entire surface shall be coated uniformly with hot asphalt, using not less than 25 pounds per 100 square feet.

(d) Upon this there shall be laid 2 layers of the saturated felt, and each sheet of each layer shall be lapped 17 inches over the preceding sheet and end laps shall be not less than 6 inches. Hot asphalt shall be mopped the full 17 inches on each sheet, so that in no place will felt touch felt, using not less than 20 pounds of asphalt per 100 square feet between successive layers. Each layer shall be fastened, approximately 6 inches from the upper edge, with nails driven through flat tin caps. These layers shall be cut off at vertical surfaces.

(e) Then the entire surface shall be coated uniformly with hot asphalt, poured from a dipper, using not less than 60 pounds per 100 square feet.

(f) Into this, while hot, there shall be embedded to each 100 square feet not less than 400 pounds of gravel or 300 pounds of slag.

NOTE.—The total quantities of saturated felt and of asphalt per 100 square feet of roof area shall be not less than 60 and 105 pounds, respectively.

VIII. *Type 4ACS*.—Four layers of rag felt class RA14 and asphalt grade AR1, surfaced with gravel or slag, over concrete or poured gypsum.

(a) If of concrete, the decks shall be coated uniformly with asphalt primer, using not less than 1 gallon (7.5 pounds) per 100 square feet and allowing it to dry. If of poured gypsum, the decks shall be given two such coats. Upon this there shall be applied a uniform coat of hot asphalt, using not less than 30 pounds per 100 square feet.

(b) Over this there shall be laid four layers of the saturated felt; each sheet of each layer shall be lapped 24½ inches over the preceding sheet and end laps shall be not less than 6 inches. Hot asphalt shall be mopped the full 24½ inches on each sheet, so that in no place will felt touch felt, using not less than 20 pounds of asphalt per 100 square feet between successive layers. If the decks are of poured gypsum, each layer, in addition to the above, shall be fastened, approximately 6 inches from the upper edge, with nails driven through flat tin caps. These layers shall be cut off at vertical surfaces.

(c) Then the entire surface shall be coated uniformly with hot asphalt, poured from a dipper, using not less than 60 pounds per 100 square feet.

(d) Into this, while hot, there shall be embedded, to each 100 square feet, not less than 400 pounds of gravel or 300 pounds of slag.

NOTE.—The total quantities of saturated felt and of asphalt, exclusive of the primer, per 100 square feet of roof area shall be not less than 60 and 150 pounds, respectively.

IX. Type 3xAAW.—One layer of asbestos felt class AA53, two layers of asbestos felt class AA14, and asphalt grade AR2 or AR3, over wood sheathing or precast gypsum.

(a) The sheathing or precast gypsum shall be covered with one layer of felt class AA53 laid perpendicular to the eaves of the roof with 3-inch side and end laps sealed with asphalt and fastened with $\frac{1}{8}$ -inch, bright, barbed nails driven through flat tin caps and spaced 6 inches on centers. The felt shall be turned up vertical surfaces not less than 2 inches above the top edge of a 3-inch 45° wood cant.

(b) Then the entire surface shall be coated uniformly with hot asphalt, using not less than 25 pounds per 100 square feet.

(c) While the asphalt is hot, there shall be laid, parallel to the eaves, two layers of felt class AA14, and each sheet of each layer shall be lapped 17 inches over the preceding sheet and end laps shall be not less than 6 inches. The entire surface between layers shall be mopped with hot asphalt, so that in no place will felt touch felt, using not less than 25 pounds per 100 square feet. Sheets shall be rolled closely behind the mop. Each layer shall be fastened with $\frac{1}{8}$ -inch, bright, barbed nails driven through flat tin caps and spaced 9 inches on centers along a line $\frac{1}{4}$ inch from the upper edge. These layers shall be turned up vertical surfaces not less than 2 inches above the top edge of the 3-inch, 45° wood cant.

(d) Then the entire surface shall be coated uniformly with hot asphalt, using not less than 20 pounds per 100 square feet. It shall be brushed out thoroughly, and shall be finished neatly in order to secure an even appearance.

NOTE.—The total quantities of saturated felt and of asphalt per 100 square feet of roof area shall be not less than 88 and 70 pounds, respectively.

X. Type 3xAAC.—One layer of asbestos felt class AA30 or AA53, two layers of asbestos felt class AA14, and asphalt grade AR2 or AR3, over concrete or poured gypsum.

(a) If of concrete, the decks shall be coated uniformly with asphalt primer, using not less than 1 gallon (7.5 pounds) per 100 square feet and allowing it to dry. If of poured gypsum, the decks shall be given two such coats. Upon this there shall be applied a uniform coat of hot asphalt, using not less than 30 pounds per 100 square feet.

(b) While the asphalt is hot there shall be laid, perpendicular to the eaves of the roof, one layer of felt class AA30 or AA53 with 3-inch side and end laps sealed with the asphalt. If the decks are of poured gypsum, the felt, in addition to the above, shall be fastened with $\frac{1}{8}$ -inch, bright, barbed nails driven through flat tin caps and spaced 6 inches on centers. This layer shall be turned up vertical surfaces not less than 2 inches above the top of a 3-inch, 45° wood cant.

(c) Then the entire surface shall be coated uniformly with hot asphalt, using not less than 25 pounds per 100 square feet.

(d) While the asphalt is hot, there shall be laid, parallel to the eaves, two layers of felt class AA14, and each sheet of each layer shall be lapped 17 inches over the preceding sheet and end laps shall be not less than 6 inches. The entire surface between layers shall be mopped with hot asphalt, so that in no place will felt touch felt, using not less than 25 pounds per 100 square feet. Sheets shall be rolled closely behind the mop. If the decks are of poured gypsum, each layer, in addition to the above, shall be fastened with $\frac{1}{8}$ -inch, bright, barbed nails driven through flat tin caps and spaced 9 inches

on center along a line $\frac{3}{4}$ inch from the upper edge. These layers shall be turned up vertical surfaces not less than 2 inches above the top edge of the 3-inch 45° wood cant.

(e) Then the entire surface shall be coated uniformly with hot asphalt, using not less than 20 pounds per 100 square feet. It shall be brushed out thoroughly, and shall be finished neatly in order to secure an even appearance.

