

F. L. FELLOWES,
CITY ENGINEER



City Engineer's Office

VANCOUVER, B. C. August 30, 1922.

J. F. C. B. Vance, Esq.,
City Analyst,
Police Department,
City.

Dear Sir:

Enclosed, herewith, is extract from U. S.
Department of Agriculture, Specification for testing
Bituminous Road Materials.

This is a copy of the specification which
Mr. Jenkins and Mr. Brakenridge stated was used by the
Columbia Bitulithic at their Portland Plant.

Yours truly,

F. L. Fellowes,
City Engineer,

JNA/RJ
Encl. 1.

Per- *John Anderson*

TYPICAL SPECIFICATIONS
FOR BITUMINOUS ROAD MATERIALS.

by
Prevest Hubbard, Chemical Engineer, and
Charles S. Reeve, Chemist.

Penetration.

Pages 55, 56

(A.S.T.M. Standard Test D5-16.)

I. Definition.

1. Penetration.- Penetration is defined as the consistency of a bituminous material expressed as the distance that a standard needle vertically penetrates a sample of the material under known conditions of loading, time and temperature. Where the conditions of test are not specifically mentioned, the load, time and temperature are understood to be 100 g., 5 seconds, 25° C. (77° F.), respectively, and the units of penetration to indicate hundredths of a centimeter.

II. Apparatus.

2. Container.- The container for holding the material to be tested shall be a flat-bottom, cylindrical dish, 55 mm. (2 3/16 inches) in diameter and 35 mm. (1-3/8 inches) deep. (This requirement is fulfilled by the American Can Company's gill style ointment box, deep pattern, 3-ounce capacity).

3. Needle.- The needle (Journal of Agricultural Research, Vol. V, No. 24, pp. 1125-1126) for this test shall be of cylindrical steel rod 50.8 mm. (2 inches) long and having a diameter of 1.016 mm. (0.04 inches) and turned on one end to a sharp point having a taper of 6.35 mm. (1/4 inch).

4. Water bath.- The water bath shall be maintained at a temperature not varying more than 0.1° C. from 25° (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. (4 inches) and shall be supported on a perforated shelf not less than 5 cm. (2 inches) from the bottom of the bath.

5. Apparatus for penetration.- Any apparatus which will allow the needle to penetrate without appreciable friction, and which is accurately calibrated to yield results in accordance with the definition of penetration, will be acceptable.

II. Apparatus. Cont'd.

6. Transfer dish for container.- The transfer dish for 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 the container.

III. Preparation of Sample.

7. 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. (5/8 inch). The sample shall be protected from dust and allowed to cool in atmosphere not lower than 18° C. (65° F.) for one hour. It shall then be placed in the water bath along with the transfer dish and allowed to remain one hour.

IV. Testing.

8. Testing.- (a) In making the test the sample shall be placed in the transfer dish filled with water from the water bath of sufficient depth 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 specified weight, shall be adjusted to make contact with the surface of the sample. This may be accomplished by making contact of the actual needle point with its image reflected by the surface of the sample from a properly placed source of light. Either the reading of the dial shall then be noted or the needle brought to zero. The needle is then released for the specified period of time, after which the penetration machine is adjusted to measure the distance penetrated.

At least three tests shall be made at points on the surface of the sample not less than 1 cm. (3/8 inch) from the side of the container and not less than 1 cm. (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 towards its point with a clean, dry cloth to remove all adhering bitumen. The reported penetration shall be the average of at least three tests whose values shall not differ more than four points maximum and minimum.

(b) When desirable to vary the temperature, time and weight and, in order to provide for a uniform method of reporting results when variations are made, the samples shall be melted and cooled in air as above directed. They shall then be immersed in water or brine, as the case may require, for one hour at the temperature desired. The following combinations are suggested:

At 0° C. (32° F.) 200-g. weight, 60 seconds.

At 46.1° C. (115° F.) 50-g. weight, 5 seconds.

WARRENITE BITULITHIC PAVEMENT. (2).

- Mixing Method -

Sub-grade and Drainage. H-1. The sub-grade and drainage shall be constructed to the plans, profiles and specifications of the City Engineer.

Foundation. H-2. The foundation upon which the pavement is to be laid shall be macadam, and shall be prepared according to specifications and requirements of the City Engineer.

