

DEPARTMENT OF COMMERCE

BUREAU OF STANDARDS

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CIRCULAR OF THE BUREAU OF STANDARDS

No. 117

November 8, 1921

RECOMMENDED SPECIFICATION FOR INTERIOR
VARNISH

PREPARED AND RECOMMENDED BY THE U. S. INTERDEPARTMENTAL COMMITTEE ON PAINT SPECIFICATION STANDARDIZATION, SEPTEMBER 12, 1921, P. H. WALKER, BUREAU OF STANDARDS, CHAIRMAN; J. W. GINDER, TREASURY DEPARTMENT, SECRETARY.

[This committee was appointed at the suggestion of the Secretary of Commerce, and consisted of representatives of the War, Navy, Agriculture, Interior, Post Office, Treasury, and Commerce Departments, the Panama Canal, the U. S. Shipping Board, and the Educational Bureau of the Paint Manufacturers' Association of the United States. The committee submitted a preliminary draft of the specification to a large number of representatives of the paint and varnish manufacturers, and gave careful consideration to the replies received.]

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1. GENERAL

The varnish shall be suitable for general interior use, including both rubbed and unrubbed finish, exclusive of floors. It must be capable of easy application with a brush in the ordinary manner according to the rules of good standard practice, must flow out to a good level coat free from runs, sags, pits, or other defects, and dry with reasonable promptness to a hard, somewhat elastic glossy coating which can be rubbed in 48 hours or less. The manufacturer is given wide latitude in the selection of raw materials and processes of manufacture, so that he may produce a varnish of

the highest quality. The varnish must meet the following requirements:

APPEARANCE.—Clear and transparent.

COLOR.—Not darker than a solution of 3 g of potassium dichromate in 100 cc of pure sulphuric acid, specific gravity 1.84.

FLASH POINT (CLOSED-CUP).—Not below 30° C (85° F).

NONVOLATILE MATTER.—Not less than 45 per cent by weight.

SET TO TOUCH.—In not more than 4 hours.

DRY HARD.—In not more than 24 hours.

DRY TO RUB.—In not more than 48 hours.

TOUGHNESS.—Film on metal must stand rapid bending over a rod 3 mm ($\frac{1}{8}$ inch) in diameter.

WORKING PROPERTIES.—Must have good brushing, flowing, covering, leveling, and rubbing properties; and must show no impairment of luster or other defect when used where natural or illuminating gases are burned or when subjected to air currents during the process of drying or application.

WATER RESISTANCE.—The dried film must stand application of cold water for not less than 18 hours without whitening or showing other visible defect.

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

2. SAMPLING

It is mutually agreed by buyer and seller that a single package out of each lot of not more than 1000 packages be taken as representative of the whole. Whenever possible, an original unopened container shall be sent to the laboratory, and when for any reason this is not done, the inspector shall thoroughly mix the contents of the container sampled, transfer not less than 1 quart to a clean dry glass bottle or tin can which must be nearly filled with the sample, securely stoppered with a new clean cork or well-fitting cover, or cap, sealed, and distinctly labeled by the inspector.

The inspector should take a duplicate from the container sampled to be held for check in case of dispute, and, when requested, should take a sample for the seller.

3. LABORATORY EXAMINATION

The tin panels used in the following tests shall be cut from bright tin plate weighing not more than 25 g nor less than 19

g/dm² (0.51 to 0.39 lb./ft.²). (Commercial No. 31 gage bright tin plate should weigh about 0.44 lb./ft.² It is important that the tin plate used shall be within the limits set.)

(a) APPEARANCE.—Pour some of the thoroughly mixed sample into a clear glass bottle or test tube and examine by transmitted light. The varnish must be clear and transparent.