NOTE.—The total quantities of saturated felt and of asphalt per 100 square feet of roof area shall be not less than 63, using felt class AA30, or 88, using felt class AA53, and 100 pounds, respectively.

XI. Type 2W.—One layer of rag felt class RA14 or RT14, one layer of prepared slate surfaced felt class PR80 or PA80, and asphalt grade AR3, over wood sheathing.

(a) The sheathing shall be covered with one layer of felt class RA14 or RT14 laid perpendicular to the eaves, and the sheets shall be lapped 2 inches at the sides and 4 inches at the ends and shall be sealed with asphalt. Then the sheet shall be fastened with $\frac{3}{4}$ -inch galvanized barbed nails driven through flat tin caps and spaced 6 inches on centers on the laps and 18 inches on centers (staggered) along parallel lines 10 inches apart and 10 inches from the lower edge of each sheet. The felt shall be turned up vertical surfaces not less than 4 inches.

(b) Then the entire surface shall be coated uniformly with hot asphalt, using not less than 25 pounds per 100 square feet.

(c) While the asphalt is hot, there shall be laid parallel to the eaves one layer of felt class PR80 or PA80 and the sheets shall be lapped 2 inches at the sides and 6 inches at the ends. Each lap shall be coated the full width with the asphalt. Each layer shall be fastened with $\frac{3}{4}$ -inch bright, barbed nails driven through flat tin caps and spaced 9 inches on centers along a line $\frac{3}{4}$ inch from the upper edge. The roofing shall be turned up vertical surfaces not less than 4 inches.

NOTE.—The total quantities of saturated felt and of asphalt per 100 square feet of roof area shall be not less than 97 and 25 pounds, respectively.

2-07. Membrane waterproofing.—Except as modified herein, membrane waterproofing shall conform to the following corresponding types of built-up roofing:

Type MW5T to built-up roofing type 5TCS.

Type MW5A to built-up roofing type 5ACS.

Type MW4T to built-up roofing type 4TCS.

Type MW4A to built-up roofing type 4ACS.

Type MW2T to built-up roofing type 4TCS, except that two layers of felt shall be used.

Type MW2A to built-up roofing type 4ACS, except that two layers of felt shall be used.

In lieu of the bituminous, and gravel or slag, finished surface, the top layer of felt shall be given a coat of pitch or asphalt using not less than 25 and 20 pounds, respectively, per 100 square feet. Where practicable, waterproofing shall extend up vertical surfaces not less than 6 inches. All pipes and pipe sleeves shall be made tight, and all flashing, pans, and similar construction shall be mopped thoroughly into place. Asphalt for types MW5A, MW4A, and MW2A shall be grade AW; pitch for type MW5T, MW4T, and MW2T shall be grade TW.

2-08. Prepared roofing—Rag and asbestos felts; smooth and slate surfaced.—The roof deck shall be covered with one layer of prepared roofing laid parallel to the lower edge of the roof deck with 2-inch side laps and 6-inch end laps. Each lap shall be coated the full width with liquid cement, then nailed along a straight line, $\frac{3}{4}$ inch from the edge, with galvanized, barbed roofing nails having $\frac{5}{8}$ -inch heads and shanks 1 inch long. The nails shall be driven not more than 2 inches apart at side laps and not more than $1\frac{1}{2}$ inches apart at end laps. The roofing shall be turned up vertical surfaces not less than 4 inches, and turned down properly over edges of eaves, gables, and similar construction, to form a drip, and shall be nailed along straight lines as specified for side laps. Approved galvanized clamp nails and galvanized roofing clamps secured in place end to end along all laps, $\frac{1}{2}$ inch from edges of sheets, may be used in lieu of the nails. A capping or finishing strip of the roofing material shall be provided along ridges and hips. The capping shall extend 8 inches on each side and shall be cemented thoroughly and shall be nailed at the edges $1\frac{1}{2}$ inches on centers. Except for slate surfaced roofing, the contractor shall cement carefully over all lap joints and exposed nail heads with liquid cement.

2-09. Slate-surfaced shingles shall be laid 4 inches to the weather. The first course at eaves shall be laid on a strip of felt class PR80 nailed 6 inches on centers on a row 2 inches from its bottom edge. Single shingles shall be spaced $\frac{1}{2}$ inch apart and shall be secured with two nails placed $4\frac{1}{2}$ inches above the butt and 1 inch from the side edges; strip shingles shall be secured with nails driven $\frac{1}{2}$ inch above each cut and 1 inch from the side edges of the strip. Ridges and hips shall be covered with individual shingles or with 8-inch strips of felt class PR80 laid shingle fashion.

2-10. Shingle (asbestos and wood) and slate roofing.—The sheathing shall be covered with one layer of felt class RA29 or RT29 laid parallel to the eaves. The sheets shall be lapped 3 inches at all longitudinal joints and 6 inches at the end joints, and shall be secured along the edges with $\frac{3}{4}$ -inch, galvanized iron roofing nails to hold them in place until the remainder of the roofing is laid. The felt shall be extended up vertical surfaces to the same height as the flashing, and shall be lapped well over metal aprons of box gutter linings and over valley linings. For a distance of 12 inches from gables and the lower side of vertical surfaces, 24 inches from the upper side of vertical surfaces, and 12 inches on each side of ridges, hips, and valleys, asbestos shingles and slates shall be laid in plastic cement, and all exposed nail heads shall be covered with plastic cement. The shingles or slates at the eaves, ridges, hips, valleys, and dormer walls shall be cut and laid so that their bond pattern will be preserved and so that they will align in their tail coursing, or weather edge. A $\frac{3}{8}$ -by 1-inch wood furring strip shall be nailed flush with the lower edge of the sheathing to give the proper cant to the first course so that the succeeding courses will have full bearing.

