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NORFOLK AND WESTERN RAILWAY COMPANY

MOTIVE POWER DEPARTMENT

SPECIFICATION NO. 120-B

ASBESTOS CEMENT FOR BOILER LAGGING.

1. Scope - The material desired under these specifications is an intimate mixture of fibrous asbestos and binder. When the proper proportion of water is added it should form a plaster readily applied to a metal surface required to be insulated against heat losses.

2. Asbestos - The asbestos shall be of light texture, free from cords or lumps. Preference will be given to the cement which is of lightest texture and contains the longest and strongest fibre in the largest amount.

3. Binder - The binder may be finely ground clay of good adhesive properties, or a mixture of such clay and magnesium carbonate o or magnesium oxide or a combination of any or all of these. Manufacturers desiring to use any other binder must, before making shipment, obtain approval from the Purchasing Agent. In any case the binder must be of such nature that the cement will stand the heat and vibration of a locomotive without cracking or disintegrating.

4. Chemical Composition - The cement shall meet the following requirements as to chemical composition:

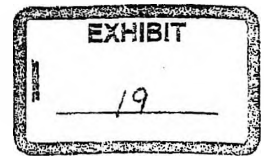
Sulphur Trioxide, in neutral sulphates, Max. per cent	1
Sulphur compounds other than sulphates	None
Free Lime (CAO) Max. per cent	1
Water soluble substances, Max. per cent	1
Organic Matter	None

The cement shall be free from substances which are acid, or corrosive, or which produce acid or corrosive substances on exposure to heat, air or moisture, or any combination of those agents.

5. Physical Properties - The cement shall conform to the following requirements for physical properties:

Weight, oz. per 100 cu. in., Max.	22
Voids, Min., per cent	75
Fibre, Min., per cent	12
Modulus of rupture in transverse test, Min.....	50
Shrinkage, Max., per cent	25

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6. (a) Weight per 100 cu. in. - Sprinkle the cement slowly from a height of 6 in. into a cylindrical vessel 5 in. in diameter and 5.09 in. deep, until it is heaped, then strike off level and weigh the contents.

(b) Voids - Use a vessel of cement prepared as describe in (a). Through a narrow tube reaching to the bottom of the vessel, pour in water slowly until the vessel is just full. The volume of water required determines the percentage of voids.

(c) Fibre - Mix a weighed portion of cement gently with water and wash thoroughly, but without rubbing, through a standard 30-mesh sieve. From the material left on the sieve, pick out any non-fibrous material, then dry and weigh the remaining fibre.

(d) Modulus of Rupture and Shrinkage - Mix the cement with water to proper working consistency and mold five blocks 2 x 4 x 14 in. Dry them in the air, then in an oven or on a steam plate at 220 deg. F., until constant in weight. Allow them to cool and measure for shrinkage, then break them transversely, on a span of 10 in., at a crosshead speed of one to two inches per minute. Calculate the modulus per square inch of cross-section of the blocks in their dried condition, and take the average figure. The highest result should not exceed the lowest by more than 12 per cent. Modulus of rupture in transverse test is obtained by the following formula:

$$m = \frac{3}{2}\frac{wl}{th2} = \frac{3}{2}\frac{\text{Load x Length}}{\text{Width x (Thickness)2}}$$

7. The cement shall be uniformly and thoroughly mixed and have a distinctly fibrous appearance. It shall be free from hard lumps and bits of non-fibrous rock.

8. From each shipment of 5 tons a bag will be selected at random for test and from this bag samples will be taken for examinatio with reference to the requirements of Sections 4, 5, 6 and 7.

9. Inspection - This material will be inspected and tested at destination.

10. Rejection - All material not conforming to the requirements of these specifications will be rejected.

11. Rehearing - Samples representing rejected material will be retained in the Testing Department for a period of fourteen days after reporting the results to the manufacturer. If, at the end of such time, the manufacturer has not given shipping directions, the material will be returned he paying all freight charges both ways.

