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INSIDE WALL PAINT FOR CHEMICAL LABORATORIES

(FUME-RESISTING ENAMEL PAINT)

Contents

I. INTRODUCTION

It is well known that white lead paints, although excellent for other purposes, should not be used in painting chemical laboratories. However, as the result of tests and experience in painting the chemical laboratories of this Bureau, additional information has been obtained on the subject. It is the purpose of this letter circular to tell something of the properties of fume-resisting paints, to suggest a procedure for painting, to suggest a specification for the paint, and to show some typical results of tests of paints purchased under the specification.

The usual flat washable wall paints and the usual mill gloss whites are excellent for ordinary interior use, but under the special conditions which exist in chemical laboratories, commercial kitchens and bakeries, tobacco factories, gas works, refrigerator rooms, dairies, sewage-disposal plants, etc., they often become discolored. Exposure to ammonia or to continued high temperatures causes the drying oils commonly used in white paints to turn yellow; and hydrogen sulfide or ammonium sulfide blackens any paint containing iron or lead, either in the pigment or in the drier.

II. COMPOSITION

To produce paint that will not be discolored by heat or the fumes of the ordinary chemical laboratory, a special composition is required. The pigment must be free from lead and iron; it may consist of light-proof lithopone, titanated lithopone, the various titanium pigments, zinc oxide, or a mixture of these. The vehicle must also be free from lead and other metallic drying compounds that form dark-colored sulfides. Preferably, it should also be free from linseed, soya, tung or other drying oils unless they constitute a portion of or are combined with the synthetic resins subsequently referred to and it can be shown that they do not adversely affect the resistance properties of the coating. A satisfactory vehicle frequently used consists of the best grade of damar resin dissolved in turpentine or mineral spirits and plasticized with a softener such as pine oil. In addition to the older damar resin, some of the newer synthetic resins of the alkyd and phenolic types, and rubber resins, chlorinated rubber resins, acrylic resins, vinyl resins, polystyrene resins, etc., dissolved in solvents are finding use in coatings for walls, floors, and general interior surfaces of chemical laboratories. Fume-resisting enamels formulated with the correct acrylic resins are particularly good for the purpose.

White paints of satisfactory performance are available from a number of paint manufacturers in flat, semigloss, and full-gloss enamel finishes. When tints are desired, care must be used in selecting the proper tinting pigment to avoid discoloration. White, damar varnish-base enamel and tinted enamels made by grinding into the white enamel small amounts of dry chromium oxide green (Cr_2O_3) and dry lampblack, to make light green and light gray enamels respectively, all retained their original colors on exposure to a test atmosphere saturated with water and ammonium sulfide vapors. On the other hand, a pale buff tint obtained by adding dry yellow ochre to the white enamel was converted into a fairly dark battleship gray on exposure for 24 hours to the same atmosphere, because of the formation of black iron sulfide.

In order to obtain the desired resistance to discoloration, it may be necessary to subordinate certain other properties. For example, the usual architectural white enamel paint is apt to be more flexible than the fume-resisting enamel, and the "four-hour" type of white enamel is apt to be more water-resistant.

III. PAINTING PROCEDURE

1. Unpainted Walls

When the fume-resisting enamel is to be used on unpainted plaster or concrete, the clean surface should be first primed, and then painted with a body coat. The heat- or fume-resisting enamel is strictly a finishing paint. Whenever possible, it is recommended that the same manufacturer's products be used throughout the process to avoid incompatibility of coatings.

The priming coat should be a pigmented plaster primer and sealer and should contain no lead pigments. To insure freedom from small plaster cracks, streaks, suction spots, etc., the primed surface should be carefully inspected and, if necessary, touched up before applying the intermediate or body coat. In order to avoid "alligatoring", which is a cracked condition of the top coat caused by soft or insufficiently dried undercoats, each coat must be allowed to dry hard. The intermediate coat may be the conventional enamel undercoater or it may be a suitable primer-surfacer. It should, of course, contain no lead pigments. The proper type of intermediate coat provides a surface to which the final coat adheres well without showing any nonuniformity of gloss or color.