I. *Asbestos shingles*.—The first course (9 by 18 inches) shall be laid end to end, with the longer dimension parallel to and overhanging the cornice line or eaves about 1 inch. Over the first course the second course (8 by 16 inches) shall be laid side to side so as to cover entirely and to break joints with the first course, with the longer dimension of the shingles perpendicular to the eaves line. The

remainder of the roof shall be covered in the same manner as the second course, but so that each course will have a 2-inch head lap. Shingles shall overhang $\frac{1}{2}$ inch at all gable ends. Each course shall break joints with the preceding one. Each shingle shall be secured with not less than two $1\frac{1}{4}$ -inch galvanized iron or copper slating nails driven through holes in the shingle. Nails which come in contact with copper work shall be of copper. Ridges and hips for asbestos shingle roofs shall be covered with asbestos rolls, and shall be made watertight previous to the application of the rolls, which shall be lapped not less than 2 inches and shall be secured in place with copper ridge roll clips, bent flat. Ends of ridges and hips shall be closed. Where ridges and hip members intersect and terminals are not indicated, the rolls shall be mitered carefully, flashed with 6-pound sheet lead, and laid in plastic cement. Where terminals are indicated, they shall be of sheet lead, fastened securely in place.

II. *Wood shingles* shall be laid in a manner similar to that specified for asbestos shingles, except that all shingles of the doubled first course shall be laid with the longer dimension perpendicular to the eaves and all shingles shall have an exposure to the weather of $4\frac{1}{2}$ inches. Unless required otherwise by the special specification or its accompanying drawings, the ridges shall be finished by sawing off the tops of the shingles and covering the ridge with saddle boards rabbeted together; the hips shall be laid "Boston style" by laying a course of 4- or 5-inch shingles on each side of and parallel to the hip and over the field shingles, the two courses lapping each other alternately.

III. *Slate* shall be laid in a manner identical with that specified for asbestos shingles, except that the head lap shall be 3 inches. Ridges and hips for slate roofs unless required otherwise by the special specification or its accompanying drawings, shall be covered with slates laid double saddled or "Boston style", with all butt joints made watertight by a limited amount of plastic cement. Slate with the grain running horizontally shall not be used except for undereaves courses and for ridges. Curved slates shall be laid with the convex sides up.

2-11. *Promenade tile roofing.*—The roof decks shall be covered with five layers of impregnated felt as specified under types 5AWS, 5ACS, 5TWS, or 5TCS, except that in the final application of pitch or asphalt 25 pounds per 100 square feet shall be used and except that the gravel, or slag, shall be omitted. On this there shall be placed $1\frac{1}{4}$ inches of 1 to $2\frac{1}{2}$ cement mortar into which the tile shall be embedded. All joints shall be $\frac{1}{2}$ inch wide and shall be filled flush with the top surface of the tile. As soon as practicable after the joints are filled the surface shall be cleaned thoroughly to show the natural color of the tile. Tiles shall be laid in straight courses, breaking joints with adjacent tiles except at expansion joints, which shall be provided 10 feet on centers and which shall be filled with asphalt mastic. Where necessary to cut tile, they shall be trimmed or rubbed so that the finished tile edges and joints will be straight and uniform. The tiles shall be wetted thoroughly before being laid, regardless of the season of the year. The tiles shall be laid so that no pieces smaller than half tiles will occur at ends of rows or at expansion joints. Tile shall be laid after all roof leader connections, flashings, and similar construction are in place. The entire finished roof

surface shall be graded uniformly to outlets and shall contain no depressions which might hold water. To insure the proper setting of the mortar, the tile roofing shall be kept moist with clean water for 3 days after the joints are filled.

2-12. Pan and cover tile roofing.—The sheathing shall be covered with one layer of class RA29 or RT29 felt laid parallel to the eaves. Felt shall be lapped 4 inches over gutter and valley metal, 3 inches at longitudinal joints, and 6 inches at end joints. The sheets shall be secured along the edges with a limited number of $\frac{3}{4}$ -inch, large head, galvanized iron roofing nails to hold them in position until the wood strips and roofing tiles are laid. The ridges and hips shall be provided with one additional layer of the felt extending 18 inches on each side. The felt shall be turned up all vertical surfaces to the same height as the flashing. The tiles at the ridges, hips, and valleys shall be laid so that their bond pattern will be preserved and so that they will aline in their tail coursing, or weather edge. Continuous wood strips, about $1\frac{1}{2}$ by 3 inches, shall be laid over the felt at right angles to the eaves and spaced about 10 $\frac{3}{4}$ inches on centers to suit the rolls and spiked securely to the roof sheathing at least 2 feet on centers. Similar strips, $1\frac{1}{2}$ by $4\frac{3}{4}$ inches, shall be spiked along the center lines of ridges and hips to provide proper support and nailing surface for the tile ridge and hip rolls. The tiles shall be laid irregularly in parallel courses perpendicular to the eaves, exposing 9 to 13 inches to the weather. All special tile shapes necessary shall be provided. Ridges shall be covered with tile ridge rolls and suitable top fixtures. Each hip shall be covered with tile hip rolls with a tile hip starter at bottom. Tile terminals shall be provided where ridges and hips intersect; at gable ends of ridges closed end ridge tiles shall be installed. At eaves, all roll pattern and cover tiles shall be provided with eave closures; the line of closure shall be $1\frac{1}{2}$ inches from the lower end of the tile. Detached gable rake tiles shall be installed along all gable ends. Suitable tile deck mold and tile top fixtures shall be provided along the sides of decks. Tile top fixtures shall be provided in front of walls and similar vertical surfaces. The tiles which verge along hips shall be cut to the proper angles so as to fit close to the wood hip stringer and a watertight joint shall be made by cementing, with plastic cement, the cut hip tile to the wood hip stringer. Each piece of hip roll shall then be nailed to the wood hip stringer. The interior spaces of hip and ridge rolls shall not be filled with pointing material. The pan tiles shall be omitted over concealed gutters; the cover tiles shall be doubled at the eaves. Large pieces of tile shall be used at the valleys and hips. A limited amount of best quality plastic cement may be used for leveling tile, for pointing around the edges of top fixtures and eaves closures, and between the joints of hip and ridge rolls. The use of plastic cement or other pointing material to overcome defects or irregularities in the tile or to form watertight joints, where such results can be obtained by the use of specially shaped tile, flashing, or counterflashings, will not be permitted. Tiles shall be secured in place by nails driven through holes in the tile; nails shall be of ample size and of solid copper. Care shall be taken not to drive roofing nails too tight.