Office, Superintendent Motive Power,
Roanoke, Va., September 14, 1938.

NORFOLK AND WESTERN RAILWAY COMPANY

MOTIVE POWER DEPARTMENT

SPECIFICATION NO. 59-A

EXHIBIT 37

CAR AND LOCOMOTIVE SAND

1. SCOPE - These specifications cover a clean silica sand free from clay, loam, mica, and other foreign material, for use in car and locomotive sanding equipment.

2. The sand shall conform to the following requirements:

(a) CHEMICAL REQUIREMENTS - The sand shall contain not less than 90% silica.

(b) PHYSICAL REQUIREMENTS -

(1) CAKING TEST - The sand shall have satisfactory non-caking properties as determined by the following test: A cylinder not less than 11 inches high and 1 inch in diameter shall be filled with the sand after the sand has been saturated with distilled water. After drying in an oven at 100°C for 12 hours, it shall run freely through an opening of 1/2 inch in the bottom of the container without shaking or tapping.

(c) GRADING - The sand shall meet the following grading requirements:

	Min.	Max.
Percentage Passing U.S. Standard Sieve No. 10	100	--
Percentage Passing U.S. Standard Sieve No. 30	40	--
Percentage Passing U.S. Standard Sieve No. 50	10	30
Percentage Passing U.S. Standard Sieve No. 80	--	5

3. METHODS OF TEST -

(a) The true silica shall be determined as follows: A representative sample of the sand shall be thoroughly dried and a 1 gram sample (±0.05) weighed in a tared platinum crucible. Add 4 drops of distilled water, 2 drops of conc. H_2SO_4 (Sp. Gr. 1.84) and 10-15 cc. of pure hydrofluoric acid. Evaporate to dryness. Add 10-15 cc. of pure hydrofluoric acid twice more, evaporating to dryness each time. The crucible is then rotated carefully, using crucible tongs, over an open gas flame to avoid splattering until all sulfur trioxide fumes have been expelled, after which the crucible is blasted for one minute, cooled, and reweighed. The percent silica is computed from the loss in weight of the weighed sample.

4. SAMPLING - A 25-lb. sample taken at various points of each carload will be accepted as representing the entire carload shipment. Samples will be taken at the point of destination and forwarded to the Chemical Laboratory for analysis.

5. REJECTION -

(a) Material represented by samples which fail to conform to the requirements of these specifications will be rejected.

(b) Material which shows injurious defects subsequent to its original inspection and acceptance will be rejected, and the manufacturer shall be notified.

6. REHEARING - Samples tested in accordance with these specifications which represent rejected material, shall be held for a period of 14 days from date of test report. In case of dissatisfaction with results of the test, the manufacturer may make claim for a rehearing within that time. If, at the end of that time, the manufacturer has not made claim for rehearing or given shipping directions for the rejected material, the material will be returned, he paying all freight charges both ways.

Office of General Supt. Motive Power,
Roanoke, Va., December 24, 1954.

NORFOLK & WESTERN RAILWAY COMPANY
MOTIVE POWER DEPARTMENT
TENTATIVE SPECIFICATION

ASBESTOS WELDING PAPER

The material shall be composed of not less than 95% of asbestos fiber and not more than 5% of organic matter used as a binder.

The asbestos fiber shall conform to the following requirements as to chemical composition:

Silica - percent - - - - -	39.00 - 42.00
Magnesia - percent - - - -	40.00 - 43.00
Iron (Combined) percent Max	3.50
Alumina - Percent - Max. -	3.50
Water (Combined) % Max. -	14.50

The material shall be furnished 36-inches wide and of 1/16-inch nominal thickness, in rolls weighing approximately 100-lbs.

The allowable range in thickness shall be .052-inch to .065-inch.

The maximum allowable weight per 100 square feet - 85-Lbs.