(b) COLOR.—Prepare a standard color solution by dissolving 3 g of pure powdered potassium dichromate in 100 cc of pure concentrated sulphuric acid of specific gravity 1.84. Gentle heat may be used if necessary to perfect the solution of the dichromate. The standard color solution and a sample of the varnish to be tested shall be placed in clear, thin-walled glass tubes of the same diameter. The color comparison shall be made by placing the tubes close together and looking through them by transmitted light. The tubes used for this test should be 1.5 to 2.0 cm ($\frac{5}{8}$ to $\frac{13}{16}$ inch) in diameter and shall be filled to a depth of at least 2.5 cm (1 inch). (Since the potassium dichromate-sulphuric acid must be freshly made for this color comparison, it is frequently more convenient to compare samples with a permanently sealed tube of varnish which has previously been found to be slightly lighter in color than the standard solution of 3 g dichromate in sulphuric acid. When samples are found to be darker than this standard tube of varnish, the dichromate standard should be made up for final decision.)

(c) FLASH POINT.—Determine with either the Tag or Elliott closed-cup tester. The former is preferred, and directions for its use are found in A. S. T. M. Standards D 56-19. For method of determining with the Elliott cup see Proceedings A. S. T. M., 1917, part 1, p. 414.

(d) NONVOLATILE MATTER.—Place a portion of the sample in a stoppered bottle or weighing pipette. Weigh container and sample. Transfer about 1.5 g of the sample to a weighted flat-bottomed metal dish about 8 cm diameter (a friction-top can plug). Weigh container again and by difference calculate the exact weight of the portion of sample transferred to the weighed dish. Heat dish and contents in an oven maintained at 105 to 110° C (221 to 230° F) for three hours. Cool and weigh. From the weight of the residue left in the dish and weight of the sample taken, calculate the percentage of nonvolatile residue.

(e) DRYING TIME.—Pour the varnish on a clean glass or bright tin plate not less than 15 cm (6 inches) long and 10 cm (4 inches) wide. Place the plate in a nearly vertical position in a well-ventilated room but not in the direct rays of the sun. The temperature of the room should be from 21 to 32° C (70 to 90° F). The film is tested at points not less than 2.5 cm (1 inch) from the edges of the film by touching lightly with the finger. The varnish is considered to have set to touch when gentle pressure of the finger shows a tacky condition but none of the varnish adheres to the finger. The varnish is considered to have dried hard when the pressure that can be exerted between the thumb and finger does not move the film or leave a mark which remains noticeable after the spot is lightly polished. If rapid light rubbing breaks the surface, the sample is considered not to have satisfactorily dried hard. In case the test shows time of setting to touch or drying hard more than 4 and 24 hours, respectively, two additional tests shall be run on different days and if the varnish does not meet the above drying and hardening requirements on *both* of these additional tests, it shall be considered unsatisfactory.

(f) TOUGHNESS.—Thoroughly clean with benzol a sheet of bright tin 7.5 by 13 cm (about 3 by 5 inches). Flow the varnish on one side of the tin plate and set in a vertical position in a well-ventilated room, not in the direct rays of the sun, at a temperature not below 21° C (70° F).

After the varnish on the tin plate has dried for 48 hours bring to a temperature between 21 and 24° C (70 to 75° F), and with the varnish film on the outside, bend rapidly over a rod 3 mm ($\frac{1}{8}$ inch) in diameter. The film must show no evidence of cracking or flaking.

(g) WATER RESISTANCE.—Prepare a panel as in (f) and let it dry in a well-ventilated room for 48 hours. Place the panel in a beaker containing about 2.5 inches of distilled water at room temperature (immersing the end of the panel which was uppermost during the drying period) and leave in water for 18 hours. The varnish shall show no whitening and no more than a very slight dulling when observed after removing the panel from the water and drying for 2 hours.

(h) FLOWING AND RUBBING PROPERTIES.—Thoroughly clean with benzol a glass plate about 15 by 20 cm (6 by 8 inches). Flow the varnish so as to entirely cover one side of the plate and stand in a nearly vertical position with the long edge horizontal for 8 minutes.