2-13. Corrugated asbestos sheets.—End laps in roofing and siding shall be not less than 6 and 4 inches, respectively; side laps in roofing

and siding shall cover 2 and 1 corrugations, respectively. Vertical joints shall be kept plumb and in alinement, and horizontal joints straight. End laps shall be made at purlins or girts so that fasteners will pass through both upper and underlying sheets. The overhang at eaves shall be adequate and at gables shall be not more than one corrugation. Holes for bolts, ties, or other fasteners shall be drilled and shall be made in the high part of the corrugation. Sheets shall be secured to all purlins and girts. Side laps shall be secured together between purlins and girts by galvanized bolts or aluminum rivets. Over wood framing the sheets shall be secured thereto by $\frac{1}{8}$ - by 3-inch galvanized barbed nails spaced approximately 5 inches apart, or by $\frac{1}{4}$ - by 2 $\frac{1}{2}$ -inch, round-head, galvanized wood screws spaced approximately 7 $\frac{1}{2}$ inches apart; over steel framing the sheets shall be secured thereto, at not more than 19-inch centers, by $\frac{1}{4}$ -inch galvanized bolts and suitable galvanized clips, or by tie wires consisting of aluminum wire not less than 0.162 inch in diameter, with flat heads on the upper or outer ends. Fastenings for ridge rolls, corner rolls, battens, louvers, flashings, and other special shapes shall conform to the applicable requirements specified above. Lead washers of suitable type shall be provided under the heads of all rivets, nails, screws, bolts, and other fasteners. Provision shall be made to insure weathertight connections or flashings at and about door, window, and other openings, gable ends, eaves, valleys, vertical surfaces, roof ventilators, pipes, water tables, gutters, and leader openings on roofs, inside and outside corners or angles. Where weathertight connections or flashings cannot be properly formed by the roofing and siding or by special shapes of the same material, 4-pound sheet lead shall be used and shall, in all cases, be shaped to fit into the corrugations. Where ridge rolls are of the butt-joint type, ridge-roll battens shall be provided. Where corner rolls are not of the overlapping type, the joints shall be flashed with 4-pound sheet lead which shall be carried up 3 inches inside of the upper roll, carried through joint, and brought down 3 inches. The weather ends or parts of all fastenings shall be made waterproof by use of a roof putty or cement specially adapted for such purpose in connection with asbestos roofing. Similar putty or cement shall be used for filling corrugations under edges of ridge rolls. Drawings showing all details of construction and assemblage of work proposed shall be submitted for approval.

2-14. Corrugated galvanized steel, asbestos-covered metal, and zinc.—Roofing sheets shall be lapped 6 inches at the ends and 1 $\frac{1}{2}$ corrugations at the sides; siding sheets, 4 inches at the ends and 1 $\frac{1}{2}$ corrugations on the sides. They shall be secured together at the side laps not more than 12 inches on centers. End laps shall be made at purlins or girts. Sheets shall be secured to all purlins and girts at side laps and midway between side laps. At end laps and at intermediate purlins and girts sherardized or galvanized straps or mushroom- or cone-headed nails shall be used. Sherardized or galvanized bolts and nuts shall be used with the straps and for side-lap connections. Lead washers shall be used between bolt heads or nuts and the sheets. Holes shall be drilled so that the heads of bolts or rivets will be at the top of corrugations. Sheets on walls shall finish flush at internal and external angles, which shall be covered with special sheets made for the purpose. These shall lap at least 6 inches on each wall. Valley metal and suitable trim for eaves, gables, and

hips shall be provided and shall insure water and windproof construction. Ridge rolls shall be not less than 3 inches in diameter and shall have aprons not less than 5 inches wide. Where flat aprons are used, adequate provision shall be made to seal the spaces and make the work water and windproof. All special shapes shall be secured in a manner similar to that specified for side and end laps. Valleys shall be laid open, and valley metal shall be supported properly throughout the entire length on wood sheathing. Valley metal, ridge rolls, and trim shall be of the same material as the roofing.

2-15. Flat tin, copper, and zinc.—Before laying the roofing the roof deck shall be covered with one layer of rosin-sized building paper, each sheet of which shall be lapped 2 inches at the joints and shall be secured in place with a limited number of roofing nails. All solder shall be composed of equal parts of tin and lead, and shall be sweated to seams with a heavy iron, using rosin only for the flux. The edges of all copper to be soldered shall be tinned at least $\frac{3}{4}$ inch before the sheets are locked. All nails used in terneplate shall be barbed, tinned, roofing nails; in copper, solid copper roofing nails; and in zinc sherardized or galvanized nails. In the angle formed where roof decks abut vertical masonry surfaces the metal roofing shall be turned up the vertical surfaces not less than 6 inches. Where the vertical surfaces are covered, the roofing shall be carried up, not less than 6 inches, back of the covering. Unless the special specification requires otherwise, the standing seam method shall be used for roofs having a rise of more than 3 inches per foot, and the flat seam method when the rise is 3 inches or less per foot.

I. *Standing seam method.*—The standing seams shall be parallel to the slope of the roof. The sheets shall be made into long lengths at the shop by locking the short dimensions together and soldering thoroughly the seams thus formed. In applying the metal one edge of a course at each side seam shall be turned up at right angles $1\frac{1}{4}$ inches; then $1\frac{1}{2}$ - by 3-inch cleats spaced 10 inches apart shall be installed by fastening one end of each cleat to the roof with two 1-inch nails and folding the roof or bottom end back over the nailheads and the top end over the upstanding edge of the course. The adjoining edge of the next course shall be turned up $1\frac{1}{2}$ inches, and the abutting upstanding edges shall be locked, turned over, and flattened tightly against one side of the standing seam. Standing seams shall be straight, rounded neatly at the top edge, and shall stand 1 inch above the roof deck.

II. *Flat-seam method.*—The metal shall be laid so that the short dimension will be parallel with the gutter or eave lines and so that all seams will be flattened upon the roof. All seams shall be made by turning the edges of the sheets $\frac{1}{2}$ inch, and locking and soldering them together. If the sheets are laid one at a time they shall be secured to the roof with cleats, using three cleats to each sheet, 2 on the long side and 1 on the short side. Cleats shall be $1\frac{1}{4}$ inches wide, hooked carefully over the $\frac{1}{2}$ -inch upturned edges of sheets and nailed to the roof with two 1-inch nails. The roof or bottom end of each cleat shall be turned back over the nailheads before the next sheet is applied. If desired, the sheets may be made into long lengths at the shop by locking the short dimensions together and soldering thoroughly the seams thus formed. The long lengths shall have their edges turned $\frac{1}{2}$ inch and each length shall be secured

to the roof by cleats spaced 8 inches apart, locked into the seams, and fastened in place as specified above.