Wearing Surface. H-3. Upon the foundation shall be laid the asphaltic concrete wearing surface, consisting of a base mixture of selected hard durable crushed trap rock or granite of uniform quality, and sand, mixed with asphaltic cement and a mineral filler coat, both as hereinafter specified. The wearing surface shall be of a thickness of one and one half (1½) inches after thorough compression with a tandem roller weighing not less than 8 tons, and also three-wheel steam roller weighing not less than 12 tons, and shall contain between 7 and 12 per cent. bitumen soluble in carbon bisulphide, depending on the mineral aggregate treated.

Mineral Aggregate. H-4. STONE. The stone shall be crusher run varying in size from a maximum of 1 inch to the smallest particles retained on the finest mesh screen commonly used on crushing plants. The dust or fine screenings shall be completely removed from the stone, and added in such proportions as may be required. Sufficient sand and filler, varying from 20 per cent. to 30 per cent., shall be added to completely close and fill the interstices of the mineral aggregate. After being rolled the surface shall present a marbled appearance. The asphaltic cement shall be in sufficient quantities to bind and fill the mixture as specified above, but not to flush to the surface as free cement under the roller.

SAND. Sand shall be clean, moderately sharp and well graded, and shall be free from loam and foreign matter.

BASE MIX. The mix shall consist of a mixture of sand and stone as above specified, so as to comply with the following specifications:

Passing 100 x 200 mesh sieve 0 to 10%.

Passing 10 mesh sieve	20 to 35%	
Passing 1/4" ring	10 to 15%	
Passing 1/2" ring	15 to 25%	Mineral
Passing 3/4" ring	2 to 10%	Aggregate
Passing 1" ring	30 to 40%	

Mineral
Filler
Coat.

H-5. As soon as the base mixture has been raked to a uniform surface, there shall be spread (in the manner known as "gasting") a mixture consisting of coarse sand in the proportion of 50 to 75%, and fine, specially approved sand (sample to be submitted with tender) in the proportion of 25 to 40%, and asphaltic cement.

This mixture shall be prepared in the same manner, and worked at the same temperatures, as described for the preparation.

The amount of asphaltic cement shall be from 80 to 150 pounds per 1000 pounds of Aggregate, as required.

The filler coat shall be spread at the rate of 25 to 40 pounds per square yard, and shall be paid for at the same rate as the base mixture.

Where necessary, in the opinion of the Engineer, the surface shall be given a paint coat as specified in H-12.

The completed surface of the roadway shall be brushed over with Portland Cement.

Method
of
Mixing.

H-6. The aggregate shall be thoroughly dried in properly designed driers before mixing with the bitumen. The driers shall be of the revolving type, thoroughly agitating and turning the materials during the process of drying. When the aggregate is thoroughly dried and heated to a temperature of from 260 to 300 degrees F. (depending upon asphaltic cement used), it shall immediately before cooling or exposure to moisture, be mixed with hot asphaltic cement as hereinafter specified.

The asphaltic cement shall be melted in a tank arranged so that the heat can be properly and easily regulated. When melted and raised to a temperature of from 260 to 300 degrees F. (depending upon the asphaltic cement used), it shall be combined in proper proportions with the hot aggregate and immediately mixed in a standard asphaltic pugmill having power driven revolving blades until a thorough and

intimate mixture of the ingredients has been accomplished and the particles composing the aggregate evenly and thoroughly coated with the asphaltic cement. Mixing by the ordinary concrete gravity mixer will not be allowed.

Laying.

H-7. Paving mixture at a temperature of from 260 to 300 degrees F. shall be hauled on to the street in dump wagon, and shall be kept well covered with canvas to retain the heat, and dumped (the filler being dumped on a wooden platform) and shovelled into place. While it is still hot it shall be evenly spread with hot iron rakes, and while still pliable shall be rolled (the filler or coat having been previously spread) with a steam roller as above specified, so that when ultimate compression is accomplished the surface shall be even and true to grade. The rolling must be steadily kept up, lengthwise, crosswise and diagonally, and continued until all roller marks disappear and surface shall give no appearance of further compressibility. Along the curb, around manholes and catch basins, where roller cannot reach, the required compression shall be made by the use of hot iron tampers. Tamping shall be done as quickly as possible after the material is spread, while it is still hot and pliable.