Where only a two-coat job is desired, the primer-surfacer referred to above may be used. The fume-resisting enamel is applied as the second or final coat. Generally, this enamel should not be applied over itself (two coats) nor should any of it be added to the undercoats. The reason for this is that the damar-resin type of enamel, when brushed out in a film, sets up quickly but stays soft for a considerable time; furthermore, it is good practice to build up suitable ground coats and to apply the enamel as a finishing material. Linseed oil, drier, varnish, oil colors, etc., should not be added to this fume-resisting enamel. Nothing should be added, except a small amount of turpentine if necessary. This type of enamel is apt to pull somewhat under the brush, as it sets to touch rather quickly. It should be flowed on like an enamel and not brushed out like a house paint. However, the application of excessively thick films should be avoided so that sagging does not occur. <u>The manufacturer's directions for application should be followed.</u>

If wood trim is to be coated, several coats of a good interior varnish are recommended rather than paint or enamel. If the wood is to be enameled to blend with the walls, the same painting procedure as that used on the walls should be followed. Aluminum paint may be used as a primer on wood.

2. Old Painted Walls

On old plastered walls containing flat wall paint, the surface should be cleaned thoroughly - washing with soap and water if necessary to remove all dust, dirt, grease, soot, chemical salts, and particularly any powdery material on the surface of the painted plaster. It may seem surprising to suggest that a size or sealing coat be applied over the old flat wall paint before applying the finishing, fume-resisting enamel. However, old coats of flat wall paint are apt to be quite porous - so much so that a finish coat of paint, particularly a semi-gloss type, applied directly over the old flat coat is almost certain to dry unevenly (spotted). If the old paint appears to be quite porous, the first coat on repainting may be a combination sealer and undercoater; for example a paint containing one or two quarts of plaster sealer added to each gallon of flat wall paint. The pigment portion of each paint should be free from lead. This coat of paint should be allowed to dry hard, and then a finishing coat of the fume-resisting enamel is applied.

IV. SPECIFICATION FOR HEAT- AND FUME-RESISTING ENAMEL PAINT

The following specification is suggested for purchasing the heat- and fume-resisting enamel for walls and ceilings of chemical laboratories. It has been used by two Governmental agencies in purchasing this special type of paint, and several well-known brands of fume-resisting white enamels have been found to conform. It should be noted that although ordinary ready-mixed, interior flat wall paints and interior gloss enamels do not contain lead pigments, they usually contain small amounts of lead or other metals introduced as driers and fail to meet the specification for this reason. These two types of paint are likely also to contain a considerable amount of drying oil (linseed, soya bean, tung oil, etc.), which may cause the materials to fail in the test for resistance to heat or ammonia fumes.

The fume- and heat-resisting enamels may be had in flat, semi-gloss, and full gloss. The purchaser should state the gloss desired. Ordinarily, the full gloss is recommended for best resistance to steam and moisture, although the semi-gloss finish has less glare and is slightly superior for fumes of ammonia and for heat above 130° F. The full gloss is the easiest to wash.

Suggested Specification for Fume- and Heat-Resisting White Enamel

The enamel shall be free from any lead pigments, and the vehicle shall be free from any drying metals and vehicle components liable to discoloration by fumes or heat. The pigment may be any suitable mixture of titanium pigments, zinc sulfide, pigments, or lead-free zinc oxide. No restriction is placed on the combination to use. The vehicle shall be of the resin-varnish type. No restriction is placed on the ratio of pigment to vehicle, so long as the enamel is of a good brushing consistency and meets the hiding power requirements.

The enamel shall be of easy flowing consistency, shall be self-leveling (brush marks shall disappear), shall be a brilliant white, resistant to fumes, and shall set rapidly to a smooth, white finish that will stay white.

In addition, the fume- and heat-resisting enamel should meet the following requirements:

(1) It shall have a daylight reflectance of at least 82 percent in the full gloss and at least 84 percent in the flat and semi-gloss finishes, relative to magnesium oxide as the standard.

(2) The wet hiding power over a black and white checkerboard shall be not less than 180 square feet per gallon for the gloss and not less than 200 square feet for the flat and semi-gloss enamels.

(3) On a smooth, properly prepared surface, one gallon shall cover at least 400 square feet.

(4) The enamel shall set to touch (not come off on the finger) within two hours at a temperature between 70 and 90° F and shall dry firmly overnight to a smooth, brilliant white, adherent film.