2-16. Steel roof decks.—The sheet steel roof shall be secured to the structural steel supports with $\frac{1}{4}$ -inch galvanized bolts and nuts or steel clips not less than 0.063 inch thick. The maximum spacing of bolts or clips shall be such that if load were applied to the underside of the sheet the fastenings would develop the strength thereof without exceeding a working stress of 16,000 pounds per square inch. If bolts and nuts are used, sheet lead washers shall be installed between the purlins and the sheet steel. Sheets shall be lapped properly at the sides and shingled at the ends or, in lieu of shingling, end joints may be covered by splice pieces. Sheets when in place shall have no rusted or bare spots on the underside and all such spots which appear shall be cleaned and touched up with red-lead or other approved paint.

2-17. Insulation for roof decks shall be embedded solidly in a mopping of asphalt, grade AR3, with the sheets spaced about $\frac{1}{4}$ inch apart at all joints. Where more than one layer is used, each layer shall be embedded in a mopping of asphalt with the sheets in each layer arranged so the joints will not be over those in the layer below. On steel roof decks having a pitch of 3 inches per foot and more, the insulation shall be secured to the decking with substantial metal fasteners, using not less than one fastener for each 4 square feet of surface. Before the asphalt mopping is applied the deck shall be swept clean of all rubbish, and it shall be dry and smooth. The insulation material shall be kept dry until applied and no more shall be laid than can be covered the same day with one layer of the roofing felt, or protected in case of rain while work on the roof is actually in progress. Provision shall be made for the proper installation of ventilators and valley gutters and for the fastening of hanging gutters. The insulation shall be covered with the type of roofing given in the special specification, and where not so specifically stated therein the covering shall be built-up roofing type 4ACS, except that the primer coat shall be omitted, or type 4TCS.

2-18. Flashing shall be provided in the angles formed where roof decks abut walls, curbs, ventilators, pipes, and other vertical surfaces and where necessary to make the work watertight. On built-up roofings the flashing shall be installed before the top coating and surfacing is applied. Flashing strips shall be in lengths not exceeding 10 feet. End joints shall be lapped at least 3 inches and shall be made watertight with plastic cement. The following types shall be used for the several types of roofings noted:

Type F1.—Built-up roofings, types 5TWS, 5TCS, 5AWS, 5ACS, 4TWS, 4TCS, 4AWS, and 4ACS.

Type F2.—Built-up roofings, types 3xA AW and 3xAAC.

Type F3.—Built-up roofing type 2W, prepared roofings, and slate surfaced shingles.

Type F4.—Pan and cover tile, promenade tile, and slate—using copper.

Asbestos and wood shingles—using galvanized sheet steel.

Type F5.—Corrugated metal roofings—using the same material as on roofing.

Corrugated asbestos—using galvanized sheet steel.

I. *Type F1*.—Three layers of felt flashing shall be extended up the vertical surfaces to the raglet and onto the roof decks 6, 5, and 4 inches, respectively. The layers shall be cemented to each other and to the underlying surfaces, and exposed surfaces shall be coated with plastic cement $\frac{1}{8}$ to $\frac{1}{4}$ inch in thickness. Where practicable, flashing shall be secured along the upper edge with large head, galvanized, roofing nails spaced not more than 8 inches on centers and driven through the first two layers. Aprons of roof ventilators, of metal flashing for pipes and chimneys, and of similar construction, shall be covered with two layers of felt cemented with plastic cement. The first and second layers shall overlap the metal aprons 3 and 6 inches, respectively.

II. *Type F2*.—Felt flashing strips shall be extended up the vertical surfaces not less than 6 inches and onto the roof decks not less than 4 inches. Each flashing strip shall be mopped with plastic cement, then fitted securely in place while the cement is plastic, shall be nailed properly at both edges with large head galvanized nails, and shall be uniformly covered with plastic cement. The exposed edge of the flashing strip on the roof deck shall be covered with a 4-inch strip of felt, mopped into place and covered with plastic cement. Aprons of roof ventilators, of metal flashing for pipes, and of similar construction shall be covered with two layers of single-ply felt cemented with plastic cement. The first and second layers shall overlap the metal aprons 3 and 6 inches, respectively.

III. *Type F3*.—Felt flashing strips shall be installed as specified for type F2, except that the 4-inch strip covering the edge on the roof deck shall be omitted and except that aprons and metal flashings shall be covered with a layer of felt overlapping the metal 4 inches.

IV. *Type F4*.—On the slopes of pitched roofs the metal flashing shall be turned up vertical surfaces approximately 10 inches; elsewhere 6 inches. Metal flashing shall be extended under the roof covering at least 6 inches. The upper edge of metal flashing shall be secured with tinned flashing hooks spaced not more than 12 inches on centers. Flashing shall be in lengths not exceeding 8 feet. End joints shall be lapped at least 3 inches and made watertight. Flat seams shall be used where necessary to secure watertight work, and such seams shall not be soldered where the length over all the sections so joined is greater than 30 feet. Where sides of slates, wood and asbestos shingles, or pan and cover tile along slopes of roof decks abut dormer walls, chimneys, curbs, and other vertical surfaces, metal flashings shall be provided and laid in with each course of the roof covering, shingle fashion. The vertical leg against masonry shall extend up the vertical surfaces to the height where the counterflashing is to be inserted. In the case of dormer walls, etc., where the finished wall covering forms a proper counterflashing the vertical leg shall extend up behind the finished wall covering not less than 6 inches. On pan and cover tile roofs the leg of the flashing extending on the roof shall be turned up at the edge $\frac{1}{4}$ inch. At the upper side of chimneys, curbs, and similar vertical surfaces extending through pitched roof decks covered with slate, shingles, or tiles the metal flashings shall extend over a cricket. At the lower side of dormer walls, chimneys, and similar vertical surfaces extending through roof decks, metal flashings shall extend onto the finished roof covering at least $4\frac{1}{2}$ inches, and in the case of slate, wood, or

asbestos shingle roofing in lower edge of the flashing, shall be secured with copper storm nails placed in every joint of the top row of slate or shingles. On pan and cover tile roofs the lower edge of the flashing shall fit closely the contour of the tile. Where skylights are required, sheet metal flashing shall be joined to the sheet metal work of the skylights in a manner such as to form a watertight joint.