Then draw lightly a 25 mm (1 inch) section of a hard-rubber comb (having 8 to 10 teeth to the centimeter) horizontally across the varnish surface, first 2 cm from the bottom and then 2 cm from the top of the plate. Let panel stand in the same position for 20 minutes longer, then lay flat. An exaggerated condition of a dusty room shall be created by rubbing some cotton batting between the hands immediately over the panel. Let panel dry for a total of 48 hours in a well-ventilated room. If the comb marks show at this time, the varnish shall be rejected. If no comb marks show, the surface shall then be rubbed with pumice flour, water, and a felt pad with long, even, firm strokes back and forth in one or another direction, but not in circles, until every portion of the panel has been rubbed. Most of the pumice will then be removed from the pad and panel, and the varnish film given a "water rub" with the pad.

A satisfactory rubbing varnish in the above test will yield a smooth, dull film even at those places where the dust particles have been encrusted in the film, and shall show no spots where the pumice has been ground into and become attached to the film, nor show any other evidence of gumming. No sweating shall occur anywhere on the film in 18 hours after rubbing.

(i) GAS TEST.—*Apparatus*.—The necessary apparatus consists of a glass bell jar approximately 20 cm (8 inches) in diameter and 30 cm (12 inches) in height, inside dimensions, having a ground-glass rim; a ground-glass base plate of suitable size; a small, kerosene glowlamp without chimney, or a small alcohol lamp filled with kerosene, using a round wick not over 6 mm ($\frac{1}{4}$ inch) in diameter and adjusted to give a flame 2 cm ($\frac{4}{5}$ inch) in height. A wire or a light wooden frame is fitted inside the jar and provided with a support for holding a disk of tin plate 15 cm (6 inches) in diameter in a horizontal position 5 cm (2 inches) above the wick of the lamp. The frame must also be provided with several other supports above this disk for holding in a horizontal position the various varnished panels under test. The test panels consist of semicircular pieces of bright tin plate approximately 15 cm (6 inches) in diameter.

The form and arrangement of the above apparatus is designed to provide an even distribution of the products of combustion over the test panels.

Method.—First determine the normal time required for the varnish under examination to set to touch at room temperature.

Divide this time by five to arrive at the different drying periods at which the varnish is to be tested in the gas tester. Thus, if a varnish sets to touch in five hours, samples should be tested for resistance to gas at drying periods of one, two, three, and four hours; it is needless to use the fifth or five-hour period for the above varnish, as a varnish which has set to touch is practically immune to injury from gas fumes. Similarly a varnish which sets to touch in one hour should be tested for resistance to gas at drying periods of 12, 24, 36, and 48 minutes.

Example.—A varnish which sets to touch in five hours is tested as follows:

First, clean two of the semicircular, bright, tin-plate panels carefully with benzol. Flow the varnish on one-half of panel No. 1 at, say, 10 a. m., and allow to drain in a nearly vertical position at room temperature. At 11 a. m. flow the varnish on the other half of panel No. 1; allow to drain as before. At 12 m. varnish one-half of panel No. 2, and at 1 p. m. varnish the other half, as above. At 2 p. m. place the two panels close together in a horizontal position on the upper supports of the frame. Light the lamp and set it under the circular tin. Place the bell jar in position, centering it as nearly as possible, properly seated on the ground-glass plate. If the chamber is tight and lamp properly adjusted, the flame will be extinguished in about four minutes. After the panels have been in the chamber for half an hour, remove the bell jar and examine the varnished panels for gas effects.

The varnish on all four sections should remain bright and clear without trace of pitting, "crow's footing," frosting, or other defects.

4. BASIS OF PURCHASE

Varnish shall be purchased by volume, the unit being a gallon of 231 cubic inches at 15.5° C (60° F). The volume may be determined by measure, or, in case of large deliveries, it may be easier to determine the net weight and specific gravity at 15.5/15.5° C (60/60° F) of the delivery. The weight per gallon in pounds can then be determined by multiplying the specific gravity by 8.33. The net weight in pounds divided by the weight per gallon gives the number of gallons.

WASHINGTON, September 17, 1921.

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