The average tensile strength, dry, in pounds per inch of width of any set of specimens from a single roll shall be not less than:

Lengthwise - - - - 8 Pounds (Average of 6 tests)
Crosswise - - - - 6 pounds (Average of 6 tests)
When pulled at a speed of 12 inches per minute.

Sufficient strips 1-inch wide by 10-inches long for tensile and bend tests shall be cut both with the grain and across the grain of the sheet and then dried to constant weight at a temperature between 212°F and 220°F. Immediately after withdrawing the specimen from the oven the tensile and bend tests shall be made.

Bend Test - The specimen shall bend in both directions in the form of an "S" flat on itself, -Not more than 10% of the fibers on the outside of the bend shall rupture.

Flame Test - Upon being subjected to the flame of a Bunsen burner no objectionable odor shall be given off nor shall the asbestos welding paper support combustion. The material shall not become brittle enough to badly crack or crumble after it has been heated to a dark cherry red.

Office: Supt Motive Power,
Norfolk & Western Rwy Co.,
Roanoke, Virginia,
September 18th, 1936.

EXHIBIT
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NORFOLK AND WESTERN RAILWAY COMPANY

MOTIVE POWER DEPARTMENT



SPECIFICATION NO. 119-B

CAR CEMENT

1. Scope - The material desired under this specification is a mixture of asphalt, petroleum thinner, and asbestos fiber for use on the interior of freight cars and other miscellaneous purposes.

2. Composition - (a) The car cement as received shall consist of a combination of the following materials in the quantities specified, and shall conform to the following requirements:

	Maximum	Minimum
Petroleum Asphalt base, per cent	---	45
Petroleum Thinner, per cent	35	30
Asbestos Fiber, per cent	20	15

(b) This car cement shall not contain carbon black or filler in any form.

(c) The predominating odor shall be that of petroleum naphtha.

3. Physical Characteristics - (a) The consistency of the car cement shall be such that it can be applied either by brush or spraying.

(b) When applied to a metal surface, this material shall dry by evaporation at room temperature to a non-tacky film within 24 hours

(c) When applied to No. 26 gauge black iron or steel and allowed to dry at room temperature for 48 hours, it shall permit bending through 180° around a pin, the diameter of which shall not be greater than 0.050 inch, without checking or cracking of the car cement.

4. Asphalt - (a) Method of Extraction - The asphalt shall be extracted using the following method which is a modified version of ASTM Designation D762-47T:

The asphalt is extracted with chloroform and the sample centrifuged to remove the asbestos. The clear liquid is distilled in a creosote still using an air condensor. A centigrade thermometer is used and is lowered as the chloroform distills off so that it is 1/2" from the liquid in the flask. Bring the temperature up to 250°C and hold there for 15 minutes. Pour the pure asphalt into a penetration can and let cool.

(b) The asphalt shall conform to the following requirements:

Penetration	50 - 75
Ductility	15 cm Min.
Melting Point	140 - 150°F
Bitumen Soluble in CS_2	99% Min.

The above will be determined by latest Standard ASTM Methods.

Ash	1.0% Max.

5. Petroleum Thinner - (a) The thinner employed in reducing this material to the proper consistency shall conform to the following requirements:

	Maximum	Minimum
Flash Point, Tag Closed Cup	---	100°F
End Point	500°F	---

(b) The thinner must be free from wood distillates.

6. Sampling - A sample will be taken at random from a single drum as representing the shipment.

7. Inspection - This material shall be inspected and tested at destination.

8. Rejection - All material not conforming to the requirements of this specification shall be rejected.

9. Rehearing - Samples representing rejected material will be retained in the Laboratory for a period of fourteen (14) days after reporting the results to the manufacturer. If, at the end of such time, the manufacturer has not given shipping instructions, the material will be returned, he paying all freight charges both ways.

Office, General Superintendent Motive Power,
Roanoke, Virginia, May 21, 1948.