V. *Type F5*.—Flashing shall conform, in general, to that specified under type F4. Rake flashing shall have 1 corrugated apron and 1 flat apron. Flashing shall extend up vertical surfaces not less than 6 inches and upon roof decks not less than 5 inches or two corrugations. Flashing shall be secured in a manner similar to that specified for side and end laps.

2-19. Counterflashing in masonry walls shall be inserted in raglets $\frac{1}{4}$ to $\frac{3}{8}$ inch wide in brick walls and $\frac{1}{2}$ inch wide in concrete, and not less than $1\frac{1}{2}$ inches deep and located from 6 to 10 inches above the roof level. Counterflashing shall extend down vertical surfaces not less than 3 inches. Counterflashing shall be secured in place by lead wedges spaced 18 inches apart or by galvanized flashing hooks $3\frac{1}{2}$ inches long and spaced 3 feet apart. At chimneys and other short lengths of wall the fastenings shall be spaced closer. After placing counterflashing the raglets shall be filled with plastic cement. Metal counterflashing and metal parts of combination counterflashings shall be in lengths not exceeding 10 feet. End joints shall be lapped at least 3 inches and shall be made watertight with plastic cement. The following types shall be used for the several types of roofings noted:

Type C1.—Built-up roofing types 5TWS, 5TCS, 5AWS, and 5ACS—using copper for the metal part.

Built-up roofing types 4TWS, 4TCS, 4AWS, and 4ACS—using galvanized sheet steel for the metal part.

Built-up roofing types 3xAAW and 3xAAC—using galvanized sheet steel for the metal part.

Type C2.—Pan and cover tile, promenade tile, and slate—using copper.

Asbestos and wood shingles, corrugated asbestos, built-up roofing type 2W, slate surfaced shingles, and prepared roofing—using galvanized sheet steel.

Corrugated and flat metal roofings—using same kind of metal as roofing.

I. *Type C1*.—Counterflashing shall be a combination of metal and a strip of felt; the felt shall be class PR52 for use with rag-felt roofings or of the special strips made especially for use with asbestos felt roofings. The metal portion shall cover completely the exposed surface of the felt portion, and it shall be bent flat through 180° along its upper edge to form a lap $1\frac{1}{4}$ inches wide into which the felt shall be fastened securely. This lapped portion shall be inserted into the raglets in the masonry; then the flashing and the back of the counterflashing shall be coated thoroughly with plastic cement, and the counterflashing shall be turned down and fitted securely into place while the cement is plastic. The felt part of the counterflashing shall extend to the roof deck. End joints shall be lapped not less than 3 inches and shall be sealed with plastic cement. The exposed face of counterflashing, including the metal part if of galvanized steel, shall be coated uniformly with plastic cement; copper shall be cleaned and oiled.

II. *Type C2.*—Counterflashings shall have both edges folded $\frac{1}{2}$ inch and shall extend down over flashings with the lower edge parallel to the roof line. Counterflashings shall be bent to the required shape before being placed.

2-20. Dampproofing shall consist of a coating of hot asphalt grade AW or hot pitch grade TW, using not less than 25 pounds per 100 square feet of surface and being applied in 1 or 2 coats as may be necessary to secure an even, uniform coating.

SECTION 3. SHEET METAL WORK

3-01. Scope of work.—The contractor shall provide and install all flashing, counterflashing, gutters, downspouts, wire strainers, roof leader connections, ridges, hips, scuppers, barging, gravel stops, snow guards, eave and gable trim, scuttles, cornices, louvers, ventilators, skylights, and all sheet metal and other work necessary to complete the work and to make it watertight. Except where specified otherwise herein, the sheet metal required to complete the work shall be of the particular kind called for by the special specification for the work, and where not so specifically mentioned it shall be of the material required to be used in connection with counterflashing.

3-02. General requirements.—Generally all joints of sheet metal shall be locked, but where such joints are not practicable the metal shall be lapped and riveted. All lock joints on exposed surfaces shall be turned in the direction of the slope. All miters shall be lapped and riveted, or abutted with straps riveted on the back. All joints and miters shall be soldered. Where necessary for strength or stiffness, heavy gusset plates shall be employed and securely riveted in place. All nails and rivets for tin shall be tinned; for zinc and for galvanized sheet metal work, galvanized or sherardized; and for copper work, hard copper. Where copper is joined to or would otherwise come in contact with steel, iron, zinc, tin, or galvanized metal it shall be separated therefrom by strips of sheet lead weighing not less than 3 pounds per square foot or the copper shall have lead coating, on the contact side or both sides, of approximately 2 ounces per square foot of coated surface. Joints between tin and galvanized sheet metal shall be given a heavy coat of red-lead paint immediately before locking. Care shall be taken not to scratch the sheet metal in any manner. Acid flux shall not be used in soldering except in connection with galvanized sheet steel. Copper shall not be stained by any substance used in soldering. Sheet metal work against vertical surfaces, at exposed edges of roofs, and where necessary in conjunction with roofing shall be placed when the roofing is laid so that it may be mopped or built into the roofing construction.

3-03. Hung gutters shall be provided with miter corners, outlets, end pieces, and similar special pieces necessary. The outside edges shall in all cases be beaded; the inside edges shall likewise be beaded where practicable. The gutters shall be lapped, riveted, and soldered at the joints, except that slip joints shall be provided at the summit of each gutter having a mitered corner. Gutters shall be supported on adjustable hangers, of an approved type, spaced not more than 4 feet on centers, and secured in place with heavy screws. Hangers and screws for copper gutters shall be of brass or copper; for galvanized sheet steel gutters they shall be of tinned or galvanized iron.

3-04. Box gutters shall have the pitch of the gutter formed in the roof construction. Where seams in box and secret gutters cannot be locked and soldered, they shall be lapped, riveted, and soldered. Longitudinal seams will not be permitted where they can be avoided by the use of wider sheets. The back edges of gutter linings in connection with tile, slate, or shingle roofs shall extend under the roofing as far as possible without being punctured by the nailing of the roof covering, and the edge shall be folded $\frac{1}{2}$ inch and secured to the roof with sheet metal cleats as specified for metal valley lining. Box gutters in connection with the sheet metal roofing shall be locked and soldered to the roofing. Cleats for securing gutter linings shall be spaced not more than 15 inches on centers. The front edge of the gutter lining shall be turned down the outer edge of the gutter construction to form a drip and shall be nailed securely in place not more than $1\frac{1}{2}$ inches on centers.