(5) When a coat brushed on a tin panel (#31 gage) is allowed to dry for 24 hours and then is bent over a half-inch mandrel, it shall show no cracking. The film shall show pronounced adhesion to the tin.

(6) One coat brushed on white milk glass, allowed to dry for 24 hours and then placed in a dark cabinet (for example Gardner color change cabinet) containing ammonia fumes (equal parts by volume of strong ammonium hydroxide and water) for 24 hours (at room temperature) shall meet the test for yellowing. One brushed coat on white milk glass, allowed to dry for 24 hours and then placed in an oven at 200° F for 24 hours shall meet the test for yellowing. In both the ammonia test and the heat test, the ratio of the measured reflectance of the exposed panels, using the red filter (see note), divided by the measured reflectance using the blue filter, shall be not more than 1.14, all values relative to magnesium oxide.

Note: In making the above reflectance measurements, and those to follow, the red filter used is Standard Lighthouse Red, Corning Glass Works #246. The blue glass filter is Corning Signal Blue (70%) #556. The daylight filter is Corning Daylight Glass #590. The Hunter Reflectometer (H. A. Gardner Circular #461) is a suitable instrument.

(7) One coat brushed on white milk glass, allowed to dry for 24 hours, and then exposed for 24 hours (room temperature) in a desiccator saturated with fumes of ammonium sulfide and a humidity close to saturation shall show a minimum of darkening. The result shall be the same if hydrogen sulfide is substituted for ammonium sulfide. In either case (whether ammonium sulfide or hydrogen sulfide is used), the reflectance of the exposed panels using the red filter shall be not less than 78 percent relative to magnesium oxide.

Note: A large desiccator having all glass, gas-tight, stopcocks for both inlet and outlet is recommended for this test. The desiccator cover must make a gas-tight joint with the desiccator proper. About 200 ml of distilled water saturated with hydrogen sulfide gas is placed in the bottom of the desiccator. The glass panels are then put in the desiccator, and the cover placed on it. Hydrogen sulfide gas, led through a bubbling tower containing distilled water saturated with the gas, is passed in the dessicator until all the air is driven out. Both stopcocks are then closed and the panels kept there for 24 hours. The panels are then removed and the reflectance is measured immediately. For the ammonium sulfide test, hydrogen sulfide gas is passed into 100 ml of concentrated ammonium hydroxide until saturated, then 67 ml more of concentrated ammonium hydroxide and 134 ml of water are added. This mixture is placed in the bottom of the desiccator, the panels put in place, and the desiccator covered. The panels are allowed to remain for 24 hours, then removed and the reflectance measured immediately.

(8) One coat brushed on milk glass, allowed to dry for 24 hours and then immersed in water (room temperature) saturated with hydrogen sulfide for 24 hours shall show no appreciable darkening or other discoloration. After drying the daylight reflectance shall not be below 78 percent.

(9) The enamel shall be at least the equal of a high-grade fume- and heat-resisting enamel in any other respects specifically required by the purchaser.

V. RESULTS OF TESTS UNDER THE PROPOSED SPECIFICATION

Three commercial paints purchased by the Government were tested under this specification and met all requirements. The vehicles appeared to be of the damar-resin type and, when separated from the pigments, they all dried to practically water-white, glossy, very adherent but rather brittle films. The approximate compositions of the paints and the results of tests for hiding power, whiteness, and retention of color follow:

Paint No.	1	2	3
Gloss	semi-gloss	full gloss	full gloss
Pounds per gallon	11.2	10.1	12.0
Volatile thinner, %	23	27	20
Nonvolatile vehicle, %	33	41	32
Pigment, %	44	32	48
Pigment, composition:			
Titanium oxide, %	present	100	...
Lithopone, %	none	...	63
Zinc oxide, %	none	...	...
Titanium-barium pigment, %	none	...	26
Barium sulfate, %	present	...	...
Silicates, %	present	...	...
Wet hiding power, sq. ft./gal. . . .	300	320	180
Daylight reflectance, %	84	84	84
Ammonia fume test - ratio	1.04	1.02	1.03
Heat test - ratio	1.05	1.04	1.05
Ammonium sulfide fume test, % reflectance	80	79	80
Hydrogen sulfide fume test, % reflectance	78	81	80
Hydrogen sulfide immersion test, % reflectance	79	80	79