NORFOLK AND WESTERN RAILWAY COMPANY

MOTIVE POWER DEPARTMENT

SPECIFICATION NO. 109-A

EXHIBIT 20

LAGGING, MAGNESIA, FOR LOCOMOTIVE BOILERS

1. Scope - These specifications cover segmental magnesia lagging for the insulation of locomotive boilers.

MANUFACTURE

2. Manufacture - (a) All lagging furnished to these specifications shall be of the best quality for the purpose. It shall consist of basic carbonate of magnesia in combination with sufficient long fibre asbestos to give it the proper physical properties.

(b) It shall be uniform in texture, thoroughly seasoned and free from lumps and flaws.

CHEMICAL PROPERTIES AND TESTS

3. Chemical Composition - The lagging shall comply with the following requirements as to chemical composition:

Hydrated Magnesium Carbonate, $(4MgCO_3.Mg(OH)_2XH_2O)$ percent	Not under 80.0
Long Asbestos Fibre, percent	Not under 10.0
Foreign Matter, percent	Not over 5.0

4. Chemical Analyses - Sample for chemical analyses shall be a composite taken from all pieces used for the transverse strength test.

PHYSICAL PROPERTIES AND TESTS

5. Weight - After being heated on a steam plate for a period of 24 hours, the average weight of the lagging shall be not more than 14 pounds per cubic foot.

6. Transverse Tests - After being heated on a steam plate for a period of 24 hours, the transverse strength of samples of the lagging tested, when supported on knife edges 10 inches apart and loaded in the center, shall show a minimum average modulus of rupture of 40 pounds per square inch.

7. Number of Tests - From each lot of 2,500 pieces, or less, of any given order, one sample for test purposes shall be selected from every 10th carton or equivalent to a total of 10 samples per lot. The density and transverse strength shall be based on the average of 10 samples tested. The transverse strength shall preferably be made on a 10-inch span so that approximately 3 transverse tests will be made on each piece or an average of 30 breaks for the 10 blocks tested Samples and lots from which the samples are taken shall be similarly marked so that they may be identified in case of rejections.

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PERMISSIBLE VARIATIONS IN DIMENSION

8. Permissible Variations - A variation of plus or minus 1/8-inch will be permitted from the specified thickness, length and width.

PACKING AND MARKING

9. Packing - Lagging shall be well packed in cartons or cases so as to avoid abrasion or breakage in transit.

10. Marking - Each case shall legibly show the name of the manufacturer, point of shipment, kind, amount and size of material and the Railroad order number.

INSPECTION AND REJECTION

11. Inspection:

(a) All tests and inspection, unless otherwise specified, will be made at destination.

(b) The purchaser reserves the right to make tests to govern the acceptance or rejection of the material at the place of manufacture or elsewhere.

(c) In case tests and inspection are made at the place of manufacture, the manufacturer shall notify the General Superintendent of Motive Power of the Railroad at least four (4) days in advance of the time when material will be ready for shipment to permit of arrangements for inspection.

(d) The inspector representing the purchaser shall have free entry to all parts of the manufacturer's works which concern the manufacture of the material ordered while the work on the contract of the purchaser is being performed.

(e) The manufacturer shall afford the inspector, free of charge, all reasonable facilities and necessary assistance to satisfy him that the material is being furnished in accordance with these specifications.

12. Rejection:

(a) Material represented by samples which fail to conform to the requirements of these specifications shall be rejected.

(b) Material which, subsequent to test and inspection at the factory or elsewhere and its acceptance, shows manufacturer's defects, shall be rejected and the manufacturer notified. In case of rejection after arrival of the material at destination, the manufacturer shall pay all transportation charges.

13. Rehearing - Samples tested in accordance with these specifications, which represent rejected material, will be held for fourteen (14) days from date of test. In case of dissatisfaction with the results of the tests, the manufacturer may make claim for a rehearing within that time.

Office of General Supt. Motive Power.
Norfolk and Western Railway Company
Roanoke, Virginia, December 19, 1946.