3-05. Downspouts shall be flanged properly and soldered to the gutters. Gooseneck connections of the material specified for downspouts shall be provided where offsets occur. The downspouts shall be secured to the building with metal straps, not less than $\frac{1}{2}$ by 2 inches in cross section, soldered to downspouts and fastened to woodwork with screws, to hollow tile with toggle bolts, and to masonry by screws and lead sleeves. Lead sleeves shall be a type having a V-shaped wedge on the inner end and which, when driven into a hole, expands the sleeve and is again expanded when the screw is inserted. Straps for copper downspouts shall be of cold-rolled copper and shall have bronze fastenings; straps and fastenings for galvanized downspouts shall be galvanized. Conductor heads shall be of the material specified for downspouts. Where downspouts discharge at grade or on an adjacent roof space they shall terminate at the lower end with a single-piece elbow of the same material as the downspouts. Joints between sheet metal downspouts and cast-iron pipe or boots shall be made with cement mortar worked well into place and finished smooth and to a neat bevel.

3-06. Wire strainers.—All downspout openings on roofs and in gutters, except where the roof leader connections have integral cast-iron strainers, shall be provided with globe-shaped wire strainers made of not less than 0.062-inch diameter wire. The strainers shall be set in loose. Wire strainers in connection with copper work shall be of copper wire; all other wire strainers shall be of steel wire, tinned or galvanized after weaving.

3-07. Roof leader connections.—Wrought- and cast-iron pipe downspouts shall be provided with roof leader connections of a standard commercial type of the proper size and design. They shall be furnished complete with cast-iron strainer, cast metal, gravel, or tile stop as may be necessary, flashing flange not less than 4 inches wide on all sides, and roof lock and expansion joint fittings constructed so as to provide for expansion and contraction of the downspout and settlement, shrinkage, and vibration of the building. They shall be secured to the roof in a manner to insure the functioning of the expansion joint and to prevent the outlet being lifted above the roofing. They shall have tapped ends for connection to screw-threaded pipes.

3-08. Ridges and hips, not specified otherwise herein, shall be covered with metal rolls having not less than 5-inch aprons and 3-inch diameter rolls. The rolls shall be lapped 6 inches at the joints, and ridge and hip ends shall be closed.

3-09. Scuppers shall be lined, flashed, and made watertight in an approved manner.

3-10. Barging, gravel stops, and eave and gable trim at the exposed edges of roofs shall be made of sheet metal. The metal trim at exposed edges of roofs covered with built-up roofing shall be formed with an approved drip at the under edge of the roof decks; aprons of trim shall be mopped and secured in place properly so as to be covered by the two upper layers of felt. A metal gravel stop shall be made integral with the trim or riveted and soldered to the upper edge of the trim for slag and gravel roofs.

3-11. Scuttles.—For roof scuttles in connection with copper roofs or other types of roof coverings for which copper counterflashing or combination copper and felt counterflashing is specified, the scuttle covers shall have the exposed surfaces covered with cold-rolled copper; scuttle covers in zinc roofs shall be covered with zinc; elsewhere they shall be covered with IX terneplate roofing tin. The metal shall be laid with flat seams and shall be carried around the rim to the underside of the scuttle cover, where it shall be secured with nails spaced not more than $1\frac{1}{2}$ inches on centers. Scuttle curbs shall be covered their full heights and 2 inches down on the inside of the curb with the material specified for covering scuttle covers, and shall be secured with nails spaced $1\frac{1}{2}$ inches on centers. Seams shall be soldered.

3-12. Cornices.—Moldings of cornices shall be true, sharp, and straight. Flat surfaces over 5 inches wide shall be crimped, and miters and joints shall be fitted carefully. Angles and corners shall be reinforced and all joints shall be soldered and shall be riveted neatly where necessary. Cornice work shall be reinforced and anchored with properly shaped wrought-iron members where necessary, put together as far as practicable at the shop, shall be erected true, and shall be secured firmly in place. In the case of masonry walls the base of cornices shall be let into raglets formed in the masonry and fastened securely with lead wedges or tinned flashing hooks. The raglets shall be filled with plastic cement.

3-13. Louvers.—The metal of louver frames shall be drawn tight over the structural frames, with edges fastened securely. Louver slats shall be molded at the edges and shall have the ends bent down and riveted and soldered to the frame. The slats shall be set at an angle that will exclude driving rains. A screen having a $\frac{3}{4}$ -inch channel frame and 16-mesh screening composed of wires not less than 0.015 inch in diameter shall be provided back of each louver. The screens back of copper louvers shall have copper wire and frames and those back of galvanized sheet metal louvers shall have galvanized steel wire and frames. Copper screening shall be not less than 99.5 percent pure copper. Screens shall be secured back of louvers by means of sheet-metal clips of the same metal as the louver slats, secured to the louver frame at points not more than 10 inches apart and in a manner allowing the screen to be removed readily.

3-14. Ventilators shall be of the rotary ball-bearing or stationary type. Ventilators shall be constructed of the metal specified in the special specification, and they shall have metal tops. The ventilators shall be stormproof under all conditions and shall be of a standard commercial type, subject to approval. They shall be reinforced and braced adequately; all joints shall be riveted and soldered. Plain

surfaces shall be stiffened by beading or by other approved means and, where necessary to secure the required rigidity, exposed edges shall be wired or beaded. All ventilators shall be provided with suitable movable dampers arranged to remain securely set in the position in which it is desired to adjust them. Dampers shall be of that type which will not tend to turn the air back into the building when they are partly closed. Dampers for rotary ventilators shall be of an approved integral louver type which will close completely the ventilator opening and throw accumulated dust outside of the ventilator. Each damper shall be operated from the floor below by means of a chain and pulleys. The chain shall be extended along ceiling or underside of roof construction and brought down at the nearest wall or column. Chains shall be provided with fusible links so that dampers will close automatically in case of fire. Where chains pass through walls or ceilings, sleeves shall be installed with roses on the ends of the sleeves on the room side. Openings in the tops of all ventilator stems shall be screened in an approved manner with 16-mesh screening composed of wires not less than 0.015 inch in diameter. Screening for ventilators shall be of copper wire, except that for galvanized ventilators it shall be galvanized steel wire. Copper screening shall be not less than 99.5 percent pure copper. Ventilator bases shall be of the proper size and shape to fit the ventilator and the roof and shall be provided with flashing flanges. A complete drawing or cut and a description of each type of ventilator required shall be submitted for approval before the sheet metal work is begun.