Joints.

H-8. All contact surfaces, along curb, around manholes, castings, etc., shall be painted with an asphaltic cement before the paving mixture is laid.

The paving shall be done continuously, so that the number of joints between the hot and cold material shall be reduced to the minimum. When it is not practicable to lay it continuously, and a joint is unavoidable, the edge of the cold material shall be trimmed down to a rough feather edge and the surface where the joint is to be made painted over with asphaltic cement, and the hot material raked over the feather edge and thoroughly rolled; or, instead of trimming the cold material, joint strips may be used, consisting of strips of canvas about 18 inches wide, with three parallel lines of $\frac{3}{4}$ -inch ropes sewed on the underside about three inches apart; the joint strips shall be laid on the feather edge of the freshly raked materials, with the upper rope at the line where the thickness begins to decrease, and the rolling completed on top of the canvas as for finished pavement.

Asphaltic Cement.

H-9. The asphaltic cement shall be composed of refined asphalt and flux.

Refined
Asphalt.

H-10. The refined asphalt to be used under these specifications shall be approved and in every way satisfactory to the City Engineer. The refined asphalt shall be equal in quality to the recognized standards, and must comply with the following requirements:

(1) All shipments of any one kind of material shall be uniform in consistency and composition, and shall not vary more than 15 points in penetration at 77 degrees F.

(2) When the refined asphalt is made into an asphaltic cement by use of flux hereinafter specified it must produce an asphaltic cement of the required penetration satisfactory to the condition of the street, and at the penetration at which it is to be used it must comply with all requirements set forth herewith for asphaltic cement.

Fluxes.

H-11. The flux shall be residues obtained from distillation of paraffine, asphaltic or semi-asphaltic petroleum. They must be homogeneous and of uniform gravity and free from all signs of cracking, and must comply with the following requirements:

(1) They shall have a specific gravity at 77 degrees F. of between 0.92 and 1.04.

(2) When 20 grms. of flux are maintained at a temperature of 170 degrees C. for five hours in a cylindrical vessel 2 1/2 inches in diameter there must not be volatilized more than 5 per cent. by weight.

(3) They shall not flash below 180 degrees C. when tested in a New York State closed oil tester.

(4) They shall be soluble in carbon bisulphide to the extent of 99.5 per cent.

The asphaltic cement prepared as above described must comply with the following requirements:

(1) It must be homogeneous, adhesive, viscous and elastic, and must not be affected by the action of water.

(2) It shall have a penetration of between 600 and 750 at 77 degrees F. New York Standard Penetrometer.

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- (3) When 20 grms. of asphalt are maintained at a temperature of 170 degrees C. for five hours in a cylindrical vessel 2½ inches in diameter there must not be volatilized more than 5 per cent. by weight, nor shall the original penetration be reduced there by over 50 per cent.
- (4) The asphaltic cement shall not be so susceptible to changes in temperature as to have a penetration varying more than 125 between 0 degrees C. and 45 degrees C., and it shall have a ductility of not less than 5 cms. at 25 degrees C., and not less than 2 cms. at 0 degrees (Dow Standard).

Paint Coat.

H-12. Immediately after rolling, and while the pavement is still warm, a thin cold coat of pure bituminous cement shall be spread over the surface by means of rubber squeegees, and upon this shall be spread a thin layer of stone chips or other suitable material, dry and free from dust, and containing no particles which shall not be greater than will pass ½ -inch ring. After applying dressing the surface shall be again rolled until it presents a smooth and finished appearance, subject to the approval of the Engineer.

For every lot or shipment of asphalt or asphaltic flux used upon this contract the contractor shall furnish a statement giving the selling agent or company, the refinery that refined the asphalt or prepared the flux, the field or locality from which the crude asphalt was obtained, and a refining report of tests or penetration of each lot or run with numbers corresponding to a batch or lot number plainly stencilled on each barrel or container. This report to be delivered to the department laboratory at the earliest possible date, to allow sufficient time for sampling and making of tests as herein mentioned to verify refinery report and determine the suitability of the material offered before it will be accepted for use on this work.