3-15. Snow guards shall be of pure copper wire or of galvanized steel wire, as required by the special specification, each selected for ductility and stiffness and shall be of substantial and approved type, with outside ends looped and inside ends pronged. Guards shall be placed staggered in 3 rows near the eaves, and the width of 1 slate apart in each row. Joints in roofing shall be open sufficient to receive the shanks of the snow guards. Loops only shall be exposed. Care shall be taken to insure having the shanks well sunk into the joints so that the roofing will lie flat and not bear on the guards. (NOTE.—Snow guards shall be provided only when required by the special specification or its accompanying drawings.)

3-16. Skylights shall have the structural parts of metal and shall be made watertight without the use of putty, cement, or paint. Skylights shall be constructed so that the glass can be removed and replaced easily, and proper allowance shall be made for wind stresses and for expansion and contraction to prevent the breaking of the glass. The skylights shall be glazed with ribbed wire glass not less than $\frac{1}{4}$ inch thick, laid with the ribbed side down with the ribs parallel to the sash bars. Glass shall be in pieces not exceeding 2 feet in width or 8 feet in length and shall be bedded on flexible cushions. It shall be held in place by means of removable, adjustable caps secured to the sash bars with bolts spaced so as to secure adequate stiffness in the cap. The ends of the glass at cross joints and at ridges and eaves of skylights shall be supported properly and shall be equipped with cross-condensation gutters. All sash bars and the bearings for the glass shall be designed and fitted so as to catch all condensation or leakage and convey it to the outside of the skylight by means of gutters. All parts shall be designed so that water cannot drip therefrom, and all outlets shall be protected

so as to exclude rain and snow. The sheet metal of skylights shall be reinforced for strength and stiffness with rolled steel sections or other approved metal stiffening. Drawings showing all details of construction of the skylights proposed shall be submitted for approval before work on the skylights is started.

3-17. **Miscellaneous flashing and counterflashing.**—The cap strips of all exterior door and window frames in wood frame walls, except those protected by porches, shall be flashed with sheet metal extended up behind the stucco or finished wall covering and brought down over the edge of cap strips with a neat double-fold drip. All other miscellaneous flashing and sheet-metal work indicated in connection with exterior woodwork or required to make the installation of exterior woodwork watertight shall be installed and shall be of the material specified for the metal flashings. Flashing and counterflashing necessary to make the work watertight at the heads, jambs, and sills of steel sash shall be secured properly and shaped to fit the construction and steel sash. Galvanized sheet steel pipe sleeves shall be installed in concrete and gypsum roof decks for the passage of pipes. All pipes passing through roofs shall be flashed with 6-pound sheet lead calked into the hubs of pipe or clamped and calked to the pipe by means of an approved collar, the lead flange of flashing extending onto the roof at least 6 inches on all sides. When required by the special specification and/or its accompanying drawings, through wall flashing of an approved type of mechanical key-bond interlocking copper flashing shall be provided. It shall require no soldering and shall provide a positive mechanical bond for the mortar beds and a positive prevention of seepage and leaks. When used as counterflashing, the edges shall be turned down not less than 4 inches over the roof flashing; under copings the edges shall be turned down approximately $\frac{1}{2}$ inch, and below the roof line under sills and cornices and over lintels and spandrel beams the edges shall be bent up approximately 1 inch on the inside face of walls. At sills the wall flashing shall be bent up approximately 4 inches on each end of the sill.

3-18. Lead pans shall consist of waterproofing, pans, and coating.

I. *Waterproofing*, type MW2T or MW2A, shall be provided under lead pans and back of their turned-up surfaces.

II. *Pans* shall be formed of sheets of lead weighing not less than 6 pounds per square foot. Unless indicated or specified otherwise, the sides of pans shall be not less than 6 inches high. As far as permitted by standard commercial sizes, each pan shall be formed from a single sheet. Joints between sheets and at corners of turned-up portions shall be made by burning the lead. Before the application of the coating, pans shall be proved tight by being filled with water for not less than 24 hours.

III. *Coating of lead pans.*—The surfaces of lead pans on or against which concrete or cement mortar fill or setting beds are to be installed shall be given an even coating of hot asphalt, grade AW, of a thickness of not less than $\frac{3}{32}$ inch. The surfaces of lead pans in contact with marble, slate, and floor drains shall be given a continuous even coating of the hot asphalt. The surfaces to which the asphalt is applied shall be dry and clean. The coating shall be applied in a manner that will provide complete insulation of the lead.

IV. *Protection of openings.*—All openings into floor drains shall be closed during the application of the waterproofing and coating, using approved temporary plugs.

3-19. *Painting.*—All concealed surfaces of black and galvanized sheet steel, and all flashing, counterflashing, and cornices on the back, also all steel construction members and brackets, including those of skylights, shall be painted before laying, with a coat of red lead paint, which shall be allowed to dry before the metal is applied. Paint shall be mixed in accordance with the formula given in Federal Specification No. TT-R-191, using 95 percent dry red lead specified therein. Similar surfaces of terneplate shall be given one shop coat of venetian red and linseed oil; copper shall be oiled. Before painting galvanized metal, the surfaces shall be washed with a solution mixed in the proportion of 6 ounces of copper acetate to 1 gallon of water.

NOTES TO OFFICERS IN CHARGE OF DESIGN

Insulated steel roof.—1. Where provision must be made for snow loads in excess of 20 pounds per square foot and/or wind loads, the uniform live load requirement for the sheets specified in paragraph 1-25 should be increased in accordance with the loads given in the latest edition of Standard Specification No. 12Y, Standards of Design for Structural Steel.

2. Where increased insulation is deemed necessary or desirable, the thickness of the boards specified in paragraph 1-26 should be increased to not less than $\frac{3}{4}$ inch.

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